Pressure vessels are used in many of the technological applications. The vessel end-closures are of different forms: (i) circular diaphragms (circular plate), (ii) hemispherical, (iii) torispherical and (iv) hemi ellipsoidal. The advantage in the pressure vessel with torispherical head is the reduction in overall length, compared to that of the vessel with hemispherical head. This advantage is being utilized in the aerospace applications.

If vessels with uniform thickness are used, stress concentration occurs in knuckle region. The present study is focused on reducing the stress concentration in cylindrical pressure vessel with torispherical heads by employing variable thickness in the knuckle region. The variable knuckle thickness is obtained by spline and tangent methods. The ratios of crown radius to knuckle radius and the knuckle thickness to cylinder thickness are used as geometric parameters. Stress analyses are carried out using five types of finite elements: (i) two node axisymmetric shell element, (ii) three node axisymmetric shell element, (iii) four node quadrilateral axisymmetric solid elements (iv) four node quadrilateral axisymmetric solid elements with incompatible mode and (v) eight node axisymmetric solid elements for various combinations of the above geometric parameters. The deformed configurations
indicate that there is an inward deformation in the knuckle for an internally pressurized vessel, causing severe bending in the meridional direction and net compression in the hoop direction. The results are presented in three parts: (i) deformed configurations, (ii) meridional and hoop stresses (principal stresses) and (iii) von Mises stresses. The numerical results indicate the following: (i) use of variable thickness in the knuckle region reduces the stress levels, (ii) the failure initiates always in the inner surfaces (iii) for values of crown-to-knuckle radii ratio greater than five, the stresses are so high that cannot be controlled even using knuckle of variable thickness (iv) the four node quadrilateral element with incompatible mode and eight-node quadratic element exhibit more or less same performance and (v) the variable thickness profile in the knuckle obtained by spline method is advantageous, as the stresses are lower.