CH6511 Process Equipment Design - I

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Mechanical Design of Chemical Process Equipments Introduction

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Questionnaire

- 1. What is the approximate length x breadth x height of this class room in feet, meter units ?
- 2. What are the methods of joining two flat / cylindrical segments of a vessel ?
- 3. A vertical cylindrical vessel with circular base will be shown as ______ in front view; _______ in top view.
- 4. What are the advantages / disadvantages of glass-lined vessels ?
- Calculate the volume of vessel required to store 10 kg of air (MW: 29) at a pressure of 6 atm (abs) ?



Questionnaire

- 1. What are the methods of joining pipes / pipe fittings ?
- 2. What is the effect of diameter, and pressure on thickness requirement of a pressure vessel ?
- 3. An equipment of 10 m diameter x 8 m height is to be shown in a fabrication diagram drawn in A2 size (42 cm x 59.4 cm) drawing sheet. What **scale** (drawing size : actual size) you would choose ?
- 4. What are the most common engineering materials used for construction of process equipments ?
- 5. With increase in diameter of pipe, pressure drop for a given flow rate ______ (decreases / increases).





Syllabus Contents

- Design and drawing considerations of bolt, nut and screws, welded and riveted joints, flanged joints, nozzles and reinforcements. Pipe fittings.
- Design and drawing considerations of vessel supports such as bracket, saddle, skirt, etc. Storage Tanks for solids, liquids and gases.
- General design and drawing consideration of vessels subjected to internal pressure, and external pressure. High pressure vessels.
- 4. Fundamental principles, equations, general design and drawing considerations of **cyclone separators**, centrifuges, thickeners and filtration equipments.
- 5. General design and drawing considerations of crystallizers, agitated vessel, jacketed and coil heated vessels.



List of Exercises

- 1. Pipe Flanges
- 2. Dished Ends for Vessels
- 3. Nozzle reinforcement, Manhole support
- 4. Supports for Vessels
- 5. Storage tank
- 6. Agitated Vessel
- 7. Heating arrangements to vessels
- 8. Cyclone separator



Bolts & Nuts

- Specification: Mx (in units of millimeters)
- Preferred sizes: M2 2.5 3
 4 5 6 8 10 12 16 20 24 30
 36 42











Yield strength can be defined as the tensile force that will produce a specified amount of permanent deformation (most commonly 0.2%) within a specific fastener.

Proof load is defined as the maximum tensile force that can be applied to a bolt that will not result in plastic deformation. In other words, the material must remain in its elastic region when loaded up to its proof load. Proof load is typically between 85-95% of the yield strength.

Ultimate tensile strength can be defined as the maximum force a specific fastener must withstand before fracture.



















Hexagonal Key (Allen key)







Welded Joints



















Arc Welding









Riveted Joints





Riveting procedure.







Double-Riveted Single Strap Butt Joint

Forms of riveted joints.



Double-Riveted Double Strap Butt Joint





Welded Joint vs Riveted Joint



Advantages of Welded Joints

- The welded structures are usually light in weight compared to riveted structures. This is due to the reason, that in welding, gussets or other connecting components are not used.
- The welded joints provide high efficiency, which is not possible in the case of riveted joints.
- Alterations and additions can be made easily in the existing structures.
- Welded structures are smooth in appearance, therefore it looks pleasing.
- A welded joint has a great strength. Often a welded joint has the strength of the parent metal itself.
- It is easily possible to weld any part of a structure at any point. But riveting requires enough clearance.
- The process of making welding joints takes less time than the riveted joints.
- Shape like cylindrical steel pipes can be easily welded. But they are difficulty for riveting.
- The welding provides very strong joints. which can't be bended easily. This is in line with the modern trend of providing rigid frames.
- In welded connections, the tension members are not weakened as in the case of riveted joints.



Disadvantages of Welded Joints

- For making weld joints requires a highly skilled labour and supervision.
- Since there is an uneven heating and cooling in welding process during fabrication, therefore the members may get distorted or additional stresses may develop.
- Since no provision is kept for expansion and contraction in the frame, therefore there is a possibility of cracks developing in it.
- The inspection of defects in welding work is more difficult than riveting work.





