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ИНОСТРАННЫЙ ЯЗЫК

ШАХТНОЕ И ПОДЗЕМНОЕ СТРОИТЕЛЬСТВО

Методические указания к самостоятельной работе для студентов специальности 21.05.04

FOREIGN LANGUAGE

MINING AND UNDERGROUND CONSTRUCTION

САНКТ-ПЕТЕРБУРГ
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Предлагаемый материал направлен на совершенствование навыков профессионально-ориентированного чтения на английском языке. Методические указания включают тексты на языке оригинала, а также разработанные упражнения и задания, способствующие развитию речевой, языковой, социокультурной и информационной компетенций студентов, необходимых для общения в сфере профессиональных интересов. Предназначены для самостоятельной работы и как дополнительный материал на занятиях со студентами 2-го курса.

Методические указания предназначены для студентов специальности 21.05.04 «Горное дело» и согласованы с программой по иностранному языку для студентов неязыковых вузов.

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ПРЕДИСЛОВИЕ

Данные методические указания предназначены для учебно-методического сопровождения курса английского языка для студентов неязыковых вузов, обучающихся по специальности 21.05.04 «Горное дело», специализация «Шахтное и подземное строительство».

Изучение материала преследует цель развития навыков и умений просмотрового и изучающего чтения текстов по направлению подготовки, а также их перевода на русский язык с последующим использованием полученной информации для речевой практики; овладение студентами иноязычной коммуникативно-речевой компетенцией, позволяющей будущему специалисту осуществлять профессиональную коммуникацию; формирование активного словарного запаса, который включает наиболее употребительные английский термины.

Методические указания состоят из тематических разделов, каждый из которых посвящен одному из аспектов, связанных с шахтным и подземным строительством. Задания для чтения и перевода составлены на материале текстов в оригинале и сопровождаются специально разработанными упражнениями, направленными на активизацию когнитивной деятельности обучающихся, освоение нового лексического материала, и способствуют развитию коммуникативных навыков в сфере профессионального общения на английском языке.

Приложение содержит тексты для дополнительного чтения, перевода и обсуждения.

UNIT 1.
CONSTRUCTION: IDEAS, BUILDINGS, DESIGN

Reading Activities

1. In groups, make a list of words or phrases you already know related to building construction and architecture.

2. Read the title of the article below. Try to predict what the text is going to be about.

3. Read and translate the extract from 'Building in a bag'.

Text 1
BUILDING IN A BAG

Two young **architectural engineers** have designed a structure, which will greatly **assist** [1] the work of organizations working with **refugees** in **emergency** situations. The structure is an **inflatable shelter** [2] made out of **concrete** [3], which can be **erected** quickly. It is nicknamed 'building in a bag', because it is **delivered** in the form of **a sealed plastic sack**.

The sack consists of two parts: **fabric** [4], which has been **coated** with **cement** and **a plastic skin**. Once the sack is in place, all that is necessary to erect the structure is in the addition of water. The fabric **absorbs** [5] the water and because the volume of the sack itself controls **the amount of water**, there is no need for **measurement**. A chemical pack is then **attached** [6] to a **nozzle** [7] in the plastic skin. This **releases** [8] a controlled volume of gas and **inflates** the structure. The shelter is left **to dry out** and twelve hours later it is ready for use. Doors and windows are left without **concrete cloth**, so they can be **cut out of** the plastic inner once the cement has dried.

The shelter has been designed for **ease of use**. The dry **weight** of the sack is only 230 kilograms and it can be lifted by eight men. It is light enough to be **transported** [9] by a **truck** or light aircraft and it can be **set up** by a person without any training in under 40 minutes. The finished

structure has **curved outer surface** [10], which gives it **strength**, and 16 square meters of **floor space** [11].

(https://www.telegraph.co.uk/news/uknews/1501349/Building-in-a-bag-made-for-disasters.html)

NOTES

[1] **to assist** – помогать; содействовать
[2] **inflatable** – надувной
[3] **concrete** – цемент
[4] **fabric** – ткань
[5] **to absorb** – впитывать; поглощать
[6] **to attach** – присоединять
[7] **nozzle** – отверстие
[8] **to release** –выпускать
[9] **to transport** – перевозить
[10] **floor space** – площадь; размер помещения
[11] **curved outer surface** – изогнутая наружная поверхность

4. Read text 1 again and answer the questions.

1. What does the structure consist of?
2. What is the structure made out of?
3. What is the dry weight of the sack?
4. How long does it take to set up the structure?
5. Why is it nicknamed ‘building in a bag’?

5. In pairs, find English equivalents for the following phrases in the text above.

Создали конструкцию; нет необходимости в измерении; в значительной степени способствовать; представляет собой надувное укрытие; выполненное из бетона; быстро установить; в виде запечатанного пластикового мешка; в чрезвычайных ситуациях; ткань, покрытая цементом и пластиковой оболочкой; контролирует количество воды; оставляют просохнуть; через двенадцать часов он готов к использованию; вырезать из пластмассы внутри.

6. The words below refer to stages in a life of a building structure. Which verb belongs to the first stage and which to the last one?

To erect, to design, to demolish, to construct, to set up

7. Read the last part of text 1 again and get ready to say what or who the main focus of it is:

a) the designers of the shelter
b) the users of the shelter
c) the shelter itself

The shelter has been designed for ease of use. The dry weight of the sack is only 230 kilograms and it can be lifted by eight men. It is light enough to be transported by a truck or light aircraft and it can be set up by a person without any training in under 40 minutes. The finished structure has curved outer surface, which gives it strength, and 16 square meters of floor space.

8. Find all the passive forms in the passage. Which of the passive verbs are in the present form? Which of the passive verbs belong(s) to a completed process?

9. Complete the text below by filling in the gaps. Use the passive form of the verbs in the box.

place	*dig*	*hold*	*install*	*lay*
fill	*erect*	*build*	*finish*	*know*

Construction of a brick house

It (1) _____ that building a house is not an easy thing. The foundations of the house (2) _____ using the architect's plans. First of all, a narrow trench (3) _____, and then (4) _____ with cement. The walls (5) _____ on this firm base. When they reach shoulder height, a scaffolding (6) _____. Openings for doors and windows (7) _____ in place by

wooden frames. When the walls (8) _____, the framework for the roof (9) _____ on top. Finally, interior fittings such as pipes and wiring (10) _____.

10. Read text 2 paying attention to the words in bold.

Text 2
BUILDING CONSTRUCTION

Building construction**,** the techniques and industry involved in the assembly and **erection** of structures, primarily those used to provide shelter.

Building construction is an ancient human activity. Constructed shelters were one means by which human beings were able to adapt themselves to a wide variety of climates and become a global species.

Human shelters were at first very simple and perhaps lasted only a few days or months. Over time, however, even temporary structures evolved into such highly refined forms. Gradually more durable structures began to appear, particularly after the **advent** of agriculture, when people began to stay in one place for long periods.

The history of building is marked by a number of trends. One is the increasing **durability** of the materials used. Early building materials were **perishable**, such as leaves or branches. Later, more durable natural materials – such as clay, stone, and **timber** – and, finally, synthetic materials (brick, concrete, metals, and plastics) were used. Another is a quest for buildings of ever-greater **height and span**; this was made possible by the development of stronger materials and by knowledge of how materials behave and how to exploit them to greater advantage. A third major trend involves the degree of control exercised over the interior environment of buildings: increasingly precise regulation of air temperature, light and sound levels, **humidity**, **odours**, air speed, and other factors that affect human comfort has been possible. Yet another trend is the change in energy available to the construction process, starting with human muscle power and developing toward the powerful machinery used today.

(Written by Alfred Swenson)

11. Match the words from text 2 with the translation.

1) erection	a) высота и пролет
2) advent	b) лесоматериал; пиломатериал
3) durability	c) возведение; монтаж
4) perishable	d) налёт; запах
5) timber	e) прочность; срок службы
6) height and span	f) непрочный; с коротким сроком службы
7) humidity	g) появление
8) odours	h) влажность

12. Read text 2 again and answer the questions.

1. What is an ancient human activity?
2. How long did human shelters last at first?
3. Can you give examples of perishable building materials?
4. What synthetic materials were used in construction?
5. What does the third trend in the history of building involve?

13. Read text 3 and insert the missing words from the box into the gaps.

Text 3
BUILDING PRODUCTS AND SYSTEMS

construction	*to meet*	*properties*	*craftsmen*	*coordinate*
enforce	*building*	*site*	*insurance*	

The present state of building (1) _____ is complex. There is a wide range of building products and systems, which are aimed primarily at groups of (2) _____ types or markets. The design process for buildings is highly organized and draws upon research establishments that study material (3) _____ and performance, code officials who adopt and (4) _____ safety standards, and design professionals who determine user needs and design a building (5) _____ those needs. The construction

process is also highly organized; it includes the manufacturers of building products and systems, the (6) _____ who assemble them on the building (7) _____, the contractors who employ and (8) _____ the work of the craftsmen, and consultants who specialize in such aspects as construction management, quality control, and (9) _____.

(Written by Alfred Swenson)

14. Name the noun suffixes you can remember. Then form the nouns from the verbs in the table, where possible.

VERB	NOUN -ion	NOUN –er/or	NOUN -ment
to construct			
to manage			
to erect			
to determine			
to build			
to establish			
to measure			
to develop			
to coordinate			
to manufacture			
to employ			

15. Find English equivalents in text 3.

Современное состояние строительства; широкий ассортимент строительных продуктов и систем; процесс проектирования зданий; свойства и характеристики материалов; обеспечивают соблюдение стандартов безопасности; проектируют здания для удовлетворения этих потребностей; мастера; на строительной площадке, подрядчики; управление строительством; контроль качества и страхование.

Discussion Points

1. Discuss the main trends in the history of building.

2. Point out all the information necessary for the controller of the material properties.

3. Prove that building a house is not an easy thing.

4. Do you think that two young architectural engineers have designed a structure, which will actually assist the work of organizations working with refugees in emergency situations?

UNIT 2.
BUILDING MATERIALS.
PROPERTIES AND USES IN CONSTRUCTION

Reading Activities

1. What do you expect to be covered in the extract? Can you name the main materials used for centuries?

Text 1
MODERN BUILDING MATERIALS

All building materials are divided into three main groups: main building materials such as rocks and **artificial stones** [1], timber and metals; binding materials such as lime, gypsum and cement, secondary building materials, which are used for the interior parts of the buildings. We use main building materials for **bearing structures** [2]. Binding materials are used for making artificial stones and for binding together **masonry units** [3]. For interior finish of the building we use secondary materials.

Natural building materials are stone, sand, lime and timber. Cement, clay products and concrete are examples of artificial building materials.

Timber is referred to the group of the main building materials. It is the most ancient structural material. It is light, cheap and easy to work. But wood has certain disadvantages: it burns and **decays** [4].

Stone belongs to one of the oldest building materials used by man. It has many properties, such as mechanical strength, compactness, porosity, sound and **heat insulation** [5] and fire-resistance. The stones, which are usually used for masonry work are granite, sandstone and mar-

ble. Granite is very hard, strong and durable. It is used for foundations, columns, steps and for entire facades. Its colour may be gray, yellow, pink or deep red. Sandstone is comparatively easy to cut and shape. It is often used for facing rough walls and for interior decorations. **Marble** [6], is a crystalline stone chiefly used for decorative purposes. It takes on a high polish.

Bricks were known many thousands of years ago. They are the examples of artificial building materials. Brick is made by pressing clay into blocks and burning them to hardness. Bricks are hard and easily fastened together with the help of mortar. They are produced in a great variety for widely different purposes.

(https://is.vstecb.cz/do/5610/OPP/Informace/OP_VK/1883490/2657046/2657051/2657259/3_BUILDING_MATERIALS.pdf)

NOTES

[1] **artificial stones** – эксплуатационные преимущества
[2] **bearing structures** – несущие конструкции
[3] **masonry units** – элемент каменной кладки (блок, кирпич)
[4] **to decay** – гнить; портиться
[5] **heat insulation** – теплоизоляция
[6] **marble** – мрамор

2. Read text 1 for the second time and answer the questions.

1. What main groups are all building materials divided into?
2. What can you say about natural building materials and artificial building materials?
3. Which group is timber referred to?
4. What is often used for facing rough walls and for decorations?
5. What is used for foundations, columns, steps and facades?

Discussion Points

1. Talk to a partner. Discuss all possible problems that can arise with wood, which belongs to naturally growing materials. Start with the passage given below.

*It is known that **wood** is the oldest construction material and is still used for different purposes. Wood is popular since it has low weight and is easy to work. Besides that, it grows naturally and is cheap. But its usage is limited because of its disadvantages…*

2. Discuss where glass and plastics are widely used. Then, read the extract given below. What haven't you mentioned?

***Glass and plastics** are widely used nowadays in construction of different kinds of buildings. Glass has excellent combination of physical, chemical, and mechanical properties. The outstanding property of glass is its chemical inertness. It is used for constructing doors, walls, roofs, pipelines, etc. Plastics is the name for various derivatives of resin, cellulose, and protein. Nowadays plastics can be applied to almost every branch of building.*

3. Read text 2 about metals. Fill in the gaps with appropriate words from the box.

Text 2
DIFFERENT METALS

ferrous	*steel*	*characteristics*	*Cast iron*
aluminium	*corrosion*	*framework*	*non-ferrous*

Metals are divided into (1) _____ metals and (2) _____ metals. Ferrous metals include iron, (3) _____ and its alloys. (4) _____ is the cheapest of the ferrous metals. It is chiefly used in building for compressed members of construction. Steel is used for (5) _____ of buildings, and as reinforcement in modern ferroconcrete structures. Non-ferrous metals have the following (6) _____ : high electric and heat conductivity, high (7) _____ resistance, light weight. The oldest and the best known light metal is (8) _____. It is used in lift bridges, long span roofs, dome roofs, crane jibs, and in other structures.

4. Read the sentences, make them negative and change if needed.

1. The main modern materials include iron, bricks and clay.
2. Plastics are based on the silicon basis.
3. This used to be the most important material in the 19 century.
4. The company built the house only of wood.
5. Limestone belongs to the extrusive rocks.
6. Peat is mined in our neighbourhood.
7. They have already finished the tiling in their bathroom.
8. Metals can be divided into light and heavy.

UNIT 3.
DEEP UNDERGROUND ENGINEERING

Reading Activities

1. Can you name the main method used principally for underwater crossing?

2. Read text 1 and try to retell the main points stipulated in the text.

Text 1
MODERN PRACTICE

The world's longest and deepest application to date is the twin-tube subway crossing of San Francisco Bay, constructed between 1966 and 1971 with a length of 3.6 miles in a maximum water depth of 135 feet. The 330-foot-long, 48-foot-wide sections were constructed of steel plate and launched by shipbuilding procedures. Each section also had temporary end **bulkheads** [1] and upper pockets for gravel ballast placed during sinking. After placement of the interior concrete lining at a fitting-out dock, each section was towed to the site and sunk in a trench previously **dredged** [2] in the mud in the bottom of the bay.

With diver guidance, the initial connection was accomplished by hydraulic-jack-powered **couplers** [3], similar to those that automatically join railroad cars. By **relieving** [4] the water pressure within the short compartment between bulkheads at the new joint, the water pressure acting on the forward end of the new section provided a huge force that pushed it

into intimate contact with the previously laid tube, compressing the rubber **gaskets** [5] to provide a **watertight seal** [6]. Following this, the temporary bulkheads were removed on each side of the new joint and interior concrete placed across the connection.

(https://www.britannica.com/technology/tunnel/Underground-excavations-and-structures#ref72473)

NOTES

[1] **bulkheads** – защитные дамбы; перемычки
[2] **to dredge** – углублять
[3] **couplers** – соединительные устройства; сцепляющие муфты
[4] **to relieve** – понижать (давление)
[5] **gaskets** – уплотнители
[6] **watertight seal** – водонепроницаемый уплотнитель (шов)

2. Read the text again and answer the following questions.

1. What is the world's longest and deepest application?
2. What did each section also have for gravel ballast placed during sinking?
3. What are the hydraulic-jack-powered couplers like?
4. What is normally done to provide a watertight seal?

3. Think of the possible techniques to ensure safety of underground works. Then read the abstract below to find out if you were right.

THEORY AND TECHNIQUES

Structural design of underground works is a process that takes into account various aspects that depend on the specific nature of the works. It covers the conception stage – choice of the site, location and orientation, and shape and geometry of eventual cavities; and the calculation stage – determination of structural solutions for achieving a certain performance. A great effort is made to ensure safety of the works, and each step is taken to integrate advances in various fields, like site investigation, hydromechanical characterization, computer modelling techniques, monitoring techniques, theory of structural safety and other theories.

(https://www.graphyonline.com/archives/archivedownload.php?pid=IJEES-158)

4. Read text 2 to identify the message of the author. After reading the text, try to put the facts in succession and summarize.

Text 2
UNDERGROUND GEOENGINEERING

The use of underground space for engineering systems has been increasing worldwide. Underground geoengineering is characterized by complex, uncertain geology and geomechanics that present challenges that require new techniques to be dealt with. **Artificial Intelligence** [1] (AI) techniques provide a means to deal with these ever more complex and large data that are generated from the design and construction of these systems.

The **application** [2] of **Data Mining** [3] (DM) techniques to deep underground engineering problems is being discussed today. Specifically, DM techniques are used in the evaluation of geomechanical properties parameters in a large underground **hydroelectric scheme** [4], a very deep underground research laboratory. The models developed showed good **accuracy** [5] with reality, and have the advantage to allow one to identify the importance of various parameters, as well as, in the case of BN classifiers, the relationship between these **variables** [6]. The wide range of case studies shows, the importance that such AI techniques can play in future underground engineering problems. **Novel studies** [7] are being developed to identify new strength criteria for rock mass in order to meet the demand of the scientific rock mechanics community.

(https://www.graphyonline.com/archives/archivedownload.php?pid=IJEES-158)

NOTES

[1] **Artificial Intelligence** – искусственный интеллект
[2] **application** – применение
[3] **Data Mining** – разработка (поиск) данных
[4] **hydroelectric scheme** – гидроэнергетическая система
[5] **accuracy** – точность
[6] **variables** – переменные величины
[7] **novel studies** – инновационные исследования

5. Read text 2 for the second time to answer the questions.

1. What presents challenges that require new techniques today?
2. What do these two letters 'AI' stand for?
3. What means do AI techniques provide?
4. What is used in the evaluation of geomechanical properties parameters?
5. In your view, what makes it possible to meet the demand of the scientific rock mechanics community?

6. Match the words from column A to the words from column B to form word combinations.

A	B
Artificial	parameters
underground	properties
various	techniques
strength	Intelligence
geomechanical	criteria
Data Mining	space

7. Think of excavation methods, which one can be applied to reduce the explosive charge. Read the abstract below to find out the answer.

In order to reduce the explosive charge required for excavation of a section and control blasting scale, the top heading and bench tunneling method may be adopted. As most of the city tunnels are of the shallow-buried type and the surrounding rock of top heading is weak, the explosive charge required is low (or even manual excavation is possible). After blasting of the top heading, a free face that is helpful for blasting the bench will be formed, so as to reduce the vibration. For hard strata, the bench and top heading method may be reserved for smooth blasting. The cutting is placed at the bottom to increase the distance from the explosive center of the cutting.

Discussion Points

1. Discuss how technologies have influenced the use of underground space.

UNIT 4.
UNDERGROUND EXCAVATION INDUSTRY

Reading Activities

1. What do you know about excavation industry?

2. Read text 1 and do the tasks below.

Text 1
EXCAVATION INDUSTRY PROSPECTS

The excavation industry is booming and this trend will continue due to the growing **world population** which is likely to be doubled from 6 billion in the year 2000 to 12 billion at its present growth rate by the year 2040, and also due to changes in the lifestyle, living standards and progressive outlook within countries. To meet this predicted demand, the industry must grow as internationally competitive sector, underpinned by innovations and technology.

The use of **underground space** in urban areas is becoming increasingly important due to **scarcity of land** in the **densely populated** areas and due to environmental concerns. Methods, techniques and equipment are available to excavate a large volume of rocks beneath the surface efficiently. This is the reason that thousands of kilometers of tunnels for transportation (rail, road and water conveyance) and large excavations, which are known as 'caverns', are being created for **civil works**, **storage facilities**, defense installations, **hydro-electric power plants**, and recreation facilities.

(by Ratan Raj Tatiya)

1. Match the words from text 1 with the translation.

1) world population	a) густо населенный
2) densely populated	b) ГЭС
3) civil works	c) мировое население
4) underground space	d) складские помещения
5) storage facilities	e) нехватка земель
6) scarcity of land	f) подземное пространство
7) hydro-electric power plant	g) строительные работы (гражданских объектов)

2. Read text 2 for the second time to answer the questions.

1. Why is the excavation industry booming?
2. Why is it important to use underground space?
3. What objects/facilities are created through excavation works?

3. Using vocabulary in the unit and a dictionary, translate the following phrases into Russian.

Конкурентоспособный сектор; поддерживать индустрию; мировое население увеличится вдвое; уровень жизни; городские районы; методы, технологии и оборудование; водоотведение; оборонительные сооружения; рекреационные зоны.

4. Read text 2 paying attention to the words in bold.

Text 2
SURFACE AND UNDERGROUND EXCAVATIONS

The meaning of the word 'excavate' is to dislodge the **rock massif** [1] from its original place (in-situ). This involves two operations: digging the ground and its disposal, as a result creating openings or excavations of different sizes, shapes and configurations at the desired location. The location could be within an **urban area** [2] or in the countryside and even sometimes within bodies of water. It could commence at, above or below the ground level and extend in any direction: horizontal, inclined, vertically up or down.

Broadly, based on locale, the **excavations** [3] can be grouped into two main classes: 1. surface excavations. 2. subsurface or underground excavations. At both these locales excavations are required principally for the following two purposes: a. Excavations necessary to **exploit** [4] minerals (i.e. mining excavations). b. Excavations necessary to build structures including tunnels (civil excavations).

There are two locales where subsurface openings or tunnels are driven. The first category includes those tunnels or openings, which serve for passage to rails, roads, navigation, pedestrian use etc. and also for

conveyance of water and that serve as **sewerage** [5]. These tunnels, constructed for civil works and built to have a very long life, need to be very safe with regard to their stability, ventilation, illumination and risks of getting flooded etc.

The second category of tunnels or openings is for the purpose of exploring and exploiting **mineral deposits** [6], which are **deep-laying** [7], and cannot be mined by surface mining methods. These tunnels are small in size (cross section) but during the life of a mine, their lengths might extend greatly. For example, Mount Isa Mines, which is largest copper, silver and zinc producing company in Australia, owns 975 km of underground openings (tunnels, raises and shafts).

(adapted from Ratan Raj Tatiya)

NOTES

[1] **rock massif** – массив горной породы
[2] **urban area** – городская территория
[3] **excavations** – выемка, экскавация
[4] **exploit**– разрабатывать (месторождение)
[5] **sewerage** – канализационная система
[6] **mineral deposits** – месторождение полезных ископаемых
[7] **deep-laying** – глубокозалегающий

5. Read text 2 for the second time to answer the questions.

1. What types of excavation can you name?
2. Where and why are excavations necessary?
3. What is civil excavation used for?
4. What is mining excavation used for?

6. Transform the verbs into nouns using suffixes -ion, -tion, -al.

VERB	NOUN	VERB	NOUN
excavate		dispose	
explore		construct	
exploit		remove	
extend		locate	
ventilate		illuminate	

7. Read text 2 again and find synonyms to the following words.

Displace, position, civic, rural, underground, to mine, transference, sanitary piping, increase, prospecting, lighting.

8. Translate the following sentences into Russian using the passive voice.

1. Жителям городских территорий предлагается переехать в сельские районы. 2. Недавно в Забайкальском крае обнаружено глубокозалегающее месторождение. 3. Образец был взят из массива горной породы. 4. На данный момент месторождение разрабатывается другим предприятием. 5. В жилых помещениях канализационная система используется для отвода сточных вод. 6. Для освещения тоннеля подведены специальные провода.

Discussion Points

Imagine you are in a team of engineers designing an underground hydro power plant. Discuss its advantages over the surface hydro power plant and stipulate some possible problems.

UNIT 5.
HEALTH, SAFETY AND ENVIRONMENT

Reading Activities

1. What do you know about health and safety in construction area?
2. Explain the notion 'safety risk management'.
3. Read text 1 and do the tasks below.

Text 1
SAFETY RISK MANAGEMENT OF UNDERGROUND ENGINEERING

Underground construction is in a great demand in many civil and infrastructure projects all over the world, such as metro and hydropower projects. In the last decade, tunnel construction has presented a powerful

momentum for rapid economic development. However, violations of **safety rules** [1] occur frequently in tunnel construction, resulting in serious problems. On 6 July 2010, a tunnel collapse took place in Prague, Czech Republic, causing a 15-m-wide **subsidence** [2] on the ground surface. On 23 August 2012, water leakage in metro line caused chaos in Warsaw, Poland. Water flooded into the tunnel at the planned power station, causing considerable transportation problems in the already gridlocked city.

Nowadays there are many problems with regard to the cost and safety risk management in the underground construction. In general, there arises a public concern that underground construction may cause **ground distortion**[3], which may affect the safety of surface buildings and road traffics, and lead to unacceptable damages.

The causes for most accidents are similar in nature, including poor technologies, management and performance on **hazard rectification** [4].

The objective causes for accidents in the tunnel engineering include adverse hydrogeological conditions, groundwater or heavy rainfall, and **soft soil layers** [5]. **Collapse** [6] is the most dominant accident type in the tunnel engineering, accounting for 60% of the total accident records. For example, on 15 November 2008, a fatal tunnel collapse occurred one year after construction of Hangzhou metro, resulting in 12 lives loss.

This is the reason why governments of different countries as well as international organizations are developing various solutions. There have already been issued numerous guidelines of risk management for construction of underground works. Moreover, engineering companies develop systems intended to predict structural and environmental instability risks, which are frequently encountered in underground construction.

Still there is a strong need for the new strategies **safety risk management** [6] in underground construction in such aspects as the management system and policy, the legal, administrative, economic, educational and technical countermeasures.

(Adapted from https://www.researchgate.net/publication/305616651)

NOTES

[1] **safety rules** – правила техники безопасности

[2] **subsidence** – оседание грунта

[3] **ground distortion** – деформация грунта

[4] **hazard rectification** – устранение опасных факторов
[5] **soft soil layers –** мягкий слой грунта
[6] **collapse** – обрушение
[7] **safety risk management** – меры по предотвращению угрозы производственной безопасности

4. Match the words from column A to the words from column B to form word combinations.

A	B
international	leakage
public	construction
economic	rules
water	concern
underground	organisation
safety	development

5. Find the English equivalents in text 1.

Растет общественная обеспокоенность; востребованный в гражданском строительстве; проект строительства гидроэлектростанции; стремительное развитие экономики; обрушение тоннеля; протечка воды; транспортный коллапс в городе; безопасность наземных сооружений; дорожное движение; строительство туннелей; неудовлетворительные технологии, уровень организации и исполнения; неблагоприятные гидрогеологические условия; грунтовые воды и сильные ливни; разрабатывать различные решения; издавать руководство; нестабильные условия окружающей среды; профилактические меры.

6. Turn two sentences into one using non-finite verb form. Translate sentences into Russian.

1. Violations of safety rules occur frequently in tunnel construction. This results in serious problems. 2. In 2010 a tunnel collapsed in Prague. That collapse caused a 15-m-wide subsidence the ground surface.

3. Collapse is the most dominant accident type in the tunnel engineering. It accounts for 60% of the total accident records. 4. Water flooded the tunnel. The tunnel was built for the power station. 5. The collapse caused considerable transportation problems in the city. The city had already been gridlocked. 6. Engineering companies develop various systems. These systems are intended to predict structural and environmental instability risks. 7. Students had a great opportunity. They visited the best laboratory. 8. He can join our construction team. I don't mind.

7. Read text 1 again and answer the questions.

1. What are the possible consequences of the safety rules violations?

2. What are the basic reasons of accidents during tunnel engineering?

3. What measures are taken to prevent accidents in underground construction?

8. Read text 2, fill in the gaps with the appropriate words from the box.

Text 2

integral	disasters	nature	achieved	rain
warming		productivity	ozone	

HSE

Such hazards as fires, explosions, inundation, and other accidents or _____ are often associated with the excavation activities. All these are detrimental both to the human's health and to the _____. Growing health-problems of the world's citizens and global issues such as acid _____, _____ depletion, photochemical smog, acid drainage and global _____ prove this fact.

Productivity brings excellence to the production. However, both cannot be _____ if safety is jeopardized, pollution is at its peak, workers' health is not looked after. Thus, Health, Safety and Environment

(HSE) must be considered a critical business activity on a par with production and _____.

There is no doubt that minimizing losses of various kinds should be among top priorities. As such loss prevention strategy should be an _____ part of the procedure of running mines and tunnelling projects effectively.

(adapted from Ratan Raj Tatiya)

9. Explain the meaning of the following terms from the text in English. Find Russian equivalents.

Global issues; acid rain; ozone depletion; photochemical smog; acid drainage; global warming; production and productivity; Health, Safety and Environment (HSE); to be on a par with; loss prevention; to run a mine.

10. Match the words from column A to the words from column B to form word combinations.

A	B
health	prevention
loss	rain
ozone	problems
photochemical	warming
acid	depletion
global	smog

Discussion Points

1. Talk to a partner. Discuss how Health, Safety and Environment (HSE) is performed in Russia.
2. Suggest some solutions for safety risk management in underground construction industry.

APPENDIX

ADDITIONAL TEXTS FOR PROFESSIONAL READING

In this section, you will find some additional texts and articles on the topics of the corresponding units included in the manual. They can be used either as an additional classroom material for the unit, home reading, or as an extra reading activity for the advanced learners in the group.

TEXT 1.

CEMENT COMPOSITES

Cement bonded composites are an important class of construction material. These products are made of hydrated cement paste that binds wood or alike particles or fibers to make precast building components. Various fibrous materials including paper and fiberglass have been used as binders.

Wood and natural fibres are composed of various soluble organic compounds like carbohydrates, glycosides and phenolics. These compounds are known to retard cement setting. Therefore, before using a wood in making cement boned composites, its compatibility with cement is assessed.

Wood-cement compatibility is the ratio of a parameter related to the property of a wood-cement composite to that of a neat cement paste. The compatibility is often expressed as a percentage value.

To determine wood-cement compatibility, methods based on different properties are used, such as, hydration characteristics, strength, interfacial bond and morphology.

Various methods are used by researchers such as the measurement of hydration characteristics of a cement-aggregate mix; the comparison of the mechanical properties of cement-aggregate mixes and the visual assessment of microstructural properties of the wood-cement mixes.

It has been found that the hydration test by measuring the change in hydration temperature with time is the most convenient method. Re-

cently, Karade et al. have reviewed these methods of compatibility assessment and suggested a method based on the 'maturity concept' i.e. taking in consideration both time and temperature of cement hydration reaction.

(From https://theconstructor.org/building/types-of-building-materials-construction/699/)

TEXT 2.

CONSTRUCTING A TUNNEL

At its most basic, a tunnel is a tube hollowed through soil or stone. Constructing a tunnel, however, is one of the most complex challenges in the field of civil engineering.

It is found that the first tunnel was made by the Egyptians and the Babylonians, 4000 years ago. This tunnel served the purpose of connecting two buildings in Babylon. The connection was from the royal palace to the temple. The length of this tunnel was found to be 910m, which was brick lined.

Many tunnels are considered technological masterpieces and governments have honored tunnel engineers as heroes. That's not to say, of course, that some tunnel projects haven't encountered major setbacks. The Tunnel Project (the 'Big Dig') in Boston was plagued by massive cost overruns, allegations of corruption, and a partial ceiling collapse that resulted in a fatality. But these challenges haven't stopped engineers from dreaming up even bigger and bolder ideas, such as building a Transatlantic Tunnel to connect New York with London.

A tunnel is a horizontal passageway located underground. While erosion and other forces of nature can form tunnels, in this article we'll talk about man made tunnels – tunnels created by the process of excavation. There are many different ways to excavate a tunnel, including manual labor, explosives, rapid heating and cooling, tunneling machinery or a combination of these methods. Some structures may require excavation similar to tunnel excavation, but are not actually tunnels. Shafts, for example, are often hand-dug or dug with boring equipment. But unlike tunnels, shafts are vertical and shorter. Often, shafts are built either as part of a tunnel project to analyze the rock or soil, or in tunnel construction to provide headings, or locations, from which a tunnel can be excavated.

(From "How tunnels work" by William Harris)

TEXT 3.

PRELIMINARY MINING CONSTRUCTION

Before a mine is even built it takes many years to survey lands to determine their viability of producing required minerals and rocks. The environment needs to be analysed to determine the state of health, plans need to be created to limit the impact of mining, and strategies are thought out to mitigate any impacts. Then a post-mine plan is created for re-establishing the environment. Both surface water and groundwater in the surrounding areas or within a mine needs to be protected to ensure save consumption and prevent contamination. Mining companies are environmentally responsible for their actions and planned activities.

Only once the above procedures are planned for can a company apply for the necessary permits to mine the land. This again can take many years and can become quite costly. If the company receives approval to proceed with the mining construction, further preliminary procedures need to be followed before the actual mine can be built. The designated land area needs to be prepared for the construction site. Preparation includes the removal or stripping of vegetation, rocks and mountainous terrains, and any previous buildings or structures. Any wildlife or protected plant species need to be relocated and top soils can be stored for future use. Once the land is cleared fencing is erected and new carriageways need to be built. This includes railway lines, roads and bridges. Workers camps or 'mining towns' need to be built to house the workers. The size will be dependent on the expected size of the mine and the number of workers needed. Sewage, water systems and sediment traps will also need to be built.

(From http://www.miningoilgasjobs.com.au/construction/all-you-need-to-know/mining)

TEXT 4.

INSULATING MATERIALS

Waterproofing and ground moisture insulation – protects the building against atmospheric moisture, rainwater, surface and ground water and ground moisture. Bitumen and foils based on plastics are used for

waterproofing insulations. The group of bitumens is bitumen in a form of suspensions, emulsions, paints, sealants, coatings and asphalt insulating strips. Waterproofing membranes are most commonly made of PVC and polyethylene. The category also includes protection against radon.

Thermal insulation materials ensure thermal comfort in buildings, protects buildings against heat loss, prevents the precipitation of water vapour on the surface or inside structures, but also prevents excessive heating of building space. Thermal insulation materials can be divided into fiber – mineral, glass and basalt wool; shaped – products of diatomaceous earth and cork products of cellular plastics; loose – expanded perlite or vermiculite, cork.

Sound insulation – is represented by the sound insulating material. It is crucial if we want to soften the sound which spreads in the building structures, or if it is necessary, to solve the audibility and intelligibility in the space. Soft fibrous material and porous materials (the same as for the thermal insulation), as well as metal siding and plastic foils, are used. Insulations against shock also belong into the sound insulation.

(https://is.vstecb.cz/do/5610/OPP/Informace/OP_VK/1883490/2657046/2657051/2657259/3_BUILDING_MATERIALS.pdf)

TEXT 5.

CONCRETES

Concrete is a mixture of aggregate, cement, water and additives. The filler in concrete comprises a mixture of small and coarse aggregates (sand, gravel) and a binder is cement (type and amount depend on the nature of the concrete). Water for concrete production is divided into the mixing and treatment. Additives in concrete affect workability, properties and solidification process and hardening of concrete. Concrete is used for monolithic structures – casting of concrete directly into the formwork at the construction site, but also for the production of prefabricated elements. Like mortars, concrete is usually produced in the central concrete factories and is transported via truck mixers or truck mixers. Only in individual constructions, mixers are used.

Concretes are classified according to the nature into simple concretes (without reinforcement), reinforced concrete (steel reinforced), pre-

stressed (pre-stressed reinforcement), light (concrete spotty-coarse aggregate fraction, lightweight concrete. Lightweight concrete has porous fillers such as perlite or expanded clay, lightweight aerated concrete - the creation of pores in the mass by using additives) and special concrete (vacuum concrete, architectural, heavy, fireproof and heat resistant).

Concrete products for construction are masonry units – blocks and ceiling elements – boards, panels, beams and fittings, as well as floor tiles, wall tiles, chimney fittings, stair treads, etc.

(https://is.vstecb.cz/do/5610/OPP/Informace/OP_VK/1883490/2657046/2657051/2657259/3_BUILDING_MATERIALS.pdf)

TEXT 6.
ENVIRONMENTAL AND ECONOMIC FACTORS

Unexpectedly rapid increases in urbanization throughout the world, especially since World War II, have brought many problems, including congestion, air pollution, loss of scarce surface area for vehicular ways, and major traffic disruption during their construction. Some cities relying principally on auto transport have even found that nearly two-thirds of their central land area is devoted to vehicular service (freeways, streets, and parking facilities), leaving only one-third of the surface space for productive or recreational use. During the past decade there has been a growing awareness that this situation could be alleviated by underground placement of a large number of facilities that do not need to be on the surface, such as rapid transit, parking, utilities, sewage and water-treatment plants, fluid storage, warehouses, and light manufacturing. The overriding deterrent, however, has been the greater cost underground. Hence planners have rarely dared to propose underground construction except where the surface alternate was widely recognized as intolerable. Underground construction in urban areas has, thus, generally been limited to situations without a viable surface alternate; as a result, additional increases in surface construction have further aggravated the problem. At the same time, the low volume of underground construction has provided insufficient incentive for the development of innovative technology.

(https://www.britannica.com/technology/tunnel/Future-trends-in-underground-construction)

TEXT 7.

THE MINING INDUSTRY AND SHAFTS

The mining industry has been the primary constructor of shafts, because at many locations these are essential for access to ore, for ventilation, and for material transport. Depths of several thousand feet are common. In public-works projects, such as sewer tunnels, shafts are usually only a few hundred feet deep and because of their high cost are avoided in the design stage wherever practical. Shallower shafts find many uses, however, for penstocks and access to underground hydroplants, for dropping aqueduct tunnels beneath rivers, for missile silos, and for oil and liquefied-gas storage. Being essentially vertical tunnels, shafts involve the same problems of different types of ground and water conditions but on an aggravated scale, since vertical transport makes the operation slower, more costly, and even more congested than with horizontal tunneling. Except when there is a high horizontal geostress in rock, the loading on a shaft support is generally less than for a tunnel. Inflowing water, however, is far more dangerous during construction and generally intolerable during operation. Hence, most shafts are concrete-lined and waterproofed, and the lining installation usually follows only a short distance behind excavation. The shape is usually circular, although, before current mechanized excavation methods, mining shafts were frequently rectangular. Shafts may be sunk from the surface (or drilled in smaller sizes), or, if an existing tunnel provides access, they may be raised from below.

(https://www.britannica.com/technology/tunnel/Underground-excavations-and-structures)

TEXT 8.

UNDERGROUND GEOENGINEERING

Underground geoengineering is characterized by complex, uncertain geology and geomechanics that present challenges and require new tecniques to be dealt with. Problems are mainly related to heavy overburden which causes high levels of stresses and temperatures leading to a difficult geological environment that requires complex engineering design. Special cases of the use of the deep underground are related to pe-

troleum engineering, nuclear waste disposal, storage of products and energy, storage of CO2, geothermal energy, and these pose specific problems due to the environmental consequences they may have in case of failure.

(https://graduatedegrees.online.njit.edu/resources/msce/msce-articles/basics-of-underground-construction/)

TEXT 9.
BASICS OF UNDERGROUND AND MINING CONSTRUCTION

Underground construction is essential in the mass transportation systems that move millions of urban commuters in cities every day. It also plays a role in protecting and securing structures against natural disasters, as well as supporting water quality with underground systems for wastewater control.

In every corner of the globe, ambitious, multi-million dollar projects are actively underway. Innovative new technologies, equipment and tools have made it easier than ever before to take on massive jobs without disturbing life above ground. The demand for underground construction engineers is unprecedented as the current labor force begins to age out of the workplace. Areas of opportunity include several specialties, such as:

Mining projects are happening around the world as the search for new deposits of valuable materials increases. From iron ore to copper and silver, the earth still holds unexplored pockets of opportunity, primarily in developing nations in South America and Asia. Technological advancements in mining equipment are helping companies drill ever-deeper caves, at a faster pace. Other developments in concrete and concrete admixture are also available to improve safety along with speed, thanks to advanced applications for backfilling, anchoring, and shielding.

(https://graduatedegrees.online.njit.edu/resources/msce/msce-articles/basics-of-underground-construction/)

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Методические указания к самостоятельной работе для студентов специальности 21.05.04

FOREIGN LANGUAGE

MINING AND UNDERGROUND CONSTRUCTION

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