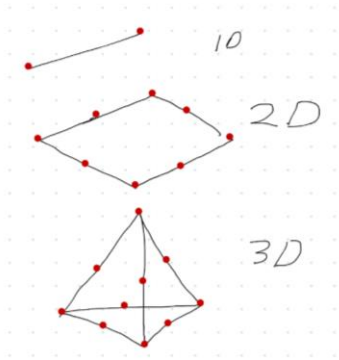


1

- a. With the aid of a diagram, discuss what is meant by 1D, 2D or 3D elements.



A 1D element be seen above. This shows 1 element with 2 nodes. The section and the orientation of the section is needed so that second moment of area and polar second moment of area etc can be calculated. The 2D element shown is a 'quad' element. This needs the thickness defined so that the sectional properties can be calculated. The 3D element shown is a 'tet' element. This has all of the geometry of the structure defined by the size and shape of the element.

- b. Using your diagram in part a, discuss what is meant by first order and second order elements.

If an element is first order then nodes exist in the corners only, if it is second order then mid-side nodes are also used. A quad element (as seen above) would have 4 nodes if it was first order and 8 if it was second order. A tet element (as seen above) would have 4 nodes if it was first order and 10 if it was second order.

- c. Discuss when you would use 1D, 2D or 3D elements and how you would decide whether to use first order or second order elements.

Generally if the structure is 1 dimensional you would use 1D elements (that is to say that one dimension is much greater than the other two). 2D elements would be used if the structure was 2 dimensional (i.e. one dimension is much smaller than the other two). Finally, you would use 3D elements if the structure was essentially 3 dimensional. That is to say that all the dimensions are approximately the same. However, increasing the element type from 1D to 2D to 3D elements will adversely impact the run time hence you should use the simplest element type possible.

The stresses and strains are calculated at each node. Hence second order elements are more accurate than first order elements. However this too adversely impacts that run time so that there is always a trade off between runtime and accuracy.