DESIGN AND DRAWING OF WATER TANKS

Attempt all the questions

Time: three hours

Observe silence

Question 1. (10 Marks)

Define the following terms:

a) **Gantry girder**: The gantry girders are girders which supports the loads that are transmitted through the traveling wheels of the crane. The crane girder spans from column to column, this usually does not have any lateral support at the intermediate points excepting when a walkway is formed at the top of the girder.
b) **Truss**: a framework, typically consisting of rafters, posts, and struts, supporting a roof, bridge, or other structure.
c) **Footings –** Footings are structural elements that transmit column or wall loads to the underlying soil below the structure. Footings are designed to transmit these loads to the structure without exceeding its safe bearing capacity to prevent excessive settlement of the structure to a tolerable limit, to minimize differential settlement and to prevent sliding and overturning.
d) **Reinforced Cement Concrete (R.C.C) –** Reinforced cement concrete a composite material has been accepted worldwide as a construction material for different civil engineering structures like dams, retaining walls, bridges etc., is a composite material in which concrete's relatively low tensile strength and ductility are compensated for by the inclusion of reinforcement having higher tensile strength or ductility. The reinforcement is usually, though not necessarily, steel bars and is usually embedded passively in the concrete before the concrete sets.
e) **Weld** – This is to join two pieces of metal or plastic by heating and allowing the edges to flow together. It is also the idea of the metal or plastic being capable of being joined by heating and allowing the edges to flow together.

Question 2. (10 Marks)

When two members are connected by means of welds, such a connection is known as a welded connection. There are several types of welded connections as was discussed in class. Discuss any FIVE.

a) Groove welds (butt welds) – these are created when the members to be joined are lined up. Groove welds are costlier since it requires edge preparation. Groove welds can be employed safely in heavily stressed members.
b) Fillet welds – fillet welds are created when two members to be jointed are in different lanes. Since this situation occurs more frequently, fillet welds are more common than butt welds. Fillet welds are easier to make as it requires less surface preparation. They are not

as strong as the groove welds and cause concentration of stress. They are preferred in lightly stressed members where stiffness rather than strength governs the design.

c) Slot and plug welds – slot and plug welds are used to supplement fillet welds where the required length of fillet weld cannot be achieved
d) Lap welded joints - Lap welding joints are essentially a modified version of the butt joint. They are formed when two pieces of metal are placed in an overlapping pattern on top of each other. They are most commonly used to joint two pieces with differing thicknesses together. Welds can be made on one or both sides.
e) Corner welded joints - This weld is a type of joint that comes together at right angles between two metal parts to form an L. These are common in the construction of boxes, box frames and similar fabrications.
f) Slot welds - A slot weld joins the surface of a piece of material to another piece through an elongated hole. The hole can be open at one end and can be partially or completely filled with weld material.

Question 3. (20 Marks)

State FIVE advantages and FIVE disadvantages of welded joints

Advantages

I. Due to the absence of gusset plates and other connectors, the welds are usually lighter
II. Welding process is quicker as it requires no drilling of holes
III. Welding is more adaptable than other types of connections and can be even used in circular pipes
IV. 100% efficiency can be achieved in welding where as the connection such as bolts can have a maximum efficiency of 70-80%.
V. Noise produced during the welding process is relatively less
VI. Welds usually have good aesthetic appearance
VII. Welded joints are air tight and water tight and can be used for water tanks and gas tanks
VIII. Welded joints are rigid
IX. Mismatch of holes will never happen in welded connection
X. Alternation of joints can easily be made in the case of welded connections

Disadvantages.

I. Due to the uneven heating and cooling, members are likely to distort in the process of welding
II. Possibility of brittle fracture is more in the case of welded connections
III. Welded connections are more prone to failure due to fatigue stresses
IV. The inspection of welded joints is difficult and expensive. It can only be done by employing **NDT** (NDT stands for Non-Destructive Testing. It refers to an array of

inspection methods that allow inspectors to evaluate and collect data about a material, system, or component without permanently altering it. NDT may also be called: NDE (non-destructive examination or evaluation) NDI (non-destructive inspection))

V. Highly skilled persons are required for welding
VI. Proper welding in field conditions is difficult
VII. Welded joints are over rigid.

Question 4. (10 Marks)

Discuss briefly the following heads of tension members listed below.

i. Wires, strands and cables – A strand consists of individual wires wound helically around a central core. A wire rope consists of a number of strands wound helically around a core. Cables are group of individual strands wound helically around a core.
ii. Bars and rods – Bars and rods are straight members which have considerable cross section. These can either be circular, square or rectangular in cross section. Unlike cables, wires and strands, they can be used individually as structural members. They are often bolted to other members by means of threaded ends.
iii. Plates and flat bars – they are very commonly used. Plates are members where one dimension in thickness is very small in comparison with other dimensions. Flat bars are usually rectangular in cross section and the cross sectional dimensions are comparable where as the length is very large in comparison with the cross sectional dimension.
iv. Structural sections – standard structural steel sections like angles are also used as tension members. These are available in standard dimensions and length
v. Built up sections – built up sections are also used very frequently in construction. These are formed by using a combination of more than one standard sections and/ or plates

Question 5. (10 Marks)

When designing and building conventional retaining walls, the earths pressure is considered for its stability. Earth pressure is the pressure exerted by the retaining material on the retaining wall. This pressure tends to deflect the wall outward. There are two types of earth pressure. State and discuss each of them.

I. Active earth pressure (Pa) – Active earth pressure is the lateral pressure developed at the onset of shear failure by the wall moving away from soil in the direction of the acting earth pressure. It is the pressure exerted by the soil towards the structure. This pressure tends to deflect the wall away from the backfill. Earth pressure depends on type of backfill, the height of the wall and the soil conditions.

II. Passive earth pressure (Pp) – Passive earth pressure is the lateral pressure developed at the onset of shear failure by the wall moving in the direction opposite to the direction of acting earth pressure. The pressure is exerted by the structure towards the soil.

Question 6. (10 Marks)

State FIVE steps necessary for checking the stability of any retaining wall

I. Check for overturning about its toe
II. Check for sliding along its base
III. Check for bearing capacity failure of the base
IV. Check for settlement
V. Check for overall stability.