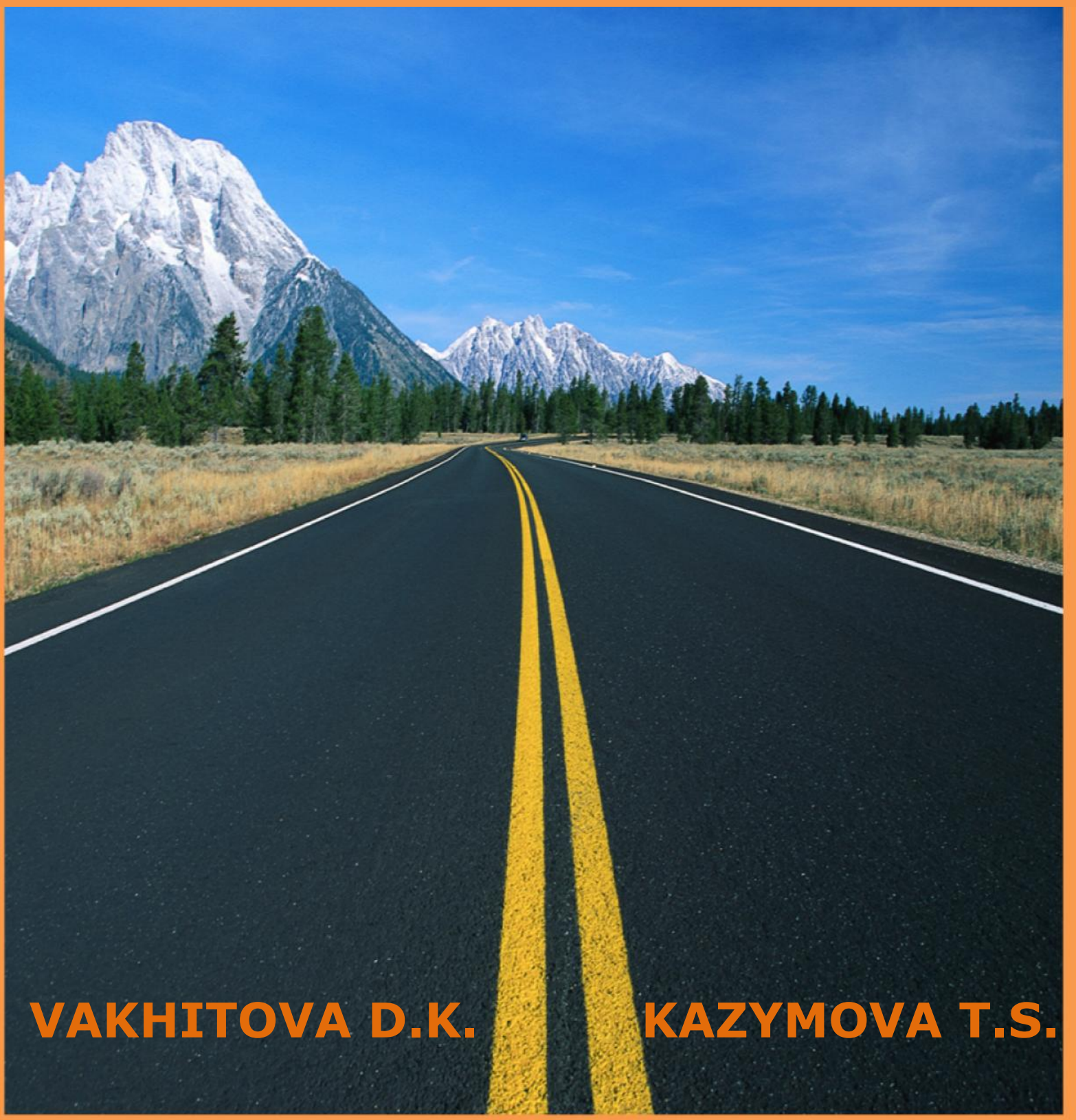
HIGHWAY ENGINEERING



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Основная цель учебного пособия – развитие и совершенствование навыков устной коммуникации и письменной речи в рамках предложенной тематики.

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MAP OF THE BOOK

INTRODUCTION

Настоящее учебное пособие предназначено для студентов первого курса автодорожных специальностей, изучающих английский язык. Главными целями учебного пособия являются развитие и совершенствование умений и навыков устной речи в деловой и общепрофессиональной коммуникации, а также формирование профессионально ориентированной лингвистической компетентности студентов. Учебное пособие направлено на развитие разных видов речевой деятельности: чтения, диалогической и монологической речи, навыков письменного и устного перевода.

Структура учебного пособия состоит из девяти разделов (Units). Деление на разделы осуществляется в соответствии с тематикой. Первый раздел посвящен истории строительства автомобильных дорог, второй – слоям дорожного покрытия, элементам дороги и типам дорог, третий – типам дорожного покрытия, четвертый – процессу строительства дороги, пятая глава рассказывает о типах дорожных развязок. Начиная с шестого раздела, речь идет о строительстве мостов, а именно истории данного процесса. В седьмом разделе рассматриваются типы мостов, а в восьмом – процесс их строительства. Заключительная девятая глава посвящена строительству тоннелей.

Каждый раздел включает в себя тексты для ознакомительного, изучающего и просмотрового чтения, которые содержат актуальную информацию из аутентичных источников. Тексты сопровождаются также значительным количеством иллюстраций, что привлекает внимание студентов и облегчает понимание представленного им материала.

Автодорожная терминология, представленная перед каждым текстом, закрепляется и активизируется в послетекстовых упражнениях. Каждый раздел включает в себя лексические упражнения, направленные на расширение словарного запаса по специальности. Профессиональная лексика изучается и запоминается также с помощью использования визуального компонента – цветных иллюстраций (картинок, схем, фотографий).

В учебном пособии предусмотрены задания для индивидуальной, парной и групповой работы, в которых студенты создают и участвуют в коммуникативных ситуациях профессиональной направленности, что способствует уменьшению языкового барьера при реальном общении с носителями языка. Таким образом, каждый текст

сопровождается упражнениями, имеющими коммуникативную направленность и позволяющими активизировать приобретенные навыки в речи.

Представленные задания помогут студентам научиться вести беседы на темы вышеуказанных сфер деятельности на английском языке, тем самым формируя общее представление об области дорожного строительства. Таким образом, изучив представленные в учебном пособии материалы, студенты смогут на базовом уровне участвовать в процессе коммуникации на профессиональные темы.

Каждый раздел содержит контрольные задания (Final Tasks), направленные на контроль усвоения пройденного материала.

Учебное пособие содержит приложение (Appendix), в котором представлены тексты, содержащие дополнительную информацию о строительстве автомобильных дорог, тоннелей и мостов. Эти тексты предназначены как для переводов, так и для использования в процессе подготовки докладов и презентаций.

Учебное пособие может быть использовано как для работы в аудитории, так и для самостоятельной работы.

UNIT 1. HISTORY OF ROAD CONSTRUCTION

1A. ROADS. HOW IT ALL STARTED

1. Before you start!

- ✓ When do you think was the first road built?
- ✓ Who built it?
- ✓ What was its purpose?

2. Read the words and learn them by heart.

MUST KNOW

site – территория, площадка, строительная площадка

pothole – яма

to tend – стремиться

to take for granted – принимать как само собой разумеющееся

vast – огромный

extensive – большой, протяженный

well-maintained – в хорошем состоянии

grumbling – ворчание

to level – выравнивать

to carry – нести, перевозить

to pave – мостить

paved road – мощеная дорога

route – маршрут, путь

traffic jam – затор в уличном движении

market outlet – рынок сбыта, торговая точка

to consume – потреблять

supplies – припасы, провиант

equipment – оборудование

engineer corps – инженерные войска

pontoon bridge – понтонный мост

track – тропа, курс

cart – телега, повозка

to stretch – тянуться, простираться

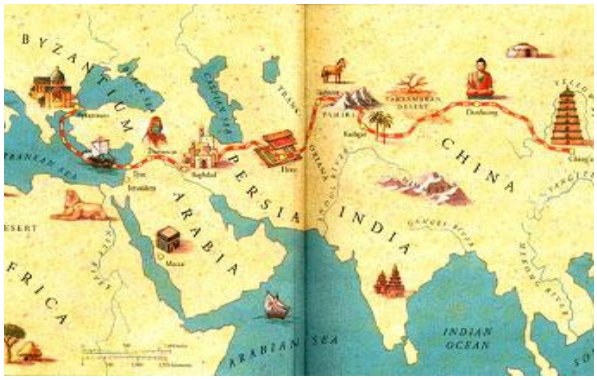
siege engine – осадное орудие

3. Read and translate the text to learn more about ancient roads.

Roads. How it all started.

Most of us give very little thought to the roads we drive on every day, and tend to take them for granted – at least until they are closed for repairs, washed out in a flood and so on.

However, only during the past forty years or so have we enjoyed the luxury of a vast, extensive, and well-maintained system of roads accessible to everyone. In the midst of our grumbling about potholes, traffic jams, and incompetent drivers, we forget how fortunate we truly are. Obviously, it was not always the case.



http://www.unmultimedia.org/radio/russian/archives/108878/

From the earliest times, one of the strongest indicators of a society's level of development has been its road system – or lack of one. Increasing populations and the advent of towns and cities brought with it the need for communication and commerce between those growing population centres.

A road built in Egypt by the Pharaoh Cheops around 2500 BC is believed to be the earliest paved road on record – the road 1000 yards long and 60 feet wide that led to the site of the Great Pyramid.


http://geofacts.ru/tajny-egipetskix-piramid/#

The various trade routes, of course, developed where goods were transported from their source to a market outlet and were often named after the goods which travelled upon them. For example, the Silk Route stretched 8,000 miles from China, across Asia, and then through Spain to the Atlantic Ocean. However, carrying bulky goods with slow animals over rough, unpaved roads was a time consuming and expensive. As a general rule, the price of the goods doubled for every 100 miles they had to travel.

Some other ancient roads were established by rulers and their armies. The Old Testament contains references to ancient roads like the King's Highway, dating back to 2000 BC. This was a major route from Damascus in Palestine, and ran south to the Gulf of Aqaba, through Syria to

Mesopotamia, and finally on to Egypt. Later it was renamed Trajan's Road by the Romans, and was used in the eleventh and twelfth centuries by the Crusaders.

Around 1115 BC the Assyrian Empire in western Asia began what is believed to be the first organized road-building, and continued it for 500 to 600 years. Since they were trying to dominate that part of the world, they had to be able to move their armies effectively along with supplies and equipment. Their army's engineer corps laid pontoon bridges and levelled tracks for carts and siege engines.

http://www.razlib.ru/istorija/mosty/p3.php

Later another imperial road, the Royal Road, was being built by the Persians from the Persian Gulf to the Aegean Sea, a distance of 1775 miles. Around 800 BC, Carthage, on the northern coast of Africa, began to use stones for paving roads. Although they may not have been the first to pave their roads with stones, they were among the earliest, and some people believe that the Romans imitated Carthaginian techniques.

Source: http://www.triplenine.org/articles/roadbuilding.asp

Mind the pronunciation of the following geographic names:

Pharaoh Cheops [ˈfeərəʊ ˈkiːɒps] – Фараон Хеопс

Damascus [dəˈmɑːskəs] – Дамаск

Palestine [ˈpalɪstʌɪn] – Палестина

Aqaba [ˈakəbə] – Акаба

Syria [ˈsɪrɪə] – Сирия

Mesopotamia [ˌmɛsəpəˈteɪmɪə] – Месопотамия

Persian [ˈpəːʒ(ə)n] – перс, персидский

Aegean Sea [iːˈdʒiːən] – Эгейское море

Carthage [ˈkɑːθɪdʒ] – Карфаген

Carthaginian [ˌkɑːθəˈdʒɪnɪən] – карфагенский

4. Answer the following questions.

1. What was one of the indicators of the society's development level?
2. When and where was the first paved road built?
3. Where did it lead?
4. What was one of the main purposes to create routes?
5. How long was the Silk Route?
6. By whom were some ancient roads established?
7. What is the King's Highway?
8. What country began the first organized road-building?
9. Why did the country do it?
10. What road was built by Persians?
11. What is the achievement of Carthage?

5. Match the words with their definitions.

1. pothole	**a.** to cover an area of ground with a hard, flat surface of pieces of stone, concrete or bricks
2. route	**b.** a large number of vehicles close together and unable to move or moving very slowly
3. to pave	**c.** a bridge that floats on water and in which barge- or boat-like pontoons support the bridge deck and its dynamic loads
4. traffic jam	**d.** a logistical network identified as a series of pathways and stoppages used for the commercial transport of cargo/ a particular way or direction between places
5. to carry	**e.** the set of necessary tools, clothing, etc. for a particular purpose
6. pontoon bridge	**f.** a type of disruption in the surface of a roadway where a portion of the road material has broken away, leaving a hole.
7. equipment	**g.** to make something flat
8. to level	**h.** move someone or something from one place to another

6. Give English equivalents to the following words and word combinations.

В хорошем состоянии, некомпетентные водители, уровень развития, мощеная дорога, торговый путь, инженерные войска, понтонный мост, тропа, строительство дороги, камень, расстояние, широкий, появление городов, оборудование, занимающий много времени.

7. Put ✓ for true and ✗ for false statements.

1. People always have had a good system of roads.
2. Any developed society doesn't have and doesn't need road system.
3. The first paved road was built by Tutankhamun.
4. The Pharaoh Cheops road was 1000 yards long and 60 feet wide.
5. Ancient routes were usually called after people who built them.
6. The Silk Route includes China, Asia, Egypt and Spain.
7. Romans called the King's Highway Trajan's Road.
8. The Assyrian Empire built its road for 200 years.
9. Assyrians used pivots (опоры) to build their bridges.
10. Romans imitated Carthaginian techniques when building their roads.

8. Discuss with the group the following topics:

- ✓ Which of the roads mentioned in the text do you find more important?
- ✓ Are there any other famous ancient roads or routes?

1B. ROMAN AND SOUTH AMERICAN ROADS

1. Before you start!

- ✓ Who are the most famous road builders?
- ✓ What civilizations do you know? Do they still exist?

2. Read the words and learn them by heart.

MUST KNOW

road builder – строитель дорог

network of roads – система дорог

to extend – расширять

to radiate – расходиться лучами

to compose – составлять, складывать

course – слой

bedding – основание

sand – песок

soil –почва, грунт

mortar – строительный раствор

gravel – гравий

branch – ветвь

flint – кремень, мелкий песчаник

thick – толстый

consecutive – последовательный, следующий друг за другом

causeway – дорога по насыпи на заболоченной территории

roadway – дорожное полотно

width – ширина

to invent – изобретать

wheel – колесо

lime – известняк

vehicle – транспортное средство

to ascend – подниматься, восходить

steep – круто, высоко

incline – склон, скат, уклон

draft animals – тягловые животные

swamp – трясина, болото

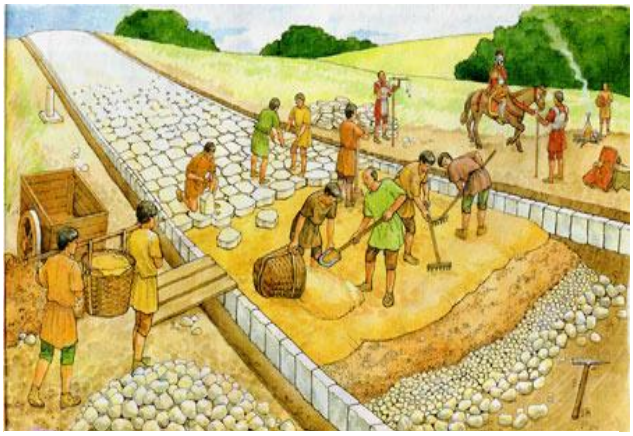
surface – поверхность

to maintain – осуществлять техническое обслуживание

3. Read and translate the text to learn more about the Roman and South American roads.

Roman roads

Without doubt, the champion road builders were ancient Romans, who, until modern times, built the world's straightest, best engineered, and most complex network of roads in the world. At their height, the Roman Empire maintained 53000 miles of roads, which covered all of England to the north, most of Western Europe, radiated throughout the Iberian Peninsula, and encircled and crisscrossed the entire Mediterranean area. Famous for their straightness, Roman roads were composed of a soil foundation topped by four courses: a bedding of sand or mortar; rows of large, flat stones; a thin layer of gravel mixed with lime; and a thin surface of flint-like lava. Typically they were 3 to 5 feet thick and varied in width from 8 to 35 feet, although the average width for the main roads was from 12 to 24 feet. Their design remained the most sophisticated until the advent of modern road-building technology in the very late XVIII and XIX centuries. Many of their original roads are still in use today, although they have been resurfaced numerous times.



http://pochemy.net/?n=559

http://ezhe.ru/ib/issue1008.html

Under Roman law, the public had the right to use the roads, but the district through which a road passed was responsible for the maintenance of the roadway. This system was effective so long as a strong central authority existed to enforce it. Unfortunately, as the Roman Empire declined so did their roads and their work fell into disrepair all across Europe and Great Britain.

South America

On the other side of the Atlantic Ocean, several centuries after the fall of the Roman Empire, the Inca Empire began to rise in South America during a period that corresponded with the Middle Ages in Europe. Centred in what is now Peru, the Incas branched out into Ecuador,

Colombia, Bolivia, Argentina, and Chile, and, like the Romans, recognized the need for a system of roads that would enable them to extend their conquests and to govern their empire. Interestingly enough, the Incas built their empire without inventing the wheel, without the use of draft animals, and without a written language. Because they had no wheeled vehicles to worry about, their roads could ascend steep inclines via terraces or steps.

http://anton-klyushev.livejournal.com/47998.html

In one place a road going up a steep mountainside was built of 3000 consecutive stone steps. They also built over swamps, and constructed a causeway 24 feet wide and 8 miles long, which had a paved surface and stone walls. Unfortunately, their well-constructed system of roads assisted in their downfall as the invading Spaniards used the Incas' own roads to move Spanish armies, weapons, and supplies.

Source: http://www.triplenine.org/articles/roadbuilding.asp

Mind the pronunciation of the following geographic names:

Iberian [ʌɪˈbɪəgɪən] – иберийский

Mediterranean [ˌmɛdɪtəˈreɪnɪən] – средиземноморский

Inca [ˈɪŋkə] – инка

Ecuador [ˈɛkwədɔː] – Эквадор

Colombia [kəˈlɒmbɪə] – Колумбия

Bolivia [bəˈlɪvɪə] – Боливия

Argentina [ˌɑːdʒənˈtiːnə] – Аргентина

Chile [ˈʧili] – Чили

4. Answer the following questions.

1. Why did the Romans decide to build roads?
2. What territory did Roman roads cover?
3. How long are they?
4. What was the design of these roads?
5. Are Roman roads used nowadays?

6. Who was responsible for the maintenance of the road?
7. What did the Incas recognize?
8. Why did Inca roads differ from Roman roads?
9. What territory did Inca roads cover?
10. What was the reason for road-building?
11. What was the difficulty in building Inca roads?
12. Why were the roads one of the components to lead to Inca civilization fell down?

5. Give Russian equivalents for the following English words and word combinations.

Course, lime, bedding, soil, to maintain, to extend, swamp, to invent, width, network of roads, straightness, maintenance, step, surface, wheeled vehicle.

6. Match the words with their definitions.

1. sand	**a.** small rounded stones, often mixed with sand
2. mortar	**b.** the part of the road on which vehicles drive
3. gravel	**c.** a raised path, especially across a wet area
4. road builder	**d.** a circular object connected at the centre to a bar, used for making vehicles or parts of machines move
5. roadway	**e.** a substance that consists of very small grains of rock, found on beaches and in deserts
6. wheel	**f.** animals, usually domesticated, those are kept by humans and trained to perform tasks
7. causeway	**g.** individual involved into the process of road construction
8. draft animals	**h.** a workable paste used to bind construction blocks together and fill the gaps between them.

7. Put ✓ for true and ✗ for false statements.

1. First road builders were the Babylonians.
2. The technology of Roman road building used to be advanced till X century.
3. For road-building Romans used sand, mortar, flat stones and flint-like lava.
4. The system of road maintenance was effective.

5. According to Roman law rich and powerful Roman citizens were responsible for the maintenance of roads.
6. The Inca civilization developed on the coast of the Pacific Ocean.
7. The Incas decided to build roads to deliver letters from one town to another.
8. The Incas didn't have wheeled transport so they didn't need very wide roads.
9. The civilization lived in mountainous region that's why their roads had terraces and steps.
10. British invaders used Inca roads to conquer the Inca Empire.

8. Using the information from the text and pictures given in the text compare the road systems of two civilizations: Roman roads and Inca roads.

1C. XVIII CENTURY AND FURTHER...

1. Before you start!

- ✓ Do you know how technologies have changed since roman times by XVIII century?
- ✓ What famous engineers dealing with road building do you know?

2. Read the words and learn them by heart.

MUST KNOW

highway – скоростная автодорога

bridge – мост

overdue – запоздалый, опоздавший

boost – стремительный рост

structure – конструкция

pole – шлагбаум

stonemason – каменщик

speed – скорость

turnpike – платная дорога, магистраль

to charge for – платить

to resurface – менять покрытие

to pay toll – платить дорожную пошлину

throughout – повсюду, везде

to outstrip – обгонять, превосходить

narrow – узкий

lack – нехватка, недостаток чего-либо

foundation – основа, фундамент

trail – тропа

to wane – убывать, слабеть, идти на убыль

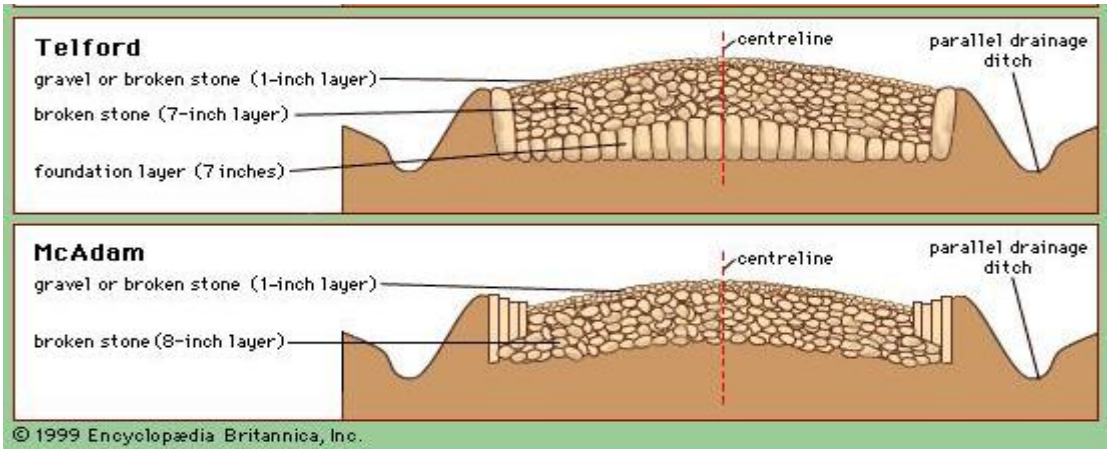
to face – столкнуться, встретиться лицом к лицу

3. Read and translate the text to learn more about the development of road construction in the XVIII century.

XVIII century and further...

In the XVIII century in England the technology of highway construction was getting a long overdue boost from two British engineers, Thomas Telford and John Loudon McAdam. Telford, originally a stonemason, built over 1000 roads, 1200 bridges, and numerous other structures. Although his system was faster and less

expensive than the Romans' method, it was still costly and required frequent resurfacing with gravel. On the other hand, the greatest advantages to McAdam's system were its speed and low cost, and it was generally adopted throughout Europe.



http://www.britannica.com/EBchecked/media/19288/Cross-sections-of-three-18th-century-European-roads-as-designed

During this same time period, the growth of turnpikes was resulting in much improved road conditions across England. Private individuals built roads themselves and then charged for their use, usually blocking passage by setting a long pole (pike) across the road. Once the toll had been paid, the pole would be swung (turned) out of the way, allowing the travellers access to the road (turnpike).

By 1829 nearly 4000 different turnpike companies operated 20000 miles of highway throughout England. However, during the latter half of the XIX century, canal building and the growth of railroads outstripped the turnpikes, and roads in general became less important until the turn of the century.

http://www.polyline.ru/publications/istoriya-rossijskih-dorog

As European settlers migrated across the Atlantic to the U.S., they found themselves faced with an almost total lack of roads – in Europe they at least had the Roman roads to use as a foundation for rebuilding. In America there were only Indian trails which were very narrow. Like England, went through a period of turnpike development, and for many years, turnpikes were the best roads in the U.S.

Not surprisingly, the overall development of transportation in the U.S. continued in the same way as in England and interest in building and maintaining long distance roads waned during the last half of the XIX century. But the invention of the motorcar changed all that for

everyone. Obviously, motorized vehicles made it possible for both people and goods to travel both more quickly and more comfortably – so long as there were adequate roads upon which they could travel. Thus the Good Roads Movement was born.

As they say, the rest is history. Ironically, even at its height, American modern highway system totals only about 42500 miles. Granted, this figure does not include surface streets or other roads.

But 2000 years ago the Romans, without the help of all our engineering technology or road-building machinery, constructed 53000 miles of roads, much of which is still in use today.

Source: http://www.triplenine.org/articles/roadbuilding.asp

4. Answer the following questions.

1. What are the two engineers who started developing road-building in England in XVIII century?
2. What were the advantages of Thomas Telford?
3. What type of roads was popular in England at that time?
4. How does a turnpike work?
5. Why did turnpikes become less popular?
6. What was the main difficulty with road-building in America?
7. What was the purpose of Good Road Movement creation?

5. Match the words with their definitions.

1. highway	**a.** to put a new surface on a road
2. bridge	**b.** a main road that you usually have to pay to use
3. to resurface	**c.** a long, thin stick made of wood or metal, often used to hold something up or to close a road until the driver gets a permission to use the road
4. speed	**d.** an important public road that joins cities or towns together
5. turnpike	**e.** not having something, or not having enough of something
6. pole	**f.** the distance covered per unit of time
7. trail	**g.** a structure that is built over a river, road, or railway to allow people and vehicles to cross from one side to the other
8. lack	**h.** a path through the countryside, often where people walk

6. Put ✓ for true and ✗ for false statements.

1. Tomas Telford and John McAdam were American engineers.
2. Originally Tomas Telford was a scientist.
3. McAdam's system was worse than Telford's system.
4. Everybody could use turnpikes for free.
5. At the beginning of the road there was a pole to control number of travelers.
6. Road-building in the UK has been rapidly developing since the XVIII century.
7. Americans used Roman roads as a base for their own.
8. The invention of motorcar made road building popular again.
9. The Good Roads Movement was born in the UK.
10. During the latter half of the XIX century roads became less important until the turn of the century.

7. Give English equivalents to the following words and word combinations.

Каменщик, конструкция, платить дорожную пошлину, столкнуться, фундамент, узкий, платная дорога, нехватка, технология строительства дорог, низкая стоимость, железные дороги, моторные транспортные средства.

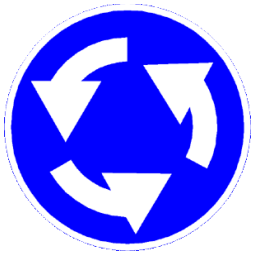
8. Discuss with the group the following topics:

- ✓ Using additional information, make up your own opinion and say whose system was more efficient: Telford's or McAdam's.
- ✓ What are the difficulties of road building nowadays?

1. Fill in the gaps using the words below:

traffic jams, network of roads, well-maintained, roadway, potholes, road-builders, route, maintain, lack, turnpikes.

We take for granted that all roads must be [1]_____. But in real life we have quite opposite situation. Unfortunately roads in our city have many [2]_____. Another problem is [3]_____. Sometimes it takes us plenty of time to travel the [4]_____ which in fact takes 15 minutes. So, what should we do to make our [5]_____ better? May be first of all it is necessary to provide a [6]_____ of a good quality and [7]_____ it efficiently to avoid cracks and potholes. We may also use [8]_____ as an alternative. If there is no [9]_____ of funding it will be easier to have good maintenance. And certainly [10]_____ must be highly qualified.



2. Translate the following sentences using the vocabulary of Unit 1.

1. В России есть протяженная система дорог, однако, их качество не всегда хорошее.
2. Построить понтонный мост проще, чем обычный.
3. Основой для дорог в Америке были индейские тропы.
4. Оборудование для строительства дорог должно быть высокого качества.
5. Раньше строительством дорог занимались инженерные войска.
6. Для строительства дорог использовались гравий, известняк, камень, песок.
7. Первый слой дорожного покрытия – это основание.
8. Изобретение колеса привело к созданию колесного транспорта и развитию строительства дорог.
9. Скоростная автодорога – это дорога, на которой ограничение скорости составляет 130 километров в час.

10. Министерство транспорта планирует строительство платных магистралей, дублирующих наиболее популярные маршруты движения.
11. Конструкция моста должна быть прочной и устойчивой.
12. После того как вы заплатили дорожную пошлину, шлагбаум открывается, и вы едете дальше.

3. Make a presentation on the following topics:

1. Importance of building roads in ancient times and nowadays.
2. Process of building any famous road.
3. History of road-building in Russia.

UNIT 2. ROAD. TYPES, ELEMENTS AND LAYERS

2A. TYPES AND ELEMENTS OF A ROAD

1. Before you start!

- ✓ Look at the road types in the picture and translate them.
- ✓ What is the difference between cul-de-sac and dead end?

2. Match the words or phrases with the definitions.

1. boulevard	**a.** a road on which a driver must pay a fee
2. cul-de-sac	**b.** a road that is perpendicular to a street
3. street	**c.** a wide avenue
4. highway	**d.** a large paved road connecting two cities
5. avenue	**e.** a short dead end street in a circle shape
6. toll road	**f.** a public road in a town or city

3. Read the words and learn them by heart.

MUST KNOW

right-of-way – полоса отвода

carriageway – проезжая часть дороги

road shoulder – обочина

traffic lane – полоса движения

pavement – дорожное покрытие, дорожная одежда

outer slope – внешний откос

inner slope – внутренний откос

curb – бордюр

embankment – насыпь

cutting – выемка

formation / roadbed – земляное полотно, основание дороги

diversion – отвод

side ditch – кювет

edge of the roadbed – бровка земляного полотна

level – уровень

to reinforce – усилить, укрепить

lateral support – боковая опора

median – разделительная полоса

required – требуемый

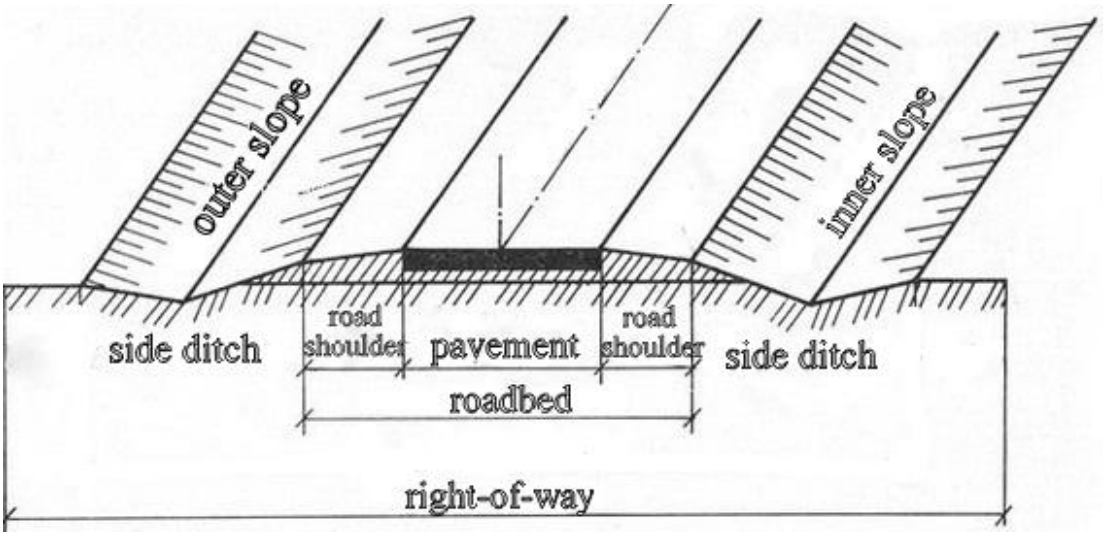
4. Read and translate the text to learn more about the basic elements of a road.

Elements of a road

The zone which is marked to lay the road is called the road zone or right-of-way. The higher is the technical classification of the road, the wider is the right-of-way for its construction.

The road zone includes such parts of a road as a carriageway, road shoulders, inner and outer slopes and other parts.

A carriageway is the road surface strip within the limits of which motor vehicles run. A carriageway generally consists of traffic lanes. Median separates opposing traffic lanes. Usually it is reinforced by means of natural or artificial stone aggregates. These stone aggregates form the pavement.



http://stroitelstvo-new.ru/1/dorogi

The strips of the ground which adjoin the carriageway are called the road shoulders. The shoulders render lateral support to the pavement. The pavement is always made of solid materials within the limits of the carriageway.

To lay the carriageway at the required level above the ground surface a formation (roadbed) is constructed. It is constructed in the form of embankments or cuttings with side ditches for drainage and the diversion of water.

The carriageway and shoulders are separated from the neighbouring land by slopes. There are inner and outer slopes. The junction of the surface of the shoulders and the embankment slope is called the edge of the roadbed. The distance between the edges is the width of the roadbed.

Source: Англ. яз. / Л.В. Лукина. Воронеж: Воронеж. гос. арх.-строит. ун.-т., 2009 – С.72

5. Answer the following questions.

1. What is called the road zone or right-of-way?
2. What parts of a road does the road zone include?
3. What is called a carriageway?

4. What is a roadbed constructed for?
5. What is called the edge of the roadbed?
6. What materials reinforce carriageway?
7. What is the function of median?
8. What is called the width of the roadbed?
9. What does carriageway include?

6. Put ✓ for true and ✗ for false statements.

1. Road shoulders include carriageway, inner and outer slopes.
2. Outer slopes adjoin the carriageway.
3. Sand aggregates form the pavement.
4. Vehicles run within the limits of carriageway.
5. Slopes separate carriageway from neighbouring land.
6. The distance between the edges of roadbed is length of the roadbed.
7. Medians generally consist of carriageways.

7. Match the words with their definitions.

1. curb	**a.** a raised row of concrete along the edge of a road
2. lane	**b.** an area in the middle of a road, separating opposite directions of traffic
3. median	**c.** a narrow channel dug at the side of a road or field, to hold or carry away water
4. road shoulder	**d.** a lengthwise division of a road that is meant for one line of cars to drive in
5. side ditch	**e.** various kinds of synthetic stone products used in building construction, civil engineering work
6. artificial stone	**f.** a strip of land immediately adjacent to the traffic lane of a road

8. Give English equivalents to the following words and word combinations.

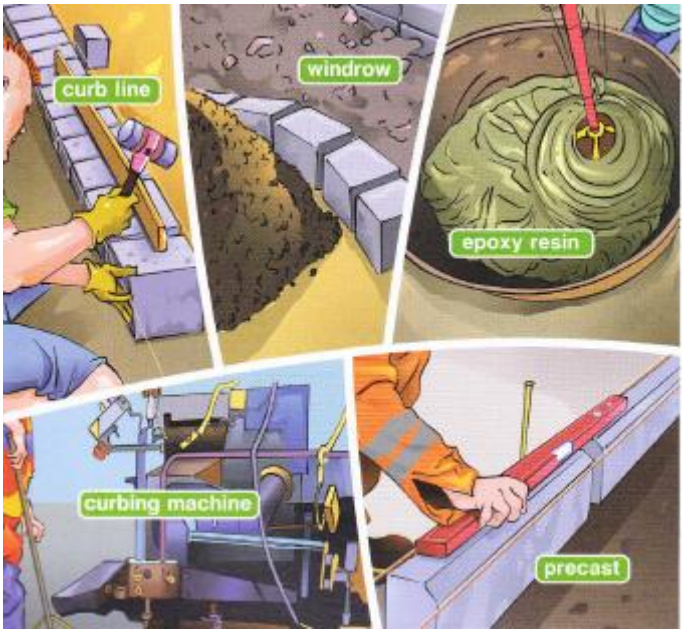
Кювет, требуемый уровень, поверхность дороги, в пределах чего-либо, твердый материал, полоса отвода, прилегать к проезжей части, автотранспортное средство, боковая опора, отвод воды, в форме насыпи, включать в себя, полоса движения, прилегающая земля, откосы, бровка земляного полотна, ширина дорожного полотна, разделительная полоса.

9. Match the words or phrases with the definitions.

1. bonding	**a.** the foundation layer under a curb
2. windrow	**b.** a device that lays concrete for a curb
3. haunching	**c.** the boundary between a road and sidewalk
4. curb bed	**d.** the process of adhering things together
5. curb line	**e.** the process of installing a concrete support
6. curbing machine	**f.** a mound of concrete along a curb bed

10. Read the text to learn more about curbs.

Curb installation requires precision and proper materials to ensure strength and consistency. Curbing machines can be very useful, but machines aren't always available for small projects. This guide includes tips for constructing a strong, even curb without a machine. Before installing a curb, you must provide a secure foundation along the curb line. This curb bed is what supports a curb and ensures it is positioned correctly.



Tips:

- ✓ if you use a wet bed, remember to place the curb before the concrete sets.
- ✓ if you use a dry bed, you will need bonding to affix the curb to the curb bed. A strong, durable adhesive like epoxy resin is appropriate. Once the curb bed is laid, you are ready to install the curb.
- ✓ most experts recommend using precast concrete curbing instead of laying wet concrete directly into the curb bed. Precast concrete is easier to work with and generally allows for better strength.
- ✓ haunching is recommended to support the curb from the inside edge. Install concrete haunch alongside the curb before placing pathway or sidewalk material.

Source: Career Paths: Construction II- Roads & Highways, 2013

11. Answer the following questions.

1. What does curb installation require?
2. What should you do before installing a curb?
3. What is a curb bed?
4. Why is precast concrete more preferable than wet concrete?

12. Complete the article on the British road types by adding the missing words and phrases.

areas, radiating, human, arterial, groups, slow, important, signposts, high-speed

British roads are classified in three [1]_____. The [2]_____ roads, so called because they might be compared to the arteries in the [3]_____ body, are known as A or Class I roads. The arterial roads include the principal roads [4]_____ from London to far parts of the country, and many roads joining big cities. The second group of classified roads consists of B or Class II roads which are a little less [5]_____than A roads. The third group has no official name. Each road of the first two classes, A and B, has a different number, which appears on all [6]_____, so that a motor driver can find his way across Britain if he has previously looked up the number on a map.

In the late 1950s a programme started functioning for building some 400 miles of motorways in the form of a network over the country, the chief ones radiating from London to the industrial [7]_____ in South Wales, the Midlands, and Lancashire.

In many countries there are [8]_____ motorways, like the German "autobahnen" or Italian "autostrade". They are usually fenced in, and motorists are admitted to them only at special gates where they pay a toll. Once inside, they can travel at 80 or 90 miles an hour, for there are hardly any junctions, and no [9]_____ moving traffic is allowed.

13. Make a description of the main parts of the road.

2B. PAVEMENT STRUCTURAL LAYERS

1. Before you start!

- ✓ What information do you remember about the pavement from the previous text?
- ✓ What layers do you think a road consists of?

2. Read the words and learn them by heart.

MUST KNOW

vehicle – транспортное средство

wheel – колесо

to ensure – обеспечивать

rigid – жесткий

semirigid – полужесткий

multilayer – многослойный

gravel – гравий

(pavement) base – основание дорожного покрытия

binder course – подстилающий связующий слой

sub-base – дополнительный слой основания

capping layer – защитный слой

abrasion – износ

course – слой покрытия

wearing course – слой износа

sub-grade – грунт земляного полотна

surface course – верхний защитный слой дорожного покрытия

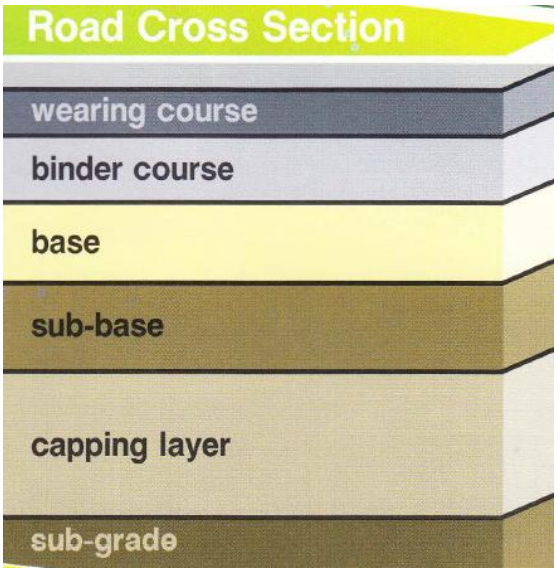
slag – шлак

3. Read and translate the text to learn more about the basic layers of pavement used in road construction.

Pavement Structural Layers

To ensure all-year-round operation of vehicles traffic on a road, the carriageway is covered with a pavement. It can have rigid or semi-rigid structure. The pavement resists traffic stresses and climatic factors.

The stresses induced in the pavement by motor vehicle wheels attenuate with the depth. This enables the pavement to be designed in the form of a multilayer structure. The layers work together to create a solid road. But each layer must meet certain requirements to be effective. The main layers of the pavement are the sub-grade, sub-base, base and surface course.



First, workers ensure that the sub-grade level can support the pavement. This requires the dirt in the sub-grade level to be solid. If it's not, the workers add a capping layer to strengthen it.

The sub-base is made of gravel, slag, soil treated with binding agents, sand, etc. It is inserted when necessary between the pavement base and the sub-grade. Sub-base is often the main load-bearing layer of the pavement. The primary functions of the sub-base are to provide structural support and improve drainage. Contractors occasionally skip this level to save money. But many times, they pay more to fix the problem this causes. The quality of sub-base is very important for the useful life of the road.

The base layer protects the pavement from moisture and cold temperatures. This layer is designed to distribute the individual wheel-loads. The pavement base is not subjected to the direct action of automobile wheels.

The surface course endures the most pressure because it's the top layer. It is comparatively thin, but resists well the abrasion and the impacts caused by the wheels, and also the effect of weather conditions. Usually the surfacing is the most expensive part of the pavement. Surfacing usually comprises two courses – a binder course and a wearing course. Surface course generally contains superior quality materials.

Source: Англ. яз.. Контр. задания. / Л.В. Лукина Воронеж. гос. арх.-строит. ун.-т., 2009, Career Paths: Construction II- Roads & Highways, 2013

4. Answer the following questions.

1. Why is the carriageway covered with a pavement?
2. What structure can the pavement have?
3. What enables the pavement to be designed in the form of a multilayer structure?

4. How many courses does the surfacing comprise?
5. What does the base layer protect pavement from?
6. What is the pavement base designed for?
7. Why do workers sometimes add capping layer?
8. What is sub-base made of?
9. Why is quality of sub-base so very important?
10. What are the main functions of the sub-base?

5. Put ✓ for true and ✗ for false statements.

1. The pavement resists only traffic stresses.
2. Surfacing is the most expensive part of the pavement.
3. The stresses induced in the pavement by vehicle wheels attenuate with the width.
4. The sub-base is inserted when necessary between the pavement base and the surface course.
5. The sub-grade consists of a binder course and a wearing course.
6. The sub-base layer is always necessary.
7. The pavement base course is subjected to the direct actions of wheels.
8. Sub-grade protects the pavement from moisture and cold temperatures.
9. Surface course contains high quality materials.
10. The base layer is the top layer.

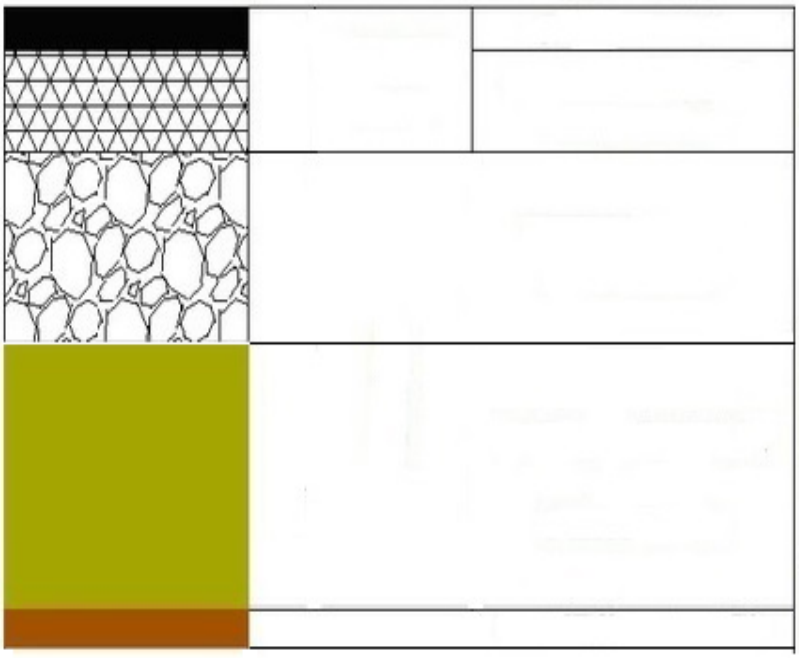
6. Explain in English the meaning of the following words and word-combinations used in the text:

pavement base, multilayer structure, sub-base, sub-grade, wheel, stone.

7. Find in the text synonyms to the following words and word-combinations:

include, provide, decrease, wet, substance, relatively, firm, significant, course, sometimes, influence.

8. Fill in the table “Pavement structural layers” using the basic terms from the text:



9. Describe each structural layer of the pavement.

2C. SIDE DITCH

1. Before you start!

- ✓ Do you know why after heavy rain many streets of our city are flooded?
- ✓ What is the main function of side ditches?

2. Read the words and learn them by heart.

MUST KNOW

roadside – обочина

saturation – подтопление

flume – открытый водоотвод

interceptor ditch – нагорная канава

drain channel – дренажный канал

water discharge – сток воды

crown – уклон

evaporation – испарение

ponding – затопление

impermeable soil – непроницаемая почва

runoff – сток

surface runoff – поверхностный сток

ground water – грунтовые воды

flue – канал

blade grader – автогрейдер

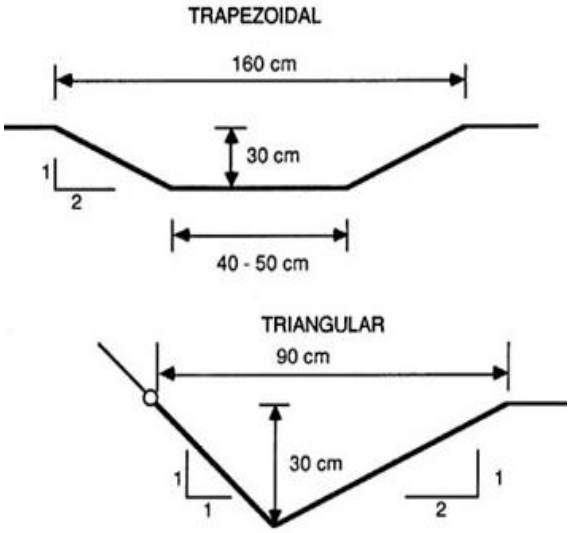
3. Read and translate the text to learn more about a side ditch, its functions and use.

Side Ditch

For collecting water from the roadbed side ditches, flumes, interceptor ditches and drain channeling can be used. Road construction provides side ditches parallel with the roadway. A side ditch is intended to collect the water discharged by the crown. It also collects the water from the roadside. Water from the adjoining land must be collected by the side ditch too. The side ditch discharges into a natural outlet at the first opportunity.

Side ditches in cuttings and next to embankments may be excavated to a depth of up to 0.6 m. These ditches are for the collection of water flowing off the road surface and from adjoining land during rainfall or snow thawing. The side ditch may contribute to the drainage of the sub-grade because of the evaporation of moisture from the side ditch inner slopes. However, the major use of the side ditch is to permit the rapid discharge of water. When this water discharge is not ensured and ponding occurs, the side ditch becomes a source from which water may penetrate back under the road, resulting in saturation of the sub-grade.

The cross-section of the ditch is either V-typed (triangular) or trapezoidal. In the case of impermeable soils and in less favorable conditions of runoff the side ditches can be given a trapezoidal cross-section with a bottom width of 0.4 m and a depth of up to 0.7-0.8 m from the edge embankment. If the road must be built in dry country with a rapid surface runoff, and the occurrence of ground water is deep, the side ditches are given the shape of triangular flues of 0.3 m minimum depth. The V-typed side ditch can be easily constructed and maintained with the blade grader. The V-typed side ditch cannot be deep and, therefore, it is much safer than the trapezoidal side ditch.



http://www.fao.org/docrep/006/t0099e/t0099e04.htm

Source: Английский язык. Контрольные задания. / Л.В. Лукина, Л.Н. Крячко, О.Ф. Нестерова, Н.В.Сидорова. Воронеж: Воронеж. гос. арх.-строит. ун.-т., 2009 – С.73-74

4. Answer the following questions.

1. What does road construction provide?
2. What is the side ditch intended to?
3. What does the side ditch discharge into?
4. What is the major use of the side ditch?
5. Why may the side ditch contribute to the drainage of the sub-grade?
6. When does the side ditch become a source from which water may penetrate back under the road?
7. What are the main types of cross-section of the ditch?

8. When are side-ditches given a trapezoidal form?
9. Which of the types of cross-section is safer? Why?
10. What machine can the side ditch be easily constructed and maintained with?
11. When are side-ditches given a triangular form?

5. Put ✓ for true and ✗ for false statements.

1. Road construction provides side ditches perpendicular with the roadway.
2. Saturation of the sub-grade takes place water discharge is not ensured.
3. The side ditch permits the rapid discharge of water.
4. Side ditches are used for the collection of water during dry periods.
5. There are several types of cross-sections of the ditch.
6. Triangular flues are used if the road must be built in dry country with a rapid surface runoff.
7. The V-typed side ditch is much safer than the trapezoidal one.
8. The cross-section of the ditch can be categorized as triangular and trapezoidal.
9. The main aim of a side ditch is to collect the water discharged by the crown.
10. The V-typed side ditch can be very deep.

6. Match the words with their definitions.

1. surface runoff	**a.** the water located beneath the earth's surface in soil spaces and in the fractures of rock formations
2. interceptor ditch	**b.** a construction machine used to create a flat surface
3. ground water	**c.** the process by which water changes from a liquid to a gas
4. blade grader	**d.** the water flow that occurs when the soil is infiltrated to full capacity and excess water from rain flows over the land
5. ponding	**e.** soil through which water has difficulty flowing
6. evaporation	**f.** a small ditch or channel constructed to intercept and convey water to an area where it can be safely discharged
7. impermeable soil	**g.** the unwanted pooling of water

7. Give English equivalents to the following words and word-combinations.

Предназначен для сбора воды, примыкающий участок, при первой же возможности, во время ливня, вода, стекающая с поверхности дороги, таяние снега, способствовать, дренаж грунта земляного полотна, испарение влаги, внутренний откос, быстрый сток воды, подтопление грунта земляного полотна, при менее благоприятных условиях, ширина дна, быстрый поверхностный сток.

8. Describe the main characteristics of side ditches.

9. Compile as many words as you can with the letters of the word.

CONSTRUCTION

_____

_____

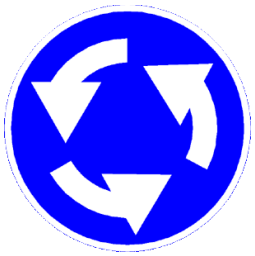
_____

_____

1. Fill in the gaps using the words below:

sub-base, cross-section, road shoulders, dead ends, to ensure, rigid, to excavate, surface runoff, right-of-way, vehicle, road zone.

1. _____ is the territory on which the road is laid.
2. Ditches may be _____ to a depth of up to 0.6 m.
3. _____ reduces the required thickness of the pavement base.
4. In addition to causing water erosion and pollution, _____ in urban areas is a primary cause of urban flooding which can result in property damage and street flooding.
5. Pavement base _____ the distribution of individual wheel-loads over the sub-base.
6. Pavement can have _____ structure.
7. If the occurrence of ground water is deep, the side ditch is given triangular _____.
8. _____ are intended to support the pavement.
9. Most _____ have internal combustion engines.
10. _____ contains such parts as carriageway, slopes, road shoulders, etc.
11. _____ have no exits.



2. Translate the following sentences using the vocabulary of Unit 2.

1. Полоса отвода – это участок, который предназначен для размещения конструктивных элементов дороги.
2. Обочина не предназначена для движения транспортных средств.
3. Дорога может иметь одну или несколько проезжих частей, между которыми располагается разделительная полоса.

4. Дорожная одежда имеет многослойную структуру: верхний слой дорожного покрытия, основание дорожного покрытия, дополнительный слой основания, грунт земляного полотна.
5. Дополнительный слой основания сделан из гравия, шлака, песка и т.д.
6. Кюветы собирают воду, стекающую с поверхности дороги, в период дождей или таяния снега.
7. Колеса автомобиля оказывают влияние на слой износа дорожного покрытия.
8. Кюветы обеспечивают сток воды, в противном случае подтопление грунта земляного полотна неизбежно.
9. При неблагоприятных условиях используется трапециевидное поперечное сечение кювета.
10. Внешний и внутренний откосы земляного полотна также являются важными элементами в дорожном строительстве.
11. Качество дополнительного слоя основания играет очень важную роль, т.к. имеет огромное влияние на срок службы автомобильной дороги.

3. Form several groups and using the plan of the road given on p. 25 make your own plan of the road and describe its main elements.

UNIT 3. TYPES OF PAVEMENT

3A. RIGID AND FLEXIBLE PAVEMENT

1. Before you start!

- ✓ What do we call a pavement?
- ✓ What structural layers of pavement do you remember?

2. Read the words and learn them by heart.

MUST KNOW

rigid – жесткий

flexible – гибкий, нежесткий

modulus of elasticity – степень эластичности

maintenance – содержание дороги

rehabilitation – ремонт

subsequent layer – следующий слой

flexural strength – прочность при изгибе

life span – срок службы

road network – дорожная сеть

significant – значительный

rebar – арматурный стержень

BST (bituminous surface treatment) – обработка дорожного покрытия битумом

curing – выдерживание бетона для набора прочности

mode of communication – способ связи

indirect – косвенный

lime – известь

asset – достояние

cobblestone – булыжник

granite setts – гранитные брусчатки

to bend – изгибаться

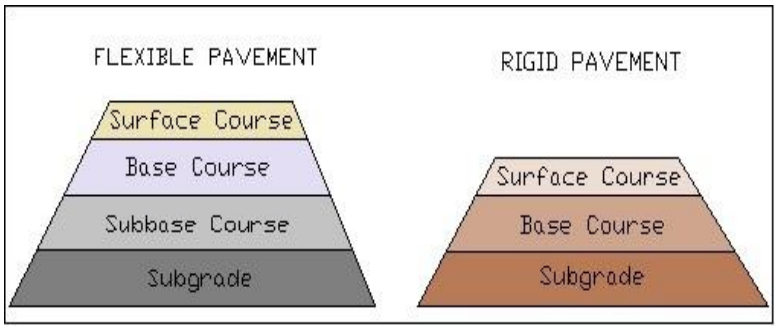
flexing – деформация, изгиб

stiff – жесткий

3. Read and translate the text to learn more about the main types of pavement.

Rigid and Flexible Pavements

In fact development of a country depends on the connectivity of various places with adequate road network. Obviously roads are the major channel of transportation for carrying goods and passengers. They play a significant role in improving the socio-economic standards of a region. Roads constitute the most important mode of communication in areas where railways have not developed much and form the basic infrastructure for the development and economic growth of the country. The benefits from the investment in road sector are indirect, long-term and not immediately visible. Roads are important assets for any nation. In the past, gravel road surfaces, cobblestone and granite setts were extensively used, but these surfaces have mostly been replaced by asphalt or concrete.



http://www.enggpedia.com/civil-engineering-encyclopedia/dictionary/highway-a-transportation/1564-flexible-and-rigid-pavement

There are various types of pavements depending upon the materials used. Basically, all hard surfaced pavement types can be categorized into two groups, flexible and rigid. Flexible pavements are those which are surfaced with asphalt materials. These types of pavements are called “flexible” since the total pavement structure “bends” due to traffic loads. A flexible pavement structure is generally composed of several layers of materials which can accommodate this “flexing”. On the other hand rigid pavements are composed of a PCC (Portland Cement Concrete) surface course. Such pavements are “stiffer” than flexible pavements due to the high modulus of elasticity of the PCC material.

State highway agencies generally select pavement type either by policy, economics or both. Flexible pavements generally require some sort of maintenance or rehabilitation every 10 to 15 years. Rigid pavements, on the other hand, can often serve 20 to 40 years with little or no maintenance. Thus, it should come as no surprise that rigid pavements are often used in urban, high traffic areas. But, when a flexible pavement requires major rehabilitation, the options are generally less expensive than for rigid pavements.

Flexible VS Rigid Pavement

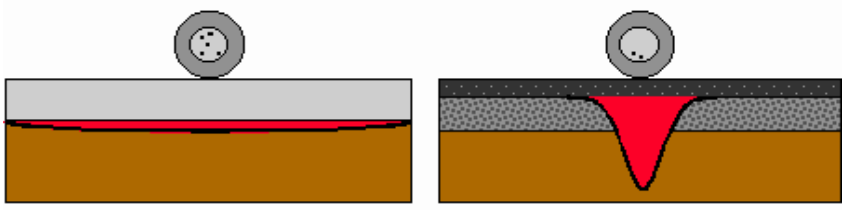
Flexible Pavements	Rigid Pavements
• Deformation in the sub-grade is transferred to the upper layers	• Deformation in the sub-grade is not transferred to subsequent layers
• Have low completion cost but repairing cost is high	• Have low repairing cost but completion cost is high
• Have low life span	• High life span
• Surfacing cannot be laid directly on the sub-grade but a sub-base is needed	• Surfacing can be directly laid on the sub-grade
• Road can be used for traffic within 24 hours	• Road cannot be used until 14 days of curing
• Have low flexural strength	• Have high flexural strength
• Damaged by oils and certain chemicals	• No Damage by oils

Source: http://www.aboutcivil.org/types-of-pavements.html

4. Answer the following questions.

1. What role do roads play?
2. How can you characterize the benefits from the investment in road sector?
3. What types of road surfaces were used in the past?
4. What do the variety of pavement types depend on?
5. What groups of pavement types are distinguished?
6. Why is flexible pavement called so?
7. What are rigid pavements composed of?
8. What are the principles of state highway agencies in choosing the pavement type?
9. What are the basic differences between flexible and rigid pavements?

5. Look at these pictures and define the types of pavement.



6. Put ✓ for true and ✗ for false statements.

1. Flexible pavements are composed of a PCC surface course.
2. Roads are used as a mode of communication in areas where railways are not developed much.
3. Variety of pavement types depends on the instruments used.
4. Roads form the infrastructure for the cutback of economic activity of the country.
5. Rigid pavements do not require maintenance.
6. Rigid pavements have high repairing cost.
7. Flexible pavements are surfaced with asphalt materials.

7. Circle the odd word.

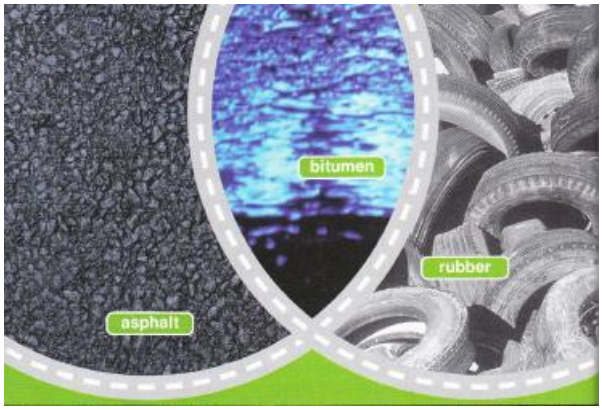
1.	rigid	sub-grade	sub-base	base
2.	concrete	asphalt	gravel	maintenance
3.	cost	economic growth	passengers	investment
4.	pavement	chemicals	road network	road surface
5.	repair	rehabilitation	maintenance	cobblestone

8. Give English equivalents to the following words and word combinations.

Перевозка товаров, значительная роль, не сразу заметный, в зависимости от используемых материалов, нагрузка от транспортных средств, портландцементный бетон, высокая степень эластичности, требовать определенного содержания дороги, район с интенсивным транспортным движением, высокая прочность при изгибе.

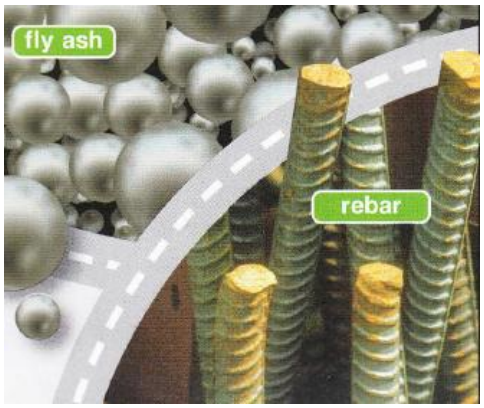
9. Describe advantages and disadvantages of each pavement type.

10. Read the text about modern road materials and say what materials are used today in road construction.



Today's roads are made from several materials. The material selected depends mainly on the expected traffic load of the road. For example, in rural areas **gravel** roads often perform well. Others may be coated with a **bituminous surface treatment (BST).**

However, **asphalt** made of **bitumen** and a mineral aggregate is the most common material. It has largely replaced Portland cement **concrete. Lime** may be used as a stabilizer. Roads may be reinforced with **steel rebars** to increase their lifespan.



In recent years, recycled industrial materials have been added to asphalt. This lowers costs and improves performance. For example, **rubber** from old tires reduces the noise level of a road. **Fly ash** from burned coal makes concrete more durable.

Source: Career Paths: Construction II- Roads & Highways, 2013

11. Match the words or phrases with the definitions.

1. concrete	**a.** a steel bar used to reinforce concrete structures
2 . lime	**b.** a sticky, black liquid that is combined with a solid such as crushed stone to form a road covering
3. BST	**c.** a mix of cement, water, gravel, and sand used as a building and roadway material
4. rebar	**d.** an inorganic material containing calcium, sometimes used to stabilize a roadway
5. asphalt	**e.** a layer of asphalt and fine aggregate used as a roadway seal, especially on a roadway with low traffic volume

12. Put ✓ for true and ✗ for false statements.

1. Gravel roads are not coated with bituminous surface treatment.
2. Portland cement concrete has replaced asphalt.
3. Rubber in asphalt makes a road more durable.
4. Rubber from burned coal makes concrete more durable.
5. Steel rebars increase lifespan of roads.
6. Recycled industrial materials lower costs and improve performance.
7. Lime may never be used as a stabilizer.
8. Gravel roads perform well in rural areas.

13. Fill in the gaps using the words below:

gravel, steel, rubber, fly ash, bitumen

1. _____ holds asphalt together.
2. A _____ road has loose rocks on the surface.
3. Some pavements are reinforced with _____ bars.
4. Does this concrete contain any recycled _____ from coal?
5. Adding _____ from old tires to asphalt lowers road noise.

14. Is a busy road more likely to have asphalt or gravel as a surface material? Explain your choice.

3B. ASPHALT

1. Before you start!

- ✓ What pavement type can asphalt be referred to?
- ✓ Is asphalt pavement popular in your country?

2. Read the words and learn them by heart.

MUST KNOW

primary highway – магистральная автомобильная дорога

traffic load (volume) – интенсивность движения

rural road – сельская дорога

perceived – очевидный

durability – срок службы

tensile strength – предел прочности при растяжении

slick – гладкий, скользкий, ровный

amount – количество

hydrocarbon – углеводородный

pollution – загрязнение

3. Read and translate the text to learn more about asphalt pavement.

Asphalt

Asphalt (specifically, asphalt concrete) has been widely used since the 1920s. Most asphalt surfaces are laid on a gravel base, which is generally at least as thick as the asphalt layer, although some asphalt surfaces are laid directly on the native sub-grade.

Depending on the temperature at which it is applied, asphalt is categorized as hot mix, warm mix and cold mix. Cold mix asphalt is often used on lower volume rural roads, where hot mix asphalt would cool too much on the long trip from the asphalt plant to the construction site.

An asphalt concrete surface will generally be constructed for high volume primary highways having an average annual daily traffic load greater than 1200 vehicles per day. Advantages of asphalt roadways include relatively low noise, relatively low cost compared with other paving methods, and perceived ease of repair. Disadvantages include less durability than other paving methods, less tensile strength than concrete, the tendency to become slick and soft in hot weather and a certain amount of hydrocarbon pollution to soil and groundwater.

http://rollacity.blogspot.ru/2012/09/city-of-rolla-weekend-e-updates-sept-21.html

Source: http://en.wikipedia.org/wiki/Asphalt_concrete

4. Answer the following questions.

1. Where are most asphalt surfaces laid?
2. What types of asphalt are distinguished depending on the temperature?
3. Which type of asphalt is used on rural roads?
4. What highways is asphalt pavement constructed for?
5. When did road builders start to use asphalt?
6. Are there more advantages or disadvantages of asphalt pavement?

5. Give English equivalents to the following words and word combinations.

Ежедневная интенсивность движения, загрязнение почвы и грунтовых вод, сельские дороги с меньшей интенсивностью движения, в зависимости от температуры, широко используемый, асфальтовый завод, относительно низкая цена, очевидная легкость ремонта, меньший срок службы, в жаркую погоду, преимущества, определенное количество, бетон, скользкий, хотя, строительная площадка.

6. Put ✓ for true and ✗ for false statements.

1. Asphalt has not been widely used until the 1920s.
2. Gravel base is as thick as sub-grade layer.

3. Asphalt roadways have less tensile strength than gravel.
4. One of the main disadvantages of asphalt roadways is low noise.
5. Depending on the temperature at which asphalt is applied, it can be hot mix, warm mix and cold mix.
6. Asphalt causes pollution to groundwater.
7. Generally asphalt surfaces are laid on gravel base, however, sometimes some asphalt surfaces are laid directly on the native sub-grade.

7. Translate the text about asphalt.

Асфальт – это смесь минеральных материалов (гравий и песок) и битума. В недрах Земли (Earth's interior) он может быть как жидким, так и твердым. Когда температура повышается, он становится жидким. Когда температура снижается, асфальт снова застывает. Различают два вида асфальта: натуральный, который лежит почти у поверхности земли, и искусственный – его производят на современных заводах из сырой нефти (crude oil). Натуральный асфальт содержит от 60% до 75% битума.

На острове Тринидад находится самое большое «озеро асфальта», оно занимает площадь в сорок гектаров, глубина составляет более тридцати метров. Большинство улиц Вашингтона покрыто асфальтом из Тринидада.

В XIX веке улицы городов были покрыты камнями. В таких странах, как США, Швейцария, Франция с середины XIX века для дорожного покрытия стали использоваться битумно-минеральные смеси. Первый асфальт на основе нефтяных битумов появился в США в 1876 году. Инженер И.Ф. Буттац стал первым производителем асфальта в России. Первым российским заводом, который производил этот дорожный материал, стал Сызранский (в 1873 году).

8. Tell all the information that you learnt about asphalt pavement.

3C. CONCRETE

1. Before you start!

- ✓ What pavement type can concrete be referred to?
- ✓ Is concrete pavement popular in your country?

2. Read the words and learn them by heart.

MUST KNOW

jointed plain concrete pavement (JPCP) – бетонное дорожное покрытие с поперечными швами

jointed reinforced concrete pavement (JRCP) – армированное железобетонное дорожное покрытие с поперечными швами

continuously reinforced concrete pavement (CRCP) – армированное железобетонное дорожное покрытие без поперечных швов

coarse aggregate – крупный щебень

admixtures – примеси, добавки

workability – пригодность к обработке

to mitigate – ослабить

severe – суровый

substitute – заменитель

fly ash cement – зольный цемент

crack – трещина

warping joint – шов для предупреждения перекоса (бетонных плит и т.д.)

contraction joint – шов сжатия (поперечный шов бетонного покрытия)

expansion joint – шов расширения

slab – плита

reinforcing steel – арматура

dowel bar – стыковой штырь

tie bar – соединительный штырь

skid-resistant – противоскользящий

consuming – затратный

offset – возмещение, компенсация

vertical temperature gradient – вертикальный температурный градиент

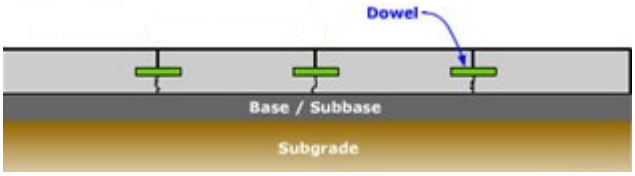
tamper bar – трамбующий брус

3. Read and translate the text to learn more about concrete pavement.

Concrete

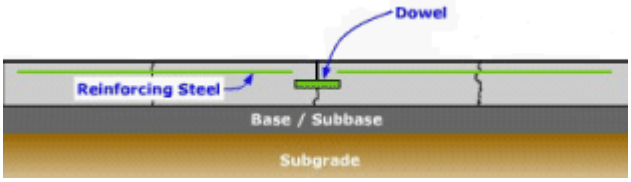
Concrete surfaces (specifically, PCC) are usually used on roads with heavy traffic of heavy vehicles and created using a concrete mix of Portland cement, coarse aggregate, sand and water. In virtually all modern mixes there will also be various admixtures added to increase workability, reduce the required amount of water, mitigate harmful chemical reactions and for other beneficial purposes. In many cases there will also be Portland cement substitutes added, such as fly ash. This can reduce the cost of the concrete and improve its physical properties.

Concrete surfaces are divided into three common types: jointed plain (JPCP), jointed reinforced (JRCP) and continuously reinforced (CRCP). Each of the jointing system types is used to control crack development.



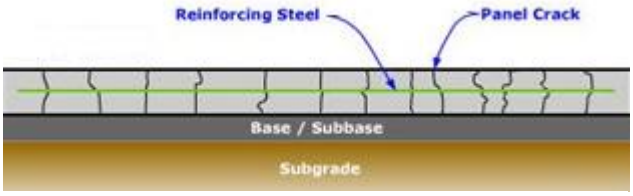
http://www.pavementinteractive.org/category/pavement/pavement-types/rigid-pavement-types/

Jointed plain concrete pavement is the most common type of rigid pavement. JPCP controls cracks by dividing the pavement up into individual slabs separated by contraction joints. JPCP does not use any reinforcing steel but uses dowel bars and tie bars. Today the majority of US state agencies build jointed plain pavements.



http://www.pavementinteractive.org/category/pavement/pavement-types/rigid-pavement-types/

Jointed reinforced concrete pavements control cracks by dividing the pavement up into individual slabs separated by contraction joints. However, these slabs are much longer than JPCP slabs, so JRCP uses reinforcing steel within each slab to control within-slab cracking. Today very few of agencies use this design, because it is not recommended as both of the other types offer better performance and are easier to repair.



http://www.pavementinteractive.org/category/pavement/pavement-types/rigid-pavement-types/

Continuously reinforced concrete pavements do not require joints in their design. Cracks are held tightly together by the underlying reinforcing steel. A number of agencies have made decisions to use continuously reinforced designs in their heavy urban traffic corridors.

One of the major advantages of concrete pavements is that they are typically stronger and more durable than asphalt roadways. They can also provide a durable skid-resistant surface. A notable disadvantage is that it can typically have a higher initial cost, as well as can be more time consuming to construct. This cost can typically be offset through the long life cycle of the pavement.

Source: http://en.wikipedia.org/wiki/Road_surface

4. Answer the following questions.

1. What materials are concrete surfaces created from?
2. For what purposes are various admixtures added?
3. What are the main types of concrete surfaces?
4. What type of concrete pavement does not use reinforcing steel?
5. Why is jointed reinforced concrete pavement used only by very few agencies?
6. Where is continuously reinforced concrete pavement used?
7. What are the main advantages of concrete pavements?
8. Is concrete or asphalt pavement more time consuming to construct?
9. What type of pavement would you recommend and why?

5. Put the following sentences in the correct order.

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____

A. Portland cement substitutes can reduce the cost of the concrete and improve its physical properties.

B. Concrete pavements are typically stronger and more durable than asphalt roadways.

C. JPCP controls cracks by dividing the pavement into slabs separated by contraction joints.

D. Concrete surfaces are created using a concrete mix of Portland cement, coarse aggregate, sand and water.

E. Continuously reinforced concrete pavements use reinforcing steel rather than contraction joints for crack control.

F. JRCP uses reinforcing steel within each slab to control within-slab cracking.

6. Look at these pictures and name two types of concrete pavement.

1.

2.

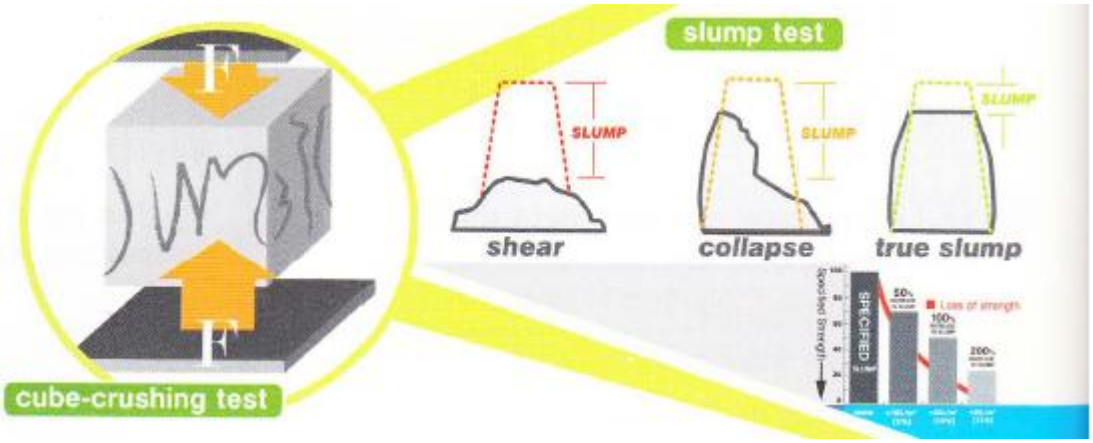
7. Find in the text synonyms to the following words and word-combinations:

aim, regulate, divide, though, fix, lasting, perceptible, taking much time, primary, decide, plus.

8. Give English equivalents to the following words and word combinations.

Интенсивное движение, большегрузное транспортное средство, бетонная смесь, требуемое количество воды, ослабить вредные химические реакции, физические свойства, отдельные плиты, противоскользящее покрытие, заметный недостаток, требующий много времени.

9. Before you start your work you need to ensure that the concrete is usable. So start by performing a slump test and cube-crushing test. If it passes both tests, start laying the concrete. Look at the pictures and describe these tests.



Career Paths: Construction II- Roads & Highways, 2013

10. Match the word or phrase with the definition.

1. formwork	**a.** it prevents bending stresses in concrete by evenly distributing weight and releasing tension
2. strike formwork	**b.** the act of making concrete more compact
3. warping joint	**c.** to remove formwork
4. vertical temperature gradient	**d.** a frame into which concrete is poured
5. tamp	**e.** a situation that occurs when the top portion of concrete is much hotter or cooler than the bottom portion
6. tamper bar	**f.** a tool that compresses concrete

11. Read the tips on laying concrete.

TIPS ON LAYING CONCRETE

- ✓ Please make sure that you lay a solid formwork for the concrete.
- ✓ Don't forget to place expansion and warping joints. You know how severe the weather can get. We need to prevent any possible vertical temperature gradients from occurring.

- ✓ Lastly, please have your crew tamp the concrete. They can use a tamper bar to tamp the concrete by hand.
- ✓ Remember to strike the formwork when you're done.

Source: Career Paths: Construction II- Roads & Highways, 2013

12. Translate the text about concrete in road construction.

Бетонное дорожное покрытие

Прочный цементный бетон является один из лучших материалов для дорожных покрытий. В 1913 г. в Тифлисе была построена первая дорога с бетонным покрытием.

Высокая долговечность бетона позволяет сократить расходы на содержание и ремонт. Срок службы бетонного покрытия автомобильной дороги в несколько раз больше по сравнению с покрытием из асфальта. Хорошо построенная дорога с цементобетонным покрытием может служить без ремонта несколько десятков лет. Цементобетонное дорожное покрытие представляет собой плиту толщиной 18-24 сантиметра.

Если дорогу покрыть только бетоном, то при изменениях температуры (днем и ночью, летом и зимой) бетонная плита будет изменяться в размерах – расширяться и сокращаться, и в ней возникнут напряжения, которые могут привести к растрескиванию бетона.

Чтобы предотвратить разрушение бетонной плиты, устраивают швы расширения, которые заполняют эластичной массой (paste) из битума, чтобы в основание под плиту не проникала вода. Расстояние между швами расширения зависит от температуры бетонной смеси в момент укладки, а также от климата местности.

Без швов расширения, покрытие будет так нагреваться в жаркий солнечный день, что с его поверхности могут откалываться (chip) большие куски бетона. Они могут стать причиной несчастных случаев. Такие явления наблюдались на одной из дорог Калифорнии (США), где не было необходимых швов.

Чтобы предотвратить растрескивание бетонной плиты при охлаждении покрытия до температуры меньшей, чем температура бетонной смеси, покрытие разделяется швами сжатия. Шов сжатия заливают массой, так же как и шов расширения.

Таким образом, цементобетонное дорожное покрытие состоит из отдельных плит.

13. Tell all the information that you learnt about concrete pavement, its types, advantages and disadvantages.

3D. OTHER TYPES OF PAVEMENTS

1. Before you start!

Do you know any other pavement types?

Have you ever seen a road covered with material different from concrete or asphalt?

2. Read the words and learn them by heart.

MUST KNOW

bituminous surface treatment (BST) – поверхностная обработка дорожного покрытия битумом

paver – материал для мощения (камень, кирпич, брусчатка, гравий)

to rehabilitate – реконструировать, восстановить

chip seal – щебеночное уплотнение

sealing coat – покрывающий слой

to rejuvenate – обновить

aggregate – щебень

emulsion – эмульсия

cut-back asphalt cement – жидкий асфальтовый битум

to embed – укладывать

rubber-tired roller – каток на пневматических (резиновых) колесах

rolling – укатка

low-traffic – низкая интенсивность движения

unstable terrain – слабый грунт

application – применение

to thaw – таять

sett – брусчатка

to top – покрывать

pre-cast concrete block – бетонный блок заводского изготовления

cobblestone – булыжный камень

granular surface – поверхность из мелкого каменного материала (гравия, щебня)

3. Read and translate the text to learn more about other types of pavement.

Other types of pavement

Composite surface combines Portland cement concrete and asphalt. They are usually used to rehabilitate existing roadways rather than in new construction.

Bituminous surface treatment (BST) is used mainly on low-traffic roads, but also as a sealing coat to rejuvenate an asphalt concrete pavement. It generally consists of aggregate spread over a sprayed on asphalt emulsion or cut-back asphalt cement. The aggregate is then embedded into the asphalt by rolling it, typically with a rubber-tired roller. This type of surface is described by a wide variety of regional terms including "chip seal", "oil and stone" etc.

en.wikipedia.org/wiki/Road_surface

The ease of application of BST is one reason for its popularity, but another is its flexibility, which is important when roadways are laid down over unstable terrain that thaws and softens in the spring.

Gravel is known to have been used extensively in the construction of roads by soldiers of the Roman Empire. A granular surface can be used with a traffic volume where the average annual daily traffic is 1200 vehicles per day or less. There is some structural strength as the road surface combines a sub-base and base and is topped with a seal aggregate with emulsion. The decision whether to pave a gravel road or not often depends on traffic volume. Obviously, it is not as durable as concrete or asphalt pavements, but relatively cheap.

http://en.wikipedia.org/wiki/Road_surface

Pavers generally have the form of pre-cast concrete blocks, are often used for aesthetic purposes. Pavers are rarely used in areas with high-speed vehicle traffic.

Brick, cobblestone, sett pavements were once common in urban areas throughout the world, but fell out of fashion in most countries, due to the high cost of labor required to lay and

maintain them, and are typically only kept for historical or aesthetic reasons. In some countries, however, they are still common in local streets.

Source: http://en.wikipedia.org/wiki/Road_surface

4. Answer the following questions.

1. What other types of pavement did you learn from the text?
2. For what purposes are composite surfaces used?
3. What materials does BST consist of?
4. When was gravel road extensively used?
5. Why is BST so popular?
6. What does the decision to pave a gravel road or not depend on?
7. What is the main disadvantage of a gravel road?
8. Where are pavers rarely used?
9. Why did brick, cobblestone, sett pavements fall out of fashion?
10. Where is bituminous surface treatment used?

5. Put ✓ for true and ✗ for false statements.

1. Pavers are used only in areas with high-speed vehicle traffic.
2. Composite surface is used to rehabilitate existing roadways.
3. BST consists of pre-cast concrete blocks spread over a sprayed on asphalt emulsion.
4. Gravel was extensively used in Ancient Greece.
5. Pavers fell out of fashion in most countries because the cost of labor required to lay and maintain them is rather high.
6. BST is popular because of its flexibility and ease of application.
7. Concrete pavement is more durable than gravel.
8. The decision whether to pave a gravel road or not never depends on traffic volume.
9. Gravel is as durable as concrete or asphalt pavements, and it is relatively cheap.

6. Give English equivalents to the following words and word combinations.

Реконструировать существующие дороги, обновить асфальтобетонное дорожное покрытие, широкое разнообразие, легкость применения, широко использовался, зависеть

от интенсивности движения, иметь форму бетонных блоков заводского изготовления, в целях эстетики, интенсивное скоростное движение транспортных средств, выйти из моды, в городской местности.

7. Put the words and phrases in the correct column.

Portland cement, pre-cast concrete blocks, low-traffic roads, rubber-tired roller, cut-back asphalt cement, structural strength, emulsion, relatively cheap, high-speed vehicle traffic, cobblestone, seal aggregate, flexibility, chip seal, unstable terrain, sub base and base, sett, high cost of labour.

Composite surface	Bituminous surface treatment	Gravel surface	Pavers

8. Describe the following types of pavements:

- ✓ *Composite surface*
- ✓ *Bituminous surface treatment*
- ✓ *Gravel surface*
- ✓ *Pavers*

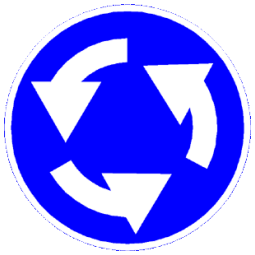
1. Fill in the gaps using the words below:

flexible, combine, reinforcing steel, sett, mode of communication, repairing cost, depend on, time consuming, cobblestone, asphalt pavement, rigid, Portland cement, rural roads, flexibility, jointed plain concrete pavement.

1. All pavement types are divided in two groups: _____ and _____.
2. A road is the most important _____ in areas where railways have not developed much.
3. The decision whether to pave a gravel road or not _____ traffic volume.
4. Cold mix asphalt is used on lower volume _____.
5. Advantages of _____ include relatively low noise and low cost compared with other paving methods.
6. Concrete pavement is created using _____, coarse aggregate, sand and water.
7. _____ controls cracks by dividing the pavement up into individual slabs separated by contraction joints.
8. Composite surface _____ Portland cement concrete and asphalt.
9. There are two main reasons for BST popularity: ease of application and _____.
10. Continuously reinforced concrete pavements use _____ rather than contraction joints for crack control.
11. A notable disadvantage of concrete pavement is that it can be more _____ to construct.
12. The _____ of flexible pavements is high.
13. Brick, _____, _____ pavements were once common in urban areas throughout the world, but fell out of fashion in most countries.

2. Circle the odd word.

1.	bituminous surface treatment	rubber-tired roller	gravel surface	pavers
2.	concrete	asphalt	gravel	chemical reactions
3.	brick	sett	composite surface	cobblestone
4.	sand	properties	water	Portland cement
5.	continuously reinforced concrete pavement	jointed reinforced concrete pavement	maintenance	jointed plain concrete pavement



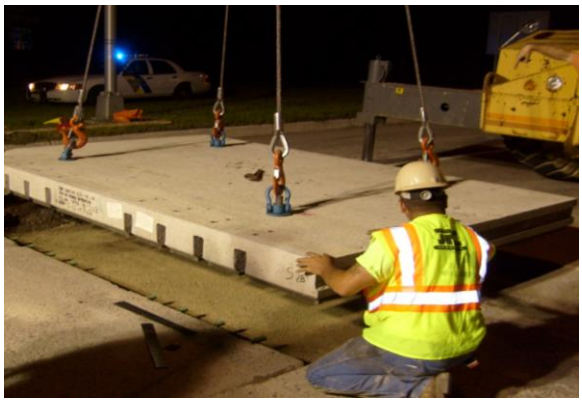
3. Translate the following sentences using the vocabulary of Unit 3.

1. Жесткая дорожная одежда более долговечная, чем нежесткая.
2. Асфальтобетонные дорожные покрытия строятся на участках с высокой интенсивностью движения.
3. Бетонный слой состоит из портландцемента, щебня, песка и воды.
4. На строительство бетонного дорожного покрытия требуется больше времени.
5. Большинство асфальтобетонных дорожных покрытий укладывается на щебеночную основу.
6. При непрерывно армированном железобетонном дорожном покрытии используется арматура, а не швы сжатия.
7. Нежесткие дорожные покрытия состоят из битумных материалов, а жесткие из портландцемента.
8. Поверхностная обработка дорожного покрытия битумом используется в основном на участках с низкой интенсивностью дорожного движения.
9. Гравийное основание является относительно дешевым.
10. Кирпич, булыжный камень и брусчатка используются для эстетических целей.
11. Жесткие покрытия предназначены для дорог с высокой интенсивностью движения.

4. Match the type of pavement with its picture.

asphalt, cobblestone, concrete, sett, gravel

1. _____ 2. _____ 3. _____



4. _____ 5._____

5. Form several groups. Each group should describe one of the following points for discussion:

- ✓ *rigid (cement) pavement*
- ✓ *flexible (asphalt) pavement*
- ✓ *other types of pavements.*

UNIT 4. ROAD CONSTRUCTION PROCESS

4A. PRE-CONSTRUCTION ACTIVITIES

1. Before you start!

- ✓ Have you ever seen road works? What were the road builders doing?
- ✓ What do you think about the quality of roads in our country? What influences the quality of roads?

2. Read the words and learn them by heart.

MUST KNOW

bump – дорожная неровность

drainage – водоотвод

to compact – спрессовывать

timing – расчет времени

land survey – топографическая съемка

to handle – осуществлять, проводить

evaluating – оценка

to take into account – учитывать

environmentalist – эколог

density – плотность

transportation planner – дорожно-транспортный планировщик

accuracy – точность

terrain – грунт

capability – возможность, способность

ratio – соотношение

to spray – опрыскивать

soil scientist – почвовед

screened dirt – просеянный грунт

dip – впадина

landscape architect – ландшафтный архитектор

3. Read and translate the text to learn more about the basic steps in pre-construction activities.

Pre-construction activities

The type of construction which is adopted for a particular road depends on:

1. the nature of available materials,
2. topography,
3. foundation conditions,
4. type and availability of construction equipment,
5. financing arrangements and timing.

There are many steps in the road construction process which involve teams of people and much organization from the use of a surveying company to handle land surveys to project managers. The steps must be carefully followed to ensure a successful project is completed. These steps can be summarized as:

1. planning;
2. design;
3. earthworks;
4. pavement construction;
5. open to traffic.

http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

Step I. Planning

A road project begins with evaluating the transportation system, taking into account statewide priorities, including strategic plans for the state's transportation system. Department of Transportation collects and maintains information about our roads, including road and bridge conditions, traffic volumes, crash statistics.

Using this data, transportation planners, engineers, environmentalists, landscape architects, soil scientists and others identify trends that determine what and how to build.

Step II. Design

http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

A survey of the area is step two. Recently, Global Positioning Systems, laser surveys, and other technology have sped up the process and improved accuracy. Many factors influence designs, including location, terrain and soil properties, drainage capabilities, traffic volume, the ratio of cars to trucks and buses, possible future development in the area, effects on the environment or nearby residents.

Step III. Earthwork

Earthwork is one of the most important elements in road construction because it establishes a stable foundation. The aim of the earthworks phase of the construction is to position the sub-grade underlying the pavement layers in the right location and at the correct level and to provide drainage.

http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

First, embankments are built. Next, a grader or bulldozer levels the screened dirt. Leveling bumps and filling in dips creates a surface that will support a road for decades. The screened dirt is sprayed with water and compacted to its maximum density. During this stage, drains and sewers are installed. The center of the road must be higher than the edges so water will run off into the storm sewers. Drainage is a critical element because improper drainage will greatly reduce the new pavement's life expectancy. All of this work must pass strict inspections before the project can continue. To complete the earthwork, workers place gravel in 12-inch layers on the road bed, then moisten and compact each layer. Layers are added and compacted until the road bed reaches the height called for in the design.

The earthwork is often the largest task in the road building process and therefore careful planning and organization are essential. Speed and efficiency depend very much upon the quantity and types of earthmoving plant available.

Source: http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

4. Answer the following questions.

1. What are the main factors on which the type of construction depends?
2. How many steps are distinguished in road construction?
3. What does the road project begin with?
4. What data do transportation planners and others use to identify trends?
5. What has improved the accuracy of surveying the area?
6. Why is earthwork considered one of the most important elements in road construction?
7. By what machines is the screened dirt leveled?
8. When are drains and sewers installed?
9. Why should the centre of the road be higher than the edges?
10. What do speed and efficiency of earthworks depend upon?

5. Put ✓ for true and ✗ for false statements.

1. The type of road construction doesn't depend on any factors.
2. The road construction process involves many teams of people and much organization.
3. A road project begins with positioning the sub-grade underlying the pavement layers in the right location.
4. Global Positioning Systems, laser surveys and other technology have slowed down the process of surveying the area.
5. Terrain and soil properties, drainage capabilities, traffic volume have no influence on design.
6. Earthwork establishes a stable foundation.
7. Improper drainage reduces the new pavement's life expectancy.
8. Excavator levels the screened dirt.
9. Screened dirt is sprayed with water at the stage of paving.

6. Explain in English the meaning of the following words and word combinations used in the text:

topography, drainage, sewer, landscape architect.

7. Give English equivalents to the following words and word combinations.

Статистика аварий, срок службы, воздействие на окружающую среду, находящийся под слоем дорожной одежды, ускорить процесс, прочный фундамент, подготовительные строительные работы, обеспечить водоотвод, максимальная плотность, интенсивность движения, приоритеты государственного масштаба, соотношение автомобилей и грузовиков, выравнивание дорожных неровностей.

8. Complete the article on the influence of bad roads by adding the missing words and phrases.

goods, frequent, attempts, out-of-date, traffic jams, vehicle, consumption

THE INFLUENCE OF BAD ROADS

The influence of inadequate road system on the cost of living and on the price of [1]_____ is enormous. It needs to be realized that [2]_____ roads are a dangerous brake upon the development of national productivity.

There have been many [3]_____ to count the cost of poor roads, and the fact is that the totals are astronomical. The basic facts are simple enough. The effective life of a [4]_____ is considerably shortened by bad road surfaces and the need for [5]_____ braking. Repairs are expensive. Petrol [6]_____ increase rapidly when the vehicle cannot move at the most economical speed. Throughout the working day vast quantity of fuel is wasted in the [7]_____ that occur all over the country because roads have long ago ceased to be able to carry all the traffic put on them.

9. Describe the steps of pre-construction activities on the site.

4B. CONSTRUCTION ACTIVITIES

1. Before you start!

- ✓ What is the last step of pre-construction activities?
- ✓ Is that step basic for the following construction steps?

2. Read the words and learn them by heart.

MUST KNOW

paving – мощение

pavement marking – дорожная разметка

crushed rock – щебень

wire basket – сетчатая корзина

joint – стык

finishing machine – бетоноотделочная машина

dowel – стыковой стержень

landscaping – озеленение

to grind – шлифовать

paving equipment – асфальтобетоноукладочное оборудование

3. Read and translate the text to learn more about the basic steps in highway construction activities.

Construction activities

Step IV. Pavement Construction

At last, the road bed is ready for paving. Planners and engineers study such factors as the cost of maintaining the road, the amount and type of traffic, the cost of paving material.

A formula that includes all these factors tells engineers to use either asphalt (bituminous) or concrete pavement.

Asphalt uses bitumen, a petroleum product, to glue together sand and crushed rock. This mixture is heated to approximately 300 degrees at the asphalt plant. At the construction site, workers spread and compact the hot mixture onto the roadbed.

Concrete uses cement and water as the glue between sand and crushed rock. Workers place concrete into steel molds called forms. A finishing machine vibrates and trims it to the necessary height. To prevent cracks, workers cut joints between the concrete slabs.

http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

At each joint, wire baskets and steel dowels connect the slabs. These allow the slabs to expand and contract as the temperature changes. The slabs can slide from side to side along the dowels, but not up and down.

Step V. Open to traffic

With the new surface in place, quality testing is conducted. Testers use seismology equipment to measure vibrations of the new pavement. If there is too much vibration, the contractor must grind the pavement to ensure a smooth surface. The final steps are:

- another drainage test;
- grading and landscaping around the pavement (where applicable);
- applying the permanent pavement marking.

http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

Source: http://www.michigan.gov/mdot/0,1607,7-151-9615-129011--,00.html

4. Answer the following questions.

1. How many stages are distinguished in highway pre-construction and construction activities?
2. What tells the engineers to use either asphalt or concrete pavement?
3. What does asphalt use to glue sand and crushed stone?
4. What connects the slabs at each joint?
5. Why is landscaping around the pavement necessary?
6. What does concrete use to glue sand and crushed stone?
7. What does seismology equipment measure?
8. What are the final steps?

5. Put ✓ for true and ✗ for false statements.

1. Asphalt uses cement and water to glue together sand and water.
2. Concrete slabs can slide from side to side, up and down.
3. Seismology equipment is used to measure vibrations of the new pavement.
4. Applying pavement markings is the initial step in road building activities.
5. Workers cut joints between the concrete slabs to prevent cracks.
6. Contractor grinds the pavement if there is too much vibration.

6. Give English equivalents to the following words and word combinations.

Заливается бетон, предотвращение трещин, содержание дороги, современное асфальтобетоноукладочное оборудование, отшлифовать покрытие, приблизительно 300 градусов, долговременная дорожная разметка, дорожное полотно, озеленение вокруг дорожного покрытия, гладкая поверхность.

7. Describe the main stages of highway construction.

8. Complete the article on the road maintenance by adding the missing words and phrases.

regularly, activities, require, specialized, grass, economic, periodic, include, frequency

Roads make a crucial contribution to [1]_____ development and growth. Although the need for maintenance is widely recognized, it is still not getting adequately done. Road maintenance comprises [2]_____ to keep pavement, shoulders, slopes, drainage facilities in safe and usable conditions. Road maintenance is categorized as routine, [3]_____, and urgent.

Routine maintenance, which comprises small-scale works, conducted [4]_____, aims to ensure safety of existing roads. [5]_____ of activities varies but is generally once or more a week or month. Typical activities include roadside clearing and [6]_____ cutting, cleaning of ditches and pothole repair.

Periodic maintenance, which covers activities on a section of road at regular and relatively long intervals, aims to preserve the structural integrity of the road. These operations require [7]_____ equipment and skilled personnel. They cost more than routine maintenance works. Activities [8]_____ resurfacing, overlay, etc.

Urgent maintenance is undertaken for repairs that [9]_____ immediate attention, such as collapsed culverts or landslides that block a road.

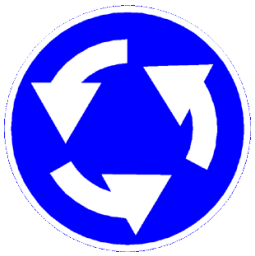
Source: Transport Notes No. 4, Operational Guidance pp.1-10.

1. Find in the texts 4A and 4B synonyms to the following words and word combinations:

information, ecologist, precision, correlation, decrease, get better, affect, lorry, location, wrong, price, quantity, using.

2. Match the words with their definitions.

1. landscaping	**a.** the native material underneath a constructed road
2. paving	**b.** activity of growing plants with the aim of creating a beautiful environment
3. paving equipment	**c.** a space-based satellite navigation system that provides location and time information in all weather conditions
4. earthwork	**d.** material used on a road surface in order to provide separation between traffic moving in opposite directions
5. drain	**e.** a sticky, black and highly viscous liquid or semi-solid form of petroleum
6. asphalt	**f.** work involving moving quantities of soil
7. to grind	**g.** surfacing of roads and walkways
8. sub-grade	**h.** a collection and transportation system for storm water
9. Global Positioning System	**i.** a piece of construction equipment used to lay asphalt on roads, bridges, parking lots and other such places
10. pavement marking	**j.** to produce a smooth finish on flat surfaces



3. Translate the following sentences using the vocabulary of Unit 4.

1. Иногда земля не подходит для озеленения.
2. Бульдозер выравнивает просеянный грунт.
3. Мы должны принять во внимание все факторы, включая интенсивность движения и доступные материалы.
4. Огромное количество специалистов, таких как почвоведы, экологи, инженеры вовлечены в строительство дорог.
5. Подрядчик отвечает за безопасность рабочих на стройплощадке.
6. Дорожная разметка – заключительная часть дорожных работ.
7. Ось дороги выше обочин.
8. Рабочие укладывают слой гравия на песчаный слой.
9. Скорость и эффективность работы зависит от асфальтобетоноукладочного оборудования.
10. Дорожные неровности уменьшают срок службы дорожной одежды.
11. Битум связывает песок и щебень.
12. Бетон состоит из цемента и воды.
13. Рабочие укладывают асфальт на дорожное полотно.
14. Стальные стыковые стержни связывают бетонные плиты.
15. Под слоем дорожной одежды находится грунтовое основание.
16. Вода уплотняет просеянный грунт.

4. Form several groups and make up your own plan of road construction. Consider the following points:

- ✓ *the place of construction*
- ✓ *the amount and type of traffic*
- ✓ *type of the pavement*
- ✓ *describe the process of construction.*

5. Find all the words you can and give their translation.

E	M	A	R	K	I	N	G	T	A	S	P	H	A	L	T	M	C
A	C	E	M	E	N	T	P	F	L	E	X	I	B	L	E	O	O
R	I	G	I	D	I	C	A	R	R	I	A	G	E	W	A	Y	N
T	R	A	F	F	I	C	V	C	O	V	E	H	I	C	L	E	T
H	I	C	O	N	C	R	E	T	E	T	P	W	H	E	E	L	R
W	L	A	N	E	R	M	M	G	U	B	S	A	N	D	N	R	A
O	S	U	R	F	A	C	E	A	S	L	A	Y	E	R	P	A	C
R	O	A	D	P	C	O	N	S	T	R	U	C	T	I	O	N	T
K	A	P	R	I	G	H	T	O	F	W	A	Y	C	U	R	B	O
S	U	B	G	R	A	D	E	Q	V	G	R	A	V	E	L	A	R

UNIT 5. ROAD JUNCTIONS AND INTERSECTIONS

5A. TYPES OF INTERSECTIONS

1. Before you start!

- ✓ Do you have many road junctions in your city?
- ✓ What is the main purpose of road junctions?

2. Read the words and learn them by heart.

MUST KNOW

intersection – пересечение дорог в одном уровне, перекресток

segregation – разделение потоков движения

island – островок безопасности

T-junction – Т-образный перекресток

to cross – пересекать

collision – столкновение

stream – поток

percentage – процентное соотношение

to fulfill – выполнять

clover-leaf junction – развязка типа «клеверный лист»

multi-level junction – многоуровневая транспортная развязка

flyover bridge – путепровод

flyover junction – дорожная развязка в разных уровнях

roundabout – круговое движение

through route – сквозной проезд

to drop the speed – сбавить скорость

pedestrian – пешеход

costly – дорогостоящий

over-pass – надземный переход

converging streams – сходящиеся потоки

to weave – перестраиваться в другой ряд движения

under-pass – тоннель для автотранспорта, пешеходный тоннель

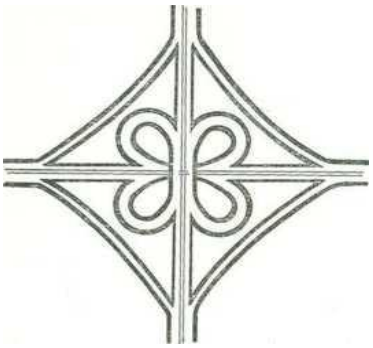
angle of approach – угол сближения

angle of convergence – угол слияния потоков

3. Read and translate the text to learn more about road junctions and their types.

Types of intersections

The problems of reducing danger at intersections are those of cost. If all classes of traffic meet each other at the same level, there is a danger of collision. Almost complete segregation of different classes can be achieved, and the need for road users to cross traffic streams can be avoided.

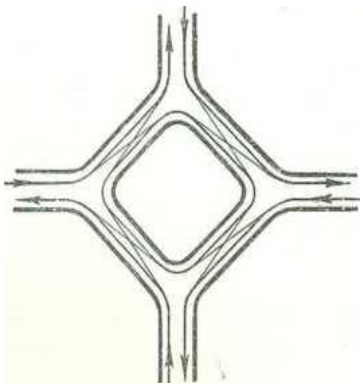


It's important to understand different types of intersections**.** Intersections can be grouped into two main categories. The first category is intersections that require vehicles to come to a full stop, for example, T-junctions. The second type of intersection allows traffic to flow without stopping, for example, roundabouts. At any type of intersection, you should know the regulations that apply, which change by nation and region.

The perfect example of complete segregation of different classes of traffic and avoidance of crossing traffic streams is the clover leaf junction, at which practically no collision can occur between vehicles.

All forms of road junctions can be classified into three groups: multi-level junctions, roundabouts and flyover-junctions.

Multi-level junctions. There is need for multi-level intersections where several conditions are fulfilled:



- only a small percentage of the traffic must turn to left or right;
- the major volume of traffic is travelling on a fast through route.

Roundabouts. Unlike multi-level intersections, roundabouts do not enable traffic to cross without dropping speed but pedestrians and cyclists cannot be segregated unless costly over- or under-passes are constructed.

The success of a roundabout depends greatly upon the ease with which vehicles using it can "weave" or pass from one traffic lane to another. The greater the length of the road in which

the weaving can be carried out and the smaller the angle of approach of converging streams of traffic, the more easily can weaving be performed. The angle should not be greater than 30 degrees. The greater the diameter of the island, the smaller the angle of convergence is.

Flyover-junctions. These have been developed chiefly at places where there are no pedestrians. These "flyovers", which enable high speeds to be maintained, are extremely expensive, costing about ten times as much as roundabout, so it is much better to have ten roundabouts at ten dangerous junctions than a single flyover at a single junction. A combination of roundabout and flyover bridge can be of great value.

Source: Пособие по англ. яз. для студентов строит. вузов / М.: Высш. школа, 1978. – 159 с.

4. Answer the following questions.

1. In what case is there a danger of collision?
2. What is the perfect example of complete segregation?
3. What are the main types of intersections?
4. What conditions should be fulfilled for multi-level junctions?
5. What are the main groups of road junctions?
6. What should be constructed for pedestrians in the case of roundabouts?
7. What does the success of a roundabout depend on?
8. Where have flyover junctions been developed?
9. What advantages and disadvantages does a flyover have?

5. Put ✓ for true and ✗ for false statements.

1. The greater the angle of convergence, the more easily weaving can be performed.
2. In the case of roundabout junctions the most part of traffic volume travels on a fast through route.
3. Roundabouts are expensive and cost about ten times as much as flyover.
4. The perfect example of avoidance of crossing traffic streams is clover-leaf junction.
5. The combination of multi-level junctions and roundabouts is of great value.
6. Clover-leaf junctions have been developed chiefly at places where there are no pedestrians.
7. Junctions are dangerous spots in a road system.

6. Give English equivalents to the following words and word combinations.

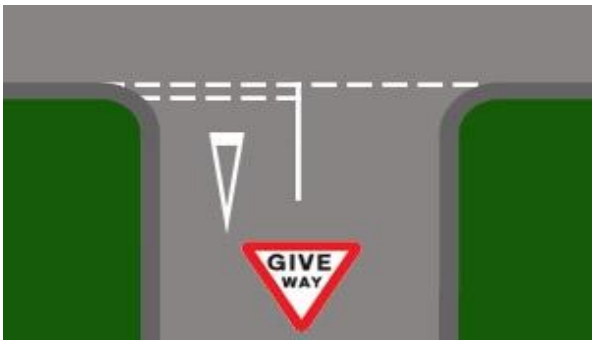
Полная остановка, опасность столкновения, полное разделение потоков движения, пересекать транспортные потоки, выполняются несколько условий, небольшое процентное соотношение, дорогостоящие надземные переходы и пешеходные тоннели, перестраиваться из одной полосы движения в другую, угол сближения сходящихся потоков, диаметр островка безопасности, сохранять высокие скорости, в десять раз больше, иметь большую ценность.

7. Match the picture with the type of intersection.

flyover, roundabout, clover-leaf, T-junction

1. _____

2. _____



3. _____

4. _____

8. Match the words with their definitions.

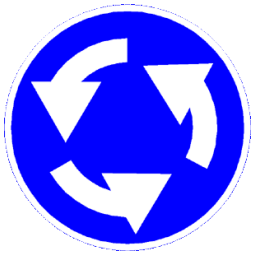
1. underpass	**a.** a type of circular intersection or junction in which road traffic flows almost continuously in one direction around a central island
2. collision	**b.** a crash or conflict
3. island	**c.** a place for pedestrians and cyclists beneath a road or railway, allowing them to reach the other side in safety
4. intersection	**d.** a raised curbed area, often used to delineate rows of parking spaces or lanes of traffic
5. roundabout	**e.** a bridge, road, railway or similar structure that crosses over another road or railway
6. flyover	**f.** a person traveling on foot, whether walking or running
7. pedestrian	**g.** an intersection where one road ends at a right angle
8. T-junction	**h.** the point where two or more streets or roads come together

9. What types of road junctions are common in your city? Describe other types of road junctions.

1. Fill in the gaps using the words below:

to turn right, pedestrians, flyover bridge, angle of convergence, costly, to achieve, sufficiently, traffic lane, speed.

1. You should watch out for _____ crossing a road into which you are turning.
2. Improvements for cyclists can be _____ by: rising drivers' awareness of cyclists and dropping the _____.
3. _____ less than 30º is generally considered to be safest, with better visibility and slower vehicle speeds.
4. Increased journey time for all users is _____.
5. At some spots drivers are not permitted _____.
6. At many existing roundabouts vehicle speeds are not dropped _____.
7. A combination of roundabout and _____ is very valuable.
8. _____ can be indicated by road marking.



2. Translate the following sentences using the vocabulary of Unit 5.

1. Благодаря многоуровневым развязкам риск столкновения снижается.
2. Транспортное средство может легко выполнить перестроение на другую полосу при круговом движении.
3. Если водитель видит пешехода, переходящего дорогу, он должен сбавить скорость.
4. Развязка типа «клеверный лист» способствует разделению потоков движения.
5. При круговом движении, как правило, строятся надземные переходы и пешеходные тоннели.
6. Обычно движение транспортных средств в одном направлении организуется по полосе движения.

7. Островок безопасности был обозначен горизонтальной дорожной разметкой.
8. На дорожных развязках на разных уровнях транспортные средства могут сохранять самые высокие скорости.
9. Данных условий недостаточно для построения путепровода, так как это чрезвычайно дорого.
10. Дорожная разметка является необходимым условием безопасного движения и помогает избежать нарушения правил дорожного движения.

3. Describe other types of road junctions (Y- junctions, stack interchanges, etc.)

UNIT 6. HISTORY OF BRIDGE BUILDING

6A. HISTORY OF BRIDGES

1. Before you start!

- ✓ How do you think first bridges appeared?
- ✓ What was their purpose?
- ✓ What materials were they made of?

2. Read the words and learn them by heart.

MUST KNOW

suspension bridge – подвесной мост

welded bridge – сварной мост

log – бревно

stream – ручей

span – перекрытие

pole – столб

well – водоем

stick – палка

branch – ветка

deciduous – опавший, упавший

fibre – волокно (древесное)

to wave (wove, woven) – сплетать

rope – веревка

to bind – связывать

intact – сохранившийся

volcanic rock – вулканическая порода

aqueduct – акведук

timber – древесина, пиломатериал

breakthrough – прорыв

erection – возведение, строительство

cast iron – чугун

truss system – решетчатая конструкция

wrought iron – кованое железо

tensile strength – нагрузка на растяжение

load – нагрузка

advent – появление

welding – сварка

to stand – выдерживать

variation – колебание

pozzolana – пуццолана

3. Read the text to learn more about the history of bridge building in the world.

History of bridges

One of the outstanding statesman once said in his speech, "There can be little doubt that in many ways the story of bridge-building is the story of civilization. By it we can readily measure an important part of a people's progress." Great rivers are important means of communication for in many parts of the world they have been, and still are, the chief roads. But they are also barriers to communication, and people have always been concerned with finding ways to cross them.

http://ru.advisor.travel/poi/Arkadiko-Bridge-12306

The first bridges were made by nature itself – as simple as a log fallen across a stream or stones in the river. The first bridges made by humans were probably spans of cut wooden logs or eventually stones, using a simple support and crossbeam arrangement. Some early Americans used trees or bamboo poles to cross small wells to get from one place to another. A common form of sticks, logs, and deciduous branches together involved the use of long fibres woven together to form a rope used for binding and holding together the materials used in early bridges.

The Arkadiko Bridge is one of four Mycenaean arch bridges, part of a former network of roads in Greece. Dating to the Greek Bronze Age (13th century BC), it is one of the oldest arch bridges still in existence and use. Several intact arched stone bridges from the Hellenistic era can be found in the Peloponnese in southern Greece.

The greatest bridge builders of antiquity were the ancient Romans. The Romans built arch bridges and aqueducts that could stand in conditions that would damage or destroy earlier designs. Some stand today. An example is the Alcántara Bridge, built over the river Tagus, in Spain. The Romans also used cement, which reduced the variation of strength found in natural stone. One type of cement, called pozzolana, consisted of water, lime, sand, and volcanic rock. Brick and mortar bridges were built after the Roman era, as the technology for cement was lost then later rediscovered.

An ancient Indian treatise mentions the construction of dams and bridges. The use of stronger bridges using plaited (переплетенный) bamboo and iron chain was visible in India by about the 4th century. A number of bridges, both for military and commercial purposes, were constructed by the Mughal administration in India.

Although large Chinese bridges of wooden construction existed at the time of the Warring States (476-221 BC), the oldest surviving stone bridge in China is the Zhaozhou Bridge, built from 595 to 605 AD.

Alcántara Bridge

Rope bridges, a simple type of suspension bridge, were used by the Inca civilization in the Andes Mountains of South America, just prior to European colonization in the 16th century.

During the 18th century there were many innovations in the design of timber bridges by Hans Ulrich, Johannes Grubenmann, and others. The first book on bridge engineering was written by Hubert Gautier in 1716. A major breakthrough in bridge technology came with the erection of the Iron Bridge in Coalbrookdale, England in 1779. It used cast iron for the first time as arches to cross the river Severn.

http://www.history.ucsb.edu/faculty/marcuse/classes/2c/2c06/lectures/06L03IndRev.htm

With the Industrial Revolution in the 19th century, truss systems of wrought iron were developed for larger bridges, but iron did not have the tensile strength to support large loads. With the advent of steel, which has a high tensile strength, much larger bridges were built, many using the ideas of Gustave Eiffel.

In 1927 welding pioneer Stefan Bryła designed the first welded road bridge in the world.

Source: http://en.wikipedia.org/wiki/Bridge#History

Mind the pronunciation of the following proper names:

Mycenaean [ˌmʌɪsɪˈniːən] – микенский

Hellenistic [hɛlɪˈnɪstɪk] – эллинистический

Peloponnese [ˌpɛləpəˈniːz] – Пелопоннес

river Tagus [ˈteɪgəs] – река Тахо

Mughal [ˈməʊg(ə)l]– могольский (империя)

Warring States – Сражающиеся Царства

Zhaozhou [djaodjou] Bridge – мост Аньцзи

4. Answer the following questions.

1. What were first bridges like?
2. What did early Americans use to build bridges?
3. What is one of the oldest survived bridges?
4. Who were the most famous bridge builders?
5. What did Indians use to reinforce the structure of their bridge?
6. When was the oldest stone bridge in China built?
7. What nation started building rope bridges?
8. What innovation was introduced in the XVIII century?
9. What is the disadvantage of using iron for bridge construction?
10. What did Stefan Bryla invent?

5. Put the words and phrases in the correct column.

Span, stick, cement, arch, destroy, pole, timber, erect, branch, aqueduct, steel, weld, cast iron, cut, rope, suspension bridge, wave, sand, damage, volcanic rock, bind, dam, stand, cross, mortar, log, lime, build.

Building materials	Actions	Structures

6. Put ✓ for true and ✗ for false statements.

1. First bridges were built by aliens.
2. Wooden logs, bamboo poles and timber boards were used to build early bridges.
3. Aqueducts and arch bridges were built by the Romans.
4. Pozzalana used by Romans consisted of lemon, sand, water and crushed stone.
5. Ancient Indians started building bridges and dams using bamboo and iron chains.
6. In China wooden and stone bridges appeared in Christian Era (Common Era).
7. Rope bridge is the prototype of an arch bridge.
8. First rope bridges appeared in South America.
9. The most significant achievement of XVII century was the construction of a concrete bridge.
10. Steel has lower tensile strength than iron.

7. Complete the article on the Quebec Bridge by adding the missing words and phrases.

FAMOUS BRIDGES

twice, wonders, sufficient, completion, happen, knowledge

In the first decade of the XX century at the Canadian city of Quebec, work began on one of the engineering [1]_____ of the age. It was the Quebec Bridge, with a center span 549 m. American engineer Theodore Cooper was chosen to design it. However Quebec Bridge had to be designed, fabricated and erected [2]_____. On August 29, 1907, when the first half of the main span was nearing [3]_____, it collapsed, killing 74 men.

How could so serious mistake [4]_____? A number of design errors have been mentioned in the Government report. The official report said: "The professional [5]_____ of

the present day concerning the action of steel columns under load is not [6]_____ to enable engineers to economically design such structures as the Quebec Bridge. To build a bridge a considerably larger amount of metal would have to be used than might be required".

8. Match the words with their definitions.

1. tensile strength	**a.** the activity of joining metal parts together
2. log	**b.** to go across from one side of something to the other
3. variation	**c.** iron that can be bent into attractive shapes and used to make gates, furniture, etc.
4. welding	**d.** the ability of a material or object to be stretched or pulled without breaking.
5. wrought iron	**e.** a mixture of sand, water, and cement or lime that is used to fix bricks or stones to each other when building walls
6. aqueduct	**f.** a thick piece of tree trunk or branch, especially one cut for burning on a fire or building something.
7. dam	**g.** a structure, consisting of a curved top on two supports, that holds the weight of something above it.
8. mortar	**h.** a wall built across a river that stops the river's flow and collects the water, especially to make a reservoir (= an artificial lake) that provides water for an area.
9. to cross	**i.** a change in amount or level.
10. arch	**j.** a structure for carrying water across land, especially one like a high bridge with many arches that carries pipes or a canal across a valley

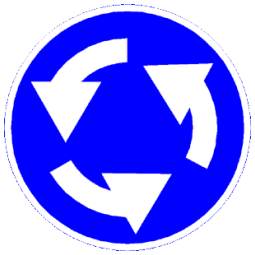
9. Discuss with the group the following topic:

- ✓ What did the invention of a bridge mean for ancient people?
- ✓ How did it influence their life?

1. Fill in the gaps using the words below:

aqueduct, logs, to damage, arch, sticks, mortar, load, ropes, welding, erection, branches, to stand.

1. Imitating monkeys, ancient people used _____ to cross obstacles such as wells and chasms (ущелье).
2. Ancient Romans built _____ to provide water to their cities.
3. _____ is a way to connect metal units with each other.
4. To span a stream or a well _____, _____ and _____ are used.
5. _____ on the bridge should be spread along the whole span length.
6. A bridge must be strong enough to _____ the entire load imposed.
7. The influence of bad weather conditions may _____ the bridge.
8. _____ of a bridge is difficult process.
9. _____ is made of cement, sand and water.
10. _____ was invented by Romans.



2. Translate the following sentences using the vocabulary of Unit 6.

1. Чтобы сплести веревку, древние люди использовали древесное волокно.
2. Арка – это красивое и прочное сооружение, которое может выдерживать большую нагрузку.
3. К сожалению, многие древние мосты на сегодняшний день повреждены или разрушены.
4. Первый сварной мост был построен по проекту Стефана Брила в 1927 году.
5. Основным недостатком использования железа, как материала для строительства мостов, является низкая нагрузка на растяжение.

6. После индустриальной революции XIX века для строительства мостов начали использоваться решетчатые конструкции.
7. Строительный раствор может состоять из известняка или цемента, смешенного с песком и водой.
8. Возведение дамбы необходимо для защиты земель от затопления, а также для создания водохранилищ и других искусственных водоемов.
9. Веревочный мост это самая простая форма подвесного моста.
10. Акведук – очень прочное сооружение, построенное римлянами и сохранившееся до наших дней.

3. Do you know any other ancient bridges? Using Power Point presentation tell your groupmates about one of them. (Use the Internet for additional information)

UNIT 7. TYPES OF BRIDGES

7A. BEAM TYPE

1. Before you start!

- ✓ What is a bridge?
- ✓ How many types of bridges do you think exist?

2. Read the words and learn them by heart.

MUST KNOW

span – расстояние между опорами, пролет

beam – балка

simple span – разрезной пролет

continuous span – неразрезной пролет

cantilever span – консольный пролет

deck – проезжая часть моста

truss – ферма

abutment – опора

pile – свая

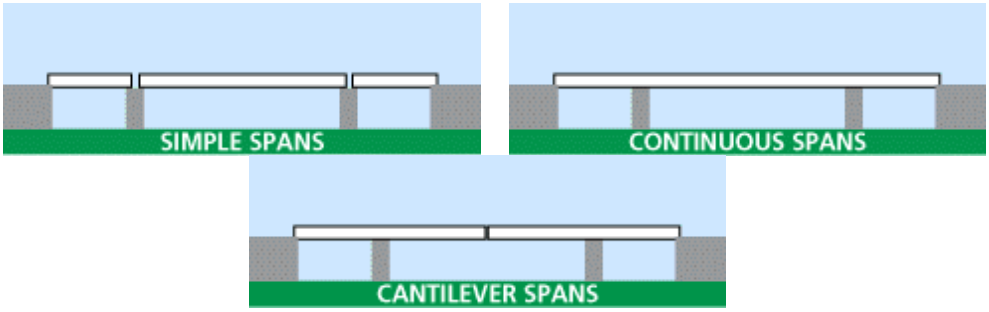
3. Read and translate the text to learn more about the basic types of bridges and beam bridge in particular.

Beam type

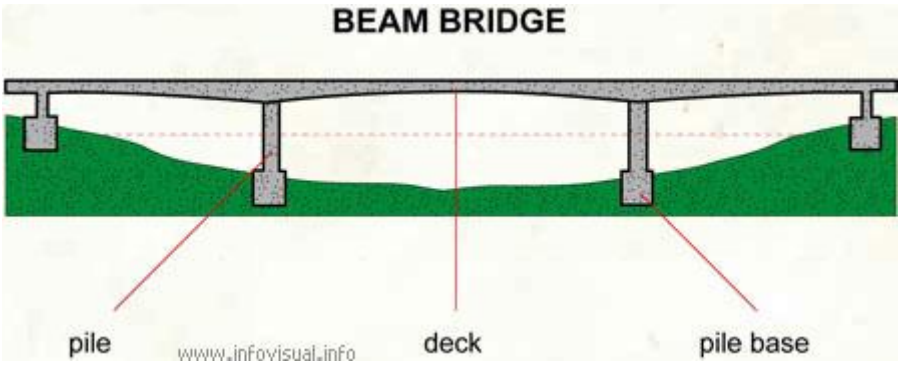
The four main factors are used in describing a bridge. By combining these terms one may give a description of bridge types:

- span (simple, continuous, cantilever),
- material (stone, concrete, metal, etc.),
- form (beam, arch, truss, etc.).

The three basic types of spans are shown below. Any of these spans may be constructed using beams or trusses.



Beam bridge is one of the basic forms. In the past it may have taken the form of a log across a stream. Modern beam bridges are usually constructed of steel or reinforced concrete, or a combination of both. In its most basic form, a beam bridge consists of a horizontal beam that is supported by abutments at each end. However, beam bridges are often only used for short distances because they have no built in supports. The only supports are provided by abutments. As a result, beam bridges rarely span more than 250 feet. This doesn't mean beam bridges aren't used to cross great distances, it only means that a series of beam bridges must be joined together, creating a continuous span.



Source: https://en.wikipedia.org/wiki/Beam_bridge

4. Answer the following questions.

1. What factors are used in describing a bridge?
2. What form did a beam bridge have in the past?
3. What materials are modern beam bridges constructed of?
4. What is the function of abutment?
5. Why are beam bridges often used for short distances?
6. Can beam bridges cross great distances?
7. What are the basic types of spans?

5. Give English equivalents to the following words and word combinations.

Консольный пролет, железобетон, через ручей, горизонтальная балка, поддерживаемый опорами, короткие расстояния, объединенный вместе, огромные расстояния.

6. Match the words with their definitions.

1. abutment	**a.** a heavy structure that supports a bridge at both ends
2. bridge	**b.** mix of cement, water, gravel, and sand used as a building and roadway material
3. steel	**c.** the horizontal space between two supports of a structure
4. concrete	**d.** the top surface of a bridge which carries the traffic
5. span	**e.** a strong metal that is a mixture of iron and carbon
6. deck	**f.** a raised structure built to carry vehicles or pedestrians over an obstacle

7. Translate the following article about beam bridges.

Ранее балочные мосты строились из дерева, пролеты которых составляли от 8 до 10 метров. В наши дни строительство деревянных мостов балочного типа ведется редко, в основном на грунтовых дорогах.

Основным несущим элементом являются балки, которые несут основную нагрузку проезжей части моста. Пролеты бывают разрезными, неразрезными, а также консольными. Разрезные пролеты опираются на две опоры по краям, а неразрезные на три и более. Крупнейший балочным мостом является железобетонный мост через озеро Понтчартрейн (США) длиной 38,4 км.

8. Find the example of a beam bridge and make its short description.

7B. ARCH TYPE

1. Before you start!

- ✓ How old do you think arch bridge is?
- ✓ Are arch bridges widely used in your country?

2. Read the words and learn them by heart.

MUST KNOW

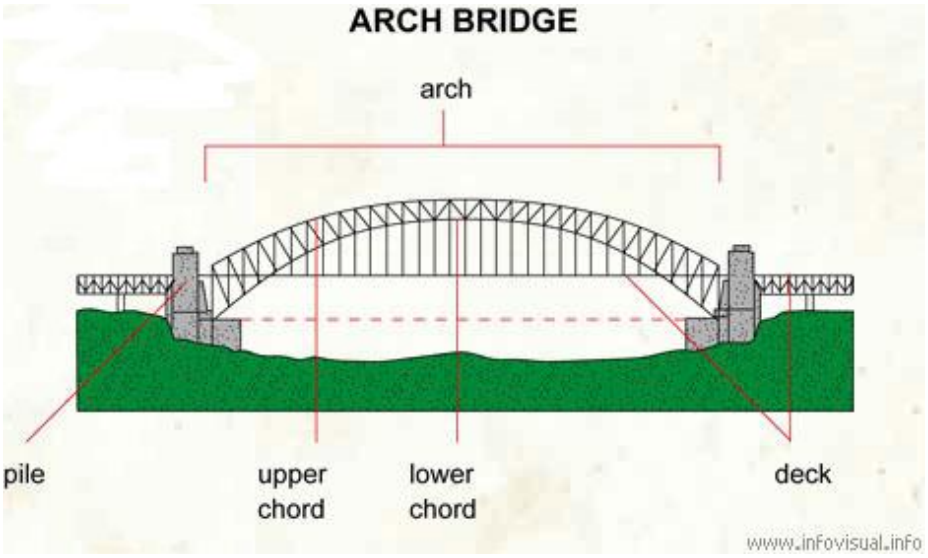
arch barrel – арочный свод

chord – арочный пояс

3. Read and translate the text to learn more about arch bridge.

Arch types

Arch bridge is one of the most popular types of bridges, which came into use over 3000 years ago and remained in height of popularity until industrial revolution and invention of advanced materials enabled architects to create other modern bridge designs. However, even today arch bridges remain in use, and with the help of modern materials arches can be build on much larger scales.



It is a bridge with abutments at each end shaped as a curved arch. Its basic principle is curved design. Abutments carry the load of the bridge and are responsible for holding the arch in the unmoving position.

Because of this design, stone and wood arch bridges became very popular during the Roman Empire, whose architects managed to build over 1000 stone arch bridges in Europe, Asia and North Africa. Many of those bridges remain standing even today, giving us the chance to see the wonders of the ancient architecture. Roman designs were usually made with semicircular arches. During the life of Roman Empire, they built many wondrous arch bridges.

Medieval architects improved the designs of Romans, creating arch bridges with narrower piers, thinner arch barrels, and increased spans of arches. Renaissance architects mixed engineering and fashion of their time, creating some of the most beautiful and famous bridges of the modern human civilization (such as Rialto Bridge in Venice).

Most modern arch bridges are made from reinforced concrete or steel. The introduction of these new materials allows arch bridges to be longer with lower spans.

Source: http://www.historyofbridges.com/facts-about-bridges/arch-bridges/

4. Answer the following questions.

1. When did arch bridges appear?
2. Are arch bridges used today?
3. What is the main principle of arch bridges?
4. How did medieval architects improve arch bridges?
5. What are abutments responsible for?
6. What materials are arch bridges made from?

5. Put ✓ for true and ✗ for false statements.

1. Arch bridge remained in height of popularity until the X century.
2. The basic principle of arch bridge is its straight design.
3. Roman designs were usually made with semicircular arches.
4. Renaissance architects created arch bridges with thinner arch barrels.
5. Modern arch bridges are made from wood.
6. Without the help of modern materials arches can be build on much larger scales.

6. Give English equivalents to the following words and word combinations.

Неподвижное положение, выдерживать нагрузку, пик популярности, усовершенствованные материалы, более крупные масштабы, изогнутый дизайн, Римская Империя, архитекторы эпохи Ренессанса, средневековые архитекторы, более тонкие арочные своды.

7. Do you know any famous arch bridges? (Use the Internet for additional information)

8. Translate the article about the Ponte Vecchio arch bridge.

«Понте Веккьо» – один из старейших и знаменитейших мостов Италии, являющийся символом Флоренции. Это самый старый каменный мост в мире. При римлянах мост был сделан из дерева, но после наводнений в 1333 году, через 12 лет он был восстановлен в камне. И уже с тех пор «Понте Веккьо» ни разу не был разрушен. Даже германские войска, взорвавшие много зданий в городе и все мосты, пощадили именно «Понте Веккьо».

По его сторонам стоят дома, в которых со средних веков размещаются торговые лавки. Мост состоит из трех отдельных арок: центральная имеет длину 30 метров, а боковые по 27 метров. Высота сводов колеблется между 3.5 и 4.4 м. Прямо над мостом еще в 1565 году был построен коридор, который сохранился до сих пор.

7C. TRUSS TYPE

1. Before you start!

- ✓ Are truss bridges popular in your country?
- ✓ What do you think is the difference between arch and truss bridges?

2. Read the words and learn them by heart.

MUST KNOW

in compression– при сжатии

in tension– при натяжении

deck truss – ферма с ездой поверху

through truss – ферма с ездой понизу

pony truss – низкая ферма без верхних связей

slope – иметь наклон

transition – переход

web member – элемент решетки фермы

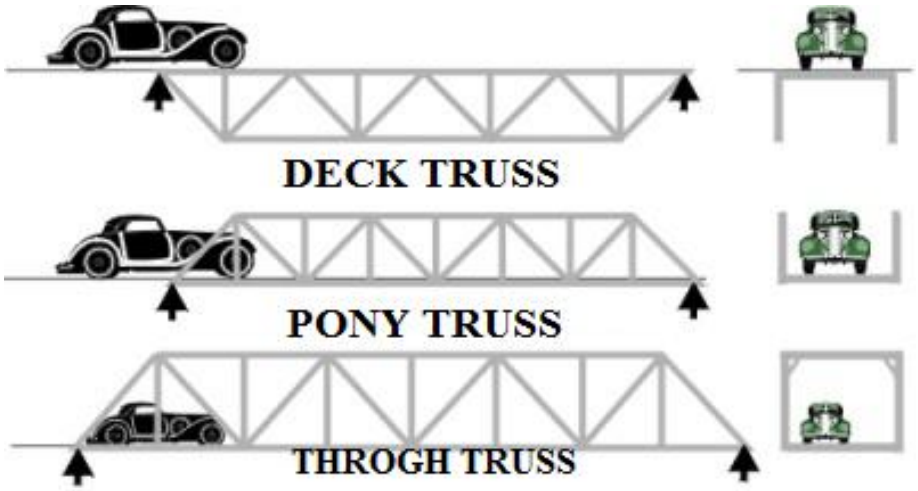
3. Read and translate the text to learn more about a truss bridge.

Truss types

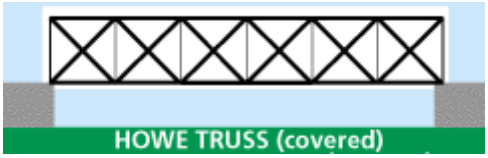
Truss bridges are one of the oldest types of modern bridges. Truss is a structure of connected elements forming triangular units. It is used because of its rigid structure and it transfers the load from a single point to a much wider area. A truss is made of many small parts. A truss bridge is economical to construct because it uses materials efficiently. Once constructed of wood, and later including iron members, most truss bridges are built of metal.

In 1820 a simple form of truss, Town lattice truss, was patented, and had the advantage of requiring neither high labor skills nor much metal. Few iron truss bridges were built in the United States until 1850. Truss bridges became a common type of bridge built from the 1870s up to the 1930s.

From the first truss bridge, engineers experimented with different forms of truss bridges trying to find better shape and the one that will suit them for the particular problems. Because of that we have many forms of truss bridges today. Truss bridge can have deck on top (deck truss), in the middle (pony truss), or at the bottom of the truss (through truss).

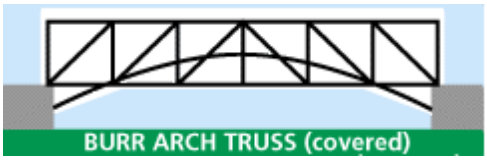


Howe truss bridge is a basic design of truss bridges based on which many engineers gave modified designs for other famous truss bridges of the world.

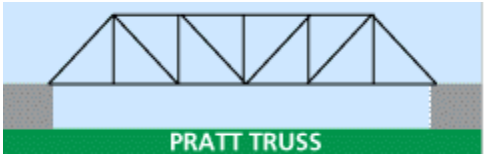


It has a simple design which consists of diagonal and vertical trusses. The diagonal trusses move upwards and slope towards the centre of the bridge. The vertical members of the truss are in tension while the members of the diagonal truss are in compression. This bridge was first designed by William Howe in 1840. Jay Bridge in New York is based on Howe's design.

Theodore Burr built a bridge over the Hudson River in 1804. It is a combination of an arch and truss which gives a strong and rigid bridge.

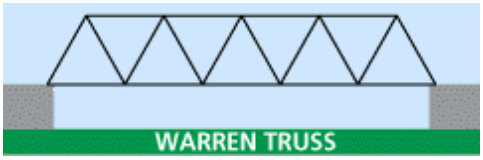


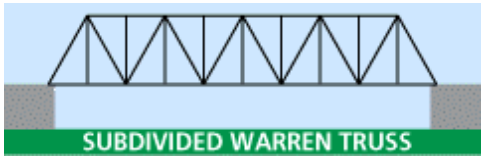
The Pratt truss is a very common type, but has many variations. Originally designed by Thomas and Caleb Pratt in 1844, the Pratt truss successfully made the transition from wood designs to metal. Such bridge has vertical members and diagonals that slope downward to the center. It is a variant commonly used for railroad bridges.



A Warren truss, patented by James Warren and Willoughby Monzani in 1848, contains many triangles formed by the web members which connect the top and bottom chords. These

triangles may also be further subdivided. It is relatively light but strong and economical truss. Warren truss may also be found in covered bridge designs.





Source: http://pghbridges.com/basics.htm

4. Answer the following questions.

1. What materials are truss bridges built of?
2. What advantage did Lattice truss type have?
3. What three types of decks does a truss bridge have?
4. What does Warren truss contain?
5. What elements does Howe truss bridge contain?
6. When was Howe truss bridge designed?
7. What does Burr bridge combine?
8. What type of a truss is used as a railroad bridge?

5. Complete the sentences using the necessary truss type.

1. _____ combines an arch with a truss.
2. _____ is a variant commonly used for railroad bridges.
3. _____ has many triangles formed by the web members which connect the top and bottom chords.
4. _____ has vertical members which are in tension and diagonal members which are in compression.

6. Give English equivalents to the following words and word combinations.

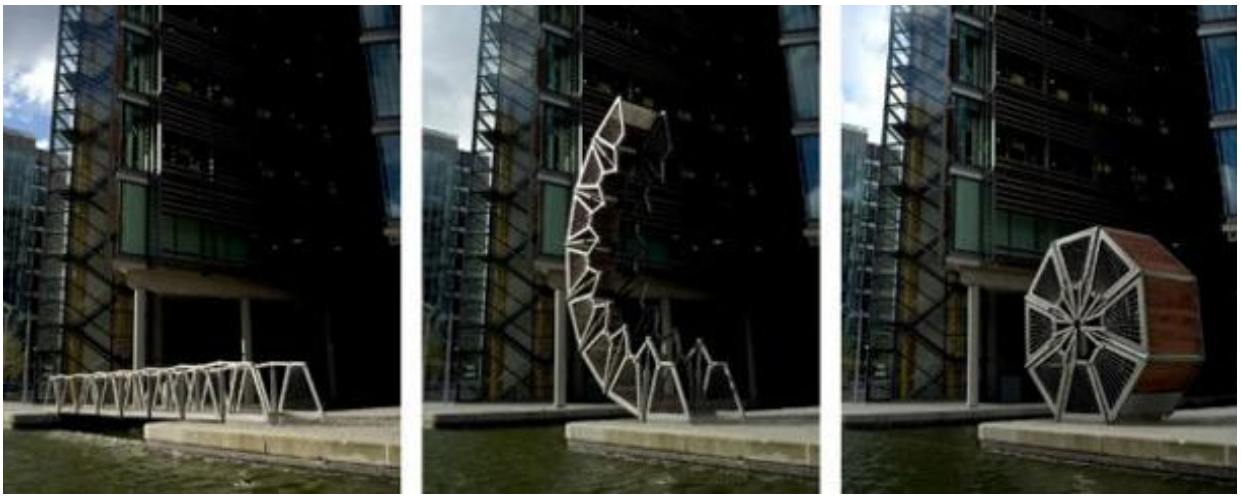
Элементы решетки фермы, сочетание арки и фермы, относительно легкий, треугольные элементы, жесткая структура, более хорошая форма, измененный дизайн, к центру моста, железнодорожные мосты, верхний и нижний пояс, крытый мост, ферма с ездой понизу.

7. Match the synonyms.

1. contain	**a.** build
2. construct	**b.** additional
3. variation	**c.** remove
4. achieve	**d.** consist of
5. extra	**e.** strength
6. eliminate	**f.** reach
7. force	**g.** modification
8. feature	**h.** decide
9. basic	**i.** characteristic
10. determine	**j.** key

8. Translate the article about the Rolling Bridge.

FAMOUS BRIDGES



Скручивающийся мост (Rolling Bridge) – это мост, который умеет сворачиваться и разворачиваться. Оригинальность идеи его создателя, английского скульптора Томаса Хизервика (Thmas Heatherwick) в 2005 году, принесла автору престижную архитектурную премию British Structural Steel Design Award.

Мост расположен в лондонском районе Падингтон (Paddington), имеет длину 12 метров, и является только пешеходным. Он сделан из стали и дерева. Данный мост связывает два берега в спокойном состоянии, но когда приближаются лодки, он

сворачивается и превращается в колесо на одном из берегов. Неудивительно, что эта удивительная конструкция привлекает много туристов.

9. What other types of truss bridges do you know? (Use the Internet for additional information)

10. Compile as many words as you can with the letters of the word.

REINFORCEMENT

_____

_____

_____

_____

7D. SUSPENSION TYPE

1. Before you start!

- ✓ What types of bridges do you remember?
- ✓ Do you know any suspension bridges in your country?

2. Read the words and learn them by heart.

MUST KNOW

suspension bridge – висячий мост

suspension cable – подвесной канат

pier – опора

severe – суровый

mat – настил

anchor – анкер, закрепление

tremendous – огромный

galloping – скачущий

withstand – выдерживать, противостоять

superstructure – верхнее строение

substructure – нижнее строение

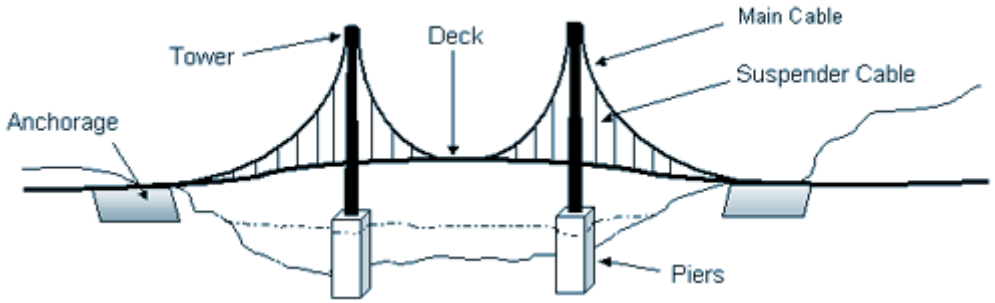
3. Read and translate the text to learn more about a suspension bridge.

Suspension type

The longest bridges in the world are suspension bridges or their cousins, cable-stayed bridges. A simple bridge based on the suspension principle was made by early man by means of ropes, and is still used in Tibet. Two parallel ropes suspended from rocks or trees on each bank of the river, with a platform of woven mats laid across them, made a secure crossing. Further ropes as handrails were added. When the Spaniards reached South America, they found that the Incas of Peru used suspension bridges made of six strong cables, four of which supported a platform and two served as rails.

The basic parts of a typical suspension bridge fall into two categories, "superstructure" and "substructure." The superstructure (super = above) is composed of a deck, two towers, and

the main suspension cables. The substructure (sub = below) is composed of the piers in the middle of the span that support the towers, and the anchors for the cables at each end of the bridge.



http://www.wsdot.wa.gov/tnbhistory/machine/machine1.htm

These bridges are usually suspended by the main cables (chain or rope) that are anchored with the towers at both ends of the bridge. Earlier, towers were not provided in suspension bridges because they were usually constructed for short spans. The cables are held up only by the towers, which means that the towers support a tremendous weight (load). The steel cables are both strong and flexible.

The greatest advantage, and disadvantage, of the suspension bridge is its lightness. This allows them to span very long distances. The lightness also allowed for quick construction but it also made them highly flexible. As a result many bridges collapsed and had to be rebuilt. This may be combination of poor design and severe weather conditions.

When it was opened in 1940, the Tacoma Narrows Bridge was the third longest suspension bridge in the world. It later became known as "Galloping Gertie", due to the fact that it moved not only from side to side but up and down in the wind. Attempts were made to stabilize the structure with cables, but they were unsuccessful.

Eventually only four months after it was built the bridge collapsed in a wind of 42 mph. The bridge was designed to withstand winds of up to 120 mph.

Today all new bridges prototypes have to be tested in a wind tunnel before being constructed. The Tacoma Narrows bridge was rebuilt in 1949.

Source: http://www.aiacincinnati.org/community/abc/curriculum/fivebridgetypes.pdf

4. Answer the following questions.

1. How was a simple suspension bridge made by early man?
2. What does superstructure include?
3. What is substructure composed of?
4. Is lightness an advantage or disadvantage? Why?
5. Why was the Tacoma Narrows Bridge called “Galloping Gertie”?
6. What kind of test is held over bridges nowadays?

5. Put ✓ for true and ✗ for false statements.

1. The cables are held up only by the towers.
2. The towers support little weight.
3. Suspension bridges can span long distances.
4. The steel cables are both strong and flexible.
5. Tacoma Narrows Bridge collapsed in 1940.
6. Bridges prototypes are tested in a wind tunnel before being constructed.
7. Earlier, there were no towers in suspension bridges because they were constructed for long spans.

6. Give English equivalents to the following words and word combinations.

Охватывать большие расстояния, выдерживать огромный вес, были сделаны попытки, суровые погодные условия, плохой проект, стабилизировать конструкцию, безопасный переход, перила, гибкий, из стороны в сторону.

7. Translate the article about the San Francisco-Oakland Bay Bridge and answer the questions.

FAMOUS BRIDGES

In 1923 a thorough study showed to authorities that a bridge across the bay (залив) between San-Francisco and Oakland could never be built. Eight miles long, the bay was the longest span of navigable water man has ever dreamed of spanning with a bridge. Also it was an earthquake area. In an earthquake a bridge pier would break like a pencil.

Ten years later the work began. A caisson (железобетонная кессонная конструкция) half an acre in area and 77 1/2 feet high was brought to the bay and anchored by 24 concrete

anchors.

The caisson had been designed like a ship with watertight compartments (водонепроницаемый отсек). By manipulating the water pressure and air pressure the huge structure was made to descend.

Even before the caisson was in place, its sides were built up high again. It was like putting up a building by building up the walls as it sank into the earth. So the caisson went down to become the main foundation of San-Francisco Oakland Bay Bridge.

https://commons.wikimedia.org/wiki/File:San_Francisco_Oakland_Bay_Bridge-2.jpg

The bridge contains six lanes for automobiles on the upper deck and, on the lower deck, three for trucks and two for trains. It tunnels through a hill on the one of the islands. Cables were needed to hold up a suspension span 71,000 miles of wire. This made a pretty problem for engineers. A rise of one degree in the temperature in San-Francisco increases the length of wire by nearly half a mile, a fall of one degree contracts (сокращаться) it that much, and the weight of the spans alone has stretched the wire 140 miles.

1. Why could a bridge pier easily break in that area?
2. What did the caisson remember?

8. Complete the article on the Akashi-Kaikyo suspension bridge by adding the missing words and phrases.

FAMOUS BRIDGES

1988, longest, cubic, earthquakes, concrete, circle, Japan's, disaster, Kobe

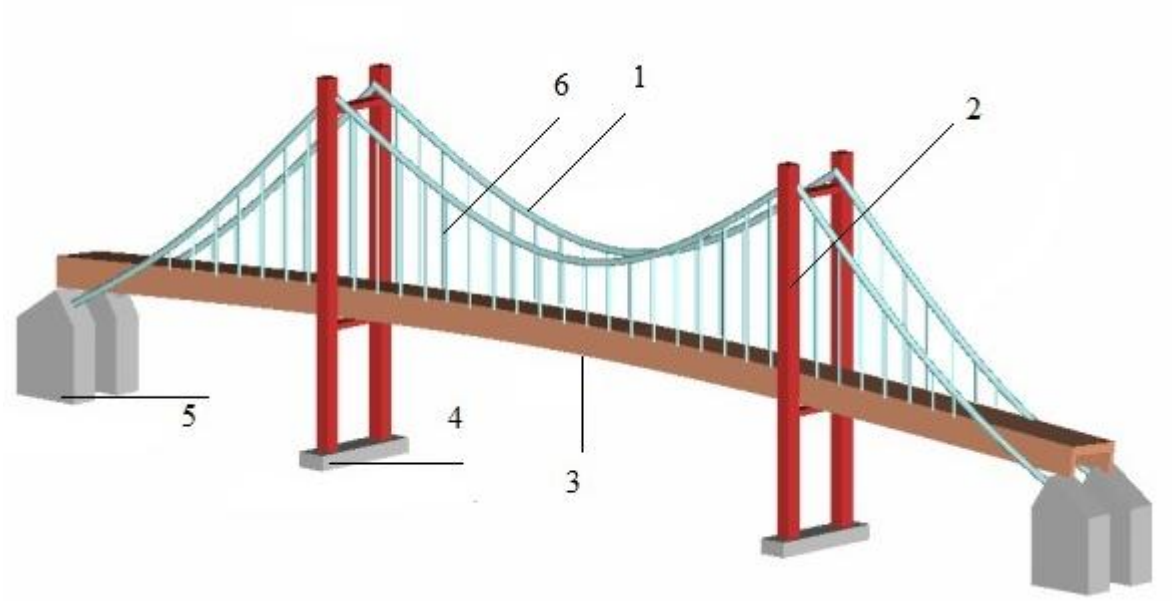
The Akashi Kaikyo Suspension Bridge is the [1]_____ suspension bridge in the world and it is probably [2]_____ greatest engineering feat (подвиг). In addition to the long span, this bridge was designed to resist huge [3]_____ and hurricane force winds.

It took 2 million workers ten years to construct the bridge, 181 000 tons of steel and 1.4 million [4]_____ metres of [5]_____. The steel cable used would [6]_____ the world seven times.

It has six lanes and links the island of Awaji and the mainland city of [7]_____, a distance of four miles. The concept of building a bridge across the Akashi Straits became urgent after a [8]_____ in 1955. A ferry (паром) carrying over one hundred children sank after colliding with another ferry in the busy shipping lane. One hundred and sixty eight children and adults died in the disaster. Political pressure for a bridge increased and in [9]_____ construction began.

9. Match the following words and word combinations with parts of a suspension bridge shown in the picture given below:

main cable, tower, piers, anchor, deck, suspender cable



10. Describe three well-known suspension bridges. One in each of the following countries:

- ✓ Japan
- ✓ UK
- ✓ USA

7E. CABLE-STAYED TYPE

1. Before you start!

- ✓ Do you know any cable stayed bridges in your country?
- ✓ Are they similar to suspension bridges?

2. Read the words and learn them by heart.

MUST KNOW

cable-stayed bridge – вантовый мост

computer aided design (CAD) – система компьютерного проектирования

to simulate – моделировать

precisely – точно, четко

anchor block – анкерный блок

substantially – практически, по существу

to counter balances – уравновешивать

to surpass – превосходить

3. Read and translate the text to learn more about a cable-stayed bridge.

Cable-stayed type

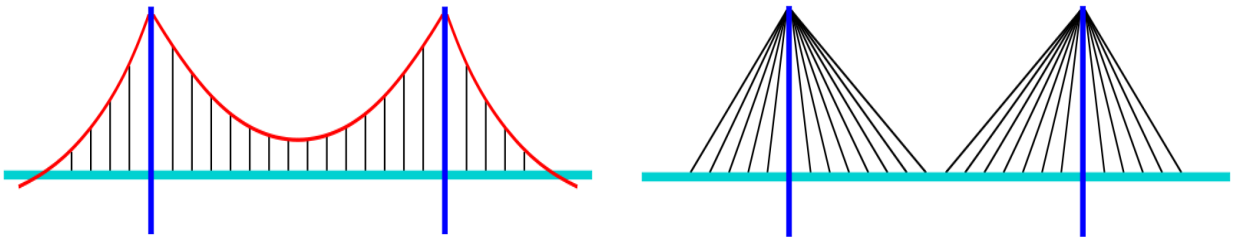
A scientific understanding of the properties of modern materials and the availability of computer software have made it possible to build new types of bridges. The newest type of bridge is the cable-stayed bridge. They have great popularity in recent years because of their great beauty and economy.

These modern bridges are designed using computer aided design (CAD). Bridge designers are now able to design a bridge on computer, simulate its use and correct any faults before building begins. Modern materials, especially special steels are used to construct this type of bridge. This means that bridges can be made from lighter, stronger materials and engineered precisely. Today materials are used efficiently. Older bridges (built in the 19th and early 20th century) such as suspension bridges were designed on paper and the design could not be

simulated before being built. Consequently, designers ensured that early steel, stone, concrete bridges were constructed from more materials than were actually required – just in case the final bridge was too weak and collapsed.

Unlike suspension bridges, cable stayed bridges do not need anchor blocks. The cables are fixed to either side of each tower – this means that the weight of each side of the bridge counter balances the opposite side. The absence of anchor blocks substantially reduces the amount of materials needed and the cost of building the bridge. Also, the towers tend to be positioned down the centre of the roadway and half as many towers are needed compared to suspension bridges.

Two well known cable-stayed bridges can be found in France. The 'Le Pont de Normandie', can be found in Normandy, Northern France. This was once the longest cable stayed bridge in the world. However, this engineering feat has been surpassed by the opening of the Millau Bridge in Southern France. This cable stayed bridge is the highest bridge in the world, with its deck almost at the same height as the Eiffel Tower.



Suspension type

Cable-stayed type

Source: http://www.aiacincinnati.org/community/abc/curriculum/fivebridgetypes.pdf

4. Answer the following questions.

1. Why are cable-stayed bridges so popular?
2. What do bridge designers use for the construction of a cable stayed bridge?
3. Does a cable stayed bridge need an anchor block?
4. What modern material is used to construct a cable stayed bridge?
5. Where are the cables fixed?
6. What does the absence of anchor reduce?
7. Where are towers positioned?
8. What is the highest bridge in the world?
9. How are modern bridges designed?

5. Put the following sentences in the correct order.

1. ____ 2.____ 3.____ 4.____ 5.____ 6.____ 7.____ 8.____ 9.____ 10.___

A. Suspension bridges were designed on paper.

B. These modern bridges are designed using CAD.

C. Cable-stayed bridges have great popularity because of their great beauty and economy.

D. The absence of anchor blocks reduces the amount of materials needed and the cost of building the bridge.

E. The 'Le Pont de Normandie' was once the longest cable stay bridge in the world.

F. The cables are fixed to either side of each tower – this means that the weight of each side of the bridge counter balances the opposite side.

G. Millau Bridge in Southern France is the highest bridge in the world.

H. Cable stayed bridges do not need anchor blocks.

I. Modern materials, especially special steels are used to construct this type of bridge.

J. The towers tend to be positioned down the centre of the roadway.

6. Give English equivalents to the following words and word combinations.

Свойства современных материалов, система компьютерного проектирования, самый высокий мост, в отличие от висячих мостов, кабели (тросы) зафиксированы, уравновешивать противоположные стороны, исправлять какие-либо ошибки, следовательно, слишком слабый, количество требуемых материалов, отсутствие анкерных блоков, стоимость строительства моста, компьютерное программное обеспечение, доступность, до начала строительства, разрушаться, значительно снижает.

7. Read the article about Brooklyn Bridge which refers to cable-stayed type.

FAMOUS BRIDGES

The Brooklyn Bridge was built in 1883. It is still one of the most popular places of interest in New York. The plan for the Brooklyn Bridge was made by John Roebling in 1867. By this time he had already been famous. Years before he had invented the steel cable. Using this steel cable he has built several bridges, one at Niagara Falls and a second across the Monongahela River at Pittsburgh. He was sure he could build this new bridge. He began to work

making the plans for the bridge. He sent his son Washington to Europe to study some new bridges there. Some experiments had been made with working in a large box under water.

And then the accident happened. Roebling was working near the river. A boat struck the dock on which he was standing. Two weeks later he died. Before he died he asked that his son Washington would continue his work.

W. Roebling began to work with the same interest and energy as his father. According to the plans, there were to be two large towers. One of these towers was to be on the Brooklyn side of the river and the other was to be on the Manhattan side. The system of steel cables was to hung from the towers. These steel cables were to hold the bridge.

https://commons.wikimedia.org/wiki/File:Brooklyn_Bridge_panorama.jpg

Today engineers know how to do these things as they have special machines. But at that time no one knew exactly how to do this work. The Brooklyn Bridge was the first bridge of its kind in the world. They used the new box that Washington Roebling had studied in Europe. The box was made of wood and was about the size of a house. In this box men could work under water. Air was forced into the box and the water was forced out of it. It was very dangerous. One day a worker went down into the box, but within-half an hour he began to feel strong pains. Five minutes later he was dead. The same thing happened to other men. One day Roebling himself had a similar attack. He could not talk. He could not hear. He became paralyzed. After a week or two he felt better. He went back again to work in the box. He had a second attack, more serious than the first. He was unable to work again during the rest of his life. He remained a cripple (калека). Yet the work had to continue. And Washington Roebling continued to direct the construction of the bridge. His home was near the bridge. Using a telescope he watched the work. Every day his wife went to the bridge and carried her husband's orders to the men. In this way, year after year the work continued.

In 1883 the bridge was officially opened. Many important people, including the President

of the US, took part in the ceremony. Washington Roebling watched the ceremony through his telescope.

The bridge was one of the wonders of the nineteenth century. It is still today. There is more traffic on it today than ever before. The bridge remains very strong. It also remains a monument to the two men who built it, John Roebling and his son Washington.

Mind the pronunciation of the following geographic names:

Niagara Falls [nʌɪˈag(ə)rə] – Ниагарский водопад

Monongahela [məˌnɒngəˈhiːlə] – р.Мононгахила

Pittsburgh [ˈpɪtsbəːg] – г. Питтсбург

8. Choose the correct answer.

A. During the construction of the bridge the people used the box:

1) which was constructed by John Roebling;
2) which was used in Europe;
3) which was invented by Washington Roebling.

B. Washington Roebling became a cripple after:

1) he had fallen down the bridge;
2) he had an accident during the construction of the bridge at Niagara Falls;
3) he had worked in the box.

C. Washington Roebling:

1) did not live to see the ceremony of the opening the bridge;
2) could see the ceremony;
3) was at the ceremony.

9. Complete the article on the Normandy bridge by adding the missing words and phrases.

FAMOUS BRIDGES

engineers, suspension, 1995, France, lorries, employed, tested, largest, height, expensive

Le Pont De Normandie or the Normandy Bridge (Northern France) is one of the [1]_____ cable stayed bridges in the world and while under construction the building site was the largest in [2]_____. Over 1600 people were [3]_____ to help design and build the

bridge including designers, [4]_____, suppliers and people from other sectors of industry. It was built from 1988 to [5]_____ and at this time it was the longest in the world.

One of the main reasons for building a cable-stayed bridge is that it is more stable in the wind than a [6]_____ bridge but also it is less [7]_____ to construct. The Normandy Bridge has 184 cable stays which support the weight of the deck. The bridge was [8]_____ after completion with a weight of [9]_____ equal to 16000 tons. Each of the two pylons which hold the cables are 214 metres in [10]_____ and weigh 20,000 tons.

10. Read the following texts about three cable-stayed bridges. Put ✓ for true and ✗ for false statements.

1. The longest bridge is the Sutong Yangtze River Bridge.
2. The oldest bridge is the Tatara Bridge.
3. The Tatara Bridge is longer than the Rion-Antirion Bridge.
4. The Rion-Antirion Bridge has the highest towers.
5. The Sutong Yangtze River Bridge has the shortest main span.

The Sutong Yangtze River Bridge in China has a main span of 1,088 m. There are also side spans, making the total bridge length 8,206 m. The two highest towers in the bridge are 306 m high. The bridge opened in May 2008.

The Rion-Antirion Bridge is in Greece. Completed in August 2004, the bridge is 2,880 m long and 28 m wide. The cable-stayed deck is 2,252 m long. It has four towers, each 220 m high.

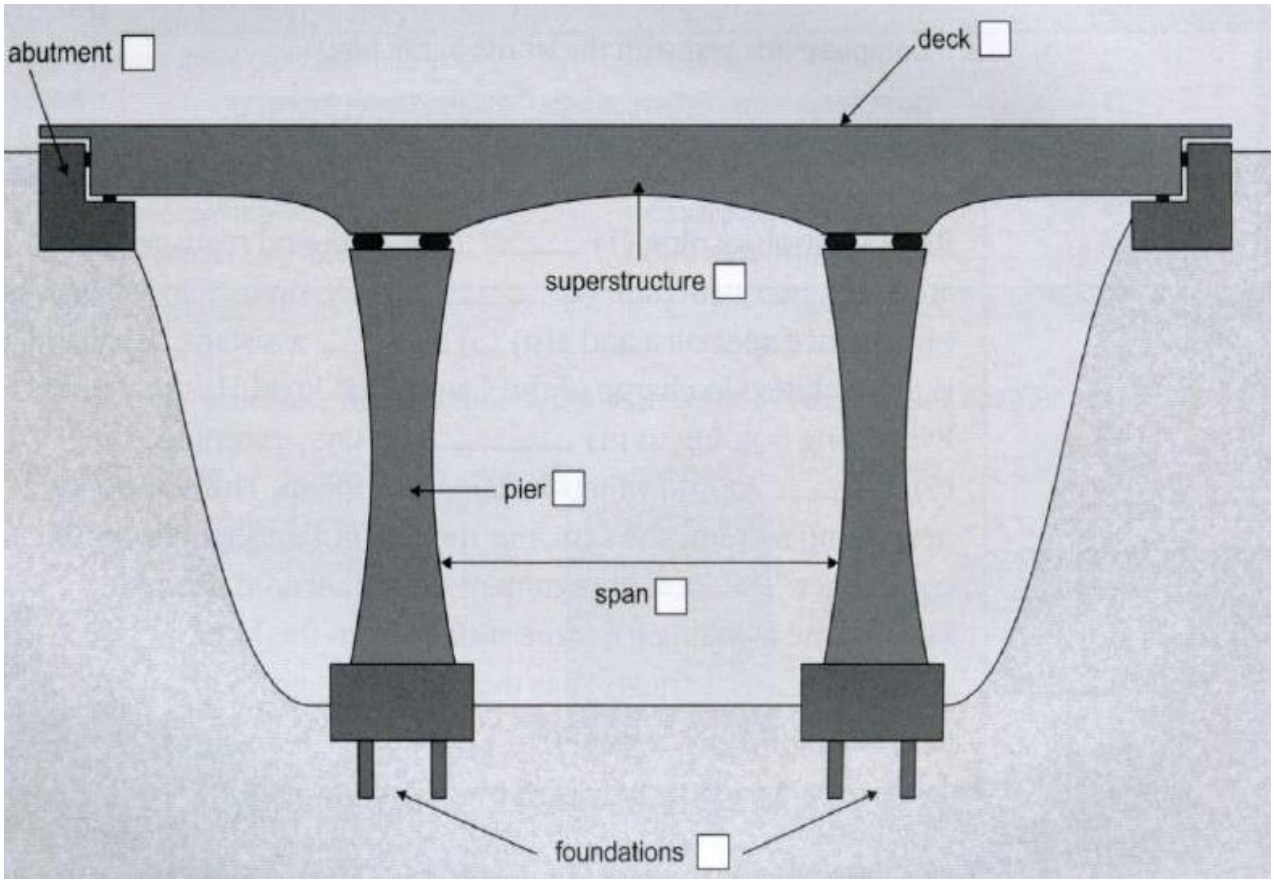
The Tatara Bridge in Japan has a total length of 1480 m, with a main span of 890 m. The deck width is 30.6 m and the towers are 220 m high. The Tatara Bridge was completed in May 1999.

11. Find the example of cable-stayed bridge type in the internet and make a presentation.

FINAL TASKS

1. Look at the picture given below and put ✓ for true and ✗ for false statements. Correct the false sentences.

1. The deck is above the superstructure.
2. The piers are below the foundations.
3. The superstructure rests on the piers and abutments.
4. The bridge has three abutments.



2. Read the descriptions of five bridge types and match texts A-E to pictures 1-5.

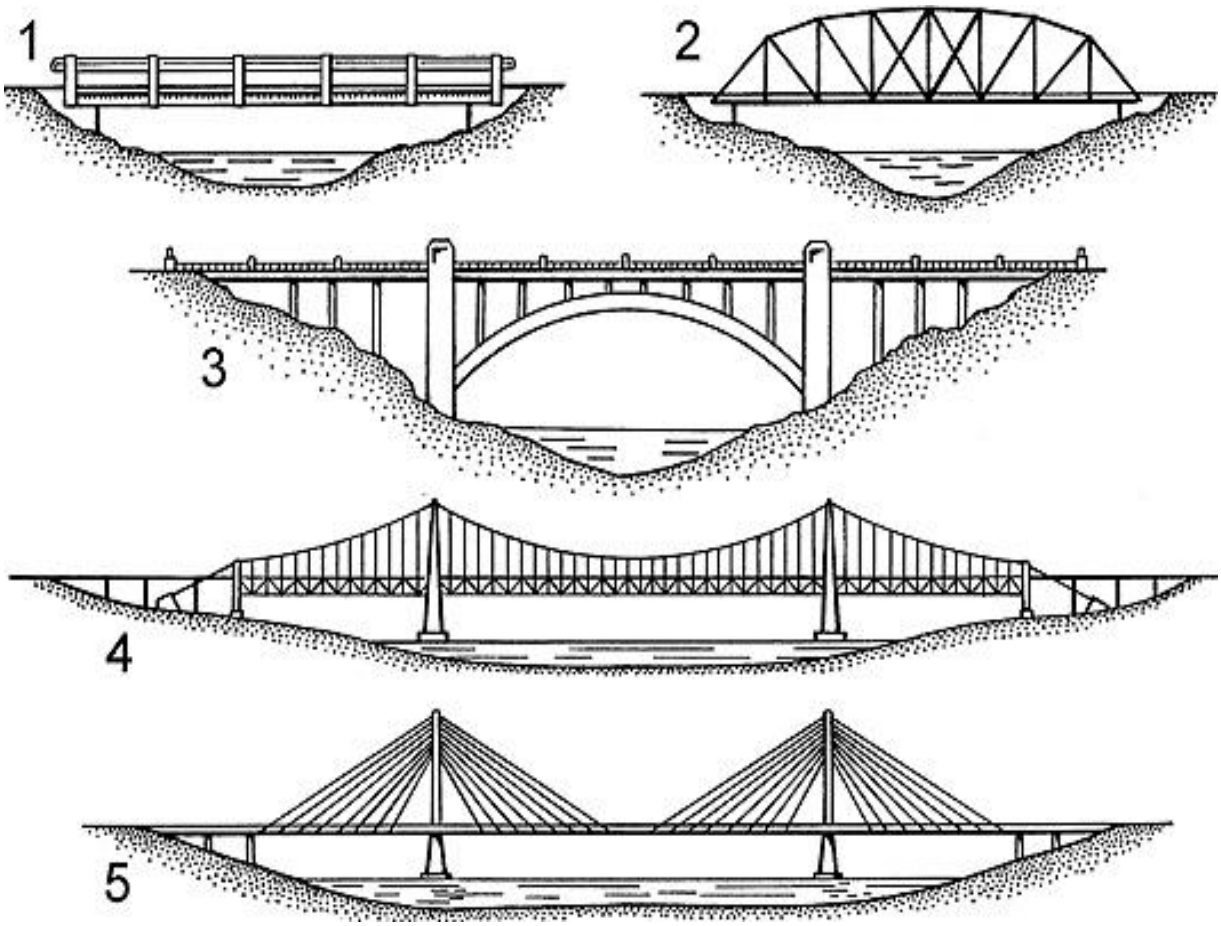
A. In a suspension bridge, cables go from one tower to another and the deck hangs from vertical suspenders attached to the main cable.

B. Arches are normally semicircular in shape. In this type of bridge, there are no cables or towers.

C. Beam bridges are the most common type of bridge. The design is very simple. The beam sits on top of two or more supports or abutments.

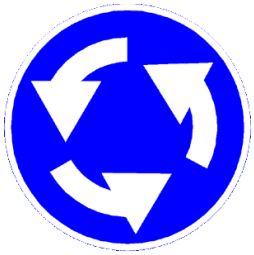
D. In a cable-stayed bridge, the cables go directly from the tower to the deck. Cable-stayed bridges can have any number of towers.

E. A truss bridge is a bridge whose load-bearing superstructure is composed of a truss, a structure of connected elements forming triangular units.



3. Put these phases of bridge construction in the correct order 1-7.

___ foundations
___ pier construction
___ superstructure
_1_ design
___ deck
___ site preparations
___ opening ceremony



4. Translate the following sentences using the vocabulary of Unit 7.

1. Мост Миллениум, находящийся в Казани, является примером вантового моста.
2. Арочные мосты могут быть с ездой поверху и понизу.
3. Ферма состоит из элементов, образующие треугольные детали.
4. Пролетные строения балочных мостов выполняются из стали, дерева или железобетона.
5. Мост со сквозными фермами выдерживает силу сжатия и натяжения.
6. В России висячие мосты не получили такого большого развития, как в США, Англии, Франции, Японии и других странах.
7. Ферма Пратта содержит элементы решетки фермы, которые образуют V-образную форму.
8. Висячие мосты используются в случае большой длины моста.
9. Мост является одним из древнейших инженерных изобретений человечества.
10. Арочные мосты характерны для горных условий, поскольку позволяют перекрыть больший пролет, чем балки.
11. Русский мост, относящийся к вантовому типу, является одним из самых уникальных и сложных объектов во всей практике мостостроения в России.
12. Самым длинным разводным мостом (drawbridge) является мост Александра Невского через Неву.
13. Разводные мосты позволяют пропускать судна любой высоты через реку.

5. Read this information about a bridge project and present your own project about it. Draw and label a diagram with the dimensions.

Type:	beam	**Height:**	56 m (highest point)
Materials:	steel and concrete	**Start date:**	Sept 2009
Piers:	3	**Completed:**	Nov 2010
Length:	46 m	**Location:**	northern Germany
Width:	24 m	**Client:**	government

6. Find and present the information about the bridge which you consider the most beautiful. You should mention:

1) the name of the bridge;
2) the type of the bridge;
3) where it was constructed;
4) when it was constructed;
5) who it was designed by;
6) construction materials which were used;
7) how long, wide, high it is;
8) some interesting facts connected with this bridge
9) why you consider it to be most beautiful.

UNIT 8. BRIDGE CONSTRUCTION PROCESS

8A. STAGES OF BRIDGE CONSTRUCTION

1. Before you start!

- ✓ What should you start from when you are building a bridge?
- ✓ What aspects should you consider?
- ✓ What resources will you need?

2. Read the words and learn them by heart.

MUST KNOW

inspection – контроль качества

surveyor – геодезист, землемер

to pour – заливать

to aid – помогать

ravine – ущелье, овраг

legwork – пеший обход

to ship – доставлять

filling – заполнение

measuring device – измерительный прибор

upkeep costs – эксплуатационные расходы

to break ground – начинать экскаваторные работы

to take into account (consideration) – принимать во внимание

steel design manual – руководство по проектированию стальных конструкций

placement – размещение

to resist – противостоять

traffic load – транспортная нагрузка

tinker toy – детский конструктор

engineered – специализированный

nuts and bolts – детали

to make calculations – делать расчеты

corrosion – ржавление, коррозия

paving machine – асфальтоукладчик, бетоноукладчик

replacement costs – издержки на замену деталей

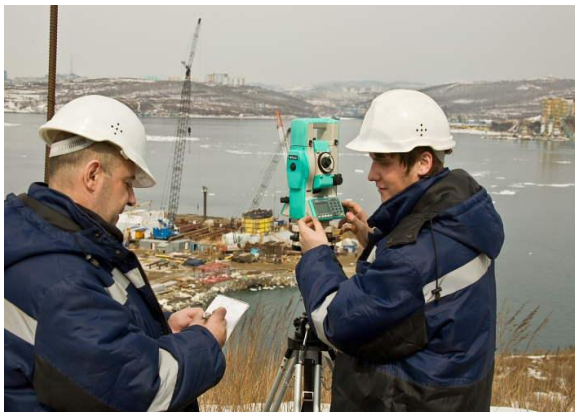
composite material – композиционный материал

3. Read and translate the text to learn more about the process of bridge construction.

Stages in bridge construction

1. Determine what type of bridge you need for the situation. The common types are arch, suspension, truss, cable-stayed and beam types. If you're crossing a short span, you probably only need to build a beam or a small truss bridge. If you're crossing a deep ravine, an arch bridge might be the best choice. A bridge to span an ocean bay requires the very expensive suspension bridge.

2. Identify an ideal place to build the bridge. A lot of legwork goes into determining the ideal site to build anything, and when you're talking about something as expensive as a bridge, engineers are even more careful. The engineering team will send out surveyors, people who use electronic measuring devices to make a map of the general area. From this map, they will make calculations and determine the length and placement of the bridge.



http://www.rusmost.ru/news/press/2010/04/19/news_160.html

3. Design the bridge. The engineer will take into account the potential traffic load of the bridge and use steel design manual and computer programmes to aid in the bridge designing process. The materials chosen should also take into consideration the inspection and upkeep costs after the bridge is built.

4. Break ground. Once the design has been finalized and stamped with approval, the actual building can begin. This will involve excavation or filling the banks on either side, stabilizing the ground where the supports will be placed and, depending on what type of bridge is going to be built, pouring concrete.

5. Assemble the steel. Some bridges are built on site and some are put together in pieces small enough to ship to the location and then assembled. Using the anchors placed in the concrete, the steel units are put together like tinker toys using nuts and bolts.

6. Build the decking for the bridge. This is usually concrete, but can also be aluminium and new engineered composite materials which resist corrosion, decreasing bridge replacement costs.

7. Pave the new bridge. This is done with paving machines. The government agency sponsoring the project might also include a repaving of the surrounding roadway as well.

http://www.crec.cn/ecrpcec/tabid/1421/InfoID/16049/frtid/1374/Default.aspx

8. Have the ribbon cutting ceremony. Building a bridge is one of the most tremendous accomplishments. After months or possibly years of building this bridge the dust can settle and the public can finally use it.

Source: http://www.ehow.com/how_2045959_build-bridge.html

4. Answer the following questions.

1. What type of bridge should you chose if you want to cross a short span?
2. Is it easy to find a good site for a bridge?
3. What specialists and equipment will you need for it?
4. What aspects should be considered for correct bridge design?
5. What does the first step of building operations include?
6. What are the two ways of assembling a bridge?
7. What decking is usually used for bridges?
8. What type of decking can reduce bridge replacement costs?
9. What equipment is used for paving a bridge?
10. In what approximate period of time will people be able to use the bridge?

5. Give English equivalents to the following words and word combinations.

Анкер, транспортная нагрузка, издержки на замену деталей, противостоять, асфальтоукладчик, проезжая часть моста, план местности, строительная площадка, геодезист, эксплуатационные расходы, проектирование, ржавление, композиционный материал, размещение, длина, собирать, контроль качества, заполнение, измерительный прибор.

6. Put ✓ for true and ✗ for false statements.

1. If the ravine you need to cross is shallow and short you need to use a beam or small truss bridge.
2. Engineers should be careful when choosing a place for bridge construction.
3. Crane operators usually make a map of the general area.
4. The map is necessary for not to get lost at the construction site.
5. When designing a bridge engineers pay special attention to people needs and conservation of nature around.
6. To start building a bridge it is necessary the design to be stamped with approval.
7. Where supports are to be placed deep holes must be dug.
8. It is impossible to assemble the units of a bridge beforehand.
9. Engineered composite materials can resist corrosion better than concrete.
10. A bridge is paved with the help of concrete pavers.

7. Match the words to get the correct word combinations.

1. to resist	**a.** metal
2. building materials	**b.** costs
3. to assemble	**c.** a support
4. corrosion of	**d.** tension
5. to make	**e.** bridge
6. to ship	**f.** decking
7. replacement	**g.** inspection
8. to place	**h.** calculations
9. aluminium	**i.** a house
10. to pave	**j.** units

8. Discuss with the group the following topics:

- ✓ What other stages of bridge construction would you point out? Why?
- ✓ What is the most difficult stage in your opinion?

9. Complete the conversation.

drawbridge, types, projects, experience, bridge

Interviewer: So, Ms. Andrews, it says on your application that you used to work for GMA Engineering.

Applicant: That's right. I headed several bridge design [1]_____ there.

Interviewer: That's excellent. What [2]_____ of projects did you handle?

Applicant: Well, for my last project, I was the lead engineer on the Unibar Bridge construction.

Interviewer: That's a suspension [3]_____, isn't it?

Applicant: Yes, it replaced the old beam bridge across the bay. The county needed something that could handle much higher traffic flow.

Interviewer: Wow. We do need someone with that kind of [4]_____. That must have been a major project.

Applicant: It was. We made it a double-decked (двухъярусный) bridge with northbound traffic above and southbound traffic below.

Interviewer: Our upcoming project is actually a [5]_____ that needs to accommodate passing boats. Are you prepared to take on a project like that?

Applicant: I don't have a lot of experience with drawbridges, but I'm eager to learn.

Interviewer: Well, that's something we like to see, too.

10. Make up a dialogue.

Student A: You are an interviewer for a construction company. Talk to Student B about:

• his or her bridge design experience

• types of bridges

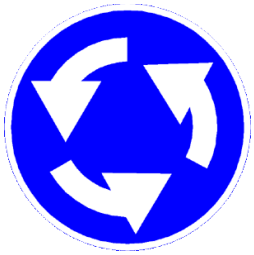
• an upcoming project

Student B: You are a job applicant. Talk to Student A about your bridge design experience.

1. Fill in the gaps using the words below:

replacement cost, corrosion, ship, measuring equipment, ravines, surveyors, to determine, to pour, break ground, map.

1. To measure tensile strength you need to use _____.
2. To fix supports concrete is usually _____ on the site.
3. _____ aid project managers to create the map of the general area.
4. A _____ gives us information about the construction site.
5. _____ can be decreased if we use aluminium decking.
6. Before building a bridge you need to _____ what type of bridge you are going to use.
7. It is possible to _____ only when all formal procedures are settled.
8. Lorries _____ prefabricated units to the construction site.
9. Bridges are used to cross _____.
10. _____ can be caused by bad weather conditions, especially rains.



2. Translate the following sentences using the vocabulary of Unit 8.

1. Количество опор зависит от предполагаемой длины моста.
2. Бетон – один из необходимых материалов при строительстве моста.
3. Транспортная нагрузка в больших городах очень велика.
4. При строительстве моста необходимо учитывать и эксплуатационные расходы.
5. Пеший обход строительной площадки очень важен для составления плана местности.
6. Анкер фиксирует арматуру железобетонной конструкции.
7. Проектирование моста это сложный и трудоемкий процесс.

8. Использование современных композиционных материалов в строительстве мостов позволяет снизить издержки на замену деталей.
9. Принимая во внимание размещение будущего моста, выбирается его тип.
10. Чтобы правильно построить мост, нужно следовать руководству по проектированию стальных конструкций.

3. Tell your groupmates about one particular bridge construction process. Discuss it together.

4. Find all the words related to bridges and give their translation.

P	**R**	**C**	**T**	**S**	**B**	**R**	**I**	**D**	**G**	**E**
I	**U**	**H**	**R**	**S**	**A**	**N**	**D**	**P**	**S**	**E**
L	**F**	**O**	**U**	**N**	**D**	**A**	**T**	**I**	**O**	**N**
E	**S**	**R**	**S**	**L**	**W**	**B**	**D**	**E**	**C**	**K**
Z	**P**	**D**	**S**	**B**	**L**	**U**	**A**	**R**	**C**	**H**
C	**A**	**B**	**L**	**E**	**S**	**T**	**A**	**Y**	**E**	**D**
I	**N**	**G**	**H**	**A**	**C**	**M**	**D**	**F**	**L**	**T**
P	**O**	**V**	**B**	**M**	**N**	**E**	**M**	**J**	**C**	**B**
Q	**S**	**U**	**S**	**P**	**E**	**N**	**S**	**I**	**O**	**N**
A	**N**	**C**	**H**	**O**	**R**	**T**	**S**	**I**	**T**	**E**

UNIT 9. TUNNEL CONSTRUCTION

9A. HISTORY OF TUNNELS

1. Before you start!

- ✓ Are there many tunnels in your country?
- ✓ What is the difference between tunnels and bridges?

2. Read the words and learn them by heart.

MUST KNOW

workforce – рабочая сила

harsh terrain – труднопроходимая местность

sewer – водосточная труба

vicinity – окрестность

hostile – неблагоприятный

march – поход

ventilation shaft – вентиляционная шахта

footprint – земля, отчужденная под строительство

tide – морской прилив и отлив

shipping – судоходство

3. Read and translate the text to learn more about a tunnel and its history.

History of tunnels

A tunnel is an underground or underwater passage that is primarily horizontal. A tunnel may be for foot or vehicle traffic, for rail traffic, or for a canal. Some tunnels are aqueducts to supply water for consumption or for hydroelectric stations or are sewers. A tunnel is relatively long and narrow; the length is often much greater than twice the diameter.

Some 3000 years ago, when our ancestors started discovering techniques of building stable and strong bridges, they also discovered new way of connecting two points of land – tunnels. This discovery was initially used not for transport of goods and people across harsh

terrains, but for defensive purposes in the vicinities of important military or royal posts (tunnels below castles). Babylonian and Persian architects were the first who saw the potential of large underground networks of tunnels called kareez. These irrigation tunnels were used to transport water underground trough deserts, enabling life in some of the most hostile lands on planet. In Babylonia, royal families enjoyed fresh water from Euphrates that was delivered to them through incredibly built 900m long tunnel that was lined with bricks.

Greeks and Romans took all the knowledge of Babylon and Ancient Egypt, and improved it. With tunnels they were able to transform marches, transport water through mountains, and create pedestrian tunnels trough very harsh terrains. To this day historians wonder how much workforce was involved in the construction tunnel between Naples and Pozzuoli that was created around 36 BC. This incredible structure was 4800 foot long, 25 foot wide and 30 foot high, and it even had ventilation shafts. Less than 100 years later in 41 AD, Romans used around 30,000 workers to build even larger tunnel that was 5.6 km long.

http://samoe-samaya.ru/wp-content/uploads/2012/08/samyi-dlinnyi-avtomobilnyi-tonnel-v-mire.jpg

In European Middle Ages, tunnels were almost exclusively used for mining or for military. After public transportation they finally started to grow under the influence of Renaissance and trading with distant lands. Hundreds of smaller tunnels were created between mid-1600s and XIX century, but by then new driving force of tunnel construction came – railroads. This new form of transport soon enabled spreading of tunnels across entire world.

Choice of tunnels vs. bridges

Bridges usually require a larger footprint on each shore than tunnels. In areas with expensive real estate, such as Manhattan and urban Hong Kong, this is a strong factor in tunnels' favor. Boston's Big Dig project replaced elevated roadways with a tunnel system to increase traffic capacity, hide traffic, redecorate.

Other reasons for choosing a tunnel instead of a bridge include avoiding difficulties with tides, weather and shipping during construction, aesthetic reasons (preserving landscape and scenery).

However, there are particular hazards with tunnels, especially from vehicle fires when combustion gases can asphyxiate users, as happened at the Gotthard Road Tunnel in Switzerland in 2001.

Source: http://www.historyofbridges.com/bridges-history/history-of-tunnels/

Mind the pronunciation of the following geographic names:

Babylonia [ˌbabɪˈləʊnɪə] – Вавилон

Euphrates [juːˈfreɪtiːz] – р. Евфрат

Naples [ˈneɪp(ə)lz] – г. Неаполь

Pozzuoli [pɒtˈswoʊli] – г. Поццуоли

4. Answer the following questions.

1. What is a tunnel?
2. Is the length or diameter of a tunnel greater?
3. When were tunnels discovered?
4. What were tunnels initially used for?
5. Who was the first to notice the potential of tunnels?
6. What was the function of irrigation tunnels?
7. What was the function of tunnels in Middle Ages?
8. What form of transport enabled spreading of tunnels across the world?
9. What are the main reasons for choosing tunnels instead of bridges?
10. What hazards are there with tunnels?

5. Give English equivalents to the following words and word combinations.

Гидроэлектростанции, пешеходное движение или движение транспортных средств, дорогая недвижимость, железные дороги, поставлять воду, водосточные трубы, для оборонительных целей, перевозка товаров, распространение тоннелей, средние века, рабочая сила, пешеходные тоннели, тоннели через труднопроходимые местности, торговля с далекими краями, ирригационный тоннель.

6. Put ✓ for true and ✗ for false statements.

1. A tunnel is an underground or underwater passage that is primarily vertical.
2. Greeks were the first to see the potential of large underground networks of tunnels.
3. Some tunnels are aqueducts to supply water for consumption or hydroelectric stations.
4. Tunnels were initially used for transport of goods and people.
5. Irrigation tunnels were used to transport water though desserts.
6. Due to tunnels Greeks and Romans could transforms marches and create pedestrian tunnels trough very harsh terrains.
7. In Middle Ages tunnels were used only for mining or military.
8. Railroads contributed to spreading of tunnels across the world.
9. Tunnels usually require a larger footprint on each shore than bridges.
10. Reasons for choosing a tunnel instead of a bridge include avoiding difficulties with tides, weather and shipping during construction, aesthetic reasons.

7. Match the synonyms.

1. supply	**a.** link
2. entire	**b.** impact
3. defensive	**c.** originally
4. vicinity	**d.** unbelievable
5. relatively	**e.** transfer
6. connect	**f.** protective
7. influence	**g.** deliver
8. transport	**h.** comparatively
9. initially	**i.** surroundings
10. incredible	**j.** whole

8. Find information about one ancient tunnel and describe it.

9. Complete the article on tunneling by adding the missing words and phrases.

Babylon, contribution, engineering, disadvantages, pyramids, railways, construct, dangerous, cope, cross-section

Tunneling is difficult, expensive and [1]_____ engineering work. Tunnels are built to provide direct automobile or railway routes through mountain ranges, under rivers. They can also provide underground channels for water, sewage or oil. Before the XIX century men had not acquired enough skill in [2]_____ to carry out extensive tunneling. Tunnels, however, were known in ancient times. They were, for instance, driven into the rock under the [3]_____ of Egypt. One of the earliest tunnels known was made in [4]_____. It passed under the river Euphrates, and was built of arched brickwork being 12 feet high and 15 feet wide. Other ancient tunnels were built for water supply and for drainage.

Modern tunnels are often very long and deep. Many are circular in [5]_____. Others are horseshoe-shaped, with a level floor on which it is easy to lay permanent roads and railways.

Whenever the proposed path of a road or railway is obstructed by a hill, a waterway, or some form of construction, the engineer designing the project has to decide whether or not it is practical to [6]_____ a tunnel through or under the obstacle. In making his decision, he has not only to consider the economic aspect, but must also weigh up all the constructional advantages and [7]_____ of both tunneling and the alternative method of either passing around or over the obstacle. In practice it is often found that tunneling, although costly, proves to be less expensive than any alternative system.

The inability of the existing road system of many large towns to [8]_____ with modern traffic requirements made tunnel construction a possibility worth serious consideration. A considerable [9]_____ towards a satisfactory solution is made by underground railway networks. Many of larger cities of the world have been successfully served by underground [10]_____ for years, and most of them are still extending their networks.

9B. METHODS OF TUNNEL CONSTRUCTION

1. Before you start!

- ✓ Do you know how a tunnel is built?
- ✓ What are the purposes of tunnel construction?

2. Read the words and learn them by heart.

MUST KNOW

cut-and-cover tunnel – тоннель, сооруженный открытым способом

bored tunnel – тоннель, сооруженный щитовым способом

tunnel drive – проходка тоннеля

blast hole – скважина для взрывных работ

tunnel boring machine – бурильная установка для проходки тоннелей

cutter head – буровая (режущая) головка

lining of the tunnel – обделка тоннеля

drill and blast method – буровзрывной способ

shaft – шахта

shallow tunnel – тоннель мелкого заложения

immersed tube tunnel – подводный тоннель из опускных секций

trench – котлован

shield – щит

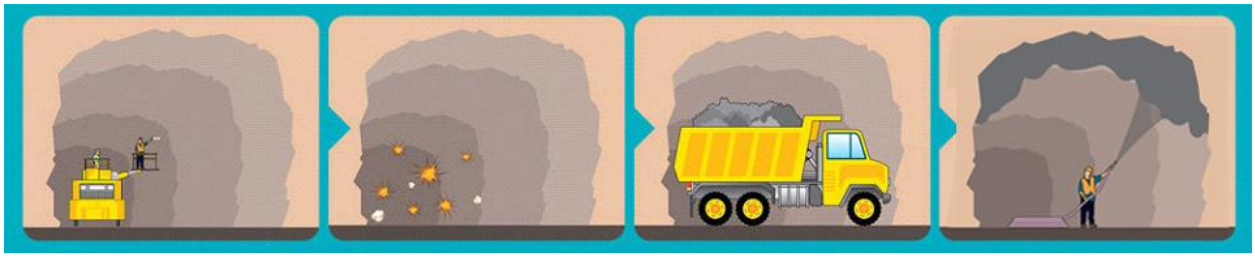
rear end – задняя часть

3. Read and translate the text to learn more about the ways of tunnel construction.

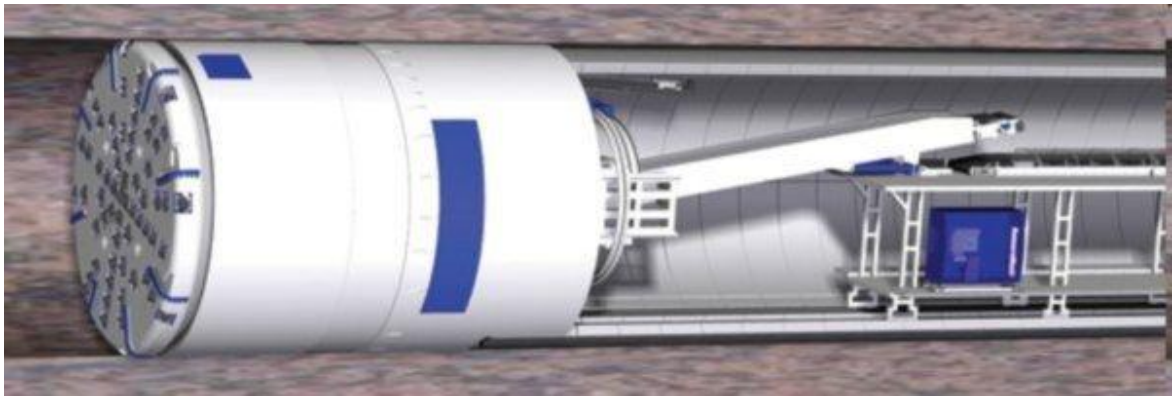
Methods of tunnel construction

The method of tunnel construction depends on such factors as the ground conditions, the ground water conditions, the length and diameter of the tunnel drive, the depth of the tunnel, the final use and shape of the tunnel. Drill and Blast is one of the most widely used tunneling methods. It is used when the tunnels are in rock and

involves the use of explosives. Explosives and timed detonators are placed in the blast holes. Once blasting is carried out, waste rocks and soils are transported out of the tunnel before further blasting.



Bored tunneling by using a Tunnel Boring Machine (TBM) is often used for excavating long tunnels. Tunnel Boring Machine (TBM) is specially designed for constructing tunnels which could perform different functions during tunneling works. With a large rotating steel cutter head at the front of the shield, TBMs can pass through different types of soil, rock or mixture of both. The TBM can excavate and remove excavated materials and at the same time install the reinforced concrete lining of the tunnel as it progresses. The use of TBM requires relatively less works area, thus minimizing the impact to the traffic of nearby area.



A shaft is built for delivering the components of the TBM from ground level to the tunnel level for assembly. As the TBM pushes forward, the excavated materials will be transported to the rear end of the TBM for removal through the vertical shaft.

Shallow tunnels are often of the cut-and-cover type, while deep tunnels are excavated often using a tunneling shield. For intermediate levels, both methods are possible.

Cut-and-cover is a simple method of construction for shallow tunnels where a trench is excavated and roofed over to carry the load of what is to be built above the tunnel. Strong supporting beams are necessary to avoid the danger of the tunnel collapsing.

There are also several approaches to underwater tunnels, the two most common being bored tunnels or immersed tubes.

Immersed tube construction of underwater tunnels will have its elements built separately in a dry dock. These elements are then taken to the site where a trench has already been made under the water to receive them. Segments are then immersed in the water and then joined to each other to form the tunnel.

Costs for immersed tube tunnels are considerably lower than those involved in boring a tunnel beneath the water. The speed of construction is greater, mainly because activities are simultaneously carried out for almost the entire length of the tunnel.

Source: http://www.mtr-shatincentrallink.hk/en/construction/construction-methods.html

4. Answer the following questions.

1. What are the main factors on which methods of tunnel construction depend?
2. What method is applied when tunnel is in rock?
3. What method is preferred for excavating long tunnels?
4. What does drill and blast method use?
5. What is the function of a tunnel boring machine?
6. Where is cut-and-cover method applied?
7. Why are supporting beams necessary in the case of cut-and-cover method?
8. What are the peculiarities of an immersed-tube method?

5. Give English equivalents to the following words and word combinations.

Выполнять различные функции, тоннель мелкого заложения, скважина для взрывных работ, железобетонная обделка тоннеля, минимизировать воздействие, оба метода, задняя часть бурильной установки, глубокие тоннели, использование взрывчатки, опорные балки, разрушение тоннеля, подводный тоннель из опускных секций, одновременно, доставка

компонентов, котлован, различные типы почвы, относительно, вся длина тоннеля, избегать опасность, несколько подходов, значительно ниже.

6. Put ✓ for true and ✗ for false statements.

1. The two most common methods of underwater tunneling are cut-and-cover and drill and blast.
2. The elements of immersed tube construction are built in the shipyard.
3. Cut-and-cover method uses explosives in the process of tunneling.
4. Tunnel boring machines can pass through both rock and soil.
5. For intermediate level of depth cut-and-cover method is applicable.
6. The main function of a shaft is delivering the components of the tunnel boring machine from ground level to the tunnel level.
7. Tunneling shield is used for the construction of shallow tunnels.

7. Match the words to get the correct word combinations.

1. tunnel	**a.** hole
2. ground	**b.** construction
3. rear	**c.** drive
4. nearby	**d.** level
5. blast	**e.** tube
6. reinforced	**f.** shaft
7. immersed	**g.** water
8. intermediate	**h.** area
9. speed of	**i.** end
10. vertical	**j.** concrete

8. Read the article on Mont Cenis tunnel and answer the questions.

FAMOUS TUNNELS

In 1857 French and Italian engineers combined to undertake the gigantic task of building the Mont Cenis tunnel. This carries the main railway lines from south-eastern France to north-western Italy. The tunnel is nearly 8 miles long and is of great technical interest, because air

compressors and rock drills operated by compressed air were first used in this work.

https://www.geocaching.com

It was also probably the first large project on which dynamite was employed for breaking the rock. But when it was started, drilling was done by hand. Black gunpowder was used for breaking the rock. At first progress was very slow, and if it had continued at the initial rate, it would have taken 75 years to complete! In fact for the first 4 years the tunnel advanced only 9 inch a day on each side. With the introduction of compressed air drills and dynamite, progress was accelerated to 6 ft. a day.

1. What countries were connected by the Mont Ceris tunnel?
2. Why is that tunnel of great technical interest?
3. Why was the process of building the tunnel very slow at the beginning?

9. Put the steps of cut-and-cover construction in the correct order.

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____

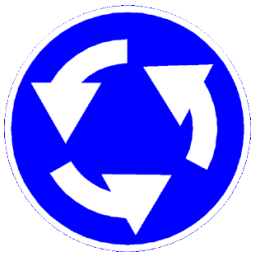
A. Water pipes, electricity and communication cables are moved away from the tunnel route.
B. The tunnel is opened to traffic.
C. Surveyors mark out the route the tunnel will take and the lines the tunnel walls will take.
D. Cranes and excavators arrive on site and build the walls of the tunnel.
E. The floor of the tunnel is built, and anchored into the bedrock below.
F. Excavators remove the dirt and rock from between the walls.
G. The tunnel services are installed including lights, fire protection systems, emergency exits and ventilation fans.
H. The roof beams are installed between the walls to hold them in place.

10. Discuss the methods of tunnel construction and find the examples to each method.

1. Fill in the gaps using the words below:

cut-and-cover, hard rock, blast, tunnel boring machines, trench, immersed tube tunnel method, ground, shafts, underwater, sizeable.

1. Before building a tunnel it is important to examine the conditions and type of _____ and groundwater.
2. Tunnels are dug in types of materials varying from soft clay to _____.
3. A _____ is excavated with ground support as necessary and the tunnel is constructed in it.
4. _____ are the main entrance in and out of the tunnel until the project is completed.
5. The world's oldest _____ tunnel is the Terelek kaya tüneli under Kızıl River in Turkey.
6. Seven _____ will be used to construct the tunnels for SCL project.
7. A 1.3 km SCL cross-harbour tunnel across Victoria Harbour will be built by using _____.
8. _____ is a method of tunnel construction where a trench is excavated and roofed over.
9. The first _____ tunnel in soft ground was the Tronquoy tunnel on the St Quentin canal in France in 1803.
10. Before the advent of tunnel boring machines, drill and _____ was the only economical way of excavating long tunnels through hard rock, where digging is not possible.



2. Translate the following sentences using the vocabulary of Unit 9.

1. Тоннели строятся как для пешеходов, так и для транспортных средств.
2. До начала строительства тоннелей важно исследовать грунтовые воды и тип почвы.
3. Тоннель является одним из древнейших изобретений человечества, наряду с мостом.
4. Буровзрывной метод строительства тоннелей использовался еще до появления буровых машин.
5. Существуют также так называемые экологические тоннели, которые прокладываются под автомобильными или железными дорогами, чтобы животные могли безопасно перемещаться.
6. В раннее Средневековье тоннели строились редко и, в основном, в военных целях.
7. Основная часть метро также проложена в виде тоннелей.
8. Самым длинным автомобильным тоннелем в России является Гимринский тоннель (4303 м), расположенный в Дагестане.
9. Тоннели играют важную роль в развитии инфраструктуры современных городов, но в то же время они являются зоной опасности.
10. Тоннели под водой часто строят вместо мостов там, где мосты мешают проходу судов.
11. Обделка является важнейшим элементом тоннеля, которая обеспечивает гидроизоляцию тоннеля.
12. Проходка тоннелей является одним из самых сложных видов строительных работ.
13. В 1826 – 1830гг. в Великобритании на участке Ливерпуль – Манчестер был построен первый в мире железнодорожный тоннель.

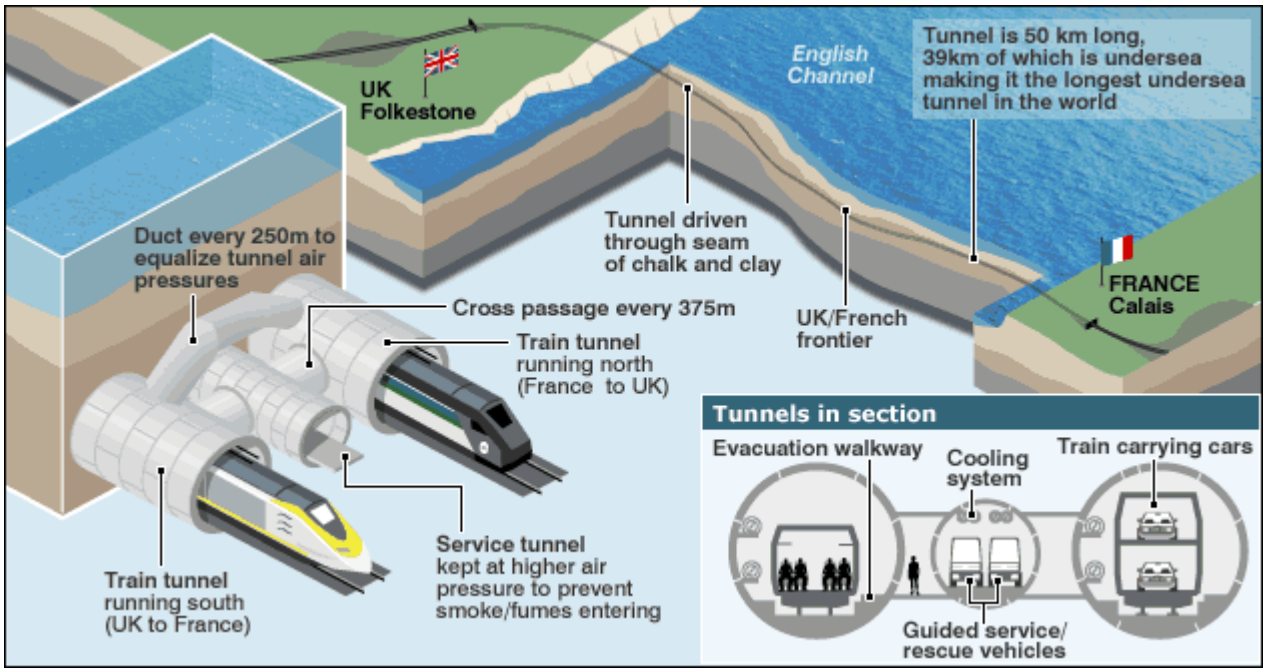
3. Find information about a modern tunnel and describe it.

4. Read the article on Tunnel under Channel and answer the questions.

FAMOUS TUNNELS

A tunnel under the English Channel was first suggested in 1856. It was agreed in 1875 to build it and work actually began. However, the British War Office objected that an enemy on the European mainland could easily invade England through such a tunnel, and the British Government objected to the scheme.

In 1957 interest revived in the idea of a Channel Tunnel and the question was studied afresh by a group of French and British engineers. In the 1980's permission was given to a company to build the tunnel using private funds. It was decided that the tunnel would be designed only for trains. The "Channel" as it was nicknamed, was actually designed as three tunnels: two 25 foot diameter tubes running parallel to carry trains and a 16 foot diameter service tunnel between them. To speed the digging the company used eleven tunnel boring machines (TBMs). TBMs had first been used in 1825, but became the standard way of constructing tunnels after 1953.



http://blogs.umb.edu/buildingtheworld/tunnels/channel-tunnel-england-and-france/

In 1994 the tunnel was officially opened. Construction took eight years and cost $21 billion making it the most expensive construction project in the world. The Channel tunnel remains a marvel of engineering even today. It was elected by American Society of Civil Engineers as one of the Seven Wonders of the Modern World in 1996.

Source: http://www.unmuseum.org/7wonders/chunnel.html

1. Why did the British War Office object to the building of the tunnel under the English Channel?
2. How was the tunnel designed?
3. What machines were used to speed the digging?

5. Compile as many words as you can with the letters of the word.

MAINTENANCE

_____
_____
_____
_____

FINAL TEXT FOR EXAM: HIGHWAY CONSTRUCTION

1. Read and translate the text to learn more about highway construction.

Highway construction

Development of a country depends on the connectivity of various places with adequate road network. Roads are the major channel of transportation for carrying goods and passengers.

The zone which is marked to lay the road is called the right-of-way or road zone which includes such parts of a road as a carriageway, road shoulders, inner and outer slopes, side ditches and other parts. The carriageway is covered with a pavement which resists traffic stresses and climatic factors.

The main steps in the road construction process are planning, design, earthworks, pavement construction and finally open to traffic. A road project begins with evaluating the information about our roads, including road conditions, traffic volumes, crash statistics. Land survey is step two. Recently, Global Positioning Systems and other technologies have sped up the process and improved accuracy.

The next step is earthwork which is one of the most important elements in road construction because it establishes a stable foundation. The aim of the earthworks phase is to position the sub-grade underlying the pavement layers in the right location and at the correct level. During this stage, drains and sewers are installed. The center of the road must be higher than the edges so water will run off into the storm sewers. To complete the earthwork, workers place gravel in layers on the road bed, then moisten and compact each layer. Layers are added and compacted until the road bed reaches the necessary height.

At last the road bed is ready for paving. Engineers study the cost of maintaining the road, the amount and type of traffic, the cost of paving material. These factors tell engineers what pavement type is required. Pavement can be rigid and flexible. Flexible pavements are those which are surfaced with asphalt materials. These types of pavements are called “flexible” since the total pavement structure “bends” due to traffic loads. At the construction site, workers spread and compact the hot mixture of asphalt onto the roadbed. Rigid pavements are composed of concrete. Workers place concrete into steel forms. To prevent cracks, workers cut joints between the concrete slabs.

The main layers of the pavement are the sub-grade, sub-base, base and surface course. Workers ensure that the sub-grade level can support the pavement. This requires the dirt in the sub-grade level to be solid. If it's not, the workers add a capping layer to strengthen it. The sub-base is inserted when necessary between the pavement base and the sub-grade. The primary function of the sub-base is to provide structural support and improve drainage. The base layer protects the pavement from moisture and cold temperatures. This layer is designed to distribute the individual wheel-loads. The pavement base is not subjected to the direct action of automobile wheels. The surface course endures the most pressure because it's the top layer. It is comparatively thin, but resists well the abrasion and the impacts caused by the wheels, and also the effect of weather conditions. It has courses – a binder course and a wearing course.

With the new surface in place, quality testing is conducted. The contractor must grind the pavement to ensure a smooth surface. The final steps are another drainage test, landscaping around the pavement, applying the permanent pavement marking.

2. Answer the following questions.

1. What is right-of-way? What does it include?
2. What does pavement resist?
3. What are the basic steps in road construction?
4. Why is earthwork so important?
5. Why must the road centre be higher than the edges?
6. When are sewers installed?
7. What factors influence the choice of pavement type?
8. What is the difference between rigid and flexible pavement?
9. What layers does the pavement consist of?
10. What are the final steps of road construction?

3. Give English equivalents of the following words and word combinations.

Дорожная сеть, статистика аварий, зависеть от, стекать, устанавливать, необходимая высота, стоимость содержания дороги, нежесткое дорожное покрытие, бетонные плиты, прямое воздействие, относительно тонкий, колеса автомобиля, обеспечить, дорожная разметка.

4. Put ✓ for true and ✗ for false statements.

1. The pavement resists only traffic stresses.
2. The sub-base is inserted when necessary between the pavement base and the sub-grade.
3. The pavement base course is subjected to the direct actions of wheels.
4. Road shoulders include carriageway, inner and outer slopes.
5. Rigid pavements are composed of concrete surface course.
6. A road project begins with positioning the sub-grade underlying the pavement layers in the right location.
7. Earthwork establishes a stable foundation.
8. Global Positioning Systems, laser surveys and other technology have slowed down the process of surveying the area.
9. Applying pavement marking is the initial step in road building activities.
10. Workers cut joints between the concrete slabs to prevent cracks.

5. Match the words with their definitions.

1. landscaping	**a.** the native material underneath a constructed road
2. paving	**b.** activity of growing plants with the aim of creating a beautiful environment
3. road shoulder	**c.** a space-based satellite navigation system that provides location and time information in all weather conditions
4. earthwork	**d.** material used on a road surface in order to provide separation between traffic moving in opposite directions
5. drain	**e.** a sticky, black and highly viscous liquid or semi-solid form of petroleum
6. asphalt	**f.** work involving moving quantities of soil
7. side ditch	**g.** surfacing of roads and walkways
8. sub-grade	**h.** a collection and transportation system for storm water
9. Global Positioning System	**i.** a strip of land immediately adjacent to the traffic lane of a road not bordered by kerb
10. pavement marking	**j.** a narrow channel dug at the side of a road or field, to hold or carry away water

6. Translate the article on the Aqueduct Veluwemeer in Netherlands.

Акведук Велуве (Aquaduct Veluwemeer) – это чудо инженерной мысли. Это подводный тоннель, который расположен на границе провинций Гельдерланд и Флеволанд в Нидерландах. Акведук является единственным примером подобного рода инфраструктуры в мире.

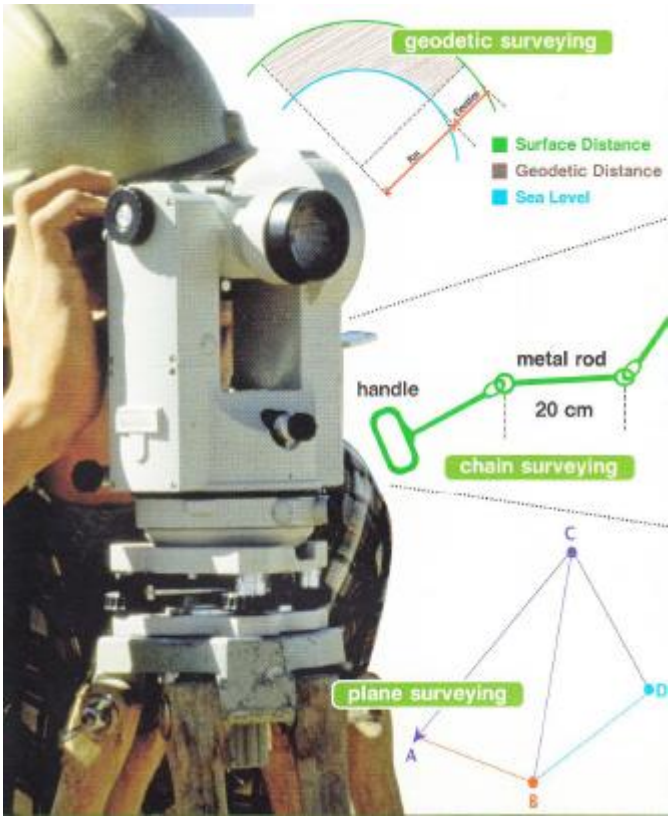
Тоннель проходит по дну озера Veluwemeer и соединяет материк с крупнейшим в мире искусственным островом. Он был открыт для движения в 2002 году: 25 метров в длину и 19 метров в ширину, глубина воды 3 метра, что позволяет пройти небольшим лодкам. Пешеходные тротуары построены по обе стороны от акведука, предусмотрены балконы для публики, чтобы насладиться видом. По тоннелю каждый день проходит около 28000 автомобилей. Эта часть дороги, таким образом, является одной из самых оживленных в Голландии.

7. Describe the basic peculiarities of highway construction.

APPENDIX

METHODS OF SURVEYING

There are two main methods of surveying: geodetic surveying and plane surveying. Geodetic surveying requires a lot of time and advanced instruments. Plane surveying can be done using a chain and measuring tape. It is faster and accurate enough for everyday uses. The following steps will guide you through the process.



Chain surveying relies on the principle of triangulation. Always begin with larger distances to minimize accumulated errors.

A. Preliminary survey – Review the layout of the area before beginning the survey. Locate and sketch the positions of all major features.

B. Marking station – Decide on the locations of stations and place station pegs.

C. Measuring survey line AB – Place ranging rods at end of line to be measured. Walk towards point B with the chain and markers. At the end of the chain push marker into ground. Survey line is the length between point A and the marker.

D. Taking offsets – Measure distance from marker to each feature using measuring tape.

BRIDGE BUILDING HISTORY

For hundreds of years men have built bridges over fast-flowing rivers or deep and rocky canyons. Early man probably got the idea of a bridge from a tree fallen across a stream. From this, at a later stage, a bridge on a very simple bracket or cantilever principle was evolved. Timber beams were embedded into the banks on each side of the river with their ends extending

over the water. These made simple supports for a central beam reaching across from one bracket to the other. Bridges of this type are still used in Japan and India.

All these bridges made possible crossings only over narrow rivers. The type of temporary floating bridge, the pontoon bridge, has been used for military purposes; military engineers can construct a temporary bridge on this principle, able to carry all the heavy equipment of a modern army, in an extremely short time.

The idea of driving wooden piles into the bed of the river in order to support a platform was put into practice 3,500 years ago. This is the basis of the 'trestle' or pile bridge which makes it possible to build a wider crossing easier for the transport of animals and goods.

With the coming of the railway in the 19th century there was a great demand for bridges, and the railways had capital for building them. The first railway bridges were built of stone or brick. In many places long lines of viaducts were built to carry railways; for instance, there are miles of brick viaducts supporting railways to London.

The next important development in bridge-building was the use of iron and, later, steel. The first iron bridge crossed the river Severn in Great Britain.

The idea of a drawbridge, a bridge hinged so that it can be lifted by chains from inside to prevent passage, is an old one. Some St. Petersburg bridges were built on this principle. A modern bridge probably demands greater skill from designer and builder than any other civil engineering project. Many things should be taken into consideration, and these may vary widely according to local conditions. In deciding what type of bridge is most suitable the designer has to allow for the type and weight of the traffic, and width and depth of the gap to be bridged, the nature of the foundations and the method of erecting the bridge. The designer has to calculate carefully how the various loads would be distributed and to decide which building materials are more suitable for carrying these loads.

GREAT ST. BERNARD TUNNEL

Europe's first automobile tunnel under the Alps – the 3.4-mile Great St. Bernard Tunnel between Italy and Switzerland – was officially opened to traffic on the 19 March 1969. The tunnel was under construction slightly over five years and cost about 38 million dollars. Actual digging starting from both sides was under way from February 1959 to April 1961. Some 1,650 tons of explosives were used to excavate more than a million cubic yards of rock. The project also required 44,000 tons of steel for use in the construction of walls and road-bed, and 165,000

tons of reinforced concrete for lining the inside of the tunnel. The tunnel has a two-line road-bed 24 ft. wide and 14 ft. 9 in. high. Leading up to it on both sides are several miles of approaches built on concrete stilts and roofed with concrete to protect the roads from snow and avalanches and make them useable throughout the year. Up to now the Great St. Bernard Pass has been closed much of the year by snow.

More than 30,000 cars a year are expected to use the tunnel. Tolls range from 2.10 dollars to 4.65 depending on the engine, size of the car and the number of passengers. There are 12 other important tunnels under the Alps in central Europe all for rail traffic. Soon a second Alpine motor tunnel will be ready. It will connect Italy and France under Mont Blanc.

https://en.wikipedia.org/wiki/Great_St_Bernard_Tunnel

BRIDGE OR TUNNEL?

Should a motorway pass under or over a large waterway? For a narrow waterway there is no problem, the water is always bridged. Until 1960 only two alternatives existed bridging over or tunnelling under the waterway, but now a third choice is available, the immersed tube is made by lowering pipes of great length into a trench in the bed of the sea or river, and joining them under water.

The main considerations in the decision are now generally traffic capacity, gradient, obstruction of shipping, costs of construction and maintenance, speed of completion, possible later widening and so on.

The choice often falls on a bridge because it can carry more vehicles per hour and its capacity is more easily extended by widening or by adding a deck.

One of the largest bridges in the world, with twelve traffic lanes, six on each of its two decks, is the Verrazano-Narrows Bridge in New York. For many years the United States Army engineers would not allow a bridge to be constructed at this site because its destruction in war time could block the harbour, and they insisted on building a tunnel. But after work on the tunnel under the English Channel to France although the preliminary work was by then so advanced that lengths of 1 km of pilot tunnel of some 2 m diameter had already been driven from each shore. These lengths were still in perfect condition when inspected eighty years later, because

they had been driven through a chalk rock which is ideal for tunneling, being fairly watertight and just strong enough.

The ever increasing motor traffic needs an ever growing number of highways, which will have to cross important waterways, with also increasing shipping. In several cases tunnels will not only be the cheapest solution, but also the best with regard to weather conditions (no ice or snow, no wind or rain), maintenance, danger of collision with a ship, aesthetic reasons, etc.

Bridge/tunnel combinations form attractive and often obvious solution for crossings of great length.

It is easy to predict that in the next decades an ever increasing number of important and interesting tunnels – submerged or bored – will be built, and that the existing methods of building, sinking, etc. will be improved and perfected and new and astonishing techniques will be developed.

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ENGLISH FOR ROAD CONSTRUCTION

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