Finite Element Analysis final test Spring 2018

1. For a 8-node rectangular shell element with 5 DOF per node, which exist in x-y plane,

   1) Show the nodal displacement vectors and the corresponding shape functions when Mindline theory is applied. What are the differences when they are compared to those of elements of Kirchihoff theory.

   2) calculate the M(1,1) and M(1,2) of the consistent mass matrix for dynamic analysis. Mass density = 1.0, thickness=1.0. The edge lengths in x and y axes = 2a and 2b, respectively.

2. Regarding stress invariants,

   1) What is the definition of stress invariants? Why are they invariable regardless of the directions of coordinate systems?

   2) In general, the majority of three dimensional material strength models are defined with the stress invariants. Explain the reason.

3. Explain the background of the linearized stability analysis and how it is performed.

4. Structural analysis is required for A) tensile thin fabric structure and B) concrete dome structure.

   1) What kind of finite element will be good for A and B structures considering computational efficiency and accuracy?

   2) Show examples of the finite element type and the nodal dofs.

   3) In case of A, because of very thin fabric, large deformation is expected under loading. How is such behavior characteristics considered in the structural analysis.

5. large deformation analysis is considered for 3-D finite elements. Define the relationships between the strains and displacements.

6. When the isoparametric formulation is used, local axes of each element is not necessarily defined. Explain the reason.

9. In general, the accuracy of strains and stresses obtained from FE analysis is lower than that of the displacements. Explain the reason. How can we get the results as accurate as possible?

10. For a plane stress six node triangular element, define the shape function matrices for the nodal displacements and geometry, using the area coordinate system.

11 For the following structure with axisymmetric geometry and loading,

1) show the structure model and element type for finite element analysis considering computational efficiency.
2) show the relationship between the generic displacements and strains in the polar coordinate system.