Pandemics readiness assessment of building design and engineering services related legislation in Kazakhstan and the EU

Journal:	*Engineering, Construction and Architectural Management*
Manuscript ID	ECAM-07-2022-0661.R2
Manuscript Type:	Original Article
Keywords:	Construction Planning, Construction Safety, Design, Engineering
Abstract:	

Abstract

Purpose

The current COVID-19 pandemic is influencing our life in every aspect, including working and living environments. Millions of people were forced to isolate themselves in their homes, which has posed significant pressure on buildings and shown us that our dwellings are not designed for such purposes. This is partly due to the fact that homes are designed and built for occasional use rather than isolated and long-term occupation. The legislative system of a country plays an important role in defining and shaping the conditions of people living there. Hence, the aim of the study is to evaluate the readiness of Kazakhstani and the EU construction-related legislation for pandemics.

Design/methodology/approach

Previously developed pandemic-resilient indicators were used for the evaluation of construction legislation. Both legislative systems were reviewed, and the quality of responses was evaluated by assigning response scores.

Findings

The results based on response scores indicate that the environmental resources consumption sub-category was better covered by EU legislation. At the same time, the buildings' health, safety, and comfort are better taken into account in Kazakhstani legislation. Seven pandemic-resilient indicators were not responded to by any legislative system indicating a gap between current legislation and requirements for new living conditions.

Originality

No study has analyzed how COVID-19 can transform construction legislation. The study reveals the limitation of current construction legislation in Kazakhstan and the EU, indicating the need for transformation to meet the requirements of the pandemic era.

Introduction

The recent COVID-19 pandemic has abruptly changed the lifestyles of billions of people around the world. In the realities of strict lockdowns, people had to adjust to the new lifestyle restricted by their residences. Thus, a home has become much more than before: during the pandemic, it became a workplace, a study room, a leisure space, and a sports facility; therefore, requirements for building comfort increased for teleworkers and remote learners, as the indoor environment becomes more important in terms of affecting one's health, well-being, satisfaction from remote work and study (Awada *et al.*, 2022; Fukumura *et al.*, 2021; Pang *et al.*, 2021; Salamone *et al.*, 2021; Tleuken, Turkyilmaz, Sovetbek, *et al.*, 2022; Tleuken, Turkyilmaz, Unger, *et al.*, 2022). Residential buildings started experiencing more pressure: people started using building engineering services (water and energy) more frequently, and the amount of greenhouse gas emissions in the residential sector increased (Abu-Bakar *et al.*, 2021; Kalbusch *et al.*, 2020; Navaratnam *et al.*, 2022; Shrestha *et al.*, 2021; Tleuken, Tokazhanov, Serikbay, *et al.*, 2021). This, in turn, creates a concern regarding the reliability of water and energy services - whether the pipes are ready for the increased flows or the energy stations can provide a larger amount of energy - for people locked in their residences for the purpose of social distancing. Another concern is the environmental impact of the increased surge and the types of solutions that can be implemented to keep the energy and/or water consumption sustainable even during the pandemic-related quarantine period. These new requirements lead to the reconsideration of legislative systems, which guide the building engineering design to create safe and convenient end-user structures.

Moreover, imposing appropriate construction codes and legislative acts helps to minimize the environmental effect – reducing embodied energy consumption and the amounts of materials used. Buildings contribute significantly to the overall consumption of resources, energy use, and greenhouse gases (GHG) emissions (Abergel *et al.*, 2017). In developed countries, introducing and enforcing up-to-date construction codes and relevant legislation, among other measures, have always been considered important interventions by the government to protect the environment and capitalize on the benefits of energy savings and GHG reduction (Scheuer *et al.*, 2003). Hence, legislation plays a crucial role in transforming the future of building design into a more pandemic-resilient and sustainability-friendly way.

In general, construction standards and norms tend to be updated depending on various reasons such as, for example, meeting sustainability or energy efficiency targets, having stricken environmental policies, adapting to climate change, or adopting more advanced standards and norms (e.g., Eurocodes) both voluntarily and due to joining a new standards zone (e.g., the EU) (Carter *et al.*, 2015; Davda and Broomfield, 2010; Osman and Sevinc, 2019). A study by Davda (Davda and Broomfield, 2010) investigated the impacts of the demand for energy efficiency and thermal comfort in new buildings in the UK on construction materials selection. The study argues that the sustainability imperative made construction codes more stringent in terms of energy efficiency while neglecting the potential of overheating under current and higher temperatures projected due to climate change. Another study by Wilkinson (Wilkinson 2014) tracked some legislations on energy efficiency and the environment over a period of time and found that the environmental adaptation of buildings in Australia has been affected by them in the long-term perspective. A similar study was conducted in Spain by López-Ochoa et al. (López-Ochoa *et al.*, 2019) on the evolution of technical building regulations and their impact on reaching the zero-energy level for educational buildings. It was observed that upgraded legislation decreased the level of non-renewable primary energy sources used by about 66% and CO_2 emissions by 71%, respectively. França and Ornstein (2021) also claim the design requirements need to be reconsidered through the prism of the recent COVID-19 pandemic (França and Ornstein, 2021).

A study by Carter et al. (2015) considered the impacts of climate change and relevant adaptation needs to environmental and spatial planning processes. The study found that adaptation to climate change is necessary for planning processes, and the legislation approaches at national and supranational levels should consider cities and urban areas individually to appreciate the local context. Another study by Osman and Sevinc (2019) explored the potential impacts of climate change on the performance of buildings in Khartoum city, Sudan, over several decades and identified a set of potential strategies to adapt the buildings by using the two-stage evaporative cooling systems and passive-design strategies to tap on the renewable energy sources. Such technical modifications need to be supported by changes in construction standards and codes. The studies by Teo et al. (2005); Saez et al. (2011), and Verichev et al. (2021) have found that the aspects such as health and safety of the personnel, demolition waste management, and the thermal performance of buildings, among other aspects, are all directly or indirectly dependent on effective and comprehensive policies introduced by respective countries at certain points of time. All the findings above indicate that the construction-related standards and norms directly impact the performance of buildings in terms of various parameters and, therefore, should be studied in detail in the context of both developed and developing countries. In this study, these two domains are represented by the European Union and Kazakhstan, respectively.

The effect of the pandemic on the sustainability requirements of residential buildings was previously studied by Tokazhanov et al. (2020), where the major required changes in sustainability were grouped into three major categories, including *Health & Safety, Environment,* and *Comfort.* An extensive literature review relating COVID-19 and residential buildings conducted by Tokazhanov et al. (2020) was further developed into pandemic-resilient indicators by round table discussion involving various stakeholders as described in a previous study by Tleuken et al. (2021). Literature review and round-table discussion resulted in thirty-three indicators, which were further categorized into ten sub-categories and three main

categories. A list of indicators together with sub-categories and categories can be found in Table I. Their detailed description can be read in the previously conducted research by Tleuken et al. (2021).

Table I. Pandemic sustainability (PANSUST) indicators for residential buildings (Tleuken, Tokazhanov, Guney, *et al.*, 2021).

Category	Sub-category	Indicators
Health & Safety	Prevention of Virus Propagation	PVP1. Innovative and smart solutions
		PVP2. Touchless sensor technologies
		PVP3. Self-disinfecting areas
		PVP4. Smart and safe indoor materials
		PVP5. Natural light
		PVP6. The flexibility of indoor air conditions
	Mental Health	MH1. Inclusion of plants and gardens
		MH2. Outdoor spaces
		MH3. Common spaces
		MH4. Physical activity spaces
	Air Quality	AQ1. Effective air filtrations
		AQ2. Air pollution control
		AQ3. Airflow control
		AQ4. Natural ventilation
	Water Quality	WQ1. Drinking water safety level
		WQ2. Water system safety
	Wastewater Management	WWM1. Prevention of household-level virus propagation
		WWM2. Separate toilets
		WWM3. Greywater separation
Consumption of environmental resources	Energy Use	EU1. Backup energy
		EU2. Sustainable alternative energy
		EU3. Energy-saving appliances
	Waste Management	WM1. Medical waste separation
		WM2. Waste disinfection
		WM3. Waste management
	Water Consumption	WC1. Alternative water sources
		WC2. Water-saving appliances
Comfort	Personal Comfort (PC)	PC1. ICT Infrastructure
		PC2. Adjustable indoor space
		PC3. Personal space
		PC4. Noise insulation
	Local Services (LS)	LS1. Self-sufficient local services
		LS2. Urban farming

To the best of the authors' knowledge, no study has yet analyzed how construction legislation systems can adopt measures for COVID-19 and investigated whether those can address new pandemic realities. The present study aims to assess the readiness of legislation systems for the realities of the recent COVID-19 pandemic. Thus, the Kazakhstani legislation system is compared with pandemic-resilient indicators, followed by suggestions to improve the building design and services norms in terms of pandemic resilience. In addition, this paper attempts to review the current policy framework in the European Union with a specific focus on codes and regulations in the building sector and compare the EU policy framework with the current practices and policies in the building sector of Kazakhstan. This

comparative analysis is needed to better understand the topic of legislation both in the case of the EU and Kazakhstan in order to analyze the existing standards and norms and know whether they have already adopted measures needed to address the COVID-19 pandemic. This research paper is a continuation of the previous work, which has investigated the need for green building rating and certification systems which are ready for the COVID-19 pandemic and also developed a set of indicators that would provide pandemic resilience during the COVID-19 pandemic (Tleuken, Tokazhanov, Guney, *et al.*, 2021; Tokazhanov *et al.*, 2020; Tokazhanov, Tleuken, Durdyev, *et al.*, 2021; Tokazhanov, Tleuken, Guney and Turkyilmaz, 2021; Tokazhanov, Tleuken, Guney, Turkyilmaz, *et al.*, 2021).

Legislation in the EU and Kazakhstan

The European Union (EU) is reported to be one of the world's most advanced international organizations in terms of environmental policy (European Commission, 2008; Jordan and Adelle, 2012). Since the 1970s, a considerable amount of environment-related laws have been developed and adopted in Europe, currently consisting of about 500 directives, regulations, and decisions (European Environment Agency Programme, 2015). However, this does not imply that all member states are at the same level of success in adopting and implementing such policies. For example, some Eastern European member states are still struggling with the "legacy of the socialist period" and, therefore, need to strive and streamline their national legislations to adjust to the high environmental standards of the Union. A lot needs to be done in terms of regular monitoring, reporting and assessment of implementation of the legislation at national and EU levels in general (Ansari, 2000; United Nations Environment Programme, 2012).

Construction industry-related legislation in the EU is represented by a well-established regulatory system that defines the key requirements for goods and engineering services delivered to the market. The specifications of these goods and services are regulated by the European technical standards for structural design: Eurocodes (European Union, n.d.). The Eurocodes are directly or indirectly affected by various EU Regulations and Directives related to construction products, procurement, services, and provision of information (European Union, n.d.). Regulations are legally enforced across EU member states, whereas Directives define goals to be achieved, but each member state decides whether it should integrate it into the national legal framework (United States Department Of Agriculture, 2016). Eurocodes contain ten standards, EN 1990 - EN 1999, which define requirements for the design of buildings as well as construction works and products in the fields of, for example, structural safety, serviceability, design and detailing, geotechnical and seismic design, etc. ("The EN Eurocodes," n.d.).

In CIS countries (Commonwealth of Independent States, ex-Soviet Union countries), which includes Kazakhstan, the construction process is directed by SNIPs (Construction Norms and Rules), which is a set of normative and technical documentation in the fields of architecture, urban planning and construction. SNIP contains several regulatory documents, such as organizational and methodological normative documents, general technical regulations, and normative documents on urban planning, engineering equipment, building structures, and products (CBS, 2011). Another important set of documents is ENiR – the uniform norms and prices - it contains standardized prices for preparatory work, construction and installation works, finishing works, engineering networks, fences, etc. ("Chto takoye ENiR?", n.d.). In developing countries, such as Kazakhstan, the process is less dynamic, and increasing standards of life lead to higher demands for comfort and quality, thus, leading to the growth of energy and resource consumption. Extreme climate conditions with temperatures ranging from -30 to 40 degrees Celsius require special attention to the design and construction of the buildings and relevant codes and regulations (Climatology, 2011). In Kazakhstan, construction standards and norms are mainly represented by the national law on Architectural, Urban-Planning, and Building Activities, which is a basic set of requirements and procedures regulating construction-related activities (The Law of the Republic of Kazakhstan, 2001). This law is backed up by a set of normative documents such as (1) normative legal acts; (2) regulatory technical documents such as, for example, construction norms (CN) or construction norms

and regulations (SNiP); (3) optional regulatory technical documents; (4) safety requirements (The United Nations Economic Commission for Europe, 2018). At present, the building codes in Kazakhstan are in their transition period to Eurocodes as the country has the ambition to update existing policies and regulations to the level of the EU.

Methodology

The current study adopted the previously developed indicators by Tleuken et al. (2021) to analyze construction legislation for its readiness for the pandemic. Selection of legislative documentation for the study consists of two main steps: (i) search for relevant literature (norms, standards, regulations, directives) and (ii) screening of the literature. The first step included a literature review using the combination of the following keywords: "СНИП" ("Construction Norms and Rules"), "строительные нормы" ("construction norms"), "Республика Казахстан" ("Republic of Kazakhstan") for Kazakhstan, and "EU," "construction," "building," "directives," "regulations," "policies," "standards" for EU. The second step of the selection process contained screening of the literature. The screening process was conducted using the list of indicators in Table I. If the literature mentioned any of the indicators from the list, then the literature was selected for further analysis.

Regulations and norms of the building design of the Republic of Kazakhstan are written in *Construction norms of the Republic of Kazakhstan* (CN RK), state standards in the field of architecture, urban planning, and construction. Various types of CN RK focus on the building design (e.g., housetop and roofs, heating, ventilation, and air conditioning).

To identify the level of response of construction legislation of the Republic of Kazakhstan (KZ) to pandemic-resilient factors, 16 CN RK were selected out of 125 CN RK depending on their relevance to the design and construction of residential buildings, and one document focusing on the development of the city of Astana were selected for the revision (Table II).

Binding legislative instruments of the EU consists of three main parts: (i) regulations, (ii) directives, and (iii) decisions (ICARO, 2019). Regulation is a legislative instrument that is entered into force in all Member States from the set date. The directive is a legislative instrument to set the goal for the Member States, and each Member State has a right to decide how to achieve that goal. A Decision is a legislative instrument that is binding only to the Member States or organizations it is being addressed (European Union, n.d.).

Three EU regulations, four directives related to pandemic-resilient indicators, and one *Manual of Standard Building Specifications* were identified and reviewed to assess the readiness of European legislation. The list of regulations and directives can be found in Table III and Table IV, respectively. *Manual of Standard Building Specifications* covered the following indicators: PVP2, PVP4, PVP5, PVP6, MH1, MH4, AQ4, WQ1, WWM3, EU2, EU3, WM3, WC1, WC2, PC1, PC4.

Response score analysis was conducted to measure the quality of responses to pandemic-resilient indicators (Tleuken, Tokazhanov, Guney, *et al.*, 2021) in a similar way to readiness assessment tools in other fields (Cowan *et al.*, 2020; Donkor *et al.*, 2021; Liu *et al.*, 2022). The response quality rating scale includes three orders – from 1 to 3 (Table V). Each documentation has been carefully reviewed for identification of its response to pandemic-resilient indicators, and the appropriate response score was given. In Table V, 'directly addresses' means that the documentation of certain legislative systems fully covers the indicator. 'Indirectly addresses' means that the documentation of certain legislative systems addresses the issue behind the indicator in a general way, not in a specific way as required by the indicator. 'Vaguely mentions' means that the indicator is just mentioned in the documentation, not as a main subject of the issue. If the indicator is addressed by more than one documentation, the scores are not added, with only the highest score obtained remaining for further analysis. For the comparative analysis of two legislation systems, the sum of the response scores of each indicator in the sub-category was found to

result in the response score of the sub-category. The response score of the category is the sum of the sub-category score belonging to that category.

Finally, scores of all indicators were calculated and compared for further analysis.

Table II. List of Kazakhstani legislative documentation addressing pandemic-resilient indicators

Policy/Law/Regulation name	Impact Sector Area	Year of Implementation	Covered PANSUST Indicators	Reference
CH PK 2.04-01-2011	Natural and Artificial Lighting	2011	PVP5, MH1	(JSC "KazNIISA", 2011a)
CH PK 2.04-02-2011	Noise protection	2011	PC4	(JSC "KazNIISA", 2011b)
CH PK 2.04-03-2011	Thermal protection of buildings	2011	EU2, EU3	(JSC "KazNIISA", 2015a)
CH PK 2.04–05–2014	Isolation and finishes coatings	2015	PC1, PC4, AQ2, EU3, PVP4	(JSC "KazNIISA", 2014)
CH PK 3.02-03-2012	Public Housing	2012	PC3, MH1, MH2, PVP5, AQ4	(JSC "KazNIISA", 2015b)
CH PK 3.02-01-2018	Residential Apartment Buildings	2018	AQ, PVP5, PVP6, PC4, WQ1, EU2, EU3, PC1, MH4, MH3, MH1, MH2, PC3, PC4	(JSC "KazNIISA", 2018a)
CH PK 3.02-36-2012	The floor	2012	EU3, PVP4, PC4	(JSC "KazNIISA", 2015c)
CH PK 3.02-37-2013	Housetop and Roofs	2013	MH1	(JSC "KazNIISA", 2018b)
CH PK 3.02-38-2013	Energy Efficient Buildings	2013	EU2, EU3	(JSC "KazNIISA", 2015d)
CH PK 4.01-01-2011	Domestic Water supply and Plumbing systems	2011	WQ1, WWM1	(JSC "KazNIISA", 2015e)
CH PK 4.02-01-2011	Heating, Ventilation, Air Conditioning	2011	PC4, AQ1, AQ2, AQ4, AQ3, EU2, EU3	(JSC "KazNIISA", 2011c)
3.01-01-AC-2007	Planning and development of the city of Astana	2007	MH1, WM1, WM3, PC3, PC4, LS1	(JSC "KazNIISA", 2019)
CH PK 3.01-02-2012	Planning and construction of individual housing areas	2012	LS1	(JSC "KazNIISA", 2015f)
CH PK 3.01-05-2013	Improvement of the Territory of Settlements	2013	MH1, PC4	(JSC "KazNIISA", 2015g)
CH PK 4.01-02-2013	Indoor Plumbing System	2013	EU3	(JSC "KazNIISA", 2015h)
CH PK 4.01-03-2013	The External Networks and Facilities Water and Sanitation	2015	WQ1, WQ2, WWM1, EU2, EU3	(JSC "KazNIISA", 2015i)

Table III. List of EU Regulations addressing pandemic-resilient indicators

Regulation name	Impact Sector Area	Year of Implementation	Covered PANSUST Indicators	Reference
Regulation No 305/2011	Construction Products Regulation	09.03.2011	WQ1, WWM1, EU3	(European Parliament, 2011)
Regulation No 66/2010	EU Ecolabel Regulation	25.11.2009	EU3	(European Parliament, 2009a)
Regulation No 1907/2006	Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH)	18.12.2006	PVP4	(European Parliament, 2006)

Table IV. List of EU Directives addressing pandemic-resilient indicators

Directive name	Impact Sector Area	Year of Implementation	Covered PANSUST Indicators	Reference
Directive 2018/844/EU	Energy Performance of Buildings	30.06.2018	EU1, EU2, EU3	(European Parliament, 2018a)
Directive 2018/2001	Renewables Energy Directive	11.12.2018	EU2	(European Parliament, 2018b)
Directive 2008/98/EC	Waste Framework Directive	19.11.2008	WM1	(European Parliament, 2008)
Directive 2009/125/EC	Ecodesign Directive	21.10.2009	EU3	(European Parliament, 2009b)

Table V. The assessment scale of legislative documents' responses to pandemic-resilient indicators

Response score	Meaning
1	Legislative document vaguely mentions pandemic-resilient indicator
2	Legislative document indirectly addresses pandemic-resilient indicator
3	Legislative document directly addresses pandemic-resilient indicator

1

Results and Discussion

Summary of responses to pandemic-resilient indicators by KZ and EU legislative documentation (Table II, III, IV) can be seen in Table VI and Table VII, which show the legislative documentation that addressed the indicator, the response score, and the short description of how the indicator is covered in the documentation. A more detailed description of the responses to each indicator can be found in supplementary material appendix 1.

Table VI. Summary of the response of KZ legislation for pandemic-resilient indicators

Indicators	Legislative documentation	Response score	Short description
PVP1	Not addressed	0	
PVP2	Not addressed	0	
PVP3	Not addressed	0	
PVP4	CN RK “The floor”; CN RK “Isolation and Finishing”	2	The choice of a constructive floor solution should be based on technical and economic feasibility, considering the provision of optimal hygienic conditions for people
PVP5	CN RK “Natural and Artificial Lighting”; CN RK “Public Housing”	3	Premises with the constant presence of people, as a rule, must have natural lighting
PVP6	CN RK “Public Housing”; CN RK “Residential Apartment Buildings”	2	Internal engineering systems of the building must provide appropriate temperature, humidity and air speed, thermal stability, and heat assimilation of structures
MH1	CN RK “Planning and Development of the City of Astana”; CN RK “Improvement of The Territory of Settlements”; CN RK “Public Housing”; CN RK “Housetop and Roofs”	3	The minimum specific provision of green areas (square, boulevard, garden) in a residential group
MH2	CN RK “Residential Apartment Buildings”	3	The apartments should provide summer rooms, including loggias, balconies, terraces, verandas
MH3	CN RK “Residential Apartment Buildings”	1	It mentions connecting elements between residential buildings, including open non-residential floors (first and intermediate)
MH4	CN RK “Public Housing”	2	The premises of the apartment may include premises for rooms for physical education
AQ1	CN RK “Heating, Ventilation, and Air Conditioning”	2	Air purification should be provided to ensure the required indoor air quality
AQ2	CN RK “Isolation and Finishes Coatings”; CN RK “Heating, Ventilation, and Air Conditioning”	3	The installed insulating and finishing coatings must ensure the average daily maximum permissible concentration or safe level in the air of inhabited premises
AQ3	CN RK “Residential Apartment Buildings”	3	air from rooms in which harmful substances or unpleasant odors can be emitted must be removed directly to the outside and must not enter other rooms of the building
AQ4	CN RK “Public Housing”	3	the intensity of air exchange in the premises of a social dwelling should be provided by providing natural ventilation

WQ1	CN RK “Residential Apartment Buildings”; CN RK “Domestic Water supply and Plumbing Systems”	3	supply of water in the required amount, avoiding pollution, leaks
WQ2	CN RK “The External Networks and Facilities Water and Sanitation”	2	During the operation of the water facilities, safety for health (people and animals) and the environment, and requirements for sanitary and hygienic conditions are ensured
WWM1	CN RK “Domestic Water supply and Plumbing Systems”	3	Liquid effluents are removed without entering the water supply system
WWM2	Not addressed	0	
WWM3	Not addressed	0	
EU1	Not addressed	0	
EU2	CN RK “Thermal Protection of Buildings”; CN RK “Energy Efficient Buildings”	3	Reducing the consumption of non-renewable natural resources during construction and operation
EU3	CN RK “Heating, Ventilation, Air Conditioning”; CN RK “Energy Efficient Buildings”; CN RK “Indoor Plumbing System”	3	The energy efficiency of buildings should be ensured through rational architectural solutions
WM1	CN RK “Planning and development of the city of Astana”	1	Measures for sorting, collection, storage, and processing of waste
WM2	Not addressed	0	
WM3	CN RK “Planning and development of the city of Astana”	3	Analysis of the generation, use, disposal, and disposal of all types of waste should be carried out
WC1	Not addressed	0	
WC2	CN RK “Isolation and Finishes Coatings”; CN RK “Indoor Plumbing System”	2	Exclude the irrational consumption of resources to ensure resource and energy saving
PC1	CN RK “Residential Apartment Buildings”	3	a city telephone distribution network, installation of satellite antennas (collective reception antennas signal), etc.
PC2	Not addressed	0	
PC3	CN RK “Public Housing”	3	The standardized lower limits of the living and usable area, the level of comfort of the dwelling
PC4	CN RK “Noise Protection”	3	Design of objects with noise protection measures, noise sources, and their noise characteristics
LS1	CN RK “Planning and development of the city of Astana”; CN RK “Planning and construction of individual housing areas”	2	Objects of the local service level are located within a radius of pedestrian accessibility
LS2	Not addressed	0	

Table VII. Summary of the response of EU legislation for pandemic-resilient indicators

Indicators	Legislative documentation	Response score	Short description
PVP1	Not addressed	0	
PVP2	Manual of Standard Building Specifications	2	Centralized remote management of all technical installations in the building
PVP3	Not addressed	0	
PVP4	Regulation #1907/2006; Manual of Standard Building Specifications	2	High level of protection of the environment and human health from the use of various chemicals
PVP5	Manual of Standard Building Specifications	3	80% of the surface area should have a 0.7% or 1.5% of daylight factor depending on the façade
PVP6	Manual of Standard Building Specifications	3	Operation of heating and air conditioning must be adaptable to the new requirements
MH1	*Manual of Standard Building Specifications*	*3*	Prioritization of the eco-managed areas, including plantings, green roofs, and 'wetland' areas, which improves the quality of urban life
MH2	Not addressed	0	
MH3	Not addressed	0	
MH4	*Manual of Standard Building Specifications*	*2*	Multipurpose areas might be reassigned into sports spaces depending on the assessment
AQ1	Not addressed	0	
AQ2	Not addressed	0	
AQ3	Not addressed	0	
AQ4	Manual of Standard Building Specifications	3	The internal air quality section requires mandatory availability of a mechanical ventilation system for fresh air supply
WQ1	Regulation #305/2011; Manual of Standard Building Specifications	3	The safety of drinking water from the release of hazardous substances with negative impact
WQ2	Not addressed	0	
WWM1	Regulation #305/2011	3	The safety of drinking water from the release of hazardous substances with negative impact
WWM2	Not addressed	0	
WWM3	Manual of Standard Building Specifications	1	A greywater collection system is possible after a special feasibility study
EU1	Directive 2018/844/EU	2	Effective energy storage of buildings
EU2	Directive 2018/844/EU	3	Zero- or low-emission alternative energy sources must be used based on their cost effectiveness and availability
EU3	Regulation #305/2011; Regulation #66/2010	3	The regulation requires to design of buildings in a way that consumes a low amount of energy in terms of heating, cooling, ventilation, and lighting
WM1	Directive 2008/98/EC	2	Waste must be handled in a way to minimize human health, and hazardous waste should be handled under special regulations to minimize its negative impact
WM2	Not addressed	0	

WM3	Manual of Standard Building Specifications	0	A separate area for the collection and storage of recyclable materials such as food packaging, paper, glass, etc
WC1	Manual of Standard Building Specifications	3	Rainwater must be collected based on collection potential and requirements assessment
WC2	Manual of Standard Building Specifications	3	Given preference should be water-saving based
PC1	Manual of Standard Building Specifications	3	Requirements for IT and telephony installations
PC2	Not addressed	0	
PC3	Not addressed	0	
PC4	Manual of Standard Building Specifications	3	Acoustic comfort requirements by EC
LS1	Not addressed	0	
LS2	Not addressed	0	

Categories of pandemic-resilient indicators gained different response scores by EU and KZ legislations. Figure 1 illustrates the percentage of scores gained in each category separately. Health & Safety category was addressed for 61% by KZ and for 44% by EU legislation. However, the ERC category scored higher by EU legislation (67%) than KZ legislation (50%). The Comfort category was better responded to by KZ legislation (61%) than EU legislation (33%). KZ legislation is equally focused on Comfort and Health & Safety categories (61%) with a little less attention on ERC (50%). However, EU legislation responded better to the ERC category, followed by Health & Safety and Comfort categories. It indicates that EU and KZ legislative systems have different focuses and gaps.

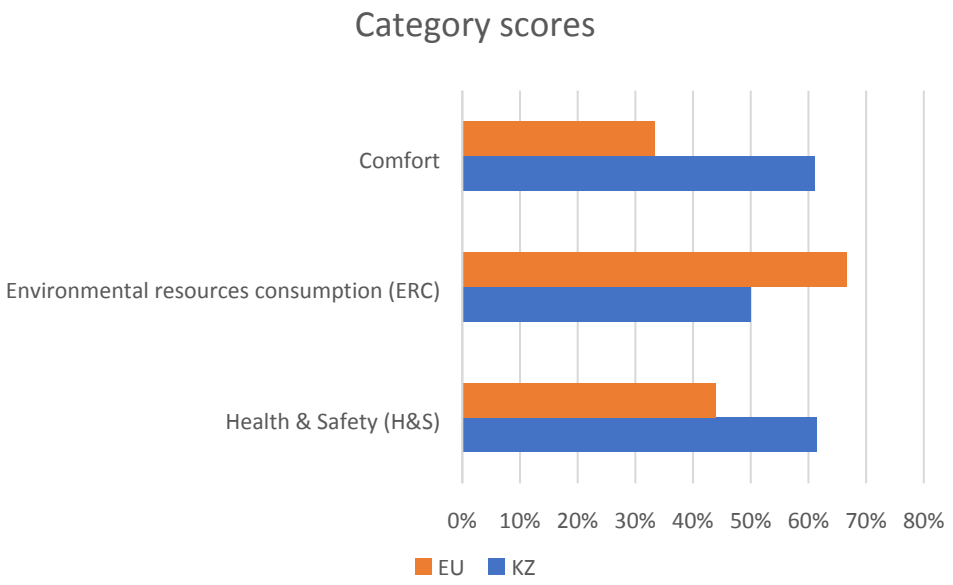


Figure 1. Comparison of category scores.

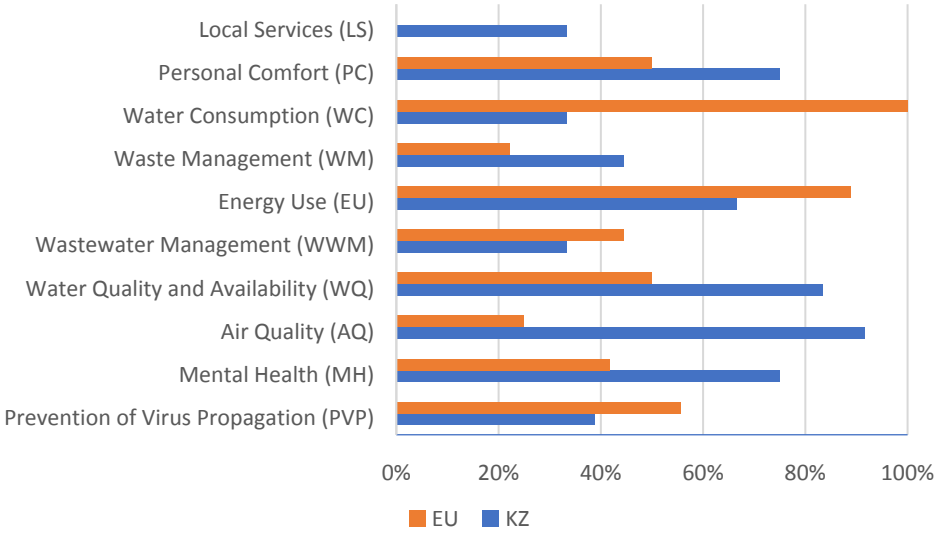
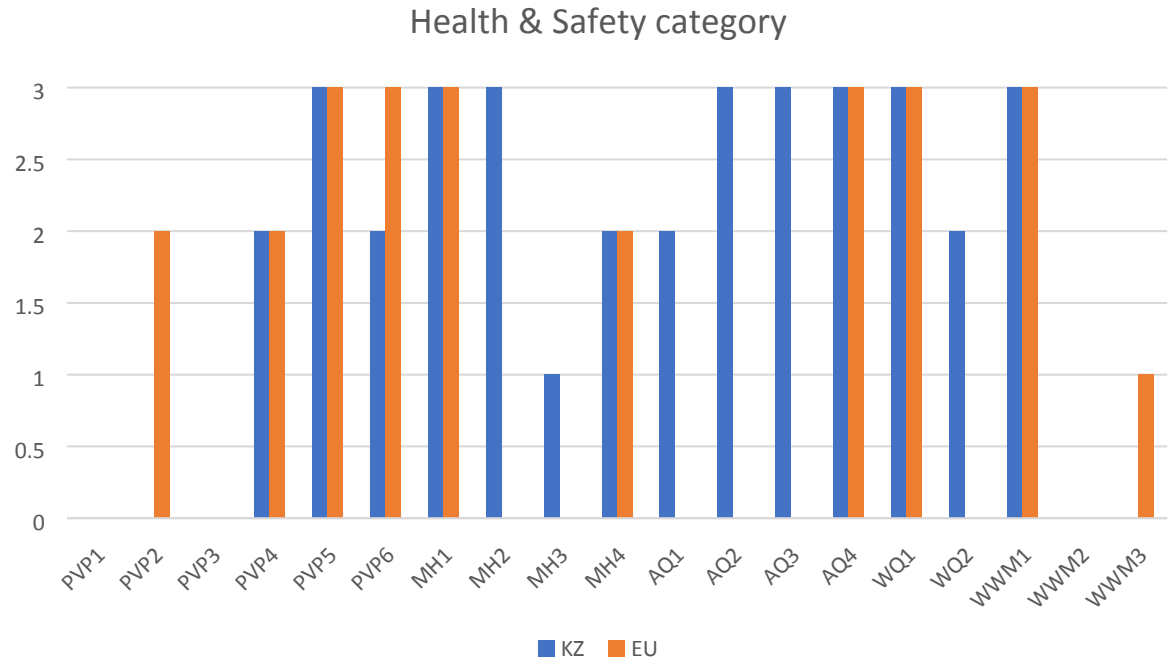


Figure 2. Comparison of sub-category scores.

Figure 2 compares the level of responses of each sub-category for KZ and EU legislations. Sub-category response scores indicate that the prevalence of KZ or EU legislation in a certain category does not mean prevalence in all of its sub-categories. Even though the H&S category was better responded to by KZ legislation, EU legislation gained higher response scores for PVP and WWM sub-categories, which means that there is a high fluctuation among sub-categories within the category. Similarly, even though EU legislation got higher response scores in the ERC category, KZ legislation showed better performance in the WM sub-category, which also confirms that there are high fluctuations in responses among sub-categories. Thus, better response in H&S and ERC categories by KZ and EU legislation is caused by significant differences in particular sub-categories rather than slight differences among all sub-categories. At the same time, the dominance of KZ legislation in the Comfort category is in accordance with its sub-categories results.



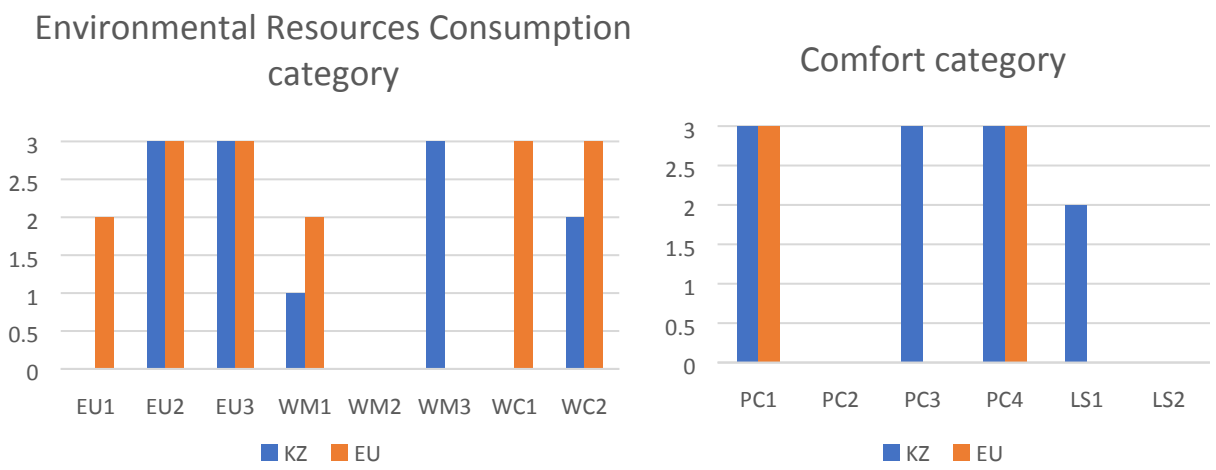


Figure 3. Response scores of indicators in each sub-category.

Figure 3 illustrates scores of each indicator sorted by its belonging sub-category. Seventeen indicators out of thirty-three total indicators received the same response scores from KZ and EU legislation, while seven indicators responded better to EU legislation and nine indicators to KZ legislation. A comparison of each indicator's response scores reveals that the difference between EU and KZ legislation is not as significant as seen from category and sub-category score comparisons. Seven indicators for EU and nine for KZ legislation are not a big difference considering a total of 33 indicators. EU legislation showed better response for indicators such as touchless sensor technologies, HVAC system, greywater separation, medical (hazardous) waste separation, alternative water sources, backup energy, and water efficient appliances. Those indicators are somehow related to conventional sustainability pillars (environmental, economic, and social). At the same time, KZ legislation responded better to mental health, air quality, increased waste management, and comfort category indicators. Mental health indicators are related to the availability of outdoor spaces and spaces within the building. The territorial advantage could explain why Kazakhstan has over EU countries, allowing larger buildings with ample outdoor areas to construct. Also, the pandemic resulted in increased energy consumption of residential buildings in Kazakhstan (Tleuken, Tokazhanov, Serikbay, *et al.*, 2021), creating a need for backup energy source, which was not covered by KZ legislation. It clearly indicates a need to adapt the construction norms. In addition, even though both legislative systems fully address the MH1, the inclusion of plants and gardens indicator, many studies emphasize the importance of green spaces for mental health during pandemics (Bi *et al.*, 2022; García Flores and Ordoñez Díaz, 2022; Maury-Mora *et al.*, 2022; Trevino *et al.*, 2022). It indicates that the green spaces in our dwellings are still not enough during pandemic times, which requires changes in the requirements as the Chinese government is already implementing (Ding *et al.*, 2022).

It is important to note that PVP1, PVP3, WWM2, WM2, PC2, and LS2 are the indicators that are not responded to by both legislations. The reason is that those are pandemic-specific indicators, which are not normally practiced in conventional buildings. Self-disinfection areas, technologies to prevent virus propagation, and separate toilets were not an issue before the pandemic, leading to no legislation response. Similarly, waste disinfection was not necessary before the pandemic. In addition, indoor space adjustability and urban farming are essential when people are isolated and work from home. Hence, those indicators are not addressed by any legislation and should be the focus of future changes in our architectural design of homes, which is well described in the studies conducted by Alhusban *et al.* (2022) and Asojo *et al.* (2022).

Conclusion

As recent history has shown, the pandemics create significant pressure on society and the built environment, which in turn requires adaptation of how society works and operates. Various aspects of human lives have been transformed, including how people live and work. Isolation and quarantine during the COVID-19 pandemic showed that the building stock was unsuitable for such living conditions. Working from home and isolating indoors requires a multipurpose functioning of residential apartments and houses. Legislation, including regulations and norms, is an effective instrument to transform already established standards. Construction legislation of buildings determines their functionality and safety during their lifetime. Hence, the role of legislation in the future of housing design and living conditions during a pandemic is significant. KZ and EU legislations were reviewed and analyzed for their readiness for the new paradigm that pandemics can bring.

The EU legislation is better prepared in terms of environmental resources consumption of buildings, while KZ legislation has a better adaptation in terms of health, safety, and comfort of the residents. However, at the sub-category level, differences indicate that these advantages of the EU and KZ systems are not ubiquitous within the category, so there are still some pros and cons of each legislative system. Indicators' response scores show that, generally, both legislative systems showed relatively similar readiness. Eleven indicators have the same response; six and nine indicators were better responded to by EU and KZ legislations, respectively, while seven indicators were not responded to at all. Those seven indicators that show the gap between the legislative systems and pandemic-resilient building requirements are focused on specific needs during pandemic times.

This study has several limitations, including differences in legislative systems, not precise enough meanings of response scores, and different levels of compliance with legislative standards. First, EU and KZ construction legislative systems are different in terms of their structure. KZ construction legislative system was easier to review since all standards were within one set of documents. However, EU construction legislation is scattered into various documents (directives, policies, regulations, etc.), making it difficult to gather all construction-related standards. Hence, the depth of gathered information might be different for KZ and EU cases. Second, there is no clear line that divides the meanings of response scores (vaguely mentions; indirectly addresses; directly addresses), making it difficult to give appropriate response scores. Finally, the level of compliance of construction companies with construction legislation should not be eliminated, which can lead to the difference between a real picture of constructed buildings and the standards provided by legislation.

The study reveals the need for the society and built environment to adjust already established norms and living environment by transforming the current legislative systems to make them more pandemic-resilient, which will, as a result, allow people to live a healthier and comfortable life during pandemic times, with minimum effect on human well-being as well as the environment. The results can be used for policy- and decision-makers and associated stakeholders to adapt the legislative systems in the construction field for the new requirements set by potential pandemics. The future direction for the study could be organizing a round-table discussion with various stakeholders, including experts from the construction field, policy- and decision-makers, to identify the risks and barriers of adapting construction legislation using the results of the current study. Another future direction can be the analysis of construction legislations that have already implemented the changes due to the pandemic and compared with the results of this study.

Acknowledgments

The authors acknowledge the financial support from Nazarbayev University Faculty Development Competitive Research Grant Program (FDCRGP; Funder Project Reference: 280720FD1904).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Manuscript Number: ECAM-07-2022-0661.R1

The authors again express their gratitude to the editors and reviewers for their time and effort in reviewing our manuscript for the second time. Your comments were very helpful to enhance the quality of our study. We hope the final minor changes listed below have made the manuscript acceptable for publication. In the revised manuscript, the changes are highlighted in yellow.

Once more, thank you very much!

Reviewers' comments

Reviewer 1: The revised version of the manuscript contains improvements which are in sync with the reviewers' comments. Noticeably, the problem being investigated has been clearly articulated in this version whilst the literature review has become more succinctly presented. The methodology has been modified to vividly present the methods that was deployed and the rationale behind the choice of such methods. Other comments regarding the manuscript have been presented in the sections below.

Reviewer 2: This is a good research that will be helpful to raise awareness to amend building codes and regulations that considers human well-being as well as environmental sustainability during pandemics. The authors have now clarified several of the questions I raised in my previous review. Considering these improvements, I recommend that this paper be accepted for publication.

Reviewer 3: Generally, the author(s) have addressed most of the reviewers' comments.

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Additional questions

Question	Reviewer's/Editor's comment			Authors' response
	Reviewer 1	Reviewer 2	Reviewer 3	
Originality: Does the paper contain new and significant information adequate to justify publication?	Yes, the paper contains original and significant information adequate to justify publication.	The paper contributes to the body of knowledge by analysing the pandemic readiness of construction legislation of Kazakhstani and EU. The result of this study can be used to revise current legislation to make the building industry ready for the required changes that a pandemic might bring.	Yes	Thanks for the comment!
Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?	The literature review section has witnessed significant improvement as a plethora of redundant information has been deleted. The section now reads better.	Adequate understanding of the literature has been demonstrated.	The paper demonstrates an adequate understanding of the relevant literature.	Thanks for the comment!
Methodology: Is the paper's argument built on an appropriate base of theory, concepts or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?	The methodology section has been improved in accordance with the reviews from the previous round of reviews. The methods applied are considered appropriate. However, the authors also highlighted associated limitations in subsequent parts of the study.	The methodology section has been revised and clarified.	Still, the methodology section clearly does not justify the use of document analysis. The methodology section must be better supported with relevant literature on research methodologies.	Methodology was supported with following literature: Cowan, C., El-Hage, N., Green, J., Rice, L., Young, L. and Whiteside, M. (2020), "Investigating the Readiness of Hospital Social Workers to Respond to Domestic and Family Violence", *Australian*

Manuscript Number: ECAM-07-2022-0661.R1

				Social Work, Routledge, Vol. 73 No. 3, pp. 357–367. Donkor, A., Luckett, T., Aranda, S., Vanderpuye, V. and Phillips, J.L. (2021), "Development of the 'REadiness SElf-assessment (RESEA) guide' to assist low and middle-income countries with establishing safe and sustainable radiotherapy services: a pragmatic sequential mixed qualitative methods project", *BMC Health Services Research*, BMC Health Services Research, Vol. 21 No. 1, pp. 1–10. Liu, T., Suprun, E., Stewart, R.A. and Duran, S. (2022), "Developing a framework for assessing the readiness of entities in the construction industry in addressing modern slavery", *Sustainable Production and Consumption*, Elsevier Ltd, Vol. 31 No. June 2020, pp. 139–151.

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Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?	The use of Tables and Bar Charts instead of text in presenting the results from the Ordinal Prioritization Analysis has facilitated easy comprehension of the manner through which the results discussed therein were sourced.	The results and discussion sections are clearly presented and previous issues have been addressed.	Yes	Thanks for the comment!
Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?	The implications of the study's findings with regards to the practice and research is articulated in the concluding section of the manuscript.	As mentioned in previous review, the paper contributes to the knowledge by analyzing the EU and Kazakhstan building code and legislation. It evaluates their resilience during the pandemic and how well they address the issue that can arise during the pandemic. The implications of the research have now been clearly stated in a separate section.	Yes	Thanks for the comment!
Quality of Communication: Does the paper clearly express its case, measured against the technical language of the fields and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and	The quality of communication has improved considerably.	The article is well written. The previous minor issues have been resolved in the new version of the manuscript.	Yes	Thanks for the comment!

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readability, such as sentence structure, jargon use, acronyms, etc.:				

PVS. Prevention of Virus Spread

'PVS4. Proper selection of indoor material' is mentioned by two CN RK documentations. CN RK "The floor" indirectly addresses the '*PVS4. Proper selection of indoor material'* in *Section 5.3.1.1*, which states that the choice of a constructive floor solution should be based on the technical and economic feasibility of the decision made in the specific construction conditions, considering the provision of optimal hygienic conditions for people (JSC "KazNIISA", 2015a). Hygienic conditions for people might potentially include the selection of anti-viral materials, which is the aim of the indicator. Hence, the indicator is only indirectly addressed by the documentation. CN RK "Isolation and Finishing" also indirectly addresses *'PVS4. Smart and safe indoor materials*' in *Section 5.2.10* (JSC "KazNIISA", 2014).

'PVS5. Natural light' is mentioned by two CN RK documentations. CN RK "Natural and Artificial Lighting" directly covers *'PVS5. Natural light'* indicator in *Section 5.2. Requirements for natural lighting of premises*. The section states that premises with the constant presence of people, as a rule, must have natural lighting (JSC "KazNIISA", 2011a). CN RK "Public Housing" also directly covers *'PVS5. Natural light'* indicator in *Section 6.4.6. Requirements for the illumination of the premises of a social dwelling* and indirectly addresses the *'PVS6. Flexibility of indoor air conditions'* indicator in *Section 6.4.1. Section 6.4.1.* states that sanitary and hygienic comfort in the premises of a social dwelling is ensured by the requirements for temperature and humidity comfort and the intensity of air exchange (JSC "KazNIISA", 2015b).

CN RK "Residential Apartment Buildings" is the only documentation that addresses (indirectly) the *'PVS6. Flexibility of indoor air conditions'* indicator in *Paragraph 2* of *Section 4. Functional building code requirements.* The paragraph includes a clause stating that internal engineering systems of the building are designed in such a way as to provide living conditions, including the appropriate temperature, humidity and air speed, thermal stability, and heat assimilation of structures (JSC "KazNIISA", 2018a).

'PVS1. Innovative and smart solutions', *'PVS2. Touchless sensor technologies',* and *'PVS3. Self-disinfection areas'* indicators are not addressed by any CN RK documentation.

Regulation #1907/2006 is aimed to maintain high level of protection of environment and human health from use of various chemicals. The regulation indirectly addresses *'PVS4. Proper selection of indoor material'* indicator by ensuring safety of environment, which potentially might also include protection of environment from bacteria and viruses, which harms human health (European Parliament, 2006).

'PVS2. Touchless sensor technologies' indicator is indirectly addressed by *Remote Management* section of *Manual of Standard Building Specifications*, which requires centralized remote management of all technical installations in the building (European Commission, 2011).

Covering Materials section of *Manual of Standard Building Specifications* indirectly addresses *'PVS4. Proper selection of indoor material'.* It is mentioned that the paints used for kitchen must be resistant to bacteria (European Commission, 2011).

'PVS5. Natural light' indicator is directly addressed by *Visual Comfort* section of *Manual of Standard Building Specifications,* which states that 80% of the surface area should have 0.7% or 1.5% of daylight factor depending on the façade (European Commission, 2011).

'PVS6. Flexibility of indoor air conditions ' indicator is directly addressed by *Terminal Units* section of *Manual of Standard Building Specifications*, which states that operation of heating and air conditioning must be adaptable to the new requirements (European Commission, 2011).

MH. Mental Health

CN RK "Natural and Artificial Lighting" vaguely mentions general MH sub-category in *Section 5.1. General requirements*, which highlights the importance of proper lighting for psychological state of people (JSC "KazNIISA", 2011a).

CN RK "Planning and Development of the City of Astana" directly addresses *'MH1. Inclusion of plants and gardens'* indicator in *Section 6. Residential areas,* which set minimum specific provision of green areas (square, boulevard, garden) in a residential group, micro-district, residential area with pedestrian accessibility of no more than 400 m (JSC "KazNIISA", 2019). Also, CN RK "Improvement of The Territory of Settlements" and CN RK "Public Housing" directly addresses *'MH1. Inclusion of plants and gardens'* indicator in *Section 5.2.* and *Section 6.5,* respectively (JSC "KazNIISA", 2015c, 2015b). While CN RK "Housetop and Roofs" indirectly addresses *'MH1. Inclusion of plants and gardens'* indicator in *Section 6.7.7* (JSC "KazNIISA", 2018b).

The apartments should provide summer rooms including loggias, balconies, terraces, verandas, which is also mentioned in *Paragraph 2. Apartments* of CN RK "Residential Apartment Buildings" (JSC "KazNIISA", 2018a). It directly addresses '*MH2. Outdoor spaces'* indicator.

'MH3. Common spaces' is only vaguely mentioned by CN RK "Residential Apartment Buildings" (JSC "KazNIISA", 2018a).

In addition, according to *Section 5.17* of CN RK "Public Housing"*,* the premises of the apartment may include premises for labor rehabilitation (offices, workshops), rooms for physical education, dressing rooms, etc., according to the design assignment (JSC "KazNIISA", 2015b). The statement indirectly addresses the *'MH4. Physical activity spaces'* indicator.

CN RK "Residential Apartment Buildings" vaguely mentions *'MH3. Common spaces'* indicator in *Paragraph 3. Requirements for ensuring the protection of human health during the operation of buildings* (JSC "KazNIISA", 2018a). It states that the necessary safety measures are provided as the device of fences and measures to protect the ventilation outlets in the connecting elements between residential buildings, including open non-residential floors (first and intermediate).

Biodiversity section of *Manual of Standard Building Specifications* directly addresses *'MH1. Inclusion of plants and gardens'* indicator by prioritizing the eco-managed areas including plantings, green roofs, 'wetland' areas, which improves the quality of urban life. While section of *Premises Intended for Various Services* indirectly addresses *'MH4. Physical activity spaces'* indicator stating that multipurpose areas might be reassigned into sport spaces depending on the assessment (European Commission, 2011).

AQ. Air Quality

CN RK "Isolation and Finishes Coatings" vaguely mentions addresses *'AQ2. Air pollution control'* indicator in *Section 4.2.5,* which states that the installed insulating and finishing coatings must ensure the average daily maximum permissible concentration or safe level in the air of inhabited premises, established for the atmospheric air of populated areas (JSC "KazNIISA", 2014). The statement does not directly cover the indicator, but still contributes for the reduction of indoor air pollution.

CN RK "Public Housing" directly covers *'AQ4. Natural ventilation'* indicator in *Section 6.4.1,* which states that the fulfillment of the requirements for temperature and humidity comfort and the intensity of air exchange in the premises of a social dwelling should be provided by providing natural ventilation and microclimate parameters in the premises of the apartment (JSC "KazNIISA", 2015b).

Section 8 of CN RK "Residential Apartment Buildings" states that air from rooms in which harmful substances or unpleasant odors can be emitted must be removed directly to the outside and must not enter other rooms of the building, including through ventilation ducts (JSC "KazNIISA", 2018a). It directly covers *'AQ3 Air flow control'* indicator.

CN RK "Heating, Ventilation, and Air Conditioning" directly addresses *'AQ2. Air pollution control'* in Section *5.1* (JSC "KazNIISA", 2011b). The section states that the concentration of harmful substances in the air, air quality, and air purity in clean rooms must be ensured during the life cycle of buildings. Also, *Section 7.7.5* indirectly addresses *'AQ1. Effective air filtrations'* indicator, stating that air purification should be provided to ensure the required indoor air quality.

Manual of Standard Building Specifications by EC directly covers *'AQ4. Natural ventilation'* indicator. Internal air quality section requires mandatory availability of mechanical ventilation system for fresh air supply (European Commission, 2011).

WQ. Water Quality

CN RK "Residential Apartment Buildings" directly addresses *'WQ1. Drinking water safety level* indicator in *Paragraph 2. Functional building code requirements.* It is stated that residential multi-apartment buildings are designed taking into account the creation of conditions for the continuous supply of water in the required amount, avoiding pollution, leaks (JSC "KazNIISA", 2018a). CN RK "Domestic Water supply and Plumbing Systems" also directly addresses *'WQ1. Drinking water safety level* indicator in *Section 4.2.2* (JSC "KazNIISA", 2015d).

CN RK "The External Networks and Facilities Water and Sanitation" indirectly addresses *'WQ2. Water system safety'* in *Section 5.2.* The *Section 5.2* states that the construction, expansion and reconstruction of external networks and water supply and sewerage facilities should be carried out in such a way that during the operation of the network and structures, safety for health (people and animals) and the environment, and requirements for sanitary and hygienic conditions are ensured (JSC "KazNIISA", 2015e).

EU Regulation #305/2011 related to construction products covers WQ1 indicator. Basic requirements for construction work in the *ANNEX I* include the safety of drinking water from release of hazardous substances with negative impact (European Parliament, 2011). It directly addresses *'WQ1. Drinking water safety level* indicator.

Manual of Standard Building Specifications by EC directly covers *'WQ1. Drinking water safety level* indicator in *Heating, ventilation, air conditioning* section. The section considers tapping points in water pipe system to enable intervention to disinfect water or takes samples (European Commission, 2011).

WWM. Wastewater Management

CN RK "Domestic Water supply and Plumbing Systems" directly addresses '*WWM1 Prevention of household level virus propagation'* indicator in *Section 4.2.3,* which states that it must be ensured that liquid effluents are removed without entering the water supply system (JSC "KazNIISA", 2015d).

Moreover, *Section 6.1.9* of CN RK "The External Networks and Facilities Water and Sanitation" directly addresses '*WWM1 Prevention of household level virus propagation'* indicator (JSC "KazNIISA", 2015e).

'WWM2. Separate toilets' and *'WWM3. Greywater separation'* indicators are not addressed by any documentation.

'*WWM1 Prevention of household level virus propagation'* indicator was also directly mentioned by EU Regulation #305/2011, which mention safety of drinking water from release of hazardous substances with negative impact (European Parliament, 2011).

Manual of Standard Building Specifications by EC vaguely mentions *'WWM3. Greywater separation'* indicator in *Water Drainage Installations* section, which states that greywater collection system is possible after special feasibility study (European Commission, 2011).

Energy Use (EU) and Water Consumption (WC)

CN RK "Thermal Protection of Buildings" directly addresses the *'EU2. Sustainable alternative energy'* indicator in *Section 4.2.1,* which states that the building codes establish mandatory minimum requirements for the thermal protection of buildings, including increasing the energy efficiency of buildings and reducing the consumption of non-renewable natural resources during construction and operation (JSC "KazNIISA", 2015f).

Section 9.3 of CN RK "Heating, Ventilation, Air Conditioning" directly addresses *'EU3. Energy-saving appliances*' indicator, stating that energy efficiency of buildings should be ensured through rational architectural solutions, an economically justified thermal protection of buildings and energy-efficient window structures, an efficient heating system, the use of optimal heat supply and systems of air exchange control (JSC "KazNIISA", 2011b).

CN RK "Isolation and Finishes Coatings" indirectly addresses '*WC2. Water-saving appliances*' indicators. Section 6.3 states that it is necessary to provide technologies and materials that allow to exclude the irrational consumption of resources to ensure resource and energy saving (JSC "KazNIISA", 2014).

CN RK "Energy Efficient Buildings" indirectly addresses *'EU3. Energy-saving appliances*', *'EU2. Sustainable alternative energy'* indicators, while CN RK "Indoor Plumbing System" indirectly addresses *'EU3. Energy-saving appliances*' *and* '*WC2. Water-saving appliances*' indicators in *Section 4.2* (JSC "KazNIISA", 2015g, 2015h).

'EU1. Backup energy' and *'WC1. Alternative water sources'* indicators are not addressed by any CN RK documentations.

'EU3. Energy-saving appliances' and '*WC2. Water-saving appliances*' indicator is indirectly mentioned by EU Regulation #305/2011 related to construction products (European Parliament, 2011). The regulation requires to design buildings in a way that is consumes low amount of energy in terms of heating, cooling, ventilation, and lighting. Moreover, Regulation #66/2010 indirectly addresses *'EU3. Energy-saving appliances*' indicator(European Parliament and Council of the European Union, 2009). Regulation encourages sustainable production and consumption by labeling products based on their impact on environment including energy consumption. Eco-labeling of products including household appliances allows consumers to choose energy-efficient appliances.

Manual of Standard Building Specifications by EC directly addresses *'EU2. Sustainable alternative energy' and 'EU3. Energy-saving appliances*' indicators (European Commission, 2011). *Energy*

Efficiency section states that zero- or low-emission alternative energy sources must be used based on their cost effectiveness and availability. Also, all appliances must have as highest level of energy efficiency as possible. *Directive 2018/844/EU* also directly addresses *'EU2. Sustainable alternative energy' and 'EU3. Energy-saving appliances*' indicators. Moreover, the directive indirectly addresses *'EU1. Backup energy'* by mentioning effective energy storage of buildings (THE EUROPEAN PARLIAMENT, 2018).

Manual of Standard Building Specifications by EC directly addresses *'WC1. Alternative water sources'* indicator in *Water Drainage Installations* section, which states that rainwater must be collected based on collection potential and requirements assessment (European Commission, 2011). '*WC2. Water-saving appliances*' indicator is directly addressed in *Water-saving appliances* section, which states that given preference should be water-saving based (European Commission, 2011).

WM. Waste Management

Waste management sub-category is addressed only by CN RK "Planning and development of the city of Astana" (JSC "KazNIISA", 2019).

Section 10.6.5 vaguely mentions '*WM1. Medical waste separation' indicator* claiming that the design should provide measures for sorting, collection, storage and processing of waste with the definition of their specific locations (JSC "KazNIISA", 2019).

Section 10.6.2 directly addresses '*WM3. Waste management'* indicator stating that when developing project documentation an analysis of the generation, use, disposal and disposal of all types of waste should be carried out, including the identification of the most dangerous sources of waste generation (JSC "KazNIISA", 2019).

'WM2. Waste disinfection' indicator is not addressed by any CN RK or EU legislative documentation.

Manual of Standard Building Specifications by EC directly addresses '*WM3. Waste management*' indicator. *Waste management, reuse and recycling during occupation* section requires a separate area for the collection and storage of recyclable materials such as food packaging, paper, glass, etc (European Commission, 2011).

Directive 2008/98/EC indirectly addresses '*WM1. Medical waste separation*' stating that waste must be handled in a way to minimize human health, and hazardous waste should be handled under special regulation to minimize its negative impact (THE EUROPEAN PARLIAMENT, 2008).

PC. Personal Comfort

CN RK "Noise Protection" directly addresses '*PC4. Noise insulation'.* The documentation includes sections, which focus on design of objects with noise protection measures, noise sources and their noise characteristics, recommendations for the design of sound insulation of enclosing constructions (JSC "KazNIISA", 2011c).

According to *Section 5.1* of CN RK "Public Housing", the design of the state social dwelling should be carried out taking into account the social and consumer qualities of residential buildings, as well as the standardized lower limits of the living and usable area, the level of comfort of the dwelling (JSC "KazNIISA", 2015b). The statement directly addresses '*PC3. Personal space'* indicator.

According to *Paragraph 3. Requirements for ensuring the protection of human health during the operation of buildings* of CN RK "Residential Apartment Buildings", a city telephone distribution

network, installation of satellite antennas (collective reception antennas signal), laying cable television and racks of wire radio broadcasting networks on the roofs of residential multi-apartment buildings is provided, in accordance with the requirements of state standards in the field of architecture, urban planning and construction (JSC "KazNIISA", 2018a). It directly addresses '*PC1. ICT infrastructure'*

According to *Paragraph 2. Apartments* of CN RK "Residential Apartment Buildings", planning solutions for apartments are selected ensuring that there are zones of necessary household processes in the apartment - sleep, family rest, activities (work/education), dining, household activities. Also, as part of the apartment, it is allowed to provide an isolated living room for professional work (office). Apartments in residential multi-apartment buildings are designed in such a way as to provide sufficient isolation from the effects of external and internal noise sources, visual isolation from adjacent dwellings (JSC "KazNIISA", 2018a). The statement directly addresses '*PC3. Personal space'* and '*PC4. Noise insulation'* indicators.

'PC2. Adjustable indoor space' indicator is not addressed by any CN RK documentation.

Manual of Standard Building Specifications by EC directly addresses '*PC1. ICT infrastructure'* indicator. *Telecommunication* section includes requirements for IT and telephony installations (European Commission, 2011).

'*PC4. Noise insulation'* indicator is directly addressed by *Acoustic Comfort* section of *Manual of Standard Building Specifications* by EC (European Commission, 2011).

LS. Local Services

The sub-category is addressed by two CN RK documentations including "Planning and development of the city of Astana" and "Planning and construction of individual housing areas" (JSC "KazNIISA", 2015i, 2019).

CN RK "Planning and development of the city of Astana" indirectly addresses '*LS1. Self-sufficient local services'* in *Section 11.2.1,* which claims that objects of the local service level are located with a radius of pedestrian accessibility: daily demand - 300 - 500 meters, periodic demand - 1200 meters. The local level of service includes kindergartens and schools, outpatient clinics, pharmacies, milk distribution points, convenience stores, catering and consumer services, institutions of mass culture and sports, post offices and banks, and parking lots (JSC "KazNIISA", 2019).

According to *Section 5.5.6* of CN RK "Planning and construction of individual housing areas". in areas of individual residential development, all the necessary institutions and service enterprises should be provided to meet the daily demand of the population (JSC "KazNIISA", 2015i). The statement indirectly addresses '*LS1. Self-sufficient local services'* indicator.

'LS2. Urban farming' indicator is not addressed by any CN RK documentation or EU legislation.

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