Федеральное агентство по образованию

Государственное образовательное учреждение
высшего профессионального образования
«Ивановский государственный архитектурно-строительный университет»

Е. Н. Жукова, И. К. Тихонова

ПОСОБИЕ ПО АНГЛИЙСКОМУ ЯЗЫКУ ДЛЯ СТУДЕНТОВ АВТОДОРОЖНЫХ И СТРОИТЕЛЬНЫХ СПЕЦИАЛЬНОСТЕЙ

2-е издание, исправленное и дополненное

*Рекомендовано Учебно-методическим объединением
по образованию в области лингвистики
Министерства образования и науки Российской Федерации
в качестве учебного пособия
для студентов автодорожных и строительных специальностей*

Иваново 2007

УДК 802:62(075.8)
Ж 86

Рецензенты:
Н. А. Васильева – кандидат филологических наук, доцент кафедры иностранных языков Ивановского государственного энергетического университета
Н. А. Дударева – заведующая кафедрой интенсивного изучения английского языка Ивановского государственного энергетического университета

Печатается по решению редакционно-издательского совета ИГАСУ

Жукова, Е. Н.
Ж 86 Пособие по английскому языку для студентов автодорожных и строительных специальностей : Учеб. пособие / Е. Н. Жукова, И. К. Тихонова. Иван. гос. архит.-строит. ун-т. — 2-е изд., испр. и доп. — Иваново, 2007. — 188 с.

ISBN 978-5-88015-207-0

Цель пособия – совершенствование навыков чтения оригинальной литературы по специальности, развитие навыков перевода и аннотирования. Послетекстовые упражнения и практические задания направлены на анализ текста и работу со специальным словарем.
Для студентов автодорожных и строительных специальностей.

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ПРЕДИСЛОВИЕ

Актуальность данного пособия продиктована нехваткой в учебном процессе англоязычных изданий, предназначенных для студентов автодорожных и инженерно-строительных специальностей.

Данное пособие рассчитано на тех, кто уже имеет базовую начальную подготовку по английскому языку: знает фонологическую систему, знаком с основными грамматическими категориями, владеет определенным объемом лексических единиц и речевыми моделями, которые позволяют вести общение на английском языке по специальности.

Главной целью данного пособия является совершенствование навыков чтения, перевода и извлечения информации для подготовки студентов к самостоятельной работе над оригинальной литературой по специальности.

Пособие состоит из трех разделов.

Первые два раздела содержат технические тексты и упражнения, необходимые для формирования навыков чтения, перевода и аннотирования, а также анализа текста и работы со специальным словарем.

Включенные в пособие тексты носят как научно-популярный, так и специальный научно-технический характер. Основываясь на многолетнем опыте преподавания английского языка в техническом вузе, авторы подобрали тексты не только познавательные и информативные, но и способствующие формированию у студентов базового терминологического тезауруса по избранной специальности, а также расширяющие общетехническую эрудицию студентов.

В пособии представлены тексты аутентичного характера, взятые из современных учебников, учебных пособий, журналов, изданных в основном за рубежом (Journal of the Franklin Institute; P.C.I. Journal of Presstressed Concrete Institute; Construction Australia; Standardization News; World Highways).

Речевой материал текстов отражает богатство современного английского языка, представляет специальные языковые речевые выражения, обороты и термины профессиональной речи. Расположение материала в пособии не обязывает к определенной последовательности работы над ним. Тексты подобраны так, чтобы их смысл был понятен при изучении теории в рамках данного раздела, а их содержание и перевод не стоят в зависимости от более широкого контекста.

Каждый раздел пособия рассчитан на 40–60 аудиторных занятий и предполагает отработку умения и навыков чтения и устного общения на английском языке. В конце пособия имеется англо-русский словарь, отражающий основные лексические единицы, используемые в текстах. В конце каждого раздела приводятся тестовые задания, направленные на проверку усвоения профессиональных терминов.

Третий раздел включает тексты для дополнительного чтения. Тематика текстов, предназначенных для дополнительного чтения, соответствует содержанию текстов основных разделов. Дополнительные тексты носят проблемный и образовательно-развивающий характер и могут использоваться для изучающего, ознакомительного и поискового видов чтения, для развития навыков перевода, реферирования, навыков работы со словарями, а также служат базой для совершенствования навыков говорения.

Данное пособие является 2-м изданием, исправленным и дополненным. По сравнению с 1-м, 2-е издание дополнено общим словарным списком по каждой из двух включенных в пособие специальностей, что дает студентам возможность в полной мере представить себе материал, который они должны усвоить в процессе обучения.

Авторы выражают благодарность рецензентам пособия, сделавшим ряд ценных рекомендаций, а также особую благодарность Л.В. Воронковой за помощь в подготовке данного пособия.

PART I. HIGHWAY CONSTRUCTION

ROAD

Road is the traveled way on which people, animals, or wheeled vehicles move. In modern usage the term road describes a rural, lesser traveled way while the word street denotes an urban roadway. Highway refers to a major rural traveled way; more recently it has been used for a road, in either a rural or urban area, where points of entrance and exit for traffic are limited and controlled.

The Romans were the first to construct roads scientifically. Their roads were characteristically straight, and the best ones were composed of graded soil foundation that was topped by four courses (layers): a bedding of sand or mortar; rows of large flat stones; a thin layer of gravel mixed with lime; and finally a thin wearing surface of flint like lava. Roman roads varied in thickness from 3 to 5 feet (0,9 to 1,5 m), and their design remained the most sophisticated until the advent of modern road building technology in the late 18th and early 19th centuries.

When interest in road building revived in Europe in the late 18th century, engineers began designing roads that incorporated lighter surfaces, relying on the subsurface for load support. Roads could thus be built relatively cheaply and quickly. The most influential of the early engineers was John Loudon McAdam, inventor of the macadam road surface. His design comprised a compacted subgrade of crushed rock to support the load, and a surface covering of light stone to absorb wear and shed water to the drainage ditches.

By the end of the 19th century the widespread use of the bicycle created a demand for roads with smoother surfaces. A pavement of natural rock asphalt was used in Paris as early as 1854, and Portland cement concrete was used in Scotland in 1865.

Two classifications of pavement have been developed: flexible and rigid. Flexible pavement is usually made of an asphalt-gravel aggregate that is laid in one or more courses over the subgrade. The aggregate can be mixed at the road-building site or at a central plant, and its quality varies with the production method used.

A cheap method of pavement, called surface treatment, is made by spraying hot asphalt or tar on a compacted stone base and then placing small stone chips on the tar; it is suitable for lightly traveled roads and can be built up in layers. Pavements made with a high-temperature plant mix are suitable for the heaviest loads and are made by laying the asphalt while it is hot and rolling it before it cools. A flexible pavement has the advantage of being easy to build and repair, its asphalt binder is both waterproof and plastic.

Rigid pavement made of Portland cement concrete, generally has greater strength but is susceptible to cracking. The cement, mixed with water and various grades of crushed stone called aggregate, is poured onto the built-up and graded foundation as a plastic mass. It shrinks as it dries, causing tensile stresses. The concrete also contracts and expands with temperature change, so that cracking is a constant problem. The best solution has been by pouring a continuous concrete slab in which a mesh of steel bars is embedded. The bars, running lengthwise through the concrete, absorb the tension of shrinkage and hold shut any cracks that form.

Modern highway design entails careful study of soil types, the topography of the intended route, and the drainage systems around the roadway. Where necessary, measures are taken to provide additional drainage facilities to prevent water from eroding the road base or freezing in cracks. The techniques of cutting and filling (excavating in one place and depositing it nearby to form a level roadbed) and switch-backing (zigzagging up a slope) have been used for centuries to obtain easy gradients in varied terrains.

The prototype of the modern superhighway was the Bronx River Parkway, which was completed in 1925 in New York City. It was a limited-access, high-speed highway designed to carry a large volume of traffic without disturbing the natural landscape. In the 1920s the Italians began the autostrada, and the Germans followed not long after with the autobahn. Military use was an important design feature of these highways, which could accommodate heavy traffic at speeds of 100 mi (160 km) per hour. In the United States the federal government created the national Interstate Highway System after World War II. It incorporated the toll-road network with other limited-access highways and linked all of the nation's major cities. Most industrialized countries in the world built similar systems to facilitate automobile and truck traffic.

VOCABULARY NOTES

road дорога, шоссе
way путь; направление; способ
highway шоссе; автомагистраль
to revive возрождаться; расцветать
revival(n) возрождение; расцвет
subsurface нижний горизонт (почва)
surface поверхность, (земная поверхность)
macadam road surface щебёночное покрытие дороги
to shed лить, проливать
ditch ров, канава
flexible pavement нежёсткое дорожное покрытие
rigid pavement жёсткое дорожное покрытие
subgrade земляное полотно

chips (stone) обломки (камня)
tar гудрон, смола, дёготь
to shrink давать усадку
mesh зацепление
to erode размывать
slope уклон
terrain территория, местность

EXERCISES

I. Read the text and translate it.

II. Read and translate the sentences. Pay attention to the meaning of the words "way" and "road".

1. This way, sir.
2. It's only a short way to the square. It's a long way from here.
3. Which is the best way there?
4. You're going in the opposite way.
5. Which is the way out?
6. Can't you find your way home alone?
7. Are you going my way?
8. They might have lost their way in the dark.
9. It is an out-of-the-way place.
10. Where does this road lead?
11. I know this road, it's a good one.
12. May I help you over the road?
13. Follow the road until you reach the hotel.

III. Answer the questions:

1. What were the first roads like and where did they appear?
2. Who was the most influential road engineer in the 18^{th} century? What were the characteristic features of his design?

3. What were two classifications of pavement? Explain the difference between them.

4. What does the modern highway design entail?

5. What were the prototypes of the modern superhighways?

IV. Make up a summary of the text using the questions of exercise III as a plan.

FROM THE HISTORY OF ROADS

The history of roads has been related to the centralizing of populations in powerful cities, which the roads have served for military purposes and for the collection of supplies and tribute. In Persia, between 500 and 400 B. C., all the provinces were connected with the capital, Susa, by roads, one of them 1,500 mi (2,400 km) long. The ancient Greeks, cherishing the independence of their city-states and opposing centralization, did relatively little road making. The Roman roads, however, are famous. In Italy and in every region that the Romans conquered, they built roads so durable that parts of them yet remain serviceable. The Roman roads were generally straight, even over steep grades. The surface, made of large slabs of hard stone, rested on a bed of smaller stones and cement about 3 ft. (91cm) thick. From the fall of the Roman Empire until the 19^{th} cent., European roads generally were neglected and hard to travel. People usually walked, rode horses, or were carried in sedan chairs. Goods were transported by pack animals. In France, Louis XIV and Napoleon built good roads for military purposes.

Elsewhere on the Continent roads were not much improved before the middle of the 19^{th} century. In Great Britain two Scottish engineers, Thomas Telford and John L. McAdam, were responsible for the development of the macadam road. The expansion of the Industrial Revolution brought this and other road improvements to the Continent, although the emphasis was on railroad construction until after the invention of the automobile. In the Americas the Inca Empire was remarkable for its fine roads. In what is now the United States, however, the waterways were the normal mode of travel for Native Americans, and their trails, though numerous, were simply crude footpaths. These were used by white settlers and were eventually widened to make wagon trails. The increasing use of stagecoaches led to some improvement, and the turnpike, or toll road, was introduced at the beginning of the 19^{th} century. Although the planning and building of road arteries, notably the National Road, marked the early years of the century, canals and then railroads took precedence. It was not until the invention of the automobile that the road became paramount again. Hard-surfaced highways were stretched across the entire land in a relatively few years. The building of the roads became a major branch of engineering, and even the most difficult obstacles were surmounted. Roads have helped greatly to equalize and unify large heterogeneous nations. In the United States the Interstate Highway System consists of 42,796 mi (68,474 km) of roads (all but 30 mi/48 km of which are completed) connecting every city. Other well-known road networks which serve to unify large areas include Germany's Autobahn, The Trans-Canada Highway, and the Pan-American Highway.

VOCABULARY NOTES

pavement тротуар; мостовая; дорожное покрытие
macadam road дорога, покрытая щебёнкой
railroad железная дорога
turnpike магистраль; платная скоростная автострада
toll road платная автомобильная дорога
road network сеть дорог

tribute дань
steep grade крутой подъём
to be neglected быть заброшенным
sedan chairs носилки
mode метод, способ
stagecoach почтовая карета; дилижанс
paramount первостепенный
to surmount преодолевать
heterogeneous различный; неоднородный

EXERCISES

I. Read the text and translate it.
II. Explain the difference between the words: road – way – highway – turnpike.
III. Put up five questions to the text.
IV. Retell the text with the help of the questions (ex. III).

ROAD ENGINEERING

Since the beginning of the 20^{th} century, as the automobile and truck have offered ever higher levels of mobility, vehicle ownership per head of population has increased. Road needs have been strongly influenced by this popularity and also by the mass movement of people to cities and thence to suburban fringes – a trend that has led to increasing travel needs and road congestion and to low-density cities, which are difficult to serve by public transport. Often the building of new roads to alleviate such problems has encouraged further urban sprawl and yet more road travel. Long-term solutions require the provision of alternatives to car and truck transport, controls over land use, and the proper pricing of road travel. To this end, road managers must be concerned not merely with lines on maps but also with the number, type, speed, and loading of individual vehicles, the safety, comfort, and convenience of the traveling public, and the health and welfare of bystanders and adjoining property owners.

Ideally, the development of a major road system is an orderly, continuous process. The process follows several steps: assessing road needs and transport options; planning a system to meet those needs; designing an economically, socially and environmentally acceptable set of roads; obtaining the required approval and financing; building, operating, and maintaining the system; and providing for future extensions and reconstruction.

Planning. Road needs are closely associated with the relative location of centers of population, commerce, industry, and transportation. Traffic between two centers is approximately proportional to their populations and inversely proportional to the distance between them. Estimating traffic on a route thus requires a prediction of future population growth and economic activity, an estimation of their effects on land use and travel needs, and knowledge of any potential transport alternatives. The key variables defining road needs are the traffic volumes, tonnages, and speeds to be expected throughout the road's life.

It is necessary to predict the extent of the road works needed to handle the traffic. A starting point in these calculations is offered by surveys of origins, destinations and route choices of present traffic; computer models are then used to estimate future traffic volumes on each proposed route. Estimates of route choice are based on the understanding that most drivers select their estimate of the quickest, shortest, or cheapest route. Consideration in planning is also given to the effect of new traffic on existing streets, roads, and parking provisions.

The next step in planning a road system is to refine the selected route to a narrow corridor. The various alignment options are drawn, considering the local terrain and conditions. The economic, social, and environmental benefits and costs of these options are discussed with relevant official and community groups until an acceptable specific route is determined.

Road design. In order fully to understand the design stage, a few standard terms must be defined. A traffic lane is the portion of pavement allocated to a single line of vehicles; it is indicated on the pavement by painted longitudinal lines or embedded markers. The shoulder is a strip of pavement outside an outer lane; it is provided for emergency use by traffic and to protect the pavement edges from traffic damage. A set of adjoining lanes and shoulders is called a roadway or carriageway, while the pavement, shoulders, and bordering roadside up to adjacent property lines is known as the right-of way.

In order to maintain quality and uniformity, design standards are established for each functional road type. The number of traffic lanes is directly determined by the combination of traffic volume and speed, since practical limits on vehicle spacing means that there is a maximum number of vehicles per hour that pass through a traffic lane. The width of lanes and shoulders, which must strike a balance between construction cost and driver comfort allows the carriageway with to be determined. Standards also specify roadside barriers or give the clear transverse distances needed on either side of the carriageway in order to provide safety in the event that vehicles accidentally leave the carriageway. Thus it is possible to define the total right-of-way width needed for the entire road although intersections will add further special demands.

Design standards also help to determine the actual alignment of the road by specifying, for each design speed the minimum radius of horizontal curves, the maximum vertical gradient, the clearance under bridges, and the distance a driver must be able to see the pavement ahead in order to stop or turn aside.

VOCABULARY NOTES

suburban пригородный
fringe край; кайма
congestion перегруженность, затор (уличного движения)
to alleviate облегчать; смягчать
bystander свидетель; наблюдатель
to adjoin примыкать, граничить
to assess облагать налогом; штрафовать
option выбор
to estimate оценивать
to handle управлять, регулировать
feasible вероятный, возможный
to refine облагораживать; усовершенствовать
terrain местность, территория
alignment выравнивание, регулировка
shoulder обочина (дороги)

EXERCISES

I. Read the following text, translate it and note the main facts.

II. Suggest the Russian equivalents:

low-density cities; long-term solutions; proper pricing; to meet needs; future extensions; approximately proportional; key variables; parking provisions; environmental benefits; three-dimensional profiles; traffic lane; total right-of-way width.

III. Give explanations in English:

travel needs

comfort and convenience of the travelling public

development of a major road system

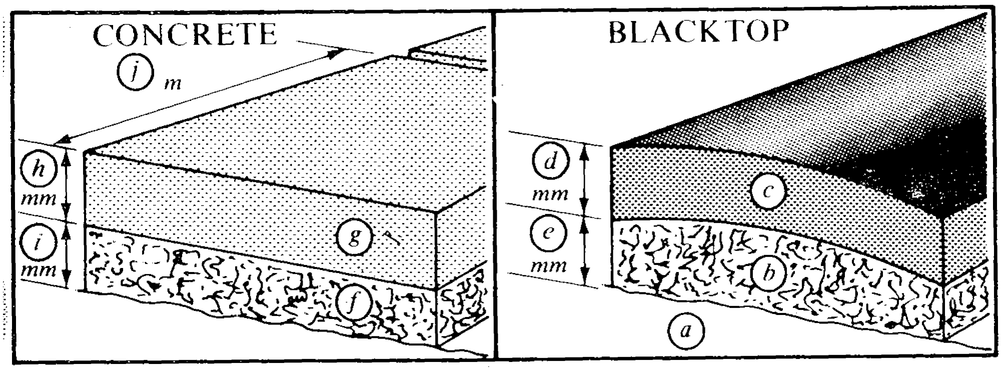
congestion

traffic lane

shoulder

IV. Annotate the text in Russian.

BUILDING A ROAD



First, the earth is removed using bulldozers and diggers.

Then the ground is levelled. This is done by cutting the top layer until it is flat and level.

Next a layer of gravel (approximately 300 mm thick) is spread over the ground.

Finally the top layer is added. There are two main types: blacktop and concrete. If it is a blacktop road, layers of hot tar-macadam are poured onto the gravel and pressed down using rollers. The total layer of blacktop materials is approximately 300 mm thick. If it is a concrete road, the concrete is laid on top of the gravel. The concrete slabs are usually approximately 250 mm thick and 4,5 m long.

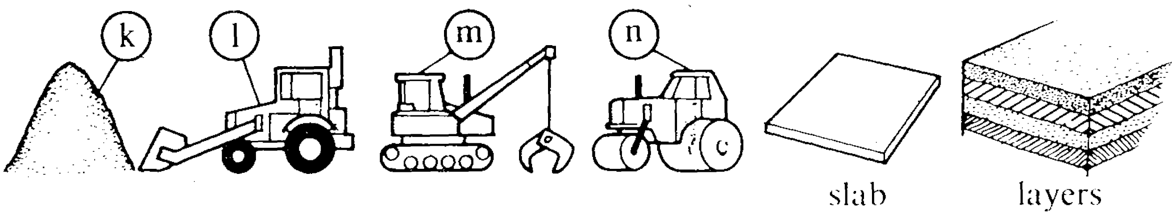
EXERCISES

I. Read the text and follow the information.

II. What are (a) - (n)? Use words and numbers from the passage.

Examples: (a) ground

(d) 300 mm



III. Answer these questions:

1. How do you make the ground flat and level?
2. How is the tar-macadam pressed down?
3. How thick is a concrete road (down to ground level)?
4. What equipment do you use to move earth away?

CAR

The story of the car is one of the most important and exciting chapters in the history of transport. World-wide, there are more than 400 million passenger cars and over 100 million light trucks such as vans and pick-ups. Million of people use their cars to help them earn a living or to travel for pleasure. People in the United States often refer to cars as automobiles. In Britain and many other countries, they are sometimes called motorcars.

Most of the world's cars are in the United States, Canada, and Western Europe. Ways of life have changed greatly in all those countries because of the car. Farm families no longer live lonely lives. In most countries, their cars put them within reach of cities and towns.

Increased mobility for all types of people has led to greater enjoyment of leisure time. The development of the car has meant that city dwellers can travel into the country for relaxing break, and people can visit relatives living in remote or distant areas.

The wide use of the car has brought about many features of life today. Many of these features are associated with the United States, the country in which widespread use of the car first developed. They include out-of-town shopping centers, motels, and several kinds of drive-ins including restaurants, banks, and cinemas. Huge roads and motorways, built mainly for cars, are found in many countries. Therefore people had cars to drive; they generally walked or rode bicycles when travelling short distances. Most long-distance travel was by railway, tram, or some kind of horse-drawn carriage. In fact, the early cars were sometimes called “horseless carriages”.

The origin of the car can be traced to Europe. But it became a major form of transportation first in the United States. Most European cars were built by hand, and were expensive. Only rich people could afford them. In early 1900s, Ransom E. Olds, Henry Ford, and other pioneers began mass-producing cars. Although some people disliked the “horseless carriage”, many welcomed the introduction of the new machine because it would replace horse-drawn carriages.

Today, the United States has about 130 million cars, more than any other country. In the U.S.A., Australia, France, and western Germany there is approximately one car to every two people. The United Kingdom has approximately one car for every three and Japan one for every four.

Car manufacture is one of the world’s major industries producing more than 30 million cars each year. Japan and the United States together produce about half of the world’s output. Other important car manufacturing countries include Germany, France, Italy, and Spain.

Australia, the Czech Republic, India, South Korea, Malaysia, Sweden and the United Kingdom also have motor industries.

Many developing nations want to set up car industries. This is because it generates and supports a wide range of businesses, and stimulates economic growth. The car industry is an important customer of other industries, such as steel. Millions of people are employed in businesses connected with cars, such as showrooms, garages, and petrol stations.

The car has brought much employment, and introduced many benefits in everyday life. But it has also brought many problems. Traffic congestion, especially in major cities, has reduced the benefits from car ownership and has brought problems of noise and pollution.

Countries without a car industry have economic problems resulting from the high cost of car imports. Car accidents have now become a major cause of death or injury throughout the world.

Problems of car use have been addressed in a number of ways in recent years. Pollution has been reduced in many places by laws regulating car design. Engineers have found ways of building safer roads, and car manufacturers have improved car safety features. Laws in many countries have forced drivers to use car safety features such as seat belts.

The importance of cars

The development of cars has had an enormous effect on people's way of life throughout much of the world. Probably no other invention, discovery or technological advance has created greater or more rapid changes in society.

VOCABULARY NOTES

truck грузовой автомобиль

van (авто) фургон

to refer to иметь отношение к чему-либо; ссылаться на…
relaxing break отдых, передышка
feature особенность, признак
car safety features средства безопасности автомобиля
drive in(s) сервис (не выходя из автомобиля)
to trace (to) восходить к источнику или периоду в прошлом
approximately приблизительно, приближённо
output продукция; выпуск
showroom демонстрационный зал для показа образцов товара
employment занятие; работа
major важный, главный
to reduce уменьшать, сокращать
to result from происходить в результате; проистекать

EXERCISES

I. Read the following text and translate it into Russian.

II. Give Russian equivalents of the following:

no longer live lonely lives; for a relaxing break; has brought about many features; out-of town; shopping centers; horse-drawn carriage; huge roads; horseless carriage; can be traced to Europe; half of the world's output; to set up car industries; problems of noise and pollution; safety features; seat belts.

III. Put about 15 key questions to the text and answer them.

IV. What are the questions to which the following are the answers? (Use the text).

1. Ways of life changed greatly in many countries.
2. The car became a major form of transportation first in the United States.
3. Only rich people could afford cars.
4. Many developing nations want to set up car industries.

5. The car has also brought many problems.

6. Problems of car use have been addressed in a number of ways in recent years.

V. Retell the text.

IMPACT ON SOCIETY

The car has given many people freedom of movement. It enables them to decide where they want to go and when. The car influences where people live and work and how they spend their leisure time.

When the first cars were produced, only the well-to-do could afford them. Soon, however, prices declined as production increased in response to the growing demand. The lower prices put the car within reach of more and more people. Well-off urban residents found car ownership cheaper then keeping a horse and carriage. The growth in car ownership led to the building of more and better roads, which further increased travel.

Although cars were first bought mainly by affluent city dwellers, it was country people who became the first large-scale group of car owners. Many were farmers or residents of small towns that served farmers, in the early 1900s, those people became the first mass group of car buyers. Cars and trucks enabled farmers to sell their goods faster and farther away, and to travel more often and in greater comfort than ever before.

Before the development of cars, urban workers walked, cycled, or rode on railway trains or horse-drown vehicles to their jobs. But as roads improved and car ownership expanded during the 1920s, people increasingly moved to the suburb because of the freedom provided by car ownership. By the mid-1950s, even factories had begun to relocate in the suburbs.

Economic impact. Such industrialized nations as the United or no car production — for example, Norway and New Zealand — the widespread use of cars has become vital to the economy. Filling stations, motels, restaurants, and other businesses that serve car travelers are of major importance to the economic well-being of all industrialized countries and increasingly of developing ones. In addition, many developing nations have begun making motor vehicles or parts to stimulate industry and to provide the vehicles needed for growth. For example, China has promoted broad-based car manufacturing, and the Philippines has expanded parts production for export to car manufacturers in other countries.

Environmental impact. As cars burn petrol, they release hydrocarbons, carbon monoxide, and nitrogen oxides into the air and so pollute it. Air pollution endangers people's health and damages crops and livestock. Cars produce terrible pollution in many of the world's big cities. Especially severe pollution occurs in such cities as Los Angeles, Mexico City, Tokyo, and Madrid, where the streets and roads are choked with traffic.

In many countries, steps have been taken to control air pollution caused by cars as well as by other sources. Agencies that enforce these regulations set emission standards that limit the amount of pollution new cars may produce.

Car manufacturers have made great progress in reducing the emission of major pollutants by meeting the increasingly strict environmental standards. For example, since the 1960s the emission of hydrocarbons and carbon monoxide by American-built cars has been reduced by 96 per cent and nitrogen oxides by 76 per cent. The reduction has been achieved largely with the installation of a catalytic converter in the exhaust system of cars. The device changes carbon monoxide and hydrocarbons into carbon dioxide and water vapor.

VOCABULARY NOTES

impact удар, толчок; влияние, воздействие
to enable давать возможность что-либо сделать; облегчать
well-to-do состоятельный, обеспеченный
carriage экипаж, коляска
affluent богатый, изобильный
dwelling жильё, жилище; проживание
vehicle перевозочное средство
widespread широко распространённый
vital жизненно важный
filling station заправочная станция
to promote выдвигать; поощрять; рекламировать
to pollute загрязнять
air pollution загрязнение воздуха
livestock живой инвентарь; домашний скот
to choke загромождать

EXERCISES

I. Read the text and note the main facts.

II. Try to explain in English the meaning of the following words:

impact; leisure time; well-to-do people; in response to; to travel in comfort; industrialized nations; to promote; air pollution.

III. Topics for discussion:

1. Why was it country people who became the first large-scale group of car owners?

2. Why the widespread use of cars has become vital to the economy?

3. What steps have been taken in big cities to control air pollution caused by cars as well as by other sources?

PROBLEMS OF SAFETY

Each year motor vehicle accidents kill an estimated 300,000 people throughout the world. A high proportion of those people are young people. In fact, more Americans from 5 to 32 years old die as a result of traffic accidents than of any other cause. Young people also have the highest accident rate of all drivers.

Drivers are chief factor in vehicle safety because they are responsible for about two-thirds of all accidents. They cause accidents by speeding, driving in the wrong lane, making improper turns, and breaking other rules of safe driving. Many traffic deaths involve drunken drivers. Alcohol slows a driver's reflexes, reduces alertness and concentration, impairs vision, and clouds judgment. The growing use of illegal drugs by drivers is also a serious safety problem.

The car itself has become safer over the years because of advances in its design and manufacture. Car manufacturers must meet strict government standards designed to prevent accidents and to protect drivers and passengers. The standards to prevent accidents involve such things as the installation of government-specified lights, reflectors, brakes, tyres, windows, windscreen wipers, and dashboard controls. Standards to protect car occupants include the installation of automatic seat belts or airbags, head restraints, and bumper systems. Seat belts are probably the main safety equipment. A driver must not assume that a car's engine, brakes, lights and steering system always operate properly. All equipment should be tested frequently.

Modern road building techniques have increasingly lowered the risk of car accidents. To build safe roads, engineers consider such factors as road foundations and surfaces, lighting, safety barriers and grading. They carefully plan bypasses, road junctions, slip roads leading onto major motorways, traffic signals, and the number lanes.

EXERCISES

Read the text and speak on the problems raised in it; say what points in the text you consider most important and why.

CARS: PASSION OR PROBLEM

For some people, the car is a convenient form of transportation. But for others, the car is an exciting hobby. Some people spend their lives collecting valuable cars. Others drive them in races, including the Mille Miglia in Italy, the Carrera Panamericana in Mexico, and the world - famous Indianapolis 500.

For many people, cars are more than transportation: They are a source of passion and pleasure. Yet cars can also be a source of many problems.

In 1903, Henry Ford began selling the Model T car for $825. His company, Ford Motors, was the first to produce cars in large numbers. This made the car available to large numbers of people and helped them to travel long distances quickly and easily. The car has brought people much closer to places of work, study, and entertainment.

Many people also work in car-related industries: fixing cars, washing cars, advertising cars, and selling car products such as stereos and cellular phones.

Most Americans buy a new car every five or six years. This means that one American may own a dozen cars in a lifetime. In fact, there are more cars then people in the United States. In New York City, 2,5 million cars move in and out of the city each day. In this traffic, the average speed is sometimes 8,1 miles per hour. This speed could easily be reached by riding a horse instead of driving a car. But New Yorkers continue to drive, just as people do in California, where freeways are often crowded.

Some environmentalists believe that forms of public transportation such as buses and trains have not been fully developed in the United States. They try to teach others that public transportation saves fuel and helps to protect the environment

Many people are unhappy with car traffic and pollution, as well as with the use of beautiful land for building new roads. One environmentalist, Jan Lundberg, left his Mercedes-Benz in Los Angeles and moved to the forests of northern California. There he works on the *Auto-Free Times*, a newspaper that teaches people how to live without driving. Lundberg travels on foot, on bicycle, or by bus. Before he decided to live without a car, Lundberg worked for the oil companies, studying the prices of gasoline.

Lundberg and other environmentalists' dream of turning parking lots into parks and replacing cars with bicycles, but most people around the world believe that the car is a necessary part of life in today’s world. Still, there is an important question that must be answered: What kind of fuel will we use when gasoline is no longer available? Lundberg believes that by the year 2021, there will no longer be oil for gasoline makers to use. To solve this problem, car companies in Korea, Japan, Europe, and the United States are trying to develop an electric car that will not require gasoline at all.

The electric car is not a new idea. It had success with American women in the early 1900s. Women liked electric cars because they were quiet and did not pollute the air. Electric cars were also easier to start than gasoline-powered ones. But gasoline-powered cars were faster, and in the 1920s they became much popular.

The electric car was not used again until the 1970s, when there were serious problems with availability of oil. Car companies began to plan for a future without gasoline. The General Motors Company had plans to develop an electric car by 1980; however, oil became available again and this car was never produced.

Today there is a new interest in the electric car, which is partly related to a passion for speed and new technology. In1977, engineer Paul MacCready, designed a human-powered airplane that successfully completed a three-mile flight.

A similar airplane crossed the English Channel in 1977, followed by a solar-powered airplane. In 1987, the Sunraycer, a solar-powered car, won a 2,000-mile race in Australia. As a result of this success, the General Motors Company began new work on the development of the electric car. The Toyota Company recently decided to spend $800 million a year on the development of new car technology. Many engineers believe that the electric car will lead to other forms of technology being used for transportation.

Cars may change, but their importance will not. Cars are important to nearly everyone, including engineers, businesspeople, environmentalists, and even poets. Poet Curt Brown believes that cars are part of our passion for new places and new experiences. According to Brown, this “very, comfortable flying chair” will continue to bring us travel and adventure, no matter how it changes in the future.

EXERCISES

I. Number the following main ideas in order they appear in the text:

1. Soon there will be no oil to fuel cars.
2. Cars, whether gasoline or electric powered, will always be important.
3. Cars can cause problems.
4. To some people, cars are more than transportation.
5. Some environmentalists teach people how to live without cars.
6. People in the United States need cars to go to school, to work, and to places of entertainment.

II. Complete the following lists with information from the text:

Advantages of the car.

1. Some people enjoy…
2. People can travel…
3. People are closer to…
4. Some people make money by…

Disadvantages of the car.

1. Lots of traffic and…
2. Cars use more fuel than…
3. Beautiful land is replaced with…
4. Gasoline may no longer be…

COMPONENTS OF THE AUTOMOBILE

Automobiles are trackless, self-propelled vehicles for land transportation of people or goods, or for moving materials. There are three main types of automobiles. These are passenger cars, buses and lorries (trucks). The automobile consists of the following components: a) the engine; b) the framework; c) the mechanism that transmits the power from engine to the wheels; d) the body.

Passenger cars are, as a rule, propelled by an internal combustion engine. They are distinguished by the horsepower of the engine, the number of cylinders in the engine and the type of the body, the type of transmission, wheelbase, weight and overall length.

There are engines of various designs. They differ in the number of cylinders, their position, their operating cycle, valve mechanism, ignition and cooling system.

Most automobile engines have six or eight cylinders, although some four-, twelve-, and sixteen-cylinder engines are used. The activities that take place in the engine cylinder can be divided into four stages which are called strokes. The four strokes are: intake, compression, power and exhaust. “Stroke” refers to the piston movement. The upper limit of piston movement is called top dead centre, TDC. The lower limit of piston movement is called bottom dead centre, BDC. A stroke constitutes piston movement from TDC to BDC or from BDC to TDC. In other words, the piston completes a stroke each time it changes the direction of motion.

EXERCISES

I. Read the text and translate it.

II. Answer the following questions:

1. What types of automobiles do you know?
2. How many cylinders do automobile engines have?
3. What components does an automobile consist of?
4. What is a passenger car propelled with?
5. What is a stroke?

III. Retell the text.

MAKING A CAR PANEL

This panel (FIG. 1) fits onto the front right-hand side of a car. It is made by three methods.

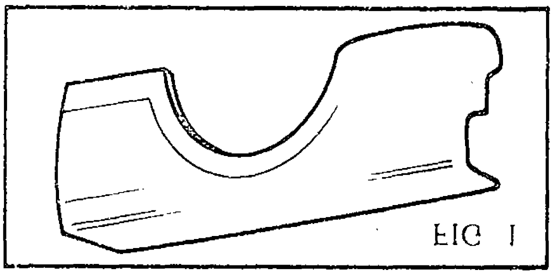
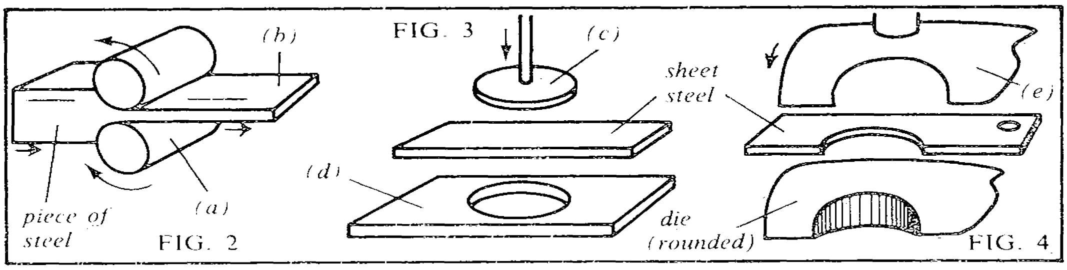


FIG 1

First, *sheet steel* is made. This is done by pushing a piece of steel between two *rollers* (see FIG. 2), which squeeze the metal and make it longer and thinner. This method is called ROLLING. Not all metals can be rolled. For example, iron cannot be rolled because it is too brittle. But steel can be rolled because it is tough and malleable enough.

Next, the steel is cut into a flat shape (see FIG. 3). This is done by placing the sheet onto a *die*, and then cutting a hole in it with a *punch*. The method is called PUNCHING. The steel can be cut easily because it is now very thin**.**

Finally, the sheet steel is bent and pressed into a rounded shape (like in FIG. 1). This is done by putting the sheet onto a die and then bending the sheet around the die with a *press* (see FIG. 4). This method is called PRESSING. It is not difficult to press sheet steel because it is thin and malleable.



EXERCISES

I. Read the text and translate it.

II. What are the objects in the diagrams called?

III. Answer these questions:

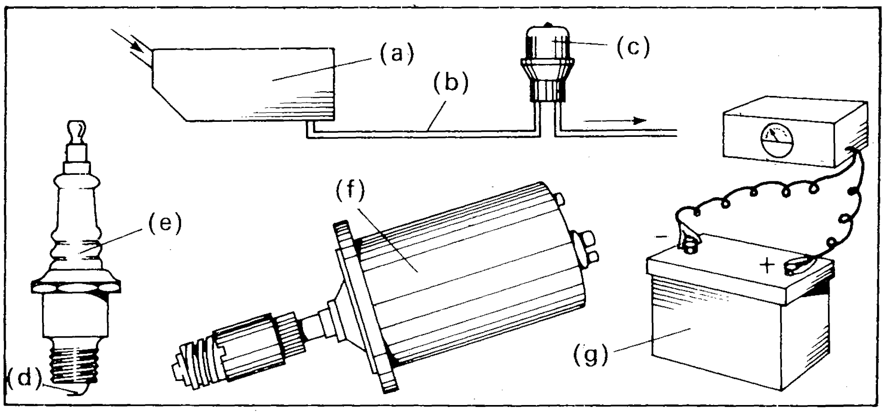
1. What makes the metal longer and thinner? Why?/Why not?
2. How is this done?
3. What does the punch do?
4. What is the press for?
5. What are the rollers for?
6. Is it easy to roll iron? Why?/Why not?
7. Is it easy to cut sheet steel?
8. What do you think "malleable" means? Choose two brittle / easy to break / easy to squeeze / rigid / easy to bend.

FINDING A FAULT IN A CAR

If your car doesn't start in the morning, you should check three things first: the battery, the fuel level and the spark plugs. It is easy to repair these faults. If the battery is flat, you should recharge it. If doesn’t work, you should replace it. If the *petrol tank* is empty, fill it up. If the spark plugs are dirty, clean them, and if the gap in a *spark plug* is too narrow or too wide, adjust it to the correct.

If your car still doesn’t start, the *petrol pump* may be broken or the *fuel pipe* may be blocked. If the pump is broken, it must be repaired or replaced. If the fuel pipe is blocked, take it off and unblock it.

It there is a loud CLICK! when you work, you turn the key, the *starter motor* may be jammed. If it is, you can try to release it by pushing the car forwards and backwards (in 2nd gear). If the car still doesn’t start, the starter motor should be repaired or replaced.



EXERCISES

I. Read the text and translate it.

II. Match these pictures with words from the text:

III. Answer these questions:

1. You check the battery. It’s flat. You try to recharge it. It’s still flat. What do you do next?

2. If the gap in a spark plug is too narrow, how do you adjust it? Do you widen it or make it narrower?

3. How do you know that the starter motor might be jammed? What do you hear?

4. You push the car forwards and backwards, but the starter still doesn't work. What do you do now?

TRUCKS

A truck, or lorry, is a motor vehicle designed to carry freight or goods or to perform special services. The truck was derived from horse-driven wagon technology, and some of the pioneer manufacturers came from the wagon business. Because of their speed and flexibility, trucks carry a quarter of the intercity freight in the United States. By the year 2000, 900 billion ton-miles of freight can be expected to be moved by trucks annually in the United States. Trucks enjoy an almost total monopoly in intracity freight delivery.

In 1896 Gottlieb Daimler of Germany built the first motor truck. It was equipped with a four-horsepower engine and a belt drive with two speeds forward and one in reverse. In 1898 the Winton Company of the United States produced a gasoline-powered delivery wagon with a single-cylinder six-horsepower engine. In World War I motor trucks were widely used, and in World War II they largely replaced horse-drawn equipment. A notable vehicle was the four-wheel-drive, quarter-ton-capacity, short-wheelbase jeep, capable of performing a variety of military tasks.

Types and definitions. Trucks can be classified as either straight or articulated. A straight truck is one in which all axles are attached to a single frame. An articulated vehicle is one that consists of two or more separate frames connected by suitable couplings. A truck tractor is a motor vehicle designed primarily for drawing truck trailers and constructed to carry part of the weight and load of a semi-trailer, which is a truck trailer equipped with one or more axles, so constructed that the end and a substantial part of its own weight and that of its load rests upon a truck tractor. In contrast, a full trailer is so constructed that all of its own weight and that of its load rests upon its own wheels. More than half of the world production of trucks consists of small pickup trucks and vans. Medium trucks have GVW (gross vehicle weight) ratings of from 14,000 to 33,000 pounds and are generally straight designs. They make up about 4 percent of sales. In each of the late decades of the 20th century, about 45 million trucks were added to the world total. The ratio of trucks to passenger cars in the world is increasing annually.

VOCABULARY NOTES

truck (lorry) грузовой автомобиль
straight truck грузовой автомобиль с цилиндрами в ряд
articulated truck грузовой прицеп
freight груз, фрахт; грузовые перевозки
coupling соединение, сцепление

EXERCISES

I. Read the text, translate it and render it in Russian.

II. Answer the questions:

1. What is a truck?
2. What do the trucks carry in the U.S.A.?
3. When and where was the first truck built?
4. How were the trucks used in World War I and II?

5. What are the main types of trucks? What is the difference between them?

6. What is a truck trailer?

7. What is the ratio of trucks to passenger cars in the 20^{th} century?

III. Make up a brief summary of the text.

MODERN BUSES

There are four main types of buses: city or transit, suburban, intercity or tour, and school. The city bus operates within the city limits and is characterized by low maximum speed, low-ride platform, provision for standing and wheelchair passengers, two entrances on the curb side, low-back seats, and no luggage space. The suburban bus is designed for short intercity runs and has high-back seats, luggage compartments and racks, and a single front entrance.

The inter-city type has a high-ride platform to provide maximum luggage space under the passengers, high-back seats, overhead luggage racks, individual reading lights, and a washroom. A typical intercity coach weighs about 26,000 pounds (12,000 kilograms), has a capacity of up to 47 passengers, a two-stroke-cycle V-8 diesel engine with up to 450 horsepower, an electronically controlled automatic transmission, and air brakes. School buses generally consist of a 50-passenger bus body, with special signal lamp and safety provisions, mounted on a long-wheelbase truck chassis.

Articulated buses were first used in Europe in the 1950s. In this arrangement a trailer body is connected to the rear of a conventional front-engine bus by means of a hitch, a flexible diaphragm, and a continuous floor panel with arcurate mating surfaces during turn maneuvers. This arrangement permits up to a 75 percent increase in seating capacity and a 20 percent improvement in fuel efficiency per seat-mile. The turning radius is the same as that of a conventional bus. Manufacture of this design was begun in the United States in the 1980s by several European firms.

VOCABULARY NOTES

city (transit) bus городской автобус
suburban bus пригородный автобус
intercity (tour) bus междугородный автобус
coach автобус (междугородного сообщения)
curb обочина, край тротуара
rack полка; сетка для вещей (в автобусе)
rear задняя, тыльная сторона
hitch удар, толчок
arcuate mating surface дугообразная парная поверхность
conventional bus обычный, традиционный автобус

EXERCISES

I. Read the text and translate it.
II. Speak on the topics:
1) main types of buses;
2) first articulated buses in Europe and the U.S.A.

III. Give the summary of the text.

MOTOR COMPANIES

As America moved into the "Roaring Twenties", the automobile became an important part of the every citizen's life. The car became more affordable for the people with the average income. Automobile production figures rose from two million in 1920 to five and a half in 1929. By the late twenties a point was reached at which it was possible to move the entire population of the United States by road at one time, since there was close to one motor vehicle for every five people. Thus the car was no longer a luxury, but a useful and necessary item of the household.

There are two factors that made this possible. First- the price drop on the cars, which reached its lowest point in 1926, when a Model T (one of the first Ford's cars) could be bought for $290. Secondly there was a liberal access to the credit for both consumes and dealers. The big companies such as General Motors and Ford went into financing of sales on a big scale. The result was that by 1925 three-fourths of all sales of motor vehicles, new and used, were made on time-payment plans.

Motor-vehicle manufacturing was by then the largest industry in the country and was still growing rapidly. Employment in the automobile factories was a quarter of a million in 1922 and in excess of the 400,000 in 1929; the of paid wages doubled from $400 millions to $800 millions. It also had a great effect on other industries: highway construction, retail, repair and gas services. These industries employed about the 1,2 million people. The motor vehicle was now consuming annually 90 % of the country's petroleum products, 80 % of the rubber, 20 % of steel, 75 % of the plate glass, and 25 % of the machine tools.

Of course all this auto mobilization of such huge country as U.S.A. required reorganization of a whole highway system in order to provide motorists with usable ways of transportation. In 1916 the Congress passed the Road Aid Act by which all state governments were required to have a highway department to keep state roads in order. But new Federal Highway Act of 1921 went even further by providing states with federal help in maintaining of the roads of the federal importance (about 7 % of the non-urban road mileage in each state) on a fifty-fifty matching basis. Initially about two hundred thousand miles of trunk highways received federal support. In order to justify these expenses Oregon's state government used simple and apparently painless method of taxing the sale of gasoline in an amount of one cent per gallon. Ten years later every state had gasoline tax, and the average had risen to three cents per gallon.

During this time the automobile industry was undergoing fundamental changes in structure. The day, when the individual with technical skills and a garage could start a motor company like in the beginning of the century, was gone. In order to gain the mass market the company had to have a tremendous capital, great manufacturing facilities and widespread network of dealerships. Thus during this time the so-called Big Three consolidate about three-fourth of the market, leaving the remaining 25 % to about 50 other companies. So this Big Three consisted of Ford, General Motors and Chrysler.

VOCABULARY NOTES

to afford иметь возможность, позволять себе что-то
affordable возможный, допустимый
accessible доступный, удобный (в употреблении)
dealer торговец
on a big scale в большом масштабе
highway construction строительство автомобильных дорог
retail продавать в розницу
petroleum, gasoline моторное топливо, газолин
rubber резина, каучук
tools инструменты
mileage расстояние (в милях)
tax налог
facilities удобства; средства обслуживания

EXERCISES

I. Read the text and translate it.

II. Give the English equivalents to the Russian words:

бензин, условия, розничная торговля, строительство автомобильных дорог, инструменты, в большом масштабе.

III. Give the synonyms to the following words:

road, seller, amenities, possible, to sell, distance.

IV. Answer the questions:

1. How can you explain the words "Roaring Twenties"?
2. How did the number of automobiles rise during this period?
3. What factors made it possible that the car was no longer a luxury, but a necessary item?
4. Why was the motor-vehicle manufacturing the largest industry in the world?
5. How did the American authorities support reorganization of highway system?
6. What are the main demands to gain the mass market?
7. What are the names of so-called Big Three companies?

FORD MOTOR COMPANY

At the beginning of the boom period of 1920s, Ford's leading position was unchallenged and seemingly unchallengeable: in 1921 the Ford Motor Company made three-fifth of all the motor vehicles manufactured in the United States. But soon General motors moved it from this position.

Ford was born on a farm near Dearborn, Michigan, on July 30, 1863, and educated in district schools. He became a machinist's apprentice in Detroit at the age of 16. From 1888 to 1899 he was a mechanical engineer, and later chief engineer, with the Edison Illuminating Company. In 1893, after experimenting for several years in his leisure hour, he completed the construction of his first automobile, and in 1903 he founded the Ford Motor Company.

By early 1914 this innovation, although greatly increasing productivity, had resulted in a monthly labor turnover of 40 to 60 percent in his factory, largely because of the unpleasant monotony of assembly-line work and repeated increases in the production quotas assigned to workers. Ford met this difficulty by doubling the daily wage then standard in the industry, raising it from about $2,50 to $5. The net result was increased stability in his labor force and a substantial reduction in operating costs. These factors, coupled with the enormous increase in output made possible by new technological methods, led to an increase in company profits from $30 million in 1914 to $60 million in 1916.

In 1908 the Ford Company initiated production of the celebrated Model T. Until 1927, when the Model T was discontinued in favor of a more up-to-date model, the company produced and sold about 15 million cars. Within few years, however, Ford's preeminence as the largest producer and seller of automobiles in the nation was gradually lost to his competitors, largely because he was slow to adopt the practice of introducing a new model of automobile each year, which had become standard in the industry.

Henry Ford obviously missed the fact that more attractive and more comfortable cars appeared on the market, and low price (Model T was the cheapest one) wasn't a solution to everything.

The price from now became just one, but not the only one, of the criteria for the consumer's decision.

On May 31st, 1927 the last model T (no. 15,007,003) rolled off the assembly line and all Ford manufacturing operations came to a prolonged halt. This was the result of final realization of the inevitable Ford was loosing to the General Motors, and it needed something new. For about a year and a half Ford was keeping silence, but finally he came out with the Model A. Although it was a good car (in its first year it outsold General Motor's Chevrolet) but it wasn't significantly different from its competitors and certainly not superior to them. Thus in spite of all Ford's effort his company would remain on its second place till nowadays.

VOCABULARY NOTES

to challenge подвергать сомнению; оспаривать
(un)challengeable (не) вызывающий сомнение
machinist's apprentice ученик механика
mechanical engineer инженер-механик
chief engineer главный инженер
interchangeable взаимозаменяемый
assembly line сборный конвейер
labor turnover текучесть рабочей силы
to assign назначать, устанавливать
wage зарплата
to reduce сокращать, понижать
to discontinue прекращать, прерывать
preeminence превосходство, преимущество
to compete соревноваться, конкурировать
competition конкуренция, соперничество
competitor соперник, конкурент
halt остановка, полустанок

EXERCISES

I. Read the text and translate it.

II. Correct the statements according to the text:

1. The Ford Motor Company was not large and leading in motor vehicles manufacture of 1920's in the United States.
2. Henry Ford founded the Ford Motor Company in 1863.
3. In 1927 the Ford Company initiated production of the Model T.
4. The Ford Company was always the largest producer and seller of automobiles.
5. Model A was superior to its competitors and the Ford Company remained the first till nowadays.

III. Describe the most important facts of Henry Ford's biography.

IV. Put up the items of the plan into logical order and make up a brief summary according to it.

1. Production of Model A, which, however didn't help to occupy the leading position in car manufacturing industry.
2. The Ford Motor Company was founded in 1903.
3. Henry Ford is the founder of the Company.
4. The beginning of the Model T manufacturing and its importance for the company's development.

GENERAL MOTORS COMPANY

General Motors was founded by William C. Durant in 1908. General Motors was the major Ford's competitor and was able to defeat Ford's Company nit only due to the Ford's mistakes but also because of Alfred P. Sloan, Jr., one of the greatest organizing geniuses in the American industry. After Durant bought Sloan's business, which was pretty successful, Sloan came to work for General Motors too.

Soon he was promoted to vice president and became president of the General Motors in 1923.

In 1920 General Motors began to experience big troubles with quality control and sales William Durant was forced out of his job and Pierre Samuel DuPont took his place. Sloan was in charge of operations at the time. He had to reorganize the whole company because management team was unorganized. Few different lines of cars were produced: Chevrolet, Oldsmobile, Buick, Cadillac, Pontiac, La Salle, and more. None of them had production planning but they all competed among each other. Only Buick and Cadillac were known for quality. Company had no inventory control.

When Sloan familiarized himself with the mess in the company, he realized what the company could be if it was organized. He noticed few main advantages over Ford: General Motors had variety of cars when Ford only had Model T in production, also GM's cars were in different price ranges. GM started making cars with 4, 6, and 8 cylinders.

He established inventory control, and discontinued any line of cars, which wasn't popular with consumers. Also he formed a policy of annual model changes to attract customers. Also he set up advertisements and banquets to help him to sell cars.

In 1921 General Motors sold 457,000 cars and their profit was 61 million dollars. Next year 800,000 cars were sold and profit was 80 million dollars. President DuPont was so pleased that he retired and named Sloan the president of General Motors. In 1929 the profit of General Motors was 248 million dollars with 1,9 million cars sold. During the Great Depression sales dropped by a lot but General Motors still made a huge profit compared to all other companies because the company so organized under Sloan that it was able to adapt fast to any major market change.

When Alfred Sloan took charge of the General Motors, company was a mess and was on the edge of collapse. Alfred Sloan basically made General Motors the company that became first on the market and kept that position.

VOCABULARY NOTES

to defeat наносить поражение; уничтожать
to promote повышать; производить (в чин)
trouble трудность, неприятность
quality control контроль качества
inventory control контроль наличия товаров
sale торговля
to be in charge of заведовать; отвечать за что-либо
consumer потребитель
customer покупатель
to advertise рекламировать
advertisement реклама
profit доход
to retire увольнять; оставлять должность
to drop понижать

EXERCISES

I. Read the text and translate it.

II. Give the Russian equivalents to the following words and word combinations:

was founded; major competitor; one of the greatest organizing geniuses; pretty successful; was promoted to; to experience big troubles; was forced out; management team; inventory control; main advantages; popular with consumers; to attract customers; made a huge profit; on the edge of collapse.

III. Use one of the following words in the sentences given below: competition; big troubles; variety; management; inventory.

1. There were … with quality control in General Motors Company.

2. General Motors has … of cars.

3. General Motors was the main … for Ford's Company.

4. Sloan reorganized the company because … team was unorganized.

5. There were no … control in General Motors.

IV. Make up 10 questions and use them as a plan for the retelling of the text.

CHRYSLER

At the next level below Ford and General Motors, when the 1920s began, was a group of apparently well-established companies with some potential: Hudson (including Essex), Studebaker, Dodge, Maxwell (later Chrysler), Willys-Overland, Nash, Packard, and Durant Motors. From these only Chrysler emerged to form what became one of the Big Three of American automobilidom.

This was the result of a conscious decision on Chrysler's part, along with an ability to grasp opportunities. He was aware that, despite its promising start, the Chrysler Corporation would be a minor and possibly short-lived member of the automobile world unless it could get established in the mass market. But the manufacturing resources were too limited to enable Chrysler to produce a low-priced car competitively, and the company still lacked the financial strength to build a new plant on the scale that would be required. The solution to the problem was found when the Dodge Brothers Manufacturing

Company was put on the market in 1928. John and Horace Dodge had been victims of the influenza epidemic that followed the First World War, and their heirs subsequently decided to get out of the automobile business.

Consequently, after some dickering Dodge was absorbed by the Chrysler organization. The assets received by Chrysler were just what he needed: a first-class manufacturing plant with a well-equipped foundry and other facilities for large-scale production; a car with a well-known name and an established position in the medium-priced market; and a dealer network some twelve thousand strong that could be used as an outlet for other Chrysler products. The Dodge sales organization was considered to be one of the best in the country, and Chrysler's autobiography makes it clear that he wanted the Dodge dealers as much as the Dodge manufacturing capacity. With these resources at his command Chrysler was able to introduce the Plymouth in 1928, a step neatly timed to take advantage of Henry Ford's temporary disappearance from the mass market.

With the rise of Chrysler the developing structure of the American automobile industry became clearly appreciable. At the top were General Motors and Ford, between them out-producing the rest of the industry put together. Both were also international automotive powers. Ford had established manufacturing subsidiaries in Europe before the First World War and had regional assembly plants throughout the world. General Motors bought the British Vauxhall and the German Opel companies during the 1920s. Chrysler was well behind the leaders but definitely ahead of the rest of the field.

The total effect of the motor vehicle on American life has still to be measured, if indeed such measurement is even possible. Certainly the automobile brought major social changes, and some of these were becoming evident with the widespread extension of car ownership in the 1920s. It would be an exaggeration to say that the automobile made Americans a mobile people; the people who made their way across the American continent while the motorcar was still a dream were far from static. It would be more accurate to say that an already mobile people were given the means to travel farther, faster, and more freely.

VOCABULARY NOTES

ability способность
to grasp захватывать; понять, постичь
to lack испытывать недостаток, нуждаться
to put on the market поставлять на рынок
dicker обмен, мелкая сделка
to absorb поглощать
outlet выпуск; рынок сбыта
subsidiary филиал, дочерняя фирма
mobile подвижный

EXERCISES

I. Read the text, translate it and say what you think on this problem.

II. Translate compound words from English into Russian; give your own examples of such word combinations:

well-established company; short-lived member; low-priced car; a first-class plant; well-equipped foundry; large-scale production; well-known name; medium-priced market; widespread extension.

III. Put up 6 questions to the text in the form of the plan.

IV. Give a brief summary of the text.

MODERN TRANSPORTATION VEHICLES AND SYSTEMS

The Modern Automobile. It is a complex technical system employing subsystems with specific design functions. Some of these consist of thousands of component parts that have evolved from breakthroughs in existing technology or from new discoveries such as electronic computers, high-strength plastics, and new alloys of steel and nonferrous metals, as well as from factors such as air pollution, safety legislation, and foreign competition.

Approximately 500 different models have been offered annually to U.S. car buyers, about half domestic and half foreign in origin. New designs have been brought into the market more quickly in recent years than in the past to permit manufacturers to capitalize on their proprietary technological advances. With more than 30 million new units built each year worldwide, manufacturers have been able to split up the total into many very small segments that nonetheless remained economical to market.

New technical developments are recognized to be the key to successful competition. Research and development engineers and scientists have been employed by all automobile manufacturers and suppliers to improve the car body, chassis, engine, drive train, vehicle control systems, occupant safety, and environmental emissions, and further work by the industry is necessary to meet the needs of the 21st century.

Vehicle design depends to a large extent on its intended use. Automobiles for off-road use in countries that lack service facilities must be durable, simple systems with high resistance to severe overloads and extremes in operating conditions. Conversely the customers for products that are intended for the high-speed, limited-access road systems in Europe and North America expect more passenger comfort options, increased engine performance, and optimized high-speed handling and vehicle stability. Stability depends principally on the distribution of weight between the front and rear wheels, the height of the centre of gravity and its position relative to the aerodynamic centre of pressure of the vehicle, suspension characteristics, and whether front or rear wheels are used for propulsion. Weight distribution depends principally on the location and size of the engine. The common practice of front-mounted engines exploits the stability that is more readily achieved with this layout. The development of aluminum engines and new manufacturing processes has, however, made it possible to locate the engine at the rear without necessarily compromising stability.

Body. Automobile body designs are frequently categorized according to the number of doors, the arrangement of seats, and the roof structure. Automobile roofs are conventionally supported by pillars on each side of the body.

Automobile bodies are generally formed out of sheet steel. Elements are added to the alloy to improve its ability to be formed into deeper depressions without wrinkling or tearing in manufacturing presses. Steel is used because of its general availability, low cost, and good workability. For certain applications, however, other materials, such as aluminum, fiberglass, and carbon-fiber reinforced plastic, are used because of their special properties. Polyamide, polyester, polystyrene, polypropylene, and ethylene plastics have been formulated for greater toughness and resistance to brittle deformation. This material has been designed successfully for some body panels.

To protect bodies from corrosive elements and maintain their strength and appearance, special priming and painting processes are used. Bodies are first dipped in cleaning baths to remove oil and other foreign matter. They then go through a successions of dip and spray cycles. Enamel and acrylic lacquer are both in common use. Electrodeposition of the sprayed paint, a process in which the paint spray is given an electrostatic charge and then attracted to the surface by a high voltage, helps assure that an even coat is applied and that hard-to-reach areas are covered, Ovens with conveyor lines are used to speed the drying process in the factory. Galvanized steel with a protective zinc coating and corrosion-resistant stainless steel are used in body areas that are more likely to corrode.

Chassis. The chassis of the modern automobile is the main structure of the vehicle. In most designs a pressed-steel frame forms skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members are mounted. The body is flexible bolted to the chassis during the manufacturing process. The combination of body and frame absorbs the reactions from the movement of the engine and axle, receives the reaction forces of the wheels in acceleration and braking. Absorbs aerodynamic wind forces and road shocks through the suspension, and absorbs the major energy of impact in the event of an accident.

In modern small car designs there has been a trend toward combining the chassis frame and the body into a single structural element. In this arrangement the steel body shell is reinforced with braces that make it rigid enough to resist the forces that are applied to it. Separate frames are used for other cars to achieve better noise-isolation characteristics. The presence of heavier-gauge steel components in modern separate frame designs also tends to limit intrusion in accidents.

Engine. A wide range of energy-conversion systems has been used experimentally and in automotive production. These include electric, steam, solar, turbine, rotary, and a variety of piston-type internal-combustion engines. The most successful for automobiles has been the reciprocating-piston internal-combustion engine, operating on a four-stroke cycle, while diesel engines are widely used for trucks and buses. The gasoline engine was originally selected for automobiles because it could operate more flexibly over a wide range of speeds, and the power developed for a given weight engine was reasonable; it could be produced by economical mass-production methods; and it used a readily available, moderately priced fuel — gasoline. Reliability, compact size, and range of operation later became important factors.

In late 1940s a trend began to increase engine horse-power, particularly in American models. Design changes incorporated all known methods of raising engine capacity, including increasing the pressure in the cylinders to improve efficiency, increasing the size of the engine, and increasing the speed at which power is generated. The higher forces and pressures created by these changes created engine vibration and size problems that led to stiffer, more compact engines with V and opposed cylinder layouts replacing longer straight line arrangements.

European automobile engines were of a much wider variety, ranging from 1 to 12 cylinders, with corresponding differences in overall size, weight, piston displacement, and cylinder bores. A majority of the models had four cylinders and horsepower ratings from 19 to 120. Several three-cylinder, two-stroke-cycle models were built Most engines had straight or in-line cylinders.

Fuel and lubrication. Specially formulated gasoline is essentially the only fuel used for automobile operation, although diesel fuels are used for many trucks and buses and a few automobiles. The most important requirements of a fuel for automobile use are proper volatility, sufficient antiknock quality, and freedom from polluting by-products of combustion.

All moving parts of an automobile require lubrication. Without it, friction would increase power consumption and damage the parts. The lubricant also serves as a coolant, a noise-reducing cushion, and a sealant between engine piston rings and cylinder walls. The engine lubrication system incorporates a gear-type pump that delivers filtered oil under pressure to a system of drilled passages leading to various bearings. Oil spray also lubricates the cams and valve lifters.

Cooling system. Almost all automobiles employ liquid cooling systems for their engines. A typical automotive cooling system comprises (1) a series of channels cast into the engine block and cylinder head, surrounding the combustion chambers with circulating water or other coolant to carry away excessive heat, (2) a radiator, consisting of many small tubes equipped with a honeycomb of fins to radiate heat rapidly, that receives and cools hot liquid from the engine, (3) a centrifugal-type water pump with which to circulate coolant, (4) a thermostat, which maintains constant temperature by automatically varying the amount of coolant passing into the radiator, and (5) a fan, which draws fresh air trough the radiator.

Coolants contain corrosion inhibitors designed to make it necessary to drain and refill the cooling system only once a year.

Air-cooled cylinders operate at higher, more efficient temperatures, and air cooling offers the important advantage of eliminating not only freezing and boiling of the coolant at temperature extremes but also corrosion damage to the cooling system. Control of engine temperature is more difficult, however, and high-temperature-resistant ceramic parts are required when design operating temperatures are significantly increased.

Transmission. The transmission is such a speed-changing device. It is installed in the power train that connects the crankshaft of the engine to the driving wheels. This permits the engine to operate at a higher speed when its full power is needed and to slow down to a more economical speed when less power is needed. Under some conditions, as in starting a stationary vehicle or in ascending steep grades, the torque of the engine is insufficient, and amplification is desirable. Most devices employed to change the ratio of the speed of the engine to the speed of the driving wheels multiply the engine torque by the same factor by which the engine speed is increased.

The simplest automobile transmission is the sliding-spur gear type with three or more forward speeds and reverse. Most automatic transmissions employ a hydraulic torque converter, a device for transmitting and amplifying the torque produced by the engine. Each type provides for manual selection of reverse and low ranges that either prevent automatic upshifts or employ lower gear ratios than are used in normal driving. Grade-retard provisions are also sometimes included to supply dynamic engine braking on hills.

The transmission control unit is interconnected with the vehicle's emission control unit to permit the engine timing and air-to-fuel ratio to be momentarily tailored to optimize the control of exhaust emission chemistry during the transmission shift cycle.

Small, low-powered cars usually have manually shifted, five-speed transmissions. Fully automatic transmissions are used for the most part in larger cars with ratings above 60 horsepower.

VOCABULARY NOTES

chassis шасси, ходовая часть

engine двигатель

piston-type internal combustion engine двигатель внутреннего сгорания

reciprocating engine поршневой двигатель

wheel колесо

front (back-rear) wheel переднее (заднее) колесо

wheel broke колёсный тормоз
wheel assembly колёсное шасси
wheel drive привод колёс
wheel load давление на колесо
to suspend вешать, подвешивать
suspension members подвесные части
propulsion движущая сила; движение вперёд (назад)
priming заправка (двигателя)
succession последовательность
electro-deposition гальваническое покрытие
electrostatic charge электростатический заряд
axle ось, вал
steering mechanism рулевое управление
stroke ход (поршня, клапана)
camshaft распределительный вал
lubrication смазка
friction трение
cushion (техн.) подушка
fan вентилятор
train зубчатая передача; система рычагов
crankshaft коленчатый вал
torque редуктор
gear ratio передаточное число
middle (to, bottom, first…) gear средняя (высшая, самая малая, первая) скорость
reverse gear задний ход
to put into (out of) gear включать (выключать) передачу
to be tailored приспосабливаться

EXERCISES

I. Read and translate the following text.

II. Find Russian equivalents to the English ones:

engine	заднее колесо
chassis	редуктор
front wheel	вентилятор
rear wheel	система рычагов
axle	шасси
camshaft	трение
friction	переднее колесо
train	двигатель
torque	ось, вал
fan	распределительный вал

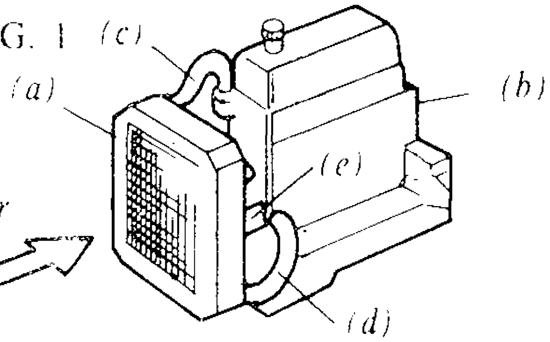
III. Answer the following questions:

1. What are the main parts of the vehicle?
2. What does the vehicle design depend on?
3. Why is steel used for automobile bodies?
4. What other materials are used for automobile?
5. Why is chassis the main structure of the vehicle?
6. What types of engines can you name?
7. Why do you think the gasoline engine was selected for automobile?
8. What kind of fuel is used for automobile operation? Why?
9. Why do all moving parts require lubrication?
10. What are the main types of cooling systems?
11. What is the simplest automobile transmission?

IV. Make up a brief summary of the text.

A CAR COOLING SYSTEM

FIG. 1



Most car engines are cooled by water. The water flows around the *engine* and then passes through the *radiator*. It then passes through the water pump and around the engine again.

Here are the stages:

1. Water flows around the engine. The engine is cooled and the water is heated.
2. The hot water enters the radiator through the *top hose.*
3. It flows down through the radiator. Here it is cooled by air.
4. The cool water leaves the radiator through the *bottom* hose.
5. The water is pumped around the engine again.

Look at FIG. 3. Air is pulled through the radiator by a *fan*. This fan is turned by a *belt*, which is driven by the engine.

FIG. 2

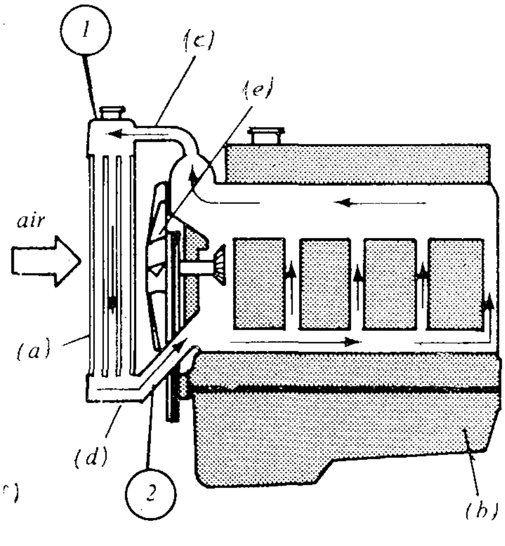
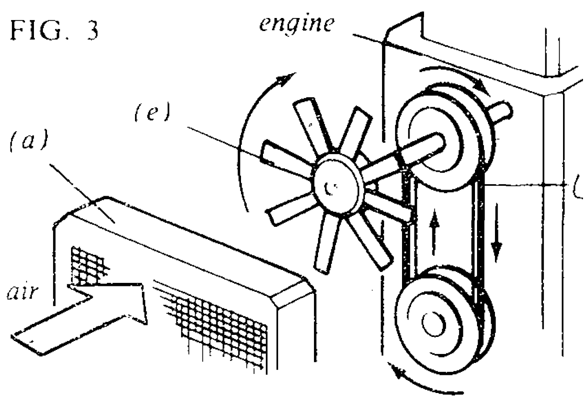


FIG. 3



EXERCISES

I. What are the objects in the diagrams called?

Example: (a) is called a radiator.

II. Answer these questions:

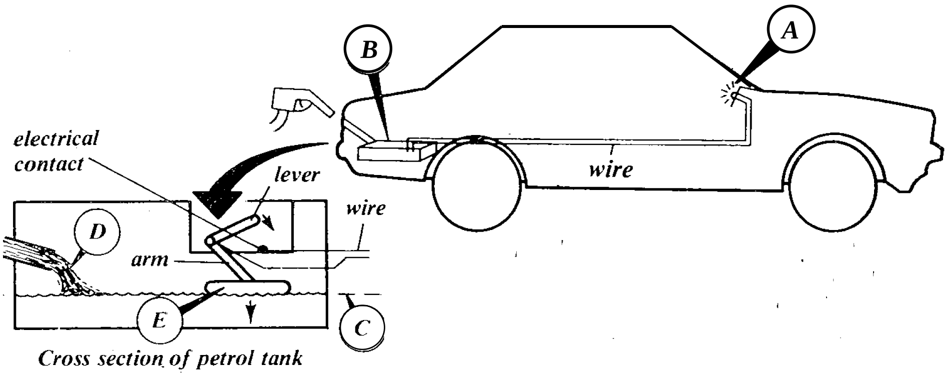
1. Look at Fig. 2. Is the water hot or cold at point (1)? At point (2)?
2. What cools the engine?
3. What makes the water hot?
4. What makes the water cool?
5. What pumps the water round the engine?
6. What pulls air through the radiator?
7. What does the belt turn?
8. What drives the belt?

FUEL WARNING LIGHT

Many cars have a fuel warning *light*. When the level of fuel (petrol) in the *tank* is very low, this light switches on and the driver can see that he needs more petrol. How does this light work?

When the *level* of the fuel falls, the *float* moves downwards. When this happens, the *arm* also moves downwards and makes the *lever* touch an electrical contact. This switches on the fuel light in the car.

When the driver sees the fuel warning light, he puts more *petrol* into the tank. This makes the fuel level rise and pushes the float upwards. When the float rises, it makes the arm move upwards and this causes the lever to move upwards also. The fuel warning light then switches off.



EXERCISES

I. Read the text and follow the information.

II. What do the letters in the diagrams refer to? (Look at the words in italics in the passage.)

Example: (a) This is called a *light,*

III. Answer these questions:

1. When does the fuel warning light go on?
2. Why does the float go down?
3. What makes the lever move downwards?
4. Does the float go up or down when the fuel level rises?
5. When does the lever move upwards?

TEST I

I. Give the Russian for:

highway

macadam road surface

pavement

turnpike

network

truck

van

car safety features

drive in(s)
toll road
mobile
engine
wheel
axle
steering mechanism

II. Translate into Russian:

1. Modern highway design entails careful study of soil, the topography of the intended route, and the drainage systems around the roadway.

2. Road traffic accidents have become a particular problem in Great Britain.

3. A new type of engine for sports cars will have been produced by the end of the year.

4. The company offers road pavers on crawlers and on wheels, with diesel-hydraulic or diesel-electric drive systems.

5. New forms of city transport may involve buses on specially constructed reserved tracks.

6. A mobile road safety barrier, developed in Germany, has been used to provide traffic management on road repair project.

7. Macadams made with tar have been used for many years for surfacing lorry parks and depots because the solvency effect of light petroleum residues on tar is minimal.

8. The national expressways which are fully access controlled must be frequently separated from other crossing roads.

9. Transportation problems of the big cities can be solved by better organization of conventional means of transport.

10. The automobile has been described as either a menace to civilization or a symbol of personal freedom.

TEST II

I. Give the Russian for:

carriage
vehicle
filling station
freight
straight truck
articulated truck
coupling
coach
crankshaft torque
friction
rigid pavement
lubrication
facilities
sub-grade
reciprocating engine

II. Translate into Russian:

1. India has the third largest road network in the world.

2. For new roads, our products help stabilize soil, provide drainage, and separate layers of stone from sub-grades.

3. A flexible pavement has the advantage of being easy to build and repair, its asphalt binder is both waterproof and plastic.

4. A single overweight truck passing over a section of roadway can cause more damage than an entire day's volume on a typical interstate highway.

5. To use more glass in a modern motor vehicle means improvement of visibility.

6. Demand for road transport in Europe has constantly outpaced the development of the road network, in particular for mo-

torways and express links.

7. A driver must not assume that a car's engine, brakes, lights and steering system always operate properly.

8. Axle assemblies of heavy trucks may be made up of two or more axles, any of which may be powered.

9. The simplest automobile transmission is the sliding-spur gear type with three or more forward speeds and reverse.

10. Surely no one will disagree that the car has given millions of people more options of where to live and work and opened up greater access to social and economic opportunity.

PART II. HOUSING CONSTRUCTION

ENGINEERING

Engineering is the professional art of applying science to the optimum conversion of the resources of nature to the uses of humankind. Engineering has been defined by the Engineers Council for Professional Development, in the United States, as the creative application of "scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property".

The term engineering is sometimes more loosely defined, especially in Great Britain, as the manufacture or assembly of engines, machine tools, and machine parts.

The word engine derived from the same Latin root, ingenerare, which means “to create”. The early English verb engine meant “to contrive”. Thus the engines of war were devices such as catapults, floating bridges, and their designer was the “engineer”, or military engineer. The counterpart of the military engineer was the civil engineer, who applied essentially the same knowledge and skills to designing buildings, streets, water supplies, sewage systems, and other projects.

The function of the scientist is to know, while that of the engineer is to do. The scientist adds to the store of systematized knowledge of the physical world; the engineer brings this knowledge to bear on practical problems. Engineering is based principally on physics, chemistry, and mathematics and their extensions into materials science, solid and fluid mechanics, thermodynamics, transfer and rate processes and systems analysis.

Engineers employ two types of natural resources – materials and energy. Materials are useful because of their properties: their strength, ease of fabrication, lightness, or durability; their ability to insulate or conduct; their chemical, electrical, or acoustical properties. Important sources of energy include fossil fuels (coal, petroleum and gas), wind, sunlight, falling water, and nuclear fission. Since most resources are limited, the engineer must concern himself with the continual development of new resources as well as the efficient utilization of existing ones.

ENGINEERING AS A PROFESSION

History of engineering. The first engineer known by name and achievement is Imhotep, builder of the Step Pyramid at Saqqarah, Egypt, probably in about 2550 B.C. Imhotep's successors — Egyptian, Persian, Greek, and Roman — carried civil engineering to remarkable heights. The Pharos (lighthouse) of Alexandria, Solomon's Temple in Jerusalem, the Colosseum in Rome, the Persian and Roman road systems, the Pont du Gard aqueduct in France, and many other large structures, some of which endure to this day, testify to their skill and imagination.

Civil engineering emerged as a separate discipline in the 18th century, when the first professional societies and schools of engineering were founded. Civil engineers of the 19th century built structures of all kinds, designed water-supply and sanitation systems, laid out railroad and highway networks, and planned cities.

Engineering functions. Problem solving is common to all engineering work. The problem may solve quantitative or qualitative factors: it may be physical or economic; it may require abstract mathematics or common sense. Of great importance is the process of creative synthesis or design, putting ideas together to create a new and optimum solution. The major functions of all engineering branches are the following:

Research. Using mathematical and scientific concepts, experimental techniques, and inductive reasoning, the research engineer seeks new principles and processes.

Development. Development engineers apply the results of research to useful purposes. Creative application of new knowledge may result in a working model of a new electrical circuit, a chemical process or an industrial machine.

Design. In designing a structure or a product, the engineer selects methods, specifies materials, and determines shapes to satisfy technical requirements and to meet performance specifications.

Construction. The construction engineer is responsible for preparing the site, determining procedures that will, economically and safely yield the desired quality, directing the placement of materials, and organizing the personnel and equipment.

Production. Plant layout and equipment selection are the responsibility of the production engineer, who chooses processes and tools, integrates the flow of materials and components, and provides for testing and inspection.

Operation. The operating engineer controls machines, plants, and organizations providing power, transportation, and communication; determines procedures; and supervises personnel to obtain reliable and economic operation of complex equipment.

Management and other functions. In some countries and industries, engineers analyze customers' requirements, recommend units to satisfy needs economically, and resolve related problems.

VOCABULARY NOTES

engineering инженерное искусство
to apply использовать, применять
application использование, применение
science наука
scientific научный
structure здание, сооружение, строение
machine apparatus механизм; станок; машина
machine tools станок
machine parts детали станка, механизма
water supply водоснабжение

sewage system система сточных вод
sewerage канализация
material science материаловедение
solid mechanics механика твердых тел
fluid mechanics гидромеханика
strength of material сопротивление материалов
research engineer инженер-исследователь
development engineer инженер-технолог
construction engineer инженер-строитель
production engineer инженер по организации производства
operating engineer инженер-механик
to equip оборудовать
equipment оборудование

EXERCISES

I. Read and translate the text.

II. Match the words (according to their meaning):

requirement	прогнозировать
resources	человечество
humankind	важность
to create	требование
development	развитие
transportation	ресурсы
to forecast	количественный
to design	создавать
quantitative	качественный
qualitative	перевозка
importance	проектировать

III. Try to give the proper definition of the following:

1) sewage system

2) water supply system

3) civil engineer

4) military engineer

5) designing a structure

IV. Find English sentences in the text with the following words:

1) первые инженеры

2) инженер-исследователь

3) участок для строительства

4) технический персонал (инженер)

V. Answer the questions:

1. Where was the term “engineering” defined?

2. What is the origin of this word?

3. What science is engineering based on?

4. Why are materials and energy the main types of natural resources?

5. Can you name the world-known monuments of civil engineering?

6. What are the main functions of engineering?

VI. Retell the text according to the plan:

1. The definition and the origin of the term “engineering”.

2. History of engineering.

3. Engineering functions.

TYPES OF ENGINEERING

The primary types of engineering are chemical, civil, electrical, industrial, and mechanical.

Chemical engineering deals with the design, construction, and operation of plants and machinery for making such products as acids, dyes, drugs, plastics, and synthetic rubber by adapting the chemical reactions discovered by the laboratory chemist to large-scale production. The chemical engineer must be familiar with both chemistry and mechanical engineering.

Civil engineering includes the planning, designing, construction, and maintenance of structures and altering geography to suit human needs. Some of the numerous subdivisions are transportation (e.g., railroad facilities and highways); hydraulics (e.g., river control, irrigation, swamp draining, water supply, and sewage disposal), and structures (e.g., buildings, bridges, and tunnels).

Electrical engineering encompasses all aspects of electricity from power engineering, the development of the devices for the generation and transmission of electrical power, to electronics. Electronics is a branch of electrical engineering that deals with devices that use electricity for control of processes. Subspecialities of electronics include computer engineering, microwave engineering, communications, and digital signal processing. It is the engineering specialty that has grown the most in recent decades.

Industrial engineering, or management engineering, is concerned with efficient production. The industrial engineer designs methods, not machinery. Jobs include plant layout, analysis and planning of workers' jobs, economical handling of raw materials, their flow through the production process, and the efficient control of the inventory of finished products.

Mechanical engineering is concerned with the design, construction and operation of power plants, engines, and machines. It deals mostly with things that move. One common way of dividing mechanical engineering is into heat utilization and machine design. The generation, distribution, and use of heat is applied in boilers, heat engines, air conditioning, and refrigeration. Machine design is concerned with hardware, including that making use of heat processes. Another way of dividing engineering is by function. Among the top functional divisions are design, operation, management, development, and construction.

VOCABULARY NOTES

to deal with иметь дело (с кем-либо)
machinery машинное оборудование; механизм
acid кислота
dye краска; краситель
to adapt приспосабливать; упрощать
to alter изменять(ся); менять(ся)
device устройство; приспособление
digital цифровой механизм
hardware металлические изделия

EXERCISES

I. Read the text.
II. Annotate this text in Russian.

CIVIL ENGINEERING

The term civil engineering was first used in the 18^{th} century to distinguish the newly recognized profession from military engineering. From earliest times, however, engineers have engaged in peaceful activities, and many of the civil engineering works of ancient and medieval times — such as the Roman public baths, roads, bridges, and aqueducts; the Flemish canals; the Dutch sea defenses; the French Gothic cathedrals; and many other monuments — reveal a history of inventive genius and persistent experimentation.

History. The beginnings of civil engineering as a separate discipline may be seen in the foundation in France in 1716 of the Bridge and Highway Corps, out of which in 1747 grew the "National School of Bridges and Highways". Its teachers wrote books that became standard works on the mechanics of materials, machines, and hydraulics, and leading British engineers learned French to read them. As design and calculation replaced rule of thumb and empirical formulas, and as expert knowledge was codified and formulated, the nonmilitary engineer moved to the front of the stage. Talented, if often self-taught, craftsmen, stonemasons, millwrights, toolmakers, and instrument makers became civil engineers. In Britain, James Brindley began as a millwright and became the foremost canal builder of the century; John Rennie was a millwright's apprentice who eventually built the New London Bridge; Thomas Telford, a stonemason, became Britain's leading road builder.

Formal education in engineering science became widely available as other countries followed the lead of France and Germany. In Great Britain the universities, traditionally seats of classical learning, were reluctant to embrace the new disciplines. University College London, founded in 1826, provided a broad range of academic studies and offered a course in mechanical philosophy. King's College, London, first taught civil engineering in 1838, and in 1840 Queen Victoria founded the first chair of civil engineering and mechanics at the University of Glasgow, Scotland. Rensselaer Polytechnic Institute, founded in 1824, offered the first courses in civil engineering in the United States. The number of universities throughout the world with engineering faculties, including civil engineering, increased rapidly in the19th and early 20th centuries. Civil engineering today is taught in universities on every continent.

Civil engineering functions. The functions of the civil engineer can be divided into three categories: those performed before construction (feasibility studies, site investigations, and design), those performed during construction (dealing with clients, consulting engineers, and contractors), and those performed after construction (maintenance and research).

Feasibility studies. No major project today is started without an extensive study of the objective and without preliminary studies of possible plans leading to a recommended scheme, perhaps with alternatives. Feasibility studies may cover alternative methods — e.g., bridge versus tunnel, in the case of a water crossing — or, once the method is decided, the choice of route. Both economic and engineering problems must be considered.

Site investigations. A preliminary site investigation is part of the feasibility study, but once a plan has been adopted a more extensive investigation is usually imperative. Money spent in a study of ground and substructure may save large sums later in remedial works or in changes made necessary in constructional methods. Since the load-bearing qualities and stability of the ground are such important factors in any large-scale construction, it is surprising that a serious study of soil mechanics did not develop until the mid-1930s. Today there are specialist societies and journals in many countries, and most universities that have a civil engineering faculty have courses in soil mechanics.

Design. The design of engineering works may require the application of design theory from many fields — e.g., hydraulics, thermodynamics, or nuclear physics. Research in structural analysis and the technology of materials has opened the way for more rational designs, new design concepts, and greater economy of materials. The theory of structures and the study of materials have advanced together as more and more refined stress analysis of structures and systematic testing has been done. Modern designers not only have advanced theories and readily available design data, but structural designs can now be rigorously analyzed by computers.

Construction. The promotion of civil engineering works may be initiated by a private client, but most work is undertaken for large corporations, government authorities, and public board and authorities. Many of these have their own engineering staffs, but for large specialized projects it is usual to employ consulting engineers.

The consulting engineer may be required first to undertake feasibility studies, then to recommend a scheme and quote an approximate cost. The engineer is responsible for the design of the works, supplying specifications, drawings, and legal documents in sufficient detail to seek competitive tender prices. The engineer must compare quotations and recommend acceptance of one of them. Although he is not a part to the contract, the engineer's duties are defined in it; the staff must supervise the construction and the engineer must certify completion of the work. Almost all civil engineering contracts include some element of construction work. The development of steel and concrete as building materials had the effect of placing design more in the hands of the civil engineer than the architect. The engineer's analysis of a building problem, based on function and economics, determines the building's structural design.

Maintenance. The contractor maintains the works to the satisfaction of the consulting engineer. Responsibility for maintenance extends to ancillary and temporary works where these form part of the overall construction. After construction a period of maintenance is undertaken by the contractor, and the payment of the final installment of the contract is held back until released by the consulting engineer. Central and local government engineering and public works departments are concerned primarily with maintenance, for which they employ direct labor.

Research. Research in the civil engineering field is undertaken by government agencies, industrial foundations, the universities, and other institutions. Most countries have government-controlled agencies, such as the United States Bureau of Standards and the National Physical Laboratory of Great Britain, involved in a broad spectrum of research, and establishments in building research, roads and highways, hydraulic research, water pollution, and other areas. Many are government-aided but depend partly on income from research work promoted by industry.

VOCABULARY NOTES

to distinguish различать, распознавать
to engage заниматься чем-либо
medieval средневековый
to reveal открывать, обнаруживать; разоблачать
expert опытный, квалифицированный
persistent стойкий; постоянный
to codify приводить в систему
millwright монтажник; слесарь-монтер
apprentice ученик, подмастерье
available доступный; имеющийся в распоряжении
to be reluctant быть вынужденным
chair кафедра

EXERCISES

I. Read the text "Civil Engineering" and follow the information.
II. Find in the text the English equivalents for:

впервые был использован; вновь признанная профессия; творения древних и средневековых времен; история изобретательных гениев и постоянных экспериментирований; как отдельная дисциплина; ведущие инженеры; опытные знания; ученик монтажника; основанный в 1826 году; первая кафедра по гражданскому строительству.

III. Summarize the information of the text "Civil Engineering".

IV. Read the text "Civil engineering functions". Speak on the problems raised in it and make reports.

BUILDING MATERIALS

CEMENT

Cement is a binding material used in construction and engineering, often called hydraulic cement, typically made by heating a mixture of limestone and clay until it almost fuses and then grinding it to a fine powder. When mixed with water, the silicates and aluminates in the cement undergo a chemical reaction; the resulting hardened mass is then impervious to water. It may also be mixed with water and aggregates (crushed stone, sand, and gravel) to form concrete.

Cement made by grinding together lime and a volcanic product found at Pozzuoli on the Bay of Naples (hence called pozzuolana) was in ancient Roman construction works, notably the Pantheon. During the middle Ages the secret of cement was lost. In the 18^{th} century John Smeaton, an English, rediscovered the correct proportions when he made up a batch of cement using clay limestone while rebuilding the Eddystone lighthouse off the coast of Cornwall, England. In the United States, production of cement at first relied on processing cement rock from various deposits, such as those found in Rosendale, N.Y. In 1824, Joseph Aspdin, an English bricklayer, patented a process for making what he called Portland cement, with properties superior to its predecessors; this is the cement used in most modern construction.

Modern Portland cement is made by mixing substances containing lime, silica, alumina, and iron oxide and then heating the mixture until it almost fuses. During the heating process dicalcium and tricalcium silicate, tricalcium aluminum, and a solid solution containing iron are formed. Gypsum is later added to these products during a grinding process. Natural cement, although slower-setting and weaker than Portland cement, is still employed to some extent and is occasionally blended with Portland cement. Cement with high aluminum content is used for fireproofing, because it is quick-setting and resistant to high temperatures; cement with high sulfate content is used in complex castings, because it expands upon hardening, filling small spaces.

Of the various Portland cements, the following varieties are now generally available:

a) Ordinary Portland cement, the cheapest,

b) Rapid-hardening cement, which is slightly more expensive because it is ground rather finer and is thus more chemically active,

c) Sulfate-resisting cement which has a special chemical composition to resist sulfates, and can be used in ground which contains them,

d) Air-entraining cement for building roads which may suffer from frost damage,

e) Low-heat cement for massive construction such as dams where the speed at which the heat is given off must be reduced, and slow development of strength does not matter.

These are the main Portland cements. Different cement, which should be mentioned, is high-aluminum cement. High-aluminum cement is usually black, unlike Portland which is grey, but reaches “Portland 28-day” strength in twenty-four hours with correspondingly high heating and it must therefore not be cast in masses which are thicker than 60cm. This common high-alumina cement costs roughly three times as much as Portland. White Portland cement is also obtainable and more expensive than ordinary. It is used for making white concrete or for painting or plastering concrete.

VOCABULARY NOTES

cement цемент
aluminum cement глинозёмистый цемент
quick-setting cement быстросхватывающийся цемент
to bind связывать
to fuse плавить; расплавлять
grinding измельчение; размалывание
to undergo испытывать, подвергаться (чему-либо)
impervious непроницаемый
crushed stone дроблёный камень; щебень
batch дозировка; порция; замес бетона
predecessor предшественник
oxide окись
to blend смесь
casting отливка; литьё

EXERCISES

I. Read the text and note the main facts.
II. Put 5 or 6 key questions to the contents of the text.
III. Annotate the text in Russian.

MORTAR

Mortar is a mixture of lime or cement with sand and water, used as a bedding and adhesive between adjacent pieces of stone, brick, or other material in masonry construction. Lime mortar, a common variety, consists usually of one volume of well-slaked lime to three or four volumes of sand, thoroughly mixed with sufficient water to make a uniform paste easily handled on a trowel. Lime mortar hardens by absorption of carbon dioxide from the air. Once universally used, lime mortar is now less important because it does not have the property of setting underwater and because of its comparatively low strength. It has largely been supplanted by cement mortar, commonly made of one volume of Portland cement to two or three volumes of sand, usually with a quantity of lime paste added to give a more workable mix.

Cement mortar, besides having a high strength, generally equal to that of brick itself, has the very great advantage of setting or hardening underwater. Other varieties include gauge mortar, for rapid setting, composed of plaster of Paris used either pure or combined with lime or with lime and sand, and grout, a thin liquid mixture of lime or cement, poured into masonry to fill up small interstices. Primitive mortars took various forms: in early Egypt, Nile mud was used as an adhesive; the Mesopotamians used bitumen (the slime mentioned in Genesis) or sometimes a mixture of clay, water, and chopped straw, to cement together their unbaked bricks; Greeks of the Mycenaean era probably employed soft bituminous clay. The advanced Greek buildings are notable for their construction without mortar, the huge blocks of stone being consummately fitted with dry beds. The Romans likewise used little mortar in cut stonework or vaulting but in later periods bedded the rough stone of their mass masonry in strong cement mortar. In medieval times and in all periods since, mortar of some sort has been almost universally used in masonry construction.

VOCABULARY NOTES

mortar строительный раствор
mixture смесь, смешивание
bedding основа, основание
adhesive клейкий, связующий
adjacent смежный, примыкающий
to handle управлять; оперировать
trowel мастерок
dioxide двуокись
setting застывание; схватывание (цемента, бетона)
to supplant выжить, вытеснить; занять место
plaster штукатурка
chopped straw соломенная сечка
vault свод; выемка

EXERCISES

I. Read the text and point the most interesting facts.
II. Make the summary of the text.

BRICKS

The many different names given to bricks are rather confusing. Some refer to the districts where the bricks are made, some to color, some to method of manufacture, and others to intended use.

Bricks are always made with their length slightly more than twice their width, so that they can be laid to “bond”. They may vary in thickness, although at present the British Standard (B. S. 657) defines two thicknesses only.

There are three main stages, regardless of which method of manufacture is used: winning the clay and preparing it, shaping it, and last and most important, the drying and firing process.

General properties of clay bricks

Strength. Strength is a property which is so often used to judge the quality of a brick. In fact, however, strength in itself is not always important factor, since the great majority of bricks are used in positions where they are not required to carry anything like their full safe load. It is true that a really strong brick will nearly always be good in many other respects, but the converse does not by any means follow; for there are some excellent types, quite suitable for many purposes, which are of low strength.

To a large extent the strength is dependent upon the type of clay used and method of making, but with most types of brick there is also a considerable variation according to the temperature at which the bricks are burnt.

Where considerable loads have to be carried a strong brick is needed, but it should be remembered that the strength of a wall is derived from a combination of brick and mortar. Building regulations define the type of mortar to be used with bricks of varying strength to carry varying loads.

Resistance to rain penetration. This again is a property that depends upon the brick and mortar combined rather than on the brick itself. In fact it is only with extremely permeable bricks that rain is ever likely to penetrate a 9 in. or even thicker solid wall, but it does so through cracks (often minute) between the bricks and the mortar.

Weathering and appearance. It is well known that brick are usually extremely durable and that although they may change in appearance after considerable exposure, they usually do so in a manner which is pleasant rather than otherwise. In spite of this there are sufficient examples of brickwork which has deteriorated on exposure to make it necessary to consider how such defects occur. The two chief causes of deterioration are frost and the crystallization of soluble salts.

For an estimate of probable resistance to frost damage, an expert view would be based upon a combination of strength, porosity and saturation coefficient. For a quick judgement by the architect probably the best course is to make sure that no underburnt bricks occur in the normal deliveries.

It is important to differentiate between the conditions of exposure to which the bricks will be subjected. Chimneys, parapet walls and retaining walls are very much more severely exposed to both rain and frost than is the general walling of a building, and they are likely to suffer accordingly. Contrary to general belief, brickwork below damp course level is not especially liable to frost damage.

The effect of soluble salts may vary considerably. They may crystallize on the surface, usually in a spell of dry weather after a wet period. When this occurs they form white crystals which may be very disfiguring to the building, but are unlikely to cause any real damage to the bricks unless the quantity present is abnormal. This crystallization can continue for some years and is usually most obvious in the spring. Normally the crystals are gradually washed away and the trouble gets less each year. There is no cure for such efflorescence once the salts are present in the wall, though dry brushing of the efflorescence may help to get rid of the trouble more quickly.

The subject of the appearance of brickwork cannot be dismissed without referring to the importance of the pattern of jointing – which depends upon the brick bond, and also on the thickness of joints, their color and their type. All these things, together with the type of brick itself, give the overall appearance of color and texture to a wall, and they need careful study on actual examples before they can be handled competently as part of the design technique.

VOCABULARY NOTES

bond связь, соединение
property свойство
clay глина
to derive получать, извлекать; происходить
exposure местоположение, вид; выставление (под дождь и т. п.)
to deteriorate ухудшать(ся); портить(ся)
to define определять
appearance внешний вид
efflorescence продукт кристаллизации
brickwork кирпичная кладка
damage повреждение
damp course изолирующий от сырости слой
joint соединение
texture структура, строение

EXERCISES

I. Read the text and answer the following questions:

1. What are the main three stages in manufacturing bricks?

2. Why is the strength of bricks not always an important factor?

3. What factors does the strength of bricks depend on?

4. What are the two chief causes of the deterioration of bricks?

5. What parts of a building are most severely exposed to rain and frost damage?

6. Describe the effect of soluble salts in a brick wall.

7. What different kinds of bonds do you know?

II. Retell the text. Use the questions above as a plan.

CONCRETE

Concrete is a structural material consisting of a hard substance, and known as aggregate (usually sand and gravel), that is bonded together by cement and water.

Among the ancient Assyrians and Babylonians, the bonding substance most often used was clay. The Egyptians developed a substance using lime and gypsum as binders. Lime derived from limestone, chalk, continued to be the primary cement-forming agent until the early 1800s. In 1824 an English inventor, Joseph Aspdin, burned and ground together a mixture of limestone and clay. This mixture, called Portland cement, has remained the dominant cementing agent used in concrete production.

Aggregates are generally designated as either fine (ranging in size from 0,025 to 6,5 mm) or coarse (from 6,5 to 38 mm or larger). All aggregate materials must be clean and free from admixture because even small quantities of compounds seriously affect the strength of the concrete.

Concrete is characterized by the type of aggregate or cement used, or by the methods used to produce it. In ordinary structural concrete, the character of the concrete is largely determined by a water-to-cement ratio. The lower the water content is, the stronger the concrete. Another durability factor is the amount of cement in relation to the aggregate. Where especially strong concrete is needed, there will be relatively less aggregate. The strength of concrete is measured in pounds per square inch or kilograms per square centimeter of force needed to crush a sample of a given age or hardness. Concrete's strength is affected by environmental factors, especially temperature and moisture.

In the process known as curing, the concrete is kept damp for some time after pouring to slow the shrinkage that occurs as it hardens. Low temperatures also adversely affect its strength. Concrete that has been hardened onto imbedded metal (usually steel) is called reinforced concrete, or ferroconcrete. Its invention is usually attributed to Joseph Monier, a Parisian gardener who made garden pots and tubs of concrete reinforced with iron mesh; he received a patent in 1867. The reinforcing steel, which may take the form of rods, bars, or mesh, contributes tensile strength. Plain concrete does not easily withstand stresses such as wind action, earthquakes, and vibrations and other bending forces and is therefore unsuitable in many structural applications.

Another innovation in masonry construction is the use of prestressed concrete. It is achieved by either pretensioning or posttensioning processes. In pretensioning, length of steel wire, cables, or ropes are laid in the empty mold and then stretched and anchored. After the concrete has been poured and allowed to set, the anchors are released and, as the steel seeks to return to its original length, it compresses the concrete. In the posttensioning process, the steel is run through ducts formed in the concrete. When the concrete has hardened, the steel is anchored to the exterior of the member by some sort of gripping device. By applying a measured amount of stretching force to the steel, the amount of compression transmitted to the concrete can be carefully regulated. Because it achieves strength without using heavy steel reinforcements, it has been used to great effect to build lighter, and more elegant structures such as bridges and vast roofs.

Concrete is fire resistant and has become one of the most common building materials in the world.

VOCABULARY NOTES

strength of concrete прочность бетона
reinforced concrete армированный бетон
ferroconcrete железобетон
prestressed concrete предварит. напряженный бетон
structural material строительные материалы
sand песок
gravel гравий
cement цемент
lime известь
gypsum гипс
aggregate заполнитель
fine aggregate мелкий заполнитель
coarse aggregate крупный заполнитель
binder вяжущее
curing выдерживание
pouring заливка бетона, укладка бетонной смеси
shrinkage усадка
to mold отливать в форму

EXERCISES

I. Read and translate the text.

II. Find synonyms for the following words:

structural material; amount of cement; to affect; construction; essential; aggregate; to erect.

III. Explain the meaning of the following words:

aggregate; mixture; to be free from; water-to-cement ratio; environmental factors; masonry construction.

IV. Form nouns from the following words:

to mix; practical; to produce; to develop; to design; strong; to measure; to shrink; to invent; to contribute; to apply.

V. Put the questions:

Q: ...

A: I know that concrete is compound structural material.

Q: ...

A: The main aggregates are sand, lime, and clay.

Q: ...

A: The character of concrete is determined by a water-to-cement ratio.

Q: …

A: The strength of concrete is measured in pounds per square inch.

VI. Retell the text using words and word combinations from the vocabulary list.

REQUIREMENTS FOR CONCRETE QUALITY

Uniform quality of a concrete is of great importance for modern construction. Procedures for obtaining high quality concrete are given in many publications.

Both normal weight and structural lightweight concrete can be made uniform with proper mix proportioning and production controls. Normally concrete for segmental construction will have a slump of 3 to 5 in., and 28-day strength greater than the strength specified by structural design. It is recommended that statistical methods be used to evaluate concrete mixes

The methods and procedures used to obtain the characteristics of concrete required by the design may differ somewhat depending on whether the segments are cast in the field or in a plant. The results will be influenced by curing temperature and type of curing. Liquid or steam curing or electric heat curing may be used.

A sufficient number of test mixes should be made to assure uniformity of strength and modulus of elasticity. Careful selection of aggregates, cement, admixtures and water will improve strength and modulus of elasticity and will also reduce shrinkage and creep. Soft aggregates and poor sands should be avoided. Creep and shrinkage data for concrete mixes should be available or should be determined by tests.

It is better not to use corrosive admixtures such as calcium chloride or those containing substantial chlorides, nitrates, sulfates and fluorides. Water-reducing admixtures which improve concrete resistance to environmental effects, such as de-icing salts and freeze and thaw actions are highly desirable. However, their use should be rigidly controlled in order not to increase undesirable variations in strength and modulus of elasticity of the concrete.

Mixes should be designed to minimize creep and shrinkage. Reliable data on the potential of the mix in terms of strength gain and creep and shrinkage performance should be used as a basis for improved design parameters.

VOCABULARY NOTES

normal weight concrete обычный бетон
lightweight concrete лёгкий бетон
slump оползание грунта, оползень
curing выдержка
creep ползучесть

EXERCISES

I. Give the Russian equivalents for the following terms:

concrete; prestressed concrete; precast concrete; mix proportioning; lightweight concrete; aggregate; cement; admixtures; strength; sand; elasticity.

II. Put up questions to the following sentences:

1. Quality of a concrete is of great importance for modern construction.
2. Different statistical methods must be used to evaluate concrete mixes.
3. The results will be influenced by curing temperature and type of curing.
4. Careful selection of aggregates, cement, admixtures and water will improve strength, modulus of elasticity and will reduce the shrinkage and creep.
5. Water-reducing admixtures are highly desirable.

III. Make up a brief summary of the text.

ADMIXTURES FOR CONCRETE

Concrete can sometimes be improved by an admixture added to the cement, aggregates, and water to modify one or more of the properties of the mix. Admixtures are not magic powders that can be added indiscriminately to poor concrete mixes to make good concrete. Neither can it be assumed that they will necessarily make good concrete better. The right admixture for the job must be used if the admixture is to do more good than harm. When a change is made to improve one property of concrete, some other properties will be affected, frequently adversely. Principal admixtures are:

1) air-entraining agents,

2) water-reducing admixtures.

Perhaps the most widely used admixtures are air-entraining agents. Air entrainment is used to improve the resistance of concrete to damage from freezing and thawing. It also makes concrete slabs much more resistant to scaling where salts are used for de-icing. It makes the mix more workable, or at least more cohesive. It permits a substantial reduction in the water requirement, and consequently the cement content in mass concrete, and has helped with the temperature problem by reducing the amount of heat generated during setting of the cement. Air entrainment is generally considered to be the greatest advance in concrete technology in recent years.

Air-entraining admixtures. The materials used as air-entraining agents include vinyl resin and tall oil, the latter a by-product of the paper industry. Both are derived from southern pine trees. Petroleum by-products and other materials are sometimes used. These materials have generally been treated by an alkali to form a salt or soap.

Normally, the amount of air entrained should be about 9 per cent of the mortar portion of the mix. The amount of air, expressed as a percentage of the entire mix, will of course be less than this. In a conventional mix with up to 1,5 in. aggregate, 4 to 5 per cent of air is usually sought. For best durability the air bubbles should be small, ranging from about 0,001 to 0,003 in. in diameter. They should be less than 0,01 in. apart, yet not interconnected.

Air entrainment has improved the resistance of concrete to frost action to an amazing degree in laboratory tests. Air-entraining concrete seems to be performing satisfactorily in the field, although there has been some scaling and freeze-thaw damage in severe exposures. It is an oversimplification to say that if air entrainment is used there will be no scaling or freeze-thaw deterioration. Also necessary are durable aggregates and good proportions – a low water/cement ratio and a cement content that will give adequate strength when freezing occurs.

The principal disadvantage of air entrainment is that it reduces the strength of most mixes and is harmful to other properties, such as abrasion resistance, which depend on strength. For normal mixes, 4 to 5 per cent of entrained air will result in a strength reduction of about 20 per cent. In lean mixes, air entrainment may not reduce the strength; in fact it may increase it.

Water-reducing admixtures. Use of water-reducing admixtures has expanded rapidly in the past few years. The name comes from the ability of these additives to reduce the mixing water required. Also they generally increase strength and they may make it possible to meet a strength requirement that could not otherwise be met with the cement and aggregate at hand.

In their basic formulation, these materials usually retard the set of the concrete. This property is useful in warm-weather construction to delay the initial set and help prevent cold joints. Some state highway departments specify retarders in bridge decks so that the concrete will remain plastic until all of it is in place, thus preventing cracks as the forms sag under the gradually increasing weight of the concrete deposited during the pour. The admixture manufacturer may modify the basic formulation with accelerators and other additives to change the setting time and other properties.

VOCABULARY NOTES

admixture примесь; добавка
aggregate заполнитель
bubble пузырёк; раковина (в металле)
degree степень; градус
to assume принимать на себя; допускать
entrainment погружение; проникновение
cohesive способный к сцеплению; связующий
to thaw таять
scaling образование окалины; отслаивание
to occur случаться, происходить
lean скудный
additive присадка; добавка
retarder замедлитель
to prevent предотвращать; предохранять
to result in иметь результатом
to result from происходить в результате, проистекать

EXERCISES

I. Translate into Russian:

1. Water-reducing admixtures can be used for achieving the desired effects.
2. This admixture improves one property of concrete only.
3. It permits an essential reduction in water requirement.
4. These materials have generally been treated by an alkali.

5. Increase the cement content of the mix!
6. It makes the mix more workable.
7. In some mixes air entrainment will reduce the strength.
8. These materials usually retard the setting of the concrete.

II. Answer the questions:

1. Speak about the limitations in using admixtures for concrete.
2. Which are the two basic groups of admixtures?
3. Which are the effects of air entrainment?
4. Name some materials used as air-entraining agents.
5. Describe some disadvantages of air entrainment.
6. What effect do water-reducing admixtures have?

III. Translate the text into Russian in written form and make a back translation orally.

GAS CONCRETE

Lime and silica are ground together to very fine limits. The siliceous material can vary considerably in its composition. Much use is made of such waste materials as fly ash from power stations, shale ash, blast furnace slag, as well as natural pozzolana, pumice, etc.

The degree of foaming in the gas concrete, and thus its specific gravity, is determined by the amount of alumina powder or other agent added. The practical limits of the final density are between 13 and 90 lb. per cu ft. If the gas concrete is allowed to harden on its own, it usually takes about three weeks before the final strength is achieved. It is more customary to accelerate the setting of the gas concrete by steam hardening it in autoclaves with superheated steam at about 140 lb. per sq. in. The steam hardening process takes about 15–20 hr.

Gas concrete can be used as thermally insulating floor screeds or as an additional thermally insulating layer on top of a concrete roof.

The density of the gas concrete mix can be varied according to the degree of thermal insulation required, but at the same time it must not be forgotten that the lower density grades, that have the highest degree of insulation, are also the softest.

Air-cured gas concrete can be used for the manufacture of special components for the refrigeration industry. Such blocks are cast to special dimensions.

Gas concrete can be cast horizontally to form room-sized outer wall units. It is possible to incorporate electric conduit pipes, piping for the cold and hot water systems and also drainage pipes. The units usually include windows and doors, and are reinforced by embedding steel mesh in the mix.

Cast gas concrete is often used as the thermally insulating layer in “sandwich wall” units.

Gas concrete is often used as a thermally insulating layer when casting buildings by a continuous casting technique.

VOCABULARY NOTES

silica кремний
siliceous кремнистый
fly ash летучая зола
blast furnace slag доменный шлак
pumice пемза
foam пена
foaming пенообразование
density плотность
cure вулканизация; выдерживание (бетона)
cast лить, отливать (металл)
to incorporate соединять; помещать, включать

to embed заливать; вставлять; внедрять
mesh отверстие, ячейка

EXERCISES

I. Read the text and answer the following questions:

1. Which materials are used for the production of gas concrete?
2. How can the setting of gas concrete be accelerated?
3. Can you name the main purposes for which air hardening gas concrete is used?
4. Where can gas concrete be successfully used?
5. What can you say about cast gas concrete?

II. Ask questions to which the words printed in italics are the answers:

1. *Steam hardening* accelerates *the setting of gas concrete.*
2. *Gas concrete* can be sawn into *all desired* shapes.
3. *After foaming* the material is treated in *autoclaves.*
4. *Experts* watched *the process.*
5. The strength of concrete depends on *several factors.*
6. *The architect's* design necessitated *the laying of pipes.*
7. *These concrete blocks* come from *a modern factory.*

THE STRUCTURAL USE OF PLASTICS IN BUILDING

During the past decade the plastics industry all over the world has expanded at a phenomenal rate. Various developments have taken place, resulting in the introduction of new and increasingly better plastics materials. The use of plastics in building is at present confined mainly to the non-load-bearing elements. Considerable interest is focused now on structural and semi-structural applications, in many of which plastics offer advantages which are not possible with other building materials.

In Canada a garden shelter recently built in Strathcona Park aroused a considerable amount of interest. It was designed as a dome in reinforced polyesters, with overhangs on all four sides. It is supported at four corners only. The overall dome dimensions are 54 ft. and the height is 16 ft. The dome consists of thin-skin sections reinforced with ribs, which are integrally molded with each unit. The sections were epoxy bounded and bolted on the site. The material used was a fire-resistant polyester resin reinforced with a laminate. The total weight of this structure was 3,000 lb. It proved to be remarkably rigid and shortly after the erection resisted an 80 M.P.H. gale without any ill effects.

Current trends put a special emphasis on membrane structures in which bending is either minimized or eliminated entirely. A typical example is a hyperbolic parabolic. A special mention must be made of the studies at the Massachusetts Institute of Technology on the structural use of prefabricated plastics hyperbolic parabolic structural sandwich panels in the construction of an elementary school.

It is quite possible that during the next few years some new structural systems will be developed for which plastics will be even more suitable. This review can be concluded with the statement that plastics, so often called the materials of the future, already influence to a considerable extent contemporary architecture.

VOCABULARY NOTES

to confine ограничивать

load нагрузка

bearing опорный; несущий

to mould формовать; отливать

resin смола; канифоль

rigid жесткий; устойчивый

to bend изгибать; сгибать
semi полу…(первая часть сложных слов)
dome купол; свод
overhang нависать; свешивать(ся)
to bond связывать; соединять; сцеплять
to eliminate устранять; исключать
contemporary современный

EXERCISES

I. Read the text and translate it. Discuss what you have learned from it.

II. Translate into Russian:

1. Plastics can be used in this case.
2. This engineer will not be able to find the suitable method.
3. Why do you want to reinforce the dome?
4. This material is to be used for structural purposes.
5. Why has he not been allowed to buy those prefabricated units?
6. These advantages are to be considered.
7. Such elements cannot have been used.

III. Get ready to retell the text and make reports on the use of modern plastics in industry.

PRESTRESSED CONCRETE STRUCTURES

STRUCTURES

A structure is the part of a building that carries its weight, and for at least half of the world's civil engineers, structures are most of civil engineering. We should also remember that anything built is a structure. (From an aero plane engineer's point of view, an aero plane also is a structure.) A structure may be a dwelling house, or a pyramid in Egypt, or a dam built by beavers across a Canadian river. A building is a structure with a roof and much of civil engineering structural design is the design of building structures. The building as a whole is designed by an architect, particularly in a densely populated area. Every structural design includes the foundation design. The structural design itself includes two different tasks, the design of the structure, in which the sizes and locations of the main members are settled, and the analysis of this structure by mathematical or graphical methods or both, to work out how the loads pass through the structure with the particular members chosen. For a common structure, such as a building frame, many methods have been developed for analysis, so that the design and analysis will be relatively easy and may need to be performed only once or twice.

But for any unusual structure the tasks of design and analysis will have to be repeated many times until, after many calculations, a design has been found, that is, strong, stable and lasting. For the typical multi-storey structure in a city, whether it is to be used for offices or dwellings, the most important member which the engineer designs is the floor – for two reasons: it repeats all the way up the building, and it has the greatest effect on the dead load of the building.

VOCABULARY NOTES

structure конструкция; сооружение; строение

to carry выдерживать

dwelling house жилой дом

dam дамба

dense плотный

load (dead, live) нагрузка (постоянная, переменная)

strong прочный

stable устойчивый
lasting длительный

EXERCISES

I. Find the English equivalents for the following Russian words:

здание; вес; строительный проект; по крайней мере; плотно заселённые территории; размер; расположение; относительно; один раз; дважды; расчёты; многоэтажная конструкция.

II. Name the part of speech of the following words:

building; structural; is designed; includes; mathematical; graphical; relatively; may; calculations; greatest.

III. Put up 5 questions to the text.

IV. Make up a summery of the text (using questions of ex. III).

REASONS FOR PRESTRESSING

The development of reinforced-concrete construction has been very rapid. Its application in engineering structures and buildings began toward the end of nineteenth century. Within the period of about 50 years, it has reached a high qualitative level and applied to the most important engineering structures.

Up to present, steel construction, rather than reinforced concrete, has succeeded in holding the field of long-span bridges and other long-span engineering structures. The main reasons why reinforced concrete has been lagged behind steel structures may be found in the following:

a) The dead load of structure increases with the length of the span. This causes a sharp drop in economic efficiency of the structure when a certain length of span is exceeded.

b) Materials cannot be used efficiently in reinforced-concrete members subjected to bending. The use of high-strength reinforcing steel in unprestressed reinforced concrete is limited because of the considerable elongation of the steel under high tensile stresses. No economy can be achieved by applying high- strength steel in conventional reinforced concrete.

c) One of the fundamental principles of conventional reinforced-concrete theory is the proper transmission of stresses from concrete to steel so that the steel may be considered as an incorporated part of the concrete section.

In view of the consideration outlined above, steel structures are in a privileged position in the field of long-span construction, and reinforced-concrete structures of conventional design are unable to compete with them. To place reinforced-concrete construction in a wider competition with steel construction, it has been necessary to develop new ideas and systems for the application of reinforced concrete which are more economical and technically more refined than those previously used. One of these ideas was prestressing. Although not very new idea (the first attempts to apply prestressing were made in 1886), prestressing was not applied successfully in early days of its development. First of all, as the physical properties of concrete, such as shrinkage, plastic flow, etc. were unknown and compression strength was then less than 3,000 psi.

PRINCIPLES OF PRESTRESSING

The basic principle of prestressing is the induction of stresses in a concrete member before the dead and live loads are applied, so that these stresses act in the opposite direction to those developed by loading (dead, live, temperature). When the loads are applied, the resulting stresses from loading will be superposed on the prestresses. In this manner a more economical stress distribution over the cross section is obtained, and cracking in the tension face of the member can be better controlled.

Prestressing converts a concrete structure into a more homogeneous state with improved elastic capacity; the stresses and deformations caused by load can be computed quantitatively and qualitatively with satisfactory accuracy.

Another important advantage of prestressing is that, if the design load on the prestressed member is exceeded and cracks occur, the latter will be closed when the excess load is removed. Thus, as compared to conventional reinforced-concrete structures, maintenance costs are considerably reduced and the life of the structure is increased. So it is obvious that prestressed reinforced-concrete structures are now able to compete with steel structures in wide range of spans and applications.

VOCABULARY NOTES

prestressing предварительное напряжение (бетона)
span пролет
long-span (beam) длинная балка
load нагрузка
dead load постоянная нагрузка
live load переменная нагрузка
stress напряжение
tensile stress растягивающее напряжение
shrinkage усадка
plastic flow пластическое течение
to compress сжимать

compression strength сила сжатия
to superpose совмещать; накладывать (одну вещь на другую)
to crack образовывать трещину
cracking растрескивание
elastic capacity мощность на растяжение
excess load перегрузка

EXERCISES

I. Read the texts "Reasons of Prestressing" and "Principles of Prestressing". Translate them into Russian.

II. Answer the following questions:

1. When did the application of reinforced-concrete structures begin?
2. What are the main reasons for using steel structures?
3. Why was it necessary to develop new ideas and systems?
4. What are the principles of prestressing?
5. What is the main advantage of prestressing?

III. Make the following sentences simple.

1. Up to present, steel constructions, rather than reinforced concrete, have succeeded in holding the field of long-span bridges and other long-span engineering structures.
2. The use of high strength reinforcing steel in unprestressed reinforced concrete is limited because of the considerable elongation of the steel under high tensile stresses.
3. One of the fundamental principles of conventional reinforced-concrete theory is the proper transmission of stresses from concrete to steel so that the steel may be considered as an incorporated part of the concrete section.

SYSTEMS AND METHODS OF PRESTRESSING

The classifications often used in existing literature on prestressed structures are sometimes based on the methods used to transfer the stretching forces from steel to concrete, and are even based on the techniques used in tensioning and anchoring the prestressed reinforcement. Such methods of classification are not completely suitable. A more desirable method of classification would be based on the static carrying action of the prestressed structure. According to this method of classification two different groups of prestressed structures may be distinguished:

a) prestressed beams, arch beams, slabs, shells;

b) prestressed trussed beams, trussed arch beams, trussed girders and open-spandrel arches.

In the first group, the prestressed steel reinforcing is a properly incorporated part of the concrete section and is not an independent structural member. The entire member, with its concrete and steel components, act statically as a homogeneous structural unit.

In the second group, the pretensioned main steel reinforcing is not an incorporated part of the concrete section but acts separately as an independent structural member in a structural system. Such a combined framework, having members of different materials with different stiffness, may be considered as a structural system with non-homogeneous static action.

VOCABULARY NOTES

to transfer переносить, передавать, перемещать

stretching force сила натяжения

tensioning напряжение

beam балка

arch beam арочная балка
trussed beam шпренгельная балка
shell раковина; кожух
slab панель
trussed girder шпренгельная ферма
open-spandrel arch сквозное надарочное строение
framework каркас
stiff жесткий
stiffness жесткость

EXERCISES

I. Translate the following text.
II. Annotate the text in Russian.

HOW PRESTRESSED CONCRETE WORKS

What happens when any beam carries a load? It bends and its center sags lower than its ends. Thus the bottom fibers are stretched while the top fibers are compressed. Since concrete resists compression well, the designer puts enough of it in the top to absorb all the compression safely. On the other hand, since the concrete has very little tensile strength – but steel has a lot – he inserts steel bars to take care of tensile stresses.

The trouble is that concrete shrinks as it hardens. The reinforcing bars, however, do not shorten much and consequently offer resistance to the concrete shrinkage, actually putting the bars in compression. When the concrete is loaded, the load causes considerable tension in the reinforcement. Since this reinforcement started out with a slight compression, and then in turn is subjected to considerable tension, it is obvious that its change in lengths is of such magnitude that the concrete cannot usually follow; it cracks.

In prestressing, concrete's virtue of high compressive strength is used to compensate for its lack of tensile strength through a very different concept in the use of reinforcing steel.

Steel wires are strung through a concrete beam, for example, are stretched and then anchored at the ends of the beam when the concrete is hard, to put a "squeeze" on the beam. The wires either are strung through a hole in the beam provided by a mold, and are tensioned against the end of the beam (we shall call this process post-tensioning), or else they are stretched first and held by some anchorage, after which the concrete is poured around them. When the concrete is hard, the wires are cut and the ends of the wires return to their original shape outside the beam – because the stress is relieved there – and act as wedges to help hold the wires bonded to the concrete in tension.

In prestressing, the concrete in the beam is squeezed so that it is always in compression, and any tensile stresses that might appear due to loading, and cause cracks, are automatically canceled out. The application of the stresses before the beam is loaded is the basis for the name "prestressed concrete".

The advantages of prestressed concrete are:

a) it is economical of materials due to the use of higher steel and concrete stresses;

b) it eliminates cracks because the concrete is always in compression;

c) it permits less depth of beam as related to the span, and hence gives more headroom (this is especially important with bridges and airplane hangars);

d) beams do not have to be cast at the site in one form, but may be cast in small sections or blocks at the factory with reinforcing wires threaded through them. When the wires are stressed, the small units are brought together like one large beam;

e) it develops remarkable resistance to shear stresses. In one case its resistance to this shearing action was 800 psi.

The items which contribute most to the higher cost of making prestressed concrete in comparison with regular reinforced concrete are the special form-work and devices required to anchor the pre-stressing steel on the ends of the beam, and the cost of the actual pre-stressing operation in the field.

VOCABULARY NOTES

beam балка, брус, перекладина
to bend изгибать, сгибать
to sag провисать; прогибаться
to stretch растягиваться; простираться
to compress сжимать
tensile stress растягивающее напряжение
tension напряжение; растяжение; натяжение
magnitude величина, размер; значение (цифровое**)**
virtue сила действия
to string подвешивать провода
to anchor закреплять
squeeze сжатие; сдавливание
to pour отливать; заливать (бет. смесь)
to relieve выпускать (газ); понижать (давление)
formwork опалубка
shear срезание, срез

EXERCISES

I. Read the text, translate it into Russian.
II. Discuss the advantages of prestressed concrete.

PRESTRESSED BEAMS, ARCH BEAMS, SLABS AND SHELLS

The prestressing of these structural systems may be achieved in two ways:

a) Pretensioning of the reinforcing before the concrete is hardened.

The steel is tensioned against exterior anchors and embedded in fresh concrete. When, after certain, curing process, the concrete is sufficiently hardened to carry the stretching forces, the steel is released from the prestressing bed, thus inducing compressive stresses in the concrete as a result of the bond between the embedded steel and concrete.

b) Pretensioning of the reinforcing after the concrete is hardened.

The prestressing wires or cables are pulled through ducts or grooves left for them in the concrete member or are surrounded by a sheath of thin sheet metal before the concrete is placed, in order to prevent bond prior to pretensioning.

When the concrete is hardened sufficiently, the wires or cables are tensioned by jacks acting against the ends of the concrete member. During the pretensioning the wires or cables are held in predetermined positions by means of special spacers. After the prestressing load is applied to the cables or wires, they are grouted in under high pressure for protection against corrosion and to establish bond.

Economic consideration. The economy of various structures for a given span and live load depends primarily on the dead load of the structure, the total coast of materials used, the man-hours required for construction, and the cost of maintenance.

VOCABULARY NOTES

hard жесткий, твердый

to harden затвердевать

to embed вставлять; внедрять; монтировать

curing(concrete) выдерживание (бетона)

bond связь; соединение; сцепление

duct канал (для арматуры)

groove желобок; паз

jack домкрат

spacer распорка

grout раствор

EXERCISES

I. Answer the following questions:

1. What different groups of prestressed structures do you know?
2. What is the main difference between them?
3. How is the prestressing of the beams, arch beams slabs and shells achieved?
4. What are the main economic considerations of prestressing?

II. Make a brief summary of the text.

BUILDING INDUSTRY

Building is the process of constructing buildings as distinct form of the art of science of designing buildings, which is architecture.

The building industry has developed from the process of using natural materials for building simple shelters in early times to the complex industrial process of modern times. Many of the materials used today are made in factories and are often partly put together before they even reach the building site.

Large Modern Buildings. When we look at the buildings around us we may put them into two groups: large commercial, industrial, of institutional buildings, and the smaller, residential buildings in which many people live.

The large buildings of the first kind may be “high rise” buildings, which in extreme cases can be described as “skyscrapers”. There are special techniques used in building skyscrapers. Other large buildings such as factories, warehouses, schools, and hospitals also have to be built of materials that will bear heavy weights. Often it is desirable to produce spaces inside without posts or supporting walls. Arches, called trusses, are used to span the area to be left open. These may be made of wood, metal, or reinforced concrete. Concrete is a material used frequently in modern buildings, especially this kind of large commercial building. Another way to span a large space is to use a dome, which may be made of plastic or glass, as well as concrete or metal.

VOCABULARY NOTES

building materials строительные материалы
natural materials природные материалы
commercial buildings торговые здания
industrial buildings промышленные здания
residential buildings жилые здания
high-rise buildings высотные здания
skyscraper небоскрёб
to bear (bore, born) выдерживать нагрузку
post стойка
supporting walls несущие стены

arch арка
truss ферма
span пролёт
dome купол
plastic пластмасса

EXERCISES

I. Read the text "Large Modern Buildings" and answer the following questions:

1. What is a building?
2. What was the beginning of building industry?
3. What are the main two groups of large modern buildings?
4. What are the specific features in constructing "high-rise" buildings?

II. Make up the summary of the text.

BUILDING HOUSES

The ordinary houses which many of us live in appear to be comparatively small and simple, and you might not realize how many different people have been employed to build them.

The outer "shell" of the house may be made of brick, wood, or stone, but that may not be what is actually holding the building up.

In order to understand how a house is built we must start at the beginning.

When a building contractor is asked to put up a building, he must first look at the site, choose the people who are going to work for him, and plan a schedule of work so that he knows which people should be on the site at the right time.

Some of the people needed to build a house are bricklayers, plasterers, carpenters, plumbers, electricians, painters, and roofers, as well as all the laborers who help them. When you have so many people working together in a small space you must not have they getting in each other's way and they must not be waiting about on the site with no work to do because someone else has not finished his job on time.

Foundations. The first thing to do is to level the ground and make the foundations. These are usually made of concrete which is poured into trenches dug in the ground. They have to be strong enough to hold up the building, and so it is important to prevent them from cracking or shifting. While the foundations are being built, the main drains must be laid to connect up the public sewers.

A timber-framed building has concrete foundation walls on top of a "footing" of concrete, and then timber "sills" which are anchored to the concrete while it is still wet. In brick-built houses the layers of bricks start on top of the concrete foundations. The first layers or courses of bricks must be built very carefully, for the whole house will rest on them.

It is important to prevent dampness coming up from the ground into the house, and so all houses have to have a damp-proof layer built into them. In brick- built houses this is a layer of waterproof material put into the brickwork when it reaches about 15 centimeters (6 inches) high, in timber-framed houses the waterproof material must go in the layer of concrete, and in all houses it must be incorporated into the floor when it is being laid. The floor of the house will be made of a layer of rubble, gravel, or stones, covered with concrete.

Building the walls. Once the foundations and floor are complete, the main part of the house can be built up. In timber-framed houses the main supporting joists are sometimes made of steel or reinforced concrete. Heavy timbers must be used for supporting the roof and stairs and for door and window frames; for the rest of the structure lighter timber is used. In brick-built houses the walls are built up in double layers and the wooden framework for doors and windows, as well as the wooden joists for the floors, are incorporated as work goes on. As the house rises it is necessary to provide scaffolding and platforms for the workers to stand on. This is made of steel tubing with planks laid across, ladders to go up and down, and hoists to lift up the building materials.

Roofing. The roof of the house may be flat or sloping. Rafters of wood are laid across, which are then covered with slates or tiles. In some places they are called shingles. They may be made of any material that is waterproof, including clay, concrete, metal, and asbestos. They are laid so that they overlap and let the water run off.

A timber-framed house must be covered with timber, bricks, or some other covering to finish the walls. There will also probably be an insulating layer of, for instance, fiberglass, to keep the house warm and dry. This will be put in between the living space and the roof to prevent heat escaping upwards. Brick-built houses have insulation put in the cavity between the walls and below the roof.

Finishing the inside. When the outer shell is complete, work can begin inside of the house. The walls are usually lined with plaster. Later it will be painted or papered for decoration; wet plaster must be given a few weeks to dry out before that can be done. Plastering must be carefully timed to fit in with the work of the plumbers and electricians.

Plumbers lay pipes for the water supply, heating system (including gas pipes where they are needed), and drainage. They also have to fix the drainage pipes on the outside of the house, which will join up to the drains and sewers, and put in the bathroom and kitchen fittings to which the pipes are connected. Most of these pipes have to be hidden from view in the finished house and so some of them will be fixed so that they are behind the plaster after it has been applied, and some will be under the floorboards. Similarly, the electric wires and fittings will mostly be embedded in plaster or laid under the floors. Sometimes the wires are encased in plastic tubes which are laid around the edge of the floors and window frames. The plumber and electrician also work together in installing such things as central-heating boilers.

At the same time, carpenters will be working inside the house finishing the wooden floors, staircases, window frames and doors, as well as fitting cupboards. Last of all, the painters and decorators come in to paint the house inside and out.

VOCABULARY NOTES

site строительная площадка
bricklayer каменщик
plasterer штукатур
carpenter плотник
plamber водопроводчик
electrician электрик
painter маляр
roofer кровельщик
labourer рабочий
cracking растрескивание
shifting сдвиг, смещение
to anchor скреплять, фиксировать
damp-proof layer влагостойкий слой
joist брус, балка

heavy timber твердые породы дерева
light timber мягкие породы дерева
scaffolding леса, возведение лесов
hoist подъемное устройство
flat roof плоская крыша
sloping roof покатая крыша
rafter стропило, балка, бревно
slate шифер, шиферная плитка
tile черепица, кафель
shingle кровельная дранка, тонкая доска
cavity пустота (внутри чего-либо)
fitting установка, сборка, монтаж

EXERCISES

I. Read the text "Building Houses" and translate it. Pay attention to the usage of the terms.

II. Read the list of main building professions and explain what each of them does in building the house:

bricklayer
plasterer
carpenter
plumber
electrician
painter
roofer

III. Read and translate the following compound words and combinations of words. Use them in your own sentences.

Brick-built house; timber-framed building; damp-proof layer; waterproof material; brickwork; wooden framework; central-heating boiler.

IV. Retell the text according to the following plan:

1. The beginning of house construction.
2. Foundation construction.
3. Building the walls.
4. Roofing.
5. Finishing the inside.

FOUNDATIONS

A building has two main parts, the substructure (the part below ground) and the superstructure (the part above ground). The substructure is usually called the foundation and includes the basement walls even though these may extend above the ground.

Both the substructure and superstructure help to support the load (weight) of the building. The dead load of a building is the total weight of all its parts. The live load is the weight of the furniture, equipment, stored material, and occupants of a building. In some regions, the wind load of a building is important if the structure is to withstand storms. The snow load may also be an important factor. In some areas, buildings have to be constructed to withstand earthquake shocks.

The purpose of foundation is to carry the load of structure and spread it over a greater area, evenly and without undue settlement, to the ground beneath. They carry both dead and live loads. There are three main types of foundations: (1) spread, (2) pier, and (3) pile.

Spread foundations are long slabs of reinforced concrete that extend beyond the outer edges of the building. Such foundations are not as firm as those based on solid rock. The footing areas in contact with the soil must be of sufficient size to spread the load safely over the soil and to avoid excessive or uneven settlement. Any such settlement would cause walls to crack or doors to bind.

Pier foundations are heavy columns of concrete that go down through the loose topsoil to a bed of firm rock. This bed may also be sand, gravel, or firm clay. If the bed consists of firm clay, the pier is usually enlarged at the base, to increase the bearing area.

Pile foundations are long, slender columns of steel, concrete, or wood. Machines called pile drivers hammer them down as deep as 60 meters to a layer of solid soil or rock. Workers can tell when the columns reach their proper depth by the number of blows. The pile driver needs to drive the columns a few centimeters deeper. These columns transmit the building load to the supporting soil.

The importance of pile foundations in building and industrial construction as well as in civil engineering has increased considerably over recent years. The piles transmit the loads of the structure to deep-lying, load bearing strata of the subsoil. Today's modern, large structures force the civil engineer to develop advanced methods and techniques in order to make sure that the ever increasing and highly concentrated loads are safely transferred to the subsoil without causing settlements.

The significance of pile foundations is reflected in the large number of pile systems currently available on the market. Depending on the method of production, piles can be divided into two main types: cast in-situ concrete piles and prefabricated piles.

Cast in-situ piles are mostly bored piles while precast piles or prefabricated piles are driven.

Beams, girders, and columns support a building much like bones support the body. They form the skeleton of the superstructure and bear the weight of the walls and each floor of the building. Beams and girders run horizontally. Girders are usually larger than beams.

Closely spaced beams are called joists, especially in wooden buildings. Purlins are small beams that brace ratters or girders and help provide the structure to support roofs. Beams above window and door openings are called lintels. Slabs are beams whose width is greater than their depth.

Columns are heavy vertical supports that carry the load of beams and girders. Trusses consist of many wood or steel supports that are connected in triangular patterns. They provide the strength and rigidity to span large distances with relatively small amounts of material. Arches are curved supports that usually extend over openings.

VOCABULARY NOTES

live load переменная нагрузка
dead load постоянная нагрузка
spread foundation уширенный фундамент
pier foundation столбчатый фундамент
pile foundation свайный фундамент
girder балка; ферма; прогон
joist балка; брус
purling обрешетина; прогон
lintel перемычка
truss ферма
arch арка

EXERCISES

I. Read the text and translate it.

II. Put up questions to the following sentences:

1. Foundations carry both the dead and live loads.
2. Spread foundations are long slabs of reinforced concrete be-

tween the outer edges of the building.

3. Pier foundations go down through the topsoil to a bed of firm rock.

4. Pile foundations transmit the load to the supporting soil.

III. Answer the questions to the second part of the text:

1. What is the main function of beam, girder and columns?
2. What is the difference between beam and girder?
3. What is joist? purlin? lintels?

IV. Make up the summary of the text.

BRICKMAKING

Brick is formed in three ways: the soft-mud, stiff-clay, and pressed brick processes. In the soft-mud process, clay is mixed with water to form a stiff paste which is then thrown by hand or forced by machine into wooden or metal box-like molds the size of a brick. Sand or water is sprinkled on the inside of the molds to keep the clay from sticking. The sand or water also gives the brick a pleasant finish. Such bricks are called “sand-struck” or “water-struck” bricks. The soft, wet bricks are removed from the molds for drying. The molds are used again.

In the stiff-clay process, the ground clay is mixed with water in a long trough containing a revolving shaft with blades. The blades mix the clay with water as they revolve and at the same time push it forward into an extrusion machine. This forces it through a rectangular opening in the same way as toothpaste is squeezed from a tube. It comes out, or is extruded, in a long bar the length and width of a brick. A moving belt carries the clay bar to a cutter, which is a metal frame with a number of wires stretched across it. The wires are spaced

65 millimeters (2 inches) — the height of a brick — apart. The wires are brought down on the bar to cut it into bricks, which are then dried. Bricks formed in this way are known as extruded wire-cut bricks.

In the pressed brick system, the clay is semidry, and is pressed by heavy machine into metal molds under such high pressure that the clay particles hold together. Because pressed brick has very little water, it needs little drying.

After being formed, both the soft-mud and the stiff-clay bricks are loaded on to carts on rails and pushed into driers, and then into kilns to be fired. The driers are long rooms or sheds through which hot air is forced by large fans. Water must be removed from the bricks before firing, as a wet brick warp when fired. Drying takes two to three days and then the bricks are ready for firing.

Until the 17^{th} century a lot of brick-making was carried out in brick-fields near where the bricks were to be used. The clay was dug from the field and molded there. It was then fired in a “clamp”, which a temporary kiln was built of fuel and bricks. The inside of this stack consisted of unfired bricks and fuel, usually small coals, while the outside was made of fired bricks. The clamp was then set alight and allowed to burn itself out. This took several weeks.

In permanent brickyards, an early type of kiln was used. This was a separate building which, after the unfired bricks stacked inside it, was closed and the fires lit. The kiln gradually warmed up until the necessary heat was reached, and after about two days the fire was allowed to die down and the kiln became cool enough for the bricks to be carried out.

The problem with both the clamps and the early kilns was that they did not give evenly fired bricks. This meant that the bricks were very variable in quality. Some bricks would have to be re-fired and the cracked ones would be thrown away. They were also uneconomical with fuel.

Nowadays kilns usually allow a continuous process. There are many different types, the most modern of which is the tunnel kiln. This kiln is 90 meters (300 feet) or more in length. The fire burns all the time in a zone about half way through the tunnel. The dried bricks are drawn slowly through the fire on carts, taking two or three days to travel the whole length of the tunnel. This speeds up production, is easily controllable, and economical with fuel.

Materials. Clay is the material most often associated with bricks, but since the late 19th century other materials have been used. For example, calcium silicate bricks, sometimes known as sand-lime bricks, are made by pressing a mixture of moist sand and lime into brick shape by machine. The bricks are then steamed under high pressure in an autoclave (a sort of giant pressure cooker). This process produces bricks of an attractive light sandy color which can be textured and pigmented in a variety of ways.

Pigments and texturing can also add interest to concrete bricks which are naturally light gray in color. These are made from a mixture of crushed rock and Portland cement mixed together and moistened. The cement sets and hardens to bind the particles of rock together.

Shape. Not all bricks are completely solid. Some have “frogs” in them. A frog is a recess in the brick named after the frog in horse’s hoof. They make it easier to press and fire the bricks and also reduce the weight. Lighter bricks are easier to handle and cheaper to transport. Nowadays many machine-made bricks have holes in them for similar reasons. These are called perforated bricks. “Specials”, as the name suggests, are bricks made for a specific purpose. They are usually shaped to fit angles and curves or to produce a decorative effect. There are various commonly made ones such as “angled”, “radial”, and “bull-nosed”.

Color. The color of clay bricks depends on several factors. The type of clay used, chemicals in the clay, the supply of oxygen while the bricks are being fired, and the temperature the bricks reach during firing. The colors range from dark purple to light yellow. The red color of ordinary brick is due to the iron found in most clay. A large amount of iron gives a bright-red color; reducing the supply of oxygen may give dark-blue. By adding manganese to the clay a brown color is produced. Clay combined with lime produces yellow bricks. Facing bricks, to be used in the outer walls of buildings, can be given a rough or textured surface, or they may be glazed to add to their attractiveness.

Sand-lime bricks are naturally white, off-white, or pink, depending on the sand used to make them. By adding pigments, any colors from pale pastels to dark tones can be produced.

Blocks are essentially oversize bricks — commonly about the size of six bricks. They may be made of clay or concrete. Clay blocks are usually hollow; concrete blocks may be solid or hollow. The advantage of blocks over bricks is that building can be carried out faster with them.

VOCABULARY NOTES

soft-mud мягкий раствор
stiff-clay жесткая глина
pressed brick прессованный кирпич
mold форма
to sprinkle разбрызгивать; посыпать
trough желоб
wire-cut-brick проволочный кирпич
kiln печь
sand-lime brick песчано-известковый кирпич
perforated brick дырчатый кирпич

EXERCISES

I. Read and translate the following text. Annotate it in Russian.

II. Speak on the three-ways of forming bricks.

III. Speak about the materials, used for brick-making; different shapes of bricks; possible colors of bricks.

IV. Make up sentences from the following words:

1. Brick-making – sand – water – are – widely – for – used
2. Heavy machine – is pressed – under – clay – in – pressure – high
3. Before – from the bricks – water – firing – removed – must be
4. Must be – bricks – carefully – in the wall – arranged – to produce – good – strength – appearance – high – and

V. Determine the part of speech and the grammatical form of the following words. Translate them into Russian:

1. Construct; construction; constructional feature; construction site reconstruction; a reconstructed building.
2. Conclude; conclusion; conclusive; inclusively.
3. Require; requirement; required.
4. Undertake; undertaker; undertaking; undertook.

BRICKLAYING

When a wall is built of bricks, the bricks are set in mortar. Mortar usually consists of a mixture of sand and either lime or Portland cement or, more often, a mixture of the two. Enough water is used in mixing the mortar to produce a paste in which the bricks can be firmly bedded. The bricks must be carefully arranged or "bonded" as it is called, in the wall in order to produce a structure of good strength and appearance, the pattern of the brickwork depending on the bond which is used. The “pointing”, or finishing, of mortar joints is also given careful attention since it affects the appearance and the weather resistance of the wall.

Each layer of bricks is called a “course” and the bricklayer has to be very skillful to keep the courses exactly level and the thickness of mortar between each course of bricks the same throughout the length and depth of the wall. The corners of the walls must be absolutely upright or “plumb”.

Nowadays the outer walls of buildings often consist of an outer and inner wall with a space of about 5 centimeters (2 inches) between them, the two layers being held together at intervals by small metal ties. These cavity walls, as they are called, help moisture evaporate better than solid walls. A layer of insulating material is often put in the space between the walls to prevent heat escaping from the building. This is known as “cavity wall insulation”.

When bricks are built in curves, as in arches or curved walls, the bricklayer has to shape the bricks in order to fit them together. Sometimes quite soft bricks called “rubbers” are used; these can be rubbed on a hard stone in order to shape them so accurately that they can be built with thin mortar joints. Work of this type is known as “gauged brickwork” and demands great skill.

VOCABULARY NOTES

cavity впадина; полость
coarse of brick ряд кирпича
gauged brick лекальный кирпич

EXERCISES

I. Read the following text and retell it keeping close to the text.

PARTITION WALLING

Partitions, as they are normally called, are internal walls usually built of the same materials as other types of walling previously described. When they are used simply as dividing walls and have only their own weight to carry, they are termed "non-load bearing" partitions. When, however, they are required to support the weight of the structure above, they are termed "load bearing" partitions.

"Non-load bearing" partitions are often built of light-weight materials, such as thin light-weight precast concrete blocks, hollow clay blocks and timber studding covered with either plasterboard, fiberboard, match-boarding, plywood, chipboard, resin bonded block-board or other form of cladding. The construction of a stud partition is used in a typical timber framed house. Where sound insulation is of the utmost importance, as in ordinary houses, even "non-load bearing" partitions should be built of bricks or dense precast blocks. Partitions of light-weight precast concrete blocks and hollow clay blocks have fire-resisting qualities and contribute to thermal insulation and are, therefore widely used.

Stud partitions, although commonly used in former years, are not so common nowadays, due to mainly to their low resistance against fire. On the other hand, they contribute quite a great deal to thermal insulation. Special partitions, for use in toilets etc., are often made of pressed steel, plastics, asbestos cement, tiles or glass. These are normally prefabricated and erected in sections and can be easily removed or re-arranged.

Piers are a particular form of walling, which is either completely isolated from the other walling or is attached there to. These are often constructed in brickwork, although they also occur in stonework and concrete block-work. Attached piers are intended to strengthen the walling, usually at those points where a load is being directly supported. Isolated piers, acting as columns, usually support the weight of a floor or beam between the walls of the main structure.

EXERCISES

I. Read the following text and note the interesting facts.

II. Find the Russian equivalents for the following words:

non-load, load-bearing, light-weight precast concrete, plaster board, fiberboard, match-boarding, plywood, chipboard, resin bonded block-board, dense precast block, hollow clay block, pressed steel, asbestos cement, tile, glass.

III. Answer the questions:

1. What is a partition?
2. What is the difference between "non-load bearing" and "load bearing" partitions?
3. What building materials are used for partitions?
4. What building materials are used for thermal insulation in stud partitions?
5. What is a pier?
6. What types of piers are mentioned in the text? Characterize them.

IV. Give a brief summary of the text.

THE NEW LOOK IN BUILDINGS

Buildings have taken on a new look in the past decade. Metal and thin-wall back-up with more glass have completely changed the facades of the new buildings. The construction is more expensive than brick, and the large glass areas increase air conditioning costs. But people like the new look.

Until recently masonry was the principal material for the exteriors of buildings. Individual stones or bricks have been laid one on top of another to express the aesthetic conceptions of architects since prehistoric times. In recent years there has been some use of metal for window and door frames.

Before 1946 metal facades were used only to a very limited degree. In that year the Aluminum Company of America started a big research program to develop practical methods for the use of aluminum as a building facade material.

The three basic requirements for a metal-glass façade are:

a) light-weight,

b) ease-of-erection,

c) weather-tightness.

In 1948 most cities required a spandrel wall having a 4-hr. fire rating. An 8-in. brick wall would satisfy this requirement, but brick weighs 120 lb. per cu. ft. Since light-weight construction was important, a back-up wall 4 in. thick (either precast or poured) made of diacrete and cement was developed, weighing 20 lb. per sq. ft. compared to 80 lb. for an 8 in. brick wall. Light-weight construction, in many instances, brought savings in the structural frame as well as in building costs.

Ease of erection is important. In most cases, façades made of metal can and should be erected from the inside of the building, thus avoiding outside scaffolding. This item can create large savings in both time and money. Weather conditions become of little importance, and a minimum of time is lost. This contrasts with earlier operations which were practically brought to a stop by adverse weather conditions. Since metal frames are light, they can be handled easily by a few men without resort to expensive equipment.

Weather tightness is essential. Joints should be treated to shed water, and their number kept to a minimum. Generally they are located at expansion joints, at mullions, and at ceiling and floor levels. Today panels are mostly one story high and extended the full width between vertical mullions. Weather-tightness is generally attained by use of neoprene gaskets or calking compounds.

There should be no maintenance cost as far as metal-glass façade is concerned except window cleaning, which deserves consideration. Two methods are commonly used:

1) use of reversible in-swinging windows,

2) use of outside window-washing scaffolding, running up and down the facade, in which case mullions are designed to provide guides for the scaffolding and the glass in all windows can be fixed.

Close cooperation among the architect, engineer and contractor during the design is essential to achieve greatest economy. Materials, methods and budgets can be worked out for acceptable treatment of the facade. The architect, being an artist as well, will envisage certain shadow lines for his facade treatment and will justly insist that these be maintained. However, there are many ways to put the pieces together and still achieve the desired architectural features. Methods of assembly greatly influence cost.

Increased research by manufacturers is developing improved methods of shop handling and field erection that create savings in labor costs. Today there are many manufacturers in the business, and competition is healthful. The large selection available in design and color tends to create a greater desire for curtain-wall construction.

VOCABULARY NOTES

frame корпус; каркас
facade фасад; внешний вид
to erect сооружать; воздвигать
tightness плотность; герметичность
spandrel wall стенка подоконная
back-up wall опорная стена
scaffolding леса; возведение лесов
to handle управлять; оперировать
to shed распространять; проливать
mullion средний брусок оконной рамы
to attain достигать
gasket (техн.) прокладка
calking уплотнение
(in)swinging window (не)распашное окно
curtain wall подвесная стена

EXERCISES

I. Read the text; translate into Russian; speak about the advantages of light-weight construction.

II. Answer the following questions:

1. How does the weather affect the erection of a building and the building itself?

2. What can create large savings in both time and money?

III. Form sentences with the following words and put questions to these sentences.

1) research – started – has been – year – this – a – program big.

2) this new building – of – may affect – weather conditions – the erection.

3) window cleaning – only – are – there – two methods – of.

4) large aluminum panels – the – wants – architect – to use.

IV. Explain the meanings of the following words and use them in the sentences of your own:

architect, treatment, assembly, business, frame, facade, precast, light-weight construction.

V. Get ready to retell the text.

HIGH-RISE BUILDING

High-rise building, also called “high-rise”, a multistory building tall enough to require the use of a system of mechanical vertical transportation such as elevators. The skyscraper is a very tall high-rise building.

The first high-rise buildings were constructed in the United States in the 1880s. They arose in urban areas where increased land prices and great population densities created a demand for buildings that rose vertically rather than spread horizontally, thus occupying less precious land area. High-rise buildings were made practicable by the use of steel structural frames and glass exterior sheathing. By the mid-20^{th} century, such buildings had become a standard feature of the architectural landscape in most countries in the world.

The foundations of high-rise buildings must sometimes support very heavy gravity loads, and they usually consist of concrete piers, piles, or caissons that are sunk into the ground. Beds of solid rock are the most desirable base, but ways have been found to distribute loads evenly even on relatively soft ground. The most important factor in the design of high-rise buildings, however, is the building’s need to withstand the lateral forces imposed by winds and potential earthquakes. Most high-rises have frames made of steel or steel and concrete. Their frames are constructed of columns (vertical-support members) and beams (horizontal-support members). Cross-bracing or shear walls may be used to provide a structural frame with greater lateral rigidity in order to withstand wind stresses. Even more stable frames use closely spaced columns at the building's perimeter, or they use the bundled-tube system, in which a number of framing tubes are bundled together to form exceptionally rigid columns.

High-rise buildings are enclosed by curtain walls, these are non-load-bearing sheets of glass, masonry, stone, or metal those are affixed to the building's frame through a series of vertical and horizontal members called mullions and muntins.

The principal means of vertical transport in high-rise is the elevator. It is moved by an electric motor that raises or lowers the cab in vertical shaft by means of wire ropes. Each elevator cab is also engaged by vertical guide tracks and has a flexible electric cable connected to it that provides power for lighting, door operation, and signal transmission.

Because of their height and their large occupant populations, high-rises require the careful provision of life-safety systems. Fire prevention standards should be strict, and provisions for adequate means of egress in case of fire, power failure, or other accident should be provided. Although originally designed for commercial purposes, many high-rises are now planned for multiple uses. The combination of office, residential retail, and hotel space is common.

VOCABULARY NOTES

dense плотный

density плотность

structural frame строительный каркас

sheathing обшивка

gravity load гравитационная нагрузка

pier устой; столб

pile свая

caisson кессон

cross-bracing крестовая связь

lateral боковой; поперечный

rigid жесткий; устойчивый

rigidity жесткость; устойчивость

to bundle связывать

curtain wall навесная стена

mullion средник

muntin горбылек (оконного переплета)

egress выход

retail розничная торговля

EXERCISES

I. Read the text and answer the following questions:

1. What is a high-rise building?
2. When were the first skyscrapers constructed?
3. What kind of foundation can be used in high-rise buildings?
4. What kind of walls was used in construction of high-rises?

II. Speak on high rise buildings making use of the following words and word combinations:

first high-rise building

urban areas

frame

column

beam

curtain walls

elevator

life-safety systems

III. Put questions to the following sentences:

1. The first skyscraper was built in American city Chicago.
2. Steel was the main structural material for framework.
3. The walls were hung to the skeleton as curtains.
4. The principle means of vertical transport in skyscraper is the elevator.
5. The first high-rise building was designed for commercial purposes.

IV. Retell the text using questions and answers of ex. III.

GLASS-WALLED SKYSCAPER

Delicate and transparent a narrow shaft of glass 24 stories high pierces the NEW YORK CITY, mirror like exterior incongruously reflecting its massive opaque skyscraper neighbors.

Its broad, two-story high base keeps surrounding buildings at a respectable distance. This glass tower was designed to be seen by the man in the street as well as to capture daylight for interior illumination.

It is the new headquarters office LEVER BUILDING in New York.

The building, which is completely air conditioned, contains 21 office floors, plus three floors for mechanical equipment on top.

A garage in the basement accommodates 50 automobiles. Cross building area is 289,600 sq. ft. net office area 131,000 sq. ft.

Street level is occupied by an auditorium seating 200, a demonstration kitchen, service areas in the rear, including provision for off-street, loading and a glass-enclosed lobby, with stainless steel trim.

Though there are entrances from the three bordering streets, the lobby is set back on all three sides, leaving space for an arcade and garden. Building columns outside the lobby thus are exposed to view from the street. Hence, the structure appears to be standing on stilts.

The second floor covers the entire lot, except for an open well directly over the garden. Purpose of the well is to admit daylight into the interior of the building base.

EXERCISES

I. Read the text and translate it.

II. Discuss the most interesting facts.

26-STOREY BLOCKS AT WYNDFORD, GLASGOW

Four 26-storey blocks of flats were erected for the Scottish Special Housing Association at the old Maryhill Barracks site in Wyndford, Glasgow.

The four identical blocks are the highest dwellings on the site. They provide 600 dwellings for tenants from all over Glasgow.

The ground floors house stores, water tanks, etc., and on each floor above there are six dwellings, four single-bedroom flats and two bedrooms flats.

Two of the buildings have raft foundations and two piled foundations. One block was built on a foundation of 195 two-foot diameter bored piles, 22 ft. deep and sitting on solid rock.

The blocks are of in situ concrete floor and cross-wall construction with precast concrete Italian mosaic-faced cladding panels.

A distinguished feature of the flats is three-foot fins projecting from each corner. Adding to the attractive design, fretwork panels run up the sides of the blocks.

A striking effect has been obtained on the walls of the ground-floor, where etched plywood has been placed against the wet concrete to give a grained appearance.

Two eight-person lifts serve all floors in each block and the flats are centrally heated by electric off-peak storage heaters.

There are also 24 garages, additional parking and landscape areas, and a fire pumping station.

EXERCISES

I. Read and translate the following text.

II. Retell the text using questions below as a plan.

1. In what country were 26-storey blocks constructed?
2. How many dwellings do the four identical blocks provide for tenants?
3. What kind of rooms is there on the ground floor?
4. What types of foundations do the buildings rest upon?
5. What is the distinguished feature of the flats?
6. What can you say about the walls of the ground floor?
7. How are the flats heated?

NATIONAL THEATRE OF JAPAN

The National Theatre of Japan, in Tokyo, was completed in October 1966. The design was selected on the basis of a nation-wide architectural design competition.

The theatre embodies traditional Japanese architectural concepts and resembles the 8^{th} century Shosoin Treasure Hall in Nara. However, instead of the wooden logs which typify its ancient predecessor, the National Theatre features precast concrete beams with artificial lightweight aggregate. The concrete surface was sand-blasted, then coated with special chemicals which produce the stable color of timeworn lumber. Eaves, the wall above the picture rail, and pillars were processed in the same manner.

The total floor space of the three-storey basement is 286,000 sq. ft. The theatre is equipped with all facilities necessary to the stage traditional classic Japanese theatrical arts, to train performers, and to collect, preserve and display research material on the traditional theatrical arts of Japan. The building houses two separate theatres: the main theatre with a seating capacity of 1746 and a small theatre with a seating capacity of 630. Other facilities include library, recording and videotape recording rooms, filming rooms, rehearsal room, control rooms, and parking lot.

EXERCISES

I. Read the text and follow the information.

II. Put 5 key questions to the contents of the text.

ROUND TOWER IN SYDNEY'S AUSTRALIA SQUARE

Constructed a few blocks from Sydney's beautiful harbor, the Australia Tower, a 50 storey, 602 ft. high, lightweight concrete office building, dominates the business section of the city. The tower cost 30.24 million and was completed in 1967.

The tower, 135 ft. in diameter, provides an area of 14,225 sq. ft. per floor. A circular service core at the center incorporates all services, including 17 elevators in three banks.

Reinforced lightweight concrete was used for 88 percent of the project.

The structural spine of the tower consists of 22 exterior columns with a central service core made like a double-walled chimney connected with 20 radial walls forming 20 cells. Seventeen cells are for elevator shafts, and three are entrances to the service center core. The outside diameter of this circular wall system is 61 ft. 6 in.

Reinforced concrete was used throughout fir beams and slabs in the main system outside the service core.

Precast formwork — to form the outer skin of the columns and upturned and down-turned spandrel beams — was tied by bolts and welded stirrups to the monolithic on-site structures, which was cast against the outer skin. Plywood was used for the inner skin.

This tying-in procedure enabled the precast formwork, finished in white quartz chip, to become part of the stressed structure in the same way that reinforcing bars become stressed with the on-site concrete.

Lightweight concrete was also used for the basement and plaza slabs, which did not have expansion or shrinkage joints. The slabs were cast in three sections with shrinkage gaps for 4 months between placements. Then gaps were filled.

The tower's first five levels are of flat plate construction for service flexibility and reduced floor-to-floor height.

EXERCISES

I. Read the text and translate it. Note the main building materials and structural elements mentioned in the text. Memorize them.

II. Give definitions of the following words:

reinforced concrete; beam; column; bar; structure; shrinkage; gap; flexibility.

SCOTLAND'S LARGEST SUPERMARKET

New supermarket was recently opened at Cumbernauld.

The store, which is the largest supermarket in Scotland and the second largest in the U. K., is the centerpiece of the new Cumbernauld town shopping precinct.

The supermarket is a completely new answer to the problem of creating the most pleasant environment possible for busy shoppers.

A new specially designed ceiling has been installed which creates a sunny and inviting atmosphere, completely outdating the oppressive strip lighting generally found in supermarkets.

This, together with new ideas in the whole design and layout of the public areas, for example, signs indicating the whereabouts of foodstuffs which can be read by customers from all parts of the building, will make housewives' shopping expeditions effortless and harmonious.

Every part of the 14,500 sq. ft. building, including the snack bar and the off-sales area, has been designed to ensure the highest standards of hygiene.

The construction and the finishes used allow thorough cleaning and maintenance, and the layout of the building gives freedom of shopper circulation and flexibility in display.

All the Galbraits shops throughout the Clyde Valley are usually recognizable as being part of the same organization.

EXERCISES

I. Read the text; translate it into Russian.

II. Speak about new ideas in the design of the building.

MODERN BRIDGE DESIGNS

There are six basic bridge forms: the beam, the truss, the arch, the cantilever, the cable-stay, and the suspension. A beam bridge is made of long timber, metal, or concrete beams anchored at each end. If the beams are arranged in a lattice, such as a triangle, so that each shares only a portion of the weight on any part of the structure, the result is a truss bridge.

An arch bridge has a bowed shape causing the vertical force of the weight it carries to produce a horizontal outward force at the ends. It may be constructed of steel, concrete or masonry

A cantilever bridge is formed by self-supporting arms anchored at and projecting toward one another from the ends; they meet in the middle of the span where they are connected together or support a third member.

In a cable-stayed bridge, the roadway is supported by cables attached directly to the supporting tower or towers. This differs from a suspension bridge where the roadway is suspended from the vertical cables that are in turn attached to two or more main cables. These main cables hang from two towers and have their ends anchored in bedrock or concrete.

The modern era of bridge building began with the development of the Bessemer process for converting cast iron into steel. It became possible to design framed structures with greater ease and flexibility. Single-piece, rolled steel beams can support spans of 50 to 100 ft. (15–30 m), depending on the load. Larger, built-up beams are made for longer spans; a steel box-beam bridge with an 850 ft. (260 m) span crosses the Rhine at Cologne.

Movable bridges. They are generally constructed over waterways where it is impossible or prohibitive to build a fixed bridge high enough for water traffic to pass under it. The most common types of movable bridge are the lifting, bascule, and swing bridges. The lifting bridge, or lift bridge, consists of a rigid frame carrying the road and resting abutments, over each of which rises a steel-frame tower. The center span in existing bridges is as long as 585 ft. (178 m) and is hoisted vertically. The bascule bridge follows the principle of the ancient drawbridge. It may be in one span or in two halves meeting at the center. It consists of a rigid structure mounted at the abutment on a horizontal shaft, about which it swings in a vertical arc. The lower center span of the famous Tower Bridge in London is of the double-leaf bascule type. Because of the need for large counterweights and the stress on hoisting machinery, bascule bridge spans are limited to about 250 ft. (75 m). The swing bridge is usually mounted on a pier in midstream and swung parallel to the stream to allow water passage.

Military bridges. In wartime, where the means of crossing a stream or river is lacking or a bridge has been destroyed by the enemy, the military bridge plays a vital role. Standard types of military bridges include the trestle, built on the spot by the engineering corps from any available material, and the floating bridge made with portable pontoons.

Pontoon. It is one of a number of floats used chiefly to support a bridge, to raise a sunken ship, or to float a hydroplane or a floating dock. Pontoons have been built of wood, of hides stretched over wicker frames, of copper or tin sheet metal sheathed over wooden frames, of aluminum, and of steel. The original and widespread use was to support temporary military bridges. Cyrus the Great built (536 B.C.) the earliest pontoon bridge in history, using skin-covered pontoons. However, Homer mentions pontoon bridges as early as c.800 B.C. The U.S. army began experimenting with rubber pontoons in 1846 and in 1941 adopted collapsible floats of rubber fabric with steel-tread roadways. At the same time the navy developed box pontoons of light, welded steel for ship-to-shore bridges during landing operations. These box pontoons could be assembled into bridges, docks, causeways and, by adding a motor, into self-propelling barges. Permanent civilian pontoon bridges have been built where the water is deep and the water level fairly constant or controllable, often also where the crossing is narrow or where the bottom makes it difficult to sink piers. The modern permanent pontoon is composed of many compartments, so that if a leak occurs in one compartment, the pontoon will not sink. Permanent pontoons are fastened together and several anchors are dropped from each. Often a section of a bridge built on them can swing aside to let a ship pass.

Several pontoon bridges have been built across the Mississippi River. Pontoons for raising sunken ships are watertight cylinders that are filled with water, sunk, and fastened to the submerged ship; when emptied by compressed air, they float the ship to the surface. A pontoon lifeboat consists of a raft supported by watertight cylinders.

VOCABULARY NOTES

beam bridge балочный мост
cantilever bridge консольный мост
cable-stay bridge вантовый мост
suspension bridge висячий мост
bascule bridge раскрывающийся мост
draw bridge натяжной мост
trestle bridge эстакадный мост
lattice решётка
bowed shape дугообразная форма
abutment опора

EXERCISES

I. Read the text and answer the questions:

1. What are the basic types of modern bridges?
2. When did the era of modern bridge building begin?
3. Where are the movable bridges constructed?
4. What are the main types of movable bridges?
5. What types of military bridges can you name?
6. Where have permanent pontoon bridges been built?
7. How are they composed?

II. Make up a brief summary of the text using questions of ex. I as a plan.

III. Make up reports about the oldest and most famous bridges.

TEST I

I. Give the Russian for:

mortar
durability
to meet industrial requirements
equipment
research engineer
strength of material
solid mechanics
mold
pouring
scaffolding
to bend
brickwork
carpenter
span
construction site

II. Translate into Russian:

1. The properties of the concrete mix depend on the activity of the binding materials.

2. To reinforce ordinary concrete structures is to introduce steel rods in stretched zones of concrete elements.

3. Portland cement is manufactured by burning shale and limestone; aggregates such as sand and crushed stone can be easily obtained.

4. The importance of piled foundations in building and industrial construction as well as in civil engineering has increased considerably over recent years.

5. Concrete beams, floors, roofs, and wall panels may be precast for many types of structures.

6. Being brittle, concrete cannot withstand tensile stresses, and it cannot therefore be used in structures subjected to tensile stresses under load.

7. Construction of the bridge is divided into four elements: the pylon, the back span, the anchor beam and the deck.

8. The purpose of foundation is to carry the load of structure and spread it over a greater area, evenly and without undue settlement, to the ground beneath.

9. Selection of the cement alone doesn't ensure concrete with the properties desired, which depend also on the choice of aggregates and mixes, the control of the quality of water added to the mix, and on a series of other factors.

10. Various methods of constructing reinforced concrete houses involve extensive use of large sections manufactured in heavily mechanized factories and erected at the site.

TEST II

I. Give the Russian for:

to insulate
water supply
tensile stress
curing
shrinkage
prestressed concrete
cracking
beam
bearing structure
cast in-site concrete
reinforcement

bar

density

dead load

binding materials

II. Translate into Russian:

1. Depending on the method of production, piles can be divided into two main types: cast in-situ concrete piles and prefabricated piles.

2. Concrete beams, floors, roofs and wall panels may be precast for many types of structures.

3. The floor beam may be sufficiently strong to carry the load on it, but its deflection may be so great that a plastered ceiling wold crack or the floor would vibrate.

4. The proper thickness for bearing walls depend on the loads and are determined by the safe stress allowed per square inch on the brickwork.

5. Brick basement walls should be at least as thick as the walls above them and never less than 12 in.

6. Until recent years there was a tendency to consider reinforced concrete as a method of construction suited to massive structures.

7. Buildings of reinforced concrete may be constructed with load-bearing walls or with skeleton frame.

8. If the weight of any building exceeds the bearing resistance of the material, either soil or rock on which it rests, the material will give way and the building will sink.

9. The foundations are spread out to distribute the load over the bed so that the safe bearing power of the bed per square foot is not exceeded.

10. Common bricks are very little used at the present time because they do not withstand the moisture and frost as well as stone or concrete.

PART III. TEXTS FOR SUPPLEMENTARY READING

National and international highway systems

The Romans had realized that coordinated system of roadways connecting the major areas of their empire would be of prime significance for both commercial and military purposes. In the modern era, the nations of Europe first introduced the concept of highway system. In France, for example, the State Department of Roads and Bridges was organized in 1716, and by the middle of the 18th century the country was covered by an extensive network of roads built and maintained primarily by the national government. In 1797 the road system was divided into three classes of descending importance: (1) roads leading from Paris to the frontiers, (2) roads leading from frontier to frontier but not passing through Paris, and (3) roads connecting towns. By the early 1920s this general plan remained essentially the same except that a gradual change in class and responsibility had taken place. At that time the road system was divided into four classes: (1) national highways, improved and maintained by the national government, (2) regional highways, improved and maintained by the department under a road service bureau appointed by the Department Commission, (3) main local roads, connecting smaller cities and villages, built and maintained from funds of the communes supplemented by grants from the department, and (4) township roads, built and maintained by the communities alone.

While the British recognized the necessity for national support of highways and a national system as early as 1878, it was the Ministry of Transport Act of 1919 that first classified the roadway system into 23,230 miles of Class I roads and 14,737 miles of Class II roads. Fifty percent of the cost of Class I roads and 25 percent of the cost of

Class II roads were to be borne by the national government. In the mid-1930s the need for a national through-traffic system was recognized, and the Trunk Roads Act of 1939, followed by the Trunk Roads Act of 1944, created a system of roadways for through traffic. The Special Roads Act of 1949 authorized existing or new roads to be classified as “motorways” that could be reserved for special classes of traffic. The Highway Act of 1959 swept away all previous highway legislation in England and Wales and replaced it with a comprehensive set of new laws.

The mammoth U.S. Interstate Highway System developed in response to strong public pressures in the 1950s for a better road system. These pressures culminated in the establishment by President Dwight Eisenhower of the Clay Committee in 1954. Following this committee’s recommendations, the Federal Aid Highway Act and the Highway Revenue Act of 1956 provided funding for an accelerated program of construction. A federal gasoline tax was established, the funds from which, with other highway-user payments, were placed in a Highway Trust Fund. The federal-state ratio for funding construction of the Interstate System was changed to 90 percent federal and 10 percent state. It was expected that the system would be completed no later than 1971, but cost increases and planning delays extended this time by some 25 years. The system grew to a total length of more than 45,000 miles, connecting nearly all the major cities in the United States and carrying more than 20 percent of the nation’s traffic on slightly more than 1 percent of the total road and street system.

The Canadian Highway Act of 1919 provided for a system of 40,000 kilometers (13,000 miles) of highways and provided for a federal allotment for construction not to exceed 40 percent of the cost. By the end of the century, more than 134,000 kilometers (83,000 miles) of highway had been built, of which approximately 16,000 kilometers (9,900 miles) were freeway.

In search of smoother roads

In the past concrete was considered too expensive and noisy to be an effective road surface. But that has changed – longer life, less noise is now the aim of researchers around the world.

For example, U.S. Departments of Transportation are trying to determine the rate at which concrete pavements expand and contract with temperature changes that hopefully will lead to smoother, longer-lasting roads.

The thermal coefficient of expansion test involves taking a 160 mm concrete core from pavements and measuring its length using a linear variable differential transducer.

The core is then submersed in a heating bath on a stand heated from a starting temperature of 10 ^{o}C to 50 ^{o}C. The core expands under the increase in temperature and is measured following the test to check on its rate of growth.

According to researchers, the new testing procedure will significantly improve the road design process by matching a concrete to its environment. The process could reduce the maintenance required on a stretch of road.

In the U.K. the in-service performance of concrete roads has led to the development of technologies aimed at reducing future maintenance requirements, and making the treatment of rigid pavements economic, without the need to remove the concrete.

Research has also stimulated the introduction of measures during the construction of flexible composite pavements to reduce "reflection cracking" which can allow water to enter the pavement structure and cause long-term breakdown.

Implementation of these research findings has effectively extended the design life for these types of pavements and this may encourage the increased use of concrete in future road construction.

Rigid pavements have a long design life due to their inherent strength and minimal maintenance requirements in their early life (15-20 years). After 20 years, long-term maintenance may be required. For this maintenance, the traditional method in the U.K. is to overlay with a thick asphalt layer, for example 180 mm, to inhibit the development of reflection cracking.

Reflection cracks in the asphalt surfacing, above cracks or joints in the rigid pavement, are caused by the thermal contraction of the concrete. More specifically, there are two methods that are being used by the U.K. Highways Agency in maintenance schemes on trunk roads. These are to “crack and seat” the concrete pavement prior to overlay or to “saw-cut and seal” the overlay after overlaying. Also a combination of the two may be used.

The crack and seat method is to induce fine, vertical transverse cracks in jointed un-reinforced concrete road slabs before overlaying with asphalt. This allows the seasonal contraction to take place at locations other than at the joints and reduces reflection cracking in the asphalt overlay.

The fine cracks retain the aggregate interlock necessary to ensure the satisfactory load spreading ability, while still allowing for thermal movements to take place.

In general, concrete slabs are “cracked” at 1 to 1,5 m centers using a guillotine and then “seated” using a pneumatic-tyre roller. Initially, this technique was developed for the maintenance of un-reinforced pavements but more recently the technology has been applied to reinforced concrete.

In the U.K., concrete is being used as a sub-base, particularly in “rutting” lanes. A section of the M25 was the test for an innovative CRCP (Continuously Reinforced Concrete Pavement). The major innovation here was to design the pavement on flexural strength, as opposed to using compressive strength. In this way, the full benefit of using the specified limestone (as opposed to gravel) aggregate was realized, with a saving of 40 mm of concrete thickness. The concrete was then topped with 12 mm thick stone mastic asphalt (SMA).

In the U.S., white-topping is being examined closely as a means of maintenance. It is a process in which 50 to 100 mm of high-strength, fiber-reinforced concrete is placed over a milled surface of distressed asphalt concrete pavement. This ultra-thin white-topping (UTW), has proved to be a low-cost, effective, and fairly simple solution, and is designed for low-speed traffic areas or areas with a lot of stop-and-go traffic, such as street intersections, bus stops, or toll booths. The best part is that UTW requires significantly less time to construct, and repairs last much longer. Given its success in these limited applications, UTW is now being considered for a range of other applications.

Concrete protection

Deterioration of concrete structures in aggressive environments is a major problem today. Coating the surfaces, and thereby leaving the risk of cracks in the coating, has until now solved the problems with the durability of concrete structures.

A new concept now improves the ability of the concrete to resist the ingress in aggressive elements. It deals with the problems instead of only treating the symptoms.

Road constructions are increasingly exposed to chloride ingress as a result of the steadily increasing use of de-icing salts. A weak concrete cover allows ingress of chloride ions causing corrosion of the steel reinforcement. As a result of the corrosion, the steel expands, causing spalling of the concrete structure. Enormous sums are spent on repairing concrete structures, which have been damaged as a result of the environment they are exposed to.

Insufficient focus on the importance of the concrete cover is often the main reason for deterioration of a concrete structure. The concrete cover is the outer centimeter of a construction that protects the steel reinforcement bars from aggressive elements slowly diffusing through the concrete. However, research shows that the concrete cover is often of a lower quality than the rest of the construction because the concrete surface is cast against impermeable formwork.

With the introduction of the Controlled Permeability Formwork (CPF) liner concept, focus is directed to the concrete cover. A CPF liner consists of a filter and a drainage layer. The filter faces the freshly placed concrete and the drainage layer faces the formwork. The liner is either tensioned or glued on the formwork before casting.

The concept was invented in Japan and later adopted by European manufacturers. Among the leading manufacturers of CPF in Europe are Fibertex A/S of Denmark, which markets the product under the name Formtex, and DuPont of Luxembourg.

It is internationally acknowledged fact that the lower the water/cement ratio, the stronger, denser and more penetration-resistant is the concrete.

The function of the non-woven CPF liner is to drain surplus water and air from the surface of freshly placed concrete. When water is drained off the surface, the water/cement ratio in the concrete surface is reduced and this improves the strength and durability of the concrete cover.

Several independent test reports have documented the effect of using CPF when casting concrete. CPF form liners have found a variety of uses in the European and Middle East markets. The primary usage area is concrete structures placed in aggressive environments such as road constructions, parapets, drinking water tanks, waste-water tanks, dams and marine constructions.

The CPF liner concept is gaining ground and usage is increasing steadily.

The available documentation material supports the concept as a sound alternative to the more expensive surface treatment in achieving an acceptable lifetime in aggressive environments.

Innovative backfill for bridge

New research by the Transport Research Laboratory has identified the loading requirements and investigated various compressible materials which may be suitable for use as innovative structural backfill behind integral bridge abutments.

Investigations have confirmed, that most bridge deck expansion joints leak and contribute more than any other factor to corrosion of the deck by de-icing salts. For this reason joint-free integral bridges are more durable and cheaper to maintain.

However, thermal expansion and contraction of an integral deck may lead to the development of very high soil pressures behind the abutments. Traditionally thorough compaction of high quality granular backfill has been used behind bridge abutments to avoid settlement of the carriageway. In an integral bridge, however, better quality backfill accentuates the risk of high soil pressures developing.

Integral bridge design has therefore to accommodate or avoid the high forces and bending moments that may develop in the structure. One method of avoiding high soil pressures on the abutments is to use an elastic cushioning layer, thus allowing more economical design of new integral bridges. In addition, the method may also provide an economical conversion of existing conventional bridges into integral structures as part of the need to reduce long term maintenance costs. The TRL has also developed a laboratory test to quantify the capillary suction properties of concrete.

Corrosion of reinforcement caused by chloride penetration of concrete cover is a problem which affects many bridges worldwide. In many cases the corrosion starts much earlier in the life of a bridge than expected. This suggests that factors other than the historically accepted properties of concrete strength and permeability need to be taken into account.

Research on chloride ingress into structural concrete, carried out for a number of years at TRL, has shown that capillary suction is an important mechanism by which chloride is absorbed. The absorption is fast-approximately one million times faster than the movement of chloride through concrete by permeability processes. TRL say current guidance on the design of concrete mixes for durability does not take capillary suction into account. The test procedure uses cubes of concrete placed on foam, saturated with either water or salt solution, and the quantity of liquid absorbed is determined by measuring the weight change of the cubes. In order to reproduce, to some extent, the conditions experienced on site, the cubes are subjected to a cyclic wetting and drying regime, rather than to a continuous period of wetting.

Distances of penetration of the liquid can be calculated if the porosity of the concrete is known, and chloride concentrations are determined by drilling the cubes to different depths and analyzing the drilling dust for chloride content. Research aimed at reducing the time taken to carry out a test is currently in progress.

Germany's highway vision

The Verkehrsprojekt Deutsche Einheit (VDE) is a building program that aims to bring East German roads up to the standards of the west. So far 11 000 km of roads have been built or rebuilt. Next year, $1,6 billion is allocated to road construction in the east. The government's goal is to make the seven large motorway projects operational in significant parts by the turn of the century. These roads total 2000 km, of which 150 km is now usable and a further 440 km is already under construction.

The three road widening projects, from four to six lanes, are showing the most progress. Many sections are complete, and about 310 km is under construction including the A2/A10 Hannover-Berlin Ring, The A9 Berlin-Nuremberg and the A4 Eisenach-Dresden.

Marrying a sustainable environmental policy with widespread construction is another challenge the country faces. In western Germany, 440 km of new motorway was built, and 163 km was widened from four to six lanes. An additional 650 km of roads were also built, most of these being bypasses. These bypasses play a central role in the government's environmental policy and a further 52000 km is planned. Just in the last year, 37 bypasses with a length of around 200 km have been built at a cost of $600 million. The government has also invested $3 billion to date in noise protection and has 2 000 km of noise barriers installed along roadsides.

Transport minister Matthias Wissmann says: "We can say this with pride: No country spends as much as we do on the environment and noise protection. That should stay that way!"

Reduced pollution is one of the benefits of intelligent transport systems (ITS), which the government is supporting, through its own economic forum. Wissmann sees the other opportunities that modern communication and information technology offers as being:

- better use of the available infrastructure, especially by increasing capacity at bottlenecks and smoothing the traffic flow;
- better coordination between the different modes of transport, spreading the burden equally;
- avoidance of unnecessary jams and unladed journeys, including motorists seeking parking spaces;
- improvement in safety.

The transport minister says that the intelligent transport industry has reached the stage now where close cooperation between transport policy makers and industry can significantly accelerate a widespread introduction of the technology.

Forming a tunnel

Europe’s most current important infrastructure project, a key element of the Oresund 16 km long bridge/tunnel link between Denmark and Sweden is the 3,7 km Drogden road tunnel.

This immersed tube structure will be the largest in the world, with the 42 m wide and 8,5 m high tunnel segments produced on land using the incremental launching methods, in use for the first time for a tunnel.

Production of the 20, 178 m-long elements making up the tunnel requires massive concrete placement and the use of formwork. Each of the tunnel elements is composed of eight 22,5 m-long segments, making a total of 160 tunnel segments, calling for 80 reuses per formwork assembly. The segments do not have any horizontal joints, and in view of the large number of segments and the need for top quality concrete, a method was needed that was based on factory prefabrication methods.

The segments were cast in a weekly cycle in a special plant in North Harbor, on the outskirts of Copenhagen. The requirements were stringent. Since the final position of the tunnel will be under the sea, the outer walls must be watertight.

The formwork must have only two levels of formwork ties in the wall height of 8,5 m and the holes must be watertight sealed. To achieve this the company is using the concrete cones bonding technique whereby the cones are bonded to the tie holes using a two component adhesive with granulate, which prevents the cones from setting during bond hardening.

A further challenge was the adaptability of the formwork to the changes in the cross-section of the tunnel geometry. The thickness of the tunnel bottom slab varies, as does the roof slab strength. However, the greatest difficulty is the alignment of the longitudinal incline of the tunnel segments. Some 50 different adjustments are required to the formwork in order that the entire tunnel profile is guaranteed.

Like the formwork of an incremental launching bridge, the base and external formwork is fixed. The inside formwork forms two motorway and two railway bores and one service gallery. Due to the monolithic construction, the inside formwork units must not be supported within the 22,5 m long segments, but suspended on giant lattice girders. These are supported outside the casting section. One lattice girder is 50 m long, 4m high and weighs 53 t. The total weight of the formwork assemblies is 2 300 t.

During the casting procedure, the entire dead weight of the segment and the dead weight of the inside formwork transfer to the bottom formwork. The load of about 7 500 t is distributed over 250 compression braces and conducted into the casting yard.

A casting procedure takes between 32 and 40 hours without interruption. After a segment has been cast and cured, bottom and outside forms are struck as in a bridge incremental launching plant, and the segment, together with the inside form, is then pushed forward one step on skidding beams.

Once the reinforcement — in this case a complete prefabricated reinforcement cage of 380 t dead weight — has been positioned for the next casting section, the inside formwork is retracted from the moved completed tunnel segment into the reinforcement and into the starting position for the next casting section.

The 50 m-long lattice girders serve as a "track" on which the inside formwork is hydraulically transported 22,5 m each time. This formwork procedure is repeated eight times, until a tunnel element of 178 m length is completed.

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 tunneling 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 the 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 harbor, and they insisted on building a tunnel. But after the first atomic bombs had been exploded, the U.S. Army saw that it was purposeless to continue to insist on a tunnel.

In the eightieth of the last century, also for military reasons, the British government would not allow further 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.

Prestressed concrete runways and concrete pavements

This prestressed concrete runway, the first in the world, was designed by Freyssinet and was constructed as an experiment. It is

14 000 ft. long and 200 ft. wide and is divided into large triangular slabs separated by special joints. The large triangular slabs are composed of smaller, square precast slabs, measuring 39 in. on edge. Each slab has a uniform thickness of 6,33 in. The large triangular slabs can move laterally only by sliding along the joints between slabs. These joints rest on concrete foundations and are formed by placing short vertical steel rollers between steel plates fastened to the edges of the triangular slabs. The joints are filled with asphalt, which permit the slabs to move relative to one another. The runway is prestressed transversely by 200 ft. long cables, composed of 30 wires each placed between the joints of the small precast slabs and anchored in border units, which are required to "pack" these slabs and distribute the cable forces. The prestressing is obtained automatically by the wedge action which accompanied the transverse prestressing.

Bridge at Kirchkein, Germany

This bridge carries the Frankfurt-Eisenach-Dresden Autobahn across the Frankfurt-Hassel Autobahn. It is a double bridge. It was constructed in 1949.

The total width of double bridge is 2 by 36 ft. Each bridge carries a 29 ft roadway and two sidewalks. Each consists of two spans, one 78,49 ft. and the other 83,75 ft. in length. The primary supporting elements in each span are six simply supported prestressed beams spaced at 5,84 ft. and braced laterally by crossbeams 14 ft. on centers and by the reinforced slabs of the roadway deck. The prestressed reinforcing in each beam consists of seventy-six 0,4 in. round bars having an ultimate tensile strength of 150,000 psi.

The amount of material required for the superstructure, per square foot of bridge area, is as follows:

prestressed steel	- 5,85 lb,
structural-grade steel	- 4,55 lb,
concrete	- 1,715 cu ft.

This system of prestressing is not the most economical for field operations. The massive presressing bed required by this system is expensive, and thus it is undesirable to erect more than one or two such at any construction site. Therefore the manufacture of several beams requires a fairly long period of time. Moreover, a heavy crane is needed for placing the beams. These constructions are sustained by the beds received for this type of work, in which the cost of steel bridges and conventional reinforced bridges were in the same general range as the cost of this type of prestressed bridge.

The George Washington Bridge bus terminal, New York

One of New York's most striking new buildings was opened on 17th January by the Governors of the States of New York and New Jersey. This is the bus terminal at George Washington Bridge. On the New York side of the Hudson river. It has been constructed for the Port of New York Authority; its roof was designed by Pier Luigi Nervi.

The new building, which straddles the twelve-lane depressed George Washington Expressway forming the approach to the bridge, is designed to distribute the various bus lines, and some 2,000 busses, which terminate at this point, and to provide a passenger station which will facilitate the daily movement of some 50,000 New Jersey commuters, replacing a number of small terminals scattered over half a mile radius of the bridge head. It will thus bring about two practical improvements: suburban buses to and from New Jersey will be removed from the New York streets, and passengers' journeys will be shortened by anything from five to twenty minutes.

The three-level bus station, at right angles to the road, is 460 ft. long and 187 ft. wide. The lowest level provides terminal facilities for long-distance buses; the main concourse is at the second level, and the "computer' bus terminal, with 36 bus-loading island platforms and a continuous unloading platform the full length of the building, is at the top level. The terminal is directly connected by ramps with the upper level of the George Washington Bridge.

The site of the new building is a striking one and the George Washington suspension bridge is itself a striking structure. The terminal had thus to be worthy of its prominent position, and only a designer of the caliber of a Nervi was considered qualified to combine the aesthetic aspect with the solution of the undoubted practical difficulties involved in its construction.

One of the foremost requirements was for constant natural ventilation, which would ensure the removal of bus exhaust fumes even in the lightest breeze. The original scheme was drawn up by the Port of New York Authority to provide for this, with a roof formed of series of units, alternately inclined and horizontal, and with side openings for ventilation. This scheme was, in its broad outlines, retained in the final design.

The lower portion of the structure incorporates structural steel framing to tie in with the suspension bridge approach; from second floor upwards comes Nervi's striking concrete structure with its wing-like roof. The association of the two materials, however, in itself created an added difficulty in design and construction; special methods of joining the steel and reinforced concrete parts of the structure had to be carefully studied with particular reference to the different elastic characteristics of the two materials.

The final scheme comprises two large reinforced concrete lattice beams along either edge of the building, and a longitudinal spine beam supported on a central row of columns. Spanning diagonally between spine beam and edge beams are lattice trusses, each a right-angle triangle in elevation, so placed that their high points meet on the edge beam. The triangular spaces thus formed between them are in filled by the roof slabs – alternately flat, carried on the lower flange of the trusses, and up tilted, carried on the top flange. Each of these large triangular roof units is made up of a series of smaller triangles, carried on a network of intersecting beams, and topped with a continuous 4 in. concrete slab.

The whole roof structure is thus a complex of triangles: triangulations in the edge lattice beams; triangles of the diagonal lattice beams; triangles of the wing-like roof sections, triangles making up each of these sections.

The central row of columns carrying the main spine beam is of the subtly twisted section beloved of Nervi, which besides its aesthetic appeal, has the advantage of presenting a minimum obstruction at the base and a maximum supporting surface in the required direction at the top.

The building has an expansion joint midway along its 460 ft., length, and is divided across the width into two 93 ft. 6 in. bays by the central row of columns, which are placed at approximately 65 ft. 6 in. centers.

In construction, the 10 ft. deep spine beam, the bottom flange of the diagonal roof trusses and the horizontal roof sections were cast monolithically, some 550 sq. yds. concrete being placed continuously.

The triangulations of the trusses and their outer end posts were then placed individually on the bottom flanges, and the final stage was to place the concrete of the up tilted roof sections with their network of beams.

The whole structure was cast in situ, and all the concrete is exposed, and left as it came from the forms. Very great care was therefore taken in the choice of mix and the choice of formwork. Experiment and testing of concrete mixes was begun almost two years ago before actual concreting began on site. Altogether 129 different mixes were tested, and nearly 100 test specimens made up with variations of mix, type of formwork, form liners and coatings, and methods of compaction. Finally a specimen roof panel was made up and tested, using plastic-lined forms; these tests showed some instability in the plastic linings under temperature changes, and eventually plastic-coated plywood was used. A test section of the lattice edge beam was also made up for approval of the finished surface.

Formwork for the columns and trusses was designed to give the concrete a definite board-marked pattern, using butt-jointed pine boards. The roof covering units, on the other hand, were given an extremely smooth surface by casting them against the plastic coated plywood.

Constructing a skyscraper

New methods in the design and construction of skyscrapers have been closely related to the development of computers. Engineers use computers to solve the complex mathematical problems involved in such construction projects. Computers do this work quickly by breaking the design down into a limited number of recalculated elements.

When an organization decides to erect a skyscraper it usually signs a contract with building firm. The company awards the contract after many firms have submitted bids showing the price they will charge and the time they will need to erect the building. The company that receives the contract must make detailed building plans that construction can be done as quickly and as cheaply as possible. The construction firm often subcontracts to other companies such work as electrical wiring, plumbing, and bricklaying. Such subcontracting saves money because it means using a worker only when the production schedule requires the individual's services.

Before construction begins, engineers determine the strength of the soils that will lie underneath the new building. With this information, they can design the proper foundation. After the building site is cleared, leveled, and drained of water, excavation (digging) begins. Mobile diggers usually excavate the foundation. Ground made of rock may be excavated by blasting.

Sometimes workers dig a trench on all sides of the foundation and fill it with concrete before excavation begins. Any excavation that may cave in is braced and shored with wood or steel. Pumps can be used to keep water from the excavation area at all times. But if the soil becomes too watery, caissons (protective walls) may be built so the work can continue.

After the excavation is finished, the footings (base) and the superstructure are built. Most steel used in the superstructure, such as beams, girders, and columns comes prefabricated. Each piece of steel should have a number indicating the exact place where it should be used. When the steel is raised into place, workers fasten the pieces together temporarily with bolts. Later, welders and riveters join these pieces together permanently.

Most kinds of derricks and cranes are used in the construction of skyscrapers. The two main kinds are mobile cranes and tower cranes. Mobile cranes are mounted on trucks or special vehicles and can maneuver around the outside of the building to hoist materials and equipment from various locations. Tower cranes are supported on a steel tower erected next to or inside a building's framework. They can only hoist materials positioned within the maximum radius of their lifting mechanisms. Some tower cranes can add sections to increase the height of their support tower as the building goes up. Others are mounted directly on the recently constructed upper storey of the building's framework. A derrick, mobile crane, or even a helicopter can help in removing sections of a tower crane once the building is nearly complete.

After workers complete the superstructure and outside walls, the building is ready to be finished, decorated, and furnished.

Often used in high class work as a finishing to a reinforced concrete roof slab, but very seldom to timber flat roof construction.

The old method of soldering metal sheets together has now been largely replaced by welted joints, which are made by a special efficient mechanical device. The welted joint, executed in this way, is a rather rapid means of jointing and effectively allows for expansion and contraction of the metal covering.

Eastbourne's new Congress Theatre

Eastbourne — judging from recent buildings — is at last bursting out of its Victorian reserve. New flats, shops and restaurants, put up in the last few years, have livened the town up. The latest addition to the amenities is the Congress Theatre, commissioned by the Corporation as a building for conference and entertainment purposes. It has an auditorium with 1,640 standard seats extendable by removable seats to 2,000, and a stage suitable for plays, ballet, opera and concerts.

The theatre is built on to one end of the existing Winter Garden and is linked with it by a restaurant, so that the whole can be used as a single unit if necessary. Approached from the front, the building has a definite kinship with the Festival Hall, with a fully glazed front elevation through which the various foyers, levels and open stairways can be glimpsed. Basically, it comprises a central auditorium, 88 ft. wide and 98 ft. long, with access from foyers on three levels, and a five-storey stage block at the back.

Inside, the two levels of upper foyers, with their external glass walls, are wrapped round the back of the auditorium. They are thick-carpeted, open spaces, equipped with two bars, each with 30 to 40 ft. of counter. The levels are linked on each side of the building by wide stairs of precast terrazzo trends cantilevered from in situ reinforced concrete spine beams. These are fully expressed and structurally are very interesting to look at. The auditorium itself, with its stalls, circle and side galleries, is a spacious air place with uncluttered ceilings, plain finishes and red upholstered seating. It is lit by large double-glazed windows at each side, which can be blacked out if required, and it is hoped that this natural lighting will help to do away with "conference fatigue". A point worth mentioning — usually nonexistent in old theatres — is the access for wheeled chairs by way of a scenery ramp, or by a lift serving all the main levels. Another interesting point is the orchestra lift in front of the stage, which can be raised to increase the size of the stage for concerts, or else sunk below auditorium floor level to form an orchestra pit.

The main frame of the auditorium and stage block is of in situ reinforced concrete. The stepping of the stalls, however, is built up of precast reinforced concrete units. Over the entrance foyer, at ground level the bones of the structure can be seen in the soffit to the rear stalls where the stepping is supported on radial beams linked by transverse members. This produces a coffered ceiling, painted in white and lime green as a decorative canopy to the entrance hall and first floor foyer. The columns of the frame are free-standing at the front and sides of the building; they are circular in plan. The tall fly tower, over the stage, juts up some 28 ft. above the main roof level, and has three walls of reinforced concrete. The erection of the frame was carried out by the general contractors very economically indeed. From the concrete point of view, the highlight of the building is undoubtedly the varied use of concrete finishes on the main elevations and in the paving. At the front and sides of the building, concrete facing blocks provide depth and texture as a foil to the large glazed areas and smoother surfaces. The blocks have a pronounced rugged texture which shows up well in the sunshine, and measure 15 in. by 6 in. by 3 in. thick. They are, in this instance, used vertically and laid in a stacked bond, forming a broad capping to the glazed front facade, which is continued round on the side elevations. Also made by this company there are the thin horizontal units of black concrete which form glazing bars round the foyers. A tribute to the precision of construction and manufacture of the main concrete elements is the fact that the whole of the glazing at the front is fixed direct to the concrete and housed only in butyl gaskets; tolerances of 1/8 in were worked to.

Also of special interest is the finish on the circular columns which form a colonnade at the front and sides. These are of natural in situ concrete cast in cardboard tubes, with a beautifully even exposed aggregate finish, achieved by the “Jason” pistol method of tooling the surface (the instrument is also used for de-scaling ships). This is a rather more delicate method of treating the concrete – particularly the matrix round the coarse aggregate – than ordinary bush-hammering. The texture of these columns is most effectively thrown up at height by small lights set flush with the paving at the base of the columns. This represents an outstanding example of exposed aggregate carried out in situ. The same surface treatment has also been applied to the facing slabs which form bands of concrete at the base of the foyer glazing, and again at a point two-thirds of the way up. Another point of interest in this area is the ribbed concrete soffit to the first floor slab, achieved by casting against plywood formwork fitted with battens.

Diaphragm walls

In densely built-up inner city areas the use of diaphragm walls as sheeting for deep construction pits in groundwater-bearing strata is frequently advantageous. The construction of a diaphragm wall has no adverse effects on the groundwater and causes only minimal noise and vibration. Prior to excavation of the trench, support walls, usually of in-situ concrete, are made in the upper part of the trench: they stabilize the ground in that area and at the same time serve as a locating and guiding walls for the grab.

The soil is excavated in primary and secondary sections using special grabs, while bentonite slurry supports the trench walls. First the primary sections are excavated with spacing between the slots. Stop-end tubes are then placed at both ends and the slot is reinforced and concreted. The stop-end tubes are removed as soon as the concrete begins to set and harden. The half-round vertical joints which are created this way serve as guides for the grab during excavation of the secondary sections between the primary ones and leave a close watertight contact face for the concrete of the adjacent section. The bentonite slurry is reclaimed during concreting and prepared for re-use.

If required, the prefabricated reinforcement cages can be provided with circumferential reinforcement for anchors or bracing, or with recesses and starter bars for base and floor slabs.

For the construction of precast walls, precast reinforced concrete wall elements are immersed into a hardening supporting liquid with a cement constituent. The faces are completely smooth when exposed.

Diaphragm walls can also be constructed for sealing purposes, to keep excavations dry, to render dams impermeable or to protect the groundwater near industrial plants and refuse deposits from pollution by industrial waste. In this case the stabilizing slurry, by the addition of cement and filler, becomes the sealing compound. After hardening, the compound remains sufficiently plastic to enable the wall to accept minor movements of the soil without cracking.

Both for economic reasons and in order to reduce the risk of defects in the wall (which increases with increasing depth) sealing walls are generally constructed to depths ranging from 30 to 40 m, with thicknesses varying from 0,4 m to 1,2 m.

Thin diaphragm cut-off walls

Thin diaphragm cut-off walls (also with incorporated synthetic sealing membranes) and bored pile walls serve as enclosures for construction pits and waste dumps in order to protect the ground water from pollution. In addition, they are used to render earth dams impermeable and to seal impounded areas of hydroelectric power plants.

With this method a steal beam is vibrated to the required depth using a tandem vibratory hammer. The hollow space which is created after withdrawal of the beam is grouted with a sealing compound consisting of bentonite, cement, filler (e.g. stone dust) and water. Depending on the thickness of the beam tip the wall has a thickness of approx. 10 cm which, in highly permeable soils, due to the penetration of the sealing compound into the surrounding soil, is increased further. In this way, section by section, a structurally sound wall is constructed, with defects being avoided by overlapping the individual sections.

With this method a great number of square meters can be constructed per shift Thin diaphragm cut-off walls may also be constructed as double walls connected by transverse bulkheads at certain intervals to form the so-called cut-off chambers which, combined with hydraulic measures, can be used to good effect for waste dump enclosures.

The scope of civil engineering.

Civil engineering is an extremely broad professional field. The areas of interest may range from psychology of the motorist to the physical structure of plastics, from the mechanics of dispersion of flow to knowledge of computers, from traffic-flow theory to the behavior of thin shells, from earth physics to bacteriology. Civil engineering problems involve the physical, mathematical life, social, communications and engineering sciences.

Civil engineering projects involve many other professional areas, including law, public health, economics, management, finance, and the other branches of engineering. The scope and complexity of the field, and its degree of involvement with other fields, has increased rapidly with the development of modern science and technology and the growth of populations and national economics.

During the past 25 years we have experienced more scientific development than in all previous history and it is as well that we should differentiate between the work and responsibility of the scientists as contrasted with that of the civil engineer. A noted scientist has explained that "the most common activity in which a scientist finds himself is to make mistakes, recognize them and correct them". Through constant research and experimentation the scientist unlimitedly makes his great discovery. In contrast the professional civil engineer, in the application of scientific principles, is trained not to make mistakes. One failure can completely ruin his career and this extremely important difference must be always kept in mind.

The word "construction" is used in a general sense today to cover the erection and repair of all types of buildings, roads, bridges and other structures. Construction involves large members of people whose skills and special interests cover a wide range of occupations. It embraces work that varies from house building to the engineering of vast hydro-electric schemes in remote and mountainous country. In all these fields there is a wide choice of creative and satisfying forms of activity.

The word "building" is mainly concerned with domestic dwellings, including houses and multi-storey flats, schools, hospitals, and office blocks, while "civil engineering" deals more with their surrounding features like bridges, roads, harbors, water supply and hydro-electric schemes. Civil engineering projects are mostly on a greater scale and take longer to complete than the average building work. There is no hard and fast dividing line; a builder might construct an estate road, civil engineering contractors can erect buildings, and both may be employed on different parts of one large project. The foundations of major buildings for example, are usually civil engineering work and involve more field-survey work.

Concrete and steel are the chief materials in civil engineering and the techniques of building with steel and reinforced concrete and timber are so widely used that many projects can be described as building with a large amount of theoretical engineering knowledge. The work known as "structural engineering" deals particularly with the calculation and design of all kinds of structures whose strength is mostly provided by steel, reinforced, prestressed or precast concrete or other alloys. This work involves a great deal of mathematics and a sizeable project may well embody contributions from several different professions acting as consultants, and many other subcontractors in addition to the main contractor.

Why "civil" engineer?

The term engineer has long been applied in Italy, France and England, to the builders of war machines and fortifications. This custom can ever be traced back to the middle Ages, to the twelfth and thirteenth centuries. In Germany too as late as the 18^{th} century, the German word "Ingenieur" still meant a designer and constructor of military engineering works.

The word may have originated in the fact that the technical aids of warfare and defense used to be known under the joint term "ingenia".

Today the members of the branch of the army that builds roads and bridges are called "engineers".

The direct ancestors of the modern civil engineer however were the French “genie” officers who, apart from their military tasks, were also entrusted with public works of a civilian character.

The non-military builders and architects came from artisan trades and artist professions such as painting, learnt by practical experience. The French “genie” officers on the other hand had a scientific education at state colleges and institutions with special emphasis on mathematics.

The “School of Bridges and Highways” in Paris was the only one of its kind in Europe. At this college a great number of excellent engineers received a training which secured for French bridge and road building supremacy throughout the Continent for a long time to come. Engineers who left the army and in civil life continued to be mainly concerned with public works called themselves “civil engineers”. Soon the term “civil engineer” meant any professional man who tackled problems of what we now call “civil engineering”.

The first man who advertised himself as a civil engineer was John Smeaton (1724–1792) an Englishman who in 1761 designed and built the famous Eddystone lighthouse.

In actual fact, the foundations of this profession were laid by a soldier Sebastien le Prestre Vauban (1633–1707) who built numerous fortresses and brought the system of polygonal and star-shaped fortifications to perfection. In 1678 he was appointed Inspector-General of the French Fortresses, and became a Marshal of France in 1703.

One of Vauban’s greatest achievements was conversion of Dunkirk into a coastal fortress. Apart from the construction of several forts there were extensive harbor basins, the construction of two long jetties, flanking the entrance channel, the erection of storehouses and workshops. However the fortress was demolished barely 30 years later after the Spanish War of Succession which ended badly for France. As a military man Vauban took part in more than a hundred battles. Yet he also took every possible opportunity of carrying out important public works serving peaceful purposes. Thus he planned the water supply system of the Park of Versailles, and was concerned in the completion of the Canal Du Languedoc.

Vauban's projects are noteworthy for the careful methods he applied. Each project was accompanied by a memorandum in four sections:

1) general background of the scheme,
2) detailed descriptions with references to drawings,
3) estimate of cost,
4) notable features of the work.

Today the scope of civil engineering has become very broad and we subdivide it into structural engineering (all kinds of buildings), highway and railway engineering, hydraulic engineering (canals, dams, drainage and irrigation systems) and municipal engineering (city planning, traffic regulation, water supply and sewerage).

VOCABULARY

PART I

A: **ability** способность
absorb поглощать; амортизировать
acceleration ускорение; разгон
accessible доступный, удобный (в употреблении)
accident авария; несчастный случай; происшествие
accommodation размещение; приспособление
actuate приводить в действие
adjoin примыкать, граничить
advertise рекламировать
advertismet реклама
affluent богатый, изобильный
affordable возможный, допустимый
air pollution загрязнение воздуха
alignment выравнивание, регулировка
alleviate облегчать; смягчать
approximately приблизительно, приближённо
arcuate mating surface дугообразная парная поверхность
arm плечо, рукоядка; рычаг
articulated truck грузовой прицеп
assembly line сборный конвейер
assess облагать налогом; штрафовать
assign назначать, устанавливать
axle ось, вал; мост автомобиля

B: **bearing** подшипник; опора
belt приводной ремень; лента
body кузов; корпус; остов
body shell обшивка кузова

brake тормоз; тормозить
bystander свидетель; наблюдатель
C: **camshaft** распределительный вал
capacity ёмкость; вместимость
car safety features средства безопасности автомобиля
carriage экипаж, коляска; вагон
chassis шасси, ходовая часть
chief engineer главный инженер
chips (stone) обломки (камня)
choke загромождать
city (transit) bus городской автобус
coach автобус (междугородного сообщения); кузов
compete соревноваться, конкурировать
competition конкуренция, соперничество
competitor соперник, конкурент
compression сжатие; компрессия; ход сжатия
congestion перегруженность, затор (уличного движения**)**
consumer потребитель
conventional bus обычный, традиционный автобус
coupling соединение, сцепление
crankshaft коленчатый вал
curb обочина, край тротуара
cushion (техн.) подушка
customer покупатель
D: **dealer** торговец
dicker обмен, мелкая сделка
diesel engine дизель
discontinue прекращать, прерывать
ditch ров, канава
drive in(s) сервис (не выходя из автомобиля)
drop понижать
dwelling жильё, жилище; проживание

E: **electrodeposition** гальваническое покрытие
electrostatic charge электростатический заряд
employment занятие; работа
enable создавать возможность, облегчать
engine двигатель
erode размывать
estimate оценивать

F: **facilities** удобства; средства обслуживания
fan вентилятор
feasible вероятный, возможный
feature особенность, признак
filling station заправочная станция
flexible pavement нежёсткое дорожное покрытие
freight груз, фрахт; грузовые перевозки
friction трение
fringe край; кайма
front wheel переднее колесо

G: **gear ratio** передаточное число
grasp захватывать; понять, постичь

H: **halt** остановка, полустанок
handle управлять, регулировать
heterogeneous различный; неоднородный
highway шоссе; автомагистраль
highway construction строительство автомобильных дорог
hitch удар, толчок

I: **impact** удар, толчок; влияние, воздействие
interchangeable взаимозаменяемый
intercity (tour) bus междугородный автобус
inventory control контроль наличия товаров

L: **labor turnover** текучесть рабочей силы
lack испытывать недостаток, нуждаться
livestock живой инвентарь; домашний скот

lubrication смазка

M: **macadam road** дорога, покрытая щебёнкой

macadam road surface щебёночное покрытие дороги

machinist's apprentice ученик механика

major важный, главный

mechanical engineer инженер-механик

mesh зацепление

middle (top, bottom, first…) gear средняя (высшая, самая малая, первая…) скорость

mileage расстояние (в милях)

mobile подвижный

mode метод, способ

motion движение

motor car автомобиль

motorway автострада

O: **option** выбор

outlet выпуск; рынок сбыта

output продукция; выпуск

P: **paramount** первостепенный

pavement тротуар; мостовая; дорожное покрытие

petroleum, gasoline моторное топливо, газолин

piston-type internal combustion engine двигатель внутреннего сгорания

pollute загрязнять

power сила, мощность; энергия; приводить в действие

preeminence превосходство, преимущество

priming заправка (двигателя)

profit доход

promote поощрять; рекламировать

propulsion движущая сила; движение вперёд (назад)

put into (out of) gear включать (выключать) передачу

put on the market поставлять на рынок

Q: **quality control** контроль качества

R: **rack** полка; сетка для вещей (в автобусе)

railroad железная дорога

rear задняя, тыльная сторона

rear wheel заднее колесо

reciprocating engine поршневой двигатель

reduce уменьшать, сокращать

refine усовершенствовать, облагораживать

relaxing break отдых, передышка

retail продавать в розницу

reverse gear задний ход

revive возрождаться; расцветать

revival(n) возрождение; расцвет

rigid pavement жёсткое дорожное покрытие

road дорога, шоссе

road network сеть дорог

rotation вращение

rubber резина, каучук

S: **sale** торговля

sedan chairs носилки

shoulder обочина (дороги)

shed лить, проливать

showroom демонстрационный зал для показа образцов товара

shrink давать усадку

slope уклон

stagecoach почтовая карета; дилижанс

steep grade крутой подъём

steering mechanism рулевое управление

straight truck грузовой автомобиль с цилиндрами в ряд

stroke ход (поршня, клапана)

subgrade земляное полотно

subsidiary филиал, дочерняя фирма

subsurface нижний горизонт (почва)
suburban пригородный
suburban bus пригородный автобус
succession последовательность
surface поверхность, (земная поверхность)
surmount преодолевать
suspend вешать, подвешивать
suspension members подвесные части

T: **tar** гудрон, смола, дёготь
tax налог
terrain местность, территория
toll road платная автомобильная дорога
tools инструменты
torque редуктор
train зубчатая передача; система рычагов
tribute дань
trouble трудность, неприятность
truck (lorry) грузовой автомобиль
turnpike магистраль; платная скоростная автострада
two-stroke engine двухтактный двигатель

V: **valve** клапан
van (авто) фургон
vehicle перевозочное средство
vital жизненно важный

W: **wagon** фургон; вагон; вагонетка
water-cooled с водяным охлаждением
way путь; направление; способ
well-to-do состоятельный, обеспеченный
wheel колесо
wheel assembly колёсное шасси
wheelbase колёсная база
wheel broke колёсный тормоз

wheel drive привод колёс
wheel load давление на колесо
widespread широко распространённый

PART II

A: **abutment** опора
acid кислота
adapt приспосабливать; упрощать
additive присадка; добавка
adhesive клейкий, связующий
adjacent смежный, примыкающий
admixture примесь; добавка
aggregate заполнитель
alter изменять(ся); менять(ся)
alumina cement глинозёмистый цемент
anchor скреплять, фиксировать
appearance внешний вид
application использование, применение
apprentice ученик, подмастерье
arch арка
arch beam арочная балка
assume принимать на себя; допускать
attain достигать
available доступный; имеющийся в распоряжении

B: **back-up wall** опорная стена
bascule bridge раскрывающийся мост
batch дозировка; порция; замес бетона
beam балка, брус, перекладина
beam bridge балочный мост
bearing опорный; несущий
bedding основа, основание

bend изгибать, сгибать
bind связывать
binder вяжущее
blast furnace slag доменный шлак
bond связь; соединение; сцепление
bowed shape дугообразная форма
bricklayer каменщик
brickwork кирпичная кладка
bubble пузырёк; раковина (в металле)
building materials строительные материалы
bundle связывать

C: **cable-stay bridge** вантовый мост
caisson кессон
calking уплотнение
cantilever bridge консольный мост
carpenter плотник
carry везти, перевозить
cast лить, отливать (металл**)**
casting отливка; литьё
cavity впадина; полость
cement цемент
chair кафедра
chopped straw соломенная сечка
clay глина
coarse aggregate крупный заполнитель
coarse of brick ряд кирпича
codify приводить в систему
cohesive способный к сцеплению; связующий
commercial buildings торговые здания
compress сжимать
compression strength сила сжатия
confine ограничивать

construction engineer инженер-строитель
contemporary современный
cracking растрескивание
creep ползучесть
cross-bracing крестовая связь
crushed stone дроблёный камень; щебень
cure вулканизация
curing выдержка
curing(concrete) выдерживание (бетона)
curtain wall навесная стена

D: **dam** дамба
damage повреждение
damp course изолирующий от сырости слой
damp-proof layer влагостойкий слой
deal with иметь дело (с кем-либо)
define определять
degree степень; градус
dense плотный
density плотность
derive получать; извлекать; происходить
deteriorate ухудшать(ся); портить(ся)
development engineer инженер-технолог
device устройство; приспособление
digital цифровой механизм
dioxide двуокись
distinguish различать, распознавать
dome купол; свод
draw bridge натяжной мост
duct канал (для арматуры)
dwelling house жилой дом
dye краска; краситель

E: **efflorescence** продукт кристаллизации
egress выход
elastic capacity мощность на растяжение
electrician электрик
eliminate устранять; исключать
embed вставлять; внедрять; монтировать
engineering инженерное искусство
entrainment погружение; проникновение
equip оборудовать
equipment оборудование
erect сооружать; воздвигать
excess load перегрузка
expert опытный, квалифицированный
exposure местоположение, вид; выставление (под дождь и т. п.)

F: **facade** фасад; внешний вид
ferroconcrete железобетон
fine aggregate мелкий заполнитель
fitting установка, сборка, монтаж
flat roof плоская крыша
fluid mechanics гидромеханика
fly ash летучая зола
foam пена
foaming пенообразование
formwork опалубка
frame корпус; каркас
framework каркас
fuse плавить; расплавлять

G: **gasket** (техн.) прокладка
gauged brick лекальный кирпич
girder балка; ферма; прогон
gravel гравий
gravity load гравитационная нагрузка

grinding измельчение; размалывание
groove желобок; паз
grout раствор
gypsum гипс
H: **handle** управлять; оперировать
hard жесткий, твердый
harden затвердевать
hardware металлические изделия
heavy timber твердые породы дерева
heavy weights тяжелый вес
high-rise buildings высотные здания
hoist подъемное устройство
I: **impervious** непроницаемый
incorporate соединять; помещать, включать
industrial buildings промышленные здания
J: **jack** домкрат
joint соединение
joist балка; брус
K: **kiln** печь
L: **labourer** рабочий
lasting длительный
lateral боковой; поперечный
lattice решётка
lean скудный
light timber мягкие породы дерева
lightweight concrete лёгкий бетон
lime известь
lintel перемычка
load (dead, live) нагрузка (постоянная, переменная)
long-span (beam) длинная балка
M: **machine apparatus** механизм; станок; машина
machine parts детали станка, механизма

machine tools станок
machinery машинное оборудование; механизм
magnitude величина, размер; значение (цифровое**)**
material science материаловедение
medieval средневековый
mesh отверстие, ячейка
millwright монтажник; слесарь-монтер
mixture смесь, смешивание
mold форма
mortar строительный раствор
mould формовать; отливать
mullion средний брусок оконной рамы
mullion средник
muntin горбылек (оконного переплета)

N: **natural materials** природные материалы
normal weight concrete обычный бетон

O: **occur** случаться, происходить
open-spandrel arch сквозное надарочное строение
operating engineer инженер-механик
overhang нависать; свешивать(ся)
oxide окись

P: **painter** маляр
perforated brick дырчатый кирпич
persistent стойкий; постоянный
pier устой; столб
pier foundation столбчатый фундамент
pile свая
pile foundation свайный фундамент
plamber водопроводчик
plaster штукатурка
plasterer штукатур
plastic пластмасса

plastic flow пластическое течение
post стойка
pouring заливка бетона, укладка бетонной смеси
predecessor предшественник
pressed brick прессованный кирпич
prestressed concrete предварительно напряженный бетон
prestressing предварительное напряжение (бетона)
prevent предотвращать; предохранять
production engineer инженер по организации производства
property свойство
pumice пемза
purling обрешетина; прогон

Q: **quick-setting cement** быстросхватывающийся цемент

R: **rafter** стропило, балка, бревно
reinforced concrete армированный бетон
relieve выпускать (газ); понижать (давление)
research engineer инженер-исследователь
residential buildings жилые здания
resin смола; канифоль
result from происходить в результате, проистекать
result in иметь результатом
retail розничная торговля
retarder замедлитель
reveal открывать, обнаруживать
rigid жесткий; устойчивый
rigidity жесткость; устойчивость
roofer кровельщик

S: **sag** провисать; прогибаться
sand песок
sand-lime brick песчано-известковый кирпич
scaffolding леса, возведение лесов
scaling образование окалины; отслаивание

science наука

scientific научный

semi полу… (первая часть сложных слов)

setting застывание; схватывание (цемента, бетона)

sewage system система сточных вод

sewarage канализация

shear срезание, срез

sheathing обшивка

shell раковина; кожух

shifting сдвиг, смещение

shingle кровельная дранка, тонкая доска

shrinkage усадка

silicious кремнистый

site строительная площадка

skyscraper небоскрёб

slab панель

slate шифер, шиферная плитка

sloping roof покатая крыша

slump оползание грунта, оползень

soft-mud мягкий раствор

solid mechanics механика твердых тел

spacer распорка

span пролет

spandrel wall стенка подоконная

spread foundation уширенный фундамент

sprinkle разбрызгивать

squeeze сжатие; сдавливание

stable устойчивый

stiff жесткий

stiff-clay жесткая глина

stiffness жесткость

strength of concrete прочность бетона

strength of material сопротивление материалов
stress напряжение
stretch растягиваться; простираться
stretching force сила натяжения
strong прочный
structural frame строительный каркас
structural material строительные материалы
structure конструкция; сооружение; строение
superpose совмещать; накладывать (одну вещь на другую)
supplant выживать, вытеснять; занимать место
supporting walls несущие стены
suspension bridge висячий мост
swinging window распашное окно

T: **tensile stress** растягивающее напряжение
tension напряжение; растяжение; натяжение
tensioning напряжение
texture структура, строение
thaw таять
tightness плотность; герметичность
tile черепица, кафель
transfer переносить, передавать, перемещать
trestle bridge эстакадный мост
trough желоб
trowel мастерок
truss ферма
trussed beam шпренгельная балка
trussed girder шпренгельная ферма

U: **undergo** испытывать, подвергаться (чему-либо)

V: **vault** свод; выемка
virtue сила действия

W: **water supply** водоснабжение
wire-cut-brick проволочный кирпич

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СОДЕРЖАНИЕ

Учебное издание

Жукова Елена Николаевна
Тихонова Ирина Константиновна

ПОСОБИЕ ПО АНГЛИЙСКОМУ ЯЗЫКУ ДЛЯ СТУДЕНТОВ АВТОДОРОЖНЫХ И СТРОИТЕЛЬНЫХ СПЕЦИАЛЬНОСТЕЙ

Учебное пособие

2-е издание, исправленное и дополненное

Технический редактор Л. В. Воронкова

Подписано в печать 31.11.2007. Формат бумаги 60x84 1/16.
Печать трафаретная. Усл. печ. л. 11,75. Тираж 50 экз.

Государственное образовательное учреждение высшего профессионального образования
«Ивановский государственный архитектурно-строительный университет»
Сектор редакционно-издательской деятельности ЦНИТ
153037, г. Иваново, ул. 8 Марта, 20

Отпечатано на копировальной технике частного предприятия
ОГРН 304370230300436