RLA ACADEMY

CIVIL ENGINEERING

TNMAWS & TNPSC EXAM

BASED ON

EXAM

SYLLABUS

PATTERN

- Unit wise PDF Study Material for Diploma Standard
- 10 Units Covered
- Useful for TNPSC & TNEB AE, JDO, ESE, GATE, Any state (JE/AE) Exam, RRB, PSUs, SSC-JE etc
- Various Civil Engineering Competitive Exams
- Topic wise well illustrated Formulae & Key Theory Concept.

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Modified Feb 23

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New

Unit - I
SIMPLE STRESSES AND STRAINS

1.1 INTRODUCTION TO STRESSES AND STRAINS:

1.1.1 Importance of study of engineering mechanics / Strength of materials.

ஒரு கட்டுமான பொறியாளர் கட்டுமானத்திற்கு தேவைப்படும் பொருட்களின் தரத்தை பற்றியும், அந்த பொருட்களின் மீது வெளிவிசை செயல்படும் பொழுது பொருட்களில் ஏற்படும் மாற்றங்களை பற்றியும் நன்கு அறிந்து கொள்ள வேண்டும்.

இவ்வாறாக பொறியாளருக்கு தேவைப்படும் விளக்கங்களை அறிந்து கொள்வதற்காக, பல்வேறு கோட்பாடுகளை நமது அறிவியல் தருகிறது. எனவே, நமது அறிவியல் அறிவைப் பயன்படுத்தி memberகளை analysis மற்றும் design செய்யலாம்.

(a) Homogeneous materials.

A homogeneous material என்பது modulus of elasticity (E) and Poisson's ratio (μ) ஒவ்வொரு புள்ளியிலும் மாறாமல் இருக்கும். Materialல் physical மற்றும் chemical composition மாறாமல் இருக்கும்.

(b) Isotropic material:

ஒரு materialலில் எந்த directionனிலும் elastic properties மாறாமல் இருப்பது isotropic எனப்படும்.

(c) Anisotropic (or) Aeolotropic:

ஒரு materialலில் elastic properties ஒவ்வொரு direction மற்றும் புள்ளியிலும் மாறுபடும்.

1.1.1 FORCE

Force என்பது ஒரு பொருளின் மீது செயல்படுத்தப்படும் வெளிவிசை ஆகும். இதனால் நிலையாக இருக்கும் பொருள் மற்றும் சீரான வேகத்தில் இயங்கும் பொருள் தனது நிலையை மாற்றிக்கொள்ள முயற்சி செய்யும். Unit N or KN

1.1.2 MOMENT OF FORCE

Moment of a force என்பது, விசையையும் (force) அது செயல்படும் செங்குத்து தூரத்தையும் பெருக்கி கிடைப்பதாகும். Unit N.m (Newton. Metre)

1.1.3 Actions

ஒரு பொருளின் மீது செயல்படும் வெளி விசைக்கு actions எனப்பெயர்.

1.1.4 Reactions

ஒரு பொருளின் மீது செயல்படும் வெளிவிசையினை தாங்குவதற்கு பொருளில் ஏற்படும் எதிர்ப்பு விசை reaction எனப்படும்.

Example : Beam ஆனது column மேல் இருக்கும் பொழுது Beamல் ஏற்படும் விசை action எனப்படும். Columnத்தில் ஏற்படும் எதிர்விசை reaction எனப்படும். Action மற்றும் reaction இரண்டும் எதிர் எதிர் திசையில் சமமாக இருக்கும்.

1.1.5 STATICS

Statics என்பது engineering mechanicsன் ஒரு பிரிவு ஆகும். நிலையாக இருக்கும் ஒரு பொருளின் மீது செயல்படும் force மற்றும் அதனால் ஏற்படும் விளைவுகளைப்பற்றி விளக்குவது statics ஆகும்.

1.1.6 STATIC EQUILIBRIUM OF BODIES

நிலையாக இருக்கும் ஒரு பொருளின் மீது செயல்படும் resultant force மற்றும் moment ஆகியவை zero (0) ஆக இருந்தால், அந்த நிலைக்கு static equlibirum எனப்பெயர்.

Sum of Forces in X direction = 0

Sum of Forces in Y direction = 0

Sum of Forces in Z direction = 0

Sum of Moments about a stationary point (or instantaneous center of mass) or the body's mass center = 0

UNIT – I

1.1 SLOPE AND DEFLECTION OF BEAMS

1.1 SLOPE AND DEFLECTION OF BEAMS

Deflected shapes / Elastic curves of beams with different support conditions –Definition of Slope and Deflection- Flexural rigidity and Stiffness of beams- Mohr's Theorems – Area Moment method for slope and deflection of beams – Derivation of expressions for maximum slope and maximum deflection of standard cases by area moment method for cantilever and simply supported beams subjected to symmetrical UDL & point loads – Numerical problems on determination of slopes and deflections at salient points of Cantilevers and Simply supported beams from first principles and by using formulae.

CHAPTER 1

1.1 INTRODUCTION

1. Beam

A structural member which is acted upon by a system of external loads at right angles to its axis is known as beam. Generally, a beam is a horizontal member to support floor slabs, secondary beams, walls, stairs etc.

2. Classification of structure

In general, the following are two types of structures

a) According to static equilibrium equation

i) Statically determinate structures

ii) Statically indeterminate structures

Further, the above structures are classified according to support conditions as presented below

b) According to support conditions

1. Cantilever beam
2. Simply supported beam
3. Propped cantilever beam
4. Overhanging beam
5. Fixed beam
6. Continuous beam

3. Shear force (S.F)

The Shear Force at any section of a beam is the algebric sum of all the forces acting either left or right of that section. It is denoted by F (or) SF. The symbol of SF is F(or)V(or)SF.

4. Bending moment (B.M)

The bending moment at any section of a beam is the algebric sum of all the moments of the forces acting either left (or) right of that section. It is denoted by B.M(or) M.

1.1.1 Deflected shapes of beam / Elastic line (or) elastic curve of beam

When a beam is subjected to transverse loads it develops shear force and bending moment at every cross section. Due to transverse load the beam gets deflected. The deflected configuration of the beam is known as deflected shape.

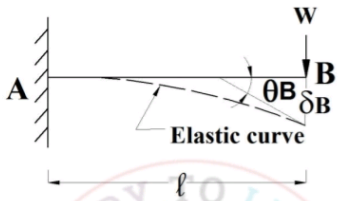

Fig 1.1 Elastic curve

Where, θB = Slope at B

SB = Deflection of free end(B)

(a) Elastic line (or) elastic curve of beam

The configuration of the longitudinal axis of the beam after bending takes place due to loading is called elastic curve. (or)

The edge view of the deflected neutral surface of a beam is known as elastic curve.

The deflected shape of various types of beam is presented below

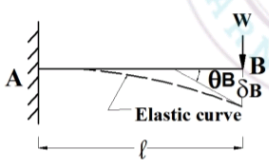

Fig 1.2 For a cantilever beam

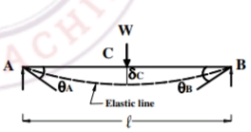

Fig 1.3 For a simply supported beam

UNIT-I

BUILDING MATERIALS

1.1 Introduction

Engineering structures are made of different materials. These materials are known as **Engineering Materials** or **Building materials**.

A study of Engineering materials and their application in construction is very important for a civil engineer. Some engineering materials are available from natural sources. Others can be manufactured. Engineering materials obtained from nature have properties, which cannot be easily altered.Artificial engineering materials may be manufactured and possesses the desired properties.

1.1.1 Physical Properties of Materials

The following are the **physical** properties of a material.

1. Density
2. Bulk Density
3. Specific Gravity
4. Porosity
5. Water Absorption
6. Permeability
7. Chemical Resistance
8. Fire Resistance
9. Weathering Resistance
10. Thermal Conductivity
11. Durability

Definitions of Physical Properties of Materials

1. **Density**: The **density** of a material is defined as its mass per unit volume of homogeneous material. Its unit is **kg/m³**.
2. **Bulk Density**: Bulk density is defined as the weight per unit volume of a material. Its unit is **kN/m³**.
3. **Specific Gravity**: Specific gravity is defined as the ratio of weight of unit volume of material to the weight of an equal volume of water. It is also called as relative density.
4. **Porosity**: Porosity is the ratio of the volume of

1.1 INTRODUCTION

1.1.1 GENERAL

Transportation is the movement of people or goods from one place to another. Transport is important since it enables trade between people, which in turn augment economic growth and foster civilizations. The transport system comprises of highways or roadways, Railways, water ways and air ways.

Road ways include highways, city roads, village roads, feeder roads and ghat roads. Roadways provide maximum service to one and all. It is possible to provide door to door services only by road.

1.1.2 DEVELOPMENT OF ROADS IN INDIA

Transportation is one of the infrastructures of a country. Transportation helps in economic, industrial, social and cultural development of a country. Transportation is very important for the economic development of any region since commodities produced, like food, clothing, industrial products, medicine need transport at all stages from production to distribution. It is also essential for strategic movement in emergency for defence of the country and to maintain better law and order. Transportation also helps in tourism development.

Road transport is one of the most common modes of transport. Roads in the form of track ways, human pathways etc. were used even from the pre-historic times. Since then many experiments were going on to make the riding safe and comfort. Thus road construction became an inseparable part of many civilizations and empires.

The history of highway engineering gives us an idea about the roads of ancient times. Roads in Rome were constructed in a large scale and it radiated in many directions helping them in military operations. Thus they are considered to be pioneers in road construction.

In India the Mauryan dynasty rulers and Harsha Vardhana took much interest in the development of road system as they were able to appreciate the importance of road in terms of strategic and economical development of country. In the later period the Mughal emperors paid much importance in counstrucion of roads; Patna-Kabul, Delhi-Surat, Delhi-Golconda, Golconda-Bijapur, Bijapur-Ujjain and Surat-Maulipatanam are some of the notable highways developed by them.

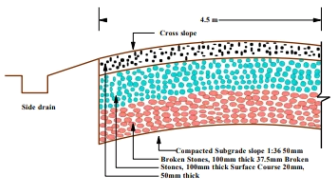

Figure : 1.1.2.1 British Road

1.1.2.1 BRITISH ROAD

The British government also gave importance to road construction. The British engineer John Macadam introduced what can be considered as the first scientific road constru method. Stone size is an important element of Macadam surface formation. By emp observation of many roads, he came to realize that 250 mm layers of well compacted b angular stone would provide the same strength and stiffness and a better running surface th expensive pavement made on large stone blocks. Thus he introduced an economical metho road construction.

The mechanical interlock between the individual stone pieces provides strength and stiffness to the course. But the inter particle friction abraded the sharp interlocking faces and partly destroy the effectiveness of the course. This effect was overcome by introducing good quality interstitial finer material to produce a well-graded mix. Such mixes also proved less

UNIT - I

1.1 INTRODUCTION

1.1.1 Fluid mechanics or Mechanics of fluids

Fluid Mechanics is that branch of science which deals with the behaviour of the fluids (liquids or gases) at rest as well motion. It has the following main divisions.

(a) Hydrostatics

(b) Hydrokinematics

(c) Hydrodynamics

1.1.1.1 Hydrostatics

The study of fluids at rest is called hydrostatics.

1.1.1.2 Hydrodynamics

The study of fluids in motion where pressure, forces are considered is called hydro dynamics.

1.1.1.3 Hydrokinematics

The study of fluids in motion, where pressure, forces are not considered, is called hydrokinematics.

1.1.2 Hydraulics

Hydraulics is a technology and applied science using Engineering, Chemistry and other sciences involving the mechanical properties and use of liquids. It is a branch of science that deals with the practical applications of liquids in motion.

1.1.3 Fluids

Any substance which is capable of flow from the point of view of internal molecular structure can be defined as a fluid.

A fluid cannot resist shear force at rest. Shear stresses occur in fluids when they are in motion only. They confirm to the shape of the container.

They are includes,

(a) liquids

(b) Gases

1.1.3.1 Liquids

A liquid has a definite mass and volume. It takes the shape of the vessel containing it. It would occupy the vessel fully or partially depending on its content and it can have free surface. They are highly incompressible. They cannot be fractured or broken into smaller pieces.

Example : Water, Oils etc.,

1.1.3.2 Gases

Gas has no definite shape and it would expand and occupy the vessel fully and it cannot have a free surface. A Gas undergoes considerable change in volume due to change in temperature and pressure. Hence gases are compressible fluids.

Example : air etc.,

1.1.4 Physical properties of fluids

Properties of fluids are as below :

1.Mass,	2.Weight,	3.Force,
4. Density,	5.Specific weight,	6.Specific volume,
7.Relative density (or) Specific gravity,		8.Compressibility,
9.Viscosity,	10. Cohesion,	11. Adhesion,
12.Capillarity,	13.Surface tension,	14.Vapour pressure.

1.1.4.1 Mass (M)

Mass is dimensionless quantity representing the amount of matter in a particle or object. The standard unit of mass in the International system (IS) is Kilograms (kg). Mass will be same at all places. Mass measured with a balance would be the same on the moon as its on the earth. It is measured by a lever balance. It is denoted by M.

1.1.4.2 Weight (W)

The weight of an object is usually taken to be the force on the object due to gravity (or) Weight is a force that acts at all times on all objects near earth. The earth pulls on all objects with a force of gravity downward towards the centre of earth. It is denoted by W. It varies from place to place. It is measured by a spring balance.

Weight = Mass x Acceleration due to gravity

DETAILED SYLLABUS

UNIT-I

THEODOLITE SURVEYING

Introduction - Types of Theodolites : Transit and non-transit Theodolite, Vernier and Micrometer Theodolites – Electronic Theodolite (Principles and description only) – Component parts of a transit Theodolite – Functions – Technical terms used in Theodolite surveying – Temporary adjustments – Fundamental lines and relationship between them – Measurement of horizontal angle by method of repetition and reiteration – Measurement of vertical angle and deflection angle – Reading bearing of a line – Theodolite traversing – Methods – Field checks in closed traverse - Latitude and departure – Consecutive coordinates - Independent coordinates – Problems on computation of area of closed traverse – Balancing the traverse - Omitted measurements – Problems

UNIT-II

TACHEOMETRIC SURVEYING

Introduction – Instruments used in tacheometry – Systems of tacheometry: Stadia and Tangential tacheometry – Principles – Fixed hair method of tacheometry – Distance and Elevation formulae – Anallactic lens (No proof): Advantages and uses – Simple problems – Distomats (Description only) – Direct reading tacheometers - Determination of constants of a tacheometer: Problems – Tacheometric traverse – Errors in tacheometric surveying.

UNIT-III

3.1 TRIGONOMETRICAL LEVELLING

Introduction – Finding elevation of objects – Base accessible - Base inaccessible: Single Plane and Double Plane methods – Problems on determination of elevation of objects.

3.2 REMOTE SENSING, PHOTOGRAMMETRIC SURVEYING AND HYDROGRAPHIC SURVEYING

Remote sensing – Definition – Basic Process – Methods of remote sensing – Applications - Photogrammetric Surveying – Definition – Terrestrial and Aerial photographs – Applications - Hydrographic surveying – Definition- Uses – Sounding: Definition, Purpose, Instruments needed – Steps in hydrographic surveying

UNIT-IV

CURVES

Introduction – Types of curves – Designation of curves – Elements of simple circular curve – Setting out simple circular curve by: Offsets from long chords, Offsets from tangents, Offsets from chords produced and Rankine's method of deflection angles – Simple problems – Transition curves: Objectives – Vertical curves: Definition and types

UNIT-V

TOTAL STATION AND GEOGRAPHICAL INFORMATION SYSTEM

5.1 TOTAL STATION

Introduction – Application of total station – Component parts of a Total Station – Accessories used – Summary of total station characteristics - Features of total station – Electronic display and data reading – Instrument preparation, Setting and Measurement (Distance, Angle, Bearing etc.) – Field procedure for co-ordinate measurement – Field procedure to run a traverse survey - Linking data files for various Applications.

5.2 GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Introduction – Geographical information – Development of GIS – Components of GIS – Steps in GIS mapping - Ordinary mapping to GIS – Comparison of GIS with CAD and other system – Fields of Applications: Natural resources, Agriculture, Soil, Water resources, Wasteland management and Social resources – Cadastral survey and Cadastral records – Land Information System(LIS).

PART I

WATER SUPPLY ENGINEERING

UNIT – I

(1.1: Water supply - need for protected water supply - objectives of public water supply system – demand -types of demand - per capita demand - prediction of population - problems in arithmetical increase method, geometrical increase method, incremental increase method - sources of water - surface and subsurface sources)

1.1 – QUANTITY OF WATER

1.1.1 Introduction

The important requirement of any life including human is water. It is nature's gift to lives. It is available in various forms such as rivers, lakes, streams, ponds etc. The development of any city is based on the source of water supply.

Universally every living soul requires water for its survival. It is essential for life, health and sanitation. It is the principal raw material for food production and on the farms. Human can live without food for about 2 months, but cannot survive for two or three days without water. It also plays vital role in the production of essential commodities, generation of electric power, transportation, recreation etc…… With our growing population, the demand for water is increasing day by day and hence every country ensures the availability of pollution free water resources.

1.1.2 Need of Protect Water Supplies:

The water when exposed to atmosphere definitely contains several contaminants which are dangerous to any living organisms. Consumption of polluted water may cause serious diseases to the health of living beings. Hence it is very much needed to protect water supplies.

1.1.3 Objectives of Water Supply:

The following are the objectives of water supply system

1. Through the supply of whole some water, the public health will be improved
2. Sanitation of surroundings will be improved
3. Fire safety will be ensured
4. The living standards of people will be improved by industrialization
5. Health and Wealth will be improved at the maximum limit.

1.1.4 Demand:

When an engineer has to design a water supply scheme for a community, he has to ascertain the required quantity of water and its availability. The quantity of water required to meet out the various needs of communities is called demand of water.

The following are the types of demand.

1. Domestic demand
2. Civic or Public demand
3. Industrial demand
4. Waste and loss

1.1.4.1 Domestic Demand

1. Drinking - 2 lit
2. Cooking - 5 lit
3. Bathing - 40 lit
4. Washing hands face etc - 10 lit
5. House hold sanitary purpose - 50 lit
6. Gardening - 15 lit
7. Domestic animals & vehicles - 13 lit

Thus the quantity of water required for domestic purposes can be calculated as above. Normally it varies from 100 lit – 135 lit per head per day.

1.1.4.2 Civic or Public:

The quantity of water for these purposes can be divided into road washing, sanitation purposes ornamental purposes and fire demands. Normally this category is taken as 10 lit per head per day.

1.1.4.3 Industrial purposes:

The quantity of water required for this purpose is taken into account as factories, power stations, railways etc. and it will be taken as 50 lit per head per day.

UNIT-I

ESTIMAING AND COSTING-I

1.1 INTRODUCTION

1.1.1 ESTIMATION

- Estimation is the method of process of determining the probable cost of a construction before the work is started.
- It involves the predetermination of the quality and quantity of material required, labour required etc.,

1.1.2 DEFINITION OF ESTIMATE

- An Estimate of a project is a fore-cost of its probable cost.
- It may also be defined as the process of calculating the quantities and cost of various items of proposed work.
- It depends on plan, elevation and section.

1.1.3 NECESSITY OF ESTIMATES

1. To work out the quantity of materials and labour requirements.
2. To prepare bills for the project.
3. To calculate the actual cost of construction.
4. To prepare construction schedule.
5. To frame tender document and arrange the type of contract.
6. To control the expenditure of a project.
7. To arrange for labour required for a building
8. To get permission for the construction of building by local authorities.
9. To get bank loan.
10. To buy or sell a building.

1.1.4 IMPORTANCE OF FAIR ESTIMATION

Fair estimation is prepared based on actual quantity of various items of work and the actual cost of the materials and the labour in that local authority. It also gives nearly the actual cost of the building it is very important for purchasing and selling a building at the actual cost in the locality.

1.1.5 DUTIES AND REQUIREMENTS OF A GOOD QUANTITY SURVEYOR

A qualified or experienced person who does the mentioned works (taking off, squaring , abstracting and billing) is called a quantity surveyor.

The following are the qualities of a good surveyor:

- He must have good knowledge of measuring and billing.
- He must have thorough knowledge of construction methods and procedure, materials of construction, labour problem, specifications and local customs.
- He must have knowledge in reading and interrupt drawing and accurately and efficiently.
- He must posses accuracy in calculations and cost.
- He must have common sense, skill, experience, initiative, foresight, good judgment and patience.

1.1.5.1 DUTIES OF GOOD QUANTITIY SURVEYOR

- Preparation of bill of quantities.(taking off, squaring , abstracting and billing)
- Preparing bill for part payment at intervals during the execution of works.
- Preparing the bill of adjusting in case of variations ordered during the execution of works.
- Giving legal advice in case of court proceedings.
- After complication of works bills are prepared for final payment.

1.1.5.2 REQUIREMENTS OF A GOOD QUANTITY SURVEYOR

- Quantity surveyor should have a good knowledge in construction procedure.
- He should be able to read the drawing correctly and bill the quantities accurately.
- He should be able to write the description of works in a simple and clear language.
- He should have good knowledge in legal proceedings of building works.
- He should be able to prepare schedule to be priced by tenderor.
- He should be able to value all variations under the contract.
- He should have good knowledge in execution.

UNIT - I

(A) REINFORCED CEMENT CONCRETE STRUCTURES

1.1. INTRODUCTION TO WORKING STRESS AND LIMIT STATE METHOD

1.1. GENERAL

Reinforced concrete has today become widely used material and is extensively used in construction of almost all types of structures like buildings, bridges, water reserviors, foundations, dams etc.

Concrete

A proportioned mixture of cement (binder), fine aggregate (sand) and coarse aggregate (gravel) and water, which hardens to a stone like mass is called cement concrete.

Concrete is very strong in compression but weak in tension. In practice, in the same structural member, both compression and tension are induced and as such, plain concrete can not be used for these members. To overcome this difficulty, steel which is strong in tension is used along with concrete and this combination of steel and concrete is known as Reinforced Concrete. The main reason behind the successful use of the above combination is due to the bond between concrete and steel and due to this bond, concrete and steel act as one material.

Combination of concrete and steel is ideal because when concrete sets, it contract and thus, it grips the reinforcement. Because of this adhesion, steel and concrete can wo together as a single material.

Reinforced cement concrete

The steel bars are used to reinforce the concrete. The steel bars completely sorrounded by the hardened concrete form integral part of the structural member. The concrete reinforced with the steel bars is known as the reinforced cement concrete.

Advantages of RCC

1. Concrete components can be easily cast in any desired size and shape like beams, columns, slabs, shell, folded plates etc.
2. Most of the materials required for concrete are easily and locally available.
3. Different grades of concrete can be made to provide the required degree of stren ng
4. Concrete structures offer greater strength against water proofing and fire resis

6. Maintenance cost is low compared to timber and steel structures.
7. Strength of concrete increases with age.
8. Monolithic construction in concrete is possible which provides greater flexibility in planning and design.
9. It is free from corrosion and weathering effects.
10. It is easy to make and it is durable.

Disadvantages

1. The R.C. member once cast cannot be dismantled and re-used as in the case of steel and timber construction.
2. It is not very much suitable for members like trusses.
3. It requires centering, curing etc, and hence difficult to construct.
4. The time required for construction is more than that required for steel.
5. It shrinks and sets up shrinkage stresses.
6. It is weak in tension and cracks easily when subjected to tensile stress
7. It is not completely imprevious.
8. R.C. are not used for very long spans.

Concept of composite material

A system consisting one bar or tube of the same or different materials rigidly connected in such a way that when subjected to loads or variations in temperature, each individual component undergoes equal changes in length. This is the concept of composite

UNIT - I

1.1. CONSTRUCTION SECTOR IN INDIA

1.1.1. Management

The organization and co-ordination of the activities of a business in order to achieve defined objectives.

1.1.2 Construction Management

Construction Management is the process of planning, co-ordinating and providing monitoring and controlling of a construction project.

1.1.3 Need for Construction Management

The following are nine reasons why construction management is needed.

(i) Effective project management,
(ii) It improves efficiency by reducing delays.
(iii) It ensures a project stays on budget,
(iv) It enhances communication
(v) It ensures quality control,
(vi) It improves safety at sites,
(vii) It promotes a team-building culture,
(viii) To avoids disputes and gives solutions,
(ix) It improves business resilience.

1.1.4 Scope of Construction Management

(i) In our country, the construction industry is growing as fast as any other industry. Among 50% of the total development expenditure is spent on construction.

(ii) The kind of projects that a construction management engineer looks into can include designing drainage or sewage systems, constructing buildings, and possibly projects in the infrastructure department like roadways, railways, airport design, water waste management and designing ports, among others.

(iii) Every construction engineer equipped with a knowledge of modern management principles to related to construction industry.

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1.1.5 Objectives of construction management

The objectives of construction management as follows.

(i) Completing the work within specified time and budget.
(ii) Evolving a reputation for high quality workmanship.
(iii) Providing safe working conditions for staff and workers.
(iv) Taking sound decisions at lowest practical management level through delegation of authority.
(v) Motivating people to give their best.