**Linear quadrilateral element formulation**

A general approximation for  in terms of and  can be expressed as



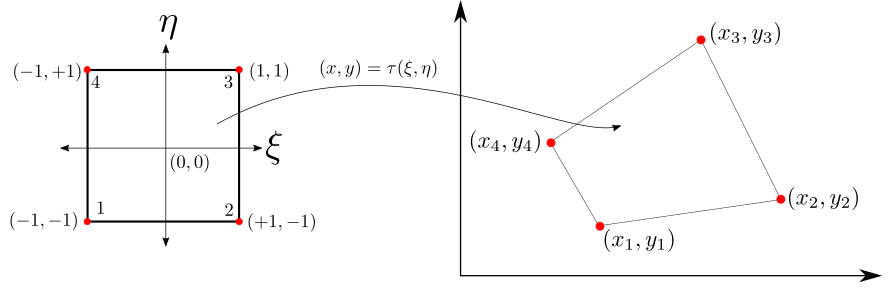


Figure 1: Geometrical Transformation

We have four nodes where we can evaluate the above equation as follows. In other words, takes four values of (-1, -1), (+1, -1), (+1, +1) and (-1, +1). Substituting these values, we arrive at four equations as shown below.









Representing the above equations in matrix form



or in a more compact form as



Thus, the coefficients can be calculated by inverting A as shown below



We find that



Substituting this we get





Further simplifying,



where









**8-node hexahedron element formulation**



Evaluating this equation at eight nodes of the reference element,

















Expressing the above equation in matrix form, we get







We can express the above equation as





















The derivatives of the shape functions are

1. With respect to 

















1. With respect to 

















1. With respect to 















