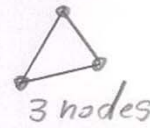


Area Element Types



more general ?

A solid Axisymmetric

- 2D Analysis
- In plane forces

Z = axis of symmetry

thickness = $\theta = 360^\circ$
if $\theta = 0^\circ$

Sap puts $\theta = 1$ rad

Plane (membrane)

plane stress

- 2D Analysis
- In plane forces

- Small t ?
- $\sigma_{out-plane} = 0$
- Gusset plate, Shear wall

plane strain

- 2D Analysis
- In plane forces

Dam

- Large t , take unit t ?
- $\epsilon_{out-plane} = 0$
- Dam, Culvert

plate (bending)

- 2D Analysis
- Out of plane forces

- Small t ?
- No in-plane forces
- Slabs under vertical loads.

Shell

- 3D Analysis
- In + out of plane forces

Shell ?
Plane Membrane + plate
 t ? t ?

- Slabs under gravity loads and horizontal (Wind or EQ) loads
- 6Dof at node

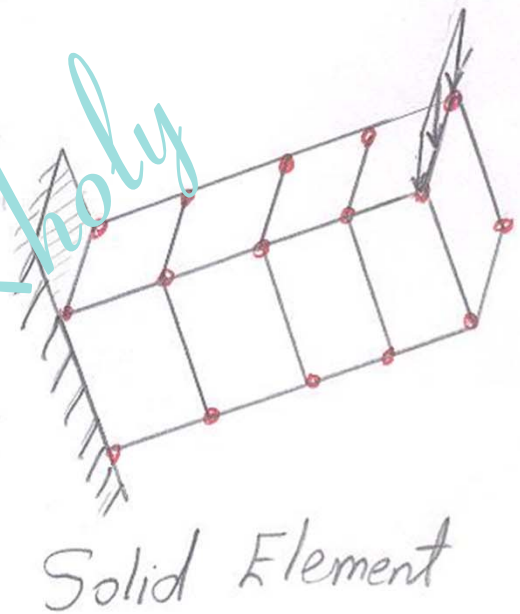
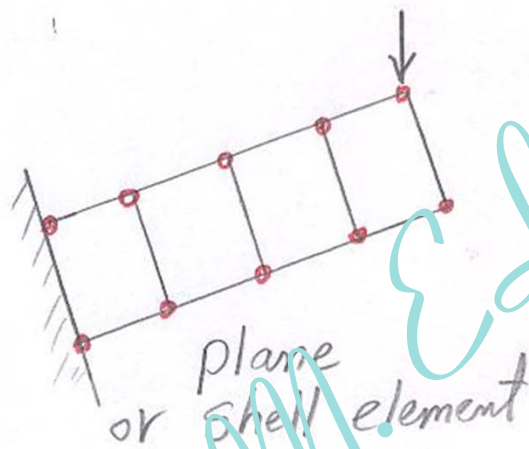
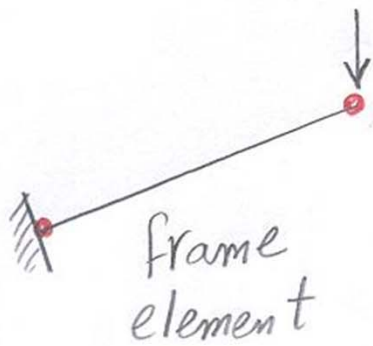
Define Section properties Area sections

• Thin: Neglect transverse? Shear deformation

• Thick: Include transverse? Shear deformation

• Thick: $t \geq \frac{1}{10} \sim \frac{1}{5}$ span

* Transfer slab Use thick



b. Modeling of RC beam with different 3 alternatives

More Realistic "Research Problems"

More Simplicity + Design Problems"

OK for Design

Better for Research