Computational Structural Mechanics and Dynamics

Assignment 9

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1) Describe in extension how can be applied a non-symmetric load on this formulation.

Solution

For axisymmetric shell subjected to any arbitrary load including non-symmetric loading, it is convenient to define the load and displacement using Fourier series in a circumferential direction including sine and cosine terms. The main point is to decompose the loading terms into symmetric and anti-symmetric parts and calculate the corresponding terms according to the formulations and then summing them over. This decomposition should be done both for the load and displacement using the same harmonic function.

2) Using thin beams formulation, describe the shape of the $B^{(e)}$ matrix and comment the integration rule.

Solution

For thin beams we have previously studied the Kirchhoff assumptions. Applying Kirchhoff to thin shells yields to the simplicity that the normal to the axis of symmetry remains orthogonal during the deformation since the thickness of the shell is assumed to be too small. This condition is equivalent to neglecting the effect of transverse shear deformation.

Considering two kinds of displacements as normal and tangential displacement, it should be mentioned that a C^1 continuous interpolation should be used for the normal displacement in order to satisfy the conformity and C^0 can be used for tangential displacement for simplicity. The tangential displacement can be linearly interpolated using 2-noded Kirchhoff elements. Taking into account these considerations, the B matrix consist of two parts as B_m (membrane) and B_b (bending).

A two-point quadrature can be used for integration. We have to use Gauss points to do the integration since they lie inside the elements. This is while using Lobatto integration rule should be avoided since the integration points lie in axis of revolution tending the B matrix to reach infinity.

If other types of assumption are to be used for thin shells, it should be taken into account the shear locking effects which can be avoided using one-point reduced quadrature.