3 CHAPTER

Welded Connections

Q.1 Which of the following statement is incorrect?
(a) In welding, gross section is effective in carrying the load.
(b) Welded joints perform very bad in case of fatigue loads, impact loads and vibrations.
(c) Welding offers complete freedom to architects and the engineers for their design.
(d) None of the above.

Q.2 Match List-I (Type of stresses in joining members of mild steel by welding) with List-II (Permissible stresses) and select the correct answer using the codes given below lists :

List-I
A. Plug weld
B. Bending stress in tension or compression.
C. Shear or section through throat of butt or fillet weld.
D. Tension or compression on section through throat of butt weld.

List-II
1. 108 N/mm²
2. 150 N/mm²
3. 165 N/mm²

Codes :

	A	B	C	D
(a)	2	2	3	1
(b)	2	3	2	1
(c)	1	3	1	2
(d)	1	2	3	1

Q.3 The reinforcement in weld should not exceed
(a) 1.5 mm (b) 2 mm
(c) 3 mm (d) 2.5 mm

Q.4 Consider the following statements
Assertion (A) : Incomplete penetration of weld is undesirable.
Reason (R) : Incomplete penetration makes the surface rough.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.5 Match List-I (Type of weld) with List-II (weld symbol) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Spot	1. 
B. Plug	2. 
C. Fillet	3. 
D. Seam	4. 

Codes:

	A	B	C	D
(a)	2	1	3	4
(b)	4	1	3	2
(c)	2	3	1	4
(d)	4	3	1	2

Q.6 When fillet weld is applied to sections with rounded toes, there the maximum size of fillet weld should not exceed by what percentage of the thickness of the section at the toe?
(a) 60% (b) 75%
(c) 80% (d) 85%

Q.7 The minimum effective throat thickness of a fillet weld is
(a) 1.5 mm (b) 2 mm
(c) 3 mm (d) 3.5 mm

Q.8 Consider the following statements :
Assertion (A) : Effective length of filled weld = Actual length of weld – 2*S*.
Reason(R) : It is done in order to relieve ends of weld length from high stress concentrations.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.9 Effective throat thickness of a fillet weld is given as, $t = kS$, where S is the size of weld. If the angle between fusion faces is 110°, then the value of k is
(a) 0.70 (b) 0.65
(c) 0.60 (d) 0.55

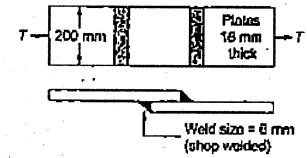
Q.10 Which of the following is the mode of failure in a fillet welded member?
(a) Tension (b) Shear
(c) Bearing (d) Crushing

Q.11 A circular plate 100 mm diameter is welded to another plate by means of 6 mm fillet weld. If the ultimate tensile stress of weld material is 410 MPa, then the greatest twisting moment that can be resisted by the weld will be (take $\gamma_{mw} = 1.50$)
(a) 208.2 kNm (b) 20.8 kNm
(c) 10.41 kNm (d) 40.12 kNm

Q.12 In a fillet weld, the weakest section is the
(a) smaller side of the weld
(b) throat of the fillet
(c) side perpendicular to force
(d) side parallel to force

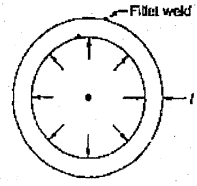
Q.13 The effective length of the fillet weld is
(a) total length – 2 x throat size
(b) total length – 2 x weld size
(c) 0.7 x total length
(d) total length – kS

Q.14 The maximum factored load that can be applied at the joint for the figure shown below will be (Take, $f_u = 410$ MPa)



(a) 159.11 kN (b) 132.55 kN
(c) 265.12 kN (d) 318.14 kN

Q.15 A circular penstock of mild steel, 1.2 m diameter is fabricated in workshop with 12 mm thick plates. The plates are secured by 8 mm size fillet welds, provided on inside and outside of the overlapped ends as shown in figure (Take $f_u = 410$ MPa, $K = 0.7$). The safe internal pressure that can be allowed in the penstock will be (Take FOS = 1.5)



(a) 4.36 N/mm² (b) 3.36 N/mm²
(c) 3.54 N/mm² (d) 2.36 N/mm²

Q.16 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

Q.17 Match List-I (Use) with List-II (Type of weld) and select the correct answer using the codes given below the lists:
List-I
A. Structural members subject to direct tension or compression
B. Joining two surfaces approximately at right angles to each other
C. A hole is made in one of the components and welding is done around the periphery of the hole
D. Pressure is applied continuously

Q.24 The actual thickness of butt weld as compared to the thickness of plate is usually
(a) more (b) less
(c) equal (d) None of these

Q.25 A butt weld is specified by
(a) Effective throat thickness
(b) Plate thickness
(c) Size of weld
(d) Penetration thickness

Q.26 Fillet weld is not recommended if the angle between fusion faces is
1. less than 45°
2. greater than 120°
3. less than 60°
4. greater than 145°

Which of these statements are correct
(a) 1 and 2 (b) 1 and 4
(c) 2 and 3 (d) 3 and 4

Q.27 The overlap of the plates to be fillet welded in a lap joint should not be less than
(a) 16 times the throat thickness
(b) 5 times the thickness of thinner plate
(c) 3 times the thickness of thinner palte
(d) 24 tiems the throat thickness

Q.28 Consider the following statements:
Assertion (A) : The strength of longitudinal fillet weld is about 30% more than the transverse fillet weld.
Reason (R) : Strength of filled weld depends on the uniformity of stress.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

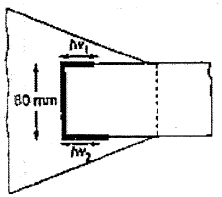
Q.29 Consider the following statements:
1. A fillet weld saves the operation of veeing and finishing the ends of members.
2. Butt welds have higher residual stresses as compared to fillet welds.

Which of these statements is/are correct?
(a) 1 only (c) 2 only
(c) Both 1 and 2 (d) Niether 1 nor 2

Q.30 Which of the following types of weld offer more gradual flow stress?
(a) concave weld (b) Convex weld
(c) both (a) and (b) (d) Neither (a) nor (b)

Q.31 The equivalent stress for fillet weld which is subjected to normal stress (σ_n) and shear stress (τ_s) is
(a) $\sqrt{\sigma_n^2 + \tau_s^2}$ (b) $\sqrt{\sigma_n^2 + 3\tau_s^2}$
(c) $\sqrt{3\sigma_n^2 + \tau_s^2}$ (d) $\sqrt{0.5\sigma_n^2 + 3\tau_s^2}$

Q.32 The total weld length for the angle section if weld is to be done on three sides is given assuming strength of tie member 222.27 kN



Assume f_u = 410 (for Fe410 steel), Y_{mw} = 1.5, size of weld 6 mm
(a) 336 mm (b) 256 mm
(c) 306 mm (d) 296 mm

Q.33 A mild steel circular penstock of 1.2 mm diameter is fabricated n workshop with 12 mm thick plates. Which are secured by 8 mm weld size provided on inside and outside of the lapped ends. The safe internal pressure that can be allowed is:
(Assume f_u = 410 MPa, Y_{mw} = 1.25, K = 0.7)
(a) 2.36 N/mm^2 (b) 1.26 N/mm^2
(c) 3.46 N/mm^2 (d) 5.16 N/mm^2

Q.34 A circular plate having diameter 150 mm is welded to another plate by means of 6 mm fillet weld. The ultimate twisting moment that can be resisted by the weld use steel of grade Fe410 and shop welding. (f_u = 410 MPa, Y_{mw} = 1.25)
(a) 18.11 kNm (b) 23.11 kNm
(c) 28.11 kNm (d) 32.11 kNm

Q.35 Which of the statement is correct regarding fillet weld.
(a) A convex fillet weld is preferred over concave fillet weld for static loads.
(b) The minimum size of the weld for 8 mm thick member is 5 mm.
(c) Reinforcement on the weld is given due consideration in design of welded joint.
(d) A fillet weld fails by shear at an angle of 30° through the throat.

■■■■

Answers Welded Connections

1. (b)	2. (c)	3. (c)	4. (c)	5. (a)	6. (b)	7. (c)	8. (a)	9. (d)	10. (b)
11. (c)	12. (b)	13. (b)	14. (d)	15. (d)	16. (c)	17. (b)	18. (a)	19. (a)	20. (d)
21. (c)	22. (c)	23. (b)	24. (a)	25. (a)	26. (c)	27. (b)	28. (d)	29. (c)	30. (a)
31. (b)	32. (b)	33. (a)	34. (c)	35. (a)					

Explanations Welded Connections

1. (b)
Welded joints perform better in case of fatigue loads, impact loads and vibrations.

3. (c)
Reinforcement is the extra weld metal which makes the throat dimension atleast 10% greater than the thickness of the welded material. It improves the efficiency of the joint. The reinforcement should not exceed 3 mm in any case.

4. (c)
Incomplete penetration is undesirable since it causes stress concentrations under load and may cause shrinkage cracks.

7. (c)
The effective throat thickness should not be less than 3 mm and should not exceed 0.7 t or 1.0 t under certain situations, where t is the thickness of the thinner member jointed.

11. (c)
Design weld strength,
P_{dw} = Design stress × Effective area

$$= F_{dw} \times A_{eff}$$

$$= \frac{f_u}{\sqrt{3} \times \gamma_{mw}} \times (L_{eff} \times t_{eff})$$

$$= \frac{410}{\sqrt{3} \times 1.5} \times (\pi \times 100) \times (0.7 \times 6) \text{N}$$

$$= 208.2 \text{ kN}$$

Greatest twisting moment = $P_{dw} \times \frac{\text{Diameter}}{2}$

$$= 208 \times \frac{100 \times 10^{-3}}{2}$$

$$= 10.41 \text{ kN-m}$$

12. (b)
Throat has the minimum section hence will carry the maximum stress, thus it is the weakest.

14. (d)
Maximum factored load = Weld capacity

$$= \frac{f_u}{\sqrt{3} \times \gamma_{mw}} \times L_{eff} \times t_{eff}$$

$$= \frac{410}{\sqrt{3} \times 1.25} \times 400 \times 0.7 \times 6$$

$$= 318.14 \text{ kN}$$

15. (d)

Let p_u = ultimate internal pressure

Given, $d = 1.2$ m diameter

$S = 8$ mm

$K = 0.7$

Resistance offered by weld per mm length

$$= (1 \times t_{eff}) \times \frac{f_u}{\sqrt{3} \times \gamma_{mw}} \times 2 \qquad \text{(two sides)}$$

$$= 0.7 \times 8 \times \frac{410}{\sqrt{3} \times 1.25} \times 2$$

$= 2120.95$ N/mm

Internal force causing bursting of the penstock = Hoop pressure = $\frac{p_u d}{2}$

Hence, $\frac{p_u d}{2} = 2120.95$

or $p_u = \frac{2120.95 \times 2}{1200} = 3.53$ N/mm^2

$\therefore$ Safe internal pressure = $\frac{p_u}{FOS}$

$$= \frac{3.53}{1.5} = 2.36 \text{ N/mm}^2$$

16. (c)

Throast thickness, $t = k \times$ weld size

For a standard 45° fillet, $k = \frac{1}{\sqrt{2}}$

$$\therefore \frac{\text{Size of fillet}}{\text{Throat thickness}} = \sqrt{2}$$

22. (c)

The safe load theat can be transmitted by the fillet welded joint is given by

$$P = t \times \frac{S}{\sqrt{2}} \times 108$$

$$= (60 + 50 + 60) \times \frac{6}{\sqrt{2}} \times 108$$

$= 77895$ N $= 77.895$ kN

28. (d)

The strength of the transverse fillet weld is about 30% more than the longitudinal fillet weld, because a transverse fillet weld is stressed more uniformly for full length where as the longitudinal fillet weld is stressed non-uniformly due to varying deformations along the weld length.

31. (b)

When subjected to combination of stresses (due axial tension/compression or bending tension/compression) and shear stresses, the equivalent stress σ_e should satisfy,

$$\sigma_e = \sqrt{\sigma_a^2 + 3\tau_s^2} \le \frac{f_u}{\sqrt{3}\gamma_{mw}}$$

32. (b)

Total weld length = $(L_{w1} + l_{w2} + 80)$ mm

Strength of weld = strength of the member

$= 222.22$ kN

$$T_d = l_w t_t \frac{f_u}{\sqrt{3}\gamma_{mw}}$$

Design strength of 6 mm ($t_t = 0.7 \times 6$)

$= 4.2$ mm weld per mm length

$$= 1 \times 4.2 \times \frac{410}{\sqrt{3} \times 1.5} = 662.79 \text{ kN}$$

Equating strength of weld to the load

$(l_{w1} + l_{w2} + 80) \times 662.79 = 222.27 \times 10^3$

$l_{w1} + l_{w2} = 256$ mm

33. (a)

Size of the weld = $S = 8$ mm

Effective throat thickness,

$t = KS = 0.7 \times 8 = 5.6$ mm

Internal force causing bursting of penstock

$$= \frac{p_u d}{2}$$

where, p_u = ultimate internal pressure

d = diameter of penstock

$= 1.2$ m $= 1200$ mm

Resistance offered by weld/length

$$= 2 \times t \times \frac{f_u}{\sqrt{3}\gamma_{mw}}$$

Hence,

$$\frac{p_u d}{2} = 2t \times \frac{f_u}{\sqrt{3}\gamma_{mw}}$$

$$\Rightarrow \quad p_u = \frac{4.0 \times 5.6 \times 410}{\sqrt{3} \times 1.25 \times 1200} = 3.545 \text{ N/mm}^2$$

Safe internal pressure

$$= \frac{3.545}{1.5} = 2.36 \text{ N/mm}^2$$

34. (c)

Size of weld = $S = 6$ mm

Effective throat thickness

$= KS = 0.7 \times 6 = 4.2$ mm

Strength of weld per mm length

$$= 1 \times t_t \times \frac{f_u}{\sqrt{3}\gamma_{mw}} = 1 \times 4.2 \times \frac{410}{\sqrt{3} \times 1.25}$$

$= 795.36$ N/mm

Total length of weld provided

$= \pi d = \pi \times 150 = 471.24$ mm

Greatest twisting moment

$$= 795.36 \times 471.24 \times \frac{150}{2}$$

$= 28.11$ kNm

35. (a)

A convex fillet weld is preferred over concave fillet weld for stable loads due to spread of stress over the convex in more uniform way.