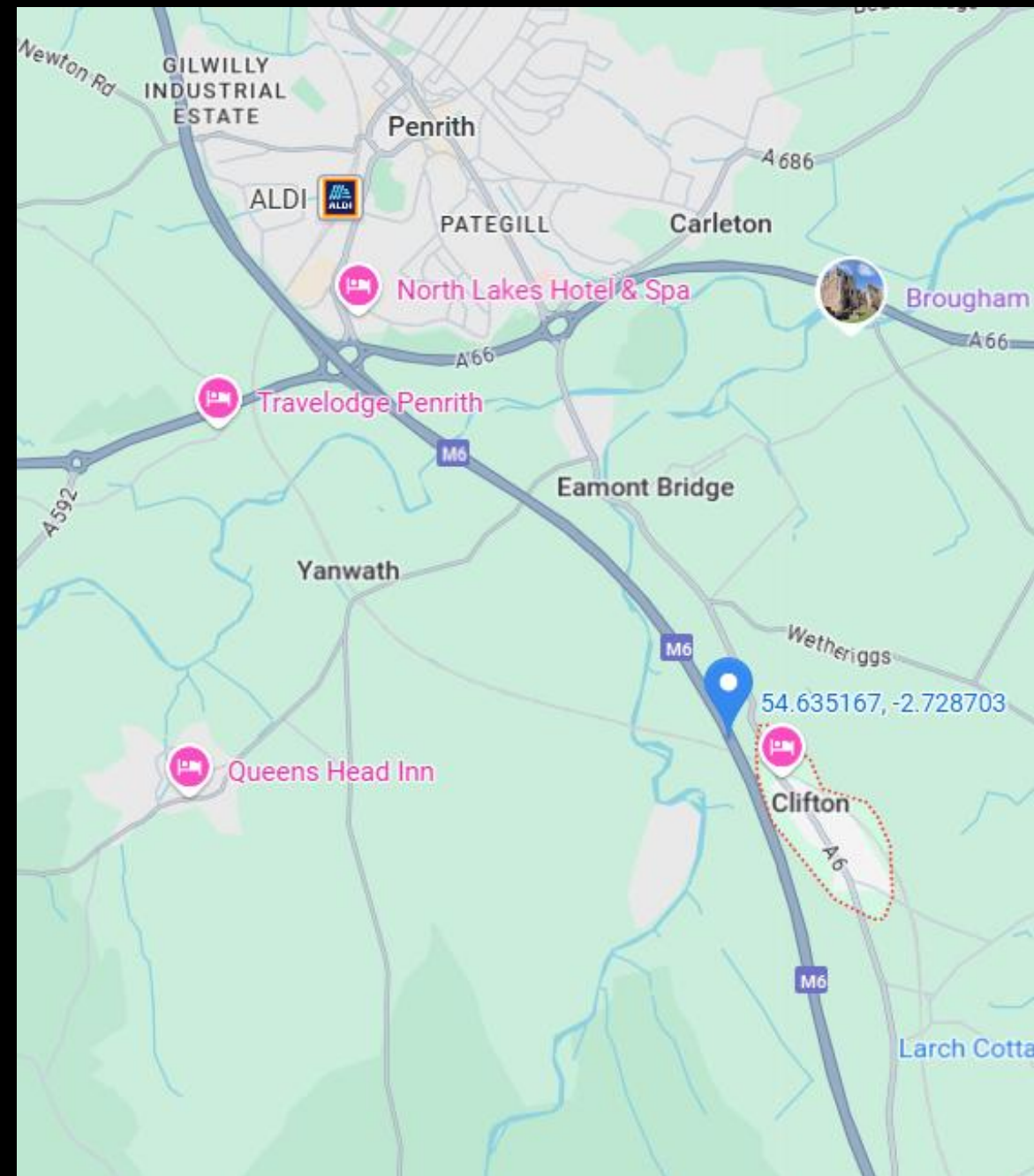
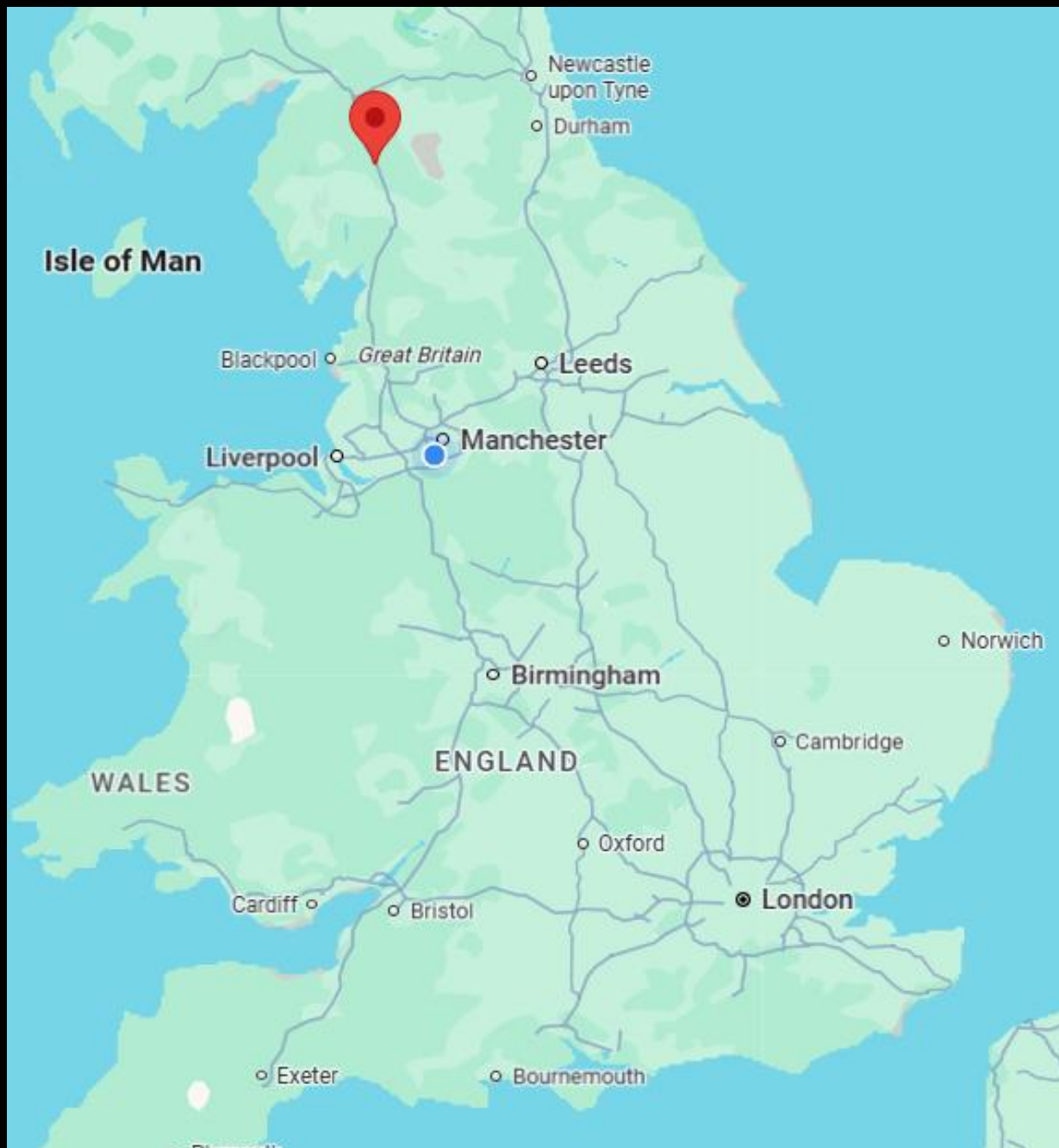


CLIFTON BRIDGE



OVERVIEW

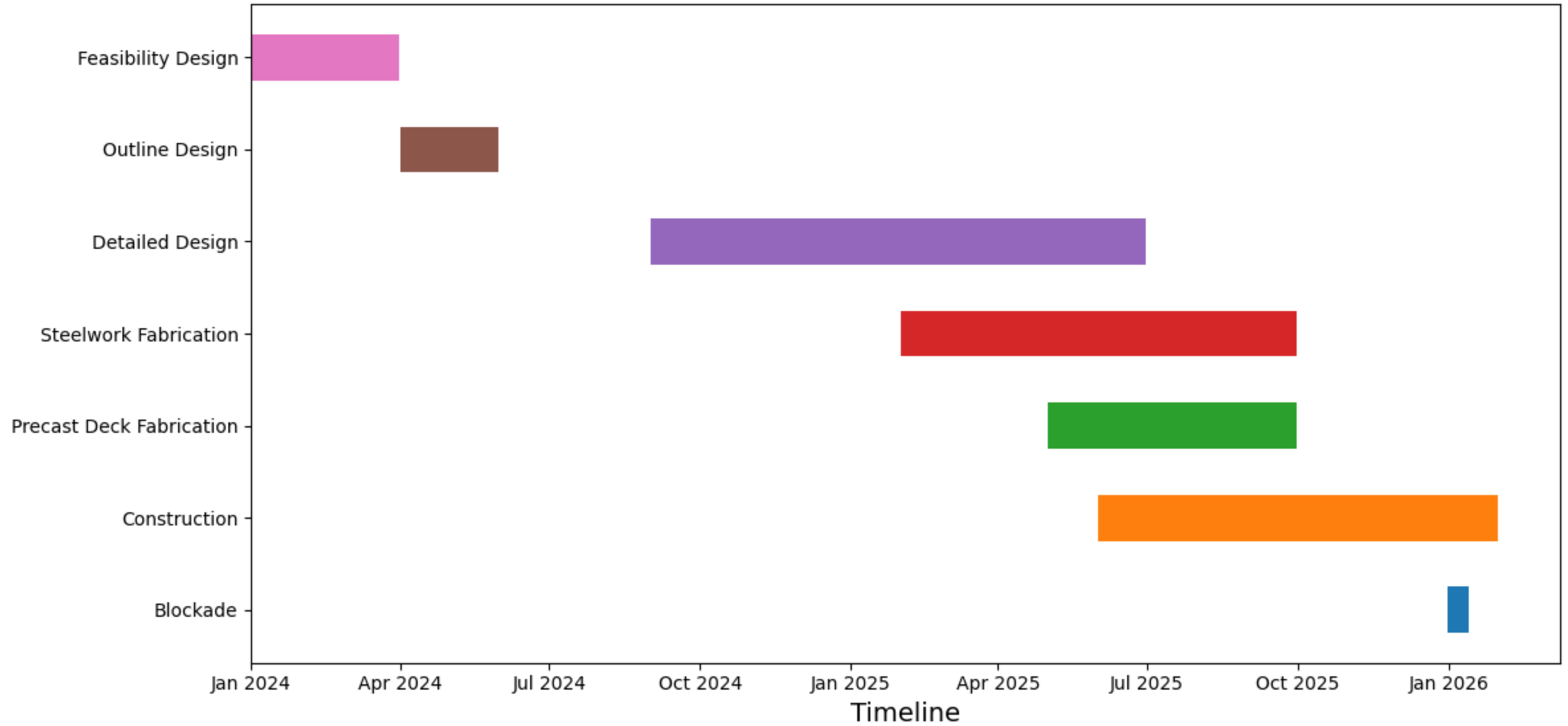
- Project Overview
- Structural Form
- Outline Design
 - Workflow
 - Analysis Approach
 - Global Model
 - Moving Loads
- Detailed Design
 - Construction Stages
 - Virtual Beams



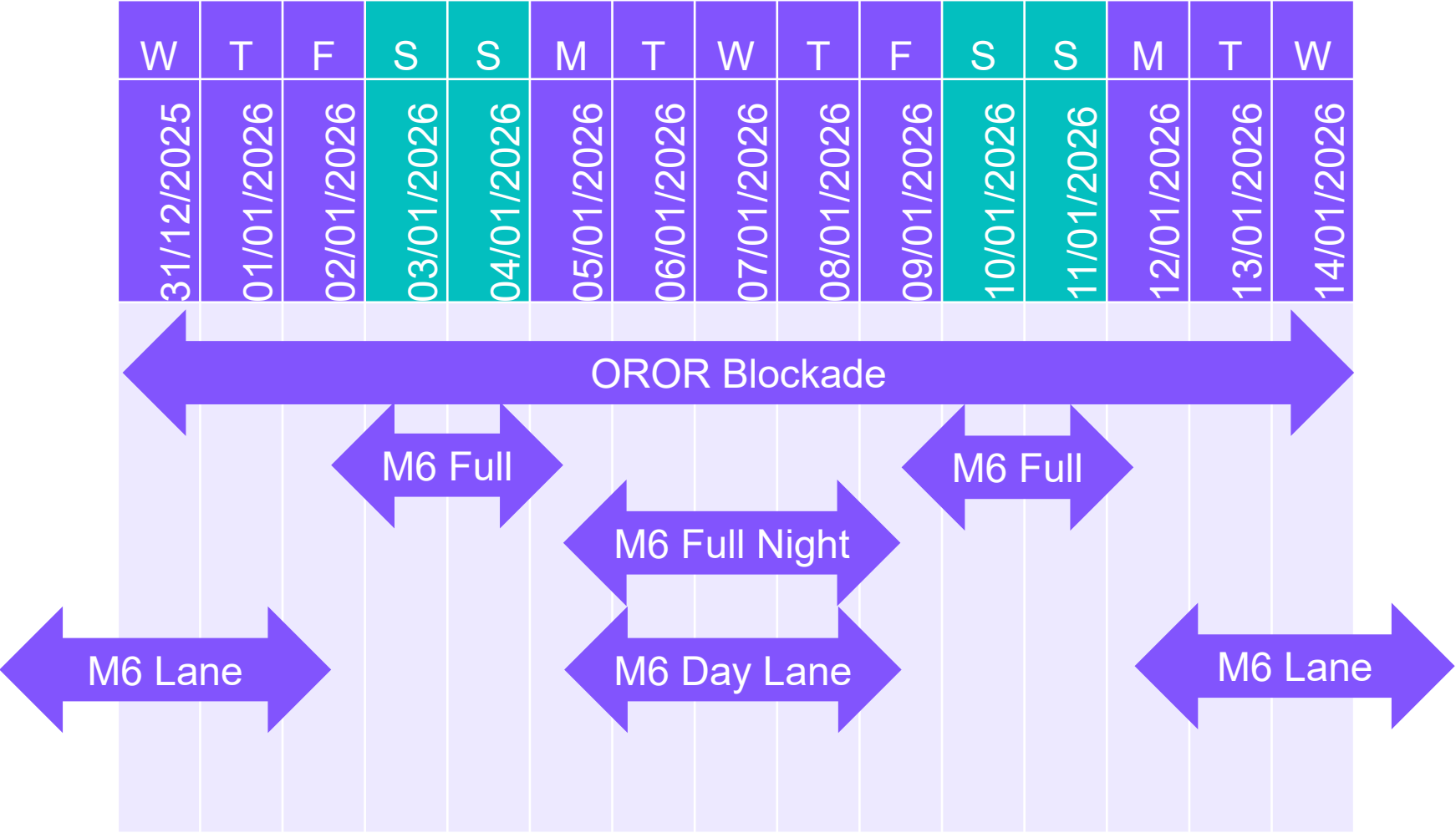


Post-Tensioned Box Girder
Deteriorating post-tensioning tendons.

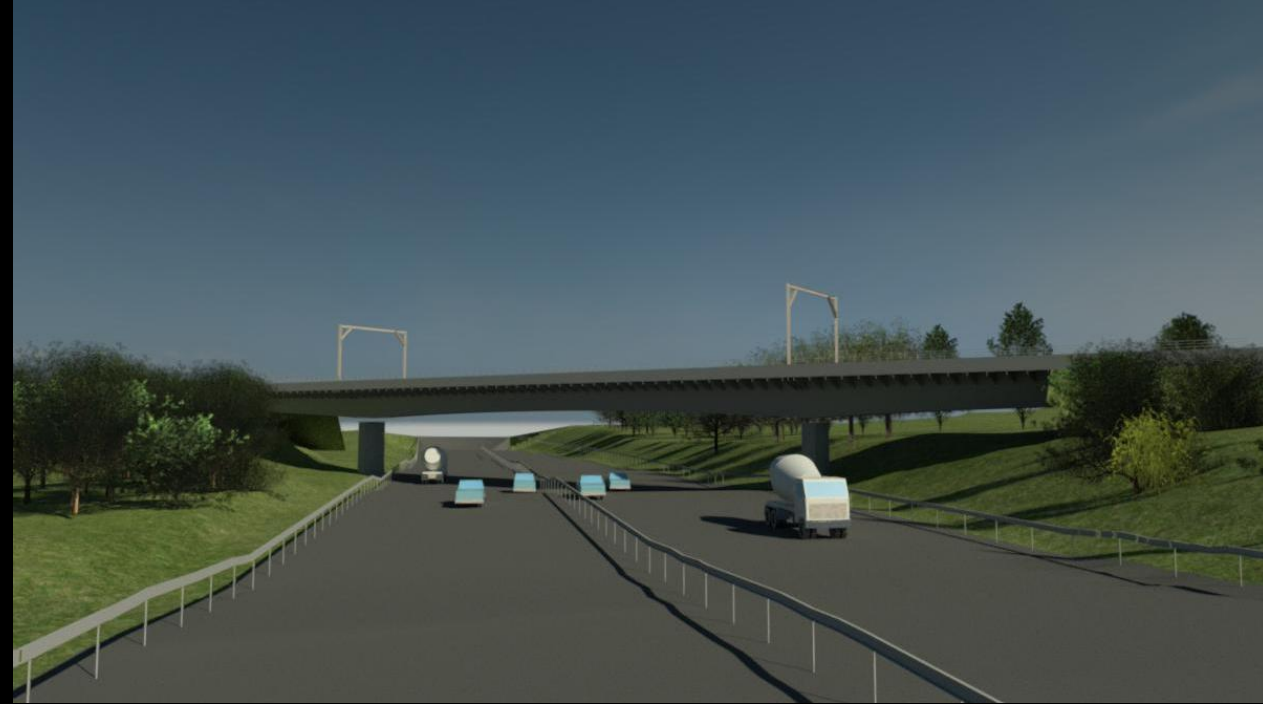
Clifton Bridge Programme Timeline



Blockade Constraints



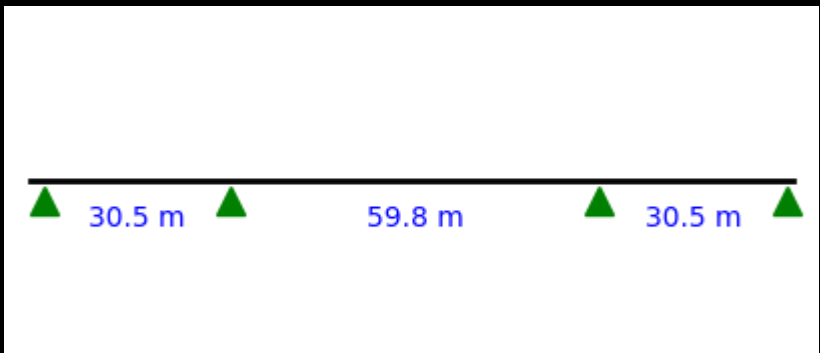
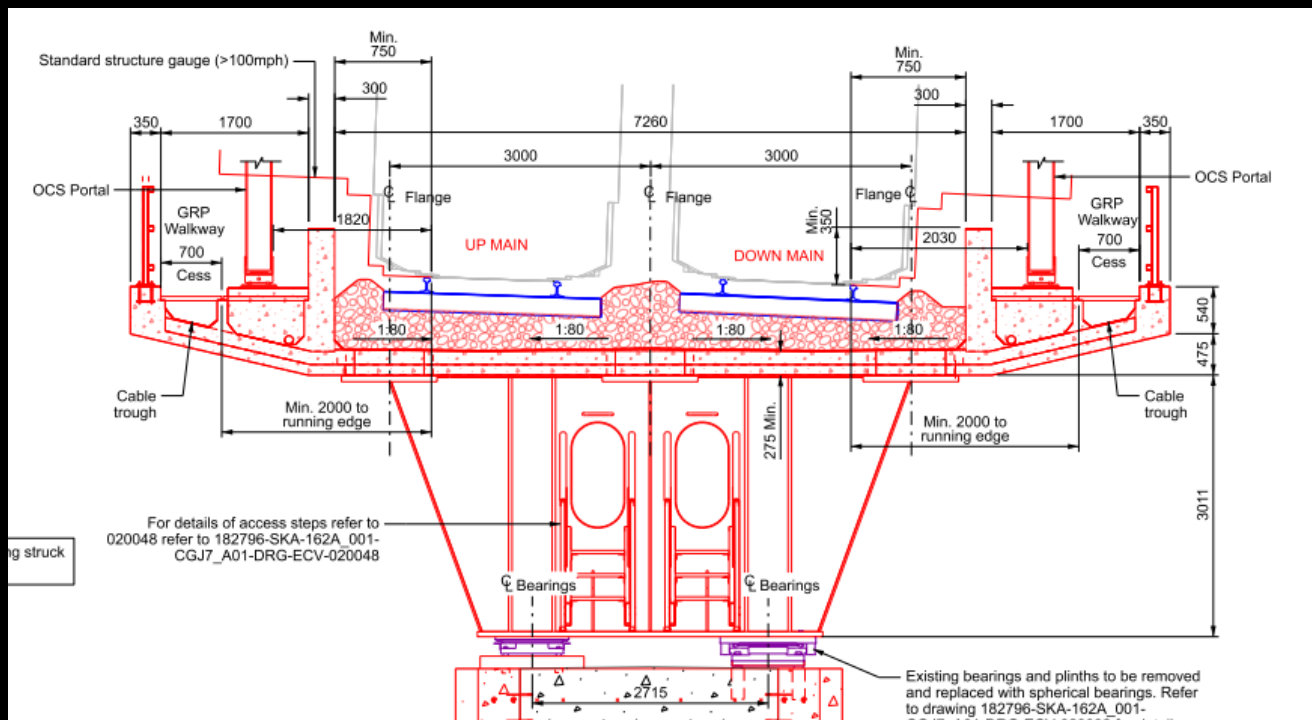
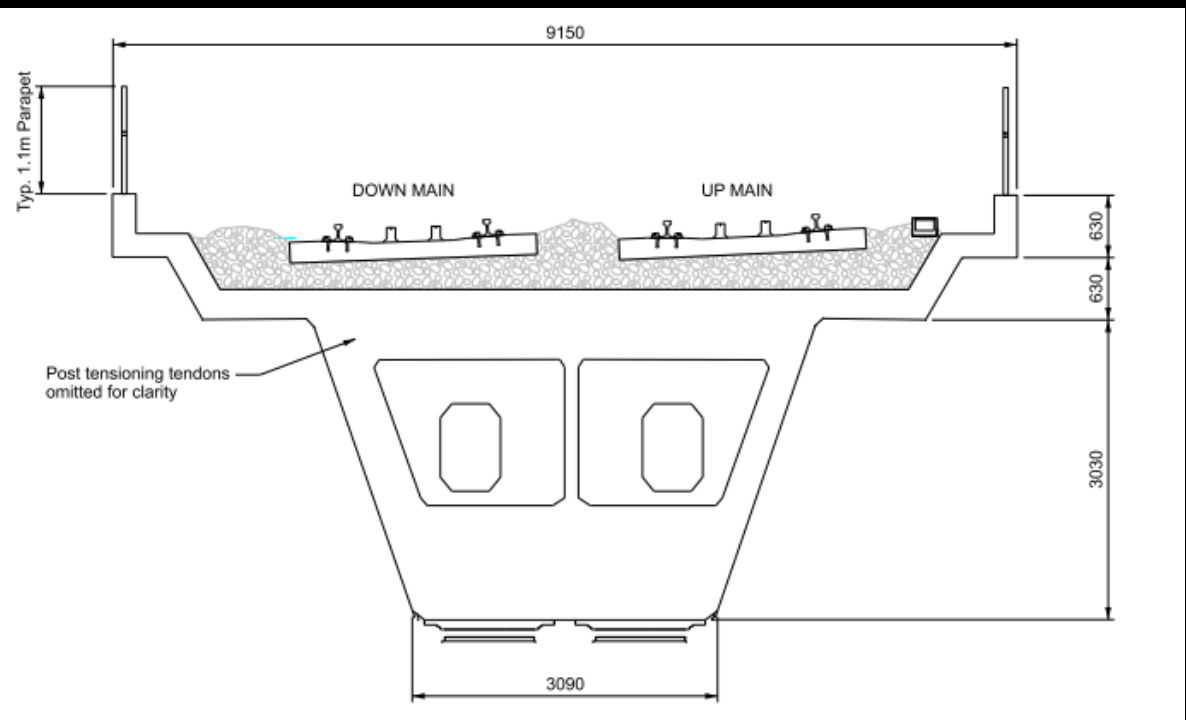
Option Development



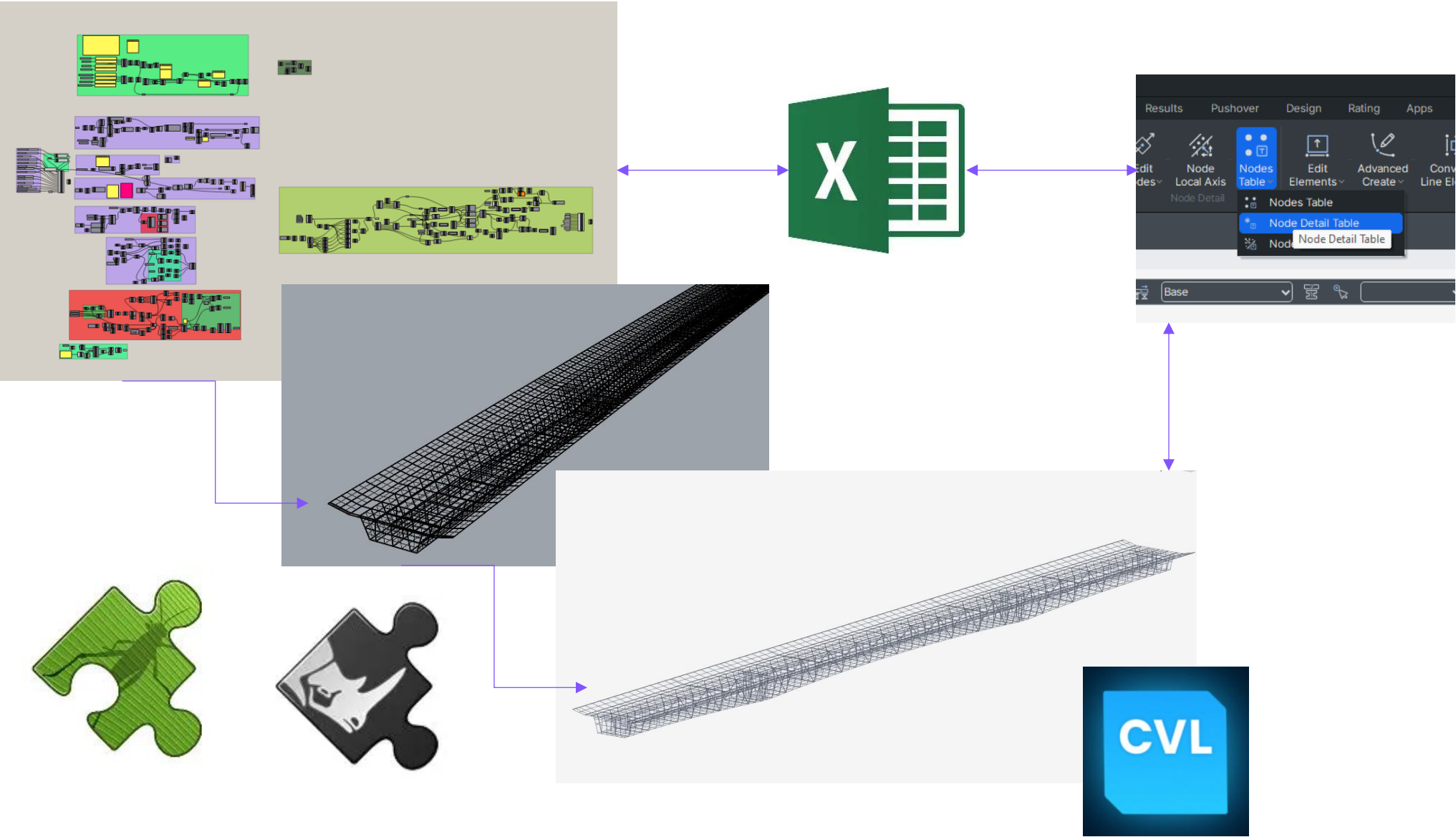
DETAILED DESIGN
ANALYSIS



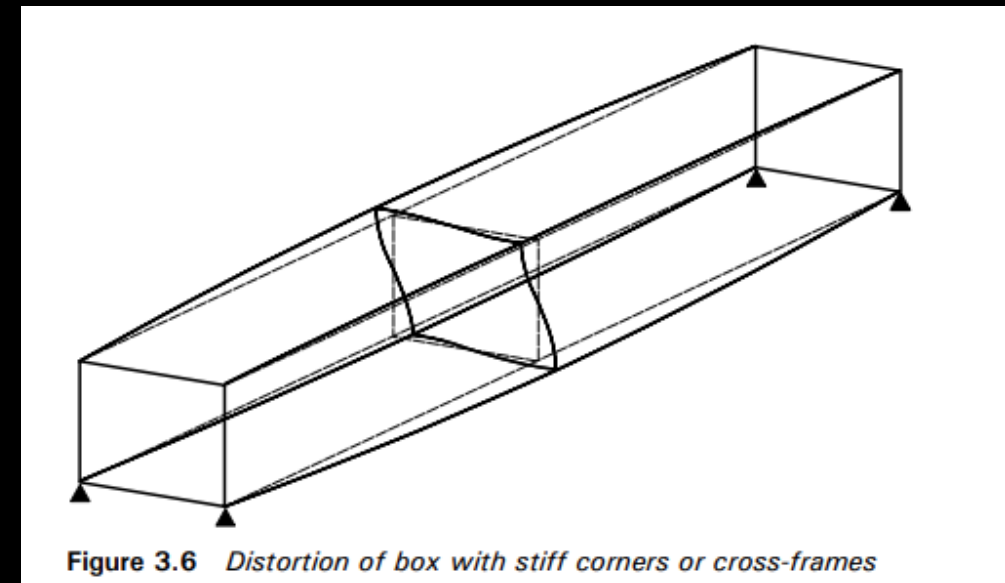
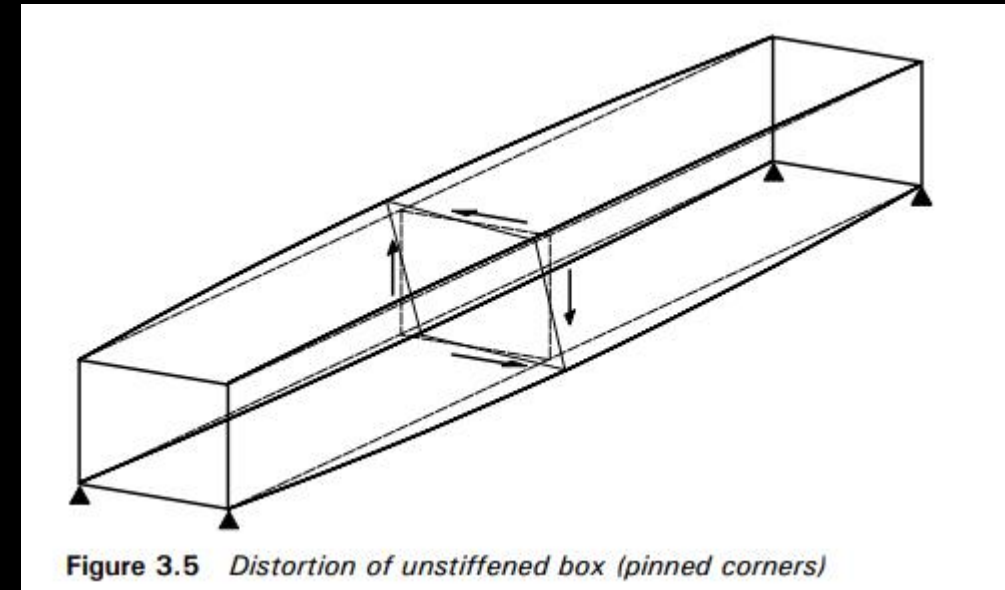
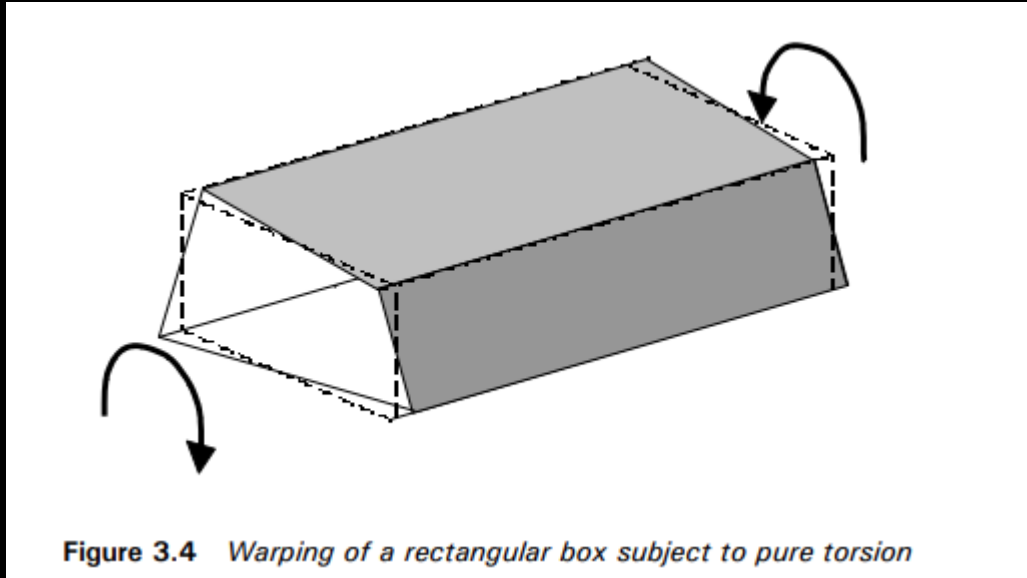
Typical Sections

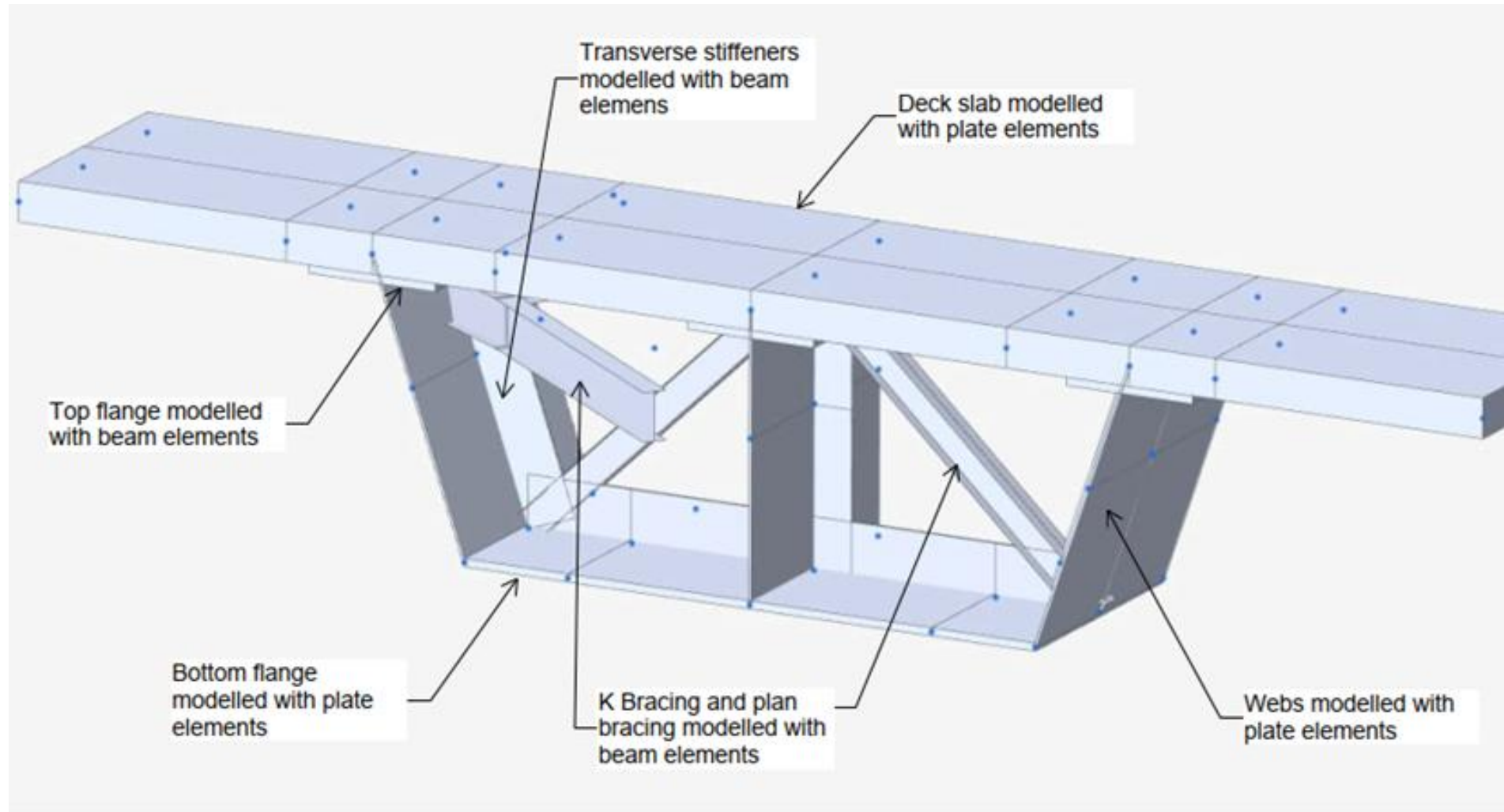


Analysis Workflow



Warping and Distortion of Box Girders





Structural Idealisation
Distortion and Warping Implicitly included

Kirrow

LM71

Define Standard Vehicular Load

Standard Name

EN 1991-2:2003 - Rail Traffic Load

Vehicular Load Properties

Vehicular Load Name

Load Model 71

Vehicular Load Type

Load Model 71

No	Load(kN)	Spacing(m)
1	250	1.6
2	250	1.6
3	250	1.6
4	250	end

dW1

80

kN/m

DD1

∞

m

dD1

0.8

m

dW2

80

kN/m

DD2

∞

m

dD2

0.8

m

Adjustment factor (α) :

1.21

☒ Consider Longitudinal Distribution of Point Loads

Distance between Rail Support Points :

0.65

m

☒ Eccentricity of Lateral Displacement of Vertical Loads :

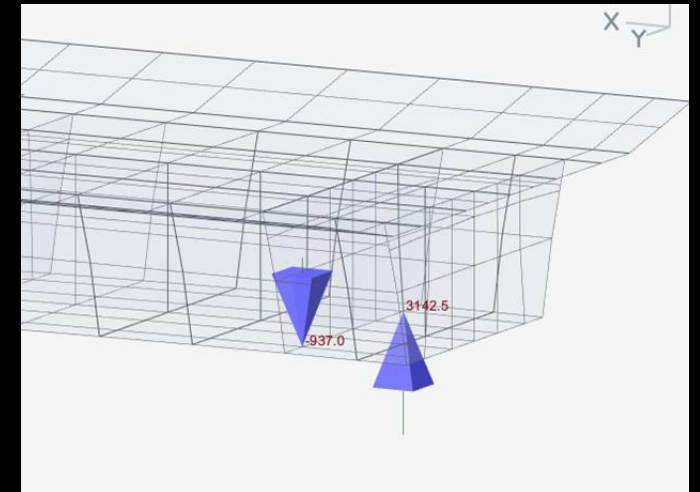
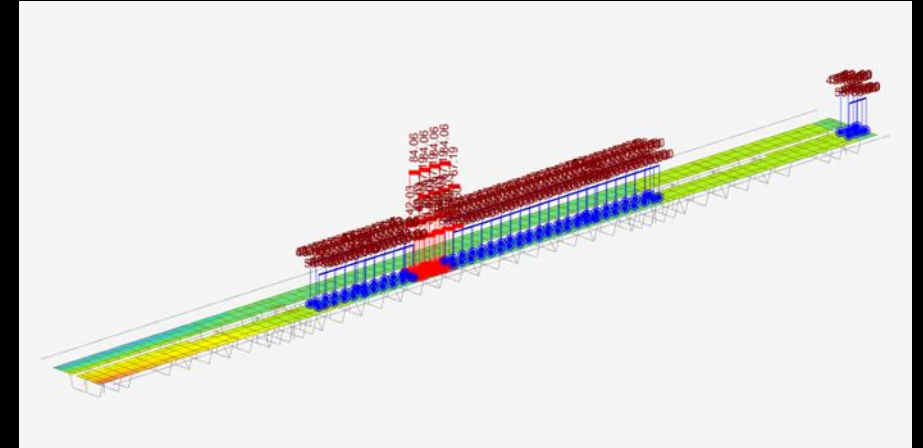
0.08

m

OK

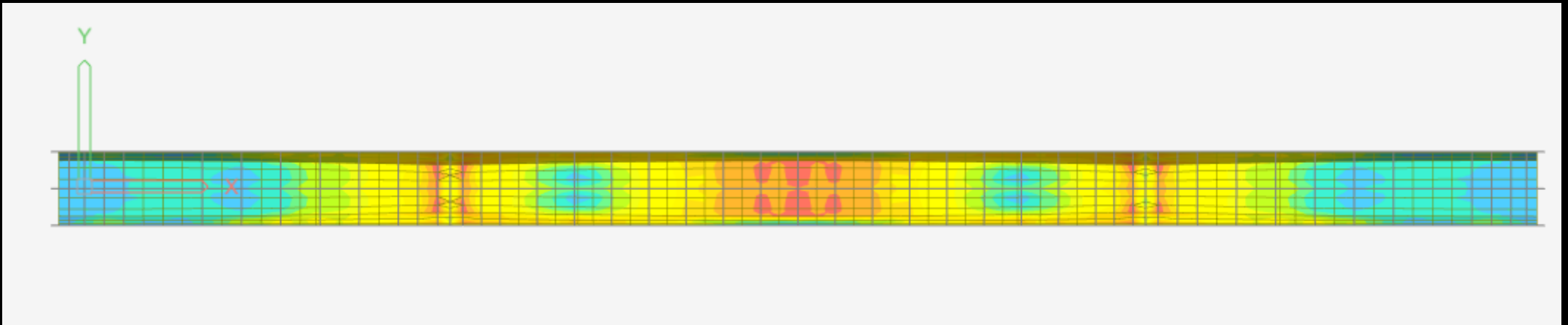
Cancel

Apply



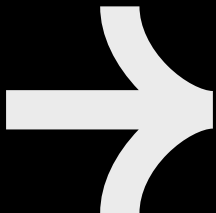
Calibrate Model Against Line Beam Model

Determine Max Plate thicknesses

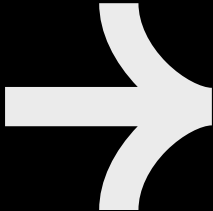


Moving Loads (Rail) - Uplift

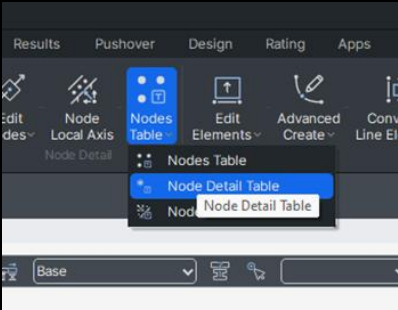
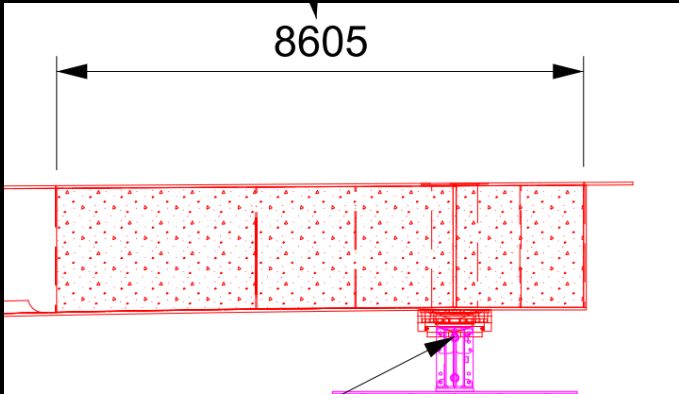
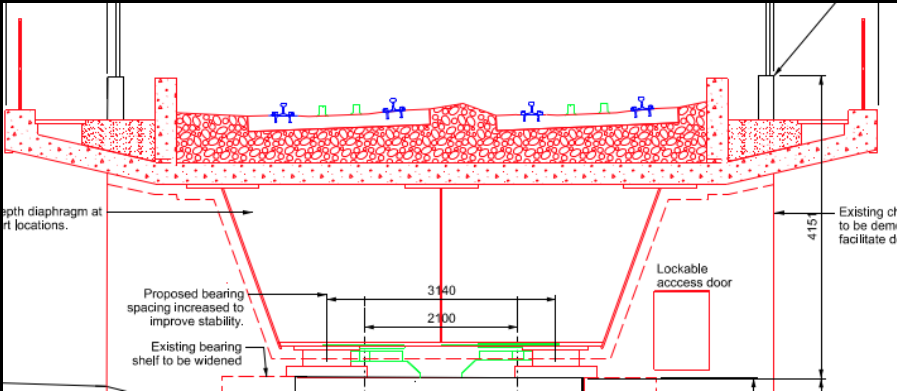
2MN Uplift



1MN Uplift



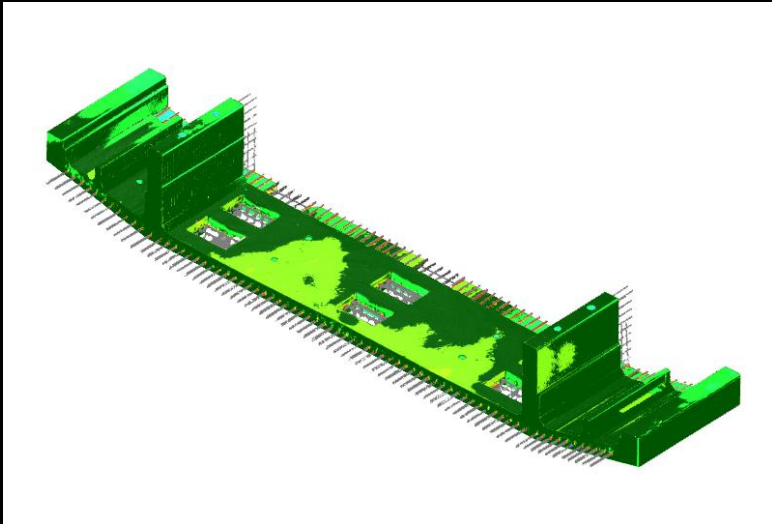
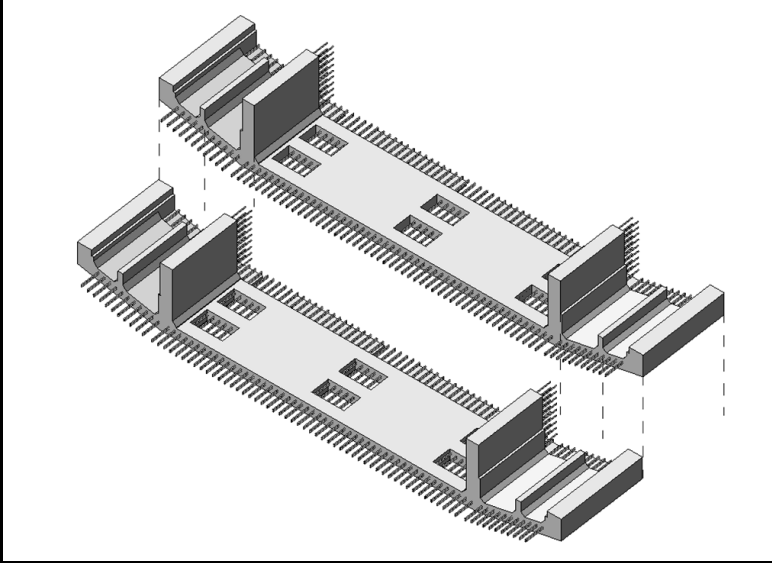
Positive contact



DETAILED DESIGN
ANALYSIS



Precast Deck Units.

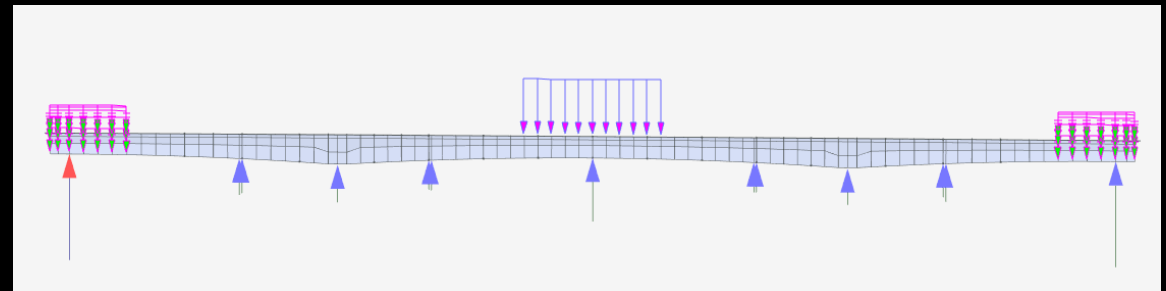
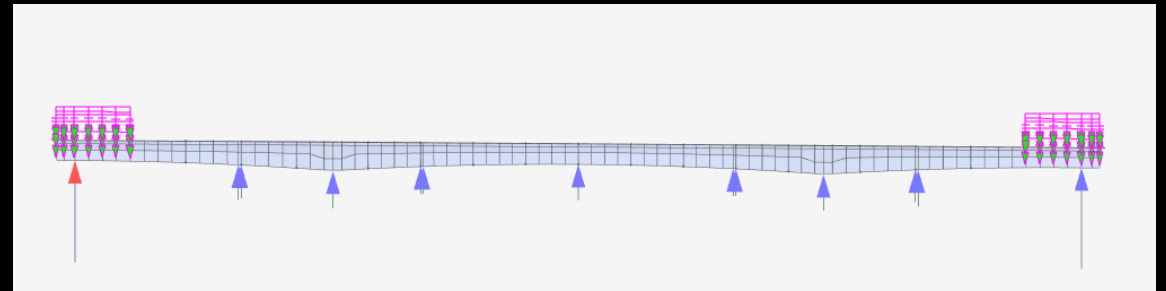
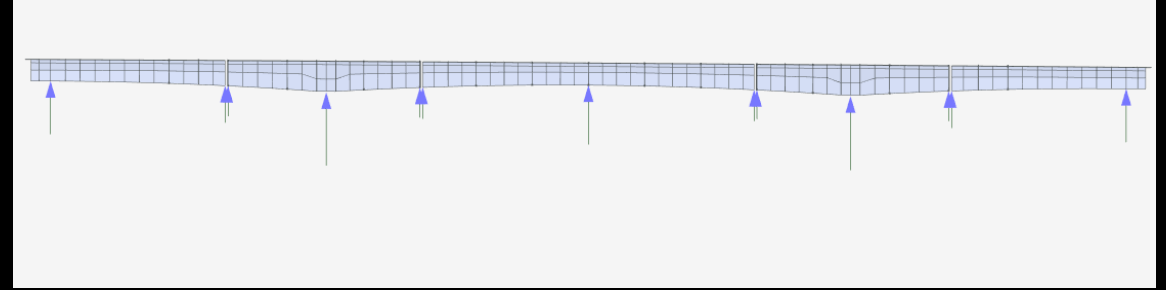


Construction Stage Analysis

Steelwork Assembly

Steelwork Continuous/Pour Mass Concrete
Kerledge

Concrete Units Stage 1



Construction Stage Analysis

Concrete Units Stage 2

Concrete Units Stage 3

Concrete Units Stage 4

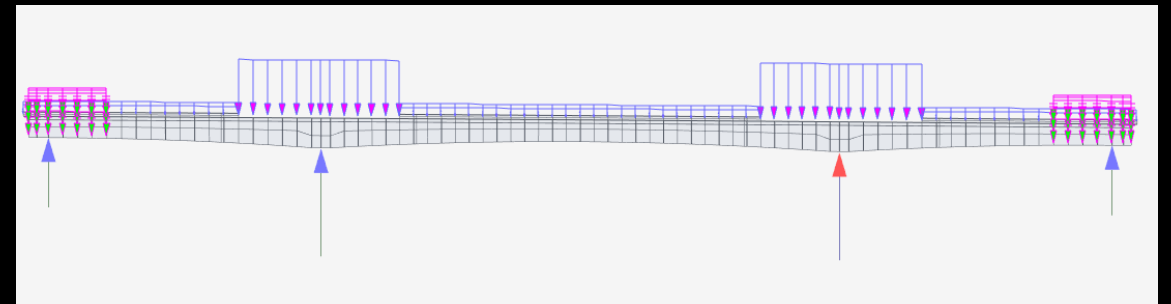
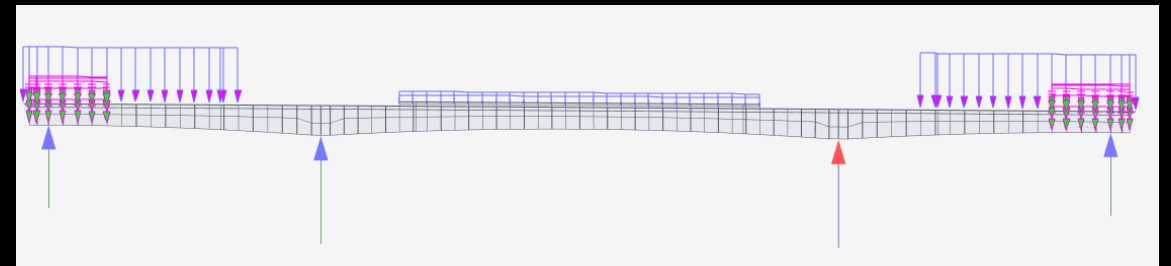
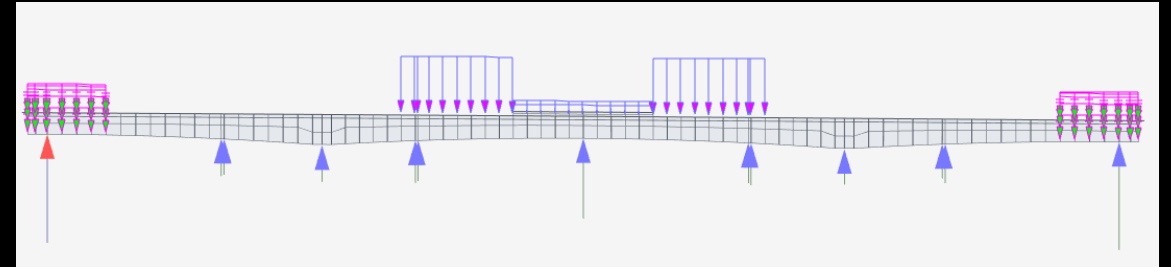
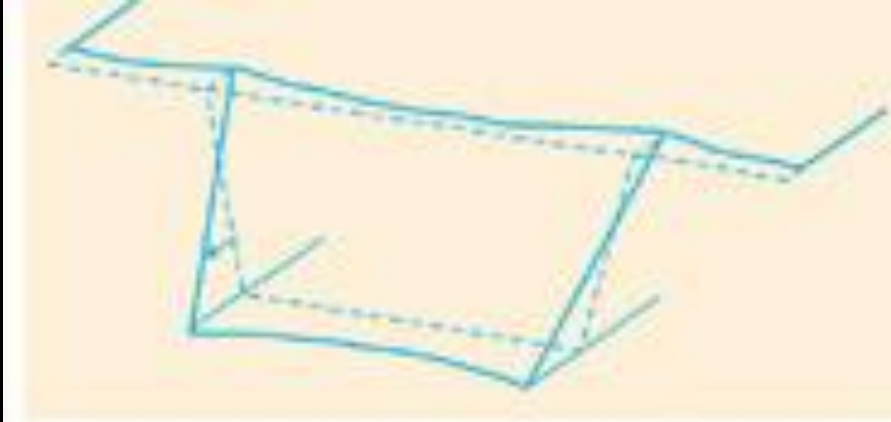
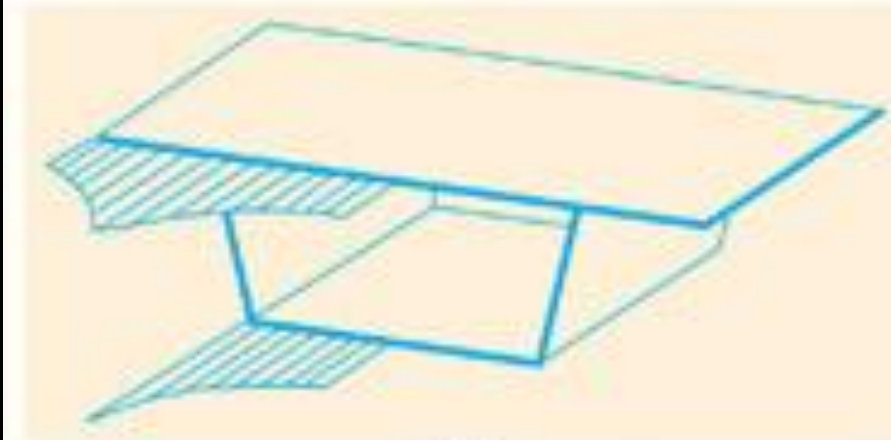


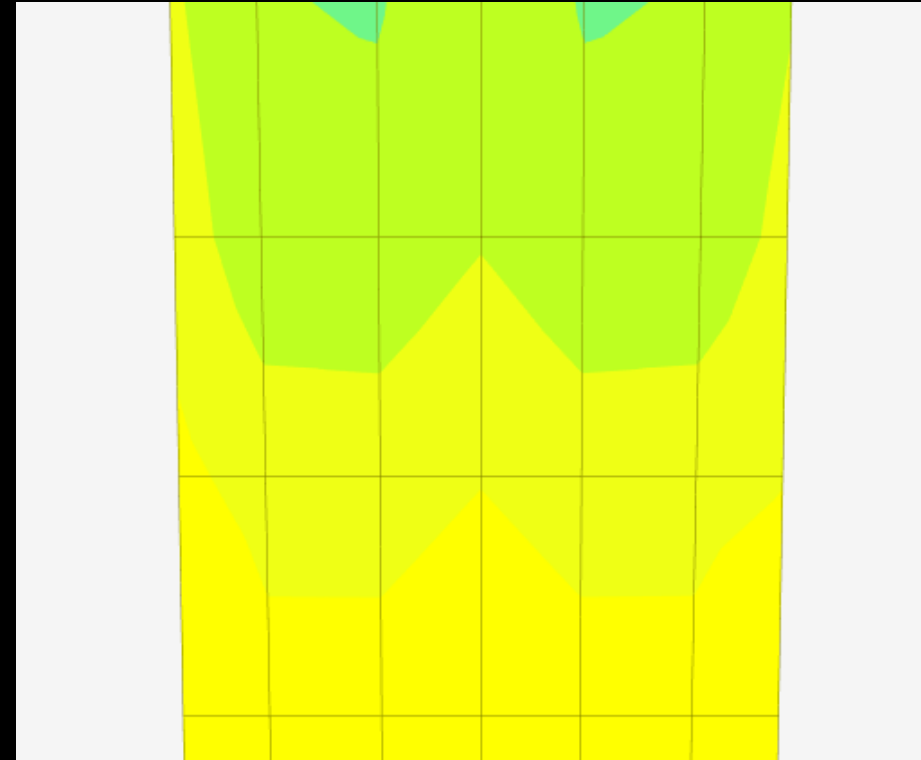
Plate Elements – Shear Lag



(b)



(c)



Virtual Beams – Section For Resultant Forces

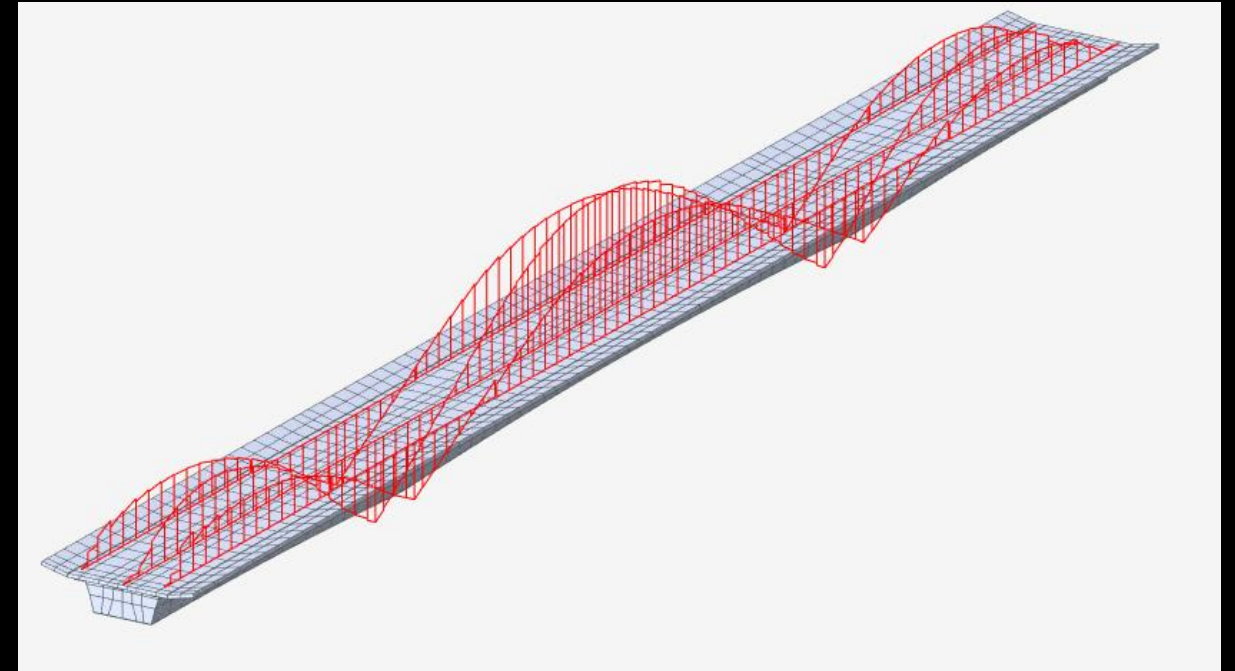
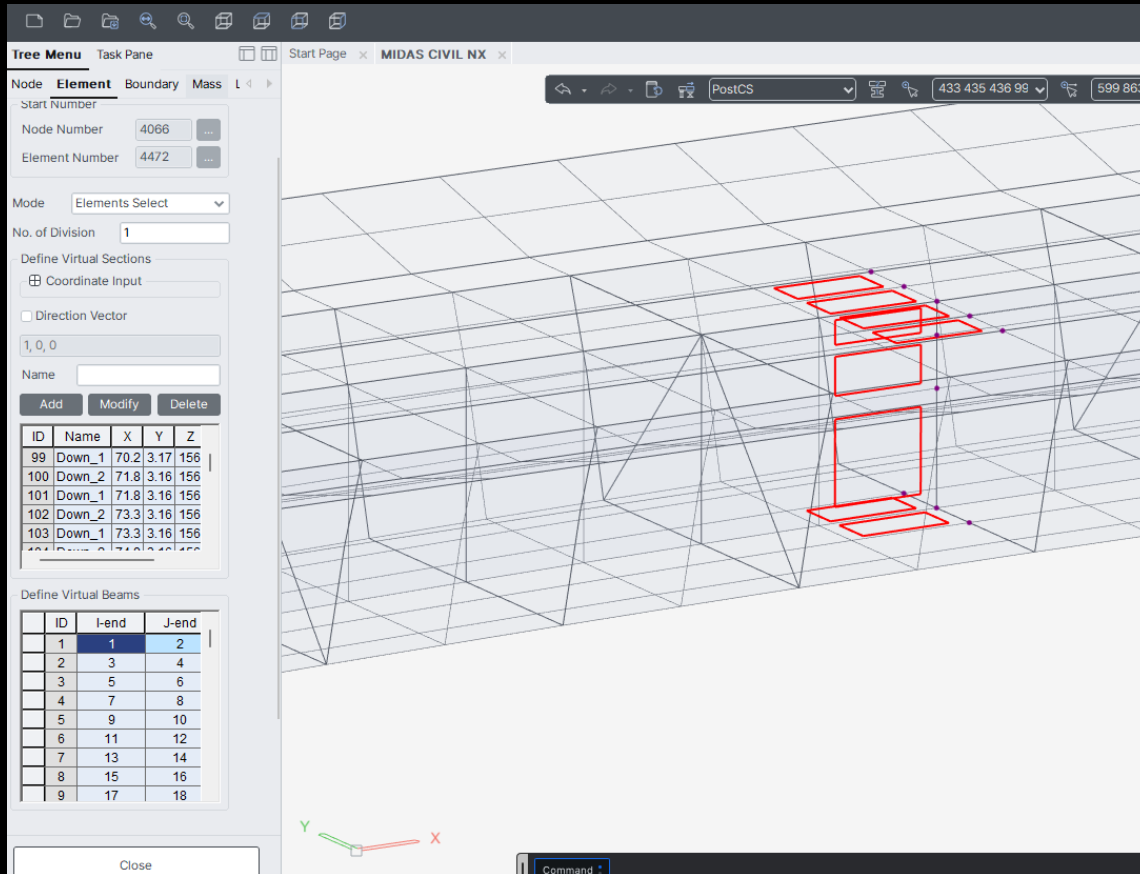
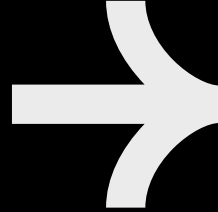
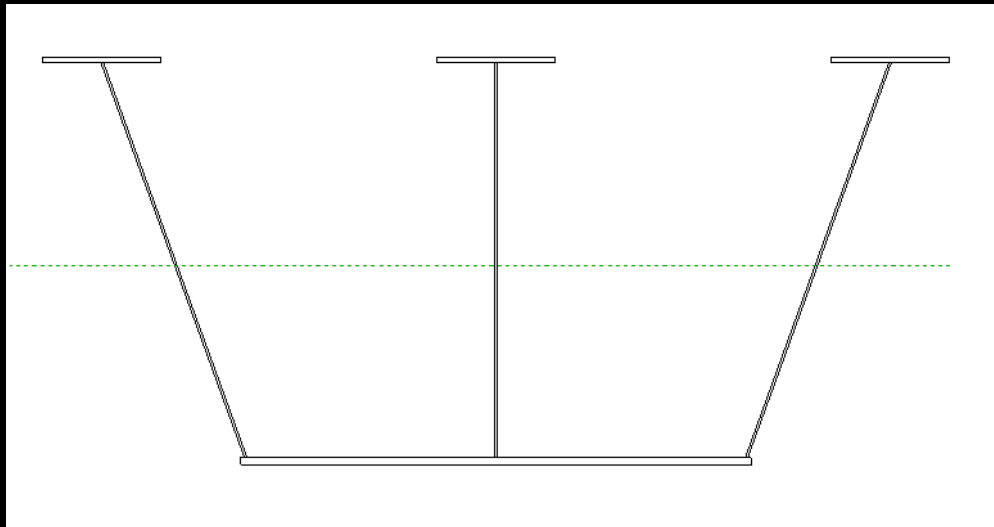
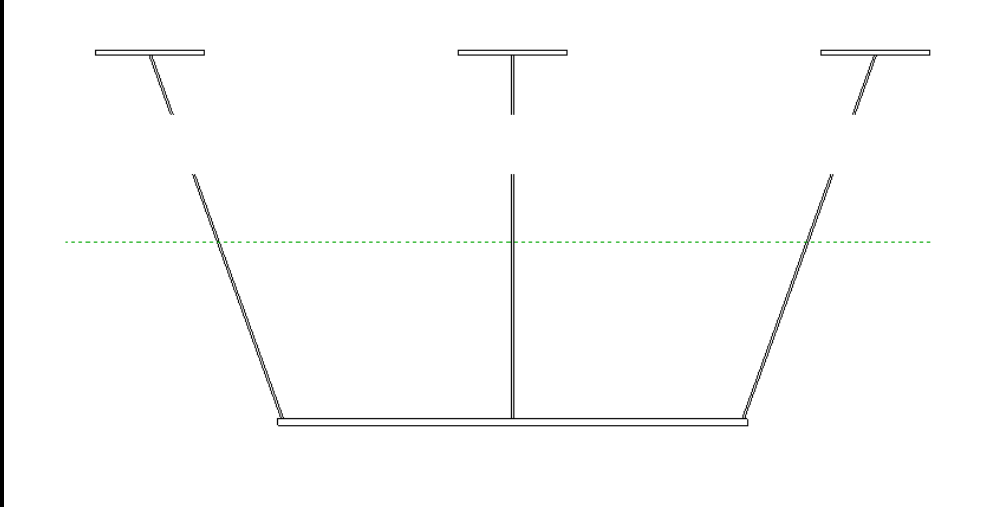
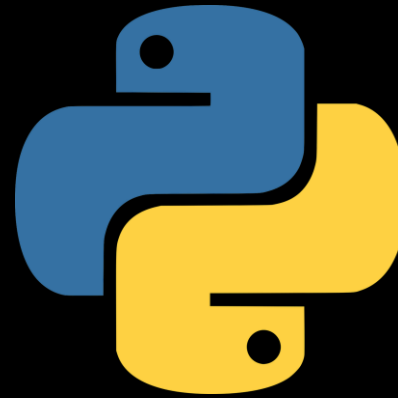
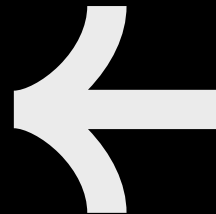
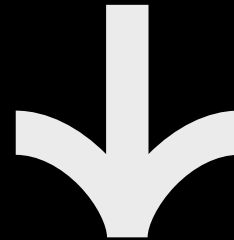


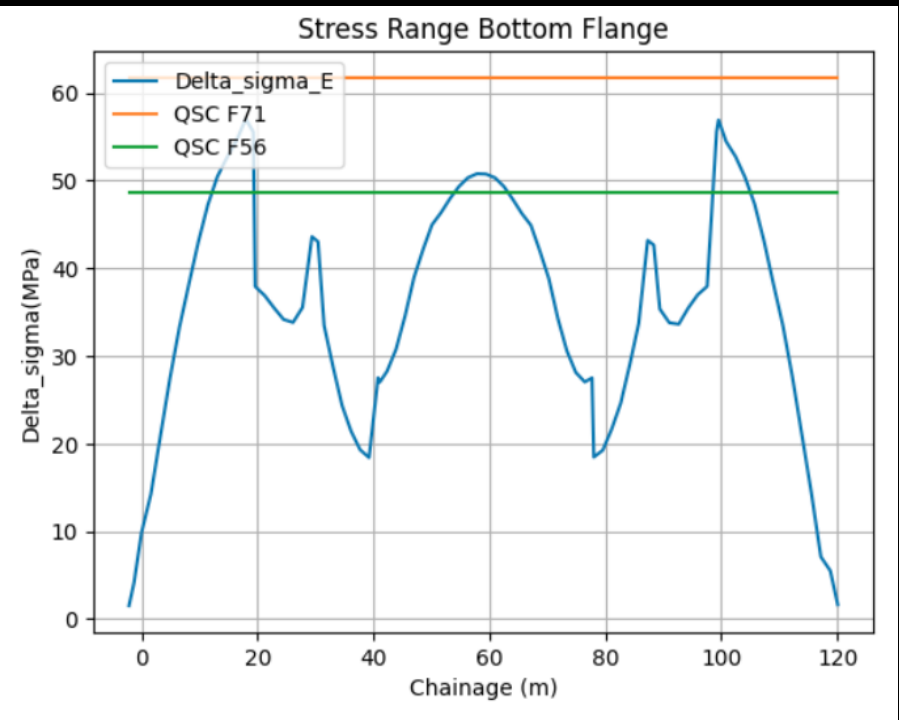
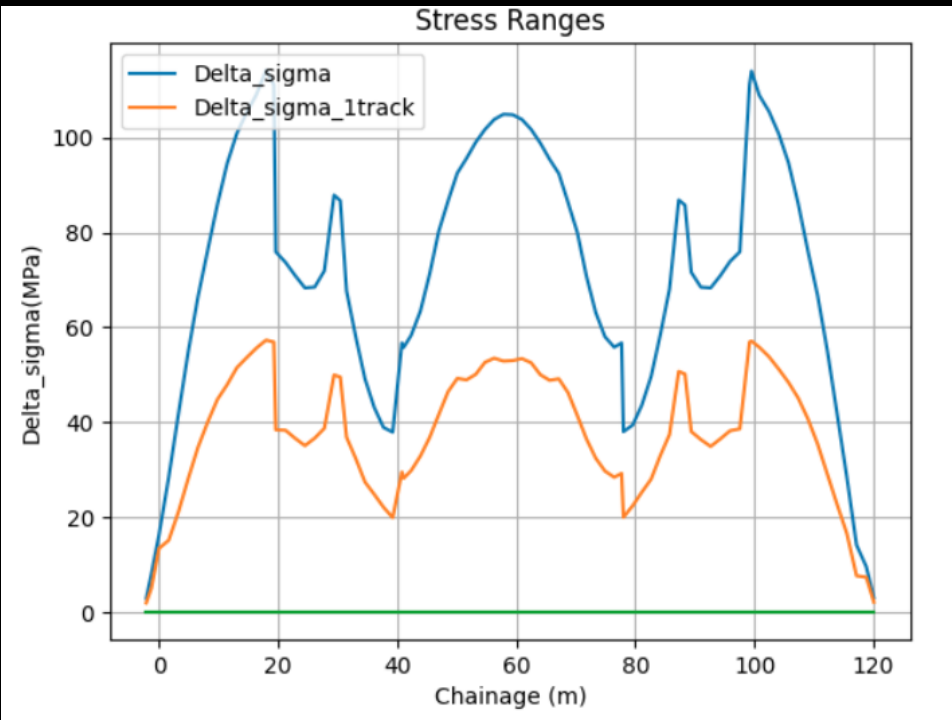
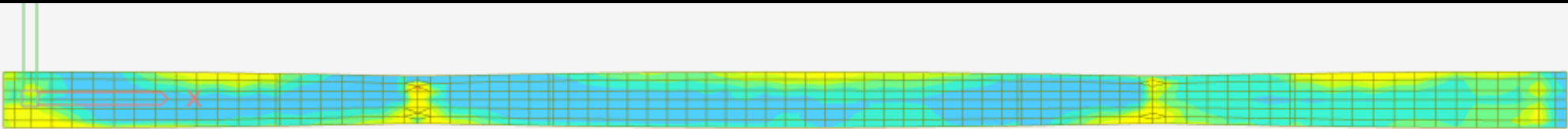
Plate Buckling



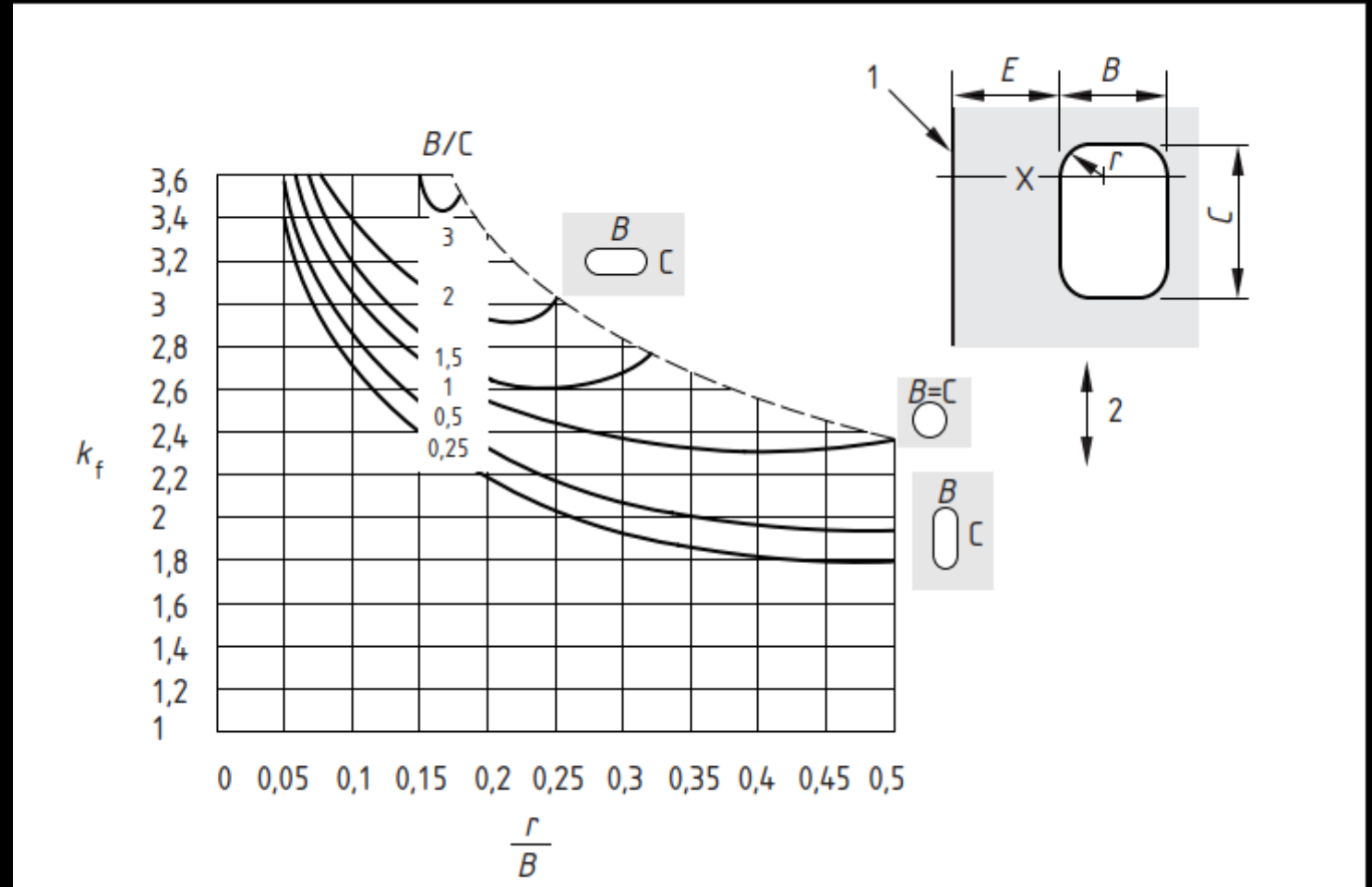
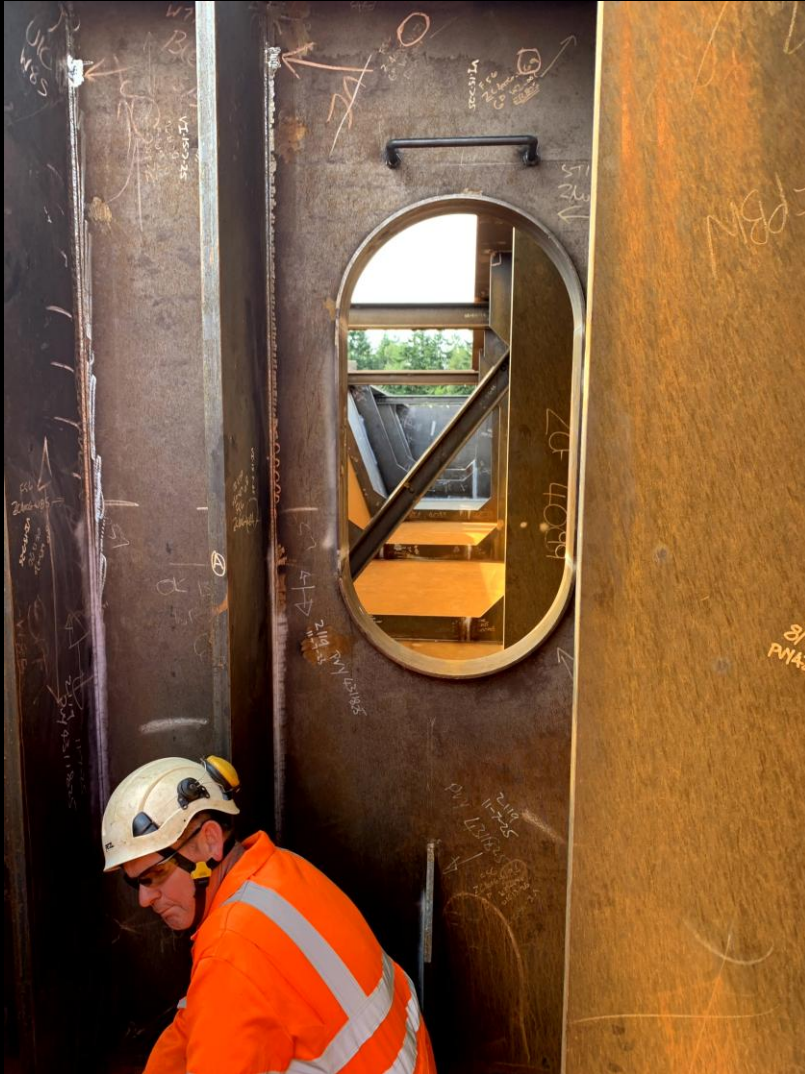
$$\bar{\lambda}_{p,red} = \bar{\lambda}_p \sqrt{\frac{\sigma_{com,Ed}}{f_y / \gamma_{M0}}}$$



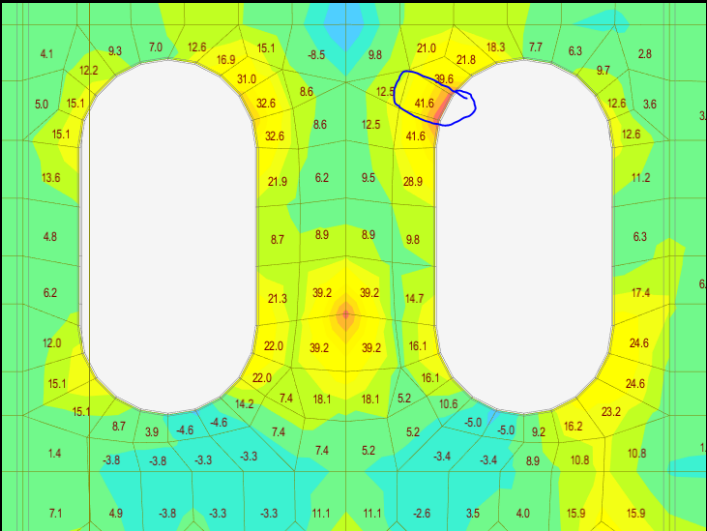
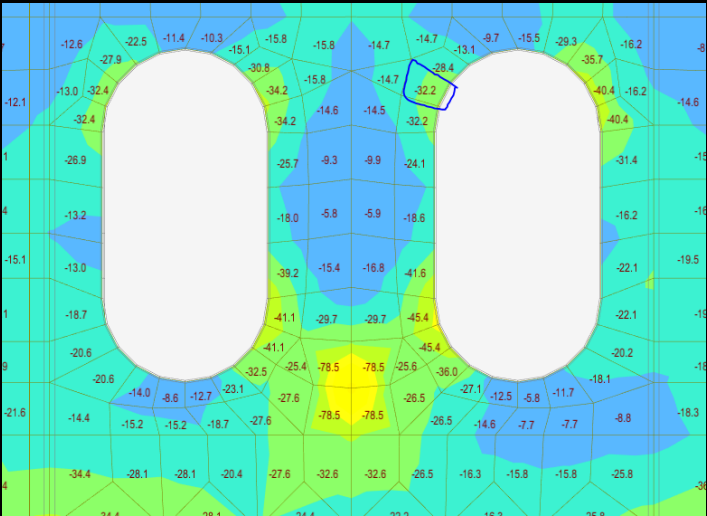
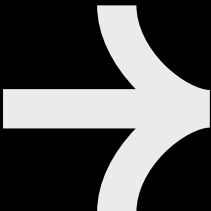
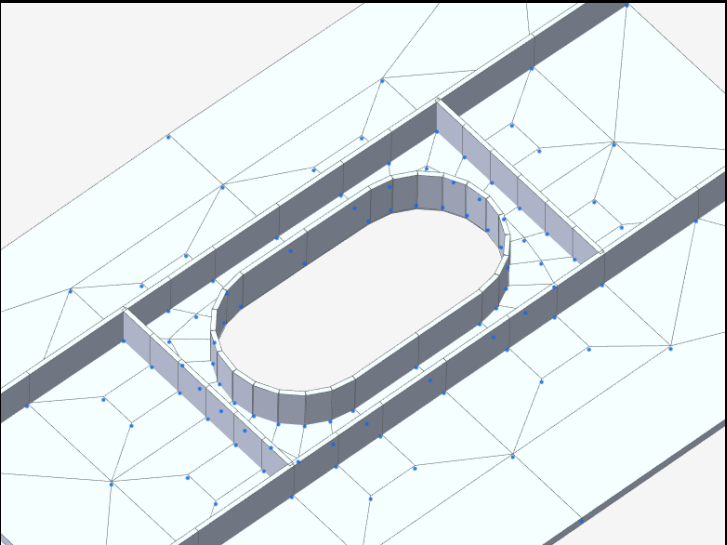
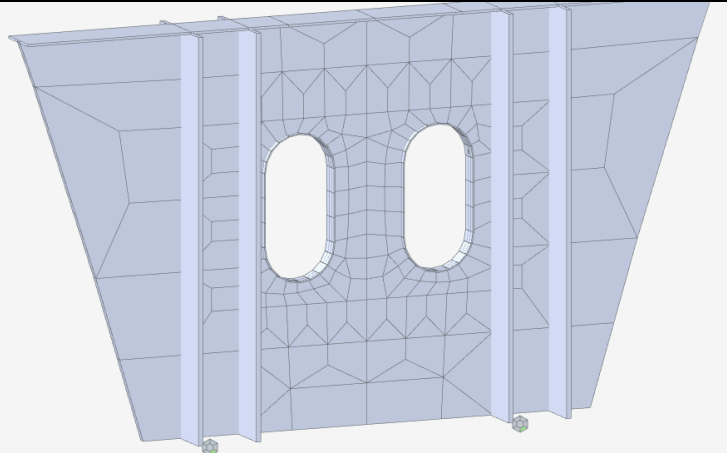
Fatigue



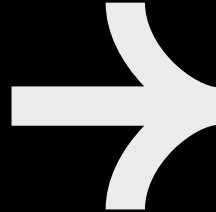
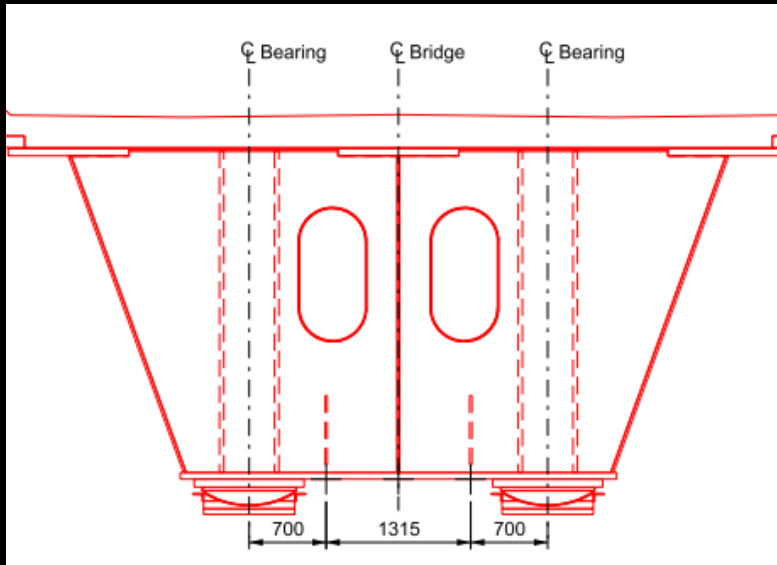
Fatigue



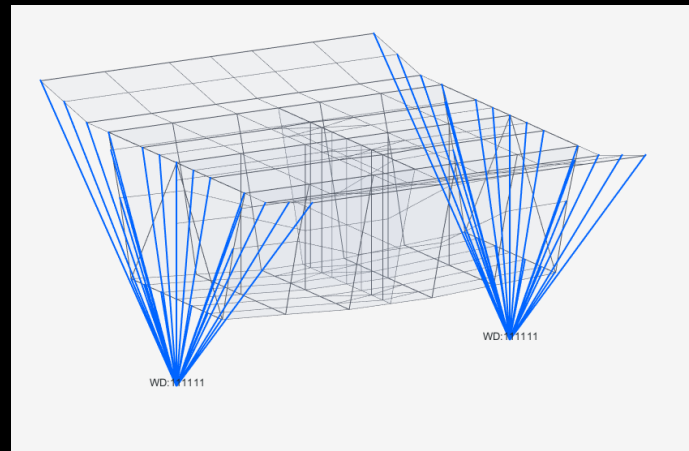
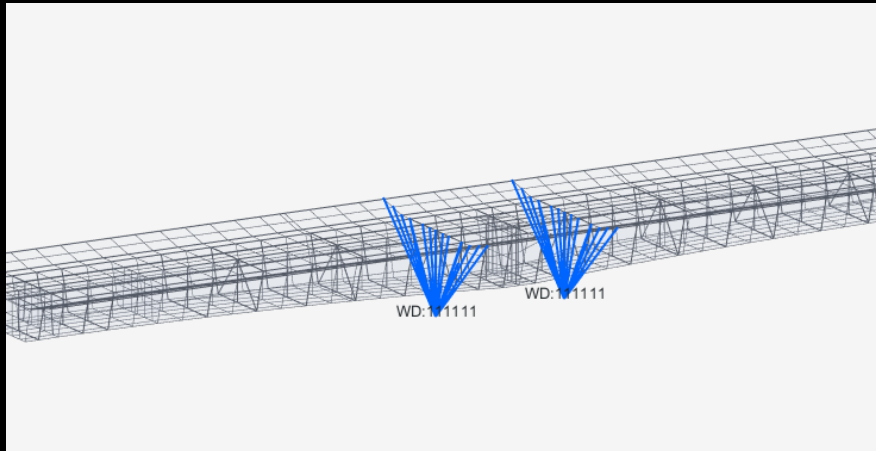
Fatigue



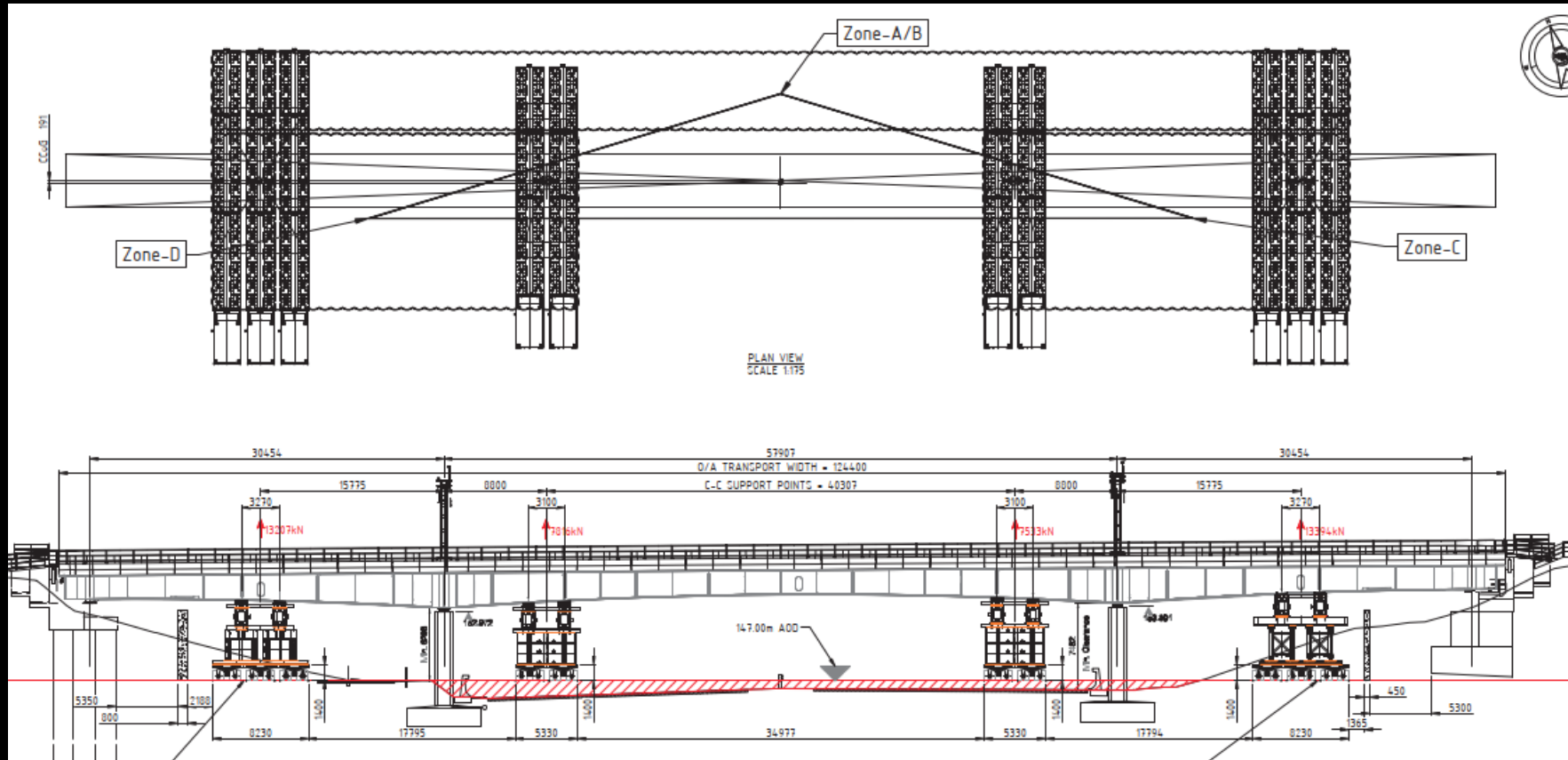
Diaphragms



Closed form solutions have limited applicability.



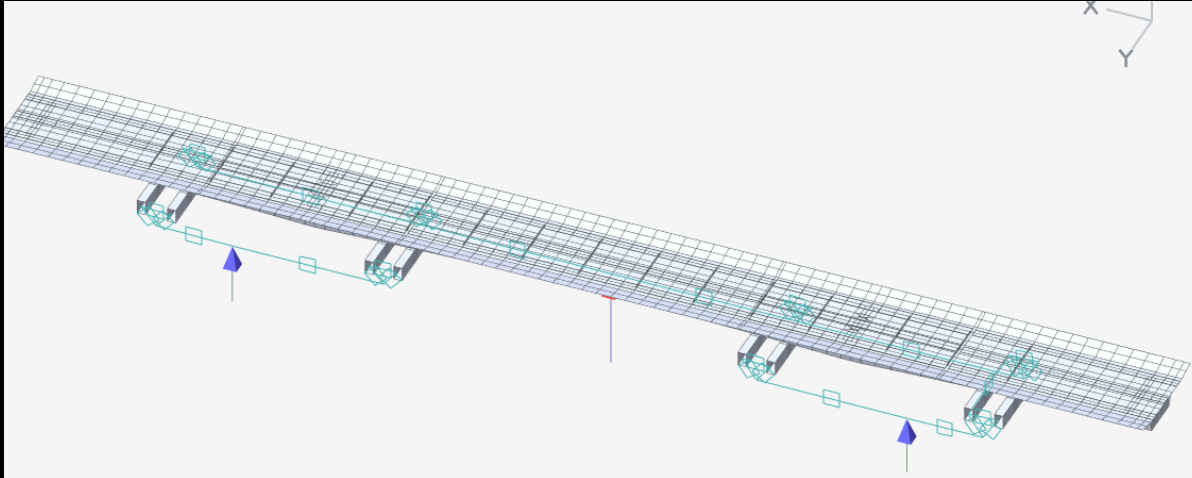
Installation



Statical Determinacy

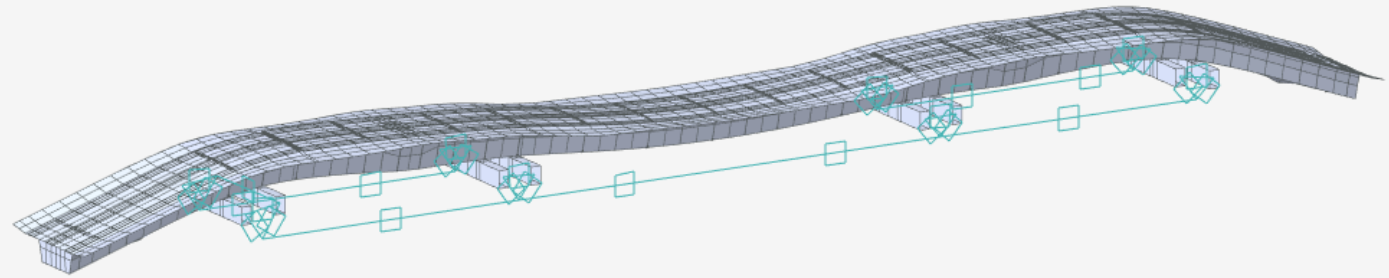
Higher confidence in of load effects

Installation



+/- 300mm
stroke in SPMT
Jacks.

Need to clear
the bearings.



M

MOTT
MACDONALD

M

THANK YOU