SSC-JE

Staff Selection Commission

Junior Engineer

Civil Engineering

Topicwise Objective Solved Questions

Previous Years Solved Papers : 2007-2023

Also useful for ***RRB-JE Mains*** *as well as various* **public sector examinations** and other competitive examinations

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SSC-JE : Civil Engineering Previous Years' Solved Papers

First Edition: 2019
Second Edition: 2020
Third Edition: 2021
Reprint: 2022
Fourth Edition: 2023

Fifth Edition: 2024

Preface

B. Singh (Ex. IES)

Staff Selection Commission-Junior Engineer has always been preferred by Engineers due to job stability. SSC-Junior Engineer examination is conducted every year. MADE EASY team has deeply analyzed the previous exam papers and observed that a good percentage of questions are repetitive in nature, therefore it is advisable to solve previous years papers before a candidate takes the exam.

The SSC JE exam is conducted in two stages as shown in table given below.

Papers	Subject	Maximum Marks	Duration
Stage 1: Paper-I : Objective type	(i) General Intelligence & Reasoning (ii) General Awareness (iii) General Engineering : Civil	50 Marks 50 Marks 100 Marks	2 hours
Stage 2: Paper-II : Objective Type	General Engineering : Civil	300 Marks	2 hours
Note: In Paper-I, every question carry one mark and there is negative marking of ¼ marks for every wrong answer. Candidates shortlisted in Stage 1 are called for Stage 2. On the basis of combined score in Stage 1 and Stage 2, final merit list gets prepared.			

MADE EASY has taken due care to provide complete solution with accuracy. Apart from Staff Selection Commission-Junior Engineer, this book is also useful for Public Sector Examinations and other competitive examinations for engineering graduates.

I have true desire to serve student community by providing good source of study and quality guidance. Any suggestion from the readers for improvement of this book is most welcome.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group

Syllabus of Engineering Subjects

(For both Objective and Conventional Type Papers)

Civil Engineering

Building Materials : Physical and Chemical properties, Classification, Standard Tests, Uses and manufacture/ quarrying of materials e.g. building stones, silicate based materials, Cement (Portland), Asbestos products, Timber and Wood based Products, Laminates, bituminous materials, Paints, Varnishes.

Estimating, Costing and Valuation : Estimate, Glossary of technical terms, Analysis of rates, Methods and unit of measurement, Items of work – Earthwork, Brick work (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering. Boundary wall, Brick building, Water Tank, Septic tank, Bar bending schedule. Centre line method, Mid-section formula, Trapezodial formula, Simpson's rule. Cost estimate of Septic tank, flexible pavements, Tube well, isolated and combined footings, Steel Truss, Piles and pile-caps. Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

Surveying: Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling, Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation, advanced surveying equipment.

Soil Mechanics: Origin of soil, phase diagram, Definitions- void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses. Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart. Permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, Vane shear test, Triaxial test. Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test.

Hydraulics: Fluid properties, hydrostatics, measurements of flow, Bernoulli's theorem and its application, flow through pipes, flow in open channels, weirs, flumes, spillways, pumps and turbines.

Irrigation Engineering : Definition, Necessity, Benefits, III effects of irrigation, types and methods of irrigation. Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canals, types of canal irrigation, loss of water in canals. Canal lining – types and advantages. Shallow and deep to wells, yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow. Definition of flood, causes and effects, methods of flood control, water logging, preventive measures. Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes. Major irrigation projects in India.

Transportation Engineering : Highway Engineering – cross sectional elements, geometric design, types of pavements, pavement materials – aggregates and bitumen, different tests, Design of flexible and rigid pavements – Water Bound Macadam (WBM) and Wet Mix Macadam (WMM), Gravel Road, Bituminous construction, Rigid pavement joint, pavement maintenance, Highway drainage. Railway Engineering – Components of permanent way – sleepers, ballast, fixtures and fastening, track geometry, points and crossings, track junction, stations and yards. Traffic Engineering – Different traffic survey, speed-flow-density and their interrelationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety.

Environmental Engineering: Quality of water, source of water supply, purification of water, distribution of water, need of sanitation, sewerage systems, circular sewer, oval sewer, sewer appurtenances, sewage treatments. Surface water drainage. Solid waste management – types, effects, engineered management system. Air pollution – pollutants, causes, effects, control. Noise pollution – causes, health effects, control.

Structural Engineering

Theory of structures: Elasticity constants, types of beams - determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section.

Concrete Technology: Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures.

RCC Design: RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and doubly reinforced beams, cantilever beams. T-beams, lintels. One way and two way slabs, isolated footings. Reinforced brick works, columns, staircases, retaining walls, water tanks (RCC design questions may be based on both Limit State and Working Stress methods).

Steel Design: Steel design and construction of steel columns, beams roof trusses plate girders.

■■■■

Contents

Civil Engineering
Objective Solved Papers

SSC-JE
Paper-I

■■■■

CHAPTER 1

Paper - I : Objective

Building Materials

1. Bricks

1.1 Clay and silt content in a good brick earth must be at least
(a) 20% (b) 50%
(c) 35% (d) 70%
[SSC-JE : 2007]

1.2 The standard size of a masonry brick is
(a) 18 cm × 8 cm × 8 cm
(b) 19 cm × 9 cm × 9 cm
(c) 20 cm × 10 cm × 10 cm
(d) 21 cm × 11 cm × 11 cm
[SSC-JE : 2008]

1.3 Crushing strength of first class bricks should not be less than
(a) 35 kg/cm^2 (b) 70 kg/cm^2
(c) 100 kg/cm^2 (d) 150 kg/cm^2
[SSC-JE : 2009]

1.4 The size of modular bricks are :
(a) 20 × 10 × 9 cm
(b) 19 × 9 × 9 cm
(c) 22.5 × 10 × 8.5 cm
(d) 22.5 × 8.0 × 9 cm
[SSC-JE : 2010]

1.5 King closers are related to
(a) doors and windows
(b) king post truss
(c) queen post truss
(d) brick masonary
[SSC - JE : 2011]

1.6 The water absorption for good brick should not be more than
(a) 10 % of its dry weight
(b) 15% of its dry weight
(c) 10% of its saturated weight
(d) 15% of its saturated weight
[SSC - JE : 2012]

1.7 Clay bricks are made of earth having
(a) Nearly equal proportion of silica and alumina
(b) Nearly equal proportions of alumina silica and lime
(c) 35 – 70% silica and 10 – 20% alumina
(d) 10 – 20% silica and 35 – 70% alumina
[SSC - JE : 2012]

1.8 The plasticity to mould bricks in suitable shape is contributed by
(a) Alumina (b) Lime
(c) Magnesia (d) Silica
[SSC : JE : 2013]

1.9 The crushing strength of a first class brick is
(a) 3 N/mm^2 (b) 5.5 N/mm^2
(c) 10.5 N/mm^2 (d) 7.5 N/mm^2
[SSC - JE : 2013]

1.10 Strength based classification of brick is made on the basis of
(a) IS : 3101 (b) IS : 3102
(c) IS : 3495 (d) IS : 3496
[SSC - JE (Forenoon) : 2014]

1.11 Water absorption of class I brick after 24 hours of immersion in water should not exceed _____of self weight
(a) 25% (b) 18%
(c) 20% (d) 22%
[SSC - JE (Afternoon) : 2014]

1.12 The compressive strength of common building bricks should not be less than
(a) 3.5 N/mm^2 (b) 5.5 N/mm^2
(c) 7.5 N/mm^2 (d) 10.5 N/mm^2
[SSC-JE : 2015]

1.13 The number of standard bricks in one cubic metre of brick masonry is
(a) 300 (b) 500
(c) 700 (d) 1000
[SSC-JE : 2015]

1.14 The standard size of a masonry brick is
(a) 18 cm x 8 cm x 8 cm
(b) 18 cm x 9 cm x 9 cm
(c) 19 cm x 9 cm x 9 cm
(d) 19 cm x 8 cm x 8 cm
[SSC-JE : 2015]

1.15 The indentation provided in the face of the brick is called
(a) frog (b) pallet
(c) strike (d) None of the these
[SSC - JE (Forenoon) 1.3.2017]

1.16 A layer of dry bricks put below the foundation concrete, in the case of soft soils, is called
(a) soling (b) shoring
(c) D.P.C. (d) None of these
[SSC - JE (Forenoon) 1.3.2017]

1.17 Hollow bricks are generally used with the purpose of_______.
(a) reducing the cost of construction
(b) providing insulation against heat
(c) increasing the bearing area
(d) ornamental look
[SSC - JE (Afternoon) 1.3.2017]

1.18 The shape of the brick gets deformed due to rain water falling on hot brick. This defect is known as_______.
(a) chuffs (b) bloating
(c) nodules (d) lamination
[SSC - JE (Afternoon) 1.3.2017]

1.19 The operation of removal of impurities of clay adhering to iron ore is known as
(a) calcination (b) purification
(c) dressing (d) refining
[SSC - JE (Afternoon) 1.3.2017]

1.20 The number of bricks required per cubic metre of brick masonry is_______.
(a) 480 (b) 500
(c) 520 (d) 540
[SSC - JE (Afternoon) 1.3.2017]

1.21 The standard size of brick as per Indian standards is
(a) 20 cm × 10 cm × 10 cm
(b) 23 cm × 12 cm × 8 cm
(c) 19 cm × 9 cm × 9 cm
(d) 18 cm × 9 cm × 9 cm
[SSC - JE (Forenoon) : 2.3.2017]

1.22 A brick masonry could fail due to_______.
(a) Rupture along a vertical joint in poorly bonded walls
(b) Shearing along a horizontal plane
(c) Crushing due to overloading
(d) Any of these
[SSC - JE (Forenoon) : 2.3.2017]

1.23 Which of the following statements is correct?
(a) Excess of alumina in the clay makes the brick brittle and weak.
(b) Excess of alumina in the clay makes the brick crack and warp on drying.
(c) Excess of alumina in the clay leaves high power deposit on the brick.
(d) Excess of alumina in the clay improves impermeability and durability of the brick.
[SSC - JE (Forenoon) : 2.3.2017]

1.24 The portion of the brick without a triangular corner is equal to half the width and half of the length is called_______.
(a) Closer (b) queen closer
(c) King closer (d) squint brick
[SSC - JE (Afternoon) 2.3.2017]

1.25 When a brick is cut into two halves longitudinally, one part is called:
(a) king closer (b) cornice brick
(c) queen closer (d) voussoir
[SSC - JE (Forenoon) 3.3.2017]

1.26 The red colour obtained by the bricks is due to the presence of
(a) lime (b) silica
(c) manganese (d) iron oxide
[SSC - JE (Forenoon) 3.3.2017]

1.27 The brick work is measured in square metre, in case of
(a) Honey comb brick work
(b) Brick flat soling
(c) Half brick walls or the partition .
(d) All options are correct
[SSC - JE (Forenoon) 3.3.2017]

1.28 Brick walls are measured in square metre if the thickness of the wall is
(a) 10 cm (b) 15 cm
(c) 20 cm (d) None of these
[SSC - JE (Forenoon) 3.3.2017]

5.316 (a)	5.317 (b)	5.318 (c)	5.319 (a)	5.320 (b)	5.321 (b)	5.322 (d)	5.323 (a)
5.324 (c)	5.325 (a)	5.326 (b)	5.327 (d)	5.328 (b)	5.329 (b)	5.330 (d)	5.331 (b)
5.332 (d)	5.333 (a)	5.334 (c)	5.335 (d)	5.336 (b)	5.337 (a)	5.338 (d)	5.339 (b)
5.340 (a)	5.341 (d)	5.342 (a)	5.343 (a)	5.344 (c)	5.345 (b)	5.346 (b)	5.347 (b)
5.348 (c)	5.349 (a)	5.350 (d)	5.351 (c)	5.352 (a)	5.353 (d)	5.354 (c)	5.355 (c)
5.356 (d)	5.357 (a)	5.358 (b)	5.359 (a)	5.360 (b)	5.361 (a)	5.362 (d)	5.363 (d)
5.364 (b)	5.365 (b)	5.366 (c)	5.367 (b)	5.368 (c)	5.369 (b)		

6. Paints

6.1 (c)	6.2 (d)	6.3 (b)	6.4 (c)	6.5 (a)	6.6 (c)	6.7 (c)	6.8 (b)	6.9 (d)
6.10 (c)	6.11 (a)	6.12 (c)	6.13 (c)	6.14 (d)	6.15 (c)	6.16 (c)	6.17 (c)	6.18 (b)
6.19 (b)	6.20 (c)	6.21 (d)	6.22 (b)	6.23 (d)	6.24 (d)	6.25 (c)	6.26 (b)	6.27 (b)
6.28 (b)	6.29 (a)	6.30 (a)	6.31 (b)	6.32 (a)	6.33 (b)			

7. Miscellaneous

7.1 (c)	7.2 (b)	7.3 (a)	7.4 (b)	7.5 (d)	7.6 (*)	7.7 (d)	7.8 (c)	7.9 (d)
7.10 (d)	7.11 (b)	7.12 (a)	7.13 (b)	7.14 (c)	7.15 (c)	7.16 (d)	7.17 (c)	7.18 (c)
7.19 (d)	7.20 (a)	7.21 (a)	7.22 (d)	7.23 (c)	7.24 (b)	7.25 (c)	7.26 (c)	7.27 (d)
7.28 (d)	7.29 (d)	7.30 (d)	7.31 (b)	7.32 (a)	7.33 (a)	7.34 (a)	7.35 (b)	7.36 (a,c)
7.37 (d)	7.38 (d)	7.39 (d)	7.40 (b)	7.41 (d)	7.42 (c)	7.43 (d)	7.44 (d)	7.45 (a)
7.46 (d)	7.47 (d)	7.48 (d)	7.49 (c)	7.50 (a)	7.51 (d)	7.52 (c)	7.53 (a)	7.54 (b)
7.55 (b)	7.56 (d)	7.57 (b)	7.58 (d)	7.59 (d)	7.60 (b)	7.61 (c)	7.62 (d)	7.63 (d)
7.64 (b)	7.65 (c)	7.66 (a)	7.67 (b)	7.68 (b)	7.69 (a)	7.70 (c)	7.71 (a)	7.72 (a)
7.73 (b)	7.74 (c)	7.75 (c)	7.76 (d)	7.77 (b)	7.78 (a)	7.79 (a)	7.80 (a)	7.81 (a)
7.82 (c)	7.83 (b)	7.84 (a)	7.85 (a)	7.86 (b)	7.87 (d)	7.88 (c)	7.89 (a)	7.90 (c)
7.91 (c)	7.92 (c)	7.93 (b)						

Explanations Building Materials

1. Bricks

1.1 (b)

Clay and silt contains silica primarily. The silica content in good brick earth should be 50-60%.

1.2 (b)

- Based on dimensions bricks are of two types, the traditional bricks and the modular bricks.
- The traditional bricks vary in size from place to place.
- Bureau of Indian standards specifies standard size of bricks as 20 cm × 10 cm × 10 cm, which includes thickness of mortar.
- Size of standard brick also known as modular brick should be 19 cm × 9 cm × 9 cm.
- However, a bricks available in most part of the country still are $9'' \times 4\frac{1}{2}'' \times 3''$ and are known as traditional bricks or field bricks.

1.3 (c)

Clay bricks are classified as first class, second class, third class and fourth class based on their physical and mechanical properties:

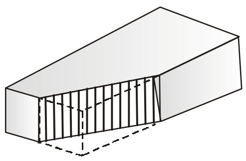
Particular	Remarks
First class bricks	• Crushing strength $\nless$ 10 N/mm^2 • Water absorption = 12-15% of its dry weight when immersed in cold water for 24 hours
Second class bricks	• Crushing strength $\nless$ 7 N/mm^2 • Water absorption about 16-20% of its dry weight
Third class bricks	• Water absorption is about 25% of its dry weight • Crushing strength $\nless$ 5 N/mm^2

1.4 (b)

A brick of standard size 19 cm × 9 cm × 9 cm is recommended by the BIS. With mortar thickness, the size of such a brick becomes 20 cm × 10 cm × 10 cm and it is known as the nominal size of the modular brick. Thus the modular brick size includes the mortar thickness.

1.5 (d)

- King closer is a portion of brick which is cut in such a way that the width of one of its end is half that of a full brick, while the width at the other end is equal to the full width.



King Closer

- It is thus obtained by cutting the triangular piece between the centre of one end and the centre of the other side. It has half header and half stretcher face.

1.6 (b)

As per clause 7.2 of IS 1077 : 1992, water absorption should not be more than 20% by weight up to class 12.5 (crushing strength ≥ 12.5 N/mm^2) and 15% by weight for higher class.

1.7 (c)

Composition of good brick earth and their function are:

(i) **Alumina:** Content of 20% to 30% is necessary. It imparts plasticity to the earth, so it helps in moulding of brick.

(ii) **Silica:** A good brick earth contains about 50% to 60% of silica. It prevents shrinkage, cracking and warping of raw bricks. It thus imparts uniform shape to the brick. Excess of silica makes the brick brittle.

(iii) **Lime:** Less than 5% of lime is desirable. It prevents shrinkage of raw bricks.

(iv) **Iron Oxide:** It helps in fusing of sand and provides red colour to the bricks.

1.8 (a)

Alumina is the chief constituent of a good brick. A content of about 20% to 30% is necessary to form the brick earth of a good quality. It imparts plasticity to the earth so it helps in the moulding of the brick earth. If alumina is present in excess with inadequate quantity of sand then the raw bricks shrink and warp during drying, and on burning they become too hard.

Constituent	Function
(i) Silica (50-60)%	Provides strength hardness and durability of bricks.
(ii) Alumina (20-30)%	Imparts plasticity of bricks.
(iii) Lime (75)%	Causes silica to fuse during burning and binding particles together.
(iv) Magnesia (<1%)	Imparts yellow tint to bricks.
(v) Iron oxide (5-6%)	Provide red colour and improves impermeability and durability.

1.9 (c)

Clay bricks are classified as first class, second class, third class and fourth class based on their physical and mechanical properties:

Particular	Remarks
First class bricks	• Crushing strength $\nless$ 10 N/mm^2 • Water absorption = 12-15% of its dry weight when immersed in cold water for 24 hours
Second class bricks	• Crushing strength $\nless$ 7 N/mm^2 • Water absorption about 16-20% of its dry weight
Third class bricks	• Water absorption is about 25% of its dry weight • Crushing strength $\nless$ 5 N/mm^2

1.10 (b)

IS : 3101 – Aluminium collapsible tubes.
IS : 3102 – Classification of burnt clay brick.

IS : 3495 – Method of test of burnt clay brick.
IS : 3496 – Specification for dobby lags and pegs.

1.11 (c)

The method of determination of water absorption of burnt clay building bricks is covered as per IS : 3495 (Part-II) 1992.

- 1st class brick–Not more than 20% by dry weight.
- 2nd class brick–Not more than 22% by dry weight.
- 3rd class brick–Not more than 25% by dry weight.

1.12 (a)

Types of bricks	Compressive strength (N/mm^2)
Common building bricks	3.5
Third class bricks	5
Second class bricks	7
First class bricks	10.5

1.13 (b)

The nominal size of a brick is

$= 20 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}$

∴ Volume of one brick

$= 0.2 \times 0.1 \text{ m} \times 0.1 \text{ m} = 2 \times 10^{-3} \text{ m}^3$

∴ The number of bricks in one cubic meter of brick masonry

$$= \frac{1}{2 \times 10^{-3}} = 500$$

1.14 (c)

- Based on dimensions bricks are of two types, the traditional bricks and the modular bricks.
- The traditional bricks vary in size from place to place.
- Bureau of India standards specifies standard size of bricks as 20 cm × 10 cm × 10 cm, which includes thickness of mortar.
- Size of standard brick also known as modular brick should be 19 cm × 9 cm × 9 cm.
- However, a bricks available in most part of the country still are $9'' \times 4\frac{1}{2}'' \times 3''$ and are known as traditional bricks or field bricks.

1.15 (a)

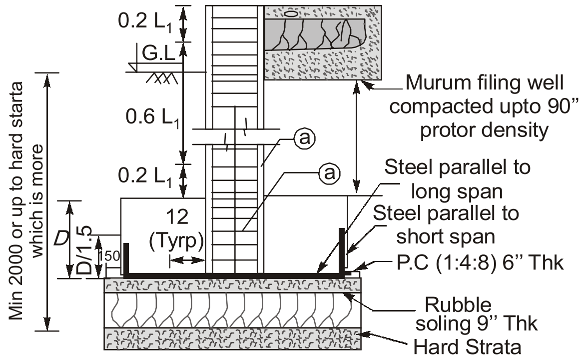
An indent called frog, 1-2 cm deep is provided:

- The purpose of providing frog is to form a key for holding the mortar and therefore, the bricks are laid with frogs on top.

1.16 (a)

Soling: It is the bottom most layer of any component of structure.

- It is done before laying the foundation, to provide batter strength to the foundation.

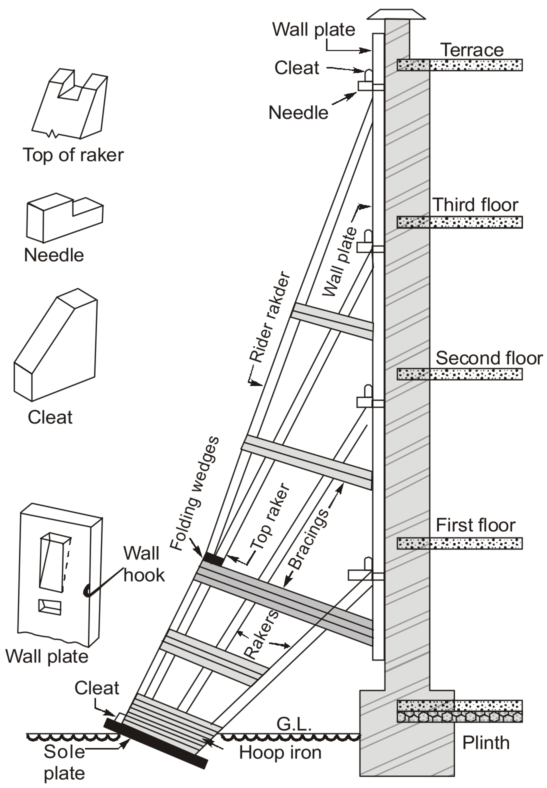


Typical detail of column and column links

Soling

Shoring: It is the technique of using a temporary support, usually from prop, to make a structure stable and safe.

- Shoring is often used to provide lateral support.



DPC (Damp Proof Course): It is a horizontal

CHAPTER 2

Paper - I : Objective

Estimating, Costing and Valuation

1. Estimates

1.1 If d is the constant distance between the sections, then the correct prismoidal formula for volume is

(a) $\frac{d}{3}$ [first area + last area + 4 Σ even area + 2Σ odd areas]

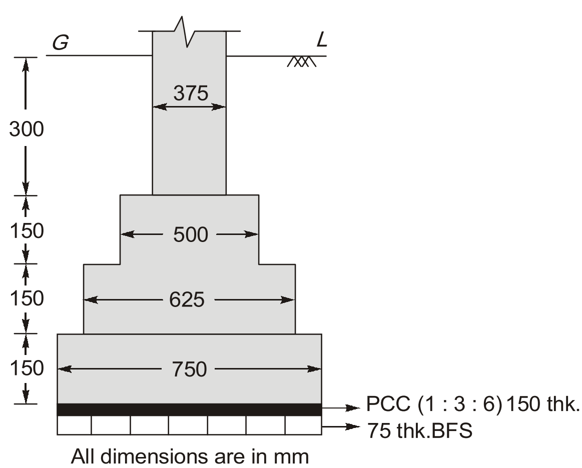
(b) $\frac{d}{6}$ [first area + last area + 2 Σ Even area + 4Σ odd areas]

(c) d[first area + last area + Σ Even area + 2Σ odd areas]

(d) $\frac{d}{3}$ [first area + last area + 2 Σ Even area + 4Σ odd areas]

[SSC - JE : 2012]

1.2 The cross-section of a strip footing is shown below:



The quantity of 150 thick PCC (1 : 3 : 6) per metre is

(a) 0.094 sq.m (b) 0.094 cu.m

(c) 0.0625 sq.m (d) 0.0625 cu.m

[SSC - JE : 2012]

1.3 The measurement is NOT made in square metres in case of

(a) Damp proof course

(b) Form works

(c) Concrete Jaffries

(d) R.C. Chhajja

[SSC - JE : 2012]

1.4 For one sq.m. single brick flat soling (conventional size), the number of bricks required is

(a) 54 (b) 62

(c) 32 (d) 44

[SSC - JE : 2012]

1.5 The number of bricks (conventional size) required for one square metre of brick on edge soling is

(a) 54 (b) 64

(c) 34 (d) 44

[SSC - JE : 2012]

1.6 For 1 sq. m. of 7.5 cm thick lime terracing in roof with brick khoa, Surkhi, lime (2 : 2 : 7) including finishing, the quantity of Surkhi required is

(a) 0.023 cu.m (b) 0.025 cu.m

(c) 0.019 cu.m (d) 0.022 cu.m

[SSC - JE : 2012]

1.7 In straight line method, the annual depreciation of the property is

(a) $\frac{\text{Original cost - Annual sinking fund}}{\text{Life (in years)}}$

(b) $\frac{\text{Life (in years)}}{\text{Original cost + Scrap value}}$

(c) $\frac{\text{Original cost - Scrap value}}{\text{Life (in years)}}$

(d) $\frac{\text{Original cost + Scrap value}}{\text{Life (in years)}}$

[SSC - JE : 2012]

2. Rate Analysis, Valuation and Miscellaneous

2.1 (d)	2.2 (b)	2.3 (a)	2.4 (d)	2.5 (c)	2.6 (a)	2.7 (b)	2.8 (d)	2.9 (d)
2.10 (d)	2.11 (d)	2.12 (a)	2.13 (b)	2.14 (a)	2.15 (c)	2.16 (c)	2.17 (b)	2.18 (c)
2.19 (b)	2.20 (a)	2.21 (b)	2.22 (d)	2.23 (a)	2.24 (c)	2.25 (c)	2.26 (a)	2.27 (a)
2.28 (a)	2.29 (a)	2.30 (a)	2.31 (b)	2.32 (d)	2.33 (b)	2.34 (c)	2.35 (d)	2.36 (c)
2.37 (c)	2.38 (d)	2.39 (b)	2.40 (d)	2.41 (d)	2.42 (c)	2.43 (d)	2.44 (a)	2.45 (d)
2.46 (a)	2.47 (d)	2.48 (b)	2.49 (b)	2.50 (d)	2.51 (d)	2.52 (d)	2.53 (b)	2.54 (d)
2.55 (b)	2.56 (d)	2.57 (a)	2.58 (b)	2.59 (d)	2.60 (c)	2.61 (d)	2.62 (b)	2.63 (c)
2.64 (d)	2.65 (b)	2.66 (*)	2.67 (d)	2.68 (b)	2.69 (c)	2.70 (c)	2.71 (d)	2.72 (b)
2.73 (b)	2.74 (c)	2.75 (b)	2.76 (d)	2.77 (d)	2.78 (c)	2.79 (c)	2.80 (b)	2.81 (c)
2.82 (a)	2.83 (b)	2.84 (d)	2.85 (c)	2.86 (b)	2.87 (d)	2.88 (b)	2.89 (c)	2.90 (a)
2.91 (d)	2.92 (b)	2.93 (c)	2.94 (b)	2.95 (a)	2.96 (c)	2.97 (a)	2.98 (b)	2.100 (d)
2.101 (c)	2.102 (a)	2.103 (d)	2.104 (c)	2.105 (d)	2.106 (b)	2.107 (b)	2.108 (a)	2.109 (b)
2.110 (c)	2.111 (c)	2.112 (a)	2.113 (c)	2.114 (b)	2.115 (b)	2.116 (c)	2.117 (b)	2.118 (d)
2.119 (b)	2.120 (b)	2.121 (d)	2.122 (d)	2.123 (a)	2.124 (a)	2.125 (a)	2.126 (a)	2.127 (d)
2.128 (b)	2.129 (c)	2.130 (d)	2.131 (b)	2.132 (b)	2.133 (d)	2.134 (a)	2.135 (a)	2.136 (d)
2.137 (b)	2.138 (d)	2.139 (c)	2.140 (c)	2.141 (b)	2.142 (a)	2.143 (d)	2.144 (b)	2.145 (c)
2.146 (c)	2.147 (c)	2.148 (a)	2.149 (d)	2.150 (a)	2.151 (b)	2.152 (c)	2.153 (c)	2.154 (a)
2.155 (b)	2.156 (b)	2.157 (a)	2.158 (b)	2.159 (c)	2.160 (a)	2.161 (c)	2.162 (c)	2.163 (a)
2.164 (c)	2.165 (c)	2.166 (c)	2.167 (c)	2.168 (c)	2.169 (c)	2.170 (c)	2.171 (d)	2.172 (c)
2.173 (d)	2.174 (c)	2.175 (b)	2.176 (b)	2.177 (c)	2.178 (a)	2.179 (c)	2.180 (a)	2.181 (d)
2.182 (a)	2.183 (b)	2.184 (c)	2.185 (b)	2.186 (b)	2.187 (a)	2.188 (b)	2.189 (c)	2.190 (a)
2.191 (c)								

Explanations Estimating, Costing and Valuation

1. Estimates

1.1 (a)

Prismoidal formula for volume calculation:

$$V = \frac{D}{3}[\text{First section area} + \text{Last section area} + 2\Sigma\text{odd numbered section area} + 4\,\Sigma\text{even numbered section area}]$$

D = Distance between section

Note: End area (or trapezoidal formula)

$$V = \frac{D}{2}\left[(A_1 + A_n) + 2(A_2 + A_3 + \ldots + A_{n-1})\right]$$

$$= \frac{D}{2}\{\text{First section area} + \text{Last section area} + 2\Sigma\text{all remaining section area}\}$$

1.2 (b)

Quantity of 150 thick PCC per m length of footing

$= 0.625 \times 0.15$

$= 0.09375$ m^3/m of footing

1.3 (d)

Type of work	Units of measurements
Damp proof course	m^2 (sq.m.)
Form works	m^2 (sq.m)
Concrete Jeffries (or Jali work) (Thickness specified)	m^2 (sq.m)
R.C. Chajja	m^3 (cum)

1.4 (c)

Conventional size of brick

$= 250$ mm $\times$ 125 mm $\times$ 75 mm

$\therefore$ No. of bricks required in 1 m^2

$$= \frac{1 \times 1}{0.25 \times 0.125} = 32$$

1.5 (a)

For edge soling,

$$\text{No. of bricks required} = \frac{1 \times 1}{0.250 \times 0.075} = 54$$

1.6 (c)

Volume of lime terracing

$= 1$ m^2 $\times$ 0.075 m $= 0.075$ m^3

Ratio of brick khoa, surkhi, lime

$= 2 : 2 : 7$

$\therefore$ Wet volume of surkhi

$$= \frac{2}{11} \times 0.075 = 0.0136 \text{ m}^3$$

Dry volume is 1/3rd extra of wet volume

Volume of surkhi required

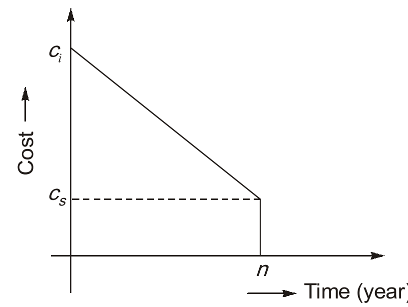
$$= \frac{4}{3} \times 0.0136 = 0.019 \text{m}^3$$

1.7 (c)

Straight line method of depreciation: This method is used for all the asset which do not get obsolete during its utility period.

Ex.: Civil engineering equipment

In this method asset losses its value by a constant amount every year.



$$D = \frac{c_i - C_s}{n}$$

c_i = Initial cost of an asset at zero time

c_s = Salvage value

n = Life of asset

D = Depreciation

1.8 (d)

Dry volume of mortar = 0.015 × 100 = 1.5 m^3

Assuming that materials consist of 60% voids

For 1 m^3 of wet cement mortar, 1.6 m^3 of materials are required

For 1.5 m^3 of wet cement mortar, materials required = 1.5 × 1.6 = 2.4 m^3

Now, quantity of cement required

$$= \frac{1}{7} \times 2.4 = 0.343 \text{m}^3$$

1.9 (d)

As per clause 6.1 of IS 1077 : 1992, size of modular brick is 200 mm × 100 mm × 100 mm

$\therefore$ No of bricks required for 1 m^3 brick masonry

$$= \frac{1}{0.2 \times 0.1 \times 0.1} = 500$$

1.10 (b)

Volume of earthwork

$= [4 \times 6 - (4 - 2 \times 0.8) \times (6 - 2 \times 0.8)] \times 0.6$

$= 8.064$ m^3

Alternate Solution:

CHAPTER 3

Paper - I : Objective

Surveying

1. Fundamental Concepts of Surveying

1.1 The curvature of the earth's surface is taken into account if the extent of survey is more than

(a) 100 km^2 (b) 160 km^2
(c) 500 km^2 (d) 260 km^2

[SSC-JE : 2007]

1.2 The limiting length of an offset does not depend upon

(a) accuracy of the work
(b) method of setting out perpendiculars
(c) scale of plotting
(d) indefinite features to be surveyed

[SSC-JE : 2008]

1.3 The construction of optical squares is based on the principle of optical

(a) reflection
(b) refraction
(c) double refraction
(d) double reflection

[SSC-JE : 2008]

1.4 The survey in which the curvature of the Earth is taken into account is called

(a) Geodetic survey
(b) Plane survey
(c) Hydrographical survey
(d) Topographical survey

[SSC-JE : 2009]

1.5 In a metric chain, number of links per meter run can be

(a) 2 (b) 5
(c) 8 (d) 0

[SSC-JE : 2009]

1.6 Cross staff is used for :

(a) setting out right angle
(b) measuring horizontal angle
(c) both (a) and (b)
(d) none of the above

[SSC-JE : 2010]

1.7 The fixed point whose elevation is known, is called as

(a) benchmark (b) change point
(c) reduced level (d) station

[SSC : JE : 2011]

1.8 Which of the following scales is the smallest one?

(a) 4 : 200000
(b) 1 cm = 5000 m
(c) 1 cm = 50 m
(d) RF = 1/50000

[SSC - JE : 2012]

1.9 When the curvature of earth is taken into account, the surveying is called as

(a) Plane surveying
(b) Preliminary surveying
(c) Geodetic surveying
(d) Hydrographic surveying

[SSC - JE : 2012]

1.10 Ranging is defined as

(a) measuring the distance from starting point
(b) establishing intermediate points on a chain line
(c) the distance between end points
(d) a point on a chain line

[SSC : JE : 2013]

1.11 A line joining some fixed points on the main survey lines is called as

(a) check line (b) tie line
(c) chain line (d) base line

[SSC : JE : 2013]

1.12 The main principle of field surveying is to work from

(a) higher level to lower level
(b) lower level to higher level
(c) part to whole
(d) whole to part

[SSC : JE : 2013]

4. Tacheometric, Curve & Hydrographic Surveying

4.1	(a)	4.2	(b)	4.3	(a)	4.4	(a)	4.5	(d)	4.6	(a)	4.7	(a)	4.8	(b)	4.9	(a)
4.10	(b)	4.11	(c)	4.12	(c)	4.13	(b)	4.14	(d)	4.15	(d)	4.16	(b)	4.17	(c)	4.18	(c)
4.19	(a)	4.20	(d)	4.21	(b)	4.22	(b)	4.23	(b)	4.24	(b)	4.25	(b)	4.26	(b)	4.27	(b)
4.28	(a)	4.29	(b)	4.30	(c)	4.31	(b)	4.32	(a)	4.33	(c)	4.34	(d)	4.35	(b)	4.36	(d)
4.37	(b)	4.38	(d)	4.39	(b)	4.40	(b)	4.41	(d)	4.42	(c)						

5. Miscellaneous

5.1	(d)	5.2	(b)	5.3	(c)	5.4	(d)	5.5	(b)	5.6	(c)	5.7	(b)	5.8	(a)	5.9	(a)
5.10	(c)	5.11	(a)	5.12	(d)	5.13	(d)	5.14	(c)	5.15	(c)	5.16	(c)	5.17	(d)	5.18	(c)
5.19	(d)	5.20	(a)	5.21	(b)	5.22	(d)	5.23	(d)	5.24	(c)	5.25	(a)	5.26	(a)	5.27	(c)
5.28	(b)	5.29	(c)	5.30	(b)	5.31	(d)	5.32	(b)	5.33	(d)	5.34	(b)	5.35	(a)	5.36	(a)
5.37	(d)	5.38	(d)	5.39	(a)	5.40	(b)	5.41	(a)	5.42	(a)						

Explanations Surveying

1. Fundamental Concepts of Surveying

1.1 (d)

The differences between plane and geodetic surveying are the following.

Plane Surveying

- Effect of the curvature of the earth surface is ignored.
- The earth surface is assumed to be plane, i.e. two dimensional.
- Involves smaller areas less than about 260 km^2.
- Lower degree of accuracy.
- Done locally by the individual organization

Geodetic Surveying

- Effect of the curvature of the earth surface is included.
- The earth surface is assumed to be spherical, i.e. three dimensional.
- Involves larger areas more than about 260 km^2.
- Higher degree of accuracy.
- Done by the concerned state or government department.

1.2 (d)

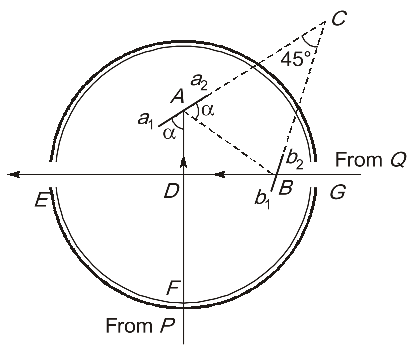
Limiting length of offset: It is the maximum length of offset allowed in chain survey due to which error should not exceed 0.025 cm.

Limiting length of an offset depends on:

- Scale of map
- Accuracy designed
- Nature of ground
- Method of setting out perpendicular.

1.3 (d)

- The construction of optical square is based on the principle that a ray of light reflected successively from two surfaces undergoes a deviation of twice the angle between the reflecting surface.
- The angle between the reflecting surfaces is kept 45° so that light after double reflection is at right angle to the incident ray of light.
- More convenient and accurate then cross-staff for setting right angles.



An Optical Square

1.4 (a)

Plane survey: The surveying in which curvature of earth is neglected and is assumed to be a flat surface is called plane surveying, it is suitable for small area.

Geodetic survey: Curvature of earth is considered, suitable for large area. E.g. survey of country.

Hydrographic survey: It is also called as bathymetric surveying which is done to know the features under water. E.g Determination of channel depth etc.

Topographical survey: To know about general topography of area (man-made and natural features both) such as river, hills, lakes, building, monuments etc.

1.5 (b)

There are two types of metric chain, (i) 20 m = 100 links and (ii) 30 m = 150 links which gives 5 links per meter length of chain.

Other types of chain:

Gunter's chain: 66 feet — 100 links (Surveyor's chain)

Revenue chain: 33 feet – 16 links (Cadastral survey)

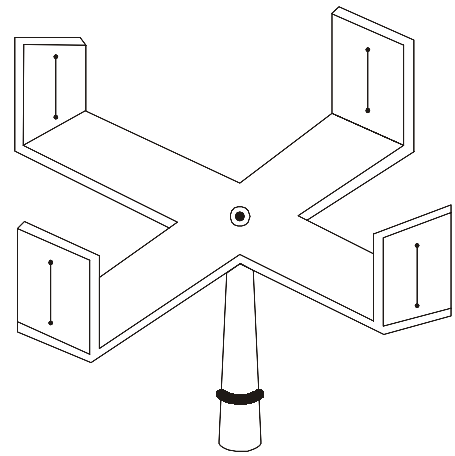
Engineers chain: 100 feet — 100 links

1.6 (a)

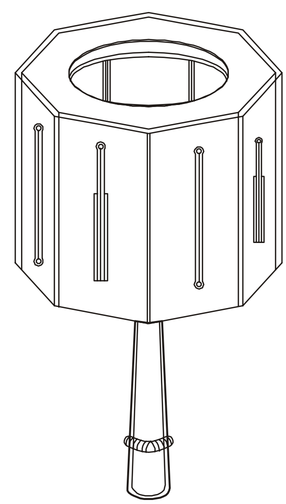
Cross staff: It is used for setting out a right angle at a given point on the chain line.

Various type of cross staff:

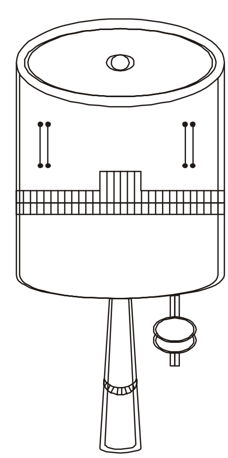
(i) **Open cross-staff** can set two lines at right angles to each other.



(ii) **French cross-staff** can set lines at 45° or 90°.



(iii) **Adjustable cross-staff:** Can set any angle .



An adjustable cross-staff

1.7 (a)

Benchmark: Relatively permanent point of

CHAPTER

6

Paper - I : Objective

Irrigation Engineering

1. Water Requirement of Crops

1.1 The discharge capacity required at the outlet to irrigate 2600 ha of sugarcane having a kor depth of 17 cm and a kor period of 30 days is
(a) 2.3 m^3/s (b) 1.71 m^3/s
(c) 14.7 m^3/s (d) 0.18 m^3/s
[SSC : JE : 2011]

1.2 The water utilizable by plants is available in the form of
(a) gravity water (b) hygroscopic water
(c) capillary water (d) chemical water
[SSC : JE : 2013]

1.3 The ratio of the quantity of water stored in the root zone of the crops to the quantity of water actually delivered in the field is known as
(a) water use efficiency
(b) water conveyance efficiency
(c) water application efficiency
(d) water storage efficiency
[SSC - JE (Forenoon) : 2014]

1.4 Irrigation efficiency of an irrigation system is the ratio of
(a) Water reaching the farm to water delivered from the source.
(b) Crop yield to total amount of water used in a field.
(c) Water actually stored in root zone to water delivered to the farm.
(d) Water actually utilised by growing crops to water delivered from the source.
[SSC - JE (Afternoon) : 2014]

1.5 On rolling land, the method of applying water is
(a) Check flooding (b) Free flooding
(c) Border flooding (d) Furrow flooding
[SSC - JE (Forenoon) 1.3.2017]

1.6 Intensity of irrigation is
(a) The percentage of culturable commanded area proposed to be irrigated annually
(b) Is always more than 100%
(c) Is the percentage that could be ideally irrigated
(d) All options are correct
[SSC - JE (Afternoon) 1.3.2017]

1.7 The field irrigation requirement is computed as
(a) Consumptive use + field application losses
(b) Net irrigation requirement + field application losses
(c) Net irrigation requirement + conveyance losses
(d) Consumptive use + conveyance losses
[SSC - JE (Forenoon) : 2.3.2017]

1.8 The state of the soil when plants fail to extract sufficient water for their requirements is_______.
(a) maximum saturated point
(b) permanent wilting point
(c) ultimate utilization point
(d) None of these
[SSC - JE (Afternoon) 2.3.2017]

1.9 The field capacity of a soil is 25%, its permanent wilting point is 15% and specific dry unit weight is 1.5. If the depth of root zone of a crop is 80 cm, the storage capacity of the soil is_______.
(a) 8 cm (b) 10 cm
(c) 12 cm (d) 14 cm
[SSC - JE (Afternoon) 2.3.2017]

1.10 A sprinkler irrigation system is suitable when
(a) the land gradient is steep and the soil is easily erodible
(b) the soil is having low permeability
(c) the water table is low
(d) the crops to be grown have deep roots
[SSC-JE (Forenoon) 3.3.2017]

2. Hydraulics Structures

2.1	(a)	2.2	(c)	2.3	(a)	2.4	(d)	2.5	(a)	2.6	(d)	2.7	(a)	2.8	(a)	2.9	(b)
2.10	(b)	2.11	(b)	2.12	(d)	2.13	(b)	2.14	(c)	2.15	(d)	2.16	(b)	2.17	(b)	2.18	(c)
2.19	(a)	2.20	(b)	2.21	(a)	2.22	(c)	2.23	(d)	2.24	(b)	2.25	(b)	2.26	(d)	2.27	(b)
2.28	(b)	2.29	(b)	2.30	(c)	2.31	(b)	2.32	(d)	2.33	(c)	2.34	(c)	2.35	(d)	2.36	(a)
2.37	(b)	2.38	(a)	2.39	(a)	2.40	(d)	2.41	(d)	2.42	(b)	2.43	(a)	2.44	(d)	2.45	(a)
2.46	(d)	2.47	(a)	2.48	(c)	2.49	(a)	2.50	(c)	2.51	(c)	2.52	(d)	2.53	(d)	2.54	(d)
2.55	(c)	2.56	(d)	2.57	(a)	2.58	(d)	2.59	(c)	2.60	(a)	2.61	(c)	2.62	(d)	2.63	(a)
2.64	(a)	2.65	(c)	2.66	(a)	2.67	(b)	2.68	(b)	2.69	(a)	2.70	(d)	2.71	(b)	2.72	(c)
2.73	(d)	2.74	(a)	2.75	(d)	2.76	(b)	2.77	(b)	2.78	(a)	2.79	(b)	2.80	(c)	2.81	(c)
2.82	(c)	2.83	(d)	2.84	(b)	2.85	(d)	2.86	(c)	2.87	(b)	2.88	(d)	2.89	(b)	2.90	(a)
2.91	(d)	2.92	(c)	2.93	(a)	2.94	(d)	2.95	(a)	2.96	(b)						

3. Hydrology and Miscellaneous

3.1	(a)	3.2	(b)	3.3	(a)	3.4	(d)	3.5	(d)	3.6	(c)	3.7	(b)	3.8	(c)	3.9	(*)
3.10	(c)	3.11	(c)	3.12	(c)	3.13	(a)	3.14	(a)	3.15	(c)	3.16	(a)	3.17	(a)	3.18	(a)
3.19	(b)	3.20	(b)	3.21	(d)	3.22	(a)	3.23	(b)	3.24	(c)	3.25	(c)	3.26	(d)	3.27	(*)
3.28	(b)	3.29	(a)	3.30	(d)	3.31	(a)	3.32	(d)	3.33	(d)	3.34	(b)	3.35	(a)	3.36	(c)
3.37	(c)	3.38	(d)	3.39	(a)	3.40	(d)	3.41	(c)	3.42	(c)	3.43	(b)	3.44	(b)	3.45	(a)
3.46	(b)	3.47	(b)	3.48	(c)	3.49	(d)	3.50	(c)	3.51	(c)	3.52	(b)	3.53	(c)	3.54	(b)
3.55	(b)	3.56	(c)	3.57	(b)	3.58	(b)	3.59	(d)	3.60	(d)						

Explanations Irrigation Engineering

1. Water Requirement of Crops

1.1 (b)

$$\Delta = 8.64\frac{B}{D}$$

$$\therefore \quad D = \frac{8.64B}{\Delta} = \frac{8.64 \times 30}{0.17}$$

$$= 1524.7 \text{ hectare/cumec}$$

$\therefore$ Discharge capacity required

$$= \frac{2600}{1524.7} = 1.71 \text{ m}^3/\text{s}$$

1.2 (c)

Soil water may be classified into the following three categories:

1. **Gravitational water:**
   - It is that water which is not held by the oil but drains out under the action of gravity.
   - Till the time it is required to drainout, it prevents circulation of air in the soil hence it is harmful to the crops, if present for longer duration.
2. **Capillary water:**
   - It is that part of water which is retained in the soil after gravity water is drained off

and it can be absorbed by the plant roots.

- This water is held in the soil by surface tension between the soil particles.
- Plant roots gradually absorbed capillary water, hence it is main source of water for plant growth, therefore it is also called as available water.

3. Hygroscopic water:
   - It is that water which is absorbed by the soil particles from the atmosphere and it is held very tightly by the soil particles therefore it can't be extracted by plant roots.

1.3 (c)

Water use efficiency

$$= \frac{\text{Water used consumptively}}{\text{Water delivered in the field}}$$

Water conveyance efficiency

$$= \frac{\text{Water availabe at field}}{\text{Water applied at headwork}}$$

Water application efficiency

$$= \frac{\text{Water stored in root zone}}{\text{Water delivered to the field}}$$

Water storage efficiency

$$= \frac{\text{Actual water stored in root zone}}{\text{Water needed to bring water content upto field capacity}}$$

1.4 (d)

It is defined as the ratio between the amount of water utilized (i.e., used to meet the consumptive use requirement of crop plus that necessary to maintain a favourable salt balance in the crop root zone) to the total volume of water diverted, stored or pumped for irrigation.

1.5 (b)

There are various ways in which the irrigation water can be applied in the field:

(i) **Free flooding:** Used on rolling land (topography irregular) where borders, checks, basins and furrows are not feasible.

(ii) **Border flooding:** In this method, the land is divided into a no. of strips, separated by low levels called borders.

(iii) **Check flooding:** This method is suitable for both more permeable and less permeable soil.

(iv) **Basin flooding:** This method is a special type of check flooding and adopted specially for orchard trees.

(v) **Furrow flooding/irrigation:** It is suitable for a wide range of soil types, crops (especially row crops) and land slopes.

1.6 (a)

Intensity of irrigation: The intensity of irrigation is defined as the percentage of the culturable commended area proposed to be irrigated annually.

The yearly intensity of irrigation may be obtained by adding the intensities of irrigation for all the crops seasons.

E.g., If the intensity of irrigation for Rabi is 50% and that for Kharif is 60% then the yearly intensity of irrigation will be 110.%

1.7 (b)

Field irrigation requirement is defined as the amount of water required to meet the net irrigation requirements plus the field application losses due to surface runoff and deep percolation.

1.8 (b)

At permanent wilting point soil does not have enough capacity to extract water as soil moisture tension at permanent wilting point is very high. Hence the plant dies if water is not supplied immediately to the root zone to bring it back to field capacity.

1.9 (c)

Given, $FC = 25\% = 0.25$

$PWP = 15\% = 0.15$

$$G = 1.5 = \frac{\gamma_d}{\gamma_\omega}$$

Depth of root zone,

$d = 80$ cm

∴ Storage capacity of the soil is given by

$$d = \frac{\gamma_d}{\gamma_\omega} \times d \times (FC - PWP)$$

$$= 1.5 \times 80 \times (0.25 - 0.15) \text{ cm}$$

$$= 12 \text{ cm}$$

1.10 (a)

Advantages of sprinkler irrigation:

(i) Suited to complete range of topographies and field dimensions.
(ii) High irrigation efficiency due to uniform distribution of water.
(iii) Accurate and easy measurement of water applied.
(iv) Land levelling is not essential.
(v) Soluble fertilizer, herbicides and fungicides can be applied in the irrigation water economically and with little extra equipment.
(vi) More land is available for cropping.
(vii) No interfere with the movement of farm machinery.
(viii) Easy to operate, operator may be trained quickly.

Limitation of sprinkler irrigation:

(i) It requires high initial investment.
(ii) Power requirement is usually high since sprinklers operate with more than 0.5 kg/cm^2 water pressure.
(iii) Fine textured soils that have low infiltration rate cannot be irrigated efficiently in host windy area.
(iv) Loss of water due to evaporation from the area during irrigation.
(v) The water must be clean and free of sand, debris and large amounts of dissolve salts.
(vi) Wind distorts sprinkler pattern and cause uneven distribution of water.

1.11 (d)

Given, Conveyance loss = 20%; Irrigation efficiency = 80%

∴ Water reaching the field

$$= \frac{\text{Actual depth of watering}}{\text{Irrigation efficiency}}$$

$$= \frac{16 \text{ cm}}{0.8} = 20 \text{ cm}$$

For conveyance loss of 20%, water conveyance efficiency is = 100 – 20% = 80%

∴ Water at canal outlet

$$= \frac{\text{Water reaching the field}}{\text{Water conveyance efficiency}}$$

$$= \frac{20}{0.8} = 25 \text{ cm}$$

1.12 (a)

Intensity of irrigation: The intensity of irrigation is defined as the percentage of the culturable commended area proposed to be irrigated annually.

The yearly intensity of irrigation may be obtained by adding the intensities of irrigation for all the crops seasons.

E.g., If the intensity of irrigation for Rabi is 50% and that for Kharif is 60% then the yearly intensity of irrigation will be 110.%

1.13 (b)

Drip Irrigation Method:

- One of the latest method of irrigation which is becoming increasingly popular in areas with acute scarcity of irrigation water and salt problems.
- In this method, water and fertilizer is slowly and directly applied to the root zone of the plants in order to minimise the losses due to evaporation and percolation.

1.14 (d)

$$\text{Duty} = \frac{864 \times B}{\Delta} = \frac{864 \times 100}{100}$$
$$= 864 \text{ hectare/m}^3\text{/s}$$

B (in days)
Δ (in cm)
D (he/m^3/sec)

1.15 (c)

Factors affecting duty of water:

(i) Type of crops: Lower duty for crop requiring large quantity of water.
(ii) Climatic condition
  (a) Temperature → Temperature ↑ — Duty↓
  (b) Wind velocity → Wind velocity↑ — Duty↓
  (c) Humidity → Humidity ↑ — Duty ↑
  (d) Rainfall → Rainfall ↑ — Duty ↑
(iii) Method of irrigation:
  Method of irrigation in which losses are more duty will be less.
(iv) State of crop:
  In initial stages duty will be higher whereas in lateral stages duty will be lower.
(v) Quality of water:

CHAPTER

8

Paper - I : Objective

Environmental Engineering

1. Water Demand its Source and Conveyance

1.1 The total water requirement of a city is generally assessed on the basis of
(a) maximum hourly demand
(b) maximum daily demand + fire demand
(c) average daily demand + fire demand
(d) greater of (a) and (b)

[SSC-JE : 2007]

1.2 Pick up the incorrect statement
(a) Sluice valves are provided to allow flow of water only in one direction, preventing back flow
(b) Air valves are provided at summits along a pipeline to admit/release air
(c) Scour valves are provided at low points to empty a pipeline
(d) Gate valves are provided to regulate flow of water through the pipelines

[SSC-JE : 2007]

1.3 Water supply includes
(a) collection, transportation and treatment of water
(b) distribution of water to consumers
(c) provision of hydrants for fire fighting
(d) All the above

[SSC-JE : 2008]

1.4 The total water demand may be taken as
(a) 135 lpcd (b) 160 lpcd
(c) 210 lpcd (d) 270 lpcd

[SSC-JE : 2009]

1.5 The distribution system in water supplies is designed on the basis of :
(a) average daily demand
(b) peak hourly demand
(c) coincident of draft
(d) greater of (b) and (c)

[SSC-JE : 2010]

1.6 The population of a town as per census records were 2,00,000; 2,10,000 and 2,30,000 for the year 1981, 1991 and 2001 respectively. Find the population of the town in the year 2011 using arithmetic mean method.
(a) 250000 (b) 255000
(c) 240000 (d) 245000

[SSC - JE : 2012]

1.7 The population of a town as per census records were 200000, 210000 and 230000 for the years 1981, 1991 and 2001 respectively. The population of the town as per geometric mean method in the year 2011 is
(a) 244872 (b) 245872
(c) 246820 (d) None of the above

[SSC : JE : 2013]

1.8 Pollution potential of domestic sewage generated in a town and its industrial sewage can be compared with reference to
(a) their BOD value (b) population equivalent
(c) their volume (d) the relative density

[SSC-JE : 2015]

1.9 As per Indian Standard Specifications, the peak discharge for domestic purposes per capita per minute, is taken
(a) 1.80 litres for 5 to 10 users
(b) 1.20 litres for 15 users
(c) 1.35 litres for 20 users
(d) All options are correct

[SSC - JE (Forenoon) 3.3.2017]

1.10 Pick up the correct statement in case of water supply.
A. Pipes laid in trenches and pipes fixed to walls are measured separately
B. Cutting through walls and floors are included with the item
C. Pipes are classified according to their sizes and quality

5. Air and Sound Pollution

5.1	(c)	5.2	(b)	5.3	(a)	5.4	(a)	5.5	(c)	5.6	(c)	5.7	(a)	5.8	(c)	5.9	(b)
5.10	(b)	5.11	(b)	5.12	(c)	5.13	(a)	5.14	(a)	5.15	(a)	5.16	(b)	5.17	(c)	5.18	(a)
5.19	(b)	5.20	(b)	5.21	(c)	5.22	(b)	5.23	(d)	5.24	(a)	5.25	(a)	5.26	(c)	5.27	(a)
5.28	(c)	5.29	(d)	5.30	(b)	5.31	(b)	5.32	(a)	5.33	(d)	5.34	(c)	5.35	(c)	5.36	(b)
5.37	(b)	5.38	(b)	5.39	(d)	5.40	(d)	5.41	(d)	5.42	(a)	5.43	(c)	5.44	(a)	5.45	(c)
5.46	(b)	5.47	(b)	5.48	(a)												

Explanations Environmental Engineering

1. Water Demand and Population Projection

1.1 (d)

The maximum daily demand along with fire demand is known as coincident draft.
The total water demand of the city is the maximum of either the coincident draft or maximum hourly demand.

1.2 (a)

Sluice valves are also known as gate valves whose function is to regulate the flow of water through the pipes.
The valve which allows the water to flow in one direction only is known as check/reflux/non-returning valve.

1.3 (d)

The essential elements of a public water supply scheme included intakes and reservoirs water treatment plant having screening, sedimentation, filtration, disinfection units etc; elevated tanks and stand pipes which provide storage to meet peek demands occurring for limited periods; valves which control the flow of water in pipe system; hydrants which provide a connection with the water supply mains for fighting fire, flushing streets etc.

1.4 (d)

For an average Indian town the requirement of water in variation uses is as under:

Domestic use	—	134 l/c/d
Industrial use	—	40 l/c/d
Public use	—	25 l/c/d
Fire demand	—	15 l/c/d
Losses wastage and thefts	—	55 l/c/d
Total demand	=	270 l/c/d

1.5 (d)

The distribution system in water supply is designed for the maximum of (i) peak hourly demand and (ii) Coincidental draft, which is the summation of fire demand and peak daily demand.

1.6 (d)

Year	Population	Increment
1981	200000	—
1991	210000	10000
2001	230000	20000

$$\text{Average increment} = \frac{10000 + 20000}{2} = 15000$$

(Population after n-decade $P_n = P_o + n\bar{x}$)

Population in 2011 = 230000 + 15000 = 245000

1.7 (b)

Year	Population	Increment	Growth rate per decade
1981	200000	—	—
1991	210000	10000	$\frac{10000}{200000} \times 100 = 5\%$
2001	230000	20000	$\frac{20000}{210000} \times 100 = 9.5\%$

Geometric mean of growth rate,

$$r = (0.05 \times 0.095)^{1/2}$$
$$= 0.069 \text{ or } 6.9\%$$

Population after n-decade $P_0\left(1+\frac{r}{100}\right)^n$

∴ Population in year 2011 (i.e., after 1 decade)

$$= 230000 \times (1 + 0.069)^1$$
$$= 245870$$

1.8 (b)

Industrial wastewaters are generally compared with per capita normal domestic wastewaters, so as to rationally charge the industries for the pollution caused by them. The strength of the industrial sewage is thus, worked out as:

Population equivalent

$$= \frac{\text{Standard BOD}_5 \text{ of industrial sewage}}{\text{Standard BOD}_5 \text{ of domestic sewage per person per day}}$$

1.11 (d)

Gullies: These are opening on the road surface at the lowest point for draining water from roads.

Siphons: When sewer needs to be made below railway tracks, the siphons are used.

Trap: Traps are used in water closet to seal foul gases.

In all these, the cost include setting and laying, bed concreting, connection to drains.

1.12 (d)

We know that, maximum hourly consumption of the maximum day

= 1.5 × (Avg. hourly consumption of max. day)

$$= 1.5\times\left(\frac{\text{Maximum daily demand}}{24}\right)$$

$$= 1.5\times1.8\left(\frac{\text{Average daily demand}}{24}\right)$$

= 2.7 (Annual average hourly demand)

∴ Maximum hourly consumption

= 2.7 × 100000

= 270000 m^3

1.13 (d)

Units	Design Parameter
Water treatment units.	Maximum daily demand
Main supply pipe (water mains)	Maximum daily demand
Wells and tube wells	Maximum daily demand
Demand reservoir	Average annual demand
Distribution system	Maximum hourly demand of maximum day or coincident draft.

1.14 (c)

According to geometric increase method

$$P_n = P(1 + r)^n$$

Year	Population	Increment	Geometric increase
I	6000	2000	$\frac{2000}{6000}=0.333$
II	8000	2000	$\frac{2000}{8000}=0.25$
III	10000		

$$r = \sqrt{0.33\times0.25} = 0.2885$$

Thus, $P_{IV} = 10000 \times (1 + 0.2885)^1$

= 12885 (near to option (c)

1.15 (a)

Population forecast method	Applicable
Arithmetical increase method.	Large and established cities where there is limited scope of expansion.
Geometric increase method.	Applied to Young and rapidly developing cities with a large scope of expansion.
Incremental increase method.	Adopted for any city whether old or new.

1.16 (b)

In water supply scheme, of maximum day maximum hourly demand

= 1.5 × average diamond hourly of max. day

1.17 (b)

Year	Population	Increase in population
1951	100000	
		9000
1961	109000	
		7000
1971	116000	
		12000
1981	128000	

CHAPTER 10

Paper - I : Objective

RCC Design

1. Working Stress & Limit State Method

1.1 An RCC beam can have maximum tension reinforcement as
(a) 6% bD (b) 2% bD
(c) 3% bD (d) 4% bD
[SSC-JE : 2007]

1.2 Characteristic strength of concrete is measured at
(a) 14 days (b) 28 days
(c) 91 days (d) 7 days
[SSC-JE : 2007]

1.3 The maximum depth of neutral axis for a beam with Fe-415 bars in limit state method of design is
(a) 0.46d (b) 0.48d
(c) 0.50d (d) 0.53d
[SSC-JE : 2007]

1.4 I.S. has specified the full strength of concrete after
(a) 7 days (b) 14 days
(c) 21 days (d) 28 days
[SSC-JE : 2008]

1.5 Permissible compressive strength of M20 concrete grade is
(a) 100 kg/cm^2 (b) 150 kg/cm^2
(c) 200 kg/cm^2 (d) 250 kg/cm^2
[SSC-JE : 2008]

1.6 Ordinary concrete is not used for concrete grade
(a) M 10 (b) M 15
(c) M 25 (d) M 40
[SSC-JE : 2009]

1.7 Permissible compressive strength of M20 concrete grade is
(a) 100 kg/cm^2 (b) 150 kg/cm^2
(d) 250 kg/cm^2 (d) 200 kg/cm^2
[SSC-JE : 2009]

1.8 If a beam fails in bond, then its bond strength can be increased most economically by
(a) increasing the depth of beam
(b) using thinner bars but more in number
(c) using thicker bars but less in number
(d) None of the above
[SSC-JE : 2009]

1.9 According to IS: 456-2000, the maximum reinforcement in a column is
(a) 4% (b) 2%
(c) 6% (d) 8%
[SSC-JE : 2009]

1.10 The modular ratio *m* is given by
(a) $\frac{280}{\sigma_{cbc}}$ (b) $\frac{280}{2\sigma_{cbc}}$
(c) $\frac{280}{3\sigma_{cbc}}$ (d) None of the above
[SSC-JE : 2009]

1.11 The load factors for live load and dead load are
(a) 1.8 and 2.2 (b) 1.5 and 1.5
(c) 1.8 and 1.8 (d) 2.2 and 2.2
[SSC-JE : 2009]

1.12 The partial safety factor for concrete is
(a) 1.15 (b) 1.5
(c) 1.95 (d) 2.0
[SSC-JE : 2009]

1.13 The minimum grade of reinforced concrete in sea water as per IS 456 : 2000 is :
(a) M 15 (b) M 20
(c) M 30 (d) M 40
[SSC-JE : 2010]

1.14 The value of ultimate creep coefficient for concrete:
(a) increases with age of loading
(b) decreases with age of loading
(c) remains constant
(d) is taken as 0.0003 **[SSC-JE : 2010]**

4.28 (b)	4.29 (d)	4.30 (c)	4.31 (d)	4.32 (b)	4.33 (c)	4.34 (c)	4.35 (d)	4.36 (c)
4.37 (c)	4.38 (c)	4.39 (a)	4.40 (d)	4.41 (d)	4.42 (b)	4.43 (a)	4.44 (c)	4.45 (c)
4.46 (b)	4.47 (a)	4.48 (c)	4.49 (d)	4.50 (d)	4.51 (c)	4.52 (b)	4.53 (a)	4.54 (d)
4.55 (c)	4.56 (d)	4.57 (d)	4.58 (b)	4.59 (a)	4.60 (c)	4.61 (d)	4.62 (c)	4.63 (a)
4.64 (c)	4.65 (b)	4.66 (c)						

Explanations RCC Design

1. Working Stress & Limit State Method

1.1 (d)

As per IS 456: 2000, Clause 26.5.1.1. (b)
The maximum area of tension reinforcement shall not exceed 0.04bD i.e. 4% of the total area.

1.2 (b)

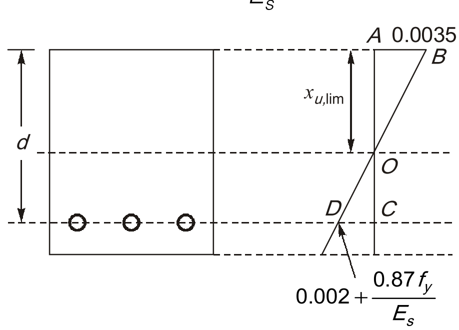
As per IS 456: 2000, Clause 6.2.1.
The design should be based on 28 days characteristics strength of concrete.
Generally, there is a gain of strength beyond 28 days.

1.3 (b)

Limiting depth of neutral axis: ($x_{u.lim}$)
It corresponds to balanced section i.e. amount of steel in section is such that strain in concrete in extreme compression fibre is 0.0035 and strain in steel is ($0.002 + 0.87\, f_y/E_s$) at the time of failure,

$$\varepsilon_c = 0.0035$$

$$\varepsilon_s = 0.002 + 0.87\frac{f_y}{E_s}$$



d = effective depth of beam
$x_{u \cdot lim}$ = limiting depth of neutral axis

From similar triangles,

$$\frac{OA}{AB} = \frac{OC}{CD}$$

$$\frac{x_{u \cdot lim}}{0.0035} = \frac{d - x_{u \cdot lim}}{0.002 + \frac{0.87 f_y}{E_s}}$$

$$x_{u \cdot lim} = \frac{0.0035}{0.0055 + \frac{0.87 f_y}{E_s}} d$$

For Fe 250:
$x_{u \cdot lim} = 0.53\, d$
Fe 415: $x_{u \cdot lim} = 0.48\, d$
Fe 500: $x_{u \cdot lim} = 0.46\, d$

Note: $x_{u,lim}$ is independent of fck (or grade of concrete).

1.4 (d)

As per IS 456: 2000, Clause 6.2.1.

1.5 (c)

In 'M20; grade concrete, 'M' indicates mix and '20' indicates compressive strength of concrete in N/mm^2. The permissible compressive strength of concrete grade is 20 N/mm^2, i.e. 200 kg/cm^2.

1.6 (d)

As per IS 456: 2000, Table 2 : Grade of concrete-
Ordinary Grade - M10-M20
Standard Grade - M25-M55
High strength concrete- M60-M80

1.7 (d)

In 'M20; grade concrete, 'M' indicates mix and '20' indicates compressive strength of concrete in N/mm^2. The permissible compressive strength of concrete grade is 20 N/mm^2, ie 200 kg/cm^2.

1.8 (b)

Bond strength depends on surface area of embedded bar. For the same cross-sectional area. If we provide large number of smaller diameter bars, surface area will be more, hence bond strength is increased without increased cost or material.

Bond strength can also be improved by:

- Increasing grade of concrete
- Using deformed bars in place of plain bars.
- Increased cover provided around each bar.
- Providing bends, hooks, mechanical anchorages.

1.9 (c)

As per IS 456:2000, Clause 26.5.3.1 (a)
The cross-sectional area of longitudinal reinforcement, shall not be less than 0.8 percent nor more than 6 percent of the cross-sectional area of the column.

1.10 (c)

In WSM, (Modular reHO is defined as):

$$M = \frac{E_s}{E_s} = \frac{280}{3 \cdot \sigma_{cbc}}$$

σ_{cbc} = Permissible compressive stress due to bending in concrete (in N/mm^2)
E_s = Modulus of elasticity of steel
E_c = Modulus of elasticity of concrete

1.11 (b)

Values of Partial Safety Factor γ_f for Loads:

Load combination (1)	Limit state of collapse DL (2)	IL (3)	WL (4)	Limit states of serviceability DL (5)	IL (6)	WL (7)
DL + IL	1.5	1.5	–	1.0	1.0	–
DL + WL	1.5	–	1.5	1.0	–	1.0
DL + IL + WL	1.2	1.2	1.2	1.0	0.8	0.8

Note: While considering earthquake effects, substitute EL for WL.

1.12 (b)

As per IS 456:2000, Clause 36.4.2.1
When assessing the strength of a structure or structural member for the unit state of collapse, the values of partial safety factor, γ_m should be taken as 1.5 for concrete end 1.15 for steel.

1.13 (c)

As per Is 456 : 2000, Clause 8.2.8, Concrete in sea-water or exposed directly along the sea-coast shall be at least M 20 Grade in the case of plain concrete and M30 in case of reinforced concrete.

1.14 (b)

As per IS 456: 2000, clause 6.2.5.1, it is seen that ultimate creep coefficient decreases with age.

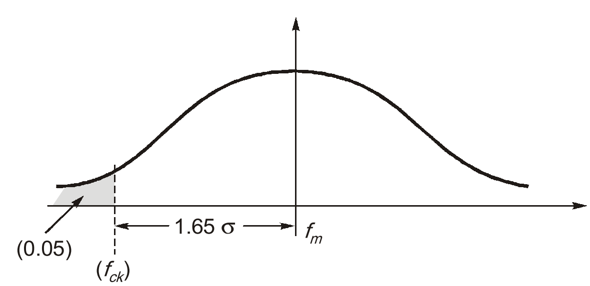
Age of loading	Creep coefficient
7 days	2.2
28 days	1.6
1 year	1.1

1.15 (a)

As per IS 456:2000, Clause 36.4.2.1
When assessing the strength of a structure or structural member for the unit state of collapse, the values of partial safety factor, γ_m should be taken as 1.5 for concrete end 1.15 for steel.

1.16 (b)

Characteristics strength (f_{ck}):
It is that strength below which not more than 5% of test results are expected to soil.



$f_m = f_{ck} + 1.65\sigma$
f_m = target mean strength

1.18 (c)

As per IS 456:2000
For concrete,

$$\text{Design strength} = \frac{\text{(Characteristics strength)}}{\text{Partial FOS}}$$

Characteristics strength of concrete

$$= \frac{f_{ck}}{1.5} = 0.67\, f_{ck}$$

$$\text{Design strength of concrete} = \frac{0.67 f_{ck}}{1.5} = 0.45\, f_{ck}$$

CHAPTER

11

Paper - I : Objective

Steel Design

1. Structural Fasteners

1.1 The type of welding used to connect two plates at a lap joint is called
(a) Butt weld (b) Slot weld
(c) Plug weld (d) Fillet weld
[SSC-JE : 2007]

1.2 A riveted joint can fail in
(a) tearing of plate only
(b) shearing of rivet only
(c) bearing of plate or rivet only
(d) Any of the above
[SSC-JE : 2007]

1.3 The gross diameter of a 14 mm nominal diameter rivet is
(a) 15.5 mm (b) 16 mm
(c) 16.5 mm (d) None of the above
[SSC-JE : 2007]

1.4 The effective length of a fillet weld of length l is (where s = the size of the weld.)
(a) $l - 4s$ (b) $\left(\frac{2}{3}\right)l$
(c) $l - 2s$ (d) $\left(\frac{4}{5}\right)$
[SSC-JE : 2007]

1.5 The strength of field rivets as compared to shop rivets is
(a) same (b) 90%
(c) 80% (d) 75%
[SSC-JE : 2007]

1.6 The maximum centre to centre distance between rivets in a tension member of thickness 10 mm is
(a) 200 mm (b) 160 mm
(c) 120 mm (d) 100 mm
[SSC-JE : 2007]

1.7 Which of the following does not describe a weld type?
(a) Butt weld (b) Plug weld
(c) Zigzag weld (d) Lap weld
[SSC-JE : 2007]

1.8 A beam is defined as a structural member subjected to
(a) axial loading
(b) transverse loading
(c) axial and transverse loading
(d) None of these
[SSC-JE : 2008]

1.9 To the calculated area of cover plates of a built up beam, an allowance for rivet holes to be added is
(a) 10% (b) 13%
(c) 15% (d) 18%
[SSC-JE : 2008]

1.10 Minimum pitch of the rivets shall not be less than
(a) 1.5 d (b) 2.5 d
(c) 2.0 d (d) 3.0 d
where d is the gross diameter of the rivets
[SSC-JE : 2009]

1.11 It p and d are pitch and gross diameter of rivet; the efficiency η of the riveted joint, is given by
(a) $\eta = p/(p - d)$ (b) $\eta = (p - d)/p$
(c) $\eta = p/(p + d)$ (d) $\eta = (p + d)/p$
[SSC-JE : 2009]

1.12 The permissible bending stress in steel is
(a) 1500 kg/cm^2 (b) 1890 kg/cm^2
(c) 1900 kg/cm^2 (d) 1300 kg/cm^2
[SSC-JE : 2009]

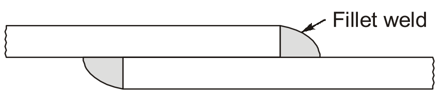
1.13 Minimum pitch of rivets should not be less than how many of gross diameter of rivet ?
(a) 2 times (b) 2.5 times
(c) 3 times (d) 4 times
[SSC-JE : 2010]

Explanations **Steel Design**

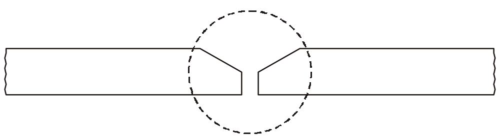
1. Structural Fasteners

1.1 (d)

- Fillet welds are provided when two members to be jointed are in different plane i.e., lap joint.

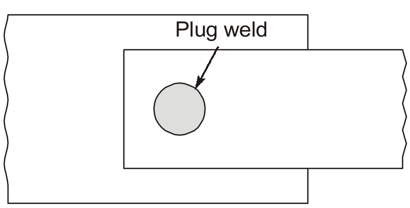


* **Butt weld:** It is also known as groove weld. It is provided when the members to be jointed are lined up.

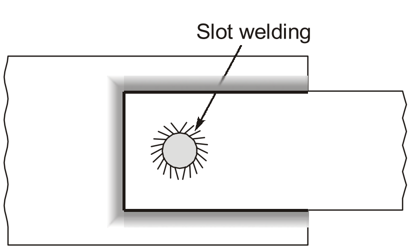


Single V-butt weld

- **Plug weld:** In plug welds small holes are made in one plate and is kept over another plate to be connected and then entire hole is filled with filler material.



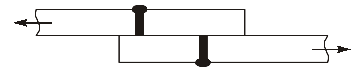
- **Slot weld:** In slot weld fillet welding is made along the periphery of hole.



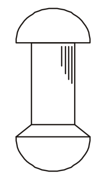
1.2 (d)

A riveted joint can fail either by shearing of rivet, or by bearing of rivet or by tearing of plate.

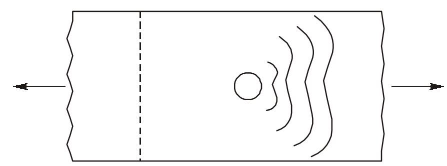
(i) Shear failure of rivets



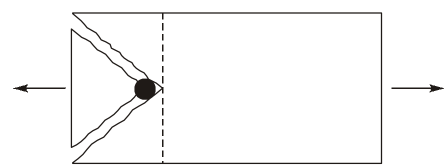
(ii) Bearing failure of rivets



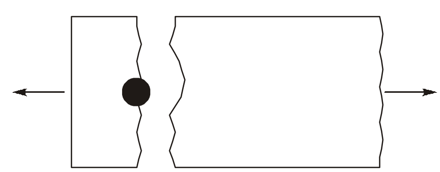
(iii) Bearing failure of plates.



(iv) Shear failure of plate.



(v) Tearing failure of plate.



(vi) Edge cracking or splitting failure of plate.

1.3 (a)

As per IS 800:1984, clause 8.9.3

For nominal diameter upto 25 mm,

Gross diameter = Nominal diameter + 1.5 mm

= 14 mm + 1.5 mm

= 15.5 mm