SSC-JE

Staff Selection Commission

Junior Engineer

Civil Engineering

Previous Years Solved Papers
(2007–2018)

Topicwise Objective Solved Questions

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SSC-Junior Engineer : Civil Engineering Previous Year Solved Papers

First Edition: 2016
Second Edition: 2018
Third Edition: 2019

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 three 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 & Structural	50 Marks 50 Marks 100 Marks	2 hours
Stage 2: Paper-II Conventional Type	General Engineering : Civil & Structural	300 Marks	2 hours
Stage 3: Personal Interview		100 Marks	---
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, shortlisted candidates are called for Personal Interview.			

In the second edition, the book has been thoroughly revised and Reasoning-Aptitude section is also added. 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. I hope this book will prove as an important tool to succeed in SSC -JE and other competitive exams. Any suggestion from the readers for improvement of this book is most welcome.

With Best Wishes

B. Singh

CMD, MADE EASY

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, Ill 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.

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CHAPTER

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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 If 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]

1.14 Effective throat thickness (t) and size of weld (s) are connected as :
(a) $t = k\,s^2$ (b) $t = k\,s^3$
(c) $t = k\,s$ (d) $t = k\sqrt{s}$
[SSC-JE : 2010]

1.15 Bolts are most suitable to carry
(a) shear (b) bending
(c) axial tension (d) shear and bending
[SSC-JE : 2010]

1.16 For a rivet of 36 mm diameter, the diameter of hole shall be taken as :
(a) 37.5 mm (b) 36.0 mm
(c) 38.0 mm (d) 38.5 mm
[SSC-JE : 2010]

1.17 What should be multiplied with permissible bearing stress to find out strength of rivet in bearing?
(a) $(p - d)t$ (b) V
(c) $\frac{\pi}{2}d^2$ (d) $d.t^2$
[SSC-JE : 2010]

1.18 Pick the wrongly written assumption taken in analysis of riveted joints
(a) Friction in plates is negligible
(b) Uniform stress distribution in plates is not considered .
(c) Bending moment is not taken into consideration
(d) Total load on the joint is equally shared by all rivets
[SSC-JE : 2010]

1.19 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 : 2010]

1.20 The type of weld 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 : 2010]

1.21 According to Unwin's formula, the relation between diameter of rivet hole (d) in mm, and thickness of plate (t) in mm is given by
(a) $d = t$ (b) $d = 6.01\sqrt{t}$
(c) $d = 2t$ (d) $d = 2.6\sqrt{t}$
[SSC : JE : 2011]

1.22 The distance between two rivets measured perpendicular to the direction of applied force is known as
(a) pitch (b) gauge
(c) staggered pitch (d) edge distance
[SSC : JE : 2013]

1.23 Maximum size of the fillet weld for a plate of square edge is
(a) 1.5 mm less than the thickness of the plate.
(b) one-half of the thickness of the plate.
(c) thickness of the plate itself.
(d) 1.5 mm more than the thickness of the plate.
[SSC : JE : 2013]

1.24 The minimum edge and end distance from the centre of any hole to the nearest flame-cut edge shall **not** be less than
(a) 1.5 times hole dia
(b) 1.7 times hole dia
(c) 2 times hole dia
(d) 1.5 times bolt/rivet dia
[SSC : JE : 2013]

1.25 The throat in a fillet weld is
(a) larger side of the triangle of the fillet
(b) hypotenuse of the triangle of the fillet
(c) smaller side of the triangle of the fillet
(d) perpendicular distance from the root to the hypotenuse
[SSC - JE (Forenoon) : 2014]

1.26 The size of a rivet is identified by
(a) diameter of shank
(b) diameter of head
(c) length of shank
(d) shape of head
[SSC - JE (Forenoon) : 2014]

1.27 The maximum permissible stress for power driven field rivet in bearing on rivet is
(a) 100 N/mm^2 (b) 250 N/mm^2
(c) 270 N/mm^2 (d) 300 N/mm^2
[SSC - JE (Forenoon) : 2014]

1.28 The maximum permissible stress for hand driven rivet in axial tension is :
(a) 250 N/mm^2 (b) 80 N/mm^2
(c) 90 N/mm^2 (d) 100 N/mm^2
[SSC - JE (Afternoon) : 2014]

1.29 The size of a fillet weld is indicated by :
(a) size of the plate
(b) side of the triangle of fillet
(c) throat of the fillet
(d) length of fillet weld
[SSC - JE (Afternoon) : 2014]

1.30 Diameter of a rivet hole is made larger than the diameter of the rivet by
(a) 0.5 mm (b) 1.0 mm
(c) 3 mm (d) 2.0 mm
[SSC - JE (Afternoon) : 2014]

1.31 Partial safety factor on steel stresses is
(a) 6.7 (b) 1.15
(c) 1.77 (d) 1.5
[SSC-JE : 2015]

1.32 When a load is exerted or transferred from one surface to another in contact, the stress is known as
(a) bearing stress (b) shear stress
(c) binding stress (d) direct stress
[SSC-JE : 2015]

1.33 The actual thickness of a butt weld when compared with the thickness of the plate is
(a) less (b) more or less
(c) more (d) equal
[SSC-JE : 2015]

1.34 The fillet weld whose axis is parallel to the direction of the applied load is known as
(a) side fillet weld (b) end fillet weld
(c) flat fillet weld (d) diagonal fillet weld
[SSC-JE : 2015]

1.35 Tacking rivets in compression plates exposed to weather have a pitch not exceeding 200 mm or
(a) 8 times the thickness of outside plate
(b) 16 times the thickness of outside plate
(c) 24 times the thickness of outside plate
(d) 32 times the thickness of outside plate
[SSC-JE : 2015]

1.36 The diameter of a rivet connecting plate of thickness 16 mm given by Unwin's formula is
(a) 28 mm (b) 24 mm
(c) 22 mm (d) None of these
[SSC - JE (Forenoon) 1-3-2017]

1.37 Fillet weld is not recommended if the angle between fusion faces is
A. Less than 45° B. Greater than 120°
C. Less than 60° D. Greater than 145°
(a) A and B (b) A and D
(c) B and C (d) C and D
[SSC - JE (Forenoon) 1-3-2017]

1.38 If 'b' is the width of the plate and 'd ' is the diameter of the rivet, then the efficiency of a riveted joint having diamond riveting is given by_____.
(a) $\frac{(b-d)}{b}$ (b) $\frac{(b-d)}{d}$
(c) ($\frac{(b-2d)}{b}$ (d) $\frac{(b-2d)}{d}$
[SSC - JE (Afternoon) 1-3-2017]

1.39 Bolts are most suitable to carry
(a) shear (b) bending
(c) axial tension (d) shear and bending
[SSC - JE (Forenoon) : 2-3-2017]

1.40 For a standard 45° fillet, the ratio of size of fillet to throat thickness is
(a) 1 : 1 (b) 1 : $\sqrt{2}$
(c) $\sqrt{2}$: 1 (d) 2 : 1
[SSC - JE (Forenoon) : 2-3-2017]

1.41 Centre to centre distance of adjacent rivet or bolt holes measured in the direction of stress is called
(a) Gauge (b) Pitch
(c) Lap (d) Edge distance
[SSC - JE (Forenoon) : 2-3-2017]

1.42 Design of a riveted joint assumes that_____.
(a) the bending stress in rivets is accounted for
(b) the riveted hole is to be filled by the rivet
(c) the stress in the plate is not uniform
(d) the friction between plates is considered
[SSC - JE (Afternoon) 2-3-2017]

1.43 The rivets which are heated and then driven in the field are known_____.
(a) power driven shop rivets
(b) power driven field rivets
(c) hand driven rivets
(d) cold driven rivets
[SSC - JE (Afternoon) 2-3-2017]

1.44 The gross diameter of a rivet is the diameter of_____.
(a) cold rivet before driving
(b) rivet after driving
(c) rivet hole
(d) None of these
[SSC - JE (Afternoon) 2-3-2017]

1.45 Working shear stress on the gross area of a rivet as recommended by Indian Standards is_____.
(a) 785 kg/cm^2 (b) 1025 kg/cm^2
(c) 2360 kg/cm^2 (d) None of the these
[SSC - JE (Afternoon) 2-3-2017]

1.46 The transverse fillet welds are designed for
(a) Tensile strength
(b) Shear strength
(c) Compressive strength
(d) Bending strength
[SSC-JE (Forenoon) 3-3-2017]

1.47 Which of the following assumptions are made in the design of rivet joints?
A. Rivets are stressed equally
B. Stress in plate is maximum at mid-width
C. Rivet hole is completely filled by rivet
D. Friction between plates is neglected
(a) only A (b) A and C only
(c) B and D only (d) A, C and D only
[SSC - JE (Afternoon) 3-3-2017]

1.48 The strength of fillet weld is
(a) About 80 to 95 percent of the main member
(b) Equal to that of the main member
(c) More than that of the main member
(d) Equal to or more than that of main member
[SSC - JE (Afternoon) 3-3-2017]

1.49 Which one of the following is the mode of failure in a fillet weld material?
(a) Tension (b) Shear
(c) Bearing (d) Crushing
[SSC - JE (Afternoon) 3-3-2017]

1.50 When the effect of wind or earthquake load is taken into account, the permissible stress as specified in rivets may be increased by
(a) 33.33% (b) –50%
(c) 10% (d) 25%
[SSC - JE (Afternoon) 3-3-2017]

1.51 Cold driven rivets range from_____.
(a) 6 to 10 mm in diameter
(b) 10 to 16 mm in diameter
(c) 12 to 22 mm in diameter
(d) 22 to 32 mm in diameter
[SSC - JE (Forenoon) 4-3-2017]

1.52 The distance measured along one rivet line from the center of a rivet to the center of adjoining rivet on an adjacent parallel rivet line is called_____.
(a) pitch of rivet
(b) gauge distance of rivet
(c) staggered pitch
(d) All options are correct
[SSC - JE (Forenoon) 4-3-2017]

1.53 When two plates are placed end to end and are joined by two cover plates, the joint is known as_____.
(a) lap joint
(b) butt joint
(c) chain riveted lap joint
(d) double cover butt joint
[SSC - JE (Forenoon) 4-3-2017]

1.54 Diameter of a rivet hole is made larger than the diameter of the rivet by
(a) 1.0 mm for rivet diameter upto 12 mm
(b) 1.5 mm for rivet diameter exceeding 25 mm
(c) 2.0 mm for rivet diameter over 25 mm
(d) None of these
[SSC - JE (Afternoon) 4-3-2017]

1.55 An imaginary line along which rivets are placed is known as
(a) rivet line (b) scrieve line
(c) back line (d) all options are correct
[SSC - JE (Afternoon) 4-3-2017]

1.56 The main type of butt joints is a double cover
(a) shear riveted joint
(b) chain riveted joint
(c) zigzag riveted joint
(d) all options are correct
[SSC - JE (Afternoon) 4-3-2017]

1.57 Number of rivets required in a joint is
(a) load/shear strength of a rivet
(b) load/bearing strength of a rivet
(c) load/tearing strength of a rivet
(d) None of these
[SSC-JE : (Evening) 22.01.2018]

1.58 A riveted joint may experience
(a) shear failure
(b) shear failure of plates
(c) bearing failure
(d) All option are correct
[SSC-JE : (Morning) 23.1.2018]

1.59 If p and d are pitch and gross diameter of rivets, the efficiency (η) of the riveted joint is given by
(a) $\eta = p/(p - d)$ (b) $\eta = p/(p + d)$
(c) $\eta = (p - d)/p$ (d) $\eta = (p + d)/p$
[SSC-JE : (Morning) 23.1.2018]

1.60 Design of a riveted joint, is based on the assumption.
(a) Load is uniformly distributed among all the rivets
(b) Shear stress on a rivet is uniformly distributed over its gross area
(c) Bearing stress is uniform between the contact surfaces of the plate and the rivet
(d) All option are correct
[SSC-JE : (Evening) 23.1.2018]

1.61 In a tension member if one or more than one rivet holes are off the line, the failure of the member depends upon
(a) pitch
(b) gauge
(c) diameter of the rivet holes
(d) All of these
[SSC-JE : (Forenoon) 24.01.2018]

1.62 According to the Unwin's formula, if t is the thickness of the plate in mm, the nominal diameter of the rivet is
(a) $d = 1.91t$ (b) $d = 1.91t^2$
(c) $d = 1.91\sqrt{t}$ (d) None of these
[SSC-JE : (Afternoon) 24.01.2018]

1.63 A riveted joint may experience
(a) tearing failure of plates
(b) bearing failure of plates
(c) splitting failure of plates at the edges
(d) All option are correct
[SSC-JE : (Morning) 25.01.2018]

1.64 Pick up the correct statement from the following
(a) Tacking rivets are used if the minimum distance between centers of two adjacent rivets exceeds 12 t or 200 mm, whichever is less
(b) Tacking rivets are not considered to calculate stress
(c) Tacking rivets are provided throughout the length of a compression member composed of two components back to back
(d) All option are correct
[SSC-JE : (Morning) 25.01.2018]

1.65 IS : 800 - 1971 recommends that in a splice plate the number of rivets carrying calculated shear stress through a packing greater than 6 mm thick, is to be increased by 2.5% for every
(a) 1.00 mm thickness of packing
(b) 1.50 mm thickness of packing
(c) 2.0 mm thickness of packing
(d) None of these
[SSC-JE : (Morning) 25.01.2018]

1.66 The strength of a riveted lap joint is equal to its
A. Shearing strength B. Bearing strength
C. Tearing strength
(a) Only A (b) Only B
(c) Only C (d) Least of A, B and C
[SSC-JE : (Morning) 27.01.2018]

1.67 When plates are exposed to weather, tacking rivets are provided at a pitch in line not exceeding
(a) $8t$ (b) $16t$
(c) $24t$ (d) $32t$
[SSC-JE : (Morning) 27.01.2018]

1.68 Pick up the correct statement from the following:
(a) When the gauge distance is larger than the pitch, the failure of the section may occur in a zig-zag line
(b) When the gauge distance is smaller than the pitch, the failure of the section many occur in a straight right angle section through the centre of rivet holes
(c) When the gauge distance and pitch are both equal, the failure to the section becomes more likely as the diameter of the hole increases
(d) All option are correct
[SSC-JE : (Evening) 27.01.2018]

1.69 Efficiency of a riveted joint us defined as the ratio of
(a) least strength of a riveted joint to the strength of solid plate
(b) greatest strength of a riveted joint to the strength of solid plate
(c) least strength of a riveted plate to the greatest strength of the riveted joint
(d) All option are correct

[SSC-JE : (Evening) 29.01.2018]

2. Tension, Compression and Flexural Member

2.1 In a steel beam section, the web carries
(a) the compression (b) the tension
(c) the moment (d) the shear

[SSC-JE : 2007]

2.2 An electric pole is 5 m high and it is fixed to the ground. It carries a wire at the top and is free to move sideways over there. The effective length of the pole is
(a) 3.25 m (b) 4.0 m
(c) 5.0 m (d) 10.0 m

[SSC-JE : 2007]

2.3 Net sectional area of a tension member is equal to its gross section-area
(a) plus the area of the rivet holes
(b) divided by the area of the rivet holes
(c) multiplied by the area of the rivet holes
(d) minus the area of the rivet holes

[SSC-JE : 2008]

2.4 A tension member, if subjected to possible reversal of stresses due to wind; the slenderness ratio of the member should not exceed
(a) 180 (b) 200
(c) 250 (d) 350

[SSC-JE : 2008]

2.5 Minimum thickness of main steel members, not exposed to weather, is :
(a) 4.5 mm (b) 6.0 mm
(c) 8.0 mm (d) 8.5 mm

[SSC-JE : 2010]

2.6 Euler's formula is valid for :
(a) short columns only
(b) Jong columns only
(c) both short and long columns
(d) none of the above

[SSC-JE : 2010]

2.7 Maximum value of slenderness ratio of lacing flats in a steel column is :
(a) 120 (b) 145
(c) 180 (d) 320

[SSC-JE : 2010]

2.8 The maximum allowable slenderness ratio for axially loaded member carrying tension only is
(a) 180 (b) 250
(c) 350 (d) 400

[SSC : JE : 2011]

2.9 A strut is a
(a) tension member (b) compression member
(c) flexural member (d) torsion member

[SSC : JE : 2011]

2.10 The effective slenderness ratio of laced column, compared to actual maximum slenderness ratio shall be considered as
(a) 1.05 times (b) 1.10 times
(c) 1.15 times (d) 1.20 times

[SSC : JE : 2011]

2.11 The lacing bars in steel columns should be designed to resist
(a) 0.5% of column load
(b) 1.5% of column load
(c) 2.5% of column load
(d) 3.5% of column load

[SSC : JE : 2011]

2.12 The slenderness ratio $\frac{l}{r}$ of a lacing bar should be less than
(a) 250 (b) 350
(c) 145 (d) 180

[SSC - JE : 2012]

2.13 The effective length of a steel column, effectively held in position and restrained against rotation at both ends is
(a) 0.80 L (b) 1.0 L
(c) 0.5 L (d) 0.65 L

[SSC - JE : 2012]

2.14 Which one of the following factors does not affect the lateral buckling strength of a steel I-section undergoing bending about its major axis?
(a) Laterally unsupported length of the compression flange.
(b) Radius of gyration about the major axis of the section.
(c) Boundary conditions at the ends.
(d) Radius of gyration about the minor axis of the section.
[SSC - JE : 2012]

2.15 For simply supported beams, the allowable deflection shall **not** exceed
(a) 1/325 of span (b) 1/350 of span
(c) 1/375 of span (d) 1/400 of span
[SSC : JE : 2013]

2.16 A tie is a
(a) tension member
(b) compression member
(c) flexural member
(d) torsion member
[SSC - JE (Forenoon) : 2014]

2.17 The slenderness ratio of lacing bars should not exceed
(a) 120 (b) 145
(c) 180 (d) 100
[SSC - JE (Forenoon) : 2014]

2.18 The maximum allowable slenderness ratio for members carrying compressive load due to wind and seismic force only is
(a) 180 (b) 250
(c) 350 (d) 400
[SSC - JE (Forenoon) : 2014]

2.19 Compression members always tend to buckle in the direction of the:
(a) Least radius of gyration
(b) Axis of load
(c) Perpendicular to the axis of load
(d) Minimum cross-section
[SSC - JE (Afternoon) : 2014]

2.20 The width of lacing bars in mm is kept
(a) twice the nominal rivet diameter
(b) thrice the nominal rivet diameter
(c) maximum of the all rounded to nearest 5 mm
(d) equal to normal rivet diameter
[SSC-JE : 2015]

2.21 Web crippling in beams generally occurs at the points where
(a) concentrated loads act
(b) bending moment is maximum
(c) shear force is maximum
(d) deflection is maximum
[SSC-JE : 2015]

2.22 A column splice is used to increase
(a) the strength of the column
(b) the rigidity of the column
(c) the cross-sectional area of the column
(d) the length of the column
[SSC-JE : 2015]

2.23 If a rolled steel flat designated as 55 ISF 12 mm is used as lacing, then minimum radius of gyration will be_____.
(a) 3 mm (b) 6 mm
(c) 3.46 mm (d) 3.8 mm
[SSC - JE (Afternoon) 1-3-2017]

2.24 Angle of inclination of the lacing bar with the longitudinal axis of the column should preferably be between_____.
(a) 10° to 30° (b) 30° to 80°
(c) 40° to 70° (d) 20° to 70°
[SSC - JE (Afternoon) 1-3-2017]

2.25 The effective length of battened column is increased by_____.
(a) 10% (b) 7%
(c) 12% (d) 25%
[SSC - JE (Afternoon) 1-3-2017]

2.26 The buckling load in a steel column is_____.
(a) Related to length
(b) Directly proportional to the slenderness ratio
(c) Inversely proportional to the slenderness ratio
(d) Non linearity of the slenderness ratio
[SSC - JE (Afternoon) 1-3-2017]

2.27 For unstiffened flange of a beam in flexural compression, the maximum allowable outstand is equal to_____.
(a) $20t$ (b) $16t$
(c) $32t$ (d) $14t$
[SSC - JE (Afternoon) 1-3-2017]

2.28 The problem of lateral buckling can arise only in those steel beams which have_____.
(a) moment of inertia about the bending axis larger than the other
(b) moment of inertia about the bending axis smaller than the other
(c) fully supported compression flange
(d) None of these
[SSC - JE (Afternoon) 1-3-2017]

2.29 The working stress (in N/mm^2) for structural steel in tension is the order of
(a) 15 (b) 75
(c) 150 (d) 750
[SSC - JE (Forenoon) : 2-3-2017]

2.30 Rolled steel T-sections are used_____.
(a) as columns
(b) with flat strips to connect plates in steel rectangular tanks.
(c) as built up sections to resist axial tension.
(d) None of these.
[SSC - JE (Afternoon) 2-3-2017]

2.31 Lug angles_____.
(a) are used to reduce the length of connection
(b) are unequal angles
(c) increases shear legs
(d) All options are correct
[SSC - JE (Afternoon) 3-3-2017]

2.32 Rolled steel angle sections are classified as_____.
(a) equal angles
(b) unequal angles
(c) bulb angles
(d) All options are correct
[SSC - JE (Forenoon) 4-3-2017]

2.33 Rolled steel beams are_____.
(a) mainly used to resist bending stress
(b) used as independent sections to resist compressive stress
(c) used as independent sections to resist tensile stress
(d) All options are correct
[SSC - JE (Forenoon) 4-3-2017]

2.34 Which of the following material is not used in making trusses?
(a) Wooden struts (b) Metal bars
(c) Channel (d) Concrete
[SSC-JE : (Morning) 22.01.2018]

2.35 In a truss it is assumed that the members are joined by___.
(a) Rough pins
(b) Smooth pins
(c) Either rough or smooth pins
(d) None of these
[SSC-JE : (Morning) 22.01.2018]

2.36 What is the major difference between truss and beam?
(a) Beam can't transmit load in vertical direction while truss can
(b) Truss can't transmit load in vertical direction while beam can
(c) Beam can't transmit load in axial direction while truss can
(d) Truss can't transmit load in axial direction while beam can
[SSC-JE : (Morning) 22.01.2018]

2.37 Net sectional area of a tension member, is equal to its cross section area____.
(a) plus the area of the rivet holes
(b) divided by the area of rivet holes
(c) multiplied by the area of the rivet holes
(d) minus the area of the rivet holes.
[SSC-JE : (Morning) 22.01.2018]

2.38 When a tension member consists to two channel sections, the allowance for rivet hole is made for two holes from
(a) each web
(b) each flange
(c) each web or one hole from each flange whichever is more
(d) each web or one hole from each flange whichever is less
[SSC-JE : (Morning) 22.01.2018]

2.39 Effective length of a column effectively held in position and restrained in direction at one end but neither held in position nor restrained in direction at the other end is
(a) L (b) 0.67 L
(c) 0.85 L (d) 2 L
[SSC-JE : (Evening) 22.01.2018]

2.40 A compression member consisting of angle sections may be a
(a) continuous member
(b) discontinuous single angle strut
(c) discontinuous double angle strut
(d) All option are correct
[SSC-JE : (Evening) 22.01.2018]

2.41 It the area of cross-section of a single angle discontinuous strut is 30 cm^2 and allowable working stress corresponding to its slenderness ratio is 625 kg/cm^2, the safe load carrying capacity of the member is
(a) 10 tonnes (b) 12 tonnes
(c) 15 tonnes (d) 18 tonnes
[SSC-JE : (Evening) 22.01.2018]

2.42 If the depth of two column section are equal, then the column splice is provided
(a) with filler plates
(b) with bearing plates
(c) with filler and bearing plates
(d) None of these
[SSC-JE : (Evening) 22.01.2018]

2.43 When a tension member is made of four angles with a plate as web, the allowance for holes is made as
(a) two holes for each angle and one hole for the web
(b) one hole for each angle and one hole for the web
(c) one hole for each angle and two holes for the web
(d) None of these
[SSC-JE : (Evening) 22.01.2018]

2.44 For a cantilever beam of length *L* continuous at the support and unrestrained against torsion at the support and free at the end, the effective length '*l*' is equal to
(a) $l = L$ (b) $l = 2$ L
(c) $l = 0.5$ L (d) $l = 3$ L
[SSC-JE : (Evening) 22.01.2018]

2.45 Spans of continuous fillers are considered approximately equal if the longest span does not exceed the shortest span by more than
(a) 0.05 (b) 0.1
(c) 0.15 (d) 0.2
[SSC-JE : (Evening) 22.01.2018]

2.46 Allowable working stress corresponding to the slenderness ratio of double angles placed back to back and connected to one side of a gusset plate is reduced to
(a) 50% (b) 60%
(c) 70% (d) 80%
[SSC-JE : (Morning) 23.1.2018]

2.47 According to I.S. : 800 - 1871, lacing bars resist transverse shear equal to ____.
(a) 1.0 % of the axial load
(b) 2.0 % of the axial load
(c) 2.5 % of the axial load
(d) 3.0 % of the axial load
[SSC-JE : (Morning) 23.1.2018]

2.48 Effective length of a column effectively held in position and restrained in directions at both ends is
(a) L (b) 0.67 L
(c) 0.85 L (d) 1.5 L
[SSC-JE : (Evening) 23.1.2018]

2.49 The slenderness ratio of a column is zero when its length
(a) is zero
(b) is equal to its radius of gyration
(c) is supported on all sides throughout its length
(d) None of these
[SSC-JE : (Evening) 23.1.2018]

2.50 Outstanding length of a compression member consisting of a channel is measured as
(a) half of the nominal width
(b) nominal width of the section
(c) from the edge to the first row of rivets
(d) None of these
[SSC-JE : (Evening) 23.1.2018]

2.51 The gross section of the web of a beam is defined as
(a) depth of the beam multiplied by its web thickness
(b) width of the flange multiplied by its web thickness
(c) sum of the flange width and depth of the beam multiplied by the web thickness
(d) None of these
[SSC-JE : (Evening) 23.1.2018]

2.52 The connection of one beam to another beam by means of an angle at the bottom and an angle at the top, is known as
(a) unstiffened seated connection
(b) stiffened seated connection
(c) seated connection
(d) None of these

[SSC-JE : (Evening) 23.1.2018]

2.53 For double, angles carrying tension, placed back to back and connected to either side of the gusset plate, the sectional area of the section, is equal to the cross sectional area of
(a) the section
(b) the section plus area of rivet holes
(c) the section minus area of rivet holes
(d) the section multiplied by the area of the rivet hole

[SSC-JE : (Forenoon) 24.01.2018]

2.54 Effective length of a column effectively held in position at both ends and restrained in direction at one end is
(a) L (b) 0.67 L
(c) 0.85 L (d) 1.5 L

[SSC-JE : (Afternoon) 24.01.2018]

2.55 If the unsupported length of a stanchion is 4 meters and least radius of gyration of its cross section is 5, the slenderness ratio of the stanchion is
(a) 60 (b) 70
(c) 80 (d) 90

[SSC-JE : (Afternoon) 24.01.2018]

2.56 A column splice is used to increase _____.
(a) length of the column
(b) strength of the column
(c) cross-sectional area of the column
(d) None of these

[SSC-JE : (Afternoon) 24.01.2018]

2.57 A structural member subjected to tensile force in a direction parallel to its longitudinal axis, is generally known as
(a) a tie
(b) a tie member
(c) a tension member
(d) All option are correct

[SSC-JE : (Afternoon) 24.01.2018]

2.58 A major beam in a building structure is known as
(a) a girder (b) a floor beam
(c) a main beam (d) All option are correct

[SSC-JE : (Afternoon) 24.01.2018]

2.59 Pick up the correct statement from the following:
(a) The steel beams placed in plain cement concrete are known as reinforced beams
(b) The filler joists are generally continuous over three supports only
(c) Continuous fillers are connected to main beams by means of cleat angles
(d) Continuous fillers are supported by main steel beams

[SSC-JE : (Afternoon) 24.01.2018]

2.60 The ratio of the length of the column to the minimum radius of gyration of the cross sectional area of the column is known as
(a) slenderness ratio (b) buckling ratio
(c) crippling ratio (d) compressive ratio

[SSC-JE : (Morning) 25.01.2018]

2.61 In a built-up section carrying tensile force, the flanges of two channels are turned outward
(a) to simplify the transverse connections
(b) to minimize lacing
(c) to have greater lateral rigidity
(d) All option are correct

[SSC-JE : (Morning) 25.01.2018]

2.62 A tension member, if subjected to possible reversal of stress due to wind, the slenderness ratio of the member should not exceed
(a) 180 (b) 200
(c) 250 (d) 350

[SSC-JE : (Morning) 25.01.2018]

2.63 The maximum axial load which is just sufficient to keep a column in a small deflected shape is called
(a) crippling load (b) buckling load
(c) critical load (d) all option are correct

[SSC-JE : (Morning) 25.01.2018]

2.64 Slenderness ratio of a compression member is
(a) Moment of inertia/radius of gyration
(b) Effective length/area of cross-section
(c) Radius of gyration/effective length
(d) None of these

[SSC-JE : (Morning) 25.01.2018]

2.65 The thickness '*t*' of a single flat lacing should not be less than
(a) 1/30th length between inner end rivets
(b) 1/40th length between inner end rivets
(c) 1/50th length between inner end rivets
(d) 1/60th length between inner end rivets
[SSC-JE : (Morning) 25.01.2018]

2.66 To keep the intensity of bearing pressure between the column base and concrete compressive and to vary from zero to 2P/BL, the ratio of the moment M to the axial load P should be
(a) $\frac{L}{2}$ (b) $\frac{L}{3}$
(c) $\frac{L}{4}$ (d) $\frac{L}{6}$
[SSC-JE : (Morning) 25.01.2018]

2.67 To the calculated area of cover plates of a built-up beam, an allowance for rivet holes to be added is
(a) 0.1 (b) 0.13
(c) 0.15 (d) 0.18
[SSC-JE : (Morning) 25.01.2018]

2.68 Maximum permissible slenderness ratio of compressive members which carry dead and superimposed load is
(a) 350 (b) 250
(c) 180 (d) 80
[SSC-JE : (Morning) 27.01.2018]

2.69 In double lacing, the thickness '*t*' of flat lacing is
(a) *t* is less than 1/40th length between inner end rivets
(b) *t* is less than 1/50th length between inner end rivets
(c) *t* is less than 1/60th length between inner end rivets
(d) *t* is less than 1/70th length between inner end rivets
[SSC-JE : (Morning) 27.01.2018]

2.70 The rolled steel I-sections are most commonly used as beams because these provide :
1. large moment of inertia with less cross-sectional area
2. greater lateral stability
(a) Only 1 (b) Only 2
(c) 1 and 2 (d) None of these
[SSC-JE : (Morning) 27.01.2018]

2.71 For simply supported beams, the maximum permitted deflection is
(a) 1/250 of the span (b) 1/300 of the span
(c) 1/350 of the span (d) None of these
[SSC-JE : (Morning) 27.01.2018]

2.72 A single angle in tension is connected by one leg only. If the areas of connecting and outstanding legs are respectively a and b, then what is the net effective area of the angle?
(a) $a-\frac{b}{1+0.35\frac{b}{a}}$ (b) $a+\frac{b}{1+0.35\frac{b}{a}}$
(c) $a-\frac{b}{1+0.2\frac{b}{a}}$ (d) $a+\frac{b}{1+0.2\frac{b}{a}}$
[SSC-JE : (Evening) 27.01.2018]

2.73 The net area of round bars to resist the tension, is the area of cross section at
(a) mid-section
(b) root of the thread
(c) difference of midsection and root of the thread
(d) None of these
[SSC-JE : (Evening) 27.01.2018]

2.74 When the length of a tension member is too long
(a) A wire rope is used
(b) A rod is used
(c) A bar is used
(d) A single angle is used
[SSC-JE : (Morning) 29.01.2018]

2.75 The allowable stress in axial tension is generally kept less if thickness of the member is more than
(a) 10 mm (b) 12 mm
(c) 15 mm (d) 20 mm
[SSC-JE : (Morning) 29.01.2018]

2.76 When a large value of radius of gyration is not required
(a) Channels are placed back to back
(b) Channel flanges are kept inward
(c) Channel flanges are kept outward
(d) None of these
[SSC-JE : (Evening) 29.01.2018]

2.77 Perforated cover plates are particularly suitable for built up sections consisting of
(a) channels placed back to back
(b) channels placed toe to toe
(c) four angle box section
(d) all option are correct
[SSC-JE : (Evening) 29.01.2018]

2.78 Lug angle is
(a) used with single angle member
(b) not used with double angle member
(c) used with channel member
(d) All option are correct
[SSC-JE : (Evening) 29.01.2018]

3. Plate Girders and Industrial Roofs

3.1 A plate used for connecting two or more structural members intersection each other is called
(a) Template (b) Base plate
(c) Gusset plate (d) Anchor plate
[SSC-JE : 2007]

3.2 A web plate is called unstiffened if the ratio of clear depth and thickness is less than
(a) 35 (b) 50
(c) 60 (d) 85
[SSC-JE : 2008]

3.3 The heaviest I-section for the same depth is
(a) ISLB (b) ISMB
(c) ISHB (d) ISWB
[SSC-JE : 2009]

3.4 The economical spacing of trusses varies from
(a) *L*/3 to *L*/4 (b) *L*/4 to *L*/5
(c) *L*/4 to *L*/6 (d) None of the above
[SSC-JE : 2009]

3.5 Normally, the angle of roof truss with asbestos sheets should not be less than
(a) 26° (b) 30°
(c) 40° (d) None of the above
[SSC-JE : 2009]

3.6 A column splice is used to increase
(a) length of the column
(b) strength of the column
(c) cross-sectional- area of the column
(d) None of the above
[SSC-JE : 2009]

3.7 The member of roof truss which supports the purlins is called as
(a) Sag rod (b) Main strut
(c) Principal rafter (d) Principal tie
[SSC - JE : 2012]

3.8 Bearing stiffeners are designed as
(a) beams (b) beam-ties
(c) ties (d) column
[SSC - JE (Forenoon) : 2014]

3.9 Horizontal stiffeners are needed in plate girders if the thickness of web is less than
(a) 6 mm (b) Depth/200
(c) Span/500 (d) Flange thickness
[SSC - JE (Forenoon) : 2014]

3.10 In single laced column construction, the thickness of the flat lacing bars shall not be less than :
(a) $\frac{1}{15}$ th of the width of the lacing bar.
(b) $\frac{1}{30}$th of the effective length of single lacing.
(c) $\frac{1}{40}$th of the effective length of single lacing.
(d) $\frac{1}{10}$th of the width of the lacing bar.
[SSC - JE (Afternoon) : 2014]

3.11 The purpose of stiffeners in a plate girder is to:
(a) prevent buckling of web plate.
(b) reduce the shear stress.
(c) take care of bearing stress.
(d) increase the moment carrying capacity of the girder.
[SSC - JE (Afternoon) : 2014]

3.12 The sag tie in a truss is mainly used to reduce
(a) moment and deflection
(b) tension
(c) weight of the truss
(d) compression
[SSC-JE : 2015]

3.13 An angle section can be used as purlin when slope of the roof truss is_____.
(a) Between 40° and 70°
(b) Less than 30°
(c) Greater than 30°
(d) Less than 45°
[SSC - JE (Afternoon) 1-3-2017]

3.14 In a truss girder of a bridge, a diagonal consists of mild steel flat 400 ISF and carries a pull of 800 kN. If the gross diameter of the rivets is 26 mm, then the number of rivets required in the splice is
(a) 6 (b) 7
(c) 8 (d) 9
[SSC - JE (Afternoon) 1-3-2017]

3.15 Which of the following elements of a pitched roof industrial steel building primarily resists lateral load parallel to the ridge?
(a) bracings (b) purlins
(c) truss (d) columns
[SSC - JE (Afternoon) 3-3-2017]

3.16 How does an increase in the pitch of the roof affects the amount of load that can be placed on it ?
(a) It increases
(b) It decreases
(c) Remains constant
(d) Depends upon case
[SSC-JE : (Morning) 22.01.2018]

3.17 The flange splice in plate girder is subjected to
(a) axial force only
(b) shear and axial force
(c) bending moment and axial force
(d) shear force and bending moment
[SSC-JE : (Evening) 22.01.2018]

3.18 In factory buildings, the horizontal beams spanning between the wall columns supporting a wall covering are called
(a) stringers
(b) trimmers
(c) girts
(d) lintels
[SSC-JE : (Morning) 23.1.2018]

3.19 The average shear stress (in kg/ cm^2) for rolled beam section, is
(a) 845 (b) 945
(c) 1025 (d) 1500
[SSC-JE : (Morning) 23.1.2018]

3.20 The space between adjacent bents in a roof truss is called:
(a) Purlins (b) Bay
(c) Knee (d) Braces
[SSC-JE : (Forenoon) 24.01.2018]

3.21 In rolled steel beams, shear force is mostly resisted by
(a) web only
(b) flanges only
(c) web and flanges together
(d) None of these
[SSC-JE : (Afternoon) 24.01.2018]

3.22 In a truss girder of a bridge, a diagonal consists of mild steel flat 400 I.S.F. and carries a pull of 80 tones. If the gross diameter of the rivet is 26 mm, the number of rivets required in the splice is
(a) 6 (b) 7
(c) 8 (d) 9
[SSC-JE : (Morning) 27.01.2018]

3.23 Rise of a jack arch is kept about
(a) $\frac{1}{2}$ to $\frac{1}{3}$ of the span
(b) $\frac{1}{3}$ to $\frac{1}{4}$ of the span
(c) $\frac{1}{4}$ to $\frac{1}{8}$ of the span
(d) $\frac{1}{8}$ to $\frac{1}{12}$ of the span
[SSC-JE : (Evening) 29.01.2018]

3.24 In a grillage footing, the maximum shear force occurs at the
(a) Edge of grillage beam
(b) Center of base plate
(c) Center of grillage beam
(d) None of these
[SSC-JE : (Evening) 29.01.2018]

4. Miscellaneous

4.1 The moment of inertia of a rectangle of width d and depth b about its horizontal axis at mid-depth is

(a) $\frac{db^3}{12}$ (b) $\frac{bd^3}{12}$

(c) $\frac{bd^3}{3}$ (d) $\frac{db^3}{3}$

[SSC-JE : 2007]

4.2 According to I.S. : 800-1962 the permissible bending stress in steel slab plates is

(a) 1500 kg/cm^2 (b) 1420 kg/cm^2

(c) 2125 kg/cm^2 (d) 1890 kg/cm^2

[SSC-JE : 2008]

4.3 The method of design of steel formwork for greatest rigidity and economy in weight is known as

(a) simple design (b) semi-rigid design

(c) fully rigid design (d) None of these

[SSC-JE : 2008]

4.4 Section modulus for a rectangular section is given as :

(a) $bd^2/36$ (b) $bd^3/6$

(c) $bd^2/6$ (d) $bd^3/12$

[SSC-JE : 2010]

4.5 Shape factor for a circular section is equal to :

(a) 1.00 (b) 1.50

(c) 2.34 (d) 1.70

[SSC-JE : 2010]

4.6 Standard loads are given in :

(a) IS 885 (b) IS 1375

(c) IS 675 (d) IS 875

[SSC-JE : 2010]

4.7 The beams supporting the stair steps are generally known as

(a) headers (b) trimmers

(c) stringers (d) spandrel beam

[SSC : JE : 2013]

4.8 As per IS : 800, the factor of safety adopted with respect to the yield stress of steel is

(a) 1.45 (b) 1.5

(c) 1.67 (d) 2.0

[SSC - JE (Forenoon) : 2014]

4.9 Permissible stress may also be known as

(a) ultimate stress (b) working stress

(c) limit stress (d) yield stress

[SSC - JE (Forenoon) : 2014]

4.10 The load factor applied to wind and seismic loads in design of steel structures is

(a) 2.2 (b) 1.3

(c) 1.5 (d) 1.8

[SSC - JE (Afternoon) : 2014]

4.11 The steel beam of light section placed in plain cement concrete are called

(a) filler joists

(b) concrete joists

(c) simple joists

(d) joists

[SSC-JE : 2015]

4.12 If the depth of the section of an upper column is much smaller than the lower column

(a) bearing plates are provided with column splice

(b) filler and bearing plates are provided with column splice

(c) filler plates are provided with column splice

(d) neither filler nor bearing plates are provided with column splice

[SSC-JE : 2015]

4.13 The minimum thickness of the plates used in prestressed steel tanks is

(a) 4 mm (b) 5 mm

(c) 6 mm (d) 3 mm

[SSC-JE : 2015]

4.14 Consider the following factors

A. Large number of loading cycles

B. Large variations in stress

C. Large stress concentrations

Those associated with fatigue failure would include_____.

(a) A and B (b) A and C

(c) B and C (d) A, B and C

[SSC - JE (Afternoon) 1-3-2017]

4.15 As per IS specifications, which of the following physical properties of structural steel is taken irrespective of its grade?
(a) Unit mass of steel
(b) Modulus of elasticity
(c) Poisson's ratio
(d) All options are correct
[SSC - JE (Afternoon) 3-3-2017]

4.16 The main advantage of a steel member is_____.
(a) its high strength
(b) its gas and water tightness
(c) its long service life
(d) All options are correct
[SSC - JE (Forenoon) 4-3-2017]

4.17 As per ISI, rolled steel beam sections are classified into
(a) two series (b) three series
(c) four series (d) five series
[SSC - JE (Afternoon) 4-3-2017]

4.18 The channels get twisted symmetrically with regard to its axis
(a) parallel to flanges
(b) parallel to web
(c) perpendicular to flanges
(d) perpendicular to web
[SSC - JE (Afternoon) 4-3-2017]

4.19 Bulb angles are used in
(a) column building (b) bridge building
(c) ship building (d) water tank building
[SSC - JE (Afternoon) 4-3-2017]

4.20 What will be the rain load (in psf) if d_s is 2 inch and d_h is 1 inch?
(a) 5.2 (b) 10.4
(c) 15.6 (d) 20.8
[SSC-JE : (Morning) 22.01.2018]

4.21 If in planar system, *X* parts/ members are there with Y no. offers, then condition for statically determinate is :-
(a) Y < 3X (b) Y > 3X
(c) Y = 3X (d) None of these
[SSC-JE : (Morning) 22.01.2018]

4.22 If a system has more equations of equilibrium than no. of forces, then the system is : -
(a) Improperly constrained
(b) Partially constrained
(c) Stable
(d) None of these
[SSC-JE : (Morning) 22.01.2018]

4.23 Given that J is no. of joints. B and R are no. of members and no. of reactions.
If B= 4, R= 3 and J = 4, then the truss is :-
(a) Statically determinate
(b) Statically indeterminate and stable
(c) Stable
(d) Unstable
[SSC-JE : (Morning) 22.01.2018]

4.24 The beam outside a wall up to floor level above it, is known as
(a) rafter (b) lintel
(c) spandrel beam (d) None of these
[SSC-JE : (Evening) 22.01.2018]

4.25 Web crippling generally occurs at the point where
(a) bending moment is maximum
(b) shearing force is minimum
(c) concentrated loads act
(d) deflection is maximum
[SSC-JE : (Morning) 23.1.2018]

4.26 In case of a simply supported rectangular - section beam of span L and loaded with a central load W, the length of elasto-plastic zone of the plastic hinge is
(a) L/2 (b) L/3
(c) L/4 (d) L/5
[SSC-JE : (Evening) 23.1.2018]

4.27 In case of a simply supported rectangular beam of span *L* and loaded with a central load *W*, the length of elasto-plastic zone of the plastic hinge is

(a) $\frac{L}{2}$ (b) $\frac{L}{3}$

(c) $\frac{L}{2}$ (d) $\frac{L}{5}$

[SSC-JE : (Afternoon) 24.01.2018]

4.28 The moment of the couple set up in a section of a beam by the longitudinal compressive and tensile force is known as
(a) bending moment
(b) moment of resistance
(c) flexural stress moment
(d) None of these
[SSC-JE : (Morning) 25.01.2018]

4.29 In plastic analysis, the shape factor for a rectangular section is
(a) 1.4 (b) 1.5
(c) 1.6 (d) 1.7
[SSC-JE : (Morning) 25.01.2018]

4.30 If Q is load factor, S is shape factor and F is factor of safety in elastic design, the following
(a) $Q = S + F$
(b) $Q = S - F$
(c) $Q = F - S$
(d) $Q = S \times F$
[SSC-JE : (Evening) 29.01.2018]

■■■■

Answers Steel Design

1. Structural Fasteners

1.1	(d)	1.2	(d)	1.3	(a)	1.4	(c)	1.5	(b)	1.6	(a)	1.7	(c)	1.8	(b)	1.9	(a)
1.10	(b)	1.11	(b)	1.12	(b)	1.13	(b)	1.14	(c)	1.15	(c)	1.16	(c)	1.17	(d)	1.18	(b)
1.19	(d)	1.20	(d)	1.21	(b)	1.22	(b)	1.23	(a)	1.24	(a)	1.25	(d)	1.26	(a)	1.27	(c)
1.28	(b)	1.29	(b)	1.30	(d)	1.31	(b)	1.32	(a)	1.33	(c)	1.34	(a)	1.35	(b)	1.36	(b)
1.37	(c)	1.38	(a)	1.39	(c)	1.40	(c)	1.41	(b)	1.42	(b)	1.43	(b)	1.44	(c)	1.45	(b)
1.46	(b)	1.47	(d)	1.48	(a)	1.49	(b)	1.50	(d)	1.51	(c)	1.52	(c)	1.53	(d)	1.54	(c)
1.55	(d)	1.56	(d)	1.57	(d)	1.58	(d)	1.59	(c)	1.60	(d)	1.61	(d)	1.62	(c)	1.63	(d)
1.64	(d)	1.65	(c)	1.66	(d)	1.67	(b)	1.68	(d)	1.69	(a)						

2. Tension, Compression and Flexural Member

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

3. Plate Girders and Industrial Roofs

3.1	(c)	3.2	(a)	3.3	(c)	3.4	(b)	3.5	(b)	3.6	(a)	3.7	(c)	3.8	(d)	3.9	(b)
3.10	(c)	3.11	(a)	3.12	(a)	3.13	(b)	3.14	(d)	3.15	(a)	3.16	(b)	3.17	(a)	3.18	(c)
3.19	(b)	3.20	(b)	3.21	(a)	3.22	(c)	3.23	(d)	3.24	(b)						

4. Miscellaneous

4.1	(a)	4.2	(d)	4.3	(a)	4.4	(c)	4.5	(d)	4.6	(d)	4.7	(c)	4.8	(c)	4.9	(b)
4.10	(c)	4.11	(a)	4.12	(c)	4.13	(c)	4.14	(d)	4.15	(b)	4.16	(d)	4.17	(d)	4.18	(a)
4.19	(c)	4.20	(c)	4.21	(c)	4.22	(b)	4.23	(d)	4.24	(c)	4.25	(c)	4.26	(b)	4.27	(b)
4.28	(b)	4.29	(b)	4.30	(d)												

Explanations Steel Design

1. Structural Fasteners

1.1 (d)

Generally fillet welding is used to connect two plates at a lap joint.

1.2 (d)

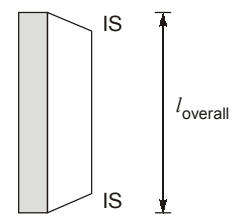
A riveted joint can fail when either the rivets (due to shearing or bearing) or plate (due to tearing) fail.

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

1.4 (c)

As per IS 800:2007, clause 10.5.4.1



$l_{effective} = l_{overall} - 2s$

1.5 (b)

As per IS 800: 1984, Clause 8.9.4.2.

1.6 (a)

As per IS 800: 1984, Clause 8.10.1, the distance between centres of two adjacent rivets, in a line lying in the direction of stress, shall not exceed 16t or 200mm, whichever is less in tension members, where t is the thickness of the thinner member.
Given, thickness (t) = 10mm
therefore, 16t = 160 mm
since 160mm < 200 mm, hence maximum centre to centre distance is 160 mm.

1.7 (c)

Zigzag is pattern of riveting/bolting. Other options are variants of welding.

1.8 (b)

Beam resists the load by virtue of flexure. Although it can take a little axial load, but primarily it is meant for transverse loading.

1.10 (b)

As per IS 800: 2007, Clause 10.2.2.

1.11 (b)

Efficiency per pitch length,

$$\eta = \frac{(P-d)\times t\times \sigma_y}{P\times t\times \sigma_y} = \frac{P-d}{P}$$

(where, t = thickness of plate)

1.12 (b)

As per IS 800: 1984.

1.13 (b)

As per IS 800 : 2007.

1.16 (c)

For nomial diameter > 25 mm

Hole dia, d' = Nomial diameter + 2 mm
= 36 mm + 2 mm
= 38 mm

1.17 (d)

Area for bearing stress is calculated as $A = d \times t$; where 'd' is hole diameter of the rivet and 't' is the thickness of the plate where connection is being made.

1.18 (b)

In the analysis of riveted joints, uniform distribution of stress in plates is considered.

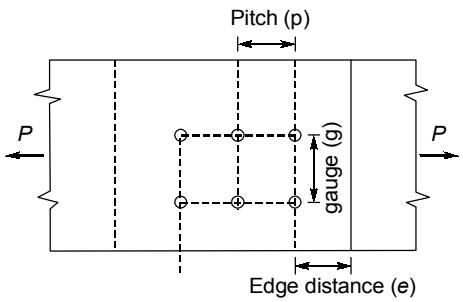
1.21 (b)

When thickness of plate is more than 8 mm, Unwin's formula is used, which gives:

$$d = 6\sqrt{t} \text{ mm}$$

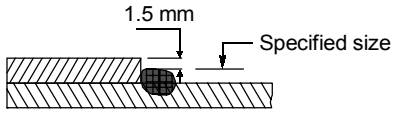
If $t < 8$ mm, d is obtained by equating crushing strength to shear strength of the joint.

1.22 (b)



1.23 (a)

According to clause 10.5.8.1 of IS 800 : 2007 (General construction in steel : Code of practice) where a fillet weld is applied to the square edge of a part, the specified size of the weld should generally be at least 1.5 mm less than the edge thickness in order to avoid washing down of the exposed areas.

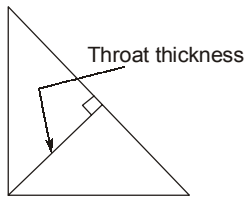


1.24 (a)

The minimum edge and end distances from the centre of any hole to the nearest edge of a plate should not be less than 1.7 times the hole diameter for sheared or hand-flame cut edges, and 1.5 times the hole diameter for rolled, machine-flame cut, sawn and planned edges.

The maximum edge distance from the centre of the hole to the nearest edge should not exceed $12\,t\varepsilon$ where $\varepsilon = \left(\frac{250}{fy}\right)^{1/2}$ and t is the thickness of the thinner outer plate.

1.25 (d)



1.27 (c)

Maximum permissible stress in rivet (clause 4.6 of IS 1367 : 1967)

Type	Axial tension (MPa)	Shear (MPa)	Bearing (MPa)
(i) Power driven			
(a) Shop rivet	100	100	300
(b) Field rivet	90	90	270
(ii) Hand driven	80	80	250

1.29 (b)

Size of the fillet weld is minimum weld leg size.

1.30 (d)

Diameter of rivet hole is made larger than nominal diameter of the rivet by 1.5 mm for rivets less than or equal to 24 mm diameter and by 2 mm for diameter exceeding 2 mm diameter.

1.31 (b)

The partial safety factor for steel is 1.15 and the partial safety factor for material for concrete is 1.5.

1.32 (a)

Bearing stress is a contact pressure between separate bodies. It differs from compressive stress because compressive stress is the internal stress caused by a compressive force.

1.33 (c)

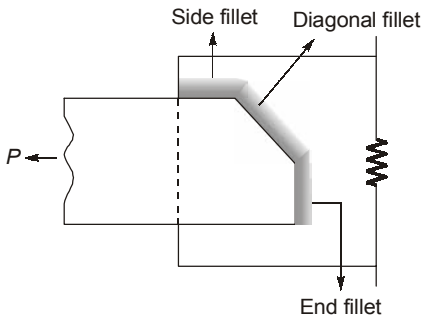
A butt weld is a technique to join two parts which are parallel or basically don't overlap.

1.34 (a)

Side fillet → Weld is placed parallel to the direction of force.

End fillet → Weld is placed perpendicular to the direction of force

Diagonal fillet → Axis of the weld is inclined to the direction of force.



1.35 (b)

As per IS 800: 1984, Clause 8.10.3.1.

1.36 (b)

Unwin's formula,

$$d = 6.05\sqrt{t}$$

Given, $t = 16$ mm

$\therefore$ Dia of rivet, $d = 6.05 \times \sqrt{16}$

$= 24.2 \simeq 24$ mm

1.37 (c)

Fillet weld is recommended only if the angle between fusion faces lie between 60° to 120° .

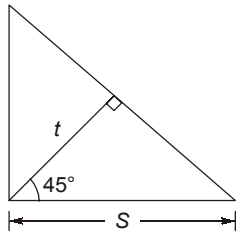
1.38 (a)

For diamond riveting, first line of rivet is critical for main plate which has only one rivet. Hence net area at that section would be $(b\text{-}d) \times t$ and gross area of solid plate would be $b \times t$. Hence the efficiency would be the ratio of net area to solid plate area, permissible stress being same in both the case. Hence efficiency would come out as $(b\text{-}d)/b$.

1.39 (c)

Bolts can resist by shearing, bearing and axial tension. However it is most suited for axial tension because tensile yielding capacity of bolts is greater than that of shear yielding.

1.40 (c)



Here, S = Size of fillet

t = Throat thickness

Now, from the figure above

$$S\cos 45° = t$$

$$\Rightarrow \quad \frac{S}{\sqrt{2}} = t$$

$$\Rightarrow \quad \frac{S}{t} = \frac{\sqrt{2}}{1} = \sqrt{2} : 1$$

1.41 (b)

Pitch is measured along the direction of stress and gauge is measured perpendicular to the direction of stress.

1.42 (b)

Assumptions in riveted connection are:

(i) Rivets fill the hole completely.

(ii) Bending stress in rivets is neglected.

(iii) Stress in the plate is uniform.

(iv) Friction between the plates is neglected.

(v) Rivets in group subjected to direct load share the load equally.

1.43 (b)

If a rivet is heated and then driven, then it is a power driven rivets, else it is a cold riveting.

1.45 (b)

As per Indian Standard code, IS 800: 1984, the working shear stress of a power driven shop rivet is taken as 100 N/mm^2, which is approximately equivalent to 1025 kg/cm^2.

1.46 (b)

All the fillet welds are assumed to resist the loading by shearing on its throat.

1.47 (d)

Refer IS 800: 1984 for the assumptions for riveted joints.

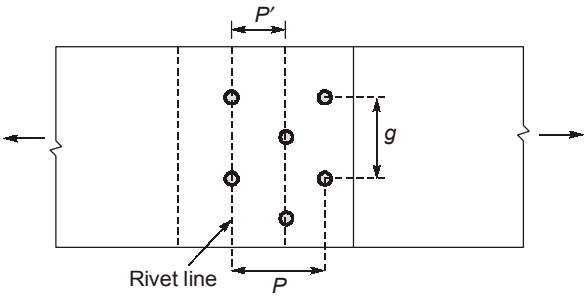
1.48 (a)

Joint strength are generally kept less than the strength of the main member, else the main member may fail before the joint.

1.50 (d)

Refer IS 800: 2007.

1.52 (c)



In the figure above

P = Pitch of rivet

g = gauge distance of rivet

P' = staggered pitch

1.53 (d)

In double cover butt joint, main plates are connected by using cover plates on both sides.

1.54 (c)

Diameter of a rivet hole is made larger than the diameter of the rivet by 1.5 mm up to rivet diameter of 25 mm and by 2 mm for rivet diameter over 25 mm.

1.55 (d)

All the terms can be used be interchangeably

1.56. (d)

All the options are generally adopted for double cover butt joint.

1.57 (d)

$$\text{Number of rivets} = \frac{\text{Load}}{\text{Rivet value}}$$

Where rivet value is minimum of shearing strength and bearing strength of rivet.

1.59 (c)

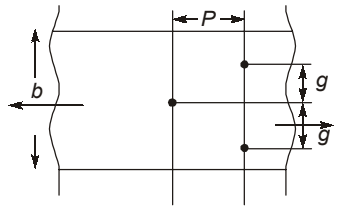
Efficiency of the riveted joint

$$= \frac{(P-d)}{P}$$

1.68 (d)

For plate,

$$\text{Net area} = \left(b - nd + \frac{p^2}{4g}\right) \times t$$



$d_h \rightarrow$ hole diameter

$P \rightarrow$ Pitch (s taggered)

$g \rightarrow$ Gauge

$b \rightarrow$ plate width

$t \rightarrow$ thickness of plate

1.69 (a)

efficiency of riveted joint (η)

$$\eta = \frac{\text{minimum of } \{P_s, P_b, P_t\}}{P}$$

$P_s \rightarrow$ strength of joint in shear

$P_b \rightarrow$ strength of joint in bearing

$P_t \rightarrow$ strength of joint in tearing

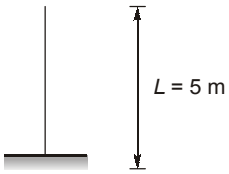
$P \rightarrow$ strength of solid plate

2. Tension, Compression and Flexural Member

2.1 (d)

Generally, in a steel beam section, the web is considered to carry the shear whereas the flange is considered to carry the moment.

2.2 (d)



The electric pole can be considered as a cantilever. For cantilever, one end fixed and other end free

$$L_{eff} = 2L = 2 \times 5 \text{ m} = 10 \text{ m}$$

2.3 (d)

Gross sectional area = Net sectional area + area of the rivet holes.

2.4 (d)

As per IS 800: 2007, Table 3.

2.6 (b)

Euler's formula take into consideration of the failure of column by buckling which is a phenomena occurring in long columns only. Short columns fail by crushing of the material rather than buckling.

2.7 (b)

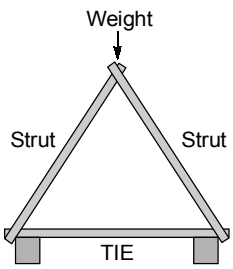
As per IS 800: 2007, clause 7.6.6.3.

2.8 (d)

Refer table 3 of IS 800 : 2007.

2.9 (b)

A strut is a structural component designed to resist longitudinal compression.



2.10 (a)

For laced column

Effective slenderness ratio = 1.05 times actual maximum slenderness ratio

For battened column

Effective slenderness ratio = 1.1 times actual maximum slenderness ratio.

2.12 (c)

This is in accordance to clause 7.6.6.3 of code IS 800 : 2007.

2.18 (b)

This is in accordance to Table 3 of code IS 800 : 2007.

2.19 (a)

Slenderness ratio is more in the direction having least radius of gyration. So member fails by buckling in the direction having least radius of gyration.

2.20 (b)

As per IS 800: 1984, Clause 5.7.3.

2.21 (a)

Web crippling is a common mode of local failure experienced by web elements of thin-walled beams under concentrated loads or reactions.

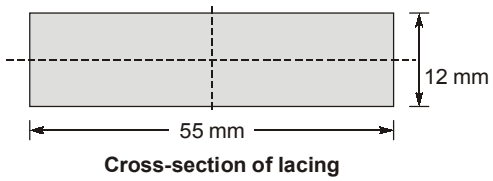
2.22 (d)

Column splices are used when different sections are used in one column in order to increase the length as pre-fabricated sections have definite and limited length.

2.23 (c)

Given, Rolled steel flat designation

= 55 ISF 12 mm



Cross-section of lacing

$$\therefore \quad I = \frac{bd^3}{12} = \frac{55 \times 12^3}{12} \text{ mm}^4$$

$$A = 55 \times 12 \text{ mm}^2$$

Now, minimum radius of gyration,

$$r_{min} = \sqrt{\frac{I}{A}} = \sqrt{\frac{\frac{55 \times 12^3}{12}}{55 \times 12}} = \sqrt{12}$$

$$= 3.46 \text{ mm}$$

2.24 (c)

As per IS 800: 2007, Clause 7.6.4

2.25 (a)

As per IS 800: 2007, Clause 7.7.1.4

2.26 (c)

The buckling load in steel column is given by Euler formula as

$$P = f_{cr}.A = \frac{\pi^2 EA}{\lambda^2}$$

$$\therefore \quad P \propto \frac{1}{\lambda^2},$$

λ = Slenderness ratio

2.27 (b)

As per IS 800 : 1978, the maximum allowable outstand for unstiffened flange is limited to 16t. This is to avoid local buckling phenomena in the flange plates.

2.28 (b)

Lateral buckling always occurs due to bending about minor axis having smaller moment of inertia.

2.29 (c)

The working stress of structural steel if approximately about 55% of f_y, which being 130 N/mm^2 for Fe250 and 230 N/mm^2 for HYSD bars.

2.31 (a)

Lug angles may or may not be unequal angles which helps to connect the outstanding leg. Thus it helps to reduce shear lag and length of the connection as both the legs of the main angle are now connected.

2.32 (d)

Rolled angles can be equal, unequal or bulb.

2.33 (d)

Beam sections are flexural members which are used to resist bending stress.

2.34 (d)

Concrete can not take axial tension in the truss.

2.37 (d)

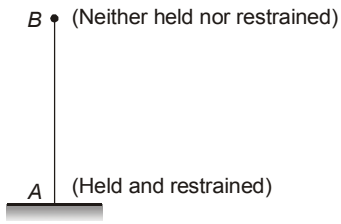
$A_{net} = (A_{gross} - n \times d)$

A_{gross} = Plate area

n = Number of rivets in the section

d = Dia of rivet hole

2.39 (d)



2.41 (d)

Maximum axial compressive load = $\sigma_{ac} \times A$

$= [625 \text{ kg/cm}^2 \times 30 \text{ cm}^2]$

$= 18750 \text{ kg} = 18.75 \text{ tonnes}$

So, 18 tonnes can be taken as safe load.

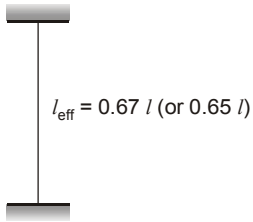
2.44 (d)

Reference **IS: 800 2007**

2.45 (c)

If the longest span does not exceed 15% more than the shortest span.

2.48 (b)

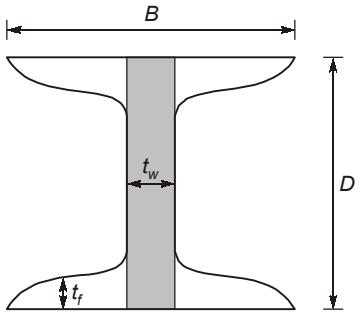


2.49 (c)

$$\lambda = \frac{l_{eff}}{r_{min}}$$

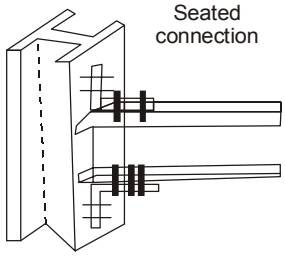
For $l = 0$, either leff = 0 means the column is supported throughout its length. i.e. it will not buckle.

2.51 (a)



Gross area of web = $D \times t_w$
where D is depth of the beam.

2.52 (c)



2.54 (c)

$$l_{eff} = 0.85\, l$$

2.55 (c)

Given, $l = 4\text{ m} = 400\text{ cm}$

$r_{min} = 5\text{ cm}$

$$\lambda = \frac{l}{r_{min}} = \frac{400}{5} = 80$$

2.62 (d)

Description	λ_{max}
Tension member in which reversal of direct stress is due to loads other than wind or earthquake	180
A member normally acting as a tension member but in which stress reversal is due to wind or E.Q. Load	135
A member always under tension except pretension member	400

2.64 (d)

$$\text{Slenderness ratio} = \frac{\text{effective length}}{\text{radius of gyration}}$$

2.71 (d)

For simply supported beam the maximum permitted deflection is $\frac{1}{325}$.

2.72 (b)

Given,

area of connecting leg= a

area of outstanding leg $= b$

$$A_{net} = a + kb$$

where, $$k = \frac{3a}{3a+b}$$

$$A_{net} = a + \frac{3ab}{3a+b}$$

$$= a + \frac{b}{1+0.33\frac{b}{a}}$$

2.73 (b)

The net area of round bar to resist the tension is the area of cross-section at root of the thread.

2.74 (c)

When tension member is too long we provide a bar to reduce slenderness ratio (λ)

$$\lambda = \frac{\text{effective length}}{\text{least radius of gyration}}$$

2.75 (d)

As the thickness of member exceeds 20 mm we decrease the allowable stress in axial tension to prevent failure of member.

2.76 (a)

Channel should be placed back to back when less radius of gyration is required.
and should be placed face to face when large radius of gyration is desirable.

2.77 (c)

Perforated cover plates are suitable for build up sections consisting of four angle box section to prevent entry of moisture.

2.78 (d)

Lug angle is used at a joint to reduce length of joint, to reduce shear lag effect and to increase efficiency of tension member.
It is generally used with single angle and channel member.

3. Plate Girders and Industrial Roofs

3.1 (c)

Gusset plates are thick sheets of steel that are used to connect beams and girders to columns or to connect truss members. A gusset plate can be fastened to a permanent member either by bolts, rivets or welding or a combination of the three.

3.3 (c)

ISLB - Indian Standard Light Weight Beam.
ISMB - Indian Standard Medium Weight Beam.
ISHB - Indian Standard Heavy Weight Beam.
ISWB - Indian Standard Wide Flange Beam.

3.4 (b)

For economic spacing of roof trusses, the cost of truss should be equal to twice the cost of purlins +the cost of roof covering. As a guide the spacing of the roof trusses can be kept:
(i) 1/4 of span up to 15 m.
(ii) 1/5 of span up to 15 m to 30 m.

3.5 (b)

Generally, the angle of roof truss with asbestos sheets should not be less than 30 degrees.

3.7 (c)

In architecture or structural engineering or building, a **purlin** (or purline) is a horizontal structural member in a roof. Purlins support the loads from the roof deck or sheathing and are supported by the **principal rafters** and/or the building walls, steel beams etc.

3.8 (d)

Bearing stiffener are designed as strut.

3.10 (c)

For single lacing:

$$t \geq \frac{1}{40} \text{ of effective length of lacing}$$

For double lacing:

$$t \geq \frac{1}{60} \text{ of effective length of lacing}$$

3.11 (a)

Stiffners are used for:
(i) Controlling local buckling
(ii) Connecting bracing or transverse beam

3.12 (a)

A sag tie is the central vertical member of the truss used to reduce the moment due to self-weight in the long middle tie member and also to reduce its resulting deflection.

3.14 (d)

Given, Pull, $P = 800$ kN
Gross dia, $d = 26$ mm
Considering two mild steel flat connected on each side of gusset plate.

$$\therefore \text{ Load on each flat, } P_1 = \frac{800}{2} = 400 \text{ kN}$$

Now, For field riveting,
Shearing strength $= 90$ N/mm^2

$$\therefore \text{ Rivet value, } R_v = \frac{\pi}{4} \times 26^2 \times 90$$

$$= 47783.62 \text{ N} = 47.78 \text{ kN}$$

∴ Number of rivets required,

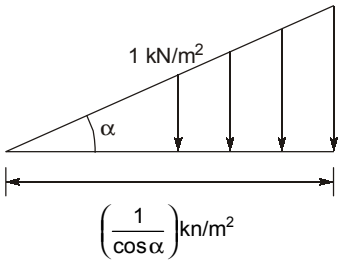
$$n = \frac{P_1}{R_v} = \frac{400}{47.78} = 8.37 \simeq 9$$

3.15 (a)

Bracings are primarily responsible to resist the lateral load.

3.16 (b)

Pitch of the roof affects the load that can be placed on it.



Dead load per horizontal surface area of roof cover materials increases with the slope of roof, multiply with $\left(\frac{1}{\cos\alpha}\right)$ where α is the roof pitch/ slope.

3.18 (c)

Girts are the beam supporting wall covering and purlins are the beams supporting roof covering.

3.20 (b)

Bay is spacing between 2 bents in roof truss of space frames.

3.21 (a)

Shear is mainly resisted by web & bending is mainly resisted by flanges in rolled steel beams.

3.23 (d)

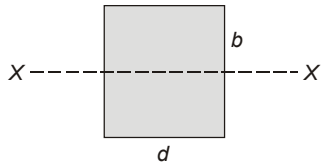
The rise of the jack arch is kept 1/12 th of span and the minimum depth at crown is kept at 150 mm.

3.24 (b)

In grillage footing maximum bending moment occurs at edge of base plate and maximum shear force occurs at centre of base plate.

4. Miscellaneous

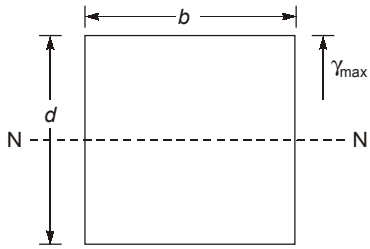
4.1 (a)



Moment of inertia about axis *XX* is given by

$$I = \frac{db^3}{12}$$

4.4 (c)



Section modulus,

$$Z = \frac{I}{\gamma_{max}} = \frac{\frac{bd^3}{12}}{\frac{d}{2}} = \frac{bd^2}{6}$$

4.5 (d)

Shape factor is defined as the ratio of plastic section modulus to that of elastic section modulus.

Section	Shape factor
Rectangle/Square	1.5
Circle	1.7
Diamond	2
I-section	1.1 - 1.2

4.6 (d)

Types of load	IS standard
Dead load	IS 875 : Part I
Live load	IS 875 : Part II
Wind load	IS 875 : Part III
Snow load	IS 875 : Part IV
Seismic load	IS 1893

4.7 (c)

Stringers: These are beams in a bridge running parallel to the roadway and spanning between other beams which transfer the loads to main girders or trusses. Inclined breams supporting stairs in buildings are also called stringers.

Spandrel beam: These are the exterior or edge beams in a building supporting loads from exterior walls and from parts of the floor system.

4.9 (b)

Permissible stress refers to amount of stress that will not cause failure.

$$\text{Permissible stress} = \frac{\text{Ultimate stress}}{\text{Factor of safety}}$$

4.10 (c)

Load factor to be applied with wind and seismic load depends on type of load combination. For example:

At limit state of collapse:

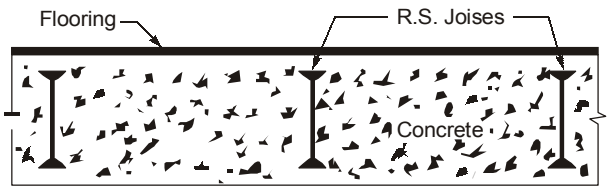
(i) 1.5 *DL* + 1.5 *LL*

(ii) 1.5 *DL* + 1.5 *WL*/*EL*

(iii) 0.9 *DL* + 1.5 *WL*/*EL*

(iv) 1.2 *DL* + 1.2 *WL* + 1.2 *WL*/*EL*

4.11 (a)



4.12 (c)

Filler plates are provided because the dimensions of the sections of the columns are different.

Bearing plates are used to transfer concentrated compressive forces between two structural elements.

Column splices are to be used always whenever two different sections are used in a single column to ensure proper joint.

4.13 (c)

As per IS 804: 1967.

4.14 (d)

Fatigue failure occurs due to infinite repeated cycles of loading along with large variation of stress including reversal of stresses and also large stress concentration.

4.15 (b)

Refer IS 456: 2000.

4.16 (d)

All the options are the advantages of a steel member especially over a concrete member.

4.17 (d)

The five series are :

ISJB (Indian Standard Junior Beam).

ISLB (Indian Standard Light Beam).

ISMB (Indian Standard Medium Beam).

ISWB (Indian Standard Wide flange Beam).

ISHB (Indian standard Heavy Beam).

4.20 (c)

$$\text{Rain load (in PSF)} = 5.2\,(ds + dh)$$
$$= 5.2\,(2 + 1)$$
$$= 15.6$$

(As per code followed in US)

4.22 (b)

Partially constrained, – if it has two or fewer reactions components. There are not enough reactions to prevent motion under all possible loading conditions.

4.23 (d)

Degree of in determinary, $D_s = m + r - 2j$

m = member = 4

$r = 3$

$j = 4$

$D_s = (4 + 3) - (2 \times 4) = -1$ (Unstable)

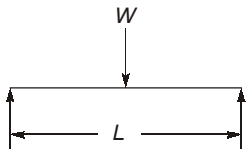
4.24 (c)

Spandreal beam extending horizontally from one column to another and supporting a section of wall.

4.25 (c)

Concentrated load is the cause of local bulking also called web crippling.

4.26 (b)



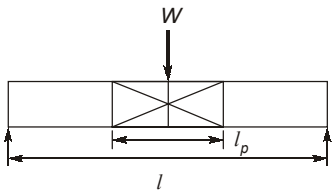
For rectangular c/s, shape factor = 1.5
and we know, length of plastic hinge (L_P)

$$= l\left(1-\frac{1}{SF}\right)$$

$$= L\left(1-\frac{1}{1.5}\right)$$

$$L_P = \frac{L}{3}$$

4.27 (b)



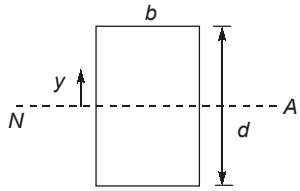
$$l_p = l\left(1-\frac{1}{SF}\right)$$

where SF in shape factor of the cross section. l_p is length of plastic hinge. for rectangular c/s, S.F = 1.5

$$l_p = l\left(1-\frac{1}{1.5}\right) = \frac{l}{3}$$

4.29 (b)

$$\text{shape factor} = \frac{Z_P}{Z_e}$$



Calculating for z_e

$$z_e = \frac{I}{y_{max}} = \frac{\left(\frac{bd^3}{12}\right)}{d/2}$$

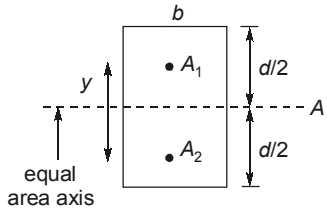
$$Z_e = \frac{bd^2}{6}$$

Calculation for Z_P

$$Z_P = A_1y_1 + A_2y$$

for rectangle,

$$A_1 = A_2 = \frac{A}{2}$$



Thus, $$Z_P = \frac{A}{2}(y_1 + y_2)$$

and $$y_1 = y_2 = \frac{d}{4}$$

Thus, $Z_P = \frac{bd}{2}\times\left(\frac{d}{4}+\frac{d}{4}\right)=\frac{bd^2}{4}$

Thus, $\text{S.F.} = \frac{\frac{bd^2}{4}}{\frac{bd^2}{6}}$

$\Rightarrow$ SF = 1.5

4.30 (d)

Load factor(Q) = factor of safety(F) × shape Factor(S), $Q = F\times S$

where, $F = \frac{\text{yield stress}}{\text{working stress}} = \frac{f_y}{f}$

shape factor, $S = \frac{M_P}{M_y} = \frac{f_y \times Z_P}{f_y \times Z}$

$= \frac{Z_P}{Z} = \frac{\text{Plastic section modulus}}{\text{Elastic section modulus}}$

■■■■