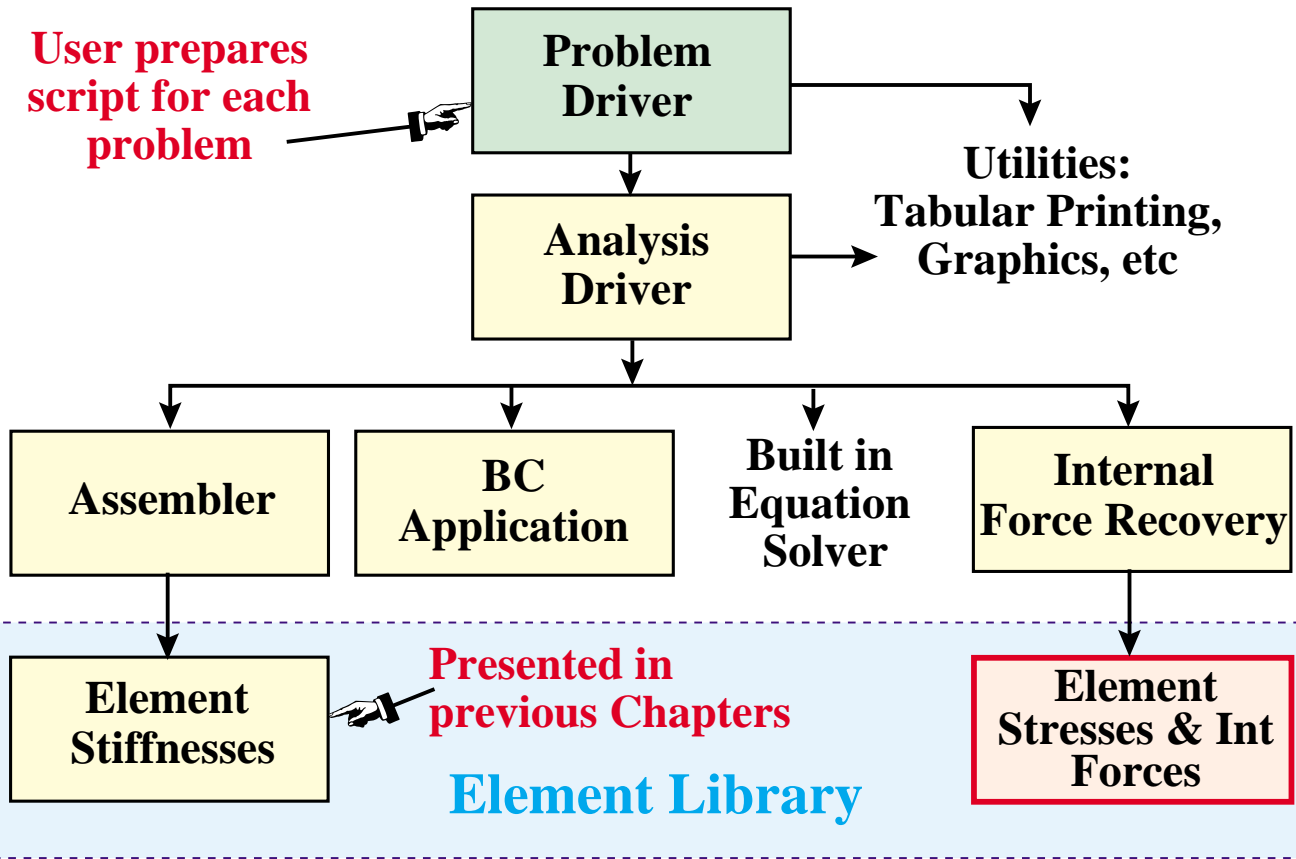


28

Stress Recovery

Plane Stress Program Configuration

User prepares script for each problem



Stress Recovery

***Processing* phase has solved for node displacements from the (modified) master stiffness equations**

$$\mathbf{K} \mathbf{u} = \mathbf{f}$$

***Postprocessing* phase now starts to get derived quantities. Among them are internal forces and stresses.**

The process of computing stresses from node displacements is called *stress recovery*.

General Comments

Stresses recovered from low order elements (e.g. 3-node triangles and 4-node quads) often display large *interelement jumps*.

In-plane bending situations are particularly troublesome

Jumps can be eliminated by *interelement averaging at nodes*
This usually improves the stress quality at interior nodes, but may not be effective at boundary nodes.

Stress recovery over quadrilateral elements can be improved by *extrapolation from Gauss sample points*

Nodal Stress Averaging

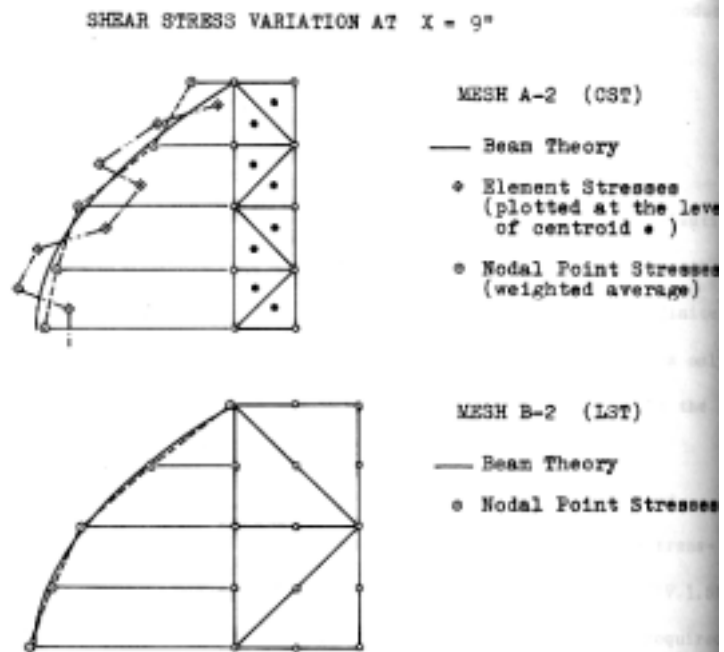


Fig. 5.2 - Cantilever Beam: Comparison between LST and CST Meshes.

Gauss Elements

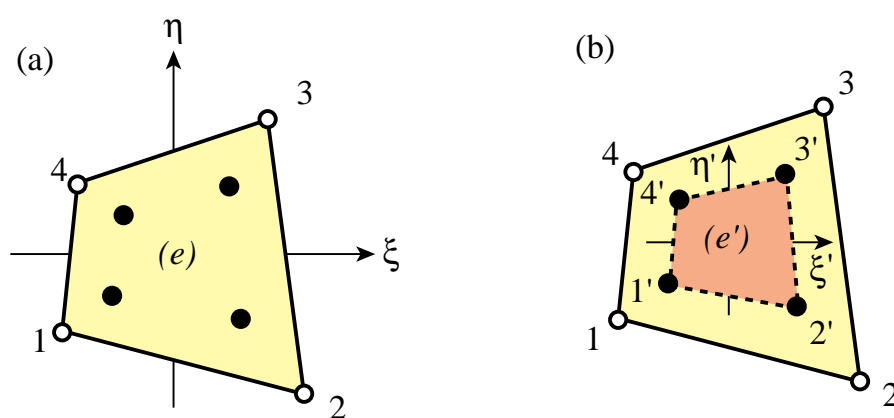


Table 28.1 Natural Coordinates of Bilinear Quadrilateral Nodes

Corner node	ξ	η	ξ'	η'	Gauss node	ξ	η	ξ'	η'
1	-1	-1	$-\sqrt{3}$	$-\sqrt{3}$	1'	$-1/\sqrt{3}$	$-1/\sqrt{3}$	-1	-1
2	+1	-1	$+\sqrt{3}$	$-\sqrt{3}$	2'	$+1/\sqrt{3}$	$-1/\sqrt{3}$	+1	-1
3	+1	+1	$+\sqrt{3}$	$+\sqrt{3}$	3'	$+1/\sqrt{3}$	$+1/\sqrt{3}$	+1	+1
4	-1	+1	$-\sqrt{3}$	$+\sqrt{3}$	4'	$-1/\sqrt{3}$	$+1/\sqrt{3}$	-1	+1

Gauss nodes, and coordinates ξ' and η' are defined in §28.4 and Fig. 28.1

Extrapolation to the Corner Points

Shape functions of "Gauss element"

$$N_1^{e'} = \frac{1}{4}(1 - \xi')(1 - \eta')$$

$$N_2^{e'} = \frac{1}{4}(1 + \xi')(1 - \eta')$$

$$N_3^{e'} = \frac{1}{4}(1 + \xi')(1 + \eta')$$

$$N_4^{e'} = \frac{1}{4}(1 - \xi')(1 + \eta')$$

To extrapolate, replace the ξ' and η' corner coordinates of the actual element:

$$\begin{bmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \end{bmatrix} = \begin{bmatrix} 1 + \frac{1}{2}\sqrt{3} & -\frac{1}{2} & 1 - \frac{1}{2}\sqrt{3} & -\frac{1}{2} \\ -\frac{1}{2} & 1 + \frac{1}{2}\sqrt{3} & -\frac{1}{2} & 1 - \frac{1}{2}\sqrt{3} \\ 1 - \frac{1}{2}\sqrt{3} & -\frac{1}{2} & 1 + \frac{1}{2}\sqrt{3} & -\frac{1}{2} \\ -\frac{1}{2} & 1 - \frac{1}{2}\sqrt{3} & -\frac{1}{2} & 1 + \frac{1}{2}\sqrt{3} \end{bmatrix} \begin{bmatrix} w'_1 \\ w'_2 \\ w'_3 \\ w'_4 \end{bmatrix}$$

Other "Gauss Element" Configurations

