زبان فنی معماری[1]

استاد:

فرشاد کیخائی

English for the Students of Civil Engineering, The Institute of Higher Education of Eqbal Lahoori Mashhad, Iran

Unit-One

Architecture

People have been planning and building for a long time. But was it architecture? Until fairly recently, it was common to distinguish between architecture and 'mere buildings', but this is becoming more difficult. Certainly the origins of architecture predate the first architect, who is traditionally taken to have been the designer of a stepped pyramid in Egypt. Even if one includes the specialist builders of certain chiefs' houses and ritual buildings, most of what was built was not designed by professionals but was rather an expression of the same architectural impulse that prompts high-style design. Thus, in dealing with the origins of architecture or an understanding of what architecture is, we must be concerned with the folk or popular tradition–the buildings called 'primitive' or 'vernacular' that have always comprised the bulk of the built environment and that are essential for any valid generalizations, and certainly critical for a discussion of origins.

All such environments, as well as all human artifacts, are designed, in the sense that they embody human decisions and choices and specific ways of doing things. A person clearing a forest, putting up a roadside stand, or laying out a camp is as much a designer as an architect–such activities change the face of the earth and create built environments.

All environments result from choices made from among all possible alternatives. The specific choices tend to be lawful, reflecting the culture of the people concerned. In fact, one way of looking at culture is in terms of the most common choices made. It is the lawfulness of decisions that makes places–and buildings–recognizably different from one another; lawfulness also leads to specific ways of dressing, behaving, eating, and so on. It affects the way people interact, the way they structure space and time. These consistent choices result in style–whether of built environments or of life.

Thus, culture concerns a group of people who have a set of values and beliefs and a world view that embody an ideal. These rules also led to systematic and consistent choices. With our earlier statement that architecture is a result primarily of sociocultural factors, and with our definition of design to include most purposeful changes to the physical environment, architecture can be thought of as any construction that deliberately changes the physical environment according to some ordering schema. The difference between buildings and settlements is one of scale. As Aldo Van Eyck once said, "A building is a small city; a city is a large building.

To answer the question of why people build environments, we need to understand how the human mind works. Schemata represent one product of what seems a basic process of the human mind, to give the world meaning, to humanize it by imposing order on it–a cognitive order often achieved through classifying and naming, or *differentiating*. The world is chaotic and disorderly; the human mind classifies, differentiates, and orders. We could say that the order is thought before it is built. Settlements, buildings, and landscapes are part of this activity, which, as we have already seen, goes back a long way. When Neanderthals buried their dead with flowers they were trying to impose an order reconciling life and death. The cave paintings of Europe mark complex ordering systems and define caves as sacred spaces, different from other spaces such as dwelling caves that were not painted. Symbolic notational systems, in this case of lunar observations, are found remarkably early and clearly represent attempts to impose an order on time and natural phenomena.

People think environments before they build them. Thought orders space, time, activity, status, roles, and behavior. But giving physical expression to ideas is valuable. Encoding ideas makes them useful mnemonics; ideas help behavior by reminding people of how to act, how to behave, and what is expected of them. It is important to stress that all built environments–buildings, settlements, and landscapes–are one way of ordering the world by making ordering systems visible. The essential step, therefore, is the ordering or organizing of the environment.

Civil Engineering

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like bridges, roads, canals, dams, and buildings. Civil engineering is the oldest engineering discipline after military engineering. It is traditionally broken into several sub-disciplines including structural engineering, earthquake engineering, geotechnical engineering, water resources engineering, hydraulic engineering, environmental engineering, surveying, transportation engineering, and municipal engineering.

1- Structural engineering

Structural engineering is concerned with the structural design and structural analysis of buildings, bridges, towers, tunnels, off shore structures like oil and gas fields in the sea, and other structures. This involves identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads, and then designing the structure to successfully support and resist those loads. The loads can be self weight of the structures, other dead load, live loads, wind load, earthquake load, load from temperature change etc (et cetera). The structural engineer must design structures to be safe for their users and to successfully fulfill the function they are designed for (to be *serviceable*). Design considerations will include strength, stiffness, and stability of the structure when subjected to loads which may be static, such as furniture or self-weight, or dynamic, such as wind, seismic, crowd or vehicle loads, or transitory, such as temporary construction loads or impact. Other considerations include cost, safety, and aesthetics.

2- Earthquake engineering

The main objectives of earthquake engineering are:

• Understand interaction of structures with the shaky ground.
• Foresee the consequences of possible earthquakes.
• Design, construct and maintain structures to withstand hazardous earthquakes

3- Geotechnical engineering

Geotechnical engineering is an area of civil engineering concerned with the rock and soil that civil engineering systems are supported by. Knowledge from the fields of geology, material science and testing, mechanics, and hydraulics are applied by geotechnical engineers to safely and economically design foundations, retaining walls, and similar structures. Soil mechanics, which describes the behavior of soil, is complicated because soils exhibit nonlinear strength, and stiffness.

4- Water resources engineering

Water resources engineering is concerned with the collection and management of water (as a natural resource). This area of civil engineering relates to the prediction and management of both the quality and the quantity of water in both underground (aquifers) and above ground (lakes, rivers, and streams) resources.

5- Hydraulic engineering

Hydraulic engineering is concerned with the flow and conveyance of fluids, principally water. This area of civil engineering is related to the design of pipelines, water supply network, drainage facilities (including bridges, dams, channels, culverts, levees, storm sewers), and canals. Hydraulic engineers design these facilities using the concepts of fluid pressure, fluid statics, fluid dynamics, and hydraulics, among others.

6- Environmental engineering

Among the topics covered by environmental engineering are pollutant transport, water purification, waste water treatment, air pollution, and hazardous waste management. Environmental engineers can be involved with pollution reduction, and green engineering. Environmental engineering also deals with the gathering of information on the environmental consequences of proposed actions and the assessment of effects of proposed actions for the purpose of assisting society and policy makers in the decision making process.

7- Surveying

Surveying is the process by which a surveyor measures certain dimensions that generally occur on the surface of the Earth. Surveying equipment, such as theodolites, are used for accurate measurement of angular deviation, horizontal, vertical and slope distances. Surveyors may also lay out the routes of railways, tramway tracks, highways, roads, pipelines and streets as well as position other infrastructures, such as harbors, before construction.

8- Transportation engineering

Transportation engineering is concerned with moving people and goods efficiently, and safely. This involves specifying, designing, constructing, and maintaining transportation infrastructure which includes streets, canals, highways, rail systems, airports, and ports. It includes areas such as transportation design, transportation planning, traffic engineering, some aspects of urban engineering, pavement engineering, Intelligent Transportation System (ITS), and infrastructure management.

Essential Words:

1. Civil engineering
2. Design
3. Construction
4. Maintenance
5. Bridge
6. Road
7. Canal
8. Dam
9. Building
10. Structural engineering
11. Earthquake engineering
12. Geotechnical engineering
13. Water resources engineering
14. Hydraulic engineering
15. Environmental engineering
16. Surveying
17. Transportation engineering
18. Municipal engineering
19. Analysis
20. Tower
21. Tunnel
22. Off shore structure
23. Load
24. Force
25. Stress
26. Support
27. Resist
28. Dead load
29. Live load
30. Wind load
31. Earthquake load
32. Temperature
33. Safe
34. Serviceable
35. Strength
36. Stiffness
37. Stability
38. Subject
39. Static
40. Furniture
41. Dynamic
42. Seismic
43. Impact
44. Safety
45. Aesthetics
46. Objective
47. Interaction
48. Shaky
49. Withstand
50. Building codes
51. Geology
52. Material
53. Mechanics
54. Hydraulics
55. Economically
56. Foundation
57. Retaining wall
58. Soil mechanics
59. Nonlinear
60. Management
61. Prediction
62. Quality
63. Quantity
64. Underground
65. Aquifer
66. Flow
67. Conveyance
68. Fluid
69. Pipeline
70. Water supply network
71. Drainage
72. Facilities

Planing	Certainly	Chief's	Octivites
Until	Critical	Ritual	Change
Fairly	Discussion	Rather	Earth
Recently	Allsuch	Expressin	Create
Common	Human	Impluse	Result
Distinguish	Ortifacts	Prompts	Made
Mere buildings	Sense	thus	Among
Certainly	Embady	Dealing	Possible
Origins	Decision	Concerned	Olternative
Predate	Choices	Folk	Specific
First	Ways	Called	Lawful
Traditionally	Person	Primitive	Reflecting
Stepped	Elearing	Vernacular	Culture
dyramid	Forest	Comprised	Concerned
Egypt	Putting	Bulk	Road side
Even	Stand	Environment	Choices
Incudes	That make	Essential	Thut
Specialist	Places	Valid	Cultur
Qeneralizations	Recogzinably	Laying	Concerns
	Different	Such	

Exercise

I. Put "T" for true and "F" for false statements.

….. 1- Civil engineering is the oldest engineering discipline after mechanical engineering.

….. 2- The aquifers are the underground resources.

….. 3- Hydraulic engineering is concerned with the rock and soil that civil engineering systems are supported by.

….. 4- Water resources engineering is concerned with water purification, waste water treatment, air pollution, and hazardous waste management.

….. 5- Municipal engineering is concerned with specifying, designing, constructing, and maintaining streets, sidewalks, public parks and bicycle paths.

II. Choose a, b, c or d which best completes each item.

1- Structural engineering is concerned with the structural design and structural analysis of ....

a. streets and sidewalks

b. water supply networks, and sewers
c. buildings, bridges, towers, tunnels, and off shore structures.
d. canals, highways, rail systems, airports, and ports.

2- The loads which act upon a structure can be ....
a. self weight of the structures
b. dead load, live loads, wind load, and earthquake load
c. load from temperature change
d. a, b and c

3- The ....should understand interaction of structures with the shaky ground.
a. structural engineers
b. earthquake engineers
c. geotechnical engineers
d. environmental engineers

4- Soil mechanics, which describes the behavior of soil, is complicated because..........
a. soils exhibit linear strength and stiffness
b. soils show nonlinear strength and stiffness
c. soils do not have nonlinear strength and stiffness
d. a and c

5- .... is the process by which a surveyor measures certain dimensions that generally occur on the surface of the Earth.
a. Dilatancy
b. Theodolites
c. Surveying
d. Equipment

III. Fill in the blanks with the appropriate form of the words given.

1- Maintain
a. The country's railways need better...............
b. Earthquake engineers design, construct and .... structures to withstand hazardous earthquakes

2- Construct
a. The .... of several apartment buildings will ease the housing shortage.
b. This company plans to .... a new hotel in the heart of the town.
c. Everybody should work .... to produce a better environment.

3- Safe

a. Geology, mechanics, and hydraulics are applied by geotechnical engineers to................ and economically design foundations

b. Other considerations include cost, ..., and aesthetics.

c. The structural engineer must design structures to be .... for their users

IV. Select the proper answer to the following items.

1- For certain structures, the ………………..… of earthquake damage may be very serious.

a) consequences b) construction c) stability d) strong

2- Some buildings are designed to …………… very strong earthquakes.

a) produce b) withstand c) resist d) b & c

V. Read the following words and definitions and write the corresponding words in the space provided.

Aquifer	Surveyor	Foundation	Equipment
Treatment	Tower	Fluid	

1		tall structure
2		base, substructure
3		Underground water resources
4		liquid or gas
5		a process by which something is cleaned
6		someone whose job is to measure and record the details of an area of land
7		the tools, machines etc that you need to do a particular job or activity

VI. Choose the word that is most nearly <u>synonym</u> in meaning to the word in capital letters.

1- RESIST	
2- FORESEE	
3- PATH	
4- GOAL	

Objective

Track

Predict

Withstand

VII. Fill in the blanks with the following words.

upon	temperature	analysis	arise
self	off shore	resist	

Structural engineering is concerned with the structural design and structural ………. of buildings, bridges, towers, tunnels, ………. structures like oil and gas fields in the sea, and other structures. This involves identifying the loads which act ………. a structure and the forces and stresses which ………. within that structure due to those loads, and then designing the structure to successfully support and ………. those loads. The loads can be ………. weight of the structures, other dead load, live loads, wind load, earthquake load, load from ………. change etc (et cetera).

Unit Two

Statics

A force has been defined as the action of one body on another. We find that force is a vector quantity, since its effect depends on the direction as well as on the magnitude of the action and since forces may be combined according to the parallelogram law of vector combination. The effect of the force vector **P** of magnitude P on the bracket in Figure (1) will depend on P, the angle θ, and the location of the point of application A.

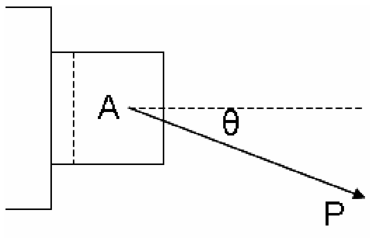


Figure 1

Changing any one of these three specifications will alter the effect on the bracket. Thus the complete specification of the action of a force must include its magnitude, direction, and the point of application, in which case it is treated as a fixed vector.

Force is applied either by direct mechanical contact or by remote action. Gravitational and magnetic forces are applied by remote action. All other forces are applied through direct physical contact. The action of a force on a body can be separated into two effects, external and internal. For the bracket of Figure (1) the effects of **P** external to the bracket are the reactions or forces (not shown) exerted on the bracket by the foundations and bolts because of the action of **P**.

Forces external to a body are then of two kinds, applied forces and reactive forces. The effects of **P** internal to the bracket are the resulting internal stresses and strains distributed throughout the material of the bracket. The relation between internal forces and internal strains involves the material properties of the body and is studied in strength of materials, elasticity and plasticity.

Forces may be either concentrated or distributed. Actually every contact force is applied over a finite area and is therefore a distributed force. When the dimensions of the area are very small compared with the other dimensions of the body, we may consider the force to be concentrated at a point with negligible loss of accuracy. Force may be distributed over an area, as in the case of mechanical contact, or it may be distributed over a volume when gravity or magnetic force is acting. The weight of a body is the force of gravitational attraction distributed over its volume and may be taken as a concentrated force acting through the center of gravity. The position of the center of gravity is frequently obvious from considerations of symmetry. If the position is not obvious, then a separate calculation will be necessary to locate the center of gravity.

The standard unit of force in SI units is the newton (N) and in the U.S. customary system is the pound (lb). The characteristics of a force expressed by Newton's third law must be carefully observed. The action of a force is always accompanied by an equal and opposite reaction.

The principal of transmissibility

In dealing with the mechanics of rigid bodies, where concern is given only to the net external effects of forces, experience shows us that it is not necessary to restrict the action of an applied force to a given point. Hence the force **P** acting on the rigid plate in Figure (2) may be applied at *A* or at *B* or at any other point on its action line, and the net external effects of **P** on the bracket will not change. The external effects are the force exerted on the plate by the bearing support at *O* and the force exerted on the plate by the roller support at *C*. This conclusion is described by the principal of transmissibility, which states that a force may be applied at any point on its given line of action without altering the resultant effects of the force external to the rigid body on which it acts. When only the resultant external effects of a force are to be investigated, the force may be treated as a sliding vector, and it is necessary and sufficient to specify the magnitude, direction, and line of action of the force.

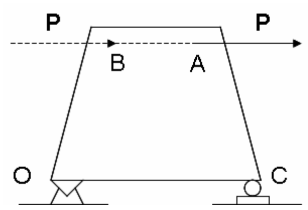


Figure 2

Parallelogram law

Two forces $\mathbf{F_1}$ and $\mathbf{F_2}$ that are concurrent may be added by the parallelogram law in their common plane to obtain their sum or resultant **R** as shown in Figure (3).

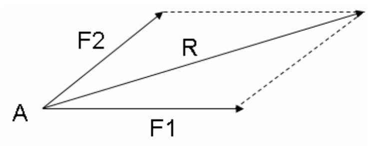


Figure 3

If the two concurrent forces lie in the same plane but are applied at two different points as in Figure (4), by the principal of transmissibility we may move them along their lines of action and complete their vector sum **R** at the point of concurrency.

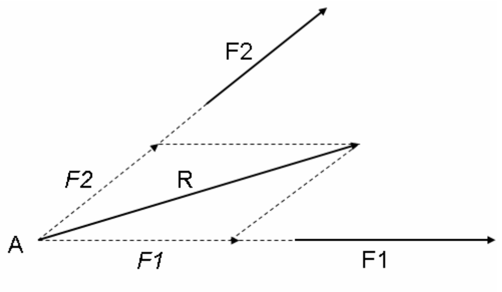


Figure 4

In addition to the need for combining forces to obtain their resultant, we often have occasion to replace a force by its components which act in two specified directions. Thus the force **R** in Figure (3) may be replaced by or resolved into two components $\mathbf{F_1}$ and $\mathbf{F_2}$ with these specified directions merely by completing the parallelogram as shown to obtain the magnitudes $\mathbf{F_1}$ and $\mathbf{F_2}$. The most common two-dimensional resolution of a force **F** is resolution into rectangular components $\mathbf{F_x}$ and $\mathbf{F_y}$ as shown in Figure (5).

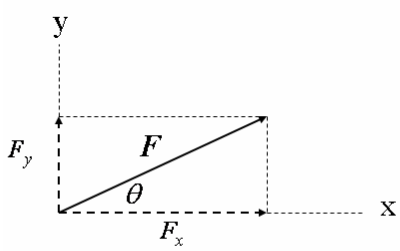


Figure 5

Triangle law

The triangle law may also be used to obtain **R**, but it will require moving the line of action of one of the forces as shown in Figure (6).

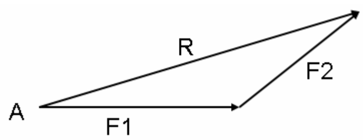


Figure 6

Couple

The moment produced by two equal and opposite noncollinear forces is known as a couple. Couples have certain unique properties and have important applications in mechanics. Consider the action of two equal and opposite forces **F** and **-F,** a distance d apart**,** Figure (7). These two forces cannot be combined into a single force since their sum in every direction is zero. Their effect is entirely to produce a tendency of rotation. The combined moment of the two forces about an axis normal to their plane and passing through any point such as *O* in their plane is the couple **M**. It has a magnitude

$$\mathbf{M}=\mathbf{F}d$$

and is in the counterclockwise direction when viewed from above for the case illustrated.

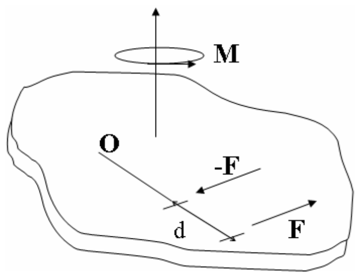


Figure 7

Essential Words for Civil Engineers

115. Statics
116. Vector
117. Effect
118. Direction
119. Magnitude
120. Parallelogram law
121. Combination
122. Bracket
123. Angle
124. Location
125. Remote
126. Gravitational
127. Magnetic
128. External
129. Internal
130. Action

131. Reaction
132. Bolt
133. Strain
134. Distribute
135. Elasticity
136. Plasticity
137. Concentrated
138. Finite
139. Negligible
140. Loss
141. Accuracy
142. Gravity
143. Gravitational attraction
144. Center of gravity
145. Position
146. Symmetry
147. Separate
148. Locate
149. Rigid
150. Net
151. Restrict
152. Bearing support
153. Roller support
154. Principal
155. Transmissibility
156. Resultant
157. Investigate
158. Sliding vector
159. Concurrent
160. Common plane
161. Sum
162. Component
163. Resolve into
164. Resolution
165. Two-dimensional
166. Rectangular
167. Triangle law
168. Collinear
169. Noncollinear
170. Moment
171. Equal
172. Opposite
173. Couple
174. Apart
175. Tendency
176. Rotation
177. Axis
178. Normal
179. Counterclockwise
180. Illustrate
181. Geometric center
182. Mass
183. Stationary
184. Equilibrium
185. Smoothly
186. Limitation
187. Bound
188. Restriction
189. Convergent
190. Identical
191. Straight
192. Perpendicular

Exercise

I. Put "T" for true and "F" for false statements.

….. 1- The complete specification of a force includes its magnitude, direction, and point of application.

….. 2- Weight of a body is not considered as a force.

….. 3- The principle of transmissibility only applies to rigid bodies.

….. 4- Newton's third law states: The action of a force is always accompanied by an equal and opposite reaction.

….. 5- The parallelogram law does not apply to concurrent forces.

II. Choose a, b, c or d which best completes each item.

1- According to the passage the weight of a body may be considered as ....

- a- An external force which may be treated as a sliding vector
- b- An internal force acting over the volume of the body
- c- A concentrated force acting through the center of gravity
- d- A uniformly distributed load acting through the center of gravity

2- The resultant of two forces F1 and F2 ....

- a- May not replace the two forces
- b- May replace the two forces
- c- Can always have altering effects
- d- Has usually no specified dimension

3- The..........of a system of forces is the simplest force combination that can replace the original forces.

- a- average
- b- minimal
- c- resultant
- d- norm

4- The .... of a force is always accompanied by an equal and opposite force.

- a- aim
- b- result
- c- action
- d- dimension

5- In general, a force can be ....into three components.

- a- resulted
- b- assembled
- c- computed
- d- resolved

III. Fill in the blanks with the appropriate form of the words given.

1- Gravity

- a- It can be stated that the geometric center of a mass and its center of ………..… could be the same point.
- b- The ………..… forces are directed towards the center of earth.

2- Elastic

2. Steel is an .... material.

3. Theory of ………..…. includes discussions of stress and strain.

IV. Read the following words and definitions and write the corresponding words in the space provided.

Effect	Center of gravity	Couple	Sliding	Finite
Internal	Statics	Restrict	Gravity	Resolve into
Concurrent	Transmissibility	Collinear	Magnitude	
Vector	Moment	Normal	Equal	

1		ability to be transmitted
2		branch of mechanics which studies stationary masses or bodies in equilibrium
3		that slides, moving easily and smoothly
4		quantity with magnitude and direction (represented by an arrow indicating its direction)
5		having limitations, having bounds; subject to limits or restrictions
6		result, outcome; influence; impact;
7		attractive force which causes all bodies to move toward the center of the earth
8		size, greatness
9		point where the force of gravity has the most effect
10		interior, inner, inside
11		Convergent
12		Limit
13		separate into constituent parts
14		same, identical
15		on the same straight line
16		perpendicular; vertical; regular, usual
17		product of a force and the distance from its action to a point
18		two equal forces acting in opposite directions

Unit Three

Reinforced Concrete

Concrete is a stonelike material obtained by permitting a carefully proportioned mixture of cement, sand and gravel or other aggregate, and water to harden in forms of the shape and dimensions of the desired structure. The bulk of the material consists of fine and coarse aggregate. Cement and water interact chemically to bind the aggregate particles into a solid mass. Additional water, over and above that needed for this chemical reaction, is necessary to give the mixture the workability that enables it to fill the forms and surround the embedded reinforcing steel prior to hardening. Concretes with a wide range of properties can be obtained by appropriate adjustment of the proportions of the constituent materials. Special cements, special aggregates (such as various lightweight or heavyweight aggregates), admixtures (such as plasticizers, air-entraining-agents, silica fume, and fly ash), and special curing methods (such as steam-curing) permit an even wider variety of properties to be obtained.

These properties depend on the proportions of the mix, and on the conditions of humidity and temperature in which the mix is maintained from the moment it is placed in the forms until it is fully hardened. The process of controlling conditions after placement is known as curing. To protect against the unintentional production of substandard concrete, a high degree of skillful control and supervision is necessary throughout the process, from the proportioning by weight of the individual components, through mixing and placing, until the completion of curing.

Several factors make concrete a universal building material. The facility with which, it can be deposited and made to fill forms or molds of almost any practical shape is one of these factors. Its high fire and weather resistance are evident advantages. Most of the constituent materials, with the exception of cement and additives, are usually available at low cost locally or at small distances from the construction site. Its compressive strength, like that of natural stones, is high, which makes it suitable for members primarily subject to compression, such as columns and arches. On the other hand, again as in natural stones, it is relatively brittle material whose tensile strength is small compared with its compressive strength. This prevents its economical use in structural members that are subject to tension.

To offset this limitation, it was found possible, in the second half of the nineteenth century, to use steel with its high tensile strength to reinforce concrete, chiefly in those places where its low tensile strength would limit the carrying capacity of the member. The reinforcement, usually round steel rods with appropriate surface deformation to provide interlocking, is placed in the forms in advance of the concrete. When completely surrounded by the hardened concrete mass, it forms an integral part of the member. The resulting combination of two materials, known as reinforced concrete, combines many of the advantages of each: the relatively low cost, good weather and fire resistance, good compressive strength, and excellent formability of concrete and the high tensile strength and much greater ductility and toughness of steel. It is this combination that allows the almost unlimited range of uses and possibilities of reinforced concrete in the construction of buildings, bridges, tanks, reservoirs, and a host of other structures.

In more recent times, it has been found possible to produce steels, at relatively low cost, whose yield strength is 3 to 4 times and more that of ordinary reinforcing steels. Likewise, it is possible to produce concrete 4 to 5 times as strong in compression as the more ordinary concretes. These high-strength materials offer many advantages, including smaller member cross sections, reduced dead load, and longer spans.

Design of Concrete Structures, 13th Edition
By: Nilson, Darwin, and Dolan
McGraw-Hill, 2004

Essential Words for Civil Engineers

193. Concrete
194. Reinforce
195. Reinforcement
196. Reinforced Concrete
197. Proportion
198. Mixture
199. Cement
200. Sand
201. Gravel
202. Aggregate
203. Harden
204. Form
205. Shape
206. Bulk
207. Fine aggregate
208. Coarse aggregate
209. Interact
210. Chemically
211. Bind
212. Particle
213. Solid
214. Mass
215. Additional
216. Workability
217. embedded
218. Reinforcing steel
219. Appropriate
220. Adjustment
221. Constituent
222. Admixtures
223. Plasticizer
224. Air-entraining-agent
225. Silica fume
226. Fly ash
227. Curing
228. Steam-curing
229. Mix
230. Humidity
231. Place
232. Placement
233. Protect
234. Substandard
235. Supervision
236. Factor
237. Facility
238. Deposit
239. Mold
240. Resistance
241. Advantage
242. Additive
243. Available
244. Locally
245. Compressive strength
246. Tensile strength
247. Stone
248. Compression
249. Tension
250. Column
251. Arch
252. Relatively
253. Brittle
254. Offset
255. Possible
256. Steel
257. Carrying
258. Capacity
259. Round
260. Rod
261. Deformation
262. Interlock
263. Integral
264. Formability
265. Ductility
266. Toughness
267. Allow
268. Tank
269. Reservoir
270. Yield strength
271. Ordinary
272. Cross section
273. Reduce
274. Span
275. Strengthen
276. Strengthening
277. Fortify
278. Fortification
279. Bend
280. Compound
281. Stretch
282. Execution
283. Practicality
284. Norm
285. Decrease

Exercise

I. Choose the word that is most nearly opposite in meaning to the word in capital letters.

1- COARSE	
2- TENSION	
3- HIGH	
4- ELASTIC	

Compression

Low

Plastic

Fine

II. Read the following words and definitions and write the corresponding words in the space provided.

Reinforcement	Aggregate	Workability
Mixture	Coarse	Constituent
Concrete	Tensile	Substandard
Cement	Bulk	Reduce

1		powder which, when mixed with water, becomes hard like stone; it is used for making concrete
2		involving a force that produces stretching
3		act of strengthening, fortification
4		volume, mass
5		possibility of execution, practicality
6		mixture of cement, sand, and gravel with water in varying proportions
7		component
8		below standard, below the norm, of low quality
9		combination, blend, compound
10		decrease
11		sand and small stone used for making concrete
12		not fine, made up of fairly large parts

Unit Four

SOIL MECHANICS

It is the task of the geotechnical engineer to predict the behavior of the soil, the settlement of a road or a railway under the influence of its own weight and the traffic load, the margin of safety of an earth retaining structure, the earth pressure acting upon a tunnel, or the allowable loads and the settlements of the foundation of a building. Important pioneering contributions to the development of soil mechanics were made by Terzaghi, who, among many other things, has described how to deal with the influence of the pressures of the pore water on the behavior of soils. This is an essential element of soil mechanics theory.

All structures require a sound foundation and should transfer their loads to the soil. The deformations of a soil often depend upon time, even under a constant load. This is called creep. Sand and rock show practically no creep, except at very high stress levels. Clay in particular shows this phenomenon. It causes structures founded on clay to settlements that practically continue forever. A new road, built on a soft soil, will continue to settle for many years. For buildings such settlements are particular damaging when they are not uniform, as this may lead to cracks in the building.

Soils are usually classified into various types. In many cases these various types also have different mechanical properties. A simple subdivision of soils is on the basis of the grain size of the particles that constitute the soil. Coarse granular material is often denoted as gravel and finer material as sand. It has been agreed internationally to consider particles larger than 2 mm, but smaller than 63 mm as gravel. Larger particles are denoted as stones. See the following Table. The soil may also contain layers of peat, consisting of organic material such as decayed plants.

Soil type	min.	max.
clay		0.002 mm
silt	0.002 mm	0.063 mm
sand	0.063 mm	2 mm
gravel	2 mm	63 mm

A special characteristic of soil is that water may be present in the pores of the soil. This water contributes to the stress transfer in the soil. It may also be flowing with respect to the granular particles, which creates friction stresses between the fluid and the solid material. In many cases soil must be considered as a two phase material.

Porosity

Soils usually consist of particles, water and air. An important basic parameter is the porosity, n, defined as the ratio of the volume of the pore space and the total volume of the soil,

$$n = \frac{V_p}{V_t}$$

For most soils the porosity is a number between 0.30 and 0.45 (or, as it is usually expressed as a percentage, between 30 % and 45 %). When the porosity is small the soil is called densely packed, when the porosity is large it is loosely packed.

The amount of pores can also be expressed by the ***void ratio,*** e, defined as the ratio of the volume of the pores to the volume of the solids,

$$e = \frac{V_p}{V_s}$$

The porosity can not be smaller than 0, and can not be greater than 1. The void ratio can be greater than 1.

Degree of saturation

The pores of a soil may contain water and air. The degree of saturation, S, is introduced as

$$S = \frac{V_\omega}{V_p}$$

Density

The density of a substance is the mass per unit volume of that substance.

$$\rho = \frac{M}{V}$$

Volumetric weight

In soil mechanics it is often required to determine the total weight of a soil body. The volumetric weight defined as the weight per unit volume.

$$\gamma = \frac{W}{V}$$

Water content

The water content is another useful parameter, especially for clays. The water content is the ratio of the weight (or mass) of the water and the solids.

$$\omega = \frac{W_{\omega}}{W_s}$$

Soil Mechanics, By: Arnold Verruijt
Delft University of Technology, 2001

Essential Words for Civil Engineers

286. Settlement
287. Margin
288. Earth
289. Allowable
290. Pore
291. Element
292. Constant
293. Creep
294. Rock
295. Clay
296. Phenomenon
297. Soft
298. Uniform
299. Crack
300. Classify
301. Grain
302. Constitute
303. Granular
304. Peat
305. Organic material
306. Silt
307. Characteristic
308. Friction
309. Solid
310. Two phase material
311. Porosity
312. Parameter
313. Ratio
314. Volumetric
315. Space
316. Total
317. Percentage
318. Dense
319. Loose
320. Amount
321. Void
322. Saturation
323. Contain
324. Density
325. Substance
326. Unit
327. Content

Unit Five

Steel Structures

The advantages of the structural steel frame are the speed of erection of the ready prepared steel members and the accuracy of setting out and connections.

Mild steel

Mild steel is the material generally used for constructional steelwork.

Properties of mild steel

a) Strength

Steel is strong in both tension and compression.

b) Elasticity

Under stress, induced by loads, a structural material will stretch or contract by elastic deformation and return to its former state once the load is removed. The ratio of stress to strain, which is known as Young's modulus (the modulus of elasticity), gives an indication of the resistance of the material to elastic deformation. If the modulus of elasticity is high the deformation under stress will be low. Steel has a high modulus of elasticity and is therefore a comparatively stiff material.

c) Ductility

Mild steel is a ductile material which is not brittle and can suffer strain beyond the elastic limit through what is known as plastic flow.

Standard rolled steel sections

The steel sections most used in structural steelwork are standard hot rolled steel universal beams and columns together with a range of tees, channels, and angles illustrated in figure 1. The deep web to flange dimensions of beams has shown in this figure. The series of structural tees is produced from cuts that are half the web depth of standard universal beams and columns.

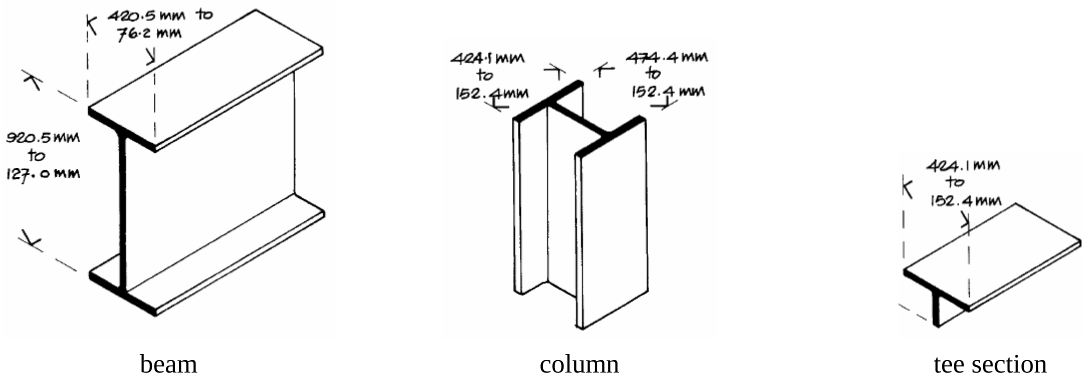


Figure 1. Hot rolled structural steel sections

Castellated beam

This open web beam section is made by cutting the web of a beam. The two halves are then welded together to form the castellated beam illustrated in figure 2. The castellated beam is one and a half times the depth of the beam section from which it was cut.

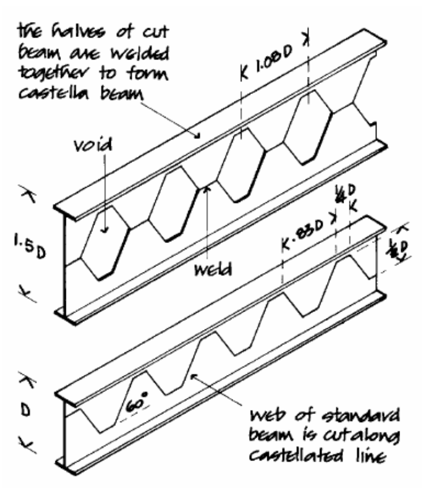


Figure 2. Castellated beam

Steel tubes

A range of seamless and welded seam steel tubes is manufactured for use as columns.

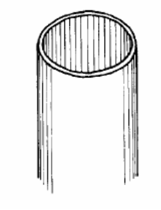
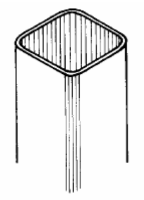


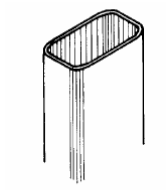
Figure 3. Steel tube

Hollow rectangular and square sections

Hollow rectangular and square sections are made from round tube which, after heating, is passed through a series of rolls which progressively change the shape of the tube from a round to a square or rectangular section.



square section



rectangular section

Figure 4. Hollow rectangular and square sections

Wind bracing

The connections of beams to columns in multi-storey skeleton steel frames do not generally provide a sufficiently rigid connection to resist the considerable lateral wind forces. Therefore, it is necessary to include some system of bracing between the members of the frame to maintain the right-angled connection of members.

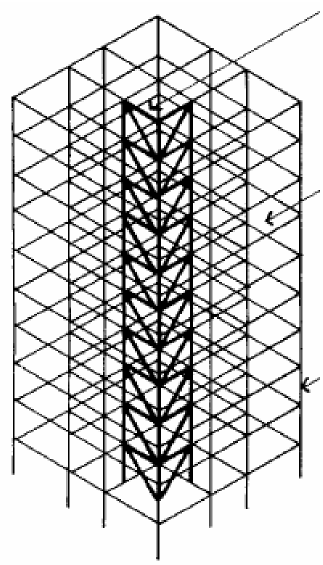


Figure 5. Wind bracing

The Construction of Buildings, By: R. Barry
Blackwell Science, 1996

Essential Words for Civil Engineers

328. Frame
329. Speed
330. Erection
331. Prepare
332. Member
333. Connections
334. Mild steel
335. Constructional
336. Steelwork
337. Property
338. Strong
339. Induce
340. Contract
341. Elastic
342. Return
343. Former
344. State
345. Remove
346. Modulus
347. Comparatively
348. Stiff
349. Ductile
350. Suffer
351. Beyond
352. Limit
353. Plastic
354. Roll
355. Section
356. Universal
357. Beam
358. Tee section
359. Channel (steel section)
360. Angle (steel section)
361. Web
362. Flange
363. Deep
364. Depth
365. Castellated beam
366. Weld
367. Seamless
368. Seam
369. Tube
370. Manufacture
371. Hollow

372. Square
373. Bracing
374. Multi-storey
375. Skeleton
376. Provide
377. Lateral
378. Right-angled

Exercise

I. Choose the word that is most nearly opposite in meaning to the word in capital letters.

1. DENCE	
2. SMALL	
3. STRETCH	
4. DUCTILE	
5. TENSILE	
6. SEAMLESS	
7. TENSION	

Compressive
Brittle
Compression
Seamed
Loose
Contract
Great

II. Read the following words and definitions and write the corresponding words in the space provided.

Grain	Erection	Quantity	Member
Include	Prepare	Percentage	Hollow
Material	Mild steel	Two Phase	Tube
Frame	Seamless	Solid	Former
Elastic	Manufacture	Depth	Contract
Storey	Right-angled		

1		Three-dimensional; not liquid or gas
2		Exists in two separate states of being
3		Particle
4		Rate or proportion per hundred
5		Amount
6		Contain

7		Substance
8		Skeleton; structure
9		Construction, act of building
10		Make ready
11		Individual belonging to an organization or group
12		Kind of steel that is softer than average because of the lower percentage of carbon present
13		Make smaller; become smaller
14		Able to return to its original shape after being stretched or pulled; flexible
15		Previous, prior
16		Distance from top to bottom
17		Lacking a seam
18		Hollow cylinder; pipe
19		Make by machine (especially on a large scale); create, make, produce
20		Empty, having nothing inside
21		Floor, level in a building
22		Containing a 90 degree angle

III. For questions 1-10 read the text below. Use the word given at the end of each line to form a word that fits in the space in the same line. There is an example at the beginning (0).

Steel is strong in both tension and …*Compression*.. (0).	Compress
Mild steel is a ……………….. (1) material which is not brittle	Ductility
and can suffer strain beyond the ……………….. (2) limit	Elasticity
through what is known as ……………….. (3) flow.	Plastic
Hollow ……………….. (4) and square sections are made	Rectangle
from round tube which, after heating, is ……………….. (5)	Pass
through a series of rolls which ……………….. (6)	Progressive

change the ……………….. (7) of the tube from a round	Shape
to a ……………….. (8) or rectangular section.	Square
It is necessary to include some system of ……………….. (9)	Brace
between the ……………….. (10) of the frame.	Member

IV. Put "T" for true and "F" for false statements according to the passages of Unit 4 and Unit 5.

	1- Sand and rock show practically no creep, except at very high stress levels.
	2- Coarse granular material is often denoted as sand and finer material as gravel.
	3- The soil may also contain layers of peat, consisting of organic material such as decayed plants.
	4- Water contributes to the stress transfer in the soil.
	5- In many cases soil must be considered as a one phase material.
	6- Void ratio, is defined as the ratio of the volume of the pore space and the total volume of the soil.
	7- The porosity can not be smaller than 0, and can not be greater than 1.
	8- The pores of a soil may contain water and air.
	9- Concrete is the material generally used for constructional steelwork.
	10- Steel is strong in compression and weak in tension.
	11- The modulus of elasticity is the ratio of strain to stress.
	12- Steel has a low modulus of elasticity and is therefore a comparatively stiff material.

V. Select the proper answer to the following items according to the passages of Unit 4 and Unit 5.

1- A system of bracing is necessary to resist ……………….. forces.
a) vertical b) lateral c) snow d) tensile

2- The castellated beam is **………………..** times the depth of the beam section from which it was cut.
a) two halves b) two and a half c) one and a half d) two

3- The series of structural ……………….. is produced from cuts that are half the web depth of standard universal beams and columns.

a) tees b) channels c) angles d) castellated beams

4- Mild steel is a ductile material which is not ……………….. and can suffer strain beyond the elastic limit through what is known as plastic flow.

a) soft b) strong c) brittle d) flexible

5- The modulus of elasticity is the ratio of ……………….. to strain.

a) pressure b) stress c) deformation d) strength

6- A geotechnical engineer should predict the ……………….. of a road or a railway

a) depth b) settlement c) behavior d) weight

7- The ……………….. of a road or a railway may lead to its settlement.

a) depth b) settlement c) behavior d) weight

8- When the settlements of the foundation of a building are not ……………, cracks will damage the building.

a) uniform b) particular c) strong d) deep

9- The …………… weight defined as the weight per unit volume.

a) density b) content c) porosity d) volumetric

10-When the porosity is large it is …………… packed.

a) loosly b) losely c) loosely d) loosli

Unit Six

Construction Management

Many past users of construction management believe that the greatest benefits from using this approach occur during the project's design phase. The construction manager's emphasis at this stage in the building process is to provide continuing project management, to coordinate the building process, develop schedules, and to review designs and specifications to save the owner construction time and money. Another important function is to develop cost models and component budgets.

During a project's design phase the responsibilities of the construction manager (CM) do not include performance of actual design decisions. The CM will review designs, but final decisions are made by the design professionals and the owner. Prime responsibilities of the CM are to keep design activities on schedule, to develop construction schedules, and to provide expertise to reduce and control costs. The cost control function of the construction manager has two very important parts: (a) cost estimating and (b) value management.

The construction manager reviews estimated and actual construction costs as an independent party, often using computers extensively. Construction cost and budget control is a basic function of the construction manager, not a secondary function. The construction manager should be familiar with detailed labor and materials costs and typical cycle times. Cost estimates are regularly provided to the project design professional and the local administration throughout the design phase as a major feedback for evaluating whether the design is within desired cost boundaries. On certain projects a representative of the construction manager will work full time in the design professional's office to speed the exchange of information on cost estimates.

Value Management is the second design phase approach to cost control. Though discussed here as a distinct form of cost control, many construction management organizations integrate value management into their overall cost control services. Value management is an organized and vigorous search directed at the analysis of requirements for achieving essential functions at the lowest total cost, consistent with needed performance, quality, reliability, aesthetics, safety, and operation. Value specialists routinely expect that project savings they suggest will exceed the cost of their services by a factor of eight to one. General Services Agency (GSA) Public Buildings Service reported $10 million in savings for 1974 from value management programs with a return on its investment of nearly thirteen to one.

Construction management organizations are well-suited to provide value management advice on construction projects as they can take an independent look at design progress using the wealth of construction knowledge and design knowledge at their disposal. Typical value management examples could include properly sized heating and cooling equipment for life-cycle cost and energy savings; information for choosing the most economical structural system; advice to modify a design to speed construction sequencing; and advice on the most economical interior finishes and partitions, based on initial cost and projected maintenance costs.

Much of the construction management activity that takes place simultaneously with design is directed toward scheduling and coordinating the construction process. Overall project schedules including both design and construction phases are prepared by the construction manager. Great emphasis is placed on these schedules as management tools to increase project efficiencies. As design progresses the construction manager develops a plan for separating construction work into an integrated set of construction contracts. Work is frequently separated by construction disciplines - heating, electrical work, finishes, etc. On the other hand it may be desirable to separate some construction work in terms of assemblies within the facility. This would be appropriate if a given assembly (e.g., an air diffuser with built-in lighting) could best be installed by a single contractor with multiple capabilities (e.g., heating and electrical work).

Other concerns may enter the decisions on separation of construction contracts. For example, laws for policies on the use of local firms or small businesses and minority contractors are often important in forming a plan for separating construction work and developing contracts. Overall, the goal of the construction manager in developing this plan for construction contracts is to assure that all necessary construction work can be contracted out in the owner's best interest. As prerequisites, each construction firm must be able to carry out its portion of work efficiently and problems such as overlapping trade jurisdictions must be avoided.

Public Technology, Inc., Washington D.C. (1976).
Using Construction Management for Public and Institutional Facilities

Essential Words for Civil Engineers

379. Management
380. Manager
381. Approach
382. Occur
383. Design Phase
384. Process
385. Coordinate
386. Schedule
387. Review
388. Specification
389. Budget
390. Responsibility
391. Performance
392. Actual
393. Decision
394. Professional
395. Owner
396. Prime
397. Expertise
398. Estimate
399. Value
400. Independent
401. Party
402. Extensively
403. Secondary
404. Labor
405. Typical
406. Cycle
407. Administration
408. Major
409. Feedback
410. Evaluate
411. Boundary
412. Representative
413. Full Time
414. Exchange
415. Distinct
416. Organization
417. Integrate
418. Overall Cost
419. Vigorous
420. Requirements
421. Achieve
422. Consistent
423. Performance
424. Reliability
425. Operation
426. Specialist
427. Routinely
428. Expect
429. Saving
430. Exceed
431. Investment
432. Advice
433. Progress
434. Wealth
435. Disposal
436. Properly
437. Heat
438. Cool
439. Life-cycle
440. Modify
441. Sequence
442. Interior
443. Finish
444. Partition
445. Initial
446. Project
447. Take place
448. Simultaneously
449. Tool
450. Increase

451. Efficiency
452. Separate
453. Contract
454. Contractor
455. Frequently
456. Electrical
457. Desirable
458. Assembly
459. Diffuser
460. Built in
461. Lighting
462. Install
463. Multiple
464. Capability
465. Law
466. Policy
467. Firm
468. Business
469. Minority
470. Goal
471. Assure
472. Prerequisite
473. Carry out
474. Portion
475. Efficiently
476. Overlap
477. Trade
478. Jurisdiction
479. Avoid

Exercise

I. Put “T” for true and “F” for false statements.

.................1- During a project’s design phase, the CM will review designs and make the final decisions.

.................2- Overall project schedules including both design and construction phases are prepared by the construction manager.

.................3- Value specialists routinely expect that project savings they suggest will exceed the cost of their services by a factor of eighteen to one.

.................4- An important function of a construction manager is to develop cost models.

II. Choose a, b, c or d which best completes each item.

1- In 1974, GSA Public Buildings Service reported $................million in savings from value management programs with a return on its investment of nearly thirteen to one.

a- 15
b- 10
c- 13
d- 25

2- A basic function of the construction manager is ....

a- Budget planning
b- Design review
c- To control the cost of the project
d- To conduct geotechnical surveys

3- In the design stage, a construction manager does not do ....

a- budgeting
b- scheduling
c- structural/architectural design
d- design reviews

4- Project schedules prepared by a CM are to ....

a- Make presentations for the owner
b- Control cost
c- Help the owner obtain bids
d- Increase project efficiencies

5- The Prime responsibility of a CM is not to ....

a- keep design activities on schedule
b- develop construction schedules
c- provide expertise to reduce and control costs
d- hire an administrative team

III. Fill in the blanks with the following words.

coordinate	estimates	contracts	accounting	construction
owner	value	budgets	schedule	

Repeating several major points, the construction manager works as a professional agent of the ....to control costs and ....and to ....all activities within an efficient .... During the design phase the ....manager provides cost control through ....management and preparation of detailed cost .... During the construction phase construction management services normally include .... of all construction ...., coordination of schedules, cost estimating, and often general control of the construction site.

IV. Fill in the blanks with the appropriate form of the words given.

1- Schedule

a. One of the most important functions of a construction manager is ....
b. Although the work was .... to be completed by the end of last week, the carpenter did not manage to finish it on time.

2- Construction

a. It is a .... move to eliminate poverty in the society.
b. By .... the bridge, the people on one side of the river can go to the other side.

3- Manage

a. Construction ....must help the owner make all decisions.

b. The construction.................emphasis at this stage in the building process is to provide continuing project................. .

V. Read the following words and definitions and write the corresponding words in the space provided.

Schedule	Finish	Distinct	Heat
Secondary	Simultaneously	Firm	Overlap

1		final coating on a surface
2		clear, separate
3		create a timetable; plan for a certain date
4		have something in common
5		of lesser importance
6		become hot; make hot
7		company, corporation, strong, solid; stable
8		concurrently, at the same time

VI. Choose the word that is most nearly <u>synonym</u> in meaning to the word in capital letters.

1- PERFORMANCE		Professional
2- OCCUR		Interior
3- DUTY		Execution
4- REAL		Vigorous
5- SPECIALIST		Take place
6- SKILL		Trade
7- LIMIT		Responsibility
8- STRONG		Boundary
9- PROPERLY		Capability
10- INTERNAL		Actual
11- DIVIDER		Goal
12- FIRST		Expertise
13- ABILITY		Well
14- AIM		Initial
15- BUSINESS		Partition

Unit Seven

Earthquake

An earthquake is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured using observations from seismometers. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests.

A 5.5-magnitude earthquake struck the area of the city of Neyshabour in northeast Iran on 19 January 2012, injuring at least 100 people and damaging several houses. "In the quake, 100 people were injured. Eighty-three were treated as out patients and the rest have been admitted to hospital." Khorasan Razavi provincial crisis management director Hojat Ali Shayanfar was quoted as saying.

Local media said around a dozen aftershocks were felt, breaking windows in some houses and causing cracks in walls terrifying some residents. Neyshabour, a city of nearly half a million, is around 100 kilometers (60 miles) west of Iran's holy city of Mashhad, where reports said the tremor was also felt.

Iran sits astride several major fault lines in the Earth's crust and is prone to frequent earthquakes, many of which have been devastating. The deadliest in recent times was a 6.3-magnitude quake which struck the southern city of Bam in December 2003, killing 31,000 people, about a quarter of the population, and destroying the city's ancient mud-built citadel.

The effect of earthquake ground shaking is to make buildings vibrate. To design a building so as to sustain damage in the event of strong ground shaking is justified by economic considerations. The very strong ground shaking occurs so infrequently that the cost of repairing damage is less than the investment required to provide more earthquake resistance.

For very important structures, the consequences of severe damage or failure may be so great that special precautions are required. Nuclear reactor power plants, large dams, long suspension bridges, and exceptionally tall buildings are examples of such special structures. Such structures are not designed according to ordinary building code requirements but are given special consideration. Their potential earthquake vibrations are analyzed, and the maximum stress and displacements produced by earthquake ground motions are determined by means of digital computers. They accordingly are given more earthquake resistance than ordinary buildings.

Essential Words for Civil Engineers

480. Release
481. Crust
482. Seismic waves
483. Frequency
484. Seismometers
485. Rupture
486. Fault
487. Volcanic activity
488. Landslide
489. Mine blast
490. Nuclear
491. Strike
492. Injure
493. Damage
494. Quake
495. Crisis
496. Aftershock
497. Terrify
498. Resident
499. Tremor
500. Prone
501. Devastate
502. Deadly
503. Destroy
504. Ancient
505. Mud-built
506. Citadel
507. Shake
508. Vibrate
509. Sustain
510. Repair
511. Severe
512. Failure
513. Precaution
514. Suspension bridges
515. Analyze
516. Displacement
517. Motion

Exercise

I. Put “T” for true and “F” for false statements.

.................1- Earthquakes are measured using observations from hydrometers.

.................2- Iran is prone to frequent earthquakes, many of which have been devastating.

.................3- The deadliest in recent times was a 6.3-magnitude quake which struck the southern city of Neyshabour in December 2003.

.................4- To design a building so as to sustain damage in the event of strong ground shaking is justified by economic considerations.

.................5- The very strong ground shaking occurs so frequently that the cost of repairing damage is less than the investment required to provide more earthquake resistance.

II. Fill in the blanks with the following words.

precautions	suspension	motions	severe
code	consequences	digital	

For very important structures, the ....of ....damage or failure may be so great that special ....are required. Nuclear reactor power plants, large dams, long ....bridges, and exceptionally tall buildings are examples of such special structures. Such structures are not designed according to ordinary building ....requirements but are given special consideration. Their potential earthquake vibrations are analyzed, and the maximum stress and displacements produced by earthquake ground ....are determined by means of ....computers. They accordingly are given more earthquake resistance than ordinary buildings.

III. Choose the word that is most nearly synonym in meaning to the word in capital letters.

1- STRIKE		hurt
2- INJURE		shaking
3- TREMOR		very old
4- DEVASTATE		fix
5- ANCIENT		hit
6- REPAIR		destroy

IV. Read the following words and definitions and write the corresponding words in the space provided.

Deadly	Vibrate	Resident
Displacement	Aftershock	

1		additional tremor, small earthquake that follows a larger earthquake
2		one who lives in a particular location;
3		causing death
4		move back and forth rapidly, oscillate
5		act of moving something from its usual place;