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**Department of Civil Engineering**

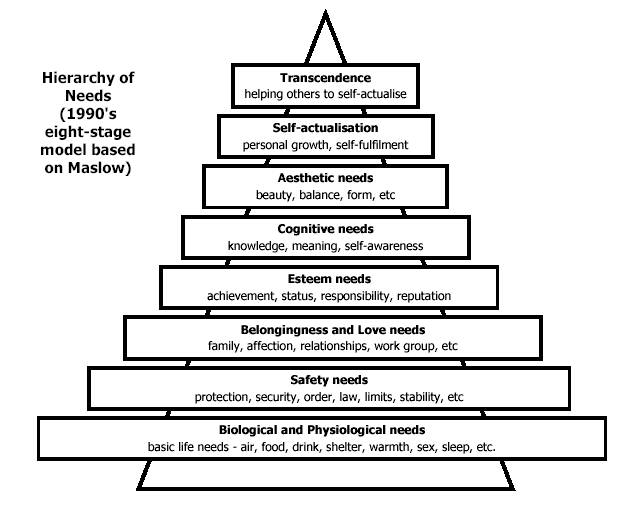
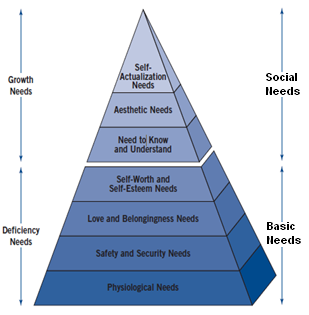
**Lecture Notes - 141CE0105 – Introduction to Civil Engineering**

**(Most part of the notes are borrowed from different sources)**

**UNIT-1 :ROLE OF ENGINEERING IN SOCIETY**

**Human Needs**

Psychologist Abraham Maslow identified seven categories of basic needscommon to all people. Maslow represented these needs as a hierarchy in the shape of a pyramid as shown in Figure.1.1. A hierarchy is an arrangement that ranks people or concepts from lowest to highest. According to Maslow, individuals must meet the needs at the lower levels of the pyramid before they can successfully be motivated to tackle the next levels. The lowest four levels represent deficiency needs, and the upper three levels represent growth needs.



**Figure 1.1** – [Courtesy: http://worlduni.com/extras/human\_behavior.htm]

**The Deficiency Needs**

The first (from bottom of the pyramic) four levels of Maslow’s hierarchy of needs are essential for a person’s well-being and must be satisfied before the person is motivated to seek experiences that pertain to the upper levels. If a person cannot meet any of these needs, that person may not be able to pursue any of the needs in the succeeding levels. Because of this, the first four levels of needs are called deficiency needs.

**Physiological Needs**

Notice that the physiological needs are the foundation of the pyramid. Maslow suggested that the first and most basic need people have is the need for survival: their physiological requirements for air, water, food and shelter (the right temperature, environment to live in). People must have air to breath, water to drink, food to eatand a place to call home before they can think about anything else.Absence of any of these will ensure the person’s demise. Hence, meeting this need, any living being or human being works to satisfy this need.

Still most of the people, in the under developed, developing and even in developing countries, need to satisfy their physical needs. Owning Shelter (the home) by most of families become their life time dream.

Have you ever had a hard time paying attention to what the professor is saying when you are hungry? Some of students may not have had breakfast—or even dinner the night before. Free and reduced breakfast and lunch programs have been implemented in schools by governments to help students meet some of their physiological needs.

**Safety and Security Needs**

Safety and Security needs are those which emanate from threats or potential threats from surroundings, such as theft, assault, attack by wild animals or people, natural disasters like flood, earthquake etc. After their physiological needs have been satisfied, people will work to meet their needs for safety and security. (But the physiological needs must be met first). Safety is the feeling people get when they know no harm will come to them, physically, mentally, or emotionally. Security is the feeling people get when their fears and anxieties are low. Government and society formed a system to protect the people through emergency call system and police to maintain law and order.

**Love and Belongingness Needs**

The third level of the pyramid are needs associated with love and belonging. Belonging needs are to do with the fact that the human normally suffer stress if alone for long periods. Solitary confinement was used as a punishment in human history long ago. Once human are well fed and safe, then they need the company of others for reasons. They wish to belong to a group like a family group, work group, occupational groups, clubs etc. These needs are met through satisfactory relationshipswith family members, friends, peers, classmates, teachers, and otherpeople with whom individuals interact. Satisfactory relationships imply acceptanceby others.

**Self-Worth and Self-Esteem Needs**

The need for “Self-Worth and Self-Esteem status” is an expression of the fact that people have a need to be needed. Once individuals have satisfactorily met their need for love and belonging, they can begin to develop positive feelings of self-worth and self-esteem, and act to foster pride in their work and in themselves as people. Once they belong to a group they must have a role within that group. It is not sufficient to just belong to a family. The more extended the family, the more important becomes the role of a person may occupy. The same thing happens with clubs, such positions as club chairperson, club secretary treasurer etc. confer status and importance.

Fortunately, many students come to college/school with the deficiency needs of physiology, safety and security, love and belongingness, and self-esteem already met—at home; in peer groups; in church, scouting, athletic, or music groups; in other groups; or in some combination of these. However, some students who come to college/school are not having these needs met elsewhere and look for ways to satisfy these needs in school. And all students must meet these deficiency needs before they can successfully work at learning.

**Cognitive needs**: Humans have the need to increase their intelligence and thereby chase knowledge. Cognitive needs is the expression of the natural human need to learn, explore, discover and create to get a better understanding of the world around them. This growth need for self-actualization and learning, when not fulfilled leads to confusion and identity crisis. Also, this is directly related to need to explore or the openness to experience.

**Aesthetic needs:** Based on Maslow’s beliefs, it is stated in the hierarchy that humans need beautiful imagery or something new and aesthetically pleasing to continue up towards Self-Actualization. Humans need to refresh themselves in the presence and beauty of nature while carefully absorbing and observing their surroundings to extract the beauty that the world has to offer. This need is a higher level need to relate in a beautiful way with the environment and leads to the beautiful feeling of intimacy with nature and everything beautiful.

**Self-actualization needs:** Self-actualization is the instinctual need of humans to make the most of their abilities and to strive to be the best they can. This need when fulfilled leads to commitment to promoting the well-being of youth and future generations (generativity).

**Self-transcendence needs:** Maslow later divided the top of the triangle to add self-transcendence which is also sometimes referred to as spiritual needs. Spiritual Needs are a little different from other needs, accessible from many level. This need when fulfilled, leads to feelings of integrity and take things to another level of being.

Explain basic human needs – 10marks

Explain Physiological needs with an Example. – 2marks

Explain Safety and Security Needs – 2marks

Explain Love and Belongingness Needs – 2 marks

Explain Self-Worth and Self-Esteem Needs – 2 marks

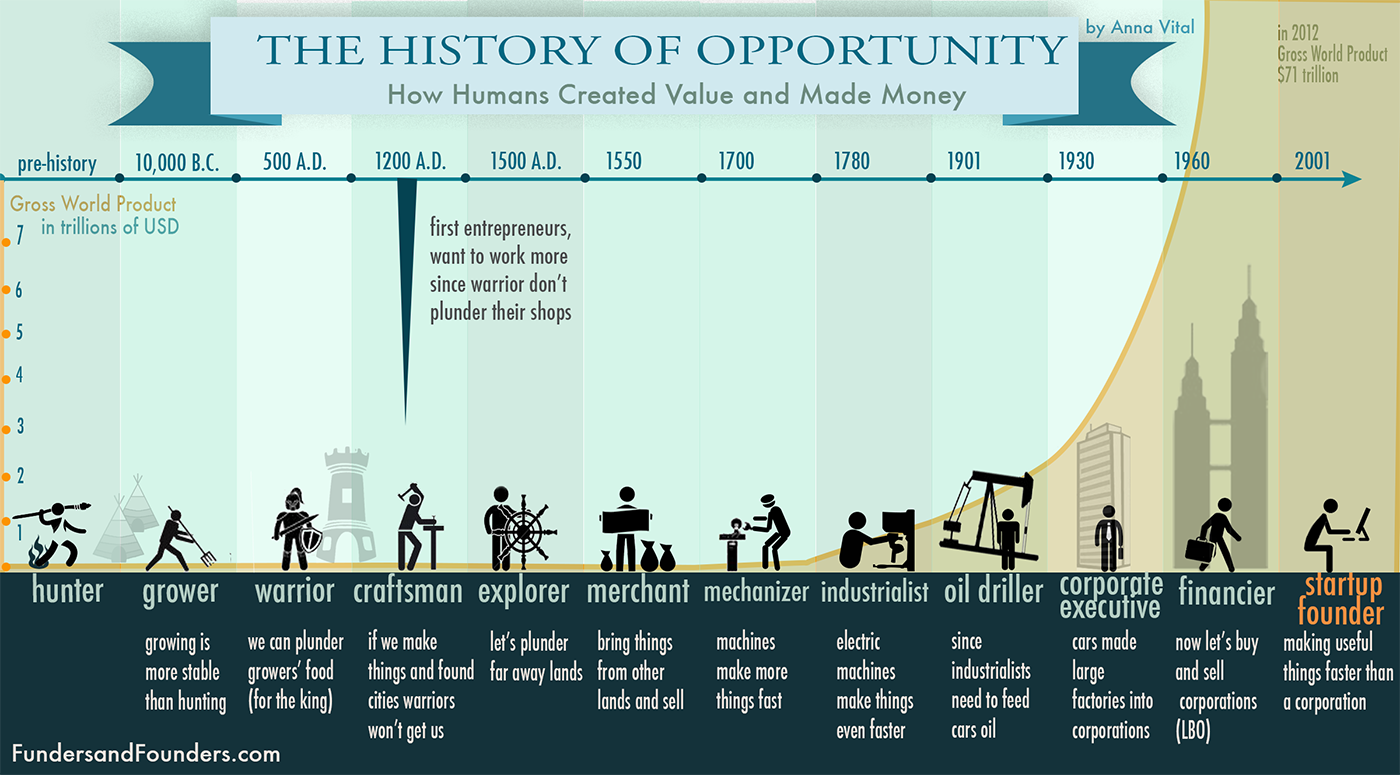
Explain deficiency needs of humans with an Example. – 10marks

Why do physiological needs occupy at the lowest position in Maslow’s hierarchy of needs? – 2marks

**A big question for faculty and students: (Coutesy – http://2cents.onlearning.us/?p=4744)**

What was the biggest development that has led to our modern day life? The Gutenberg Press, the typewriter, electricity, the computer? How can students harness this technology in order to take advantage of the opportunities this infographic claims there is?

Most importantly in preparing for tomorrow, students must look to tomorrow, what are going to be the technological advances of tomorrow that will build the opportunities of tomorrow. Without knowing what they are, what can the students do to prepare for the technology of tomorrow. Better yet, what can students do to create the technology of tomorrow.



**THE BENEFITS THAT ENGINEERING HAS BROUGHT TO THE WORLD**

People depend on the engineering every day. The engineering has been contributed to human and the world since ancient time. When people get advanced and intelligent, more technology and engineering have been developed to fulfill human’s needs. The specific benefits of broad engineering disciplines are too much to be listed and it proves that the people cannot live without it. The sustainable of human civilization relies on the engineering and it has been proved by the history that the more advanced civilization can out match other weaker civilization. More or less, the people will continue to be reliable on engineering in the future either the people want it or not. The engineers may not be recorded in the history book, but they are the truly guardian of the humankind.

Engineers apply the principles of science and mathematics to develop economical solutions to technical problems. Their work is the link between scientific discoveries and the commercial applications that meet societal and consumer needs. They also use their imagination and analytical skills to invent, design, and build things that matter. They are team players with independent minds who turn ideas into reality. Many become licensed professional engineers in order to better protect the health, safety, and welfare of the public. By dreaming up creative and practical solutions, engineers are changing the world all the time.

Engineering has existed since ancient times as humans devised fundamental inventions such as the pulley, lever, and wheel. Each of these inventions is consistent with the modern definition of engineering, exploiting basic mechanical principles to develop useful tools and objects. First and foremost, is invention of the wheel and the benefit of the wheel is huge until now. More people advanced, more advance the technology and engineering were. Look at the 7 Ancient Wonders; some people would like to appreciate from the art and culture point of view, but these are the symbols and icons of tremendous engineering achievement on that time. Some of the engineering mechanisms in them are still mysterious pieces of work until now. For example, the earliest civil engineer known by name is Imhotep. As one of the officials of thePharaoh,Djosèr, he probably designed and supervised the construction of the Pyramid of Djoser (theStep Pyramid) at Saqqarain Egypt around 2630-2611 BC.

Engineering has brought development to humankind in all ages. Life and death, rise and fall of kingdoms were based on development of the engineering and technology.

In the last century alone, many great engineering achievements became so common place that we now take them mostly for granted. Technology allows an abundant supply of food and safe drinking water for much of the world. We rely on electricity for many of our daily activities. We can travel the globe with relative ease, and bring goods and services wherever they are needed. Growing computer and communications technologies are opening up vast stores of knowledge and entertainment.

**Grant Challenges for Engineering**  [http://www.engineeringchallenges.org/File.aspx?id=11574&v=ba24e2ed]

As remarkable as these engineering achievements are, certainly just as many more great challenges and opportunities remain to be realized. While some seem clear, many others are indistinct and many more surely lie beyond most of our imaginations

Foremost among the challenges are those that must be met to ensure the future itself. The Earth is a planet of finite resources, and its growing population currently consumes them at a rate that cannot be sustained. Widely reported warnings have emphasized the need to develop new sources of energy, at the same time as preventing or reversing the degradation of the environment.

Another popular proposal for long-term energy supplies is nuclear fusion, the artificial re-creation of the sun’s source of power on Earth. The quest for fusion has stretched the limits of engineering ingenuity.

Engineering solutions for both solar power and nuclear fusion must be feasible not only technologically but also economically when compared with the ongoing use of fossil fuels.

A further but less publicized environmental concern involves the atmosphere’s dominant component, the element nitrogen. The biogeochemical cycle that extracts nitrogen from the air for its incorporation into plants — and hence food — has become altered by human activity. With widespread use of fertilizers and high-temperature industrial combustion, humans have doubled the rate at which nitrogen is removed from the air relative to pre-industrial times, contributing to smog and acid rain, polluting drinking water, and even worsening global warming. Engineers must design counter measures for nitrogen cycle problems, while maintaining the ability of agriculture to produce adequate food supplies.

Chief among concerns in this regard is the quality and quantity of water, which is in seriously short supply in many regions of the world. Both for personal use — drinking, cleaning, cooking, and removal of waste — and large-scale use such as irrigation for agriculture, water must be available and sustainably provided to maintain quality of life. New technologies for desalinating sea water may be helpful, but small-scale technologies for local water purifi cation may be even more effective for personal needs.

Through the engineering accomplishments of the past, the world has become smaller, more inclusive, and more connected. The challenges facing engineering today are not those of isolated locales, but of the planet as a whole and all the planet’s people. Meeting all those challenges must make the world not only a more technologically advanced and connected place, but also a more sustainable, safe, healthy, and joyous.

**History of engineering**

People have constructed buildings and other structures since prehistory, including bridges, amphitheatres, dams, roads and canals. Building materials in present use have a long history and some of the structures built thousands of years ago are regarded as remarkable. The history of construction overlaps that of structural engineering and many other fields. To understand why things were constructed the way they were in prehistory, we also need to rely on archaeology to record the form of the parts that survive and the tools used, and other branches of history and architecture to investigate how the builders lived and recorded their accomplishments.

**Neolithic construction- (New Stone Age - 10,000 to 6,000-4,000 years ago)**

Neolithic, also known as the New Stone Age, was a time period roughly from 9000 BC to 5000 BC named because it was the last period of the age before wood working began. The tools available were made from natural materials including bone, antler, hide, stone, wood, grasses, animal fibers, and the use of water. These tools were used by people to cut such as with the hand axe, chopper, adze, and celt. Also to scrape, chop such as with a flake tool, pound, pierce, roll, pull, leaver, and carry. Building materials included bones such as mammoth ribs, hide, stone, metal, bark, bamboo, clay, lime plaster, and more.

Neolithic architecture ranges from the tent to the megalith (an arrangement of large stones) and rock-cut architecture which are frequently temples, tombs, and dwellings. The most remarkable Neolithic structure in Western Europe is the iconic megalith known as Stonehenge, regarded by some archaeologists as displaying methods of timber construction such as at woodhenge translated into stone, a process known as petrification. The now ruinous remains are of post and lintel construction and include massive sandstone lintels which were located on supporting uprights by means of mortise and tenon joints; the lintels themselves being end-jointed by the use of tongue and groove joints. There is also evidence of prefabrication of the stonework; the symmetrical geometric arrays of stone clearly indicate that the builders of Stonehenge had mastered sophisticated surveying methods.



**Copper Age and Bronze Age construction**

The Copper Age is the early part of the Bronze Age. Bronze is made when tin is added to copper and brass is copper with zinc. Copper came into use before 5,000 BC and bronze around 3,100 BC, although the times vary by region. Copper and bronze were used for the same types of tools as stone such as axes and chisels, but the new, less brittle, more durable material cut better. Bronze was cast into desired shapes and if damaged could be recast. A new tool developed in the copper age is the saw. Other uses of copper and bronze were to "harden" the cutting edge of tools such as the Egyptians using copper and bronze points for working soft stone including quarrying blocks and making rock-cut architecture.

During the Bronze Age the corbelled arch came into use such as for beehive tombs. The wheel came into use but was not common until much later. Heavy loads were moved on boats, sledges (a primitive sled) or on rollers. The Egyptians began building stone temples with the post and lintel construction method and the Greeks and Romans followed this style.

**Iron Age construction**

The Iron Age is a cultural period from roughly 1200 BC to 50 BC with the widespread use of iron for tools and weapons. Iron is not much harder than bronze but by adding carbon iron becomes steel which was being produced after about 300 BC. Steel can be hardened and tempered producing a sharp, durable cutting edge. A new woodworking tool allowed by the use of steel is the hand-plane.

The chief building material was the mud-brick, formed in wooden moulds similar to those used to make adobe bricks. Bricks varied widely in size and format from small bricks that could be lifted in one hand to ones as big as large paving slabs. Rectangular and square bricks were both common. They were laid in virtually every bonding pattern imaginable and used with considerable sophistication. Drawings survive on clay tablets from later periods showing that buildings were set out on brick modules. By 3500 BC, fired bricks came into use and surviving records show a very complex division of labour into separate tasks and trades.[citation needed] Fired bricks and stone were used for pavement.

The Mesopotamian civilizations, particularly Babylon and thence Susa, developed glazed brickwork to a very high degree, decorating the interiors and exteriors of their buildings with glazed brick reliefs, examples of which survive in the Tehran archaeological museum, the Louvre Museum in Paris and the Pergamon Museum in Berlin.

As opposed to the cultures of ancient Mesopotamia which built in brick, the pharaohs of Egypt built huge structures called pyramids in stone. The pyramids are chiefly impressive for their enormous size and the staggering manpower that must have been employed in their construction. The largest is the Great Pyramid of Giza which remained the tallest structure in the world for 3800 years. The engineering problems involved were chiefly to do with the transport of blocks, sometimes over long distances, their movement into location and exact alignment. It is now generally agreed that the skilled building workers were respected and well treated, but undoubtedly very large numbers of labourers were necessary to provide the brute force.

The ancient Greeks, like the Egyptians and the Mesopotamians, tended to build most of their common buildings out of mud brick, leaving no record behind them. However very many structures do survive, some of which are in a very good state of repair, although some have been partly reconstructed or re-erected in the modern era. The most dramatic are the Greek Temples. The Greeks made many advances in technology including plumbing, the spiral staircase, central heating, urban planning, the water wheel, the crane, and more.

The great Roman development in building materials was the use of hydraulic lime mortar called Roman cement. Previous cultures had used lime mortars but by adding volcanic ash called a pozzolana the mortar would harden under water. This provided them with a strong material for bulk walling. They used brick or stone to build the outer skins of the wall and then filled the cavity with massive amounts of concrete, effectively using the brickwork as permanent shuttering (formwork). Later they used wooden shuttering which was removed for the concrete to cure. An example of a temple made of Roman concrete in the 1st century BC is the Temple of Vesta in Tivoli, Italy. The concrete was made of nothing more than rubble and mortar it was cheap and very easy to produce and required relatively unskilled labour to use, enabling the Romans to build on an unprecedented scale. They not only used it for walls but also to form arches, barrel vaults and domes, which they built over huge spans. The Romans developed systems of hollow pots for making their domes and sophisticated heating and ventilation systems for their thermal baths.[citation needed].

The Romans substituted bronze for wood in the roof truss(s) of the Pantheon's portico which was commissioned between 27 BC and 14 AD. The bronze trusses were unique but in 1625 Pope Urban VIII had the trusses replaced with wood and melted the bronze down for other uses. The Romans also made bronze roof tiles. Lead was used for roof covering material and water supply and waste pipes. The Latin name for lead is plumbum thus plumbing. Romans also made use of glass in construction with colored glass in mosaics and clear glass for windows. Glass came to be fairly commonly used in windows of public buildings. The invention of the waterwheel, sawmill, arch, and were by the Romans. The Romans also began using glass for architectural purposes after about 100 CE and used double glazing as insulated glazing. Roman roads included corduroy roads and paved roads, sometimes supported on raft or pile foundations and bridges. Vitruvius gives details of many Roman machines. The Romans developed sophisticated timber cranes allowing them to lift considerable weights to great heights. The upper limit of lifting appears to have been about 100 tonnes.Roman building ingenuity extended over bridges, aqueducts, and covered amphitheatres. Their sewerage and water-supply works were remarkable and some systems are still in operation today. The only aspect of Roman construction for which very little evidence survives is the form of timber roof structures, none of which seem to have survived intact.

China is a cultural hearth area of eastern Asia, many Far East building methods and styles evolved from China. A famous example of Chinese construction is the Great Wall of China built between the 7th and 2nd centuries BC. The Great Wall was built with rammed earth, stones, and wood and later bricks and tiles with lime mortar. Wooden gates blocked passageways. The oldest archaeological examples of mortise and tenon type woodworking joints were found in China dating to about 5000 BC. The YingzaoFashi is the oldest complete technical manual on Chinese architecture. The Chinese followed the state rules for thousands of years so many of the ancient, surviving buildings were built with the methods and materials used in the 11th century. Chinese temples are typically wooden timber frames on an earth and stone base. The oldest wooden building is the Nanchan Temple (Wutai) dating from 782 CE. However, Chinese temple builders regularly rebuild the wooden temples so some parts of these ancient buildings are of different ages.

**Medieval construction**

The Middle Ages of Europe span from the 5th to 15th centuries AD from the fall of the Western Roman Empire to the Renaissance and is divided into Pre-Romanesque and Romanesque periods. Fortifications, castles and cathedrals were the greatest construction projects. The Middle Ages began with the end of the Roman era and many Roman building techniques were lost. But some Roman techniques, including the use of iron ring-beams, appear to have been used in the Palatine Chapel at Aachen, c. 800 AD, where it is believed builders from the Langobard Kingdom in northern Italy contributed to the work. A revival of stone buildings in the 9th century and the Romanesque style of architecture began in the late 11th century. Also notable are the stave churchs in Scandinavia. Models were used for designing structures and could be built to large scales.

**Construction in the Renaissance**

The major breakthroughs in this period were to do with the technology of conversion. Water mills in most of western Europe were used to saw timber and convert trees into planks. Bricks were used in ever increasing quantities. In Italy the brickmakers were organised into guilds although the kilns were mostly in rural areas because of the risk of fire and easy availability of firewood and brickearth.

The rebirth of the idea of an architect in the Renaissance radically changed the nature of building design. The Renaissance reintroduced the classical style of architecture. The resulting change in status of architecture and more importantly the architect is key to understanding the changes in the process of design. The Renaissance architect was often an artist (a painter or sculptor) who had little knowledge of building technology. Occasionally the architect would get involved in particularly difficult technical problems but the technical side of architecture was mainly left up to the craftsmen. This change in the way buildings were designed had a fundamental difference on the way problems were approached. Where the Medieval craftsmen tended to approach a problem with a technical solution in mind, the Renaissance architects started with an idea of what the end product needed to look like and then searched around for a way of making it work. This led to extraordinary leaps forward in engineering.

The wish to return to classical architecture created problems for the Renaissance buildings. The builders did not use concrete and thus comparable vaults and domes had to be replicated in brick or stone. The greatest technical feats were undoubtedly in these areas. The first major breakthrough was Brunelleschi's project for the dome of Santa Maria del Fiore.

**Construction in the seventeenth century**

The seventeenth century saw the birth of modern science which would have profound effects on building construction in the centuries to come. The major breakthroughs were towards the end of the century when architect-engineers began to use experimental science to inform the form of their buildings. However it was not until the eighteenth century that engineering theory developed sufficiently to allow sizes of members to be calculated. Seventeenth-century structures relied strongly on experience, rules of thumb and the use of scale models.

Most buildings had stone ashlar surfaces covering rubble cores, held together with lime mortar. Experiments were made mixing lime with other materials to provide a hydraulic mortar, but there was still no equivalent of the Roman concrete. In England, France and the Dutch Republic, cut and gauged brickwork was used to provide detailed and ornate facades. The triangulated roof truss was introduced to England and used by Inigo Jones and Christopher Wren.

**Construction in the eighteenth century**

The eighteenth century saw the development of many the ideas that had been born in the late seventeenth century. The architects and engineers became increasingly professionalised. Experimental science and mathematical methods became increasingly sophisticated and employed in buildings. At the same time the birth of the industrial revolution saw an increase in the size of cities and increase in the pace and quantity of construction. The major breakthroughs in this period were in the use of iron (both cast and wrought). Iron columns had been used in Wren's designs for the House of Commons and were used in several early eighteenth-century churches in London, but these supported only galleries. In the second half of the eighteenth century the decreasing costs of iron production allowed the construction of major pieces of iron engineering.Brick production increased markedly during this period. Many buildings throughout Europe were built of brick, but they were often coated in lime render, sometimes patterned to look like stone. Brick production itself changed little. Bricks were moulded by hand and fired in kilns no different to those used for centuries before. Terracotta in the form of Coade stone was used as an artificial stone in the UK.

**Construction in the nineteenth century: Industrial Revolution**

The industrial revolution was manifested in new kinds of transportation installations, such as railways, canals and macadam roads. These required large amounts of investment. New construction devices included steam engines, machine tools, explosives and optical surveying. The steam engine combined with two other technologies which blossomed in the nineteenth century, the circular saw and machine cut nails, lead to the use of balloon framing and the decline of traditional timber framing.

As steel was mass-produced from the mid-19th century, it was used, in form of I-beams and reinforced concrete. Glass panes also went into mass production, and changed from luxury to every man's property. Plumbing appeared, and gave common access to drinking water and sewage collection. Building codes have been applied since the 19th century, with special respect to fire safety.

**Construction in the twentieth century**

With the Second Industrial Revolution in the early 20th century, elevators and cranes made high rise buildings and skyscrapers possible, while heavy equipment and power tools decreased the workforce needed. Other new technologies were prefabrication and computer-aided design.

Trade unions were formed to protect construction workers' interests. Personal protective equipment such as hard hats and earmuffs also came into use. From the 20th century, governmental construction projects were used as a part of macroeconomic stimulation policies, especially during the Great depression (see New Deal). For economy of scale, whole suburbs, towns and cities, including infrastructure, are often planned and constructed within the same project (called megaproject if the cost exceeds US$1 billion), such as Brasília in Brazil, and the Million Programme in Sweden.

In the end of the 20th century, ecology, energy conservation and sustainable development have become more important issues of construction.

**Importance of infrastructural development**

Infrastructure refers to the fundamental facilities and systems serving a country, city, or area, including the services and facilities necessary for its economy to function. Infrastructure is the network of power, telecom, ports, airports, roads, civil aviation, railways, and transportation in a country. Its importance in the development of a country cannot be over-emphasised. As a matter of fact, infrastructure is the lifeline of the economy of a country. All developed countries have adequate infrastructure so that all the activities are executed efficiently, smoothly in time. On the other hand, all poor countries have little infrastructure. The plans of these countries target the building of adequate infrastructure to put their economies on a high growth path.

Power is an essential input for economic development and improving the quality of life of people. Development of conventional forms of energy for meeting the growing needs of people is the responsibility of the government. In the pre- independence period, the power supply was mainly in the private sector and that too restricted to the urban areas. With the formation of State Electricity Boards during the Five-Year Plans, a significant step was taken in bringing about a systematic growth of power supply for industries all over the country. A number of multi-purpose projects came into being with the setting up of hydro, thermal and nuclear power stations.

India at present is at the threshold of becoming a developed country. Its economy has been growing at a high GDP growth of over 8 per cent per annum. With the increase in population the demand for goods and services is increasing every year. The number of dwelling units in big and small cities is increasing. There is more demand for power to run home appliances in these as well as existing units. To meet this ever increasing demand we need to build a huge power infrastructure. That is why India has entered into a nuclear deal with America whereby the sole superpower in the world shall provide us with nuclear technology. Many nuclear reactors will be set up in India. The nuclear fuel will be supplied by some of the countries in the Nuclear Suppliers Group (NSG). Nuclear energy will be harnessed to be used for peaceful purposes.

The transportation infrastructure includes roads, vehicles, railways, tracks, trains, ports, airports, ships and vessels. Road transportation is perhaps the most important because the railway tracks cannot be laid everywhere. The roads are the means by which the movement of people and goods from one place to another is ensured. Millions of people move out of their houses everyday to reach their places of work, trade or business daily. They not only generate income from working but also fulfil the needs of others. They use roads and vehicles available to them.

The national highways are mainly used to move from one city to another and for supply of essential goods-foodgrains and other articles of use from one city to another. Thus, roads are a key to the success of Public Distribution System. If there is no road transportation, the supply of these goods will not be possible to different cities and towns. The whole economy will collapse.

Railways are another important part of transportation infrastructure. India has a huge railway network with a route length of 63,221 km, a fleet of over 7,800 locomotives, 5,340 passenger service vehicles and nearly 5,000 other coaching vehicles. There are 7,031 stations across the length and breadth of the country. The total network is divided into 16 zones. Crores of passengers travel through railways for the job, work and personal needs every day. Thousands of tonnes of goods are taken from one place to another. The transportation of heavy goods like steel and raw material like coal cannot be transported by any other mode of transport than the railways. Apart from performing these vital functions for the economy and the country, the railways are a huge source of revenue for the government. It has also given employment to lakhs of employees directly or indirectly.

Airports and civil aviation are also part of the transportation network in the country. Air travel is fast and highly comfortable. It caters to the needs of rich sections of people and the high executives and political delegates whose time is highly precious. It is also used for speedy transportation of goods, particularly the perishable goods which, if sent through road or railway transport will rot in the way.

In India the civil aviation has three main functional divisions-regulatory, infrastructure and operational. On the operational side India Airlines, Alliance Air, private scheduled airlines and non-scheduled operators provide domestic air services while Air India provides international air services. Pawan Hans Helicopters Limited provides helicopter services to 11 and Natural Gas Corporation (ONGC) in its offshore operations to inaccessible areas and difficult terrains. Sahara Airlines and Jet Airways have also been permitted to operate on international sector. In order to help the Indian exporters and make their exports more competitive, the government introduced an ‘open sky policy’ for cargo.

Under this policy, foreign airlines or associations of exporters can bring any freighters to the country for the upliftment of cargo. Charter flights for tourists are also allowed to and from India. Thus, air services infrastructure plays a key role in civil aviation, international flights and cargo transportation. It benefits the economy immensely and earns millions of rupees every year for the country.

India has a coastline of over 7500 km which is serviced by 12 major ports and 186 other ports. The major ports are under the purview of the central government while the minor ports come under the jurisdiction of the respective state governments. The major ports are: Mumbai, NhavaSheva, Kandla, Marmugao, Mangalore, Cochin, on the west coast; Kolkata, Haldia, Paradip, Visakhapatnam, Chennai, Ennore, and Tuticorin on the east coast.

These ports have a capacity of over 450 million tonnes. The number of cargo vessels handled at these ports is about 16,500 per annum. The cargo handled is liquid cargo, dry cargo and container cargo. In order to improve the efficiency, productivity and quality of services and to bring competitiveness in port services, the government has encouraged private participation in it in the wake of liberalisation and globalisation of the economy. The Eleventh Plan outlay for port sector is around Rs. 6,500 crore.

If one sector has developed more than any other sector during the last one decade or so, it is the communication sector. It encompasses the postal network, mail system, telecommunications, including telephones, mobile phone services, etc. The postal service is catering to the mailing, telegraphic services which have now been supplemented by courier services. India has a huge infrastructure for postal and telecommunication services whereby letters, parcels and messages are sent to various parts of the country and abroad. Mobile phone services are the buzzword of our society now. Several companies like Bharti Airtel, Reliance Communication, Hutch and Vodafone are flourishing apart from the public sector MTNL.

Infrastructure is the base on which all economic activities of the country depend. The government is spending thousands of crores of rupees every year to create this infrastructure where it does not exist or is not fully functional. It has also established adequate systems for their maintenance and upkeep so that it remains efficient and durable.

**Scope of Civil Engineering**

Civil engineering is the oldest branch of engineering which is growing right from the stone age of civilization. American society of civil engineering defines civil engineering as the profession in which a knowledge of the mathematical and physical sciences gained by study, experience and practice is applied with judgement to develop ways to utilize economically the materials and forces of the nature for the progressive well being of man. Dedication of engineers can be easily seen by opening a window and viewing the structures that adorn the earth. The structures that civil engineers design and build define the culture of a society and help to keep pace with a constantly changing world.

Bridges, highways, drinking water- just a few necessities to the modern world, made possible by engineers throughout history, specifically civil engineers. Tracing back to 4000 BC, civil engineering has revolutionized the lifestyles of the world population. In ancient times skilled workers called artisans carried out most construction. These artisans accomplished their engineering achievements by the use of only manual labor. Without the use of the specialized equipment used today, simple projects could take up to years to finish.

**Fields Of Civil Engineering And Their Scope**

Civil engineering may be divided into the following fields:

(i) Building materials

(ii) Building construction

(iii) Structural engineering

(iv) Geotechnical engineering

(v) Hydraulics, water resources and irrigation engineering

(vi) Water supply and sanitary engineering

(vii) Environmental engineering

(viii) Transportation engineering

(ix) Town planning and architecture

(x) Surveying

(xi) Drawing

(xii) Estimation and specification

(xiii) Management techniques

(xiv) Computer application.

1. **Building Materials.**

Shelter is the basic need of civilised society. Stones, bricks, timber and lime concrete are the traditional materials used for the construction of houses and other buildings. Theinvention of cement and concrete has prodivided durable buildings. Reinforced concrete which iscomposite construction of steel and concrete has helped in building large structurer. Steel, aluminium,glass, plastics, glazed tiles, plaster of paris, linoleum, paints and varnishes have improved the quality ofbuildings. Improved versions of many building materials keep on appearing in the market regularly. Acivil engineer has to make use of all these materials judiciously.

**(ii) Building Construction.**

Fast rate of urbanisation and increase in the cost of land has forced to go for the vertical growth of buildings. In metropolitan cities, 25 storey buildings are becoming common. Even in small towns 3 to 4 storey buildings have become common. This requirement has brought in new building technologies. Continuous research and development in construction technology is going on to see that huge investment in building is utilised at the earliest. Civil engineers have to look into the problems of rural areas and urban poor people also. There are 23 million Indians without home. Low cost housing is the need of the day to make poor people afford their own houses

**(iii) Structural Engineering.**

Before building a structure, it should be analysed and designed to decide about its size to resist the possible forces coming on it. The structure should be safe and at the same time its components should be as small as possible. Up to mid sixties lot of improvements were seen in the classical methods of analysis. Need of tall structures and improvements in computers gave rise to matrix method and finite element method of analysis. Requirement of large column free structures gave rise to analysis and design of shell roofs (curved surfaces), geodetic towers and tension structures. Disasters due to earthquakes have made civil engineers to study earthquake forces and build earthquake resistant structures. It needs the knowledge of structural dynamics. A civil engineer has to not only give a safe structure but he has to give an economical structure also. Hence, there is need for studying mathematical optimisation techniques. All these aspects of analysis and design fall under structural engineering field.

**(iv) Geotechnical Engineering.**

All structures have to finally transfer the load acting on them to soil safely. Soil property changes from place to place. Even in the same place it may not be uniform at different depth and in different seasons. Hence, a civil engineer has to properly investigate soil and decide about the safe load that can be spread on the soil. This branch of study in civil engineering is known as geotechnical engineering. Apart from finding safe bearing capacity for foundation of buildings, geotechnical engineering involves various studies required for the design of pavements, tunnels, earthen dam, canals and earth retaining structures. It involves study of ground inprovement techniques also

**(v) Hydraulics, Water Resources and Irrigation Engineering.**

Water is an important need for all living beings. Study of mechanics of water and its flow characteristics is another important field in civil engineering and it is known as hydraulics. Requirement of water in cities for domestic purpose and for industries is continuously increasing. Rural areas need water for agricultural field also. Hence civil engineers have to look for new water resources and for storing them. This branch of civil engineering is known as water resources engineering. Water stored in reservoirs by building bunds and dams should be brought to agricultural fields through canals and distributories. Study connected with this aspect is known as irrigation engineering.

**(vi) Water Supply and Sanitary Engineering.**

When water is required for drinking purpose it should be purified and made potable. Purification of water and the technology involved in taking it to the houses is known as water supply engineering.

Waste waster and solid waste should be treated and disposed so that they do not create health hazard. This branch of civil engineering is known as sanitary engineering.

**(vii) Environmental Engineering.**

Apart from tackling solid and waste water disposal civil engineers have to tackle air pollution problem also. Due to industrialisation air pollution is becoming a major problem. It is estimated that for every tonne of cement produced one tonne of CO2 is released to environment. Vehicles also produce lot of CO2. During the last one century, the environmental pollution has resulted in global warming by 4°C. An environmental disaster will be unavoidable if China, India and other developing countries start consuming as much energy and materials as the West did it in its march to industrialisation. Hence environmental engineering is emerging as an important field of study in civil engineering.

**(viii) Transportation Engineering.**

Transportation facility is another important need. Providing good and economical road links is an important duty of civil engineers. It involves design and construction of base courses, suitable, surface finishes, cross drainage works, intersections, culverts, bridges and tunnels etc. Railways is another important long-way transport facility. Design, construction and maintainance of railway lines are parts of transportation engineering. Globalisation has resulted into requirement of airports and harbours. For proper planning of these transport facilities, traffic survey is to be carried out. Carrying out traffic survey and then planning, designing, construction and maintainance of roads, railways, bridges, tunnels, airports and harbours is known as transportation engineering.

**(ix) Town Planning and Architecture.**

With the growth of population and industries new towns are coming up and existing ones are growing. Proper town planning is to be made by civil engineers. Structures should be aesthetically good also. Architecture covers this area. This field of civil engineering has grown up so much that it has become a separate branch of engineeing.

**(x) Surveying.**

For planning all developmental activities, proper maps are required. The science of map making is known as surveying. Survey maps provide the relative positions of various objects of the area in the horizontal as well as vertical directions. Earlier conventional instruments like chain, tape, compasses, theodolites and levels were used for various measurements in surveying. In this electronic era the modern equipments like electronic distance meters and total stations are used for measurements. Modern technology like remote sensing has made surveying vast area in a short period possible.

**(xi) Drawing.**

Drawing is the language of engineers. The survey maps and plans, the building description etc. are to be provided with neat scaled drawings.

**(xii) Estimation and Specification.**

Civil engineers have to prepare estimation and detailed specifications for each and every work to be taken up.

**(xiii) Management Techniques.**

Civil engineers must manage, men, materials and equipments efficiently. Since huge funds are to be handled in civil engineering projects, a civil engineer must know the basics in financial management and leagal obligations. Knowledge of management techniques is an asset to practising civil engineer

**(xiv) Computer Applications.**

Since the magnitude of designing the structures and storing information is increasing very fast nowadays civil engineers go for computer applications. Nowadays neat drawings are also produced using computers. There are a good number of civil engineering software commercially available

**ROLE OF CIVIL ENGINEER**

A civil engineer has to conceive, plan, estimate, get approval, create and maintain all civil engineering infrastructure activities. He has to carry out research and training programmes to technology.

Civil engineer has a very important role in the development of the following infrastructures:

(i) Town and city planning

(ii) Build suitable structures for the rural and urban areas for various utilities.

(iii) Build tanks, dams to exploit water resources.

(iv) Purify the water and supply water to needy areas like houses, schools, offices, andagriculture field.

(v) Provide good drainage system and purification plants.

(vi) Provide and maintain communication systems like roads, railways,airports.

(vii) Monitor land, water and air pollution and take measures to control them.

The civil engineers perform the following functions in all the above tasks:

1. conception of idea and investigation : Collection of data such as the need aconceiving an idea. Eg: Gathering rain fall, runinformation, source of quantity and quality of water etc.

2. Surveying: Preparation of maps and plans locating buildings and structures. Eg:alignment, levels for dams, bridges and buildings etc.

3. Planning : Working out alternative solutions and schemes to meet present and future needs,sizes, capacity and locations of components.

4. Design: Working out details of structure, dimensions of components for the materials used,component processes. Eg: Sizes of beams, the water supply treatment method etc.

5. Execution: Preparation of specification, detailed estimation ofscheduling, tendering process, construction, and quality control during construction.

6. Research and development: Finding new materials, efficient structural forms and newer designmethods based on scientific knowledge, maths.

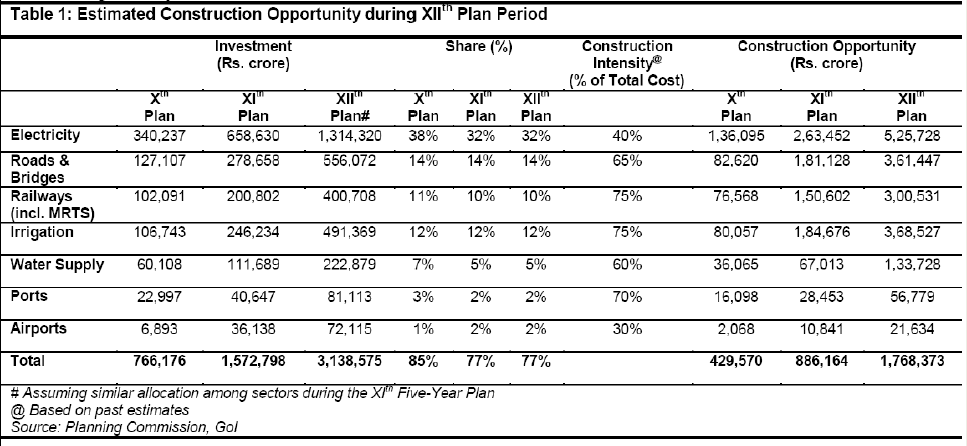
**Government funding plans for construction**

The Construction industry of India is an important indicator of the development as it creates investment opportunities across various related sectors. The construction industry has contributed an estimated Rs. 6708 billion (Rs. 6,70,800 crores) to the national GDP in 2011-12 (a share of around 8%). The industry is fragmented, with a handful of major companies involved in the construction activities across all segments; medium-sized companies specializing in niche activities; and small and medium contractors who work on the subcontractor basis and carry out the work in the field. In 2011, there were slightly over 500 construction equipment manufacturing companies in all of India. The sector is labor-intensive and, including indirect jobs, provides employment to more than 35 million (3.50 crore) people.

India is on the verge of witnessing a sustained growth in infrastructure build up. The construction industry has been a witness to a strong growth wave powered by large spends on housing, road, ports, water supply, railways and airport development. Its share as a percentage of GDP has increased considerably as compared to the last decade. To put things in perspective, the total investment in infrastructure - which in this case also includes roads, railways, ports, airports, electricity, telecommunications, oil gas pipelines and irrigation - is estimated to have increased from 5.7% of GDP in 2007 to around 8.0% by 2012. The Planning Commission of India has proposed an investment of around US$ 1 trillion (Rs. 65,79,463 crores) in the Twelfth five-year plan (2012-2017), which is double of that in the Eleventh five-year plan.



The above government funding for various infrastructures, major fund goes to the construction of these infrastructures. The opportunities for construction is given below as given in the planning commission 12th five year plan report



There huge funding will be provided by Government of India on

Electricity, Roads & Bridges, Railways, irrigation projects, Water supply schemes, Sea Ports, Airports.

**Opportunities for Civil Engineers**

Opportunities for civil engineers exist in the public as well as private sectors in large numbers in all branches of design, construction and maintenance, infrastructure development in both India and abroad. Right now constructions industry is booming as there is growth in infrastructure requirement throughout the country. This is going to stay for next few decades. Scope of civil engineers lies with many developing countries in Middle East, Africa, Asia where infrastructure development is picking up and Indian engineers are in great demand.

Civil Engineers can find job in Government departments, private and public sector industries, research and teaching institutions etc. Job opportunities for civil engineers are expected to increase as fast as the average for all jobs, although the construction industry is vulnerable to fluctuations in the economy.

Civil Engineers will always be needed to maintain and repair existing facilities and structures and to construct new ones. After getting degree in civil engineering, one can look for jobs in road projects, building work, consultancy firms, quality testing laboratories or housing societies. The experts say there is a high demand for experienced civil engineers in developed countries also. Civil engineers are employed in all the major construction projects carried out by the state or central government, the railways, private construction companies, military, engineering services, consultancy services etc. Civil engineering graduates can also go in for research and take up teaching or they can open their own independent consultancy services or construction companies.

B.E.(civil) students, now a days, [as of 2015] has the maximum chances in Govt. sector than any other fresh engineers. Freshers are employed as trainee, junior engineer or Assistant Engineer, sr. section Engineer depends upon the vacancies and companies. Those who are skilled in this field have a chance to get promoted into the posts of Assistant Engineers, Executive Engineers etc. Engineering professionals in the field of Civil Engineering are required in fields such as Gas and Oil plants, Power generation firms, Construction of pipelines and water mains etc. The Railway recruitment Board is another major recruiter of Civil Engineers. Candidates can also try in the defense sector.

Civil engineering graduate can get a government job through:

1.UPSC conducted IES,IAS,IPS,ISS

2.Indian Railway Recruitment Board

3.Indian Army

4.State Service Commisions (like TNPSC)

Also can go for PSUs like 1.HAL, 2.NIC, 3.NTPC, 4.SAIL, 5.BHEL, 6.IOCL, 7.ONGC 8.DMRC 9.JMPC , 10.NHPC, 11.NPCIL, 12.Ministry of road &railways transport, 13.HPL-Hindustan Prefab Limited, 14.ISRO, 15.DRDO, 16.BSNL, 17.BPL, 18.BPCL, 19.GAIL, 20.RVNL, 21.bEL, 22.NHAI, 23.BARC, 24.CDS etc.

If you are interested in Teaching profession then first do M.E./M.Tech.(through GATE, TANCET etc) and then apply for faculty positions. You will be a lecturer in a Govt./Private college if you qualify NET exam. However, you can get a job in some private institution through just an interview but that will not raise you to Professor.

Private Jobs: 1.L&T, 2ADITYA BIRLA GROUP, 3.DLF, 4.BRIGRADE, 5.SANKALP GROUP, 6.RELIANCE INFRA, 7.INDIA CEMENTS, 8.CCCL etc.

[http://depakmuniraj.blogspot.in/2012/01/scope-for-civil-engineers-in-india.html#sthash.aPtmXgS1.dpuf]

**Questions**

List and explain how engineering brought benefits to mankind.

What is Civil Engineering?

Outline historical development of civil structures/engineering.

Explain why infrastructural development is important to any country.

Explain the impact of civil engineering infrastructure on economic growth of the country.

What are the major divisions of Civil Engineering and explain them?

What are the functions of Civil Engineering profession?

Explain each type of infrastructure needed for the country and towns.

What are roles of Civil Engineers and explain them?

Outline the 12th five year Indian government funding plan for infrastructure and construction

Discuss the career opportunities available to civil engineers.