DESIGN, ANALYSIS AND FABRICATION OF PRESSURE VESSEL END DOME
1. ABSTRACT

Tanks, vessels and pipelines that carry, store or receive fluids or gases are called pressure vessels. A pressure vessel is defined as a container with a pressure differential between its inside and outside surface. Usually, the inside pressure is higher than the outside. However, there also exist external pressure vessels like submarines, submersible pumps etc. The fluid inside the pressure vessel may undergo a change in state as in the case of steam boiler or may combine with other reagent as in the case of chemical reactor.

Pressure vessel often has a combination of high pressure together with high temperature and in some cases flammable fluids or highly radioactive material. Because of such hazards it is imperative that the design be such that no leakage can occur. In addition vessel has to be design carefully to cope with the operating temperature and pressure. Safety is one of the prime design criteria for pressure vessels design. ASME Boiler and Pressure vessel code is the guiding document for the design, construction and maintenance across the world including India.

Pressure vessel are used in a number of industries; for example, the power generation industry for fossil and nuclear power, the petrochemical industry for storing and processing crude petroleum oil in tank farms as well as storing gasoline in service station, and the chemical industry. Pressure vessel and tank are essential to the chemical, petroleum, petrochemical, space and nuclear industry.

Pressure vessels are usually spherical or cylindrical with dome end. The end domes of cylindrical pressure vessels can be made of different shapes, the guiding design parameters being the thickness of material required (and hence the weight), the volume covered, the fabrication constraints and the design factor of safety.

The most common shapes of end domes are flat, ellipsoidal, hemispherical, and tori-spherical. This project report structurally analyses the various end dome geometries of a φ2m cylindrical pressure vessel and compares the results using Ansys 14.0. 2-D axis-symmetric modeling and meshing is done using commercially available Ansys FEA package. The comparative stress and strain plots are discussed. Finally a comparative table is made analyzing the stress and strains for different end-dome shapes and an optimal dome shape is proposed. The material used for the analysis is Boiler grade steel.
Further, each of the dome shapes are fabricated and studied for fabrication feasibility and to have a better knowledge of the shapes.