

Вінницький національний технічний університет

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**АНГЛІЙСЬКА МОВА ДЛЯ СТУДЕНТІВ ІНЖЕНЕРНО-БУДІВЕЛЬНИХ
СПЕЦІАЛЬНОСТЕЙ**

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Посібник призначений для студентів других курсів будівельних спеціальностей факультету будівництва, теплоенергетики та газопостачання технічного університету. Його метою є формування у майбутніх інженерів-будівельників практичних навичок володіння англійською мовою в обсязі, необхідному для роботи з науковою літературою за фахом, усного та письмового спілкування в професійній сфері.

Навчальний посібник містить іншомовні (англ.) тексти за спеціальностями. До кожного з них запропоновано систему завдань, що допоможуть студентам оволодіти термінологією з фаху, усвідомити особливості перекладу технічної літератури в галузі будівництва, зрозуміти головну думку тексту, набути умінь критичного мислення і навичок висловлюватися англійською мовою, що в цілому сприятиме повноцінному спілкуванню в професійній діяльності.

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ПОЯСНЮВАЛЬНА ЗАПИСКА

Вашій увазі пропонується навчальний посібник для студентів будівельних спеціальностей вищих навчальних закладів технічного профілю, які вивчають англійську мову у сфері професійної комунікації. Він відповідає програмі «Іноземна мова за професійним спрямуванням» навчального плану та рекомендується для використання студентами II-го курсу факультету будівництва, теплоенергетики та газопостачання.

Навчальною метою посібника є формування у студентів умінь спілкуватися на професійну тематику, читати іншомовну спеціальну літературу за фахом середнього рівня складності з безпосереднім розумінням прочитаного, здобувати необхідну для виробничої практики інформацію. Для досягнення визначених цілей у посібнику передбачена регулярна навчальна діяльність, метою якої є створення словника активної лексики, що включає як найбільш вживані для даної спеціальності поняття, так і загальні терміни технічного профілю.

Посібник складається з двох розділів, які містять чотирнадцять навчальних текстів та охоплюють за змістом наступні теми: планування міста; будівля та її частини; будівельні матеріали; будівельні машини; опалення та вентиляція, водопостачання і каналізація; джерела енергії. Тематика текстів, що вміщені в навчальному посібнику, відповідає основним спеціальностям факультету будівництва, теплоенергетики та газопостачання і за своїм характером дозволяє охопити спільними завданнями всіх студентів, які там навчаються. Тексти, включені в посібник, є оригінальними, лише деякі з них зазнали мінімальної обробки, що продиктовано методичними міркуваннями.

Кожен урок-підрозділ цього навчального видання має чітку структуру: лексика тексту для активного засвоєння; основний текст; післятекстові вправи різного типу.

На початку кожного заняття пропонується нова фахова лексика (в англійському та українському варіантах) в обсязі, необхідному для розуміння тексту та активного обговорення зазначених в завданнях матеріалів. Слід зауважити, що під час вибору і перекладу цих слів ми, головним чином, дотримувалися їх термінологічного значення. Показником того, що лексичний мінімум засвоєно, є набуття умінь тими, хто навчається, вільно, у нормальному мовному темпі відтворити кожне слово в його англійському та українському варіантах. Лише після цього рекомендується переходити до активізації слів у контексті та до безпосередньої роботи з матеріалом.

До кожного тексту запропоновано систему завдань, метою яких є формування у студентів умінь і навичок усного та письмового мовлення в межах професійної підготовки, технічної тематики, спрямованих на

подальше спілкування англійською мовою в реальних ситуаціях виробництва. Відповідно до поставленої мети вправи побудовані так, щоб навчити студентів самостійно працювати з іншомовним текстом, забезпечити виокремлення основної інформації, її уточнення і деталізацію. З цією метою передбачається виконання вправ, що розвивають уміння виділяти головну думку, факти і групувати їх за принципом спільності; вправ на конкретизацію основної інформації; вправ тематичного узагальнення, що підводять до вміння анотувати та реферувати текст; лексичних вправ, що розвивають мовну здогадку; вправ на розвиток техніки перекладу з метою уточнення розуміння прочитаного. В цілому, в посібнику використовується більше 10 видів вправ.

За своїм характером вони не тільки навчальні й тренувальні, а ще й стимулюють логічне мислення майбутніх інженерів-будівельників. Виконання цих вправ допомагає сформувати у студентів уміння критичного мислення та навички висловлювати власну думку іноземною мовою, що дуже важливо для розвитку української молоді в сучасних ринкових умовах, з їхньою мобільністю, бажанням поїхати за кордон.

За формою завдань вправи поділяються на окремі види, наприклад, вибір правильного - неправильного варіанту, сполучення слів у реченні, розташування в певній послідовності, множинний вибір. За наповненням вони складаються з речень текстів. Їх виконання є по суті багаторазовим читанням уривку з конкретно поставленим в окремому випадку новим завданням. До кожного тексту передбачаються також вправи, що мають на меті розвиток вміння дати вмотивовану відповідь (спростувати твердження, дати відповідь на питання, що обмежується кількістю варіантів).

Зміст Додатків складають фахові текстові матеріали різного рівня понятійної та мовної складності, метою яких є розвиток умінь і навичок аналітичного читання, техніки перекладу. Додаткові тексти, зокрема, дають можливість розширити лексичний запас і кругозір студентів по кожній темі. Викладач на свій власний розсуд може використовувати ці тексти в аудиторії, або залишити їх на самостійне опрацювання студентами.

РОЗДІЛ I

CIVIL ENGINEERING AND CITY PLANNING

Text 1. City Planning

1. Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

| | |
|-----------------------------|--------------------------------|
| environment | навколишнє середовище; околиці |
| forecast | прогноз |
| master plan | генеральний план забудови |
| flexible | гнучкий |
| congestion | перенаселеність, скупчення |
| pattern | зразок |
| design | проектувати |
| dwelling | житловий |
| pollution | забруднення |
| survey | геодезичний огляд |
| suburbs | передмістя, райони |
| housing construction | житлове будівництво |
| recreation | відпочинок |
| define | визначати |
| development | (тут) забудова |

2. Прочитайте і перекладіть текст. Дайте визначення поняттю «генеральний план».

That cities should have a plan is now admitted in our time of large-scale construction and plan-making has become an everyday activity. The purpose of a town plan is to give the greatest possible freedom to the individual. It does this by controlling development in such a way that it will take place in the interests of the whole population.

The new development absorbs or modifies an existing environment, and so before it can be designed it is necessary to find out about that environment. It is also necessary to do research of the trends of population growth, the distance from work to home, the preferences for different types of dwelling, the amount of sunshine in rooms, the degree of atmospheric pollution and so on. After the survey is complete a forecast of future development is made in the form of a map, or series of maps: the master plan or development plan. As no one can be certain when the development is to take place and since a society is an organic thing, with life and movement, the plan of a city must be flexible so that it may extend and renew its dwellings, reconstruct its working places, complete its communications and avoid congestion in every part

The plan is never a complete and fixed thing, but rather one that is continually being adapted to the changing needs of the community for whom it is designed. Until quite recent years town plans were always made as inflexible patterns, but history has shown that a plan of this description inevitably breaks down in time.

The flexible plan, preceded by a survey, is one of the most revolutionary ideas that man has ever had about the control of his environment.

Most towns today have a characteristic functional pattern as follows: a central core containing the principal shopping center: business zones, surrounded by suburbs of houses. Most town planners accept the traditional town pattern. In the preparation of a master plan they are preoccupied with the definition of the town center, industrial areas, and the areas of housing; the creation of open space for recreation, the laying down of a pattern of main roads which run between the built-up areas (thus leaving them free of through traffic) and connect them to each other.

The master plan thus has to define the ultimate growth of the town, but though the master plan is a diagram, and even a flexible one, it is the structure upon which all future development is to take place.

3. Згадайте значення наступних англійських слів і підберіть до них відповідний переклад з правого стовпчика таблиці.

| | |
|-----------------|--------------------------|
| 1. description | a. повний; |
| 2. purpose | b. основний; |
| 3. freedom | c. свобода; |
| 4. development | d. змінювати; |
| 5. to exist | e. рух; |
| 6. society | f. розвиток; збільшення; |
| 7. recent | g. оточувати; |
| 8. needs | h. потреби; |
| 9. to accept | i. опис; |
| 10. to define | j. ціль, мета; |
| 11. to connect | k. визначати; |
| 12. complete | l. створення; |
| 13. movement | m. здійснювати; |
| 14. to change | n. пристосовуватися; |
| 15. main | o. суспільство; |
| 16. to adapt | p. з'єднувати; |
| 17. creation | q. приймати; |
| 18. to surround | r. нещодавній. |

4. Вкажіть, які з поданих речень розкривають головну думку тексту.

1. In the preparation of the master plan it is necessary to define the town zones.
2. All cities should have a plan.
3. Before a flexible plan is made it is necessary to find out about the existing environment.
4. The master plan also defines places for active and passive recreation.

5. Вкажіть, до яких підрозділів тексту можуть підходити запропоновані назви. Розташуйте їх послідовно до викладу матеріалу.

1. Features of the traditional town pattern.
2. The purpose of a master plan.
3. The purpose of a town plan.
4. What main points should be included in a survey?

6. Доповніть незакінчені речення відповідно до змісту тексту одним із запропонованих варіантів (a, b, c).

1. The purpose of a town plan is...
 - a) to do research of the trends of population growth;
 - b) to give the greatest possible freedom to the individual;
 - c) to find out about the existing environment.
2. Before a town plan is designed, it is necessary...
 - a) to renew and extend the dwellings, reconstruct the working places;
 - b) to make a forecast of future development in the form of a map or a series of maps;
 - c) to find out about the existing environment.
3. History has shown that a town plan should be flexible, because...
 - a) it should continually be adapted to the changing needs of the community for whom it is designed;
 - b) it defines the position of schools, shopping centers and business centers;
 - c) it suggests the routes of public transport.
4. The master plane has to define the ultimate the town and...
 - a) noone can be certain when the development is to take place;
 - b) a society is an organic thing with life and movement;
 - c) therefore it is the structure upon which all future development is to take place.
5. In the preparation of a master plan the planners are preoccupied with...
 - a) the idea that in our time plan-making has become an everyday activity;
 - b) the definition of the town pattern and the laying down of a pattern of main roads;
 - c) the necessity to determine the distance from work to home.

7. Складіть план до тексту із п'яти пунктів і перекажіть його.

8. Звіртеся з текстом і оберіть потрібне значення для наведених нижче виділених слів у словосполученнях і перекладіть їх.

- | | |
|-----------------------------|---|
| 1. large-scale construction | a. шкала; масштаб; розмір; |
| 2. everyday activity | b. щоденний; звичний; |
| 3. in such a way | c. дорога; засіб; спосіб; шлях; |
| 4. development plan | d. розвиток; удосконалення; забудова; |
| 5. master plan | e. головний; провідний; керівний; |
| 6. most towns | f. більш за все; найбільший; більшість; |
| 7. through traffic | g. крізь; наскрізний; без перешкод; |
| 8. town pattern | h. зразок; характер; тип; структура; |
| 9. lay down the pattern | i. укласти; скласти; установити. |

9. Дайте відповіді на наступні запитання, використовуючи один із запропонованих варіантів.

1. Why is it necessary to make a survey of the existing environment?
 - a) It is because no one is certain when the development is to take place;
 - b) It is because the new development absorbs or modifies the environment;
 - c) It is because growth is a law of life.
2. What does a survey consist in?
 - a) It consists in completing the town's communications;
 - b) It consists in finding out about the environment, in research into the trends of population growth and the types of dwellings and into atmospheric pollution as well;
 - c) It consists in defining a place for recreation.

10. Висловіть заперечення до наступних невірних тверджень відповідно до змісту тексту.

ЗРАЗОК: Most city planners suggest quite new town patterns.

– No, they don't. Most city planners do not suggest quite new town patterns.

As the text says, most town planners accept the traditional town pattern.

1. The purpose of a plan is to limit the active life of its population.
2. The plan is a complete and fixed thing, since the needs of the community do not change.
3. Growth is a law of life and town growth should not be controlled by any plan.

11. На основі змісту тексту накресліть план-схему нової забудови. Прокоментуйте її англійською мовою.

12. Відповідно до тексту визначте, до якого поняття належить наступне визначення: “It means showing on maps which areas are to

locate housing or different kinds of industry". Перекладіть текст усно без словника (Час – 30 хв.).

Planning

Planning, or town and country planning, is the control of the locations of towns, of industry, shops, housing, railways, parks, lakes, schools, universities and of the roads and rail ways to them. Zoning means the planning decisions which have been made and drawn out on maps, showing which area or zone is for heavy or light industry or for housing or so on.

There are many professions among practicing planners, including lawyers, architects, agriculturists, economists, scientists, public health doctors and engineers. A civil engineer is probably the most suitable person to locate a town site, apart from such purely civil engineering structures as reservoirs, railways, roads and so on, which only a civil engineer can locate.

The past growth of the population must be studied carefully with all known plans for future industrial development for at least the next twenty-five years, so as to predict with some accuracy the population growth. It is also helpful to know, based on the last count of the population, what its age grouping is. The water engineers and sewage treatment engineers of any area will, with the planners, be particularly interested in any forecasts of population growth.

Text 2. Town Design

1. Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту

| | |
|----------------------|---------------------------|
| to site | розташовуватися |
| a layout | план, забудова |
| urban | міський |
| to pollute | забруднювати |
| convenient | зручний |
| a pavement | тротуар |
| a lamp post | вуличний ліхтар |
| raw materials | сировина |
| quality | якість |
| a vital need | життєво необхідна потреба |
| to restore | відновлювати |
| to arouse | викликати |

2. Прочитайте і перекладіть текст.

In considering the design of a town or city we must always remember that the town must be sited in a healthy position, free from dust, fogs, its layout must not encourage winds through urban spaces, and it must not pollute its own atmosphere. It must provide proper standards of space and sunlight to its buildings and open spaces, and it must be possible to move about the town

easily and without danger to life. Its parts must be so arranged that it is a convenient place for dwelling, working and playing.

Connected with these and many other technical problem is the problem of economy. The problem must be thoroughly examined which does not suggest that the cheapest scheme may be the best.

The town must work properly but it should also give pleasure to those who look at it. When we say that a town should be beautiful, we do not mean that it should have some fine parks and noble buildings, we mean that the whole of the environment, down to the most insignificant detail, should be beautiful.

If we examine a typical urban scene we see all kinds of objects like buildings, lamp posts, pavements, posters and trees. It is all of them, together with all the other kinds of objects that are found in the town, that are called the raw materials of a town design. Each of them down to the least important should be aesthetically satisfying.

Designing in terms of past time does not imply the imitation of the existing environment but respect of the form, colour, texture, and general qualities of the existing development. That which is being constructed is for immediate use which is not to suggest that there must be an attempt to ignore the past and be “modern”.

Future time must also be thought of in terms of the estimated life of the objects. Objects like buildings and lamp posts grow old and become out-of-date, and the designer must select those materials that are adequate for their life, no more and no less.

Until comparatively recent times the growth of cities has been without purpose in any sense. Cities must grow, for growth is a law of life. But this natural overgrowth should have aroused action to restore balance. Mere size, as such, is no index of greatness.

All overgrowth means overcrowding, which is loss of space, one of the vital needs of cities. The lesson that has to be learned is that natural growth, and all the other forms of growth have to be made subject to will and intelligence, or the city must be harmed. This is a certain lesson of history.

3. Згадайте значення наступних англійських слів і підберіть до них відповідний переклад з правого стовпчика таблиці.

- | | |
|-----------------|---------------------------|
| 1. to design | a. пропонувати; |
| 2. dwelling | b. розширення, забудова; |
| 3. building | c. проектувати; |
| 4. through | d. кризь; |
| 5. to suggest | e. розглянути; |
| 6. development | f. житловий будинок; |
| 7. to construct | g. можливий; |
| 8. growth | h. будівля; |
| 9. environment | i. задовільний, приємний; |
| 10. to remember | j. навколишнє середовище; |

| | |
|-----------------|---------------------------|
| 11. to consider | к. вивчати; |
| 12. to examine | л. будувати; |
| 13. possible | м. існувати; |
| 14. satisfying | п. пам'ятати; |
| 15. population | о. ріст; |
| 16. to exist | р. руйнувати; |
| 17. to demolish | q. населення; |
| 18. to site | г. відповідний, належний; |
| 19. to provide | s. розташовувати; |
| 20. proper | t. забезпечувати. |

4. *Визначте, які з поданих нижче речень не відповідають змісту тексту.*

1. When building a town we should be very careful not to spoil what exists already. 2. The streets and buildings of existing towns will serve many future generations. 3. When designing a town we should not forget that its citizens should be able to move about it without any danger to their life. 4. The economies of a town plan and the technical problems are closely connected. 5. Scientific forecast also includes progressive methods of planning. 6. The designer should select the best building materials for the objects of his planned town. 7. Cities will grow but their growth must be controlled.

5. *Розташуйте наступні пункти плану відповідно до змісту тексту.*

1. The whole town, and even its details, should be beautiful.
2. A town should be a nice place to live, to work and to rest in.
3. The town designer should remember that his raw materials will exist in the future.
4. All the objects in the town are called the raw materials of town design.
5. City growth should be controlled.

6. *Запропонуйте закінчення до наступних речень згідно тексту.*

1. Before a development plan is made, it is necessary...
2. The plan of a city has to be flexible because...
3. The traditional town pattern is as follows: ...

7. *Перекладіть текст письмово зі словником (Час – 30 хв.).*

As a result of new economic and social forces, the twentieth century witnessed a multiplication of cities, a transformation of their physical utilities, and an unparalleled increase in their size – in population, in area, and often in density. The typical city of the Middle Ages, outside Italy, held less than fifteen thousand people – and often less than five thousand – though Marco Polo had brought back from China accounts of cities with a million inhabitants. As a result of the expansion of financial, industrial, and political power from the year

of 1500 onwards, the newer centres often had more than a hundred thousand people. In the twentieth century, cities of a hundred thousand became common and those of a million, like London, Paris, and Berlin, became possible. Indeed the forces that created giant cities were in operation before the technical means to make them habitable were available: London had a million inhabitants at a time (in 1800) when in many quarters the water supply was turned on only twice a week.

Text 3. Types of Buildings

1. Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

| | |
|--------------------------------------|---|
| building industry | будівельна промисловість |
| managerial staff | керівний апарат |
| industrial construction | промислове будівництво |
| technological advance | технічний прогрес |
| off-site prefabrication | заводське виготовлення |
| office buildings | службові будівлі |
| storage facilities | складські приміщення |
| site planning | планування робіт на будівельному майданчику |
| prefabricated structures | збірні конструкції |
| present-day design | сучасне проектування |
| kitchen and sanitary fittings | санітарне устаткування |
| a food-processing plant | харчовий комбінат |

2. Прочитайте і перекладіть текст .

In technically developed countries the building industry, comprising skilled and unskilled workers in many trades, building engineers and architects, managerial staff and designers, employs a considerable proportion of the available labour force.

Building industry including residential, public and industrial construction holds a considerable place in the country's economy and is being carried out on a large scale. It is the largest industry in the economy of any country. The problems of construction have grown into major, political issues in most countries.

Housing is prominent among the factors affecting the level of living. The improvement of the housing represents a concrete and visible rise in the general level of living. In many countries residential construction has constituted at least 12 per cent and frequently more than 25 per cent of all capital formation. Since in the Ukrainian home building industry is the concern of the state the research and development in housing technology is carried out on a national scale and is

being paid much attention to.

The ever growing housing demands have brought to life new methods of construction with great emphasis upon standardization, new levels of technological advance utilizing such techniques as off-site prefabrication, precasting, use of reinforced concrete panels and large-scale site planning. At present, prefabricated structures and precast elements may be classified into two principal groups – for residential houses and industrial buildings.

Present-day designs for residential construction envisage all modern amenities for a dwelling, they advocate larger, better built and better equipped flats and houses. There is a marked improvement in the heating and ventilating systems as well as in hot-water supply, kitchen and sanitary fittings. Many tenants now can afford better furnishings, refrigerators, washing machines, etc. A house which is a physical environment where a family develops is acquiring a new and modern look.

Industrial buildings comprise another significant type of construction. This type of construction involves factories, laboratories, food-processing plants, mines, office buildings; stores, garages, hangars and other storage facilities, exhibition halls, etc.

Each of these functions demands its own structural solution and techniques. But in general they may be divided into two classes according to whether the plan must give greater attention to the size and movement of machinery or of persons. The building techniques (by techniques we mean building materials and methods) depend upon the types of buildings.

Modern industrial buildings have demonstrated the advantages of reinforced concrete arches, metal frames, glass walls and prefabricated standardized mass produced parts. Steel was gradually substituted for iron and permitted wider rooms and larger windows. Windows can be enlarged to the extent that they constitute a large fraction of the wall area.

3. Вкажіть, які з поданих нижче речень, розкривають основну думку тексту.

1. In our country home building industry is the concern of the state.
2. The building industry comprises skilled and unskilled workers in many trades.
3. Building industry which includes residential, public and industrial construction is being carried out on a large scale and it has brought into being new methods and techniques.
4. There is a marked improvement in the heating and ventilating systems as well as in hot-water supply.

4. Розташуйте подані нижче речення послідовно викладу тексту.

1. The functions of industrial buildings.
2. New methods of housing.
3. Present-day design for residential construction.

4. The advantages of reinforced concrete for modern industrial buildings.
5. Building industry and national economy.

5. Вкажіть, які з поданих нижче речень належать до опису житлових будівель, а які – промислових. Згрупуйте речення за запропонованими темами.

1. In many countries residential construction has constituted at least 12 per cent of all capital formation. 2. The problem of housing has grown into a major, political issue in most countries. 3. Industrial buildings comprise another significant type of construction. 4. Modern buildings have demonstrated the advantages of reinforced concrete arches, total frames and glass walls. 5. The differing functions of industrial buildings require their own structural solutions and techniques. 6. Present-day designs for housing envisage all modern conveniences and sanitary fittings. 7. Buildings may be divided into two classes according to whether the plan must give greater attention to the size and movement of machinery or of persons. 8. Windows can be enlarged to the extent that they constitute a large fraction of the wall area. 9. A house which is a physical environment where a family develops is acquiring a new and modern look.

6. Доповніть незакінчені речення за змістом тексту одним із запропонованих варіантів (a, b, c).

1. Modern industrial buildings have demonstrated the advantages of...
 - a) hot-water supply and panel heating;
 - b) reinforced concrete arches, metal frames, glass walls and prefabricated parts;
 - c) all modern conveniences for a dwelling.
2. Industrial type of construction involves...
 - a) better built and better equipped flats and houses;
 - b) theatres, cinemas, museums, libraries, etc.;
 - c) factories, food-processing plants, mines, office buildings, stores, etc.
3. Present-day designs for residential construction envisage ...
 - a) movement of machinery and persons;
 - b) application of metal frames and glass walls;
 - c) all modern conveniences including hot-water supply and panel heating.

7. Доповніть незакінчені речення необхідними за змістом аргументами.

1. Housing construction has grown into a political issue because ...
2. In our country the research and development in housing technology is carried out on a national scale since ...
3. A house is acquiring a new and modern look for ...
4. The building techniques depend upon the types of buildings because ...

8. Висловіть заперечення до наступних невірних тверджень відповідно до змісту тексту.

3 P A 3 O K : Housing does not affect the level of living.

– *This statement is incorrect. Housing affects the level of living. The improvement of housing shows a concrete and visible rise in the general level of living.*

1. Not much attention is paid to the problems of construction.
2. Modern residential houses and industrial buildings are mostly built of bricks and timber.
3. Modern industrial buildings have demonstrated the advantages of plastics and ceramics.

9. Запропонуйте не менше, ніж три варіанти відповідей на кожне із запитань.

1. Why is a house acquiring a new and modern look?
2. What have ever growing housing demands brought into being?

10. Перечитайте текст і зазначте, які з перерахованих нижче проблем розглядаються в ньому.

1. New building materials for earthquake-proof structures.
2. Methods of constructing earthquake-proof structures.
3. The role of prediction of earthquake threats.
4. Methods of evacuating the inhabitants in case of an earthquake.
5. Some practical experience in constructing earthquake proof structures.

Text 4. Social Functions of Buildings

1. Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту

| | |
|--|-------------------------------|
| domestic (residential) construction | житлове будівництво |
| industrial construction | промислове будівництво |
| recreational construction | зведення закладів культури |
| apartment houses | багатоквартирні будинки |
| construction technique (method) | будівельна технологія (метод) |
| durability | довговічність, зносостійкість |
| availability | доступність |
| stability | стабільність |
| interchangeability | обмін, чергування |
| mass production | масове виробництво |
| dimension | розмір |

apartment assemblages
reinforced concrete blocks
erect
a high output
built-in furniture
conceal

багатоквартирні збірні конструкції
залізобетонні блоки
зводити
великий випуск
вбудовані меблі
приховувати

2. Прочитайте і перекладіть текст.

Types of buildings depend upon social functions and are classified according to the role in the community. The types of buildings may be domestic, educational, office, industrial, recreational, etc. The common and necessary conditions are: (a) its suitability to use by human beings in general and its adaptability to particular human activities; (b) the stability and permanence of its construction.

Speaking of residential construction we must say that apartment houses are mostly built to suit urban conditions. Group housing provides home for many families and is at once public and private. The techniques of construction or the methods by which structures are formed from particular materials are influenced not only by the availability and character of materials but also by the total technological development of society.

The evolution of techniques is conditioned by two factors: one is economic – the search for a maximum of stability and durability in building with a minimum of materials, labour and time; the other is expressive – the desire to produce a meaningful form.

Large housing programmes have tended to stimulate technological change in the building industry. Modular design (i.e. design in which the elements are dimensioned in combinations of a fixed unit) has led to standardization of elements; interchangeability of parts and increased possibilities for mass production, with resultant economies. Entire apartment assemblages are available and are being used to an increasing extent. These techniques aim at a higher output of better structures at lower cost.

The high degree of mechanization and standardization is successfully achieved by reinforced concrete blocks and units. Reinforced concrete homes are produced by a variety of construction methods. Various methods of constructing reinforced concrete houses involve extensive use of large sections manufactured in heavily mechanized factories and erected at the site.

The built-in space of an apartment should be carefully thought of as well. There is a considerable trend toward built-in furniture. Rooms should be both efficient and visually satisfying. The extent of built-in cabinets must be determined. Drawers and shelves can often be concealed behind walls, freeing valuable floor space

3. Згадайте значення наступних англійських слів та словосполучень

і підберіть до них відповідний переклад з правого стовпчика таблиці

| | |
|-------------------------------|------------------------------------|
| 1. building materials | a. технічний прогрес |
| 2. techniques | b. сучасний |
| 3. residential construction | c. забезпечувати |
| 4. technological changes | d. теплоізоляція |
| 5. mechanized operations | e. будівельні методи |
| 6. site | f. залізобетонні блоки |
| 7. reinforced concrete blocks | g. житлове будівництво |
| 8. construction methods | h. методи |
| 9. thermal insulation | i. будівельні матеріали |
| 10. to provide | j. механізовані операції |
| 11. technological advance | k. будівельний майданчик |
| 12. contemporary | l. зміни в технологічному процесі. |

4. Визначте, назвою якої частини тексту можуть бути використані подані нижче речення.

1. The total technological development of society influences the techniques of residential construction.
2. The interior of a modern residential building.
3. Technological changes and new techniques in the building industry.

5. Зазначте, в яких із наведених нижче речень відображено головну думку тексту.

1. Great technological advances in plumbing and ventilating systems.
2. The types of walls of concrete structures.
3. The types of exterior concrete surface.
4. Classification of buildings according to their functions, building techniques factors affecting the latter.

6. Доповніть незакінчені речення необхідними за змістом аргументами.

1. Types of buildings depend upon social factors because...
2. Large housing programmes have tended to stimulate technological change in the building industry because...
3. Entire apartment assemblages are used to an increasing extent since...
4. There is a considerable trend toward built-in furniture because...

7. Доповніть незакінчені речення за змістом тексту одним із запропонованих варіантів (a, b, c).

1. Various methods of constructing reinforced concrete houses involve...
 - a) craft operations at the building site;
 - b) building materials, labour and time;
 - c) extensive use of large sections manufactured in heavily mechanized

factories.

2. Types of buildings depend upon...

- a) the availability and character of materials;
- b) increased possibilities for mass production;
- c) social functions in the society.

3. The high degree of mechanization and standardization is successfully achieved by...

- a) reinforced concrete blocks and units;
- b) technological change in the building industry;
- c) craft operations at the building site.

8. Відповідно до тексту визначте, до якого поняття належить наступне визначення: “is the weight of the structure itself”. Перекладіть текст усно без словника (Час – 30 хв.).

Structures

A structure is the part of a building that carries its weight, and for at least half the world's civil engineers, structures are most of civil engineering. We should also remember that anything built is a structure. (From an aeroplane engineer's point of view, an aeroplane 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.

Text 5. Building Materials

1. Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту

| | |
|------------------------------|---|
| lime | вапно |
| gypsum | гіпс |
| masonry | кам'яна або цегляна кладка |
| high alumina cement | цемент с високим вмістом глинозему |
| high rate of strength | висока міцність |
| resistance to | міцність на |
| crashed stone | щебінь |
| mortar | будівельний розчин |
| aggregate | заповнювач бетону |
| fine aggregate | дрібний заповнювач бетону |
| moisture content | вміст вологи |
| workability | здатність до обробки (легкість, простота укладки) |
| compressive load | навантаження на стиск |

2. Прочитайте і перекладіть текст.

The designer must be able to select and adapt such materials of construction that will give the most effective result by the most economical means. In this choice of materials for any work of construction, the civil engineer must consider many factors. These factors include availability, cost, physical properties of materials and others.

Timber, steel and concrete all vary, sometimes over considerable ranges in the properties desired by the engineer. Even steel, uniform as it appears to be, varies considerably in its microstructure. Concrete is even less uniform than many other materials.

Lime, gypsum and cement are the three materials most widely used in building construction for the purpose of binding together masonry units, such as stone, brick and as constituents of wall plaster. Cement is furthermore the most important component of concrete.

Another important class of cement is high alumina cement. High alumina cement is a material containing alumina. It has an extremely high rate of strength increase which is, owing to the violence of the chemical reaction, accompanied by a considerable evolution of heat. It is very resistant to chemical attack.

It therefore follows that Portland cement like other materials can to some extent be modified to suit a particular application. The scope for such purpose-made cements has led to the development of an increasing variety such as high alumina cement, blast-furnace slag and pozzuolanas. Portland blast-furnace cement has greater resistance to some forms of chemicals.

The most important building materials may now be considered to be structural steel and concrete. Concrete may be considered an artificial conglomerate of crushed stone, gravel or similar inert material with a mortar. A mixture of sand, screenings or similar inert particles with cement and water which has the capacity of hardening into a rocklike mass is called mortar. The fundamental object in proportioning concrete or mortar mixes is the production of a durable material of requisite strength, water tightness and other essential properties at minimum cost. To attain this end careful attention must be given to the selection of cement aggregate and water.

The most accurate method of measuring proportions is to weigh the required quantities of each material. It is widely used in large building construction, but in small building construction the less accurate method of measuring proportions by volumes is frequently used. The chief inaccuracies in volumetric measurement arise from the wide variation in the bulk of the fine aggregate due to small changes in its moisture content and faulty methods of filling measuring devices. Workability and strength tests are chief control tests made on concrete. To be able to undergo high compressive loads is a specific characteristic of this material.

3. Розташуйте подані нижче речення відповідно до викладу в тексті.

1. Technology of concrete production.
2. Composition of cement.
3. Materials for binding masonry units.
4. The properties of major building materials.
5. The properties of Portland cement.

4. Згрупуйте наступні речення за трьома тематичними напрямками (A, B, C).

- A. The choice of materials for any work of construction.
- B. The properties of high alumina cement.
- C. The composition of concrete.

1. Another important class of cement is high alumina cement. 2. Such a material may be considered an artificial conglomerate of crushed stone or gravel with mortar. 3. A civil engineer must consider many factors when selecting the material for construction. 4. This kind of cement is very resistant to chemical attacks. 5. The principal object in proportioning concrete is the production of a durable material of adequate strength and water tightness. 6. The factors that condition the selection of materials for construction include availability, cost and physical properties. 7. This material has an extremely high rate of strength increase. 8. Timber, steel and concrete vary over considerable ranges in the properties desired by the engineer and the latter should take them into consideration in selecting the materials.

5. Які з наведених нижче речень належать до опису цементу, а які – бетону?

1. This material is most widely used for the purpose of binding together masonry units such as stone and brick. 2. This material is also known to be the most important component of concrete. 3. This kind of material may be considered an artificial conglomerate of crushed stone, gravel or similar inert material with a mortar. 4. The material which contains alumina has an extremely high rate of strength increase. 5. The fundamental object in proportioning this material is the production of a durable material of requisite strength, water tightness and other essential properties. 6. The most accurate method of measuring proportions is to weigh the required quantities of each material.

6. Оберіть правильні відповіді на запитання.

1. What influences the choice of building materials?

a) the choice of building materials is governed by the type and the function of a building;

b) availability, cost and physical properties are the main considerations for an engineer in selecting materials for construction;

c) the techniques and methods of construction are the main factors influencing the choice of building materials.

2. What are lime, gypsum and cement most widely used for?

a) these three materials are not widely used for the purpose of binding together masonry units;

b) they are used as components to produce concrete;

c) with the large-scale construction, lime, gypsum and cement may be considered to be the most important binding materials.

7. Доповніть незакінчені речення необхідними за змістом аргументами.

1. Cement is the most widely used building material because ...

2. High alumina cement is an important class of cement since ...

3. Careful attention must be given to the selection of cement aggregate and water in proportioning concrete because ...

8. Перегляньте текст і спробуйте скласти якомога більше словосполучень зі словами «concrete», «cement». Наприклад: «the production of concrete», «concrete mix».

9. Вкажіть, які із поданих нижче речень є правильними, а які ні. Обґрунтуйте відповідь не менш ніж двома-трьома виразами.

ЗАЗОК: Steel and concrete are most widely used for binding together masonry units. This statement is incorrect. Lime, gypsum and cement are used in building construction for the purpose of binding masonry units.

1. The most important building materials may now be considered to be

structural steel and concrete.

2. Lime, gypsum and cement are the three materials most widely used for making concrete.

3. Cement is the most important component of bricks.

10. Запропонуйте не менше, ніж три варіанти відповідей на наступні запитання.

1. Why is concrete the most important building material?

2. What is it necessary for the designer to know in order to select the most effective building materials?

11. Перекладіть текст письмово зі словником (Час – 30 хв.).

Reinforced-Concrete Elements Production

With the rapid growth in the employment of precast-concrete products, and particularly of wall panels, slabs, beams, etc. to serve a multitude of building needs, this industry has to maintain and improve the quality of the products. A vast amount of excellent work has already been done to raise the standards of this industry to their present level. Machinery and equipment designers have made important contributions by creating better machines and tools for the industry.

A great number of plants producing precast reinforced-concrete elements is now in operation in our country and abroad. Before the decision is made to establish a precast concrete products plant in a given area, a number of purely economic considerations deserve particular attention. A careful appraisal of the potential requirements provides valuable information for determining the size of the plant which should be built. A well-designed plant must have sufficient capacity for the normal output plus a reasonable margin for a possible increase. The design should specifically and carefully anticipate the future installation of additional equipment for increased production without disrupting the original lay-out.

Text 6. The Choice of Building Material

1. Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

mass production

масове виробництво

prefabricated concrete elements

збірні залізобетонні елементи

brittle

крихкий

tensile stress

навантаження на розтяг

volume weight

об'ємна вага

thermal conductivity

теплопровідність

rigid

жорсткий

resin

смола

2. Прочитайте і перекладіть текст.

Which material can be used to the best advantage for a particular part of the building, depends as well on the kind of load to which it is subjected and on the shape of the part. That the development of the metallurgical and machine-building industry made possible mass production of prefabricated large-size concrete and reinforced-concrete structural elements is a well-known factor to influence the choice of materials.

Reinforced concrete is a building material in which the joint functions of concrete and steel are advantageously utilized. Being brittle, concrete cannot withstand tensile stresses, and it cannot therefore be used in structures subjected to tensile stresses under load. But if steel is introduced into concrete it changes the property of the monolith.

There are two kinds of reinforced concrete: with ordinary reinforcement and concrete with prestressed reinforcement. To reinforce ordinary concrete structures is to introduce steel rods in stretched zones of concrete elements. Reinforced-concrete structures and elements are widely used both for residential houses and industrial buildings.

In many cases bricks too are very satisfactory for use in the construction. Bricks generally present a pleasing appearance and can be obtained with various qualities, colours, and textures. Being of a high volume weight and high thermal conductivity, ordinary brick is not always satisfactory in building practice. There are other kinds of bricks which are more effective; they are light-weight building bricks, hollow or porous bricks. Light-weight building bricks differ from ordinary clay bricks in a lower volume weight and lower thermal conductivity, and are therefore more economical than ordinary bricks.

One of the most significant facts about both industry and building has been research on synthetics and plastics. Plastics have appeared comparatively recently but, owing to their inherent valuable and diverse properties, have found a wide application in many industrial fields (machine-building, aviation, textile industry, etc.).

In respect to physical and mechanical properties at a normal temperature of 20°C all plastics are divided into rigid, semi-rigid, soft and plastic. In respect to the number of constituents plastics may be classified as simple and complex.

Plastics consisting of one polymer are referred to as simple. Thus, organic glass (plexiglass) consists of one synthetic resin. But in the building field we usually deal with complex plastics, e.g. plastics consisting of a polymer and other components.

3. Підберіть англійські еквіваленти до наступних українських словосполучень.

- | | |
|--------------------------------|-----------------------------|
| 1. diverse properties | a. успішно використовуються |
| 2. tensile stress | b. властивості матеріалів |
| 3. properties of the materials | c. міцність на стиск |
| 4. depending on application | d. напруга на розтяг |

- | | |
|--------------------------------|----------------------------------|
| 5. pleasing appearance | e. в залежності від застосування |
| 6. mechanical properties | f. приємний зовнішній вигляд |
| 7. wide application | g. різноманітні властивості |
| 8. compressive strength | h. широке застосування |
| 9. are advantageously utilized | i. звичайна цегла |
| 10. ordinary brick | j. успішно використовуються |
| 11. volume weight | k. властивості матеріалів |

4. Розділіть текст на логічні частини і визначте, які назви із запропонованих до них підходять.

1. The main characteristics of concrete.
2. The chief principles of plastics classification.
3. Factors that influence mass production of prefabricated large-size concrete and reinforced-concrete structural elements.
4. New tendencies in the choice of building materials.
5. The advantages of reinforced concrete.

5. Визначте, які з поданих нижче речень належать до опису бетону, а які – цегли і пластмаси.

1. There are some kinds of structural materials that have j appeared comparatively recently, sometimes they consist of one polymer. But in building industry some complex materials consisting of a polymer and other components are used. 2. In many cases bricks too are very satisfactory for use in the construction. 3. There are some kinds of materials which are 1 brittle and cannot withstand tensile stress. 4. If steel is introduced into some kind of material it changes its property. 5. Some building materials offer a good resistance to compressive loads. 6. In respect of physical and mechanical properties these materials are divided into rigid, semi-rigid and soft.

6. Доповніть незакінчені речення відповідно до змісту тексту одним із запропонованих варіантів (a, b, c).

1. Using prefabricated or precast elements...
 - a) depends only on the kind of load to which it is subjected;
 - b) builders perform a considerable amount of building work not in situ but at a factory;
 - c) made possible mass production of large-size structural elements.
2. Reinforced concrete is a building material in which...
 - a) such properties as small volume weight and high thermal conductivity are combined;
 - b) physical and mechanical properties at a normal temperature of 20°C make it semi-rigid and soft;
 - c) the joint functions of concrete and steel are advantageously utilized.
3. Bricks generally present a pleasing appearance and...
 - a) they are light-weight building materials;

- b) cannot be used in structures subjected to tensile stresses;
- c) can be obtained with various qualities, colours and textures.

7. Дайте відповіді на наступні питання за змістом тексту.

1. For what types of construction are reinforced concrete structures and elements used?
2. What new materials have come into use both in industry and building?
3. What made possible the mass production of prefabricated large-size concrete elements?
4. In what industrial fields are plastics used?
5. How does steel introduced into concrete change its properties?

8. Відповідно до тексту визначте, до якого поняття належить наступне визначення: «... is a cement which has been ground more finely than ordinary Portland cement and therefore hardens more quickly and is slightly more expensive». Перекладіть текст усно без словника (Час – 30 хв.).

Modern Building Materials

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) Sulphate-resisting cement which has a special chemical position to resist; sulphates, 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. A different cement, which should be mentioned, is high-alumina cement. High-alumina cement is usually black, unlike Portland which is grey, but it reaches a “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 60 cm. This common high-alumina cement costs roughly three times as much as Portland. Another high-alumina cement which is used for furnace linings is white; it is several times more expensive even than the black variety. White Portland cement is also obtainable, it is more expensive than ordinary. It is used for making white concrete or for painting or plastering concrete. A small addition of colouring material to white cement will often result in a pleasing colour but it may not be the colour expected because of the effect of the aggregates and impurities in the concrete.

Text 7. Earth-Moving Machinery

1. *Запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.*

| | |
|--|--------------------------------|
| plant | механічне обладнання, парк |
| leveling | планування, планувальні роботи |
| site | будівельний майданчик |
| excavation | земляні роботи |
| to plane off | стругати, знімати шар |
| bucket | ківш |
| trenching | риття траншей |
| wheel | ротор, колесо |
| blade | ніж |
| shovel | пряма лопата |
| to power | приводити в рух |
| dig | копати |
| earth-moving machines (equipment) | землерийні машини (обладнання) |

2. *Прочитайте і перекладіть текст.*

Mechanized earth digging operations require the employment of a great plant of powerful earth-moving machines, the excavators, being the most important of them.

It is not possible to start on a construction job without a good deal of preliminary leveling the site. To carry out this work one must employ the earth-moving equipment.

Site preparation and excavation are the most fully mechanized of all the operations in building construction. Most excavating machinery is heavy and slow-moving and must be carried from site to site on special transporters. It is clear that the use of expensive mechanical plant requires careful planning and efficient site organization if full advantage is to be taken of its high rate of production.

Plant for site preparation and excavation can be divided into four classes. First, machines which plane off a thin layer of soil and push it in front of them. Second, machines which plane off a thin layer of soil, at the same time picking it up and carrying it where required. Third, machines which dig out soil by some form of a bucket, and load it for transportation into separate vehicles. Fourth, machines designed specially for trenching by means of a number of buckets mounted either on a continuous chain or on a wheel.

In the first class are bulldozers of different types. A bulldozer represents by itself an earth-moving machine which carries out its work with the aid of a blade mounted on a tractor of either crawler or wheel type.

A scraper, which belongs to the second class of earth-moving machines, is

simply a large box with an open mouth, dragged along the surface of the ground until it is full. It has a cutting edge that digs. There is a considerable variety of the scrapers, from small units to huge ones made to accommodate 30 cubic yards of soil and to absorb the power of two tractors while at work.

Revolving shovels, which belong to the third class of earth-moving machines, made their first appearance in 1835 in the form of a part-swing shovel mounted on railroad tracks. It was powered by steam, it was slow and clumsy, but it did the work. Into Great Britain they were introduced; from America in 1887 to work on the Manchester Ship Canal. They were a source of wonderment to the people of that part of the country and trips were organized to provide a view «American Devils» as they were popularly called.

3. Визначте, які з наступних речень неправильні або не відповідають змісту тексту.

1. On large construction sites where a considerable volume of concrete is required a central mixing plant is generally used. 2. A bulldozer is an earth-moving machine which planes off a thin layer of soil, picks it up, and carries it where required. 3. The tower cranes are employed for lifting materials and structural elements onto the buildings being erected. 4. The first revolving shovels were mounted on railway tracks and powered by steam. 5. Site preparation and excavation are operations which are usually carried out with manpower. 6. A scraper is simply a large box fitted with a cutting edge that digs. 7. Since excavators are heavy and slow-moving machines, they are carried from site to site on special transporters.

4. Знайдіть в цьому уривку речення, що є відповіддю на поставлене запитання (Час – 3 хв.).

Are the excavators fast-moving machines?

Site preparation and excavation are labour - consuming operations. At present they are the most fully mechanized of all the operations carried out in building construction. But earth-moving machines are heavy and slow-moving units; therefore they must be carried from site to site on special trailers. It is clear that such expensive mechanical plant as excavators must be made, to carry out various classes of work.

5. З'єднайте попарно наступні неповні речення з груп А і В.

A.1. The best economy is achieved when an all-purpose earth-moving machine is designed...

2. A scraper is simply a box made of sheet steel with an open mouth...

3. Site preparation and leveling are...

4. It is not possible to start on a construction job...

5. The use of expensive mechanical plant requires...

B. 1. ... without a good deal of preliminary leveling the site.

2. ... the most fully mechanized of all the operations in building

construction.

3. ... careful planning and efficient site organization.
4. ... capable of being converted to suit any class of work.
5. ... which is dragged along the surface of the ground until it is full.

6. Продовженням яких з незакінчених речень (a, b, c) є наступні вирази?

1. ...one must use earth-moving equipment.
 - a) As the years went on...
 - b) To carry out this work ...
 - c) During the last fifty years...
2. ...can be divided into four classes.
 - a) Machines, which plane off a thin layer of soil...
 - b) The annual amount of digging operations...
 - c) Plant for site preparation and excavation...
3. ...an earth-moving machine, which carries out its work with the aid of a blade mounted on a tractor.
 - a) A scraper, which belongs to the second class of earth-moving machines, is...
 - b) A bulldozer is...
 - c) A revolving shovel, which belongs to the third class, is...

7. Складіть план-конспект до тексту англійською мовою; прокоментуйте пункти плану якомога детальніше українською мовою.

8. З'єднайте парами слова з двох стовпчиків і утворіть терміни.

- | | |
|-----------------|----------------|
| 1. earth-moving | a. tractor |
| 2. excavating | b. shovel |
| 3. site | c. equipment |
| 4. continuous | d. plant |
| 5. crawler | e. preparation |
| 6. pneumatic | f. edge |
| 7. cutting | g. tracks |
| 8. revolving | h. machinery |
| 9. railroad | i. chain |
| 10. mechanical | j. tyre |

9. Підберіть слова, що мають схоже значення з двох поданих груп слів.

- | | |
|------------------|---------------------|
| 1. annual | a. to reach |
| 2. amount | b. to fulfill |
| 3. to come up to | c. work |
| 4. to require | d. to have room for |

- | | |
|-----------------|--------------|
| 5. job | e. yearly |
| 6. preliminary | f. to demand |
| 7. to carry out | g. not small |

10. Перекладіть текст письмово зі словником (Час – 30 хв.).

Mobile Cranes

The function of a crane is to hoist or lower a load suspended from its jib. Various types of cranes are available, the type and size best suited for a specific operation being influenced by the following factors: 1. The nature of the work on which it is to operate. 2. The weight of load it has to handle.

Mobile cranes have a wide range of uses on building and civil engineering works of construction. Cranes of this type usually take the form of a frame carrying a jib, a winch, and other necessary hoisting and controlling equipment, the whole being mounted on a cast-iron bed plate fitted with road wheels of the pneumatic type. One may also have them mounted on caterpillar tracks or on a lorry chassis if desired.

At present rope-operated mobile cranes are being superseded by hydraulically operated ones, in which all working operations, but travelling, are performed with the help of hydraulic rams. The jib of the mobile crane can be of the solid or latticed type, the latter being preferred now because of its lower weight.

11. Вкажіть, які з наведених нижче тверджень, не відповідають змісту тексту *Mobile Cranes*

1. A disadvantage of cranes with telescopic booms is that it takes much time to bring them into action from the travelling position.

2. The ability to change the length of the telescopic boom makes it possible to vary the load-lifting capacity of the crane.

3. The hydraulic rams used in hydraulic-ally operated mobile cranes lower the maneuverability of such cranes.

12. Опишіть дві переваги мобільного крана з телескопічною стрілою.

РОЗДІЛ II

SANITARY AND THERMAL POWER ENGINEERING

Text 8. Panel Heating

1. Прочитайте і запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

| | |
|-----------------------------------|---------------------------|
| atmospheric environment | атмосферне середовище |
| efficiency | продуктивність; к.к.д. |
| contamination of the air | забруднення повітря |
| loss of heat | втрата тепла |
| central heating | центральне опалення |
| hot-water (heating) system | система водяного опалення |
| boiler | котел |
| steam (heating) system | парове опалення |
| copper pipes | мідні труби |
| panel heating system | панельне опалення |

2. Прочитайте і перекладіть текст.

Heating and ventilation are tip branches of engineering which are very closely connected; they are therefore treated as a dual subject. Both are concerned with providing a required atmospheric environment within a space, the former with respect to heat supply to produce a desired temperature for maintaining comfort, health or efficiency of the occupants, the latter with regard to supply and removal of air frequently with emphasis on contamination of the air. Air conditioning is closely related to both heating and ventilation.

It is for heating to prevent the too rapid loss of heat from the body. By heating the ambient air of walls, ceiling or floor the rate of heat loss from the body is controlled. Some old concepts of heating were gradually changed since engineers obtained more precise knowledge about how the body loses heat. Insufficient attention was paid formerly to loss by radiation, which is the transmission of energy in the form of waves from a body to surrounding bodies at a temperature. The human being also loses heat by conduction (through his clothes) and convection.

The determination of the capacity or size of the various components of the heating system is based on the fundamental concept that heat supplied to a space equals heat lost from; the space. The most widely used system of heating is the central heating, where the fuel is burned in one place – the basement or a specially designer room and from which steam, hot water or warm air is distributed to adjacent and remote spaces to be heated.

There are two most common systems of heating – hot water and steam. Both

systems are widely used nowadays. A hot-water system consists of the boilers and a system of pipes connected to radiators suitably located in rooms to be heated. The pipes, usually of steel or copper.

As for steam systems, steam is generated usually, at less than 5 pounds per square inch in the boiler and the steam is led to the radiators through or by means of steel or copper pipes. The steam gives up its heat to the radiators and the radiators to the room and the cooling of the steam condenses it to water. The condensate is returned to the boiler either by gravity or by a pump. The air valve on each radiator is necessary for air to escape. Otherwise it would prevent steam from entering the radiator.

Recent efforts completely conceal heating equipment have resulted in an arrangement whereby the fluid, whether it be hot water, steam, air, or, electricity, is circulated through distribution units embedded in the building construction. Panel heating is a method of introducing heat to rooms in which the emitting surfaces are usually completely concealed in the floor, walls, or ceiling.

As for fuels used for heating buildings they include coal, oil, manufactured and natural gases and wood. There are two other sources: electricity and steam. Nowadays gas fuel is being used on an ever increasing level.

3. Звіряючись з текстом, підберіть відповідний переклад з правого стовпчика до наступних англійських слів і словосполучень.

- | | |
|-------------------|--------------------------|
| 1. cooling | a. стеля |
| 2. space | b. забезпечувати |
| 3. to maintain | c. опалення |
| 4. removal | d. навколишнє середовище |
| 5. contamination | e. парове опалення |
| 6. loss | f. визначення |
| 7. precise | g. отримувати |
| 8. equal | h. рівний |
| 9. heat supply | i. застосовувати |
| 10. environment | j. видалення |
| 11. to obtain | k. втрата |
| 12. determination | l. точний |
| 13. to provide | m. забруднення |
| 14. steam heating | n. охолодження |
| 15. ceiling | o. підтримувати |
| 16. cooling | p. середовище |
| 17. space | q. паливо |

4. Вкажіть, у якому з наданих речень відображено головну думку тексту.

1. The human being loses heat by conduction and convection.

2. Heating is a branch of engineering which is concerned with providing heat supply to produce a desired temperature within a space.
3. A hot-water system consists of the boilers and a system of pipes.

5. Розташуйте наступні речення в послідовності викладу в тексті.

1. Fuels used for heating buildings.
2. Some old concepts of heating.
3. The principle of central heating.

6. Відповідно до змісту тексту знайдіть правильні відповіді на наступні запитання:

1. What are heating and ventilation concerned with?
 - a) Heating and ventilation deal with supply and removal of air.
 - b) Heating and ventilation are concerned with providing a required atmospheric environment within a space.
 - c) Heating and ventilation are meant for heat supply to produce a desired temperature.
2. Why do industrial buildings maintain a lower air temperature?
 - a) Industrial buildings maintain a lower temperature because it is necessary for the machinery they have.
 - b) Industrial buildings where the degree of activity is high maintain a lower air temperature because the heat loss from the body is greater and a compensatory heat balance is provided.
 - c) Industrial buildings maintain low temperatures because they have great amount of outside wall space and lose considerable amounts of the heat supplied.

7. Доповніть незакінчені речення необхідними за змістом аргументами.

1. Some old concepts of heating were gradually changed since...
2. The system of panel heating spares space in the room because....
3. Heating and ventilation are very closely connected for...
4. The out valve on each radiator is necessary because...

8. Знайдіть, які з поданих речень належать до опису опалення, а які – вентиляції.

1. This branch of engineering is concerned with supply and removal of air with emphasis on contamination of the latter. 2. This system consists of fee boilers and a system of pipes connected with radiators located in rooms. 3. There is certain method of introducing heat to rooms in which emitting surfaces are usually completely concealed in the floor, walls or ceilings. 4. This branch of engineering has gradually come to be associated with cleaning of air.

9. Перегляньте текст і спробуйте скласти якомога більше словосполучень зі словами «heating», «ventilation», «air conditioning».

10. Перекладіть наступні словосполучення

Heat supply; clothing surface; heating system; air valve; wall partitions; steam system; air conditioning; hot-water system; "heating equipment; distribution units; building construction; panel heating; room height; heat-storing capacity.

11. Спростуйте наступні вирази не менш, ніж двома висловлюваннями кожний

1. With panel heating the source of heat is located in the room in the form of a special radiator.

2. Heating and ventilation are two separate branches of engineering which are not connected in any way.

12. Дайте відповіді на наступні запитання, запропонуйте якомога більше варіантів відповідей

1. What is necessary to maintain comfort a building?

2. Why have new methods of heating come into being?

13. Використовуючи текст, поясніть з точки зору майбутнього інженера-будівельника призначення опалення та вентиляції в будівлях (англійською мовою)

14. Перекладіть текст письмово зі словником (Час – 30 хв.). Поясніть (українською мовою) переваги центрального опалення

Homes in most Ukrainian cities are heated by a modern system of central heating. Such a system has been in operation for about a few decades. Heat is piped to apartments in an underground network that resembles a subterranean city. Central heating not only keeps homes well-heated at a cheap cost, it also considerably reduces fire hazards. In cold regions of the world, for instance, where 40 degrees below zero is a normal temperature and the ground is kept permafrost, heat is transmitted through overhead metal pipes specially treated to withstand intense cold. Homes there are kept comfortably warm at +20 degrees Centigrade. In large cities of our country, buildings and homes are maintained and serviced by a force of over 50,000 workers. It is their responsibility to see that winterizing is properly done and heating systems are kept in good order before winter comes.

Text 9. Air Conditioning, Ventilation, Gas Supply

1. Прочитайте і запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту

| | |
|----------------------------|--------------------------|
| air-conditioning | кондиціонування повітря |
| (close) control | (ретельне) регулювання |
| humidity | вологість |
| purity | чистота |
| installations | установки |
| department stores | універсальні магазини |
| excess heat | надлишок тепла |
| supply of air | постачання повітря |
| removal of air | виведення повітря |
| contaminated air | забруднене повітря |
| fumes | запахи; випари; дим |
| hazardous to health | небезпечний для здоров'я |

2. Прочитайте і перекладіть текст.

Air conditioning implies the control of temperature, humidity, purity and motion of the air in an enclosure. In fir modern world of science and highly developed technology air conditioning is of great significance for industrial processes as well as for human comfort.

Air conditioning for human comfort employed in both large and small installations, such as theatres, office buildings, department stores, residences, airplanes, railways, cars and submarines.

All-year air conditioning systems must provide means for performing, all the processes required for winter and summer air conditioning. The basic pieces of equipment are the filters, preheat cons, humidifiers, dehumidifiers, reheat coils, additional cooling coils, fans and controls. The control of air purity can be achieved in various degrees. As a minimum control some sort of filtering must be done near the entrance of the air-conditioning system. Possibly the most efficient filtering device is the electrostatic precipitator.

In order to establish the size and operational requirements of an air-conditioning system, the maximum probable heating and co-demands have to be calculated. The maximum probable heating demand is usually for winter air-conditioning and it involves heating and humidifying. The maximum probable cooling demand is generally for summer applications and requires cooling and dehumidifying.

As far as ventilation is concerned the modern theory to this effect can be summed up in the statement that for places of general assembly the purpose of ventilation is to carry away excess heat and odours and that normally 10 cu. ft per minute of outside air per person is sufficient to accomplish this objective. In buildings such as homes, the leakage of air through cracks in doors and windows is usually sufficient to meet this requirement. Although ventilation was formerly

concerned with the supply to fresh air to and the removal of hot and contaminated air from the space it gradually came to be associated with cleaning of air.

Industrial buildings often present special problems in ventilation. There are certain industrial processes that are accompanied by the production of air-born dust, fumes toxic vapours and gases which are hazardous to the health of workers.

Another indispensable part of modern amenities is gas supply. It has come now to be of a very wide use. With an intensive exploration of finding natural gas it has gradually replaced the manufacture in its utilization. At the present time natural gas is put to large-scale economic use. The principal utilization of natural gas is as a clean, convenient, economical source of heat. In homes it is used for cooking, water heating, refrigeration for food as well as for space heating.

3. Розташуйте наступні речення послідовно викладу в тексті (Час–5 хв.).

1. Gas supply as an important part of modern amenities.
2. Ventilation for industrial buildings.
3. The importance of air conditioning for human comfort.
4. The basic parts of equipment for an all-year air-conditioning system.

4. Доповніть і закінчіть речення одним із поданих варіантів (a, b, c) відповідно змісту тексту.

1. Air conditioning implies...
 - a) rapid loss of heat;
 - b) provision for the expansion of the water;
 - c) the control of temperature, humidity, purity and motion of the air.
2. The purpose of ventilation is...
 - a) to produce a desired temperature for maintaining comfort;
 - b) to maintain air purity at an extremely high level;
 - c) to carry away excess heat and odours.
3. The basic pieces of air-conditioning equipment are...
 - a) stokers, coal furnaces and boilers;
 - b) filters, preheat coils, humidifiers, reheat coils, fans and- controls;
 - c) boilers and a system of pipes.

5. Згрупуйте наступні речення за трьома тематичними напрямками

- A. Air Conditioning.
- B. Gas Supply.
- C. Ventilation.

1. Gas supply has come to be very widely used. 2. In industrial buildings three types of ventilation are in use so as to control dangerous gases and dusts. 3. In Buildings such as homes, the leakage of air through cracks in doors and

windows is usually sufficient. 4. As for the purpose air-conditioning system may be described as winter, summer and all-year. 5. The main utilization of natural gas is as a clean, convenient, economical source of heat. 6. Natural gas supply is used also as a heat source in commercial establishments. 7. Certain industrial process requirements and human comfort are the two major factors to be considered when designing an air-conditioning system. 8. Air-conditioning is meant for the control of temperature, humidity, purity and motion of the air in an enclosure. 9. The main purpose of ventilation is to carry away excess heat and odours.

Text 10. Water Supply

1. Прочитайте і запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

| | |
|-------------------------------|-------------------------------|
| water supply | водопостачання |
| saturated | насичений |
| moisture | волога |
| through the medium | за допомогою |
| natural water sources | природні джерела води |
| body of water | водний масив |
| inland lake | материкове озеро |
| undersoil | основа |
| stratum | шар, пласт |
| sewage disposal system | система видалення стічних вод |
| pollution | забруднення |
| to foul | забруднюється |
| consumption | споживання |
| purity | чистота |

2. Прочитайте і перекладіть текст.

Water is an important part of nature which surrounds us and of those natural conditions we are changing constantly and ever more intensively: the flora, the soil, the mountains, mineral resources, the deserts, the marshes; the steppes and the taiga.

Water passes through a very interesting natural cycle. The atmosphere which surrounds the earth's surface contains water which varies in amount in direct proportion to the temperature of its gases. Water is also evaporated into atmosphere. Atmosphere which has become saturated with water precipitates its' moisture when the temperature lowers. This phenomenon is termed rainfall. The moisture falls to the earth and finds its way into a number of reservoirs provided by nature.

Vast depressions in the earth are filled with water through the medium of

natural water sources such as rivers lakes, etc. over the earth's surface. These bodies of water are classified as inland lakes and are excellent sources of water.

Sometimes the rainfall finds its way into the soil and forms water bodies at various levels because of the impervious nature of the undersoil. Often a water body deep in the soil consists of a sand or gravel stratum which connects or empties into the basin of an inland lake and provides a splendid source of water supply through the medium of a drilled well.

Man uses water for domestic and sanitary purposes and returns it to the source through sewage disposal system. Industry likewise replaces water diverted to its use. Hence the cycle is completed but it is of prime importance that the supply be protected against pollution for it is fouls no one can predict how disastrous may be the results.

An adequate supply of pure, wholesome and palatable water is essential to the maintenance of high standards of health and to provide the convenience modern society demands. In some localities water is available in unlimited quantities and converting it to use is not a difficult problem. This is especially true of towns situated on large inland takes or rivers. On the other hand there are cities where geographical location requires elaborate systems of water supply, and to provide a satisfactory supply of water in these localities becomes a large engineering task.

The importance of a sufficient supply of water for domestic and industrial purpose has long been a deciding factor in the location of cities. The earliest settlers realized this need and took advantage of natural water sources by establishing colonies in close, proximity to them.

Water may be taken from any sources of water for human consumption after it has undergone a preliminary treatment to assure its purity. As man's communities grew in population, the demand for water increased and the need for protection of the source of water supply against the possibility of contamination became evident. Progress and civilization have called for elaborate and various systems and methods of water treatment.

3. Вкажіть, яке з поданих нижче речень, виражає головну думку тексту.

1. On the earth water can be obtained from different natural sources.
2. At present the problems of water supply and treatment are the most essential for mankind.
3. Water taken from natural sources such as rivers and lakes often requires aeration.

4. Розташуйте наступні речення послідовно викладу тексту.

1. An adequate supply of water is one of the main requirements for maintaining high standards of health.
2. Vast depressions in the earth filled with water and known as inland lakes are excellent sources of water.
3. The rivers and lakes contain a great amount of chemical and biological pollution.
4. Nowadays

the problem of water treatment has become very urgent. 5. On the earth water passes through a very interesting physical cycle. 6. Water bodies deep in the soil are excellent sources of water. 7. Man after using water returns it to the source by means of sewerage systems; thus the cycle is completed. 8. Water is an important part of nature. 9. Man's earliest settlements were always close to natural water sources.

5. Доповніть незакінчені речення одним з поданих варіантів (a, b, c) відповідно змісту тексту

1. An adequate supply of pure, wholesome and palatable water...
 - a) is especially true of towns situated on large inland lakes or rivers;
 - b) is essential to the maintenance of high standards of health;
 - c) may be taken from any source of water.
2. There are cities where geographical location...
 - a) makes water pass through a very interesting cycle of treatment;
 - b) requires elaborate systems of water supply;
 - c) makes the problem of water supply very difficult.
3. The earliest settlers took advantage of natural water sources by...
 - a) building water power stations on them;
 - b) establishing colonies near them;
 - c) providing sufficient water supply for their needs.

6. «Memory test». Згадайте, в якому контексті вживаються наступні англійські словосполучення.

1. ...is essential to the maintenance of high standards of health.
2. ...is an important part of nature which surrounds us.
3. ...has long been a deciding factor in the location of cities.

7. Дайте відповідь на наступні питання (не менш, ніж трьома реченнями.)

1. Why were man's earliest communities established close to natural water sources?
2. Why must natural water undergo treatment before consumption?

8. Спростуйте наступні твердження не менш ніж двома-трьома реченнями кожне.

1. Inland lakes are bodies of water formed by the evaporation of water.
2. Water is available in unlimited quantities in all parts of the earth.

9. Відповідно до тексту визначте, описом якого виду обладнання є наступне твердження: "This equipment delivers water to different kinds of buildings". Перекладіть текст усно без словника (Час – 30 хв.).

Water Supply

A water supply may be obtained from surface water (rain) or from

underground water or both. Both are refilled by the rainfall, the surface water by the run-off, and the springs or wells by the water which enters the ground, the infiltration water. These two quantities, plus the evaporation water and the water used by the trees and plants, make up the total rainfall. Even if the community water supply includes all the springs as well as all the surface water in the area, it still does not obtain all the rainfall because of evaporation and the needs of plant life.

A water supply for a town usually includes a storage reservoir at the source of the supply, a pipeline from the storage reservoir to the distribution reservoir near the town, and finally the distribution pipes buried in the streets, taking the water to the houses, shops, factories, and offices. The main equipment is thus the two reservoirs and the pipeline between them. The function of the storage reservoir is to keep enough water over one or several years to provide for all high demands in dry periods, and the distribution reservoir has the same function for the day or the week. The storage reservoir by its existence allows the supply sources to be smaller and less expensive, and the distribution reservoir similarly allows the pipeline and pumps to be smaller and cheaper than they would be if it did not exist.

Text 11. Sewage Disposal

1. Прочитайте і запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

| | |
|-----------------------------------|---------------------------|
| waste products | відходи |
| liquid | рідина |
| sewage | стічні води |
| refuse | «тверді викиди»; сміття |
| street flushing operations | поливання вулиць |
| domestic sewage | побутові стічні води |
| industrial waste | промислові стічні води |
| sewer | каналізаційна труба |
| treatment plant | водоочисна споруда |
| discharge | виведення стічних вод |
| raw sewage | неопрацьовані стічні води |
| primary treatment | первинна обробка |
| sludge | відстій, осад |
| clarified | освітлений |
| decomposable | здатний до розкладу |
| chemicals | хімікати |

2. Прочитайте і перекладіть текст

The problem of protecting natural water resources has grown very pressing for many countries since the beginning the second half of the 20th century. The

development of human society, the growth of civilization and social and technical progress have resulted in the changing of the composition of natural water resources. The rivers, lakes and ground-waters contain today a considerable amount of the products of mechanical, chemical and biological pollution.

The waste products that result from the daily, activities in a community are of two general types: namely, the liquid waste, known as sewage and the solid wastes, known as refuse. The different wastes of which sewage is composed are the following: the wastes from lavatories, baths, sinks, and laundry tanks in residences, institutions, and business buildings; certain liquid wastes from various types of manufacturing or industrial plants, and, in many communities, the surface run-off that results from storms or street-flushing operations.

Sewage may also be divided according to its source in-to the following three classes. The sewage from residences, Institutions and business buildings is called domestic sewage, sanitary sewage or house sewage; that resulting from manufacturing or industrial processes is known as industrial waste; and that from run-off during or immediately following storms is called storm sewage. A combination of domestic sewage, industrial waste and storm water is called combined sewage.

Both sewage and refuse must be removed promptly order to avoid endangering the health of the community and also prevent decomposition of the materials of animal or vegetable origin and the subsequent production of nuisances and odours.

The removal of all kinds of sewage is usually accomplished by means of sewers. The sewers are placed in the streets at several feet below the ground surface. The general process of removing sewage is designated as sewerage and the entire systems of sewers including a sewage treatment plant are known as a sewerage system.

The method of sewage treatment to be adopted in a particular case will depend almost entirely on local conditions. It may consist only of the discharge of the raw sewage into a stream of a large body of water. The usual methods of sewage treatment consist either of preliminary treatment alone or of primary treatment followed by secondary treatment.

During primary treatment the larger and heavier solid particles settle out from the liquid. These solid particles that settle out form a slimy paste which is known as, sludge.

The partly clarified sewage that has been given primary treatment generally contains much decomposable materials. Therefore, further treatment which is known as secondary treatment, is usually required.

An auxiliary treatment which may be used with either primary or secondary treatment is disinfection or the killing of the most of the bacteria in the sewage by means of chemicals.

3. Вкажіть, в яких з поданих речень висвітлено головну думку тексту.

1. Water taken from its natural source – the ground lakes or rivers – contains many objectionable elements.

2. The waste products that result from the daily activities in a community must be removed promptly passing through different methods of treatment.

3. The drains from a residence or office buildings are connected to a single underground pipe called a louse sewer.

4. Які із поданих речень виражають основну думку тексту? Розташуйте наступні речення у послідовності викладу в тексті (Час – 5 хв.).

1. Both sewage and refuse must be removed promptly in order to avoid endangering the health of the people. 2. The methods of sewage treatment are different and depend wholly on local conditions. 3. Secondary treatment is required to remove decomposable materials from the sewage. 4. Sewage is composed of different types of wastes which, result from the daily activities in a community. 5. Sewage may also be classified according to its source. 6. The removal of sewage is accomplished by sewers which are a part of a sewerage system. 7. The killing of bacteria in the sewage is accomplished by means of chemicals. 8. Heavier solid particles settle out from the liquid during primary treatment.

5. Вкажіть, які речення (а, б, с) є відповіддю на поставлене запитання.

Why must sewage undergo secondary treatment?

a) because sewage and refuse products result from daily activities in a community;

b) because primary treatment is not sufficient as the partly clarified sewage still contains much decomposable material;

c) because chemicals help to kill the bacteria in the sewage.

6. Складіть план до тексту із чотирьох пунктів.

7. Перекладіть письмово з словником (Час –15 хв.).

Primary treatment may consist of one or all of the following processes: passing the sewage through a grit chamber, in which the sand or grit is settled out; screening or the removal of a portion of the coarse solids by passing the sewage through specially constructed screens or racks; and sedimentation, or the passing of the sewage through some type of settling tank, either with or without the application of chemicals, so that larger and heavier solid particles settle out from the liquid. These solid particles that settle out form a slimy paste which is known as sludge.

8. Дайте відповідь на наступні запитання (не менш, ніж трьома реченнями).

1. What is necessary for protecting the purity of natural water resources?
2. Why do large modern cities suffer mostly from water pollution?

9. Спростуйте наступні твердження (не менш, ніж двома-трьома реченнями кожне).

1. The problem of protecting natural water resources is of little importance as compared to other problems of our age.
2. After primary treatment polluted water may be used for drinking.

10. Прочитайте самостійно і перекладіть текст. Вкажіть, до яких термінів належать наступні формулювання.

- a) It is the liquid, usually domestic wastes from a community channels which
- b) It is the fluid flow along all pipes or takes liquid wastes or rain water.
- c) Systems of pipes or drains which earn industrial wastes.

Drainage, Sewerage and Sewage

Drainage is a general term applied to fluid flow along all pipes or open channels which takes liquid wastes or rain water. A land drain is usually a pipe buried in farm land but it may also be an open channel. In a dry hot climate, drains are rarely needed, and irrigation channels or pipes bring water to the fields instead of taking it away.

Sewage however is rather different. It is the liquid, usually domestic wastes from a community, and it must be carefully distinguished from sewerage. Sewerage means mainly the pipes or drains which carry sewage but can include all: sewage collection, treatment and removal.

Sewerage systems are either “separate” or “combined”. In separate systems the rain water is passed through a different drain from the sanitary sewer containing the sewage and they are therefore more expensive than drains but the sewage treatment is easier.

Text 12. Energy Sources

1. Прочитайте і запам'ятайте значення наступних слів і словосполучень для кращого розуміння тексту.

| | |
|--------------------|--------------|
| to face | стояти перед |
| origin | походження |
| shortage | нестача |
| deposited | відкладений |
| oil | нафта |
| consumption | споживання |

| | |
|---------------------|------------------|
| fossil fuels | ВИКОПНІ КОПАЛИНИ |
| to consume | СПОЖИВАТИ |
| amount | КІЛЬКІСТЬ |
| to store | НАКОПИЧУВАТИ |
| to relate | СТОСУВАТИСЯ |
| waste | МАРНА ВИТРАТА |
| extraction | ВИТЯГ |
| generation | ВИРОБНИЦТВО |
| radiant | ПРОМЕНИСТИЙ |
| solution | РІШЕННЯ |

2. Прочитайте і перекладіть текст. Назвіть джерела енергії, які в ньому розглядаються.

The world is facing a serious problem of potential shortage of energy, which is extremely important to meeting all of man's physical needs – clothing, shelter, transportation, convenience, recreation, etc.

The consumption of energy is expected to grow. The amount of energy consumed by a country is closely connected with its degree of technological development and industrialization, which are in turn related to the people's standard of living.

Energy can be classified according to its sources. The principal materials now used for obtaining energy are of plant and animal origin, deposited in the earth over millions of years in the form of coal, oil, and natural gas. These so-called "fossil fuels" are extremely useful raw materials because of the conveniently stored chemical energy. But when they are burned for fuel, harm» pollution may result, and there is a great waste of natural resources that will never be available again.

Wood was already the main source a hundred years ago. The growth of coal usage in the early 1900s is associated with rapidly increasing industrial development. There followed a great expansion in the consumption of natural gas and fuel oil for heating, electrical generation and especially transportation.

The reserves of such popular sources of energy as natural gas and oil are not expected to meet the long-term demands.

Natural gas is a popular source of energy because of its convenience for use and cleanliness in burning. It is generally believed that gas will be the first fossil fuel to be in short supply, and the cost of oil extraction is high.

To these sources we can add the energy obtained from water motion and the sun. Hydroelectric power is available when a stream can be dammed to form a large reservoir, permitting falling water to turn a hydraulic turbine connected to an electric generator. It is generally agreed that this source cannot meet the total need in power.

Solar power is often mentioned as the logical alternative. And indeed, the amount of radiant energy that reaches the earth's surface is more than what is

needed. For the generation of electricity, however, there are serious problems to be solved. To collect and concentrate the energy by reflectors and converters of present efficiency is the major difficulty. There remain many technological problems in this area.

Man is consuming the remaining resources at such a rate that they may last only a few centuries. This may seem to be a long time in comparison with the life of a single generation, but in man's history it is only a short period. If the world is to solve the long-range energy problem, it must look for and make use of all available practical sources economically. Efforts to eliminate the extravagant waste of energy are needed at the same time.

Several other conclusions can be made: that research and development work with a view to find new sources of energy and ways of increasing efficiency are urgently needed; that the new «sources of other types of fuels must be fully developed and utilized wherever possible. And we must give a serious consideration» as a possible solution, to nuclear energy, i.e. the energy from nuclear reactions, the burning of nuclear fuel.

3. *Визначте, в якому значенні використовуються наступні слова в тексті.*

| | |
|----------------|---|
| 1. to face | дивитись в обличчя; облицьовувати; стояти перед |
| 2. in turn | по черзі; в свою чергу; зі свого боку |
| 3. generation | покоління; виробництво; утворення; видобуток |
| 4. power | сила; міцність; влада; держава |
| 5. extravagant | екстравагантний; надмірний |
| 6. development | розвиток; забудова; розширення; зростання |
| 7. oil | масло; нафта |
| 8. plant | установка; завод; рослина |
| 9. to relate | розповідати; стосуватися чогось |
| 10. wood | ліс; дерево; дрова |
| 11. waste | викиди; марна трата; витрати |

4. *Вкажіть, які з цих положень висвітлені в тексті.*

1. In the near future most of the electrical supply will come from nuclear sources.
2. The available sources of energy must not be wasted.
3. To collect and concentrate solar energy by reflectors and converters is the main difficulty.
4. The available sources of energy will not last long.
5. The technological development demands more and more energy.
6. High, radioactivity may make the operation of a reactor dangerous.

5. Доповніть незакінчені речення за змістом тексту одним із запропонованих варіантів (a, b, c).

1. To solve the problem of energy shortage...
 - a) the consumption of energy should grow;
 - b) there should be no extravagant waste of energy;
 - c) man uses energy to meet the needs of life.
2. In future the consumption of energy will grow...
 - a) because the remaining resources will last forever;
 - b) due to the further industrial development;
 - c) and the products of burning pollute the atmosphere.
3. So-called “fossil fuel”...
 - a) can last forever;
 - b) have been formed in the earth over millions of years;
 - c) are a result of chemical reactions in reactor
4. Man must discover and use sources other than fossil fuels...
 - a) because solar energy can provide electricity for desalinization of sea water;
 - b) and nuclear energy can meet the world's needs in fuel;
 - c) for they are extremely useful natural resources.

6. Складіть план до тексту з шести речень, прокоментуйте їх українською мовою.

7. Перекладіть наступні словосполучення:

living standard; of plant and animal origin; coal usage; long-term (long-range) demands; water motion; radiant energy; at such a rate; energy problem; nuclear energy; nuclear reaction; nuclear reactor; nuclear fuel; nuclear power plant; fossil fuel.

8. Спростуйте наступні твердження (не менш, ніж двома-трьома реченнями кожне).

1. With future development of technology, world population may need less energy.
2. The supply of fossil fuels – coal oil and natural gas – is unlimited for they are natural resources.
3. Solar energy demanding solution of technological problems is believed to solve all the present and future problem; of shortage of energy.
4. The future of energy supply in our country must be based on fossil fuels, which is a solution to consider.

9. Дайте відповіді на запитання по тексту.

1. What is the problem that the world is facing? 2. Why is the energy consumption expected to grow? 3. What materials are mainly used for energy generation at present? 4. Of what origin are they? 5. When were wood and coal

the main energy sources? 6. Why are fossil fuels harmful to use? 7. How long are reserves of natural gas and oil expected to last? 8. How is if hydroelectric power generated? 9. Is solar power costly? 10. How long may the existing energy resources last? 11. What are the conclusions that must be made? 12. Can nuclear energy be considered the energy of the future?

10. Перекажіть текст англійською мовою, використовуючи не менше, ніж шість речень.

11. Самостійно прочитайте текст (6 хвилин) і знайдіть відповідь на наступне запитання: «Where and how can solar energy be used?».

Solar Technology without Exotic Elements

Contrary to what we think, water is not only present in the desert but in great quantities too. Whole seas are sometimes there under sands. But most often this water is salty and cannot be used for drinking. So it has to be lifted and desalinated.

The sun's rays can be used to operate a special turbine developing about half a kilowatt. Half a kilowatt seems very tittle. But it is quite a lot in the desert, for it means about two cubic meters of water lifted from a considerable depth, and water means life.

When we think of solar energy and its future, we imagine exotic things. But solar technology is not only great reflectors and concentrators as many people think, it is also such simple things as a turbine producing drinking water.

Besides there can be simple solar water heaters which make hot water available in the coldest conditions. Houses can be heated by the sun in winter and cooled in summer.

Creation of solar technology is not only a technical engineering problem but also a social one. Making our distant desert lands possible to live in is a dream scientists are working to realize.

12. Прочитайте і перекладіть наступний текст і дайте відповіді на поставлені запитання.

1. What device is described?
2. What is it used for?
3. What energy is it run on?

In some hot and dry countries of the world there is a great need in drinking water. They are parts covered with sand and called deserts.

Solar energy is becoming very helpful to those working in the deserts of Turkmenia where water means life. Solar energy evaporators of small size have been tested to produce drinking water, and each unit produced up to five cubic metres of water daily. On sunny days the evaporator is run on solar energy, in cloudy weather it uses the exhaust gases of diesel engines.

The evaporators have proved that they can be very useful and economical in distant areas of our country. As to solar energy which has been attracting our attention lately, it is clear that it can be used for the benefit of man and can be his ally.

Text 13. Nuclear Energy

1. Прочитайте і запам'ятайте значення наступних слів для кращого розуміння тексту.

| | |
|---------------------|--------------|
| demand | вимога |
| conventional | звичайний |
| device | механізм |
| various | різноманітні |
| processing | переробка |
| disposal | видалення |
| to force | змушувати |
| rapid | швидкий |
| tide | прилив |
| benefit | користь |
| challenge | виклик |
| existence | існування |
| prediction | передбачення |
| cost | ціна |

2. Прочитайте і перекладіть текст. Визначте, як можна вирішити проблему нестачі енергетичної сировини.

A very rapid growth of energy consumption has occurred in the twentieth century.

A major problem is that much of the world's energy supply is biased, on fossil fuels. Fossil fuels are limited and their supply is running out. From this it follows that the future of our energy supply must be based on sources other than fossil fuels like coal, oil and natural gas.

Hydroelectric, wind, tidal and solar power require much technological development. New and different sources of energy have to be found and brought into practical use. The problem consists in developing technology to extract energy from nature without causing air, water, thermal or radioactive pollution. The wise use of nuclear energy, based on an understanding of both dangers and benefits, will be required to meet this challenge to our existence.

In the near future about half of electrical supply is expected to come from nuclear sources. There are many factors that will determine the accuracy of this prediction. It is noted that the cost of construction of a nuclear plant is high but the fuel cost is relatively low.

Yet there is considerable confusion in the public mind when comes to

nuclear power plants. There are those who consider it to be a major solution to the world's energy needs. There are opponents with good reason to be critical. In either case we are faced with the rapidly, increasing energy demands of the future.

A nuclear power plant is very much like a conventional steam power plant. The only difference is that the heat used to run the electric generator is not obtained by burning coal, gas or oil but from controlled nuclear reactions.

A nuclear reactor is a device in which these reactions take place.

There are various types of nuclear reactors. All of them operate more or less on the same principle. Yet we always face the fact that the use of nuclear energy requires safe transportation, processing, storage, and disposal of potentially dangerous materials. However the dream of limitless power will force mankind to find solutions to all these problems for the satisfaction of man's needs.

3. Визначте, в якому із значень використовуються наступні слова в тексті.

- | | |
|---------------|--|
| 1. major | майор; мажор; більш важливий; старший |
| 2. to run out | керувати; вибігати; працювати; спливати; виснажувати |
| 3. to extract | видаляти; вичавлювати; видобувати |
| 4. nature | характер; вдача (норов); натура; природа |
| 5. confusion | безлад; плутанина; збентеження |
| 6. reason | розум; причина; доказ; основа |
| 7. case | скриня; футляр; випадок |
| 8. good | добрий; гарний; обґрунтований |
| 9. mind | думка; розум; пам'ять |

4. Розташуйте наступні речення у послідовності викладу в тексті.

1. The present sources of energy and the problems we face.
2. A power plant operating on a nuclear fuel.
3. Nuclear energy and the problems it causes.
4. The present necessity of new energy sources.
5. The factor determining the use of nuclear energy.

5. Дайте відповіді на наступні питання по тексту.

1. Where do nuclear reactions take place?
2. What fossil fuels are used at present?
3. What is the use of nuclear energy based on?
4. What are the energy sources of the future?
5. What happens to the heat generated by a reactor?
6. What is the main problem of our century?
7. Does everybody regard nuclear power a solution to the energy problem?
8. Is a nuclear power plant something radically new?

6. Закінчіть наступні речення за змістом тексту.

1. Sources other than fossil fuels must be found because... .
2. Energy must be extracted from nature but... .
3. Operation of nuclear power, plants involves the following activities... .
4. The power to run the electric generator in a nuclear power plant is obtained...
5. A nuclear power plant is just like a steam power plant as... .

7. Прочитайте самостійно текст і підготуйте розповідь про практичне використання радіації.

Many important economic and social benefits are derived from the use of radio isotopes and radiation. Applications of radiation are found in industry, medicine, agriculture as well as in space exploration.

The oldest and best known use of radiation is for medical diagnosis by X-rays. They penetrate the man's body to different degrees and shadows of bones and other materials appear on a photographic film.

In industry a fabric can be made soil-resistant; a new type of wood and tiles can be produced.

Radiation finds application in crime investigation in agriculture for selection of better, seeds, and for food preservation

The probable age of a piece of art can be determined by testing the paint.

Radiation methods can be of great benefit to history, archeology and anthropology as well, since they can be used to establish dates and events? The determination of the age of minerals in the earth, in meteorites, or on the moon can also be made. The technique is of particular interest in determining the date of the first appearance of man.

8. Перекладіть письмово з словником (Час – 30 хв.).

The discovery of nuclear reactions that yield energy, radiation, and radio isotopes is generally regarded as one of the most significant scientific contributions of the twentieth century in that it showed the possibility of enormous human benefit or of world destruction.

Every natural resource has mixed good and evil. For example, fire is necessary and welcome for giving warmth to our homes and buildings but can destroy our forests. Water is necessary for every living being but in the form of a flood it can ruin our cities and land. Drugs can help cure diseases but can also be evil or even kill us. Explosives are valuable in mining and construction work but are also a tool of warfare. Just as it is the case with nuclear energy—on the one hand, we have benefits of heat and radiation for many human needs, on the other, the possibility of bombs and radioactive fallout.

The key to application for either good or evil very often lies in man's decisions. He must take full advantage of good uses. Urgent national and world problems can be solved by wisdom and cooperation.

Text 14. Hydropower

1. Прочитайте і запам'ятайте значення наступних слів для кращого розуміння тексту.

| | |
|-------------------------------|-----------------------|
| reservoir | водосховище |
| dam | гребля |
| flood | паводок |
| control | контроль; регулювання |
| development | (тут) гідровузол |
| lock | шлюз |
| to discharge | скидати |
| impervious | водонепроникний |
| to impound | загатити |
| head | напор |
| generation | виробіток |
| stability | стійкість |
| safety | надійність |
| property | властивість |
| failure | руйнування |
| treatment | обробка, очистка |
| pumped-storage station | акумулююча ГЕС |

2. Прочитайте і перекладіть текст. З'ясуйте, яка роль греблі як одного із компонентів гідровузла.

With the growth of towns and their industries, with the increase of population and the improvement of living conditions the demand for water rises rendering the work of water power engineers ever more important.

There are so many uses for river water that it seems natural it is always made to serve, more than one purpose. A large reservoir formed by the dam may be used for flood control, for improving industrial and domestic water supply for nearby areas, for irrigation and navigation, for recreation and sport. To accomplish such miscellaneous tasks a hydro-power development built on the river should comprise besides the dam such structures as a power station, navigation locks, spillway facilities, and canals and tunnels for discharging floods, and other ancillary structures of minor importance.

In harnessing a river to make it serve the man a dam, an impervious barrier should be placed in its way, which impounds water and raises the level of the river thus creating the head necessary for power generation. Since dams are to withstand various stresses, much thought should be given to the problems of increasing their strength, water tightness, stability and safety. It becomes all the more important nowadays as the heights of dams have steadily been increased and the 1960s will go down in history as the decade when the dam of around 200–300 m in height became a reality. The fact calls for a drastic improvement

of the methods of design and a deeper knowledge of the foundation character and the properties of the materials used.

Well executed, the dam is of great benefit to the community but if it is not, a dam failure is, perhaps, the most serious man-made catastrophe likely to occur in the peace time. The disasters that took place showed that the mechanism of a dam failure is very complex, that a whole series of effects occur in quick succession. The determination of the true state of stress in a dam undertaken so far now requires a more elaborate treatment as people have come to realize that the best, of theories is useless if the materials used do not comply with the assumptions made about their properties.

Modern industrial growth should not be threatened for want of electric energy and this calls for providing better use of resources of various sorts to attain maximum technical and financial efficiency.

Thus the idea of a pumped-storage station using small rivers or basins appeared. As the name implies, the principle of its operation demands storing water in an upper basin and then directing it into a lower basin where from the water is pumped back into the upper basin to repeat the cycle. The scheme demands a special kind of machinery – a reversible pump-turbine type. The station of this kind readily covers peak energy periods and is most efficient when combined some other type of power plant.

In some countries for lack of any more economically exploitable water power development sites some proportion of the new power demand will be covered by nuclear stations.

Nuclear, conventional thermal and hydropower plants are complementary, but not mutually exclusive. The problem of high load factor and peak load demands is to be solved by coupling nuclear stations, providing base load energy, with hydropower plants dealing with the peaks.

3. Згадайте значення наступних англійських слів та словосполучень і підберіть до них відповідний переклад з правого стовпчика.

- | | |
|------------------|----------------|
| 1. executed | а. десятиріччя |
| 2. complex | б. утворювати |
| 3. barrier | с. складний |
| 4. to realize | д. менший |
| 5. aspect | е. зрошення |
| 6. stability | ф. сторона |
| 7. irrigation | г. стійкість |
| 8. minor | h. перешкода |
| 9. decade | і. розуміти |
| 10. to form | ј. створений |
| 11. proportion | к. частина |
| 12. to associate | л. зв'язувати |

4. З'єднайте слова із двох стовпчиків, утворюючи терміни та перекладіть їх.

- | | |
|---------------|---------------|
| 1.flood | a. water |
| 2.navigation | b. plant |
| 3. to impound | c. failure |
| 4.load | d. lock |
| 5.peak | e. generation |
| 6.power | f. factor |
| 7.dam | g. control |
| 8.power | h. load |

5. Вкажіть, в якому реченні розкрито головну думку тексту.

1. Power generation may be accomplished by thermal and nuclear power stations.
2. River harnessing serves many purposes through building a hydropower development comprising a strong and stable dam.
3. The dam forms a reservoir which contributes to meeting the needs of different fields of human life.

6. Вкажіть, в якому із цих речень (a, b) уточнюються наступні твердження:

1. Harnessing a large river contributes to meeting the needs of the community.
 - a) The demands for water rise making the work of a water power engineer still more important,
 - b) By building a hydro-power development opportunities for irrigation, water supply, navigation and power generation are created.
2. The determination of the true state of stresses in the dam and its foundation should be considerably improved.
 - a) A hydropower development comprises many structures, among them a dam, withstanding great loads.
 - b) Only well-designed and well-built dams are for benefit to man; their failures have most damaging effects.

7. Відповідно до змісту тексту доповніть незакінчені речення одним із варіантів (a, b, c).

1. Dams are placed across the river for ...
 - a) creating a reservoir and generating electric energy;
 - b) impounding water, raising the level of the river for creating the head;
 - c) building a water-power station.
2. Improvement in the methods of dam design is needed as...
 - a) a large reservoir is formed by the dam;
 - b) a hydropower development comprises various structures;

- c) the modern heights of the dams increase the stresses they withstand.
- 3. The dam is of great benefit to the community for...
 - a) its height is steadily increased;
 - b) it makes the river serve many purposes;
 - c) the design of the structure should be improved.

8. Вкажіть, яке із речень (а, б, с) може бути відповіддю на поставлене запитання.

1. What should be done before making a choice between a thermal and a water-power station?
 - a) Full technical as well as financial aspects should be thoroughly examined, taking into consideration the local conditions.
 - b) Resources of various sorts should be used for power generation.
 - c) Thermal power stations demand smaller capital investment as compared to water-power stations.
2. How does a dam help in power generation?
 - a) The dam forms a reservoir which serves many purposes.
 - b) By impounding the river water the dam creates the head necessary for power production.
 - c) The dam is one of the structures which-a hydro-electric development comprises.
3. What responsibility do the modern high dams lay on the designer?
 - a) Modern high dams impound large masses of water.
 - b) With the height, increase, methods of design should be more accurate, the investigation of the foundation character and the materials used should be improved,
 - c) Modern dams are as high as 250–300 m and they create an adequate head.

9. Закінчіть речення, додайте термін, який означає призначення греблі.

*Приклад: The dam forming a reservoir raises the level of the river. Thus it creates **the head**.*

1. The dam helps to prevent river waters in spring and autumn from covering large areas of fields and villages. Thus it provides... . 2. The dam contributes to improved delivery of water to towns and cities, houses and enterprises. Thus, it provides better... . 3. The dam helps to develop agriculture as it stores masses of water, which can be used in the fields in the dry seasons. Thus, it provides... . 4. The dam helps to use the power of water to produce electric energy. Thus it provides... .

10. Складіть план з чотирьох пунктів на тему: «The Dam, its Functions and Design».

11. Підберіть до наступних українських словосполучень англійські еквіваленти.

- | | |
|----------------------------------|--------------------------------------|
| a. споруди другорядного значення | 1. for lack (want) of |
| b. зарегулювати річку | 2. do not comply with the assumption |
| c. для скиду паводка | 3. to decide, in favour of |
| d. через нестачу | 4. to be of benefit to |
| e. не відповідати припущенням | 5. much thought should be given to |
| f. вирішити в користь | 6. to withstand stresses |
| g. витримувати напругу | 7. for flood discharging |
| h. треба як слід подумати | 8. a development should comprise |
| i. на користь | 9. structures of minor importance |
| j. гідровузол повинен включати | 10. to harness a river |
| k. заради | 11. in the name of |

12. Вкажіть, які твердження суперечать змісту тексту. Спростуйте їх декількома реченнями.

1. Large rivers may serve only one purpose, that of water supply. 2. The method of dam design should be improved since the great heights of the structure increase the stresses. 3. A power station is built to harness a river. 4. The dam is placed along the river, thus the stresses it withstands are of major importance. 5. Different kinds of power stations are not mutually exclusive but they may be coupled. 6. A deeper knowledge of the foundation character and the properties of building materials is essential in obtaining structure safety

13. Доповніть наступні речення (не менш, ніж 2-ма або 3-ма припущеннями), розвиваючи висловлену думку.

1. The pumped-storage station generating power at peak energy periods differs from the conventional hydro stations in at least three aspects which are...

2. To assure the security of the dam the designer should provide the main properties of the structure each of which may otherwise have the following consequences...

14. Прочитайте і перекладіть наданий текст усно, без словника (Час –30 хв). Вкажіть, яку додаткову інформацію ви отримали. Визначенням якого терміну є описання: “... – is water pressure created by the difference in the upstream and downstream water levels”.

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High proportion of hydropower in the electric system makes its operation more reliable and stable. The principal change in the pattern of water-power generation during the past decade concerns advances made in the development of pumped-storage techniques. Installations of this type now rate among the most powerful hydroplants in the world. It is expected that pumped-storage

stations operated in combination with nuclear stations will carry loads of fairly long peak periods. The reservoir capacity for pumped-storage generation will have to be sufficient for these much longer periods of operation than now.

In some countries it is difficult to find sites where high enough head and much water can be utilized. Some new solutions are to be found. In Japan, for instance, an interesting idea was proposed to construct a sea-water pumped-storage station with the ocean as a lower basin. As a result of a topographic investigation a site near Atashika was considered suitable for a high head and a reservoir located 470 m above the sea level, with plant capacity of 2000 MW.

15. Уважно прочитайте текст. Зробіть письмовий переклад (Час – 5 хв.).

In 1963 the greatest known disaster occurred in Northern Italy. A large landslide over a mile long and a mile wide fell down into the reservoir of the dam. In about 30 seconds it completely filled the reservoir and, as a result, a huge wave of displaced water 100 m high was formed and it passed over the dam flooding and destroying everything in its way downstream.

The catastrophe took only a few minutes and the seismic effect caused by this landslide was recorded over a wide area in Europe. In spite of the fact that the water pressure reached millions of tons and, of course, much exceeded the design values the dam withstood it without any damage. This proved once more the structural strength and stability of the arch dam. At the same time this event emphasized the critical importance of thorough geological studies not only of the rock at and near the dam itself but also of surrounding valley slopes.

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ДОДАТОК А

Supplementary Texts (Додаткові тексти)

Text 1. Building Materials

The mortars used in bricklayers' work consist of an admixture of lime, or Portland cement, and sand. A knowledge of the properties of these materials is very necessary to the craftsman, if he is to obtain the best results from his labours.

Lime is manufactured by the calcination, or burning, of a carbonate of calcium, of which chalk is the commonest example. During calcination, decomposition occurs, and carbonic acid and water are driven off, an oxide of calcium (quicklime) remaining.

If water be added to lumps of quicklime, rapid combination ensues, great heat and volumes of steam being generated. The lumps disintegrate with a series of small explosions, and are eventually reduced to a very fine powder. This process is termed slaking; and when making mortar it is highly necessary that it should be thoroughly carried out, as any unslaked particles subsequently expand and seriously damage the work.

Limes may be divided into three distinct classes –

- Rich limes.
- Poor limes.
- Hydraulic limes.

Rich Limes contain not more than 6 percent of impurities, slake very rapidly, and are entirely dependent on external agents for setting power. They are chiefly used for interior plasterers' work.

Poor limes contain from 15 percent to 30 percent of useless impurities, and possess the general properties of rich limes, only to a lesser degree. They are only fit for unimportant work.

Hydraulic limes contain certain proportions of impurities, which, during calcination, combine with the lime, and endow it with the valuable property of setting under water, or without external agents. The proportions of these impurities determine whether a lime is eminently, moderately, or only feebly hydraulic. The principal limes used in making mortar for constructional work are of the Greys tone variety. These have hydraulic properties, and will take a large proportion of sand, without weakening their setting powers. The usual proportions are from two to four parts of sand to one of lime.

The setting of lime depends largely upon its absorption of carbonic acid from the atmosphere. The particles return to their original form of a carbonate, and crystallize. These crystals have a tendency to adhere to anything rough, such

as sand or the surfaces of a brick.

Pure lime mortars built into thick walls never harden in the interior. The crystallization of the exterior of the joint when set prevents access of carbon dioxide to the inside of the wall. For this reason, pure lime mortars should not be used for constructional work, only those which are not entirely dependent on external agents. For more important work, where great strength is required, Portland cement is used instead of lime.

Portland Cement is an artificial cement, manufactured by calcining chalk and clay, or river mud containing certain chemical constituents in definite proportions. The chalk and clay are ground and mixed into a slurry, which after being strained through very fine sieves, is pumped into an orifice in the top of an inclined revolving cylinder. A blast of intense flame is directed through this cylinder, which is lined with firebrick. As the slurry drops through the flame, it is burned into small clinkers, which are afterwards ground exceedingly fine in specially constructed mills, and then passed through sieves, having as many as 35,000 meshes to the square inch. The powder is aerated by being spread on wooden floors, with an occasional turning, to ensure the thorough slaking and cooling of all particles. It is then put up in sacks ready for use.

This process of aeration has now been superseded in many cement works by the addition of a small quantity of gypsum (plaster of Paris), which retards the otherwise rapid-setting tendency of a freshly-ground cement.

Sand. – When used for mortar, sand should be angular in grain, free from clay or dirt, and moderately coarse. If too fine, the proportion of lime or cement will have to be considerably increased.

Mixing. – This should be carried out on a close-boarded platform, or stage. In the case of lime mortar, sand is best measured when brought to the stage, and the heap opened out into the form of a ring. The correct proportion of lime is measured into the ring, clean water being added to start the slaking, and more as the process advances. When the generation of steam ceases, the mass should be stirred with a long-handled, hoe-shaped tool called a larry, until a thick, cream-like consistency is obtained. The sand may then be gradually drawn into and thoroughly mixed with the lime by means of the same tool. The mortar should be allowed to stand for some days before use and again well beaten up with larry and shovel.

For cement mortar, the sand is measured and heaped on the stage, and a bottomless box of definite capacity is placed on the top of the sand. This box is filled with cement, and then removed. The dry heap is turned over at least twice and opened out into a ring. Clean water is added in sufficient quantity to wet the whole mass, which is then thoroughly mixed in the same manner as lime mortar.

Cement mortar should be used directly after being made, and should not be subjected to further mixing after setting has commenced. If this is done, the cement rapidly loses its strength, and further repetition would render it practically inert.

The proportions of sand and cement or lime, are from two to four parts of

sand to one part of either, according to the class of work for which the mortar is required.

Another mortar mix which is becoming popular, and which some engineers have proved to be stronger for some classes of work such as reinforced brickwork, is 4 parts of sand to 1 part of Portland cement and 1/8th part of lime.

On large works, mixing is usually performed in a mortar mill, which consists of a pair of heavy millstones and a pan, or container into which the measured ingredients are fed. The mill, by reason of its large and rapid output, has a distinct advantage over hand-mixing. It also has many disadvantages unless operated by a reliable man. Grinding may be carried on to such a stage that the sand is ground so fine as to render the original quantity of lime or cement inadequate. Cement mortars may be also ground long after the initial setting has commenced, and thus rendered useless for the required purpose.

Text 2. Building Stones

Classification – Building stones are classified in a general way under the heading of igneous, sedimentary, and metamorphic rocks.

Igneous Rocks. – These are formed by fusion below the earth's surface.

Sedimentary Rocks. – All sedimentary rocks, which include sandstones and limestones, come under this heading. They are formed in deposits by the agency of water or winds, and are known as stratified rocks.

Metamorphic Rocks. — These may be either of the above when, changed in formation by heat and pressure. Marbles and slates come under this heading.

Granites. – Granites are igneous rocks made up of granular particles, the latter being crystalline, and usually composed of quartz, felspar, and mica.

Granite has never flowed out over the earth's surface as lava, but became consolidated at a great depth under extreme pressure.

Quartz. – The durability of granite depends largely upon the amount of quartz and its combination with other minerals, quartz being practically indestructible. Quartz, sand, and the chemical named silica may be said to be interchangeable terms.

Felspar is the most easily distinguished mineral and its colour varies considerably. The pink felspar is known as orthoclase, and is a potash felspar; this constituent is very characteristic in granite. Sometimes the white soda or lime felspar known as plagioclase is found. Felspars are commonly found with about equal quantities of quartz.

Mica is of two kinds: Muscovite, which is potash mica (light); and biotite, which is a dark brown, iron and other substances being present. The light micas are more stable.

The proportions of mica should be small compared with quartz and felspar. Hornblende and augite sometimes occur and take the place of mica; the stone is then known as a syenite.

Iron pyrites produce oxidation and hydration either in the form of local

spots, or as a uniform tinge of brown, and should always be looked upon as a fault.

The characteristics of a good granite are: fineness of grain, the disposition of the various minerals forming the mass, and the high percentage of quartz present.

Sandstones. – Sandstones are formed by the disruption of preexisting rocks due to the action of winds or moving water, the particles being deposited in beds, or strata. The chief constituents are the original quartz crystals (or grains) and the cement that binds them together. The quality of a sandstone depends upon the cementing material. The presence of an inferior cementing material is the chief cause of disintegration upon the exposed surfaces. The cementing materials are numerous, and may be silica, clay, iron oxides, calcite, or dolomite. Usually there is a combination of these substances, but one kind predominates. Sometimes the grains, or quartz crystals, are consolidated by heat and pressure as in quartzite. Sandstones vary from fine grain to coarse grit stone, whilst the colour depends chiefly upon the cementing material. Red, brown, and yellow are due to oxide of iron. White owes its colour to the combination of clear quartz with white argillaceous or clay-containing matter free from iron stains.

If the stone contains a high percentage of mica distributed along the planes of bedding it is known as a micaceous sandstone. Great care should be exercised in placing sandstones in the building so that the laminae are horizontal.

Limestones. – The chief characteristic of limestones is the presence of a large proportion of carbonate of lime. They were formed chiefly by the accumulation of shells or calcareous skeletons of marine or fresh water organisms, which were deposited as sediment in the waters of seas or lakes. The common or chalk limestones are more suited for the production of lime. The oolitic limestones are of marine origin; they are composed chiefly of carbonate of lime, with other substances, such as carbonate of magnesia, silica, alumina, and iron. The oolite resembles the roe of a fish, and results from the accumulation of carbonate of lime around the small nuclei of fragmentary shells or grains of mud or sand. They are of spherical or oval shape, and can easily be seen with the naked eye. They vary in hardness and texture; some are fairly fine, others coarse and porous.

All limestones are soft when first quarried, but harden on exposure to the atmosphere.

The stone should be uniform in colour throughout in the case of both sandstones and limestones.

Text 3. Concrete Structures

Introduction. – Reinforced concrete is an excellent building material, adaptable to many uses. It is strong, fire-resistant, and durable when well made. On the other hand, it is a heavy material, and its use generally results in rather

bulky members so that its greatest field of usefulness is in relatively low buildings and in structures where its mass, rigidity, and strength are advantageous. Tall buildings may be made of reinforced concrete but, when they are more than six or eight stories high, it is desirable to question the economy and advisability of such construction for industrial purposes.

Structures built of concrete should be planned upon the basis of the characteristics of the material itself, and upon the essential nature of the construction processes. Concrete is not a substitute for structural steel in terms of member for member. Architects and engineers, figuratively, should throw away many of their ideas derived from experience with steel-framed structures, then tackle the project at hand on the basis of utilizing the concrete to the best advantage. Many have done this and are now producing plans for concrete structures that are both attractive and practical.

Here, as elsewhere, the designer should make sure that concrete is the most desirable material for a structure and should give careful consideration to the general proportions of the structure and to the uses for which it is intended. Because of the nature of concrete construction, careful planning is needed in the first place because extensive alterations and radical changes of future use are likely to be both difficult and expensive.

Some General Principles. – The planning and the detail designing of concrete structures are so influenced and circumscribed by practical procedures and considerations that the engineer should attack such problems entirely upon the basis of the best use of this particular material. He should remember constantly that, except for possible precast members, he is creating a structure to be made of "artificial stone", of material placed in position in a plastic state so that it must be supported temporarily by something other than itself, and of a material that will and should conform to every detail of the surfaces with which it is in contact when the plastic concrete is deposited.

Not only does concrete improve with the use of good materials, but its quality depends largely upon the excellence of the workmanship used in its manufacture, the adequacy and thoroughness of its placement, and the care with which it is cured. The attainment of the intended high quality is almost completely in the hands of the artisans, who, in the field, convert heaps of aggregates, barrels of cement, and gallons of water into a structure for the use of man. Not only does its strength depend upon highly skilled labor, but the quality of its surface and the beauty of its appearance do likewise. It is foolish to forget these obvious truths. Yet occasionally such important operations are delegated to unskilled, inefficient workmen. Fortunately, this is the exception. Expert workmen produce surprisingly fine results.

When planning concrete work, an engineer should consider the following matters, along with many others:

1. Poured-concrete structures ordinarily try to act largely as continuous frames. This is inherent in their nature. In fact, if continuity is to be avoided

without detrimental or objectionable cracking, special measures generally must be employed. Hence, the advantages of continuity can and should be utilized.

2. Since concrete is especially advantageous in resisting compression, its use is more desirable for columns and walls than for long-span beams. The arch, the dome, the cylindrical barrel, the rigid frame, the flat slab, and beam-and-girder construction are among the types most suitable for the use of concrete.

3. So-called "framed" connections are difficult to make in reinforced concrete. Junctions of beams to beams should be made by pouring the adjoining members monolithically if possible because, otherwise, it is difficult to provide for transverse shearing forces. When beams rest upon walls or columns, the construction joints should be located so that each beam has adequate bearing upon the supporting member.

4. Not only is simplicity of shape desirable in order to minimize the cost of formwork, but the duplication of parts permits the reuse of forms. It is obvious that heavy forms high in the air are costly.

5. Architectural details should be planned with consideration not only for the fabrication of the forms but also for the removal or stripping of them without damage to the concrete, or undue harm to the forms themselves. The details should also be such that the concrete will conform completely and easily to all the contours, projections, and recesses of the forms without spalling, honeycombing, slumping, air-trapping, and surface imperfections.

6. As the desired surface texture of concrete structures is something to determine carefully in advance, the structure should be planned so that the desired effects will be attained. Good effects will not just happen of their own accord; the bad ones do that.

7. The sequence of pours and the location of construction joints should be determined during the general planning of a structure in order to ascertain that what is desired can be built practicably. The volume of concrete that can be placed in one continuous pour depends upon the capacity of the equipment and upon the nature and details of the structure. It is very important to avoid the incomplete placing of a pour by depositing a portion of the concrete at one time, then pouring additional concrete alongside or on top of the first part after the latter has only partly set. Settlement or displacement of forms, an attempt to vibrate or otherwise compact the concrete, and any other operations that disturb the original material after it has partially set but is not yet strong will generally damage the concrete. After the first part has hardened, there is likely to be an unexpected plane of weakness at the junction with that deposited later. Of course, a tall pier shaft may be poured almost continuously and over a period of many hours if the work is performed properly. However, this is seldom easy of accomplishment in the case of extensive foundations, walls, and floors.

Precast Concrete. – The use of precast-concrete members and parts of members is a matter that warrants careful study. The possible savings in formwork are obvious, but the handling of heavy pieces in the field may require special equipment. If portions of a structure are to be precast, the original

planning should be based upon this fact, and all details should be worked out accordingly. Precast parts can be incorporated in an otherwise poured-in-place structure, but provision should be made for the support of these heavy pieces during construction. Most poured-concrete structures gain much from the stiffness derived from the continuity secured at the junctions of parts, whereas a building made of heavy, loosely connected, precast parts may be inherently undesirable. It is possible, however, to connect precast parts by means of poured sections at the junctions if proper bonding of reinforcement, is provided. Although such procedures have not been common in the past, their use should be investigated with an open mind. Because of the possibility of appreciable economies, the use of precast parts will undoubtedly increase in the future.

Text 4. Fire Resistance

The ability of a roof to resist fire from without and within the structure is so important that an engineer should consider the hazards very carefully before he uses combustible materials in the construction of roofs of important structures. Heavy timber framing with tight, thick sheathing and devoid of "kindling wood" is often so slow burning that it is suitable for various structures; wood may also be treated with chromated zinc chloride or other chemicals that retard its combustion greatly.

The designer should remember that large, flat, tight, horizontal surfaces made of wood will not burn easily; similar surfaces in a vertical or steeply sloping plane will burn more readily. If the air cannot circulate easily so as to provide an adequate supply of oxygen, combustion will be retarded. Exposed platforms, open construction composed of small members with free circulation around them (such as stairways), wooden partitions and floors without fire stops to prevent the flow of air, vertical shafts, and hatchways — these are the kinds of construction that may endanger the safety of a wooden building. Therefore, wooden sheathing on a roof may not be too great a fire hazard if the supporting framework is incombustible, and if the contents of the building are not highly inflammable.

On the other hand, bare steel, although incombustible, is not fireproof but may soften and yield when heated sufficiently. Concrete of adequate proportions will endure considerable heat unless it becomes badly spalled by the effects of heating and then chilling by cold water, or unless the heating effect lasts long enough to dehydrate the cementaceous compounds. Bricks, tiles, and even ordinary plaster on ; metal lath are, of themselves, fire-resistant to a considerable extent. Most of the ordinary roofings, except wooden shingles and bituminous coverings, will not burn easily, if at all.

Steel Floors. — There are several types of steel floors, and floors with steel parts to carry the loads, where concrete or some other ; material serves as a filler to close up the spaces and to form a suitable surface.

Bare steel plates are frequently useful for platforms, floors that are i

subjected to the wear of metallic wheels, floors that are heated severely or subjected to the spatter of molten materials, parts of floors that may have to be dismantled and re-erected frequently, and for the flooring on hatch covers that must be strong and light in order to facilitate handling them. Checkered floor plates are rolled with various patterns, the purpose being to secure a nonskid surface. This is an important feature because flat steel is slippery when wet or greasy. Steel gratings are used frequently instead of solid plates because, for the same weight of steel per square foot, the former are stronger and stiffer. However, the designer should not forget that dirt and small objects dropping through the openings of the grating may be objectionable or even hazardous; furthermore, the passage of smoke, gases, and hot air through them may be disadvantageous. Closing the openings in gratings by filling them flush with concrete or mortar is seldom satisfactory because the latter may eventually drop out unless the grating provides a mechanical lock for the masonry.

Text 5. Steel Mill Buildings

Adaptability of Steel for Industrial Buildings. – Structural steel rightfully holds an important position among the materials that are adapted to use in the construction of industrial buildings. Its prime function is that of constituting the skeleton framework which supports the roof and side coverings together with any other parts or equipment that must be attached to or supported by it. Steel is non-combustible, strong, yet relatively light in weight for its strength; it is ductile, reliable, and generally available; it can be fabricated in advance to form members of the desired strength and dimensions, which can be erected quickly in the field where strong connections are easily made. Thus, steel is well suited to use in large plants having long spans, heavy loads, and large clear heights. It is also adapted to use in small structures.

As a material for the framework of industrial buildings, steel has two very important advantages:

Almost any structure within reason may be built of structural steel. This is a tremendous asset because of the great variety of shapes and sizes needed to house various industries. A steel-frame structure may often be remodelled or extended to suit changed conditions, new processes, and even completely new uses. Sometimes this is exceedingly advantageous. By the use of burning, welding, and riveting, extensive alterations may be made in the field without prohibitive expense.

Another slight advantage, which may become important under special conditions, is the fact that the entire building may be dismantled and re-erected elsewhere when circumstances require it.

How can one tell whether to make a building out of steel or some other material? There may be simple but important matters that give the answer; e. g., personal preference, available materials, effect of weight on foundations if the soil is weak, suitability for the purpose, fire hazards, similarity to other buildings

previously used and found to be satisfactory, similarity to adjacent buildings to be constructed, and speed and ease of construction. However, the required strength of the material and the relative economy may overrule these other factors when spans are long and loads are heavy.

The term “mill building” as used here denotes a single-story structure having one or more relatively wide aisles of considerable length and large clearance. The siding and roofing may be one or more of a wide variety of materials; generally, however, the whole construction is relatively light. Such a building generally houses large, heavy machinery supported directly on the ground; it may or may not have crane runways, trolley beams, or other overhead equipment for transporting materials. The manufacturing operations within it are usually those which require large areas on a single floor, and the handling of heavy or voluminous objects. Obviously, such buildings require long roof beams or trusses to span the aisles, slender but strong columns to carry heavy vertical loads, and substantial bracing to resist the wind forces against such large exposed wall areas. For all these, structural steel is admirably suited.

When planning the framework of a steel building, one should bear in mind the fact that commercial sections of steel are rolled in various sizes and shapes – but in these only. Unusual, complicated, and built-up members will naturally cost more per pound than will simple rolled sections without large fabrication costs. When special members are needed, however, they can be made up by riveting and welding, but they should be so planned that they can be composed of parts that in themselves are standard shapes,

The variety of shapes, sizes, and details of industrial structures is about as extensive as the needs for which each individual building is designed.

Text 6. Air-conditioning

Air-conditioning is the bringing of air in a building to a desired temperature, purity, and humidity throughout the year to maintain healthy and comfortable atmosphere.

Air-conditioning may be divided into two main sections: one for the processing of materials in industry; the other for human comfort. It has been found that there is an optimum condition of temperature and humidity at which the processing of different materials may be carried out with the minimum of wastage and the maximum of goods of specification quality. The system is therefore designed to produce air of predetermined temperature and moisture content and to keep it so despite all external influences. Such air is filtered free of foreign material.

Conditioning air for human comfort may also be divided into two main sections — winter and summer. Frequently, the systems installed in office buildings provide control during both seasons. Complete air-conditioning provides the following services.

First, filtration of the air both in winter and summer to remove dust.

Second, circulation of the air at low velocity and with proper diffusion to prevent draughts and maintain a uniform temperature and humidity at all parts of the inhabited space.

Third, introduction of enough fresh air from the outside atmosphere.

Fourth, heating of the air in winter.

Fifth, cooling of the air in summer below the outside atmosphere.

Sixth, humidifying the air in winter to a relative humidity of at least 20-25 per cent.

Seventh, dehumidifying the air in summer to a relative humidity not exceeding 55 per cent.

The basic pieces of equipment are the filters, preheat coils, humidifiers, reheat coils, additional cooling coils, fans and controls. The control of air purity can be achieved in various degrees. As a minimum control some sort of filtering must be done near the entrance of the air-conditioning system. Possibly the most efficient filtering device is the electrostatic precipitator.

Air conditioning for human comfort is employed in both large and small installations, such as theaters, office buildings, department stores, residences, airplanes, railways, cars and

People are comfortable when they are neither too cold, nor too warm and when the air about them is neither too dry, nor too damp and is not stuffy or dusty. To bring about these desirable conditions the heating or air-conditioning apparatus must be capable of maintaining the following conditions inside the house, whatever the conditions outside may be.

To avoid stuffiness, the air should be given a certain amount of motion. Under winter conditions this must be sufficient to distribute the heat uniformly throughout the rooms. It must not be too cold at the floor, not too hot at the ceiling. A stove causes the hot air around it to rise up toward the ceiling and cooler air to flow toward the stove. A radiator acts in this respect like a stove. Warm-air registers bring heated air into a room with a certain motion or velocity which imparts movement to the air already in the room. An outlet for this air should be provided in order to have good ventilation. In summer time much greater air motion is needed, enough to change the air in a room completely from three to ten times per hour. Sometimes a fan is placed in the attic to blow the warm air out and to cause the cooler night air to flow through open windows. When this is done, air in the house can be expected to be changed completely every two or three minutes. When air is brought into a house from outside, heated in a furnace and distributed through all the rooms, it ought to be cleaned by passing it through "filters" before it enters the furnace.

Text 7. Different Methods of Heating and Ventilation

Various methods of heating have been evolved and are in use at the present day, and a knowledge of the characteristics and relative costs is necessary in making a selection of the most suitable type for any particular building.

There are two main divisions of heating systems: direct and indirect.

Direct systems are those in which the fuel is consumed in the room to be heated.

Indirect systems are those in which the fuel is consumed outside the room, the heat being conveyed to the room by a medium such as steam or hot water.

Direct systems

Direct systems are chiefly used for intermittent heating, or for heating isolated rooms.

There are many forms of direct heating, such as gas and electric overhead radiant heaters, in which a metallic plate is heated to a high temperature so as to emit strong heat radiation; and gas and electric unit heaters in which air is delivered to the room by a fan and is warmed in its passage through the unit by heated elements. There are also low-temperature gas and electric radiant panels for fixing to walls, ceilings, etc., also electric tubular heaters for fixing near skirting level. These systems are generally more expensive in first cost than those enumerated above.

Indirect systems

Indirect systems are chiefly used for the continuous heating of a number of rooms or large buildings from one central source, hence the name "central heating". This does not necessarily imply that the heating source is strictly central, indeed it may be at a considerable distance from the building.

This class of system finds its greatest application in large buildings of all types.

The advantages of the indirect system are –

- (a) Fuel and ashes are kept outside the occupied space.
- (b) Individual flues are not required.
- (c) Cleanliness.
- (d) Equable temperature maintained in all parts, easily controlled automatically.

The disadvantages are –

(a) Heat is lost from main piping where this is outside the occupied rooms. This loss can be minimized by proper insulation of the pipes.

(b) Labour is required for stoking and removal of ashes. This applies only with solid fuel and can be greatly reduced with automatic firing.

The medium employed for the transmission of heat is either steam, hot water, or heated air.

Steam. – In this system steam is generated in a boiler partly filled with water, and the steam is conveyed through pipes to radiators, unit heaters, etc., in the rooms to be heated. The steam is herein condensed into water which is preferably returned to the boiler through a system of return piping.

The advantages of steam are – low heat capacity, hence quick heating up and cooling down; low cost due to high temperature of heating surfaces.

The disadvantages are the burning effect on dust particles in the air due to the excessively hot surfaces, and the lack of regulation. To overcome the latter

the vacuum system has been developed which permits of temperatures in the radiators being maintained below the boiling point of water.

The lack of regulation referred to means wastage of heat in mild weather, hence higher fuel consumption and running cost than with a carefully controlled hot water system.

Text 8. Pipes

Copper pipes are permitted for use inside premises subject to the gauge complying with water company's regulations. Such pipes are simple to fix and have a neat appearance.

Galvanized wrought-iron pipes may or may not be permitted. Some authorities will only allow such pipes on the outlet side of a metered supply. Where the water is of a hard nature they may safely be used, owing to the formations of an insoluble coating of carbonate of lime. Galvanized wrought-iron pipes, though cheap, are little used for domestic supplies, as they are subject to corrosion at the joints and elsewhere where the galvanizing has been disturbed.

There are three grades of iron pipes, known as "gas", "water" and "steam" strengths, and for water supplies the steam quality should be specified.

Whatever type of service pipe is laid, it should be at a reasonable depth below the surface of the ground, usually not less than 2 ft. 6 in., to guard against the effects of frost. In addition, any part of the pipe which may be in an exposed situation should be properly protected.

Having excavated the ground to the required depth and exposed the water main, the next step is to apply to the water company, who will make the actual connection by supplying and fixing a ferrule for the connection.

Mains are tapped under pressure by a special machine consisting of a watertight box which is attached to the main by means of a chain. The hole is drilled and tapped, and by revolving the cover it is possible to bring the ferrule directly over the hole, into which it is screwed down.

This method allows the work of a connection to be made without shutting off the water in the main. In some cases, however, the connection may be such that a tee-piece has to be inserted for a large branch. Where this is so, it is necessary to isolate part of the main by shutting off the water by means of the valves in order to carry out the work. To cause a minimum of inconvenience, it is best to do the connection late at night.

Where it is intended to use wrought-iron galvanized pipe for the service connection, it is usual to lay the pipe from the stop valve to within approximately 2 ft. 6 in. of the water main. The tapping of the water main is then made by the water company's workmen and a ferrule inserted. Next, about 2 ft. 6 in. of lead pipe is fixed between the ferrule and the iron service pipe, by means of wiped joints and a plumber's union. The provision of the short length of lead piping is necessary to allow for the pipe to give a little without causing

trouble. Where the service pipe is in lead, the connection is made direct to the ferrule with the usual wiped joint.

When laying the main service pipe from the main to the building, care should be taken to avoid laying the service pipe through any drain inspection chambers or through any place where, in the event of the pipe being or becoming unsound, the water would be liable to become fouled or to escape without observation.

The natural tendency is to utilize the same trench as the drain occupies to save excavation, but the best method is to lay the service pipe in a separate trench altogether. In any case, where it may be impracticable to do so, the water company should be consulted.

They may allow the pipe through foul soil, provided the pipe is sufficiently protected from contact with such soil, either by being carried through an exterior cast-iron tube or by some other approved means.

Text 9. Drainage

General Principles Applicable to any Drainage Scheme

1. The diameter of the drains should be 4 in. for domestic buildings, and this size is usually proportionate to the volume of liquid expected through the pipes.

2. Where a number of houses are drained by a single pipe, or in cases of large buildings, then a 6-in. pipe is generally required for part of the drainage system.

3. Self-cleansing velocities are required, and this means that the drains should be laid to gradients of 1 in 40 for 4-in. and 1 in 60 for 6-in. pipes, where practicable. It is harmful to lay pipes to an excessive gradient or a flat gradient, and care should be exercised to obtain the right fall.

4. There should be means of inspection, usually obtained by the construction of inspection chambers suitably placed.

Separate, Partially Separate, and Combined Drainage Systems

The type of sewage in any given town determines the type of drainage required. If separate, two separate sets of drains are required - one to take off roof water and general paved drainage, usually known as surface water; the other to remove the sewage and wastes from sinks, baths, lavatory basins, etc., named foul water. Separate sewers increase the building costs a little, but the system is favoured, particularly where it is desirable to keep the volume of sewage at a minimum owing to the cost of pumping.

The public surface-water sewers discharge into streams. Consequently there may be quite a number of independent long lengths of surface- water sewers with outlets at convenient positions on the route of a stream or river passing through the district. The foul-water sewers cannot be treated in a similar manner. The sewage must be treated before disposal. The partially separate system still requires two separate sets of drains, and is similar to the separate system, with the exception that part of the roof water may be drained to the foul sewer.

Usually the rain from the rear of the roof is dealt with by the foul drain, while the rain from the front of the roof, pavements, and street surfaces is discharged to the nearest water course. If the system is combined, one set of drains must convey all soil and surface-water drainage.

Where separate drainage systems are called for, the authorities exercise special care with regard to the supervision of the connections to the public sewers. It is most important that no mistake should be made with the identification of the sewers; otherwise a wrong connection causes endless trouble and danger to public health.

If a foul-water drain is inadvertently connected to a surface-water sewer, the faulty discharge may be easily located at the outlet of the sewer to a stream; but the chief difficulty is locating the property wrongly connected once the work has been completed. The danger of wrong connections cannot be ignored; but there is little to fear if the builder makes an inspection before confirming the drain connection to the sewer.

Each system has advantages according to local conditions. Where two sewers are used, the foul-water sewer can be reduced in size. The volume of foul water to be treated is considerably less than the combined system, and where pumping is essential there is a saving in the outlay and annual expense of the pumping installation.

Natural water courses running through a district often effect a great saving on drainage costs, because it is quite reasonable to run surface-water drains to any convenient outlet on the course of stream and save excess piping.

A separate drainage system almost doubles the cost of drainage as compared with the combined system. There is, however, less likelihood of flooding during times of abnormal rainfall.

Drains

Drains and sewers must be formed of good sound pipes of glazed stoneware, heavy cast-iron, or other equally suitable material. The size will vary according¹ to the volume of drainage, but it is essential that the pipes should be of adequate size and laid to a proper gradient, with suitable watertight Joints. The minimum internal diameter for a sewage drain is 4 In., and It Is the usual practice to use this size for most work of a domestic nature where the work consists of separate units with separate sewer connections. House drains should be laid in a similar manner, as already described for sewers. The work, however, is usually less involved, owing to small sizes and shallow depths. It is best to use the sight*rail method for gradients, although frequently a tapered board is used for setting out the fall of the drain.

This method, although not so accurate, is satisfactory for the construction of short lengths of drain. A suitable tapered board cut to the required fall is used with a spirit level for grading the trench bottom.

The following are some general principles:

1. A good foundation is essential; therefore the best method is to lay a 6-in. bed of concrete, even if the soil is firm.

2. Avoid, if possible, passing drains under a building. Where no other means are practicable, then surround the drain with 6 in. of concrete or lay in cast-iron pipes and provide suitable access at each end of any straight length which passes underneath a building. The access, of course, must be provided outside and convenient for rodding purpose

3. Keep the drain about 4 ft. away at least from the external walls. Where circumstances will not permit this and the drain is adjoining the wall, make sure that concrete is carried up to underneath the footings of the wall.

4. Where a drain passes through a wall it must be protected against the weight of the wall by constructing a relieving arch or other similar support.

5. If the levels are such that part of the drain is to be above ground, then use cast-iron pipes and construct suitable pier supports adjoining the joints.

Text 10. Natural Ventilation

Small domestic buildings, offices, hotels, and other places with small floor areas are ventilated by natural means depending largely upon the provision of suitable inlets and outlets. The fittings used are too well known to set down in detail, but briefly they comprise: windows, lantern lights with sides to open, fanlights, hopper sashes, revolving cowls, draught window boards, valves and air vents, "hit and miss" ventilators, tobin tube inlets, fireplaces, doors, electric fans, etc.

With regard to the tobin tube care should be taken to see that this fitting receives attention, otherwise after a number of years the receptacle may be found full of filth owing to misuse. It is not unusual for careless people to deposit cigarette-ends, waste paper, etc., into the open ends of the ventilator. The usual height of 5 ft. to 6 ft. is convenient for this misuse, particularly as few people realize their real purpose.

This type of ventilator is used mostly in public buildings, church halls, billiard halls, etc., and can be quite efficient if given periodic attention.

Natural ventilation has the advantage of being cheap to install, and provides healthy and stimulating conditions, provided the inlets and outlets have been designed with skill.

Artificial Ventilation. – In the case of large floor areas, such as we have in designs for theatres, factories, large public halls, and other similar buildings, it is necessary to resort to artificial ventilation, which may be as follows:

- 1) Vacuum or exhaust ventilating schemes.
- 2) Plenum or propulsion ventilating schemes.
- 3) Some combination of the above systems.

These systems will be described in detail.

Vacuum Ventilation. – This is a system of ventilation whereby the internal air is extracted by suitable fans. The ingoing air is induced through windows and other similar inlets already described for natural ventilation, and a steady flow of air is maintained by means of the extraction fans.

Various types of fans may be used. They are generally made of metal of a rotary design and housed in a convenient part of the ductwork. Care must be taken to see that the ducts are fairly straight, and with easy bends if necessary. Avoid right-angled bends, which impair the efficiency of the system owing to friction.

Fans are usually driven by electric motors, but other power may be utilized where electricity is not available.

With the vacuum ventilating system there is no control of the incoming air; therefore this system can only be employed successfully where the surroundings are not noisy and windows can be opened to admit clean air.

Plenum Ventilation. – Control over the incoming air is an important feature of this type of ventilation. Where the conditions are such that the surroundings are noisy and the air is fouled by smoke and dust, the plenum system can be contemplated to provide clean air at the correct temperature and humidity. The air is drawn into the building by a fan, and is discharged through ductwork at suitable positions; conveniently placed outlets abstract the vitiated air through ducts controlled by an extraction fan or smaller power than the inlet fan. A slight pressure is created owing to a large rate of incoming air than that which is extracted, and consequently any leakage must be outwards.

The plenum system of ventilation is costly to install, owing to the necessity for expensive apparatus consisting of propulsion and extraction fans, air heaters, washers and filters (these vary according to circumstances), and distributing ductwork for the incoming air and outgoing air.

A typical arrangement of plenum heating suitable for a large auditorium is as follows: The air coming in is heated by a heater battery, fed from an independent boiler, feeding wrought-iron gilled tubes which have a good radiating surface. In summer, however, the air can be cooled by passing through the same battery fed by an ammonia refrigerating plant supplying cold water instead of hot water from the boiler.

Text 11. Ventilation and Water Heating

Adequate ventilation of buildings has received increased attention during the last few years. Low ceilings, small window areas, back-to-back houses, and excessive densities are things of the past, and now every endeavour is made to ensure a free circulation of air about buildings for the purpose of efficient ventilation.

Building byelaws prescribe the minimum heights of rooms and amount of open space to be provided in the front and rear of every building. The size of windows is controlled by the floor area of each room, and usually windows in habitable rooms should be equal to at least one-tenth of floor area. Rooms without fireplaces are to be ventilated to take the place of the chimney flue, which is usually regarded as a good ventilator. Another important clause controls the minimum heights of rooms.

It will be seen, however, that the building byelaws in this respect are useless unless some control is exercised over the grouping of building units. It is absurd to insist on suitable means of ventilation if it is permissible to construct buildings close to one another; thereby impeding the circulation of fresh air. It is now impossible to crowd dwellings together and consequently the byelaws with regard to ventilation have greater significance.

The constituents are mainly nitrogen and oxygen and suitable means have to be adopted to ensure a constant supply of air of this composition for the maintenance of life.

From experience it is found that approximately 3,000 cu. ft. of air per person per hour is required in enclosed spaces in order to maintain healthy conditions. This figure forms a basis for calculating the size of efficient mechanical ventilating schemes.

Take a room 10 ft. wide by 10 ft. broad and 10 ft. in height. The air we breathe is at first taken from common stock. When the air is breathed back it contains gaseous impurities which contaminate the remaining air until the time arrives when the air becomes so foul as to be dangerous to health. The carbon-dioxide content is increased and 0.06 percent is about the maximum allowance. Therefore a room of 1,000 cu. ft. capacity really requires three air changes per hour in order to maintain the percentage of CO₂ within reasonable limits.

Text 12. Hot-Water Supply

Valves. In general, the use of valves should be avoided where possible on hot-water systems. It is useful, however, to place a valve or tap in the cold-water feed pipe immediately under the cistern. It should be a full-way type gate valve providing no impediment to the flow of the water. When this valve is closed, the hot-water supply is immediately stopped, all distribution pipes can be emptied and most repairs can be executed. If it is deemed necessary to control the heating of the hotwater in the cylinder, a valve can be inserted on the return circulator. In no circumstance should two valves be used, otherwise the boiler and pipes will be enclosed and an explosion might follow.

Pipe Sizes. To determine pipe sizes in larger hot-water installations, calculations based on the quantity of hot water needed should be made, although previous experience generally provides satisfactory “rule of thumb” guidance.

Any system providing hot water is known as “domestic”; we must limit our concern to the average small-house installation.

In general, the back-boiler used measures about 250 mm in length, is about 200 mm from back to front, and 150 or 180 mm deep. With an ordinary fire, a boiler of this size provides enough heating surface to keep the cylinder supplied with hot water.

The primary circulation pipes are normally 19 mm diameter lead or copper pipes. They should not be less and, if the cylinder is a large one, 25 mm circulation pipes should be used.

The expansion pipe must be equal in size to the circulation pipes, and is usually 19 mm in diameter.

The cold feed-pipe is often specified as one and a half times the diameter of the largest draw-off. In practice, equally sized feed and draw-off pipes are found to be efficient. In an ordinary house system they are usually both 19 mm in diameter.

There should be no restrictions in the supply pipe to a bath, so that a 19 mm pipe to a 19 mm tap is needed.

The branch draw-off pipes to sinks and lavatory basins are generally 12 mm diameter to 12 mm taps.

The cold-water rising main of 12 mm diameter, being under pressure, is quite capable of replacing the water taken from the supply tank by gravity flow under such low "pressure head".

The overflow pipe and outlet should be sufficiently large to take the full output of the ball tap in case of failure. A 19 mm pipe is mostly used, but a 25 mm diameter overflow would give a more satisfactory margin of safety.

Heating by Hot Water. The term "central heating" applied to the heating of domestic and other buildings indicates that the whole of a building is heated from a central source. Usually an independent boiler, fired by solid fuel, gas, electricity or fuel oil.

The boiler is generally placed at the lowest available point in the building, having regard at the same time to convenience of stoking and delivery of fuel.

Boilers. The boiler may be one of a number of types. It may be a solid one-piece casting, rectangular in form; it may be sectional; or it may be conical in shape and wrought or cast iron. For smaller systems, the first and last-named types are both cheap and suitable. The sectional boiler has the advantage of the possibility of added sections should more heat be needed subsequent to initial installation.

Sectional and shell type boilers are almost invariably used for bigger installations. The former are cast iron and can, be built up *in situ* whilst the latter are usually of the "packaged" type, having all auxiliary components together with the boiler assembled as one unit ready for erection.

Designing a Heating System. In general, a heating system should be designed so that the water- will circulate by gravity. In some installations, circumstances are such that a pump or accelerator must be used to achieve a satisfactory circulation. This should be avoided if possible.

When designing a heating system for a large building, it is usual - in the interests of economy and to ensure efficient heating - to first calculate how much heat will be needed to maintain the building at the desired temperature. Then the size of the boiler and the amount of pipe and radiator heating surface required to give out this heat will be estimated. For small systems, "rule-of-thumb" methods and past experience are generally a sufficient guide.

The overhead drop-feed system shows how the hot water from the boiler is carried as high as possible in the building, from where it falls in cooling, through

the various branch pipes and radiators, back to the boiler. In this type of system, the maximum amount of “circulating head” or pressure, would be obtained.

Circulating Head or Pressure. In any gravity system of heating (i.e. no pump), circulating head is extremely important. Briefly it is due to the difference in weight of a given volume of water in the flow and return circulators. This factor governs the speed of the circulation, and it should be borne in mind that the rapidity of the circulation will determine the amount of heat which will reach a given radiator.

It will readily be seen that if a pipe were taken from a boiler and carried around a room horizontally and back to the boiler, no circulation would take place - provided the boiler connections were on the same level. If one pipe were connected to the top and the other to the bottom of the boiler, a slow circulation would be found to exist. If instead a pipe leaving the top of the boiler were to be taken to the top of the room, allowed to circulate around the room and return to the bottom of the boiler, a rapid circulation would be evident. This principle should be borne in mind in the design of any heating system.

Most heating installations are a compromise between what is ideal and what is practicable, in consideration of possible pipe runs, radiator and boiler positions, and the shape of any particular building.

There are a few rules which should be observed:

1. The boiler must be big enough for the job it has to do.
2. The pipes should be of a size sufficient to convey the volume of water required to give up the needed heat.
3. Pipe runs should be as direct as possible.
4. A system should be planned to provide enough heat in the worst possible conditions.
5. The occupants of rooms should be given a means of controlling the heat output in the room by means of valves.

From the point of view of heat control, one valve only is needed and this can be fixed on either pipe; although in practice it is usually fitted to the return or lower pipe where it is out of the way. It is useful to fit a valve on each pipe so that radiators can be taken out for repair without having to run off the whole of the water in the system.

An air-cock is fitted to each radiator so that pockets of air can be freed. These cocks are used. When the system is being filled with water. The usual practice is to let out the air floor, by floor, beginning at the lowest. Each air-cock should remain open until water appears, when it can be closed. Periodically the radiators should be freed of air which may have collected at the top. An air-cock is usually fitted with a loose key which fits on to the square end of the spindle.

Erecting and Fixing Boilers. No difficulties exist in the fixing of independent boilers. A good level concrete foundation is needed, and common-sense fire precautions should be observed.

Sectional boilers can be almost any size to as much as 5 or 6 tons in weight.. They are usually delivered in separate parts requiring assembly. Heating by hot

water is traditionally plumber's work, but in latter years specialist heating engineers have evolved, and it is true to say that larger heating jobs have become mainly their concern. However, a great deal of domestic heating and other smaller systems are carried out by the plumber; some of this work involves the use of sectional boilers.

The stand should be fixed on the level concrete foundation, and it is a good plan to raise the stand either on a course of brick-work or on a concrete curb of similar height. This gives a deeper ash-pit, which allows a considerable accumulation of ashes.

It is advisable to assemble the sections on the floor rather than on the stand, so that it will not get pulled about and maybe damaged. If, however, the boiler is a heavy one, it can be assembled on the stand if care is taken. The front of the stand can be removed for assembly of the front section.

Radiators. Most radiators are sectional; they can be extended and damaged sections can be replaced. A trade catalogue will readily indicate the many different patterns of radiator which can be had.

The majority of radiators have left- and right-hand malleable nipples connecting the sections together. This is a very useful arrangement, but it calls for some care on the part of the dissembler. To remove a section of a radiator, the plugs must first be removed from the ends. Now a special tool, designed to grip the ribs formed on opposite sides of the inside of the nipple, is inserted from the end, the depth to which it must go having already been chalked on it by trial against the outside of the radiator. The air-cock tapping is made on the return end of a radiator, which is left-hand threaded inside. A moment's thought will show that an anti-clockwise turn will screw the nipple out of the left-hand threaded end section and also out of the right-hand second section. Working from the other hand, the reverse will be the case; that is, a clockwise turn should be used.

When assembling radiator sections, the nipples should be cleaned and smeared with a good jointing paste. When coupling up radiators in a heating system, it is most efficient to supply hot water at the top, and take the return water from the bottom at the opposite end. In this way the convection principle is utilised and more positive circulation is obtained.

Sanitary Fittings. Appliances used in the collection and disposal of human and domestic waste products. They comprise commonly: water-closets, lavatory basins, baths, sinks, and urinals.

Baths. Most baths are of vitreous-enamelled cast-iron; they have a square top and are fitted with panels on any exposed sides. There is a growing tendency to use pillar taps instead of the lately common globe-type taps, fixed on the vertical end of the bath. By using pillar taps, the bib or outlet can be raised above the flood rim of the bath, and any danger of water pollution in the service pipes - due to back siphonage - is made less possible. The taps are secured as in a lavatory basin. It is important that before any tap is fixed, the tap top should be removed and reassembled. It often happens that tap tops are abnormally tight,

and a lavatory basin or any other fitment might be damaged.

When the tap end of a bath is close to a wall, it is necessary to couple up the farthest tap first, then the overflow, and finally the near tap. Here again a cranked spanner is useful.

The bath waste should be fitted before the bath is lifted into position, and the waste pipe should be in place and complete with trap, so that only a horizontal nut remains to be tightened.

Sinks. As sinks are heavy and are often well loaded, they need good support. In the old days brick pillars were often used, but they are to be deprecated. The support should be such that there is no difficulty in cleaning the wall and floor. For this reason cantilever brackets should be used. Special brackets can be bought, but two pieces of angle- or tee- iron will do admirably; they should be well fastened in the brickwork preferably by building in. For neatness, the brackets should finish about 75 mm from the front of the sink and be cut diagonally. For the same reason, they should be well away from the ends.

The back of the sink should be bedded in cement against the wall, so that the nuisance of water running down the wall is avoided.

Stainless-steel sinks are fitted with pillar taps or mixer units and require the same treatment as lavatory basins. They have a great advantage over glazed earthenware, in that less heat is taken from the water by the sink. This factor removes the need for using an enamel bowl for washing dishes, a practice so common with large earthenware sinks.

Waste Pipes. Waste pipes from lavatory basins, baths, and sinks may be executed in lead (traditional), copper, and cast-iron. Individual waste pipes should take the shortest path, sharp bends should be avoided, and they should be of such size that they will generally run fairly full, and thereby be self-cleansing.

Lead waste pipes are jointed by means of wiped joints. Whenever lead pipe is used, it should be properly supported to avoid sagging. Copper waste pipes, being more rigid than lead, require less support. Copper tube can be bent to requirement. Cast-iron pipes are sometimes used. They should be of heavy-quality, treated inside and out with a special bituminous solution. The joints should be caulked with tow and lead-wool or molten lead. Waste pipes should be laid to proper falls, and access should be provided in order that each length of pipe can be rodded. Soil pipes are those which convey the contents of water-closets and urinals to the drains. The vent-stack which is normally carried above the roof is also included in any discussion of soil pipes.

The Combined or "One-pipe System". In the "one-pipe system" all sanitary fittings discharge into the same soil pipes with an economy of pipe work, and a simplification of layout. A few precautions need to be taken.

All lavatory basins, baths, and sinks must be fitted with deep-seal traps or with anti-siphonage pipes. The anti-siphonage pipe can be returned into the vent shaft at a point not less than 1 m above the highest soil pipe junction.

The main anti-siphonage pipe must, in certain circumstances, be carried

down and connected into the main soil stack below the lowest inlet branch. This precaution is necessary where fittings are situated on two or more floors and discharge into a common stack.

Text 13. Air Quality Study

Foundry Air Quality Study. (An analysis of existing conditions along with proposals for improving both the air quality and space heating in various foundry buildings) Foundries require sufficient ventilation and adequate means to remove the airborne contaminants generated by various processes if industrial hygiene requirements are to be met. Ultimately, the study led to the recommendation that a central boiler plant be constructed to handle the makeup air and space heating loads.

Plant Ventilation. To establish the adequacy of the existing ventilation systems, a thorough visual inspection was made during normal foundry operation. No measurements of air contaminants were taken. Observations gathered by the inspection team were reviewed with foundry personnel to further establish existing conditions. All observations were made during summer operating conditions. Foundry personnel provided needed insight into winter deficiencies.

With the buildings wide open in summer, air flowed through the buildings from space to space in an indeterminate fashion. This created many areas of discomfort and because such random air flow can upset ventilation systems installed to capture contaminants, produced the potential of creating some hazardous areas. To assure satisfactory environments, it would be essential that total plant ventilation be controlled.

Warehouse. No apparent ventilation problems existed in this area during summer operation. Since no contaminants are generated in the ware-housing operation, there should be no special ventilation requirements in winter. This area should be provided with a balanced or slightly positive air supply to avoid cross-contamination from other areas.

Molding Room. This space was provided with main cooling fans for summer ventilation, and a hood was provided at the line muller. Makeup air for the hood would have to come from adjacent spaces in winter since none was supplied to the spaces. This would again cause contaminants to move into the molding room, especially from the shake-out area.

Heating Systems. The heating and air conditioning system for the office and comfort facilities areas consisted of three heat pumps and a ducted air distribution system. This system allowed for operation completely separate from the foundry buildings.

The warehouse was heated by a gas fired unit heater, which did not have enough capacity to maintain a satisfactory temperature at outdoor design conditions, especially when trucks were being loaded at the shipping docks. No protection was provided against cold air infiltration during truck loading.

The molding room was heated by a gas fired unit heater hung in the space. No heated outside makeup air was provided at the work stations.

Thermal Insulation. The several buildings comprising the foundry were insulated with various amounts of insulation from none in walls and roofs to 1½ thick blanket insulation.

1) Building 1, the new foundry, was a prefabricated building constructed as a structural steel frame with sheet metal siding and roof above a poured concrete wall approximately 8 ft above grade. The sheet metal panel walls and roof were insulated with 1½ thick glass fiber insulation blanket. Roof insulation was exposed aluminum finished plastic covering.

2) Building 2, the original foundry, had concrete block sidewalls and exposed sloping roof without any thermal insulation.

3) Building 3A, the molding room, had concrete block walls and a steel framed sloping roof with no insulation.

4) Building 5, the warehouse, had concrete block walls and metal framed pitched roof. In the office section of this building, ceilings had been installed, and in several rooms wood paneling had been applied to the block walls.

Air Quality Improvement. Systems were proposed to improve our quality, summer and winter, in each area of the foundry included in the study. The recommended systems included high levels of ventilation for summer relief cooling and heating for winter conditions. The proposed systems reflected the following considerations:

Capture of contaminants at their sources of generation is the most effective from the viewpoint of industrial hygiene and the least expensive in terms of energy.

Certain exhaust gas streams may be returned to work spaces after removal of particulate matter. This permits effective exhaust system operation without the cost (energy) burden of heating makeup air. When processes generate gases or vapors injurious to health, recirculation must be avoided.

Temperature control systems would be designed to minimize energy consumption through reduction of outside air when the spaces were unoccupied and to be responsive to useful heat gains from cooling hot molds.

Heat Recovery Vs. Economizer Cycle. (Some insights to aid you in the complex evaluations required to determine whether one or the other, or a combination, will be most cost effective in a given situation.) With the great emphasis on energy conservation today, architect-engineer teams in the building construction industry are constantly striving to design buildings and their air conditioning systems to consume the least amount of energy.

Energy can be conserved by designing well insulated and shaded building envelopes that have minimum heat gains and losses. Non-depleting energy sources can be used to conserve depletable energy sources. Energy can also be conserved by choosing the appropriate energy conserving air conditioning systems.

Characteristics of the Systems. One popular form of heat recovery in

building air conditioning is the use of the refrigeration cycle to "pump" rejected heat from spaces requiring cooling to those requiring heating. When rejected heat exceeds the heating load, the excess heat is rejected to the atmosphere through a cooling tower or air cooled condenser. With this scheme, as long as there is rejected heat to satisfy the heating needs, the heat is considered free.

Both refrigeration cycle heat recovery and the economizer cycle are designed to conserve energy. The concepts of these two energy conservation schemes are basically not compatible, however. The economizer cycle saves cooling energy. It is most effective when the refrigeration plant is shut down. On the other hand, the heat recovery scheme saves heating energy, and it relies on the operation of the refrigeration plant to transfer the rejected heat to satisfy the heating needs.

In reality, however, refrigeration cycle heat recovery and the economizer cycle can be used harmoniously in a building air conditioning system to obtain maximum operating economy.

Depending on the location and the type of building, the availability of energy sources may vary. Under different conditions, coal, oil, natural gas, propane and electricity can all be considered as primary energy sources. Where two energy sources are available, such as gas and electricity, the costs of the sources will influence the choice of systems.

There are no simple rules for deciding what energy conserving scheme should be used in a given building. The evaluation process can be so complex that computer programs may be needed to help speed up what otherwise would be an almost impossible task. In such cases, the engineer should recognize that because of the complexity involved, he must have a complete understanding of, and agreement with, the algorithms used in the computer programs to be able to claim that he, not the author of the program, performed the evaluation.

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