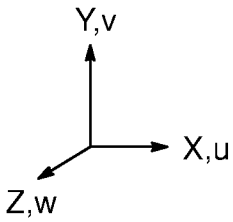
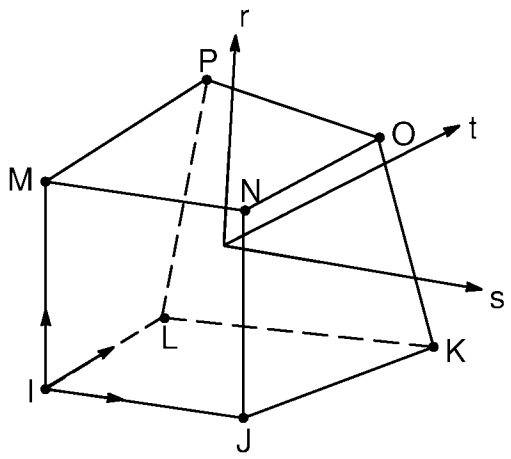
14.5 SOLID5 — 3–D Coupled Field Solid





Matrix or Vector	Shape Functions	Integration Points
Magnetic Potential Coefficient Matrix	Equation (12.8.18–22)	2 x 2 x 2
Electrical Conductivity Matrix	Equation (12.8.18–21)	2 x 2 x 2
Thermal Conductivity Matrix	Equation (12.8.18–20)	2 x 2 x 2
Stiffness Matrix	Equations (12.8.18–1), (12.8.18–2), and (12.8.18–3) or, if modified extra shapes are included (KEYOPT(3) = 0), equations (12.8.19–1), (12.8.19–2), and (12.8.19–3)	2 x 2 x 2
Piezoelectric Coupling Matrix	Same as combination of stiffness matrix without extra displacement shapes and conductivity matrix.	2 x 2 x 2
Specific Heat Matrix	Same as conductivity matrix. Matrix is diagonalized as described in Section 12.2	2 x 2 x 2

Matrix or Vector	Shape Functions	Integration Points
Mass Matrix (M)	Equation (12.8.18–1), (12.8.18–2), and (12.8.18–3)	2 x 2 x 2
Stress Stiffening Matrix	Same as mass matrix	2 x 2 x 2
Load Vector for Thermal Expansion	Same as stiffness matrix	2 x 2 x 2
Load Vector due to Imposed Thermal and Electric Gradients, Heat Generation, Joule Heating, Magnetic Forces, Magnetism due to Source Currents and Permanent Magnets	Same as coefficient or conductivity matrix	2 x 2 x 2
Load Vector due to Convection Surfaces and Pressures	Same as stiffness or conductivity matrix specialized to the surface.	2 x 2 x 2

References: Wilson (38), Taylor (49), Coulomb(76), Mayergoyz(119), Gyimesi(141, 149)

14.5.1 Other Applicable Sections

Chapter 2 describes the derivation of structural element matrices and load vectors as well as stress evaluations. Chapter 6 describes the derivation of thermal element matrices and load vectors as well as heat flux evaluations. Section 5.2 discusses the scalar potential method, which is used by this element. Section 11.1 discusses the piezoelectric capability used by the element. Section 13.1 describes integration point locations. Also, Section 14.69 discusses the thermo–electric capability.