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СТРОИТЕЛЬНЫЕ СООРУЖЕНИЯ

Сборник текстов и упражнений к практическим занятиям по английскому языку

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Оглавление

Text 1. Tunnel

A tunnel is an underground passage. The definition of what constitutes a tunnel is not universally agreed upon. However, in general tunnels are at least twice as long as they are wide. In addition, they should be completely enclosed on all sides, save for the openings at each end. Some civic planners define a tunnel as 0.1 miles (0.16 km) in length or longer, while anything shorter than this should be called an underpass or a chute. For example, the underpass beneath Yahata Station in Kitakyushu, Japan is only 0.08 miles (0.13 km) long and therefore should not be considered a tunnel.

A tunnel may be for pedestrians or cyclists, for general road traffic, for motor vehicles only, for rail traffic, or for a canal. Some are aqueducts, constructed purely for carrying water — for consumption, for hydroelectric purposes or as sewers — while others carry other services such as telecommunications cables. There are even tunnels designed as wildlife crossings for European badgers and other endangered species. Some secret tunnels have also been made as a method of entrance or escape from an area, such as the Cu Chi Tunnels or the tunnels connecting the Gaza Strip to Egypt. Some tunnels are not for transport at all but are fortifications, for example Mittelwerk and Cheyenne Mountain.

Tunnels are dug in different kinds of grounds, from soft sand to hard rock. The way of digging is chosen by the type of ground. There are two additional ways of digging: quarry and "cut and cover". In quarry, the tunnel path is drilled in a horizontal way. This system requires a deep tunnel that is built in a firm rock. In the "cut and cover" system, a tunnel is dug in the ground and afterwards a roof is built above the tunnel. This system fits tunnels that are close to the ground like road tunnels and infrastructure.

Building tunnels is a large civil engineering project that could cost very high sums of money. The planning and building of a long tunnel may take many years.

The longest canal tunnel is the Standedge Tunnel in the United Kingdom, over three miles (5 km) long.

In the United Kingdom a pedestrian tunnel or other underpass beneath a road is called a subway. This term was used in the United States, but now refers to underground rapid transit systems.

The central part of a rapid transit network is usually built in tunnels. To allow non-level crossings, some lines run in deeper tunnels than others. Rail Stations with much traffic usually provide pedestrian tunnels from one platform to another, though others use bridges.

The Channel Tunnel between France and England is one of the longest tunnels in the world. It is 50 kilometers long. The longest tunnel in the world, the Gotthard Base Tunnel, is being dug in Switzerland.

Motives to build a tunnel are:

a subway is based on a network of tunnels that are dug underground so the trains won't disturb and won't be disturbed by the local transport;

on the path of a railroad track or a road a tunnel is dug when the lane encounters an obstacle such as a mountain to avoid bypassing the obstacle;

a tunnel is built sometimes to overcome a water obstacle as a replacement for building a bridge above it;

a tunnel is built to connect between military posts so the movement between them won't be visible for the enemy;

a tunnel is built for infrastructure like electricity cables, water, communication and sewerage to avoid damage and disruption above ground;

some tunnels are used by prisoners to escape jail;

sometimes tunnels are used by criminals to do a bank robbery (e.g. in Brazil, Summer 2005).

Ex. 1.1. Read and remember the words.

communication cable	коммуникационный кабель
electricity cable	электрический кабель
to dig	рыть, копать, выкапывать
soft ground	мягкая почва
hard rock	скальная порода
quarry	каменоломня, карьер
cut and cover	открытая разработка
to drill	сверлить, бурить
firm	твердый
to fit	подходить, соответствовать
to disturb	беспокоить, мешать
railroad	железная дорога
track	железнодорожная колея
to overcome	преодолевать
obstacle	препятствие
sewerage	канализация
to avoid	избегать
damage	повреждение
disruption	разрыв

Ex. 1.2. Match a word in A with a word in B.

A	B
electricity	passage
underground	posts
deep	sums of money
to cost	cable
to avoid	tunnels
military	damage
to escape	jail
	the obstacle

Ex. 1.3. Give the Russian equivalents to the following English words and combinations.

Communication cables; soft sand; hard rock; quarry; "cut and cover"; to drill; roof; to be close to the ground; to fit; civil engineering project; network of tunnels; to overcome; to encounter an obstacle; sewerage; communication; disruption; to avoid damage; subway; to bypass; replacement.

Ex. 1.4. Give the English equivalents to the following Russian words and combinations.

Подземный проход (проезд); движение кораблей; рыть тоннель; мягкий песок; большие денежные суммы; инженерный проект; горизонтально; твердая скальная порода; дополнительный способ (метод) проходки тоннеля; проектирование и строительство; длиной 50 км; почва (грунт); коммуникационные кабели; строительство моста; во избежание (чтобы избежать); преодолевать; мешать движению; сталкиваться с препятствием.

Ex. 1.5. Answer the questions to the text.

1. What are tunnels built for?
2. What are they used for?
3. What kinds of grounds are the tunnels dug in?
4. Describe two additional ways of digging: quarry and “cut and cover”.
5. Why is tunneling considered to be a large civil engineering project?
6. Which is the longest tunnel in the world?
7. What motives for building a tunnel do you know? Speak on each of them.

Text 2. History of Tunneling

With more than six million kilometers of highways and 240,000 kilometers of railways snaking across the United States, life above ground has become increasingly congested. Tunnels provide some of the last available space for cars and trains, water and sewage, even power and communication lines. Today, it’s safe to bore though mountains and burrow beneath oceans — but it was not always this way. In fact, it took engineers thousands of years to perfect the art of digging tunnels.

Before cars and trains, tunnels carried only water. Roman engineers created the most extensive network of tunnels in the ancient world. They built sloping structures, called aqueducts, to carry water from mountain springs to cities and villages. They carved underground chambers and built elegant arch structures not only to carry fresh water into the city, but to carry wastewater out.

By the 17th century, tunnels were being constructed for canals. Without roads or railways to transport raw materials from the country to the city, watery highways became the best way to haul freight over great distances.

With trains and cars came a tremendous expansion in tunnels construction. During the 19th and 20th centuries, the development of railroad and motor vehicle transportation led to bigger, better, and longer tunnels.

Today, not even mountains and oceans stand in the way. With the latest tunnel construction technology, engineers can bore through mountains, under rivers, and beneath bustling cities. Before carving a tunnel, engineers investigate ground conditions by analyzing soil and rock samples and drilling test holes.

There are three steps to a tunnel's success. Today, engineers know that there are three basic steps to building a stable tunnel. The first step is excavation: engineers dig through the earth with a reliable tool or technique. The second step is support: engineers must support any unstable ground around them while they dig. The final step is lining: engineers add the final touches, like the roadway and lights, when the tunnel is structurally sound.

Based on the setting, tunnels can be divided into three major types:

1. Soft-ground tunnels are typically shallow and are often used as subways, water-supply systems, and sewers. Because the ground is soft, a support structure, called a tunnel shield, must be used at the head of the tunnel to prevent it from collapsing.

2. Rock tunnels require little or no extra support during construction and are often used as railways or roadways through mountains. Years ago, engineers were forced to blast through mountains with dynamite. Today they rely on enormous rock-chewing contraptions called tunnel boring machines.

3. Underwater tunnels are particularly tricky to construct, as water must be held back while the tunnel is being built. Early engineers used pressurized excavation chambers to prevent water from gushing into tunnels. Today, prefabricated tunnel segments can be floated into position, sunk, and attached to other sections.

Ex. 2.1. Read and remember the words.

congested	переполненный, перегруженный
burrow	пустая порода, отвалы; рыть, копать
extensive	обширный, громадный
sloping	наклонный, покатый
spring	источник
to carve	высекать, вырезать
chamber	отсек, камера, полость
wastewater	сточные воды
haul	транспортировать, перемещать
freight	груз
bustling	шумный, суетливый
sample	образец
stable	постоянный
unstable	неустойчивый
setting	окружение
tunnel shield	проходческий щит
rock-chewing	камнедробильный
contraption	хитроумное изобретение, приспособление
tricky	«хитроумный»
tunnel-boring machine	тоннелепроходческая машина, комбайн
pressurized	прессованный
to gush	литься потоком, хлынуть
to float	плавать, держаться (поддерживать) на поверхности воды

Ex. 2.2. Give the Russian equivalents to the English words and combinations.

To snake; increasingly congested; available space; to bore through mountains; to burrow beneath; to perfect the art of building; network of tunnels; sloping structures chambers; arch structures; wastewater; raw materials; watery highways; to haul freight; tremendous expansion; bustling cities; investigate; rock samples; test holes; unstable ground; subway.

Ex. 2.3. Give the English equivalents to the Russian words and combinations.

Водоснабжающие системы; почва; поддерживающая структура; три основных типа; предотвращение обвала; проходческий щит; в начале туннеля; скальные туннели; дополнительная опора; вынуждать; взрывать; полагаться на что-то; бурильные машины; сложно сооружать; удерживать воду; экскавация камеры; под давлением; хлынуть в туннель; рыть под чем-либо; наклонная конструкция; пробные отверстия; неустойчивый грунт; перевозить грузы по воде; образцы скальной породы.

Ex. 2.4. Match a word in A with a word in B.

A	B
bustling	space
unstable	materials
watery	ground
test	cities
to haul	segments
rock	holes
raw	chambers
excavation	freight
available	samples
prefabricated	highways

Ex. 2.5. Answer the following questions according to the text.

1. Why has life above ground become increasingly congested?
2. What provides last available space for cars and trains, water and sewage, communication lines?
3. How much did it take engineers to perfect the art of digging tunnels?
4. Who created the most extensive network of tunnels in the ancient world?
5. What did the Roman engineers build to carry fresh water into the city and wastewater out?
6. What became the best way to haul freight over great distances?
7. What did a tremendous expansion in tunnel construction come with?
8. What led to bigger, better and longer tunnels?
9. What do engineers do before carving a tunnel?
10. What are 3 major types of tunnels? Speak of them.

Text 3. Tunnel construction methods

1. Tunnel construction by means of TBM. The key element of the tunnel construction shield technology is header, mobile cylindrical-shell-shaped temporary tunnel support allowing performing the necessary heading operations: ground cutting and loading, ground transportation, lining construction. Ground excavation is performed in the head part of the machine; lining is performed in tail of the shield.

The main sizes of tunneling shields depend on lining diameter, geological conditions and type of mechanized equipment. The heading speed depends on cross-section and type of tunneling shield; and when there are favourable conditions it can reach several metres per month. The constructions of tunneling shields are improved by means of unified cutting tools and loading buckets, spare parts development.

From the point of construction the shield is a metal shell consisting of 3 main parts. The front part with cutting tools works directly with face. In the central part there are adjustable jacks for shield moving along the perimeter of the shield. The tail of the shield is a cylindrical shell where another lining circle is raised. The lining construction is accompanied with veneer wall tie grouting which helps fill space between lining and ground surface.

The world record of heading speed — 1250 metres of tunnel per month — was set in 1981 with shield KT-1-5.6 on the section of Pionerskaya-Udelnaya of main line tunnel of St. Petersburg subway. In 70s and 80s these shields were considered to be the better ones in the world.

2. Laying of communications with a trenchless method, microtunneling. Trenchless technologies allow performing underground construction without ground opening. Applying of trenchless technologies allows performing 90 % of work underground, that excludes:

the necessity of reinstating the surface of motorway;

disturbance of town-living practiced rhythm;

traffic arteries closing;

damaging of existing.

Trenchless technologies are economically (2.5—3 times) with traditional method, moreover laying of communications with a trenchless method doesn't damage the environment.

The recent tendency shows that public utilities of megapolises in different countries draw more and more attention to the issues concerning using of trenchless technologies for reconstruction and laying of water-line, drainage and other utility network; trenchless technologies are an alternative to traditional trench method of construction and reconstruction of pipes.

The problem of reconstruction and pipeline laying can be solved with wide use of trenchless technologies and special equipment. Currently the most promising equipment for these works is microshields, horizontal drilling rigs and pneumatic drifts.

Each piece of equipment has its efficient sphere of application in terms of diameter, depth, distance, hole making accuracy, type of ground, communication appropriation, working conditions on the jobsite and many other factors.

For shallow run (up to 5 m) short (up to 50 m) engineering communication laying through traffic and railroads it is efficient to use pneumatic drifts.

The laying of communications through water barriers in given direction is performed by means of horizontally-directed drilling rigs. For this method special drilling rigs performing rough (pilot) drilling along precomputed pathway with further bore enlargement and pipe laying are applied.

Underground communications up to 80 m deep and up to 1.5 km long with departure of 30 mm from project are laid in the cities by means of microshields. In this case two trenches, starting and receiving, are used; their depth matches the laying depth. Powerful adjustable jack station where tunneling shield is placed is set in the starting trench. Moving of the shield in the ground is provided by means of adjustable jack. The assembling of pipes is performed with building up of pipe column, i.e. the heading to the receiving trench is carried out. The accuracy of heading is provided with computer operation complex with laser system positioning of shield.

Microtunneling technology allows laying pipelines in various ground — from unstable sand clay and water sand to the rock ground. The cutting attachment of header is chosen according to the type of ground that allows reaching optimal parameters of heading.

Microtunneling equipment are:

microtunnel boring machines of all cut diameter with ground hydrotransport for laying of communications of various types;

microtunnel boring machines with screw transportation of ground;

microtunnel boring machines with pneumatic transportation of ground;

puncture-drilling rigs (the ground is not excavated from the bore, but is pushed apart in radial direction with formation of consolidated zone around the bore);

puncture rigs (the puncture is performed with small steel-channel-line-shaped dolly in the bore for cable laying with diameter up to 100 mm).

Pipes used for microtunneling. Polymer-concrete, reinforced concrete, ceramic, glass reinforced plastic and asbestos-cement pipes of all diameters are used for trenchless laying of the communications with microtunneling. For linkage of pipes special pump buckets are used in order to eliminate water entry through connection joints.

Trenchless technologies are used for the following works:

laying of communications cables;

oil-gas-heat pipelines laying;

laying of canalization and water pipes;

pile and pile structures formation; consolidation of crowns of underground construction;

pipe replacement, destruction of old pipes with laying of the new ones.

3. Tunnel permanent lining construction. The basic materials for tunnel lining construction are cast-in-place concrete, cast-in-place and prefabricated reinforced concrete, cast iron and steel. These materials are chosen according to conditions of construction area and tunneling methods. The lining has permanent application as opposed to temporary lining (mine working support). The shape and size of lining are defined by size, depth and function of the tunnel and sort of take up load (lock pressure, hydrostatical pressure, traffic load, etc).

Cast-in-place lining is mainly used for construction of tunnels with most complex structure and big cross-section. Precast lining is widely used for shield and erector-arm tunneling, mainly in subway tunnels.

Technological production schemes of concreting for tunnel construction are defined according to hardness of rock, tunneling methods, depth, length and appropriation of tunnel and applied mechanic machines.

The concreting of one section of Lagar-Aul tunnel in Amur region on the basis of factors above was performed after the following works were finished: excavation form was made as designed in the project, excavation consolidation by means of shotcreting; the installation of rock bolt support, film waterproofing and reinforcement cage; placing of formwork in permanent position and release material covering.

Various types of waterproofing materials are used in modern tunnel construction. Solid waterproofing is made of waterproof building organic or synthetic film filter materials, synthetic resinous materials, and steel sheets.

Cut-in-place tunnel lining, placed in stable rock ground, protected from water by means of external waterproof installed before lining construction. After that reinforced framework is performed.

Tunnel formwork “Saga Cogio” (Japan) is used for mechanization of cast-in-place concrete lining construction of single track railway tunnel, excavated to the full cross-section. The total length of formwork, 20.5 m, provides heading for 20 m. The width and height of the formwork are 5.6 m and 8.2 m respectively. Weight — 100 tones. Pneumatic motion engine capacity — 10.3 kW.

Tunnel formwork “Wortington” (Italy) is appropriate for mechanization of cast-in-place concrete lining construction of double track tunnel crown. Entrance size for traffic (finished): width — 3.6 m, height — 3.7 m. Formwork weight — 110 tones.

4. Tunnel construction by means of road headers. Performing underground mining in solid and standing ground the stage face method is used. In this case the face is opened for full section in two stages and after that the permanent lining is raised. Mining works are performed by means of heavy-duty mechanical appliances.

Roadheading tunnel construction technology with artificial production of ground is used in wide range of rocks.

In ground with coefficient of resistance f=6 according to Protodiakonov’s scale it is possible to use lower stage method when ground in the upper part is headed 30—50 m advanced as opposed to lower part. The ground in top and bottom faces is cut by means of tunnel boring machines (TBM) of selective action. In this case two independent faces are organized; there are TBM and devices for loading and transportation of excavated ground in each face.

TBM is equipped with mechanized working attachment for ground cutting, bucket-device system and conveyers which allow removing ground from the place and deliver it to the hauling unit. Ground transportation, temporary lining installation and formwork is performed on the analogy of mining method.

Using TBM instead of drill-and-blast method for tunneling prevents destabilization of rock mass due to decreased dynamic force. Moreover, the risk of falls and ground subsidence is minimized. TBM provides creating sharp tunnel outline with minimum excavation that results in decreasing of loading and transport operations and concrete consumption for formwork in comparison with drill-and-blast method.

5. Stage method of tunnel construction. This method is used for construction of tunnels with cross-section over 120—130 m^2 and height over 10 m mainly in hard rock mass. This method differs to continuous face method from the point that tunnel section is divided in two parts and each part is headed differently in different height and time.

There are two variants of stage method: upper-stage and lower-stage methods.

Upper-stage method. At first lower part of profile is headed and then the heading of upper part is started to perform. This variant has a range of technological disadvantages and is rarely used.

Lower-stage method. This variant is widely used in tunneling, especially for construction of tunnels with vast section and height. At first the upper part of profile is headed and then the heading of lower part is started to perform.

In tunnel construction by means of lower-stage method first of all the upper part of cross-section is headed with the help of continuous face method. The height of upper part is to be more than 4 m according to the location conditions and heading equipment height. Then concreting (rock bolt support, shotcreting) are performed according to the project and tunnel construction conditions.

After heading and formwork of tunnel upper part the lower part is started to head with berms along the sides of excavation; the width of berms depends on crown pressure. Then sidepieces of lower part are headed and concreted as on a chess-board.

6. Shotcreting. The process of shotcreting (rock bolt support) consists of the following stages: preparation of underground working space surface, installation and assembling of support elements (anchors, arches, expended lath), cover lamination, cover protection, quality management.

For tunnel excavation consolidation in stiff natural-moisture-content clay continuously reinforced shotcrete with reinforcing fiber and steel bars are used. Steel bars are installed along the excavation crown and are fixed in face toothing on one side and between ground and shotcrete of previous heading on another side.

It is recommended to apply admixture for acceleration of setting and hardening for shotcreting on water-bearing ground.

When shotcrete is sprayed on ground surface with the temperature below zero it is necessary to remove ice, blow the ground off with pressure air and sand-blasting machine if necessary in advance.

The shotcrete can be sprayed immediately or step-by-step, which is defined by the project according to development rate of rock pressure and work technique features.

For shotcrete placing special cars are used, where by means of “dry” technology the mixture of cement, sand and gravel batched in equal proportions is squeezed out with pressure air by means of flexible hose to the nozzle atomizer, where the mixture is moisturized with water. When the “wet” technology is used, prepared concrete is delivered to the machines.

Shotcreting has high strength properties; resistance of its extension is 10 per cent more in comparison with standard concrete. The cover of high strength, density and waterproofing capacity is formed thanks to impact laying. The other advantages of shotcreting are good adhesion to ground and reinforcement, manufacturability, reduction of cement consumption.

Shotcrete application allows decreasing face thickness and out-turn, excluding the necessity of formwork and mechanizing the concrete work process totally. Moreover, manufacturing content decreases by 2 times, and lining cost reduces by 30—40 % in comparison with cast-in-place lining.

Ex. 3.1. Read and remember the words.

key element	особенность; основной элемент
shield	щит (при проходке туннеля)
header	врубовая машина; щит для проходки
shell shaped	имеющий форму раковины
temporary	временный
heading	штрек; горная выработка; туннель
cutting	выемка грунта
loading	погрузка
lining	обшивка; облицовка
cross-section	поперечный разрез; профиль
bucket	ковш экскаватора
spare parts	запасные части
attachment	насадка
face	наружная поверхность
adjustable	регулируемый; передвижной
jack	подъемник; домкрат
accompanied	сопровождаемый; сопутствующий
veneer	шпон; каменная облицовка стены
grouting	заливка цементным раствором; цементация
trenchless method	бестраншейный метод
to exclude	удалять
reinstating	восстановление
issue	проблема; задача
drilling rig	сверлильное устройство; буровая установка
drift	сдвиг; смещение; отклонение
pneumatic	воздушный; пневматический
accuracy	точность
appropriation	ассигнование
run	зд.: отрезок пути
jobsite	строительная площадка
rough	черновой; грубый; неровный
departure	отклонение; уход (от заданных параметров)
receiving trench	приемная траншея
screw	винтовая линия (шпиндель)
puncture-drilling	точечное бурение
dolly	транспортная тележка
rig	устройство; оборудование
pump bucket	манжета

pile	свая
crown	верхняя часть
consolidation	укрепление

Ex. 3.2. Give the Russian equivalents to the following English words and combinations.

Key element; shield technology; temporary tunnel support; heading operations; ground cutting; lining construction; tail of the shield; geological conditions; cross-section; by means of; unified cutting tools; vast majority; heading speed; trenchless method; to reinstate the surface; public utilities; drainage; drilling rigs; sphere of application; hole making accuracy; pneumatic drifts; precomputed pathway; adjustable jack; microtunneling technology; cut diameter; screw transportation of ground; consolidated zone; cable laying; pump buckets; connection joints; tunnel lining construction; appropriation of tunnel; shotcreting; single track; stage face method; hauling unit; ground subsidence; concrete consumption.

Ex. 3.3. Give the English equivalents to the following Russian words and combinations.

Временная опора; срезка грунта; диаметр щита; погрузочные ковши; металлическая раковина; обивочный круг; регулируемый домкрат; бестраншейная технология; восстанавливать поверхность; приводить в прежнее положение; прокладка коммуникаций; коммунальная сеть; сверлильное оборудование; пневматические штреки; пробное сверление; сборка труб; режущее приспособление; буровые машины; радиальное направление; пробивное устройство; укрепление верха конструкции; свайные структуры; опалубка; потребление цемента для опалубки; давление свода; принимающая траншея; точечное бурение; свая; цементация.

Ex. 3.4. Match a word in A with a word in B.

A	B
vast	jack
lining	the surface
temporary	technology
key	speed
shield	pathway
heading	element
trenchless	method
ground	cutting
to reinstate	construction
precomputed	support
adjustable	majority

Ex. 3.5. Answer the questions to the text.

1. What is the key element of the tunnel construction shield technology?
2. What are the main construction technologies?

3. What do the main sizes of tunneling shield depend on?
4. Describe the shield from the point of construction.
5. Where was tunneling shield first used?
6. How were vast majority of subway tunnels in Moscow, St. Petersburg and other cities constructed?
7. What do trenchless technologies allow?
8. Why are trenchless technologies economically competitive with traditional method?
9. What are the most promising equipment for reconstruction and pipeline laying?
10. Speak on microtunneling technology.
11. Which are the basic materials for tunnel lining construction?
12. What are two types of lining?
13. Which waterproofing materials are used in modern tunnel construction?

Text 4. The Channel Tunnel

The Channel Tunnel, one of the world's most famous tunnels, is a 50 km (31 ml) tunnel under the English Channel linking Great Britain to France. This link consists of three parallel tunnels running for 39 km (24.2 ml) under the sea. Two Main Rail Tunnels, about 30 m (98 ft) apart, carry trains from the north and from the south. In between the two tunnels is the Channel Service Tunnel, which is connected by cross-passages to the main tunnels. This service tunnel allows maintenance workers to access the rail tunnels at regular intervals.

The contractor for the project, Transmanche-Link (TML) chose five Robbins TBMs to participate in boring the crossing. TBMs were deplayed at both the U.K. and France Terminals.

The majority of the Channel Tunnel passes through Chalk Marl, much of it faulted. Below the Chalk Marl is a thin 2 m (6.5 ft) band of permeable Glauconitic Marl. This rock is a weak sandstone with a stronger rock strength than the Chalk. The bottom of the tunnels pass through stiff clay with some swelling characteristics. The Chalk is much more faulted and prone to water inflows on the French side of the tunnels.

Robbins built five machines for this project, each designed for the geology of a specific length of tunnel.

The high water pressures predicted in the folded chalk on the French side required the use of three Earth Pressure Balance machines (EPBMs). These machines featured sealed cutter chambers to withstand high water pressures and screw conveyors to carry the cut material from the face.

The undersea French side of the Channel Service Tunnel also required an EPBM. Two Double Shield TBMs were built for the U.K. terminal because fewer water inflows were predicted. Robbins designed these machines to withstand unstable and faulted rock conditions. The 8.36 m (27 ft) diameter machines included 13 inch (330 mm) cutters and 65,871 kN (14,821,000 lb) of thrust. The machines generated a maximum 5,727,084 N/m of torque.

Machines were deployed on both sides of the tunnels in December 1987. The three French seaward TBMs encountered water inflows almost immediately, forcing the use of the sealed mode of operation much earlier than anticipated. The sealed cutterheads of the machines could withstand 10 bar (145 psi) of water pressure; however, additional measures were required to seal the remainder of the machines against water inflow.

The U.K. machines also experienced some difficult tunneling conditions at the outset. Unforeseen water inflows in a 3.2 km (2.0 ml) stretch caused the machines to slow their progress as each section of tunnel had to be grouted in advance of boring. After passing through this section of tunnel, the machines experienced no further difficulties and began averaging 149 m (490 ft) a week. The Robbins machines on the U.K. side averaged 873 m (2,864 ft) per month and set world records for a best day of 75,5 m (247.7 ft), a best week of 428 m (1,404 ft), and a best month of 1,719 m (5,640 ft) — all of which have yet to be beaten.

Muck transport on both sides of the tunnel was complicated but worked well. In the U.K. a rail system of 500 muck cars transported muck back to the access adit at Lower Shakespeare Cliff and fed it onto a high-speed conveyor. The conveyor then dumped the muck into lagoons behind sea walls in the English Channel. In all, about 4 million m^3 (5.23 million cubic yards) of chalk were dumped at the site. The area, called Samphire Hoe, is now a popular park.

On the French side muck was crushed and mixed with water in a chamber at the bottom of the Sangette access shaft. It was then pumped up the shaft and behind a 30.5 (100 ft) dammed reservoir.

In December 1990, the French and British TBMs met in the middle and completed the Channel Service Tunnel bore. In all of the tunnels the French TBM was dismantled while the U.K. TBM was turned aside and buried.

The Main Rail Tunnels met on May 22, 1991 and June 28, 1991. Both accomplishments were celebrated with breakthrough ceremonies to commemorate the building of one of the world's longest and most ambitions undersea tunnels.

Ex. 4.1. Read and remember the words.

to link	связывать
parallel	параллельный, параллель
to run	простираться
apart	отдельно, врозь
cross-passage	вспомогательная штольня
maintenance	эксплуатация, техобслуживание
to access	иметь доступ
regular	равномерный
interval	расстояние, промежуток
contractor	подрядчик, подрядная организация
Robbins	зд.: фирма «Роббинс» — производитель бурильной техники
TBM (tunnel boring machine)	проходческий комбайн для горизонтальной выработки
to deploy	использовать, употреблять
chalk marl	меловая глина, мергель
fault	сдвиг горной породы

band	зона, область, пояс
permeable	негерметичный, проницаемый
sandstone	песчаник
bottom	нижняя часть
stiff clay	среднепластичная глина
swelling characteristics	характеристика разбухания
prone	склонный, предрасположенный
to predict	прогнозировать
Earth Pressure Balance Machine	проходческая машина для компенсации давления горных пород
sealed	уплотненный, герметичный
to screw	завинчивать, закреплять болтами
conveyor	транспортер, конвейер
cut material	отбитый материал
main Rail Tunnel	главный железнодорожный туннель
cutterhead	рекордер, коронка (механический рыхлитель)
thrust	осевое давление
to torque	затягивать
Two Double Shield TBM	проходческий комбайн с двумя щитами
unstable	нетвердый, зыбкий, сыпучий, неустойчивый
cutter	резак, фреза
seaward	выходящий к морю
to encounter	столкнуться (с трудностями)
anticipate	предвидеть, предупреждать
bar	бар (единица давления)
remainder	остаток
muck	вынутый грунт
transport	транспортировка
muck car	вагонетка для транспортировки вынутого грунта
adit	вход, проход; штольня, подземная галерея
to dump	сваливать, выгружать
lagoon	отстойник
access shaft	вход в штольню (шахтная труба)
dammed reservoir	загруженный резервуар
dismantle	демонтировать
breakthrough	открытие, прорыв

Ex. 4.2. Complete the following sentences.

1. The Channel Tunnel, one of the world's most famous tunnels, is a…
2. In between the two tunnels is the Channel Service Tunnel, which…
3. This rock is a weak sandstone with…
4. The high water pressures predicted in the folded chalk on…
5. Robbins designed these machines to withstand…

6. Additional measures were required to seal…
7. Unforeseen water inflows in a 3.2 km stretch caused the machines to…
8. The conveyor then dumped the muck into…
9. On the French side muck was crushed and mixed with…
10. Both accomplishments were celebrated with breakthrough ceremonies to…

Ex. 4.3. Are the statements below true or false?

1. The Channel Tunnel, one of the world's most famous tunnels, is 50 km tunnel under the English Channel.
2. This link consists of two parallel tunnels running for 39 km under the sea.
3. Above the Chalk Marl is a thin 2 m band of permeable Glauconitic Marl.
4. The bottom of the tunnels pass through stiff clay with some swelling characteristics.
5. The Chalk is much more faulted and prone to water inflows on the English side of the tunnel.
6. Two Double Shield TBMs were built for the U.K. terminal because more water inflows were predicted.
7. Machines were deployed on both sides of the tunnels in December 1987.
8. The conveyor then dumped the muck into lagoons in front of sea walls in the English Channel.

Ex. 4.4. Read and translate the text "The Channel Tunnel".

Ex. 4.5. Ask and answer the questions on the text (work in pairs).

1. How long is the Channel Tunnel, one of the world's most famous tunnels?
2. What does this link consists of?
3. Where is the Channel Service Tunnel situated?
4. What does the service tunnel allow?
5. What did Robbins build for this project?
6. When were the machines deployed?
7. Which pressure could the sealed cutterheads of the machines withstand?
8. What did the U.K. machines also experience at the outset?
9. What caused the machines to slow their progress?
10. What world record did the Robbins machines on the U.K. side set?
11. When and where did the French and British TBM meet?

Ex. 4.6. Speak on the topic "The Channel Tunnel" using the above questions as a plan.

Text 5. Bridges Information

When New York City was consolidated in 1898, all the waterway bridges were placed under the jurisdiction of the Department of Bridges. In just over a decade, the Department designed, constructed, and opened 19 bridges throughout the City. Currently, the Division of Bridges, within New York City's Department of Transportation, owns, operates, and/or maintains 789 structures, including 758 non-movable bridges, 25 movable bridges, and six tunnels. While the Division is responsible for the capital rehabilitation of the 61 culverts in Staten Island, maintenance and inspection responsibilities remain with the New York City Department of Environmental Protection.

DOT is responsible for hundreds of bridges in New York City, including the four major East River crossings. But DOT does not oversee other major bridges or tunnels. Many bridges not under DOT Jurisdiction are the responsibility of the Metropolitan Transportation Authority or the Port Authority of New York and New Jersey. There are no tolls on bridges operated by New York City DOT.

The Division is comprised of six bureaus: Roadway bridges; East River Bridges / Movable Bridges / Tunnels; Engineering Review; Bridge Maintenance / Inspections / Operations; Specialty Engineering and Construction; and Management Support Services. While each of the bureaus functions independently, their interdependence provides for greater coordination of bridge design and construction projects within the Department of Transportation, and with other concerned agencies and parties.

While it is often assumed that bridges are massive structures, New York also has many small bridges. In addition, there are several different types of bridges, each built to serve a particular purpose.

For example, Girder Span Bridges are used for short spans and may be simple or continuous.

Examples include: the Hook Creek, Little Neck and Brooklyn Third Avenue bridges.

Steel Arch Bridges consist of either a single arch or a series of arches and are often economical to build. An example is the twin-arched Washington Bridge over the Harlem River at West 181 Street, in Manhattan.

Swing Bridges are supported on a center pier in the middle of a waterway and are opened by rotating horizontally on wheels riding on a circular track. Examples include the Grand Street, Macombs Dam, Ship Canal, and City Island bridges.

Vertical Lift Bridges are movable bridges having roadways which may be raised in a manner similar to a building elevator by supporting end cables attached to rotating drums in towers on the sides of the stream. Examples include the 103rd Street Ward's Island Foot Bridge and the Roosevelt Island Bridge to Queens.

Retractile Bridges date back to medieval times. Although never a very popular design, they were used in the mid-19th century for narrow crossing where maximum horizontal clearance was required. Today the Carroll Street Bridge in Brooklyn and the Borden Avenue Bridge in Queens are the only remaining examples of this design and continue to provide excellent service.

Perhaps the most celebrated type of bridge, familiar to most, is the Suspension Bridge, including the Brooklyn, Manhattan and Williamsburg bridges. These are characterized as high level bridges with spans usually exceeding 1,500 feet. Large wire cables, firmly anchored to masses of concrete and passing over tall towers, support the roadway by means of vertical wire "ropes" suspended at regular intervals along the cable.

Ex. 5.1. Read and remember the words.

DOT	Нью-Йоркский департамент городского транспорта
Division of Bridges	отдел мостов
culvert	водопропускная труба, кульверт
toll	плата за проезд по мосту
girder	балка
girder bridge	балочный мост
twin-arched bridge	двуарочный мост
swing bridge	разводной мост
vertical lift bridge	вертикально-подъемный мост
retractile bridge	откатный мост
suspension bridge	подвесной, висячий мост
bridge deck	настил моста

Text 6. Supplement. Bridges of St. Petersburg

The Big Obukhovsky Bridge is the newest (not taking into account the Blagoveshchensky Bridge rebuilt in 2007) bridge across the Neva River in Saint Petersburg, Russia. It is also the only bridge across the Neva which is not a drawbridge. It is located in Nevsky District, in the middle stream of the Neva. It connects Obukhovskaya Oborona Prospekt with Oktyabrskaya Embankment. It is a cable-stayed bridge; the steel wipe ropes are the key element of supporting construction. The bridge is located in a part of the Neva that is difficult to navigate as the Neva bends after it. The full length of the bridge passage is 2824 m, including 382 m long main span and ramps. The height of main span is 30 m. The first part of the bridge was opened on 15 December 2004. It is an important part of Saint Petersburg Ring Road. The bridge is named after the nearby Obukhovsky Okrug, considering that there is Obukhovsky Bridge in Saint Petersburg already. On 19th of October 2007 a “twin bridge” of Big Obukhovsky Bridge, the second 4-lane part of it, was opened.

The Blagoveshchensky Bridge is the first permanent bridge across the Neva River in Saint Petersburg, Russia. It connects Vasilievsky Island and the central part of the city (Admiralteysky Island). The bridge’s length is 331 m and the width is 24 m. The original name of the bridge was Nevsky Bridge, later renamed to Blagoveshchensky Bridge, after the death of Tsar Nicholas I to Nikolaevsky Bridge, and in 1918 to Lieutenant Schmidt Bridge. In 1727 a temporary bridge was built at the location of the modern bridge. The place was chosen by Menshikov whose palace is located at the opposite bank. This bridge, named Issakievsky, existed until the current bridge was built, at which time it was moved to the location of where Palace Bridge is located today. The bridge was built in 1843—1850. It was designed by Stanislaw Kierbedz, a Polish engineer working in Russia. The architect Alexander Brullov participated in the decoration. The construction was a cast iron bridge with a bascule section. At the time, it was the longest bridge in Europe.

The Alexander Nevsky Bridge in St. Petersburg, Russia is named after the legendary Russian military commander and politician Alexander Nevsky. The bridge connects Alexander Nevsky Square and Zanevsky prospect thus linking the southern and the northern parts of the city. Until 2004, when the Big Obukhovsky Bridge was built, the Alexander Nevsky bridge was the longest bridge across the Neva River in Saint Petersburg. Its length is 905.7 m, and it is 35 m wide. The bridge was built from 1960 to 1965 under the working name of Old Neva Bridge. Designed by the group of architects — A. Zhuk, S. Mayofis and Y. Sinitsa — the bridge has complemented the look of adjacent buildings in surrounding area. The project was led by a team of engineers of the "Lengiprotransmost" institute. Proof-testing was done by means of a column of army tanks. On November 5, 1965 the bridge was open for traffic. For the period of summer navigation a number of bridges on the rivers of Saint Petersburg including the Alexander Nevsky Bridge are opened to allow ships to pass. The bridge consists of seven bridge spans and the central span of 50 m can be opened in two minutes.

Palace Bridge is a road traffic and foot bascule bridge spanning the Neva River in Saint Petersburg between Palace Square and Vasilievsky Island. Like every other Neva bridge (except for Big Obukhovsky Bridge), it is drawn by night, making foot travel between various parts of the city virtually impossible. The total length of Palace Bridge is 260.1 meters, width is 27.8 m. It is actually composed of five spans, the southernmost joining Palace Embankment between Winter Palace and Admiralty and leading to Palace Square. The design was subject to strict controls so as to prevent the bridge from obstructing the view from Palace Embankment towards Kunstkammer, Imperial Academy of Arts, and other structures on Vasilievsky Island. A year after its inauguration, the bridge was renamed Republican Bridge, but the original name was restored in 1944. Various improvements and embellishments of the structure continued well into the Soviet times. In 1967, the bridge was repaired. The tramway tracks were removed in 1998.

Peter the Great Bridge also known as Bolsheokhtinsky Bridge or as Okhtinsky Bridge, is a bridge across the Neva River in Saint Petersburg, Russia. The bridge's length is 334 m, the width is 23 m. The bridge features only three spans, the central one can be drawn. The first idea to build a bridge near the Okhta river was circulated in 1829. Even before the Saint Petersburg was founded, there were settlements in the Okhta region, and with the raise of the city, it quickly grew to become big industrial center. Powder factories and shipyards existed here. However, in XIX century, Okhta district wasn't officially part of Saint Petersburg. The bridge was essential for the developing industry, and Nicholas I approved the bridge as part of strategic city development plan. However, at that time the necessary funds were not found. Next time the possibility of building a bridge was, raised in 1860th, when the Emperor approved the decision to join the Okhta district to Saint Petersburg. The city Duma organized international contest. There were total of 16 projects submitted including projects from France, Germany, Austria, Spain and USA. There also were three projects submitted out of contest. And one of the out of contest projects was declared winner. That was the project by professor of Nikolaevskaya engineering academy Krivoshein and military engineer Apyshkov. The ceremony of bridge founding took place on June 26, 1909 — exactly two hundred years from the Battle of Poltava. Hence the bridge was named after the triumphator of that battle — Emperor Peter the Great Bridge. The bridge was open for traffic on October 26, 1911. In 1956 the bridge was renamed Bolsheokhtinsky after the Big Okhta river, but in 2004 the original name was partially restored.

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к практическим занятиям по английскому языку**

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