

ESE-2017 PRELIMS TEST SERIES

Date: 11th December 2016

CE-TEST 15 (OBJECTIVE SOLUTION)... 

ANSWERS

1. (a)	28. (c)	55. (a)	82. (b)	109. (b)	136. (a)
2. (d)	29. (b)	56. (c)	83. (b)	110. (d)	137. (a)
3. (b)	30. (b)	57. (a)	84. (a)	111. (c)	138. (c)
4. (a)	31. (a)	58. (b)	85. (d)	112. (b)	139. (b)
5. (d)	32. (b)	59. (c)	86. (b)	113. (c)	140. (a)
6. (d)	33. (c)	60. (b)	87. (c)	114. (a)	141. (c)
7. (c)	34. (b)	61. (d)	88. (b)	115. (b)	142. (d)
8. (b)	35. (b)	62. (c)	89. (d)	116. (b)	143. (c)
9. (c)	36. (b)	63. (d)	90. (d)	117. (b)	144. (b)
10. (b)	37. (a)	64. (d)	91. (c)	118. (d)	145. (a)
11. (c)	38. (b)	65. (a)	92. (b)	119. (b)	146. (b)
12. (d)	39. (b)	66. (b)	93. (b)	120. (b)	147. (d)
13. (c)	40. (a)	67. (d)	94. (b)	121. (b)	148. (d)
14. (c)	41. (c)	68. (a)	95. (d)	122. (d)	149. (b)
15. (a)	42. (d)	69. (b)	96. (c)	123. (c)	150. (c)
16. (d)	43. (c)	70. (c)	97. (d)	124. (d)	151. (b)
17. (c)	44. (d)	71. (a)	98. (b)	125. (c)	152. (c)
18. (c)	45. (b)	72. (a)	99. (c)	126. (d)	153. (d)
19. (b)	46. (b)	73. (d)	100. (d)	127. (d)	154. (b)
20. (b)	47. (b)	74. (b)	101. (c)	128. (d)	155. (b)
21. (c)	48. (b)	75. (a)	102. (c)	129. (d)	156. (d)
22. (d)	49. (b)	76. (d)	103. (a)	130. (d)	157. (a)
23. (a)	50. (c)	77. (c)	104. (d)	131. (a)	158. (a)
24. (b)	51. (a)	78. (b)	105. (c)	132. (b)	159. (a)
25. (a)	52. (c)	79. (d)	106. (c)	133. (b)	160. (b)
26. (b)	53. (b)	80. (b)	107. (a)	134. (c)	
27. (b)	54. (d)	81. (a)	108. (c)	135. (b)	

1. (a) These refer to common properties of different type of structural steel.

	Cast Iron	Wrought Iron	Steel
(i)	It is quite hard and can be hardened by heating and sudden cooling.	It cannot be hardened or tempered	It can be hardened or tempered
(ii)	It is crude form of iron	It is the purest form of iron	It is midway between cast Iron and wrought Iron
(iii)	It has crystalline structure	It has fibrous structure with silky lusture	It has a granular structure.

2. (d) Following factors are accounted for in the partial safety factor.

- The possibility of unfavourable deviation of material strength from its characteristic value.
- Reduction in strength due to fabrication and tolerances.
- The possibility of unfavourable variation in member size.
- Uncertainty of theoretical assumption.
- Uncertainty in calculation of strength of due members.

3. (b) Black bolts or the common bolts are the least expensive bolts however they may not produce the least expensive connections since the connection may require a large number of such bolts. They are primarily used in light structures under static loads such as purlins, trusses, bracings etc. They are not recommended for, impact loading, fatigue and dynamic loads.

4. (a) To develop power under a low head in francis turbine B/D ratio to increase accordingly.

5. (d)

6. (d) Efficiency $\eta\% = \frac{V_{w_1}u_1 - V_{w_2}u_2}{gtl}$

For max η , $V_{w_2}u_2 = 0$

$u_2 \neq 0$

Hence $V_{w_2} = 0$

Now, if angle of absolute velocity at the outlet is 90° , then $V_{w_2} = 0$ and efficiency is maximum.

7. (c) $R = 1\text{m}$

$Q = 10\text{m}^2/\text{s}$

Torque = $2000\text{ kg m} = 2000 \times 9.81\text{Nm}$

$T = \rho Q V_w R$

$V_w = \frac{T}{\rho Q R}$

$= \frac{2000 \times 9.81}{1000 \times 10 \times 1}$
 $= 1.962\text{ m/s}$

8. (b) A tonque converter is used to transmit increased or decreased power from one shaft to another.

Efficiency of torque converter,

$\eta_{tc} = \frac{\text{Power output}}{\text{Power input}}$

9. (c)

10. (b)

11. (c) $N_s = \frac{N\sqrt{Q}}{H^{3/4}}$

Here $Q = \frac{1.5}{2} = 0.75\text{m}^3/\text{s}$

Now $N_s = \frac{750 \times \sqrt{1.5/2}}{16^{3/4}}$
 $= 81.189$

12. (d) developed in kw = 10,000 × 0756 = 7560kw

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

$$= \frac{500 \times \sqrt{7560}}{(81)^{5/4}}$$

$$= 179 \text{ is SI units}$$

Turbine	Specific speed
Pelton	8 – 30
Francis	40 – 420
Kaplon and propeller	380 – 950

13. (c)

14. (c)

15. (a) Camber can be parabolic, elliptic or straight line in cross-section.

Parabolic or elliptical → For fast moving vehicles

Straight line → Very flat cross slope in cement concrete pavement

16. (d) Minimum length of overtaking zone = 3 OSD

It is desirable that the length of overtaking zone is kept five times the overtaking sight distance.

17. (c) The method of rotating about inner edge is preferable in flat terrain in high rainfall area, when the road is not taken on embankment, in order to avoid the drainage problem.

18. (c) Mechanical widening = $\frac{nl^2}{2R}$

n = number of lanes

For 10.5 m wide pavement

n = 3

$$w_m = \frac{3l^2}{2R}$$

19. (b)

20. (b)

$$\text{of -tracking} = \frac{l^2}{2R} = \frac{6^2}{2 \times 25} = 0.72\text{m}$$

21. (c)

Circular summit curve is ideal as the sight

distance available throughout the length of circular curve is constant.

22. (d)

23. (a) For pressure on inner and outer wheels to be equal, f = 0

$$e = \frac{v^2}{127R}$$

$$= \frac{50 \times 50}{127 \times 100}$$

$$= \frac{50}{254}$$

$$= \frac{25}{127}$$

24. (b)

25. (a)

26. (b)

27. (b)

28. (c)

29. (b)

30. (b)

31. (a)

32. (b) The wheel load stress for rigid pavements are computed as interior, edge and corner using Westergaards equation. Temperature stress are developed in cement concrete pavements leading to warping and frictional stress. Critical combination of stress (load and temperature) is evaluated to determine the thickness of cement concrete pavement.

33. (c)

Tie bar are not the load transferring devices there are provided to ensure the adjacent slabs remain firmly tied together. There are provided in the transverse direction across longitudinal joints (warping joint) at mid depth.

34. (b)

Explanation : Group index

$$GI = 0.2a + 0.005ac + 0.01bd$$

Soli portion passing 0.075 mm sieve

P = 50%

LL = 40%, PI = 20%

a = P – 35 = 15 < 40

b = P – 15 = 35 < 40

c = LL – 40 = 0

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$$d = PI - 10 = 10$$

$$\begin{aligned} G.I. &= 0.2 \times 15 + 0 + 0.01 \times 35 \times 10 \\ &= 3 + 3.5 = 6.5 \end{aligned}$$

35. (b) The pressure $3.5 \text{ N/mm}^2 = 35 \text{ Kg/cm}^2$

$$\text{So, CBR} = \frac{35}{70} \times 100 = 50\%$$

36. (b) Critical combination of stresses:

(i) During summer mid-day at bottom of slab
(Load stress + warping stress – friction stress) at edge region = $210 + 290 - 10 = 490 \text{ N/mm}^2$

(ii) During winter mid-day at bottom of slab
(Load stress + warping stress + friction stress) at edge region = $210 + 290 + 10 = 510 \text{ N/mm}^2$

(iii) At top of slab during midnights
(Load stress + warping stress) at corner region

37. (a) Higher the GI value weaker is the soil sub-grade. GI method is an empirical method.

38. (b) A bitumen emulsion is a liquid product in which a substantial amount of bitumen is suspended in a timely divided condition in an aqueous medium and stabilized by means of one or more suitable materials. The function of this emulsifier is to form a perfective coating around the globules of binder resisting the coalescence of the globules. These are specially used for maintenance and patch work.

39. (b)

40. (a)

41. (c)

42. (d)

43. (c)

44. (d)

45. (b)

$$0.15 + 0.07 = \frac{V^2}{gR}$$

$$0.22 = \frac{(100 \times 5 / 18)^2}{9.81 \times R}$$

$$\Rightarrow R = 357.522 \text{ m}$$

46. (b)

47. (b)

- The population equivalent indicates the strength of the industrial waste water for estimating the treatment required at the municipal sewage treatment plant and also helps in assessing realistic changes for this treatment to be charged from the industries instead of charging them simply by the volume of sewage.
- Sullage is waste water from bath, etc exclusive of night soil.
- Domestic sewage consists of liquid wastes originating from urinals, latrines, bathrooms, kitchen sinks, wash basins, etc of the residential, commercial or institutional buildings. This sewage is generally extremely foul because of the presence of human excreta in it.
- Industrial sewage consists of liquid wastes originating from the industrial processes of various industries. The quality of the industrial sewage depends largely upon the type of industry and the chemicals used in their process waters. Sometimes, they may be very foul and may require extensive treatment before being disposed of in public sewers.
- The sum total of domestic and industrial sewage, may be termed as sanitary sewage or simply sewage.

48. (b)

49. (b)

50. (c)

51. (a)

52. (c)

53. (b) Leather tanneries produce chromium bearing residue and sludge.

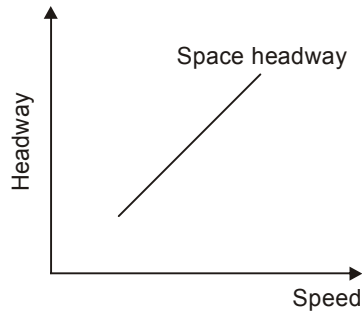
54. (d)

$$X = 6$$

$$Y = 11$$

$$Z = 24$$

55. (a)



56. (c) Silica brick is acid refractory brick.
Dolomite brick is basic refractory brick.
Chromite brick is neutral refractory brick.

57. (a)

58. (b) Vertical shaft brick kiln is healthy and environment friendly technology of brick brick manufacturing.

59. (c)

60. (b) Soft wood has distinct annular rings.

61. (d) Seasoning of timber decreases its density.

62. (c) Fine grounded cement have low specific gravity.

63. (d) Tilting mixer gives good result with dry concrete.

64. (d) Phosphorus produces detrimental effects on steel & should be kept below 0.12%

65. (a) The confined gases produces bubbles or blow holes or solidification of metal & leads to cavities or blow holes.

66. (b) It rusts easily and rapidly.

67. (d)

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \theta}$$

$$R = \sqrt{4^2 + 3^2 + 2 \times 4 \times 3 \cos 90^\circ}$$

$$R = 5 \text{ kN}$$

$$\tau = \frac{R}{A}$$

$$\tau = \frac{5 \times 1000}{500}$$

$$\tau = 10 \text{ N/mm}^2$$

$$F_D = \frac{P}{2} = 3$$

$$P = 6 \text{ kN}$$

68. (a)

$$69. \text{ (b) } Af_y \times a + Af_y \times 2a + Af_y \times 3a$$

$$= w \times \frac{a}{2}$$

$$w = 12 Af_y$$

70. (c)

71. (a) For Fe410 $f_u = 410 \text{ MPa}$

For bolts 4.6 $f_{ub} = 400 \text{ MPa}$

$$d_0 = 22 \text{ m} ; e = 33 \text{ mm} ; p = 50$$

The bolts will be in double shear and bearing.

The shear strength of bolt,

$$V_{sb} = 2 \times A_{nb} \times \frac{f_{ub}}{\sqrt{3} \times \gamma_{mb}} = \frac{2 \times 245 \times 400}{\sqrt{3} \times 1.25} = 90.53 \text{ kN}$$

Strength of bolt in bearing,

$$V_{pb} = 2.5 \times k_p d t \frac{f_u}{\gamma_{mb}}$$

$$= 2.5 \times 0.5 \times 20 \times 12 \times \frac{410}{1.25} \times 10^{-3}$$

$$= 98.4 \text{ kN}$$

\therefore The strength of bolt = 90.53 kN

72. (a)

73. (d)

74. (b) Gross dia of rivets = 20 + 1.5 = 21.5 mm

For most critical section

$$A_{nct} = t \times (b - n \times d)$$

$$A_{nct} = 1.2 \times (15 - 2 \times 2.15) = 12.84 \text{ cm}^2$$

Maximum tension in the flat

$$= \frac{150}{1000} \times 12.84 \times 10^2 = 192.6 \text{ kN}$$

75 (a)

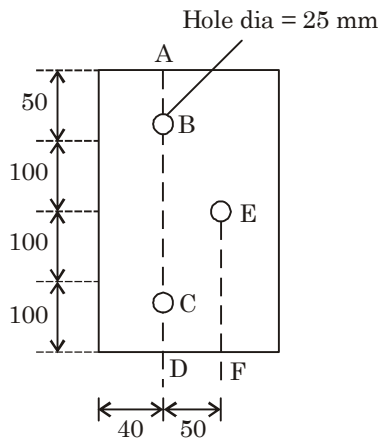
76. (d)

77. (c) **COD** : This is called chemical oxygen demand and is a measure of total organic matter (biodegradable as well as non-biodegradable) present in sewage.

BOD : It gives directly us the amount of biologically active organic matter present in sewage.

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78. (b)



ABCD

$$B_{\text{eff}} = 300 - 50 = 250$$

ABECD

$$B_{\text{eff}} = 300 - 75 + \frac{(50)^2}{4 \times 100} \times 2 = 237.5$$

ABEF

$$300 - 50 + \frac{(50)^2}{4 \times 100} = 256.25$$

$$B_{\text{eff}} = 237.5 \text{ mm}$$

79. (d) The unit stress in a tension member is increased due to the presence of a hole even in the hole is occupied by a bolt. This is because the area of steel to which load is distributed is reduced and some concentration of stress occurs along the edges of the hole.

80. (b)

81. (a)

82. (b)

83. (b) For unstiffened plate girder $t_{\min} = \frac{d}{85}$

84. (a) Struts are members of the truss which are under compression while those bearing tension are called ties.

85. (d) If there is any doubt about the lateral support from the wall, I-section with plates, may be used. Masonry is assumed to provide no lateral support even if the angle or channel section is encased in it.

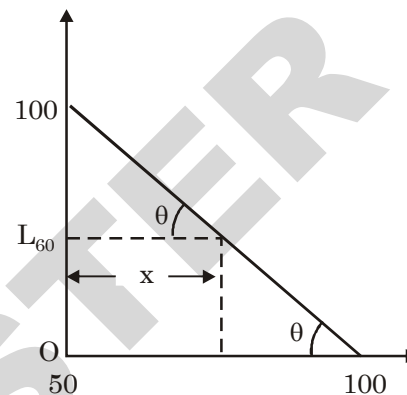
IS: 800 recommends the purlins to be designed as continuous beams. The wind force is assumed to act normal to the roof

truss and the gravity loads pass through the centre of gravity of the purlin section. Hence, the purlin section is subjected to twisting in addition to bending. Such bending is called unsymmetrical bending.

86. (b)

87. (c)

88. (b) L_{60} means 60% of time sound will exceeds the stated value.



$$\tan \theta = \frac{100}{100 - 50} = \frac{40}{x}$$

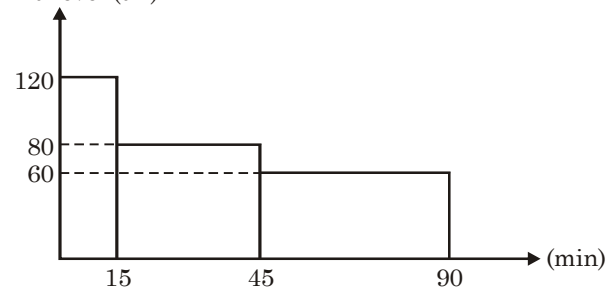
$$x = \frac{40 \times 50}{100}$$

$$x = 20$$

$$\text{Noise level will be} = 50 + 20 = 70 \text{ dB}$$

89. (d) Graphical representation of fluctuating noise

sound level (dB)



$$L = 10 \log \sum_{l=1}^{i=n} (10)^{L_l/10} \times t_i$$

$$= 10 \log \left[10^{120/10} \times \frac{15}{90} + 10^{(80/10)} \times \frac{30}{90} + 10^{(60/10)} \times \frac{45}{90} \right]$$

$$L_{\text{eq}} = 10 \log [1.667 \times 10^{11}]$$

$$L_{\text{eq}} = 112.2 \text{ dB}$$

90. (d) Photochemical oxidants are products of reactions between oxides of nitrogen (NO_x) and wide variety of volatile organic compounds (VOCs) by action of sunlight. The most well known photochemical oxidants are ozone (O₃), peroxyacetyl Nitrate (PNA) and hydrogen peroxide (H₂O₂).

91. (c)

Sol. $600 = L[1 - (10)^{-0.434 \times 0.23 \times 5}]$

$\Rightarrow L = 877.5 \text{ mg/l} = \text{ultimate BOD}$

$\Rightarrow y_{20} = 0.99 L$

$\Rightarrow 1\% \text{ of } (\text{BOD})_5 \text{ will remain unoxidised}$

92. (b)

Studies have shown that if the seed microorganisms are acclimated to the waste, then the removal of organic material is a pseudo-first order reaction.

$$-\frac{dc}{dt} = kc$$

where, $\frac{dc}{dt}$ = rate of removal of organic material

K = rate constant of the base e

C = concentration of organic material remaining at time 't'

93. (b)

94. (b)

95. (d) BoD test is carried out in complete darkness otherwise algal growth will take place and thus add oxygen to the system and the whole experiment will be wasted.

96. (c) Gate or sluice valves are used to regulate the flow of water through the pipes. They are similar to gate valves used in dams but are not so large. In large pipe lines bringing water from the source to the city, they are generally located along the pipe line at interval of about 3 to 5 km so as to divide the pipe line into different sections. The gate valves are usually placed at the summits of the pressure conduits because when so placed at these points of low pressures, they can be of cheaper and less stronger materials.

97. (d) **Gate valve of sluice valve :** Gate valves of sluice valves are used to regulate the flow of water through the pipes. The gate valves are usually placed at the summits of the pressure conduits, because when so placed at these points of low pressures, they can be of cheaper and less stronger materials and also they can be operated easily with less force.

Drain valve : In order to remove the entire water from within a pipe (after closing the supply), small gated off-takes are provided at low points. These valves are known as blow off valves or drain valves or scour valves. These valves are necessary at low level points for completely emptying the pipe for inspection, repairs, etc.

Air Valves : Air valves are the special kind of valves which are generally placed along the pipe line at summits on both sides of the sluice valves and also on the downstream side of all other sluice valves.

Check valves or reflux valves : Check valves are also sometimes called non-return valves because they prevent water to flow back in the opposite direction. They may be installed on the delivery side of the pumping set, so as to prevent the back flow of stored or pumped water, when the pump is stopped.

98. (b) In equivalent pipe system, first of all different small loops are replaced by single equivalent pipes having the same discharging capacities and causing the same head loss.

99. (c)

- i. If fire breaks in a supply zone during non-supply period, there will be a problem in relief and rescue.
- ii. The intermittent system requires the provision of small storage tanks in house so that water is available during non supply period
- iii. Greater size of pipes will be required since supply for whole day has to be made in a short time.
- iv. Pollution in supply—during the no supply period, due pressure may become

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negative which leads to drawing of contaminated water from adjacent area.

100. (d) Inferential Meters— Measure the velocity of flow

Displacement pumps— Through the movement of piston caused by water it directly measures the quantity of water.

101. (c) Surface water is mainly polluted by anthropogenic, i.e., human related activities.

While ground water is mainly polluted from dissolved gases and salts which come from the ground and are therefore referred to geochemical in nature.

102. (c)

103. (a)

104. (d)

$$\begin{aligned} \text{Pump output} &= \rho g QH \\ &= 9810 \times \frac{40}{1000} \times 30 \\ &= 11.77 \times 10^3 w \end{aligned}$$

$$\begin{aligned} \text{Power reqd} &= \frac{\text{Pump output}}{\text{Overall efficiency}} \\ &= \frac{11.77}{0.75} = 15.7 \text{kw} \end{aligned}$$

105. (c) The water is always admitted through upstream valve so as to make it flow along the gravity.

Since leakage has to be detected, until complete hydraulic gradient profiling is not done along the length, the place of leakage will not be known, it requires several pressure gauges along the length at specific intervals.

106. (c) Reduction in hardness— Caused by algal CO_2 subsequent precipitation of CaCO_3

Reduction in BOD— Caused by biodegradation during storage.

Reduction in pathogenic count— Bacteria/

Pathogen ultimately tend to die after non availability of O_2 as an effect of less turbulence.

Thermal stratification is caused due to impoundment of water.

107. (a) For max efficiency.

$$\begin{aligned} \mu &= \frac{V_1}{2} \\ \eta_{\max} &= \frac{1 + \cos \alpha}{2} \end{aligned}$$

108. (c) A minimum of three tanks are required as, one is allowed for settling, one is used in cleaning and other is used for water supply.

109. (b) Firm power corresponds to minimum stream flow condition.

110. (d)

111. (c) Gypsum prevents flash set and excess quantity decrease soundness of cement.

112. (b) The percolation rate of soil or ground is defined as the time in minutes required for seepage of water through that ground by 1 cm. Higher per colation rate would naturally would reflect less porous soil.

113. (c) Residential and commercial solid wastes consists of organics (combustible) part such as food waste and inorganic part which are non combustible. If these two waste components are not separated when discarded then the mixture of these wastes is known as commingled residential and commercial municipal solid waste.

114. (a)

Arsenic	–	10 mg/kg
Cadmium	–	5 mg/kg
Chromium	–	50 mg/kg
Copper	–	300 mg/kg

115. (b)

Location	Noise Levels dB
1. Rural areas	25–35
2. Urban residential areas	35–45
3. Hospitals	35–40
4. Radio TV studios	25–30

116. (b)

117. (b)

- (1) Slotted holes are used to give a little bit of freedom for the movement of the structures.
- (2) If the holes are longer than $2.5d$, shear transfer in the direction of the slot is not admissible even in friction type connections. (IS-800-2007)

118. (d)

A minimum spacing of $2.5d$, is specified in the code to ensure that there is sufficient space to tighten the bolt, prevent overlapping of washers and provide adequate resistance to tear out of bolts. It also limits any adverse interaction between high bearing stresses due to neighbouring bolts.

119. (b)

If the joint is short, the forces in the bolts will be redistributed by plastic action and hence, bolts will share the shear force equally.

In long bolted connections the shear force is not evenly distributed among the bolts and consequently the bolt at the end of the joints resist high amount of shear force. In such joints, the end bolt force may be so high that it may lead to progressive joint failure called 'unbuttoning'.

120. (b)

- (1) Incomplete fusion is considered as a type of weld defect. It may result if the surface to be joined are not cleaned properly and are coated with oxides, mill scale and other foreign materials. In sufficient current supplied by the welding equipment (which results in base metal not reaching its melting point) and high rate of welding will also result in incomplete fusion.

121. (b)

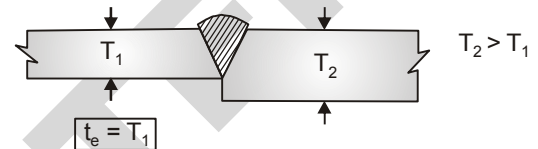
- (1) The provision of reinforcement increases the efficiency of joints and ensures depth of weld is at least equal to the depth of plate.
- (2) When two plates of different thickness

or width are to be joined, the wider/thicker part should be reduced at butt joint to make the width/thickness equal to smaller part, the slope not being steeper than one in five.

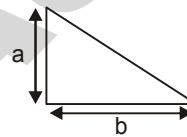
- (3) Under fatigue loading, stress concentration develops in weld leading to early cracking and failure
- (4) They also result in high residual stress.

122. (d)

The effective throat thickness of partial penetration joint weld is taken as the minimum thickness of weld metal common to the parts joined excluding the reinforcement.



123. (c)



Increasing both the components equally would be much more economical.

For an example, If we increase the horizontal component 'b' to twice of 'a', the throat dimension would increase by 26.5%. While the area of weld would be increased by 100%. Where as if we increase both legs by 26.5%, we get the same strength (i.e., throat dimension) but increase in weld area only 60%, weld area denotes the amount of weld material required.

124. (d)

- (1) The appropriate model of block shear failure is rupturing on the net tension plane and yielding on gross shear plane, which results in rupture of shear plane as length becomes shorter. It is also possible to have rupture of the shear area and yielding of tension area governing the strength of block shear failure. But in experiments and finite

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elements studies, the former mode of failure is generally found.

- (2) As in case of welds, failure generally occurs along the welds, therefore no net area computation is involved.
- (3) Due to punching, the materials around the holes is deformed in shear beyond ultimate strength to push out holes. It has been found, that strength of members with punched holes may be 10-15% less than members with drilled holes. This is due to strain hardening effect of material around the punched holes and consequent loss of ductility.

125. (c) A common and simple tension member is threaded rod. Such rods are usually found as secondary members, where the required strength is small. Some examples of tension rods is as follows.

- (a) Sag rods are used to help support purlins in industrial buildings.
- (b) Vertical ties to help support girts in the walls of the industrial buildings.

126. (d) Sulphate resisting cement is preferred for sewage & canal lining.

127. (d) Workability decrease with higher aggregate cement ratio.

128. (d) Order of test for their application for low to high workability vce be consistometer - compaction factor - slump test - flow test.

129. (d) Creep reduces with increase in size/thickness of member.

130. (d) The overlay thickness required over a flexible pavement may be determined either by one of the conventional pavement design methods or by a non-destructive testing method like the Benkelman beam deflection method. Benkelman Beam is a device which can be conveniently used to measure the rebound deflection of a pavement due to a dual wheel load assembly or the design wheel load. The amount of pavement deflection under a design wheel load or its rebound deflection on removal of this load is a measure of

the structural stability fo the pavement system under the prevailing condition of the test. Larger rebound deflection indicates weaker pavement structure which may require earlier strengthening or higher overlay thickness.

This method is suitable for bituminous concrete or Bituminous macadam with bituminous surface course as overlay over flexible pavement.

131. (a)

132. (b)

$$V = V_f \ln \left(\frac{K}{K_j} \right)$$

$$q = K V$$

$$q = K V_f \ln \left(\frac{K}{K_j} \right)$$

$$\frac{dq}{dK} = 0$$

$$0 = V_f \left[K \times \frac{K_j}{K} \times \frac{1}{K_j} + \ln \left(\frac{K}{K_j} \right) \right]$$

$$1 = -\ln \left(\frac{K}{K_j} \right)$$

$$\ln \left(\frac{K}{K_j} \right)^{-1} = \ln e$$

$$\left(\frac{K}{K_j} \right)^{-1} = e$$

$$\boxed{K = \frac{K_j}{e}}$$

133. (b) Traffic density for a highway = 1200 veh/hr = 0.33 veh/sec

Average vehicle speed = 80 km/hr = 22.22 m/s

Average CO emission per vehicle = 40 g/s

$$\therefore \text{Number of vehicles per meter of length} = \frac{0.333}{22.22}$$

$$\therefore \text{Strength of CO per meter length} = \frac{0.333}{22.22} \times 40 = 0.5999 \text{ g/s} \approx 0.6 \text{ g/s}$$

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Thus strength per unit length = 0.6 g/ms.

134. (c)

Traffic control devices

1. Signs
2. Signals
3. Road Markings
4. Islands

Signs

(1) Regulator signs

a) Stop sign



octagonal red colour with white border

b) Prohibitory signs



Parking prohibited



No stopping or standing



Speed limit

135. (b)

- One of the prime cause of flexible pavement is excessive deformation in subgrade soil. This can be noticed in the form of excessive undulations or waves and corrugations in the pavement surface and also depressions followed by heaving of pavement surface.
- The lateral shearing of pavement near the edge along the wheel path of vehicles of due to insufficient bearing capacity or a shear failure in subgrade soil.
- The failure of subgrade may be attributed due to two basic reasons:
 - (a) Inadequate stability
 - (b) Excessive stress application
- In adequate stability may be due to the inherent weakness of the soil itself or excessive moisture or improper compaction. Stability in the resistance to deformation under the stress.

136. (a)

137.(a) The order of efficiency in pump is 65% but in turbine efficiency is about 90% pump is against nature that is why efficiency is low.

138.(c) Points of potential conflicts depend on the number of lanes on intersecting lanes.

139. (b)

140. (a)

141.(c) As per 1RC standard the object high for sight distance calculation is taken as 0.15 n. So, (R) is incorrect.

142. (d) On rotating the pavement about centre line the vertical profile of the centre line remain unchanged. It has disadvantage as it will cause drainage problem due to depressing of lower or inneredge the general level.

143. (c) Tie bars are not designed as load transfer device but ensures that two slabs remain firmly together.

144. (b)

145. (a)

146. (b) Blast furnance slag cement is less reactive than OPC.

147. (d) Rounded, spherical or cubical aggregate when compacted contains less-voids than irregular & flaky aggregate of same nominal size & they give more strength.

148. (d) Large size aggregate has low specific surface area & hence high workability.

149. (b)

150.(c) The material cost of HSFG is about 50% greater than that of ordinary bolts and special workmanship is required in installing and tightening of these bolts.

151.(b) Wind has lower frequency and hence higher time period.

152. (c) Shear lag reduces the effectiveness of the component plates of the tension member

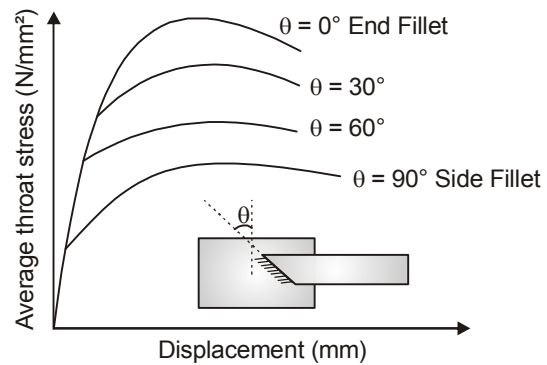
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that are not connected directly to a gusset plate.

This is the reason because the outstanding legs are kept shorter in length.

153. (d) Ethylene is an example of alkenes NOT alkanes.
154. (b) Tuberculation refers to formation of $\text{Fe}(\text{OH})_3$. Tuberculation increases the roughness of pipes, thereby decreasing carrying capacity of pipes.
155. (b)
156. (d)
157. (a)
158. (a) Traps may be defined as fittings placed at the ends of the soil pipes or the sullage pipes (waste pipes) to prevent the passage of foul gases from the pipes to the outside. This is possible because traps do enclose or maintain water seal between the pipes and the outside. This water depth is not allow gases to escape to out side of the pipes.

159. (a)



When $\theta = 0^\circ$, end fillet weld develops high strength with low ductility. On the other hand when $\theta = 90^\circ$, i.e., in case of side fillet weld, the weld strength is limited to only 56% of weld metal strength, however side fillet weld exhibits more ductility. Thus the end fillet welds are 30 – 40% stronger than side fillet welds.

160. (b) Generally a tension member without bolt holes can resist load up to ultimately load without failure. But such a member will deform considerably (nearly 10-15%) in longitudinal direction, before fracture. At such a large deformation, structure becomes unserviceable. Hence, one of limiting values in design strength is the one corresponding to the yielding of gross cross-section.