

# Current Trends in Post-tensioned Building Design

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# Introduction

- Design Software
- Drafting software
  - BOQ preparation
  - Automatic shop drawing generation
  - Extension calculations
- Structural solutions
  - Precast hybrid
  - Formwork solutions

# The Use of Metal Deck Formwork

- Type of structural system
  - One way / Two way
- Strength design
- Long term deflections
- Fire rating
- Structural detailing
  - Connections to conventionally formed sections
  - Details at the joints
  - Nominating the system on the drawings

# The Use of Metal Deck Formwork



Westfield Bondi Junction

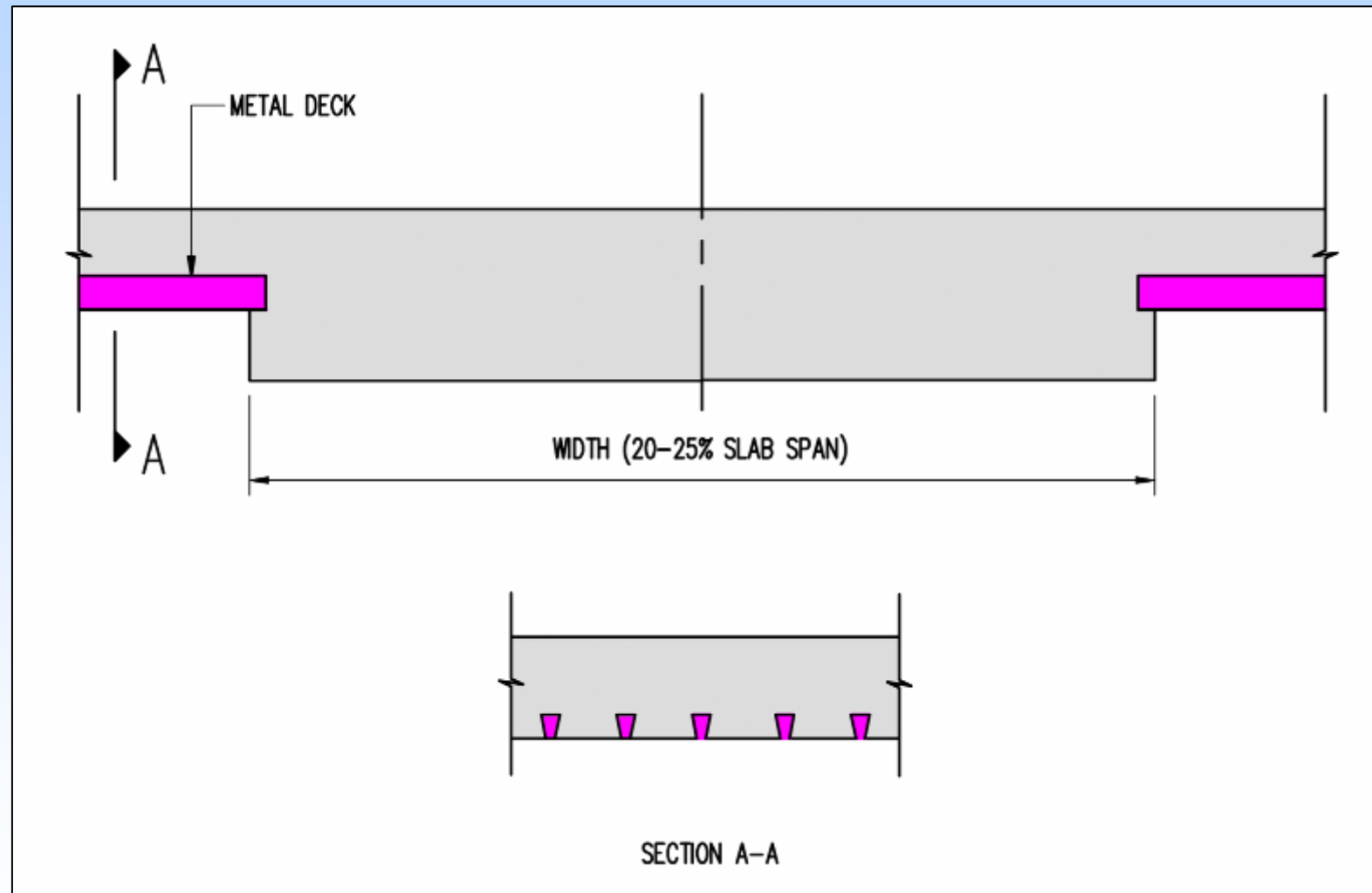


# The Use of Metal Deck Formwork



Slab soffit

# The Use of Metal Deck Formwork

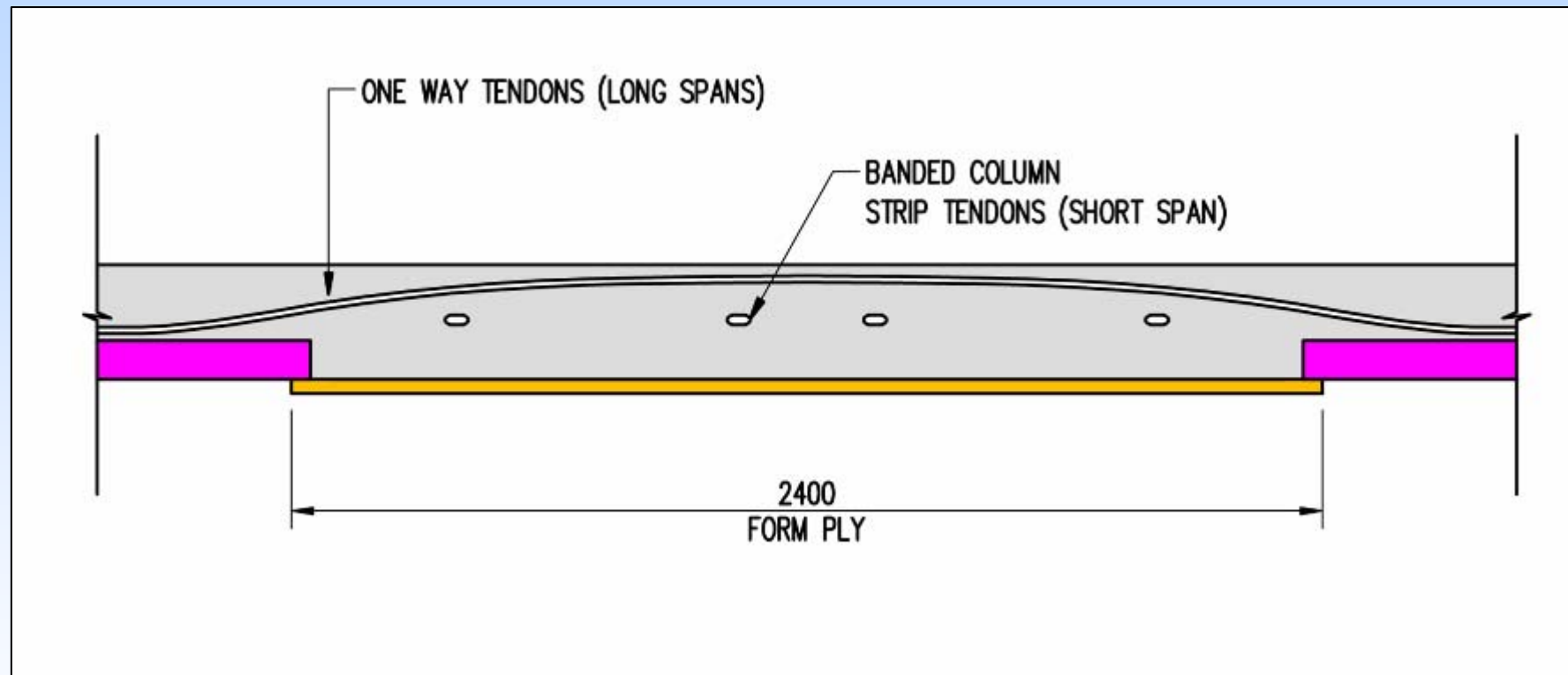


# The Use of Metal Deck Formwork



P-T tendon between ribs

# The Use of Metal Deck Formwork



Hybrid flat plate scheme



# The Use of Metal Deck Formwork

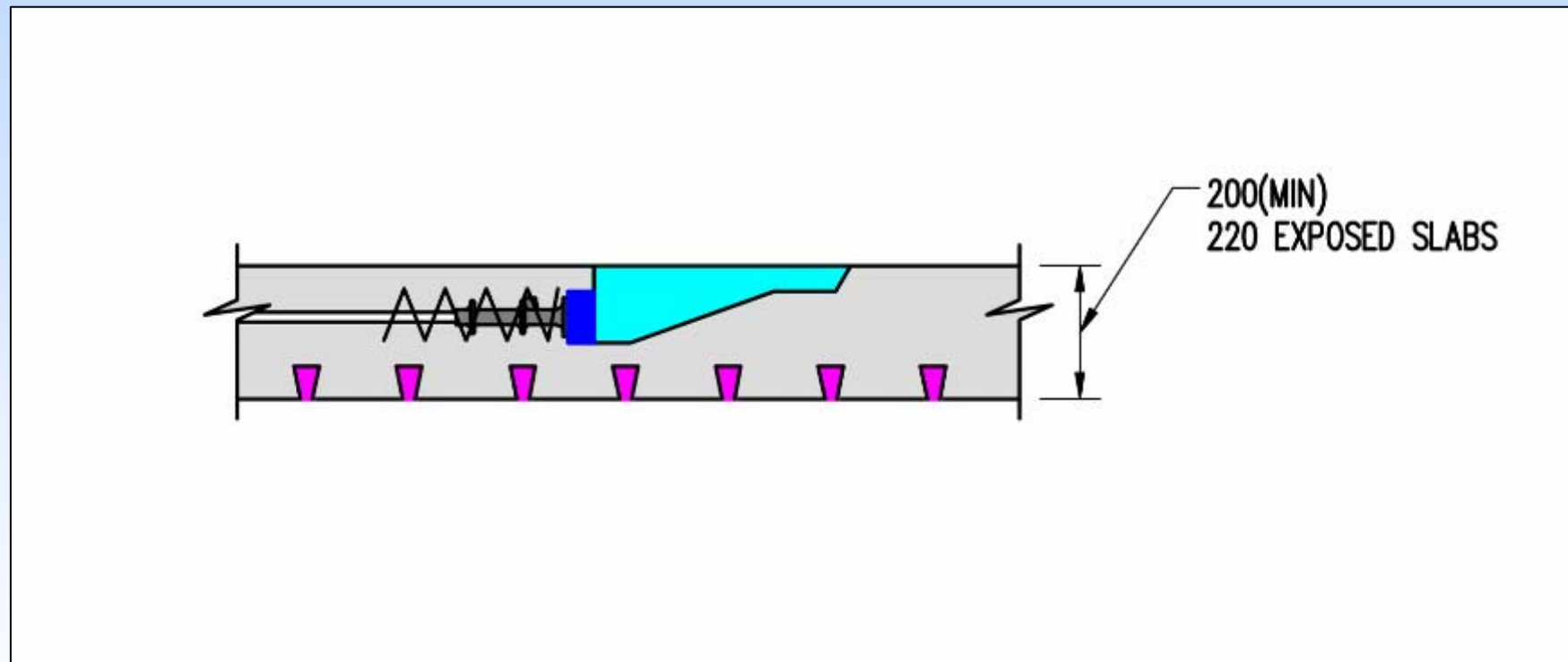
- Strength
  - Negative bending moments are generally higher
  - Do P-T slabs need bottom reinforcement?
  - Removing P-T will increase deflections
- Serviceability
  - Metal deck restrains bottom surface
  - Increased shrinkage warping deflection

# The Use of Metal Deck Formwork

- Concentrated loads
  - Reduced stiffness in the 2ndy direction
  - Check width of slab able to support loads
- Fire Rating
  - Common systems satisfactory for 2 – 3 hour FRR
  - Ribbed paneled systems need checking with manufacturer

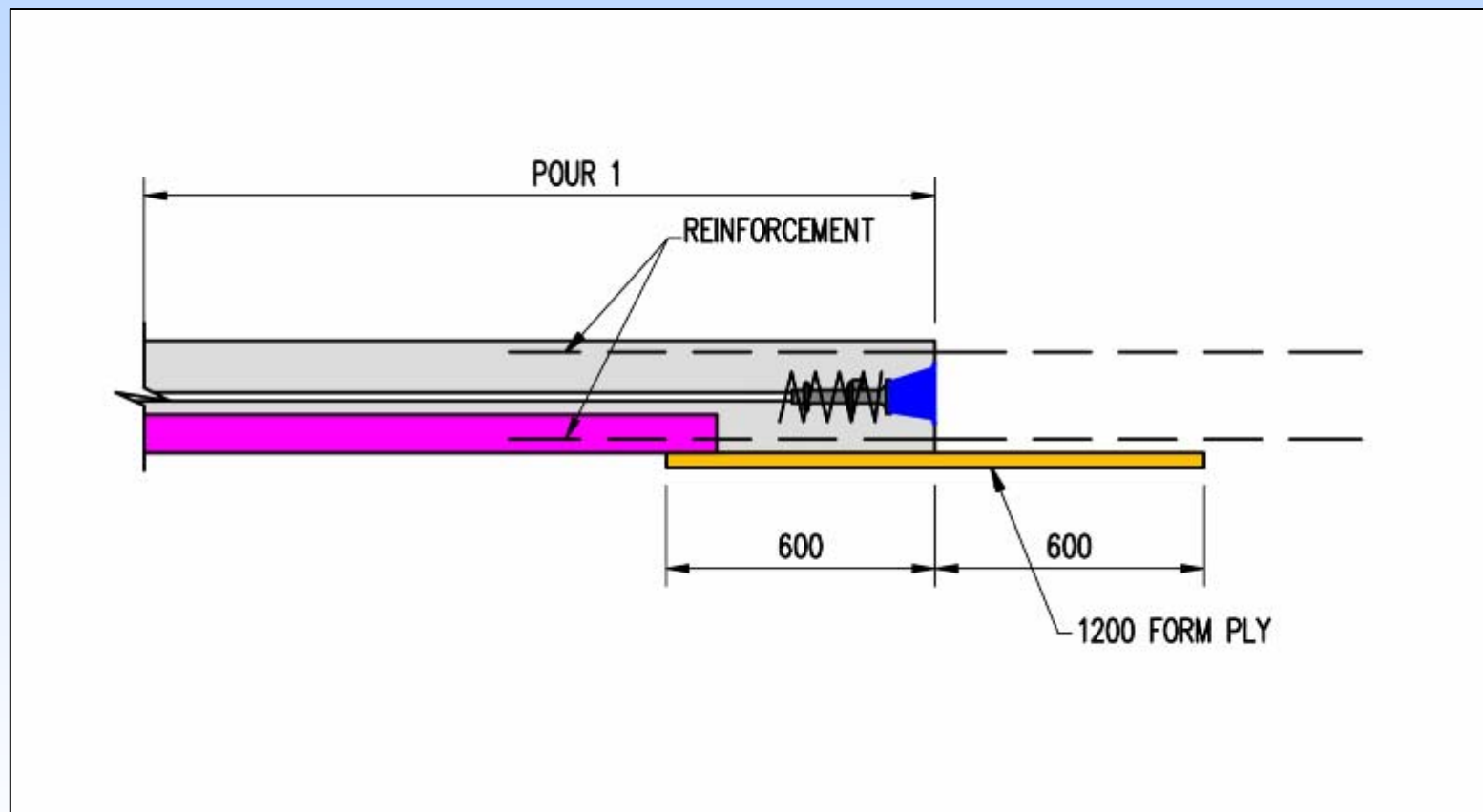


# The Use of Metal Deck Formwork



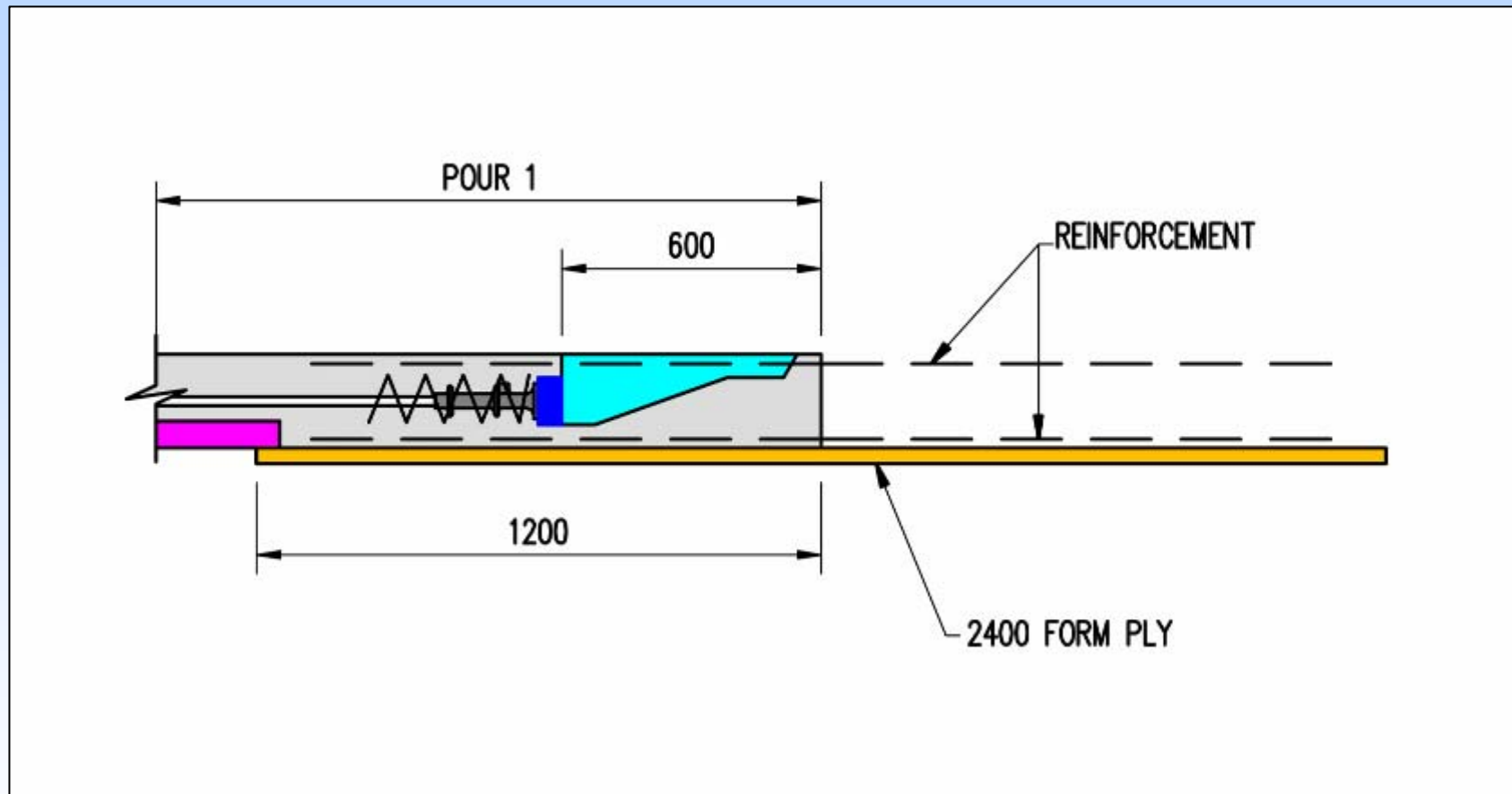
Minimum slab thickness

# The Use of Metal Deck Formwork



Construction Joint Perpendicular to Ribs

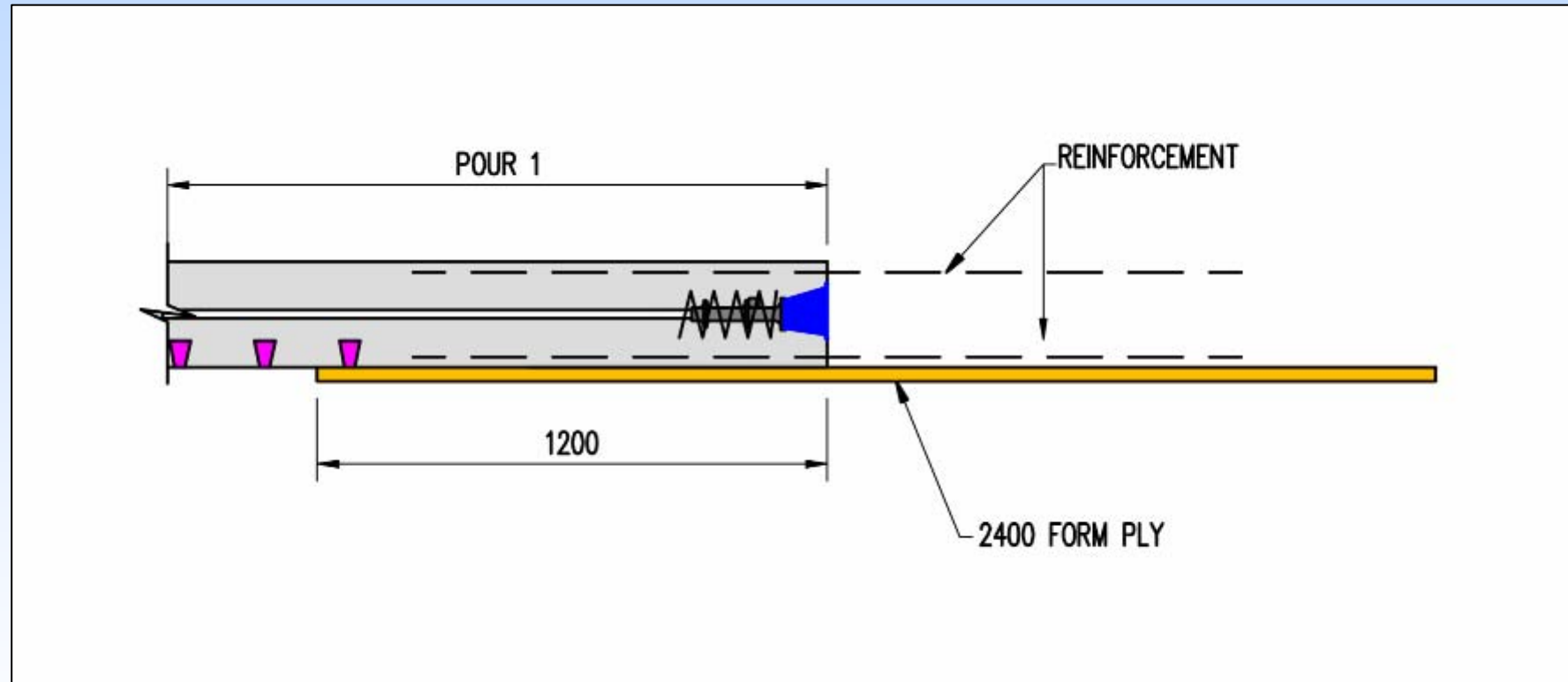
# The Use of Metal Deck Formwork



Construction Joint and Stressing Pocket

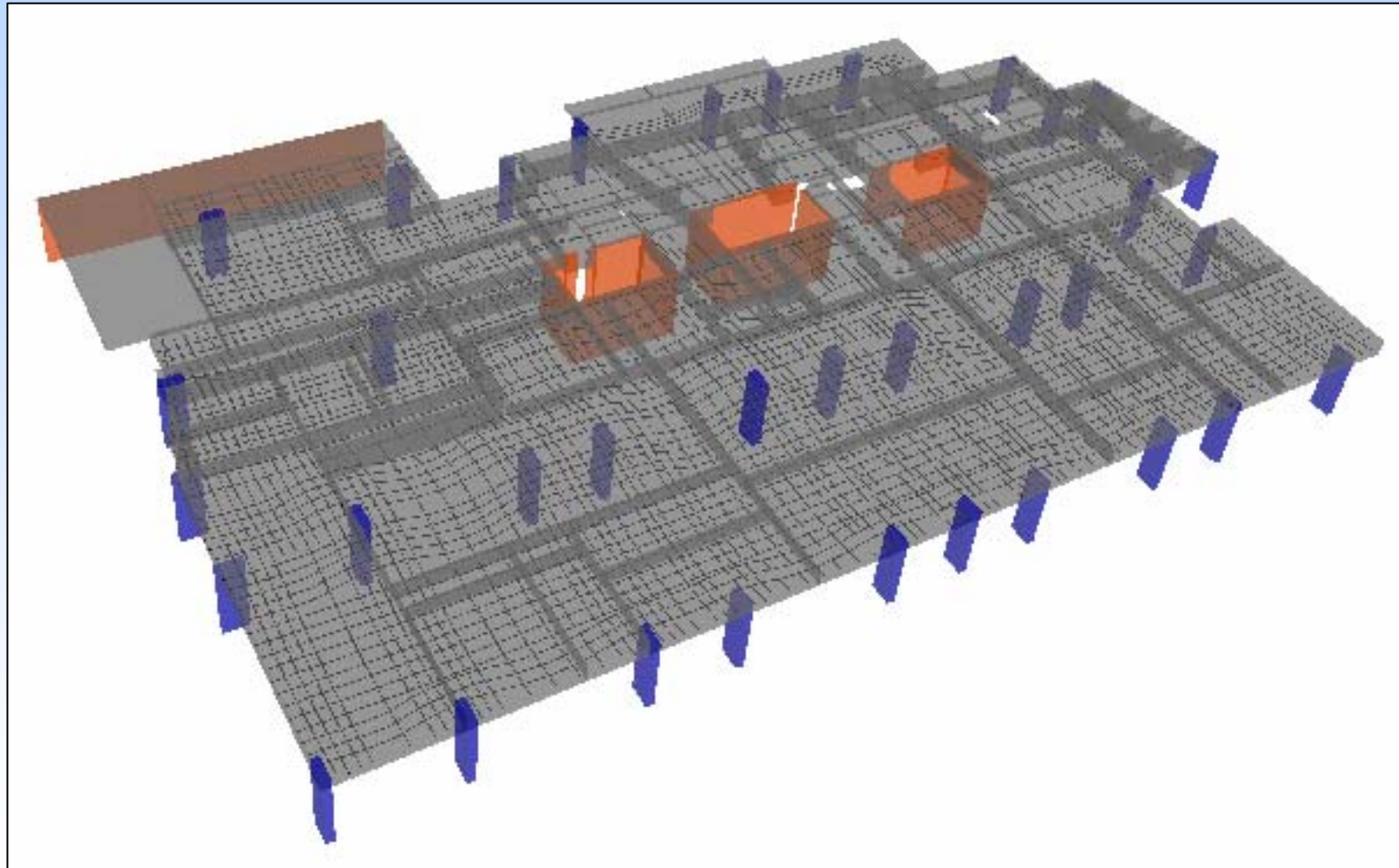


# The Use of Metal Deck Formwork



Construction Joint Parallel to Ribs

# Finite Element Methods



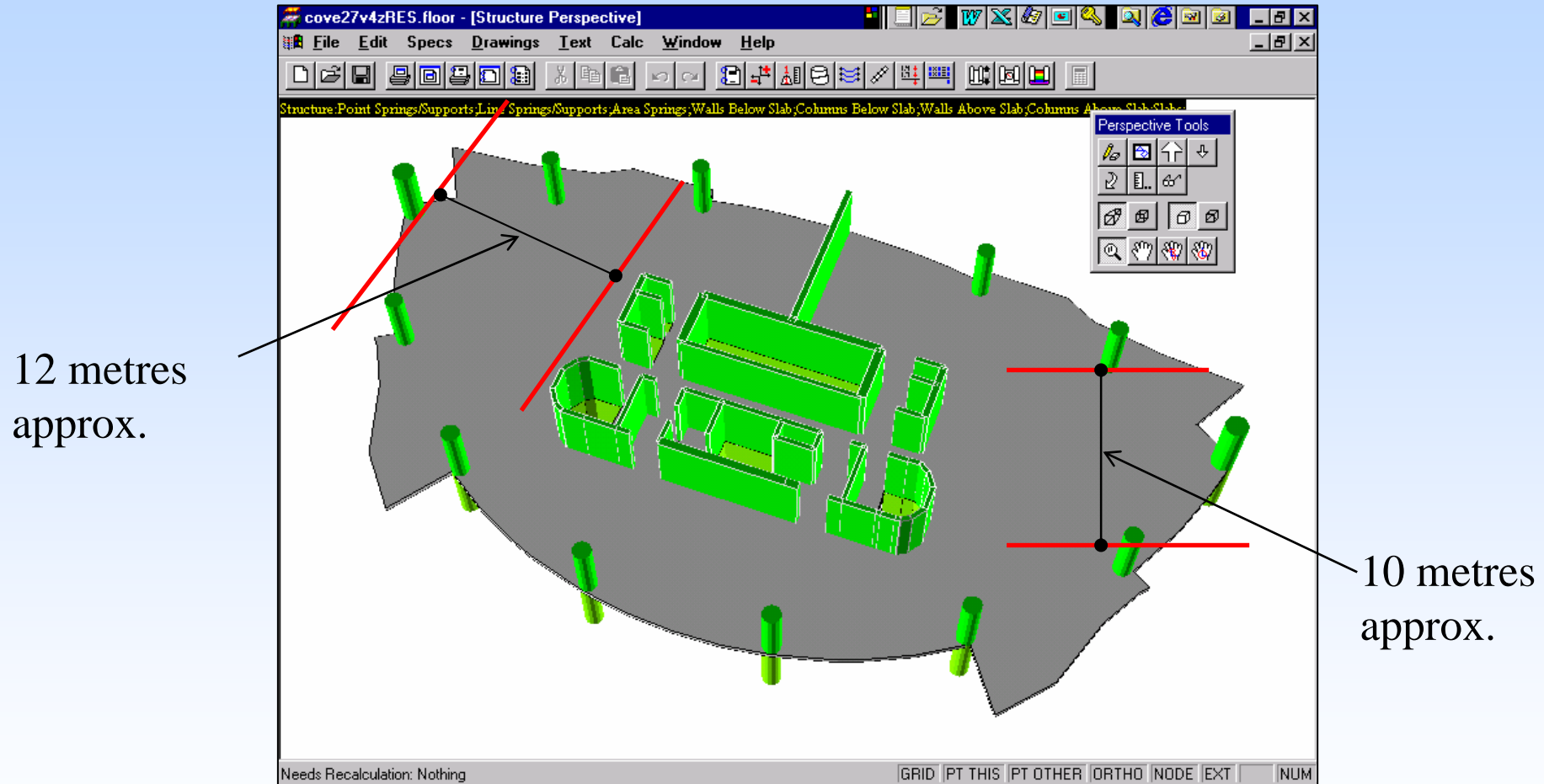
# Finite Element Methods

- In use for irregular structures for many years



The Cove Apartments,  
The Rocks, Sydney

# Finite Element Methods



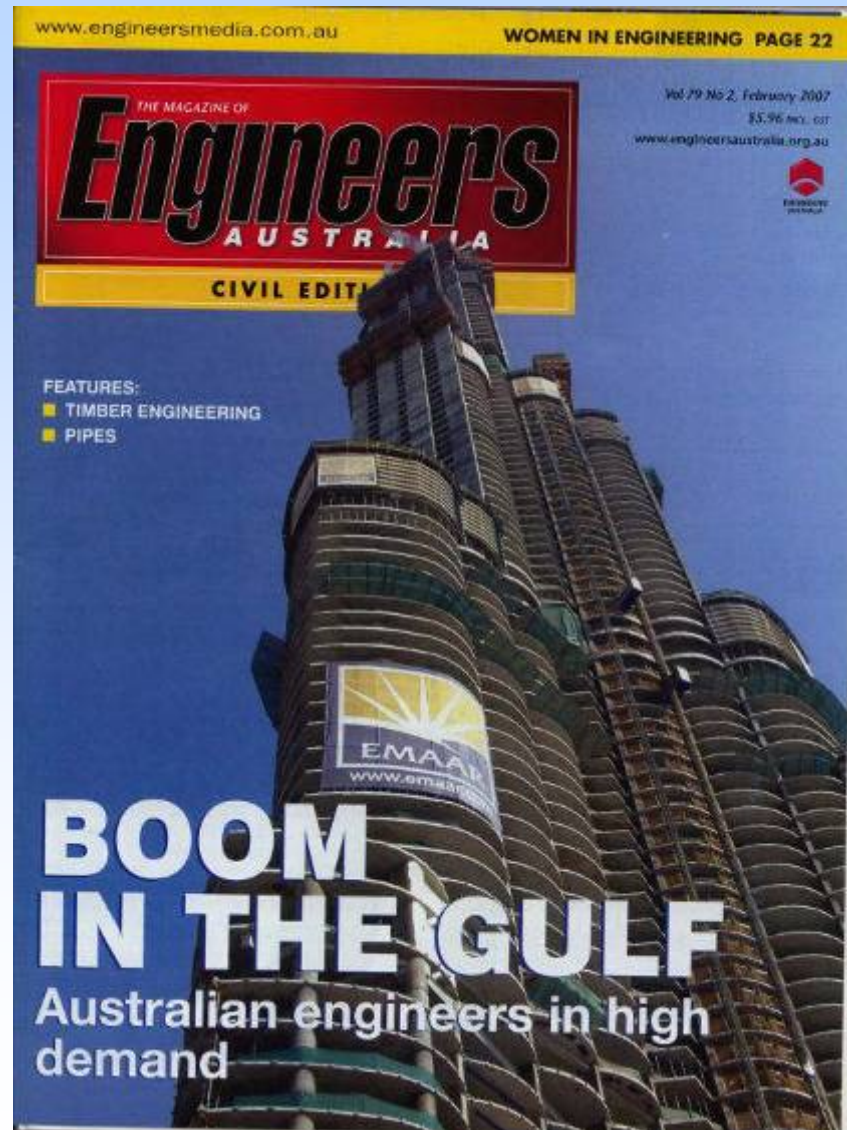
Structure Perspective

# Finite Element Methods

- Advantages
  - Design irregular structures with confidence
  - Floor can be analysed quickly
  - Interface with drafting software

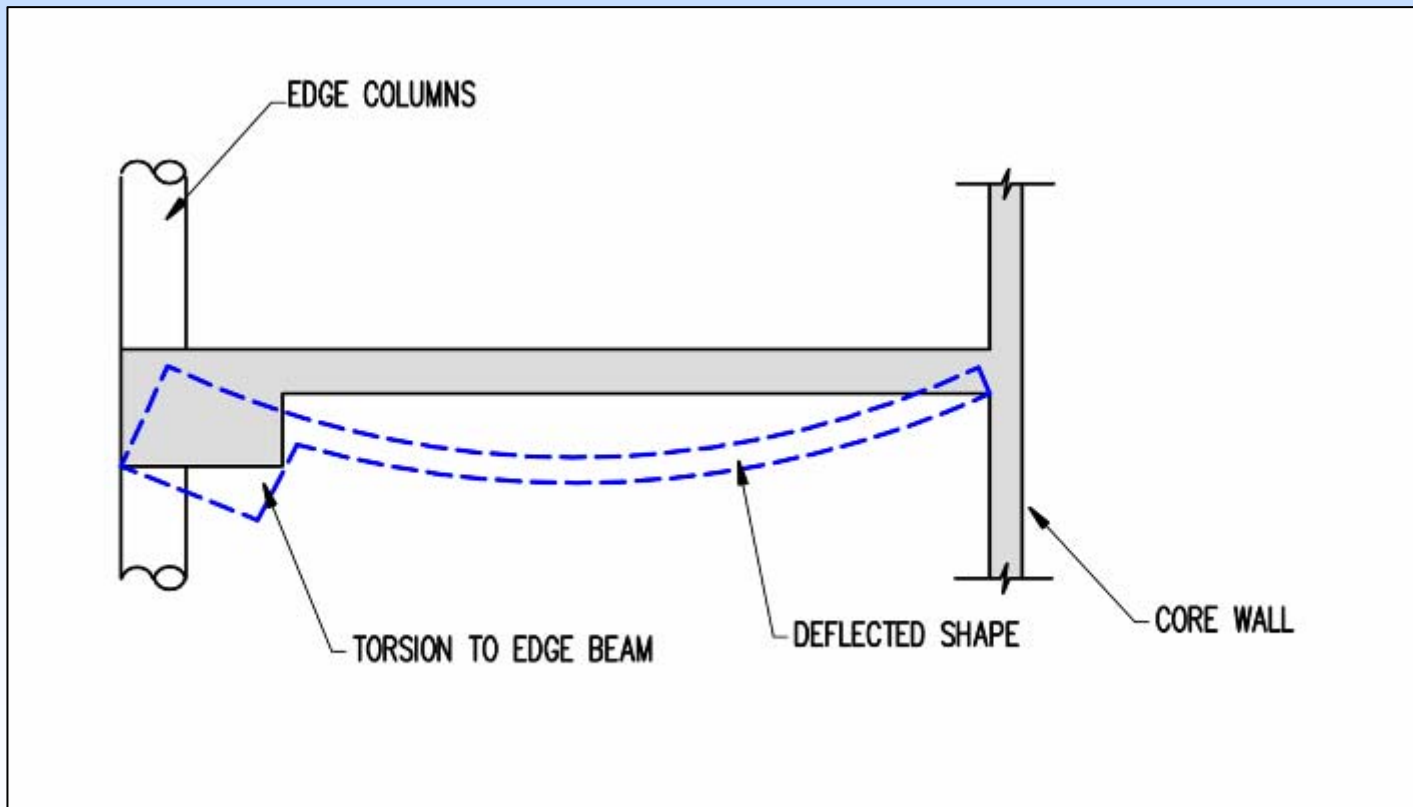


# Finite Element Methods



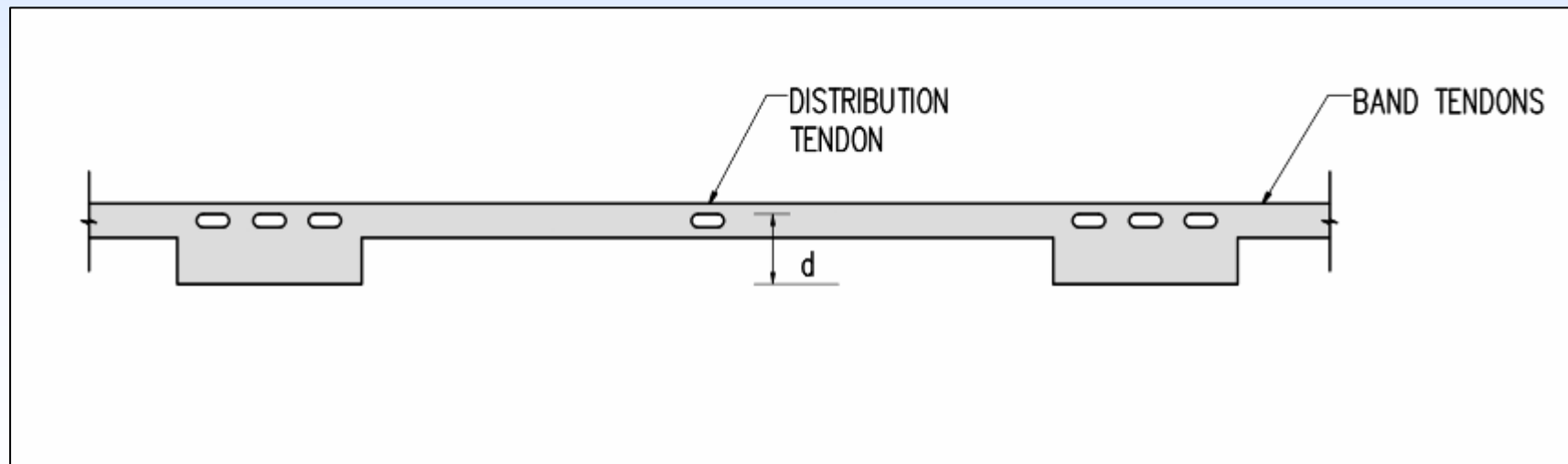
# Finite Element Methods

- Torsion to edge of slab



# Finite Element Methods

- Ensure all moments are included in the design
  - Mxy moments
- Careful with two way average moments
  - Carefully check strip widths



# Finite Element Methods

- Transfer of moments into supporting elements
  - AS3600 – 25% full panel moments resisted at the column (clause 9.1.2)
  - Check the localised area around the column (not just the column strip width)
  - Check that moment transferred into column front face is able to be resisted
  - At least 1 tendon must be located close to the column face

# Finite Element Methods

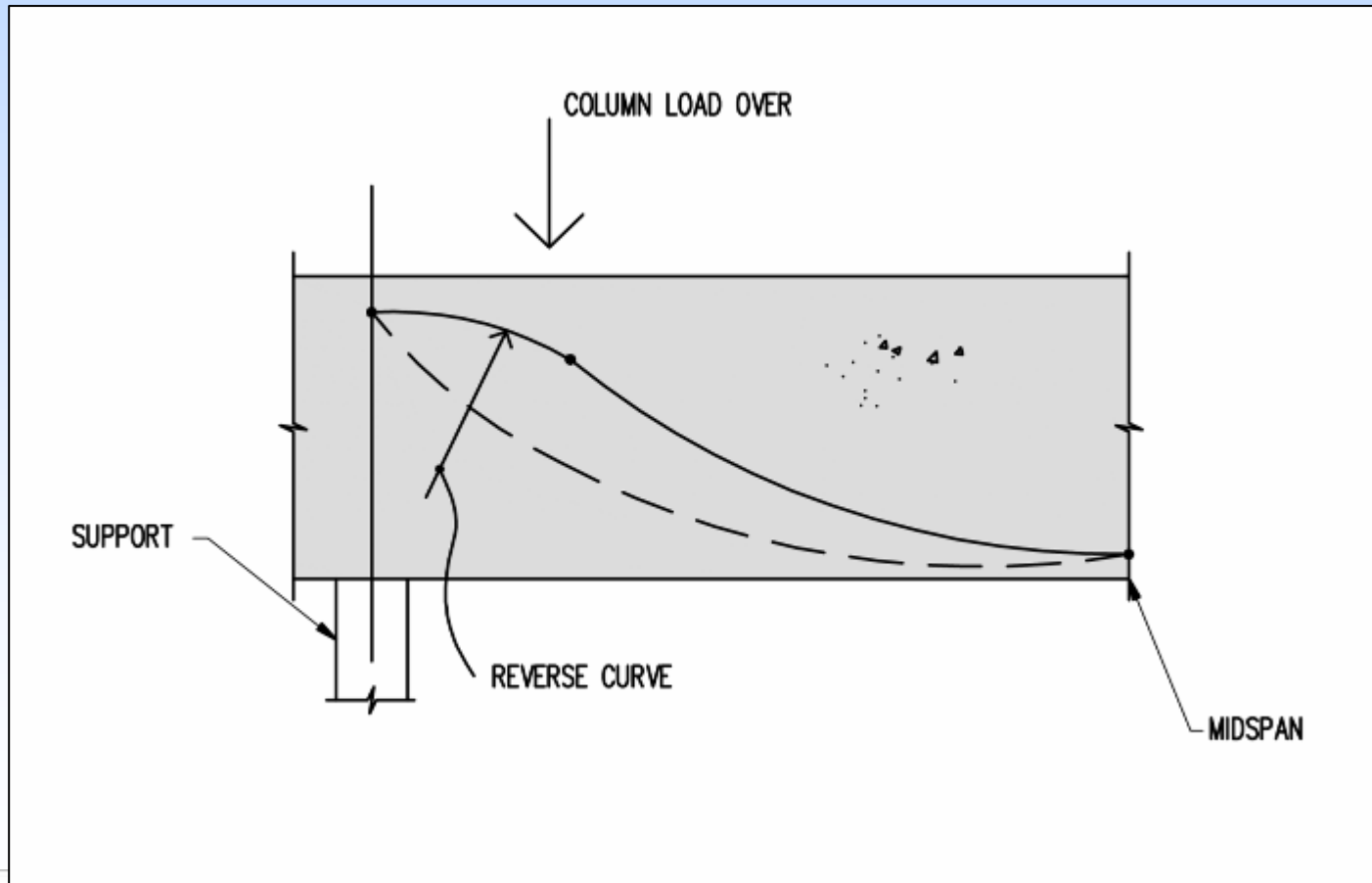
- Deflection

- Calculate  $I_{\text{effective}}$  (Branson's formula)
- Service stress limits
- Service stresses above  $0.25\sqrt{F'c}$ 
  - Bonded tendons or reinforcement close to the tensile face
- Long term load cases
  - $(DL + P-T) \cdot (1+k_{cs}) + (\Psi_i \cdot k_{cs}) \cdot LL + \Psi_s \cdot LL$
  - $(DL + P-T) \cdot 3 + LL \cdot 1.5$



# Finite Element Methods

- Correct modeling of tendon profiles



# Finite Element Methods

- Other factors to consider
  - Verification of the design
  - Calculation of losses
  - Minimum  $P/A$  to ensure control of shrinkage cracks
  - Punching shear calculations (to columns over as well)

# Conclusion

- Understand how metal deck formwork affects the structure
- Detailing is critical
- Finite Element methods can be advantages
- Understand what the software is doing
- Understand the limitations of the software
- Verify your design!