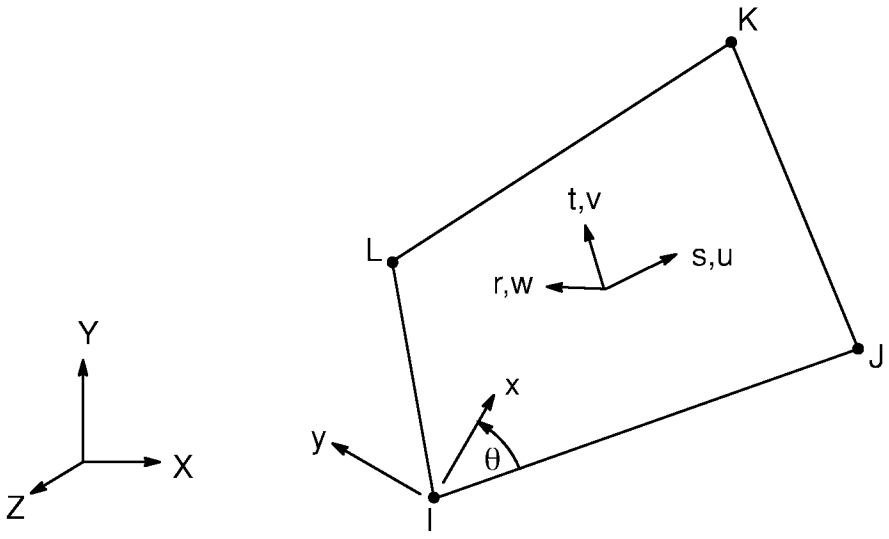
14.181 SHELL181 — Large Strain Shell



Matrix or Vector	Shape Functions	Integration Points
Stiffness Matrix	Equations (12.5.13–1), (12.5.13–2), and (12.5.13–3)	In–plane: 2 x 2 (KEYOPT(3) = 1, 2) 1 x 1 (KEYOPT(3) = 0) Thru–the–thickness: 5
Mass Matrix	Equations (12.5.8–1), (12.5.8–2), and (12.5.8–3)	Closed form integration
Stress Stiffness Matrix	Same as mass matrix	Same as stiffness matrix
Thermal Load Matrix	Same as stiffness matrix	Same as stiffness matrix
Transverse Pressure Load Vector	Equation (12.5.8–3)	2 x 2
Edge Pressure Load Vector	Equations (12.5.8–1) and (12.5.8–2) specialized to the edge	2

Load Type	Distribution
Element Temperature	Bilinear in plane of element, linear thru thickness
Nodal Temperature	Bilinear in plane of element, constant thru thickness
Pressure	Bilinear in plane of element and linear along each edge

References: Ahmad(1), Cook(5), Dvorkin(96), Dvorkin(97), Bathe and Dvorkin(98), Allman(113), Cook(114), MacNeal and Harder(115)

14.181.1 Other Applicable Sections

Chapter 2 describes the derivation of structural element matrices and load vectors as well as stress evaluations. Section 13.1 describes integration point locations.

14.181.2 Assumptions and Restrictions

Normals to the centerplane are assumed to remain straight after deformation, but not necessarily normal to the centerplane.

Each pair of integration points (in the r direction) is assumed to have the same element (material) orientation.

14.181.3 Assumed Displacement Shape Functions

The assumed displacement and transverse shear strain shape functions are given in Chapter 12. The basic functions for the transverse shear strain have been changed to avoid shear locking (Dvorkin(96), Dvorkin(97), Bathe and Dvorkin(98)) and are pictured in Figure 14.181–1.

14.181.4 Warping

A warping factor is computed as:

$$\phi = \frac{D}{t} \qquad (14.43\text{–}7)$$

where:

D = component of the vector from the first node to the fourth node parallel to the element normal

t = average thickness of the element

If $\phi > 1.0$, a warning message is printed.

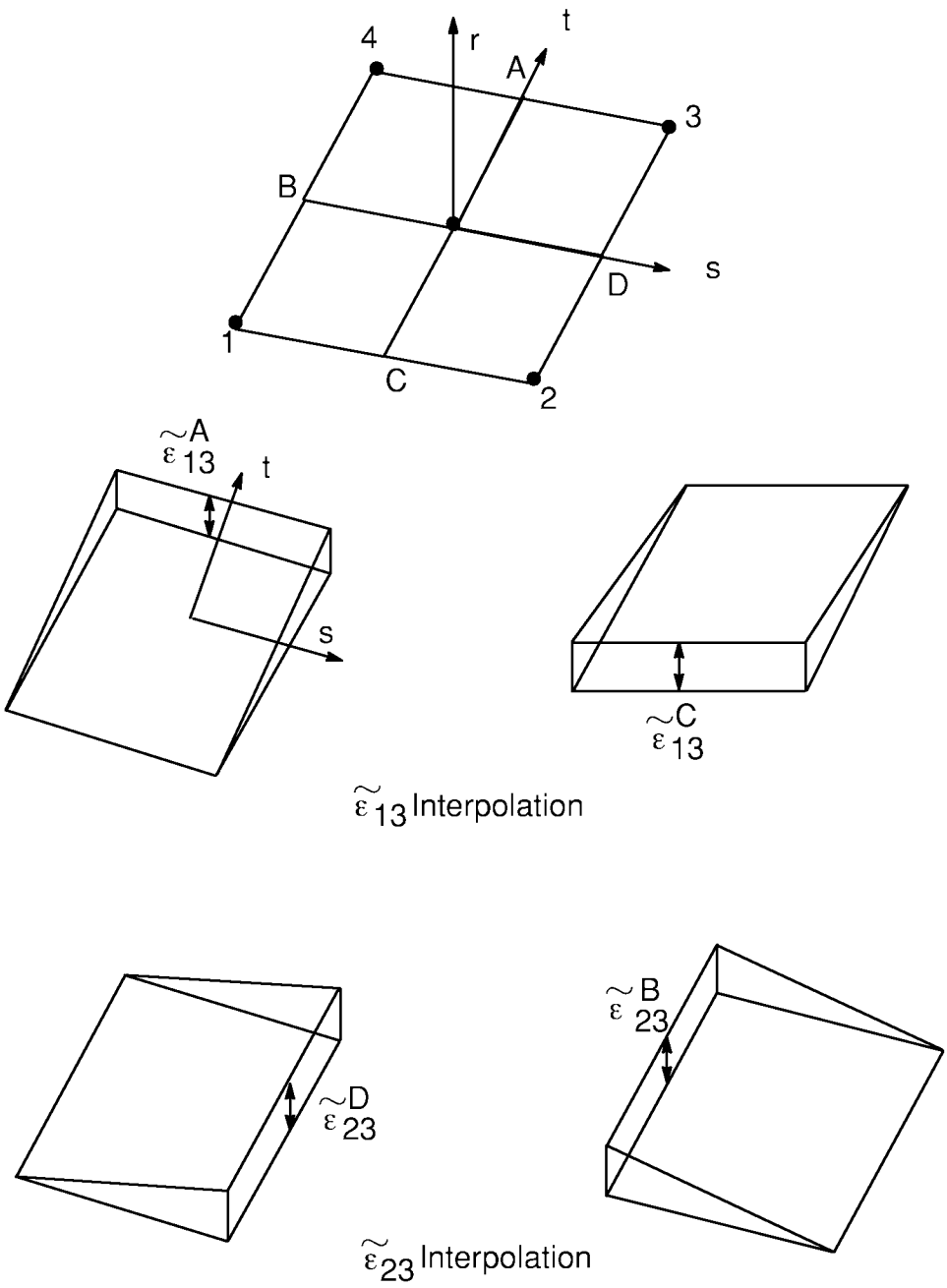


Figure 14.181–1 Shape Functions for the Transverse Strains