Chapter 15
Retaining Walls and Braced Cuts

1. The retaining walls provide a permanent lateral support to
   (a) vertical slopes of soil.
   (b) near-vertical slopes of soil.
   (c) both (a) and (b)
   (d) slopes of soil.

2. The vertical faces of the cuts made during construction of basements of buildings in
devolved areas or underground transportation facilities at shallow depths below the
ground surface should be protected by
   (a) retaining wall.
   (b) temporary bracing system.
   (c) raft.
   (d) none of the above

3. Which of the following walls depends mainly on its own weight for stability?
   (a) Gravity retaining wall
   (b) Cantilever retaining wall
   (c) Counterfort retaining wall
   (d) all of the above

4. Which of the following walls is not economical for supporting high vertical slopes of soil?
   (a) Gravity retaining wall
   (b) Cantilever retaining wall
   (c) Counterfort retaining wall
   (d) both (b) and (c)

5. Cantilever retaining walls are made of
   (a) plain cement concrete.
   (b) reinforced cement concrete.
   (c) stone masonry.
   (d) brick masonry.

6. Counterfort retaining walls are similar to
   (a) gravity retaining walls.
   (b) cantilever retaining walls.
   (c) both (b) and (c)
   (d) none of the above

7. Which of the following walls consists of a thin stem and a base slab?
   (a) Gravity retaining wall
   (b) Cantilever retaining wall
   (c) Counterfort retaining wall
   (d) both (b) and (c)
8. At regular intervals, the thin vertical concrete slabs called counterforts that tie the stem and the base slab together in the counterfort retaining wall reduce
(a) height of the wall.
(b) shear force.
(c) bending moment.
(d) both (b) and (c)

9. The design of retaining walls requires
(a) unit weight, cohesion and angle of friction of the soil retained behind the wall.
(b) unit weight, cohesion and angle of friction of the soil below the base of the wall.
(c) both (a) and (b)
(d) none of the above

10. With the lateral earth pressure known, the retaining wall as a whole is checked for
(a) overturning about its toe, and sliding failure along its base.
(b) bearing capacity failure of the base and its settlement.
(c) check for overall stability.
(d) all of the above

11. When designing retaining walls, a trial section with some of the dimensions is assumed. This initial design step is called
(a) dimensioning.
(b) proportioning.
(c) sectioning.
(d) designing.

12. The minimum width of the top of the stem of retaining walls is about
(a) 0.1 m.
(b) 0.3 m.
(c) 0.6 m.
(d) 1.0 m.

13. The minimum depth of soil in the front of retaining walls is about
(a) 0.1 m.
(b) 0.3 m.
(c) 0.6 m.
(d) 1.0 m.

14. The base width of retaining walls of height $H$ is generally between
(a) $0.1H$ to $0.3H$.
(b) $0.3H$ to $0.7H$.
(c) $0.5H$ to $0.7H$.
(d) $0.5H$ to $H$.

15. The minimum factor of safety with respect to overturning is generally
(a) 1.
(b) 1.5 to 2.
(c) 2 to 3.
(d) 1.5 to 4.
16. The minimum factor of safety with respect to sliding is generally
   (a) 1.
   (b) 1.5.
   (c) 3.
   (d) 4.

17. Which is the best option to increase the resistance to sliding of the retaining wall?
   (a) Increase the base width of the wall
   (b) Increase the height of the wall
   (c) Construct the base key
   (d) none of the above

18. The tensile stress develops at the end of the heel section of the retaining wall when
   (a) \( e = 0 \).
   (b) \( e < B/6 \).
   (c) \( e = B/6 \).
   (d) \( e > B/6 \).
   where \( e \) is the eccentricity of the resultant of the sum of the vertical forces and the horizontal earth pressure, and \( B \) is the base width of the retaining wall.

19. The main components of a mechanically stabilised earth retaining wall are
   (a) cohesive backfill and reinforcing strips.
   (b) cohesionless backfill and reinforcing strips.
   (c) cohesionless backfill, reinforcing strips and a cover on the front face of the wall.
   (d) cohesive backfill, reinforcing strips and a cover on the front face of the wall.

20. The internal stability checks for the mechanically stabilised earth retaining wall involve
   (a) determining tension in the reinforcing elements.
   (b) determining pullout resistance in the reinforcing elements.
   (c) ascertaining the integrity of facing elements.
   (d) all of the above

21. The tie force per unit length of the mechanically stabilised earth wall developed at any depth \( z \) is
   (a) \( T = \sigma_d' S_H \).
   (b) \( T = \sigma_d' S_V \).
   (c) \( T = \frac{1}{2} \sigma_d' S_V S_H \).
   (d) \( T = \sigma_d' S_V S_H \).
   where all the symbols have their usual meaning.

22. Which of the following materials are used as the soil reinforcing element?
   (a) galvanised metallic strips.
   (b) galvanised metallic strips and geogrids.
   (c) geotextiles and geogrids.
   (d) geotextiles, geogrids and galvanised metallic strips.
23. The design of braced excavations involve the selection of
   (a) wales and struts.
   (b) soldier beams.
   (c) sheet piles.
   (d) all of the above

24. Select the incorrect statement.
   (a) In the case of braced cuts, the deformation of the wall gradually increases with the depth of excavation.
   (b) At the top of the braced cut, the lateral earth pressure is close to the at-rest pressure.
   (c) At the bottom of the braced cut, the lateral earth pressure is substantially lower than the Rankine active earth pressure.
   (d) none of the above

25. For the design of braced cuts in sand, the apparent pressure envelope is generally defined as
   (a) \( \sigma = \gamma H \).
   (b) \( \sigma = 0.65\gamma HK_a \).
   (c) \( \sigma = \gamma HK_a \).
   (d) \( \sigma = 2\gamma HK_a \).
   where all the symbols have their usual meaning.

26. The instability of the braced cuts caused by the heave of its bottom may be analysed by
   (a) bearing capacity theory.
   (b) consolidation theory.
   (c) Darcy’s equation.
   (d) none of the above

27. In braced cuts, the degree of lateral yield of the sheet pile walls, which causes the ground surface surrounding the cut to settle, mainly depends on
   (a) type of soil above the bottom of the cut.
   (b) type of soil below the bottom of the cut.
   (c) method of excavation.
   (d) type of material of the sheet pile wall.
Answers, Hints and Discussion

1. (c)
2. (b)
3. (a)
4. (a)
5. (b)
   *Discussion*: (a), (c) and (d) are correct for the gravity retaining walls.
6. (b)
7. (d)
8. (d)
9. (c)
10. (d)
11. (b)

12. (a)
   *Discussion*: The top of the stem of any retaining wall should be no less than about 0.3 m wide for proper placement of concrete.
13. (c)
14. (c)
15. (b)

16. (b)
   *Discussion*: (c) is correct for factor of safety against bearing capacity failure.
17. (d)
18. (d)
19. (c)
20. (d)

21. (d)
   *Hint*: See Eq. (15.24).
22. (d)
23. (d)

24. (d)

25. (b)
   
   *Hint:* See Eq. (15.56) and Fig. (15.26a).

26. (a)

27. (b)