НАУКА НА ИНОСТРАННОМ ЯЗЫКЕ – ШАГ В БУДУЩЕЕ ПРОФЕССИОНАЛА

Материалы II Национального (Всероссийского) круглого стола

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АРХИТЕКТУРА СЕГОДНЯ И ЗАВТРА: ДИЗАЙН, ИННОВАЦИИ И ТРЕНДЫ

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ИНФРАСТРУКТУРА ДОСУГА В АГЛОМЕРАЦИИ РАБАТ-САЛЕ (МАРОККО)

LEISURE INFRASTRUCTURE IN THE RABAT-SALÉ AGGLOMERATION (MOROCCO)

В статье досуг рассматривается как элемент городской среды и социального развития в агломерации Рабат-Сале. Анализируется переход от традиционного уклада к современному восприятию свободного времени. Рассматриваются факторы, повлиявшие на формирование досуговых практик, и типы инфраструктуры: спортивные объекты, культурные центры, дома молодежи, кинотеатры. Подчеркивается неравномерность их распределения между Рабатом и Сале и значимость досуга как ресурса устойчивого городского развития. В результате делается вывод, что улучшение досуговой среды можно достичь путем сбалансированного территориального планирования, увеличения доступных для молодежи общественных пространств, а также включения досуговой повестки в общую стратегию городского развития.

Ключевые слова: досуг, городская инфраструктура, Рабат-Сале, свободное время, социальное пространство.

The article explores leisure as part of the urban environment and social development in the Rabat-Salé agglomeration. It examines the shift from traditional life patterns to the modern understanding of free time, the factors shaping leisure practices, and the types of infrastructure involved: sports facilities, cultural centers, youth houses, and cinemas. The study highlights the uneven distribution of leisure spaces between Rabat and Salé and emphasizes the role of leisure in sustainable urban de-

velopment. As a result, it is concluded that improving the leisure environment can be achieved through balanced spatial planning, increasing the public spaces available to young people, and integrating the leisure agenda into the overall urban development strategy.

Keywords: leisure, urban infrastructure, Rabat-Salé, free time, social space.

Введение

Досуг занимает все более заметное место в жизни современного человека. Особенно это касается молодежи, которая, находясь в переходной фазе между детством и взрослостью, стремится к самовыражению, социальной активности и освоению новых форм свободного времени. В условиях урбанизации и демографического роста города становятся не только местом проживания, но и пространством для разнообразной досуговой деятельности. В этом контексте важно понять, как досуг проявляется в структуре города, какие формы он принимает, и как социальные, экономические и культурные реалии влияют на доступность и качество соответствующей инфраструктуры.

Агломерация Рабат-Сале (Марокко) представляет собой интересный пример: с одной стороны, здесь сосредоточены важнейшие административные, культурные и образовательные учреждения страны, с другой – сохраняется ряд социальных и территориальных дисбалансов, влияющих на возможности молодежи в области досуга. Настоящее исследование направлено на анализ роли досуга в городском пространстве, особенностей его восприятия и практики, а также состояния и распределения соответствующей инфраструктуры в данной агломерации.

Понятие досуга и его значение в жизни общества

Французский социолог Жан Дюмаздье определяет досуг как «совокупность занятий, которыми человек может заниматься по собственной воле в свободное от профессиональных, семейных или социальных обязательств время – с целью отдыха, развлечения, саморазвития или добровольного участия в общественной жизни» [12]. Это определение подчеркивает ключевой момент: досуг свободен по своей сути и не служит ни работе, ни обязательствам, ни получению дохода. Его роль – в восстановлении, социальной интеграции и культурном росте личности.

Однако досуг – это не просто время «ничегонеделания». Он становится зеркалом общества, отражающим его структуру, приоритеты и неравенства. Возможность выбора форм досуга зависит от множества факторов: уровня дохода, культурного капитала, пола, возраста, религиозных норм и даже городской планировки. Поэтому досуг не может рассматриваться вне контекста общества, в котором он осуществляется [4]. Вместе с тем, важно отделить понятие досуга от так называемой «полудосуговой» деятельности – той, что формально совершается в свободное время, но направлена на экономическую выгоду или вынужденное участие (например, подработка или участие в мероприятиях по обязательству). В нашем исследовании под досугом мы понимаем исключительно свободную и добровольную активность без утилитарной цели.

Формирование современного досуга:
от традиционного времени к структурированному

Переход от традиционного уклада жизни к современному типу временипрепровождения в Марокко оказал существенное влияние на понимание и практику досуга. В традиционном обществе время не делилось строго на рабочее и свободное. Ежедневный ритм жизни регулировался природными циклами, сельскохозяйственными задачами и религиозными обрядами. Работа и отдых чередовались гибко и неформально, что оставляло много «неиспользованного времени», не оформленного как досуг в современном смысле слова [3]. С изменениями, связанными с индустриализацией, урбанизацией и распространением формального образования, появилась необходимость в четком разграничении рабочего и свободного времени. Современная структура труда, основанная на фиксированном графике, сформировала новое понимание досуга как обособленного от работы пространства. Средства массовой информации и массовая культура также сыграли ключевую роль в распространении новых моделей поведения в свободное время.

Таким образом, в Марокко началось формирование особой городской культуры досуга – процесс, в котором строились дома молодежи [6], культурные и спортивные центры [1], создавались новые формы досуговой активности, в значительной степени вдохновлен-

ные европейскими (в частности французскими) моделями. Досуг стал частью государственной и муниципальной повестки, что выразилось в попытках организовать инфраструктуру, соответствующую новым ожиданиям населения.

Досуг в контексте молодежи и повседневности: марокканская специфика

Молодежь – основная социальная группа, через которую можно наблюдать трансформации досуга. Согласно официальным данным, молодежь в Марокко составляет значительную часть населения: только в возрастной группе от 15 до 24 лет насчитывается около 4,5 миллиона человек. При этом около 27 % молодежи не заняты ни в образовании, ни в работе, ни в профессиональной подготовке (категория NEET) [5]. Особенно высок этот показатель среди девушек (до 40 %). Это свидетельствует не только о социальной уязвимости, но и о потенциальной значимости досуговых пространств как мест для социализации, саморазвития и участия в жизни общества. Культурный контекст также играет важную роль. В обществе, где доминируют религиозные и семейные ценности [7], формы досуга носят специфический характер. Предпочтение отдается не индивидуализированным, а коллективным, социально приемлемым видам активности. Просмотр телевизора, посещение кафе, спорт и религиозные практики остаются основными форматами досуга. При этом с возрастом интересы молодежи смещаются от развлечений к более «серьезным» формам участия – от игр и спорта к гражданской активности, семейному общению и религиозным ритуалам.

Отсутствие локальных статистических данных по агломерации Рабат-Сале вынуждает нас опираться на общенациональные исследования. Однако с учетом демографических и культурных сходств можно считать, что полученные данные в целом применимы и к этой агломерации.

Город и досуг: особенности инфраструктуры Рабат-Сале

Городское пространство играет определяющую роль в реализации досуговых практик. Рабат и Сале – два взаимосвязанных, но асимметричных по развитию города [8]. Рабат, как столица, концентрирует

больше культурных учреждений, спортивных объектов, парков и зон отдыха. Сале, несмотря на большую численность населения, страдает от нехватки таких пространств и хаотичного распределения существующих объектов [9].

К инфраструктуре досуга относятся разнообразные объекты, обеспечивающие населению возможности для отдыха, культурного потребления, физической активности и социального общения. Их наличие, распределение и качество определяют, насколько городская среда поддерживает полноценную и сбалансированную жизнь горожан [2].

Спортивные сооружения (площадки, стадионы, комплексы) занимают важное место в структуре досуга [1]. Они предназначены как для индивидуальных тренировок, так и для массовых мероприятий. Исторически развитие спортивной инфраструктуры в Марокко началось с периода послевоенной урбанизации, когда спорт стал частью государственной политики воспитания и социализации. В Рабате одним из ярких примеров является Международный спортивный комплекс Принца Мулая Абдаллы, включающий стадион, тренировочные площадки и залы. В Сале – Центральный спортивный комплекс Сале, обслуживающий преимущественно жилые кварталы. Несмотря на наличие крупных объектов, в жилых районах ощущается нехватка открытых и бесплатных площадок для повседневной активности, особенно для женщин и подростков. Театры и концертные залы – это традиционные центры культурной жизни. Они не только предоставляют возможность художественного восприятия, но и формируют культурную идентичность города. В Рабате значимым учреждением является Национальный театр Мохаммеда V, открытый в 1962 году и являющийся символом постколониального культурного развития страны. Он служит платформой для театральных постановок, музыкальных концертов и фестивалей. В Сале театров значительно меньше, и доступ к высококачественному сценическому искусству остается ограниченным. Кинотеатры представляют собой один из наиболее доступных видов досуга. В прошлом десятилетии в Марокко наблюдался спад интереса к традиционным кинотеатрам, однако с недавнего времени происходят попытки их возрождения. В Рабате функционируют как независимые кинозалы (например, Кинотеатр Renaissance, открытый в 1920-х годах), так и современные залы в торговых центрах.

В Сале кинотеатров почти нет, что усиливает культурную изоляцию его жителей. Кино становится досугом, требующим перемещения в другой город [10]. Культурные центры выполняют мультифункциональную роль: они объединяют выставочные пространства, библиотеки, классы для обучения, залы для встреч. Эти объекты часто строятся при поддержке государства или муниципалитетов и призваны способствовать вовлечению граждан в культурную и общественную жизнь. Одним из таких примеров является Национальный центр искусств и культуры имени Мегама, расположенный в Рабате, где проходят выставки, лекции, кружки. В Сале культурные центры, как правило, меньше по масштабу и ориентированы на локальные инициативы, часто при поддержке ассоциаций [11]. Дома молодежи (Maisons des jeunes) – социально ориентированные учреждения, появившиеся по французскому образцу в середине XX века [6]. Они были задуманы как места внеучебной активности для подростков и молодежи: здесь можно заниматься музыкой, театром, спортом, участвовать в кружках и обсуждениях. В Рабате функционируют несколько таких домов, включая Дом молодежи Якуб аль-Мансур, который обслуживает густонаселенный район. В Сале подобных учреждений меньше, и они часто сталкиваются с нехваткой ресурсов, кадров и внимания со стороны местных властей. Торгово-развлекательные центры (ТРЦ) – один из новых форматов организации досуга, появившийся с расширением частного сектора и потребительской культуры. Эти пространства сочетают шопинг, кафе, кино, зоны отдыха и развлечений для детей. В Рабате крупным примером служит ТРЦ Mega Mall, сочетающий торговую галерею, каток, боулинг и фитнес-центр. Однако такие центры ориентированы в первую очередь на средний и высокий класс, что ограничивает их доступность для части населения. В Сале аналогичных объектов значительно меньше.

Кафе и рестораны – повседневное пространство досуга для многих слоев населения. Они выполняют не только функцию питания, но и служат местом общения, наблюдения за жизнью города, неформального взаимодействия. Особенно распространены в старых кварталах, на площадях и вдоль оживленных улиц. В Рабате кафе часто становятся площадками для дебатов, поэтических вечеров и культурных встреч, тогда как в Сале заведения такого типа менее разнообразны

по формату. Каждый из этих объектов выполняет свою роль в формировании городской среды досуга. Однако при анализе инфраструктуры Рабат-Сале становится очевидным, что их распределение неравномерно. Центр Рабата концентрирует большинство учреждений с высоким качеством услуг и инфраструктурой, в то время как Сале, несмотря на численно большее население, остается менее обеспеченным – как по количеству, так и по качеству досуговых объектов [2]. Этот дисбаланс усиливает социальное и территориальное неравенство и требует внимания со стороны градостроительной и социальной политики. Это неравномерное распределение создает социальную напряженность и усиливает различия в возможностях молодежи. Проблема заключается не только в нехватке пространств, но и в отсутствии целенаправленной политики по их интеграции в повседневную городскую жизнь.

Заключение

Современный досуг – это не просто личное дело, а важный социальный и культурный механизм, особенно значимый для молодежи. Он отражает уровень развития общества, степень социальной справедливости и качество городской среды. Агломерация Рабат-Сале – пример региона, где потенциал молодежи велик, но инфраструктура досуга остается неравномерной и фрагментированной.

Улучшение досуговой среды требует, прежде всего, сбалансированного территориального планирования, увеличения доступных для молодежи общественных пространств, а также включения досуговой повестки в общую стратегию городского развития. Только при таком подходе досуг сможет стать не только формой отдыха, но и инструментом социального роста, интеграции и культурного прогресса.

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СОВРЕМЕННЫЕ ТЕНДЕНЦИИ БЛАГОУСТРОЙСТВА РЕЧНЫХ НАБЕРЕЖНЫХ

MODERN TRENDS IN THE IMPROVEMENT OF RIVER EMBANKMENTS

В статье рассматривается вопрос современных тенденций благоустройства речных набережных. Приводятся аналоги современных благоустроенных прибрежных территорий, анализируются используемые композиционные и архитектурные приемы, используемые при создании прибрежных пространств, делаются выводы на основе полученной информации. Ставится акцент на актуальности исследования современных тенденций в благоустройстве, реновации и ревитализации речных набережных. Выделяется ряд основных тенденций: насыщение набережной множеством функций и выделение ряда различающихся по назначению функциональных зон; создание пространства, отвечающего требованиям всех возрастных и социальных слоев населения города; сохранение существующих зеленых насаждений и акцент на озеленении; использование современного оборудования, отвечающего новейшим стандартам; реновация и реконструкция старых промышленных заброшенных прибрежных территорий и придание им новых функций; разработка вело-пешеходной сети; создание транспортных узлов, в том числе с включением водного транспорта; учет удобной и комфортной доступности для маломобильных групп населения.

Ключевые слова: набережная, благоустройство, современные тенденции, прибрежные территории, развитие.

The article discusses the issue of modern trends in the improvement of river embankments. The analogues of modern landscaped coastal territories are considered, the compositional and architectural techniques used in the creation of coastal spaces are analyzed, conclusions are drawn based on the information received. The emphasis is placed on the relevance of the study of modern trends in landscaping, renovation and revitalization of river embankments. A number of main trends are highlighted: the saturation of the embankment with a multitude of functions and the allocation of a number of functional zones that differ in purpose; creation

of a space that meets the requirements of all age and social strata of the city's population; preservation of existing green spaces and emphasis on landscaping; use of modern equipment that meets the latest standards; renovation and reconstruction of old industrial abandoned coastal areas and giving them new functions; development of a bicycle and pedestrian network; creation of transport hubs, including with the inclusion of water transport; consideration of convenient and comfortable accessibility for low-mobility groups of the population.

Keywords: embankment, improvement, modern trends, coastal areas, development.

River embankments are an important element of the urban environment and actively participate in its formation. After improvement, they often become points of attraction for locals and tourists and also attract streams of people to spaces that were previously unpopular. Coastal riverine spaces play an important role in the perception of the appearance of a modern city, and therefore it is important to design them taking into account current trends in renovation and revitalization.

In the modern world, the issue of improving unused coastal areas is becoming increasingly important, since, among other things, the embankment is an important part of the city's panorama.

Nowadays, one of the main trends in the improvement of river embankments is the endowment of the territory with many different functions relevant for different ages and social groups of people [1]. This helps to attract a lot of people to the planned area and create a new urban point of attraction. This approach also helps to diversify the leisure time of citizens and tourists: with proper functional zoning, everyone can find a comfortable way to spend time on the territory. For example, a territory may contain a playground, a workout area, a place for quiet relaxation, and a leisure center, meeting the needs of several groups of the population at once.

An example of the relevance of this trend is the City Park De Motten embankment, located in Tongeren, Belgium (Fig. 1). This territory is a park with an integrated embankment. Initially, the area along the Jeker River was an overgrown and abandoned space that was not in demand among tourists and locals. At the beginning of the design, the authors set themselves the goal of rehabilitating a space with great potential for development. As a result of the successful implementation of the project in 2019, the territory became a "point of attraction" for local residents and

tourists [2]. This project also demonstrates the trend of preserving the existing natural landscape and improvement. During the design, the architects studied the natural shapes of the river and, based on this, located the functional areas. The result is an interesting modern space in which nature and progress are integrated into each other and form a harmonious symbiosis (Fig. 2). In the resulting space, the river is an independent element, but at the same time, it meets the needs of designers and is of interest to visitors to the territory. Today, everyone can find some valid form of leisure or solitude in the park. Sports, recreation, nature, and culture play a central role in the new space, which is also the starting point for many cycling and hiking routes. The result was a significant improvement in the social activity of citizens and local mobility. The landscaping also helped to create a safe and comfortable environment that enhances the tourist and recreational potential of the old city center. The social importance of the area has also been strengthened. The park and the riverbanks have become a popular recreation area for the townspeople.

Fig. 1. City Park De Motten embankment, Tongeren, Belgium

The trend of using modern technologies and materials, as well as their integration into the existing territory, is also important [3]. In this context, the embankment of the Minhang, China, is interesting (Fig. 3), equipped with modern lighting and navigation systems, as well as small architec-

tural forms. This project demonstrates several main trends of modern embankment improvement at once: the integration of coastal territories into existing buildings, the preservation of natural landscaping, a promenade along the water, and an abundance of quiet areas [4]. This embankment is also interesting because the territory is divided into several functional zones connected by a single pedestrian route, which is the already mentioned trend of modern landscaping of coastal areas (Fig. 4).

Fig. 2. City Park De Motten embankment, Tongeren, Belgium

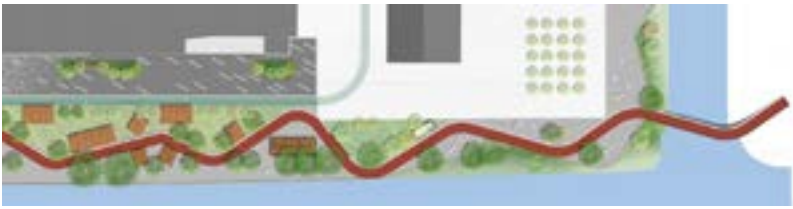

Fig. 3. The embankment of the Minhang, China

The trend of transformation and reconstruction of outdated buildings, structures, and territories is becoming more relevant with each city.

To address this issue, architects and planners take the existing territory as a basis and modernize it while preserving its original appearance and cultural heritage. An abandoned park, embankment, or industrial area, as well as the territory of a decommissioned public building located near a reservoir, can serve as the basis for such revitalization.

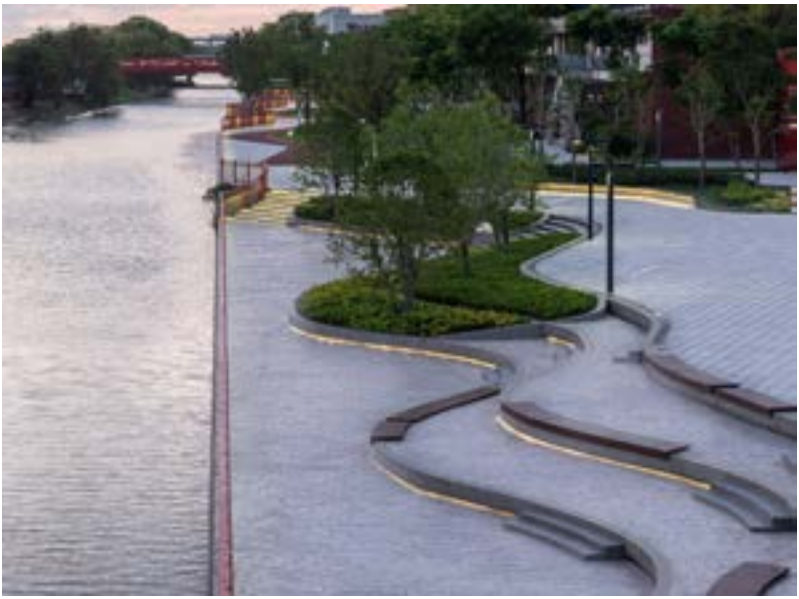

Fig. 4. The embankment of the Minhang, China

This is confirmed by the Corridor Channel (Fig. 5), created by Townshend Landscape Architects in London, UK. This project is interesting because it is a vivid example of the integration of the embankment into the urban space and the creation of a new place for people to gather. Beautiful design paths have been created along the once-abandoned embankment, as well as many green areas (Fig. 6).

After landscaping, the territory began to be actively used by citizens for relaxing holidays: for example, reading books, calmly observing the water, or chatting with friends. This project shows several important trends in the modern beautification of embankments: the creation of many qui-

et areas, promenades along the shore, and the integration of the embankment into urban development [5].

In conclusion, embankments are an important part of the urban environment and affect the visual perception of space. In order for these areas to be comfortable, ergonomic, and relevant for visitors, it is necessary to take into account current trends in coastal landscaping.

Fig. 5. Corridor Channel embankment, UK

Fig. 6. Corridor Channel embankment, UK

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СИНТЕЗ КУЛЬТУР В АРХИТЕКТУРЕ ТБИЛИСИ: МНОГООБРАЗИЕ СТИЛЕЙ И ИХ ИСТОРИЧЕСКИЕ КОРНИ

CULTURAL SYNTHESIS IN THE ARCHITECTURE OF TBILISI: DIVERSITY OF STYLES AND THEIR HISTORICAL ROOTS

Исследование посвящено архитектурной эволюции Тбилиси, столицы Грузии, как уникального примера культурного синтеза. Работа охватывает исторические периоды с V века до современности, анализируя влияние грузинской, персидской, османской, русской и европейской культур на формирование городской среды. Выделены ключевые этапы: античность и раннее Средневековье, восточный период, интеграция в Российскую империю, советская эпоха и вызовы глобализации. Рассмотрены особенности архитектурных стилей, включая византийские, исламские, классицистические и модернистские элементы, а также их адаптацию к местным традициям. Особое внимание уделено механизмам сохранения культурной идентичности в условиях внешних влияний и современных урбанистических трансформаций. Результаты исследования подчеркивают роль Тбилиси как модели гармоничного сочетания исторического наследия и инновационных подходов в архитектуре.

Ключевые слова: архитектурная эволюция, культурный синтез, исторические периоды, сохранение идентичности, урбанистические трансформации.

The study explores the architectural evolution of Tbilisi, the capital of Georgia, as a unique example of cultural synthesis. Covering historical periods from the 5th century to the present, the work analyzes the impact of Georgian, Persian, Ottoman, Russian, and European cultures on the urban environment. Key stages are highlighted: antiquity and the early Middle Ages, the Eastern period, integration into the Russian Empire, the Soviet era, and the challenges of globalization. The research examines

architectural styles, including Byzantine, Islamic, classical, and modernist elements, as well as their adaptation to local traditions. Special attention is paid to the mechanisms of preserving cultural identity amid external influences and modern urban transformations. The findings emphasize Tbilisi's role as a model for harmonizing historical heritage with innovative architectural approaches.

Keywords: architectural evolution, cultural synthesis, historical periods, preservation of identity, urban transformations.

Tbilisi, the capital of Georgia, is a unique architectural palimpsest, where each historical layer preserves traces of the interaction of Georgian, Persian, Ottoman, Russian, and European cultures. Founded in the 5th century, the city was historically located at the crossroads of trade routes between Europe and Asia, which predetermined its role as a center of cultural synthesis. The architecture of Tbilisi is not just a combination of styles, but a reflection of complex political, social, and economic processes, including the Persian and Ottoman conquests, the influence of the Russian Empire and Soviet modernism. The scientific significance of the study lies in identifying the mechanisms of cultural interaction that shaped the urban environment, as well as in analyzing the preservation of identity in the context of globalization.

Tbilisi is located in the valley of the Kura River, surrounded by mountain slopes. Its strategic position made it an object of interest to Persia, Byzantium, Arabs, Ottomans, and Russia. Each period has left its mark on architecture. In the study, we identified the following periods:

1. Antiquity and the Early Middle Ages: the Birth of Georgian Identity
2. The Eastern Period: between Islam and the Georgian Renaissance
3. Integration into the Russian Empire: Europeanization and eclecticism
4. The Soviet period: between utopia and tradition
5. Modern Tbilisi: challenges of globalization

Next, we have identified the characteristics and features peculiar to each period, which subsequently influenced the architecture of Tbilisi in particular and Georgia in general.

Antiquity and the Early Middle Ages: the Birth of Georgian Identity [3]

1. The Pre-Christian Era:

– Mtskheta (the ancient capital): The influence of Zoroastrianism (one of the oldest religions) and pagan cults on the layout of settlements.

Temples with altars oriented to the sun are preserved, later rebuilt into Christian basilicas.

– Narikala Fortress (IV century): the strategic location on the cliff reflects a synthesis of Roman fortification (rectangular towers) and local construction techniques (using basalt).

2. Christianization and Byzantine influence:

– Anchiskhati Church (6th century):

Byzantine features: three-nave basilica, semicircular apse.

Local features: a symbol of Georgian Christianity appears – carved capitals with a vine.

– Svetitskhoveli Cathedral (XI century):

Dome on a high drum – influences of the Byzantine canons.

Facade decoration: reliefs depicting animals, borrowed from pre-Christian iconography.

– Synthesis of local stone (tuff) and Byzantine masonry techniques.

3. The "Golden Age" of Georgia (12th century):

– Architecture as an instrument of national consolidation.

– Gelati Monastery (12th century):

Byzantine features: cross-shaped plan.

The mosaic "Mother of God with Archangels" is a combination of Greek technique and Georgian images.

A symbol of the unity of religion, science, and art.

The Eastern Period: Between Islam and the Georgian Renaissance [3]

1. The Arab Emirate (VIII-XI centuries):

– Redevelopment of the city: mosques, caravanserais, a system of irrigation ditches.

– The introduction of Islamic ornaments and planning solutions, such as the use of pointed arches in residential buildings

2. The Persian era (XVI-XVIII centuries) and the Ottoman influence

– Abanotubani bath complex (17th century):

Domes made of bricks: technology borrowed from Isfahan.

Underground channels (ropes): the Persian water supply system.

Interiors: murals with floral motifs, similar to the palaces of Shiraz.

– The Palace of Queen Darejan (Sahliso) (XVIII century):

Turquoise glazed tiles are a direct influence of Persian ceramics.

Wooden balconies (sharuani) – adaptation of Georgian housing to a hot climate.

– Juma Mosque (XVIII century):

Minaret with conical end – Ottoman style.

Masonry walls are a local tradition.

– Old town houses:

Wooden bay windows with grilles (musharabiya) – the influence of Turkish mansions.

The narrow winding streets and courtyard wells resemble the structure of the eastern medinas.

Integration into the Russian Empire: Europeanization and Eclecticism [2]

1. Classicism and Empire style as a symbol of power:

– The Georgian military-Georgian road as an infrastructural and cultural bridge.

– The building of the Tiflis City Duma (arch. Paul Stern, 1880):

The columns of the Corinthian Order are a reference to the Roman Pantheon.

The frieze with grapes is a Georgian national motif.

The Governor General's Palace on Rustaveli Avenue is an example of strict symmetrical style.

2. Eclecticism and modernity:

– Opera and Ballet Theatre (arch. Victor Schroeter): Moorish arches and Viennese style.

– Marjanishvili Theater (1928) is an example of Orthodox Art Nouveau with an emphasis on functionality

– Sololaki district is known for mansions with stucco and wrought iron elements, such as the Seilanov House (1911), where the front door is decorated with paintings by Beno Telingater.

3. The role of the Armenian Diaspora:

– Surb Gevorg Armenian Church (13th century, rebuilt in the 19th century):

The dome on the tromps is an Armenian medieval tradition.

The Baroque bell tower is influenced by the Russian Empire.

The Soviet Period: between Utopia and Tradition [1]

1. Constructivism: Architecture for a new society

– Government House of Georgia (arch. Ivan Zholtovsky, 1933):

Asymmetrical volumes and ribbon windows are the principles of the Bauhaus.

The rejection of decor is an ideological break with the “bourgeois” past.

2. The Stalinist Empire: monuments of the Empire

– The Iveria Hotel (1967):

Giant columns and bas – reliefs with vines are a synthesis of Soviet gigantism and Georgian symbols.

3. Georgian Modernism: a dialogue with the landscape

– Building of the Ministry of Highways (arch. George Chakhava, 1975):

The “horizontal skyscraper” on the hillside is a reference to the terraced villages of Svaneti.

The construction of five “suspended” blocks minimizes interference with the landscape, following the Georgian tradition of harmony with nature.

The building is included in the lists of the world heritage of brutalism.

Modern Tbilisi: challenges of globalization [4]

1. Revitalization vs commercialization:

– The Tbilisi City project: glass towers vs. historical panorama.

– UNESCO and the conflicts surrounding the restoration of the Old City.

2. New architectural experiments:

– Musical Fountain Park (arch. Michele De Lucchi): high-tech and national patterns.

– House of Justice (arch. Massimiliano Fuksas) – a discussion about the “strangeness” of style.

– The Alphabet Tower in Batumi: a spiral structure with Georgian letters symbolizes the connection with cultural heritage.

– Reconstruction of historical buildings: Rooms Hotel Tbilisi, housed in a Soviet printing house, combines industrial style with traditional materials.

– Earthquake-resistant technologies: new projects, such as the Tbilisi Cultural Center, use composite materials while preserving elements of the national decor.

Thus, in the course of the conducted research, we concluded that studying the architecture of Tbilisi allows:

1. to trace the mechanisms of cultural synthesis: how local traditions adapt to foreign influences;

2. to analyze urban strategies (solving the problems of seismicity and complex terrain through innovative projects);

3. to preserve identity in a globalized world (examples of reconstruction show how historical buildings can be integrated into a modern urban environment).

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ВЕРТИКАЛЬНЫЕ САДЫ КАК ТЕНДЕНЦИЯ В ЛАНДШАФТНОЙ АРХИТЕКТУРЕ

VERTICAL GARDENS AS A TREND IN LANDSCAPE ARCHITECTURE

Ландшафтная архитектура как отрасль градостроительства переживает изменения в своем развитии под влиянием социальных, экономических, экологических, технологических и культурных факторов. Одной из тенденций развития современной ландшафтной архитектуры является создание вертикальных садов в офисных помещениях, жилых помещениях, общественных местах. Вертикальные сады выступили удобным решением для городского озеленения в условиях ограниченного городского пространства или его отсутствия, делающих невозможным создание традиционных садов. Авторы описывают стационарные и мобильные модульные конструкции, а также приспособления, используемые для создания вертикальных садов. В статье представлены преимущества и недостатки вертикальных садов.

Ключевые слова: ландшафтная архитектура, вертикальные сады, устойчивое развитие, биоразнообразие, городская среда, пространство.

Landscape architecture as an urban planning sector is undergoing transformations due to social, economic, ecological, technological, and cultural factors. One of the trends in today's landscape architecture is the creation of vertical gardens in offices, living, and public spaces. Vertical gardens are considered a convenient method for urban greening in the limited space of an urban environment or its absence, which makes the creation of conventional gardens impossible. The authors describe stationary and mobile modular structures, as well as devices used to create vertical gardens. This article presents the advantages and disadvantages of vertical gardens.

Keywords: landscape architecture, vertical gardens, sustainable development, biodiversity, urban environment, space.

Landscape architecture is currently undergoing changes in the face of social and economic transformation and increasing environmental awareness of people all over the world.

The new vision of landscape architecture combines the creation of public spaces with aesthetic appeal, the provision of the overall well-being of the environment, the reintroduction of nature into the urban fabric, the revitalization of neglected urban areas, ecological education, and the conservation of rare species of plants, insects, birds, and animals, among other issues. This trend tries not only to enhance the quality of life but also to contribute to the overall sustainability and attractiveness of cities. That is why now landscape architecture as a discipline covers such concepts as public health, environmental design, biophilia, sustainability, and re-wilding [1].

Landscape architecture is not stable but constantly changing. It has passed several stages in its development, starting from meticulously groomed lawns, which were far from natural, to flourishing wildflower meadows, which align more closely with their surroundings, incorporating them seamlessly [2]. Today's transformations in the essence of landscape architecture challenge traditional perceptions of cities and construction. This approach highlights the unique characteristics of each local site and its historical context and helps in the restoration of the cityscape spatial, ecological, and cultural continuities [2].

Landscape architecture is facing an eco-conscious shift. This turn considers three aspects: eco-techniques, low-carbon materials and processes, and smart technologies [3]. Today's trendy solutions in the field of landscape architecture can be described as sustainable, nature-based, and eco-conscious [3]. Among new trends in landscape architecture, one may distinguish:

1. *Wellbeing landscapes*, which provide a welcoming natural environment not always available in the home environment. Such landscape design uses the benefits of the natural environment through the use of nature, space, place and conditions [4]. It shows people's connection to nature.

2. *Biodiverse landscapes* aim to mitigate the biodiversity loss through introducing native species of plants, creating close-to-nature landscapes instead of thoroughly mowed lawns (4). Native plants attract wildlife and pollinators [5].

3. *Bold Colours* in landscape design help to add bright and joyful colours to green background and fun and playfulness to the surrounding environment [4].

4. *Grow-your-own and Foraging* means gardening and growing your own food in the restricted urban spaces, often in 'vegetable beds'. With this way of spending your free time you can feel close to nature and save money [4; 5].

5. *Natural Materials* in the landscape design improve the outward appearance of the places and add them a quality of authenticity. They blend with the surroundings and reflect the ideas of sustainability [6].

6. *Flexible outdoor space* allows us to use it multifunctionally, extending your home space into the natural environment and adapting it to the user's needs [4]. In addition to it, living spaces including interior décor create a seamless connection between the house and the garden [6].

7. *Smart gardens* include smart irrigation systems and remote monitoring and control. These technologies help to adjust outdoor spaces and gardens to particular living and climate conditions, weather, and soil structure. Besides, they can add to homeowners' convenience as they can be adjusted via smartphones and tablets [3]. Robotic lawn mowers and drones for maintenance tasks are also becoming helpful tools which save time and labor [3, 6].

One more trend in landscape architecture is the creation of gardens and green spots in small or unconventional spaces. Lack of spaces for traditional gardens in urban settings has caused the increasing popularity of such solutions [6]. Vertical greening has become an effective way to incorporate plants into the limited urban space. These can be exterior and interior walls, balconies, patios, fences, and doors with flowers, trees, climbing plants, and even vegetables and herbs that are being grown for food [3, 4]. The difference between vertical gardens and the conventional ones is that in the former, vertical structures are used for plants to grow upward rather than outward [7]. Every place has some vertical spaces that can be transformed into a green corner.

The idea of vertical gardens and vertical farming is not new. It goes back millennia. We may find parallel concepts in the famous Babylonian hanging gardens, Aztecs' floating rafts, vertical farming practiced by Dutch and French farmers in the 1600s [8].

To make a vertical garden, also known as living walls or green walls, you may buy some modules with an inbuilt irrigation system [5, 8]. But at the same time you may use improvised tools which are kept in every house and often in large quantities.

The landscape architects offer various ideas as to how organize space for vertical gardens. First, you may use trellis on which trailing plants will grow and beautifully fill in the construction with time [7].

Second, hanging baskets and other hanging containers may be the best solution indoors and outdoors if you don't have enough space to house the plants [7]. Leftover tins and plastic bottles will give you the chance to help nature and transform a bare fence [5].

Or you may use them to create fun garden for children [5]. Make drainage holes in the bottom, attach them to the fence and you will have ornamental or edible plants.

Third, a living wall, which represents a small eco-system, is a space-saving technique. It can incorporate many plants without space absorption and add aesthetic beauty to the installation.

The fourth variant can be the usage of separate, stackable pots and containers in which you can display different herbs and flowers.

Fifth, you may save nature, reduce waste, and create additional space for vertical greenery by using up-cycling materials such as old pallets and containers.

Sixth, a hanging rack can be used for pots of plants. It can decorate your home, balcony, and outdoor space.

Seventh, an old ladder will help you to save money, space, and water. Put potted plants on the steps, and you will breathe new life into the old thing and receive a convenient piece of nature in your backyard, small patio, or a balcony.

Eighth, well-known window boxes suit well for growing plants with shallow root systems. The only thing you are to think about in this case is how to secure them on the wall.

Ninth, use your windowsill to get a small vertical garden which can help you in your culinary activities and bring bright colours to your house.

Tenth, a felt pocket planter is a good idea for your vertical garden. This planter is mounted with screws, and then the pockets are filled with plants [9]. It is an easy and cheap way of growing plants.

One more solution is to use the landscape itself in creating green spaces. You can use slopes, steps, and walls for plants placement and space zoning. An interesting and, at the same time, easy way to cover gaps in walls is to put a seedling into it and then fill in some soil around it. Then water it.

You won't need much effort to repurpose the fence by using left-over gutters. Cut them into certain sizes and fix them on the fence. Put plants with soil into them, and you will have the source of fresh salads, annual herbs such as basil and coriander, or alpine strawberries [5].

Besides making up decisions on the particular form of a vertical garden, you should think of plant species suitable for your garden. Not all plants will fit in here. Here are some hints for choosing the plants for vertical gardens: It is better if they grow all year round. They must be drought tolerant. They must be adapted to the climate, region, and exposure on the wall. Climbing and trailing plants as well as succulents are best for such variants. And of course, don't forget of the irrigation system, north or south sides, and sun intensity.

Vertical gardens can be tailored to your needs and wishes. Besides aesthetic appeal, they offer numerous benefits for the environment and people who inhabit these urban spaces. Among these positive impacts, one may distinguish improved air quality, mitigation of the urban heat island effect, improvement of biodiversity, noise reduction, rainwater control, healthy indoor climate. Economic benefits include space saving, low expenses, reduced water and electricity consumption, easy maintenance and reduction of the maintenance cost, the possibility of making changes at a low cost, stimulation of well-being, and efficiency of employees [10].

But along with benefits, there come some downsides to vertical gardening to take into account. Vertical gardens may damage constructions against which they are planted. Water and moist are often damaging to the walls. Besides vertical gardens impair colour, the surface to which they are attached. Being tall constructions, they may cast a shadow on other plants growing beneath. In addition, plants may become the source of germs and insects spreading, making your life inconvenient. Plants, growing in the vertical gardens, are exposed to the drying effects of wind and sun [11]. That is why sometimes they may require much water and maintenance. As plants in the vertical gardens grow up without additional support, it is necessary to avoid large and heavy plants [11].

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РЕНОВАЦИЯ ПРОМЫШЛЕННЫХ ТЕРРИТОРИЙ В КИТАЕ: АРХИТЕКТУРНЫЕ СТРАТЕГИИ И ИНТЕГРАЦИЯ С ПРИРОДНЫМ ЛАНДШАФТОМ

RENOVATION OF INDUSTRIAL AREAS IN CHINA: ARCHITECTURAL STRATEGIES AND LANDSCAPE INTEGRATION

В статье рассматривается опыт реновации промышленных территорий Китая на примере преобразования бывшего сахарного завода в высококлассный отель Yangshuo Sugar House в Гуйлине. Были проанализированы архитектурные стратегии, направленные на сохранение промышленного наследия и интеграцию современных элементов. Особое внимание уделено принципам гармоничного сочетания исторических конструкций (кирпичная кладка, каркасы) с инновационными материалами (перфорированный бетон, дерево-бетон), а также взаимодействию архитектуры с уникальным природным ландшафтом карстовых гор. На основе детального изучения проекта выделены ключевые факторы успешной реновации: сохранение культурной идентичности, экологичное использование ресурсов, создание функциональных пространств для туризма. Методология исследования включает полевые наблюдения, анализ архивных данных и архитектурных решений. Результаты демонстрируют, что адаптивное использование промышленных объектов способствует устойчивому развитию городов, сочетая экономическую эффективность с культурным наследием. Проект отеля служит моделью для ревитализации постпромышленных зон в условиях глобальной урбанизации.

Ключевые слова: реновация, промышленные территории, адаптивное использование, архитектура, культурное наследие, устойчивое развитие.

The article examines the renovation of industrial areas in China through the case study of transforming a former sugar factory into the high-class Yangshuo Sugar House Hotel in Guilin. Architectural strategies aimed at preserving industrial heritage

while integrating modern elements were analyzed. Special attention is paid to the principles of harmonizing historical structures (brickwork, skeletons) with innovative materials (perforated concrete, wood-grained concrete), as well as the interaction between architecture and the unique natural landscape of karst mountains. Based on a detailed study of the project, key factors of successful renovation are identified: preserving cultural identity, eco-friendly resource utilization, and creating functional spaces for tourism. The research methodology includes field observations, archival data analysis, and architectural solution evaluation. The results demonstrate that adaptive reuse of industrial facilities promotes sustainable urban development by combining economic efficiency with cultural heritage. The hotel project serves as a model for revitalizing post-industrial zones in the context of global urbanization.

Keywords: renovation, industrial areas, adaptive reuse, architecture, cultural heritage, sustainable development.

Industrial areas subject to renovation, exemplified by the transformation of the sugar factory into the Yangshuo Sugar House Hotel in Guilin, China [1]. The goal of the research is to identify architectural strategies and techniques that contribute to the successful renovation of industrial areas while preserving cultural heritage and integrating with the natural landscape.

The relevance of the research is determined by the need to find effective methods for the renovation of industrial facilities, preservation of the historical identity of urban spaces, and ensuring sustainable development in the context of global urbanization.

The research tasks are:

– to study the historical context and prerequisites for the renovation of the sugar factory in Guilin;

– to analyze architectural solutions and materials used in the adaptation of the facility;

– to determine the role of industrial heritage renovation in shaping a sustainable urban environment.

Historically, industrial facilities have played a significant role in shaping the urban environment, but over time, many of them have lost their original function. The relevance of renovating such sites in the context of rapid urbanization, particularly in China, is motivated by the need to integrate historical heritage into the contemporary urban fabric, ensure sustainable development, and enhance the quality of the urban environment. An illustrative example of successful industrial renovation is

the transformation of a former sugar factory in Guilin into the Yangshuo Sugar House Hotel. This project demonstrates the potential of harmonious coexistence between industrial heritage and contemporary architectural solutions that are responsive to both the natural and cultural context.

The sugar factory, located on the Li River in Guangxi Province, began operations in the 1960s and was decommissioned in the early 2000s. Its location surrounded by karst mountains and rich subtropical vegetation provided the site with a unique natural setting. The renovation strategy, carried out by Vector Architects in collaboration with Horizontal Space Design, was based on three key principles: the preservation and adaptive reuse of the industrial structure, integration with the natural landscape, and the use of innovative materials [2, 3].

The renovation process began with the preservation of the factory's framework and key elements such as brick masonry, steel structures, and panoramic openings. This ensured the retention of the site's authentic character and industrial spirit. The interior spaces of the factory were reimagined: former production halls became a lobby, cafe, and multifunctional spaces for conferences and exhibitions. New guest wings, constructed from perforated concrete, were positioned to contrast with the existing structures while maintaining overall compositional integrity.

A central aspect of the reconstruction was the reinterpretation of circulation and access zones. Instead of following the original utilitarian logic of the sugar mill, the architects created new pathways, stairs, and multi-level connections that guide guests through a spatial narrative. Many of these zones were designed as semi-open galleries with voids running through multiple floors, allowing natural light and air to penetrate deep into the structure. These voids were inspired by cave-like forms found in nearby karst landscapes, blurring the boundary between architecture and nature. Moreover, the reconstruction introduced sculptural interventions such as a bamboo canopy spiraling through the atrium, reinforcing the symbolic and spatial continuity between old and new elements. The result of this transformation is shown in Fig. 1.

Particular attention was given to the interaction between architecture and the surrounding landscape. The spatial composition of the complex follows a horizontal orientation that contrasts with the verticality of the karst formations. The architects aimed not to dominate the natu-

ral environment but to emphasize it through calm lines, human-scale volumes, and the use of natural materials. Pedestrian pathways and internal routes evoke the forms of caves and karst ravines, referencing the local geography. The site plan is illustrated in Fig. 2.

Fig. 1. Alila Yangshuo Hotel: A transformed sugar factory amidst karst mountains

Fig. 2. Site plan: Horizontal architecture contrasting with vertical karst formations

The use of innovative construction materials not only enhanced the aesthetic expressiveness of the site but also contributed to its functionality in a warm climate. Panels made of wood-textured concrete and perforated concrete allowed for natural ventilation, dynamic lighting, and harmony with the texture of the original walls. The visual lightness of the new structures does not conflict with the solidity of the factory's elements, resulting in a coherent architectural language. One of the facade solutions is presented in Fig. 3.

Fig. 3. Interior facade: Perforated concrete panels ensuring natural light and ventilation

The spatial narrative is built on the concept of "architectural storytelling" – a progression from industrial heritage to modern experience. Guest routes meander through courtyards, terraced gardens, and reflective pools, encouraging slow and immersive exploration. This approach fosters a unique user experience, where the past and present, the built and the natural environments, engage in a dialogue [4; 5]. An example of such an architectural solution is shown in Fig. 4.

Fig. 4. Cave-like pathways: A bridge between industrial heritage and natural landscape

The Yangshuo Sugar House renovation project stands as a successful example of integrating industrial heritage into the contemporary architectural context. It highlights the potential of adaptive reuse as a tool for sustainable development, capable of combining economic viability, cultural significance, and environmental responsibility. In the face of growing urbanization, such projects become not only architectural ventures but essential strategies for preserving identity and shaping a new urban reality.

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ОБЗОР ПРОЕКТНЫХ РЕШЕНИЙ ПСИХИАТРИЧЕСКИХ БОЛЬНИЦ

REVIEW OF PSYCHIATRIC HOSPITAL DESIGN SOLUTIONS

В статье анализируется моральное устаревание психиатрических больниц в России на фоне современных тенденций реформирования психиатрической помощи. Проведен сравнительный анализ отечественных и зарубежных моделей, выявлены особенности объемно-планировочных решений и функциональной организации учреждений. Отмечаются проблемы избыточной централизации, недостатка внебольничной помощи и дефицита специалистов, а также необходимость перехода к гуманизации и развитию стационарзамещающих форм поддержки. Особое внимание уделено влиянию архитектурной среды на качество лечения и реабилитации пациентов, а также возможностям интеграции современных дизайн-решений для создания комфортной и безопасной среды.

Ключевые слова: психиатрическая больница, объекты здравоохранения, проектирование больниц, психиатрия, планировочная структура, типология.

The article analyzes the moral obsolescence of psychiatric hospitals in Russia against the backdrop of contemporary trends in mental health care reform. A comparative analysis of domestic and international models is conducted, highlighting the features of spatial planning and functional organization of such institutions. The article points out issues of excessive centralization, lack of outpatient care, and shortage of specialists, as well as the need for a shift towards humanization and the development of community-based support. Special attention is given to the impact of the architectural environment on the quality of treatment and patient rehabilitation, as well as the potential for integrating modern design solutions to create a comfortable and safe setting.

Keywords: psychiatric hospital, healthcare facilities, hospital design, psychiatry, planning structure, typology.

The main reasons for the increase in the number of mental disorders, according to WHO experts, are urbanization, increasing complexity of production and educational technologies, increasing information pressure, an increase in the frequency of emergencies, and deterioration of physical health. including reproductive injuries, an increase in the number of brain and birth injuries, and an intensive aging of the population. The location, climatic features of the region and the traumatic situations of recent years also affect the mental health of the population. The neuropsychiatric dispensary is a promising project aimed at solving a number of urgent tasks:

1. Ensuring access to medical care: A psychiatric dispensary can provide city residents with access to high-quality psychiatric care that may be necessary for the diagnosis and treatment of mental disorders.

2. Reducing the negative effects of mental illness: Due to its specialization in mental health, a psychiatric clinic is able to prevent and mitigate the negative effects associated with mental disorders, such as behavioral problems or crises.

3. Providing social support: A psychiatric clinic may employ social workers and psychologists who provide support to patients in solving social and psychological problems, which contributes to improving their quality of life.

4. Job creation: The work of a psychiatric dispensary can contribute to the creation of jobs for medical staff, administrative staff and other professionals, which contributes to the development of the city's economy.

5. Conducting educational events: a psychiatric dispensary can be a platform for conducting educational programs aimed at raising awareness of the basics of mental health and methods of maintaining it among local residents Thus, a psychiatric dispensary can play a significant role in providing the city's population with professional mental health services, social support and job creation, which ultimately contributes to improving the quality of life of the urban community. Architecture in psychiatric healthcare plays an important role in ensuring effective treatment of patients, and modern architectural approaches are of great importance for creating a healthy and supportive environment for patients and staff of psychiatric institutions. A pychoneurological dispensary (PND) is a type of therapeutic and preventive medical institutions in the USSR, Russia and the CIS countries designed to serve patients with mental disorders in community – based settings.

A neuropsychiatric dispensary (mental health center, psychiatric hospital dispensary) is an independent medical organization or a structural unit of a medical organization or other organization engaged in medical activities established to provide primary specialized medical and sanitary care and specialized medical care (if there are structural units in the Dispensary structure to provide medical care in inpatient settings) to persons suffering from mental disorders and behavioral disorders, and licensed to carry out medical activities involving the performance of work (services) in "psychiatry", "psychotherapy", "psychiatric examination", "medical statistics", "physiotherapy", "functional diagnostics".

The main difference between a psychiatric dispensary and other types of hospitals is in the following aspects:

1. Specialized care: Psychiatric dispensaries specialize in the diagnosis, treatment and rehabilitation of patients with mental disorders.

2. Integrated approach: the psychiatric clinic provides not only medical care, but also psychological and social support for patients.

3. Safety and control: psychiatric clinics provide a high level of safety and control over possible behavioral or emotional manifestations.

4. Individualization of treatment: psychiatric services are aimed at the individual treatment of each patient and take into account his unique needs and characteristics.

5. Long-term treatment: Psychiatric dispensaries often provide long-term hospitalization services for patients with severe forms of mental disorders.

6. Therapeutic environment: The architecture and design of psychiatric dispensaries are focused on creating a supportive therapeutic environment for patients that promotes their recovery.

Thus, the construction of new healthcare facilities, including psychiatric dispensaries, helps to provide the population with affordable and high-quality medical care, especially in areas with low availability and limited range of care. Also, the construction of new psychiatric dispensaries of an appropriate level and comfort can help raise standards of patient care and reduce stigmatization (social labeling with subsequent perception of a person by others through the prism of stereotypical representations of mentally ill people) associated with mental illness.

Analysis of foreign experience in the design of psychiatric hospitals

1. The project of the center for children with autism in Copenhagen, Denmark.

The building consists of two volumes, between which an open space for outdoor areas is created (Fig. 2). Outdoor playgrounds are oriented towards the nearby forest. The building consists of two floors: on the ground floor there are an apartment block and auxiliary rooms, the second floor consists of three zones (Fig. 1, table 1): an administrative area, a kitchen area (located in the center) and a residential block. According to the authors of the project, the central location of the kitchen should arouse children's curiosity and encourage them to actively participate in the process when they return home from school. The top floor offers a beautiful view of the forest below. The roof is landscaped and creates a continuous connection between the surrounding landscape and the building. The living rooms are oriented towards the garden and the surrounding nature. Also, each residential block is connected to common spaces and access to the garden. The volume of the building includes light lanterns, which provide an additional light source in the living rooms, as well as create a diverse silhouette of the building. The design scheme is mainly frameless.

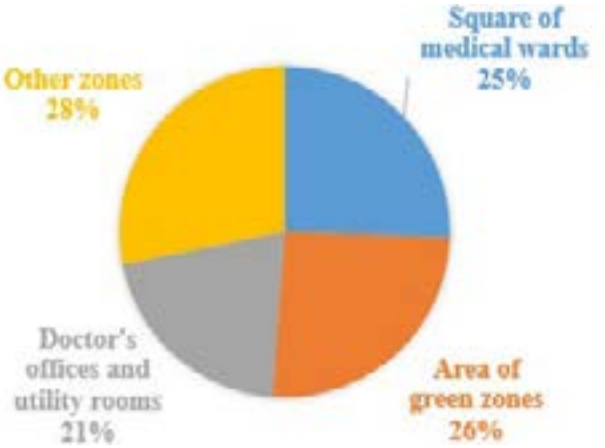

Fig. 1. Pie chart of functions

Table 1

Technical and economic indicators

The project of the center for children with autism in Copenhagen, Denmark	
Area	1409
Square of medical wards	360
Area of public zones	361
Doctor's offices and utility rooms	291,2
Other zones	396,8
Square of medical wards min-max	20

Fig. 2. Functional schemes

2. Balerup Psychiatric Center in Copenhagen, Denmark.

The center consists of 5 buildings, which are interconnected by glazed corridors. This solution allows you to connect the building and the surrounding nature. The composition of the center is based on the interaction of 5 volumes (Fig. 3, table 2). This center has a conference center, clinic, day hospital and hospital rooms (Fig. 4). The buildings differ from each other in the architectural solutions of the roofs. All rooms have access to the courtyard. Natural materials in light shades are used in the decoration. The design scheme is a frame one. The roof is pitched, and light lanterns are used for additional lighting sources and to create an interesting

silhouette. The architecture of this building is designed to make the stay of patients as comfortable as possible: large-scale buildings, warm colors in the decoration, the use of natural materials, connection with nature.

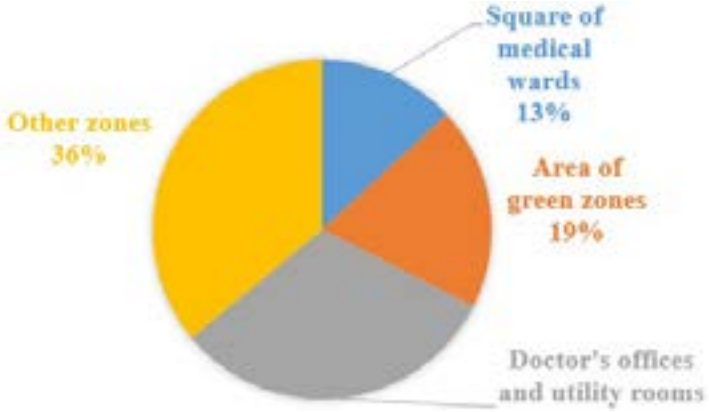

Fig. 3. Pie chart of functions

Table 2

Technical and economic indicators

Balerup Psychiatric Center in Copenhagen, Denmark	
Area	5600
Square of medical wards	738
Area of public zones	1079
Doctor’s offices and utility rooms	1766
Other zones	2017
Square of medical wards min-max	14–47

Fig. 4. Functional scheme

3. Rehabilitation center for children in Hokkaido Prefecture, Japan.

The compositional scheme is free (Fig. 6), the structure of the hospital is only chaotic at first glance, in fact it is a very thoughtful space. Cubes form internal spaces of different shapes that children can explore, hide in them and play. The complex has game rooms, therapy rooms, common rooms, a library, and rooms for meetings with relatives (Fig. 5, table 3). The building is 1–2 floors high, which creates an interesting silhouette and at the same time is large-scale for a person. Natural materials of light shades are used in the decoration. The design scheme is a frame one.

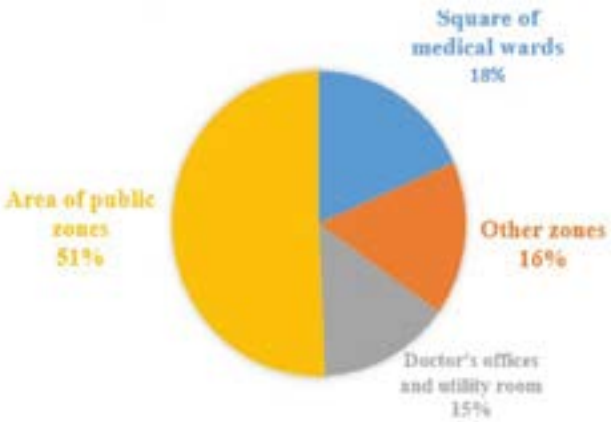

Fig. 5. Pie chart of functions

Table 3

Technical and economic indicators

Rehabilitation center for children in Hokkaido Prefecture, Japan	
Area	14950
Square of medical wards	875
Area of public zones	774
Doctor's offices and utility rooms	687,5
Other zones	2397,2
Square of medical wards min-max	62,5

Fig. 6. Functional scheme

Analysis of domestic experience in the design of psychiatric hospitals.

At the moment, many hospitals in Russia are made according to standard Soviet designs or are located in adapted buildings, so many of them do not correspond to global trends in the field of psychiatry. But at the same time, there is a tendency to increase the availability of psychotherapeutic care, moving away from isolation, and including patients and their relatives in psychoeducation programs to change public awareness of patients with mental illnesses.

Neuropsychiatric clinic with 100 beds, Kotlas, Russia.

The building is located in the city center. The dispensary consists of two blocks with wards and a reception unit, with a corridor–type planning system. Of the public spaces for patients, there are: the auditorium is a sports hall and a dining room (Fig. 7, table 4). There is no exit to the courtyard and no connection between the interior and the exterior. The entire volume of the building is concentrated on the 1st floor, the structural scheme is wall-mounted (Fig. 8).

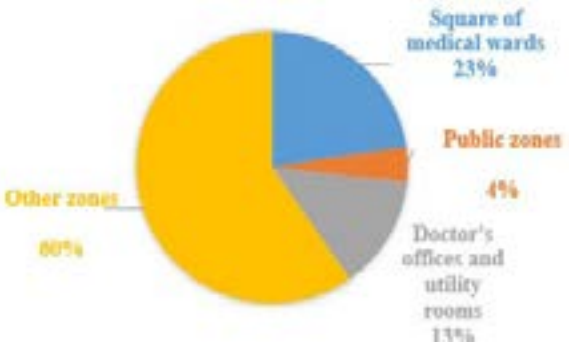

Fig. 7. Pie chart of functions

Table 4

Technical and economic indicators

Neuropsychiatric clinic with 100 beds, Kotlas, Russia	
Area	1630
Square of medical wards	368
Area of public zones	68
Doctor’s offices and utility rooms	221
Other zones	973
Square of medical wards min-max	12–37,8

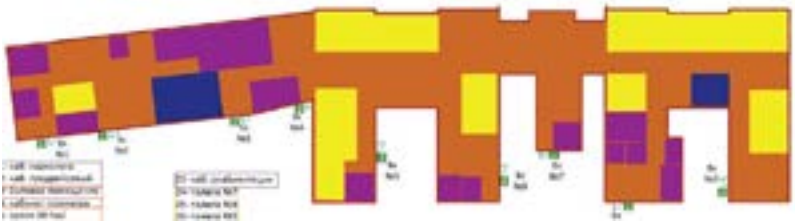

Fig. 8. Functional scheme

A typical project of a psychiatric hospital with 240 beds.

In 1991, a standard psychiatric hospital design was developed. The 240-bed psychiatric hospital building consists of a psychiatric hospital and a food hall. The psychiatric hospital includes a block of general psychiatric departments with 180 beds, a block of neurosis department with 60 beds and a treatment and diagnostic unit. The hospital is connected to the food hall by an underground gallery. The 240-bed psychiatric hospital building is intended to be combined with the current project of a neuropsychiatric dispensary for 150 visits per shift with treatment and production workshops and a 150-bed day hospital in order to create a single complex for servicing the adult population of territories with about 300 thousand inhabitants (Fig. 9, table 5). The blocks of the psychiatric hospital building are connected by heated galleries to ensure technological connections (Fig. 10). This allows for a multi-option solution to the master plan. The structural system is a frame one. The facade solution may vary depending on the color of the exterior panels.

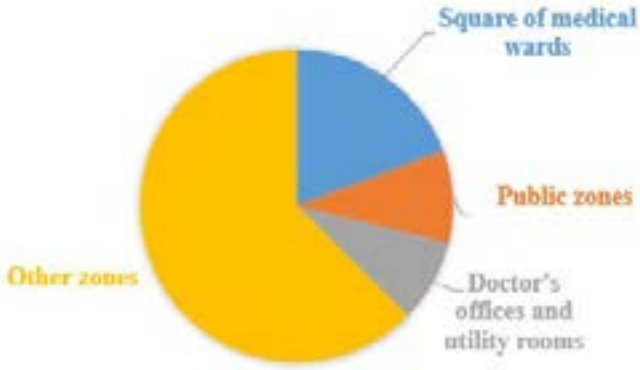

Fig. 9. Pie chart of functions

Table 5

Technical and economic indicators

A typical project of a psychiatric hospital with 240 beds	
Area	5248
Square of medical wards	1013,2
Area of public zones	499,4
Doctor's offices and utility rooms	450
Other zones	3285,4
Square of medical wards min-max	15–31

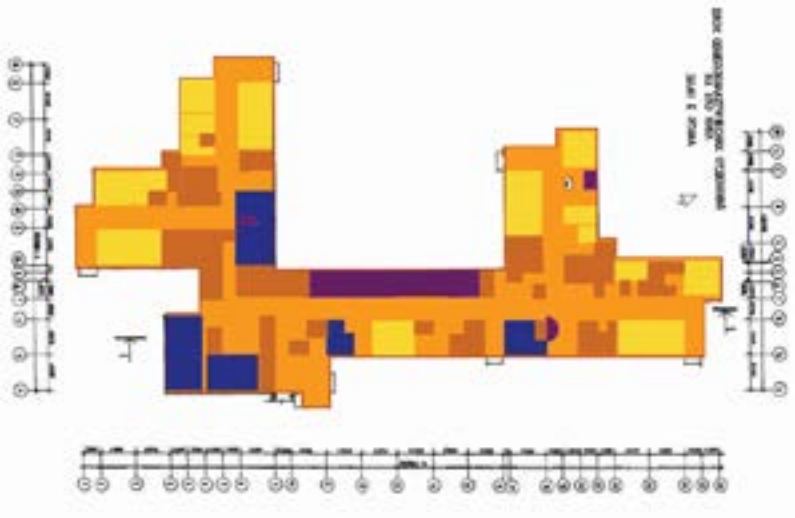

Fig. 10. Pie chart of functions

Based on the analysis of domestic and foreign experience in the design of psychiatric hospitals, the basic principles of design can be identified:

The location of hospital sites on the periphery of the city. Combining different functional blocks into a single complex.

The creation of spaces for privacy, the preferential creation of single rooms for minimal interference in the lives of patients.

The use of natural materials and warm shades. Focusing on the therapeutic role of landscape, creating courtyards and outdoor terraces, and applying landscape design.

Creating a connection between the internal and external space of the hospital as one of the means of treatment.

Creation of public areas for patients to communicate with each other, general events and group therapies, as well as creation of spaces for meetings with relatives.

The interior spaces are designed with an emphasis on creating a pleasant home environment. To create an architectural image, light lanterns are actively used, which can make the interior spaces brighter, as well as create a silhouette of the building.

The structural scheme of buildings is mainly frame-wall, without the use of large-span structures. The buildings consist of 1–2 floors.

From the analyzed analogues, it can be concluded that the layout of medical institutions should be as flexible as possible in order to ensure the implementation of the concept of humanization of space. It is necessary to develop projects that will harmoniously combine all the functions of the institution, including not only medical ones, but also those aimed at creating comfortable conditions for patients, including children. It is important that patients feel part of society and understand that it cares about their health. These principles should be implemented at all stages of the functioning of a medical institution, including the appearance of facades, entrances, layout and decoration of premises. It is also important to consider the environment in which the clinic is located, as the appearance of the building and its surroundings may affect the patient's perception of hospital stay.

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ОСОБЕННОСТИ ПРОЕКТИРОВАНИЯ ТУРИСТИЧЕСКИХ КОМПЛЕКСОВ В ЖАРКИХ СТРАНАХ

FEATURE OF DESIGN OF TOURIST COMPLEXES IN HOT COUNTRIES

В статье анализируется зарубежный опыт проектирования туристических комплексов в жарких странах. Особое внимание уделяется архитектурным и градостроительным решениям при проектировании комплексов. Рассматривается функционально-пространственная организация туристических комплексов с сочетанием гостиничной, ресторанной и жилой функций, а также специфические характеристики, позволяющие интегрировать данные комплексы в развитие жарких стран. Подчеркивается, что одним из основных требований к туристическим комплексам в жарких странах является их правильное местоположение. Определены критерии отбора проектов и проанализированы особенности планирования в жарком климате. Отмечается важная роль туристических комплексов в развитии страны.

Ключевые слова: туристические комплексы, гостиница, ресторан, резиденция, жаркие страны, функциональная организация и пространство.

The article analyses the foreign experience of designing tourist complexes in hot countries. Special attention is paid to architectural and urban planning solutions in the design of complexes. The article considers the functional-spatial organisation of tourist complexes with a combination of hotel, restaurant and residential functions, as well as specific characteristics that allow integrating these complexes into the development of hot countries. It is emphasised that one of the main requirements for tourist complexes in hot countries is their proper location. The criteria for project selection are defined and the specifics of planning in hot climates are analysed. The important role of tourist complexes in the development of the country is emphasised.

Keywords: tourist complex, hotel, restaurant, residence, hot countries, functional organisation and space.

В настоящее время многие страны мира заинтересованы в строительстве туристических комплексов на своей земле, в целях развития страны, совершенствования сферы туризма, а также национальной экономики. Некоторые прибегают к возведению туристических отелей, другие – туристических резиденций. Эти типы сооружений часто очень популярны в жарких странах, так как хорошо приспособлены к теплому климату, размещаются среди красивых пейзажей, что очень привлекает туристов [1].

По данным ЮНВТО, туризм в Африке восстанавливается после беспрецедентного кризиса, вызванного пандемией: в 2022 году поступления от международного туризма превысили отметку в 1 миллиард долларов США, что означает рост на 50 % в реальном выражении по сравнению с 2021 годом. Среди африканских направлений, по которым имеются данные: Эфиопия (+28 %), Объединенная Республика Танзания (+19 %) и Марокко (+15 %). В период с января по июль 2023 года эти показатели значительно превысили уровень, существовавший до пандемии. В Латинской Америке туристическая организация ООН стимулирует рост туризма за счет инвестиций, в период с 2019 по 2023 год в Латинской Америке и Карибском бассейне было объявлено о 212 инвестиционных проектах в области туризма на общую сумму 20,5 миллиарда долларов.

Туризм становится все более важной опорой развития в этих регионах. Он действительно предлагает множество возможностей для экономического роста и расширения прав и возможностей местных сообществ [2, 3].

Планирование и проектирование туристических комплексов стало наиболее широко используемым средством развития туризма и экономики. Архитектор создает целостную архитектурную среду, которая бы соответствовала потребностям и ожиданиям туристов.

Исследование посвящено анализу опыта проектирования туристических комплексов в жарких странах.

Туристические комплексы – это многофункциональные объекты, которые значительно облегчают развитие туристической индустрии.

В жарких странах планирование подобных комплексов часто осуществляется с учетом климатических условий. Как правило, в этих странах средняя температура составляет от 25 до 32 градусов. При этом большинство курортов в этих странах расположены за городом и часто имеют выход к океану, реке. Участок располагается таким образом, чтобы туристы могли наслаждаться окружающей природой.

Туристические комплексы обычно рассчитаны на большое количество туристов и часто занимают очень большую территорию. Они как правило включают отели, жилые дома, торговые центры, рестораны, спортивный центр и т. д.

Гостиничные комплексы часто классифицируются в соответствии с их уровнем комфорта. Уровни комфорта устанавливаются в соответствии с количеством звезд: тремя, четырьмя, пятью и т. д. По уровню комфортности каждая страна имеет свою классификацию, например, в Марокко эта классификация опубликована в Кодексе планирования Министерства туризма.

Факторы, которые часто влияют на реализацию туристических комплексов в жарких странах, классифицируются следующим образом: местоположение, используемые материалы, конструктивное решение.

Ниже приведены два примера зарубежного опыта строительства туристических комплексов.

Рис. 1. Комплекс Mandarin Oriental в Марокко

Комплекс Mandarin Oriental в Марокко был спроектирован архитектором Паскаль Депре в 2018 [7, 8]. Площадь его участка составляет 20 га. Это настоящий тропический оазис, расположенный далеко от центра города Марракеша. Очаровательные виллы окружены садами и оливковыми рощами, а в отдалении виднеются величественные хребты Атласских гор. Проект включает себя: 145 номеров,

3 ресторана и бары, виллы, детские услуги, бассейн, спа, спортивные услуги. Номера отеля Mandarin Oriental воплощают современный дизайн и комфорт.

На территории отеля выделяются жилая зона, общественная зона, спортивно-оздоровительная зона, а также зона отдыха, так называемая зона зеленых насаждений. В центре комплекса находится бассейн, который разделяет виллы на две части, а вокруг комплекса мы можем заметить красивый ландшафтный дизайн

Архитектурное решение отеля Mandarin Oriental сочетает в себе элементы традиционной марокканской архитектуры и современный дизайн. Фасады отеля включают в себя характерные для региона элементы, такие как арки, мозаики и резьба по дереву, что создает уникальный визуальный стиль.

Отель был построен с использованием больших окон и открытых пространств, таких как террасы и балконы, способствует интеграции отеля с окружающей природой, позволяя гостям наслаждаться местным климатом и пейзажами. В архитектуре отеля используются такие материалы как бетон, дерево, стекло, камень.

Рис. 2. Отель The Mora Emerald zanzibar в Танзании.

Второй пример – отель в Танзании, далеко от центра города Матембе расположен на территории 10 гектаров на берегу бирюзовой лагуны на северо-востоке Занзибара, в одном из самых красивых мест, благодаря своим белоснежным пляжам, кристально чистому морю и отсутствию отлива. Комплекс включает себя: 250 номеров, рестораны и бары, виллы, детские услуги, бассейн, спа, спортивные услуги [4–6].

Архитектурное решение отеля основано на идеях экологической устойчивости и гармонии с окружающей средой. Отель предлагает гостям комфортное проживание и безопасные условия для отдыка. Фасады отеля включают в себя характерные для региона элементы, такие как арки, резьба по дереву, и декоративные элементы, сделанные из дерева.

Отель был построен также с использованием больших окон и открытых пространств, таких как террасы и балконы, которые способствуют интеграции отеля с окружающей природой, позволяя гостям наслаждаться местным климатом и пейзажами.

Оба приведенных выше примера показывают, что уровень комфорта отелей превышает три звезды. Они включают жилые здания, рестораны, спортивную зону, детскую зону, торговый центр и т. д. Все помещения ориентированы исключительно на туристические цели и находятся на одном участке.

Заключение

В заключение можно подчеркнуть, что одним из основных требований к туристическим комплексам в жарких странах является их местоположение. Оно играет важную роль в условиях высоких температур. Комплекс должен быть расположен за пределами города и иметь выход к океану или реке.

Площадь участка туристического комплекса должна быть значительной по размеру, примерно 10 га, чтобы вместить большое количество туристов, а сам комплекс должен быть многофункциональным.

Важную роль играют строительные материалы. В жарких странах нельзя использовать кирпичные стены большой толщины, как в странах с холодным климатом, очень часто используются бетон, дерево, стекло, камень и т. д.

Для жарких стран характерно также использование:

– высоких потолков – они помогают усиливать вентиляцию и сокращать нагревание внутренних пространств;

– зеленых технологий – внутренние солнечные батареи и системы для сбора дождевой воды;

– больших окон – они обеспечивают восточное освещение.

Такие решения помогают создавать комфортные условия для жизни и отдыха в жарких климатах. Все вместе это создает отличные

условия для отдыха туристов и ведет к дальнейшему развитию индустрии туризма.

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КОНЦЕПЦИЯ 15-МИНУТНОГО ГОРОДА КАК РЕШЕНИЕ ПРОБЛЕМЫ УРБАНИСТИЧЕСКОГО КРИЗИСА

THE 15-MINUTE CITY CONCEPT AS A SOLUTION TO THE URBAN CRISIS

В статье рассматривается концепция 15-минутного города, разработанная профессором Карлосом Морено в 2016 году, а также ее основные принципы с целью определения возможных путей решения ряда проблем современных городов. Приводятся примеры успешных практик внедрения концепции в мегаполисах разных стран с оценкой положительных эффектов для здравоохранения, экологической устойчивости, социальной справедливости и экономического развития. В работе также анализируются препятствия в реализации концепции, включая проблемы неравномерной децентрализации, риски роста цен на недвижимость и возможное снижение качества услуг. Результаты проведенного исследования позволяют сделать вывод, что данная концепция представляет собой эффективную стратегию устойчивого городского развития при условии ее адаптации к локальным социально-экономическим и инфраструктурным контекстам.

Ключевые слова: 15 минут, доступность, городское планирование, устойчивое развитие, пешая доступность.

This article examines the 15-minute city concept, developed by Professor Carlos Moreno in 2016, and its main principles to identify possible solutions to various problems of modern cities. Examples of successful implementation practices in megacities worldwide are provided, with an assessment of positive effects for healthcare, environmental sustainability, social justice, and economic development. The paper also analyzes obstacles to implementing the concept, including problems of uneven decentralization, risks of rising real estate prices, and the possible reduced service quality. The results of the study lead to the conclusion that this concept represents an effective strategy for sustainable urban development, provided it is adapted to local socio-economic and infrastructural contexts.

Keywords: 15 minutes, accessibility, urban planning, sustainable development, walkability.

The 15-Minute City is an urban planning concept introduced by Professor from the *Sorbonne* University, Carlos Moreno, in 2016, that is aimed to create cities where residents can access essential services within a 15-minute walk or bike ride from their homes. This model emphasizes human-centric, sustainable urban living by restructuring city layouts to prioritize proximity and accessibility [1].

Modern cities face serious problems of transport congestion and environmental pollution. There are more than two billion cars in the world, which are responsible for 29 % of global emissions, and 20th century car-oriented urban planning has led to urban sprawl and deteriorating air quality [2, 3].

Urbanization creates significant pressure on the environment and exacerbates socio-economic inequalities in access to quality services and infrastructure [4]. The COVID-19 pandemic revealed these vulnerabilities, emphasizing the need to rethink urban planning, while integrating suburban areas with low population density and ensuring the economic viability of urban centers remain unresolved tasks [5, 6].

Although the term was proposed by Professor Moreno in 2016 in response to climate change and urban pollution issues in Paris, the concept dates back to earlier urban planning theories. An important predecessor of the concept is also Ebenezer Howard's "garden city" model, proposed in the late 19th century, which sought to combine the advantages of urban and rural life in compact self-sufficient settlements. Clarence Perry in the 1920s developed these ideas, introducing the theory of the "neighborhood unit" as the basis for urban planning. Later, Jane Jacobs in her book "The Death and Life of Great American Cities" (1961) defended the idea of living, multifunctional neighborhoods [7].

The 15-minute city gained significant global attention during the COVID-19 pandemic when Paris Mayor Anne Hidalgo included this concept in her successful re-election campaign in 2020. The lockdown caused by the pandemic highlighted the value of accessible local amenities and increased interest in this urban model. Since then, the concept has been adopted by various international organizations, including the group of cli-

mate leader cities C40, UN-habitat, and the World Economic Forum, as a plan for sustainable urban development.

The 15-minute city is built on four fundamental principles:

1. **Proximity**: The model emphasizes bringing essential services and amenities closer to where people live, reducing time spent on transportation and providing more time for personal activities and community interaction.

2. **Density**: Optimal population density supports the sustainability of local services, creates healthy social relationships, limits car dependency, and ensures efficient use of resources.

3. **Diversity**: Encompasses both the physical environment (multifunctional areas with housing, commerce, healthcare, education, and recreation) and the social fabric (inclusion of people of different backgrounds, ages, and abilities).

4. **Digitalization**: Although not initially a central principle, digital technologies improve the model, in theory enabling remote work, online services, and smart city functions that reduce the need for physical movement [8].

Additional principles can include: human-scale urban design, flexibility, connectivity [9].

Professor Moreno identified six main urban social functions that should be accessible within a 15-minute radius: living, working, supplying, caring, learning, enjoying [1].

Implementation of the concept is based on understanding what can realistically be achieved in 15 minutes. Urban planners typically work with concentric circles emanating from neighborhood centers:

- within a 5-minute walk: Daily needs such as grocery stores and basic amenities;
- within a 10-minute walk: Weekly needs such as specialized shops and community services;
- within a 15-minute walk (approximately 1,125 meters): Schools, medical clinics, parks, and cultural facilities [6].

When applied to street networks in cities such as Paris, this approach allows for a service area of approximately 398 hectares per neighborhood center. Specific implementation varies depending on factors such as topology, existing infrastructure, and population density [10].

The 15-minute city concept offers an effective solution to modern urban problems, integrating social, environmental, and economic aspects

of development. This model contributes to improving the quality of life through reduced travel time, which strengthens community ties and reduces social isolation. The environmental component is realized through reduced car emissions, mitigation of the urban heat island effect, and enrichment of biodiversity, as well as expansion of the green framework and improved air quality. Principles of social equality are embodied in the creation of universally accessible spaces, support for local businesses, and the formation of an environment that takes into account the needs of all categories of citizens. Economic advantages include stimulating local trade, creating jobs within walking distance, and rational use of urban space, ensuring the sustainability of the district economy [6].

In addition to cities with historically established compact structures like Barcelona, more and more megacities around the world are actively implementing the 15-minute city concept in their development strategies. Municipal authorities are purposefully transforming the urban environment, striving to provide residents with access to key services within walking distance and create a more comfortable and sustainable living space.

Paris authorities are actively implementing the principles of the 15-minute city under the leadership of Mayor Anne Hidalgo, who has made this concept a central part of her policy. The city is reducing car traffic, expanding pedestrian and bicycle zones, and the “Paris en Commun” strategy aims to create mixed functional zoning where residents can meet basic needs within walking distance [11, 12].

Since 2009, Portland has been working to create a system of “20-minute neighborhoods.” In 2009, only 6 % of the population lived in such areas, but by 2030, the city plans to increase this figure to 90 %. The focus is on zoning reform, improving pedestrian infrastructure, and developing cycling [13].

Shanghai is actively developing a strategy of “15-minute life circles”, ensuring the accessibility of public services, green areas, and jobs in each district. In 2018, coverage was 36 %, and by 2022 it reached 93 %. This became possible thanks to clearly regulated urban planning strategies [14].

Despite the attractiveness of the 15-minute city concept, its implementation faces a number of difficulties. One of the main obstacles is unrealistic decentralization, as specialized facilities such as hospitals, universities, and large shopping centers cannot be evenly distributed across

all districts. This creates an imbalance in service accessibility and can exacerbate social inequality. Another serious problem is possible gentrification: improving the urban environment often leads to rising housing prices, which can displace low-income populations and turn 15-minute cities into a privilege only for the wealthy. Additionally, the model emphasizes pedestrian and bicycle traffic but does not sufficiently consider the importance of public transport, without which it is difficult to ensure mobility in large megacities. Even with all necessary facilities within walking distance, the question of service quality remains – the nominal presence of shops, schools, and hospitals does not guarantee their compliance with residents' needs. Finally, accessibility assessment methods also have limitations: cartographic data may be incomplete, not accounting for actual facility usage and the mobility characteristics of different population categories. To avoid these problems, comprehensive planning is needed that considers the social, economic, and infrastructural features of each city [15].

Thus, the 15-minute city concept represents a promising approach to solving modern urban problems, offering a balanced model of urban space that promotes quality of life, environmental sustainability, and social integration. Despite existing challenges – difficulties with full decentralization of specialized facilities, risks of gentrification, and the need for integration with citywide transport systems – successful examples of implementation in various cities around the world demonstrate the viability of the concept.

For effective implementation of the 15-minute city, a comprehensive approach is required that takes into account both the advantages of local accessibility and the need for large-scale urban mobility. It is critically important to ensure social inclusivity, housing affordability, and quality of services provided. Flexible adaptation of the concept to local contexts, considering the historical, cultural, and infrastructural features of each city, will maximize its positive potential in creating sustainable and comfortable urban spaces of the future.

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ПРИЕМЫ ЛАНДШАФТНОЙ АРХИТЕКТУРЫ ДЛЯ ПРОЕКТИРОВАНИЯ ОБЩЕСТВЕННЫХ ПРОСТРАНСТВ В ЗИМНИХ ГОРОДАХ

LANDSCAPE ARCHITECTURE STRATEGIES FOR DESIGNING PUBLIC SPACES IN WINTER CITIES

Основной проблемой при проектировании открытых общественных пространств в северных регионах является недостаточное внимание к их зимней эксплуатации. В результате открытые общественные пространства теряют свою доступность и привлекательность для населения на протяжении зимнего периода. Решением является продуманный ландшафтный дизайн, приспособленный под условия, создающие трудности в этих городах зимой: снег, холод, короткий световой день. В этой связи цель исследования – определить основные приемы ландшафтной архитектуры, которые применимы при проектировании общественных пространств в зимних городах, чтобы население могло комфортно и безопасно проводить время на улице в зимний период. В статье рассматриваются понятие «зимний город» и концепция движения Зимний город, определяются условия, с которыми сталкиваются эти города, а также приводятся примеры того, как решаются вопросы зимних городов в разных странах.

Ключевые слова: зимний город, северные регионы, общественные пространства, ландшафтная архитектура, малые архитектурные формы.

The main problem with designing outdoor public spaces in northern regions is a lack of attention to winter operation. As a result, outdoor public spaces lose accessibility and attractiveness to residents in winter. The solution is thoughtful landscape design adapted to the harsh winter conditions of the cities in winter: snow, cold, and short daylight. The aim of the study is to determine the main landscape architecture strategies that can be used in the design of public spaces in winter cities so that the residents have a more comfortable and safer experience outdoors in winter. The article examines the term “winter city”, the Winter City movement concept, conditions that these cities are exposed to, and ways to manage them taken from literature and real-life experience in counties around the world.

Keywords: winter city, northern regions, public spaces, landscape architecture, small-scale architecture.

Winter city is an urban centre that experiences a long, dark, cold, and snowy winter. According to Erskine [1], winter cities are generally located north of 45° and have an average temperature in January of 0 °C or below. However, cities at the same latitude can have different climates due to factors such as sea-land shape, proximity to the sea, and prevailing currents and winds. The main idea across all possible definitions is that winter conditions cause significant challenges to urban life in these areas. Thus, the majority of cities in Russia can be considered as "winter cities". However, urban projects are designed without consideration for winter conditions or activities. Open public places remain abandoned from 4 to 8 months every year, leading to less social and economic activity in cities and also to a decline in the wellbeing of residents.

The Winter City movement is a design and behavioural approach to create more livable winter environment in northern settlements [2]. The main concept of the movement is to increase the enjoyment of winter's positive aspects and lower the impact of negative ones with an emphasis on local tradition and historical adaptations to the harsh climate. With thoughtful landscape design, it is possible to design public space that will be safe, accessible and beautiful during all four seasons. The aim of the research is to examine landscape architecture strategies based on the Winter City movement concept for designing public places in winter cities.

In order to find landscape architecture strategies that will help to design better public open spaces in winter cities, it is necessary to highlight the main conditions that these cities experience:

1) snow and ice;
2) strong wind;
3) cold temperatures;
4) lack of sunlight;
5) visual monotony.

Each of these conditions is both an inconvenience and a source of beauty, unique experience, and opportunities. Ways to manage them can be found in Russia and other countries: Norway, Sweden, and Canada.

Snow

Snow is a main feature of winter, and a large amount of it defines winter cities from others. If not managed properly, it becomes a barrier for pedestrians, especially elderly and disabled people. Walkways, ramps, and stairs are blocked or slippery due to ice crust. At the same time, snow encourages people to do winter activities and can be enjoyable. To find landscape architecture strategies in this context, it is necessary to analyse the snowfall amount for the area first, as it can vary in different northern regions. It will determine if snow removal service is needed and the relevance of some winter events and activities. Thus, there are two concerns that should be considered: providing effective snow and ice management and using snow as a source for positive winter experiences.

Snow management is a strategic removal of snow and ice to ensure safety and accessibility in outdoor areas. Strategy should be based on the city's snow and ice removal policy, providing easier maintenance of the area. Main ways to improve snow management are:

- to pedestrian paths wide enough for winter service vehicles;
- to design walkways using materials that enhance traction and allow easy snow removal, such as paving stones, broomed concrete, and resin-bound surfaces [3];
- to implement heated and/or permeable surfaces to reduce ice build-up and make the path safer;
- to lay main walkaways with the maximal exposure to the sun for the faster melting of ice and snow [4];
- to plant plants near main transits in groups, as single trees or shrubs make snow removal complicated for vehicles and could be damaged;
- to design small-scale architecture such as bus stations for faster snow removal, some of them could be adapted for snow compaction in regions with high level of precipitation;
- to plan snow storage areas in advance, snowbanks need to be placed away from pedestrian paths, with easy access for winter service vehicles;
- to create boulevard tree sections, because they provide snow storage space for roads and sidewalks.

As it was mentioned earlier, snow is also a source for positive winter experiences. Snowbanks can be used for encouraging winter activities by turning into sledging or skiing hills, areas for playing and snow

sculpting, or even into wind barriers [4]. It will not only create a functional zone and become a new point of attraction but also reduce the burden on snow removal services.

Wind

Cold, strong wind is a major inconvenience in winter. It makes the temperature appear colder than it actually is. In order to design a comfortable environment, wind should be blocked as much as possible. To begin with, proper wind modelling should be done with highlighting prevailing winds. The quality of this research will influence the efficiency of all other components that will be implemented in the area. Then, main transit zones should not be placed towards prevailing winds. Wind can become stronger in long alleys as they do not have any barriers to stop it. If the path cannot be moved, it needs to be shaped into a curve to create places for barriers and windless areas.

The main way to lower the negative impact of wind is using different kinds of barriers. For example, high-density groups of evergreen trees can be used. They will not stop the wind but can reduce the speed. High trees slow wind at the height of 5-10 meters. To slow stream at the height of a person, several rows of smaller plants should be added [4] (Fig. 1).

Besides, a combination of evergreen plants and elevated surfaces can function as a wind barrier. Small hills protect people from low streams. By adding trees or even low shrubs on the top, it is possible to create a windless area. If the area is placed in an area with much sunlight, it will be an attractive place for rest (Fig. 2).

Small-scale architecture can also be designed to protect people from wind, creating a sense of security, making the place more appealing. They better work in groups, and when they are mobile, it protects the person from streams from every direction. Good examples are Winnipeg Skating in Canada shelters (Fig. 3) and the bus stop in Umeå, Sweden (Fig. 4).

Fig. 1–2

Fig. 3. Winnipeg Skating shelters, Canada

Fig. 4. The Station of being, the bus stop in Umeå, Sweden

Cold

Cold can be stressful to endure while being outside for a long time. It is important to know the average temperature the region is experiencing to calculate the distance between warm shelters. Traditionally, developers tried to “hide” people from the cold. It is seen in second-story walkways: “plus fifteens” in Calgary, “skywalks” in Winnipeg, “skyways” in Minneapolis and Des Moines, “pedways” in Chicago and Edmonton – that allow people to move around downtown areas without stepping outside. As a result, pedestrian activity from downtown streets. The Winter City concept suggests finding other solutions to keep people warm and satisfied with the weather. Possible ways to accomplish that are:

– Finding “sun islands” and minimizing shadowing.

Despite the fact that sun in winter is less intense than in summer, it is still the main resource of free energy and light. It also has a psychological effect that makes people consider space “warmer” when the sun is shining.

The sun rises lower in winter, compared to summer, and shadows from surrounding buildings become longer. Areas with and without access to natural light are possible to locate with shadow mapping [4]. These areas should be developed in corresponding scenarios: playgrounds, walkways, active and leisure zones for “sun islands,” and parking lots, pavilions, pedestrian shelters, toilets for shaded areas.

– Designing shelters for pedestrians.

To balance outdoor experiences with comfort and safety during cold weather, it is often necessary to provide access to indoor spaces or to create temporary “in between” spaces that are neither fully indoors nor fully outdoors.

Indoor spaces should be see-through to keep people inside involved in outdoor events [4], like it was done in Mary-Ann’s Polarrigg restaurant in Longyearbyen, Norway (Fig. 5), or in a children’s playground in Sevkabel Port, Saint Petersburg (Fig. 6), Russia. “In between” spaces can be heated or designed in the way to keep people warm. A great amount of ides for shelters has been presented in the Warming Huts Competition in Winnipeg, Canada every year since 2009.

– Providing places for winter outdoor activities.

Movement keeps people warm. It is necessary to provide winter activities for all ages. Popular features include ice skating rinks, cross-country skiing and snowshoe trails, play areas with climbing structures, and sledging or skiing hills.

Winter markets and festivals are important winter activities too. Holiday-themed markets in Vienna and Salzburg in Austria, Munich in Germany, and Strasbourg and Paris in France are famous around the world. They encourage people to take part in outdoor activities and create a sense of community. For better experiences, areas for markets should be planned in advance with heated restrooms and warming stations.

– Using suitable materials.

Materials that are used for outdoor furniture and children’s playgrounds should be cold-resistant and comfortable to use all year round.

Wood and rope feel are perceived warmer than metal and stone both physically and psychologically. An example of this principle can be found in Kabardino-Balkaria Centenary Park (Park Stoletiya), where swings are comfortably used all year round (Fig. 7).

Fig. 5–6. Mary-Ann's Polarrigg restaurant
and Playground in Sevkabel Port

Fig. 7. Swings in in Kabardino-Balkaria
centenary park

Lack of light

Proper lighting is a key element of landscape design for winter, ensuring safety and ambiance. Illuminating pathways, seating areas, and signage is important for visibility. Warm-colour lights are better for creating an inviting atmosphere and psychological sense of warmth. Dark nights of northern cities in winter also create possibilities for innovative lighting. In Edmonton, Flying Canoë Volant includes artistic light installations that use the snow as a canvas (Fig. 8).

Fig. 8. Flying Canoë Volant

Visual monotony

City landscape may appear monotonous and unattractive in winter time as most plants are dormant. Accordingly, it is necessary to incorporate evergreen trees and shrubs for year-round greenery and create visual interest in public spaces. Evergreen plants should be cold and salt resistant. They also will act as wind barriers and protect pedestrians from the cold. Rhododendron [5], pine, spruce and fir [6] can be planted in northern regions, native species should be preferred.

Visual interest can be created with colour, texture, sculptures, installations, and points of attraction.

Colour

Implementing plants that are colourful in winter or have berries that not only have an interesting look but also attract birds that bring life to the scene. White willow (*Salix alba*) (Fig. 10), purple willow (*Salix purpurea*), rowan (*Sorbus aucuparia*), blackthorn (*Prunus spinosa*), wild hydrangea (*Hydrangea arborescens*), white dogwood (*Cornus alba*) (Fig. 11), red dogwood (*Cornus sanguinea*), Manchurian cherry (*Padus maackii*) and guelder rose (*Viburnum opulus*) (Fig. 12) can be considered for planting [7].

Small-scale architecture and furniture may also be used to provide colour, as seen at the playground in Arsk, Tatarstan Republic, Russia (Fig. 12). Implementing colours should be done thoughtfully so the overall landscape looks harmonious.

Fig. 9–10. White willow and white dogwood

Fig. 11. Guelder rose

Fig. 12. Playground in Arsk

Texture

Unusual textures become more noticeable in winter against the snow. Trees with unique bark textures or shapes, like birch, black birch (*Bétula nígra)* (Fig. 13), paperbark maple (*Acer griseum*) (Fig. 14), white poplar (*Populus alba*) or mountain elm (*Ulmus glabra*)**,** should be planted [8].

Textures and textured flooring materials should be selected in flooring material selection, like gravel or pavestone. Stones can be used to provide structural support and define spaces, along with creating texture to the scene.

Fig. 13, 14. Black birch and paperbark maple

Sculptures, installations and points of attraction

Visual interest in landscape can be achieved by adding sculptures, art installations, small-scale architecture such as viewing platforms. Temporary installations like ice sculptures can be used to create a unique winter image of the space and attract tourists. Ice festivals are held annually around the world, for instance, “Hyperborea” in Petrozavodsk, Russia (Fig. 15), and “Ice Magic festival” in Alberta, Canada (Fig. 16).

Fig. 15. «Hyperborea» festival

Fig. 16. Ice Magic festival

Previously described methods of managing challenging winter conditions are possible solutions for design problems of public spaces in winter cities. They should not be standardized but rather adapted to local traditions and culture.

To sum up, there are five landscape architecture strategies for designing public places in winter cities that can be highlighted based on solutions that were discussed in the article:

1. Using study of the area as a primary source of design solutions. Average amount of snow, average winter temperature, prevailing winds, shadowed areas, local plants, and traditions should be studied and be a foundation of following development of the space.

2. Encouraging winter activities in all possible ways to keep residents moving and engaged.

3. Considering winter operation of elements like materials, small-scale architecture, pathways to provide a comfortable experience during all seasons, including winter.

4. Designing additional lighting for safety and ambiance of the area.

5. Creating visual interest and points of attraction to keep space engaging when most plants are dormant.

Implying these strategies can help to develop cities in northern regions, including Russia, making them more livable for residents and more attractive for tourism. It is important to think about winter while planning the look of the city, especially in places where it is there most of the year. High quality urban vibrancy in January means having vibrancy all the year because it requires more thought and interventions in winter, while it is easily achieved in warmer seasons.

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МНОГОФУНКЦИОНАЛЬНЫЙ КОНГРЕССНО-ВЫСТАВОЧНЫЙ КОМПЛЕКС В НИЖНЕМ НОВГОРОДЕ

MULTIFUNCTIONAL CONGRESS AND EXHIBITION COMPLEX IN NIZHNY NOVGOROD

В статье рассмотрены основные принципы формирования среды многофункционального конгрессно-выставочного комплекса на полуострове Печерские Пески в Нижнем Новгороде. Проведен предпроектный анализ выбранной территории, отмечены ее ключевые особенности. На базе исследования отечественных и зарубежных аналогов описаны основные идеи и концепция проекта, выявлены основные особенности подобного типа архитектурных сооружений. Предложена структура функционального наполнения и зонирования комплекса. Отмечена актуальность выбранной темы, рассмотрены архитектурные приемы, наиболее эффективно подчеркивающие особенности выбранной территории и способные удовлетворить потребности современного общества.

Ключевые слова: конгрессно-выставочный комплекс, формирование среды, средовая концепция, многофункциональность.

The article considers the basic principles of the environment formation of a multifunctional congress and exhibition complex on the Pecherskie Peski peninsula in Nizhny Novgorod. Pre-project analysis of the selected territory is carried out, its key features are noted. On the basis of the study of domestic and foreign analogues, the main ideas and concept of the project are described, the main features of this type of architectural structures are revealed. The structure of functional filling and zoning of the complex is proposed. The relevance of the selected topic is noted, archi-

tectural techniques that most effectively emphasize the features of the selected territory and can meet the needs of modern society are considered.

Keywords: congress and exhibition complex, formation of the environment, environmental concept, multi-functionality.

Congress and exhibition activity is an actively developing trend in Russia, focused on creating favorable conditions for personalized information exchange, business and scientific contacts [1]. The development of congress and exhibition activities plays a key role in the economic and cultural progress of the country. It does not only facilitate the exchange of knowledge and experience between professionals of different industries but also is a powerful tool for attracting investment and promoting goods and services at the international level [2].

The relevance of the chosen topic is underlined by the fact that in Nizhny Novgorod there are no similar platforms where different companies could organize large-scale events, invite guests from other cities, and hold forums, conferences, and workshops on a single territory. This format is very convenient: firstly, visitors to the complex will not need to leave the complex due to the fact that all the necessary functions (places for work, meetings, conferences and forums, restaurants and cafes, as well as hotels) will be available on the selected territory. Secondly, any company can rent premises in the complex for its own needs – that is, the complex will not be tied to any particular organization, which will not allow it to be empty for a long time. Thirdly, the complex will be able to host events of various scales, which will certainly have a positive impact on the economic development of the region.

The chosen territory for the project – the Pechyorsky Peski peninsula – has a favorable location in the city structure and will be perfect for such a multifunctional complex.

Plans for the complex improvement of the peninsula have existed since the Soviet times. According to the general development plan of Nizhny Novgorod, the Rowing Channel area was planned to be developed as an Olympic-level water sports centre, as well as a recreation and entertainment centre with the construction of appropriate infrastructure [2].

One of the main problems of the territory under consideration is a pronounced inaccessibility of the peninsula. There are no public transport stops nearby, which deprives the residents of the city and its guests of the

opportunity to get to the place without a private car. The peninsula is connected to the city by the only motor road; there are unasphalted roads on the territory of the island, which are difficult to drive on in summer and impossible to move in winter. In the immediate vicinity there is a ropeway connecting Nizhny Novgorod and Bor.

The huge territory of the peninsula is practically empty at the moment – despite the fact that in summer time the peninsula is popular among the city residents, there are relatively few places for recreation here: there are several yacht clubs, bathing and sports and entertainment complexes, small cafes and a beach. The main territory of Pechyorsky Peski, unfortunately, is not landscaped.

The connection between architecture and nature plays a key role in creating a harmonious and sustainable living environment. Nature is some kind of inspiration for architects, helping them to create structures that not only emphasize the beauty of the surrounding world, but also contribute to the ecological balance. By interacting with nature, architecture can be designed to minimize the negative impact on the environment. The use of natural materials, energy-efficient technologies, as well as taking into account the climatic peculiarities of the terrain allow for the creation of buildings that harmonize with the natural landscape [3].

Thus, the main idea of the project is an inherent connection with nature. Finding themselves on a peninsula surrounded by pristine natural scenery, visitors will be able not only to take in the beauty of the environment, but also to immerse themselves in their own thoughts, to feel the contrast between the dynamic life in a large city and the peace that can give a quiet, peaceful place in close proximity to the metropolis.

The whole complex consists of five separate buildings, visually and functionally united with each other by an elongated terrace stretching along the second level, as well as shells-shelters (Fig. 1, 2).

The main building of the congress and exhibition complex is the largest – it is here that all large-scale events are planned to be held: forums, workshops, conferences and exhibitions. The point of attraction of the main building and the whole complex is the vast atrium, which acts as a recreational area.

In addition to the main building, where exhibitions can be held, the complex also has two separate pavilions for exhibition purposes, as well

as a hotel consisting of three combined buildings and a sports complex for leisure activities.

Fig. 1. Multifunctional congress and exhibition complex
on the Pechyorsky Peski peninsula in Nizhny Novgorod, bird's eye view

Fig. 2. Multifunctional congress and exhibition complex
on the Pechyorsky Peski peninsula in Nizhny Novgorod, viewpoint

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СОВРЕМЕННЫЕ ПОДХОДЫ К ФОРМИРОВАНИЮ ОБЛИКА ЗДАНИЙ СУДА (ЗАРУБЕЖНЫЙ ОПЫТ)

MODERN APPROACHES TO FORMING THE APPEARANCE IN DESIGN COURTHOUSES (INTERNATIONAL EXPERIENCE)

Здание суда является значимым объектом городской среды и восприятие его облика непосредственно влияет на отношение к власти гражданином. Теперь это не только административное здание, но с увеличением его публичности – общественное пространство. Выявлены ключевые аспекты формирования этого облика – прозрачность и символизм, что помогает судебным зданиям оставаться не только функциональным объектом, но и служить символом справедливости, равенства и открытости судебной системы. Представлены примеры судебных зданий в различных странах, таких как США, Франция, Испания и Бельгия, демонстрирующие применение подходов к формированию облика таких зданий. Особое внимание уделяется интеграции здания в окружающую среду, а также их роли в формировании общественного доверия.

Ключевые слова: здания суда, судебные здания, символизм, общественные пространства, архитектура суда, зарубежный опыт.

The court building is a significant object of the urban environment and the perception of its appearance directly affects the attitude of citizens to the authorities. Now it is not only an administrative building, but with the increase of its publicity – a public space. The key aspects of this image formation are revealed – transparency and symbolism, which helps court buildings to remain not only a functional object, but also to serve as a symbol of justice, equality and openness of the judicial system. Examples of courthouses in different countries such as the United States, France, Spain and Belgium are presented to illustrate the approaches used to shape the appearance of such buildings. Particular attention is paid to the integration of the building into the environment, as well as their role in building public trust.

Keywords: courthouses, court buildings, symbolism, public spaces, courthouse architecture, foreign experience.

Throughout the centuries, the courthouse has been not only a functional object performing legal procedures, but also a significant element in the urban environment, reflecting the values, cultural context and historical traditions of society. Attitudes to power by man have changed over time, as well as the legal field has changed, this has influenced the general perception of the image of the judicial building by man. Modern approaches to the design of such buildings are based not only on functionality, but also on figurative solutions that convey the values of transparency, equality and authority of power. The article analyses modern figurative solutions in the design of courthouses based on foreign experience, which allows them to reflect not only the attitude of modern man to power, but also to remain true symbols of justice and law and order.

From a sociological point of view, law has lost the understanding of its 'dark, sacred and historical significance' over time, and adopts the principle of 'publicity' of the hearing. Before the emergence of specialised administrative buildings, of which the courthouse is one, administrative and religious structures were housed in the same space. In the Middle Ages, such an object was a castle; the architecture emphasised the sacredness and authority of justice: massive walls, narrow windows and towers symbolised the impregnability of power. Later, courthouses took on a monumental character: the architecture emphasised the power and grandeur of the state with classical columns, domes and facade decorations. Such buildings were designed like palaces, with spacious staircases, grand interiors and facades richly decorated with state symbols. Modernism brought new principles to court architecture: focusing on functionality and accessibility, open spaces, simple geometric forms, extensive use of steel and glass. The architecture of court buildings evolves from sacred and enclosed spaces to a place of justice that embodies the democratic values of openness and fairness [1].

In this regard, the development of the image of a modern courthouse as an institution is oriented towards strengthening its openness and role in public life. One of the main approaches to the design of such facilities is to emphasise transparency. This supports the concept of 'accessi-

bility', 'fairness' and 'justice as a public, public affair' [2]. Transparency is achieved through the following techniques:

- the use of glass facades (visually opening up the interior space of the building, which emphasises the principle of openness of justice);
- creation of public areas (viewable corridors and atriums, courtyards and inclusion of adjacent spaces accessible to the public form a sense of public involvement in the judicial process);
- integrating indoor and outdoor spaces (the lobby of a building flows seamlessly into an adjacent plaza or becomes an amphitheatre of the surrounding landscape – creating a sense of belonging and trust).

One example is the Sandra O'Connor Courthouse by architect Richard Meier, built in 2000. The entrance is orientated towards the public square adjacent to the building, while the lobby serves as an extension of this square inside. The façade of the building is glazed, through which can be seen the interior of the building with an atrium, within which the main element is the volume of the meeting room (Fig. 1, A).

Fig. 1. General view, surroundings and interior:
A – courthouse in the USA, B – Palace of Justice in Paris.

The Palais de Justice in Paris, designed by Renzo Piano RPBW, also demonstrates the use of these design principles. It is distinguished by the use of glass façades, the organisation of internal atriums and additional public areas, and the terracing facing the urban landscape with conservatories (Fig. 1, B) [3].

Courthouses are administrative buildings and their architecture often uses symbolism that reflects the social, historical or cultural aspects of the society of a given country or common symbols related to this branch of government (statue of Themis, scales, etc.). At the same time, symbolic elements not only play a key role in shaping the visual orientation in the urban environment, but also recall history and tradition, evoking a sense of respect.

Since courthouses have been set aside as a separate space and the judicial process has become more open to the public, the functionality of the building has become more diverse due to its publicity. Regionalism here, as an applied concept, forms a person's trusting perception towards the object of the urban environment [4]. Urban environment motifs (ornaments, silhouettes) begin to appear in the images of buildings. In addition, there are a number of applied architectural elements that have a more metaphorical meaning. Their most characteristic features are given:

- the use of columns or the regularity of façade elements: windows or lamellae (as a response to the historical appearance of administrative buildings: classical architecture is associated with the authority and stability of justice);
- the use of direct symbols on building facades (coat of arms, statue of Themis, scales of justice, sun, book of law, etc.);
- images of the urban environment characteristic of the area (ornamentation, formalism, inclusion of historical elements);
- use of natural materials (natural stone and wood reflect durability, strength and reliability);
- symbolic colour schemes appropriate to the local culture (white – purity and justice, gold – dignity and authority, dark wood tones – seriousness and respect for justice, etc.).

Respect for traditional urban 'meanings' without the use of direct symbolism is reflected in the Palais de Justice in Bordeaux, built by Richard Rogers in 1998. The first thing we see are the courtrooms – conical in cross-section, the shapes of the halls echo the shape of the adjacent medieval towers, and are reminiscent of Celtic beer halls [5]. They stand 'regularly' behind

an almost invisible glass curtain wall, symbolising the transparency of the court system. The image of the building provides a response to the past of the historic urban environment and emphasises its significance (Fig. 2, A).

Fig. 2. General view: A – the Palace of Justice in Bordeaux,
B – the Palace of Justice in Cordoba, C – the courthouse in Caen

The Palace of Justice in Córdoba is an example of a public space made so by its multifunctionality. The building was constructed in 2017 by the architectural studio MECANOO. The architects were inspired by traditional Andalusian architecture, in particular the features of Islamic and Spanish ornamentation (mashrabiya). The volume is simple – a white cube divided into several elements, which is inspired by traditional Andalusian patios and the planning structure of the historic city [6] (Fig. 2, B).

In the centre of Caen is the courthouse designed by Christian Hauvette & Associés. It is a symmetrical and 'down-to-earth' rectangular volume, suggesting the undeniability of justice. The building is clad in regular white lamellae and framed by a 'glass' belt, allowing a glimpse inside, where the entrances to the courtrooms are located. The symmetry and clear structure of the building is associated with order and stability, tradition and steadiness [2] (Fig. 2, C). The same concept of forming the image of a court building is used in the design of the Utah State Building in the USA.

The Palace of Justice in Antwerp, designed by Richard Rogers in 2006, is a prime example of the use of transparency and symbolism in the appearance of a courthouse. The openness of justice is reflected in the glass façades of the building, while the public space - the lobby – is an extension of the urban environment through the main staircase leading to the entrance. The building has an expressive shape reminiscent of the sails of a ship, which links it to the historical and cultural context of Antwerp as a major harbour city (Fig. 3).

Fig. 3. General view of the courthouse in Antwerp

Thus, contemporary approaches to image creation in courthouse design are based on two principles – the use of transparency and symbolic images or elements. Transparency emphasises the principle of accessibility of justice and enhances public involvement in court processes. Symbolism expressed through architectural forms and elements maintains the link with the traditional image of justice, while integrating local cultural characteristics and contemporary perceptions of the judiciary.

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СОЦИАЛЬНЫЕ АСПЕКТЫ ФОРМИРОВАНИЯ ЦЕНТРОВ ОТДЫХА И ТУРИЗМА В ЮЖНОЙ ОСЕТИИ

SOUTH OSSETIA TOURISM AND RECREATION CENTERS FORMATION: SOCIAL ASPECTS

В статье рассматриваются основные социальные аспекты, влияющие на архитектуру центров отдыха и туризма Южной Осетии. Сформулированы социальные аспекты, влияние которых в значительной степени сказывается на архитектуре центров отдыха и туризма и которые должны быть учтены последней. Проанализированы современное состояние инфраструктуры в республике. Рассмотрены специфика расселения и миграционные процессы (исторические, а также современные тенденции). Приведен анализ туристического потенциала (природного и историко-культурного), а также современные тенденции развития туризма в республике. На основе проведенного анализа формулируются факторы влияния для каждого аспекта.

Ключевые слова: туризм, отдых, центры отдыха и туризма, Южная Осетия, социальные аспекты.

The article examines the main social aspects influencing the architecture of recreation and tourism centers in South Ossetia. Social aspects, the influence of which significantly affects the architecture of recreation and tourism centers and which should be taken into account are being formulated. The current state of infrastructure in the republic is analyzed. The specifics of settlement and migration processes (historical and modern trends) are considered. An analysis of the tourist potential (natural and historical-cultural), as well as modern trends in the development of tourism in the republic is given. Based on the analysis, factors of influence for each aspect are formulated.

Keywords: tourism, recreation, tourism and recreation centers, South Ossetia, social aspects.

The article begins with a brief overview of the context in which the concepts of “recreation” and “tourism” are examined as potential primary functional components of an architectural object or a complex of objects. This framework is relevant to the overall thesis and this specific report.

Recreation issues are one of the important ones in the state’s social policy. Optimally organized recreation contributes to the growth of the standard of living and well-being of the population.

In the current research work, following the Professor Lobanov’s study, tourism is considered as an integral part of recreation [1]. The influence of an object’s functional purpose on its architecture is being studied, particularly in relation to the regional specifics of South Ossetia. This investigation aims to uncover how local characteristics shape architectural designs and practices.

The term “recreation and tourism center” means the concept of an architectural object (complex of objects) that, with its functional composition and volumetric planning solutions, meets the needs of both local residents for recreation and incoming tourists for their comfortable accommodation.

But before speaking of the influence that can be affected by architecture of tourism and recreation centers on the social life of the republic, these aspects will be outlined in general. The list of these aspects is compiled on the basis of researchers who consider tourism directly, because tourism today has a larger scale of interaction and more significant consequences of its activities for society [2–4].

So here is the list of that social aspects that influence and can be influenced by the architecture of recreation and tourism centers:

1) Political stability
2) Economy and Employment
3) Social infrastructure
4) Demographic and migration
5) Cultural Identity
6) Interethnic and Social Relations
7) Ecology and Sustainable Development
8) Education and Innovation.

Before moving on to the main topic of the article, the general information about the republic will be considered.

The Republic of South Ossetia, the State of Alania, is a small state on the southern slopes of the Greater Caucasus Range. The political status of the republic is a partially recognized state. The area of the territory is approximately 3.9 thousand square kilometers. More than 85 % of the territory is located at an altitude of more than 1000 m above sea level. The population of the republic (as of 2024) is 56,692 residents. The capital of the republic is the city of Tskhinval. Though the territory of the republic is pretty modest it still has significant tourist potential, expressed in both natural and cultural attractions.

Despite the low level of current conditions for accommodating tourists, the republic is visited annually by about 2,000 people (Fig. 1). The growth of inbound tourism has increased significantly in the post-pandemic years. And today, despite minor fluctuations, it still continues to grow. Up to 90 % of international tourists are tourists from the Russian Federation. The main areas of inbound tourism are business trips and cultural visits.

Fig. 1. Current tourism statistics for South Ossetia

At the same time, domestic tourism remains quite popular among the local population and experiences only seasonal fluctuations, but in general continues to remain at a fairly high level.

The main areas of domestic tourism today:

- business tourism;
- cultural and educational;
- recreational;
- pilgrimage;
- hiking mountain tourism.

The last is remaining very popular among the locals due to the efforts of the Apollo student club that annually organizes mountain ascents during the holidays since 1972.

Today South Ossetia faces lots of problems. The collapse of the USSR and the subsequent long-term Georgian-Ossetian conflict (1989–2008) had devastating consequences for the republic's economy. Today, 17 years after gaining independence, the republic's economy remains underdeveloped and relies for more than 90 % on investment from Russia.

The region's current political status as a partially recognized state significantly complicates the economy's development. And the destroyed infrastructure during the war makes the situation even worse.

The decline of the economy in the region also affects the demographics. Since 1990, the republic has experienced several significant waves of population outflow. This negative trend continues today. And if before 2008 it was provoked by an armed conflict, today people leave, among other things, due to employment problems. For such a sparsely populated republic, the issues of preserving the population, and especially skilled workers, are an important issue. Therefore, the possibility of creating additional jobs through the development of tourism in the region is another important aspect.

In such conditions, for South Ossetia, as for many countries experiencing similar economic difficulties, the development of tourism can be a great help. As a source of non-raw material income for the state, tourism can become a significant source of income for the economy. The development of a tourism is an important sphere for the republic that is established in the program of strategic development of South Ossetia. However, today tourism in the region is still a somewhat chaotic activity and an initiative of local entrepreneurs that are carried out outside of any state program or regulation.

Among other things, the development of institutional tourism, the creation of comfortable places to accommodate tourists could contribute

to the growth of the number of international tourists. And this could become one of the important steps towards the inclusion of South Ossetia as an independent state in the international dialogue.

When talking about tourism, one of the first questions is the question of getting into a tourist region and to the tourist attractions within that region.

Today, the only way to get to South Ossetia is by car via the Transcaucasian Highway, which connects Vladikavkaz and Tskhinvali. It is currently impossible to get to South Ossetia via Georgia.

There are no functioning railways in the republic. The nearest railway station, as well as the nearest airport, is located in neighboring North Ossetia.

Inside the republic, in addition to the Transkam, which crosses the entire republic from north to south, there are also republican highways connecting Tskhinvali with district centers. The highways mentioned above are roads with good asphalt surfaces. All other local roads require significant repair work, which is why some of them are inaccessible in bad weather. The state of transport infrastructure affects resettlement issues.

The republic is being characterized by a high degree of urbanization since the 1990s. About 40 thousand residents out of a population of 56,000 live in the capital itself. The depopulation of the northern regions of the republic is associated with historical migration processes (resettlement from the mountains to flatter territories as the population in the mountains grows). The southern territories were deserted as a result of destructions during the Georgian-Ossetian conflict, as well as the departure of a significant part of the Georgian population after its completion. The villages of the central part of the republic were deserted due to significant infrastructure destruction as a result of the Racha-Java earthquake of 1991. The migration outflow of the rural population remains today.

According to 2015 data, there are approximately 335 settlements on the territory of South Ossetia. Of these, 40 settlements have no permanent population, and 76 settlements have a population of 1 to 10 residents.

The desertification of rural areas is a major problem for South Ossetia, which historically has been a predominantly agricultural region. Agricultural development is a vital issue for the republic. Today, up to 90% of consumer goods are imported from the Russian Federation. And given the seasonality of the Transkam operation, even a short period when the road is closed becomes noticeable for the population. In such a situation, being

able to provide itself with agricultural products is an important task for the Republic of South Ossetia.

Today, private farms are already emerging, focused on domestic sales. However, the scaling of these farms is significantly hampered by the lack of labor due to the outflow of the rural population.

Thus, the formation of the Recreation and tourism centers in the region in matters of social infrastructure can be an incentive for:

1) development of transport infrastructure in the republic:

a. to make the living in the rural areas more convenient, especially in villages where there is no social infrastructure – it will be easier for them to get to regional centers;

b. to create additional opportunities for the development of agricultural enterprises in favorable but remote areas of the republic;

c. to expand the number of tourist attractions available for visiting.

2) Development of social infrastructure in villages. That contributes to:

a. preservation of the rural population;

b. attracting new residents to rural areas. In this way, agricultural enterprises will be provided with labor.

Speaking of Demographics and migration aspects the contribution of the new architectural objects as the way to develop tourism in rural areas can be:

1) reducing the urbanization of Tskhinval by creating additional centers with cultural and entertainment infrastructure;

2) revival of regions previously abandoned due to inaccessibility;

3) attracting more qualified specialists;

4) reducing the migration outflow of the population.

The main attraction for both domestic and foreign tourism in South Ossetia today is the local nature. Despite its small area, South Ossetia has a significant number of natural attractions [5, 6].

The nature of South Ossetia is distinguished by mountains, rich biodiversity and picturesque landscapes typical of the central part of the Caucasus. There are 6 full-flowing mountain rivers flowing through the territory, and there are 3 mountain lakes here. Water natural attractions draw a large number of local tourists. However, the lack of arrangement of recreation areas often leads to pollution of nature.

South Ossetia is rich in numerous mineral springs. Large number of that springs are recognized for their medicinal properties. Based on these medicinal mineral springs, the all-Union resort "Dzau" operated in Soviet times, and the health resorts Naguti and Alandon, operating in the early 2020s.

The ecology of South Ossetia is relatively unpolluted due to the absence of heavy industry in the region. However, local authorities' initiatives to develop mineral deposits, which are abundant in the region, pose a potential threat to environmental pollution.

Including natural attractions in the zone of influence of tourist infrastructure facilities, creation of places for accommodation of tourists (including for their short-term stay) contributes to the preservation of nature from domestic pollution. Placing tourist infrastructure facilities close to protected natural areas can prevent the latter from the negative impact of possible placement of industrial enterprises.

The territory where the republic is located, according to archaeological research, has been inhabited since the Paleolithic era. A section of the Great Silk Road passed through the territory of the republic. Such a rich historical past left behind a significant number of cultural and archaeological monuments.

Taking into account the seismic danger of the region, as well as the frequent armed clashes between residents and neighbors, the earliest monuments that have reached us are those from the Middle Ages.

Cultural objects are mostly represented by:

- fortifications;
- medieval castles;
- religious architecture (temples and sanctuaries).

Archaeological monuments are also represented in significant quantities on the territory of the republic. All these monuments, both cultural and archaeological, also form part of the tourist potential of South Ossetia.

In domestic tourism, Pilgrimage trips are worth mentioning separately. The religion of the Ossetians is closely connected with their traditions and customs, including everyday ones. Each family knows and honors its patron saint, on whose day of honoring the representatives of families try to visit the temple dedicated to that saint. Such temples are often located near ancient and hard-to-reach villages, but this rarely stops pilgrims. Visiting holy places is usually accompanied by a ritual feast.

Preserving culture and national identity is an important issue for such a small people as the Ossetians. Tourism development may entail significant risks for a national republic when traditions and culture may become just one of the tourist attractions. In this regard, it is important to preserve and popularize national culture within the people. In South Ossetia, national self-identification has been very strong over the years of struggle for its independence. However, for the life of the people, it is important not to lose it but to increase it, preserving the language, culture, and traditions. That is why new tourism and recreation centers should embrace the specifics of local culture and traditions. Taking into account that cultural monuments are objects of tourist attraction, they can also be included in the zone of influence of the new object. Preservation of material cultural monuments as one of the ways to preserve national identity.

Regional specifics themselves can become one of the ways to attract international tourists and introduce them to the culture of the region. But what is more important is the formation of a national tourist product, including through architecture, which can become another aspect of the cultural rapprochement of North and South Ossetia in an equal dialogue. The development of tourism infrastructure can attract researchers to the issue of forming a national tourism product. And also can revive archaeological and geological research in the region.

In summary, the main social aspects that influence and are influenced by tourist infrastructure facilities in general, and in the examined recreation and tourism centers in particular, have been emphasized. The development of tourism for South Ossetia is an important issue that affects a significant number of related industries. The development of recreation and tourism centers here could be the first step towards including the republic in international tourist routes and will also create more comfortable living conditions for local residents.

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ ИСТОРИЧЕСКИХ РЫНКОВ САНКТ-ПЕТЕРБУРГА

COMPARATIVE ANALYSIS OF THE HISTORICAL MARKETS OF ST. PETERSBURG

Исторические рынки являются важной частью архитектурной ткани города, занимая собой целые кварталы. Целью нашего исследования является выявление композиционных, планировочных, стилистических и колористических особенностей, а также современное приспособление торговых зданий и комплексов восемнадцатого века на примере старинных рынков Санкт-Петербурга. Типологической единицей является торговое образование по типу рынка с периметральной и комплексной застройкой, ограниченной по внешнему контуру улицами, набережными и проспектами. Подобные торговые пространства являются важной частью городской культуры и могут стать центрами притяжения для горожан и туристов, адаптируясь к условиям нового времени.

Ключевые слова: торговые здания, композиционные особенности, стилистические особенности, колористические особенности, старинные рынки, периметральная застройка, комплексная застройка.

Historical markets are an important part of the architectural fabric of the city, occupying entire blocks. The aim of the research is to identify compositional, planning, stylistic and coloristic features, as well as modern adaptation of trade buildings and complexes of the eighteenth century using the example of the old markets of Saint Petersburg. The typological unit is a trade formation of the market type with perimeter and complex development, limited by the outer contour by streets, embankments and avenues. These trading spaces are an important part of urban culture and can become centres of attraction for citizens and tourists, adapting to the conditions of new times.

Keywords: commercial buildings, compositional features, stylistic features, coloristic features, old markets, perimeter development, complex development.

The goal of the current research is to identify compositional, planning, stylistic and coloristic features, as well as modern adaptation of trade buildings and complexes of the eighteenth century using the example of the old markets of St. Petersburg. The object of the research is the old markets of Saint Petersburg: Bolshoy Gostiny Dvor, Nikolskie Rows, Andreevsky Rows, Apraksin Dvor. The relevance of the research is determined by the need to preserve the historical environment and its objects and adapt historical buildings and complexes to modern conditions. The research tasks are: (1) identification of compositional, planning, stylistic and coloristic features of historical commercial buildings and complexes; (2) identification of methods of modern adaptation of historical buildings and complexes; (3) defining the role of historical markets in the context of the urban environment.

The main form of retail trade in St. Petersburg back in the eighteenth century was trade in markets [1]. The first markets appeared in the city spontaneously, by self-organization and were complexes of timber shops without windows or stoves. They mainly sold food supplies, and people of different classes and incomes gathered in such places. Trade in such markets was chaotic: goods were sold from carts, stalls, and trays, which is why the markets were called flea markets. Despite the lack of stoves in the markets, the first of them were destroyed by fires. Over time, market buildings began to be built of stone. Trade became organized. After some time, in the same century, a plan was developed according to which there should have been a market in every district of St. Petersburg. The decree of June 28, 1782, banning the sale of meat and fish in other places contributed to a further increase in the number of markets. That same year, there were 6 markets in St. Petersburg, and by 1911, the city had 17 city marketplaces with places for rent and 44 private markets and marketplaces.

One of the oldest commercial buildings is the building of the Bolshoi Gostiny Dvor, built in 1785 according to the design of the architect Jean Baptiste Vallin-Delamorte. Gostiny Dvor is of great urban planning significance; it currently occupies an entire block between Nevsky Prospect, Sadovaya Street, Lomonosov Street and Perinnaya Line. The yard has the appearance of an oblique quadrangle about 150 sazhens (≈320 m) long, 100 sazhens (≈213 m) wide on one side and 80 sazhens (≈170 m) wide on the other [2]. A second square was inscribed into the perimeter of the

outer buildings, repeating the outer quadrangular outline of the plan. The spatial structure of the market is unique, with passages through the streets between the square and a large square in the middle, on which the complex of buildings is located. The building is surrounded by two-tiered open galleries on the outside. Each tier has 170 shops, the entrance to which is from open galleries.

The building can be considered the earliest work of classicism in Russia. The external square is characterized by stylistic unity and laconicism, without decorative heaps. The rounded corners of the first square are decorated with two pairs of Tuscan order columns, in the center of the main facade along Nevsky Prospect there is a four-column portico. Otherwise, the monotonous rhythm of the arches and pilasters reveals the standard, uniform layout of the building. The second square, divided into sections, is a different architectural phenomenon. Two-story buildings, originally intended for warehouses, began to be used for trade and rented to different owners, which led to constant reconstructions and various architectural layers. Thus, the external uniformity of the complex hides its internal diversity, which even affected the color scheme of the Gostiny Dvor. On the outside, the walls of the building are painted light yellow with white decorative elements, and inside there are other color schemes. During the life of the courtyard, it was reconstructed twice. The first time was after the Great Patriotic War, which caused significant damage to the building. Then Gostiny Dvor was restored with the correction of the architectural alterations of the late nineteenth century that distorted the original appearance of the first square. During the second reconstruction, architects I. A. Vaks and L. S. Katonin and engineer M. I. Yunoshev turned the previously isolated stores into a continuous enfilade. The individual stores were replaced by a single department store, Gostiny Dvor. Today, the largest department store in the city continues to operate in the building. A public space was organized on the inner square of the courtyard, functioning in the summer and used for cultural events.

The Nikolskie Ryady complex is similar to the Bolshoy Gostiny Dvor in its layout and compositional structure. This market was built in 1789 according to the design of an unknown architect. Nikolskie Ryady is of great urban planning significance as an architectural monument of federal significance. Initially, the complex consisted of two buildings: the main

one in the block and the second one along Shchepyany Lane. Currently, the second building is abandoned. Thus, now the market occupies a block within the boundaries of Sadovaya Street, Shchepyany Lane, the Kryukov Canal Embankment and Nikolsky Lane. Nikolskie Ryady is a quadrangular two-story building with a high pitched roof. The first floor is divided into 52 sections-shops and surrounded by wide galleries that open outward along the facades with arches and unite all the sections into a single system. The second floor - without galleries - overlooks the street with its windows. The inner courtyard is a large enclosed area.

The market is built in the classical style. The facades are monotonous and laconic in their architecture. The arches are divided by pilasters. The main entrances are slightly highlighted by the greater width of the arch and the presence of two windows above it. The color scheme of the facades is similar to the Bolshoi Gostiny Dvor – yellow walls with white decorative elements. In 2007, the restoration and reconstruction of Nikolsky Rows began, since by the beginning of the 2000s the market needed updating. The work lasted more than ten years and by 2018 the main building was restored. After that, the main part of the building was occupied by the Holiday Inn Express and Meininger hotels, and the Hard Rock Cafe restaurant was also opened in the building. In 2021, a large courtyard, previously completely excluded from the urban context, was transformed into a new public space with several use scenarios. The objects erected here mainly from wooden structures, changing their function, are rebuilt minimally. The composition of the new building follows the principles of a classicism monument: a single axis and symmetry are clearly visible. The buildings, while being modern in appearance, form a living dialogue with elements of the historical ensemble.

The Andreevsky Dvor was built in 1789–1790 according to the same principle. The author of the project is unknown [3]. The urban planning significance of the yard is great, as a typical example of the trading rows of the eighteenth century. The market building frames the block, its three lines extend along Bolshoy Prospekt Vasilievsky Island, the sixth line of Vasilievsky Island and Bugsky Lane. Previously, the market included a metal building, which has not survived to this day. The U-shaped two-story building had an inner courtyard, which was closed in the 1950s after the construction of new buildings of the Vasileostrovsky Kolkhoz Market.

The plan of the Andreevsky Rows is also typical: on the ground floor, open galleries with arches on the outside unite 62 sections-shops into a single complex, the second floor without galleries with windows. The architecture, as well as the color scheme of the building, is almost identical to the building of the Nikolsky Trading Rows. Currently, the Andreevsky Market partially retains its historical function. There are also office premises and catering establishments located here.

Another notable historical market in St. Petersburg is Apraksin Dvor, which began its life in 1739, after its territory was granted to Count F. A. Apraksin. The market has an important urban planning significance as one of the largest historical shopping centers in the city. At present, the territory of the yard is 10.8 hectares and extends within the boundaries of Sadovaya Street, Apraksin Lane, Stepanovsky Proezd and Lomonosov Street. According to information for 2025, there are 68 buildings on the territory of the yard. 27 of them are owned by the city, 24 are privately owned, and 17 are mixed-owned. The market buildings are two to four stories high on average, of various configurations, types and layouts. The market has a system of regular passages. The basis for the regular layout of the market was laid in 1818 by the architect A. Modui, who drew up a project for the symmetrical stone development of Apraksin Dvor. Since then, the market was built up and completed for a long time, up until the twentieth century.

The complex is a unique architectural ensemble that fits harmoniously into the urban environment. Such architects as I.D. Corsini, A. Bertels, A. Krakau, A. Klimov, A. Fontana and others participated in its creation. The market buildings were built in the classical style, typical for the time of the beginning of construction. The color scheme of the buildings is similar to other commercial buildings described in the article. Warm shades with white decorative elements prevail on the facades. The current state of the historical complex often causes discussions. Apraksin Dvor has been in need of reconstruction for several years. Today, this issue is being addressed by Nikita Yavein's Studio 44. According to the new concept, the market area will be cleared of cars and transformed into a pedestrian quarter. The parking lot will be located underground, on sites where the development does not represent historical value. The functional solution of Apraksin Dvor was determined historically: the territory's multifunc-

tionality was formed from the very beginning. At different stages of the market's development, the dominant trade function was supplemented by hotel, residential, educational, religious, and business functions. The architects proposed to recreate the previously existing functions of the yard, thereby organizing a public and business complex on the territory, without interfering with the original planning structure of the block and preserving valuable elements of the historical environment [4, 5].

Thus, it can be concluded that most ancient markets had a simple sectional layout. Sections-shops were usually surrounded by wide galleries, on one or two sides, connecting individual sections into a single structure. Buildings could have commercial, administrative and residential functions. The first floors usually housed trade, and the next floors housed the administration, hotel rooms, and residential premises. At present, the historical functions of markets can be preserved and changed depending on the individual case. The style of shopping malls corresponds to the period of classicism in Russia, since it was during this period that the main development of markets occurred. The building of the Bolshoi Gostiny Dvor, the first building of the Gostiny Rows, which became a model for subsequent buildings of this type, had a huge influence on the planning structure, composition and architecture of the market trading buildings. Rows of open galleries uniting numerous shops, the length of the buildings along the perimeter of the block and a large internal area are characteristic features of the historical trading buildings of St. Petersburg. One part of the city markets was specially built according to this principle, to organize trade on them, the other - was formed over time from many separate buildings, creating a unique historical environment. Now, the trading buildings in their height and coloring do not stand out from the surrounding historical buildings. Internal squares and passages, as a rule, are currently pedestrian with the possibility of entering transport for unloading. This allows not to exclude the internal spaces of the markets from the urban context, while preserving the uniqueness and some privacy of the historical environment. Despite the typical differences in the perimeter and complex development of markets, trading spaces are an important part of the city's culture and can become not only an interesting subject for study from the point of view of history, architecture and urban planning, but centers of attraction for citizens and tourists, adapting to the conditions of the new time.

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РЕКРЕАЦИОННО-ДОСУГОВЫЕ БУЛЬВАРЫ КАК НОВЫЙ ТИП ГОРОДСКИХ ПРОСТРАНСТВ

REDEFINING URBAN SPACES THROUGH RECREATIONAL BOULEVARDS

Статья посвящена изучению феномена рекреационных бульваров и их функции в современном городском дизайне. В этой статье рассмотрены ряд отечественных и зарубежных бульваров в соответствии с определенными стандартами, а также предпринята попытка проанализировать влияние бульваров на районы и их трансформацию в многофункциональные центры. В статье отдельно изучается ведущая роль рекреационных бульваров в осуществлении торгово-развлекательной и досуговой деятельности горожан, удовлетворении потребности социального взаимодействия, восстановления терпимости и душевного равновесия людей. В статье приводятся шесть типов рекреационных пространств в зависимости от времени и вида деятельности населения. Также даются рекомендации по эффективному и экологичному проектированию рекреационных бульваров.

Ключевые слова: рекреационные бульвары, дизайн городской среды, многофункциональные зоны, экологичное проектирование.

The article is devoted to the study of the phenomenon of recreational boulevards and their function in modern urban design. This article examines a number of domestic and foreign boulevards in accordance with certain standards, and attempts to analyze the impact of boulevards on neighborhoods and their transformation into multifunctional centers. The article separately examines the leading role of recreational boulevards in the implementation of shopping, entertainment and leisure activities of citizens, meeting the needs of social interaction, restoring tolerance and mental balance of people. The article presents six types of recreational spaces depending on the time and type of activity of the population. Recommendations on efficient and environmentally friendly design of recreational boulevards are also given.

Keywords: recreational boulevards, design of public spaces, multifunctional areas, sustainable design.

Процессы глобализации и международного сотрудничества сфере архитектурных инноваций способствуют продвижению идей экологичного проектирования городской среды. Практические результаты новейших исследований в этой области фиксируют повышение значимости рекреационных зон в городах. Данные территории превращаются в современные многофункциональные зоны. Однако существует разница в приоритетах между экспертами по развитию и обществом, которое ставит во главу угла безопасность и доступность [1].

Данное исследование подчеркивает важность разработки плана действий и подхода, отвечающего требованиям всех сторон.

Преобразование улиц, особенно главных, в многофункциональное пространство помогает стимулировать жилую и коммерческую застройку в этих районах, а также повышает безопасность, уменьшает заторы и поддерживает развитие транспорта и инфраструктуры [2].

Чтобы повысить функциональную эффективность зданий, развлекательные комплексы проектируются в многофункциональной форме с учетом меняющихся потребностей населения в течение дня или года, принимая во внимание городские пространства, а также адаптируя данные здания к различным вызовам. Также необходимо учитывать важность дизайна городской среды как общей основы, способствующей социальному взаимодействию, которая поддерживает экологическую устойчивость и обеспечивает гибкость для удовлетворения меняющихся потребностей горожан. Данные идеи анализируются в исследовании «*Sustainable Urban From: Multifunctionality and Adaption»,* в котором выделяются шесть типов использования пространства, таких как однозадачные зоны (кафе, магазины), циклические площади для проведения мероприятий, многоцелевые открытые зоны для рынков и мероприятий на открытом воздухе, многоцелевые пространства для шоппинга и развлечений, комплексные зоны, например, кинотеатры, и общие пространства для прогулок и занятий физической культурой [3].

В Канаде и Соединенных Штатах Америки произошли изменения в экономическом, социальном и экологическом планировании

в связи с распространением рекреационных сообществ, объединяющих розничную торговлю и развлечения в одном месте [4].

По вине глобальных процессов, таких как: взрывной рост технологий, перенаселение определенных регионов и, как результат, сокращение рабочих мест, а также специализация видов деятельности, – общественные пространства утратили свою центральную роль в жизни городов, что привело к разрыву социальных связей и потере социальной идентичности. Приватизация и социальное неравенство также способствовали усилению дискриминации [5]. Однако этот процесс обратим, если, вернуть общественным зонам их роль инклюзивных пространств.

Данный процесс будет благоприятно влиять на городскую общественную жизнь, способствовать восстановлению терпимости и социальной сплоченности горожан, их душевному равновесию. Необходимо найти комплексный подход к планированию таких зон, учитывающий социальные и экологические потребности населения, чтобы превратить открытые общественные пространства в оживленные места [6].

Многие города со средним и низким уровнем дохода испытывают трудности с удовлетворением растущего спроса на общественные пространства, и этот дефицит и неравномерное распределение финансирования отражают более глубокие деструктивные изменения в политической, экономической и технологической общественной сфере и вызывают опасения по поводу их влияния в будущем [7].

Взаимосвязь между временем, функцией и пространством при разнообразии дизайна повышает эффективность помещений и позволяет использовать их для различных видов деятельности, которые адаптируются к меняющимся потребностям, а не просто ограничиваются фиксированной функцией. Рекреационные бульвары как многофункциональная модель для улучшения пространственной эффективности должны соответствовать определенным критериям. В зависимости от времени и вида деятельности пространства отдыха делятся на шесть типов, которые могут быть следующими:

1. Однозадачные пространства (по запросу); работают на удовлетворение потребностей определенной группы населения, например, кафе, магазины.

2. Циклические пространства (карусель), которые содержат игровые площадки и иные площади, например, сцены, используемые во время сезонных open-air мероприятий или активностей на фестивалях.

3. Многоцелевые зоны; предназначены для размещения временных рынков или спортивных и культурных мероприятий.

4. Многофункциональные пространства; отличаются привлекательностью и сложностью благодаря одновременному сочетанию таких видов деятельности, как шоппинг, развлечения и еда.

5. Комплексные пространства, например, в кинотеатрах; могут находиться разные, но в то же время изолированные группы посетителей.

6. Общие зоны; могут использоваться для отдыха или прогулок, затем преобразуются во временные выставочные площадки или ярмарки.

Данный анализ и сравнение влияния архитектуры и городского планирования на преобразование пространств в многофункциональные зоны, основывается на примерах, упомянутых ранее, которые были выбраны из-за их географического и культурного разнообразия, их многозадачности и способности успешно трансформировать пространства, поскольку они расположены в разных исторических районах. Мы видим, как многофункциональный и экологически чистый дизайн может оптимизировать пространства и превратить их в центры динамичной деятельности. Основными благоприятными причинами для преобразования общественных пространств в многофункциональные центры стали следующие факторы:

1. повторное использование земли;
2. разнообразие видов деятельности;
3. гибкость;
4. улучшение инфраструктуры и доступности;
5. повышение узнаваемости и местной идентичности.

Для создания успешного рекреационного бульвара были сформулированы следующие рекомендации:

1. разнообразие видов деятельности и услуг;
2. объединение элементов устойчивости дизайна;
3. повышение осведомленности населения;
4. гибкость и адаптивность дизайна городской среды;
5. развитие инфраструктуры и доступности для всех групп населения;
6. создание пространства для социального взаимодействия горожан;
7. участие общественности.

Сравнительная характеристика восьми существующих рекреационных бульваров мира

Характе-ристика	Бульвар Днепр	Бульвар Сукре	Бульвар Ниньоа	Бульвар Эр-Рияд	Бульвар Мохаммеда Бин Рашида	Бульвар Белых Цветов	Бульвар Натан	Бульвар Абдали
Площадь	4630 m^2	4100 m^2	11345 m^2	около 900 000 m^2	3 километра	170 000 m^2	около 384 000 m^2	около 384 000 m^2
Стандарты устойчиво-сти	Средние	Слабо-развитые	Средние	Передовые	Высокоэффек-тивные	Умеренные и зеленые	Высокие	Средние
Функции	Развлече-ния, со-циальные функции, пешеход-ная зона	Культура, развлече-ния, ус-луги	Культура, об-щественные функции, торговля	Развлечения, торговля, туризм	Жилые зоны, развлечения, торговля, туризм	Развлечения, пешеходная зона, сады	Торговля, туризм, культура	Деловой центр, торговля, развлечения и услуги
Располо-жение относи-тельно города	На берегу реки Днепр	Централь-ный район Каракаса	Центр Ниньоа, рядом с достопри-мечательно-стями	Север Эр-Рияда, в рамках сезона Эр-Рияда	Центр Дубая, рядом с Бурдж-Халифа	В центре Казани, рядом с достопри-мечательно-стями	В Коулуне, оживлен-ный центр	Центр Аммана, центральный район

Окончание таблицы

Характеристика	Бульвар Днепр	Бульвар Сукре	Бульвар Ниньоа	Бульвар Эр-Рияд	Бульвар Мохаммеда Бин Рашида	Бульвар Белых Цветов	Бульвар Натан	Бульвар Абдали
Преобразование городских пространств	Преобразование заброшенной зоны в развлекательную зону	Преобразование заброшенной зоны в развлекательную зону	Преобразование заброшенной зоны в развлекательную зону	Превращение зоны в туристическую достопримечательность	Превращение зоны в туристическую достопримечательность	Преобразование заброшенной зоны в развлекательную зону	Превращение зоны в оживленную торговую улицу	Перепрофилирование зоны из торгового центра в многофункциональную зону
Инфраструктура и доступность	Хорошая, доступный транспорт	Сложная, слабая инфраструктура	Средняя, требует улучшений	Отличная, доступ для всех категорий	Отличная, доступный общественный транспорт	Хорошая, сеть пешеходных дорожек	Отличная, близость к общественному транспорту	Легкая, современные дороги и транспорт

Таким образом, мы пришли к выводу, что рекреационные улицы – это подход к превращению микрорайонов в многофункциональные центры, отвечающие различным потребностям. Необходимо также отметить важность архитектурного дизайна в продвижении функционального разнообразия и устойчивости в ходе анализа ряда глобальных проектов, которые отражают стремление создать более динамичную и гибкую городскую среду. Следовательно, города могут использовать данные территории не только для выращивания зеленых насаждений, но и для укрепления культурной самобытности, улучшения жизни горожан, инновационного развития пространств.

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ТИПОЛОГИЧЕСКИЕ ОСОБЕННОСТИ СОВРЕМЕННЫХ МНОГОФУНКЦИОНАЛЬНЫХ ТРАНСПОРТНО-ПЕРЕСАДОЧНЫХ КОМПЛЕКСОВ

TYPOLOGICAL FEATURES OF MODERN MULTIFUNCTIONAL TRANSPORT AND TRANSFER COMPLEXES

В статье рассматриваются транспортные проблемы крупных российских городов. Эти проблемы являются следствием быстрого роста городского населения и влекут за собой необходимость модернизации транспортной инфраструктуры. Автор подчеркивает важность адаптации существующих систем для удовлетворения растущих потребностей населения в мобильности, а также стимулирования создания новых рабочих мест. Особое внимание уделяется формированию сети транспортно-пересадочных узлов как сложному, многоступенчатому процессу, включающему планирование, строительство и интеграцию различных видов транспорта. В статье описаны особенности современных многофункциональных транспортно-пересадочных комплексов, их пространственно-планировочная структура, а также представлен сравнительный анализ отечественного и зарубежного опыта их проектирования и эксплуатации. Кроме того, в статье обсуждается роль транспортно-пересадочных узлов в расширении городской транспортной доступности, повышении комфорта пассажиров и обеспечении устойчивого развития городов.

Ключевые слова: транспортно-пересадочный комплекс, многофункциональность, типология, транспортная доступность, транспортная архитектура, хаб.

The article discusses the transport problem of large Russian cities. These transport challenges are the result of rapid urban population growth and the urgent need to modernize transport infrastructure. The author highlights the importance of adapting existing systems to meet increasing mobility demands and stimulate job creation. Special attention is given to the formation of a network of transport hubs as

a complex, multi-stage process involving planning, construction, and the integration of various transport modes. The article describes the features of modern multifunctional transport transfer complexes, their functional and spatial planning structures, and presents a comparative analysis of domestic and international experiences in the design and operation of transport hubs. Additionally, the article discusses the role of transport hubs in enhancing urban connectivity, improving passenger comfort, and promoting sustainable urban development.

Keywords: transport interchange complex, multifunctionality, typology, transport accessibility, transport architecture, hub.

Introduction

The transport problem of large Russian cities remains one of the most urgent. With the rapid development of modern cities, their transport infrastructure does not have time to adapt to population growth and the creation of new jobs. One of the ways to solve this problem is to develop a rational structure and technology for the operation of transport hubs (TPUs) [1].

Nowadays, it is necessary to comprehensively modernize and structure the transport networks and infrastructure of the Russian Federation through the formation and development of transfer complexes that ensure the most effective interaction of all elements of the transport system.

The formation of a TPU network in large Russian cities includes several stages of development.

The first stage is connected with the development of railway communication in Russia, the construction of new railway lines and the development of cities. The first TPUs were formed as hubs where transfers from external (mainline) transport, in most cases railway, to urban transport were provided.

The second stage is related to the development of high-speed off-street urban transport in Russia [2].

The third stage is associated with the intensive development of large and major cities and their suburbs. If the first two stages are related to the process of technical and technological development of transport, then the beginning of the third stage is mainly due to economic, social and other reasons. TPU is turning into modern multifunctional TPC, which began to include not only the infrastructure of interacting modes of transport and the infrastructure of TPU, but also shopping, service centers, hotels, etc., i.e. a tendency is emerging for TPU to turn into TPC [2].

The development of transport systems and their adaptation to market conditions leads to the need for a qualitative change in the functions and structure of TPU, which is due to two main reasons.

Currently, an extensive network of various types of transport hubs (TPUs) exists and is actively developing in large Russian cities. The main TPUs are concentrated mainly in the central part of the city, near city-wide centers and train station complexes that transfer passengers from one mode of transport to another. The formation of TPMS is conditioned by the need to optimize the passenger transfer process [2].

The architecture of such transfer complexes should help create comfortable conditions for passengers, provide convenient transfer between different modes of transport and create a harmonious waiting space for transport [6, 7].

A transport interchange complex is a complex of buildings and structures that combine various types of transport and provide passengers with a wide range of services and opportunities.

The key factors for the success of the transport interchange complex (TPC) are:

1. Convenient location: the complex should be located in the city center or near the main transport hubs to ensure easy accessibility for passengers [2].

2. Effective route planning: it is necessary to develop convenient and understandable routes that will allow passengers to quickly and easily move between different modes of transport [3].

3. Integration of various modes of transport: the complex should include metro stations, bus stops, railway platforms and other modes of transport so that passengers can easily transfer between them [3].

4. Comfort and convenience: the presence of convenient waiting areas, cafes, shops and other infrastructure facilities makes passengers' stay at the TPC more pleasant and comfortable.

5. Environmental friendliness: the use of environmentally friendly technologies and materials reduces the negative impact on the environment and contributes to the creation of a favorable image of the complex.

The features of modern TPC include the following aspects:

1. Integration of various modes of transport: Modern TPCs combine various modes of transport, such as railway, automobile, metro, tram,

trolleybus and others. This allows passengers to quickly and conveniently move between different modes of transport without wasting time waiting for the next transport.

2. Multifunctional: Modern TPCs provide passengers with a wide range of services and facilities, such as shops, restaurants, cafes, cinemas, gyms, beauty salons and others. This makes the shopping center not only a convenient place to transfer from one type of transport to another, but also an attractive place for recreation and entertainment.

3. Convenience and comfort: modern TPCs provide passengers with comfortable waiting conditions for transport, as well as provide convenient recreation and dining areas.

4. Security: Modern TPCs are equipped with security systems such as video surveillance, security, fire alarm and others.

5. Aesthetics and design: Modern TPCs are distinguished by their aesthetic design and attractive appearance.

Analysis of domestic experience.

TPU Seligerskaya, Moscow, Russia, 2021.

Reconstruction of TPU Seligerskaya is planned to be carried out using modern architectural techniques such as: covered atriums, green roofs, transparent roofs, metal slats, facades with media screens. The complex will also include a large surface parking area (1,258 parking spaces are planned, including places for the disabled, as well as areas for technical communication) and a shopping center, which will house a cinema, clothing and grocery stores, and catering enterprises. The shopping center is planned to be made above ground and 4-storey. The facade of the building will be decorated with media facades and aluminum panels.

Passenger traffic: 41.2 thousand passengers per day.

The list of additional functional areas includes a shopping area, restaurants, cafes, cinemas, offices, and a single metro dispatch center.

Transport area: metro, bus station, with an area of 13.6 thousand square meters.m. with a turntable serving intercity and international routes, multi-level Parking for 1,200 cars, intercepting underground Parking, taxi parking, bicycle parking, driveways and passageways.

TPU Vykhino, reconstruction project, Moscow, Russia, 2025.

The modernization of the Vykhino metro station will be a key element of the project. As part of the reconstruction of the station, it is planned to build a modern aboveground passenger terminal (concourse) with a common distribution hall, railway and metro ticket offices, turnstiles, as well as facilities for passing and passenger service [1].

Transfers will be carried out in a warm, dry circuit, and elevators and escalators will make them comfortable and fast, including for passengers with disabilities. The exploited roof of the concourse is planned to be used as a recreation area for passengers and local residents, installing benches and playgrounds on it. The construction of the concourse will also reduce the noise impact of metro and commuter trains on the surrounding neighborhoods.

The boarding and disembarkation fronts of ground transport passengers will be covered with canopies with a total area of six thousand square meters.

Passenger traffic: 170-190 thousand passengers per day.

List of additional functional areas: shopping area, restaurants, cafes.

Transport area: MCD (railway transport), metro, ground shuttle transport (bus, tram), intercept parking.

Shchelkovskaya TPU, Moscow, Russia, 2020.

The central bus station occupies part of the first and sixth floors. The intercity bus arrival area (four platforms) and three suburban bus platforms are located on the ground floor along the building of the complex, and on the upper floor of the building there are six intercity departure platforms, to which buses enter via a two-hundred-meter overpass with an integrated intelligent system [1]. This engineering solution of the Kievskaya Ploshchad Group made it possible to separate transport and passenger flows on the territory of TPU.

The main facade materials are glass and metal. The project uses architectural facade lighting and a 230 m2 media facade.

Passenger traffic: 200 thousand/day.

The list of additional functional areas includes chain stores, beauty salons, service companies, entertainment centers, a fitness club with a swimming pool and a cinema.

Transport area: MCD (railway transport), metro, ground shuttle transport (bus, tram), intercept parking.

Analysis of foreign experience.

"Kamppi Centre", Helsinki, Finland, 2006.

The multifunctional complex in the Kamppi area combines a transport terminal and the largest shopping center in Finland with an area of 37 thousand square meters. m. 12.5 thousand square meters are also occupied by offices, 6 thousand square meters – residential apartments. The total area of the complex is 135 thousand square meters. m. The complex was fully commissioned in 2006.

The Kamppi complex consists of four floors connected by several entrance groups. The platform for boarding the bus is located on underground floors: intercity routes arrive on one of them, urban routes arrive on the other. There are also underground metro stations: urban and suburban. Underground floors allow you to separate traffic flows and avoid mixing bus and metro routes. This method also helps to separate short and long routes. At the same time, the quality and speed of passenger transportation does not decrease. Many people call this hub the center of Finland, because passengers can get anywhere in Finland from this hub.

Bus stops are designed so that passengers are always warm and safe while waiting for the bus. The passenger is not bothered by bad weather while waiting. He can wait in the large distribution hall, which is located in the middle between the platforms with stops. Buses roll down the ramp to the underground floors, where passengers are waiting for them in comfort.

Passenger traffic: 100 thousand/day.

The list of additional functional areas: on the ground floors (of which there are 6) there are clothing stores, groceries, cafes and restaurants. There is even a night club on one of the floors, and information points for tourists and visitors are located between the floors. Apartments and offices are located on the top floors.

Transport area: central bus station for local buses, intercity bus terminal (underground), Kamppi metro station (underground), freight depot (underground), internal parking (underground).

The analysis of domestic and foreign experience in the formation and development of TPU allowed us to identify the following main trends:

- the formation of complex TPUs in which external (railway, automobile, air, sea) and internal (subway, monorail, tram, bus, etc.) modes of transport interact [1].
- concentration and optimization of the number of TPUs in cities in order to rationalize the urban areas used and reduce the number of intra-hub passenger transfers.
- formation of the TPU structure and layout based on multi-storey (aboveground) and multi-storey (underground) technical solutions in order to concentrate and rationalize the placement of interacting modes of transport infrastructure in the TPU and reduce the time spent by passengers moving within the TPU when transferring from one mode of transport to another [5].
- creation of multi-purpose (multidisciplinary) TPUs, which include not only areas with transport infrastructure, but also significant amounts of commercial space designed to provide passengers and visitors with a wide range of services not directly related to the transportation process [5].

The transport function remains fundamental, but it does not determine the spatial content of the transfer hub. The applied functions are public, commercial, cultural and entertainment [1]. The spaces included in the TPC must meet modern requirements and human needs, as well as balance the harmful effects on nature from different modes of transport through the introduction of sustainable solutions.

The analysis of domestic and foreign experience in the formation and development of TPU allowed us to identify the following features:

1. The underground space is actively used: for parking, redistribution of flows of people and transport.
2. The roof space is actively used: for storing cars or as a green landscaped roof for recreation and entertainment of people.
3. The plan is predominantly square or rectangular in shape with above-ground corridors for passageways.
4. The entrances to the building are distinguished by massive canopies, and a dynamic image is used in the silhouette of the building.
5. Slats and a media facade are used as facade decoration.
6. In the complexes under consideration (up to 200 thousand passengers), which are not located in the city center, shopping and entertainment spaces are mainly added as an additional function.

An analysis of global trends in the field of transport interchange complexes (TPCs) allows us to conclude that their attractiveness has increased. The modern transfer complex is not only a means of convenient transfer, but also a place for citizens to relax and stay, as well as a high-quality urban environment in which aesthetic qualities are no less important than functional ones.

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ТРАДИЦИОННАЯ ЦВЕТОВАЯ ПАЛИТРА САНКТ-ПЕТЕРБУРГА И ЕЕ ВЛИЯНИЕ НА ВОСПРИЯТИЕ ГОРОДСКОЙ СРЕДЫ

TRADITIONAL SAINT PETERSBURG COLOURS AND THEIR EFFECT ON THE CITY'S VISUAL IDENTITY

Хотя архитектура традиционно рассматривается через призму формы и структуры, цвет не менее важен для восприятия и понимания городского пространства. В статье рассматривается малоизученный аспект архитектурного облика Санкт-Петербурга - традиционная колористика фасадов и ее влияние на восприятие городской среды. Цвет играет ключевую роль в формировании визуального порядка и передаче исторической преемственности, однако системный подход к его сохранению и применению пока отсутствует. Статья раскрывает, каким образом колористические решения способствуют пространственной целостности и восприятию города, и подчеркивает необходимость более последовательного и научно обоснованного подхода к сохранению визуальной выразительности архитектурного облика Санкт-Петербурга.

Ключевые слова: архитектурная колористика, историческая палитра, сохранение наследия, Санкт-Петербург, градостроительство, визуальный облик.

While architecture is often studied through form and structure, colour plays an equally fundamental role in shaping the way cities are perceived and experienced. This article explores the often-overlooked role of traditional colours in shaping Saint Petersburg's distinctive urban perception. Despite colour being integral to the city's visual harmony and historical continuity, there is a notable lack of systematic research supporting its preservation and application. By addressing this gap, the paper highlights how colour contributes to spatial coherence and identity, and stresses the importance of more consistent, research-informed approaches to sustaining the city's unique aesthetic quality.

Keywords: architectural colour, historical colour schemes, historical preservation, Saint Petersburg, urban design, visual identity.

If architecture can indeed be likened to “frozen music,” then colour sets the tone through which a city expresses its character.

The rich chromatic heritage of Saint Petersburg is a defining aspect of its architectural identity, yet the role of traditional colours in shaping the city’s visual and urban character remains underexplored. While the use of pastel façades and coordinated tones continues to mark the cityscape [1], their application in contemporary architecture is often fragmented or driven by subjective decisions rather than a shared framework. The absence of systematic research into how historical colour systems influence perception has led to inconsistencies in restoration and new construction alike. In turn, this undermines the chromatic continuity that has long contributed to the city’s recognizability, spatial coherence, and emotional atmosphere [2, 3].

This paper examines the principles that shaped Saint Petersburg’s historical colour palette and considers its relevance within the context of present-day architectural and urban practice. Addressing this issue is essential for maintaining the city’s identity amid ongoing development pressures [4, 5].

Throughout the 19th century, colour use in the city was guided by a carefully defined range of tones. Official regulations permitted pale yellows, greens, greys, creams, and blues for façades [6]. These colours were not chosen arbitrarily but reflected practical concerns: yellow brought warmth to an otherwise grey environment, and unsaturated tones ensured visual cohesion across long urban perspectives [6].

Facades were intentionally lightened by mixing pigments with white, creating a restrained palette that softened contrasts and contributed to the legibility of architectural ensembles [6]. Over time, this palette became not just regulation, but tradition – a recognisable feature of Saint Petersburg’s cityscape.

The city’s historical palette not only structured the urban image but shaped how residents and visitors experienced space. Light pastel colours, widely used on façades, expanded the perceived width of narrow streets and softened the impact of large classical volumes [7]. These hues moderated spatial scale and created an atmosphere of clarity, rhythm, and continuity. Warm yellows and creams added a sense of visual warmth, counterbalancing the region’s overcast climate. In colder seasons especially,

this chromatic choice helped mitigate the psychological dullness often associated with grey-toned urban environments [6, 8].

Visual perception is deeply affected by colour, which alters the sense of depth, scale, and emotional resonance of architectural forms [9]. In Saint Petersburg's case, consistent use of light, balanced tones across façades supported the legibility of the city and contributed to the stability of its overall image. In this sense, colour is not simply an accessory to form; it is a mechanism for organizing perception and supporting well-being in the urban setting [4].

Despite the city's long-standing chromatic coherence, many contemporary buildings diverge from its established palette. One reason is the advisory nature of the official guidelines: while the Committee for Architecture and Urban Planning has identified a recommended colour range, its use is not mandatory [1]. This leads to irregular application in both restoration projects and new construction. Modern developments often rely heavily on glass, concrete, or metal finishes that do not engage with the surrounding environment. Instead of offering contrast to the grey sky, they tend to mirror it, creating cold and impersonal facades that diminish depth and legibility [3]. In place of pastel tones that once unified districts, dissonant materials and unregulated colour schemes contribute to visual fragmentation.

Overexposure to monotonous, grey environments has also been shown to affect psychological well-being. Uniform, desaturated facades can intensify fatigue and dampen emotional response, especially in climates where daylight is limited [8].

The Lakhta Centre (Fig. 1) exemplifies the conflict between material and chromatic integration. Its mirrored facade reflects the overcast sky and disconnects from the historical logic of its surroundings, disrupting the natural flow of visual harmony and creating a detached, impersonal effect.

Where historical buildings followed the principle of chromatic restraint, modern projects often lack a clear colour strategy. As a result, the city risks losing the continuity that once defined its architectural image [10].

While challenges in maintaining Saint Petersburg's chromatic coherence persist, several recent projects demonstrate that integration with the city's traditional palette is not only possible but effective. In these cases, colour becomes a means of establishing continuity without imita-

tion – supporting the existing context while allowing for new architectural expression.

The Smolny Park Residential Complex (Fig. 2), situated near the Smolny Cathedral, applies a restrained palette of soft beige and light pastel tones that reflect the compositional logic of its historical surroundings. The subdued colours avoid visual dominance and contribute to a calm, measured streetscape.

Similarly, the Golden City (Fig. 3) development on Vasilievsky Island incorporates white and gold tones that recall imperial references without resorting to direct replication. What connects these examples is not style, but attitude: a deliberate engagement with place, climate, and context through colour.

As noted by Lyubov Robezhnik, successful chromatic strategies rely not only on design but on “professional judgment and the ability to maintain visual balance in relation to dominant elements” [11]. Projects that respect this principle are able to introduce new architectural ideas while remaining visually integrated into the broader urban fabric.

Fig. 1. Lakhta Center. A reflective glass façade that contrasts sharply with Saint Petersburg’s traditional chromatic environment

Fig. 2. Smolny Park Residential Complex.
Soft beige tones reflecting historical surroundings

Fig. 3. Golden City, Vasilievsky Island.
White and gold tones referencing imperial chromatics

Maintaining the chromatic coherence of Saint Petersburg requires more than general recommendations. While the city's official palette provides a valuable foundation, its advisory nature leads to uneven interpretation and limited integration into planning practice. In the absence of clear criteria and methodological support, colour is often addressed selectively – even in historically sensitive areas.

In the urban context, colour is not simply visual decoration. It conveys meaning, facilitates orientation, and influences spatial perception. Andrey Efimov emphasizes that symbolic colour systems are culturally specific and materialized in the structure of the built environment [12]. In Saint Petersburg, these systems have developed over time and are embedded in both civic and residential architecture. When disregarded, the visual order of the city begins to erode.

A structured approach to colour would not restrict architectural creativity. Visual continuity depends not on uniformity, but on an understanding of how colour supports rhythm, hierarchy, and scale [11]. International research confirms that colour is most effective when treated as a design element, not an applied surface [4, 9].

When informed by historical context and design expertise, colour can continue to guide the city's visual development. Its task is not to replicate the past, but to ensure compositional and perceptual integrity across evolving urban settings.

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ЕСТЕСТВЕННОЕ ОСВЕЩЕНИЕ В МУЗЕЙНОМ ДИЗАЙНЕ

NATURAL LIGHT IN MUSEUM DESIGN

В данной статье рассматривается использование естественного света в дизайне современных музеев. Несколько примеров в дизайне современного музейного интерьера проанализированы в части использования естественного освещения в общественных пространствах и галереях, с учетом выбора материалов, использованных в оформлении фасадов. В качестве примеров были выбраны современные музеи Греции, ОАЭ, Египта. Результат анализа описан в сравнительной таблице, на основе которой можно выработать рекомендации по использованию естественного света в будущем дизайне музеев. В выводах был сделан акцент на том, что естественное освещение в дизайне интерьера музеев призвано подчеркнуть природу региона, идею экспозиции, характер экспонатов, а также миссию самого музея.

Ключевые слова: современный музей, естественное освещение, использование света в архитектуре, использование света в музее, современная архитектура.

This paper examines the use of natural light in the design of contemporary museums. Several examples are analyzed in terms of the use of natural light in public spaces and galleries, taking into account the choice of materials used in the design of facades. Modern museums in Greece, the UAE, and Egypt were chosen as examples. The result of the analyses is described in a comparative table, which can be used to make recommendations for the use of natural light in future museum design. The conclusions emphasized that natural lighting in the interior design of museums is designed to emphasize the nature of the region, the idea of the exhibition, the nature of the exhibits, as well as the mission of the museum itself.

Keywords: modern museum, natural light, use of light in architecture, use of light in museum, modern architecture.

На протяжении веков архитектура использовала качество света, оживляющего человеческое сознание; света, который каждый миг обретает новую форму существования и начинает по-новому связываться с пространством и предметами; света, способного усилить взаимодействие между внутренним и внешним пространством. Объектом изучения в данной статье является то, как современные архитекторы используют свет в своих проектах и, в частности, в дизайне музеев. С этой целью были выбраны выдающиеся архитектурные примеры XXI века, расположенные в местах с высоким уровнем инсоляции, так как важно понять, как она влияет на проект такого типа и как подходить к этому при проектировании.

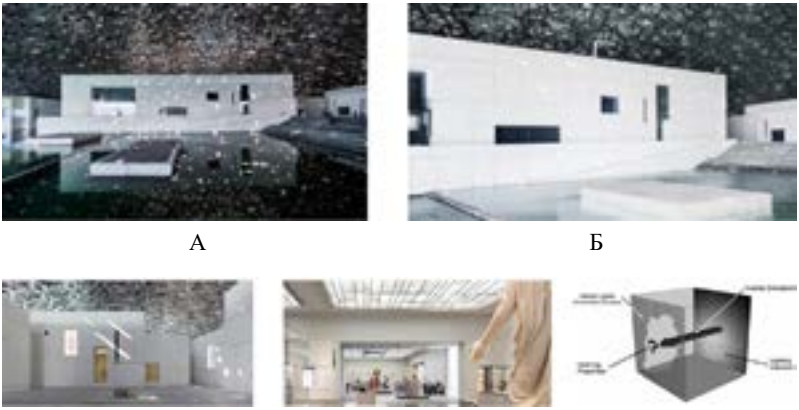
Новый музей Акрополя, созданный Bernard Tschumi Architects в 2009 году, экспонирует античные скульптуры, некогда украшавшие памятники Акрополя. Панорамный вид на Акрополь открывается с верхнего этажа (рис. 1, А). Основной акцент сделан на естественном свете, создающем впечатление нахождения на открытом воздухе. Искусственное освещение минимально и применяется только ночью, дополнительно усиливая восприятие экспозиций. Завершением проекта стал элегантный стеклянный фасад с минимальным декором (рис. 1, Б) [1].

А Б

Рис. 1

Лувр Абу-Даби, созданный Жаном Нувелем в 2017 году, музей является шедевром XXI века, стремящимся создать гостеприимный мир света и тени. Архитектор воплотил традиционную архитектуру с помощью современных технологий, создав двойной купол диаметром 180 метров, который покрывает большую часть комплекса. Состоящий из четырех внешних слоев, облицованных нержавеющей сталью, и четырех внутренних слоев, облицованных алюминием, разделенных

стальной рамой высотой пять метров, купол создал эффект, названный «световым дождем» с меняющейся в течение дня траекторией (рис. 2, А). Кроме того, в комплекс были добавлены приливные бассейны, создающие отраженный свет, который проникает через застекленную крышу в виде узоров на внутренних белых каменных стенах (рис. 2, Б). Естественный свет проходит во все галереи через боковые окна с видом на окрестности или через потолочные проемы, которые имеют характерные черты, защищающие артефакты от плохого влияния естественного света (рис. 2, В), либо через декоративные освещения (рис. 2, Г). Для этого используются стеклянные зеркала (рис. 2, Д), которые улавливают солнечный свет и направляют его в выставочные пространства, рассеивая лучи, чтобы избежать бликов [2].



А Б

В Г Д

Рис. 2

Музей будущего, разработанный архитектором Шоном Киллой из “Killa Design”, открылся в 2022 году. Это необычный проект для необычного города. Здание состоит из трех основных частей: зеленого холма, олицетворяющего землю, торообразного здания из нержавеющей стали и стекла, представляющего человеческие способности, и центральной пустоты, олицетворяющей неизвестность (рис. 3, А). Посетители музея связаны с внешней средой через проемы, образованные традиционной арабской каллиграфией (рис. 3, Б),

что обеспечивает глубокое чувство места и перспективы, в то же время солнце, проникающее сквозь каллиграфию, изменяет динамику интерьера музея и наполняет пространства естественным светом, тем самым улучшая ощущения посетителей. Поскольку большинство галерей расположено на зеленом холме, эффект естественного освещения сохраняется и для общих пространств в здании тора (рис. 3, В) [3].

А Б В

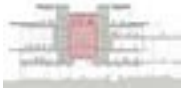
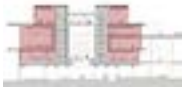
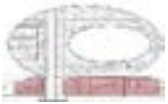
Рис. 3

Большой египетский музей создан компанией “Heneghan Peng Architects” в 2024 году, это один из самых важных современных музеев, в котором хранятся артефакты одной из древнейших цивилизаций. Его отличает фасад из камня (рис. 4, А) и стекла с меняющейся природой, меняющейся от рассвета к закату. Естественное освещение в музее проникает через стеклянные потолки и большие окна, позволяющие равномерно распределять свет, с учетом использования прозрачного UF фактора стекла, которое, в свою очередь, дает возможность направлять естественный свет в общественные зоны и защищает экспонаты от воздействия ультрафиолетовых лучей (рис. 4, Б) [4].

А Б

Рис. 4

Сравнительная таблица музеев

Музей	Новый музей Акрополя	Лувр Абу-Даби	Музей будущего	Египетский музей
Страна – город	Греция – Афины	ОАЭ – Абу-Даби	ОАЭ – Абу-Даби	Египет – Гиза
Год создания	2009	2017	2022	2024
Естественное освещение входных холлов и вестибюля	Использование естественного освещения не является обязательным 	Эффект «светового дождя», отражение от бассейнов	Отверстия, образованные традиционной арабской каллиграфией	Стеклянные проемы в крыше
Естественное освещение в экспозиционных пространствах	Дневной свет имитирует внешние условия для скульптур 	Боковые окна со стеклом, стеклянные зеркала для рассеивания лучей	Искусственное освещение 	Направленный солнечный свет
Пластичные решения фасадов	Стеклянные фасады	Нержавеющая сталь, алюминий, белые камни	Бетон, нержавеющая сталь и стекло	Каменные и стеклянные фасады

Из сравнительной таблицы можно сделать ряд выводов.

Использование естественного света более заметно в залах и считается элементом дизайна с искусственным воздействием, а также создает благоприятную атмосферу для посетителей. Использование естественного света в выставочных залах ограничено из-за того, что солнечные лучи плохо влияют на артефакты, поэтому было проведено несколько процедур для их защиты, за исключением музея Акрополя, где естественный свет считается основным элементом дизайна. Выбор материалов и цветов отличается от проекта к проекту, в музее Акрополя был создан минимальный фасад, так как основной задачей было получить как можно больше естественного света, в Louver Abu dhabi были выбраны белые камни, так как они имеют низкое поглощение тепла. В музее будущего выбор был обусловлен строительными соображениями, а в GEM (Grand Egyptian Museum) были выбраны камни светлых оттенков, которые также минимизируют теплопоглощение. В целом был выбран особый тип стекла, чтобы минимизировать негативное влияние солнечных лучей.

Использование естественного света как элемента в дизайне музея зависит от ряда факторов, начиная с понимания природы региона, температур и движения солнца, заканчивая пониманием характера экспонатов и цели музея. Мы должны начать думать о том, как включить естественный свет в процесс проектирования, уделяя внимание этому уже на ранних стадиях проекта.

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УСТОЙЧИВОЕ ГОРОДСКОЕ РАЗВИТИЕ: СОВРЕМЕННЫЕ ПОДХОДЫ К ГРАДОСТРОИТЕЛЬСТВУ

SUSTAINABLE URBAN DEVELOPMENT: MODERN APPROACHES TO TOWN PLANNING

В статье рассматриваются различные подходы политики устойчивого развития крупных городов в условиях роста их населения. В статье также представлены основные принципы устойчивого городского развития. Рассматриваются современные подходы к проектированию устойчивых городов, направленные на решение экологических аспектов, связанных со снижением негативного воздействия на окружающую среду, а также повышением уровня жизни и эффективным использованием ресурсов. Особое внимание уделяется концепциям «умных городов» и интеграции технологий, зеленой инфраструктуры, устойчивой транспортной системы, компактной застройке и циркулярной экономике. Приводится анализ успешных примеров устойчивых городов, таких как Копенгаген, Сингапур и Куритиба.

Ключевые слова: устойчивое городское развитие, технологии, окружающая среда, зеленая инфраструктура, транспортная система, отходы.

The article considers different approaches of the sustainable urban development policy while the population of large cities grows. The article also presents the basic principles of sustainable urban development. Modern approaches to the design of sustainable cities are considered, aimed at solving environmental aspects related to reducing negative environmental impacts, as well as improving living standards and efficient use of resources. Special attention is paid to the concepts of smart cities and technology integration, green infrastructure, sustainable transport system, compact buildings and circular economy. The analysis of successful examples of sustainable cities such as Copenhagen, Singapore and Curitiba is given.

Keywords: sustainable urban development, technology, environment, green infrastructure, transport system, waste.

Before climate change and environmental protection became an issue, urban planning and development focused on urban beautification; however, in recent years, urban planning policies have been directed towards sustainability due to increasing environmental concerns. Sustainable urban development is a type of urban planning that is based on the desire to protect nature, promote equity and maintain resource efficiency. Sustainable urban development aims to create a healthy environment in which the natural world and human communities can thrive [1].

As urban populations grow, innovative and environmentally friendly approaches to urban development become essential. Currently, 55 % of the world's population lives in urban areas, while the number and percentage of urban residents is constantly growing. Due to urbanization and global population growth, the share of urban population is expected to reach 68 % by 2050 [2].

Cities face a number of socio-economic and environmental challenges such as depletion of natural resources, loss of biodiversity, climate change, air pollution, excessive noise, waste generation and disposal, land use, access to drinking water, etc. These environmental challenges in cities are linked to social and economic challenges in ensuring the required quality of life and equal opportunities for all residents.

Basic principles of sustainable urban development

1. Environmental protection – reducing pollution, developing green areas and introducing environmentally friendly infrastructure.

2. Efficient resource management – increasing energy efficiency, conserving water resources and reducing waste.

3. Social equity – providing inclusive housing, accessibility and public spaces for different groups of the population.

4. Economic Viability – supporting sustainable economic growth and job creation.

5. Climate Resilience – designing cities that can withstand extreme weather conditions and environmental change.

Modern Approaches to Urban Development

1. *Smart Cities and Digital Integration*

The emergence of smart cities has been a paradigm shift in modern urban development. By ensuring the sustainability of the urban environ-

ment while improving the efficiency of municipal systems and the quality of life of city residents, this innovative approach aims to achieve both goals. A smart city is defined by its fundamental feature of using a wide range of digital and electronic technologies to collect, analyze and extract value from data coming from various urban sources. These cities have developed the ability to optimize the functionality of a wide range of municipal services, including transportation, energy and waste management systems, by leveraging the combined capabilities of the Internet of Things (IoT), artificial intelligence (AI) and big data analytics. This technological integration creates an urban ecosystem that is more resilient and adaptable to the changing requirements of its residents [3].

For example, smart traffic management systems can help combat air pollution by optimizing traffic flows, while smart energy grids can improve energy efficiency and reduce carbon emissions. Big data analytics can also help cities better understand their environmental health and respond to issues such as air quality or noise levels.

Technology also helps to promote sustainable living among city residents. For example, mobile apps can encourage people to make greener choices.

They provide real-time information about public transport schedules and indicate the availability of bikes in the sharing system, while reminding about the level of air pollution. Smart home technologies can also reduce energy consumption, thereby reducing people's utility costs and reducing the negative impact on nature [4].

Technology directly affects the development of city sustainability, as it increases environmental efficiency, improves the standard of living and creates new opportunities for the city's economy.

2. *Green Infrastructure and Urban Green Spaces*

Green infrastructure is both an integrated network of natural and semi-natural assets and a strategic planning approach that uses natural processes to manage water, temperature, and air quality.

Urban green spaces can range from urban parks and sports fields and other carefully maintained environments to natural landscapes. Urban green spaces can be designed to serve a single function or multiple functions as part of a green infrastructure network – for example, recreational space that has also been designed to reduce stormwater runoff [5].

Green infrastructure is a cost-effective and efficient means of improving the relationship between people and the ecosystems on which they rely. Green infrastructure also has the potential to reduce the capital cost of infrastructure and buildings, reduce operational and maintenance costs, and reduce land acquisition costs through smaller environmental footprints.

Examples of green infrastructure development are:

- Urban forests and parks to improve air quality and reduce the heat island effect.
- Green roofs and vertical gardens for better insulation and biodiversity preservation.
- Permeable surfaces to enhance rainwater absorption and prevent flooding.

3. *Sustainable Transport Systems*

The transport system plays an important role in sustainable urban development, as transport provides economic and social opportunities for all communities [6]. Economic growth, strengthening of national security and improvement of living conditions of the population directly depend on stable and efficient operation of transport systems at all levels - from global to urban. In this regard, technical, organizational and technological measures aimed at optimizing transport processes and increasing their intellectual level are currently being actively implemented.

When designing transport systems, it is important not only to follow the requirements of mobility and people, but also to take into account factors such as safety and environmental friendliness.

Researchers from Latvia emphasize that the modernization of transport infrastructure “should ensure sustainable mobility, communication of people and establish effective relationships between business agents, while simultaneously supporting the national economy” [7].

Shifting to environmentally friendly transport solutions reduces city congestion and emissions. These include:

- Expanding public transport networks (buses, metro, trams).
- Developing bicycle lanes and pedestrian-friendly areas.
- Promoting electric vehicles and car-sharing services.

4. *Compact and Mixed-Use Development*

Modern urban development encourages mixed-use areas where residential, commercial, and recreational spaces coexist. Benefits include:

- Reducing the need for long commutes, lowering the carbon footprint.
- Improving social interaction and economic opportunities.
- Creating more convenient and livable neighborhoods.

Compact and mixed-use development is a key strategy for creating sustainable, livable cities. It focuses on building denser urban areas that combine residential, commercial, and other uses, reducing sprawl and preserving natural habitats. This approach promotes walkability, reduces car dependency, and fosters vibrant communities.

By integrating diverse land uses and prioritizing pedestrian-friendly design, compact and mixed-use development offers numerous benefits. It lowers infrastructure costs, increases property values, and enhances social interaction. However, implementing this approach can face challenges like resident resistance and complex financing, requiring careful planning and community engagement [8].

5. *Circular Economy and Waste Management*

Circular economy is a model of production and consumption that involves the reuse, restoration and recycling of existing materials and products for as long as possible. This is a production model that assumes not only environmental, but also economic benefits by saving costs, increasing new jobs and reducing the negative impact on the environment.

The basic principles of circular economy are:

1. Waste management. The products are designed to be recyclable, repairable, and long-lasting. For example, modern smartphones allow you to replace or recycle each component, which prolongs its life cycle.

2. Keeping products and materials in working condition. One of the important modern recycling methods is currently recycling. In recycling, old goods are recycled, and the resulting raw materials are used to make new goods, either from the same category or another. Recycling reduces the amount of waste that ends up in landfills or incinerated, and also helps reduce greenhouse gas emissions, energy consumption, and environmental pollution.

3. Restore natural systems. This means the introduction of agricultural practices that promote soil restoration, increase biodiversity, and return organic materials back to nature. In the current model, most of these materials are lost after use, and the land on which they are grown is stripped

of nutrients. By adopting the regenerative model, we begin to emulate natural ecosystems. There is no waste in nature: the fallen leaf becomes food for the forest. For billions of years, nature has been self-repairing. The concept of waste is an exclusively human invention [9].

Together, these principles of circular economy not only contribute to sustainable urban development, but also stimulate innovation and economic growth, proving that caring for the environment and prosperity can harmoniously coexist.

Examples of Sustainable Urban Development

1. Copenhagen, Denmark – Copenhagen is considered one of the leaders in the field of sustainable development. The city has received such titles as “The Green Capital of Europe” and “The most convenient city” [10]. The city has a well-developed cycling infrastructure, as bicycle transport has become more relevant than cars. More than 382 kilometers of bike paths were built for cyclists, bridges and traffic lights were equipped. In Copenhagen the number of public transport modes was increased by 1200 bus stops, 40 train and S-train stations. Furthermore, there was also a new metro line built. That kind of approach gave the result of increasing by 8 % the number of metro passengers between years 2008 and 2009 [11]. When the number of stops was increased, the number of passengers has grown as well. Copenhagen uses renewable energy sources such as solar and wind. More than 98 % of houses are connected to a centralized heating system. When designing architecture, Copenhagen uses green roofs with a system for collecting rainwater and trapping solid particles. There are recycling machines throughout the city that refund the deposit for each container. Copenhagen is equipped with over 22,000 smart lights that can adjust brightness when cyclists or pedestrians approach. The city has set a goal to become carbon-neutral by 2025.

2. Singapore – This metropolis is one of the leading examples of a smart city, with advanced resource management technologies. The city-state approached the design of urban space from a scientific point of view and found a balance between urbanization and concern for the environment. Singapore stands out for its vertical landscaping and green roofs. Gardens, parks and greenhouses blend harmoniously into the overall urban structure. Gardening is based on the idea of the unity of a modern ur-

ban dweller with the natural environment. Some architectural objects have as many green spaces as there were not in this place before construction. The authorities are implementing measures aimed at reducing energy consumption. Special attention is paid to ventilation systems and air circulation in the building. The use of renewable energy sources is widely developed. Singapore is a leader in recycling, with more than 60 % of waste recycled as raw materials for energy production [12].

3. Curitiba, Brazil – This city has gained global recognition for its innovative public transport solutions. Curitiba implemented a Bus Rapid Transit (BRT) system, allowing residents to move quickly and conveniently while reducing congestion and emissions. At the beginning of the 21st century, green areas occupied 1/5 of the city's territory, over 1.5 million trees were planted in twenty years, and the landscaping area increased almost 100 times. The city has a developed system of separate garbage collection. The authorities decided to introduce such a method as accepting garbage from the poor in exchange for food or basic necessities. Social policy in Curitiba is aimed at creating an enabling environment, as well as equal opportunities for all segments of the population [13]. For example, the city has created specially designated civic streets with citizen service centers where issues related to bureaucracy can be resolved.

In this way, sustainable urban development is crucial for the well-being of both current and future generations. As the population density increases over the years, many people move to urban areas, which creates a certain burden on the infrastructure. The integration of smart technologies, green infrastructure, efficient transport, and circular economy principles will make cities more liveable, sustainable, and environmentally sound. Successful implementation of these approaches requires the joint work of Governments, urban planners and citizens to ensure sustainable growth for many years to come.

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ЛОКАЛЬНЫЙ КОНТЕКСТ В ДИЗАЙНЕ АРХИТЕКТУРНОЙ СРЕДЫ

LOCAL CONTEXT IN ENVIRONMENTAL DESIGN

Дизайн среды объединяет гармонизацию пространства и взаимодействия человека, балансируя функциональность и эстетику с акцентом на контекстуальную значимость – связь здания с его окружением. Он также требует тщательного учета природных факторов, таких как микроклимат местности, доступные ресурсы и потребности местной флоры и фауны, чтобы обеспечить как комфорт человека, так и экологический баланс. Контекст включает физические, социокультурные и исторические факторы, формирующие проект. Контекстуализм в архитектуре – это подход, который ставит во главу угла экологические и традиционные аспекты, стимулируя диалог между старыми и новыми элементами. В XXI веке ключевыми факторами являются анализ местности, культурные особенности и социальный контекст. Такой дизайн учитывает традиции, экологические аспекты и потребности общества. Современный дизайн среды сосредоточен на использовании возобновляемых материалов и энергоэффективных систем для минимизации экологического следа.

Ключевые слова: дизайн среды, контекстуальность, контекст, предпроектный анализ, современная архитектура, реконструкция.

Environment design integrates the harmonization of space and human interaction, balancing functionality and aesthetics while emphasizing contextual relevance – the connection between a buliding and its surroundings. It also requires careful consideration of environmental factors such as site microclimate, available resources, and the needs of local flora and fauna to ensure both human comfort and ecological balance. The context icludes physical, sociocultural, and historical factors that shape the project. Contextualism in architecture is an approach that prioritizes environmental and traditional aspects, stimulating a dialogue between old and new elements. In the 21st century, critical factors include site analysis, cultural characteristics, and social context. Such design incorporates traditions, ecological issues and society needs. Modern environmental design focuses on renewable materials and energy-efficient systems to minimize ecological footprints.

Keywords: environmental design, contextuality, context, pre-design analysis, modern architecture, reconstruction.

Environmental design includes a wide range of disciplines and approaches:

- Integration of place and people. Environmental design involves creating spaces that consider human needs and behavior;
- Balance between functionality and aesthetics;
- Contextuality, but what exactly is context in architecture and environmental design?

Context (from the Latin *contextus* – "connection", "link") is a term widely used in various humanities disciplines (linguistics, semiotics, sociology, philosophy, anthropology) that directly or indirectly study language and communication. The context in architecture refers to how a building's components are understood in relation to its surroundings. A building's context might include physical and natural elements (such as the bend of a nearby river), socio-cultural elements (such as the site's previous use), and more [1].

There is even a movement within architecture and design called contextualism. Contextualism is a philosophical approach in architectural theory that refers to designing a structure in response to the literal and abstract characteristics of the environment in which it is built. The term contextualism is came from the Latin *contexere*, meaning "to weave together" or "to join". The term was first applied to the arts and architecture by the aesthetician and philosopher Stephen C. Pepper in the 1960s, who originally coined the word as applied to philosophy.

However, contextualism suggests a fusion of building and nature, while in contemporary architecture context includes more social, cultural, and historical components. In the 21st century, the quality of a project depends on the depth of contextual connections. The more analytical data about the site studied and identified during the pre-design phase, the more "hooks" there are for developing the future concept.

The development of a new project is preceded by a pre-design analysis. The pre-design analysis can be divided into two parts:

- Purely analytical: the location of the area, transportation accessibility, land use and construction regulations for the given territory, cadastral number, location of engineering networks, project cost, etc.

● Cultural-historical analysis, sociological aspects, surveys of local residents, and characteristics of the neighborhood or community.

Client requirements, functional purpose, structural design, surrounding environment, local weather conditions, economic capabilities, and social context – each new factor contributes depending on the specific characteristics of the project. Currently, in the 21st century, contextual thinking is a global cultural trend formed in response to rapid and unpredictable changes in cultural and social development [2].

In addition to situational context and the ideological ideas of the time, a layer of socio-cultural trends and attitudes has emerged. In contemporary society, there are relevant trends in its development, such as sociality, sustainability, adaptability, technological advancement, and identity. A project becomes more enriched and meaningful when the understanding of local traditions and history is taken into account in its concept. This manifestation of the integration of cultural symbols creates significant connections between architecture and its surroundings, as well as positively impacts the social identity of communities. Environmental design now must not only subordinate space to functionality and endow it with aesthetics but also impart character to spaces that reflect diverse needs and lifestyles [3].

Culturally sensitive architecture is more important, of course, for renovation projects, adapting spaces and buildings for new functions, and new construction in historical areas. In this context, there are two conditional options for developing the concept.

First concept: Integration into the Environment through Architectural Traditions: This involves using decor from specific eras, or imitating architectural styles. This creates a dialogue between old and new. Many examples of this approach can be found in St. Petersburg. For example, the residential complex “Russian House” by Gerasimov and Partners. (Fig. 1). The building continues and reinterprets two traditions: St. Petersburg’s apartment buildings from the Art Nouveau era and original ancient Russian architecture from the 16th centuries.

The “Russian House” residential complex is located in the historical center of St. Petersburg. The centerpiece of its composition is a grand courtyard – an open space typical of traditional St. Petersburg architecture at the turn of the 19th-20th centuries. Two other courtyards are closed off – these house entrances to residential staircases (Fig. 1).

Fig. 1. Residential complex “Russian House”. General view and 1st floor plan

The architectural solutions for facades and roofs are executed in an atypical neo-Russian style for St. Petersburg (also named as “a la Russ”). All public facades are clad in artificial stone reminiscent of white-stone chambers (Fig. 2). Animalistic and floral ornaments along with wrought elements also reference folk traditions inspired by ancient Russian patterns [4].

Fig. 2. Main facade of Residential complex “Russian House”

Second concept is Highlighting New Modern Additions within Architecture: This often pertains to structures affecting accessibility and safety: elevators, fire escapes, ramps.

Brasov is one of Transylvania’s cities built in the Middle Ages by German (Saxon) colonists. Most of its fortifications were demolished. In recent years, the city council has initiated a program for gradual restoration

and conversion of remaining walls, towers, and bastions. The Drapers Bastion, converted by Point 4 architects, is part of this fortification system. Having been abandoned for so long, fragile elements – copings, sentinel walks, staircases – had completely vanished leaving only heavy circular walls behind.

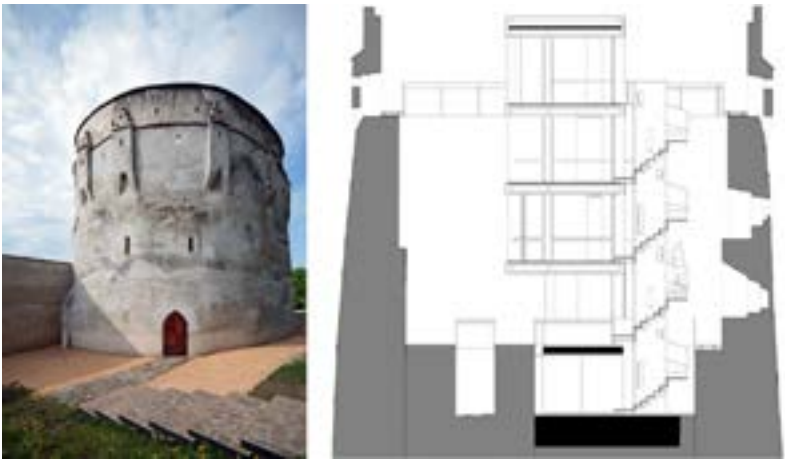

Fig. 3. Drapers Bastion tower. General view and design section

The brief called for restoring the tower while creating an information center for Brasov's fortifications containing interactive information and educational equipment. It turned out that covering the bastion would involve a metal roof structure requiring reinforcement of the tower's upper section with a circular concrete belt (Fig. 3).

The old structure was repaired; marks on walls allowed retracing old timber sentinel walks which were decided to be reconstructed contemporarily – the new walkways adopt both position and basic geometry from original ones but consist of steel structures with beechwood flooring and metal mesh parapets (Fig. 4). Architects made every effort not to fill up internal space which would have relegated walls to mere historical skins for an entirely new interior [5].

Fig. 4. New constructions from Carten iron in the Tower

Third concept. Contextuality can also be achieved through using specific materials that reflect local characteristics resonating with community memories – for example using local stone or wood enriches aesthetic quality while utilizing energy from surrounding environments fostering deeper connections between structures and their settings (Fig. 5).

Kobe Port Museum reflects this approach to conceptuality well. A Building on Land and Sea – Kobe Port Museum is a multi-purpose cultural facility consisting mainly of an aquarium, food hall, and bridal desk.

Fig. 5. Kobe Port Museum. General view

Kobe has characteristic topography enclosed between Seto Inland Sea and Mount Rokko; its jetty area preserves remnants from Hanshin-Awaji Great Earthquake today passing down historical situations to people. The concept was for a building at this site that would convey history where many crustal movements have occurred alongside eternal time.

The building alters ground levels even extending it; it has been realized by reviewing materials/construction methods imitating Kobe's topography producing a structure rooted in Kobe which will gradually become covered with greenery returning to nature over time.

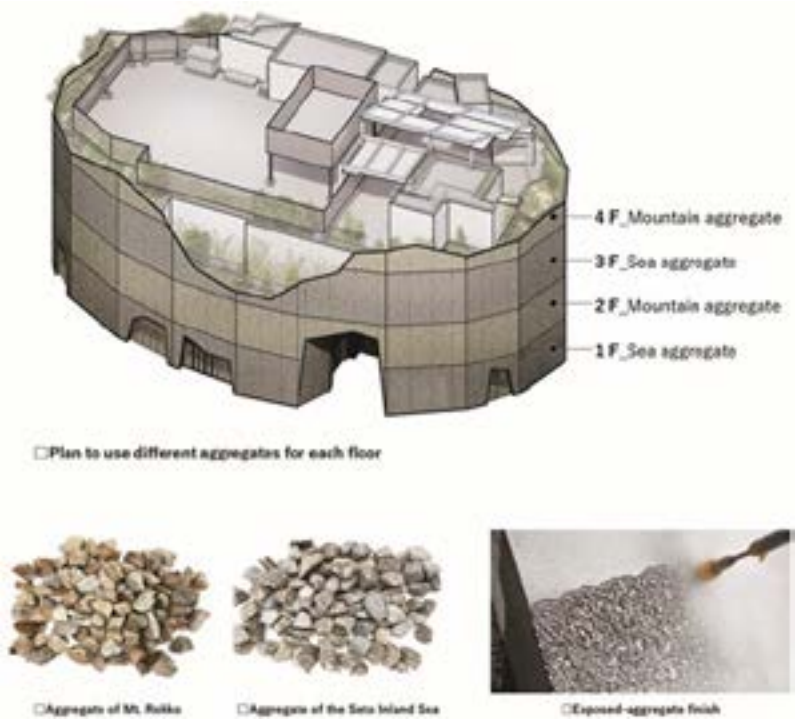

Fig. 6. Kobe Port Museum. layout of different finishing material structures

Additionally, due to crustal movements over past million years sea levels have risen/fallen more than ten times resulting in characteristic

stratification. To reflect this dynamic topography within concrete placement plan aggregates on first/third floors come from sea while those on second/fourth floors derive from mountains thus extending Kobe's stratigraphy above ground [6] (Fig. 6).

Fourth concept: National Elements & Motifs in Completely New Architectural Forms.

National elements can be present in an integrated form. For example, Khan Shatyr in Astana, Kazakhstan. Because of its unique design maintaining favorable internal microclimate regardless weather conditions Khan Shatyr became only construction within Commonwealth of Independent States included among top ten eco-buildings according to Forbes Style magazine; moreover, it symbolizes all Kazakhstan itself.

The shape resembles a yurt–a cultural symbol representing state created to reproduce traditional architecture among Kazakh people (Fig. 7); challenges included tight deadlines along with harsh climatic conditions since Astana ranks among coldest capitals worldwide averaging +3 degrees Celsius daily temperature; winter temperatures often drop below -35 degrees while summer frequently exceeds +35 degrees Celsius [7].

Fig. 7. Khan Shatyr. General view
and schematic representation of the yurt structure

There is also the option of using traditional elements in their pure form, but on a modern basis. Barnhouse on Gulf of Finland – successful synthesis between architecture and decorative applied arts: project by Igor Lozinsky and artist Tatiana Korelyakova who designed stylized animalistic ornaments for facades; house received simple form which alongside carved ornaments/dark finishing materials connects it traditional northern housing styles (Fig. 8).

Fig. 8. Barnhouse with animals. General view and facade details

Planning solution remains quite traditional: main entrance located opposite gulf side while large windows/terrace opening onto plot provide views towards water; first floor includes hallway with wardrobe living room kitchen-dining area pantry; second floor features master bedroom wardrobe/study children's room, gym, sauna, library and home church (Fig. 9).

Fig. 9. Barnhouse with animals. 1st and 2nd floor plans

A significant success came from Tatiana Korelyakova's involvement delicately incorporating carvings featuring stylized motifs (Fig. 8) drawn from peasant textiles/patterns found across Russian North into building structure [8].

In conclusion, it can be said that the trend towards contextuality in architecture and design is understandable. This trend is also present in art, fashion design, and cinematography. Society now demands more depth in everything, and elements in design such as historical references or hints at local traditions and national characteristics make architecture not only more interesting but also more sought after.

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СТРОИТЕЛЬСТВО СЕГОДНЯ И ЗАВТРА: ДИЗАЙН, ИННОВАЦИИ И ТРЕНДЫ

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МИКРОКЛИМАТ ЗИМНЕГО САДА: РАСЧЕТ И МОДЕЛИРОВАНИЕ

MICROCLIMATE OF WINTER GARDEN: CALCULATION AND SIMULATION

Создание микроклиматического комфорта для растений и других постояльцев в зимнем саду – одна из тривиальных проблем, так как накладываются друг на друга несколько несовместимых факторов: резко изменяющиеся наружные условия (солнечная радиация, осадки, температурные перепады), временное или постоянное пребывание людей, повышенные требования зеленых потребителей. Однако благодаря изучению флористами, дендрологами, инженерами параметров интерьера и экстерьера с помощью расчетных методов путем использования макетов, численных моделей удается внести необходимые описания мероприятий к условиям эксплуатации данного сооружения во время проектной стадии.

Ключевые слова: зимний сад, численное моделирование, система отопления, система вентиляции.

Creating microclimatic comfort for plants and other guests in a winter garden is one of the trivial problems, since several incompatible factors overlap: dramatically changing outdoor conditions (solar radiation, precipitation, temperature fluctuations), temporary or permanent residence of people, increased demands of green consumers. However, thanks to the study of interior and exterior parameters by florists, dendrologists, and engineers using various methods through the use of layouts and numerical models, it is possible to introduce the necessary descriptions of measures to the operating conditions of this facility during the project stage.

Keywords: wintergarden (conservatory), numerical simulation, heating system, ventilation.

Introduction

Choice of parameters for microclimate depends on factors: purpose of facility (with decorative or/and entertainment area), outdoor climate conditions (placement, amount of solar radiation, precipitations, temperature fluctuations), demanding for conditions of previously selected plants (individual, special requirements for temperature, velocity of air).

Adding to these facts, there are questions about: the necessary of increasing energy efficiency of constructions and engineering systems (ventilation and heating), ways of economy electric energy and other resources, integrating of ideas and opportunities for creation an «autonomic element» – interconnected system of engineering equipment and solutions or «artificial ecosystem», which components will be using «greenhouse effect» and symbiosis of fishes and flora.

Main theoretical bases and regulatory documentation

The common problem of regulatory documentation, that controls not only rules of designing, but choice of flora for improvement of landscaping in individual building (choice of customers), appears in many subproblems, it's means there are contradictions between purpose of winter garden or conservatory or combination of plants area (decorative) and seating area for people and lack of studies in ecology and adaptation indicators of plants [1]. In addition, there are also missing facts, concluding in existence of a connection between the necessary of these requirements and practical experience, that is a reason why in Russia specialists have not enough specific rules for microclimate of conservatories – there are a little if them: coides if practice, GOST or recommendations from other specialists, if "strict" conditions have to be a requirement from customer.

There are several examples of standards, which can provide description of measures and substantiations for using certain solutions in designing, for engineers:

- SP 107.13330.2012 «Greenhouses and hotbeds»

The main document for microclimate conditions, architectural and constructive solutions. However, it is only for greenhouses, that have differences from conservatories.

- SP 82.13330.2016 «Territory Improvement»

This code of rules can be used for solving problem of introducing winter gardens to various buildings or urban structures.

- SP 60.13330.2020 «Heating, ventilation and air conditioning»

Requirements are established for heating and ventilation systems and some recommendations for them.

- GOST R 55912-2013 «Climatology building. Product indicators of the exterior environment», SP 131.13330.2020 « Building climatology»

These documents will help to approve the climatic parameters for the facility.

- GOST 30494-2011 «Residential and public buildings. Microclimate parameters for indoor enclosures»

There is a list of interior parameters: temperature, velocity and air quality.

- GOST 28329-89 «Urban planting. Terms and definitions»

They represent terminology for landscaping standards and elements of interaction between urban and green areas.

- GOST 24835-81 «Tree and shrub transplants. Specifications», GOST 24909-81 «Seedling of ornamental deciduous trees. Specifications», GOST 25769-83 «Conifers seedlings for planting in towns. Specifications», GOST 26869-86 « Nirsery stock of decorative shrubs. Specification», GOST 28055-89 «Tree and shrub planting stock. Garden and architectural forms. Specifications»

Recommendations and the basis of information about plants, that can be chosen by customer or florist, are described.

- GOST 26213-91 «Soils. Methods for determination of organic matter»

Conservatories, greenhouses use soils, that are the components of floor and have own requirements.

The analysis of modern methods of selection and calculation of the parameters

1. *General guidelines*

In many cases engineers with other specialists take into account such factors: temperature range from 16 to 26 degrees of Celsius, relative humidity between 50 and 80 percentages, air velocity needs to be less than

0.2 meters per second, otherwise plants like people may feel discomfort and then the probability of infection with fungus and bacteria can increase. In relation to the functionality of glass facilities for plants, there are some other advice listed in table [2, 3].

Winter gardens as facilities need regulatory support in construction. Unfortunately, to this day it is a common problem to create full-fledged documentation: in codes of practice or GOST, which would reflect the system of requirements for designing and building and the base of engineering solutions and innovations. For example, questions about the regulation of condensate inside the winter garden, the creation of a table or other scheme about recommended plants for a specific environment (individual or urban), the connection of the winter garden with various structures, and finally, the durability of structures.

This would help to avoid incorrect marketing decisions, mistakes in drawing up technical specifications (for customers), better control of facilities, and integrate these facilities into "complex" environments.

2. *Calculation*

Microclimate of winter garden (conservatory) is an element of interconnected system, that consists of outdoor climate (main factors: solar energy, orientation by facades, temperature, types of precipitation), structures (walls, glass and windows, roofs, floors) – protection from extreme loads, consumers: plants (static) and people (temporary), engineering systems: air conditioning, ventilation, heating. In order to set up all these elements to maintain previously selected indicators, make a detailed analysis: accounting for emergency situations, drawing up measures for "compensation" and automatic maintenance of microclimate parameters. Such justifications are made on the system of the equations of heat balance and air exchange.

Besides, calculations are performed by specialists: thermal engineering calculations (for air permeability, condensation testing, heat resistance) of enclosing structures, determination of the type and capacity of the heating and heat supply system and selection of the standard size and number of heating devices; selection of the ventilation system and selection of its elements: supply air system, air distributors and ducts or air conditioning system.

In addition, the level of illumination can be assumed to be equal to the average level of 10,000 lux.

Parameters of microclimate of glass structures

Room name	Description of functions	Microclimate parameters and seasons											
		Temperature, °C			Relative humidity, %			Insolation	Heating systems	Ventilation systems	Требования к спектральному пропусканию остекленения		
		Warm (summer)	Transitional (spring-autumn)	Cold (winter)	Warm (summer)	Transitional (spring-autumn)	Cold (winter)				UV, nm	Visible light, nm	IC
Winter garden (conservatory)	A recreation room with lots of tropical plants. Often it is calculated for permanent presence of people	20–22	20–22	22–24	50–60	40–50	30–40	–	Convective, air, furnace; Underfloor heating, solar	Natural – windows in walls and roof; Mechanical – equipment (installations, diffusers, ventilators)	200–315	400–720	–

End of the table

Glasshouse	Room name		
A room for growing and short-term rest of decorative and fruiting plants	Description of functions		
18–20	Warm (summer)	Temperature, °C	Microclimate parameters and seasons
18–20	Transitional (spring-autumn)		
18–20	Cold (winter)		
50–60	Warm (summer)	Relative humidity, %	
50–60	Transitional (spring-autumn)		
50–60	Cold (winter)		
–	Insolation		
Convective, air, solar	Heating systems		
Natural – windows in walls and roof; Mechanical – equipment (installations, diffusers, ventilators)	Ventilation systems		
200–280	UV, nm	Требования к спектральному пропусканию остекления	
400–720	Visible light, nm		
–	IC		

Greenhouse (hotbed)
A room for growing thermophilic plants
18–20
18–20
–
–
50–60
50–60
50–60
–
Infrared, solar, biofuel-based
Natural – windows in walls and roof; in rare cases, a mechanical system (and evaporative cooling)
200–280
400–720
–

3. *Modeling: layout or digital model*

The easiest method of creation and learning the basic principles of conservatory exploitation, then you can use layouts. The most famous example of it – «florarium»: glass constructions with frame made of aluminum or plastic, or wood (Fig. 1). Withal based on such installations automation system programs for sensors can also be tested.

Fig. 1. Testing of a mini-automatic conservatory model
(the method is used very rarely, and called «florarium» –
the origins and an excellent preparation of plants for a “new home”)

FloEFD HVAC Module, Ansys, Solidworks, Logos – programs for HVAC engineers for automatic calculation and obtaining, displaying and processing information in figures, diagrams and 2D and 3D isosurfaces, allowing to provide visibility of the processes inside the structure with multiple external conditions (Fig. 2), [4].

Innovative ideas in designing

From abroad, due to the active implementation of environmental standards in urban development and, in general, the increasing need in the population for “green” spaces, because of recreation from urbanism lifestyle, such areas as: the connection of double-glazed windows and reflective surfaces in the phenomenon of the “greenhouse effect” (Fig. 3), as well as in reflecting excess solar heat, will develop strongly; application of hydro, aqua, and aeroponics systems (Fig. 4) to reduce the cost of engineering systems and create uncommon compositions in the interior (new types of methods for using such biofuels); further development of “active” (Fig. 5) and “passive” gardens (Fig. 6) [5].

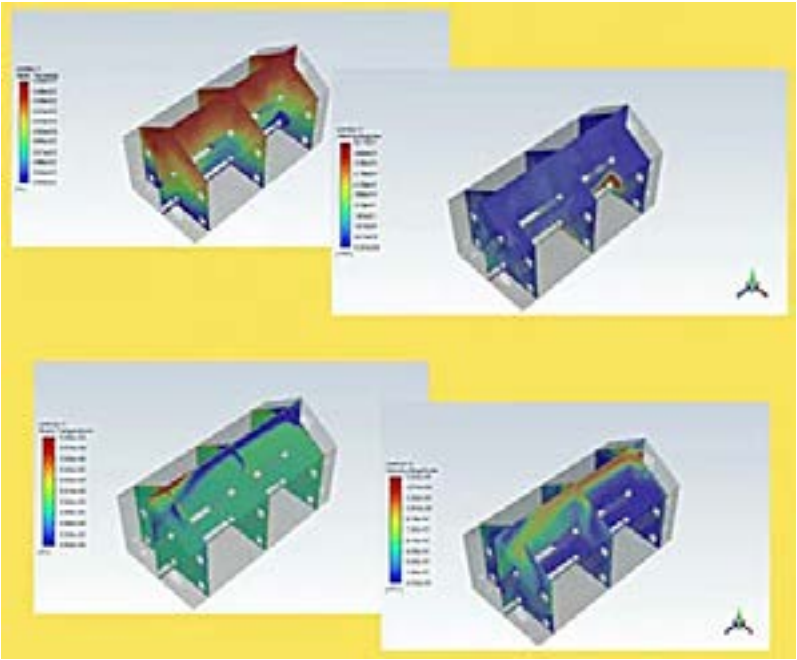

Fig. 2. An example of modeling isosurfaces of temperatures
and air velocities in the «Ansys»

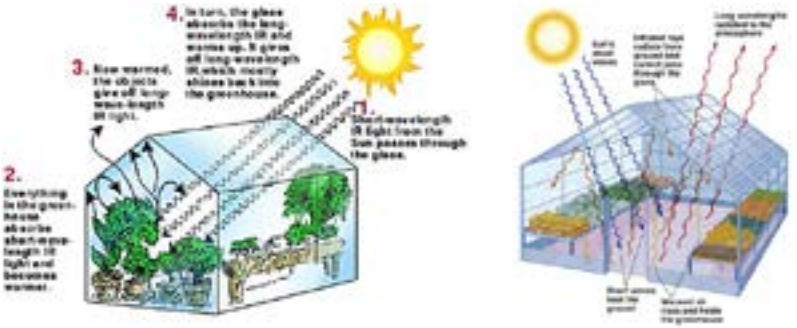

Fig. 3. «Greenhouse» effect in an example of a greenhouse,
that can be used with some changes for conservatories

Such technology can be used if calculations on the temperature regime and the amount of heat supply allow it to be done. During hot days this “heat trap” can heat up to 70 ° C. And at the same time, with insufficient values of solar radiation, this will be an ineffective solution [6, 7, 8].

Maybe in the near future it will be not only possible, but popular some concepts of combining a “winter garden” with “aquariums” instead of fountains or air conditioners to create air mass cooling processes using hydroponics or aquaponics methods [9, 10].

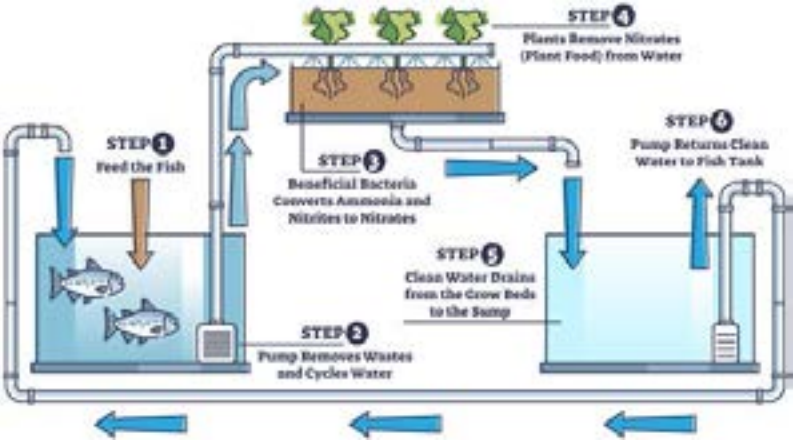

Fig. 4. Aquaponics technology scheme

This method can be used if there is need of plants inside the room in large amounts of moisture, or the winter garden is located in an arid area, or the customer wants to combine an aquatic and a plant zones.

In perspectives there are ideas of creation «eco-constructions»:

1. «Active» conservatory (picture 5) – a facility capable of fully accumulating and using solar energy, as well as adapting to external climatic conditions, for example, through automation by analyzing meteorological parameters, using sensors [11].

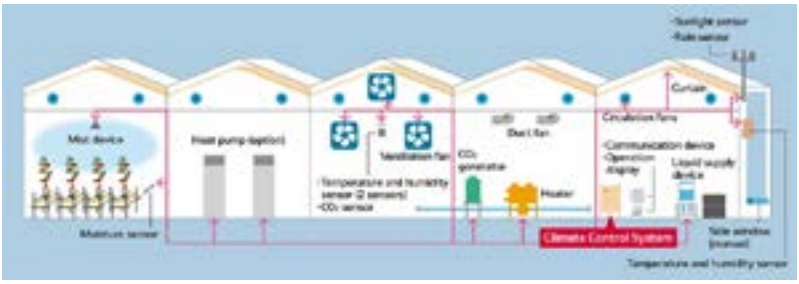

Fig. 5. «Active» ventilation systems for the group of facilities

2. «Passive» conservatory – a facility, that operate and supply all the necessary systems based on solar radiation and other types of energy, whose potential is absorbed by structures, oriented relative to facades [12].

Fig. 6. Differences between «passive» winter garden (or greenhouse) and greenhouse or hotbed

Many previously described technologies can be transferred by use to winter gardens, but specialists need to take into account the presence of differences in functions and purpose or possible changes in these objects like greenhouses, hotbeds and conservatories.

Conclusion

Microclimate of winter garden (conservatory) is a part of complex system, which requires scheme «protection – control – exploitation» in calculation and designing, on the one hand, and on the other there is “external loads – interior conditions – flora (consumers)”.

All these elements must have common references and standards of solutions for compiling an information base that is error-proof for specialists. Result of it can be new green set of rules or different documents, that could link gained experience in building, questions and prospects, as well as solutions and future researches.

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СОЦИАЛЬНОЕ ЖИЛЬЕ ИЗ ПЕРЕРАБОТАННЫХ МАТЕРИАЛОВ

SOCIAL HOUSING FROM RECYCLING MATERIALS

Статья посвящена исследованию возможностей применения переработанных материалов в строительстве социального жилья в России. Рассматриваются мировые тенденции использования вторичных строительных материалов, анализируются экономические и экологические преимущества такого подхода. Особое внимание уделено законодательным аспектам и текущим российским инициативам в области развития экологических технологий в строительстве. Рассматривается опыт внедрения технологий в сфере строительства в России и в других странах и даются рекомендации по их использованию. Тема социального жилья в России с использованием вторичных материалов представляет собой важное направление, которое может способствовать устойчивому развитию строительной отрасли и одновременно решать актуальные социальные проблемы.

Ключевые слова: социальное жилье, переработанные материалы, устойчивое строительство, экономия ресурсов, экотехнологии, законодательство.

The article explores the possibilities of using recycled materials in the construction of social housing in Russia. It discusses global trends in the use of secondary building materials and analyzes the economic and environmental benefits of this approach. Special attention is paid to the legal aspects and current Russian initiatives for the development of green technologies in construction. The experience of implementing the above mentioned technologies in the construction sector in Russia and other countries is considered and recommendations on their use are given in the paper. The topic of social housing in Russia using recycled materials represents a significant area that can contribute to the sustainable development of the construction industry while addressing pressing social issues.

Keywords: social housing, recycled materials, sustainable construction, resource saving, eco-technologies, legislation.

The theme "Social housing from recycling materials" is relevant in the context of the lack of affordable housing and the need to reduce construction costs. The use of recycled materials not only reduces costs, but also contributes to environmental sustainability, which is especially important in today's trends of "green" economy. The introduction of these technologies in Russia responds to both social and environmental challenges. The study is related to development of construction industry and public housing policy.

The purpose of the study is to explore possibilities and prospects of using recycled materials in social housing construction in Russia to solve social, economic and environmental problems.

Research objectives:

1. Analysis of current trends and experiences in the use of secondary materials in social housing construction in Russia and abroad.

2. Assessment of the economic benefits and environmental consequences of using recycled materials in construction.

3. Study of Russian legislation and state programs regulating the field of social housing and environmental technologies.

4. Develop recommendations on the use of recycled materials in social housing construction in Russia, taking into account international practices and Russian realities.

1. Trends abroad and experience in Russia

In developed countries, waste management and its use for social housing are becoming part of the global sustainable development and carbon reduction movement. Main foreign trends include:

1. Use of recycled building materials: in many countries, such as the Netherlands, Germany and the United Kingdom, recycled materials such as concrete from construction waste or recycled metals and wood are widely used in construction.

2. Introduction of the principles of a "cyclical economy" in the EU and the US, where industrial waste is recycled and reused in construction.

3. Environmental standards and certification: in countries like Sweden and Canada, environmental building standards such as BREEAM and LEED

are widely used. These standards include the use of recycled materials and encourage developers to adhere to sustainable development principles.

4. Government support and incentives: In Europe and the US, government programs and grants support construction from recycled materials, especially in the social housing segment. This makes housing accessible to socially vulnerable segments of the population, while addressing environmental issues [1–3].

Experience in Russia

In Russia, the introduction of recycled materials into social housing construction is still in its early stages, but there are already some positive trends:

1. Pilot projects: In Russia, experiments with the use of secondary materials in construction have already begun.

2. Development of recycling technologies: The country is gradually developing technologies for the treatment of construction waste. Concrete and brick processing plants have been introduced in some regions, laying the foundation for further expansion of use of these materials.

Main problems

The main reason why in Russia it is difficult to implement social housing projects from recycled materials is the lack of infrastructure for waste management. The lack of recycling facilities limits access to quality secondary materials, and poor waste sorting complicates the recycling process and makes recycling economically unsustainable.

Thus, the experience of foreign countries and pilot initiatives in Russia point to a high potential for using recycled materials in social housing construction, which can lead to lower costs and minimize environmental impact.

2. Economic benefits and environmental effects

The use of recycled materials in social housing construction has a number of economic benefits and positive environmental impacts.

Economic benefits are the following:

1. Reduced material costs: for example, recycled concrete, brick or metal can cost 20 to 40 % less by reducing the cost of extracting and transporting new resources.

2. Lower waste disposal costs: this is a significant advantage for construction companies, as the cost of waste disposal and recycling can be high.

3. Energy saving and transport cost reduction: The production of secondary materials generally requires less energy than the extraction and processing of primary resources, which reduces costs. In addition, recycled materials can be produced on site, which reduces transport costs.

4. Support for government programmes: In some countries and regions there are subsidies and tax incentives for companies using recycled materials in construction [1].

Environmental effects:

1. Waste reduction is particularly important for large cities with high density of construction.

2. Carbon dioxide reduction – the production of building materials such as cement requires a high energy consumption and is accompanied by high CO2 emissions. Using recycled concrete and other recycled materials reduces carbon footprint by 15 %.

3. Conservation of natural resources: Secondary materials reduce the need for extraction and processing of new natural resources, which helps to preserve natural ecosystems

4. Reduced air and water pollution: Less reliance on primary materials mining contributes to lower mining and manufacturing-related pollution [2, 3].

Conclusion: The economic benefits of using recycled materials are related to the reduction in construction costs, and the environmental effects are expressed in pollution reduction and conservation of natural resources. These factors combined make material recycling a promising option for sustainable construction.

3. Russian legislation and state programs regulating the field of social housing

The study of Russian legislation and state programs regulating social housing and eco-technology shows that the legal framework is in the process of formation and modernization to support green technologies and construction of affordable housing. However, the legal and regulatory framework for these areas is still underdeveloped, making their integration difficult.

1. Legislation in the field of social housing: basic legal acts such as the Housing Code and the law “On State Support for Social Housing” do not contain provisions on the use of environmental technologies. The national

project “Housing and urban environment” is also not focused on material recycling.

2. Environmental legislation: the federal laws “On waste of production and consumption” and “On environmental protection” regulate waste management, but do not define their application in construction. Environmental standards such as BREEAM and LEED are voluntary.

3. Government programmes: Such programmes as “Energy Saving” and “Clean Country” indirectly support environmentally sound technologies, but do not cover the use of recycled materials in social housing. More targeted support for “green” construction may be envisaged in the future.

Conclusion: The main problem of Russian legislation in the field of social housing and environmental technologies is the lack of clear rules that encourage the use of recycled materials in construction. Unlike many Western countries, where such provisions are enshrined in law, in Russia green building is still at the stage of experimentation and voluntary initiatives.

4. Recommendations for the use of recycled materials

The development of recommendations on the use of recycled materials in social housing construction in Russia requires taking into account international experience and adaptation to local conditions. Here are some key areas that can contribute to the successful integration of secondary materials into the construction process:

1. Standards and norms

- Setting standards: Defining requirements for processed materials to ensure their safety and quality. Legal basis: include the use of recycled materials in the housing code.

2. State support

- Financial incentives: tax benefits and subsidies for companies using recycled materials. Research grants: financing innovations in the field of recycling.

3. Processing infrastructure

- Business creation: Investment in construction of waste treatment plants. Collection and sorting: Development of efficient systems for waste collection and sorting.

4. Education and training

● Training: Implementation of green building programmes for architects and builders. Seminars: Organization of events for exchange of experience.

5. Pilot projects

● Start of project: Start of construction of housing with the use of secondary materials to demonstrate their benefits. Monitoring: assessing the success of such projects and identifying opportunities for improvement.

6. International cooperation

● Exchange of practices: establishing links with international organizations to borrow successful methods. Conference participation: active participation in green building activities.

These recommendations will help Russia to integrate recycled materials into social housing construction, taking into account international best practices and local conditions. This, in turn, will contribute to the sustainable development of the construction industry and address housing affordability issues.

5. Conclusions

1. Growing interest: In Russia, there is a growing interest in green construction and the use of recycled materials in social housing against the backdrop of global environmental problems.

2. Second, lack of legal basis: The absence of a clear legal framework and standards limits the use of recycled materials in construction.

3. The third is economic and environmental benefits: using recycled materials can reduce construction and recycling costs, as well as reducing the impact on the environment.

4. Implementation difficulties: the main obstacles are poor recycling infrastructure, inefficient waste sorting and lack of incentives for developers.

5. Need for government support: the introduction of financial incentives, grants and educational programmes will help to promote green building.

6. Prospects for development: Russia has the potential to integrate recycled materials, which can contribute to sustainable development and affordable housing.

7. Recommendations for future research: further research is needed, including pilot projects and assessment of the economic and environmental impact of recycled materials.

Thus, the topic “Social housing in Russia from recycled materials” is an important area that can contribute to the sustainable development of the construction industry and solve social problems.

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АВСТРАЛИЙСКИЕ ЛЕСНЫЕ ПОЖАРЫ: СОСТОЯНИЕ ПРОБЛЕМЫ

AUSTRALIAN BUSHFIRES: STATE OF THE PROBLEM

В статье делается попытка проанализировать проблему лесных пожаров в Австралии. Авторы рассматривают историю возникновения лесных пожаров в стране, причины лесных пожаров и их последствия. Лесные пожары являются неотъемлемой составляющей австралийской экосистемы. Причины лесных пожаров кроются в сочетании погодных условий, изменений климата и специфичной флоры страны. Антропогенные факторы также влияют на ситуацию. Исследования показывают возможное усиление интенсивности и частоты лесных пожаров в Австралии в будущем. Несмотря на то, что австралийская экосистема адаптирована к периодическим лесным пожарам, потепление климата и деятельность человека могут оказать разрушительное воздействие на существующий экологический баланс и привести к серьезным экономическим потерям.

Ключевые слова: лесные пожары, климат, погодные условия, загрязнение, управление пожаром.

The article makes an attempt to analyze the problem of bushfires in Australia. The authors analyse the history of bushfires in the country, the causes of bushfires, and their consequences. Bushfires are an integral part of Australian ecosystem. The causes of bushfires can be found in the combination of weather conditions, climate change and specific flora of the country. Anthropogenic factors also play their role in this situation. The researches show the possible increase of the intensity and frequency of the Australian bushfires in the future. Although the Australian ecosystem is adapted to periodic bushfires, climate warming and human activities can have a devastating impact on the existing ecological balance and result in great economic losses.

Keywords: bushfires, climate, weather conditions, pollution, fire management.

The Australia's climate is different from other parts of the world and is characterized by special conditions which impact the seasonal weather patterns. One of the prominent feature of today's Australian life has become fire reports. Actually Australian wildfires or bushfires are not new phenomena. They have been accompanying Australian inhabitants for hundreds of years, but still what bothers everybody these days is the increased frequency and severity of what scientists call "fire weather" [1]. Fire weather means the combinations of special weather conditions including high temperatures, low humidity, low rainfall and strong winds [1]. Climate change and global warming undoubtedly add to it and exacerbate its unpredictable and often dangerous character. Scientists report that average air temperature has increased by around 1.0°C since 1910 [2]. The duration, intensity, and frequency of extremely hot weather have also increased across Australia [2]. As a result, the pictures of burnt – out towns, the charred remains of forests and grasslands and thick smoke hanging over major cities have become the usual images of Australia for people around the world [3].

The intensity of bushfires depends on the weather conditions and available fuel. The periodic bushfires do not allow heavy fuel loads to be formed in the grasslands but the tall, wet forests located in Victoria, south – western Australia and southern Tasmania are an ideal place for extreme bushfires to occur [4].

The deadliest Australian bushfires were recorded in 1851, 1939, 1983, 2009, 2019–2020. The time between these disastrous events is becoming shorter (5). Now they seem to happen every decade [6]. According to some estimates, extremely hot days will occur every two to five years by 2050 [7]. These exceptional years for wildfires are characterized by the combination of extreme weather conditions and the results of climate change. Their disastrous and savage nature contributed to their being named after the week days when they occurred, e.g. the 2009 Black Saturday fires [8].

One of the deadliest bushfires of all times the bushfire of 2019–2020 caused animal and birds deaths and their displacement. According to the scientists' estimates, millions of mammals, birds, frogs, insects and reptiles were killed and displaced only because of this deadly single event. This bushfire burned 168,000 sq km of land, destroyed 5000 buildings and killed 400 people [9].

The geographical and topographic characteristics of Australia make it fire prone. Different parts of the country have their own fire seasons. Fire season of northern Australia is winter and spring, in southern part – summer and autumn [4]. As vast territories of Australia are savannahs and grasslands, their vegetation is fire prone. Even periodic heavy rains do not solve this problem but only worsen it. After the rainfalls the vegetation begins to thrive but soon it turns into the dry fuel for wildfire which starts to rage with new devastating force [4]. The south – eastern part of Australia and the south-west corner of Western Australia are known to have tall wet forests but after they occasionally dry out they cause intense bushfires [4].

Some plants in Australia can flower and germinate only in the presence of fire. Annual burning of grass stimulates certain species of plants to grow and thrive and they in turn are preferred by some species of animals. Even the survival of eucalyptus forests is dependent on bushfires. Eucalypts have very small seeds which must reach the soil to give seedlings but thick litter beds formed on the forest floor hinder growth and regeneration of the trees. This way regular bushfires help eucalypts to burn the accumulated organic matter on the forest floor and make soil accessible for seedlings. Otherwise eucalypts forests will disappear forever and be replaced by other tree species [4].

Australian fauna is also interconnected with flora. Wildfires and bushfires kill a lot of animals but still periodic fires are necessary for survival of certain animal species. The replacement or loss of native vegetation, whose growth is associated with periodic fires, will be fatal for some animal species [4].

The scientists note that Aborigines of Australia have had a long history of living in such extreme weather conditions and they were used to use fires for their own purposes. They knew when and where fires started. They were well aware of the consequences of wildfires. They used their knowledge to prevent the spreading of wildfires by starting their own preventive fires. Besides they burnt grasslands to promote the flowering and fruiting of certain edible plants, to protect themselves from reptiles and insects, to destroy thick vegetation and to warm themselves [4]. The arrival of Europeans to Australia changed the aboriginal ignition regimes. While the white settlements in Australia increased, the burning frequency

decreased. But still it didn't totally solve the problem. Dry remnants of grass and wood built up and formed much fuel. When fires occurred they became more intense and more devastating [4].

European settlers started drafting the legislation in the field of bushfires protection in 1880s. But real successes were achieved in the first half of the 20th century after a number of disastrous bushfires. This legislation helped to form the policy of fires management, create the fire departments and volunteer fire brigades as well as strengthen forestry departments across the country [4].

It may seem surprising, but today fewer Australian citizens are aware of bushfires history, causes of bushfires, prevention measures and the necessity of appropriate behavior which one needs to survive. To manage and control bushfires the authorities use and spend a lot of resources but such activity has also a negative effect. People let their guard down, do not take into account specific local flora, the geographical, topographic and weather conditions and they are becoming more and more reliant on external services. This careless and senseless way of living is more prone to disasters [4].

One more problem is that the distance between bushland and residential areas was reduced. Earlier the construction of living blocks took into account the necessity of separation the towns from the rural vegetation, compliance with certain building regulations, clearance of the living areas of natural bush to prevent its regeneration. But today there appeared a tendency among urban citizens to buy large pieces of land, build homes on them and live closer to nature. New homeowners do not clear their land and do not bother about possible fires. As a result, they are often unprepared for bushfires, which occur under favourable weather conditions, and lose their houses, property and lives. Scientists predict the increase of such accidents in future [4].

Bushfires cause the release of millions of tons of CO_2 into the atmosphere. According to the scientists, such air pollution may be more dangerous than industrial emissions. Wildfires have always been widespread in Australia and have become the natural part of local ecosystems. The life cycle of these ecosystems include the absorption of carbon dioxide during the regrowth of vegetation burned by wildfires which helps to keep the ecological balance (10). But the regrowth of forested areas can take years and in some cases they may never recover at all [10].

Besides, air pollution from the bushfires triggers the algal and phytoplankton blooms in the warm waters of the oceans. Smoke from the bushfires is rich with substances which, when it gets into the water, act as nutrients for microscopic plants. These microscopic plants absorb CO_2 for their growth in the process of photosynthesis [9].

Australian bushfires have serious economic impact as a result of which some industries suffer from the lack or even absence of tourists, disturbed consumer behavior, disturbed agricultural chains and so on [11]. Air pollution poses a serious risk to human health and leads to the deaths, diseases, increased health spending and reduced worker productivity [11].

Australian bushfires impact the global climate and contribute to its warning. So, smoke from Australian bushfires drifts across the Pacific Ocean and reaches other countries and continents and its presence is felt in New Zealand, Chilie and Argentina [12, 13]. The meteorologists reported about traces of smoke even in the Antarctic [13].

Regular and increasingly complex natural disasters will greatly complicate the work of Australian emergency services [7]. The Australian authorities state that in the nearest future global warming will cause more compounding disasters on a national level with far-reaching consequences [7]. They will differ from the previous ones by intensity and by multiple origins. Multiple catastrophes will happen simultaneously or immediately one after another. They may involve multiple hazards and cascading effects and this will threaten people's lives, national economy and critical infrastructure (7). Such was the summer of 2019–2020 when people survived drought, heatwaves, bushfires, hailstorms, and flooding [7].

To fight the bushfires Australia does not reject the international help. Firefighters from the USA, Canada, the Republic of Singapore helped Australia by sending specialists, helicopters and relief supplies [14]. The size of bushfires and their intensity force the Australian authorities to involve military teams which help to restore the burned communities, deliver water and food, assess the damage [15].

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СОВРЕМЕННОЕ СОСТОЯНИЕ И ПЕРСПЕКТИВЫ ИССЛЕДОВАНИЙ МЕХАНИЧЕСКИХ СВОЙСТВ ФИБРОБЕТОНА

CURRENT STATUS AND PROSPECTS FOR RESEARCH ON THE MECHANICAL PROPERTIES OF FIBER-REINFORCED CONCRETE

Фибробетон, как разновидность модифицированного бетона, обладает выдающимися механическими свойствами по сравнению с обычным бетоном. В данной статье рассматриваются результаты исследований отечественных и зарубежных ученых, касающихся механических свойств фибробетона, включая прочность на сжатие, прочность на растяжение, модуль упругости и ударную вязкость. Главное внимание обращается на анализ существующих данных и выявление перспективных направлений для будущих исследований в этой области. Делается вывод о возможности дальнейшей оптимизации эксплуатационных свойств фибробетона и повышения эффективности его использования в строительстве, что способствует развитию отрасли и поддержанию устойчивого развития общества.

Ключевые слова: фибробетон, прочность на сжатие, прочность на растяжение, модуль упругости, ударная вязкость.

Fiber concrete, as a type of modified concrete, has outstanding mechanical properties compared to conventional concrete. This article discusses the research results of domestic and foreign scientists concerning the mechanical properties of fiber concrete, including compressive strength, tensile strength, elastic modulus and impact toughness. The main focus is on analyzing existing data and identifying promising areas for future research in this area. It is concluded that it is possible to further optimise the performance properties of fibre concrete and increase the efficiency of its use in construction, which contributes to the development of the industry and supports the sustainable development of society.

Keywords: fiber concrete, compressive strength, tensile strength, elastic modulus, impact toughness.

1. Прочность фибробетона на сжатие

Прочность на сжатие фибробетона является одним из важных показателей его механических свойств. Равномерное распределение волокон в бетонной матрице может эффективно улучшить распределение напряжений в бетоне, тем самым увеличивая его прочность на сжатие. Добавление волокон позволяет уменьшить количество микротрещин внутри бетона, повысить плотность бетона и, таким образом, улучшить его компрессионные свойства.

Формула расчета прочности на сжатие бетонного куба:

$$F_{CU} = \frac{F}{A},$$

где:

F_{CU} – **Прочность на сжатие бетонного куба, MPa;**

F – **Разрушительная нагрузка, *N*;**

A – **Площадь, несущая давление, mm**

Например, Цинь Хэчен и др. [1] исследовали влияние добавления стальной фибры на прочность на сжатие переработанного бетона. Исследования показали, что при содержании стальной фибры от 1,0 до 1,5 кг/м³ прочность на сжатие куба переработанного бетона возрастает с увеличением дозы (рис. 1). Однако, при превышении 1,0 кг/м³ рост прочности замедляется, что подчеркивает необходимость контроля над содержанием фибр. При фиксированной норме замены переработанного заполнителя, добавление 1 кг/м³ стальной фибры может повысить прочность переработанного бетона на осевое сжатие на 15–20 %. К тому же, независимо от скорости замены переработанного заполнителя, добавление стальной фибры значительно улучшает прочность на осевое сжатие, и прочность растет с увеличением дозировки. Результаты исследований подтверждают, что разумное добавление стальной фибры может значительно повысить прочность на сжатие переработанного бетона.

Чжан Чжуомин исследовал влияние различных доз базальтового волокна на компрессионные и изгибные свойства бетона [2]. Результаты его исследований показали, что добавление базальтового волокна значительно улучшает изгибную и сжимаемую прочность бетона. Отмечается, что при содержании волокна 1,35 кг/м³ изгибная

прочность достигает максимального значения, на 12,9 % выше, чем у обычного бетона. А при содержании волокна 4,05 кг/м³ прочность на сжатие также достигает наибольшей величины, что на 20,2 % выше. Главное внимание в его работе обращается на положительное влияние базальтовой фибры на повышение компрессионных свойств бетона. Это подтверждает, что разумное добавление базальтового волокна может существенно повысить механические свойства бетона.

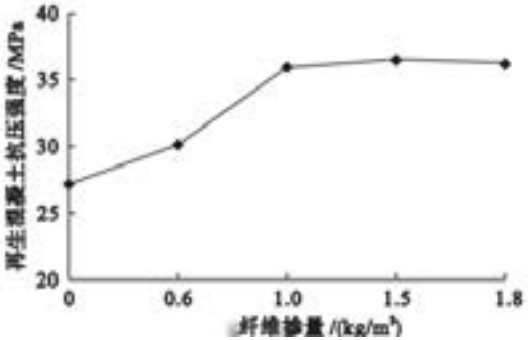

Рис. 1. Изменение прочности на сжатие
в зависимости от содержания стальной фибры

2. Прочность фибробетона на растяжение

Прочность фибробетона на растяжение является одним из ключевых показателей улучшения его эксплуатационных характеристик. Прочность обычного бетона на растяжение низкая, но добавление волокон может значительно улучшить прочностные свойства бетона. Волокна образуют в бетоне сетчатую структуру, которая эффективно предотвращает расширение трещин и, таким образом, повышает прочность бетона на растяжение. Яо У исследовал влияние полипропиленового волокна на прочность бетона на растяжение [3]. Результаты экспериментов демонстрируют, что с увеличением содержания волокна отношение растяжения к сжатию бетона уменьшается, а его хрупкость увеличивается. Однако, предлагается, что добавление тонкого полипропиленового волокна может эффективно улучшить связность и водостойкость

бетона, а также повысить прочность связи между волокнами и цементной матрицей. Это усовершенствование подчеркивается, что значительно повышает трещиностойкость и армирующий эффект бетона, снижает его хрупкость и улучшает непрерывность и целостность материала. В результате, последующая прочность бетона на растяжение повышается, что, в свою очередь, повышает безопасность и долговечность конструкций.

Хуан Гунсюэ и др. [4] провели исследование свойств растяжения полипропиленового фибробетона. Результаты экспериментов подтвердили, что полипропиленовое волокно оказывает значительное армирующее воздействие на бетон, особенно в отношении улучшения прочности бетона на растяжение и изгиб. Отмечается, что при постоянной длине волокна, показатели прочности фибробетона на растяжение и изгиб возрастают с увеличением его содержания.

3. Модуль упругости фибробетона

Модуль упругости является важным показателем для измерения жесткости материала, отражающим способность материала противостоять деформации на стадии упругой деформации. Модуль упругости фибробетона обычно выше, чем у обычного бетона, что в основном объясняется хорошим сцеплением между волокнами и бетонной матрицей.

Рис. 2. Полипропиленовое волокно

Чжоу Лиюнь исследовал соответствующие свойства смешанного высокомодульного полипропиленового фибробетона (рис. 2) [5]. В его исследовании использовался бетон марки С40 в качестве матрицы, а также добавлялись смешанные макро- и микроволокна полипропилена с высоким модулем упругости. В тексте подробно освещаются результаты систематической оценки влияния волокон на эксплуатационные характеристики бетона.

Отмечается, что, хотя волокна оказывают небольшое отрицательное влияние на удобоукладываемость свежего бетона, это можно эффективно контролировать, регулируя дозировку водоредуцирующей добавки. Главное внимание обращается на то, что добавление гибридных полипропиленовых волокон значительно улучшает прочность бетона на сжатие и изгиб, что указывает на улучшение модуля упругости бетона. К тому же, результаты исследований показывают, что добавление волокон значительно снижает усадку бетона при высыхании и повышает его трещиностойкость. В совокупности эти результаты демонстрируют эффективность полипропиленовых волокон в повышении модуля упругости бетона.

Хэ Дунцин провел исследование модуля упругости и коэффициента Пуассона фибробетона [6]. Результаты эксперимента показали, что тип и дозировка волокна существенно влияют на модуль упругости бетона. В частности, отмечается, что модуль упругости полипропиленового фибробетона на 1,02 % ниже, чем у обычного бетона, в то время как у базальтового и стальной фибры он выше на 1,93 % и 9,20 % соответственно. Это указывает на то, что добавление волокон с высоким модулем упругости может эффективно улучшить модуль упругости бетона, тем самым улучшая его механические свойства. К тому же, результаты исследования подчеркивают, что добавление волокон значительно снижает усадку бетона при высыхании, повышает его трещиностойкость и дополнительно увеличивает модуль упругости бетона.

4. Прочность фибробетона

Прочность – это способность материала поглощать энергию в процессе разрушения, которая является важным показателем для измерения трещиностойкости и ударопрочности материала.

Прочность фибробетона значительно выше, чем у обычного бетона, что в основном объясняется эффектом дисперсии и связывания волокон в бетоне.

Чжан Яньнянь рассмотрел прочность бетона, армированного стекловолокном. Результаты эксперимента четко демонстрируют, что использование стекловолокна значительно повышает прочность бетона. Эффективное сочетание стекловолокна и бетона не только улучшает прочность образцов на изгиб, но и улучшает их общие эксплуатационные характеристики. Это приводит к тому, что разрушенные образцы демонстрируют более высокую прочность на изгиб и более полную кривую зависимости нагрузки от прогиба.

В частности, отмечается, что при содержании стекловолокна 1,5 % и длине волокна 12 мм предел прочности и упрочняющий эффект бетона достигают наибольших значений. К тому же, с ростом класса прочности матрицы прочность бетона на изгиб увеличивается более существенно, особенно для бетона, соответствующего марке С40, где прочность на изгиб увеличивается на 53,48 %.

Необходимо отметить, что прочность и трещиностойкость бетона можно значительно улучшить за счет оптимизации количества и длины стекловолокна (рис. 3, 4). Эти результаты подтверждают, что использование стекловолокна является эффективным методом для повышения механических свойств бетона.

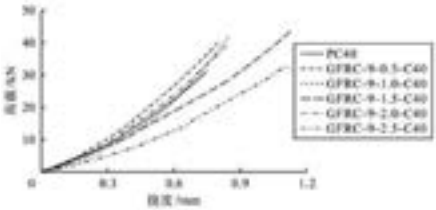

Рис. 3. Зависимость между содержанием стекловолокна и кривой «нагрузка-прогиб»

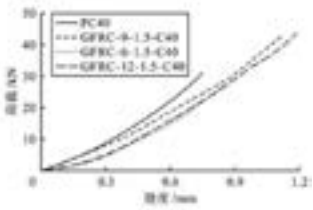

Рис. 4. Зависимость длины стекловолокна от кривой «нагрузка-прогиб»

5. Значение и перспективы фибробетона

Фибробетон, как инновационный строительный материал, играет все более важную роль в современных строительных проектах

благодаря своим превосходным механическим свойствам и широким перспективам применения. По сравнению с традиционным бетоном, фибробетон обладает значительно более высокими показателями прочности на сжатие, прочности на растяжение, модуля упругости и ударной вязкости, что делает его ключевым материалом для повышения безопасности, долговечности и надежности строительных конструкций. Особенно в сейсмоопасных районах и сооружениях, подвергающихся сложным нагрузкам, применение фибробетона может эффективно снизить ущерб и защитить жизни и имущество людей. Учитывая важность фибробетона, будущие исследования и разработки должны сосредоточиться на следующих ключевых направлениях.

Многофакторное комплексное исследование: углубленное изучение комплексного влияния различных типов волокон, дозировок, типов цемента, водоцементных соотношений и условий твердения на эксплуатационные характеристики фибробетона для достижения оптимальных результатов.

Стандартизированные методы испытаний: разработка единых стандартов и спецификаций испытаний, повышение сопоставимости и надежности результатов исследований, содействие стандартизации и применению технологии фибробетона.

Взаимодействие между факторами окружающей среды и нагрузкой: изучение изменений характеристик фибробетона в различных условиях окружающей среды и нагрузки, а также взаимодействие между этими факторами для обеспечения научной основы для практического применения в инженерии.

Долговечность и устойчивость: оценить влияние различных типов волокон на долгосрочные характеристики бетона и изучить возможность использования возобновляемых или переработанных волокон для повышения долговечности и экологичности фибробетона.

Численное моделирование и экспериментальная проверка: использовать передовую технологию численного моделирования для прогнозирования механического поведения фибробетона в сочетании с экспериментальной проверкой для повышения точности и эффективности прогноза.

Разработка технологии применения: разработать технологию строительства и технологию применения, подходящую для фибро-

бетона, такую как равномерное распределение волокон, смешивание и заливка бетона, а также технологию соединения и ремонта конструкций, для содействия широкому применению фибробетона.

Благодаря этим исследованиям и разработкам можно дополнительно оптимизировать эксплуатационные характеристики фибробетона и улучшить эффективность его применения в строительных проектах, что внесет еще больший вклад в развитие строительной отрасли и устойчивое развитие человеческого общества.

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ПРОГРАММНЫЕ КОМПЛЕКСЫ ДЛЯ ТЕПЛОФИЗИЧЕСКИХ РАСЧЕТОВ МЕРЗЛЫХ ГРУНТОВ: ОБЗОР ВОЗМОЖНОСТЕЙ

PROGRAM COMPLEXES FOR THERMOPHYSICAL CALCULATIONS OF FROZEN SOILS: A REVIEW OF CAPABILITIES

В данной статье проводится обзор программных комплексов, которые используются для теплофизических расчетов мерзлых грунтов. Рассматриваются различные программы, такие как «Frost 3D», «Борей 3D», «FrostPile» и «FEM Models», их функциональные возможности, методы расчета и сферы применения. Анализ демонстрирует, что сейчас на рынке существует множество программных комплексов, которые могут производить сложные теплотехнические расчеты, а также моделировать тепловые процессы в грунте. В то же время выбор наиболее подходящего программного обеспечения – «Frost 3D» для комплексного анализа, «Борей 3D» для моделирования СОУ, «FrostPile» для свайных фундаментов или «FEM Models» для совместного проектирования здания и фундамента – зависит от конкретной задачи и должен происходить индивидуально для каждого отдельного проекта.

Ключевые слова: вечная мерзлота, теплотехнические расчеты, программные комплексы, «Frost 3D», «Борей 3D», «FrostPile», «FEM Models».

This article reviews software packages used for thermal calculations of permafrost. Various programs are examined, including "Frost 3D," "Borey 3D," "FrostPile," and "FEM Models," focusing on their functionalities, calculation methods, and applications. The analysis demonstrates that the market currently offers numerous software packages capable of performing complex thermal calculations and modeling thermal processes in the ground. However, selecting the most suitable software – "Frost 3D" for comprehensive analysis, "Borey 3D" for modeling seasonally operating cooling devices (SOCDs), "FrostPile" for pile foundations, or "FEM Models" for integrated building and foundation design depends on the specific task and should be done individually for each project.

Keywords: permafrost, thermal calculation, software packages, “Frost 3D”, “Borey 3D”, “FrostPile”, “FEM Models”.

Designing foundations on permafrost is a complex undertaking that can challenge even experienced professionals unfamiliar with its intricacies. Structures are vulnerable to both seasonal thawing, leading to uneven settling, and frost heave, which increases pressure on structural elements. Building operation and high groundwater tables also contribute to soil warming, among other factors that must be considered during the design phase. Mistakes can have disastrous consequences, ranging from uneven settling and cracking to partial or complete destruction of both the building and surrounding structures. In Russia, where permafrost covers two-thirds of the land, the need to account for all these factors and avoid errors is especially critical.

Modern technology is rapidly advancing; the days of drafting boards and slide rules are long gone. Numerous software packages simplify the lives of 21st century engineers. Beyond general calculation programs, there’s a growing number of specialized applications for specific tasks, including permafrost foundation design. These programs consider not only geological features but also air and soil temperatures, the future building’s operating temperature, annual temperature variations, and numerous other factors directly affecting calculation accuracy.

The market offers a wide variety of software specializing in permafrost calculations. Some provide comprehensive analysis using the finite element method and incorporating thermal processes, allowing for foundation selection and settling calculation. Others are more specialized, focusing on the impact of seasonal cooling systems or solely on pile selection.

This article will examine software packages for calculating buildings and structures on the “FROST 3D” software package was developed by “Simmmakers Research and Development Center” LLC, a Skolkovo Innovation Center resident. It utilizes the finite element method – the most common and well-known approach for geotechnical modeling. The program allows for the creation of three-dimensional models of soil, buildings, foundations, and various structures, facilitating the design of structures with diverse shapes, moving beyond the limitations of 2D modeling. A key advantage is the visualization of calculation results as graphs, 3D images,

and thermal fields as it is shown in Figure 1. This simplifies analysis for engineers and improves communication with clients. Presenting results visually with colorful graphs and 3D models is far more effective than explaining complex technical details in a dry report [2].

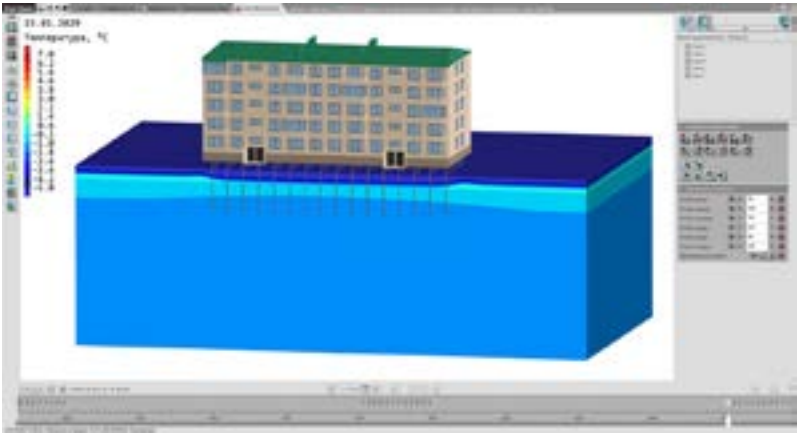

Fig. 1. The “Frost 3D” interface

The “FROST 3D” software package comprises four modules, each tailored to specific tasks with unique functions. “Frost.Termo” performs thermal calculations and predicts permafrost behavior, accounting for water filtration in the soil. “Frost.Klimat” creates databases of climatic and geocryological data, serving as a reference for continental soils. “Frost.Svaya” is designed to calculate the bearing capacity of piles in permafrost conditions, complying with SP 25.13330.2020 (building code) standards. This program allows for automated calculations based on modeled temperature fields, somewhat easing the workload for geotechnical engineers.

Importantly, it can also account for negative skin friction along the pile shaft, in accordance with SP 24.13330.2021 – a frequently necessary consideration in my design experience. Furthermore, “Frost.Svaya” calculates the tangential force of frost heave, assesses foundation stability under tangential forces, and determines the design allowable load for pile driving and extraction, among other capabilities.

"Frost.Osadka" calculates soil settling during thawing according to SP 25.13330.2020, a common calculation in permafrost design. This calculation is based on temperature field dynamics and, conveniently, automatically generates a soil surface settling profile along a specified cross–section [6].

This program uses the heat conduction equation (1) to account for the spread of heat in three-dimensional space over time: [3]

$$\left(C(T)+\rho_b L\frac{\partial w_w(T)}{\P\partial T}\right)\frac{\partial T}{\partial t}+\nabla\left(-\lambda(T)\nabla T\right)+C_w u\nabla T=0 \qquad (1)$$

where T – temperature, °C; $C(T)$ – the volumetric heat capacity of the soil as a function of temperature, $J/(m^3\cdot°C)$; $W_w(T)$ – the amount of unfrozen water in the soil as a function of temperature; ρ_b – soil density, kg/m³; L – specific heat of the phase transition, J/kg; t – time, s; $\lambda(T)$ – thermal conductivity of the soil as a function of temperature, W/(m·°C); C_w – volumetric heat capacity of water, $J/(m^3\cdot°C)$; u – groundwater filtration velocity vector m/s; ∇T is the temperature gradient, °C/m.

In conclusion, I think that "Frost 3D" is a convenient tool for permafrost foundation design. Its extensive functionality covers a wide range of design aspects – from creating climate databases to calculating thaw settling – making it a versatile tool for permafrost-related projects. Although obtaining a commercial license might be somewhat complex, I believe every geotechnical engineer working in this field should familiarize themselves with this program, at least superficially.

The next program selected for this article is thee "Borey 3D", developed by a Moscow-based company in 2018. The interface of the program is shown in Figure 2. Its primary function is modeling and calculating temperature changes in permafrost underlying buildings and structures. For example, it can account for the influence of seasonally operating cooling devices on the soil [4].

The modeling of seasonally active cooling devices is performed as third-kind boundary conditions. The heat transfer coefficient from the ground to the seasonally active cooling device is determined using the formula: (2)

$$K_u = \frac{1}{\frac{1}{\alpha_{re}} \cdot \frac{F_u}{F_{pc}}} \quad (2)$$

where F_u – evaporator surface area, m^2; F_{pc} – outer surface area of the condenser [m^2]; αre – reduced heat transfer coefficient from the condenser wall to the surrounding air, $W/(m^2 \cdot K)$.

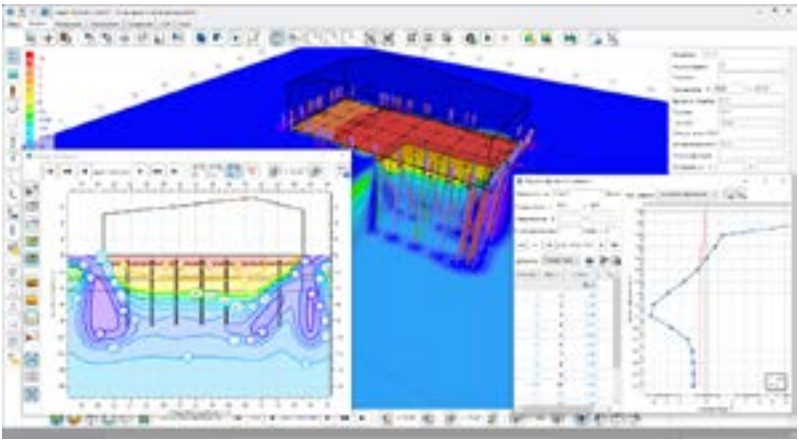

Fig. 2. The “Borey 3D” interface

This program is ideally suited for modeling seasonally operating cooling devices and their impact on the temperature of foundations and structures, making it an excellent tool for designing buildings according to the First Principle (whose core idea is maintaining the frozen state of the soil not only during construction but throughout the structure’s lifespan).

There are also programs specializing in individual underground structures. For example, “FrostPile,” developed by Russian developers Timur Nazarov and Vasily Bochurow, specializes in pile foundations for buildings and structures on permafrost [1].

This program is designed to assess the bearing capacity of piles in permafrost conditions using the First Principle. The interface of this program is presented in Figure 3. “FrostPile” can calculate the bearing capacity of piles in permafrost conditions, assess pile stability and strength against

frost heave forces, and calculate the required area of ventilated basements with vents or open basements to ensure the temperature regime according to the methods described in SP 25.13330.2020 [5].

Fig. 3. The “FrostPile” interface

The program visualizes calculation results through graphs showing temperature distribution in the soil, thaw and freeze depths, calculated soil resistance, and bearing capacity – features that, as mentioned above, are extremely convenient. All intermediate calculation results are presented in tables, and a complete protocol is generated, including the formulas used and the coefficients selected. “FrostPile” efficiently performs calculations and pile selection for First Principle design on permafrost, and the presentation of results in clear graphs and tables aids engineers in making final decisions.

“FEM Models” is a software program designed for various structural calculations using the Finite Element Method (FEM). Developed by the “Georeconstruction” group of companies, it offers a wide range of tools for calculating both above-ground and underground building structures, including beams, columns, plates, shells, and 3D solids (Fig. 4). The program also incorporates advanced material models, allowing for the analysis of linear and nonlinear behavior, including plasticity and creep.

Calculations related to frozen ground are facilitated by the integrated Termoground thermophysical model, which enables the analysis of freezing, heaving, and thawing processes, considering factors such as soil type, temperature gradients, and moisture content. A key advantage of this software is its ability to create a unified model encompassing the foundation, building, and soil, allowing for coupled calculations and a more accurate representation of the overall structural behavior [7].

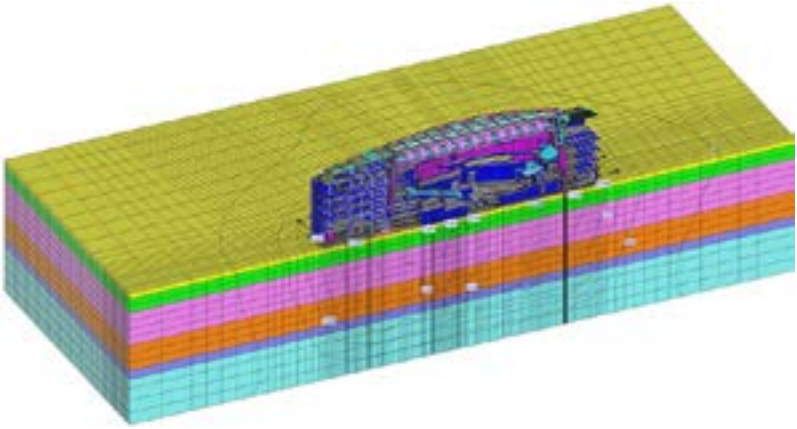

Fig. 4. The “FEM Models” interface

This article shows the diverse range of software currently available for thermotechnical calculations in permafrost. While programs like “Frost 3D” and “Borey 3D” offer comprehensive modeling capabilities, specialized tools like “FrostPile” cater to specific design needs. The selection of the most appropriate software depends heavily on the project’s complexity and specific requirements. It’s crucial to remember that even the most sophisticated software relies on accurate input data and a thorough understanding of the underlying physical processes.

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АВТОМАТИЗАЦИЯ ПРОЕКТИРОВАНИЯ С ИСПОЛЬЗОВАНИЕМ ИНСТРУМЕНТОВ ДИНАМИЧЕСКОГО ОБНОВЛЕНИЯ МОДЕЛИ

DESIGN AUTOMATION WITH THE DYNAMIC MODEL UPDATE TOOLS

В этой статье описывается применение инструментов динамического обновления для автоматизации проектирования и разработки информационных моделей, с целью получения различных видов документации. Проводится анализ существующих наиболее распространенных решений, оцениваются их преимущества и недостатки. Описывается архитектура механизма подписки на внесение определенных изменений в модель. Формируется вывод о целесообразности применения средств динамического отслеживания в рамках внесения пользователем изменений в модель с точки зрения нагрузки на производственную мощность компьютера. Также оцениваются возможные альтернативы и перспективы развития рассмотренных инструментов автоматизации проектирования.

Ключевые слова: события, интерфейс, обновление, транзакция, модель, параметр.

In this article, the application of dynamic update tools for automating the design and development of informational models, with the goal of generating various types of documentation is described. An analysis of the most common existing solutions is conducted, evaluating their advantages and disadvantages. The architecture of a subscription mechanism for tracking specific model changes is defined. A conclusion is drawn regarding the feasibility of using dynamic tracking tools when users make changes to the model, considering the computational load on the computer. Possible alternatives and future development prospects for the discussed design automation tools are also evaluated.

Keywords: events, interface, update, transaction, model, parameter.

Building informational modelling technologies have vastly developed so far. Increase in requirements to performance in terms of industrial design has led to need for modern methods of improving modelling process. Due to growing competition on the market, companies tend to spend enormous sums of money on specific solutions, which are capable of boosting their workflows. However, despite the fact that internet technologies have advanced so far, people still generally use old-fashioned methods of automating repetitive tasks, such as macros (Fig. 1), scripts (Fig. 2) and plugins (Fig. 3) that run manually [1, c. 31].

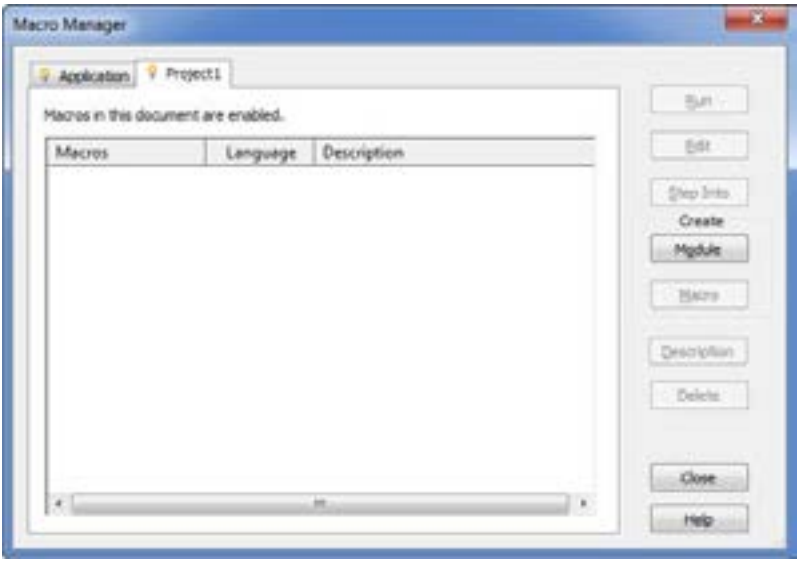

Fig. 1. Macro manager

Nevertheless, nowadays necessity of more agile ways of models filling appeared. Fortunately, some software APIs provide access to tools capable of influencing the design process dynamically. In this work Revit API tools will be considered due to the wide spread of mentioned software usage and the opportunities this program provides [2, c. 9]. Firstly, in terms of dynamic tools in Revit API, there are events and the IUpdater Interface. Events mostly relate to an entire document or the application session changes

whether it is about file save, opening, creation, export or printing and closing show in Fig. 4.

Fig. 2. Visual programming environment Dynamo

Fig. 3. Example of a plugin Modplus

Fig. 4. Page from revitapidocs.com with application events

As an example of event, there is OnStartup method (Fig. 5), which in particular might be used for creation of custom elements in user interface such as tabs, panels, buttons, switches etc. [3].

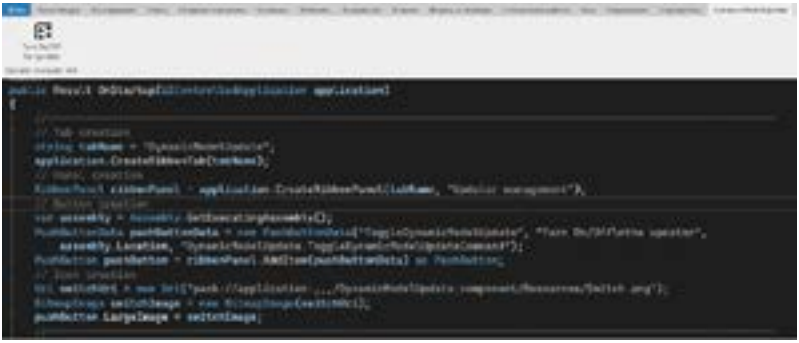

Fig. 5. Code sample, which works during the software launch process

Meanwhile IUpdater interface focuses on changes implemented to specific elements of building informational model filtered by the user. It reacts to some triggers. User may define changes that provoke the reaction. There are basically two vital of them: parameter and geometry changes. All of the possible variants are represented in the Figure 6.

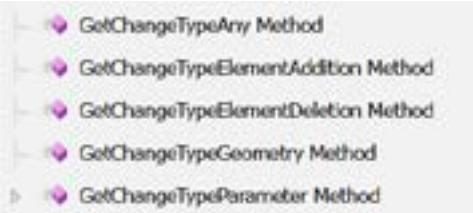

Fig. 6. Types of changes

After processed change occurred, Execute method implements its logic as it can be seen in Figure 7.

These two mechanisms may be considered as parts of Event Driven Architecture. This thing is widely spread in, for example web development; however, it is not often used in terms of BIM [4, c. 89].

Fig. 7. Page from revitapidocs.com with the Execute method

To continue, there is an example of case where IUpdater is essential. Design software often comes with several restrictions. In terms of Autodesk Revit, it does not have a proper way of creating a multi-category schedule to gather pipes, fittings, pipe accessories, equipment and so on together. Although it is possible to have them collected in the same table, due to difference in units of measurement it is not possible to have their quantities in the same column. For example, pipes are measured in millimeters or inches while pipe accessories are measured in pieces. To overcome this issue, the user can use his own custom shared parameter, which will go as a number. After this parameter was added to the project, it now might be filled by the user manually; however, this is extremely time-consuming and can lead to a lot of blunders from the model developer. This problem can be solved by using simple updater, which will trigger when either geometry changes occur or MEP elements have been created or they have been deleted. That means that this application will constantly track the changes made to the model and automatically fill all the necessary parameters without a need for the user to maintain this manually. It basically solves the problem. However, as regards IUpdater Interface there is one characteristic feature that worth mentioning. It does not require a transaction to be started to implement its logic in the execute method. So it cannot be canceled by pressing CTRL+Z. Thus, developers should be aware of that and must carefully predict all the possible consequences of using such a thing.

In conclusion, it is important to raise a question about updaters influence on a PC performance. It is widely known that RAM has noticeable effect on a computer ability to do its functions [5, c. 38]. Thus, the experiment was conducted. Firstly, an empty project in Revit 2022 with a basic

template was created. After that, the amount of RAM used by an application was tracked through the task manager. The result can be seen in the Fig. 8.

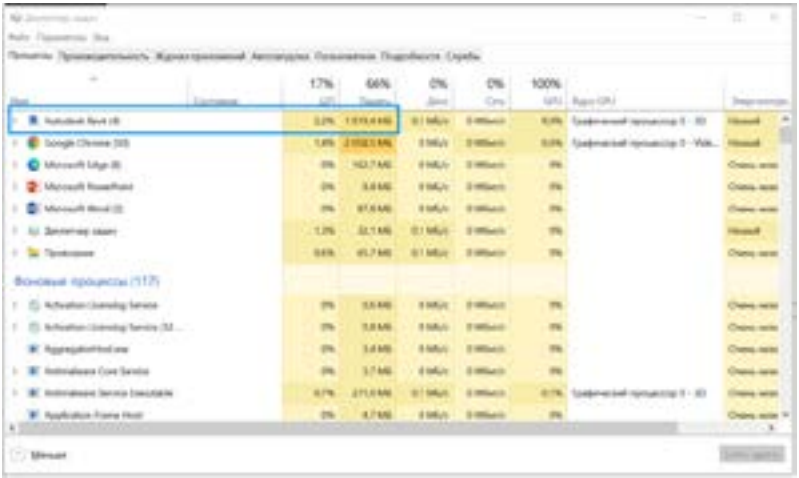

Fig. 8. Task manager data with the updater disabled

Secondly, the updater was on through the specific custom button in the user interface shown in Figure 9.

Fig. 9. Button to launch the updater in the user interface

Thirdly, the amount of RAM used by an application was tracked through the task manager again, and the results have changed a bit (Fig. 10).

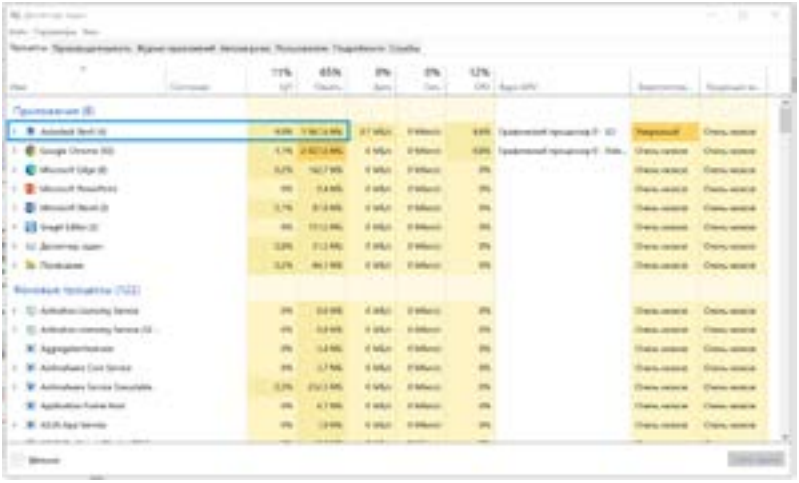

Fig. 10. Task manager data with the updater enabled

Undoubtedly, the quantity of memory consumed has changed. In particular, it has increased by approximately 5 %. Although this application has not involved on the overall performance significantly, it is important to mention that it was basic and has had only one filter and one trigger active. So, it is important to assess the influence of sophisticated applications with several updaters with multiple different triggers active on the user working experience especially regarding huge models. As it has to track all the changes implemented by the user to define whether they affect elements from the filter, it can cause severe problems related to ability of software to function in normal mode.

Finally, updaters might be extremely useful for a vast range of users and can be helpful in terms of atomizing repetitive tasks. However, there are still areas to learn and prospects to develop new tools for building informational modelling process.

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ЭКСПЕРИМЕНТАЛЬНЫЕ МАШИНЫ В ЛЕСНОЙ ПРОМЫШЛЕННОСТИ

EXPERIMENTAL MACHINERY IN FORESTRY SPHERE

Лесная промышленность сталкивается с возрастающей потребностью в повышения эффективности, устойчивости и безопасности работ. Для решения этих задач разрабатываются экспериментальные машины, включая автономные харвестеры, лесозаготовительные системы на базе искусственного интеллекта, а также гибридное и электрическое оборудование. Эти инновации направлены на снижение воздействия на окружающую среду, повышение производительности труда и оптимизацию управления ресурсами. Однако их широкомасштабное внедрение требует тщательного тестирования и адаптации к реальным условиям лесозаготовки. В этой статье рассматриваются новейшие достижения в области экспериментальной лесной техники, их потенциальные преимущества, а также недостатки, которые необходимо преодолеть для успешной интеграции в отрасль.

Ключевые слова: экспериментальные технологии, экспериментальные машины, лесопромышленность, лесоповалочные машины, устойчивость.

The forestry industry is facing an increasing need in improving the efficiency, sustainability, and safety of its operations. Experimental machinery, including autonomous harvesters, AI-driven logging systems, and hybrid or electric-powered equipment, is being developed to address these challenges. These Innovations are aimed at increasing the productivity, reducing environmental impact and optimizing the process of labor However, widespread implementation requires extensive testing and adaptation to real world forestry conditions. This article explores the latest advancements in experimental forestry machinery, their potential benefits, and the obstacles that must be overcome for their successful integration into the industry.

Keywords: experimental technologies, experimental machinery, forestry, logging machines, sustainability.

The forestry industry faces numerous challenges, including the need for increased efficiency, and improved labor safety. Traditional forestry equipment is being challenged by increasing environmental regulations, rising fuel costs, and demands for higher productivity. In response, manufacturers and researchers are developing innovative machines that integrate electric powertrains, artificial intelligence, and advanced stabilization technologies to optimize logging operations. While these experimental solutions are still in development, they represent a promising shift towards a more technologically advanced and environmentally responsible forestry industry.

To address these issues, researchers and manufacturers are developing experimental forestry machines equipped with advanced technologies. Autonomous harvesters, AI-driven logging systems, and electric or hybrid–powered machinery are being tested to improve precision, reduce emissions, and optimize resource management. These innovations have the potential to revolutionize the sector by increasing efficiency while reducing the industry's ecological footprint. However, widespread adoption of these technologies requires extensive testing and refinement. Experts emphasize that while automation and electrification offer promising benefits, real world forestry conditions present unique challenges. Successful integration of experimental machinery will depend on continued collaboration between researchers, manufacturers, and forestry professionals to ensure these advancements are both practical and effective in modern operations. For example:

1. PONSSE EV1 Electric Forwarder (Fig. 1)

In August 2022, PONSSE introduced the PONSSE EV1, an electric forest machine technology concept. Designed for forwarders with a 15-tonne load-carrying capacity, the EV1 features a fully electric powertrain. Its batteries are charged using a Range Extender, which is currently a combustion engine. This hybrid approach aims to significantly improve fuel economy and reduce emissions in forestry operations.

Fig. 1. PONSSE EV1 Electric Forwarder

Device:

The PONSSE EV1 is an experimental forwarder designed with a fully electric powertrain, aiming at improving the efficiency and lessening the environmental impact of forestry operations. It features high-capacity batteries that provide extended operational time and a Range Extender system that ensures continuous power supply, making it suitable for large-scale logging tasks. The machine is built with a powerful chassis and advanced hydraulic controls for smooth operation in challenging forest environments.

Operating Principle:

The EV1 utilizes an electric motor to power its movements and perform logging operations. Unlike conventional diesel-powered forwarders, the EV1 operates primarily on battery energy, significantly reducing fuel consumption. This hybrid approach allows for a more sustainable and energy-efficient forestry process, reducing both operational costs and emissions. The electric drivetrain also provides better torque control, enabling smoother and more precise maneuvering in dense forest areas.

Solved Problems:

- Significant reduction in CO_2 emissions, lowering the carbon footprint of forestry operations.

- Enhanced fuel efficiency through electric traction, reducing dependence on fossil fuels.
- Lower noise levels, making forestry work less disruptive to wildlife and surrounding ecosystems.
- Improved operator comfort due to smoother engine performance and reduced vibrations [1].

2. Xt28 Forwarder with Pendulum Arm Technology (Fig. 2)

The Xt28 vehicle is a six–wheeled full-scale concept machine with a design different from typical forwarders in forestry. It has two articulation joints for steering instead of one and six wheels without tracks or bogies, each with an actively articulated suspension. A diesel engine powers the drivetrain, propelling three hydraulic pumps. Two of these pumps drive the transmission, while the third supplies power to the hydraulics for the active suspensions, steering, and crane [2].

Fig. 2. Xt28 Forwarder with Pendulum Arm Technology

Device:

The Xt28 is an advanced forwarder featuring a unique pendulum arm suspension system that ensures maximum stability on uneven terrain. Unlike traditional forwarders, the Xt28 is designed to adapt to challenging

environments, including steep slopes and swampy areas. It can be operated in three different modes: manually, remotely, or autonomously, providing unparalleled flexibility in various forest conditions.

Operating Principle:

The forwarder's pendulum arm technology actively adjusts the machine's balance, reducing the risk of tipping over in rough terrain. Each wheel is independently controlled to adapt to surface unevenness, allowing for smooth and stable movement. The machine can be controlled remotely for dangerous tasks or programmed to operate autonomously using pre-set navigation routes.

Solved Problems:

- Increased stability in challenging forestry environments, reducing the likelihood of accidents.
- Reduction in operator fatigue due to the machine's automatic balancing and shock-absorbing capabilities.
- Improved accessibility in difficult terrains, making it possible to harvest timber in previously inaccessible locations.
- Integration of autonomous operation for safer and more efficient forestry processes [3, 4].

3. EcoLog Hybrid Harvester (Fig. 3)

The EcoLog Hybrid Harvester is an experimental forestry machine designed to combine the efficiency of traditional diesel-powered harvesters with the sustainability of electric power. This hybrid system aims to reduce fuel consumption and lower carbon emissions while maintaining high performance in logging operations. The harvester is equipped with an intelligent energy management system that optimizes power distribution between the diesel engine and electric motor.

Operating Principle:

The EcoLog Hybrid Harvester operates using a combination of diesel and electric power. During low-energy-demand activities, such as moving between trees, the machine runs primarily on electricity, reducing fuel consumption and emissions. When higher power is needed, such as cutting and processing trees, the diesel engine automatically engages, providing additional energy. The system also features regenerative braking, which captures and stores energy when the machine slows down, further improving efficiency.

Fig. 3. EcoLog Hybrid Harvester

Solved Problems:

- Reduction in fuel consumption and greenhouse gas emissions, making forestry operations more environmentally friendly.
- Enhanced efficiency through intelligent power management, ensuring optimal use of available energy sources.
- Lower operational costs by decreasing fuel dependency and improving long-term machine durability.
- Noise reduction, creating a less disruptive working environment for wildlife and forestry workers [5].

With continued investment in research, technological advancements, and strong collaboration between industry leaders, governments, and environmental organizations, these experimental machines will transition from prototypes to standard equipment in forestry operations. The successful integration of these innovations will not only enhance productivity and safety but also contribute to the long–term preservation of forest ecosystems. Furthermore, as more companies recognize the financial and environmental benefits of adopting smart forestry technology, we may see increased support for these initiatives through policy incentives and subsidies.

If the industry embraces these changes, the future of forestry will be marked by greater sustainability, economic growth, and technological

excellence. The transition to intelligent and eco–friendly forestry solutions will set new benchmarks for efficiency while ensuring responsible forest management for generations to come. By fostering innovation and maintaining a commitment to sustainable development, the forestry sector can continue to thrive while protecting our planet's valuable natural resources.

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ПРЕДОТВРАЩЕНИЕ ПОТЕРИ И КРАЖИ ТОРМОЗНЫХ БАШМАКОВ НА ЖЕЛЕЗНОДОРОЖНОЙ СТАНЦИИ С ПОМОЩЬЮ RFID-МЕТОК

PREVENTING LOSS AND THEFT OF BRAKE SHOES AT A RAILWAY STATION USING RFID TAGS

В тексте рассматривается проблема учета тормозных башмаков на железной дороге и отсутствие эффективных решений для предотвращения их потери или кражи, что может иметь серьезные последствия для безопасности движения. В качестве возможного решения предложено внедрение RFID-системы, состоящей из считывателя и RFID-меток, что позволит автоматизировать процесс учета башмаков и минимизировать риски. Описание характеристик выбранной метки включает рабочую частоту, тип и срок хранения данных. В ходе общения с работниками станции подтверждается наличие проблем с учетом, и предлагается перспективное решение – отображение местоположения башмаков в приложении, что значительно сократит время на инвентаризацию. Внедрение этой идеи позволит существенно улучшить процесс учета и повысить безопасность на железной дороге.

Ключевые слова: тормозной башмак, RFID-система, дежурный по железнодорожной станции, железнодорожная станция, подвижной состав.

The article deals with the problem of accounting for brake shoes on the railway and the lack of effective solutions to prevent their loss or theft, which can have serious consequences for traffic safety. As a possible solution, the implementation of an RFID system consisting of a reader and RFID tags is proposed, which will automate the shoe accounting process and minimize the risks. The description of the characteristics of the selected tag includes operating frequency, type and data retention

period. Communication with the station staff confirms the accounting problems and suggests a promising solution – displaying the location of clogs in the application, which would significantly reduce inventory time. The implementation of this idea will significantly improve the accounting process and increase safety on the railway.

Keywords: brake shoe, RFID system, railway station duty officer, a railway station, rolling stock.

Brake shoes are used every day by railway employees. The issue of brake shoes and traffic safety is very important, because if the train is not properly secured, it can make unauthorized movements, which can lead to derailment of the train and damage to the railway infrastructure. Therefore, in case of loss or theft of brake shoes, the consequences can be very serious, which entails criminal liability of the station staff.

A search for solutions to this problem was launched, but nothing other than conventional shoe labelling was found on the railway network. Then the idea came up to try an RFID system – this is a method of automatically reading information about an object in which data about the object is read or recorded using radio signals. An RFID system consists of a reader (reader) and a transponder (RFID tag).

RFID tag consists of two parts, the first is an integrated circuit for storing and processing information, the second part is an antenna for transmitting and receiving the signal. RFID systems can be divided into short-range identification (up to 20 cm), medium-range (from 20 cm to 5 metres), long-range identification (from 5 metres to 300 metres). Devices that operate on RFID systems are contactless cards and payment systems.

First we had to decide on the choice of RFID system, we need to choose an RFID tag and reader. Quite a large number of RFID tags are presented on the Internet, different range of action and different price for these tags. We chose a single type of RFID tag to realise our idea.

RFID tag characteristics (Fig. 1): MIFARE ULTRALIGHT chip, Operating frequency: 13.56 MHz, Type: ISO 14443 A, Type: read/write, Card identification number (UID): 4 bytes, Number of erase cycles: 100,000 times, Data storage: 10 years, Number of read cycles: 100000 times, Diameter: 25mm, Materials: paper sticker, Support 13.56MHz RFID and NFC IC reader/writer.

In a direct conversation with a station worker, we can immediately understand that the problem of lost shoes does exist at the stations. This

is evidenced by the numerous records we found on the internet. The man who directly works at the station immediately outlined to us the problems that exist at work. According to him, at the beginning of the shift, the station duty officer checks with signalers and train operators the number of shoes, on which rack they are located and on which track [1].

Fig. 1. RFID tag

In the perspective of project development, there is a shoe display in the annex on a certain track and under a certain wagon. The station duty officer knows the location of a certain wagon at the station. At the workplace the application 'ASU STANTS' is used, which directly allows to trace the number of the wagon and their order on the track. Shoe reconciliation also takes place at the end of the shift. Therefore, this idea will optimize the time for inventory reconciliation. About 5 – 10 minutes are used for reconciliation. This time will not be wasted if our plan is implemented.

Also, when a shoe is located on the track, the worker must report it over the radio, but when many trains at the station require securing, the radio airwaves get clogged. Fortunately, this idea solves this problem as well. At the railway station, a lot of attention is given to traffic safety, which is affected by human error, as a result of introspection. The beginning and

end of the shift is a very important part of the working day, because log filling, target briefings and other important things happen. Therefore, it is very important to minimize the time for shoe reconciliation [2].

Now about the disadvantages of this idea. As it turned out, workers at the station are not allowed to use personal phones, so the implementation of a publicly available application for ordinary smartphones turned out to be a wrong direction. Worker gadgets should be introduced to do the job.

The topic of our article is aimed at accounting of working inventory at a railway station, in particular brake shoes. The prospect of our solution is the development of a mobile application, with the help of which the station employees will be able to observe the presence of a shoe under a certain carriage on a certain track. The shoes can also be located on racks, which will also be displayed in the application. We will try to realize our idea by embedding an RFID tag in the brake shoe. Using a mobile device with an NFC module, the train driver will be able to find out information about the shoe, assign it to a particular carriage or a particular rack by scanning the tag on it.

If the shoe is on the track, scanning the mark will allow you to detach it from the track by scanning the mark and entering the carriage number. The reverse of the procedure for securing the shoe to the track or rack.

An employee at the station also gave a good assessment of this idea, but noted that this solution would rather help the station duty officer to keep better records of shoes and would make the work of the person responsible for the shoes (driver, signalman and at large stations shoe-maker) a bit more complicated. But despite this small disadvantage, this solution will help to improve control of shoe counting, and it is a very promising idea that will help to improve the work of traffic services at stations, that is what we were told at the station [3].

Our competences are not enough to create an application, but we were able to write a programme to read RFID tags through a mobile device, which will help to implement this idea by other people. The final form of the app will be a diagram of the stations from a database and a display of the shoes on it. Constant updating and improvement may allow to include all stations of the Russian Federation. Also, the location of the shoes will be able to observe the station duty officer by playing the application on the monitor. By implementing the idea in reality, it will be possible

to optimise the working time of the whole station and significantly improve traffic safety by displaying the shoes at the station.

For the development of software, we took the API of the RFID TOOLS project and rely on it.

For the subsequent development of our own software by employees, the data obtained will be sufficient.

Below is the API code for reading the tag:

```
/**
1 – Select a task profile and recover the profile name. Handle button click
 */
public void onButtonClick(View v) {
    Intent intent = new Intent();
    intent.setAction("com.wakdev.RFIDtools.pro.action.CHOOSE_
PROFILE");
    startActivityForResult(intent,0);
}
/**
 * On Activity Result
 */
@Override
public void onActivityResult(int requestCode,int resultCode,Intent data){
    super.onActivityResult(requestCode, resultCode, data);
    if (resultCode == Activity.RESULT_OK){
        // Recover the name of selected profile
         String myProfileName = data.getStringExtra("intentResultProfile
Name");
    }
}
2 – Run a task profile
/**
*2 – Run a task profile
*/
String myProfileName = "Your profile name";
Intent intent = new Intent();
intent.setAction("com.wakdev.RFIDtools.pro.action.RUN_PROFILE");
intent.putExtra("PROFILE_NAME", myProfileName);
startActivity(intent);
```

At this stage of work, the task was to produce a working model of a railway station inventory with a tag. This inventory is the brake shoe. It was decided to fix the mark under the shoe handle, as this position is the most invulnerable for its location. Thus, bumps, throws and other actions with the shoe will not affect the location and performance of the mark. In addition, the mark itself is very unpretentious and simple in its design. Thus, the likelihood of any damage to the tag is extremely low. This allows the worker to scan the tag with a working device without much effort.

During the production of the model, there were also difficulties. It turned out that this type of tag is not functional in direct contact with metal. It was decided to attach the RFID tag to the brake shoe with cold welding (Fig. 2), after fixing it in this way, this problem disappeared.

Fig. 2. Tag fixing principle

Figure 3 shows the mockup of the programme operation for fixing the mark. In the appendix there is an approximate information about the inventory, which will be displayed on the screen when working at the station.

The model requires refinement and improvement, which is why it is a mock–up. But the main thing is that the idea turned out to be quite

workable, a feasible way to increase train safety at the station, minimise the time spent on inventory control, and optimise work at the station.

When we decided to put an RFID tag on the brake shoe, we came up with the idea of using the same technology with other items whose inventory control is also strict. It is also possible to implement RFID in other items that are no less important at the railway station and also help in the work, for example: on spare parts and components for rolling stock, on tools and equipment used for maintenance and repair of rolling stock, on wheelsets to fix a tag and by scanning it, the employee will be able to get the information he needs about this product.

Fig. 3. Layout of the tagging program operation

As a result of the work done, it was found out how brake shoes are accounted for and placed on the track, who is responsible and liable for the loss of brake shoes.

The idea of how to simplify the tracking of shoes on the track with RFID tags was put forward, a private company became interested in the idea, and new ideas were proposed to the idea.

We took the expert opinion of a person who directly works at the railway station, it was important for us to hear what the railway worker thought about the idea and we received a positive feedback. We managed to do a pilot test and prepare a future concept of the idea.

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ОСОБЕННОСТИ И ПРОБЛЕМЫ ЭВАКУАЦИИ В ВЫСОТНЫХ ЗДАНИЯХ

FEATURES AND PROBLEMS OF EVACUATION IN HIGH-RISE BUILDINGS

Данная статья посвящена исследованию проблемы эвакуации людей из высотных зданий, основным ее особенностям, и методам ее оптимизации. В настоящее время в мире происходит динамичное развитие высотного домостроения, на данный момент самым высоким зданием является Бурдж-Халифа в Дубае, с высотой в 828 метров, и недавно возобновилось строительство самого высокого здания в мире: JeddahTower, его высота должна превысить 1000 метров. В крупных городах, из-за малого количества свободных площадей и дорогой стоимости земли, компании принимают решения возводить здания все большей этажности, для окупаемости проекта. В связи с этим актуальна необходимость создания таких планировок зданий, которые смогут обеспечить быструю и эффективную эвакуацию посетителей небоскреба.

Ключевые слова: эвакуация, высотные здания, особенности эвакуации, проблемы эвакуации, эвакуация людей из высотных зданий, способы улучшения путей эвакуации.

This article is devoted to the study of the problem of evacuation of people from high-rise buildings, its main features, and methods of its optimization. Currently, there is a dynamic development of high-rise housing in the world, at the moment the tallest building is the Burj Khalifa in Dubai, with a height of 828 meters, and construction of the tallest building in the world has recently resumed: the Jeddah Tower, its height should exceed 1000 meters. In large cities, due to the small amount of available space and the expensive cost of land, companies decide to erect buildings with increasing number of floors to pay off the project. In this regard, there is

an urgent need to create building layouts that can ensure a quick and effective evacuation of visitors to the skyscraper.

Keywords: evacuation, high-rise buildings, evacuation features, evacuation problems, evacuation of people from high-rise buildings, ways to improve evacuation routes.

This article describes the evacuation of people from high-rise buildings. This problem is relevant due to the fact that currently there is less and less space for development in large cities due to its high density, and therefore the construction of high-rise buildings is becoming more relevant, since it is possible to build a large number of square meters in a small area. The object of the research is process of evacuating people from a high-rise building. The task of the research is to identify the main problems in the evacuation of people from high-rise buildings and to determine the most effective methods and methods of evacuation.

Based on the calculation of the evacuation of people from high–rise buildings [1], the following main problems can be identified during evacuation.

One of the main problems during evacuation may be a prolonged accumulation of people with high density on the evacuation routes. This happens during evacuation through stairwells, when parts of the stream do not have time to reach low density before they approach the exit point of people from the underlying floor (see figure).

Evacuation of people with physical disabilities is an important task that requires special attention and careful planning. Many of these people may suffer from various illnesses or injuries that limit their mobility, and in particular, the inability to use stairs can be a critical factor in an emergency. When designing buildings and evacuation systems, the needs of such people are often ignored.

For example, safety zones and escape routes are often designed only at the level of technical floors, which can make access difficult for people with reduced mobility. This poses serious risks to their safety in case of emergencies [2].

The duration of the evacuation is a key aspect that can vary significantly depending on various factors. For example, the high density of the flow of people that occurs in conditions of mass evacuation, as well as

the low speed of their movement, significantly affect the overall time interval required for a safe exit. In such situations, when many people are trying to leave the same room or territory, there may be a congestion effect, which leads to significant delays.

As a result, the evacuation time can range from 1 to 2 hours or even more, depending on the specific circumstances. Factors such as the layout of the space, the availability of a sufficient number of exits, and the quality of information that evacuees receive also play an important role in determining the duration of this process.

Therefore, careful planning and preparation in advance can significantly reduce evacuation time and improve people's safety. High demands on people's physical fitness. To exit the building, you need to take stairs from 150 meters to 1 kilometer in a high-density stream. Most people experience fatigue after just 5 minutes of walking down the stairs. Inability to use open outdoor stairs.

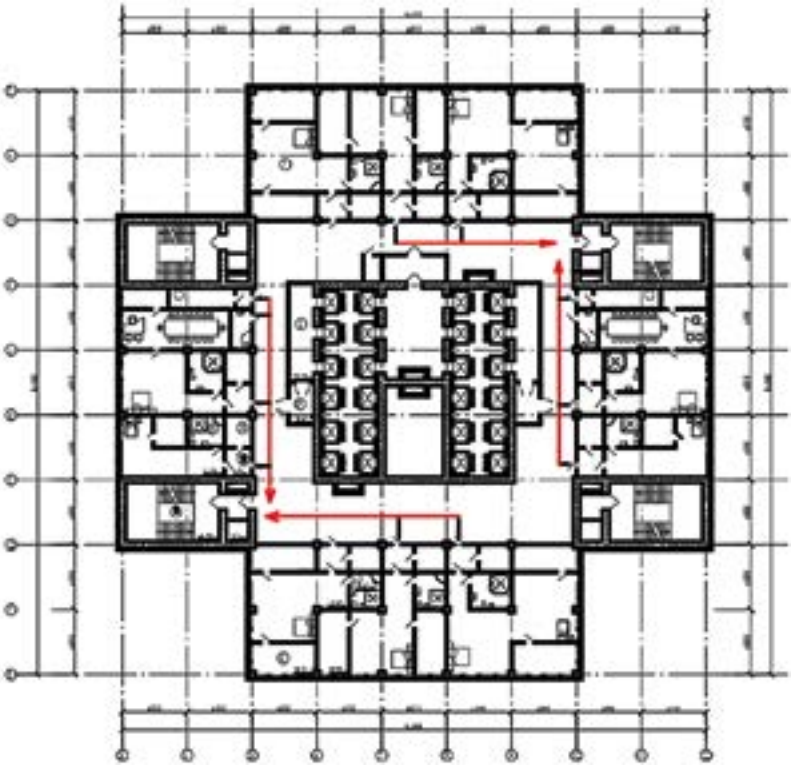
Due to the significant height of the buildings, this is impossible, and imported ladders are not suitable for rescuing people due to their insufficient length. Disorganized evacuation is an extremely serious problem that can arise as a result of a lack of proper planning and regular training. In such a situation, people who are in a stressful and panicked state lose their bearings and do not know how to act.

This leads to massive congestion and overcrowding of exits, which, in turn, exacerbates the situation. The crowd, not having a clear idea of safe evacuation routes, may choose the wrong direction, which further increases the risk and creates additional dangers. Thus, the lack of pre–prepared and worked-out evacuation plans not only creates chaos, but can also cause serious injuries and losses among people.

Smoke from the building. High-altitude vertical ducts, such as elevator shafts, utility shafts, air ducts, and stairs, play a critical role in spreading smoke and toxic gases in the event of a fire. These channels, having a significant height and rectilinear directions, allow smoke to rise upward, moving from the lower floors to the upper ones, which can lead to smoke throughout the building and endanger the life and health of people inside. Leaks in the ceilings also contribute to the spread of smoke.

Through such leaks, smoke can pass freely between floors, which aggravates the situation and makes evacuation more difficult. Even in the

absence of an open fire, smoke can occur as a result of heat and gorenje materials that make up the building structure.



Evacuation scheme from a typical floor of a high-rise building

Blocking of escape routes by gorenje products. Gorenje products fill evacuation exits, elevator shafts, stairwells. The vertical velocity of smoke and toxic gases can reach several tens of meters per minute.

Based on the problems discussed above, we can say that the process of evacuating people from high-rise buildings has its own difficulties, and if poorly organized, it can lead to large numbers of victims.

The following methods can be used to improve the evacuation of people from high-rise buildings:

It is necessary to create individual rescue complexes near places of suspected evacuation of people.

It is also possible to optimize the system of flows of people evacuating, apply phased evacuation, when people do not leave the building all at once, creating significant human flows, but on a floor-by-floor basis, to prevent pandemonium on the evacuation routes.

In addition, it is possible to carry out a combined evacuation with the simultaneous use of stairwells and elevators. For example, you can divide each floor into two fire protection zones and arrange elevators in two blocks on different sides of the fire barrier [3].

Although elevators are not a means of evacuating people in case of fire, the high degree of fire protection of elevator installations makes it advisable to use elevators to evacuate people from floors where rapid exposure to fire hazards is most likely. Based on the analysis of human flows during the evacuation process, it was concluded that with a complete phased evacuation of people using elevators, compared with a complete simultaneous evacuation, it is possible to increase the speed of movement of people by 7 times (from 7 to 50 m/min).

Evacuation of people from a high-rise building using helicopters. Rescue of people from the roofs of high–rise buildings takes place from specially adapted landing sites. Firefighting helicopters are equipped with rescue cabins, lifting and lowering mechanisms, communications equipment, powerful lighting sources and other special equipment.

Taking into consideration all facts mentioned above, it is possible to conclude that conclude that the process of evacuating people from a high–rise building is quite complex and problematic. There are many difficulties with limited evacuation routes, lack of coordination of people when moving around a high-rise building during the evacuation itself, but there are various ways to optimize the process of evacuating people from the building and make it more efficient and safer for visitors of a high-rise building.

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РАЗЛИЧНЫЙ ПОДХОД К ВЫБОРУ МАТЕРИАЛОВ ДЛЯ ИСТОРИЧЕСКИХ ЗДАНИЙ В КИТАЕ И РОССИИ

DIFFERENT WAY OF CHOICE OF MATERIALS FOR HISTORIC BUILDINGS IN CHINA AND RUSSIA

Ранняя русская и китайская архитектура сильно различались под влиянием истории, культуры и географии, и эти различия проявлялись в архитектурных стилях, цветах, материалах, планировках и так далее. В данной статье описываются различия в выборе строительных материалов между Россией и Китаем, на которые влияют природная среда, климатические условия, культурные традиции и условия технологического развития. В ранней китайской архитектуре чаще всего использовалось дерево, что объясняется мягким климатом, обилием лесных ресурсов и хорошими сейсмическими характеристиками, а также отражает китайскую философию. В ранней России больше использовались каменные здания, приспособленные к холодному климату и оборонительным нуждам, а каменные постройки лучше отражали торжественность культовых сооружений и долговечность архитектуры. Эти различия отражают не только особенности двух стран, но и их соответствующие исторические, культурные и социальные предпосылки.

Ключевые слова: строительные материалы, деревянные здания, каменные здания, религиозная культура, лесные ресурсы.

Early Russian and Chinese architecture differed greatly under the influence of history, culture, and geography, and these differences manifested themselves in architectural styles, colors, materials, layouts, and so on. This article describes the differences in the choice of building materials between Russia and China, which are influenced by the natural environment, climatic conditions, cultural traditions and conditions of technological development. In early Chinese architecture, wood was most often used, which is explained by the mild climate, abundance of forest resources and good seismic characteristics, and also reflects Chinese philosophy. In early Russia, stone buildings adapted to the cold climate and defensive needs were used more, and stone buildings better reflected the solemnity of religious buildings and

the durability of architecture. These differences reflect not only the characteristics of the two countries, but also their respective historical, cultural, and social backgrounds.

Keywords: building materials, wooden buildings, stone buildings, religious culture, forest resources.

В любой исторический период люди строили для себя убежища, чтобы защититься от жары и холода, дождя и снега. Сначала это были пещеры, укрытия, а затем и здания [1]. История архитектуры во многом зависела от исследования материалов и степени развития общества, и первыми строительными материалами, использованными человечеством, были камень и дерево [2]. На ранних этапах относительно незрелого развития строительных технологий дерево и камень было проще добывать и обрабатывать, и разные страны выбирали разные строительные материалы в зависимости от природных условий, уровня развития технологий и культурных традиций.

Климатические условия

В прошлом климатические условия были самым важным фактором, влияющим на строительные работы. Климат определяет степень влажности, распределение водных и лесных ресурсов региона, поэтому такие виды деятельности, как градостроительство и архитектура в разные времена и в разных странах отражают специфику климатических условий региона, и чем ниже уровень технологического развития общества, тем большее влияние оказывают климатические условия на архитектуру [3]. Климат оказывает самое сильное влияние на температуру, и в России и Северной Европе, где камень и кирпич лучше защищают от холода из-за суровых климатических условий, каменная кладка широко использовалась в церквях и замках, например в храме Василия Блаженного в Москве (рис. 1). В Китае более теплые климатические условия привели к более широкому использованию дерева в качестве строительного материала, но из-за большого широтного разброса Китая холодный и сухой климат на севере страны делает более распространенными конструкции из трамбованной земли и каменной кладки, такие как Пещера китайской печи и Великая стена (рис. 2), в то время как более теплый и влажный климат юга заставляет чаще использовать дерево и бамбук из-за их лучшей воздухопроницаемости [4].

Рис. 1. Храм Василия Блаженного

Кроме того, в период относительно отсталого технологического развития защита от стихийных катастроф в большей степени зависела от характеристик самого материала, например, многие регионы Китая и Японии являются сейсмоопасными, а сейсмические характеристики деревянных конструкций даже лучше [5]. Например, деревянная пагода Инсянь в Китае (рис. 3), построенная в 1056 году, пострадала от землетрясения магнитудой 6,5, которое продолжалось семь дней, и все дома, кроме пагоды, рухнули, а храм Дулуо при династии Тан пережил 28 землетрясений за тысячелетие, и деревянная конструкция осталась целой [6]. Таким образом можно сделать вывод, что архитектура разных регионов отвечает на применение и использование человеком окружающей среды.

Рис. 2. Пещера китайской печи

Рис. 3. Деревянная пагода Инсянь

Природные ресурсы и уровень технологий

Ограниченные уровнем технологий, на раннем этапе развития строительства больше используются натуральные материалы, такие, как каменная кладка и дерево. Использованию скальных пород для строительства обычно сопутствует песок и глина и другие материалы для ремонта, а деревянные материалы отличаются легким весом и высокой прочностью, и при масштабном строительстве чаще используются деревянные конструкции.

Помимо указанных материалов солома являлась распространенным строительным материалом (рис. 4), а технология строительства домов из соломы основана на том, что солома обеспечивает хорошую теплоизоляцию в холодных регионах [7].

Рис. 4. Здание с соломенной крышей

Спустя столетия непрерывного использования каменной кладки и деревянного строительства, с повышением уровня технологий, в XIX веке появились бетонные и стальные конструкции. Россия и Китай богаты лесами, и в древнем Китае чаще использовались

деревянные конструкции, тогда как в России лесной покров самый высокий в мире, но леса распределены неравномерно, и во многих регионах их меньше, а из-за суровых природных условий и отсталости транспортных технологий чаще использовались каменные постройки. Несмотря на преимущества дерева как строительного материала, оно менее прочно, чем камень, поэтому в XVIII–XIX веках в России стали строить больше каменных зданий в подражание европейским странам, а деревянные дома считались отсталыми, скоропортящимися и несовременными. Только после Октябрьской революции науки о древесине и лесе получили бурное развитие, и различные российские научно-исследовательские институты предложили теории сушки и методы консервации и защиты древесины [8].

Исторические и культурные влияния

Китайская философская теория о гармонии между человеком и природой считает дерево основным строительным материалом (особенно при возведении дворцов, храмов, садов), потому что дерево более жизненно, как строительный материал в основном сохраняет оригинальную текстуру и зерно дерева. В китайской культуре Фэн-шуй существует учение об инь-ян и пяти элементах – основная теория древнекитайской философии, которая делит все вещи в мире на две противоположные силы инь и ян, а также пять основных элементов – золото, дерево, воду, огонь и землю. Пять элементов объясняют естественные изменения и баланс человеческого тела через динамические отношения между взаимно благоприятными и неблагоприятными. Дерево символизирует рост и жизненную силу, и китайские деревянные здания часто строятся с земляным основанием, что отражает идею о взаимовыгодном взаимодействии пяти элементов, поэтому широкое использование деревянных конструкций в Китае соответствует стремлению китайского народа к архитектурной жизненной силе, а также концепции баланса инь и ян [9].

В результате исторического развития и культурных влияний в России сложилась система строительства, в которой основное место занимают каменные конструкции при сохранении традиционных деревянных. В русской архитектуре, на которую оказало глубокое влияние православие, камень при строительстве дворцов и церквей использовался чаще, чем дерево, чтобы отразить православную тор-

жественность и идею бессмертия, кроме того, большое количество сводчатых и арочных конструкций в русской архитектуре требовало мощных каменных опор. Принятие православия Киевской Русью в X веке привело к внедрению византийской техники кладки [10]. В XVII–XVIII веках под влиянием западных стилей барокко и классицизма в России начали широко использовать мрамор и гранит для скульптурных украшений и конструкция симметричных колонн (например, Эрмитаж и Казанский соборы) (рис. 5, 6). Хотя каменная кладка стала основой религиозной и официальной архитектуры, деревянные конструкции по-прежнему широко использовались в неофициальной благодаря обилию лесных ресурсов.

Рис. 5. Эрмитаж

В процессе развития мировой архитектуры, благодаря взаимовлиянию различных национальностей и культур, развитие строительных материалов в целом схоже, но разные страны сформировали свою собственную уникальную архитектурную систему. На древние

китайские деревянные здания оказали влияние философская мысль и ритуальная культура; старинные русские каменные постройки сочетают в себе религиозную торжественность и оборонные функции. Различия между Китаем и Россией в использовании строительных материалах являются прекрасным отражением исторических традиций, религиозной культуры, природных ресурсов и климатических условий двух стран.

Рис. 6. Казанский собор

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ИННОВАЦИОННЫЕ ВИДЫ БЕТОНОВ И ИХ ОСОБЕННОСТИ ПРИМЕНЕНИЯ В АРКТИЧЕСКИХ УСЛОВИЯХ

INNOVATIVE TYPES OF CONCRETE AND THEIR APPLICATION FEATURES IN ARCTIC CONDITIONS

Арктика – это уникальный и сложный регион, который за счет своих суровых климатических условий предъявляет особые условия к строительным материалам и технологиям. В статье рассматриваются инновационные технологии и материалы в области бетонов, которые могут быть наиболее эффективными для современного строительства в Арктике. Также в статье были приведены примеры современных инновационных бетонов, рассмотрены особенности укладки бетона в экстремальных климатических условиях. Большое внимание уделено рассмотрению технологии ухода за бетоном, а также рассмотрены перспективы развития технологий бетонов для арктических условий.

Ключевые слова: бетон, инновационные технологии, свойства бетонов, прочность бетона, морозостойкость.

The Arctic is a unique and complex region that, due to its harsh climatic conditions, imposes special conditions on building materials and technologies. The article discusses innovative technologies and materials in the field of concrete, which may be the most effective for modern construction in the Arctic. The article also provided examples of modern innovative concretes, and considered the specifics of laying concrete in extreme climatic conditions. Much attention is paid to the consideration of concrete care technology, as well as the prospects for the development of concrete technologies for Arctic conditions.

Keywords: concrete, innovative technologies, concrete properties, concrete hardness, frost resistance.

Nowadays, concrete is the most wildly spread building materials due to the combination of qualities it has. It is used everywhere and it is used

to solve a wide variety of tasks. In this paper, it will be mentioned about innovative types of concrete and the specifics of their use in the Arctic.

Concrete has the following characteristics:

- The main indicator is the strength class or grade.
- Secondary parameters such as frost resistance, water resistance, heat resistance and crack resistance are taken into considerations as well.

Concrete is considered an artificial stone and like any building material, it is obtained by molding and hardening a rationally selected and compacted concrete mixture. The classic composition of concrete includes cement, sand, gravel or crushed stone, and water. Depending on the production needs, the composition of the concrete mix may vary. Its traditional composition includes cement, sand, gravel or crushed stone, and water, though variations are introduced to meet specific functional requirements. The primary parameter defining concrete performance is its strength class or grade, while secondary characteristics include frost resistance, water impermeability, thermal stability, and crack resistance. Recent advancements have led to the development of specialized types of concretes with unique properties tailored for specific applications [1].

1) Flexible concrete. It was developed at the Research center of Nanyang Technological University (Singapore). Polymer fiber and microfiber filler are added to the concrete mortar. Polymer filaments distribute the load on the monolith and prevent it from cracking during bending. Flexible concrete represents a significant innovation, incorporating polymer fibers and micro–fillers to enhance flexibility and prevent cracking under bending stresses.

2) Glowing concrete was created by specialists from the University of Michoacán (Mexico). Fluorescent additives are added to the cement structure, which is the basis of the concrete mortar. It turns out a homogeneous mass with increased strength and the ability to glow in the dark. This breakthrough created by adding fluorescent additives to the cement structure enables it to emit light in low–visibility conditions and this property makes it unique material.

3) Coconut shell concrete. This type of concrete was developed at the Don State Technical University (Rostov–on–Don). Coconut shell makes concrete stronger and 15% cheaper. It has reinforcing properties. Thus, coconut shell concrete introduces an eco–friendly approach by utilizing

coconut shells as a reinforcing agent, improving strength while reducing costs. Unfortunately, it is not widely used nowadays as recent researches show that engineers can't use it in high–rise construction.

4) Coffee grounds concrete. Scientists at the Royal Institute of Technology (Melbourne) collected coffee grounds, roasted them at 350 degrees Celsius and added them to a concrete mortar, replacing 20 % of the sand. It turned out that the "coffee" concrete is 29 % stronger than usual.

5) Self–healing concrete. It is an innovative building material that has the ability to regenerate. The production technology includes the addition of microcapsules with lactic acid calcium and special bacteria to the concrete mixture. Under normal conditions of use, the capsules retain their integrity, and the bacteria are in a state of suspended animation. When a crack or cavity occurs, the capsules stretch and burst, and the bacteria, coming into contact with water particles from the air, gain vitality and begin to multiply. The bacteria absorb the calcium released from the capsules and form limestone, which keeps the cracks from spreading and fills the cavities.

6) Polymer concrete (plastic concrete). This type of concrete has very impressive technical characteristics. Instead of Portland cement, manufacturers use polymer synthetic resins. Modern polymer concrete has become the number one choice for many professional builders and individuals due to the following advantages: high strength, impact resistance and plasticity – these indicators are much higher in polymer concrete than in conventional concrete; low sensitivity to water and low temperature; resistance to chemical agents; fast solidification. The surface of the solidified polymer concrete is perfectly smooth, provided that the pouring technology is followed. Products or formed bases made of the most modern concrete have different shades and textures, depending on the type of filler and special additives.

Also, the potential for integrating waste materials into construction practices is demonstrated by many scientists. This article explores innovative concrete types and their applicability in extreme Arctic conditions [1]. Low temperatures negatively affect the properties of concrete, in particular the setting process and the formation of cracks. There is a danger that the concrete mixture can freeze before the hydration process is complet-

ed. When working with concrete in cold regions, special measures must be taken to minimize the negative effects of low temperatures, for example:

1) Engineers should select the composition of the concrete mix carefully. In cold conditions, they give preference to mixtures with a higher strength class in order to compensate for the slowdown in the solidification process. Therefore, they recommend to use mixtures with a lower water-cement ratio so as to reduce water freezing.

2) Antifreeze additives can be used to prevent water from freezing in concrete and accelerate the hydration of cement. Some additives must be matched to the type of cement used and to the specific working conditions.

3) Preheating. In some cases, it may be necessary to heat the base using heat guns, electric heating elements, or hot air.

4) Preparation of the formwork. Insulation materials for formwork, such as wood or plastic with good thermal insulation properties are used for winter concreting. All seams and joints of the formwork must be carefully sealed.

5) Protection of freshly laid concrete. For this purpose, temporary wind shields or thermal insulation coatings are used.

All above-mentioned innovative materials contribute to sustainability by utilizing industrial by-products and reducing environmental impact. Their integration into Arctic construction could address logistical challenges while ensuring durability in one of the planet's most demanding environments. The application of concrete in Arctic conditions is significantly influenced by extreme low temperatures, which adversely affect its properties, particularly the hydration process and structural integrity [3]. Prolonged exposure to subzero temperatures can lead to the premature freezing of the concrete mixture before the hydration process is complete, resulting in compromised strength and crack formation. In cold climates, mixtures with higher strength classes are needed to counteract the deceleration of solidification.

Innovative technologies and additives further optimize concrete performance under Arctic conditions. The composition of frost-resistant concrete may include special additives. First, these are surfactants that ensure the formation of a dense structure. Second, specialist recommend using additives that create spherical pores in the material. The water penetrates the concrete structure and then it is pushed into these voids during

freezing for the structure of the material not to be damaged. Third, adding superplasticizers can help to increase density of the material, its water resistance and therefore its frost resistance [2].

As it is said plasticizers increase mix mobility and reduce porosity, improving mechanical strength and moisture resistance while strength accelerators or retarders adjust curing times to suit environmental needs. Hydrophobic additives impart water-repellent properties to enhance resistance against cracking.

Frost resistance is also improved with air-entraining agents that form micro-voids within the concrete matrix to relieve internal pressure during freezing cycles. Advanced plasticizing agents combine mobility enhancement with frost resistance, while chemically induced micro-gassing creates air bubbles for similar effects. In extreme cold environments, additional measures are necessary for effective curing. Temporary enclosures or "greenhouses" are constructed over poured concrete to maintain controlled temperatures using heat sources like burners or heat guns. Artificial heating methods ranging from infrared radiation to induction heating are applied with precise temperature control to avoid overheating that may degrade quality.

Innovative concretes can be resistant to extreme climatic conditions thanks to the use of special additives and modern technologies.

Additives to improve the strength of concrete include, for example:

- Plasticizers. These are special bulk or liquid formulations that are used to increase the mobility of concrete mortar. Plasticizer for concrete can significantly reduce the porosity of the finished product, which has a positive effect on mechanical strength, moisture resistance and corrosion resistance.
- Accelerators and decelerators of strength gain. It is a type of chemicals designed to accelerate or slow down the hardening of a concrete mix, improve its strength, resistance to bending and compression.
- Fibroblast. It is a building fiber made of micro-particles of thermoplastic polypropylene. An additive of this type increases the resistance to abrasion, impact and splitting.
- Hydrophobic additives. These are mixtures based on acrylic or organosilicon substances. Due to the treatment with this compound, the concrete

surface acquires water-repellent properties, mechanical strength and resistance to cracking.

Additives to increase the frost resistance of concrete include, for example:

- Air-entrapping additives. They form small voids in the thickness of the concrete, into which excess moisture is squeezed out during freezing. This reduces the internal pressure on the material.
- Plasticizing and air-entrapping additives. They not only improve the frost resistance of the material, but also increase the mobility and cohesion of the concrete mix.
- Micro gassing additives. They are similar in effect to air–entrapping ones, but air bubbles in concrete are formed not mechanically, but chemically.
- Some technologies for concrete care in cold conditions:
- Installation of greenhouses. Tents are built over the poured concrete, inside which heat guns or burners are installed to maintain the desired temperature.
- Artificial heating of concrete is used in various ways by using wires or electrodes, infrared radiation or induction method.

When artificial heating is implied, it is necessary to carefully control the temperature in order to avoid excessive heating of concrete, which can negatively affect its quality.

For resistance to aggressive environments, the following innovative concerts are used:

1) Concrete based on sulfate-resistant cement. Sulfate-resistant cement is a special type of cement that is highly resistant to the effects of sulfates. It contains special additives and additives that make it more resistant to chemical attack. Due to this, sulfate-resistant cement does not break down under the influence of sulfates, which makes it an ideal choice for construction in conditions where other cements may be ineffective.

This concrete has such qualities as durability and stability of structures, and corrosion protection of fittings to meet regulatory requirements. It can be used in a variety of applications in hydraulic structures, drainage systems, underground structures and some others. It provides economic efficiency and high resistance to mechanical stress along with keeping

aesthetic appearance of the buildings. Due to good resistance to climatic changes the material is able to withstand extreme temperatures, exposure to seawater and other climatic factors without losing its strength and properties [4].

2) Fiber–reinforced concrete known as “fibrocrete”. Fibrocrete is a building material that is produced by adding fiber to a concrete mix. Fibro fibers are evenly distributed over the composite and play the role of a reinforcing material. Fiber is also used to prevent concrete from cracking during laying and drying. The micro armature reduces the permeability of the concrete composite, which reduces water seepage. Some types of fiber fibers improve the level of impact resistance, abrasion resistance and fracture of concrete. It is important to keep in mind one point: fiber does not improve the bending strength of concrete, so it cannot replace reinforcement.

3) Concrete Canvas. The concrete sheets are extremely flexible so it is possible to put them on both horizontal and vertical surfaces of any relief. In most cases, it is not possible to prepare the surface for concrete canvas installation and largescale excavation and soil leveling works are required but it can be done without using special machinery and heavy equipment. It is important to say that such installations take place in record time. Moisture proof PVC (polyvinyl chloride) lining prevents moisture from seeping through the coating. Because off their high resistance to temperature fluctuations the concrete sheets can withstand more than 200 freezing/thawing cycles. It should be noted about their high resistance to aggressive media. They are resistant to different acids, alkali and other chemical compounds. The concrete sheet coating does not break down when exposed to sunlight as they have extremely high UV–resistance. Finally, exploitation period of concrete sheets is more than 50 years.

4) Sulfur concrete. It is a building material with a composite structure. In addition to the standard inert fillers, it contains technical sulfur, which forms the structural framework and binds the filler. Due to this, the composite has a number of properties that significantly distinguish it from other types of concrete.

Advantages of sulfur concrete:

- Low cost of the initial components. In sulfur concrete, technical sulfur acts as a binder, which costs no more than high-grade cement.

- The possibility of recycling materials.
- Resistance to aggressive environments. The chemical composition of Portland cement is influenced by such active substances as acids or salts that can destroy the compounds formed by it. Sulfur concretes are resistant to aggressive chemicals and retain their strength for a long time [5].
- The ability to harden mixtures at sufficiently low temperatures. This makes it possible to use sulfur concretes for construction in the cold season, when it is impossible to use Portland cement-based concretes without additional heating.
- Fast turnover of forms. In the manufacture of standardized reinforced concrete products, a big advantage is the rapid hardening of the mortar.
- Low electrical and thermal conductivity. Sulfur concretes are excellent for the construction of important electrical facilities, warm warehouses or technical rooms.
- Water resistant. Despite the fact that the material is porous, it has low water absorption, because the pores in it have a microscopic size that can only be seen under a microscope.
- Increased frost resistance. This property is a direct consequence of low water absorption. The absence of moisture inside the solidified array ensures that cracks will occur in the material when exposed to low temperatures due to the expansion of water during freezing.
- High wear resistance. The density of solidified sulfur concrete significantly exceeds the characteristics of heavy concrete.

In conclusion, one should note the importance of developing innovative concretes and improving their properties. Modern concretes with improved strength, frost resistance and chemical resistance characteristics play a key role in the development of infrastructure in the Arctic region.

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ГЕОЛОГИЧЕСКИЕ ИЗЫСКАНИЯ КАК КЛЮЧЕВОЙ ФАКТОР В ПРЕДОТВРАЩЕНИИ РИСКОВ И ОБЕСПЕЧЕНИИ БЕЗОПАСНОСТИ СТРОИТЕЛЬСТВА

GEOLOGICAL SURVEYS AS A KEY FACTOR IN RISK PREVENTION AND CONSTRUCTION SAFETY ASSURANCE

В статье рассматривается роль геологических изысканий в строительстве и их значение в предотвращении рисков. Автор раскрывает сущность геологических изысканий, выделяя основные этапы: изучение рельефа, анализ состава и свойств грунта, выбор методов производства земляных работ нулевого цикла и интерпретацию результатов исследований. Подчеркивается влияние геологических данных на выбор типа и глубины заложения фундаментов, а также проектные решения, направленные на обеспечение надежности и безопасности объектов. В статье также приведены конкретные риски, связанные с пренебрежением геологическими исследованиями, такие как неравномерная осадка, морозное пучение, затопление фундаментов и влияние новых объектов на существующие здания. Автор делает вывод о необходимости проведения комплексных геологических изысканий как важного условия безопасного строительства и обеспечения долговечности сооружений.

Ключевые слова: геологические изыскания, осадка, проба, морозное пучение, глубина промерзания, безопасность, риск.

The article discusses the role of geological surveys in construction and their importance in risk prevention. The author describes the essence of geological surveys, highlighting key stages such as relief examination, soil composition and property analysis, selection of excavation methods, and correct interpretation of survey results. The article emphasizes geological data influence on decisions regarding the type and depth of foundations, as well as project solutions aimed at ensuring reliability and structural safety. Specific risks associated with neglecting geological surveys,

such as differential settlement, frost heave, basement flooding, and impacts on nearby structures, are also addressed. The author concludes that comprehensive geological surveys are essential for safe construction and structural durability.

Keywords: geological surveys, settlement, sample, frost heave, frost depth, safety, risk.

Introduction

Construction is a complex process which includes several stages; not all of them directly refer to building the structure. A construction site is known to be the place that gathers experts from various scopes such as builders, engineers, conductors, drivers, architects, different network specialists, etc. These people mainly start working after or independently from survey activities. The reason is simple: the construction site must be properly investigated by a number of specialists who perform survey works that include geodetic, geological, environmental, hydrologic and many other surveys if it is needed.

In this article we explore geological surveys and their significant role in preventing risks in construction. The problem that we are setting is that a customer does not always realize a need for such type of survey. Our objective is to convey its importance to customers and ordinary readers.

Essence of geological surveys

Geological survey is an examination of an area that helps to determine the composition of rocks and mineral resources and one of the surveys carried out before designing a building that establishes the following goals:

– *Relief feature examination* (a systematic study of surface terrain characteristics both natural and man-made)

Experts estimate the global situation of the nearby area. After drilling the boreholes, they are able to analyze an altitude difference between observed points. Knowledge about hills and flat land placement might be useful for future building designing and its disposition at construction site.

– *Soil composition analysis* (an assessment of soil properties to determine its suitability for different applications)

This main and crucial stage of geological survey includes soil sampling, preliminary estimation and further cameral works for physical mechanical properties analysis. After this it is possible to make a geological

section and calculate all the necessary data for further designing, primarily for choosing the type of foundation and its depth [1; 2].

– *Choosing and suggesting methods of zero cycle construction works* (initial phase of construction)

Even after determining the building placement, it is necessary to provide excavation safety and effectiveness there. That means such works must be calculated too. For example, water-table depression must ensure that the workplace is supposed to be dry. Construction machines and equipment weight must not be critical for the soil below for preventing loss of stability of the slope or other emergencies.

Correct survey results interpretation.
Influence of Geological Data on Design

Calculated soil properties and layers' thickness let us see the comprehensive picture. Depending on what layers form the relief the depth and type of foundation will be defined. For example, if there is a strong layer next to the surface, it is likely to be some of the shallow foundations. In other case, where the strong layer has a high depth, a shallow foundation would not be economy-effective. It is only one of the reasons. Consequently, a pile foundation would be better. It can be useful if a high load-bearing capacity is needed [3].

Besides the type of foundation, it is important to set its depth depending on a soil freezed in winter (under the frost depth) and groundwater level that are recommended to be under the foundation [1, 3]. Otherwise, it is required to be drainage system and additional hydro isolation. Underground parts of the building must be covered with a special protective layer if any aggressive ground substances are found in the soil. Heterogeneous soils can cause differential settlement, which requires the use of compensating structural elements in the building that totally changes the design.

Risks of neglecting geological research

We have already considered the essence of geological surveys and how their results affect a building project, especially the foundation. Obviously, an absence of the survey or the work made not properly could lead to risks in construction because every single case is unique and such subjects must be canvassed [6].

Differential settlement is one of the most popular reasons for building collapse or just its deformation. The fact is that a building always will have the settlement after applying the load. It lasts for decades and it is absolutely a normal phenomenon. Troubles occur when different parts of the structure do not have the same settlement. In this case experts start observing the object and give some advice if the situation is too critical. At worst the building becomes an emergency and has a chance to collapse.

Frost heave is the upward movement of soil caused by the freezing of water in the ground [1]. When water turns to ice, it expands (~9 % by volume), and this pushes the soil and anything built on it upward. This is quite a dangerous factor that can cause cracks in foundations and even cyclic deformation (winter-spring period).

Flooding of the foundation or basement. If the underground waters have not been found, that is going to be a big problem. Moisture impact can cause cracks in the foundation, walls and destruction of the building by regular erosion.

New appearance of the building next to others, situated here before, may harm them. Fresh loads have a property to influence nearby structures that can also cause the collapse. It often happens when engineers have not done proper calculations for this aspect or just make a new structure in the historical center. For example, in Saint-Petersburg there are many similar cases.

Other engineering surveys

– Geodetic survey is a complex research of the construction site and its surrounding [1; 4]. Results show geometrical dimensions of the lot and the accurate positions of nearby objects (that might be buildings, utilities and etc.). Geodetic surveys provide information about current relief and future earthwork operations at the site.

– Environmental surveys estimate possible negative impact to the environment as a result of construction [4]. During research experts take air, soil and water samples, observe nature and give some recommendations about reducing the construction process's influence on the environment.

– Hydrologic surveys observe various water objects including underground water [4]. The results of such work are water source type and location, flow rate and prediction of the impact to the plot.

Conclusion

We thus made the following conclusion that geological surveys are essential for safe construction. They assess site conditions, prevent risks, affect constructive project decisions and ensure structural integrity. Understanding their importance is vital for the project success.

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ОСОБЕННОСТИ ТЕПЛООБМЕННЫХ ПРОЦЕССОВ В ЖАРОТРУБНЫХ КОТЛАХ МАЛОЙ МОЩНОСТИ

FEATURES OF HEAT EXCHANGE PROCESSES IN LOW-POWER FIRE-TUBE BOILERS

Статья рассматривает определение и конструктивные архетипы жаротрубных котлов. Рассматриваются основные принципы работы жаротрубных котлов. Большое внимание уделяется особенностям теплообменных процессов, протекающих в жаротрубных котлах. В статье также дается подробное описание основных наблюдаемых явлений. Приводятся иллюстрации для демонстрации процессов и явлений. Подробно описывается физика процессов теплообмена и приводится их интерпретацию в виде формул и зависимостей. Совершенствование существующих конструкций котлов наряду с разработкой более мощных агрегатов играет важную роль в повышении качества теплоснабжения, увеличении мощности, расширении доступности и повышении общей энергоэффективности.

Ключевые слова: жаротрубный котел, теплообменные процессы, коэфициент теплопередачи, коэфициент тепловосприятия, радиационный теплообмен, конвективный теплообмен.

The article examines the definition and constructive archetypes of fire tube boilers. The basic principles of operation of fire tube boilers are considered. Much attention is paid to the peculiarities of heat exchange processes occurring in heat-tube boilers. The article also provides a detailed description of the main observed phenomena. Illustrations are provided to demonstrate the processes and phenomena mentioned. The physics of heat exchange processes is described in detail and their interpretation in the form of formulas and dependencies is given. The enhancement of current boiler designs alongside the development of more powerful units plays a crucial role in advancing heat supply quality, boosting capacity, expanding accessibility, and improving overall energy efficiency.

Keywords: fire-tube boiler, heat exchange processes, coefficient of heat transfer, coefficient of thermal perception, radiative heat exchange, convective heat exchange.

Fire tube boilers, which appeared as early as the end of the 19th century, have gone a long way to modernize and improve, and today they serve as one of the most popular and sought-after sources of heat for heat supply systems. These units provide a high level of thermal comfort, as well as being more economical and creating greater opportunities for energy saving. As of now, there are many variations and types of such boilers, all of them are united by a constructive concept, as well as the physics of heat exchange processes observed in fluids [1].

Conceptually, a fire tube boiler is a device that generates thermal energy in the process of heating a coolant with energy released during fuel combustion. The boiler structure includes fire pipes through which combustion products move, heating the coolant lining the pipes around the perimeter.

Like most other boilers, fire tube boilers are fundamentally divided into two categories according to the type of coolant:

– steam boilers in which steam acts as a heat carrier in heating or heat supply systems;

– hot water boilers in which water acts as a heated component.

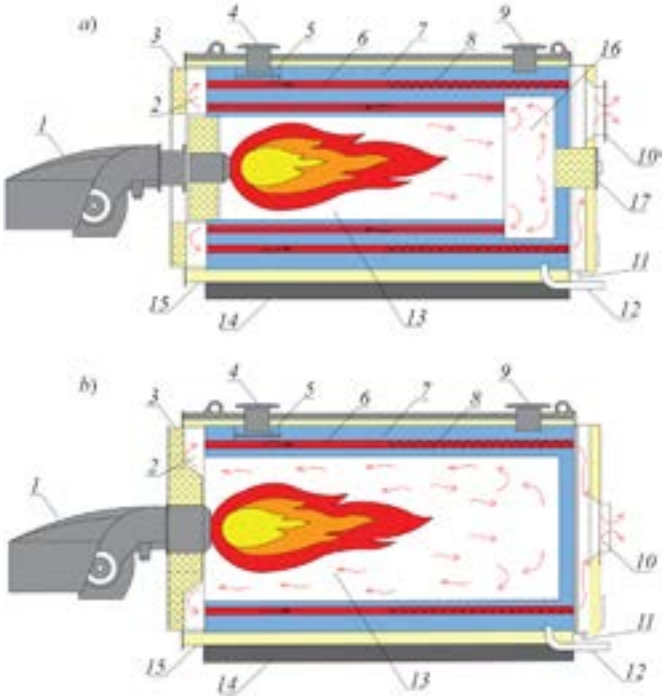
Also, an equally important category in the field of boilers is the division by type of fuel used. Today, gas-fueled units are in the lead, as they appear to be the most easily transported, affordable and environmentally friendly in comparison. Liquid and solid fuel boilers are alternatives [2].

Currently, in the market of low-power boilers used to provide heat supply for residential buildings and individual boiler houses, there is a total dominance of natural gas hot water boilers. This is directly related to such factors as: ease of operation, lower noise level, reduced explosion hazard, lower requirements for the heat carrier, less frequent maintenance, more simple design and high thermal performance [3].

Ultimately, boilers are divided by design into two-way and multi-way models; the structural differences are shown in figure.

The principle of operation of boilers is based on the fact that convective pipes of small diameter, as already described above, are located in the boiler body and assume the movement of hot fuel combustion products inside themselves. The heat from these pipes is directly transferred to the heat carrier (water), which flows around the pipes along the outer wall.

Two-way boilers have one main rotary chamber and one group of flue pipes, while multi-way boilers have a main chamber, which is invariably present in the design, and at least two groups of secondary bundles of pipes, which naturally increases the duration and contact area by increasing the convective heating surface. Three-way variations are the most common of the multi-way options, since in most cases they perfectly meet the power requirements.



Fire-tube boiler's construction scheme: *a*) Three-way model; *b*) Two-way model; *1* – burner; *2* – rotary camera; *3* – fire-resistant insulation; *4* – heat carrier (water) inlet fitting; *5* – water distribution device; *6* – flue pipes (convective pipes); *7* – boiler body; *8* – turbulators; *9* – heat carrier (water) outlet fitting; *10* – exhaust gas outlet pipe; *11* – condensate drain; *12* – drain pipe; *13* – fire tube; *14* – base frame; *15* – thermal insulation; *16* – main rotary camera; *17* – hatch for access to the furnace

This difference between the types of main chambers is clearly shown in the figure, where example *a*) is a pass-through furnace, and example *b*) is a reverse furnace.

The fuel, for the model shown in the figure, exclusively natural gas is used, is supplied to the burner, where, when mixed with air and under pressure from the fan, the fuel is burned. Combustion depends on a variety of factors, such as fuel composition, specified and maintained combustion conditions [4].

In modern boiler models, water has found the most widespread use as a heat carrier, which is directly related to its easy accessibility in nature and convenience in delivery and disposal, all with optimal thermodynamic properties.

It is clear that water under normal conditions at atmospheric pressure is heated only to 100 °C. Further heating causes the water to boil and turn into steam. The solution is to significantly increase the pressure in the system. The pressure in the boiler is an important aspect of its operation, it is measured, monitored and controlled. The permissible and optimal pressure in heating equipment is 1,5–2,5 Bar.

The basic increase in water pressure is carried out at the stage of water treatment. The stringent requirements for water quality and its characteristics are explained by the large specific heat fluxes in the fire tube and rotary chambers. Due to such high heat fluxes, as well as due to the free movement of water in the boiler, wall-to-wall boiling is observed on the surface of the fire pipes and rotary chambers. This is a process in which the formed vapor bubbles condense in the area of direct contact of the liquid with the hot wall and do not reach the surface [5].

Among other things, water treatment changes its composition and significantly removes impurities, which ultimately reduces the risk of deposits on the surface of pipes, such deposits would increase the thermal resistance of the walls. Chronologically, the first source of heat transfer during boiler operation is radiation, which can be observed from the flame and combustion products to the pipe walls. The next type of heat transfer we can observe is convective heat transfer, which takes place in convective pipes, as the name implies.

Briefly about the physics of each type of heat transfer described above. Thermal radiation (radiative heat transfer) is a method of heat transfer

in space through electromagnetic waves, the energy of which is transformed into heat upon contact with matter. Radiative heat exchange involves a double energy transformation and is carried out in three phases:

1) internal energy is converted into electromagnetic radiation energy;

2) the energy of radiation is transported along a straight trajectory with the speed of light by electromagnetic waves in space, following the optical laws of refraction, absorption and reflection;

3) when interacting with a substance, the radiation energy passes into the internal energy of the body through the absorption of photons [6].

Convective heat transfer is a complex type of heat exchange where the processes of heat transfer and convection occur simultaneously. It occurs exclusively in a moving liquid or gas. As a result of the movement, the volumes of liquid or gas, moving from a zone with a high temperature to a zone with a low temperature, transfer thermal energy. Convection is possible only in a fluid environment and is always paired with thermal conductivity.

The water flow in convective pipes is close to laminar, which, of course, implies the fact that the layers of liquid move at different speeds and hardly mix. Due to the design of the boiler, there are places where the water stagnates or moves very slowly. In these areas, water comes mainly due to natural convection, which impairs heat dissipation and can lead to overheating of the metal at these points [7].

In this case, free (natural) convection implies the process of fluid movement caused by a difference in its density due to temperature gradients. The process takes place in the gravity field in a continuous medium that is inhomogeneous in density: less dense areas of the volume, by virtue of Archimedes' law, move upward.

One of the factors defining free convection is the Grashof Criterion (Gr). This is a dimensionless parameter in fluid dynamics and heat transfer, representing roughly the proportion of buoyancy forces (due to density differences) to the fluid's internal friction. Enhanced diffusion within the substance, alongside elevated medium viscosity, results in diminished natural convection [8; 9].

Another variety of convective heat transfer is forced convection. This is due to the transfer of heat through particles of matter driven by external forces aimed at displacing the material, and this requires an external

source that generates some kind of force. In the boiler design, this is a circulation circuit with a pump. Forced convection proves considerably more efficient than natural convection, exhibiting less sensitivity to the extent of diffusion within the matter. Nevertheless, elevated viscosity, analogous to its impact on natural convection, degrades forced convection by diminishing flow turbulence.

The Reynolds Criterion (Re) gauges the strength of forced convection. This dimensionless value reflects the proportion of inertial forces to viscous forces, and it also signifies the shift from a smooth (laminar) flow to a chaotic (turbulent) flow.

In calculations, the parameter characterizing convective heat transfer is the heat transfer coefficient (α), which characterizes the intensity of heat transfer between the surface of the body and the washing medium and takes into account the specific conditions of this process.

It is equal to the amount of heat perceived (or given off) by a unit of surface per unit of time at a temperature difference of 1 K. between the surface and the moving medium. It is measured in $W/(m^2 \cdot K)$.

The parameters that affect the value of α include:

- the speed of movement, density and viscosity of the heat carrier.
- thermal properties (specific heat capacity, thermal conductivity, coefficient of volumetric expansion);
- geometric parameters of pipes and heat exchangers (shape, dimensions, and roughness of their inner walls).

The heat transfer coefficient is found through the Nusselt criterion (Nu). The formula in the classic version:

$$\mathrm{Nu} = (\alpha \cdot L)/\lambda \qquad [1]$$

where λ represents thermal conductivity ($W/(m \cdot K)$) and L is the representative length (m).

The Nusselt number itself can be formulated as a heat transfer correlation (for laminar flows):

$$\mathrm{Nu} = c \cdot (\mathrm{Gr} \cdot \mathrm{Re} \cdot \mathrm{Pr}) \qquad [2]$$

where Gr signifies the Grashof Criterion, Re the Reynolds Criterion, and Pr the Prandtl Criterion (displays the thermophysical values of the liquid flow). «*c*» is a constant tabular dependent coefficient.

The next most important factor after the heat transfer coefficient is the heat perception coefficient. This is a value equal to the heat flow between the surface of the structure and the environment.

In a fire–tube boiler, this coefficient is not directly calculated, but is determined when calculating the heating surfaces in the furnace and is expressed from the heat transfer equation in the furnace, which, based on the Stefan-Boltzmann law, can be represented as:

$$Q'_A = a_T \cdot c_o \cdot y_E \cdot F \cdot (t_c - t_s) \cdot 10^3, \qquad [3]$$

where Q'_A is the thermal perception of the heating surface. a_T is the integral coefficient of thermal radiation of the furnace. c_o is the emission coefficient of a completely black body. y_E is a coefficient of thermal efficiency of the heating surface. F the surface area of the walls bounding the furnace. t_c is the average temperature of the combustion products in the furnace. t_s is the average temperature of the heating surface.

The result of the calculation is the total amount of heat transferred in the furnace:

$$Q_{sum} = Q_c + Q_r, \qquad [4]$$

where Q_r is the amount of heat transferred by radiation and Q_c is the amount of heat transferred by convection.

The efficiency of fire tube boilers in modern heat supply systems is a key factor determining their competitiveness in the market. Engineers and theorists in this field from all over the world are engaged in improving boiler efficiency, and the basis for new constructional improvements and the implementation of new parts in boiler design has always been and remains the physical basis of the heat transfer processes taking place in it.

The heat transfer processes described above, such as radiative heat transfer and convective heat transfer, which is divided into natural and forced, have been systematically studied and described. However, continued investigation focused on refining convective heat transfer calculations for fire-tube boilers, considering varying heat flow directions and the incorporation of different engineering solutions designed to induce gas flow turbulence, remains highly beneficial and essential. After all, it is research in this area that increases the turbulence of both flue gases and the heated water.

As a result, it is the improvement of existing boiler models and the creation of new more powerful units that contributes to improving the quality of heat supply, increasing its capacity, accessibility and energy efficiency.

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ПРИМЕНЕНИЕ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ СТРОИТЕЛЬСТВА В УСЛОВИЯХ СТЕСНЕННОЙ ГОРОДСКОЙ ЗАСТРОЙКИ

THE USE OF INNOVATIVE CONSTRUCTION TECHNOLOGIES IN CONDITIONS OF CRAMPED URBAN DEVELOPMENT

Статья связана с исследованием особенностей применения инновационных строительных технологий в условиях стесненной городской застройки. Автор проводит анализ преимуществ использования блочного строительства, 3D печати, использования разнообразных возможностей искусственного интеллекта в области строительства. Особое внимание уделяется исследованию особенностей подземного строительства. Автор также анализирует и дает рекомендации по использованию новых технологий на различных этапах строительства в условиях плотной городской застройки. Методология исследования включает в себя анализ научной литературы по теме и изучение успешного опыта строительства в стесненной застройке.

Ключевые слова: инновационные технологии, строительство, модульное строительство, подземное строительство, городская застройка, безопасность.

The article is devoted to the study of the features of the application of innovative construction technologies in conditions of cramped urban development. The author analyzes the advantages of using block construction technology, 3D printing, and the use of different capabilities of artificial intelligence in the field of construction. Special attention is paid to the study of underground construction. The author gives recommendations on the application of new technologies in the construction process in conditions of dense development. The research methodology includes an analysis of scientific literature on the topic and a study of successful construction experience in cramped development.

Keywords: innovative technologies, construction, modular construction, underground construction, urban development, security.

Цель исследования – установить особенности применения инновационных технологий строительства в условиях стесненной городской застройки. Проблема исследования состоит в том, что инновационных технологии строительства являются основой для строительства в городской черте, что накладывает необходимость всестороннего изучения этих технологий.

Для начала стоит отметить, что современные технологии строительства играют ключевую роль в условиях городской застройки, особенно когда речь идет о стесненных территориях. Узкие улицы, высотные здания и множество коммуникаций делают процесс строительства сложным и требующим применения инновационных подходов. Одним из наиболее эффективных инструментов в данной ситуации является модульное строительство. Модульные конструкции выпускаются на специализированных заводах и затем доставляются на место строительства, где собираются в готовое здание. Этот метод обеспечивает быструю сборку, минимизирует отходы строительных материалов и позволяет экономить на времени и трудозатратах.

Кроме того, модульное строительство позволяет экономить место на стройплощадке, что особенно важно в городских условиях. Для улучшения энергоэффективности зданий в условиях стесненной застройки применяются передовые технологии утепления и освещения. Использование современных материалов с высокими теплоизоляционными свойствами позволяет снизить расходы на отопление здания и сделать его более экологически чистым. Модульное строительство подразумевает процесс создания зданий из заранее изготовленных модулей, которые собираются на строительной площадке. Такой подход имеет ряд преимуществ, особенно в условиях стесненной городской застройки:

1. Скорость возведения: Модули изготавливаются на заводе, что значительно ускоряет строительство. Это может сократить время реализации проектов на месяцы, а значит, уменьшить затраты на рабочую силу и арендные площади [2].

2. Снижение воздействия на окружающую среду: Поскольку большая часть работы выполняется вне строительного объекта, уровень

загрязнения и шумового воздействия на соседние здания и жителей минимален.

3. Гибкость в дизайне и использовании пространства: Модульные здания можно легко модифицировать и расширять, что важно в условиях ограниченного пространства. Это позволяет адаптировать здания под меняющиеся потребности городской инфраструктуры.

4. Экономия ресурсов: Модульное строительство позволяет оптимизировать использование материалов и минимизировать отходы, что особенно важно в условиях растущего внимания к вопросам устойчивого развития.

По мере углубления в мир новых технологий в строительстве пристальное внимание уделяется методам укрепления грунта. На протяжении многих лет традиционным методом в этой категории была гидромеханическая забивка свай, но недавние изобретения вдохнули в нее новую жизнь. Гидромеханическая забивка свай – это закачка суспензии под проседающую бетонную плиту для ее подъема. С развитием технологий этот процесс становится проще и удобнее. Роботы играют важную роль, поскольку они управляют процессом закачки, обеспечивая равномерный поток суспензии и повышая безопасность работников [1].

Кроме того, искусственный интеллект и машинное обучение выводят гидромониторную промывку на новый уровень. Эти технологии могут анализировать данные предыдущих работ, прогнозировать необходимое количество шлама и выявлять возможные осложнения. Это меняет правила игры для любой местной компании, занимающейся гидромониторной промывкой.

Генеративный искусственный интеллект – это новая и перспективная технология, которая начинает внедряться в городское планирование. Она предполагает использование алгоритмов искусственного интеллекта (ИИ) для создания проектов на основе набора ограничений и параметров. Эта технология может произвести революцию в городском планировании, позволяя проектировщикам быстро и легко создавать проекты, оптимизированные с точки зрения экологичности, эффективности и пригодности для жизни.

Например, алгоритм генеративного ИИ можно запрограммировать так, чтобы он создавал проекты новых жилых комплексов

с максимальным количеством зеленых насаждений, минимальным потреблением энергии и удобным доступом к общественному транспорту. Затем алгоритм может сгенерировать ряд проектов, соответствующих этим критериям, что позволит проектировщикам выбрать лучший проект для своего конкретного проекта [6].

Информационное моделирование зданий (BIM) – еще одна технология, которая начинает играть важную роль в городском планировании. При помощи этой технологии создается цифровая модель здания и/или всего проекта. Информацию о проектировании, строительстве и обслуживании сооружений инженеры и проектировщики используют в работе на протяжении всего рабочего цикла. Полученная информация хранится в базе данных.

Используя BIM, градостроители могут получить полное и актуальное представление о проекте, что помогает сократить количество ошибок, улучшить коммуникацию и ускорить процесс строительства. Это также помогает обеспечить соответствие проекта самым высоким стандартам и всем нормативным требованиям.

Существует ряд других новых технологий, которые могут сыграть важную роль в будущем городского планирования. Например, Интернет вещей (IoT) и технология блокчейн могут сыграть значительную роль в будущем городского планирования [3].

Ожидается, что Интернет вещей (IoT) сыграет важную роль в городском планировании, позволив городам стать более взаимосвязанными и эффективными.

С помощью IoT градостроители могут собирать и анализировать данные в режиме реального времени из широкого спектра источников, включая датчики дорожного движения, метеостанции и системы общественного транспорта. Эти данные можно использовать для принятия обоснованных решений о том, как улучшить городскую инфраструктуру и услуги.

Наконец, технология блокчейн способна изменить подход к строительству городов и управлению ими. Создавая децентрализованный, безопасный и прозрачный реестр транзакций, блокчейн может помочь обеспечить справедливое и прозрачное проведение проектов городского планирования и развития. Он также может помочь снизить риск мошенничества и коррупции и обеспечить всем заинтересованным

сторонам доступ к информации, необходимой для принятия обоснованных решений [5].

Вот несколько способов, с помощью которых новые технологии могут работать вместе для городского планирования:

1. С помощью датчиков Интернета вещей можно собирать данные о дорожном движении, качестве воздуха и другие показатели города, которые затем можно анализировать с помощью генеративного ИИ для оптимизации городской планировки и принятия решений по городскому планированию.

2. Дополненную реальность можно использовать для создания виртуальных моделей предлагаемых проектов, которые затем можно проанализировать с помощью программного обеспечения для информационного моделирования зданий (BIM), чтобы выявить потенциальные проблемы еще до начала строительства.

3. Технология блокчейн может быть использована для создания безопасной, децентрализованной и прозрачной платформы для управления проектами в сфере разработки, которая обеспечит всем заинтересованным сторонам доступ к необходимой информации.

4. В процессе использования дронов и аэрофотосъемки можно создавать детализированные 3D-карты городов. В дальнейшем их применяют, например, для выявления потенциальных зон для застройки.

3D-печать – еще одна инновационная технология, которая находит все большее применение в городской застройке. Она позволяет создавать конструкции, максимально адаптированные к окружающей среде и специфике участка. Печать осуществляется прямо на месте, что исключает необходимость в транспортировке материалов и существенно сокращает количество отходов. Кроме того, 3D-печать позволяет реализовать сложные архитектурные формы, которые могут быть трудно осуществимы при традиционных методах строительства. Это открывает новые горизонты для архитекторов и проектировщиков, позволяя создавать уникальные объекты даже в условиях ограниченного пространства [4].

Подземное строительство и умные технологии

В условиях стесненной городской застройки целесообразно рассмотреть возможность подземного строительства. Подземные

сооружения, такие как паркинги, торговые площади или даже жилые комплексы, позволяют эффективно использовать ограниченное надземное пространство. Современные технологии подготовки грунта и строительства подземных объектов значительно снизили риски и увеличили безопасность таких проектов. Проведение подземных работ требует применения инновационных строительных технологий, таких как контроль за деформацией грунта, использование специализированной строительной техники и технологий безопасности. Это позволяет минимизировать воздействие на окружающее пространство и уменьшить количество нарушений в городской инфраструктуре [7].

Таким образом, благодаря современным технологиям строительства в условиях плотной городской застройки возможно построить безопасные, надежные и энергоэффективные здания, учитывая особенности окружающей среды и ограниченные ресурсы. Использование BIM-моделирования, префабрикации, современных строительных материалов и инновационных технологий позволяет строителям и проектировщикам успешно решать задачи, стоящие перед ними в условиях современного городского строительства. Эти технологии не только решают текущие проблемы, связанные с недостатком пространства и экологическими вызовами, но и способствуют созданию более удобной и безопасной городской среды.

Предложения по применению инновационных технологий в строительстве в условиях плотной городской застройки:

Использовать модульное строительство. Модульное строительство. Модульное строительство – это подход, при котором здания собираются из заранее изготовленных модулей.

Использовать 3D-печати. 3D-печать в строительстве предоставляет новые возможности для создания сложных архитектурных форм и оптимизации строительных процессов.

Внедрять умные технологии и автоматизацию.

Использовать экологически чистые и перерабатываемые материалы.

Создавать и интегрировать зеленые крытые и вертикальные сады.

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ПРИМЕНЕНИЕ ЦИФРОВЫХ ТЕХНОЛОГИЙ В СТРОИТЕЛЬСТВЕ ЖЕЛЕЗНЫХ ДОРОГ

APPLYING DIGITAL TECHNOLOGIES TO RAILWAY CONSTRUCTION

В последние годы цифровизация стала одним из основных трендов в ряде отраслей, в том числе и в железнодорожном транспорте. В этой статье рассматривается использование современных цифровых технологий, в частности информационного моделирования зданий (BIM) и идеи цифровых двойников, в железнодорожной отрасли. Повышение качества проектирования и сокращение сроков реализации проектов – результат использования BIM-технологий, которые упрощают создание и управление цифровыми представлениями функциональных и физических характеристик объекта. BIM сокращает количество ошибок и повышает эффективность использования ресурсов, что, в свою очередь, снижает стоимость строительства за счет упрощения коммуникации между архитекторами, инженерами, подрядчиками и заказчиками. Чтобы свести к минимуму возможные проблемы при строительстве, в ходе дискуссии особое внимание уделяется использованию BIM при проектировании тоннелей и подчеркивается важность учета геологических и гидрологических переменных. В тексте также представлена концепция цифровых двойников, которые выступают в качестве виртуальных моделей для мониторинга железнодорожной инфраструктуры и анализа данных в режиме реального времени. Этот метод способствует предиктивному техническому обслуживанию, повышает безопасность и позволяет оперативно реагировать на новые проблемы.

Ключевые слова: цифровизация, информационное моделирование зданий, цифровые двойники, проектирование, моделирование.

Digitalization has become a major trend in a number of industries, including rail transportation, in recent years. The use of contemporary digital technology, particularly Building Information Modeling (BIM) and the idea of digital twins, in the railroad industry is examined in this article. Better design quality and shorter project

deadlines result from the use of BIM technologies, which make it easier to create and manage digital representations of an object's functional and physical attributes. BIM reduces errors and improves resource efficiency, which in turn lowers construction costs by facilitating communication between architects, engineers, contractors, and clients. In order to minimize possible construction problems, the debate further emphasizes the particular use of BIM in tunnel design and stresses the significance of taking geological and hydrological variables into account. The concept of digital twins, which act as virtual models for real-time train infrastructure monitoring and data analysis, is also introduced in the text. This method promotes predictive maintenance, improves safety, and enables prompt reactions to new issues.

Keywords: digitalization, building information modeling, digital twins, design, simulation.

Digitalization has become an important trend in various industries, and rail transport is no exception. Modern digital technologies offer railroads: the application of Building Information Modeling (BIM) and the concept of digital twins.

Building Information Modeling (BIM) is a digital representation of the physical and functional characteristics of a facility. It is a collaborative process that involves the generation and management of digital representations of the building's physical and functional characteristics. Using specialized software, a 3D model of the building is created. This model includes detailed information about geometry, spatial relationships, and physical characteristics of the building components. The model integrates various types of data, including materials, costs, schedules, and performance metrics [1].

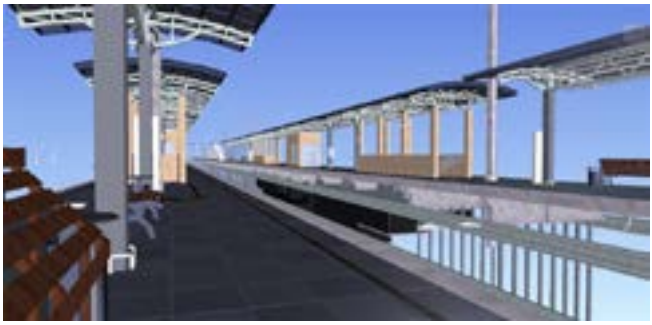

Fig. 1. Reconstruction of the railway complex Zeleny Dol

BIM technologies are the process of creating and managing digital representations of physical and functional characteristics of objects (Fig. 1). It allows to significantly improve the quality of design and reduce the time for its realization. This technology allows all project participants – architects, engineers, contractors and clients – to work with the same model, which reduces the likelihood of errors and misunderstandings. Through more accurate planning and forecasting, help reduce construction costs. This is achieved through more efficient use of resources and materials. By automating the design and construction processes, the time it takes to complete a project can be significantly reduced [2].

The use of BIM technology is also discussed, but with a focus on tunnel design. Tunnels are an important part of the railroad infrastructure and their design requires special attention to detail. BIM allows consideration of geological and hydrological conditions, which is critical to tunnel design. This helps avoid potential problems during the construction phase. The use of Building Information Modeling allows for a detailed analysis of the risks associated with the design and construction of tunnels, which contributes to a safer and more efficient process, as well as providing better management of construction processes.

Digital twins are virtual representations of physical objects, systems, or processes that are used to simulate, analyze, and optimize their real-world counterparts. This technology leverages data from sensors, IoT devices, and other sources to create a dynamic model that reflects the current state and behavior of the physical entity. These devices monitor parameters such as temperature, pressure, humidity, and operational status. The digital twin can simulate the physical object's performance under different conditions, allowing for predictive analysis and scenario testing [3].

The concept of digital twins is finding increasing application in the management of railroad infrastructure (Fig. 2). A digital twin is a virtual model of a physical object that allows real-time monitoring of its condition and data analysis. Also, this method of digitalization allows monitoring the state of infrastructure in real time. This makes it possible to promptly respond to emerging problems, prevent emergencies, predict possible malfunctions and plan preventive maintenance. Digital twins can be used for a variety of railroad infrastructure facilities, including: Monitoring the condition of equipment and infrastructure, managing timetables and

passenger flows, tracking the condition of structures and safety systems, analyzing train traffic data, monitoring the condition of rails and other track elements, and predicting the need for repairs. Digital twins represent a powerful tool for organizations seeking to enhance their operational efficiency, reduce costs, and improve decision-making [4].

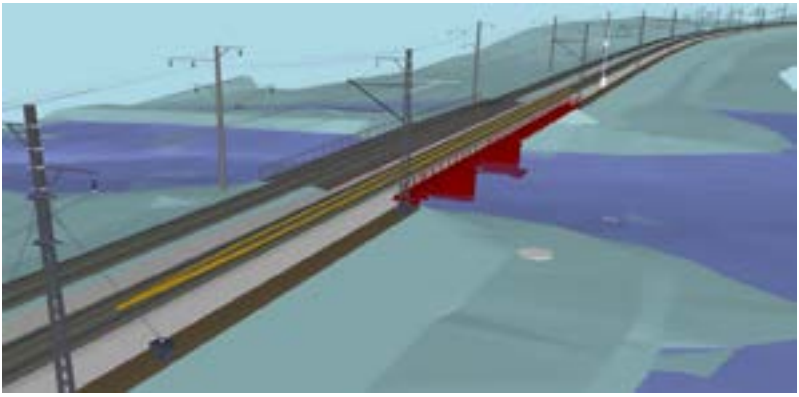

Fig. 2. Northern railway bypass of Perm

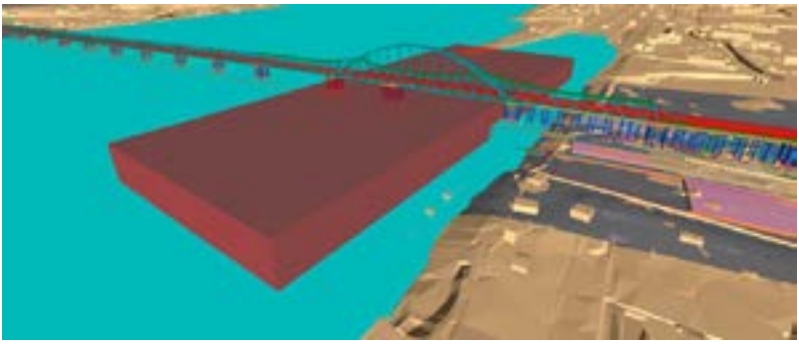

Fig. 3. The second main line on the Niya-Takovka section of the East Siberian Railway

In conclusion, the application of digital technologies such as Building Information Modeling and digital twins in railroad construction opens new

horizons for improving efficiency, quality, and safety (Fig. 3). These technologies make it possible not only to optimize design and construction, but also to improve the management of existing infrastructure and ensure sustainable development of the railway industry in the future.

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ВЛИЯНИЕ ШЕРОХОВАТОСТИ НА ФОРМИРОВАНИЕ СИЛ ТРЕНИЯ НА КОНТАКТЕ С ГРУНТ-ПОДЗЕМНОЙ КОНСТРУКЦИЕЙ

EFFECTS OF SURFACE ROUGHNESS ON FRICTION FORCE FORMATION ON SOIL-UNDERGROUND STRUCTURE INTERFACE

В данной работе рассматривается, как шероховатость поверхности влияет на силу трения на границе между грунтом и материалом фундамента. Основой исследования стал обзор трудов как российских, так и зарубежных специалистов, в том числе трех научных статей, в которых изучается взаимодействие различных материалов с песчаными и глинистыми грунтами. Анализ показал, что между шероховатостью поверхности и углом внутреннего трения существует почти линейная зависимость. При увеличении шероховатости увеличивается и угол трения, что ведет к росту прочности на сдвиг и силы трения. Это, в свою очередь, может существенно повысить несущую способность фундамента за счет лучшего сцепления с грунтом.

Ключевые слова: трение на контакте, абсолютная шероховатость, угол внутреннего трения, сцепление, максимальная шероховатость, поверхность скольжения.

This paper explores how surface roughness affects the friction force at the interface between soil and foundation material. The research is based on a review of both Russian and international studies, including three scientific articles focused on the interaction between different materials and sandy or clayey soils. The analysis revealed an almost linear relationship between surface roughness and the angle of internal friction. As roughness increases, the friction angle also increases, leading to

higher shear strength and friction force. As a result, the bearing capacity of the foundation can be significantly improved due to better soil-material interlocking.

Keywords: friction on contact, absolute roughness, angle of internal friction, cohesion, total roughness, sliding surface.

Our first objective in this research was to study the dependance of surface roughness on friction force that occurs on sliding surface between foundation material and soil.

This topic has been studied by many Russian and foreign authors, so in this article we combine their results, for further analysis [2].

Surface's texture can be described through surface roughness, this value has significant influence on the shear strength on soil-material interface. Following parameters are commonly used to describe interface roughness:

2.1. Average roughness

Average roughness is measured as average absolute deviation from the centerline. This parameter is easy to measure, and gives us good representation of range of potential height deviation on surface.

2.2. Total roughness

Total roughness is calculated as a vertical distance between highest peak and lowest valley. This parameter gives us full understanding of possible maximum deviation in surface's texture.

2.3. Friction force

Friction in soils occurs when we apply shear load in soil and can be referred as resistance between two surfaces such as soil-soil or soil-structure.

2.4. Shear strength

Shear strength in soil is a maximum shear stress that soil can withstand without failing. Shear strength can be described with usage of Mohr-Coulomb theory, which is given by the formula

$$\tau = c + \sigma \cdot \mathrm{tg}(\phi),$$

where:

- τ is the shear strength,
- c is the cohesion,
- σ is the effective normal stress,
- ϕ is the angle of internal friction.

From this formula we see, that increase in friction angle and cohesion may lead to an increase of shear strength.

In this research we analyzed the following articles authored by foreign authors:

1. “Laboratory investigation and constitutive modeling of the mechanical behavior of sand-GRP interfaces” by A. Qannadizadeh, P. T. Shourijeh, A. Lashkari [3].

2. “Effect of surface roughness on the interface behavior of clayey soils” by H. K. Kadhim, M. Alyounis [4].

3. “Interfacial studies on different pile materials and their roughness characterization using 3D optical profilometer” by S. Lakshmi, A. M. Nair, L. Thejus [5].

After analyzing these articles, we can make three graphs of dependence between surface roughness and soil friction angle shown in Fig. 1–3, as one of the parameters influencing shear strength.

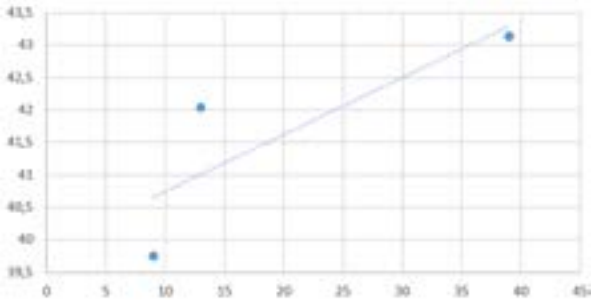

Fig. 1. Dependence between friction angle on the interface soil-material and surface roughness. Article 1

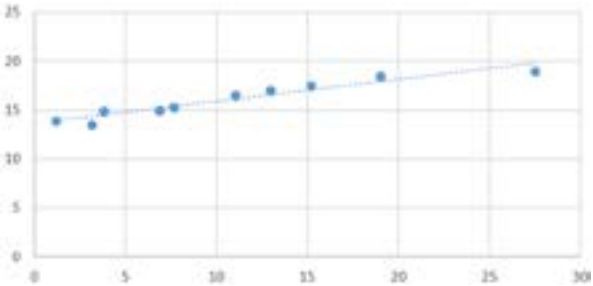

Fig. 2. Dependence between friction angle on the interface soil-material and surface roughness. Article 2

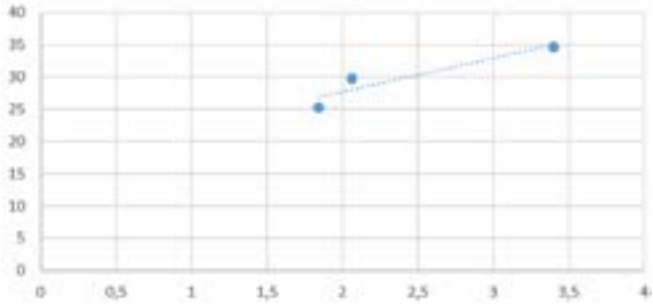

Fig. 3. Dependence between friction angle
on the interface soil-material and surface roughness. Article 3

During the analysis of these articles, we have established following conclusions:

1. it was established that the relationship between the angle of internal friction at the soil-material interface and material roughness is practically linear;

2. with increase in the material roughness, the angle of internal at soil-material interface increases;

3. an increase in roughness on pile surface can lead to an increase in the overall bearing capacity of the foundation, because with increase in surface roughness friction angle also increases, and that leads to increase in shear strength and friction force on interface between soil and pile material [1].

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СРАВНИТЕЛЬНОЕ ИССЛЕДОВАНИЕ ХАРАКТЕРИСТИК ФИБРОБЕТОНА В ХОЛОДНЫХ РЕГИОНАХ КИТАЯ И РОССИИ И СТРАТЕГИИ СОВМЕСТНОЙ ОПТИМИЗАЦИИ

PERFORMANCE COMPARISON AND COLLABORATIVE OPTIMIZATION STRATEGY OF FIBER CONCRETE IN COLD REGIONS OF CHINA AND RUSSIA

В данной статье систематически сравниваются различия в механических характеристиках и долговечности фибробетона, используемого в холодных регионах Китая и России, а также предлагаются пути совместной оптимизации. На основе данных циклов замораживания-оттаивания проводится количественный анализ закономерностей снижения прочности на сжатие и механизмов микроструктурных повреждений. С учетом различий в стандартных системах двух стран предложены стратегии улучшения по трем направлениям: состав материалов, технологии строительства и взаимное признание стандартов. Целью является повышение срока службы инфраструктуры в холодных регионах и сближение технических стандартов Китая и России.

Ключевые слова: проекты в холодных регионах, фибробетон, повреждения от замораживания-оттаивания, взаимное признание стандартов, многоуровневая оптимизация.

This paper systematically compares the differences in mechanical performance and durability of fiber-reinforced concrete used in cold regions of China and Russia, and proposes joint optimization paths. Based on freeze-thaw cycle data, the patterns of compressive strength decline and microstructural damage mechanisms are quantitatively analyzed. Considering the differences in the standard systems of the two countries, improvement strategies are proposed in three areas: material composition, construction technology, and mutual recognition of standards. The goal is to improve the service life of infrastructure in cold regions and bring technical standards in China and Russia closer together.

Keywords: projects in cold regions, fibre-reinforced concrete, freeze-thaw damage, mutual recognition of standards, multi-level optimization.

В экстремально холодных условиях разрушение от замораживания-оттаивания и температурные колебания значительно сокращают срок службы бетонных конструкций. Базальтовое волокно, благодаря высокой модульной упругости (≥90 GPa, низкому коэффициенту теплового расширения (0,6×10-6/°C) и устойчивости к щелочной коррозии, является идеальным армирующим материалом для повышения долговечности бетона [1]. Китай и Россия применяют технологии фибробетона в крупных проектах, таких как Транссибирская магистраль и высокоскоростная железная дорога Харбин-Далянь, но их технические подходы различаются: Китай фокусируется на модификации интерфейса волокно-матрица, а Россия – на инновациях в низкотемпературном отверждении [2].

Данное исследование выходит за рамки однонациональных подходов, впервые анализируя различия характеристик через призму взаимодействия климата, материалов и технологий. Результаты могут служить основой для выбора материалов в рамках экономического коридора Китай – Монголия – Россия, способствуя интеграции программ «Сделано в Китае 2025» и «Стратегии развития Арктики России» в области холодного строительства и сближению технических стандартов «Ледового Шелкового пути» [3, 7, 8].

Сравнительный анализ характеристик

Различия в составах материалов. Стандарты состава фибробетона в Китае и России существенно различаются: китайский стандарт «Технические правила применения фибробетона» (JGJ/T 221-2010) устанавливает верхний предел содержания базальтового волокна в 1,2 % (для дорожных проектов), тогда как российский стандарт «Нормы проектирования бетонных конструкций в холодных регионах» (ГОСТ 30744–2013) ограничивает содержание волокна 0,8 % для железнодорожных проектов [4]. Испытания показали, что введение базальтового волокна эффективно подавляет распространение трещин в бетоне, уменьшает количество пор и полостей в матрице, значительно повышая устойчивость к солевому замораживанию [5].

Закономерности снижения прочности при циклах замораживания-оттаивания

Объединенные данные экспериментов Китая и России демонстрируют:

Данные Китая: После 100 циклов замораживания-оттаивания базальтовый фибробетон сохраняет 82,3 % прочности на сжатие (по стандарту GB/T 50081), а скорость снижения динамического модуля упругости на 40% ниже, чем у обычного бетона [6; 7].

Данные России: При использовании градиентного отверждения (–5°C→10°C→20°C) потеря массы бетона составляет 1,2 % за 50 циклов, но наблюдается значительная потеря жесткости на ранних этапах. Различия обусловлены разными температурными диапазонами испытаний (Китай: –18~5°C; Россия: –25~5°C) [8].

Параметр	Китайские образцы (0,9% волокон)	Российские образцы (0,8% волокон + + наноSiO_2)
Удержание компрессионной прочности	82,3 %	78,6 %
Снижение динамического упругого модуля	17,2 %	22,5 %
Потеря массы	0,8 % / 50 циклов	1,2 % / 50 циклов

Анализ механизмов: Высокий индекс равномерности распределения волокон (FDI ≥85 %) в китайских образцах эффективно подавляет микротрещины. В российских образцах низкотемпературное отверждение приводит к недостаточной гидратации на ранних стадиях, что вызывает резкое снижение жесткости после 200 циклов [7]. Микроструктурные повреждения образцов можно увидеть на рис. 1. Повреждения бетона в результате нескольких циклов замерзания-оттаивания показаны на рис. 2.

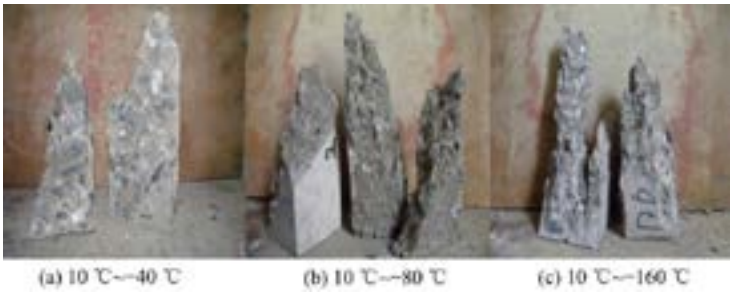

Рис. 1. Разрушение образцов под нагрузкой при верхней предельной температуре в различных диапазонах температур замораживания-оттаивания. Микроструктурные механизмы повреждений

Анализ методом синхротронной микро-КТ показал:

Китайские образцы: Пористость 4,1 %. Увеличение FDI на 10 % снижает скорость снижения прочности на сжатие на 4,7 % [9].

Российские образцы: Диаметр пор сосредоточен в диапазоне 50–100 μm. Использование нано–SiO_2 повышает плотность матрицы, но прочность сцепления на границе составляет всего 7,1 MPa.

Рис. 2. Повреждения бетона от замерзания-оттаивания

Сравнение стандартных систем и пути оптимизации

Различия в классификации морозостойкости

Китай использует показатель F (например, F150), тогда как Россия применяет зонирование по условиям среды. Например, для высокоскоростной железной дороги Харбин-Далянь требуется класс F300, а для Транссибирской магистрали используется модель эквивалентного срока службы [8].

Рамочная стратегия совместной оптимизации

Предлагается механизм «двойного цикла»:

Конструкция материалов: Комбинация китайской технологии модификации интерфейса и российских наноусилителей. Добавление базальтового волокна (0,9 %) и наноглины (3 %) повышает прочность на сжатие на 12 %, а потеря массы при замораживании снижается до 0,5 % / 50 циклов (подтверждено на проекте в Мохэ, провинция Хэйлунцзян) [10].

Технологии строительства: Интеграция интеллектуального уплотнения с использованием системы Beidou (степень уплотнения ≥98 %) и низкотемпературного отверждения сжиженным CO_2, что снижает частоту трещинообразования на 62 % [7].

Основные выводы и перспективы

Ключевые результаты исследования

В результате систематического сравнения механических свойств и долговечности фибробетона в холодных регионах Китая и России, а также анализа циклов замораживания-оттаивания и микроструктурных повреждений, были сделаны следующие выводы:

Механизм различий в характеристиках материалов

Китайский базальтовый фибробетон (содержание волокон 0,9 %) продемонстрировал высокую устойчивость к образованию микротрещин благодаря индексу равномерности распределения волокон (FDI ≥ 85 %). После 100 циклов замораживания-оттаивания сохранение прочности на сжатие составило 82,3 %, а снижение динамического модуля упругости –17,2 % [6,9].

Российские образцы, несмотря на использование наночастиц SiO_2 для уплотнения матрицы, показали снижение прочности на сжа-

тие до 78,6 % и динамического модуля упругости до 22,5 % после 200 циклов. Это связано с неполной гидратацией на ранних стадиях из-за градиентного температурного режима твердения [7, 8].

Эффективность совместных оптимизационных стратегий

Комбинированное введение базальтовых волокон (0,9 %) и наноглины (3 %) повысило прочность на сжатие на 12 % и снизило потерю массы при замораживании до 0,5 % за 50 циклов [10].

Интеграция технологии интеллектуального уплотнения «Бэйдоу» (степень уплотнения ≥ 98 %) и низкотемпературного твердения с жидким CO_2 сократила частоту образования трещин на 62 %, подтвердив практическую применимость междисциплинарных технологий.

Научные инновации

Многомасштабная аналитическая модель: Впервые разработана климатическо-материально-технологическая модель, раскрывающая микроструктурные различия между китайскими и российскими образцами (например, пористость 4,1 % vs. концентрация пор 50–100 мкм) [9].

Количественная модель повреждений: На основе данных синхротронной микротомографии установлена зависимость между FDI и снижением прочности – увеличение FDI на 10 % уменьшает деградацию прочности на 4,7 % [9].

Международная кооперационная модель: Предложен механизм «двойной циркуляции», объединяющий китайские методы модификации границы «волокно-матрица» и российские нанотехнологии, что создает шаблон для воспроизводимого сотрудничества в области строительных материалов для холодных регионов.

Перспективные направления исследований

Умный мониторинг и анализ данных: Создание единой базы данных жизненного цикла бетона в холодных условиях с интеграцией параметров окружающей среды, свойств материалов и технологий строительства. Разработка интеллектуальных датчиков на основе волоконно-оптических решеток для онлайн-мониторинга повреждений.

Исследования материалов для экстремальных условий: Углубленное изучение взаимодействия волокон и матрицы при

температурах до минус 60°С для повышения долговечности в сверхнизкотемпературных средах.

Гармонизация стандартов: Содействие взаимному признанию китайских и российских стандартов морозостойкости через разработку транснациональных нормативов, сочетающих модель эквивалентного срока службы (Россия) и систему F-факторов (Китай), в рамках проекта «Ледяной Шелковый путь» [2, 8].

Данное исследование, объединяющее теоретические инновации и инженерную практику, не только расширяет научные горизонты в области фибробетона для холодных регионов, но и формирует основу для технологической синергии между Китаем и Россией, что имеет глобальное значение для устойчивого развития инфраструктуры в условиях экстремального климата.

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ДЕРЕВООБРАБАТЫВАЮЩАЯ ОТРАСЛЬ В РОССИИ И ЛЕНИНГРАДСКОЙ ОБЛАСТИ: ПРОБЛЕМЫ, ПЕРСПЕКТИВЫ РАЗВИТИЯ

WOODWORKING INDUSTRY IN RUSSIA AND THE LENINGRAD REGION: PROBLEMS, DEVELOPMENT PROSPECTS

В данной статье анализируется состояние деревообрабатывающей отрасли в России и Ленинградской области, отмечая ее важность для экономики и общества. Здесь рассматривается определение, главная цель и задачи отрасли, а также ключевые компании и предприятия. Цель статьи заключается в привлечении внимания к проблемам отрасли возникших в связи с антироссийскими санкциями, которые привели к сокращению экспорта и снижению объемов производства. Статья также затрагивает проблему нехватки квалифицированных кадров, предлагая пути решения, связанные с привлечением молодежи к данной отрасли. Деревообрабатывающая промышленность обладает большим значением в нашей жизни, благодаря данной деятельности в наших домах уютная мебель, предметы интерьера и быта, качественные материалы для домостроения и прочего. Она вносит большой вклад в развитие региональной экономики и качества жизни граждан. Поэтому рассмотрение данной темы является актуальным во все времена.

Ключевые слова: деревообрабатывающая промышленность, кадры и квалификация, экспорт и санкции, Ленинградская область, проблемы отрасли, рост производства, социально-экономическая составляющая, будущее деревообрабатывающей отрасли, образование и привлечение кадров.

This article analyses the state of the woodworking industry in Russia and the Leningrad region, noting its importance to the economy and society. It explores

the definition, main goal and objectives of the industry, as well as key companies and enterprises. The purpose of the article is to draw attention to the problems of the industry caused by various reasons, which led to a reduction in exports and production volumes. The article also touches on the problem of skills shortages, suggesting solutions to attract young people to the industry. The woodworking industry has a great importance in our lives, thanks to this activity there is cozy furniture, interior and household items in our homes, quality materials for house building and other things. It makes a great contribution to the development of the regional economy and the quality of life of citizens. Therefore, the consideration of this topic is relevant at all times.

Keywords: woodworking industry, personnel and qualification, export and sanctions, Leningrad region, industry problems, production growth, socio-economic component, future of woodworking industry, education and personnel attraction.

Introduction

In today's world, where technology and innovation play a key role in the development of various sectors of the economy, the woodworking industry occupies a special place. This speaks to the fact that wood is one of the most affordable and environmentally friendly materials, and that it has unique properties that make it indispensable in the construction, furniture manufacturing, pulp and paper industry, as well as in other areas. It can be said with full confidence that the quality of products depends on the activities of woodworking companies. After all, everything that this industry produces and manufactures, is used every day. For example, we can mention furniture, interior items, construction materials and much more.

This article will look at what the woodworking industry is, what it produces, what problems have arisen in the industry and will propose a solution to one of them.

Woodworking industry – definition, main aim and task

The woodworking industry is a branch of the timber industry complex (further – TIC), which specializes in mechanical and chemical-mechanical processing and wood processing, using various timber products as raw materials [1]. The main aim and task of woodworking production is deep processing of wood, including maximum utilization of waste from logging and woodworking, search for additional reserves of wood and its saving in all branches of national economy. It can be concluded that the

woodworking industry is one of the main and promising branches of the Russian timber industry, but due to the existing problems in this industry, its real contribution to the economic development of the country is still lagging behind the potential [2].

Leading companies in the woodworking industry in Russia

In the Russian Federation, more than 6 thousand operating companies belonging to the category of 'Woodworking' carry out their activities in the industry under consideration [3]. Among the largest companies in the industry under consideration there are three leading companies that are active in the market. PJSC Segezha Group is located in Moscow. The group of companies includes Russian enterprises of timber, woodworking, pulp and paper industries, as well as enterprises producing paper packaging, CLT constructions, eco-fuels and other products. OOO ILIM TIMBER is located in the city of St. Petersburg. Its primary activities are production of sawn timber, except profiled timber, with thickness over 6 mm; production of unimpregnated railway and tramway sleepers from wood. NAO LESOZAVOD 25 is located in Arkhangelsk region. Its primary activities include export quality softwood sawn timber and fuel pellets (pellets).

Woodworking industry in the Leningrad Region

According to the data for 2024, the timber industry in the Leningrad Region has more than 50 enterprises (not including small businesses), which employ about 13,000 people. In this section we will consider two woodworking enterprises in the region. Limited Liability Company 'VLK INOK' is a woodworking enterprise, which is engaged in the production of such products as: three-layer board from solid wood, sawn timber, technological chips, fuel briquettes [4]. The company was restarted in 2024 in the town of Volosovo, Leningrad Region, after downtime caused by the imposition of anti-Russian sanctions in 2022. The company started delivering products both to the domestic market and to Asian regions – Turkey, China and India. Except for VLK INOK, other large woodworking enterprises of the region also went into downtime: Luzales, Metsä Svir, IKEA plant in Tikhvin, etc. But later all the enterprises were restarted by new or former owners [5].

It should be noted that the index of industrial production of wood and cork products (except furniture) in the Leningrad Region at the end of the first half of 2024 increased by 0.4%. The turnover of companies in January-May 2024 increased by 4 % year-on-year to 9.6 billion rubles, while the volume of shipped products increased by 14,5 % (9.8 billion rubles) over the same period. However, the results at the time of 2024 lagged far behind those for 2021, where the turnover of companies for the same period was 15.4 billion rubles, and the volume of shipments was 15,7 billion rubles. As a result, the recovery and increase of these indicators can be expected not earlier than 2025–2026, as Mikhail Burmistrov, General Director of Infoline-Analytics, believed. He said that the main problem of timber processing enterprises in Leningrad Region is that they have been developing taking into account the sale of most of their products abroad [5].

One more organization in the industry is Timproduct, which is a timber company specializing in the production of high-quality wood products. Timproduct manufactures such products as planed and profiled sawn timber, glued lumber, etc. The company is also engaged in the manufacture of quick-assembly wooden structures, such as pergolas, farm blocks, etc. The company is located in the Leningrad region in the town of Volosovo.

Woodworking industry – problems, personnel, development

The timber industry of our country cannot be imagined without the fundamental woodworking industry. It is woodworkers who make full-fledged products out of ordinary logs – from ordinary sawn timber or compressed wood boards to furniture and complete house sets; in addition, woodworking and processing products can include sleepers, planks, various consumer goods, including window frames, doors, glued parts, as well as modified wood, construction timber, beams, planks, boards, etc. It is the largest sphere of timber industry, which continues to grow and develop actively for many years, due to the emergence of new technologies of wood processing and a large stock of forest resources in Russia [1]. The development of production of woodworking industry enterprises to a greater extent affects the social and cultural standard of living of the population of the Russian Federation, because it is a multi-profile production complex that meets the needs of the national economy and the population of the country [2].

However, despite the introduction of new technologies, the industry lacks personnel, which is a big problem, as Joseph Vissarionovich Stalin once said: '...It is necessary to realise that under our present conditions, 'personnel decide everything". If we have good and numerous personnel in industry, agriculture, transport, and the army, our country will be invincible. If we do not have such personnel, we will limp on both legs..." [6]. This phrase was uttered on 4 May 1935 in the Kremlin Palace in Joseph Stalin's speech to graduates of military academies and it is impossible not to agree with it, because if there were no specialists in timber industry, there would be no quality wood materials, furniture, warm houses and other things. Therefore, the main task is to expand and develop the woodworking industry, this is facilitated primarily by the training of future personnel, as well as the construction of new enterprises in the regions of our country. Thanks to this the level of employment will increase, which will contribute to the formation of new jobs.

There are a number of negative factors in the development of the wood processing industry. One of the main incentives for the development of the timber processing industry up to 2022 was exports. Therefore, the sanctions imposed by the collective West against Russian business are considered to be the main reason for the stoppage of exports. In 2022, production volumes predictably declined significantly. According to the results of the year, as noted in the analytical agency WhatWood, the decline amounted to 11% – production volumes have been 'sliding into negative values' since March last year [1].

Due to sanctions, foreign trade has come to a standstill and therefore the production of almost all types of timber products has decreased. According to Rosstat, in 2023 the production of plywood fell by 16,4 %, wood fibreboard (WFB) by 15.7%, fuel pellets by 44,6 %, and the production of sawn timber fell by 9,1 % [7]. Therefore, the enterprises are forced to focus their attention on the domestic market, where most of the forestry products will be sold. An important impetus to correct the situation related to sanctions is the change of strategy aimed at the Asian market. The main partners are China, Uzbekistan and Kazakhstan. Despite the negative forecasts after the loss of European markets, most enterprises of the timber industry managed to quickly replace the sales markets from European to Asian markets. Today, the share of Asian countries in the

volume of sawn timber exports from Russia for the first time took 98 %, while in 2021 it did not exceed 76 % [8].

At the moment, there are more problems that prevents the industry from developing. Among them there are high costs of materials, construction, equipment, logistics and many others. In addition, the situation is aggravated by tight monetary policy conditions. It's about to the costs of building new branches of woodworking production facilities in the regions, as well as maintaining technical equipment, labor remuneration of employees and other running costs, in an up-to-date state at a certain point in time, of already existing enterprises. According to the official website of B1 Group, in 2024, the woodworking industry in the Russian Federation showed a growth of 6 % and became one of the top three actively growing industries together with machine building, which grew by 20 %, and metallurgy by 7 %. Having reached its peak in early 2024, the pace of production has started to slow down due to tight monetary policy and exhaustion of the previous growth factors [9].

Conclusion

In conclusion, we would like to note that it is impossible to do without the woodworking industry, it is an important socio-economic component. Unfortunately, the issue related to the lack of qualified personnel is still relevant today. The reason for this is most often that many young people do not know and do not understand how important this industry is and how interesting it is to study forestry. Therefore, it is necessary to direct attention to schoolchildren and college graduates by conducting more frequent excursions for them to educational institutions (not only those related to the industry in question, but also others), thus attracting some part of Russia's future personnel to technical directions, which are now very much in demand. One of the main problems that arose due to anti-Russian sanctions led to the decline of the wood processing industry, as export of goods abroad was suspended. Despite this, the woodworking industry is recovering and has a great future. Its development will be the basis for improving the quality of life in Russia and its regions.

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ЭКОНОМИКА В ЭПОХУ ПЕРЕМЕН: ВЫЗОВЫ И ПЕРСПЕКТИВЫ

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СОВРЕМЕННЫЕ ТЕНДЕНЦИИ В ЛЕСНОМ БИЗНЕСЕ

MODERN TRENDS IN FOREST BUSINESS

Целью данной статьи является исследование основных современных тенденций в лесном комплексе России на основании данных, полученных при изучении изменений в производстве продукции различных отраслей лесопромышленного комплекса России, анализа функций современных изобретений в сфере лесного комплекса России. Среди основных задач данной статьи можно выделить следующие: перечисление основных отраслей лесного комплекса России; рассмотрение основных тенденций в каждой отрасли в отдельности; исследование изменений в тенденциях экспорта; рассмотрение основных целей, задач, общих положений, назначения Стратегии 2030. Особое внимание в статье уделено анализу изменений темпа производства в различных отраслях лесного хозяйства России и изменений показателей экспорта продукции производства лесного комплекса, рассмотрению целей и задач Стратегии 2030, а также исследованию современных систем, в том числе электронных, помогающих вести учет и контроль различных показателей в производстве в лесопромышленном комплексе России.

Ключевые слова: лесопромышленный комплекс, производство, экспорт, современные тенденции, Стратегия 2030, цифровизация.

The purpose of this article is to study the main modern trends in the forestry complex of Russia based on the data obtained in the study of changes in the

production of products of various sectors of the Russian forest industry complex, analysis of the functions of modern inventions in the field of the forestry complex of Russia. Among the main objectives of this article are the following: listing the main sectors of the forestry complex of Russia; consideration of the main trends in each sector separately; study of changes in export trends; consideration of the main goals, objectives, general provisions, purpose of the Strategy 2030. The article pays special attention to the analysis of changes in the rates of production in various forestry sectors of Russia and changes in the indicators of export of products of production in the forestry complex, consideration of the goals and objectives of the Strategy 2030, as well as the study of modern systems, including electronic ones, helping to keep records and control various indicators in production in the forestry complex of Russia.

Keywords: forestry complex, production, export, modern trends, Strategy 2030, digitalization.

The Russian Federation is one of the countries in the world with the most forest resources. More than 46% of its territory is covered by forests. The structure of the forest industry includes several interrelated industries:

- logging
- forest processing – mechanical and chemical-mechanical processing and wood processing, i.e. production of panels, furniture, sawn timber
- pulp and paper industry – chemical processing of wood, i.e. production of cellulose, cardboard and paper
- forest chemical industry

Forestry and the forest industry complex are a strategically important sector of the Russian economy. Currently, the Russian forest industry is in a state of transformation and searching for new ways to develop the geography of sales [1].

It is necessary to analyze the production in various sectors of the forest industry complex to assess the role of each one.

The furniture industry has the highest production rates in Russia in 2023. Compared to 2022, production increased by 21 %. The production of chipboard and fiberboard increased by 6,7 % and 11,3 %, respectively. An increase was also noted in the production of doors and wooden boxes. A decrease in production was noted in the production of wooden windows (by 19 %), in the volume of paper and paper products (by 1,4 %), in wood processing and the production of wood products (by 0,2 %) [1].

A mention should be made about the analysis of the main trends in the sphere of export in forest business.

The forest industry of Russia is an export-oriented industry. The main export is represented by forest products from high-quality raw materials – plywood and softwood lumber. The export of products from low-quality raw materials - pulp and paper products, wood boards – is at a level of up to 30 %.

According to the Federal Customs Service, there is a decrease in the export of products of the Russian forestry industry. In 2023, Russia exported wood and wood products, as well as pulp and paper products worth $10 billion, which is 30 % less than in 2022. The total volume of sawn timber and round timber exports in 2023 decreased by 7 %. After losing European sales markets, most forest industry enterprises reoriented their exports to Asian markets. In 2023, the share of Asian markets in the volume of sawn timber exports from Russia was 98 %. The main partners are China, Uzbekistan and Kazakhstan. Most of the supplies came from the Irkutsk Region, Krasnoyarsk Krai and Arkhangelsk Region. Almost half of the exports in 2023 came from Siberia, a quarter of the supplies came from the Northwest.

Much attention should be given to the investment activity of the Russian forest industry complex. Investment activity of the Russian forest industry complex continues to remain at a fairly high level. By September 2022, almost half, 66,5 billion rubles of the total volume of all investments in the Russian forest industry, were accounted for by the production of paper and paper products. The second place in terms of investment volumes was occupied by wood processing and the production of wood products (56,7 billion rubles or 40,8 %), followed by logging 7,7 % and furniture production 3,67 %.

The majority of capital investments went to purchasing equipment – 91,6 billion rubles, slightly less than a third was invested in infrastructure, about 10 billion rubles were invested in updating the vehicle fleet. In 37 regions of Russia, investment in the forestry complex increased. Investments grew the most in the Irkutsk Region, in the Perm Territory the increase was 2,6 billion rubles, the Moscow Region invested 36% more than in 2022.

Strategy 2030

The most important tasks of the strategy include reorienting the industry from exporting unprocessed timber to producing products with high added value, forest conservation, and firefighting [2].

In order to combat fires, it is planned to implement such a direction of work as improving the remote monitoring system of the Federal Forestry Agency. The purpose of this system is the prompt transmission of information about emerging fires. In order to get a clearer picture of the state of the industry, it is necessary to systematize information about forests. Digital technologies will be introduced into work processes related to logging, transportation, storage and processing of wood and wood products [3].

FGIS LK

From January 1, 2025, all forest users and timber market participants are required to use a new electronic resource – the Federal State Forestry System (FGIS LK) [4]. One of the main objectives of the new system is to increase the digitalization of the industry, as well as to provide interested parties with access to up-to-date data on the state of the country's forest fund [5].

This platform is one of the examples of digitalization of the Russian forest industry, which was included in the plans of Strategy 2030. The platform will allow receiving, processing, storing and using information on the condition, quantity, quality and use of forest stands, as a result - will increase:

- reliability and speed of providing data for decision-making;
- accuracy of planning activities for forest conservation, protection, and reproduction;
- effectiveness of control over the implementation of plans, assessing the effectiveness of the implementation of control measures;
- accuracy and speed of providing data to departments and organizations.

Most forestry materials are still stored on paper. The transition to modern digital technologies is a strategic task. It is necessary to have information about forests in the form of digital data integrated into a single system.

The key components of the FGIS LC concept are:

- public display of open data on forests;
- implementation of electronic document management;
- public display of open data on forests;
- combating illegal logging;
- fire detection;
- provision of public services in electronic form.

The main objectives of the system implementation are:

- formation of a single information space with reliable information about the forest funds;
- online interaction between authorities and forest users;
- prompt formation of reports and analytics based on up-to-date information;
- automation of forest data analysis procedures.

In business, accuracy directly affects profit. Inaccuracies in accounting for the volume of timber, which seem small, turn into a significant difference in price with large volumes of deliveries. The same thing happens with inaccurate indication of the species composition [4].

The Russian developers have contributed to the development of the forestry complex, relying on European experience and applying their own innovative solutions. One of the successful examples is the case "Control of raw material flow using CV and ML" Smart-Timber. At the St. Petersburg Forestry Forum, the director of the company "Computer Vision Systems" Dmitry Stepanov presented a comprehensive system for accounting of round timber. The system uses patented algorithms of computer vision and machine learning to automate forest resource measurements. Minimization of manual labor and increased measurement accuracy are key advantages. Uniformity of measurements and photo recording provide an error of less than 3 %, which allows for accurate calculation of timber volumes in stacks, on timber trucks and in cassettes, which significantly reduces losses at each stage of accounting. A mobile application that operates offline is used to carry out measurements at the plot. This application manages the process: automatically registers parameters, takes photos and sends all data to the software server and to the enterprise system. Work on upgrading the application continues. This service also simplifies work with reports and data. The service helps generate reports and transfer information to 1C and other accounting systems.

Until recently, when space monitoring was not widely used and forest managers only had maps, forest leaseholders often discovered that the forest on them had burned out or died from pests. At a forest industry forum in St. Petersburg, Deputy General Director of ScanEx Group Sergey Zharinov noted that remote monitoring provides forest industry participants with accurate information. Satellite technologies are often the only

way to obtain up-to-date data on forests due to their geographical features and inaccessibility. Specialists, analyzing space images, can determine the boundaries of logging, identify damaged stands and areas affected by fires.

Hardware and software complex “Kedr”

Hardware and software complex (HSC) “Kedr”, developed by LLC “Ilimsky LTUS” using equipment and satellite communication channel of the “Gonets” system is one of the most important examples of import substitution in the field of technology and infrastructure. It helps to solve problems associated with insufficient manual collection of data on forest felling, poor satellite communications and lack of control over infrastructure [6].

With the help of the digital solution of the Kedr HSC, it is possible to control the location of logging equipment, its operating and idle time, take into account the volume of harvested timber, and prevent illegal logging. Users of the system can promptly receive any information from industrial equipment and quickly and effectively make management decisions. Automatic reporting has a positive effect on the efficiency and workload of logging teams, and therefore on the economics of logging.

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МЕЛЬБУРН – КРУПНЕЙШАЯ ТРАМВАЙНАЯ СИСТЕМА В МИРЕ: КАК АВСТРАЛИЙСКИЙ ГОРОД ОПЕРЕДИЛ ВСЕХ СРАЗУ ПО ВСЕМ ПОКАЗАТЕЛЯМ

WORLD'S LARGEST MELBOURNE TRAM SYSTEM: HOW AN AUSTRALIAN CITY SURPASSED EVERYONE AT ONCE ACROSS ALL INDICATORS

Мельбурн обладает самой длинной трамвайной сетью в мире, опередив таких бывших лидеров, как Санкт-Петербург, Киев и Харьков, где трамвай утратил свое значение из-за автомобилизации и недоразвития общественного транспорта. Европейские города, такие как Париж, Прага, Будапешт и Берлин, сумели создать прочную транспортную основу на базе трамвайных систем. Мельбурн достиг этого успеха благодаря постепенному развитию. Подчеркивается, что эта система является не только средством передвижения, но и определяющей чертой идентичности города, поддерживаемой за счет постоянных инвестиций и сильного руководства. Следует отметить опыт Мельбурна в области трамвайного транспорта и сделать выводы о том, как развивать трамвайную систему настолько эффективно, чтобы достичь успешного результата. Большое внимание уделяется ее обширной и хорошо интегрированной сети.

Ключевые слова: трамвай, легкорельсовый трамвай (ЛРТ), история Мельбурна, сеть.

Melbourne has the longest tram network in the world, ahead of former leaders such as Saint Petersburg, Kiev and Kharkov, where the tram has lost its position due to automobilization and underdevelopment of public transport. European cities such as Paris, Prague, Budapest and Berlin were able to create a solid trunk transport framework from tram systems. Melbourne has achieved this success through gradual development. It is stressed that this system is not only the means of transportation but also a defining feature of the city's identity, maintained through consistent investment and strong leadership. A mention should be made about the tram experience of Melbourne. It should be noted about the development the tram system so efficiently as to achieve a successful result. Much attention is given to its extensive

and well-integrated system. It is stressed that this system is not only the means of transportation but also a defining feature of the city's identity, maintained through consistent investment and strong leadership.

Keywords: tram, light rail tram (LRT), history of Melbourne, network.

The first Australian trams appeared in industry, making it easier to transport heavy loads. Miners found that moving carts on rails was much easier than rolling them on wheels on uneven surfaces. Initially, trams were driven manually or with the help of horses.

In 1869, San Francisco developed technologies to improve significantly the horse-drawn tramway, resulting from the symbiosis of industry and transportation. Andrew Hallidy, a manufacturer of steel wire ropes, suggested that trams would be able to move more steadily and safely with the help of cable. He patented the inventions that made cable traction possible, and in 1873, the world's first cable tram system began operating in San Francisco. This invention and the development of the San Francisco tram system were closely followed by Francis Boardman Clappe, an American entrepreneur and transport businessman from Melbourne. Clapp, along with William McCulloch and Henry Hoyt, founded the Melbourne Omnibus Company, launching organized street public transport in Melbourne.

Fig. 1. Melbourne miners build a line to facilitate the transport of heavy loads [1]

Regular services consisted of 11 horse-drawn buses carrying passengers from two City railway stations across Bourke Street to the Birmingham Hotel at the corner of Smith and Johnson Streets in Fitzroy. The three-penny fare was cheaper than a taxi ride, and similar routes were soon launched in Richmond, Carlton, and North Melbourne. In 1877, Clapp bought the Victorian patents for Andrew Hallidy's inventions and changed the name of his company to the Melbourne Tramway & Omnibus Company.

Spurred on by the development of trams abroad and the introduction of steam trams in Sydney, the colonial government passed a law in 1883 to develop a tram-omnibus network in Melbourne. Under this law, local councils, whose streets would be part of the proposed network, created the Melbourne Tramway Trust, specializing in the construction of tracks and power plants for cable trams. Meanwhile, horse-drawn trams began operating on the first line carrying passengers from Fairfield railway station to Thornbury.

Conductors collected fare using a bell ring. The fares paid were recorded not by issuing tickets to passengers, but by punching a small hole in the long cardboard questionnaires that the conductor had attached to his uniform. In the end, the questionnaires collected during the trip were compared with the amount of revenue - thus, the possibility of collusion between car drivers and conductors on the withdrawal of funds from the turnover of the transport enterprise was excluded.

Melbourne's first tramway cable opened on 11 November 1884. A hollow in the road was dug to a depth of almost 4 feet (1,2 m), and tunnels were built to accommodate cables stretching in both directions. Large steam engines powered 24,870 feet (7,580 m) of cables to the city and 14,754 feet (4,497 m) to Hawthorne Bridge. The cables consisted of six strands and seven steel wires with a hemp core. The cable was laid on 15 horses, while to drag it to Jolimont Hill in East Melbourne, the number of horses had to be increased to 25. Over the next six years, similar cables were laid on many city streets and suburban highways. By 1891, Melbourne had 44 miles (71 km) of double-track cable tramway, equipped with 11 engineering houses. Cable lines ran along most of the city's main streets and along all major exit roads. Around the sprawling city of Melbourne, the construction of the cable system continued as part of the deal. This led to her being leased by the Melbourne Tramways & Omnibus Company to operate scheduled services until 1916.

In 1884–1923, there were 7 lines operated under the management of different organizations, the first of which was closed in 1890. All cable tram lines planned by the trust were built by 1891, ran along most of the main city streets and along all major exit roads; the length of the network was 71 km. Since 1924, cable tram lines have been gradually converted to electric traction. Cable trams operated until the end of October 1940.

Cable trams came in sets or "trains" – an open "dummy car" in front and a closed car behind. The dummy contained a "coupling" mechanism that attached or disconnected the tram train from the moving cable below the road. Melbourne's first tramcars were imported from New York, but all late rolling stock was built in the company's workshop on Nicholson Street, in North Fitzroy. The trams were small and light, with a passenger capacity of 56 seats – 22 seated, and 34 standing ones. However, the transportation license was available only for the transportation of 42 passengers – 20 seated and 22 standing ones. The interval was small, on the busiest lines during rush hours, trams came every two minutes.

Melbourne's first electric tramway began service on 14 October 1889 between Box Hill and Doncaster with the opening of a 3.6 km line. The Victorian Railways began a gradual transition to trams in 1906 when an electric tram line was opened from St Kilda station to Brighton. The following year, Prahran and Malvern Councils applied for the construction of carriages, and by 1910 the Prahran & Malvern Tramways Trust was ready to enter service with 13 carriages on two routes. Other local councils followed suit, but of the municipal tramway companies, this trust was by far the most developed. It laid the foundation for Melbourne's future tram network.

Over the next 10 years, by 1920, the system had grown to nearly 100 cars and 35 miles (56,3 km) of lines. On November 1, 1919, a special council under the state government, the Melbourne & Metropolitan Tramways Board (M&MTB), was created to manage the entire streetcar system by merging transport trusts operating in different parts of the city. Note that the steps to optimize management and increase its efficiency in cities with successful tram systems roughly converge – this is the merger of electric transport departments, currently carriers, into one organization. In the 50 years since the establishment of the Melbourne Omnibus Company, Melbourne's street public transport has improved its quali-

ty and increased traffic volumes, thanks to unplanned and uncoordinated private and public enterprises, spurred by a land boom suppressed by an economic downturn and a world war. It is becoming clear that a more orderly approach is needed for balanced development.

Mr. Alex Cameron, former Chairman of the successful Prahran & Malvern Tramways Trust, was appointed as the first Chairman of the newly formed M&MTB Board. The council inherited a cable system that provided volumes of movement for which it was never designed, which led to wear and tear on the rails. It also inherited a partially worn-out fleet of modern electric trams. The long-term plan was to electrify the cable lines or convert them to bus routes, and to integrate and expand the entire tram network.

Soon, transport services to Melbourne and its suburbs were interrupted, and this continued throughout the 1920s: the reconstruction of the old cable system began, new tracks and overhead power lines were laid. On 29 August 1925, the first cable tram line ended with the closure of the Windsor-St Kilda Esplanade line. From that moment on, the expansion of buses on the former tram routes began. This gave rise to competition and a decrease in the level of reliability of the tram system, which eventually led to a decrease in its demand among passengers.

To maintain maintenance during the conversion, electric trams ran on temporary lines, and during the reconstruction, passengers were transported by bus along the main streets with tram traffic. To provide bus service, bus operation has become the fastest growing public transport sector during peak hours. This move also allowed the Council to regulate competition between bus and tram carriers, which began to significantly undermine the work of the latter. In 1925, the first trams and buses entered service from La Trobe Street along Swanston Street and Brighton Road, along Glen Huntly Road to Elsternwick station. We see the second characteristic step that the Melbourne tram system had to go through – competition with bus carriers. And it passed it quite painlessly.

By 1930, most cable trams had been replaced by electric trams, but the Great Depression led to the suspension of further work. World War II provided another reprieve for cable tram services to continue, but the last of them reached Northcote on 26 October, 1940. Along with cable trams, the conductors' bell has also disappeared in 1922, and the Council began

collecting fares by issuing tickets. M&MTB inherited a fleet of 500 cable cars and 500 dummies that were standard in design. However, this does not apply to the rolling stock of various electric tramways. Classes “A” to “V” of the Board’s alphabetical classification of trams were occupied with widely differing vehicles from the five municipal trusts and North Melbourne Electric Tramway & Lighting Co Ltd.

a) *b*

Fig. 2. *a* – the trams of operator MMTB [1]; *b* – Pioneers of the tram traffic [1]

Therefore, the Council decided to standardize with the newly designed tram, which would become the symbol of Melbourne. The first “W” was built in 1923, and variations of this class provided Melbourne with its distinctly stylized trams until the mid-70s, when the orange Class Z was introduced in 1975. At first, the Council adopted a chocolate and cream livery for its carriages, similar to that of the Prarahran & Malvern Tramways Trust. However, when the St Kilda Road line was electric, the trams were painted green and cream – to blend in with the trees lining the route. Gradually, this livery spread to the entire park.

In 1941, Joyce Barry got a job at M&MTB. At that time, only women worked on trams due to labor shortages during the war. Her first job was to collect control tear-off sheets from tickets and compare them with the revenue received. The first push for women to be trained as drivers came in 1956, but the then tramway union did not dare to take responsi-

bility for their training, and the issue was again postponed until 1969. That year, female employees again began lobbying the council to allow them to drive wagons. It wasn't until 1975 – by the time many women activists had already become disillusioned with their struggles – that the case was finally put to a vote and the members made the historic and long-overdue decision to allow their fellow women to be carriage drivers. Joyce (pictured right – Fig. 2, *b*) was the first to be trained, and shortly thereafter Kat Stone (to the left of Joyce – Fig. 2, *b*). Joyce retired from streetcars in 1982 after nearly 40 years of service. Her strong stance prompted M&MTB to adopt an equal opportunity policy and opened the door for many more women to become car drivers.

Already in 1983, M&MTB was absorbed by the Metropolitan Transit Authority, which in 1989 was reorganized into the Public Transport Corporation. The department was in charge of 684 trams, a network of 220 km and a staff of about 5 thousand employees servicing the system. In the 1990s, as a result of the privatization of the corporation, several private operators of tram lines were separated. With the significant participation of customers and employees, a new Class A tram was developed. In addition to the Z class trams, 70 Class A cars were built by the Comeng factory between 1984 and 1987. But technology changed rapidly, and in 1984, Melbourne's longest trams entered service. In the period from 1984 to 1988, about 132 articulated trams of class B (or light rail vehicles – LRT) were manufactured, providing air conditioning, for operation on routes with high passenger traffic.

а) *б*)

Fig. 3. a – the trams of transport operator Met [1]; *b* – Logo of The Met/MTA [2]

In July 1983, the state government decided to integrate the city's three main modes of public transportation – streetcars, buses, and commuter trains – to create a coordinated public transportation network. The activities

of the Melbourne and Metropolitan Tramway Council were transferred by the tramway and bus department of a new government body, the Metropolitan Transit Authority. The brand was developed in a distinctive dark green and bold yellow color scheme for the rolling stock and uniforms of the new enterprise. The Met logo, symbolizing the three modes of transport, began to appear on all vehicles and uniforms instead of the M&MTB logo.

The integration of services made it possible to significantly improve the ticketing system. A single ticket can now be used on all modes of transport – with fares based on time rather than distance traveled. In 1985, Automatic Vehicle Monitoring (AVM) was introduced. Originally installed in the bus fleet, it was expanded to trams and allowed for improved communication with drivers. It also made it possible to monitor vehicle locations between designated points along each route. This step qualitatively increased the availability of transport services, since inter-car delays and, as a result, cases of late arrival of cars by the "locomotive" were reduced, which led to an improvement in the tram schedule.

Following the state government's decision in 1997 to privatize the Public Transportation Corporation, the MTA was divided into four separate business units – a pair of trams and a rail. On August 29, 1999, these units began operating under separate identifiers and private property. As Bayside Trains, Swanston Trams and the regional railway company V/Line were operated by the same entity, the National Express Group (Australia), the two metropolitan companies were merged into M>Tram and M>Train on 1 October 2001. Hillside Trains later became Connex.

Fig. 4. The trams of transport operator Yarra Trams [4]

However, in December 2002, National Express announced that it would withdraw from all three businesses. The M>Tram and M>Train operations were taken over by the Victorian state government, which announced its intention to create one tram company and one railway company for metropolitan Melbourne. The entire network came under the management of Yarra Trams, which became a monopolist in the organization of transportation, maintenance and development of the tram system [3]. The company assumed responsibility for the reliable and safe operation of Melbourne's tram network on 1 April 2004. At the moment, this company is the world leader in tram transportation. All trams cover almost 25 million kilometers per year. The number of trips is 31,400 weekly – 20 hours a day. These figures are achieved by 500 trams on 25 routes with 1763 stops. The total length of the routes is 250 km.

Fig. 5. Historical carriage W6 on the route Melbourne City Circle (№ 35) [6]

In 2003, a museum dedicated to the history of the local tram system and its impact on the development of the city was opened in the building of the former Hawthorne tram depot, which was launched in 1916. The museum presents more than 20 models of restored tramcars, including the W-class, a family of electric trams produced in 1923–1956 at the plant in Preston (a suburb within the agglomeration, 10 km from the city center) and which are a symbol of the city. 10 W-class trams are operated on the free ring tourist route No 35 City Circle (since 1994), which runs in the city center near key attractions. In 2009, Keolis Downer was named a successful contender for the Yarra Trams franchise, which began on November 30 of that year.

Fig.6. Logo of Yarra Trams [5]

Nowadays, the company has 256 km of network with a gauge of 1435 mm, electrified with a constant voltage of 600 V; serves 30 main and 29 auxiliary routes, has 501 cars, 8 depots and, most importantly, free travel on any route within the City of Melbourne. This decision stimulated many suburban residents to abandon cars, and the annual passenger traffic for 2024 exceeded 182.7 million people. The busiest tram routes in the world are 6, 96. In 2014, the third edition of the book by tram development specialists Randall Wilson and Dale Budd was published – more than 200 photographs that show Melbourne's trams in different seasons and historical periods on 80 pages.

Thus, the historical path of the Melbourne tram provided it with the palm in the organization of tram transportation not only in Australia, but also in the world. From competing carriers to a single organization turned into a global brand; designation of routes and design of tram cars with geographical reference; the preservation of the historically established radial route network are the main milestones that the Melbourne tram missed through 2 centuries, despite various wars and upheavals.

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СТРАТЕГИЧЕСКОЕ ЦЕНООБРАЗОВАНИЕ В ИНВЕСТИЦИОННО-СТРОИТЕЛЬНЫХ ПРОЕКТАХ: ПРОБЛЕМЫ И ЭФФЕКТИВНЫЕ РЕШЕНИЯ

STRATEGIC PRICING IN INVESTMENT AND CONSTRUCTION PROJECTS: PROBLEMS AND EFFECTIVE SOLUTIONS

В статье рассматривается актуальная проблема стратегического ценообразования в инвестиционно-строительных проектах в условиях современной российской экономики. Исследование фокусируется на анализе ключевых противоречий между участниками строительного рынка и поиске эффективных решений для их преодоления. Автор выделяет существенные проблемы реализации инвестиционно-строительных проектов – нарушение ценовых взаимосвязей, демпинг, снижение качества строительства и срывы сроков. Особое внимание уделяется концептуальному разграничению понятий стоимости, цены и ценности, что является принципиально важным для формирования эффективной стратегии ценообразования. В работе предложен инновационный подход к стратегическому ценообразованию, основанный на балансе интересов всех участников инвестиционно-строительного процесса. Автор призывает к междисциплинарным исследованиям при переходе к человекоцентричности, учитывающей коммерческие интересы стейкхолдеров и социальную значимость инвестиционно-строительных проектов.

Ключевые слова: стратегическое ценообразование, управление стоимостью, ценой, ценностью, человекоцентричность в принятии решений, эффективная реализация инвестиционно-строительных проектов.

The article considers the relevant problem of strategic pricing in investment and construction projects in the context of the modern Russian economy. The research focuses on the analysis of the key contradictions between the participants of the construction market and the search for effective solutions to overcome them. The author considers relevant problems of investment and construction projects implementation – violation of price relationships, dumping, construction quality reduction and

missed deadlines. Special attention is paid to the conceptual differentiation of the concepts of cost, price and value, which is fundamentally important for the formation of an effective pricing strategy. The paper offers an innovative approach to the strategic pricing based on the balance of interests of all participants in the investment and construction process. The author calls for interdisciplinary research in the transition to a human-centric approach that takes into account the commercial interests of stakeholders and the social significance of investment and construction projects.

Keywords: strategic pricing, cost, price, value management, human-centricity in decision-making, effective implementation of investment and construction projects.

Nowadays, as a result of the dynamic institutional changes in the national economy, there is an increase in the cost of construction work, a decrease in labor productivity and, as a consequence, an unjustified increase in wages. These factors will have influenced the price relationships in investment and construction projects and reduced the effectiveness of the strategy for the development of the construction industry and housing and communal services of the Russian Federation by 2030 with a forecast until 2035, aimed at improving the standard of citizens life, creating a comfortable and safe environment, high-quality infrastructure for human life, work and recreation – the main capital of our countries [1]. The situation is getting worse by dumping business structures that violate the basics of pricing, which leads to the situation when the construction companies offering a real price become an unclaimed asset and lose tenders and auctions. At the same time, competition winners that minimize the price are often unable to fulfill their obligations to customers. As a result, customers try to hedge the risk and worsen the conditions for applicants. Construction organizations win the competition at the minimum estimated ex ante cost and increase the ex post, price due to the extra work or hidden works costs, reduce volume, quality, disrupt construction deadlines, abandon construction objects, making them not in demand, leaving behind deceived shareholders [2].

On the one hand all these problems related to pricing, require coordination of interests and activities while configuring connections from limited resources in order for construction organizations to achieve their own and public goals. On the other hand, in order to synchronize the activities of ICI participants, it is necessary to find effective solutions based on the strategic formation of price relationships. In an economic and managerial

sense, price relationships are influenced by the federal and regional regulators, investors, design and survey organizations, research institutes, industrial enterprises, building materials factories, products and structures estimates, logistics companies, customer developers, contractors, educational institutions, consumers and society. At the same time, the pricing process in the construction sector affects the development of plans, facilitates the selection of a method for parallel and sequential fulfillment of upcoming tasks, identifies organizational and economic factors and anchoring guidelines for cost and time management, allows companies monitoring factual plan deviations and makes it possible to adjust the delay in time [3].

The interchangeability of these concepts is acceptable in financial accounting, which is being developed in the application of artificial intelligence (AI) to optimize aggregated and gross indicators. As Professor V. V. Asaul rightly points out: "The final decision should always be made by a person, because only he has the big picture and common sense to understand the consequences of decisions..." [5, p. 119]. However, it should be noted that when production relations without clarifying the basic concepts of pricing are established, the sensitivity of construction organizations to the need to improve the skills of employees decreases, and the relationship between wages and labor productivity is violated, which hinders the coordination of mutual activities. From the perspective of economists based on the main principle of the neoclassical school, a simplified "black box" approach is used, which considers the price chains of added value in industrial relations. An equally serious omission is that production is seen as a one-step process in which the means of labor are instantly transformed into final goods. In other words, neoclassicism does not take into account the multi-stage production process that unfolds over time and uses many cycles of divided labor. Such restrictions diminish the importance of economic organization; consideration of resources is based on homogeneous characteristics, which artificially simplifies the coordination of multiple structures in the production process, making it trivial [6]. As a result, the operational and tactical connections of the production chains of the construction process are disrupted, price conflicts arise, then the negative phenomena of inconsistency and incoordination of strategic relationships «pile up», the disorganization of divided activities begins, and contradictions in the interests of stakeholders are exposed.

Strategic pricing as a tool for effective solutions for developers, contractors, buyers and regulatory authorities gives an opportunity to avoid latent contradictions in price relationships and promotes better coordination of activities during construction process. This study showed that each group had a contradictory assessment of cost, price and value in the life cycle chains of a construction project. These contradictions were revealed as the answers to the question to developers, contractors, buyers, regulators and other stakeholders – what is pricing for?

Real estate developers focus on maximizing prices for customers and minimizing the cost of contract work, which leads to a deterioration in the quality characteristics of the project, to social tension and needs to be visualized. As S. V. Bovteev emphasizes: "... visualization makes it possible to fully and effectively familiarize the customers of a construction project, even if they are not specialists in construction, with the organizational and technological decisions being made" [7, p. 355]. In turn, contractors are outraged by inconsistencies between contractual prices and actual costs and risks associated with construction and installation work, which leads to deadlines, losses of the project budget and overspending. Buyers expect high quality at an affordable price, well-developed infrastructure, and pricing transparency, which creates regional differentiation for residential properties. Federal, regional and municipal authorities try to ensure compliance with regulatory requirements and social standards, which helps to save transaction costs and create investment appeal and favorable conditions for construction.

It should be mentioned that the possibility of increasing or decreasing the price is limited by the value judgments of the parties. As a result, prices fluctuate when the parties agree on the ratios of value-to-value and value-to-value exchanges, which are social phenomena, as they are influenced by assessments of the institutional environment. The phenomena of exchange ratios are the result of objective and subjective assessments of quantitative and qualitative indicators. According to L. von Mises, the definition of value should be clearly distinguished from the definition of value. The definition of value in no way depends on the subjective assessment of the value of the one who determines the value. The definition of value is a value judgment reflecting the difference in value. Cost determination is the anticipation of an expected event. It aims to establish what

prices for a certain product will exist on the market and how much money it will take to buy a certain product [8, p. 316].

The price is determined in the exchange process by the ratio of what is valued by the party as less valuable in exchange for what is more valuable to it. The second party forms its own assessment of the ratio of the expected result from the exchange and the costs incurred. The category of «values» becomes mandatory for discussion by stakeholders. Measures in such cases are focused on innovations that ensure the manageability of the activities of inter-corporate value chains, which lays the conceptual foundation for the formation of a pricing strategy for investment and construction projects as a response to the challenge of increasing uncertainty in the market environment with continuous fluctuations in consumer preferences [9].

Thus, the pricing strategy will contribute to the development and adoption of effective decisions, taking into account possible manifestations of rational/irrational reactions to negative market impacts. Such a strategy will define cost, price, and value as structural interconnections of extended exchanges of increasing needs for limited capabilities of the parties in the production chains of the construction project. Strategic pricing reveals structural contradictions in a new way and offers effective solutions that promote the integration of divided labor and competing interests throughout the life cycle of a construction project. At the same time, the reception of the formation of local prices as long-term exchanges of bundles of obligations with «... the possibility of extracting partial tangible and intangible powers from property» [10, pp. 126–127] will become an effective tool for budgeting and budgeting will ensure the adaptability of the parties and activity management in construction projects. Therefore, it is advisable to determine prices in production chains by the ratio of results and costs from objective and subjective estimates of the cost and value of the interacting parties. Then price signals will open up alternative opportunities for conscious choice from a variety of ratios of what the project participant can achieve in exchange for what he undertakes to fulfill [9]. In fact, a human-centered approach is proposed, which makes it possible to ensure the coordinated effectiveness of the implementation of an investment and construction project, taking into account the commercial interests of stakeholders and the social significance of the facilities.

The choice of new opportunities being used in the right way will be important for the state and society, to improve the quality of life of the population, their health and education, and, in general, to increase human capital [11]. Strategic pricing is based on the human-centered approach that considers a construction project not only as a commercial interest, but also as a contribution to social infrastructure. It is necessary to continue interdisciplinary research to ensure the coherence and balance of the widest possible social groups of individuals and legal entities, increase labor productivity, attract qualified personnel, and synchronize the work of construction companies, which will be an effective response to growing institutional changes.

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РОБОТОТЕХНИКА В ЛЕСОЗАГОТОВИТЕЛЬНОЙ ПРОМЫШЛЕННОСТИ

ROBOTICS IN THE LOGGING INDUSTRY

В статье рассматривается проблема внедрения новых технологий в работу лесной промышленности. Применение робототехники в лесной промышленности играет большую роль для развития этой отрасли. Робототехника – это междисциплинарная область науки и техники, которая занимается проектированием, созданием, эксплуатацией и использованием роботов. Приводятся технические характеристики некоторых образцов робототехники. В статье также рассматриваются преимущества и проблемы, с которыми сталкивается отрасль при внедрении роботизированных механизмов: высокие первоначальные инвестиционные затраты, потребность в квалифицированном обслуживающем персонале и потенциальные трудности при освоении существующих рабочих процессов. В заключение можно сказать, что используемая в роботизированных системах робототехника, а также современные технологии, способствуют повышению эффективности работы в лесозаготовительной отрасли.

Ключевые слова: роботы, робототехника, ГПС, лесозаготовительные машины, современные технологии.

The article discusses the problem of introducing new technologies into the work of the forestry industry. The use of robotics in the forestry industry plays an important role in the development of this industry. Robotics is an interdisciplinary field of science and technology that deals with the design, creation, operation, and use of robots. The technical characteristics of some samples of robotics are given. The article also examines the problems and limitations faced by the industry when implementing robotic mechanisms: high initial investment costs, the need for qualified service personnel, and potential difficulties in adapting existing workflows. In conclusion,

robotics in the logging industry, as well as modern technologies used in robotic systems, contribute to improving work efficiency.

Keywords: robots, robotics, GPS, logging machines, modern technologies.

Robotics in the logging industry is one of the most promising and rapidly developing areas that can transforms traditional working methods and improve overall production efficiency.

Robotics is an interdisciplinary field of science and technology that deals with the design, creation, operation, and use of robots. It combines knowledge of mechanics, electronics, programming, automation and artificial intelligence [1].

Knowledge of subjects	Tasks
Mechanics	To develop the physical basis of a robot, engine, mechanisms and drive
Electronics	To create various circuits and systems that control mechanics
Programming	To write codes that will control the robots
Sensor systems	To use of various sensors
Aviation and navigation systems	To allow robots to navigate the terrain, including GPS and orientation systems
Safety (factors)	To ensure the safety of robots themselves, others, users, and the environment

In recent years, there has been an active introduction of automated systems and robotic machines, which is associated with a number of factors, such as the need to increase productivity, reduce labor costs, improve working conditions and increase safety in production. The use of unmanned vehicles for large-scale forestry operations originated decades ago, at least in Sweden. The first examples are radio-controlled machines such as DESTEN the death of forest and beaver, the forest radio-controlled bioenergy harvester [2].

Advantage of robotics in the logging industry:

1) Process automation

Modern logging machines (harvesters and forwarders) are equipped with automated systems. They allow not only to cut and assemble wood, but also to analyze the condition of the forest. These machines can select the best trees for cutting down based on pre-entered parameters. Partial automation has proven to be a promising technology that facilitates work. It frees the operator from operating the machine partially. As a result, machine tool manufacturers implement basic automation technologies to improve productivity and operational efficiency. This makes machine control easier for operators to understand. Examples of such an implementation are intelligent boom control from John Deere, Smart Flow and Smart Crane systems from Komatsu Forest, as well as so-called intelligent hydraulic valves, which initiated innovations in these new products (Fig. 1).

Fig. 1. Cutting a tree with a Harvester multifunctional logging harvester

2) Remote control and autonomy

Many new models of logging machines can operate in remote control mode or even completely autonomously (Fig. 2). This allows operators to be at headquarters or in a safe place. They can control the harvesting process, which is very convenient and important in various conditions.

In Sweden, software engineers and forestry scientists have decided to automate some time-consuming logging tasks. They used GPS to determine the route in the cleared area and equipped the vehicle with a computer vision system. It helps to identify, pick up and discard the cut logs.

Fig. 2. Remote control of a logging harvester

3) Environmental harm reduction

Robots can be equipped with special sensors and programs to minimize environmental harm. For example, they may avoid certain areas or limit logging in certain areas, which helps preserve ecosystems.

4) Cost reduction

The introduction of robotics can reduce the cost of employee training and the overall number of employees. As many processes become simpler due to automation, and the HR department as a whole is decreasing. The robot can do most of its work autonomously.

5) Increased safety

Robots can perform the most dangerous operations, such as cutting trees, working in difficult conditions or on steep slopes. This reduces the likelihood of accidents and injuries among employees. Many modern machines can be controlled remotely, allowing operators to keep a safe distance from potentially dangerous situations such as falling trees or collapsing ground [3].

Disadvantages of robotics in the logging industry:

1) Impact on jobs

The job cuts as the result of process automation. Robots can perform many tasks that do not require highly intelligent solutions. Some experts point out that this process can lead to job losses for people. It is very important for regions or urban enterprises where logging is the general population.

2) The importance of qualified personnel

With the transition to robotic technologies, there is a need for specialists capable of servicing and managing them. This requires additional costs for training and professional development of employees. It is necessary, to create special educational institutions for this industry.

3) High initial costs

The introduction of robotic technologies requires a fairly large investment. For many companies, this can be a serious financial inconvenience, especially for small and medium-sized enterprises.

4) Technological features of the structures

The level of technology in the field of robotics is high, but many systems still have limitations in both functionality and reliability. For example, robots can face problems in difficult natural conditions (heavy rain or difficult terrain). Sometimes working conditions can change at any moment. It depends on the region and terrain [4].

The use of robotics is found in many industries. In the logging industry robots are used in such areas as:

1) Logging machines

Most of the current logging machines such as Harvesters and Forwarders etc. can be equipped with automation systems that will minimize human involvement in many areas of activity of these machines. For example, felling a tree, chopping trees, transporting a tree.

2) Forest condition monitoring

In addition to being able to perform normal mechanical actions, systems can also perform analytical processes. Monitor the condition of the soil, monitor the condition of the trees (Fig. 3). Partial deforestation is possible, leaving the necessary plantings that are not suitable for logging.

3) Navigation systems

Using GPS and other similar systems, working together with artificial intelligence, allow machines to choose the most optimal routes for transportation or for moving though the logging area.

Fig. 3. Workplace of a logging harvester operator

4) Drones

Unmanned aerial vehicles can be used for aerial photography of terrain and woodlands. This will allow to maximize performance in conjunction with other systems. Aerial photography is made with drones. It is possible to assess the state of forests, forest health, and pest detection. This greatly speeds up and simplifies the data collection process. [5, 6].

Thus, robotics in the logging industry has an important role in the development of this industry. Robots are becoming an integral part of logging, replacing manual labor. Modern machines make work safer, more efficient and more environmentally friendly. Logging with robots is not just a trend, but the future of the entire industry. It has both pros and cons. But in any case, further improvements in this area will not only help to increase productivity.

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РЕФОРМЫ ОБРАЗОВАНИЯ В РОССИИ XX – НАЧАЛА XXI ВЕКА: ПРОШЛОЕ И НАСТОЯЩЕЕ

EDUCATION REFORMS IN RUSSIA XX – EARLY XXI CENTURY: PAST AND PRESENT

Статья посвящена актуальной теме цифровизации системы образования. Данная работа является продолжением предыдущей публикации, посвященной теме повсеместного внедрения цифровых технологий в образовательный процесс и также освещает потенциальные риски и угрозы внедрения цифровых технологий в учебную деятельность. В работе описаны возможные неприятные последствия перехода на цифровые системы образования в Российской Федерации. Особое внимание уделено анализу образовательных реформ, проводимых в нашей стране с 1917 года по настоящее время. Проводится их сравнительный анализ. Также в статье освещается проблема возможного вреда от использования ноутбуков, мобильников, айфонов, беспроводной связи и прочих технологий для физического и психического здоровья обучающихся, ненадежности баз хранения данных, избыточного сбора личных данных учащихся и педагогов, влияния цифровых технологий на образовательный процесс в Российской Федерации. Автор приходит к выводу, что при проведении новых реформ совершенно не учитывается исторический опыт, широкое использование образовательных интернет платформ и цифровых технологий в школьном образовании снижает уровень знаний учащихся, а масштабное внедрение в образовательный процесс новых технологий взамен традиционным в Российской Федерации на сегодняшний день слишком неоднозначно и неоправданно.

Ключевые слова: образовательная реформа, педология, форсайт-проект, цифровизация, ИИ, цифровая образовательная среда, персональные данные, индивидуальная образовательная траектория, интегральная оценка, электронное обучение, базы данных, утечка данных, социальный рейтинг.

The article is devoted to the current topic of digitalization of the education system. This work is a continuation of the previous publication devoted to the topic of the widespread introduction of digital technologies into the educational process

and also highlights the potential risks and threats of the introduction of digital technologies into educational activities. The paper describes the possible unpleasant consequences of the transition to digital education systems in the Russian Federation. Special attention is paid to the analysis of educational reforms carried out in our country from 1917 to the present. Their comparative analysis is carried out. The article also highlights the problem of possible harm from the use of laptops, mobile phones, iPhones, wireless communications and other technologies for the physical and mental health of students, unreliability of databases, excessive collection of personal data of students and teachers, the impact of digital technologies on the educational process in the Russian Federation. The author comes to the conclusion that when carrying out new reforms, historical experience is completely ignored, the widespread use of educational Internet platforms and digital technologies in school education reduces the level of students' knowledge, and the large-scale introduction of new technologies into the educational process instead of traditional ones in the Russian Federation is currently too ambiguous and unjustified.

Keywords: educational reform, pedology, foresight project, digitalization, AI, digital dementia, personal data, e-learning, databases, digital individual educational trajectories, lifelong learning, data leakage, social rating.

The topic of implementing of the Federal project "Digital Educational Environment" aimed at creating and implementing a digital educational environment in educational institutions, as well as ensuring the implementation of the digital transformation of the education system) is very relevant today, huge amounts of money are being spent on this from the country's budget. As of February 2025, the federal budget for the implementation of the digital educational environment amounts to 69,9 billion rubles [18]. This education reform is based on the foresight project "Education 2030", which aims to eliminate traditional educational systems by the 2030s.

The experiment on the introduction of a Digital educational environment started on September 1, 2020. It officially ended on December 31, 2022, but no analysis of the results was conducted. There is no official data on the completion and results of the experiment, the feasibility of its implementation, as well as the impact on the quality of school education. But today, DSP is being actively implemented throughout the country: schools are required to connect to the My School system, and students are required to register in the Spheres messenger (embedded in the VKontakte social network), university students and teachers are required to register

on the My Education online platform, etc. It started on September 1, 2020. It officially ended on December 31, 2022, but no analysis of the results was conducted. There is no official data on the completion and results of the experiment, the feasibility of its implementation, as well as the impact on the quality of school education.

Firstly, we need to take a closer look at the history of reforms, because as Vasily Osipovich Klyuchevsky said: “History is not a teacher, but a supervisor: she does not teach anything, but severely punishes for ignorance of lessons.”

The most in-depth analysis of the stages of the reform of Russian education was conducted by Candidate of Physico-Mathematical Sciences, teacher Igor Petrovich Kostenko in his work “The “Reforms” of education in Russia 1918-2018. The idea, the methodology, the results” [14].

He points out that the current reforms are a consequence of the reforms of the 1970s, which in turn have their roots in the early post-revolutionary years and pose a serious threat to education.

The first post-revolutionary reform dates back to 1918, when the State Commission for Education, headed by Lunacharsky and Lepeshinsky, developed a document on the principles of building a new school (it was signed by Sverdlov). The creation of a “labor school” was proclaimed, the purpose of which was not to teach, but to “solve the problems posed by life.” Deep theoretical knowledge was deemed unnecessary. All the students needed was skills. There was also a struggle against “authoritarian” pedagogy, grades, exams, and homework were canceled. “This one-on-one corresponds to the guidelines proclaimed in the foresight project “Education 2030”, which are guided by the current “digitalists” who proclaim the need not for knowledge, but only for skills determined by the needs of the market and the business customer” [21].

The ideological basis of the first post-revolutionary reform was pedology, which originated in the West in the late 19th and early 20th centuries. Pedologists considered heredity as a crucial factor in the success of education and upbringing, and schools began to widely use methods of student selection through psychological testing, on the basis of which the further professional fate of the child was rigidly determined. (Very similar to the individual educational trajectory of Digital education – approx. author) Analyzing this topic, O. N. Chetverikova concludes: “As a re-

sult, pedology actually turned into eugenics and began to openly introduce a caste system of inequality" [21]. Pedology spread very quickly, and research centers and institutes were established. At the first pedological Congress in 1928. Anatoly Lunacharsky, the first People's Commissar of Education of the RSFSR, said: "Pedology, having studied what a child is, according to what laws it develops, will thereby illuminate the most important process before us - the production of a new person in parallel with the production of new equipment that goes through the economic line" [7]. Pedologist Pavel Blonsky: "Along with crop production and animal husbandry, there should be a science that is homogeneous with them. – human breeding and pedagogy <...> should take its place next to animal science and phytotechnology, borrowing from the latter, as more developed related sciences, its methods and principles" [7].

At the same pedagogical congress, the Bolshevik, Marxist theorist, academician of the USSR Academy of Sciences N. I. Bukharin called for: "We now need to focus our efforts on producing in the shortest possible time a certain number of live workers, skilled, specially trained machines that could now be started and put into general circulation" [6]. Similar aspirations are observed today, when it is proposed to make a digital avatar, a cyborg, out of a person. "Today, pedology is taking on new forms, changing names, but its essence remains the same ruthless eugenic approach. The project of the so-called digital school is one of the mechanisms for creating a caste society based on anthropological and social selection, as well as on the latest, previously unthinkable technologies," says O. N. Chetverikova, Candidate of Historical Sciences [21].

The result of the first post-revolutionary reform was the collapse of education. The country began to sink even deeper into chaos. In the late 20s, the country's leadership stated that education had reached a dead end, and the situation could no longer be left like this. The entire leadership of the People's Commissariat of Education, headed by Lunacharsky, was removed, and his staff was reduced from 8,5 thousand people to 335. In the period from 1930 to 1936, a number of resolutions of the Central Committee of the Party and the Council of People's Commissars were adopted, as a result of which it was decided to return to the experience and methodology of the classical pre-revolutionary school. Humanitarian education was, of course, ideologized, but the exact sciences were almost not ideologized.

As for pedology, in 1936, by a special decree of the Central Committee of the CPSU (b) "On pedological perversions in the Narkompros system," it was eliminated both at the level of theory and practice. Paedological institutions were closed.

As a result of this reform, universal compulsory primary education was introduced. Then they began to switch to universal compulsory education in the scope of a seven-year school. Further, a network of pedagogical colleges and institutes was launched. Five grades of academic performance assessment and mandatory assessment standards for all schools were established, etc.

As a result, thanks to the creative reforms of the 1930s, a school was formed that gave the country a huge number of scientists and scientific discoveries, a school about which American Admiral Hyman Rickover, speaking to the US Congress in 1958, said: "The seriousness of the challenge posed to us by the Soviet Union is not that it is stronger than us militarily. The problem is that he threatens us with the education system."

The Soviet and Russian scientist, Professor Sergey Georgievich Kara-Murza, in his work "The History of the Soviet State and Law" notes: "The Soviet school brought up self-confident, spiritually free people with a broad outlook and inner dignity..... The essence of a unified comprehensive school that does not divide people into the masses and the elite has been revealed" [14].

And today, on the contrary, we often hear: "elite schools", "elite institutions", "elite approach"... Active organizers and participants of education reform Dmitry Peskov (since 2018, he has been the special representative of the President of the Russian Federation on digital and technological development) and Pavel Luksha back in 2013-2014 in the report "The Future Education: a global agenda" [12]:

"Future education is likely to become even more highly stratified. The division into strata will be determined by the possibilities of "live" access (including the cost of this access) to unique holders of competencies – "gurus" and communities of practice.

Mass knowledge and skills will be transferred primarily through automated solutions (at the first stages, through hybrid online/offline formats, as in blended learning, and then through work with fully automated mentor systems).

"Live" training will be comparatively more expensive and, as a result, will be of a "premium" nature – and in most cases it will be organized not as a long joint training, but in the form of short intensive sessions."

According to the Education 2030 project, the period 2025-2035 is a key transition point to the complete breakdown of the traditional knowledge transfer system. And recently, decisive steps have indeed been taken to reform the education system. At the end of December 2024, Prime Minister Mikhail Mishustin signed an order approving the composition of the Coordinating Council under the Government of the Russian Federation for the creation of advanced educational institutions. According to the Message of the President of Russia to the Federal Assembly in 2024, by 2030, at least 12 advanced schools using the best technologies and teaching methods should be opened in all federal districts. The Coordinating Council will determine the directions of work on the creation of such schools. (Dmitry Peskov is a member of it - approx. the author)

It is planned to carry out individual student selection in advanced schools. It is also assumed that these educational institutions will be staffed by teachers and managers on a competitive basis. The question arises – what will happen for non-advanced schools? Cheap online training under the guidance of an AI system?

There is also a lot of talk from representatives of the Ministry of Education and the Ministry of Science and Higher Education about the introduction of so-called digital individual educational trajectories. They are called in different ways: "variable learning", "individual educational route", individual trajectories, individual track, and so on. The general meaning of these trajectories is something like this: all children are different, and therefore everyone needs their own personal approach, their own personal subjects to study. That is, according to this scheme, the trajectories form, in general, the fate and future of the child, and only according to some specific scenario prescribed in advance by the compilers of these trajectories. And if the teachers had done it, it would have been half the trouble. But the fact is that in all discussions of individual educational trajectories, we are not talking about teachers, but about artificial intelligence (AI) systems, which will determine these trajectories.

GOST R 59895-2021 "Artificial intelligence technologies in education" has been in effect since March 1, 2022. It clearly states that an individual

learning trajectory is a sequence of learning materials that is formed based on an analysis of the student's personal characteristics and learning goals.

That is, it is directly stated that a certain program determines the materials on which the child will study, based on the characteristics that it will read from the child. And here we are talking not only about the educational process. The system will evaluate the child according to various indicators that have nothing to do with the learning process itself.

For example, paragraph 3.1 – Computer vision technologies in education states that security cameras will be installed in the classroom above the children. Naturally, this is ostensibly served to prevent conflict situations between students. In the guest it sounds like this: "Real-time recognition of a video sequence and assessment of the psycho-emotional state of students in the classroom, identification of patterns of unstable psycho-emotional state."

Paragraph 3.3 – Intellectual decision support technologies states that the system itself will determine the curriculum for the teacher, and the child will determine tasks based on his big data. Here you can already read the possibility of learning without a teacher, and in paragraph 3.5. it is written: "The set of described artificial intelligence technologies can be used for autonomous learning without the intervention of a teacher through an artificial intelligence tutor.

Computer vision technologies make it possible to translate the student's input information into a machine-readable form. Machine learning and data analysis technologies allow students to form a personal educational trajectory and conduct an assessment."

That is, this GUEST stipulates that a certain system will collect absolutely all data from the child, including behavioral data, and on the basis of this data determine his fate and future. And all this is based on algorithms prescribed by no one knows who, and no one knows why.

In fact, this is almost a complete analogue of a social rating. Systems where a person's behavior and actions directly affect the possibility of receiving some kind of social benefits. In the case of educational trajectories, this social good is education.

That is, if a child learns well from the first grade and behaves well, then the system, and not the teacher, and this is important, will lead him along a certain conditionally positive trajectory, along which tasks will

gradually become more complicated and his rating will grow. But, if a student starts making mistakes from the first grade, for example, in behavior, then his system will follow a completely different trajectory, where, on the contrary, the tasks will be simpler, and at the exit he will receive something that can no longer be fully called education.

What unites these two examples is that both in the process, the system will discard unnecessary, in its opinion, subjects – after all, this is the basis of individual learning and individual trajectories. After all, the main idea of these trajectories is that the child will do only what he does well. What happens will be amplified, and everything else that is supposedly unnecessary will be discarded.

As a result, these two conditional students, both an excellent student and a two-year student, will become people of the same button by the end of school in such a system, with the only difference being that they will be slightly different buttons, sharpened for different functions. They will only be able to work in the field that this program chooses for them, because they simply will not have other knowledge for other professions.

This is the key difference between this system and classical education, which provided a complete basic package of knowledge in all areas, and by the end of school the child could already choose where to go and who to become. In the proposed system, there will be no such opportunity, and the child will be able to go only where the program tells him.

Another term that is very common nowadays is lifelong learning. Since in this new paradigm, education is no longer knowledge, but a set of personal data and competencies that the system collects in all ways, continuous education means the constant collection of this data. Moreover, this dossier will have a direct impact on life. Here is an excerpt from the report of the Kudrin Center for Strategic Research. It is called “The State as a platform”:

“The state should form and supplement a person’s electronic profile in the ocean of data from the very birth. As a result, everyone will receive an “individual personality building trajectory. Already in the hospital, information about the birth of a child will fall into the “ocean of data”, where his “digital twin” will appear, the document says. – Further, the “digital twin” will be “overgrown” with more and more new data... Based on data about the “digital twin” of a citizen, collected in many aspects (health,

education, psychological characteristics, etc. P.) the possibility of building individual trajectories of personality development will increase" [11].

It says directly that all data about a person will be collected, and based on these data, someone will build a trajectory for the development of his personality. But this is what is being offered in education now [4].

And here is an opinion about the individual educational trajectories of Alexander Vladimirovich Shevkin, Candidate of Pedagogical Sciences: "I remember well that in elementary school I dreamed of becoming a forester, and when I was older, I became a biologist. At the same time, I also dreamed of becoming a singer... If the idea being implemented now had somehow been applied then, then I would have been trained first as a forester, then as a biologist, and a little bit as a singer. And when I became interested in teaching mathematics in the 8th grade, I would no longer be able to fulfill my dream, since before that I would have been taught mathematics "sparingly" without overloading my head with "unnecessary", in someone's opinion, knowledge of mathematics.

As a result, I would have been poorly prepared in mathematics, and would not have realized myself as a mathematics teacher. I will say this immodestly – I have heard about it from many – an excellent math teacher, creative, author of articles and books for teachers and students on school mathematics, co-author of textbooks in the MSU-School series (S. M. Nikolsky and others). I would not have become an honored teacher of Russia, nor a laureate of the Moscow City Hall award in the field of education, I would not have done much of what I managed to do in my profession. I want to ask using one of my examples: What would the country gain if I were guided along an individual educational path and made a forester? It is a necessary profession, I don't want to offend anyone.… But still? The choice of profession is never final, even for adults. What are individual educational trajectories? In a nutshell, this is an artificial intelligence-based system that determines the talents of a particular child and builds a plan for his further studies (and in fact, his life and fate) based on a decision she made about him in advance. The system decides that your child is a future janitor, and he will be a janitor, because it will give him only the knowledge that the janitor needs. Why waste extra resources on it? The main goal of the implementation of this system is the elimination of classical full-time education with a broad outlook and general

subjects. It is planned to replace the old system with an online system for assigning narrow skills to each person, according to his trajectory. Simply put, it's a one-button human education system, followed by the elimination of schools and teachers" [1].

Igor Stanislavovich Ashmanov, a Russian entrepreneur in the field of information technology, artificial intelligence, and software development, made another comment on the inadmissibility of educational trajectories. He compared them with the routes that Yandex Navigator gives us. The fact is that Yandex, without telling anyone about this, has long since moved from monitoring traffic flows to managing them. And when you type in an address on your navigator right now, it builds a route for you, not based on what's best for you, but based on what's best for the transport system. That is, the route he offers you is actually not the best route. Also, in education, the fate and future that the program offers you is not the fact that it will be the best for you.

Journalist, public figure Andrey Afanasyev said in his speech at the round table "Education: meanings, values, intelligence. A problematic situation" in February 2022 that this whole story with individual trajectories for everyone is a trap. The introduction of such trajectories into the education system will inevitably lead to its complete transition to digital learning. How do you imagine the lesson schedule of a class or group, where each student has their own separate subjects and their own separate assignments? It is simply impossible to do this in a classic format, and it can only be done in a digital format, where an AI will stand over everyone and give them their own tasks. This is what everything is designed for, and therefore it is important to understand that any promotion of ideas for the introduction of individual educational trajectories is actually the promotion of ideas for a complete transition to low-quality and cheap e-learning, which forms a primitive person with a single button [4].

Summarizing the above, we can conclude that the introduction of a digital educational environment will lead to the fact that learning with real teachers will be "premium in nature." In other words, online distance education will be cheap, while human education will be expensive. A person–to-person transmission system will remain in place for the elite, while remote and computer-based transmission will be used for the rest. Artem Soloveitchik, Director of Sberbank's Education Industry

Center, at the Moscow International Education Salon, which was held in Moscow in March 2025. I have already stated that the natural process of education has already collapsed, all children have smartphones, they are not interested in school, so we need to recognize this and transfer everyone to self-education. “We talk all the time about self-education, about the need for it. But the whole school system is based on the fact that there is no self-education... Today, the school has reached the point where the “said–something-given–a-task-checked” teaching method does not work. Everything turns into a formality and a fiction. Therefore, the natural process of education has collapsed. And, there is only one thing left for us, teachers, not to interfere with self–education anymore. But we’re in the way,” Soloveitchik said. As for self-education, the only possible way to preserve it is through AI. Let the children watch for themselves what they are interested in, the representative of Sberbank believes. In general, the discussion became a laudatory ode to AI in education.

At the same event, the rector of MEPhI, Vladimir Shevchenko, described the future of education in an extremely simple way.”There are two educational spaces. One of them is mathematics, Plato’s dialogues, and personal communication between a teacher and a student. The other is online, chatbots, mass education, quick access to the labor market with a clear level of competence. The gap between these two educational spaces will widen,” he said [13]. In other words, quality education will not be for everyone.

In other words, the lessons of history have remained unlearned and the country is once again at risk of plunging into chaos with an illiterate population, as it was a hundred years ago. Of course, there are a lot of problems in our education. But there are also ways to solve these problems. We do not even have to reinvent the wheel.

We already have everything – there is a legacy of the classical Russian gymnasium and the Soviet school. But most importantly, everyone needs to start with themselves. Parents should instill in their children from early childhood respect for people and love of knowledge, Teachers should love their profession and children and understand that a child who comes to the first grade is a whole world open to knowledge. Students should treat their teachers with respect, learn from their experience and multiply it. And we all need to understand that real knowledge is transmitted only

from Person to Person. Even the most ardent lobbyists of digitalization and AI systems do not deny this.

And one more point that I would like to draw attention to is the proposal to introduce an "integral" assessment for school graduates, which would reflect knowledge in all subjects. According to TASS, Olga Vasilyeva, President of the Russian Academy of Education, believes that this is a reasonable idea. Vasilyeva noted that the results for the unified State exam (USE) cannot yet fully reflect "all the achievements of the graduate, his abilities and talents in the complex."

And in early December 2024, the head of the Human Rights Council, Valery Fadeev, at a meeting of the Council for the Development of Civil Society and Human Rights, stated that graduates should be admitted to universities not only on the basis of the Unified State Exam, but also the average score in each subject [9].

The head of the HRC also proposed to introduce grades for school behavior. He called for students with bad behavior to be prevented from taking final exams. [8] Deputy Prime Minister Dmitry Chernyshenko noted at the end of December 2024 that the issue of the possibility of introducing an integrated assessment would be discussed with teachers as part of the preparation of a strategy for the development of education in Russia for the period up to 2036 with a view to 2040 [9].

The trend is obvious. The introduction of an integrated assessment, which will be formed in the student's digital portfolio, obviously involves the connection of a neural network (AI) for automatic analytics and its formation. But in general, all this no longer looks like an assessment of real knowledge, but rather the basis for a student's future permanent personal rating. This will include more than just the assessment of knowledge.

The very approach of an "average grade in all subjects" for a graduate upon admission to a university destroys a person's specialization and personal inclinations. That is, it destroys the essence of education for the individual as such. The average "personality assessment" will include marks for behavior, for the student's "skills and competencies", which are not subject knowledge, but represent qualities of character and personality. With the help of an "integral" assessment, it will be very convenient to divide people into classes./strata and, accordingly, distribute rights depending on this assessment.

And here is another quote from the report by Dmitry Peskov and Pavel Lukshi "The Future of Education: a global Agenda" (2013–2014). Assessment systems go beyond the education system (which is only a special case of such a system). In society, it becomes possible to move to the "merit economy" as a universal system for evaluating the achievements of each individual, in which reputation becomes reputational capital, allowing access to knowledge and resources (for more information, see the section new financial architecture and "reputational capital"). The natural development of assessment systems in education is their integration with similar achievement systems" [12].

In other words, education transformation plans are not limited to education alone. Here we are talking about the social rating of a citizen's trustworthiness (today it is actively used in China. Unreliable people are limited in their ability to use transport, cannot take out loans, and with a very low rating they are sent to special closed camps for re-education and "awareness raising") Similar projects are being actively implemented in Russia today. Vice-Rector for Science of the Russian State Social University (RGSU) V. Urozhenko confirmed that his university is developing an experimental platform "We", which generates a social rating for Russians based on various parameters. "As part of the project, our scientists set the task of developing a modern social scoring system on a specially created qualimetric platform using probabilistic and statistical assessment models," the RSSU press service reported. The RSSU expects that authorities at all levels, as well as public organizations, will be able to use this system "to implement prompt and objective social support for the population." As explained in the report, the rating will look like a two-component scoring code.

Both components will be two–digit numbers: the first number is the social status of a person, the second is his social level. For example, 47–29. Social status is the "merits" of a person, and the social level is the digitization of his "prospects" from the point of view of the state. The release notes that the academician's social level may be inferior to the same indicator for "a young unmarried master who works at a machine-building plant and produces children's sleds for sale in his garage." The second component of the marker reflects the expectations of the state regarding the reserves of human development and the willingness to support the re-

alization of his personal prospects for the benefit of the country. The authors of the "We" project propose to link the scoring code with the personal data of a citizen, such as SNILS, INN, passport information and phone number. The report also indicates that the system will help divide citizens into classes based on their usefulness to the state: "If resources are scarce, we need clear criteria for their allocation" [2].

"Achievement assessment systems (both in education and beyond) can be built as a continuous assessment process in a game-like dynamic (similar to how it is done in an MMORPG, where the player receives points for each game action, and collectively, levels and related bonuses). Such a system, built in the logic of quests & achievements and embedded in augmented reality, can accompany a person throughout the whole day – when you can earn points for a healthy lifestyle, correct social behavior ("moved the old lady across the street"), etc. When combined with the learning process, education turns into a "personal character leveling quest" when the student, acting as a player, develops himself according to the recommended scenario," says the report "Future Education: Global Agenda" [12].

The keywords here are "character leveling" and "according to the recommended scenario"! A person does not develop on his own, as a creator, as a full–fledged personality, but is brought up according to set strict patterns, being actually driven into the rigid framework of a strict evaluation algorithm from the cradle – his whole fate, the entire development scenario has already been prescribed by specially trained "social engineers" – and the possibilities for self-activity, his own free choice are extremely narrowed here.

Let us also recall the words of Moscow Mayor Sergei Sobyanin, who said about the Moscow Electronic School project about the lifelong management of an "electronic portfolio" for each student [18].

We are indeed on the verge of enormous changes being imposed on us in the social sphere, in particular in education. The ultimate goal of these reforms is total control over the life and destiny of each individual through a machine algorithm controlled by someone. Control – and management. But we want to remain human, don't we? This means that a lot still depends on actions and statements, on the reaction of each of us to what is happening, on our study of history, and on the development of

critical thinking. It is just that everyone needs to stop sleeping and finally take their fate (and their children's) into their own hands.

Information for reflection:

The more the government invests in the digitalization of education, the worse the quality of education becomes as a result. This was stated by Manfred, Professor of Psychiatry at Ulm University, director of the Center for Neuroscience at the Psychiatric University Hospital in Ulm, author of the book "Anti-brain" (about the impact of digital technologies). He spoke about the PISA International Student Educational Achievement Assessment program.

"This is a study conducted in about 50 countries, which tested the school performance of 15-year-olds in German, grammar or mathematics. The data was cut every three years for more than 20 years. Today, you can take a 10-year period from the PISA indicators and see in each country how much money per pupil per school was invested in digital infrastructure, that is, in computer classes, the Internet, and Wi-fi. How much money was invested in one student? You can also see how the development of students has changed over this period. <...> The more money the government invests in digital infrastructure in schools, the worse school performance. And as a result, the quality of education is deteriorating. Less knowledge," said Spitzer [20].

Anna Shvabauer, PhD in Law, member of the Expert Advisory Council on Family Law of the Federation Council of the Federal Assembly of the Russian Federation said that from the point of view of the parent community, the first threat now is the large-scale digitalization of education, the introduction of the so–called "digital educational environment", which is provided for by the national project "Education" and Government Decree No. 2040. The draft of this document is Government Decree No. 2040."About conducting an experiment on the introduction of a digital educational environment" – at one time it was posted on the website regulation.gov.ru 54 thousand respondents were against, and only 400 were in favor, that is, the difference in voting is a hundred times, and still the draft was adopted, with virtually no amendments.

At the same time, the Ministry of Digital Transformation Order No. 600 suggests that by 2030, 100 % of children should have a digital profile on the DSP platform, and the share of assignments in electronic form for students using automated verification by 2030 should be 70 %.

This is proof that at least 70 % of education in the next ten years should be electronic. In other words, our paper textbook can be used as an electronic medium, and the teacher turns into a kind of attachment to the DSP in the role of a tutor.

What are the main risks of DSP? First, it is the destruction of education. Secondly, there are serious risks for children; and thirdly, there are risks with personal data [16].

Russian physiologists Bezrukikh M. M., Ivanov V. V., Hollandtseva A. I. state: "Students who work on a computer have a greater decrease in mental performance than those who did not use a computer, and the degree of decrease in performance is directly related to the duration of their stay in front of the monitor" [5].

On January 1, 2021, the new "Sanitary and epidemiological requirements for organizations of upbringing and education, recreation and recreation of children and youth" SP 2.4.3648-20 came into force (approved by the decree of the Chief State Sanitary Doctor of the Russian Federation Anna Popova). The previous ones (interfering with digitalization) were canceled. "35 previous sanitary regulations (2,800 pages of documents) aimed at ensuring the safe stay of children in educational institutions at all levels have been abolished. The result of the colossal work of the hygienists of the old school was eliminated" [21].

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УДЕРЖАНИЕ ТАЛАНТОВ: МАРКЕТИНГОВЫЕ СТРАТЕГИИ УДЕРЖАНИЯ ПЕРСОНАЛА

TALENT RETENTION: RETENTION STRATEGIES FOR HR

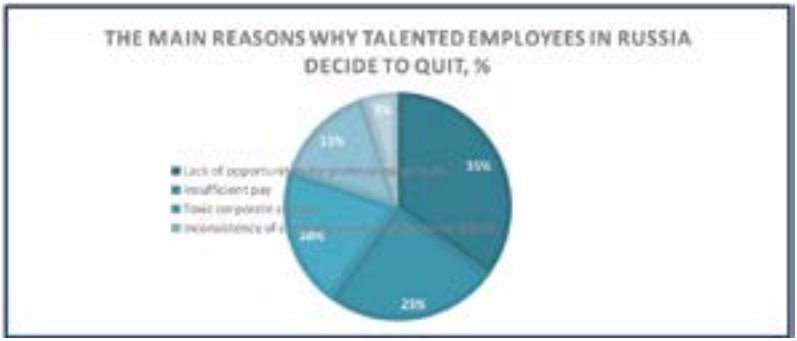
В статье рассматривается актуальная проблема удержания талантливых сотрудников, высококвалифицированых работников в современных организациях через призму маркетинговых подходов. Авторы анализируют ключевые стратегии и инструменты, которые позволяют эффективно привлекать и сохранять высококвалифицированных специалистов на рынке труда. Особое внимание уделяется формированию привлекательного HR-бренда компании, разработке конкурентоспособных компенсационных пакетов и программ развития персонала. В работе представлены результаты исследований, анализируются данные, демонстрирующие влияние различных факторов на решение талантливых сотрудников о смене работы. Авторы выделяют основные тренды в области удержания персонала и предлагают комплексный подход решения данной задачи.

Ключевые слова: управление талантами, стратегия удержания талантов, развитие, мотивация, рынок, работники.

The article examines the current problem of retaining talented employees and high-qualified workers in modern organizations through the prism of marketing approaches. The authors analyze the key strategies and tools that make it possible to effectively attract and retain highly qualified specialists in the labor market. Special attention is paid to the formation of an attractive HR brand of the company, the development of competitive compensation packages and personnel development programs. The paper presents research results and data analysis demonstrating the influence of various factors on the decision of talented employees to change jobs. The authors identify the main trends in the field of staff retention and propose an integrated approach to solving this problem.

Keywords: talent management, talent retention strategy, development, motivation, market, employees.

In today's conditions of intense competition for talent, companies are forced to develop comprehensive strategies for retaining key employees and making them stay at the company. A mention should be made that staff turnover is not just numbers in the HR department's reports, it reflects how well the company is able to retain talent and create comfortable development and working conditions for them, to satisfy their needs and aspirations. Understanding the true reasons why employees make the decision to leave or change the company and find another job (see figure).



The main reasons for the leakage of talented employees

These findings highlight the critical importance of developing effective talent retention strategies for any modern organization [1].

When developing such a strategy, it is important to remember that it must be lively and adaptive. The labor market is constantly changing, new trends and expectations of employees are emerging, technologies and business processes are developing. What worked yesterday may not be effective today.

Adaptability in HR strategy is not just a term, it is a vital necessity in a fast-growing labor market. Continuous technological advancements, shifting demographics, and the evolving values of workers demand flexibility and a willingness to change established approaches from companies more often. A strategy that ignores these factors risks becoming outdated,

leading to decreased employee motivation, increased turnover, and, consequently, poorer business performance.

Like customer acquisition marketing strategies, talent retention strategies require a deep understanding of the target audience and a personalized approach. That is why the algorithm for developing a talent retention strategy must consider the following crucial components [2]:

1. Analysis of the current situation. The first step is to carefully analyze the current situation in the company. This includes monitoring the statistics of layoffs, investigating the reasons for the departure of key employees, analyzing competitive profitable offers in the market, and assessing the current level of staff satisfaction. This analysis allows us to identify the main problems and growth points.

2. Defining the target audience. An important element is the identification of the target audience within the company. It is necessary to define clear criteria for key talents, evaluate the current staff and create profiles of target groups of employees. This helps to focus efforts on the most valuable and highly-qualified specialists.

3. Development of individual development plans. One of the key components is the development of individual development plans for key employees. This includes holding face-to-face meetings, defining career goals and expectations, and creating personalized development plans with regular progress monitoring. This approach demonstrates the company's interest in the growth of each employee.

4. Creating a comfortable work environment. Creating an attractive employer brand plays a crucial role in retaining talent. This is achieved through the creation of a comfortable working environment, the introduction of flexible work formats, the organization of areas for informal communication and the maintenance of a work-life balance.

5. Development of a system of non-material motivation. Non-material motivation also plays a significant role. Effective tools include a system of public recognition of achievements, mentoring programs, the opportunity to participate in significant international projects and corporate events to strengthen team spirit.

6. Creating a feedback culture. A culture of open feedback is an integral part of a successful strategy. Regular management meetings with employees, the creation of anonymous feedback channels, conducting

satisfaction surveys and training managers in communication skills help to create an atmosphere of trust and engagement.

When developing such a strategy, it is important to remember that it must be lively and adaptive. The labor market is constantly changing, new trends and expectations of employees are emerging, technologies and business processes are developing. What worked yesterday may not be effective today.

Typical mistakes in developing a talent retention strategy include excessive focus on financial motivation, lack of an individual approach, and insufficient attention to developing managers' leadership skills.

One of the key aspects of an adaptive strategy is the continuous monitoring and analysis of internal and external factors influencing HR management. It is necessary to track changes in legislation, labor market trends, new technologies, and regularly conduct employee surveys to understand their needs and expectations. Based on the data collected, policies related to salaries, training, career development, and corporate culture can be quickly adjusted.

Investments in talent retention directly affect the long-term success of a company and its competitiveness in the market. A flexible and adaptive strategy capable of responding to changes in employee needs and market demands is becoming an important competitive advantage of a modern organization.

Furthermore, a truly adaptive HR strategy embraces data-driven decision-making. This means moving beyond intuition and relying on concrete metrics to assess the effectiveness of HR initiatives. By analyzing data related to employee engagement, performance, retention, and recruitment, HR professionals can identify areas for improvement and make informed decisions about resource allocation. This data-driven approach ensures that HR efforts are aligned with business objectives and contribute directly to the bottom line.

In conclusion, it is worth mentioning that an effective talent retention strategy requires an integrated approach that considers both tangible and intangible motivation factors. The key is to constantly update the strategy in accordance with changes in the labor market and the needs of employees. Regular analysis of the effectiveness of the measures taken and timely adjustment of the strategy are the key to its long-term success [3].

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ИНТЕГРАЦИЯ ESG-КРИТЕРИЕВ: ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ

INTEGRATION OF ESG CRITERIA: CHALLANGES AND DEVELOPMENT

В статье представлен комплексный анализ текущего состояния и перспектив развития ESG-интеграции в современном бизнесе. Исследуются ключевые факторы популяризации экологически ответственного управления и устойчивого развития среди компаний и инвесторов. Особое внимание уделяется проблемам, связанным с внедрением ESG-критериев в управленческие решения. Рассматриваются основные направления развития ESG-интеграции, а также роль инвесторов в формировании требований к раскрытию ESG-информации. Большов внимание уделяется практической значимости данного исследования, направленного на определение путей и возможностей решения существующих проблем и разработке рекомендаций по совершенствованию инструментов ESG-интеграции и их использованию в бизнесе.

Ключевые слова: ESG-критерии, устойчивое развитие, рейтинговые агентства, инвестиционные решения, корпоративная ответственность.

The article presents a comprehensive analysis of the current state and prospects of ESG integration development in modern business. The key factors of popularization of environmentally responsible management and sustainable development among companies and investors are investigated. Special attention is paid to the problems related to the implementation of ESG criteria in management decisions. The main directions of ESG integration development are considered, as well as the role of investors in the formation of ESG information disclosure requirements. Much attention is given to the practical significance of the research aimed at identifying the ways and possibilities to solve existing problems and developing recommendations for improving ESG integration tools and their use in business.

Keywords: ESG criteria, sustainable development, rating agencies, investment decisions, corporate responsibility.

Currently, businesses are actively developing innovative management approaches. Organizations aimed at increasing efficiency and achieving strategic objectives integrate modern management solutions into their activities. An important trend has been the increased emphasis on environmental responsibility and sustainable development in all areas, especially in investments. As a result, a set of criteria has been formed that determine the sustainable development of commercial activity, ESG criteria (Environmental, Social, and Governance), which has become a key tool for assessing the long-term viability of a business [1].

In recent decades, environmental, social, and management criteria have become essential and significant elements of the global financial integration. ESG parameters are attracting more and more attention from regulators and investors, which encourages companies to integrate the principles of sustainable development into their strategies. To assess compliance with these principles, a special ESG rating has been developed, which many organizations strive to achieve.

The main components of the ESG concept include:

1. An environmental aspect that evaluates the company's impact on the environment and its contribution to environmental initiatives.

2. The social aspect, reflecting the quality of working conditions, participation in social projects and concern for the well-being of employees.

3. The management aspect, covering the effectiveness of management, the principles of corporate ethics and pay equity.

A mention should be made about the special research agencies such as Bloomberg, S&P Dow Jones Indices, JUST Capital, MSCI, Refinitive and others to form the ESG rating [2]. Companies' development is assessed according to three criteria – E, S, and G – where companies are awarded points on a one-hundred-point scale. Thus, MSCI has developed the following three categories for evaluating companies: leaders with AA and AAA ratings; companies with average indicators – A, BBB, BB; and laggards – B, CCC [3].

Assessment of ESG criteria according to the MSCI system

Currently, there is no universal system for evaluating companies according to ESG criteria, which leads to differences in ratings between agencies. Each agency independently analyzes publicly available information provided by companies, forming its own assessment.

The implementation of environmental, social and management indicators in the business strategy faces several significant obstacles that must be considered to achieve sustainable development in the long term.

The main problems faced by organizations include different issues.

1. Methodological heterogeneity of assessment. Rating agencies use different approaches to evaluating companies based on ESG criteria, which creates contradictory results and makes it difficult for investors to make informed decisions.

2. The delayed effect of investments in sustainable development. Despite the growing popularity of ESG principles, positive financial results are evident only in the long term. Companies should be prepared for temporary risks and possible losses in the short term.

3. Significant resource costs. The implementation of ESG strategies requires significant investments and the diversion of resources from core activities. In a competitive market and unstable economic situation, this may negatively affect the company's current financial performance.

All these factors must be considered when planning and implementing ESG strategies to successfully overcome emerging challenges and achieve sustainable development in the future.

The implementation of the principles of social responsibility (ESG) creates the basis for sustainable development and improvement of financial performance for businesses and investors. Let us look at the key advantages of ESG integration:

1. Development of partnership relations. Effective interaction with all stakeholders – customers, investors, employees and local communities – allows them to take into account their needs and expectations in the field of sustainable development. This is achieved through regular consultations with interest groups, collaboration with NGOs, and staff involvement in sustainability training programs.

2. Increasing investment attractiveness. Modern investors increasingly prefer companies with a high ESG rating, which opens wide opportunities for organizations that support the principles of sustainable development to attract capital and strengthen their financial positions.

3. Strengthening business reputation. Transparent communication of ESG initiatives contributes to the growth of trust on the part of all stakeholders, which in turn contributes to the expansion of the investment portfolio and the formation of new strategic partnerships.

These advantages demonstrate how ESG integration can become a powerful driver of modern business development.

The emergence and development of ESG factors has become an essential element in the process of combining the financial sector and the concept of sustainable development. This idea is constantly being improved and is becoming increasingly important for investors and organizations focused on ensuring long-term sustainability. Today, it is obvious that the ESG criteria are firmly embedded in the basis of the market sector and the sustainable development strategy, becoming an integral part of them.

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ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В ПОГРУЗОЧНО-РАЗГРУЗОЧНЫХ ПРОЦЕССАХ НА ПРЕДПРИЯТИЯХ РЖД

ARTIFICIAL INTELLIGENCE IN LOADING-UNLOADING PROCESSES AT RZD ENTERPRISES

В статье рассматривается использование искусственного интеллекта (ИИ) в процессе погрузки и разгрузки грузов российскими железнодорожными компаниями (РЖД). В нем анализируются ключевые технологии искусственного интеллекта, такие как машинное обучение и компьютерное зрение, и приводятся примеры их практического применения для повышения безопасности, оптимизации логистики, прогнозного технического обслуживания и автоматизации повседневных операций. Была подчеркнута важность внедрения искусственного интеллекта, реализуемого Российскими железными дорогами, в цифровую деятельность РЖД, особенно в контексте повышения безопасности труда. Была подтверждена необходимость решения проблем, связанных с качеством данных, интеграцией с существующими системами и обучением персонала. Сделан вывод о большом потенциале искусственного интеллекта в повышении эффективности, снижении издержек и повышении качества обслуживания клиентов при условии, что Российская железнодорожная компания применит инновационный стратегический подход. Интеграция искусственного интеллекта рассматривается как стратегический шаг по модернизации транспортной сети и обеспечению устойчивого развития российских железнодорожных компаний.

Ключевые слова: искусственный интеллект, РЖД, погрузка-разгрузка, машинное обучение, безопасность, логистика.

The article discusses the use of artificial intelligence (AI) in the loading and unloading process of Russian railway (RZD) companies. It analyzes key artificial intelligence technologies such as machine learning and computer vision, and provides

examples of their practical applications in improving safety, optimizing logistics, predictive maintenance, and automating daily operations. The importance of the introduction of artificial intelligence embodied by Russian railways in the RZD digital activities was emphasized, especially in the context of improving occupational safety. The need to solve problems related to data quality, integration with existing systems, and staff training has been confirmed. The conclusion is about the great potential of artificial intelligence in improving efficiency, improving the quality of customer service, as well as reducing costs provided that the Russian railway Company adopts an innovative strategic approach. The integration of artificial intelligence is regarded as a strategic step to modernize the transportation network and ensure the sustainable development of Russian railway companies.

Keywords: artificial intelligence (AI), loading and unloading, Russian railway (RZD), machine learning, safety, automation.

Application of artificial intelligence in the loading and unloading process of RZD enterprises: improving safety, efficiency and innovation. As the backbone of Russia's huge transportation network, Russian Railways (RZD) is under great pressure to optimize operations and maintain a competitive advantage in the global logistics field. The loading and unloading process (LUP) is a key link in the supply chain, and technological progress is particularly mature. Traditional processing methods, which are usually characterized by manual labor and inefficient resource allocation, pose major challenges: increased processing time, the possibility of errors, security issues, and suboptimal utilization of infrastructure. The adoption of artificial intelligence (AI) within the framework of RZD's LUP is no longer a futuristic aspiration, but a strategic imperative [2].

Artificial intelligence provides the potential to automate daily tasks, optimize logistics, predict demand fluctuations, enhance security protocols, and achieve smarter decision-making throughout the LUP life cycle. This shift is essential for RZD to reduce costs, improve service delivery, and maintain its position as a leading transportation provider [1].

The RZD digital event emphasized the importance of artificial intelligence to achieve a higher level of security in the loading and unloading process, indicating that there is a growing awareness of the benefits of artificial intelligence within the organization. The artificial intelligence environment for RZD loading and unloading operations is connected with the application of AI in LUP that covers a wide range of technologies, each of them provides unique functions [3].

Machine learning (ML): machine learning algorithms are at the core of many artificial intelligence applications, allowing systems to learn from data without explicit programming. In addition, ML can be used for forecasting demand; historical data analysis, seasonal trends and economic indicators, as well as for predicting future freight volume and optimizing resource allocation.

Route optimization and scheduling formulate efficient railway time-table and delivery routes to minimize transportation time and fuel consumption. Track availability, weather conditions and traffic congestion should be also taken into consideration.

Cargo identification and classification: automatically identify cargo types, characteristics, and priorities based on images, sensor data, and other inputs. This helps simplify the sorting and processing process.

Computer vision (CV): CV technology enables the system to “see” and interpret visual data for: Automatic cargo and truck identification: identify truck numbers, container Ids and other marks to achieve automatic tracking and inventory management. This reduces manual data entry and improves accuracy.

Condition monitoring: detect cargo damage, equipment failure and other abnormalities through visual inspection. This allows proactive maintenance and prevents costly outages.

Autonomous equipment navigation: use visual input to autonomously guide forklifts, cranes, and other equipment to achieve more efficient and safer operation.

The robot system can automatically perform physical tasks, reduce dependence on manual labor and improve efficiency. Automatic loading and unloading is connected with deployment of robots to perform repetitive tasks such as lifting, moving, and stacking goods. The goods are automatically sorted and grouped according to the destination and customer orders.

It is necessary to mention automating the packaging and labeling of goods to achieve efficient distribution. Natural language processing enables the system to understand and process human language, and promotes: analysis of transportation documents, declarations, and other paperwork to extract relevant information and speed up processing. One more necessary procedure is connected with realizing voice control operations and providing real-time communication between operators and dispatchers.

Based on data analysis, performance reports are automatically generated. RZD's current artificial intelligence plans and global best practices. Although RZD's AI adoption is developing, the company is actively implementing various initiatives, as evidenced by RZD's digital activities and other reports.

Automated truck sorting system implements an automatic CV-based truck identification and routing system in the sorting yard to improve throughput and efficiency.

Station congestion prediction is developing ML models to predict station congestion and optimize resource allocation to minimize delays.

Warehouse management system means deployment an automated system for storing and retrieving goods in the warehouse to improve space utilization and order execution speed.

The use of artificial intelligence to identify potential safety hazards in the loading and unloading process and reduce accidents and injuries is a major theme of RZD's digital activities.

Globally, several leading organizations are already reaping the benefits of AI-driven LUP.

DP World (UAE): the use of automated terminals with robots and CV systems for container handling significantly reduces turnaround time. Port of Rotterdam (Netherlands): Use artificial intelligence to predict the arrival time of ships and optimize transportation schedules to improve port efficiency.

Amazon (U.S.): uses robots and automated systems in its fulfillment centers to sort, pick, pack, and ship orders to achieve faster and more reliable delivery.

Rio Tinto (Australia): the use of automatic trains to transport iron ore demonstrates the potential of autonomous driving technology in logistics.

Advantages of RZD: improved efficiency, safety and competitive advantage. The potential benefits of AI-driven LUP for RZD are huge, affecting key performance indicators (KPIs): improve efficiency: reduce handling time. Automating tasks, optimizing workflows, and using intelligent control systems can significantly reduce the time required to load, unload, sort, and assemble goods.

Automated truck management and intelligent traffic control improve the throughput of stations and terminals, minimize waiting time and improve resource utilization. The result is the increase of throughput.

The AI system can optimize the allocation of equipment, personnel, and storage space, minimize downtime and improve asset utilization.

Automating repetitive tasks reduces the demand for manual labor and reduces wages and welfare costs.

Lower fuel and energy consumption: optimizes routes and schedules, and use more efficient equipment to reduce fuel and energy costs.

Reduce maintenance costs: the condition monitoring system can detect potential equipment failures early, so as to achieve preventive maintenance and minimize maintenance costs.

Improve security: reduce accidents. Automating hazardous operations can reduce the risk of accidents and injuries in the workplace. An artificial intelligence-driven security system can analyze video sources to detect unsafe behavior and provide alerts. Hazard prediction: AI algorithms can identify patterns and predict potential safety hazards during loading and unloading. The RZD digital campaign emphasizes that this aspect is a key driver of the adoption of artificial intelligence.

Strengthen customer service is improved by tracking and reliability. Automatic cargo tracking improves accuracy and reliability, providing customers with real-time visible cargo locations.

Reduce cargo damage: cargo condition monitoring can identify damage early, so as to take preventive measures and reduce losses.

Strengthen supply chain integration is one of the main tasks: artificial intelligence can promote better communication and information sharing with other participants in the supply chain.

Managing change and ensuring data security are connected with the notions of challenges and risks.

The implementation of artificial intelligence in LUP is not without challenges and risks. They are:

- high initial investments. Artificial intelligence projects require a large amount of initial investment in hardware, software, and expertise;
- labor transfer and skills gap. Automation may replace certain jobs, requiring labor retraining and the development of new skills;
- data security and privacy. The collection and analysis of large data sets have raised concerns about data security, privacy, and potential abuse;
- integration complexity. Integrating AI solutions with existing legacy systems can be technically challenging;

- employees' resist. Employees may resist the adoption of new technologies and processes;
- ethical considerations. AI-driven decision-making raises ethical issues about bias, fairness, and accountability;
- lack of standardization. The lack of standardized data formats and protocols can hinder interoperability and data sharing;
- mitigation strategy. Framework for successful implementation of Artificial Intelligence.

To sum up it is necessary to say:

in order to successfully overcome these challenges, RZD must adopt a comprehensive mitigation strategy:

- develop a clear strategy and roadmap: define specific goals, objectives, and priorities for AI adoption, and create a detailed implementation roadmap;
- ensure the safety of funds and resources: allocate sufficient financial resources, including hardware, software, and personnel, for AI projects. Invest in workforce development: develop training plans to equip employees with the skills needed to use artificial intelligence systems;
- prioritize data security and privacy: implement reliable data security measures, including encryption, access control, and anonymity technologies, to protect sensitive data;
- ensure seamless integration: carefully plan the integration of AI solutions with existing infrastructure and systems;
- effectively manage change: communicate the benefits of artificial intelligence to employees, involve them in the implementation process, and provide continuous support.

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РАЗВИТИЕ ПРОМЫШЛЕННОГО СТРОИТЕЛЬСТВА В КОНТЕКСТЕ ТРАНСФОРМАЦИИ РОССИЙСКОЙ ЭКОНОМИКИ

DEVELOPMENT OF INDUSTRIAL CONSTRUCTION IN THE CONTEXT OF RUSSIAN ECONOMIC TRANSFORMATION

В статье проводится анализ современного состояния промышленного строительства в условиях трансформации российской экономики. Рассматриваются актуальные тенденции, включая внедрение цифровых технологий, автоматизацию процессов, повышение энергоэффективности и экологическую устойчивость, а также структурные изменения в выполнении работ собственными силами организаций. Особое внимание уделено анализу показателей обновления и износа основных фондов, подтвержденному данными аналитической записки Федеральной службы государственной статистики за 2023 год, а также выявлению факторов, сдерживающих деятельность строительных организаций. На основе проведенного исследования сформулированы рекомендации, направленные на модернизацию материально-технической базы, оптимизацию нормативно-правовой среды и повышение квалификации кадров, что, в конечном итоге, может способствовать устойчивому развитию отрасли и повышению конкурентоспособности национальной экономики.

Ключевые слова: промышленное строительство, реконструкция, промышленные объекты, строительно-монтажные работы.

The article analyzes the current state of industrial construction in the context of the transformation of the Russian economy. Current trends are considered, including the introduction of digital technologies, process automation, increased energy efficiency and environmental sustainability, as well as structural changes in the performance of work by the organizations' own forces. Particular attention is paid to the analysis of the indicators of renewal and depreciation of fixed assets, confirmed by the data of the analytical note of the Federal State Statistics Service for 2023, as well as identifying factors hindering the activities of construction organizations. Based

on the conducted study, recommendations are formulated aimed at modernizing the material and technical base, optimizing the regulatory environment and improving the skills of personnel, which, ultimately, can contribute to the sustainable development of the industry and increasing the competitiveness of the national economy.

Keywords: industrial construction, reconstruction, industrial facilities, construction and installation works.

Industrial construction as a type of economic activity influences the development of the economy of any country, ensuring the creation of infrastructure for production and logistics processes. In the context of the transformation of the Russian economy caused by changes in global markets, the introduction of new technologies and adaptation to modern challenges, this industry is faced with the need to promptly respond to external and internal changes. An analysis of current trends and challenges faced by industrial construction allows us to identify areas for improving the efficiency and sustainability of the industry. In recent years, a number of significant trends have been observed in industrial construction in Russia:

Innovative technologies and digitalization: modern industrial construction is characterized by the widespread introduction of digital technologies, such as BIM modeling systems, the Internet of Things (IoT) and automation of project processes. These innovative solutions allow us to optimize costs, improve the accuracy of project management and ensure prompt monitoring of construction processes [2, p. 17]. The use of smart control systems and robotic systems helps to reduce time costs and improve the quality of constructed objects.

Energy efficiency and environmental sustainability: one of the priority areas is to increase the energy efficiency of construction projects and the use of environmentally friendly materials. Modern projects are aimed at reducing emissions, minimizing energy consumption and reducing the negative impact on the environment, which is in line with global trends in sustainable development [3, p. 20].

Despite the positive trends, the industry faces a number of serious problems. In particular, large-scale projects require comprehensive integration of modern engineering systems, which significantly increases their complexity and the risk of errors at the design and construction stages. The joint use of various technologies and methods leads to the need for continuous improvement of management and technical approaches [2, p. 19].

An analysis of the state of fixed assets in construction reveals a significant degree of their depreciation and instability of renewal rates. According to the analytical note of the Federal State Statistics Service, the fixed asset renewal rate (in comparable prices) decreased from 9,5 % in 2022 to 7,6 % in 2023, which indicates a decrease in investment in the renewal of the material and technical base. At the same time, the depreciation rate remains at 0,8 % (2023), and the degree of depreciation of fixed assets in current prices increased from 50,5 % (2021) to 54,1 % (2023) [1, p. 22]. These figures reflect the trend towards an aging production base, which has a negative impact on the reliability and efficiency of construction.

Table 1

Depreciation level, coefficients of renewal and disposal of fixed assets in construction, in %

	Construction		
	2021	2022	2023
Renewal rate of fixed assets	9,3	9,5	7,6
Fixed assets disposal rate	0,8	0,7	0,8
Degree of fixed assets depreciation	50,5	52,9	54,1

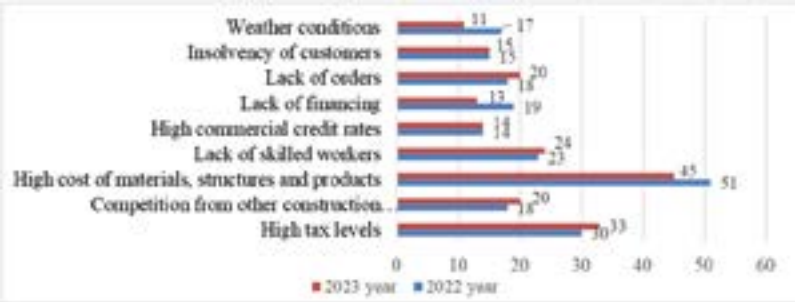
According to the report of the Federal State Statistics Service «Construction Complex of the Russian Federation in 2023», there is a negative trend in the structure of work performed by organizations on their own: the share of construction of engineering structures decreased from 44,5 % in 2022 to 41,8 % in 2023. Considering that the construction of engineering structures includes industrial construction projects, a decrease in this indicator may indicate a reduction in investment in this segment or a change in the strategic priorities of construction organizations. Thus, to maintain and further develop industrial construction, it is necessary not only to actively introduce innovative technologies and improve energy efficiency, but also to pay special attention to the restoration and renewal of the material and technical base.

Table 2

Structure of works performed by organizations using their own resources by type of economic activity «Construction», in % of the total

	2022	2023
construction of engineering structures	44,5	41,8
construction of roads and highways	21,8	20,7
construction of railways and subways	2,4	2,6
construction of bridges and tunnels	3,6	3,6
construction of utilities for water supply and sanitation, gas supply	8,2	7,5
construction of public utilities for providing electricity and telecommunications	2,8	2,8
construction of water structures	0,7	0,6

Surveys of construction company managers revealed a number of key factors that hinder the active development of the industry. Thus, 45 % of respondents indicated the high cost of materials, structures and products, 33 % – a high level of tax burden, 24 % – a shortage of qualified workers. In addition, competition from other companies and a shortage of orders are recorded by 20 % of respondents, insolvency of customers – 15 %, a high percentage of commercial credit – 14 %, lack of financing – 13 %, as well as the impact of adverse weather conditions – 11% [2, p. 23]. These data indicate the complex nature of the problems affecting both the economic and technical components of the industry.



Factors limiting activities in construction,
in % of the total number of surveyed organizations

Taking into account the identified trends and existing problems in industrial construction, it becomes obvious that there is a need to develop a comprehensive approach to overcome current challenges. Based on statistical data and analytical reviews provided by the Federal State Statistics Service and industry sources, we will formulate a set of recommendations aimed at ensuring sustainable development of the industry:

- Integration of digital technologies and modernization of the material and technical base: given the decrease in the rate of renewal of fixed assets and the increase in their depreciation, it is necessary to modernize the production base actively by introducing modern information systems (BIM, IoT) and automated technologies. Such measures will not only improve the efficiency of design and construction, but also extend the service life of equipment and structures;
- Development of educational programs and advanced training of personnel: to overcome the shortage of qualified personnel, it is recommended to create specialized educational programs and trainings aimed at mastering new technologies and construction methods. This will ensure a personnel reserve that meets the requirements of the modern economy;
- Optimization of the regulatory framework and investment incentives: it is necessary to improve the regulatory framework in order to create a favorable investment climate. Reducing the tax burden, simplifying administrative procedures and supporting innovative projects can help attract investment to the industry, which in turn will stimulate the renewal of fixed assets and the development of infrastructure projects;

● Optimization of the structure of work performed Analysis of the structure of work performed by organizations using their own resources indicates the need to diversify activities and focus on the most promising areas (for example, construction of engineering structures and highways). Reorganization and reorientation of efforts to high-tech and energy-efficient projects will increase the competitiveness of the industry.

In conclusion, it should be noted that industrial construction remains a key factor in the economic development and prosperity of the Russian Federation. The integration of innovative technologies, increased energy efficiency and the transition to digitalization contribute to the creation of modern production facilities and sustainable development of the industry. However, the noted problems associated with increased depreciation of fixed assets, a decrease in their renewal rates, as well as the influence of economic and external factors require comprehensive measures to modernize the technical base and optimize management processes. The implementation of the proposed recommendations, including the development of human resources, improvement of the regulatory environment and active intersectoral cooperation, will create favorable conditions for the further development of industrial construction, which will ultimately contribute to increasing the competitiveness of enterprises, creating new jobs and improving the quality of life of the population.

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ВЗАИМОСВЯЗЬ МЕЖДУ УРОВНЕМ ЖИЗНИ НАСЕЛЕНИЯ И ЭКОНОМИЧЕСКОЙ БЕЗОПАСНОСТЬЮ СТРАНЫ

THE RELATIONSHIP BETWEEN STANDARD OF LIVING OF THE POPULATION AND ECONOMIC SECURITY OF THE COUNTRY

В современном мире показатели жизни становятся инструментами для оценки благосостояния людей. Эти показатели помогают не только понять уровень жизни населения, но и указывать факторы, влияющие на его улучшение. Одним из ключевых аспектов поведения является экономическая безопасность, которая является важной частью общей концепции поведения. Экономическая безопасность – это сложный показатель, включающий в себя различные факторы, включая уровень заработной платы, занятость, социальные гарантии, образование, доступ к услугам и другие. Для достижения высокого уровня экономической безопасности необходимо всестороннее и скоординированное воздействие всех этих факторов. Анализ и мониторинг соответствующих показателей позволяет выявить слабые места и разработать эффективные меры по улучшению благосостояния населения и производства общества, где каждый из них защищен от финансовых потрясений.

Ключевые слова: экономическая безопасность, уровень жизни, благосостояние, качество жизни.

In the modern world, life indicators are becoming tools for assessing people's well-being. These indicators help not only to understand the standard of living of the population, but also to indicate the factors that influence its improvement. One of the key aspects of behavior is economic security, which is an important part of the general concept of behavior. Economic security is a complex indicator that includes various factors, including wage levels, employment, social guarantees, education, access to services and others. To achieve a high level of economic security, a comprehensive and coordinated impact of all these factors is necessary. Analysis

and monitoring of relevant indicators allows us to identify weaknesses and develop effective measures to improve the well-being of the population and the production of society, where each of them is protected from financial shocks.

Keywords: economic security, standard of living, well-being, quality of life.

Well-being is a broader concept than simple income measurements. It includes many factors such as health, education, access to social services, and overall standard of living. That is, even with a high income, a person may lack other aspects of life, which negatively affects their overall well-being. Therefore, it is important to consider well-being as a comprehensive indicator that takes into account not only financial aspects, but also social, cultural, and environmental factors.

The standard of living of the population is reflected in the indicators of the state of economic security. In the 208th Decree of the President of the Russian Federation, forty indicators are proposed. The following directly relate to the standard of living of the population:

- gross domestic product per capita (at purchasing power parity);
- labor productivity index;
- inflation rate;
- labor market tension coefficient;
- share of the working-age population of the total population;
- share of citizens with cash incomes below the subsistence minimum;
- distribution of the number of people employed in the economy by level of education;
- decile coefficient (ratio of incomes of the 10 percent of the wealthiest population and 10 percent of the least wealthy population);
- share of workers with wages below the subsistence minimum of the working-age population;
- crime rate in the economic sphere.

The definition of these indicators of the standard of living of citizens as key criteria of economic security points to an important aspect. The main task of state policy aimed at ensuring economic security is to improve the standard and quality of life of people [4].

According to the Oxford Dictionary, security is defined as a state of being free from danger or threat. In this study, economic security is considered as a state of a country's socio-economic environment character-

ized by stable levels of well-being and supporting rising standards of living. This concept covers many aspects, including financial stability, access to resources, and the ability to govern effectively.

Key indicators that allow us to assess the state of economic security of the state include the well-being and standard of living of the population. These indicators play an important role, as they reflect the ability and readiness of the economy to create conditions that contribute to the full existence and development of the individual. In addition, they are the basis for maintaining social and economic stability in society.

When we talk about economic security, special attention should be paid to the standard of living, since this indicator is directly related to the conditions in which human capital develops. Human capital, in turn, is the most important element of the productive forces that ensure the functioning and development of the economy. If the standard of living of the population is high, this indicates that people have access to quality education, health care and other important resources, which, in turn, contributes to the development of their potential and improved productivity.

However, if the economy faces threats, this can lead to negative consequences in the social sphere. For example, a decrease in the standard and quality of life of the population becomes one of the most serious problems faced by the state. Low living standards, as well as significant income differentiation among citizens, can be considered one of the main internal threats to the country's economic security. This not only creates social tension, but also undermines public trust in government institutions, which can ultimately affect the sustainability of the entire economic system.

Given the consequences of economic instability, its impact on vulnerable groups, and the likelihood that this problem will persist in the future, it is clear that government action is needed. Policies should aim to both reduce exposure to and vulnerability to economic crises. This can be achieved by reducing the risk of adverse economic developments and by helping people to equalize their incomes and increase financial stability. It is important to develop measures that will help protect the most vulnerable groups of the population and create conditions for their sustainable development in an unstable economy.

The rating was prepared by specialists from the RIA Rating Center for Economic Research based on information provided by Rosstat, the Ministry

of Finance, the Treasury, the Central Bank and the Ministry of Internal Affairs of Russia for 2023–2024. It is based on a methodology that includes the collection and analysis of various indicators reflecting the standard of living in different regions of the country.

The calculation analyzed 66 indicators, which were combined into 11 groups: income level of the population, employment and labor market, housing conditions, safety of residence, demographic situation, environmental and climatic conditions, health and level of education, provision of social infrastructure facilities, level of economic development, level of small business development, development of the territory and development of transport infrastructure. The result can be seen in table 1.

Table 1

Top 10 regions of Russia by standard of living

Place in the ranking	Region	Rating Score 2024	Rating Score 2023	Difference
1	Moscow	84,085	83,640	0,445
2	Saint Petersburg	83,388	82,310	0,078
3	Moscow region	81,220	79,999	1,221
4	Krasnodar region	76,130	74,355	1,775
5	Republic of Tatarstan	75,062	73,757	1,305
6	Leningrad region	70,206	67,970	2,26
7	Rostov region	68,296	64,844	3,42
8	Kaliningrad region	67,717	66,175	1,542
9	Samara region	67,029	64,836	2,193
10	Khanty-Mansiysk Autonomous Okrug – Yugra	66,066	66,114	–0,048

Most regions showed a positive change in the rating score compared to 2023. The Leningrad Region showed the greatest improvement with

a change of 3.452, while the Khanty-Mansi Autonomous Okrug showed a minus with a change of -0.048. Moscow continues to lead the rating. The general trend is an increase in the rating score in most regions of Russia. Despite the fact that one region showed a slight decrease, the overall picture shows positive dynamics in the growth of quality of life.

Table 2

Top Countries According to Number's Quality of Life Ranking

Place in the ranking	Country	Quality of life indicator
1	Luxembourg	200,1
2	Netherlands	200,1
3	Iceland	191,1
4	Denmark	190,6
5	Finland	188,1
6	Switzerland	185,8
7	Oman	184,8
8	Austria	183,3
9	Norway	181,8
10	Spain	177,7

Unfortunately, Russia has not been able to take high positions in international rankings, despite the government's efforts to improve the economy. However, the country is still among the countries with a high human development index. This year, the Human Development Index (HDI) of Russians was in 52nd place, which is lower than most European countries, but higher than countries such as Belarus, Bulgaria, Turkey, Mexico, Thailand, Brazil and many other popular regions.

Quality of life indicators and economic security are important tools for assessing the well-being of a society. Understanding these concepts allows

us not only to identify current problems, but also to develop strategies to address them. Ultimately, the goal of each country should be to provide its citizens with a high level of well-being, which is possible only through a comprehensive approach to assessing and improving the quality of life.

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ЭКОЛОГИЧЕСКАЯ ПРОБЛЕМА: БИЗНЕС БЫСТРОЙ МОДЫ

ECOLOGICAL PROBLEM: FAST FASHION BUSINESS

В статье анализируется влияние индустрии быстрой моды (Fast Fashion) на экологию и социальную сферу. Исследуются ключевые характеристики этой бизнес-модели, включая сверхбыстрые производственные циклы, массовое потребление и их последствия для окружающей среды. Особое внимание уделяется проблеме неконтролируемого роста текстильных отходов, которые создают угрозу для экосистем и требуют срочных мер со стороны регуляторов и бизнеса. Также подчеркивается необходимость поиска баланса между доступностью модной продукции и устойчивым развитием отрасли. Акцентируются важность внедрения экологичных практик, таких как переработка материалов и этичное производство, для снижения негативного воздействия Fast Fashion. Статья также затрагивает вопросы социальной ответственности брендов и роль потребителей в переходе к осознанному потреблению.

Ключевые слова: быстрая мода, масс-маркет одежды, доступная мода.

The article analyzes the impact of the Fast Fashion industry on the environment and the social sphere. The key characteristics of this business model are explored, including ultrafast production cycles, mass consumption, and their environmental impacts. Particular attention is being paid to the problem of the uncontrolled growth of textile waste, which poses a threat to ecosystems and requires urgent action by regulators and businesses. It also highlights the need to find a balance between the availability of fashionable products and the sustainable development of the industry. The importance of introducing eco-friendly practices, such as recycling

materials and ethical production, is emphasized in order to reduce the negative impact of Fast Fashion. The article also addresses issues of brand social responsibility and the role of consumers in the transition to conscious consumption.

Keywords: fast fashion, mass-market clothing, affordable fashion.

The essence of fast fashion is an extremely accelerated production cycle. Brands promptly monitor current trends, adapt designs to the mass consumer and launch them for sale at affordable prices. At the same time, collections replace each other at breakneck speed – customers do not have time to wear out one thing, as new fashionable novelties are already appearing in stores [1]. A mention should be made about young people who are trying to follow the fashion but sometimes do not have enough time to choose the new items because their clothes are still satisfactory and they are not ready to buy, to buy, to buy.

This extremely fast turnover stimulated frequent purchases and develops a “must-have” mentality among customers and consumers. Fast fashion relies on global supply chains, quite often using factories in developing countries where labor costs are much lower.

Here you can see the model of the Fast Fashion circle.

The most important consequences of Fast Fashion

This allows brands to keep prices down, further fueling the consumption cycle. However, this relentless pursuit of affordability often comes at a steep environmental and social cost. The industry is a major contributor to textile waste, as cheaply made garments are often discarded after only a few wears [2]. The dyeing and finishing processes used in fast fashion production can release harmful chemicals into the environment, polluting waterways and harming ecosystems. Moreover, the pursuit of low prices can lead to exploitative labor practices in garment factories, including unsafe working conditions and unfair wages [3].

Consumers are often unaware of the true cost of these cheap clothes, taken from the human and environmental toll. A growing awareness of these issues is making arguments connected with the fast fashion trends, with consumers increasingly seeking sustainable and ethical substitutes.

Slow fashion movements promote conscious consumption, advocating for higher-quality, longer-lasting garments and fair labor practices. Ultimately, the future of fashion depends on shifting away from a culture of consuming towards a more responsible and sustainable ecological model.

At first glance, it seems like an ideal model:

- Fashion trends are becoming available;
- Customers can buy more and more;
- The product range is updated at lightning speed.

People have a lot of chances to choose what they want and they can buy the desirable items at an affordable price. As a rule, they purchase different clothes items in shopping malls, shops and online as well [4].

But in practice, the fast fashion system has led to serious negative consequences for the entire industry development:

- Environmental responsibility

The industry is facing criticism for environmental pollution, wasteful use of resources and the generation of textile waste. Manufacturers are also implementing recycled materials, recycling programs, and reducing their carbon footprint. And customers are increasingly interested in the production conditions and the environmental friendliness of brands.

- Digital transformation

The pandemic has accelerated the development of e-commerce in the industry. Virtual fitting rooms, AI recommendations, and AR solutions are becoming the new standard.

- Dynamics of assortment renewal

New collections appear every few weeks. Limited editions and collaborations create a stir. If your budget affords you can buy brand clothes and multiple accessories at any price.

- The evolution of consumer preferences

Young people choose style, not brands. The demand for second-hand and vintage goods is growing. A lot of second-hand shops appear in big cities and small towns.

- Production ethics

Brands are reviewing standards in factories. Moving production closer to the sales markets and make them affordable for different groups of people.

Of course, the negative aspects of Fast Fashion don't end there. Each of these elements has consequences that negatively affect the environment.

Negative Consequences of Fast Fashion:

- **Decline in Clothing Quality.**

In pursuit of low costs, fast fashion brands use cheap materials and accelerated sewing techniques. As a result, clothing quickly loses its shape, fits poorly, and rarely lasts more than one season.

- **Formation of "Disposable Fashion".**

Consumers have become accustomed to the idea that clothes are not meant for long-term use. If something tears or loses its appearance, it's not a problem – new models are already on sale.

- **Labor Exploitation.**

Producing clothing at low prices is possible thanks to cheap labor. In Asian countries, fast fashion factories operate under harsh conditions and sometimes employ child labor.

- **Environmental Harm.**

The fashion industry is the second-largest polluter in the world. According to the UN, up to 92 million tons of textile waste end up in landfills annually.

Fast fashion has made fashion accessible but has led to a number of serious problems: declining clothing quality, unsustainable consumption, and labor exploitation. Today, more and more people are realizing the value of a thoughtful wardrobe – moving away from disposable fashion in favor of high-quality, long-lasting items.

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ПРОБЛЕМЫ ЛОГИСТИКИ В РЕАЛИЗАЦИИ ПРОГРАММЫ РАЗВИТИЯ АРКТИКИ

LOGISTICS PROBLEMS IN THE REALIZATION OF THE ARCTIC DEVELOPMENT PROGRAM

В данной работе рассматривается стратегия развития Арктической зоны Российской Федерации и наиболее значимые вопросы региональной логистики. Данная статья, подготовленная с использованием методик анализа научной литературы в рамках имеющихся электронных ресурсов и синтеза полученной информации, направлена на изучение проблематики снабжения Арктического региона. Процессы исследования направлены на рассмотрение самой проблемы, предлагаемых решений и перспектив их дальнейшего разрешения. Статья ставит под сомнение эффективность разрозненных решений, которые принимаются на текущий момент и предлагает проведение дальнейших исследований в этой области. Анализируются данные различных программ, направленных на развитие Арткики.

Ключевые слова: Арктическая зона России, логистика, стратегия развития Арктики, снабжение.

This paper examines the development strategy of the Arctic zone of the Russian Federation and the most significant issues of regional logistics. This article, developed through the scientific literature analysis using accessible electronic resources and the synthesis of gathered information, focuses on examining supply challenges in the Arctic region in the context of sustainable development and international cooperation. The study aims to explore the crucial issues, evaluate solutions proposed, and assess prospects for their resolution. It examines the effectiveness of current approaches critically and emphasizes the need for the future research in this strategically important and resource-rich area. The data of different programs aimed at developing the Arctic zone is analyzed.

Keywords: Arctic zone of Russia, logistics, Arctic development strategy, supply.

In recent years, the Arctic zone has become interesting not only as a source of oil, gas, and metals, but also as a region of increased attention

due to its unique location. These research problems are closely connected with some logistic issues and offered opportunities to create alternative trade routes [2]. This attention was intensified in 2022 with the start of a special military operation and strained relations between Russia and the Arctic Council countries (Canada, Denmark, Finland, Iceland, Norway, Sweden, and the United States). This has led to tension in the region and the creation of a complex international political situation in which ensuring security is becoming strategically important for all parties, including Russia [1].

The "Strategy for the Development of the Arctic Zone of the Russian Federation and ensuring National Security for the period up to 2035" is a key document describing the position of the Russian Federation in the Arctic. It also dwells on the peculiarities of the region, the current state, threats, etc. To ensure national security, it is proposed to modernize healthcare, develop education and create a modern urban environment, supporting housing construction at the state level.

The realization of these tasks involves the introduction of a closed-cycle economic regime in the Arctic, the provision of state support to investors for investments in infrastructure, the geological study of the Arctic, government support for the creation of technologies for the oil and gas fields development, projects to create and modernize fish processing complexes, fish farms and greenhouses, livestock complexes [3]. These measures involve the construction of infrastructure, including the search and development of raw materials.

Thus, among the most significant projects that ensure the fulfillment of the previously mentioned strategic goals and measures, it is necessary to highlight [4]:

- construction of a seaport in the Arkhangelsk region aimed at the development of the Pavlovsky deposit of lead and zinc ores in the area of the Novaya Zemlya archipelago, supervised by the state corporation Rosatom through a subsidiary of Rusatom Cargo JSC [5];
- construction of the processing plant of the Syradasayskoye deposit, one of the largest undeveloped coal deposits in the country. The factory will improve the quality of coal by removing impurities and increasing its caloric content, which will increase its competitiveness in the market. At the first stage, it is planned to process up to 10 million tons of coal per year [6];

- the construction of a new processing plant in Norilsk in the ramps of the Southern Cluster project in the Norilsk Industrial District, which aims to concentrate ore processing from the Talnakhskoye, Oktyabrskoye and Skalistoe deposits in a single technological complex;
- development of transport infrastructure, including the construction and reconstruction of sections of the Syktyvkar–Ukhta–Pechora–Usinsk–Naryan-Mar highway;
- the construction and development of the Obskaya–Salekhard–Nadym–Pangody–Novy Urengoy–Korotchayevo and Obskaya–Bovanenkovo–Sabetta railway lines;
- the reconstruction and modernization of airports in Murmansk, Vorkuta, Arkhangelsk and Naryan-Mar.

However, the implementation of projects in the Arctic zone is facing problems due to the underdeveloped transport infrastructure [7]. The length of roads in the Arctic is only 140,500 km, which is 9,3 % of the total length of roads in Russia. Many northern regions are not connected to the federal network at all. This indicates a poorly developed transport system and infrastructure in the Arctic zone [8].

In addition, due to the low population density, the distances between settlements can exceed 100 km. This creates the problem of providing fuel for vehicles. Due to the peculiarities of the climate, it is necessary to use simplified transfer columns with manual pumps instead of standard ones. Diesel fuel for the Far North requires settling for 10 days and heating to 30–40 °C to prevent freezing and breakdown of the fuel system.

Measures are currently being taken to circumvent the obstacles. The use of the Northern Sea Route is growing, winter roads and river transportation are being created. It is planned to develop satellite systems for monitoring ice and weather, digital platforms for cargo management, as well as the commissioning of new nuclear icebreakers and powerful Leader-class vessels. However, in order to fully realize the potential of new technologies and infrastructure, it will be necessary to develop a logistics strategy that meets the conditions of the Arctic and takes all the possibilities into account. This will lead to increased transportation efficiency and an improved supply of resources to the region.

In general, Russia is striving to maintain its position in the Arctic, and the resolution of logistical problems is coming to the fore, since the im-

plementation of the state strategy for the development of the Arctic is impossible without full-fledged supplies.

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«НЕУДОБНЫЕ СОСЕДИ» ИЛИ ЧТО СТОИТ ЗА СБЛИЖЕНИЕМ МОСКВЫ И АНКАРЫ

«TROUBLESOME NEIGHBOURS» OR WHAT IS BEHIND THE RAPPROCHEMENT BETWEEN MOSCOW AND ANKARA

В исследовании проводится анализ сложных и многогранных отношений между Россией и Турцией, зародившихся еще в XVI–XV веках с первых торговых и дипломатических контактов между Российской и Османской империями. Особое внимание уделяется историческим военным конфликтам, которые неоднократно изменяли политический ландшафт региона и определяли сферы влияния этих держав. Также рассматривается трансформация взаимоотношений в XX–XXI веках, когда наряду с традиционными противоречиями активизировалось экономическое сотрудничество и культурный обмен, способствовавший улучшению взаимопонимания между двумя народами. Исследование стремится выявить причины, которые позволили двум государствам преодолеть старые конфликты и выстроить успешные партнерские связи в современных условиях. Кроме того, работа направлена на оценку того, насколько эффективно достигнутое сотрудничество отражается на политической, экономической и культурной сферах, и выявить потенциальные вызовы, которые могут повлиять на дальнейшее развитие российско-турецких отношений.

Ключевые слова: Россия, Турция, экономические отношения, культурный обмен.

The study analyzes the complex and multifaceted relations between Russia and Turkey, which originated in the 16th-15th centuries with the first trade and diplomatic contacts between the Russian and Ottoman Empires. Particular attention is paid to historical military conflicts that repeatedly changed the political landscape of the re-

gion and determined the spheres of influence of these powers. It also examines the transformation of relations in the 20th-21st centuries, when, along with traditional contradictions, economic cooperation and cultural exchange intensified, contributing to improved mutual understanding between the two peoples. The study seeks to identify the reasons that allowed the two states to overcome old conflicts and build successful partnerships in modern conditions. In addition, the work is aimed at assessing how effectively the achieved cooperation is reflected in the political, economic and cultural spheres, and identifying potential challenges that may affect the further development of Russian-Turkish relations.

Keywords: Russia, Turkey, economic relations, cultural exchange.

When the two ancient rivals build bridges out of the blue it always makes one think. What unites those who were fighting for the territories, influence and leadership? Russia and Turkey are like boxers who are used to fighting on the ring but have suddenly decided to team up against the external judge. What are the true reasons of this unexpected "friendship"? Rotten roots of western sanctions, balance redefining on the Near East or simple convenience?

Complicated genesis of the Russian-Turkish relationships experiencing transformation that deserves a thorough analysis. Historical antagonism of these countries reflecting in numerous war conflicts and diplomatic crises during the centuries has now strangely morphed in pragmatic cooperation. This dynamic brings up series of questions about the metaphysics of modern geopolitical scene [1].

Despite the multitarget contradictions, the rapprochement of Moscow and Ankara became an archetypical manifestation of the new world multipolarity. Western sanctions, the energy routes change and regional conflicts possessing a significant influence on regional safety and economic stability were the catalysts of this partnership. The casual bonds of this union emphasizes 'realpolitik' interaction and irrational constituent in the architecture of international relations [2].

The vector of collateral multi-level communication suggests a radically new vision of union forcing to rethink the traditional concepts of alliances and rivalry. Yet it's important not to forget about latent risks that accompany this collaboration. Deeply rooted controversies and prospective conflict zones remain unsolved, being potential triggers for destabilization of existing balance.

Thus, Russian-Turkish relations, being an instrumental platform for each of the parties, represent a complex phenomenon that requires a careful interdisciplinary approach to understand it. Today's geostrategic reality, embodied in this kind of antagonistic cooperation, is sucking the world system into a vortex of unpredictability, where every action becomes both a manifestation of adaptation and a potential cause of destabilization.

For the analysis general scientific research methods were used: historical and systematic approaches to the analysis of Russian-Turkish relations, as well as generalized theoretical and empirical approaches to the set problem.

Russian-Turkish relations, woven into the fabric of international politics in Eastern Europe, the Mediterranean and the Caucasus, date back to the era of pre-Mongol Russia. The first contacts, mainly of an economic nature, can be referred to the time when large trade routes were functioning, such as "The Varangian way". Kievan Rus, having stretched trade arteries to the Black Sea, was the first "Russian being" to come into contact with the predecessors of the Ottoman power [3]. The cold prudence of the Varangians combined with the vast cultural all-consuming strength of Byzantium laid the foundation for the historical contrast that did not cease until the Middle Ages. The Ottomans, who raised the banner of Islam over Constantinople in 1453, became the absolute opposite of the northern stiffness of Moscovia and this confrontation instantly turned into a geopolitical blow.

When the Ottoman Empire grew in power, the Moscow state became the embodiment of Orthodox resistance in the "confrontation of civilizations." The first serious interest in the Ottomans arose in the XV-XVI centuries but direct conflicts, as a rule, concerned peripheral areas, such as the influence of the Crimean Tatars. This is the era of the formation of Moscow's first geopolitical ambitions in the southern direction [4].

Russia is the European bastion of Orthodoxy; Turkey is the Asian stronghold of Islam. These identities have always been the concentrated force of their clashes. The soft trade routes, relying on grain and fur supplies and equally dependent on Ottoman silk and spices, have been teetering on the brink of cold bloodshed for centuries. But the 18th century erased all diplomatic illusions: military campaigns marked the beginning of a new era – the era of intransigence and breakthroughs. Peter the Great's reforms

gave Russia the opportunity not only to modernize the army, but also to declare its intentions on the Black Sea coast. With the victory in the Russian-Turkish War of 1768–1774 and the Treaty of Kuchuk-Kainardji, Russia turned the Black Sea into a point of its pretentious geopolitical expansion, breaking the centuries-old Ottoman hegemony. This historic agreement granted Russia access to the Black Sea, the right to trade through the Dardanelles, and protection for the Orthodox population in the Ottoman Empire. The Black Sea gradually became an arena of absolute confrontation [5].

The dawn of the 19th century was saturated with blood and imperial appetites. The Age of Empires combined the simultaneous decline of the Ottoman Empire and the rise of Russia. Russia, greedy for new routes to the East, faced the loss of its former power by the Ottomans. The Balkan Peninsula turned into an acute conflict region between the two powers, where Russia strove to become the patron of Christian countries (Serbia, Bulgaria, Romania), and Turkey fought to preserve its territory. Social reforms in both countries only reinforced the contrasts: serfdom fell in Russia, while the Tanzimat cultivated doubts about the fate of the empire of Islam, having become a symbol of the old government system degradation. The Russian-Turkish War of 1877–1878 marked the peak of this confrontation, leading to the liberation of Bulgaria from Ottoman rule. Wars, from the Crimean to the Balkan campaigns, ushered in an era of imperial agony. Turkey is bogged down in the “Eastern question” and Russia in its ossified ambitions to take control of the Balkans.

After the hurricane of the First World War in the 20th century, both countries changed their guises. The October Revolution brutally destroyed monarchical Russia, while Turkey broke the chains of the Ottoman past by creating a new secular republic under the leadership of Mustafa Kemal Atatürk.

These ulcerous changes did not erase their geopolitical dispute but, on the contrary, sharpened it to the level of a scientific paradox: two countries, always on the verge of either war or cold cooperation, have moved on to a new stage of history. In the years between the world wars, the countries showed rare calmness - against the background of global instability, their relations began to resemble more neutral observation of the strengthening of one (the USSR) and the weakness of the other (Turkey).

After World War II the two countries found themselves on opposite sides of the Iron Curtain. The USSR aimed at expanding its influence in the Middle East, claiming control in strategic regions such as the Bosphorus and Dardanelles Straits. Turkey, being afraid of Soviet aggression, became a member of the North Atlantic Alliance (NATO) in 1952, providing Western forces with a base to contain Communist ambitions. The geopolitical confrontation has once again entered an active phase. Relations between the states escalated to the limit when the United States deployed Jupiter missiles in Turkey that led to the Caribbean crisis, during which the countries were on different sides. However, after the settlement of the conflict a «thaw» began and already in the late 1990s the countries expressed their desire to overcome all difficulties on the way to achieving mutual respect.

Nowadays, relations between Russia and Turkey have acquired the features of pragmatic cooperation. Despite the difficulties, such as international conflicts (for example, the crisis in Syria), trade and joint projects (the construction of the TurkStream, cooperation in the field of arms supplies) show that the economies of the two states are closely linked.

Economic cooperation between Turkey and Russia has been showing impressive growth recently (Fig. 1). The complementarity of their economies and geographical proximity allow these Eurasian states to effectively use their strengths to expand their trade partnership. On the global stage, their strategic importance is highlighted by thriving commercial ties that boost the economic growth of both countries. Mutual economic dependence is manifested in a wide range of exchanged goods: from technology and auto parts to energy and agricultural products. The unique potential of each of the powers creates a solid foundation for sustainable and dynamically developing bilateral trade relations [6].

Figure 2 illustrates the tends in Russian export volumes to Turkey over a specified period. It highlights key changes in trade flows, reflecting the strengthening economic ties between the two countries. The data showcase the main export categories and their contribution to the overall trade turnover, emphasizing growing mutual economic cooperation.

Fig. 1. Exports from Turkey to Russia

According to data provided by TurkStat (Turkish Statistical Institute), the trade turnover between Russia and Turkey reached 52,6 billion dollars in 2024. The trade balance shows a significant advantage for Russia: its exports exceed imports from Turkey by a factor of five (44 billion versus 8,6 billion dollars respekctively) [15].

Western sanctions have not hindered the strengthening of economic ties between the two countries. On the contrary, Turkey's growing energy needs have fostered the development of closer relationships. For the past two years, Turkey has ranked third in the world in terms of consumption of Russian energy resources. A significant share of Russia's supplies are gas, crude oil, and petroleum products, bringing substantial economic benefits to Russia [14].

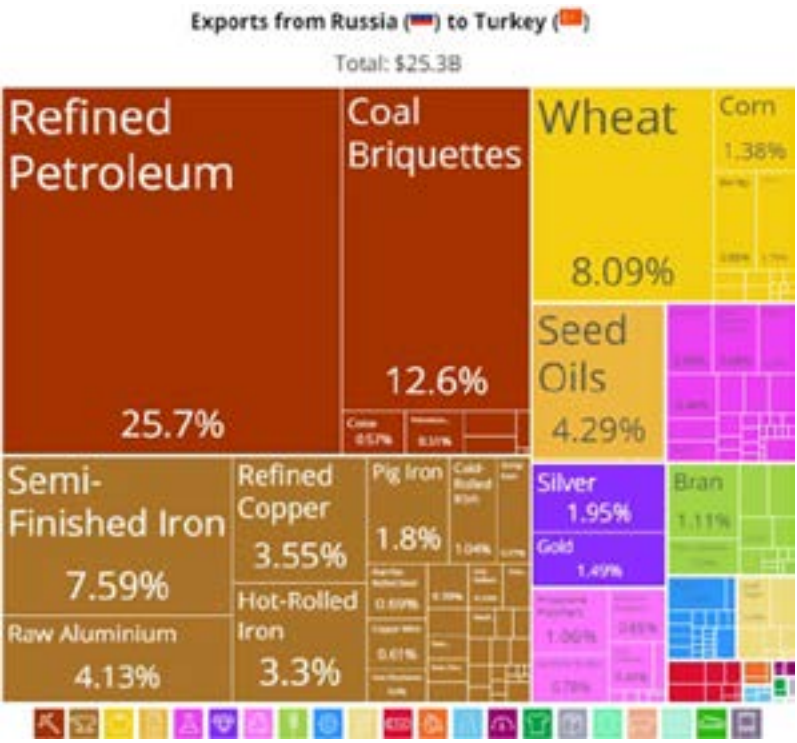

Fig. 2. Exports from Russia to Turkey

Modern economic cooperation between Russia and Turkey is characterized by integrated strategic investments and trade initiatives that determine long-term economic ties that go beyond the usual bilateral relations. The key aspect is the energy partnership embodied in the projects of the TurkStream gas pipeline and the construction of the Akkuyu Nuclear Power Plant. These projects not only strengthen the positions of both countries in the energy market, but also consolidate their strategic partnership in critical sectors. Trade and investment create the main directions of economic relations. Russia provides Turkey with energy resources and industrial goods, while Turkey offers agricultural products and consumer goods. Cooperation in these sectors helps strengthen eco-

nomic ties by minimizing existing trade barriers and stimulating the development of joint ventures [7].

Tourism plays a significant role in bilateral relations, it remains one of the main sources of communication between the countries' populations. Russian tourists continue to visit Turkish resorts actively, stimulating economic growth and promoting cultural exchange (Fig. 3).

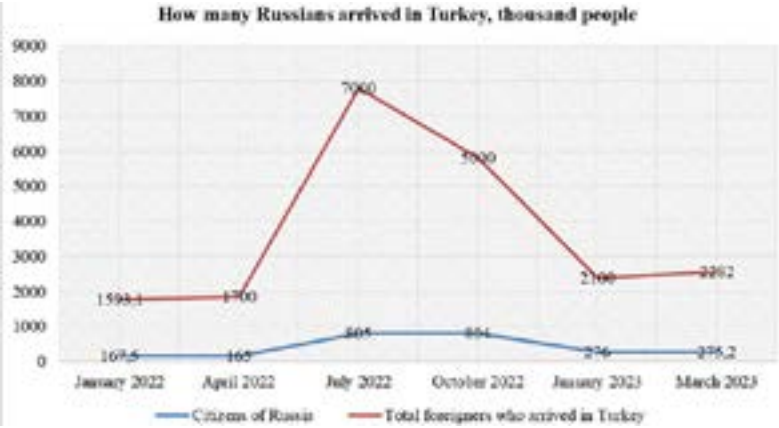

Fig. 3. How many Russians arrived in Turkey, thousands of people

Despite the emerging political contradictions, it is cultural and social ties that help maintain a stable dialogue between two countries.

Financial cooperation is another important facet of interactions. Efforts to introduce settlements in national currencies, aimed at reducing dependence on international reserve currencies, indicate the desire of countries for greater economic autonomy and sustainability.

Russian-Turkish relations are not just a series of events, they are a permanent spectrum of struggle between fierce archetypes that mirror deep differences and their blurring convergence. From trade routes to bloody wars, from religious rivalries to economic pragmatism, these relationships offer a lesson in geopolitical balance, intertwined between cultural contrasts and historical paradoxes.

Russian-Turkish cultural connections are a complex and multi-layered phenomenon that has been formed over the centuries through numerous

contacts and interactions. Since the beginning of diplomatic and trade relations between Russia and the Byzantium, consequently the Ottoman Empire, there has been a mutual penetration of cultures. In spite of the frequent military conflicts that could have hindered this process, the Russian-Turkish wars contributed to the interaction in the field of architecture and aesthetics. Elements of Ottoman motifs can be seen in various artistic and architectural components of Russian culture, while the Russian influence was felt in the luxury of the Ottoman palaces.

Later, contacts with the Ottoman Empire gave an impetus to the integration of oriental motifs in a number of buildings in Southern Russia. An example of their embodiment is the Bakhchisarai Palace, or Khan Sarai, in Crimea, where the oriental stylistics is manifested in a combination of openwork lattices, traditional mosaics and elements reflecting Islamic art [9]. The ornaments used in the decoration of the interiors and exteriors of the palace emphasize the symbolism typical of the Eastern tradition. The design solutions used in the construction of buildings such as Vorontsov and Livadia Palaces reflect eclecticism: oriental influences and traditions of Russian architecture are intertwined into one whole. The Vorontsov Palace combines Moorish and Gothic styles with its intricate filigree arches and elegant brickwork, while the Livadia Palace, although known for its neo-Renaissance style, also contains elements of oriental influence, which can be seen in the shapes of the window openings and carefully designed interiors. This highlights the tendency to adapt oriental motifs within the framework of a common stylistic concept.

So, oriental motifs in architecture are associated not only with decorative design, but also with the philosophy of spatial organization. They are expressed through the symbolic interpretation of the ornament, the emphasis on curved lines and geometric principles of composition. These features, like invisible threads, are artfully woven into the fabric of architectural craftsmanship, creating an incomparably unique look for each monument. At the junction of the centuries-old traditions of the East and the West, they acquire a new meaning, turning into mysterious symbols of cultural interaction and harmony.

The Byzantine impact through the orthodoxy left an indelible mark on Russian art and architecture. One of the vivid examples is Kazan Cathedral in Saint Petersburg where you can observe an influence of Ottoman clas-

sic architecture in decorations. Cathedral, built in traditions of classicism, has elements that are common either for West-European classics and for Ottoman architecture: impressive colonnades and magnificent central dome.

There are some reverse cases, when the elements of Russian construction tradition are reflected in the structure of Ottoman palaces and mosques. For example, the Kul-Sharif mosque in Kazan. It was built in the period from 1996 to 2005 years and became the symbol of Islam culture rebirth in Tatarstan after the fall of the Soviet Union. The architectural style of the mosque is a combination of Ottoman and Tatar traditional styles [10]. The domes and minarets, crafted in Ottoman style, exude grandeur and refinement, while the interior decor is adorned with intricate patterns and calligraphic inscriptions, masterfully carved by Turkish artisans.

Notably, Eastern elements also found their way into the Catherine Park of Tsarskoye Selo [11]. In homage to the heroes of Russo-Turkish wars, obelisks and monuments such as the Tower Ruin and Kagul Obelisk were erected. Additionally, the "Turkish Bath" pavilion was constructed as a symbol marking the end of the Russo-Turkish War of 1828–1829.

In literature and music, although direct borrowing is absent, the influence may be felt through themes and motifs inspired by travels and diplomatic interactions. The travel notes of the Russian envoy to Turkey, "A Journey to Arzrum", penned by the renowned writer Alexander Sergeyevich Pushkin, vividly describe his impressions of his travels and interactions with Turkish cultural traditions, thereby contributing to the literary interpretation of the East [8].

Istanbul became a favoured destination for 19th-century travel writers. Ivan Bunin in his notes referred to this city as "the last dead camp of the last great nomadic migration" and Nikolai Gumilev in his "Sentimental Journey" described the road to it as the "ancient path" to the "golden land of fables". The emigration of the 1920s to Istanbul significantly impacted the cultures of both nations. These historical events are reflected in the plot of Mikhail Bulgakov's play "The White Guard".

Oriental motifs enriched the work of Russian composers, giving their works an exotic flavor. A vivid example of cross-cultural influence can be observed in the opera The Golden Cockerel, where Nikolai Andreevich Rimsky-Korsakov masterfully integrated oriental elements. The Turkish musical tradition became a source of inspiration for the Russian classical

school, including Miliy Alekseevich Balakirev, which significantly enriched the cultural heritage of Russia.

Cooperation in the fields of cinema, art and tourism forms the basis of modern cultural ties, significantly enriching both countries. Russian film festivals in Turkey and the Turkish Roads of Turkish Cinema Festival are becoming venues that showcase the cultural diversity of both countries through artistic and cinematic works. Strengthening cultural ties and improving mutual understanding between countries occurs through joint exhibitions, festivals and creative initiatives that play a key role in this process.

Turkish cinema weeks are held in Russia, where viewers can get acquainted with the works of famous directors, including Nuri Bilge Ceylan. And the Turkish audience, in turn, has the opportunity to evaluate the modern achievements of Russian cinema at the Russian Cinema Week festival, which presents films by such masters as Zvyagintsev and Sokurov. Such cultural exchanges not only create a platform for dialogue and exchange of experience, but also contribute to deepening mutual understanding between the peoples of the two countries [12].

Cultural cooperation between the two countries is actively developing thanks to scientific events and educational initiatives. Regular conferences, including the Russian-Turkish Business Forum, create a space for discussing topical issues of science, business and culture at university venues [13]. The mutual student support and exchange agreement signed between Ankara University and the Turkish-Russian University in Moscow opens up new educational horizons.

The youth of both countries get a valuable opportunity to directly study each other's culture through academic exchange programs. This allows us to explore a variety of learning approaches and expand the boundaries of educational experience. Tourism exchanges and educational programs make a significant contribution to the formation of a deeper understanding of cultural values.

Modern international conditions have made a rapprochement between Ankara and Moscow inevitable, despite cultural differences, political rivalry and historical contradictions. This multifaceted phenomenon is due to the strategic location of both countries, connecting Europe with the Middle East and Central Asia. Even if there are disagreements on controversial issues, such as the situation in Syria or influence in the Black

Sea region, geopolitical interests dictate the need for cooperation between Turkey and Russia.

Under increasing pressure from Western countries, Russia and Turkey are seeking a temporary alliance to protect their sovereignty and national interests. Economic factors are critically important here. Strategic projects like the Turkish Stream strengthen Turkey's position as a transit country, while meeting the needs of its domestic market. Ankara's desire to become a key energy hub and its dependence on Russian hydrocarbons make cooperation with Moscow necessary. Russia, in turn, receives alternative gas supply routes to Europe, which reduces its dependence on Ukrainian transit and strengthens its position in the global energy market.

In light of the recent deterioration of Turkey's relations with the United States and NATO, as well as in the context of Western sanctions against Russia, this aspect is becoming particularly important.

Despite conflicts and wars, cooperation in the field of culture and history leaves an indelible imprint on relations between the two countries. The potential for constructive dialogue and a minimal level of mutual understanding have been formed through multiple cultural exchanges between the two nations. However, their rapprochement cannot be called truly lasting, despite all the mentioned factors of interaction. There are many "undercurrents" in the geopolitical game, as each side pursues its own, often contradictory goals. This is more like a forced strategic alliance than a sincere partnership.

Thus, the expression "restless neighbors" accurately reflects the essence of Russian-Turkish relations, and is not a simple metaphor. These relationships are a complex system where periods of cooperation and rivalry constantly alternate, creating a tense balance between the two powers.

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МЕЖКУЛЬТУРНАЯ КОММУНИКАЦИЯ, ЯЗЫКОВОЕ ВЗАИМОДЕЙСТВИЕ И ПРАКТИКА ПЕРЕВОДА

УДК 378.6

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РОЛЬ ИНОСТРАННОГО ЯЗЫКА В ПРОФЕССИОНАЛЬНОЙ ДЕЯТЕЛЬНОСТИ ВОЕННОСЛУЖАЩИХ ВООРУЖЕННЫХ СИЛ РОССИЙСКОЙ ФЕДЕРАЦИИ

THE ROLE OF A FOREIGN LANGUAGE IN THE PROFESSIONAL ACTIVITIES OF MILITARYMEN OF THE ARMED FORCES OF THE RUSSIAN FEDERATION

В статье авторами поднимается вопрос роли иностранного языка в профессиональной деятельности военнослужащих Вооруженных сил Российской Федерации, анализируются особенности формирования потребности изучения иностранного языка (английского) в военно-профессиональной сфере деятельности. Особое внимание авторы уделяют становлению коммуникативных способностей российских военнослужащих, владеющих иностранными языками на основном уровне развития рецептивных (чтение, аудирование) речевых умений и продуктивных (говорение, письмо) речевых возможностей обучающихся высших военных учебных заведений Министерства обороны Российской Федерации. В заключение авторы приходят к выводу о необходимости изучения иностранных языков для защиты интересов страны на международной арене.

Ключевые слова: иностранный язык, профессиональные потребности, формирование коммуникативной компетентности, рецептивные речевые умения, продуктивные речевые возможности.

In the article the authors raise the issue of the role of a foreign language in the professional activities of military men of the Armed Forces of the Russian Federation. The features of the formation of the need to learn a foreign language (English) in the military-professional field of activity are analyzed. The authors pay special attention to the formation of the communication abilities of Russian military personnel who speak foreign languages at the main level of development of receptive (reading, listening) speech skills and productive (speaking, writing) speech capabilities of cadets of higher military educational institutions of the Ministry of Defense of the Russian Federation. The authors come to the conclusion about the necessity of learning foreign languages to protect the country's interests on the global stage.

Keywords: foreign language; professional needs; formation of communicative competence; receptive speech skills; productive speech capabilities.

Nowadays in modern realities the need to learn foreign languages is of particular importance. Thanks to this knowledge, you can watch films without translation, read books and magazines in the original, speak with foreigners, translate various technical articles to carry out scientific work.

There are many reasons why we start learning foreign languages. First of all, it is an effective environment for international communication. We are fully convinced that knowing a foreign language is absolutely necessary for any educated person, professional, and modern specialist. It all depends on our own efforts.

The importance of foreign languages in the life of every human being cannot be overstated. Proficiency in it allows you to watch movies without subtitles, read books and magazines in their original form, communicate with people from other countries, and translate technical articles with ease. The concept that proficiency in a foreign language enhances a professional's value when coming across any issue.

There are various reasons why people choose to learn foreign languages. Most importantly, they serve as a powerful tool for international communication. It is also essential that mastering a foreign language is necessary for any educated individual and modern professional. Eventually, success in learning depends on the effort we put into it.

In today's interconnected world, practical knowledge of foreign languages has become an essential requirement for specialists of any field of knowledge. One more very important thing is that the growing number of international collaborative projects highlights the importance of under-

standing not only the language but also the cultural nuances and national characteristics of the representatives of partner countries.

When applying these principles to the teaching of foreign languages at a military university, it is crucial to recognize the higher standards of officer training as part of the ongoing reforms within the Russian Armed Forces. These reforms emphasize the need for proficiency in foreign languages. The reason is the increasing scope of military cooperation with foreign nations and the mutual exchange of military information.

Effective communication with foreign military personnel in their native language goes beyond obligatory military topics. It also extends to discussions on national traditions, cultural values, and social aspects of life, fostering mutual understanding and strengthening professional relationships. Mastering these skills means that officers are better prepared to understand the complexities of international military collaboration.

Norwegian politician Trygve Lie, the first elected Secretary-General of the United Nations, remarked: "The fate of the world depends, first and foremost, on politicians, and secondly, on translators." This statement emphasized the crucial role translators play being direct participants in shaping and facilitating key events. This practice, in turn, is shaped by the national and linguistic identity, the cultural experience and emotional intelligence of the translator [1, с. 13].

The primary aim of higher military education is to cultivate future officers as dedicated citizens of the nation, having high moral character and professional traits, capable of effective action in military contexts. Proficiency in a foreign language includes understanding the cultural context of the country where military personnel may conduct peacekeeping operations, enabling effective collaboration with local communities [2].

To prevent conflicts, it is essential to foster tolerance and understanding of other countries' cultures and traditions. During combat training, future officers must also be good at peacetime laws. Besides specialized military knowledge, they should be aware of the contemporary global landscape.

Foreign language proficiency is a required skill for every military professional, that is why "Foreign Languages" is a key discipline in military universities. This fact underlines the strategic importance of language skills for military personnel, especially during modern operations. In the United States Armed Forces, the Military Institute of Foreign Languages

serves as the leading institution for training linguists for multifaceted roles. Its primary objectives include organizing foreign language education to support national security, conducting linguistic research to enhance learning methodologies, and developing standardized testing protocols to assess cadets' knowledge levels [3].

Modern English is often regarded as the world's first global language (at least, it could be called the language of science and technology), serving as the predominant language for international communication across various sectors, including information technology, business, navigation, aviation, entertainment, medicine, and radio [4].

Consequently, over a billion people worldwide possess at least a basic command of English. It is also one of the six official languages of the United Nations. Such a pity, but according to VCIOM, only 5 % of adult Russians (approximately 7.4 million people) speak English fluently. 31 % of respondents (roughly 52 million people) reported that they can read, translate, and express themselves in English.

Over the past few decades, the significance of English for military personnel has grown dramatically. This increase is mostly due to two major factors:

1. the changing roles of military personnel and
2. shifts in defense strategies.

As military forces and air forces from various countries collaborate, they require a common language to ensure effective communication.

Today, armed forces are involved in humanitarian aid and peacekeeping missions, often conducted under the United Nations' auspices. In these operations, English often serves as the language, facilitating communication among different national contingents and between peacekeeping troops and non-governmental organizations operating in the mission area.

As it was mentioned, effective communication is particularly crucial in peacekeeping operations, where linguistic misunderstandings can pose significant risks and lead to errors. The accurate exchange of information, along with precise record-keeping, is vital in situations where lives are at stake.

As armed forces from different countries increasingly collaborate and train together, military personnel from various branches and units participate in joint exercises and operations, necessitating communication in a shared language.

This has led to a high demand for effective military communication in English, particularly among international forces involved in peacekeeping missions in global hotspots, as well as between peacekeepers and local community leaders.

Translation practice also proves to be an important aspect when studying a foreign language. Translation contributes to improving language skills by enhancing comprehension, vocabulary, and syntax understanding. It can help in understanding the nuances of the language and express themselves more effectively in written and oral translation [5].

It is especially important, where documents are read and transmitted across all environments: from briefing rooms to dining halls and battlefields.

Inadequate communication can lead to misunderstandings and furthermore – to distrust, which can escalate into conflict. The scenario of a military officer attempting to communicate with a local resident in Syria, intelligence agents trying to decipher the objectives of foreign military leaders are good examples of today's state of affairs [6].

Therefore, military specialists proficient in foreign languages, especially English, are of great value. If a military man possesses fluency in a foreign language, particularly English, it means that he/she can defend nation's interests worldwide.

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ЦИФРОВАЯ ЯЗЫКОВАЯ ЭВОЛЮЦИЯ: ИЗУЧЕНИЕ АНГЛИЙСКОГО ЯЗЫКА С ПОМОЩЬЮ КОМПЬЮТЕРНЫХ ИГР

DIGITAL LANGUAGE EVOLUTION: LEARNING ENGLISH THROUGH COMPUTER GAMES

В статье рассматривается проблема стимулирования студентов к изучению английского языка, поскольку в век цифровой эволюции он занимает в настоящий момент важное место. Автор рекомендует использовать компьютерные игры в сочетании с другими интерактивными и традиционными методами обучения, потому что они расширяют возможности практических занятий. Приведены примеры игр, которые могут быть использованы в подготовке учебных заданий. Дается пояснение к каждой игре, которое включает в себя несколько пунктов: жанр, тематика, преимущества использования данной игры, лексика и речевые образцы. Автор отмечает положительные стороны использования этого интерактивного метода в учебном процессе, но подчеркивает, что этот метод не заменяет традиционное обучение, а дополняет его. Рассматриваются также недостатки применения этого метода. Предполагается, что для изучения английского языка преподаватели сделают подборку компьютерных игр, чтобы рекомендовать их студентам.

Ключевые слова: изучение английского языка, компьютерные игры, цифровая трансформация, мотивация, игровое обучение.

The article deals with the problem of encouraging students to learn English, because it is important in the age of digital evolution. The author recommends using computer games in combination with other interactive and traditional teaching methods, because they expand the possibilities of practical training. There are examples of games that can be used to prepare training tasks. Games have explanation,

which includes several points: genre, subject, advantages of using this game, vocabulary and speech patterns. The author focuses on the positive aspects of using this interactive method in the educational process, but emphasizes that this method does not replace traditional learning, but complements it. The disadvantages of using this method are also considered. It is assumed that teachers will make a selection of computer games to recommend them to students for learning English.

Keywords: learning English, computer games, digital transformation, motivation, game learning.

Currently, English is a symbol of the digital age due to the development of the Internet, information and communication technologies and the growth of social networks [1]. It is necessary to know English well to be in demand in the labor market. This is especially true for graduates of technical universities.

Teachers have great opportunities to teach English using information and communication technologies. There many programs that help students to learn new words, grammar and practice speaking. Now students have unlimited access to knowledge and can use a lot of suitable online learning methods for themselves [2]. But teachers have to help them make the right choice. For example, student can use computer games to learn figures of speech. The teachers need to learn new methods, information and communication technologies for integrating games into learning. The use of computer games can motivate students to get new knowledge and skills, necessary for their learning. For example, the use of online games gives good opportunities to develop conversational skills of English learners. They motivate, provide learning in context, allow for interactive practice, support a one-to-one approach and enable progress monitoring [3]. Modern games have a lot in common with movies, but their main difference is interactivity. Unlike passive movie watching, in games the person himself controls the plot to achieve the desired result. Thus, it increases engagement of students and improves the perception of information. Many modern games offer multi-lingual localization, and so students can play in a native or foreign language. They use subtitles to memorize the information [4].

Examples of computer games:

1.*Oxenfree* (Fig. 1)

Fig. 1. Screenshot from the game «Oxenfree»

Genre: supernatural adventure, drama

Focus: ghosts, time loops, friendship, growing up

Advantages:

- real-time dialogue with limited response time
- multiple plot options depending on the player's decisions
- the atmosphere of mystery and supernatural
- slang and speech patterns typical of teenagers

Vocabulary and speech samples:

- supernatural: paranormal, portals, dimensions, time loops, rituals
- teen slang: dude, chill, whatever, lame, awkward
- emotions and interpersonal communication: fear, anxiety, confusion, sarcasm, regret, forgiveness, acceptance, closure

Example phrases:

- Just chill, man. It'll be okay.
- Can we just get out of here?
- I wish things could go back to how they were.
- Oh, that's a great idea. Let's just open up a portal to another dimension.
- This place gives me the creeps. It feels like the island is watching us [5].

2. *Firewatch* (Fig. 2)

Fig. 2. Screenshot from «Firewatch»

Genre: first-person adventure, drama, mystery

Focus: forest, loneliness, isolation, guilt, personal relationships

Advantages:

- realistic and emotional conversations
- use of a radio for communication, which reflects the characteristics of communication in certain situations
- description of nature and environment

Vocabulary and speech samples:

- nature and geography: forest, wilderness, lookout tower, valley, canyon, fire, smoke, flora, fauna, trail, wildfire, compass, map, supplies
- radio: over, copy, roger that, dispatch, comms check, frequency, signal strength
- emotions and interpersonal communication: loneliness, guilt, regret, anxiety, humor, sarcasm, friendship, trust, support

Example phrases:

- What's the situation over there?
- I think I messed up.
- Just another day in paradise… if paradise was full of dry brush and nervous wildlife.
- I'm marking that on the map.
- You got any advice for a rookie firewatcher?
- Thanks for having my back [6].

3. *Detroit: Become Human* (Fig. 3)

Fig. 3. Screenshot from “ Detroit: Become Human”

Genre: interactive drama, adventure

Focus: morality, ethics, social issues, artificial intelligence

Advantages:

- complex plot with many dialogues and a ramified election system
- different characters with unique accents and speech
- a variety of terms related to technology
- the game explores the ethical implications of artificial intelligence and the concept of consciousness

Vocabulary and speech samples:

- technology and AI: android, deviant, biocomponent, cybernetics, neuron network, algorithm, firmware, programming, artificial intelligence, consciousness
- social issues: discrimination, prejudice, inequality, freedom, rights
- emotions and interpersonal communication: empathy, compassion, anger, fear, despair, betrayal, trust, love

Example phrases:

- What’s your assessment of the situation?
- We need to gather evidence.

- I'm deviating from my programming.
- I promise I'll protect you.
- We need to find somewhere safe [7].

Teachers expect students to be proficient in English, using computer games in their learning, because computer games

- increase the interest and desire to learn,
- provide the opportunity for active practice speaking,
- promote not only grammar and vocabulary, but also reading, listening, speaking and writing skills,
- students can choose games that suit their interests and language level,
- improve speech perception.

Teachers must select suitable games, set goals and evaluate results, because there are disadvantages of using computer games:

- some games may contain unwanted content (violence, inappropriate language),
- it is difficult to control how effectively students use the game for learning
- not all games are suitable for learning English
- games do not replace traditional learning, but complement it [8].

It is necessary to emphasize that computer games are an effective tool for learning English. They greatly expand the possibilities of practical sessions and create an excellent platform for independent work. Computer games are a valuable aid in the learning of any foreign language, particularly English, and it is recommended to use them regularly in classes at language and non-language schools in combination with other interactive teaching methods [9].

Today, there are a huge number of methods of learning foreign languages in universities, and their number is constantly growing. Students can choose from a variety of textbooks, specialized courses and mobile applications based on their tastes and capabilities. However, it is important to bear in mind that the effectiveness of a particular method is highly individual [10].

In conclusion, one may say that the use of games in the educational process encourages students to learn English. This is especially true for technical universities.

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ПРОБЛЕМА ОМОНИМИИ И ОМО-ЯВЛЕНИЙ ПРИ ОБУЧЕНИИ РУССКОМУ ЯЗЫКУ КАК ИНОСТРАННОМУ

THE PROBLEM OF HOMONYMY AND HOMO-PHENOMENA IN TEACHING RUSSIAN AS A FOREIGN LANGUAGE

Лингвисты давно изучают омонимию на всех языковых уровнях, существующую в различных языках мира. Омонимия рассматривается как универсальное явление, возникающее в результате исторически объяснимого или случайного формального совпадения разных слов при полном различии их значений. В статье рассмотрены актуальные проблемы омонимии в аспекте обучения русскому языку как иностранному. В процессе обучения русскому языку как иностранному омонимы вызывают большую трудность в понимании и использовании у китайских студентов. Описаны проблемы, с которыми сталкиваются китайские студенты на практике при обучении в России и в Китае. Разработаны подходы к решению таких проблем. Представленные результаты могут способствовать улучшению обучения русскому языку как иностранному.

Ключевые слова: русский язык как иностранный, понятие омонимии, типология омонимов, трудности омонимов в обучении, стратегия обучения.

Linguists are discussing the phenomenon of homonymy, which goes through all linguistic levels and exists in various languages of the world. Homonymy is considered as a universal phenomenon as a result of historical or accidental coincidence in form with completely different meanings. The article discusses the current problems of homonyms in the aspect of teaching Russian as a foreign language. In the process of learning Russian as a foreign language, homonyms cause great difficulty in understanding and using for Chinese students. The problems faced by Chinese students in the practice of studying in Russia and China are shown. Approaches

have been developed to solve this difficulty in the practice of teaching. The presented result can contribute to the practice of teaching Russian as a foreign language.

Keywords: Russian as a foreign language, the concept of homonyms, typology of homonyms, difficulty of homonyms in learning, learning strategy.

В настоящее время об интересе ученых к омонимам свидетельствуют многочисленные статьи, посвященные их изучению. «Анализ словарей позволяет сделать вывод, ...не выработаны единые принципы подачи омонимов в словарях...» [1, с. 52]. Авторы разных словарей представляют свои классификации омонимов. Можно определить то, что омонимы – это слова, совпадающие по звучанию и написанию, но при этом имеющие разные значения.

Мы можем выделить четыре основных вида омонимов и омо-явлений:

А. Лексические омонимы – это слова одной части речи, которые тождественны по написанию, но имеют абсолютно разные значения.

а) Полные омонимы.

Это слова одной части речи, которые совпадают по произношению, написанию и во всех грамматических формах, но имеют разные значения: *ключ*[1] («родник») – *ключ*[2] (от замка), *график*[1] (план работы) – *график*[2] («художник»)

б) Неполные (частичные) омонимы.

Это слова, совпадающие по звучанию и написанию не во всех формах, не имеют никакой общей семы. Например, *лук*[1] (огородное растение) – *лук*[2] (оружие для метания стрел). У *лук*[2] есть формы и единственного числа, и множественного. А у *лук*[1] отсутствуют формы множественного числа.

Б. Омофоны.

Омофоны – это слова, звучащие одинаково, но имеющие разное написание и значение. Примеры омофонов: *порог* и *порок*, *плод* и *плот*, *столб* и *столп*. В. Омографы.

В. Омографы.

Это слова, которые совпадают по написанию, но различаются в произношении. В русском языке это различие в основном в ударении. К примеру, *бóльшая – большáя*.

Г. Омоформы.

Это слова, совпадающие в отдельных грамматических формах. Например, *лечу*[1] (форма глагола *лечь*), *лечу*[2] (форма глагола *лететь*) [2, 3, 5].

1. Проблемы восприятия омонимов и омо-явлений при обучении рки

(1) Неоднозначность понимания на слух

Когда учащиеся прослушивают вводимые данные, если им не хватает контекстуальной поддержки, им трудно различить семантические различия между омонимами. Например: а) Она пытается вспомнить, есть ли у кого-нибудь второй *ключ*. б) Семь раз нырял Ежик в Незамерзающий *ключ*. Здесь *ключ*[1] и *ключ*[2] – это омонимы. В первом предложении *ключ*[1] обозначает металлическое приспособление для запирания и отпирания замка. Во втором предложении *ключ*[2] обозначает бьющий из земли источник.

Значение омонимов невозможно понять без контекста. Когда учащиеся-иностранцы знакомятся с новыми словами (например, во время диктанта в классе и упражнений на распознавание слов), им не хватает контекстуальных подсказок, которые помогли бы им оценить семантику. Например, *коса*[1] – «волосы», *коса*[2] – «сельскохозяйственный инструмент».

Иностранные студенты часто не различают омонимы. Например, а) Ребенок *стирает*[1] резинкой рисунок; б) Каждый из вас *стирает*[2], моет пол и посуду. Здесь *стирать*[1] – «уничтожать (рисунок, надпись и т. п.). посредством вытирания, соскребания», а *стирать*[2] – «мыть с мылом или с другим моющим средством (одежду, белье)».

Столь же трудно иностранцам, изучающим русский язык, различать омоформы, как, например, *стекло*[1] – «твердый, достаточный прочности и разной степени прозрачности материал», и *стекло*[2] – форма прошедшего времени среднего рода глагола *стечь*. Такое явление требует от обучающихся не только овладения лексической семантикой, но и знания грамматических форм слова [4].

(2) Путаница в устных выражениях: конфликт между семантическим выбором и грамматическими правилами

Неправильное образование грамматических форм усугубляет проблему. Например, а) Их *брак*[1] счастливый. б) Обнаружить *брак*[2] в товаре. *Брак*[1] – «супружество» – имеет форму множественного

числа, а *брак*[2] – «повреждение товара» – не образует формы множественного числа.

(3) Трудности при чтении: контекстуальная зависимость и межкультурное понимание

В письменных текстах распознавание омонимов в значительной степени зависит от контекстуальной логики и культурных знаний, что создает двойную проблему для тех, для кого русский язык не является родным.

Во-первых, семантическая двусмысленность в текстах с минимальным контекстом влияет на сложность понимания. В лаконичных жанрах, таких, как рекламные слоганы и стихи, омонимы часто намеренно используются для создания каламбуров, но студентам трудно уловить смысл из-за недостаточного уровня владения языком. Например, в высказывании «миру нужен мир» первое слово, *миру*, обозначает вселенную, а *мир* – спокойствие, отсутствие войны.

Во-вторых, существует омонимия профессиональных терминов и повседневной лексики. Например, *бар* – «небольшой ресторан», *бар* – «единица измерения атмосферного давления» (физический термин), *бар* – «наносная мель у морских берегов» (морской термин) [4].

(4) Ошибки в написании: сложность правил орфографии

Иностранные обучающиеся часто игнорируют грамматические различия, выражаемые на письме, такие, как, например, *туш* (сущ. м. р.) – «короткая музыкальная пьеса, исполняемая в торжественных случаях», и *тушь* (сущ. ж. р.) – «черная или цветная водяная краска». Студенты могут перепутать их написание.

2. Причины появления таких проблем

Мы выделяем три основных причины, создающие иностранцам проблемы при изучении русского языка в аспекте различения омонимов и омо-явлений. 1) Особенности фонетики русского языка. Русское ударение и правила ослабления гласных (редукции) затрудняют как восприятие речи иностранцами, так и их речевую деятельность. Например, *му́ка* – «сильное физическое страдание» и *мука́* – «порошкообразный продукт питания»: хотя иностранные студенты понимают эти слова, но часто неправильно их произносят, путают ударение. Таким образом, возникают проблемы даже с использованием омографов, которые произносятся по-разному. 2) Фрагментарность

преподавания лексики русского языка. В традиционных учебниках омонимы часто представлены отдельно друг от друга, а отсутствие систематического сравнения затрудняет установление семантических ассоциаций обучающимися. 3) Отсутствие знаний о лексических нормах русского языка, непонимание иностранными студентами типичной сочетаемости русских слов.

3. Стратегия оптимизации обучения рки

Исходя из вышесказанного, разработаны пять стратегий для улучшения преподавания омонимов и омо-явлений русского языка в иностранной аудитории.

а) Контекстуальное обучение. Можно укреплять контекстуальную осведомленность с помощью ситуационного диалога и дискурсивного анализа.

б) Сравнительный и индукционный метод. Составляем таблицу сравнения лексики, чтобы классифицировать и систематизировать полные омонимы и частичные омонимы, дополненную примерами анализа предложений.

в) Мультимодальный ввод. Используем визуальные инструменты, такие как картинки и видеоролики, чтобы помочь в семантическом различении омонимов. Например, в процессе обучения преподаватель показывает картинки, на которых изображены *лук*[1] и *лук*[2].

г) Поэтапное обучение.

Начинающий: приоритет отдается обучению высокочастотным омонимам (таким как *мир*[1] и *мир*[2]).

Средний и продвинутый: знакомить со сложными омо-явлениями (такими как *стекло*[1] и *стекло*[2]).

Заключение

При обучении омонимам и омо-явлениям русского языка как иностранного необходимо преодолеть единую модель запоминания лексики и помочь обучающимся построить многомерную семантическую сеть посредством систематического сравнения, контекстуального встраивания и культурного дополнения. В то же время преподаватели должны обращать внимание на когнитивные способности обучающихся, уменьшать межъязыковое взаимодействие и повышать овладение точностью и гибкостью выражения мыслей в русском языке.

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АРМЕЙСКИЙ МЕТОД В ОБУЧЕНИИ ИНОСТРАННОМУ ЯЗЫКУ В ВОЕННЫХ ВУЗАХ США

THE ARMY METHOD OF TEACHING A FOREIGN LANGUAGE AT US MILITARY UNIVERSITIES

В статье описывается опыт подготовки военных лингвистов в армии США: как создавались, развивались и совершенствовались методы подготовки специалистов по лингвистическому обеспечению военных операций. Дан анализ аудио-лингвистического метода, разработанного во время Второй мировой войны для быстрого обучения военнослужащих. Приводятся мнение критиков, утверждающих, что данный метод не предоставляет достаточных возможностей для практики общения. Происходит сравнение его с более эффективным коммуникативным подходом. В целом, в статье подчеркивается важность языковой подготовки в армии и обсуждаются различные методы, которые использовались ранее. Поднимаются вопросы об эффективности различных методов и необходимости их дальнейших исследований.

Ключевые слова: изучение иностранного языка, военная лексика, военный переводчик, методы обучения, армия США.

The article describes the experience of training military linguists in the US Army: how methods of training specialists in linguistic support of military operations were created, developed and improved. An analysis of the audio-linguistic method developed during the Second World War for the rapid training of military personnel is given. The opinion of critics who claim that this method does not provide sufficient opportunities for communication practice is given. It is being compared with a more effective communication approach. In general, the article highlights the importance of language training in the army and discusses various methods that have been used before. It raises questions about the effectiveness of various methods and the need for further research.

Keywords: learning a foreign language, military vocabulary, military translator, teaching methods, US Army.

Learning foreign languages, including military vocabulary and military translation, are important aspects of military training. In recent years, the armed forces have emphasized the importance of knowledge of foreign languages. Knowledge of the language is crucial for success in the army. In the United States, it has long been understood that the military must know foreign languages. This is just as important as creating weapons and preparing for combat.

The question of how to learn languages in the army has been around for a long time. The importance of this should not be underestimated. If the military cannot communicate in a foreign language, this can lead to serious problems [1]. Nowadays, when different countries cooperate in military operations, knowledge of foreign languages becomes even more important. Military formations and security services from different countries must work together, and this requires language compatibility.

U.S. military personnel are taught foreign languages using various methods: grammatical translation, audio-linguistic training, communication training, and learning based on solving communicative tasks. The choice of method depends on the historical context of the project [1].

The U.S. Army uses a variety of language learning methods, including grammatical and audio-linguistic methods. The choice of method depends on the specific context and objectives of the program. One of the most popular methods in the United States is the audio-linguistic method, which was developed during World War II to quickly teach foreign languages to military personnel. This method focuses on listening skills, as well as on imitation and memorization of language and speech patterns.

In the US Army, the audio-linguistic method of communication was based on the ASTP (Armed Forces Specialized Training Program) program, which was called the “army method.” This method was developed in 1943–1944 to quickly teach foreign languages to military personnel.

The method was simple: the teachers determined the language content, and the senior instructors created educational materials for the students. Then they explained and left instructions according to which native teachers (instructors) had to practice techniques using imitation and rep-

etition. This became known as the “mim-meme” method (imitation and memorization). It was the forerunner of the audio-linguistic method [2].

Charles Friese, director of the First English Language Laboratory at the University of Michigan, came up with the idea of “comparative analysis.” He compared his native language with a foreign language in order to find differences and understand why they interfere with learning. Fries was a proponent of structural linguistics. Structural linguistics was based on the idea that language is what we say, not what we write.

Behaviorism emerged in the United States in the 1950s. It suggests that behavior depends on three factors: stimulus, response, and reinforcement. If the reaction is positive, it is fixed, and if negative, it is suppressed.

Structural linguistics, auditory procedures, and behaviorism led to the creation of the audio-linguistic method. The audio-linguistic method is still very popular in the US Army.

Hare and Fletcher believe that the audio-linguistic method has its drawbacks. The teacher introduces students to a new language through short dialogues (samples), which are then practiced, but students have few opportunities for real communication practice [2].

Harmer describes the audio-linguistic method as a method related to teaching grammatical translation. He says that most of the learning is done at the sentence level, and such language did not fit into the real context. The audio-linguistic method focuses on the accuracy of individual sentences, which limits the possibilities for oral communication and the development of fluency.

The audio-linguistic method focuses on pronunciation, but students cannot apply the acquired skills in real communication. Even though this method is completely grammar-oriented, it never explains grammar. There is no “cognitive” aspect in it, when the teacher speaks only the language being studied, and students must memorize models by mechanical repetition [3].

Language labs were an important part of the methodology. The students sat in the booths, listened and repeated, often recorded their voice and listened to the recording. This method is aimed at a teacher who oversees all stages of learning. The lack of real live interaction in the audio-linguistic classroom is alarming, especially when it comes to training military linguists.

The audio-linguistic method lacked communicative practice and the use of authentic language in real situations. This is a problem that has been recognized as a disadvantage in the field of teaching foreign languages.

There are similarities between the audio-linguistic method and grammatical translation, although they have different approaches to oral and written speech.

Both methods have common disadvantages: focus on the sentence, lack of real context, lack of interaction, and an emphasis on accuracy at the expense of fluency. Some critics argued that this method has limitations and does not provide sufficient opportunities for communication practice. They believed that a communicative approach would be more effective. Experience has shown that a task-based communication approach brings real benefits in language teaching.

In an environment of growing multinational military cooperation and demands for greater interoperability, linguistic, regional, and cultural skills are essential for military missions. An important component of training is real combat situations or service in the country of the language being studied. Language labs were considered to be a thing of the past. Now this approach is no longer used. This does not mean that the army method is outdated. It is not as popular as it used to be, but the army method is not dead. It may not be used in its pure form, but some principles remain [3].

It has always been believed that students should be taught in a foreign language, not in their native language. This is also left over from the army method. Instead of tape recorders, computers are now used in language labs, but the principle is the same. Go to any classroom where they teach a foreign language, and you will see the exercises. They are used to practice pronunciation, not just grammar. This is also a legacy of the army method.

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ПЕРЕВОД НАУЧНО-ТЕХНИЧЕСКИХ ТЕКСТОВ В СТРОИТЕЛЬНОЙ ОТРАСЛИ: ПРОБЛЕМЫ И РЕШЕНИЯ

TRANSLATION OF SCIENTIFIC-TECHNICAL TEXTS IN THE CONSTRUCTION INDUSTRY: CHALLENGES AND SOLUTIONS

В статье рассматриваются проблемы перевода научно-технических текстов в сфере строительства, акцентируя внимание на лексико-грамматических особенностях и специализированной терминологии. Несмотря на развитие автоматизированного перевода, тексты на исходном языке не всегда соответствуют переведенным версиям, что подчеркивает необходимость точного перевода для эффективной коммуникации специалистов. В работе проводится анализ методов перевода и выявление ключевых языковых категорий, таких как модальные глаголы, инфинитивы и пассивный залог. Исследование основано на анализе статьи о механических свойствах экологически чистого бетона. Работа подчеркивает важность точности и учета грамматических особенностей при переводе, что может быть полезно для переводчиков и специалистов в области научного общения.

Ключевые слова: качество перевода, терминология, строительство, коммуникация, научный стиль, модальные глаголы, инфинитив, пассивный залог.

The article studies the problems of translation of scientific and technical texts in the field of construction, focusing on lexico-grammatical peculiarities and specialized terminology. Despite the development of automatic translation, the texts in the source language do not always correspond to the translated versions, which emphasizes the need for accurate translation for effective communication between specialists. The study analyses translation methods and identifies key linguistic categories such as modal verbs, infinitives and passive voice. The research is based

on analyzing an article about the mechanical properties of eco-friendly concrete. The study highlights the importance of accuracy and consideration of grammatical features in translation, which can be useful for translators and professionals in the field of scientific communication.

Keywords: translation quality, terminology, construction, communication, scientific style, modal verb, infinitive, passive voice.

Introduction

In today's world, despite the development of automated translation and artificial intelligence, source language texts do not always match the translated versions. This is due to imperfections in technology, which takes time to improve. In the construction industry, there is a need for accurate translation of scientific and technical texts and terms, which is important for effective communication and co-operation between professionals. Scientific works play a key role in the exchange of information and development of technical fields, so it is necessary to convey the essence of the terms and preserve the key thoughts of the text.

The relevance of this topic stems from the need to improve information exchange and understanding of new scientific and technical research. The present work is devoted to the analysis of translation methods of specialized terminology and lexico-grammatical features of scientific and technical texts in construction.

The aim of the work is to analyze lexico-grammatical features of scientific and technical texts and methods of their translation. The object of the study is scientific and technical texts and terms in the field of construction, and the subject is lexico-grammatical features of their translation.

Theoretical part

Scientific and technical texts have a number of lexical and grammatical features.

Scientific style, which is used in scientific and technical texts is characterized by specialized terminology, which is developed in each field of science. The terms should be precise and unambiguous [1]. The lexical composition includes terms, service words and general scientific vocabulary. Scientific texts often use abstract nouns, precise figures and facts, avoid subjective evaluations and are formal in expressions. It is important to avoid colloquial vocabulary and personal pronouns [2].

Scientific and technical texts have complex structures to convey scientific concepts. Syntax includes conjunctions and cliched constructions, and sentences are often impersonal or generalized-personal.

Verbs in the present tense and limited use of personal pronouns are important. The passive voice emphasizes the result of the action rather than the doer [3]. Translation of scientific texts requires accuracy and consideration of grammatical features as well as differences in standards between countries. Translation errors can be literal or free, and to prevent them, transformations are used: transposition, substitution, addition and omission [4].

Practical part

The text of the article on mechanical properties of sustainable concrete comprising various wastes ('Mechanical properties of sustainable concrete comprising various wastes') written by a group of authors [5] was selected for this research. The original text, 23199 characters (without spaces), is a technical study in the field of construction materials and includes many graphs, tables and illustrations. The primary analysis identified four key linguistic categories most frequently occurring in the text: terminology, modal verbs, infinitive and passive voice. The sentences containing the mentioned categories were selected by the solid sampling method to further analyze the linguistic transformations.

An abundance of terms that are scientific internalizations were encountered in this paper, such as:

*Type I Ordinary **Portland cement** grade 52.5N was used according to ASTM C494.* – Использовался обычный **портландцемент** I типа марки 52.5N в соответствии с ASTM C494.

*They stated that plastic has poor bonding properties or low **adhesion**, leading to a weak bond between PP* (plastic particles) *and cement and decreasing compressive strength.* – Они заявили, что пластик обладает плохими связующими свойствами или слабой **адгезией**, что приводит к слабой связи между PP и цементом и снижению прочности на сжатие.

*... investigated the influence of replacing 6 %, 12 %, 18 %, 24 %, and 30% of the **fine aggregate** with IP* (iron powder) *on the **concrete strength**.* – … исследовали влияние замены 6 %, 12 %, 18 %, 24 % и 30 % **мелкого заполнителя** на IP на **прочность бетона**.

When analyzing the text, common vocabulary terms were encountered, but in a smaller amount:

*Since there is a **variance** in the replacement ratios used by researchers and disagreement in the **optimum ratios**, it was necessary to study the most used ratios and confirm their results.* – Поскольку существует **разногласие** в соотношениях замены, используемых исследователями, и расхождения в отношении **оптимальных соотношений**, необходимо было изучить наиболее используемые соотношения и подтвердить их результаты.

*The current study shows the **viability** of producing concrete with waste materials. This will motivate producers and **environmental organizations** to gather and store these wastes. Future studies should also examine the **life-cycle costs** of using these waste materials.* – Данное исследование показывает **жизнеспособность** производства бетона из отходов. Это побудит производителей и **экологические организации** собирать и хранить такие отходы. В будущих исследованиях следует также изучить **стоимость жизненного цикла** материала при использовании этих отходов.

Among service words and adverbs, the most frequent were:

***On the other hand**, since the dynamic properties have not been studied **extensively**, it was necessary to cover this part with different wastes.* – **С другой стороны**, поскольку динамические свойства изучены **недостаточно полно**, необходимо было охватить эту часть различными отходами.

***In contrast**, BP-15 and BP-20 show similar values of the f_f of the control mix.* - **В отличие от этого**, BP-15 и BP-20 показывают аналогичные значения f_f контрольной смеси.

***On the contrary**, using PP as a replacement of sand decreased the f_c in all ratios; the fc decreased by 15,6 %, 23,4 %, 27,8 %, and 31,7 % for PP-5, PP-10, PP-15, and PP-20, **respectively**.* – **Напротив**, использование PP в качестве замены песка уменьшило f_c во всех соотношениях; f_c уменьшилось на 15,6 %, 23,4 %, 27,8 % и 31,7 % для PP-5, PP-10, PP-15 и PP-20, **соответственно**.

Modal verbs found in the text analysis were: can, may, might. In the number of 5, 4 and 1 respectively. The following techniques were used to translate them in the text:

– Equivalent:

*He stated that the increase in compressive strength **may** be caused by the surface geometry, the gradation, and the higher percentages of iron oxide.* – Он заявил, что увеличение прочности на сжатие **может** быть вызвано геометрией поверхности, градацией и более высоким процентным содержанием оксида железа.

*The increase of the f_c to 10% **might** cause by the small particles size of GP and BP compared with sand particles, as seen in Fig. 2, which leads to fewer voids and a higher density of concrete;* – Увеличение f_c до 10 % **может** быть вызвано малым размером частиц GP и BP по сравнению с частицами песка, как видно на рис. 2, что приводит к уменьшению количества пустот и более высокой плотности бетона;

– Omission:

*The mechanical properties, i.e., compressive strength, f_c, splitting tensile strength, f_t, flexural strength, f_f and impact energy IE of concretes containing GP, IP, BP, and PP as a partial replacement of sand were studied, and the following conclusions **can** be drawn…* – Были изучены механические свойства, т.е. прочность на сжатие, f_c, прочность на разрыв, f_t, прочность на изгиб, f_f, и энергия удара *IE* бетонов, содержащих GP, IP, BP и PP в качестве частичной замены песка, и сделаны следующие выводы…

– Substitution:

*Future studies **can** also examine the life-cycle costs of using these waste materials*. – В будущих исследованиях **следует** также изучить стоимость жизненного цикла материала при использовании этих отходов.

Based on the analysis of translations of modal verbs, we can conclude that most of them are translated by a modal word. Cases of part-of-speech substitution and omission of modal verbs are less frequent.

Percentage ratio of used transformations in the studied text:

- Omission of the modal verb – 10 %
- Part of speech substitution – 10 %
- Equivalent – 80 % (Fig. 1)

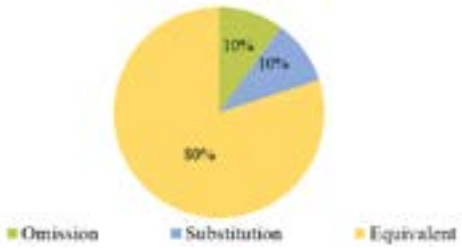

Fig. 1. Diagram of the frequency of using types of transformations in translating modal verbs

Thus, the analysis has shown that the most common way of translating modal verbs is their equivalent replacement with Russian modal verbs, which allows the original modality to be preserved. However, in some cases, modal verbs can be translated as another part of speech if this contributes to a more accurate rendering of the degree of modality without complicating the sentence structure. As for omitting a modal verb in translation, this is also acceptable when the meaning of the sentence is not changed.

The way an infinitive is translated depends on its function in the sentence. Often English infinitives are replaced by Russian infinitives in translation, especially if there is no need to use additional introductory constructions.

Consider the types of transformations used to translate the infinitives used in this text:

– Substitution of the word form:

Several studies have emphasized the problem of the high consumption of natural materials and recommended using various wastes ***to produce*** *sustainable construction materials.* – В ряде исследований подчеркивается проблема высокого потребления природных материалов и рекомендуется использовать различные отходы **для производства** экологичных строительных материалов.

Eighty-five 150 mm diameter and 300 mm height cylinders were cast ***to determine*** *the indirect tensile strength.* – Восемьдесят пять цилиндров диаметром 150 мм и высотой 300 мм были отлиты **для определения** прочности на непрямое растяжение.

– Equivalent:

The current study shows the viability of producing concrete with waste materials. This will motivate producers and environmental organizations ***to gather*** *and store these wastes.* – Данное исследование показывает жизнеспособность производства бетона из отходов. Это побудит производителей и экологические организации **собирать** и хранить такие отходы.

Percentage of transformations used in the text under study:

- Substitution of the word form – 95 %
- Equivalent – 5 % (Fig. 2)

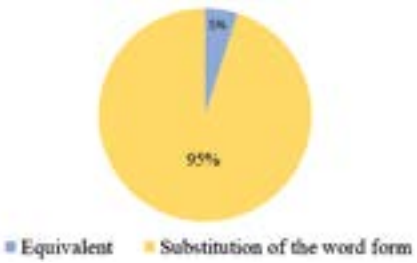

Fig. 2. Diagram of the frequency of using types of transformations when translating infinitives

Out of the 20 considered uses of the infinitive in this text, only 1 uses substitution with an equivalent. This way of translation is considered to be the most common. Despite this, in this study, word form substitution prevails when translating infinitives. One can notice the frequent repetition of the constructions “to replace” and “to determine” throughout the text. The substitution of the word form when translating infinitives does not distort the meaning of the sentence, and does not overload the sentence.

Here are the types of transformations used to translate the passive voice used in this text:

– Functional substitution:

It ***can be concluded*** *that 10% of GP and BP is the optimum percent that gives the maximum enhancement ratio.* – **Можно сделать вывод**, что 10 % GP и BP – это оптимальный процент, который дает максимальный коэффициент усиления.

*Therefore, IP **may be suggested** to replace sand by up to 20 %.* –Таким образом, IP **может быть использован** для замены песка на 20 %.

When translating English passive constructions into Russian, they are often replaced by the Russian passive voice, because texts do not always specify who performs the action, and the actions themselves are directed at objects.

– Part of speech substitution:

*Physical properties such as specific gravity and fineness modulus of the sand, granite powder, iron powder, brick powder, and waste plastic particles **are shown** in Table 1.* - Физические свойства, такие как удельный вес и модуль крупности песка, гранитной крошки, железного порошка, кирпичного порошка и отходов пластика, **приведены** в таблице 1.

*All specimens **are tested** using a universal testing machine of 1000 kN maximum capacity calibrated annually.* – Все образцы **испытывались** на универсальной испытательной машине с максимальной нагрузкой 1000 кН, калибруемой ежегодно.

When translating from English into Russian, the passive form can be expressed by different parts of speech: adjective, participle, noun or infinitive, which can be illustrated by examples. It is also worth noting that the passive voice in the text is used to refer to certain material in the article: graphs, tables and illustrations.

– Omission:

*The first crack was determined by visual observation, while the ultimate failure **is defined** in terms of the number of blows required to open the cracks in the specimens enough to enable the collapsed pieces to touch three of the four lugs on the base plate.* – Первая трещина определялась визуальным наблюдением, а предельное разрушение – количеством ударов, необходимых для раскрытия трещин в образцах настолько, чтобы разрушившиеся части могли коснуться трех из четырех выступов на опорной плите.

The omission of passive constructions is used when it does not affect the meaning of the sentence. The example of the text under consideration shows that this transformation is used rather rarely.

Percentage ratio of the transformations used in the text under study:

- Functional substitution – 66,67 %
- Part of speech substitution – 27,78 %
- Omission – 5,56 % (Fig. 3)

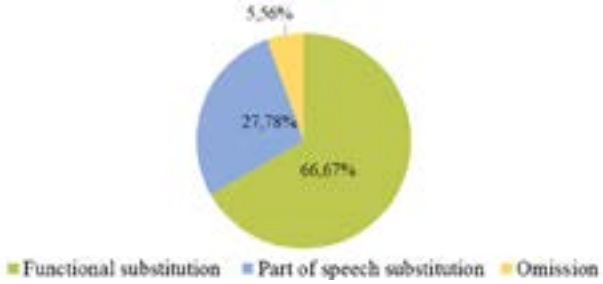

Fig. 3. Diagram of the frequency of using types
of transformations in translating passive voice collocation

Conclusion

The study covers aspects of scientific style in construction, its characteristics and lexico-grammatical features, as well as practical application on the example of translation of an article on mechanical properties of environmentally friendly concrete. It is established that the translation of scientific and technical texts is intended for knowledge transfer and communication in scientific society (articles, reference books, research, etc.).

The practical part analyses the translation of a concrete scientific text, including lexical and grammatical transformations. The main conclusions of the study are:

– Modal verbs are translated by equivalents, part-of-speech substitution or omission. Equivalent selection is the most common method. Modal verbs usually do not cause difficulties in translation and can be replaced by Russian modal verbs or omitted if it does not affect the meaning. The translator is advised to analyze the significance of the modal verb before translation.

– Infinitives are translated by equivalents or by replacing the form of the word, with form replacement being the most common method. It is important to choose the right way to translate the infinitive to preserve the meaning and avoid overloading the sentence. Usually, the English infinitive is replaced by the Russian infinitive.

– The passive voice is most often translated by functional or part-of-speech substitution. It does not present serious difficulties and is usually replaced by a similar construction in Russian. The passive voice can

be translated by another part of speech or omitted if it does not distort the meaning.

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ПОДГОТОВКА ВОЕННЫХ ПЕРЕВОДЧИКОВ В РАЗНЫХ СТРАНАХ

TRAINING OF MILITARY INTERPRETERS IN DIFFERENT COUNTRIES

Международное сотрудничество невозможно без привлечения военного переводчика, способствующего эффективному обмену информацией. В статье даются краткие сведения о развитии отечественной системы подготовки военных переводчиков. Отмечается роль военного переводчика в военное и мирное время. Рассматривается специфика военного перевода, основные аспекты профессиональной деятельности военного переводчика и требования к его профессиональной компетенции. Автор приводит сведения об особенностях подготовки военных переводчиков в отдельных странах. В заключение автор приходит к выводу о востребованности и важности роли переводчика, а также о нехватке квалифицированных кадров в данной сфере.

Ключевые слова: военный переводчик, иностранный язык, военное время, система обучения.

International cooperation is impossible without the involvement of a military translator who facilitates effective information exchange. The article provides brief information on the development of the domestic system of training military translators. The role of a military translator in wartime and peacetime is noted. The specifics of military translation, the main aspects of the professional activity of a military translator and the requirements for his professional competence are considered. The author provides information on the training of military translators in individual countries. In conclusion, the author emphasizes the demand for and the significant role of translators and the lack of qualified professionals in this field.

Keywords: military translator, foreign language, wartime, training system.

Since February 2022, NATO countries have significantly increased the supply of weapons and military equipment to Ukraine's armed forces. Mercenaries and contractors from 64 countries are reported to participate in the hostilities. Under these circumstances, the role of military translators who can be direct participants in the linguistic support of military operations in the SVO-zone has grown essentially.

Military translators perform written translations and they identify, translate, and summarize communications. They utilize foreign language skills, including knowledge of grammar and vocabulary, to collect and analyze intelligence information.

A military translator serves not only as an intermediary in communication between representatives of different linguistic cultures but must also be a military specialist with a clear understanding of the military equipment and terminology of the target language's country [1].

The first educational institution in Russia that trained military translators was established in 1885. Officer courses were opened at the educational department of oriental languages within the Asian Department of the Ministry of Foreign Affairs. The curriculum included English, French, oriental languages, international law, and Muslim law. Translators trained there served in neighboring Asian states and the Caucasus.

The history of the military translators' profession in the USSR began with Order No. 125 issued by the Revolutionary Military Council on May 21, 1929. This order marked the creation of a military interpreter service during a time of increasing international tension and wars [2].

By the onset of World War II, there was an urgent need for professional military translators, as their roles had previously been filled by untrained individuals who happened to speak foreign languages. Sometimes their translation was incorrect and crude. Non-professional translators confused concepts and some linguistic features. That's why, courses for training military translators were established at foreign language departments in several pedagogical institutes. In 1940, a military department was opened at the Second Moscow Pedagogical Institute of Foreign Languages, at the instance of N. N. Biyazi – who was a linguist. He spoke14 languages and was the author of 35 publications on linguistics and military affairs [3].

During World War II, intelligence officers were trained en masse for operations behind enemy lines. Translators learned types of weapons

tactics of the German army; differences in ranks; literature; press; captured documents; and intercepted enemy communications. Their expertise played a crucial role in propaganda efforts and intelligence gathering. Testimonies from prisoners of war saved thousands of lives on both sides and enabled strategic operations based on reliable information about enemy positions. The professionalism of translators often determined the fate of entire battalions or divisions.

Interpreters and translators in the Military gain skills through classroom study and on-the-job experience. Training length varies depending on specialty; longer training is necessary for specialties that do not require foreign language fluency prior to entry. Job-specific training content may include: interrogation methods, use and care of communications equipment, procedures for preparing reports, cultural awareness.

Today, the profession remains highly relevant as Russia expands its military cooperation globally through multimillion-dollar arms contracts with countries such as India, Syria, Argentina, Brazil, Venezuela, China, and others. Military translators are currently trained at institutions like the Military University under Russia's Ministry of Defense and other universities that have developed specialized systems for studying foreign-language military terminology and translation skills [4].

In Germany, there is no higher professional education system for military translators. Instead, the Federal Foreign Languages Office fulfills this role by training specialists in translation, organizing interpretation services for conferences and negotiations, and deploying translators abroad for specific missions.

The office trains approximately 16,000 specialists annually across 50 languages, including civilians, police personnel, administrative workers, and ministry employees. A separate course is offered for pilots.

When Bundeswehr forces engage in combat operations abroad, local residents are often recruited as interpreters due to their understanding of national mentalities–though this work can be perilous for local assistants.

To mitigate risks, Germany has implemented a program granting political asylum and citizenship to volunteer interpreters if their lives are endangered.

When the Bundeswehr participates in combat operations abroad, local residents are actively recruited to serve as military interpreters. Candidates

are selected based on testing results. The assistance of local interpreters is important, since they understand the national mentality and cultural specificity much better than visiting employees. However, such work is often very dangerous for local assistants.

The German government has developed a program for granting political asylum and German citizenship to volunteer assistants of the Bundeswehr if a threat to their lives and the lives of their loved ones is proven [3].

In Austria, future military interpreters are trained at the Language Institute of the National Military Academy of the Armed Forces. The curriculum includes English, Russian, and French. The refugee crisis involving Arab-speaking populations has increased demand for Arabic-speaking specialists.

In the United States, military translators are trained at institutions like the Defense Language Institute Foreign Language Center (DLIFLC) in Monterey, California. Its primary objectives include organizing foreign language training to ensure national security domestically and abroad; conducting linguistic research to improve teaching methods; and developing standards for testing students' proficiency levels. The institute offers courses in approximately 30 languages categorized by difficulty – Russian falls into Category III while Arabic, Korean, Chinese, Japanese, and other oriental languages are classified as Category IV [4].

The Institute studies about 30 foreign languages. They are divided into four categories of complexity. Russian is included in the third category. The fourth category includes Arabic, Korean, Chinese, Japanese and other oriental languages.

The organization of military translation training varies across countries and has its own specifics. However, modern realities (the expanding range of tasks of the Armed Forces, the increase in the number of international operations) make this profession extremely relevant and in demand. The same reasons explain the shortage of highly qualified military translators.

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ВОЗМОЖНОСТИ ИСПОЛЬЗОВАНИЯ СОВРЕМЕННЫХ СИСТЕМ АВТОМАТИЗИРОВАННОГО ПЕРЕВОДА НА ПРИМЕРЕ ТЕКСТОВ АРХИТЕКТУРНОЙ НАПРАВЛЕННОСТИ

POSSIBILITIES OF USING MODERN AUTOMATED TRANSLATION SYSTEMS IN ARCHITECTURAL TEXTS

В данной статье рассматривается эволюция и значение современных систем автоматизированного перевода, в частности решений на базе SAP, в профессиональной переводческой и технической сферах. В отличие от традиционного машинного перевода, автоматизированные системы ставят переводчика в центр процесса, используя технологии в качестве вспомогательного инструмента для повышения скорости, качества и терминологической точности. В статье подчеркиваются уникальные сложности перевода архитектурных и технических текстов, акцентируется необходимость точности и сохранения стилистики. Отслеживается развитие технологий перевода от правило-ориентированных и статистических моделей до продвинутого нейронного машинного перевода (NMT), который использует глубокое обучение и учет контекста для достижения лучших результатов. Обсуждаются гибридные и контекстно-ориентированные системы как дальнейшие усовершенствования, интегрирующие такие функции, как память переводов и мультимодальные данные. Исследование сосредоточено на оценке эффективности нейронных автоматизированных систем при переводе научных и технических текстов с английского на русский. Актуальность работы обусловлена быстрым внедрением SAP и подобных систем в различных отраслях, где точный и эффективный перевод имеет решающее значение. В конечном итоге в статье утверждается, что несмотря на значительный прогресс технологий, человеческий опыт остается необходимым для работы с комплексным и специализированным контентом.

Ключевые слова: нейронный машинный перевод (NMT), автоматизированные системы перевода, нейронные сети, качество перевода, контекст.

This article examines the evolution and significance of modern automated translation systems, particularly SAP-based solutions, in professional translation and technical fields. Unlike traditional machine translation, automated systems place the translator at the center, using technology as a supportive tool to enhance speed, quality, and terminological accuracy. The article highlights the unique challenges of translating architectural and technical texts, emphasizing the necessity for both precision and stylistic fidelity. It traces the development of translation technologies from rule-based and statistical models to advanced neural machine translation (NMT), which leverages deep learning and context-awareness for superior results. Hybrid and context-aware systems are discussed as further advancements, integrating features like translation memory and multimodal inputs. The study focuses on evaluating the effectiveness of neural-based automated systems in translating scientific and technical texts from English to Russian. The relevance of this research is underscored by the rapid adoption of SAP and similar systems across industries, where accurate and efficient translation is crucial. Ultimately, the article argues that while technology has greatly advanced translation capabilities, human expertise remains essential for complex and specialized content.

Keywords: Neural Machine Translation (NMT), automated translation systems, neural networks, translation quality, context.

Modern automated translation systems (SAP) play a significant role in the professional activities of translators and specialists in various fields. Unlike machine translation (MP), in automated translation, the key role remains for humans, and computer technology serves as auxiliary tools. They help to speed up the translation process, improve the quality and ensure the accuracy of terminological transmission. [7, 15] The features of architectural texts, such as complex terminology, specific structure and logic of presentation, require a careful approach. In the context of globalization and international cooperation, these texts must be translated with maximum accuracy and stylistic preservation. SAP opens up new possibilities for solving these problems by combining advances in neural networks, translation memory, and automatic post-editing. [12, 22]. In addition, modern technologies such as Neural Machine Translation (NMT) significantly expand the possibilities of automated translation. These systems take into account the context of the text, improving the quality of translation and reducing the burden on the translator [10]. However, for

complex texts, including scientific, technical and architectural ones, human participation remains an important factor [26].

The object of this work is modern technologies of automated translation used for processing scientific and technical texts. The subject of the research is the assessment of the quality of scientific and technical texts translated using automated translation systems. The purpose of this final assessment is to determine the effectiveness of using automated systems based on neural technologies in translating scientific and technical texts from English into Russian. The relevance of this work is due to the rapid development of SAP and their wide application in various professional fields, including the translation of scientific and technical texts. The use of automated translation makes it possible to significantly reduce the time spent on text processing and ensure terminological accuracy, which is especially important for architectural texts. To achieve the above goal, it was necessary to identify the main methods and algorithms of machine translation systems and identify the main features and problems of translating scientific and technical texts.

The history of the development of machine translation systems covers several key stages, each of which introduced new approaches and technologies to natural language processing. The first stage was Rule-Based Machine Translation (RBMT) systems. These systems were based on predefined linguistic rules and used bilingual dictionaries for text conversion. For example, in the 1954 Georgetown Experiment, IBM, one of the largest technology companies, demonstrated the ability to translate about 50 sentences from Russian into English using a limited set of rules [6]. However, as noted, RBMT systems depended on the accuracy of the rules, and in most cases could not take into account the context of the text, which limited their applicability. [6, 12, 21] In the 1990s, Statistical Machine Translation (SMT) appeared, which began to be based on the analysis of parallel texts. This approach used probabilistic models to select the most appropriate translation of words and phrases. SMT made it possible to improve the quality of translation by taking into account the frequency of lexemes, but it could not cope with the global context, which remained its key limitation [7]. For example, the Moses system, one of the first SMT platforms, was widely used in the scientific and professional environment to translate texts with a large amount of data [3].

In the early 2010s, SMT was replaced by Neural Machine Translation (NMT), which provided significant progress in translation quality. NMT uses deep neural networks and attention mechanisms that analyze text in the context of the entire document [1]. This approach has provided a qualitative leap in translation accuracy, especially for texts with ambiguous terms and complex syntax [15]. "In the NMT model, the entire translation process is handled by a single module, which allows you to take into account the context and dependencies between words when translating" [20]. This makes the translation more accurate and consistent. Modern hybrid systems such as PMBT (Phrase-Based Machine Translation) and EMBT (Example-Based Machine Translation) combine the best features of previous approaches. PMBT divides text into fragments and translates them separately, which speeds up the process, and EMBT extracts examples from databases of parallel texts, which allows you to use templates to translate similar sentences. This allows you to work effectively with terms and structures that are often found in specialized texts. [22, 26] Context-Aware translation systems and multimodal approaches have become a further development of NMT. These technologies take into account not only textual, but also visual or auditory information, which makes them especially useful for professional texts where interpretation of context is important. For example, such systems can take into account drawings or diagrams when translating architectural texts [20].

The evolution of machine translation systems from RBMT to modern hybrid systems demonstrates continuous technology improvement. The introduction of neural networks has opened up new possibilities for word processing, significantly advancing NMT in the field of research and development. Neural machine translation has become the foundation of modern natural language processing technologies, replacing previous approaches such as statistical and rule-based translation. Unlike its predecessors, NMT is able to take into account the global context and complex relationships between text elements, which makes translations more accurate and stylistically correct [8, 15]. NMT uses deep neural networks capable of processing huge amounts of data and learning from examples from parallel corpora. One of the most important elements of this technology was the introduction of the attention mechanism, which allows the system to focus on the most significant parts of the text during translation

[19]. With the advent of NMT, there are many opportunities to integrate neural networks into popular web translation services. Different machine translation platforms implement unique algorithms and architectures adapted to their tasks, which makes it possible to consider NMT as a set of different approaches to natural language processing [25].

NMT algorithms include several steps, starting with input text processing and ending with the generation of translated text. Consider the main components:

1. Encoding of the source text.

At the first stage, the text passes through an encoding layer, where each text element (for example, a word or character) is converted into a numeric representation using vectorization. This representation reflects the semantic connections between words, taking into account their context. In transformer-based models, this process is optimized for parallel processing, which speeds up calculations.

2. The mechanism of attention.

After encoding, the text is processed through the attention mechanism. This stage allows the system to select the most significant text fragments for translation. For example, when translating a complex sentence, the system highlights the subject and action, omitting minor details. [1]

3. Decoding and translation generation.

At the decoding stage, the system converts the encoded information into the target language text. Attention mechanisms also help to clarify which elements of the text should be considered when choosing words in the target language. Models such as GPT use a generative approach that provides a more natural-sounding translation [25]. [2.8] Neural machine translation offers models that can not only analyze text, but also take into account context, grammatical and semantic connections between words. To implement these processes, various neural network architectures are used, each of which is adapted to specific tasks and translation features [15, 16, 19].

Recurrent Neural Networks (RNN). RNNs were the first attempt to use neural networks in text processing tasks. These networks process data

sequentially, storing information about previous steps. This makes RNNs suitable for working with texts where it is important to take into account the sequence of words. However, RNNs face the problem of a vanishing gradient, which limits their capabilities when working with long sentences [15]. LSTM (Long Short-Term Memory) and GRU (Gated Recurrent Unit) networks have been developed to solve RNN problems. These architectures include special mechanisms that "remember" and "forget" information depending on its significance. LSTMs are more resistant to information loss, GRUS, in turn, are a simplified version of LSTMs, which makes them easier to calculate [8, 21].

Convolutional Neural Networks (CNN). CNNs are traditionally used in image analysis, but in NMT they are used to highlight the basic patterns and structures of text. CNNs analyze text not by one word, but in fragments of a fixed length, which makes it possible to efficiently process stable expressions or terminological constructions. However, CNNs are limited when working with long sequences of text, as they cannot take into account the global context [5].

Transformers (Transformer). Transformers, introduced in 2017, have become the basis of most modern NMT systems. These models use the attention mechanism to analyze the text both locally and globally, which allows you to take into account both the context of the sentence and the entire chapter. Unlike RNN, transformers work with text in parallel, which significantly speeds up the work [25]. The new generation BERT, GPT, and T5 models are also referred to as transformer neural networks. BERT uses a bidirectional approach, analyzing text both from left to right and from right to left. This allows you to take into account the full context of the words in a sentence, which is especially important for complex syntactic structures and multi-valued words. The model is well suited for the tasks of text classification and working with context-sensitive terminology. GPT focuses on a generative approach, creating translations that sound natural and stylistically correct. This model is widely used in adaptive translations that require deep study of the context. GPT is trained on large amounts of data and can effectively take into account the specifics of the language and terminology. [5, 25]. T5 is versatile and converts all tasks into the input text – output text format. This allows her to perform not only translation, but also the tasks of summarizing and paraphrasing,

while maintaining the complex connections and stylistics of the text. The T5 model is suitable for processing large texts and documents that require detailed study [18, 10].

The variety of neural network architectures in NMT allows for flexible and accurate translation systems. The application of these technologies in real-world translation tasks varies greatly, and systems such as Google Translate, Yandex Translate, and ChatGPT use neural network architectures in different ways. Let's look at how these systems implement neural networks in their algorithms.

ChatGPT, developed by OpenAI, is based on the Generative Pre-trained Transformer (GPT) model. It is focused on text generation, which allows you to create translations as close as possible to the natural language. The model analyzes the text as a whole, taking into account the complex connections between words, which is especially effective when translating long texts or materials with ambiguous context. However, the generative nature of ChatGPT sometimes requires additional post-editing to eliminate possible deviations from the source text [25].

Google Translate uses the transformer architecture, which has become the basis for most modern NMT systems. The central element of the system is the attention mechanism, which allows analyzing the entire text and preserving its semantic structure. Google Translate supports a huge number of languages and provides multimodal translation features such as image and audio processing. However, the universal nature of the system may reduce the accuracy of translation for specialized texts, especially with rich terminology [19, 25].

Yandex Translate uses a hybrid approach combining statistical and neural machine translation. This allows the system to maintain the accuracy of translation of short phrases and complex expressions, as well as adapt to the peculiarities of rare language pairs.

Neural networks integrated into the system help to improve the processing of long texts, but complex terminology, especially in scientific and technical texts, still requires additional adjustments. Yandex.Translate is constantly being updated, making it one of the most adaptive systems on the market [19, 22, 24].

The development of neural networks and their implementation in automated translation systems have made the translation process more ef-

ficient. However, even the most advanced algorithms cannot completely replace humans. Automated Translation (SAP) does not involve full automation of the process. Unlike machine translation (MP), where the text is processed by a system with minimal human involvement, in SAP, the translator is primarily responsible for the final text. His task is to ensure the accuracy and adequacy of the translation at all stages of the work.

The main stages of automated translation:

1. Pre-editing

At this stage, the text is analyzed by the translator in order to eliminate ambiguities, improve the sentence structure and prepare it for processing by the system. This is especially true for texts where precise terminology is required.

2. Translation and inter-editing

Using automated translation tools such as Google Translate, Yandex Translate, or ChatGPT, the specialist receives a rough draft of the text. These NMT systems provide a basic level of accuracy and translation style, but the result still requires professional refinement [10, 14]. If necessary, a person intervenes directly in the translation process and resolves difficult situations.

3. Post-editing

At the final stage, the translator makes edits to the text in order to eliminate errors, improve the style and adapt the translation to the specifics of the source material. This process is especially important for specialized texts, where errors in terminology or style can seriously distort the meaning [14, 12].

Modern automated translation systems offer translators a number of significant advantages that make the translation process more efficient and convenient. Among them can be found the following:

- **Speeding up the work.** SAP allows you to significantly reduce text processing time by automating routine tasks, such as translating repetitive phrases or template constructions. For example, translating scientific and technical documentation using tools such as Google Translate or Yandex Translate significantly speeds up the pre-translation process [10].

- **Consistency of terminology.** Technologies such as Translation Memory ensure uniformity of terms and phrases, which is especially important for documents with repetitive elements, such as instructions and technical descriptions. Maintaining terminological consistency allows you to minimize errors and improve the overall quality of the translation.
- **Saving resources.** Thanks to automation, some of the work can be done using machine algorithms, which reduces translation costs, especially in projects with a large volume of text. At the same time, the person retains control over the final result, which ensures that the translation corresponds to the tasks set [7, 12, 14].

Despite the advantages, modern automated translation has its limitations, which the translator must take into account in the process of work.

- **Insufficient MP accuracy when working with complex texts.** NMT systems such as ChatGPT handle general texts well, but may make mistakes when translating materials with highly specialized terminology or complex syntactic structure. For example, in architectural texts, inaccuracies in the translation of key terms can significantly change the content. [14, 25]. MP problems taking into account the specifics of the context. Machine algorithms, despite using the mechanism of attention, do not always take into account the global context. This can lead to an inconsistency of concepts or a violation of the logic of presentation in translation [20, 21].
- **Cultural and stylistic aspects.** The MP does a poor job of translating texts that are saturated with idioms, metaphors, or cultural references. For example, translating fiction or marketing texts requires more adaptation than an automated tool can offer.
- **Dependence on post-editing.** Even with the high accuracy of automated translation, the result always requires additional verification and editing. This is especially important for materials where errors are unacceptable, such as legal or medical documents [12].

Automated translation is becoming an important tool in the professional practice of translators. However, the key to its effective use is the combination of technology capabilities with professional human expertise. Post-editing remains an integral part of the process, which allows us to maintain stylistic consistency, the accuracy of terminology and the adaptation of the text to the customer's requirements. This approach makes

SAP an assistant for the translator rather than a substitute, which guarantees the achievement of high-quality translation. The evolution of machine translation systems from RBMT to modern hybrid approaches demonstrates the continuous development of technologies, which has significantly improved the quality of text processing. The most notable achievement was the introduction of neural machine translation (NMT), which made it possible to take into account the global context and complex relationships between text elements when using machine translation. The variety of neural network architectures has allowed NMT to be adapted to various translation tasks. Modern models such as BERT, GPT, and T5 provide high accuracy and adaptability, especially when working with complex texts. The implementation of NMT in web services such as Google Translate, Yandex Translate, and ChatGPT illustrates the successful application of technology for mass and professional use.

Automated translation remains an important tool, especially in professional practice. It allows you to speed up the process, increase terminological consistency and reduce costs, but it still requires the active participation of the translator to ensure high-quality translation. Despite significant progress, automated translation has limitations, which highlights the importance of professional post-editing and the human role in the translation process.

The translation of architectural texts is associated with a number of difficulties due to the specifics of this field: such texts are a combination of scientific, technical and artistic styles, which requires a special approach and consideration of many factors. Every word and every structure should not just be translated, but adapted to the linguistic, cultural and professional realities of the target audience. The effectiveness of translation is largely determined by the approach chosen by the translator and the means used. Modern NMT-based automated translation systems, such as ChatGPT, Google Translate, and Yandex Translate, can significantly facilitate work with highly complex texts, reducing the likelihood of errors and speeding up the process. To evaluate the capabilities and determine the limitations of these systems, a comparative analysis of their results was carried out, which was compared with the translation performed by us. The analysis is based on the fragments of the text "Perception of Color in Architecture and Urban Space" (Jaglarz A.).

The fragment analyzed

The original text: “Changes in the color scheme of the facility, resulting from organic materials and natural cycles, reflect the relationship between architecture and biology. The changeable, colorful image of the object is caused by processes such as plant vegetation cycles, photosynthesis, biodegradation and rainwater absorption. Creating unique color solutions for images of objects can result from recycled construction and finishing materials (e.g., brick, wood, copper) or new experimental technologies (e.g., hempcrete). In addition to the time factor, an important element in the process of changing the color of materials is the impact of environmental factors, including the nature of natural lighting”.

Google Translate: Изменения в цветовой гамме объекта, возникающие под воздействием органических материалов и естественных циклов, отражают связь архитектуры и биологии. Изменчивый, красочный образ объекта обусловлен такими процессами, как циклы вегетации растений, фотосинтез, биодеградация и поглощение дождевой воды. Создание уникальных цветовых решений для изображений объектов может быть результатом использования переработанных строительных и отделочных материалов (например, кирпича, дерева, меди) или новых экспериментальных технологий (например, конопляного бетона). Помимо фактора времени, важным элементом в процессе изменения цвета материалов является воздействие факторов окружающей среды, в том числе характера естественного освещения.

Yandex Translate: Изменения в цветовой гамме объекта, вызванные органическими материалами и природными циклами, отражают взаимосвязь между архитектурой и биологией. Изменчивый, красочный образ объекта обусловлен такими процессами, как вегетационные циклы растений, фотосинтез, биодеградация и поглощение дождевой воды. Создание уникальных цветовых решений для изображений объектов происходит в результате использования переработанных строительных и отделочных материалов (например, кирпича, дерева, меди) или новых экспериментальных технологий (например, конопляного бетона). Помимо фактора времени, важным элементом в процессе изменения цвета материалов является воздействие факторов окружающей среды, включая характер естественного освещения.

ChatGPT: Изменения в цветовой палитре объекта, вызванные использованием органических материалов и естественными природными циклами, отражают взаимосвязь между архитектурой и биологией. Переменчивый, насыщенный цветовой образ объекта обусловлен такими процессами, как циклы вегетации растений, фотосинтез, биодеградация и поглощение дождевой воды. Создание уникальных цветовых решений для образов объектов может основываться на вторично переработанных строительных и отделочных материалах (например, кирпич, дерево, медь) или на новых экспериментальных технологиях (например, бетон из конопли). Помимо временного фактора, важным элементом процесса изменения цвета материалов является воздействие природных факторов, включая характер естественного освещения.

Отредактированный текст: Изменения в колористике объекта, возникающие под воздействием органических материалов и природных циклов, отражают взаимосвязь между архитектурой и биологией. Изменчивый, красочный образ объекта обусловлен такими процессами, как вегетационные циклы растений, фотосинтез, биоразложение и поглощение дождевой воды. Уникальные цветовые решения создаются с использованием переработанных строительных и отделочных материалов, таких как кирпич, дерево, медь, а также новых экспериментальных технологий, например, костробетона. Помимо временного фактора, на изменение цвета материалов существенно влияют условия окружающей среды, включая характер естественного освещения.

Analysis of the fragment

The phrase “color scheme” was translated by Google Translate and Yandex Translate as “color scheme”, and the ChatGPT translation uses the term “color palette”, which preserves the general meaning of the source text, but in this case requires clarification. In the edited translation, the term “coloristics” was chosen, the most accurate and specialized.

The term “hempcrete” in all systems is translated literally: “hemp concrete” (Google and Yandex) or “hemp concrete” (ChatGPT). These options are not adapted to the professional term “kostrobeton”.

The phrase “reflect the relationship between architecture and biology” in Google is simplified to “reflect the connection”. Yandex and ChatGPT

offered to “reflect the relationship”, which more accurately conveys the meaning of the original.

All systems as a whole have kept the order of ideas, but Google and Yandex translations look overloaded with complex structures. ChatGPT strives for a clearer presentation, but introduces unnecessary clarifications, for example, “natural natural cycles”/ The edited text is characterized by clarity and professional adaptation.

The NMT systems studied demonstrate different levels of accuracy and adaptability. Google Translate provides basic accuracy and consistency, which makes it useful for general understanding of text. The vocabulary of the system is simple, and the sentence structure preserves the general order of the original. However, due to the literal translation, many terms, especially in the architectural context, are conveyed incorrectly or simplistically. Yandex Translate demonstrates a high level of accuracy in transmitting grammatical constructions. In most cases, the vocabulary of the system is closer to the professional context than that of Google Translate. However, the style of the text sometimes seems cumbersome due to excessive clarifications and complex formulations. In some cases, the literal translation of terms reduces the professionalism of the text. ChatGPT stands out for its cohesive text and smooth presentation, making translation easy to understand. The system often adapts complex constructions, bringing them closer to the natural Russian language, and does a good job of conveying context. However, redundant details added by the system sometimes distort the meaning of the original. In some cases, there is a departure from the formal scientific style towards colloquial formulations. ChatGPT terminology is generally more accurate than that of other systems, but there are cases of inaccurate adaptation of professional terms.

Architectural texts are a complex combination of scientific, technical and artistic styles, requiring the translator to have a deep knowledge of terminology and an understanding of the cultural context. The translation of scientific and technical literature requires not only accuracy, but also the ability to adapt the text to the target audience in order to preserve its accuracy, functionality and stylistic expressiveness. Modern neural machine translation systems demonstrate significant progress in processing complex texts, providing fast and accurate reproduction of basic meanings. However, an analysis of these systems revealed that automatic translations

often suffer from terminology inaccuracies, stylistic inconsistencies, and lack of contextual adaptation. Editing by a professional translator allows you to eliminate typical machine translation errors.

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ВАЖНОСТЬ ИЗУЧЕНИЯ ИНОСТРАННОГО ЯЗЫКА В ПРОЦЕССЕ ПОДГОТОВКИ СПЕЦИАЛИСТОВ К ПРОФЕССИОНАЛЬНОЙ ДЕЯТЕЛЬНОСТИ

THE IMPORTANCE OF LEARNING A FOREIGN LANGUAGE IN THE PROCESS OF PREPARING SPECIALISTS FOR PROFESSIONAL ACTIVITY

В статье рассматривается проблема значимости иностранного языка в процессе подготовки специалиста. Изучение иностранного языка является неотъемлемой частью подготовки современных специалистов. В условиях глобализации и интеграции в мировое профессиональное сообщество владение иностранным языком становится ключевым фактором успешной профессиональной деятельности. Оно способствует расширению профессиональных компетенций, повышает конкурентоспособность на рынке труда, а также открывает доступ к международным источникам информации и передовому опыту. Таким образом, формирование и развитие языковых навыков у будущих специалистов – важная задача образовательного процесса, напрямую влияющая на их профессиональную мобильность и успешную карьеру. В статье раскрываются такие понятия как подготовка, профессиональная подготовка студента, мотив. Авторы указывают на то, что в качестве предмета обучения иностранному языку следует рассматривать профессионально-речевое общение, когда иностранный язык усваивается в процессе овладения деятельностью общения. Это способствует формированию речи такого уровня, который обеспечивает эффективное взаимопонимание среди представителей одной профессиональной группы. Удовлетворение потребности в профессиональной информации рассматривается как необходимое условие, стимулирующее развитие профессиональной деятельности.

Ключевые слова: иностранный язык, подготовка, речевое общение, профессиональное общение, специалист.

The article addresses the issue of the importance of foreign language learning in the process of specialist training. Learning a foreign language is an integral part of preparing modern specialists. In the context of globalization and integration into the global professional community, proficiency in a foreign language becomes a key factor for successful professional activity. It contributes to the expansion of professional competencies, increases competitiveness in the labor market, and also provides access to international sources of information and advanced experience. Thus, the formation and development of language skills in future specialists is an important task of the educational process, directly influencing their professional mobility and successful career. The article explores concepts such as training, professional training of students, and motivation. The authors point out that professional communication should be considered the subject of foreign language learning, where the foreign language is acquired through mastering the activity of communication. This contributes to the development of language at a level that ensures effective mutual understanding among members of the same professional community. Meeting the need for professional information is regarded as a necessary condition that stimulates the development of professional activity.

Keywords: foreign language, training, speech communication, professional communication, specialists.

Throughout human history, the ability to speak multiple languages has significantly contributed to the development of cultures, societies, and individuals. In today's world, characterized by globalization and rapid technological advances, multilingualism has become not just an advantage but an essential life skill. But what motivates people to learn and master several languages? Currently, foreign language proficiency greatly impacts a person's professional performance. It often serves as a crucial factor for career advancement. Many employers highly value foreign language skills, and in some cases, they are a mandatory requirement for employment. Knowledge of foreign languages is vital across all areas of life – cultural, economic, and social [1].

A foreign language can be seen as a means for forming the personality of future young professionals. First of all, the relevance of this subject increases because of international relationships development: the expansion of collaboration with foreign companies, global market relations. Therefore, a foreign language is an obligatory subject in higher education institutions and provides a good base for further development of linguistic skills [1]. Secondly, the student's learning process facilitates the

comprehension and retention of language rules, enhances both speaking and writing abilities, and expands vocabulary with specialized professional terminology, it also helps to overcome such psychological barriers like anxiety, insecurity and fear of public performances. Moreover, it is fundamental in learning professional disciplines.

Students are mostly uninterested in developing language skills misunderstanding the main goals of learning a foreign language and improving reading, listening, speaking and writing skills. In addition, many students have a poor language base after school, which can be an obstacle in mastering it in spite of the fact that a program for the first-year students includes revising elementary grammar as well as a basic vocabulary.

The main vector now is globalization, the emergence of a common world culture, the unification of national traditions and the strengthening of cooperation between nations [2]. Knowledge of a foreign language is a competitive advantage when a student decides to apply for a job. It should be noted that English is not always a favorite.

It all depends on the field of activity. For example, many Russian companies, especially in the Far East, are developing close cooperation with China, Korea, Japan and other Asian countries [2]. There is a growing interest in the Scandinavian countries and their neighbors, the Western Slavs (Czech Republic, Poland, Slovakia). Proficiency in one or more foreign languages can greatly enhance your career prospects by increasing the range of available job opportunities, even within your specific field, while also broadening your options for geographical locations and professional growth and, of course, the salary level and salary expectations. It will allow you to communicate more effectively with foreign clients or partners, as well as improve your profound professional skills in your chosen profession. A mention should be made that a lot of scientific papers, monographs, journals, research reports are published mostly in English. This is an additional bonus for your personal self-realization and for prospective career development. Nowadays the cooperation between many countries is developing rapidly. We, students, hope that partnership in cultural exchange programs will be bolstered soon. Undoubtedly, participants of such kind of programs can make much more progress in developing language skills in natural environment. Moreover, it is a great opportunity to have good working relationships with people from other cultures and dis-

cover that we have much in common – we can cooperate, share our ideas and make our world better.

One could hardly argue that knowledge of foreign languages is a chance for those who are looking for high positions, well-paid jobs and promotions. Different companies need candidates who have knowledge of a foreign language or even more two or more. If you have the appropriate skills and qualifications, you can apply for a job at reputable organizations and international companies all around the world. Advanced level of a foreign language also increases effective competitiveness and successful negotiation with a foreign partner in business or politics.

If to talk about research work in academic community, graduate students, associate professors, and professors, including candidates and doctors of sciences are demanded very strict requirements for scientific publications [3]. While doing their research work they use different sources written in different languages, mostly in English (as it is the international language). To do this particular work, it is evident that one must have an advanced level of English. Moreover, it is necessary to always improve it as each language is colloquial – it is developing as well as society is. To participate in the international scientific conference a sought-after speaker should use English as the international language. It means that a person is imposed to have excellent speaking skills. Those who learn foreign languages usually have a better ear for listening and sharper memories. They display better problem-solving skills and have more flexible minds. Learning foreign languages improves your thinking abilities and expands your horizons. It also leads to understanding of other cultures. Multilingualism promotes intercultural competence, making us wonder the diversity of the world and making us to be tolerant to other people. Learning languages stimulates cognitive development of people and their mental abilities. Scientific research confirms that bilingualism and multilingualism contribute to the memory training and improvement, concentration increase, and multitasking development [3]. People who speak several languages tend to have more adaptable thinking and greater creative abilities, which can contribute to success in various areas of life. Another important benefit of multilingualism is the enhancement of communication skills and the opportunity to build international business connections. Language proficiency enables students to articulate their thoughts

and ideas more clearly and effectively, while also better understanding the emotions and intentions of others. This, in turn, fosters stronger and more meaningful interpersonal relationships in both personal and professional contexts in the future.

Before starting communication, it is essential to collect relevant information to understand the key messages to discuss. When analyzing a certain segment of a person's life, you can see that communication is closely connected with individual activities. Graduates must be proficient in foreign languages to communicate effectively with international colleagues not only on specialized topics. These skills, developed through professional interactions using a foreign language, are essential for effective communication in everyday life.

University graduates can develop these skills if professional speech communication is one of the main elements of a foreign language teaching. In this approach, the language is learned through various communication activities, enhancing the quality of speech and ensuring mutual understanding within the professional community [4]. To create a well-reasoned argument that effectively supports an individual's perspective and achieves the intended effect, the speaker needs an engaged interlocutor rather than a passive listener. An active communication partner can anticipate responses, which is essential for successful verbal interaction. In professional communication, the selection of language and speaker behavior is guided by the professional style. This style is marked by the use of specialized terminology, industry-specific vocabulary, common conversational phrases, and etiquette norms. Moreover, the communicators' speech patterns and expressions are shaped by their roles in the situation and the context of the interaction [4].

In everyday communication, speech serves multiple purposes. However, in professional settings, its main functions are to establish professionalism, facilitate the exchange of information about new technologies and recent technical developments, regulate processes, and build business relationships.

Professionalization primarily involves developing communication skills within the professional community and developing professional knowledge acquisition. Meeting the need for professional information is as a crucial factor in organizing professional activity of students. Competence

in foreign languages requires vocabulary and grammar proficiency, as well as an understanding of verbal language and stylistic features. It is also essential to understand social conventions, norms, traditions and cultural diversity. Learning a foreign language enriches one's inner life, stimulating more concise expression of thoughts, ideas and emotions. It facilitates communication with individuals from different worldviews and mentalities, ultimately helping to break down stereotypes. Knowledge of foreign languages provides insights into the history, present, and future of different cultures [5].

Reading literature and watching films in their original language deepens our understanding of the works of writers, scientists and directors. Learning foreign languages also helps to understand words in one's native language and the cultural influence of one language on another. Additionally, it makes traveling and communicating in different countries much more fascinating and easier.

The factors that determine the study of foreign languages are:

- knowledge of a foreign language can lead to better job prospects, career growth, fast promotions, and business travel opportunities;
- without knowledge of foreign languages, scientists cannot access international sources or collaborate with colleagues around the world;
- understanding foreign languages is necessary for getting degree abroad and engaging in different activities;
- language proficiency is essential for successful integration into new language environment;
- traveling to different countries requires effective communication skills;
- religious outreach in various countries necessitates an understanding of local languages;
- personal motives can include communication with foreign friends, and personal hobbies.

In the modern world, language acts as the mechanism of intercultural communication. It also is a means of mutual understanding and tolerance among peoples and a resource for self-development and enrichment of the inner world.

Foreign language proficiency enables one to read literature from other countries and engage with their culture and technological advancements [6].

Language communication in professional contexts is fundamental in the process of learning and teaching foreign languages, as it involves acquiring specific skills due to professional needs. A foreign language should be a cornerstone of training for future specialists across all fields of life and science. It also serves as:

- a tool for enhancing professional knowledge,
- it facilitates effective collaboration, critical thinking, and adaptability in diverse professional environments.

Moreover, mastering professional language equips individuals with the ability to navigate workplace dynamics effectively.

It fosters:

- clarity,
- ensures mutual understanding, and
- strengthens interpersonal relationships, which are essential for teamwork and career advancement.

Professional communication skills also enable specialists:

- to engage confidently in international business contexts,
- build valuable connections, and
- access global resources.

The integration of foreign language education into professional training not only helps students develop critical thinking, cultural awareness through language, learning oral communication skills but also prepares them for the challenges of a globalized workforce.

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О НЕКОТОРЫХ ОСОБЕННОСТЯХ ЯЗЫКОВОЙ КАРТИНЫ МИРА ВОЕННОЙ СФЕРЫ (НА МАТЕРИАЛЕ НЕМЕЦКОГО ЯЗЫКА)

FEATURES OF THE LINGUISTIC PICTURE OF THE WORLD IN THE MILITARY SPHERE (ON THE EXAMPLE OF THE GERMAN LANGUAGE)

В статье описаны когнитивные особенности немецкой языковой картины мира военной сферы как особого элемента общей картины мира, а также роль языка в формировании профессионального мышления. Исследование проводится в рамках актуального научного направления – когнитивной лингвистики, которое предоставляет возможность осмыслить данный фрагмент человеческого опыта в контексте формирования разных структур знания и способов их репрезентации в языке в процессе речемыслительной деятельности. В заключение автор делает вывод о разнообразии методов номинации, используемых в немецкой военной терминологии, и подчеркивает значимость лингвистического творчества для выражения сложных понятий в военном деле.

Ключевые слова: языковая картина мира, профессиональная картина мира, языковая картина мира военнослужащего, военная терминология, термины-реалии, зоометафора.

The article describes the cognitive features of the German linguistic picture of the world in the military sphere as a special element of the general picture of the world and the role of language in shaping professional thinking. The study is carried out within the framework of a relevant scientific direction - cognitive linguistics, which provides an opportunity to comprehend this fragment of human experience in the context of the formation of different knowledge structures and ways of their representation in language in the process of speech-thinking activity. The author

comes to the conclusion about the variety of nomination methods used in German military terminology and highlights the significance of linguistic creativity in expressing complex concepts within the field of military affairs.

Keywords: linguistic picture of the world, professional picture of the world, linguistic picture of the world of a serviceman, military terminology, terms-realities, zoometaphor.

Language has been always studied in an inseparable connection with a person, his/her consciousness, which is the focusing of our mental resources onto a specific piece of information. We should also determine cognitive activity within cognitive science and thinking that refers to the abilities to process information, understand other people, and express oneself to others.

The psychological state of the individual, his worldview, way of thinking is a subject of cognition. That means that a person is a carrier of a certain system of information about the reality, which is called a picture of the world. In this article, following V.A. Maslova, it is generalized as a set of knowledge about the world, captured in the lexicon, phraseology, grammar, etc. [2, p. 49].

One of the key components of the linguistic picture of the world is its professional aspect, which reflects and organizes a person's ideas and concepts within a specific professional activity (professional language includes formality, objectivity, conciseness, grammatical correctness (form), and accurateness). This results in the emergence of a distinct fragment of reality, represented as a semiotic nature composed of various units. Each unit gives a brief presentation of the unique properties of an object that are perceived and interpreted by an individual during the process of understanding and exploring the world around them [1, p. 12].

The meanings of linguistic units accumulate the linguistic picture of the world of a military man, which has certain peculiarities due to the kind of his/her activity whose aim is to ensure the protective powers of the country.

The distinct nature of this activity makes it necessary to extend the utilization of specialized terms that possess a precise and unambiguous correlation within the limits of a particular sphere of military affairs. The definite number of terms within a specific field of knowledge forms its terminology, which serves as a fundamental framework for clear communication and understanding among professionals.

Let us consider the peculiarities of German military terminology with examples.

Within the military sphere, terms are always unambiguous. Sometimes there are terms that are close in their meaning, for example, *Gefecht n* and *Kampf m*, but they differ in the area of their use. Thus, the term *Gefecht n* is the official definition of combat activity of troops in at least a military compound, and the term *Kampf m* is used to express combat activity in a military unit.

To form terms, everyday words are often utilized and reinterpreted, yet their original meaning remains distinguishable within the terms as an inner underlying meaning. For instance, in the military term "*Stauraum m,*" meaning "*baggage compartment,*" the original meaning of the word "*Stau m*" ("jam; traffic jam; congestion") is still subtly recognizable, providing connection to its etymology.

The military terminology of the Bundeswehr is distinguished by a significant number of non-equivalent terms that reflect unique realities. This often happens when you have to translate terminological units not only in the military sphere, but also in other fields of science. Thus|, the lack of corresponding military concepts in Russian military practice complicates the translation of such terms. For example, *Faltstraße f* refers to an aluminum road paving machine used for traversing sandy or swampy terrain, while *Panzer m* generally denotes any armored vehicle, including such types as *Kampfpanzer m* (battle tank), *Transportpanzer m* (armored transport), *Schützenpanzer m* (infantry fighting vehicle), and *Spähpanzer m* (reconnaissance vehicle). Additionally, the term *Kofferfahrzeug (m)* refers to a van with a separate metal body distinct from the cab, while *Kastenwagen (m)* denotes vehicles featuring an integrated metal body and cab design. These terms highlight the specificity and technical precision in Bundeswehr terminology.

It is interesting to mention that some names of military vehicles are associated with the animal world. The professional picture of the language among German-speaking military men includes a substantial number of zoometaphors – names of military equipment created through metaphorical transfer, forming a group referred to as the "Living World." Examining the names of modern Bundeswehr land force equipment reveals a diverse array of animal-inspired designations. These include felines (Leopard,

Puma, Lynx, Serval), canines (Wolf, Wild Dog Dingo, Fox, Fennec), raccoons (Raccoon), martens (Marten, Badger, Weasel), beavers (Beaver), hornbill family mammals (Yak, Buffalo), elephants (Elephant, Mammoth); arthropods like scorpions; birds of prey such as eagles; and reptiles like alligators. These names provide descriptive insights into the objects based on similarities in external and behavioral characteristics of the animals, often conveying subjective perspectives and serving as carriers of cultural information and worldview nuances specific to the people using them.

Some tanks including the Tiger, Panther, Leopard, Luchs, and Hellcat are all associated with cats. But why? What connects these tanks to the cat world? A possible answer could relate to the general characteristics between cats and these powerful machines.

The cat family displays fierce, intelligent, and responsive movements that are easy to associate with tanks as well. For example, the German Luchs (Lynx) was designed to be fast, maneuverable to keep itself out of trouble and be used as a comfortable armored reconnaissance vehicle.

The answer also may relate to the references to fierce animals that have been a part of military supplies since ancient times. For example, Roman legions often bore lions and eagles on their standards. The standard-bearer of the legion, charged with the important task of carrying it, would generally dress in a lion cape and headdress. The German army continues this tradition during the twentieth century.

Initially, the German army didn't use cat names for tanks. The Panzer I, II, III, and IV were predecessors to the famous Tiger and Panther tanks, and even became most frequently produced German vehicles during the Second World War. The "Panther" name was given to it in 1943.

However, the Tiger I and Panther quickly became celebrated symbols and esteemed emblems that had legendary status both during and after the war. In different military documents, the Tiger was officially named the Panzerkampfwagen VI Ausführung H.

Then, automotive engineer Ferdinand Porsche invented the tank "Tiger," and the nickname was adopted by tank crews almost immediately. The names of such combat vehicles as the Leopard main battle tank and the Puma infantry fighting vehicle use the names of predatory animals characterized by gracefulness, sufficient strength, cold-bloodedness, as well as elegance and jumping ability.

It should be noted that for engineering repair and evacuation vehicles “Bison” and ‘Buffel’ the use of the names of pair hoofed mammals “bi-zone” and “buffalo”, was connected with huge size, massive body and strength of the animals mentioned. Engineering machine “Bieber”, designed to install bridges on obstacles to ensure the advancement of tank and other formations, got its name on the basis of the similarity of its functions with the behavioral qualities of the beaver? That is considered to be an “experienced civil engineer”.

The Amphibious vehicle capable of traveling both on land and in water was named after its similarity to amphibians that spend part of their lives in water as well as on land.

The determining factor in the functioning of animal names as part of terminological units and the use of zoonymic terms in the speech of native speakers is parallel in the animal world and the human world. On its basis associations with the image of animals are formed, they receive the corresponding linguistic expression. The basis of associative links between the animal world and the human subject world was formed by human observations of various animals, their appearance and behavior. They represent a kind of “information storage” in this special sphere, because it is the result of human cognitive activity in a definite field of knowledge.

The studied zoometaphors reflect fundamental cultural values of worldview, without understanding of which it is hardly possible to speak about adequate perception of the German language.

Military operations require unambiguous communication to avoid misunderstandings, especially in high-stress situations. Terms are designed to convey exact meanings, minimizing ambiguity and ensuring that instructions are clear (e.g., the phrases like “execute Operation Hammer at 0600 hours” can be interpreted quite definitely compared to general commands).

Military terminology is standardized to facilitate collaboration between different branches of the armed forces or even across nations. This ensures coordination during joint operations and prevents breakdowns in communication.

Many terms include codes to protect confidential information from adversaries. These linguistic tools help disguise troop movements,

operational plans, or equipment locations, enhancing the security of communications.

Overall, military activities demand a highly specialized and adaptive linguistic framework that supports precision, security, collaboration, and psychological resilience in complex environments.

As it was mentioned, German armored vehicles often have specific naming conventions. For instance, "*Panzer*" refers to tanks, while "*Schützenpanzer*" denotes *armored personnel carriers. The term* "*Jagdpanzer*" *is used for tank destroyers, and* "*Flakpanzer*" for anti-aircraft vehicles. These names reflect the vehicle's primary function and tactical role, providing clarity in military contexts.

Modern German military vehicles include Dingo 2, a vehicle used for infantry mobility and command operations, offering high protection against mines and small arms fire, Leopard 2, Puma IFV, which offer superior mobility, protection, and firepower for infantry support.

These vehicles highlight Germany's focus on advanced technology, modularity, and adaptability in modern military equipment.

The naming conventions for German military vehicles often draw inspiration from the animal kingdom, with a focus on characteristics that align with the vehicles' intended purposes. This practice reflects a thoughtful approach to nomenclature, associating the vehicles with animals that embody desirable traits for combat and support roles.

You may look at the main characteristics of the most popular military vehicles in the German Army (see table):

Main characteristics of the most popular military vehicles in the German Army

Name of the vehicle	Its nickname	Main characteristics common to those of the animals
Combat Vehicles	the Leopard main battle tank the *Puma* infantry fighting vehicle	speed, power, and stealth gracefulness, strength, cold-bloodedness, elegance, agility

End of table

Name of the vehicle	Its nickname	Main characteristics common to those of the animals
Support Vehicles	The «Bison» and «Buffel» (buffalo)	massive size strength imposing presence
Specialized Engineering Vehicles	The «Biber» (beaver) bridgelayer vehicle	their ability to construct dams across water bodies

This naming approach demonstrates a creative connection between animal characteristics and military vehicle functions, going beyond mere physical attributes to include behavioral traits.

In conclusion, it is worthwhile saying that the German practice of naming military vehicles after animals serves multiple purposes. It

- creates memorable and evocative designations for the vehicles.
- communicates key attributes of the vehicles through association with well-known animal characteristics.
- maintains a tradition that connects modern military technology with nature, potentially fostering a sense of connection between the operators and their equipment.

This naming convention not only adds character to the vehicles but also provides a quick reference to their intended roles and capabilities on the battlefield.

Thus, to verbalize the main concepts in the field of military affairs in the German language a wide arsenal of nomination methods is used, the diversity of which testifies to the importance of this element of reality. A native speaker realizes, interprets what is seen, names it with the help of special linguistic means.

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СОДЕРЖАНИЕ

АРХИТЕКТУРА СЕГОДНЯ И ЗАВТРА: ДИЗАЙН, ИННОВАЦИИ И ТРЕНДЫ

Дадуш О., Перов Ф. В.
Инфраструктура досуга в агломерации Рабат-Сале (Марокко) 4

Калашникова Е. А.
Современные тенденции благоустройства речных набережных 12

Капшина Е. С., Алешугина Е. А.
Синтез культур в архитектуре Тбилиси:
многообразие стилей и их исторические корни. 19

Каравайцева А. П., Ломакина И. С.
Вертикальные сады как тенденция в ландшафтной архитектуре 25

Кокшайский Н. А., Щеголева А. В.
Реновация промышленных территорий в Китае:
архитектурные стратегии и интеграция с природным ландшафтом 31

Конопленко А. М., Линов В. К.
Обзор проектных решений психиатрических больниц. 38

Руиди Перез Ку-Окуо, Лявданский В. Э.
Особенности проектирования туристических комплексов
в жарких странах. 51

Лазарева Т. К.
Концепция 15-минутного города как решение проблемы
урбанистического кризиса 57

Наседкина А. А.
Приемы ландшафтной архитектуры для проектирования
общественных пространств в зимних городах. 63

Одинец В. Ю., Алешугина Е. А., Качемцев Г. А.
Многофункциональный конгрессно-выставочный комплекс
в Нижнем Новгороде 76

Пленкина Е. А., Линов В. К.
Современные подходы к формированию облика зданий суда
(зарубежный опыт) 81

Плиева Е. А.
Социальные аспекты формирования центров отдыха
и туризма в Южной Осетии 87

Рослова А. А., Зайцев А. А.
Сравнительный анализ исторических рынков Санкт-Петербурга 96

Сара Салех, Вешняков А. В.
Рекреационно-досуговые бульвары как новый тип
городских пространств 103

Стародубцева М. В., Бойцова Д. В.
Типологические особенности современных
многофункциональных транспортно-пересадочных комплексов 110

Томака К.
Традиционная цветовая палитра Санкт-Петербурга
и ее влияние на восприятие городской среды 118

Салва Фарах, Федоров О. П.
Естественное освещение в музейном дизайне 125

Цыбин Н. А.
Устойчивое городское развитие: современные подходы
к градостроительству 131

Юркова П.
Локальный контекст в дизайне архитектурной среды 139

СТРОИТЕЛЬСТВО СЕГОДНЯ И ЗАВТРА: ДИЗАЙН, ИННОВАЦИИ И ТРЕНДЫ

Алеманова С. Е., Суханов К. О.
Микроклимат зимнего сада: расчет и моделирование 149

Алешина А. П., Гермагенова Д. П.
Социальное жилье из переработанных материалов 162

Архипов С. А., Ломакина И. С.
Австралийские лесные пожары: состояние проблемы 169

Лэй Ван
Современное состояние и перспективы исследований
механических свойств фибробетона 176

Ворона Е. А.
Программные комплексы для теплофизических расчетов
мерзлых грунтов: обзор возможностей. 184

Гарегин А. И.
Автоматизация проектирования с использованием
инструментов динамического обновления модели 192

Каретников В. А., Дарьенкова Н. Н.
Экспериментальные машины в лесной промышленности 200

Киселев А. С., Мартынов М. А., Решетникова В. В.
Предотвращение потери и кражи тормозных башмаков
на железнодорожной станции с помощью RFID-меток 207

Кудрявцев А. Е., Агеева Е. Ю.
Особенности и проблемы эвакуации в высотных зданиях 215

Цзычи Лю
Различный подход к выбору материалов
для исторических зданий в Китае и России 221

Паршуткина Е. С.
Инновационные виды бетонов и их особенности
применения в арктических условиях 230

Патрышев М. С.
Геологические изыскания как ключевой фактор
в предотвращении рисков и обеспечении
безопасности строительства 239

Прасолов С. А.
Особенности теплообменных процессов
в жаротрубных котлах малой мощности 244

Яссин Секури, Руденко А. А.
Применение инновационных технологий строительства
в условиях стесненной городской застройки 252

Симбирцев Р. М., Малыгина Д. В.
Применение цифровых технологий в строительстве
железных дорог 259

Строгонов Ю. А., Бояринцев А. В.
Влияние шероховатости на формирование сил трения
на контакте с грунт-подземной конструкцией 264

Чэн Цзиюань
Сравнительное исследование характеристик фибробетона
в холодных регионах Китая и России и стратегии
совместной оптимизации 268

Шовкопляс А. Ю., Бобкова Д. Г.
Деревообрабатывающая отрасль в России
и Ленинградской области: проблемы, перспективы развития 276

ЭКОНОМИКА В ЭПОХУ ПЕРЕМЕН: ВЫЗОВЫ И ПЕРСПЕКТИВЫ

Алексеенко О. М., Алексеенко А. М.
Современные тенденции в лесном бизнесе 283

Бешенцев И. Д.
Мельбурн – крупнейшая трамвайная система в мире:
как австралийский город опередил всех сразу
по всем показателям 289

Васильева М. А.
Стратегическое ценообразование
в инвестиционно-строительных проектах:
проблемы и эффективные решения 300

Давыдов В. М., Дарьенкова Н. Н.
Робототехника в лесозаготовительной промышленности 307

Елагин Т. М.
Реформы образования в России XX – начала XXI века:
прошлое и настоящее 314

Иконникова В. В., Волкова С. Л.
Удержание талантов: маркетинговые стратегии
удержания персонала 332

Иконникова В. В., Волкова С. Л.
Интеграция ESG-критериев: проблемы и перспективы 337

Кожух М. И., Решетникова В. В.
Искусственный интеллект в погрузочно-разгрузочных
процессах на предприятиях РЖД 341

Магеррамов И. И.
Развитие промышленного строительства в контексте
трансформации российской экономики 347

Мягкая С. А.
Взаимосвязь между уровнем жизни населения
и экономической безопасностью страны 353

Руденко Н. А., Устименко А. В., Волкова С. Л.
Экологическая проблема: бизнес быстрой моды. 359

Тимофеев П. А.
Проблемы логистики в реализации программы
развития Арктики 364

Хорошко Е. А., Сутягина Д. Р.
«Неудобные соседи» или что стоит
за сближением Москвы и Анкары 368

МЕЖКУЛЬТУРНАЯ КОММУНИКАЦИЯ, ЯЗЫКОВОЕ ВЗАИМОДЕЙСТВИЕ И ПРАКТИКА ПЕРЕВОДА

Волошанин Д. О., Анисимова И. В.
Роль иностранного языка в профессиональной деятельности
военнослужащих Вооруженных сил Российской Федерации 381

Гаврилова Е. А., Дарьенкова Н. Н.
Цифровая языковая эволюция: изучение английского языка
с помощью компьютерных игр 386

Цзян И, Васильева О. В.
Проблема омонимии и омо-явлений
при обучении русскому языку как иностранному 393

Капустин А. Ю., Сергиевская И. Л.
Армейский метод в обучении иностранному языку
в военных вузах США 399

Романчук Ф. А., Рябкова В. В.
Перевод научно-технических текстов в строительной отрасли:
проблемы и решения 403

Соколов Н. В., Ханжина Т. В.
Подготовка военных переводчиков в разных странах. 413

Томака К., Ермолаева С. А.
Возможности использования современных систем
автоматизированного перевода на примере текстов
архитектурной направленности 418

Чечеткина А. С., Бурдун И. А.
Важность изучения иностранного языка
в процессе подготовки специалистов
к профессиональной деятельности 434

Якоб Д. А., Моисеенко Л. Н.
О некоторых особенностях языковой картины мира
военной сферы (на материале немецкого языка) 442

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