



Wunghnu Water Tower
Structural Condition Assessment
Community Reference Group

INTRODUCTIONS

CAF TEAM

Vivek Sethi

Senior Structural Engineer

20 years experience – Australia and international (USA)

Qualifications

- Master of Science in Civil
- Bachelor of Engineering – Civil
- Registered Professional Engineer

Core Capability

- Structural engineering
- Condition assessment including inspections and defect reporting

Steven Nash

Senior Water Engineer

35 years experience in water industry in NSW and Victoria

Qualifications

- Bachelor of Engineering – Civil
- Master Engineering (Civil)
- Registered Professional Engineer

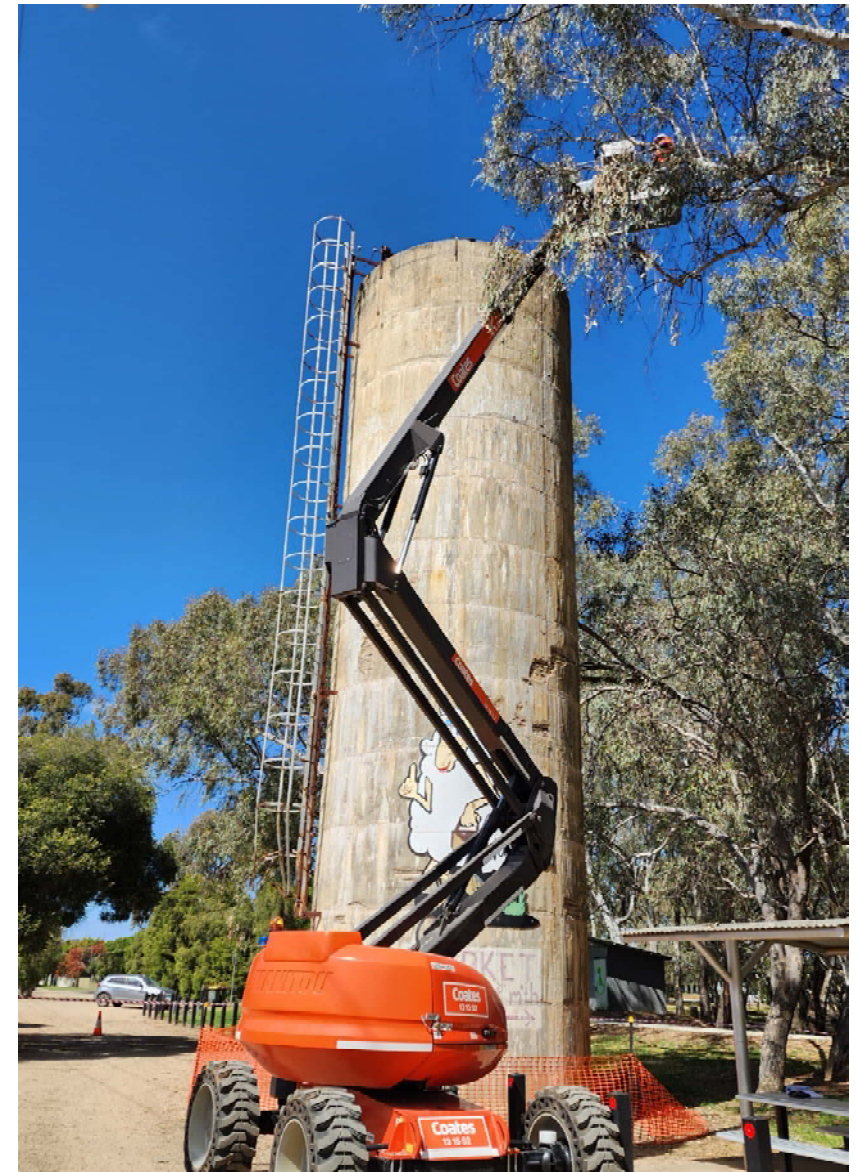
Core Capability

- Water infrastructure management
- Project management

WUNGHNU WATER TOWER

BACKGROUND INFORMATION

- Constructed in 1906 by Sir John Monash
- 15m tall and 4m diameter
- Wall thickness varies from:
 - 90mm at the top
 - 200mm at the base
- Decommissioned in 1990
- Duratec Australia Condition Assessment 2023
 - Visual inspection
 - Poor condition rating
 - Evidence of:
 - Delaminating concrete
 - Concrete spalling
 - Cracks of various widths
 - Section loss
 - Carbonation of concrete
 - Corrosion of reinforcement

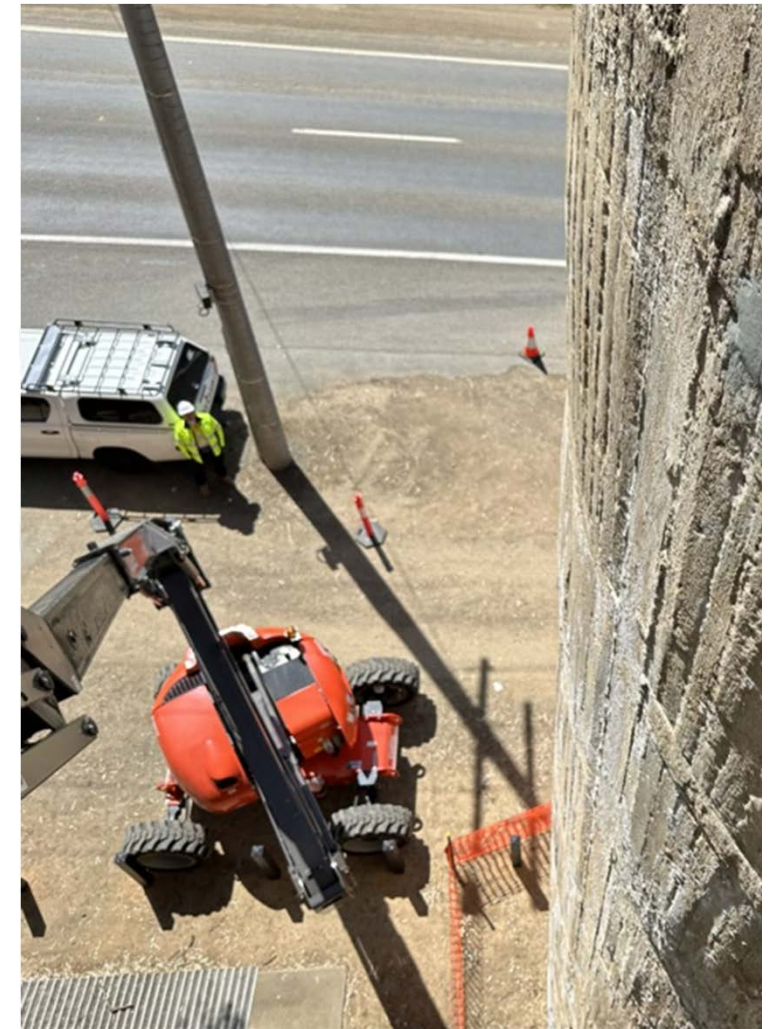


STRUCTURAL CONDITION ASSESSMENT

CAF ENGAGEMENT

Brief from GVW

- Provide a structural condition assessment to determine:
 - Is tower structurally adequate to remain in current condition
- Assessment process to include:
 - Detailed analysis of loads/actions applied
 - Stresses generated as a result
 - Calculation of structural capacity
- Inspection process included
 - Two structural engineers (Vivek Sethi and Darcy Ryan)
 - Site inspection on 31st October 2023
 - Used elevated working platform to inspect external surface
 - Striking concrete with a hammer to assess soundness
 - Measuring and documenting surface level loss
 - Inspecting and measuring exposed reinforcement



INSPECTION FINDINGS

EXAMPLES OF DETERIORATION



Example of efflorescence/calcium salt deposits on surface of concrete



Examples of concrete section loss and severe reinforcement corrosion and section loss on external wall



Internal wall example of widespread reinforcement corrosion



INSPECTION FINDINGS

EXAMPLES OF DETERIORATION



Example of leachates at horizontal construction joints (concrete pour stops)



Examples of cracking which was characteristic of structure

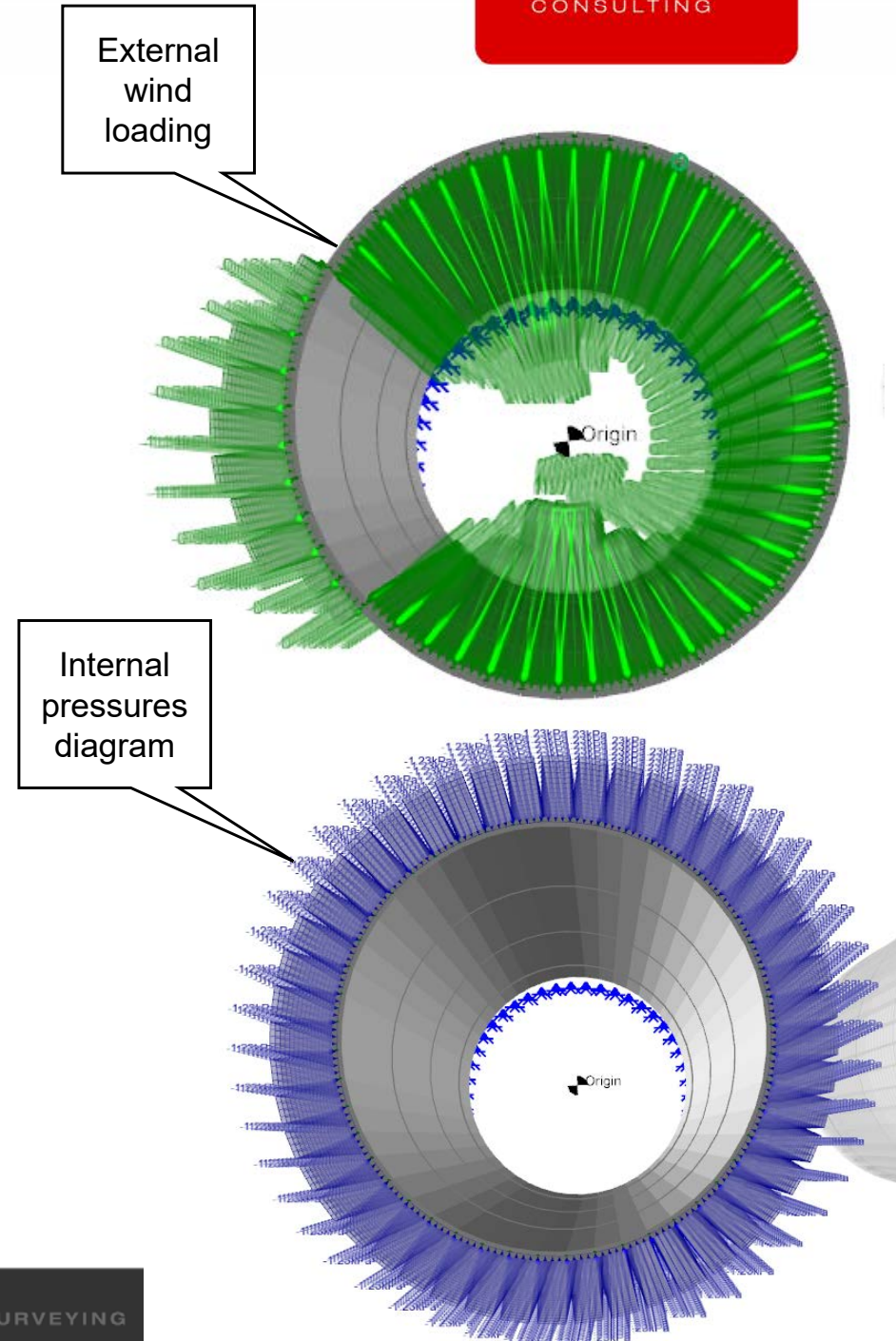


Examples of cracking present at top of tower

STRUCTURAL ANALYSIS

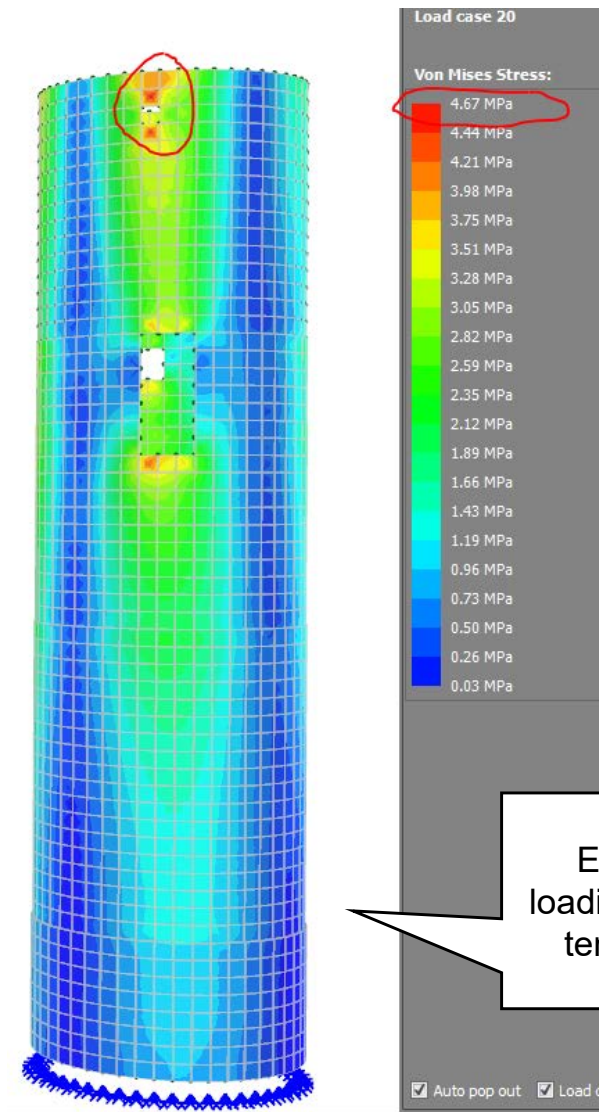
MODELLING PROCESS

- To analyse the structure, requires:
 - various loading cases calculated
 - applied to a finite elements model (FEM)
- Loading cases used:
 - Earthquake and
 - Wind loading
- Generates output of:
 - Internal stresses,
 - Deflections
 - Tensile and compressive forces
 - Structure reactions
- Multiple models created including:
 1. Full section (no section loss)
 2. Carbonation depths from Duratec report
 3. Full section loss of reinforcement

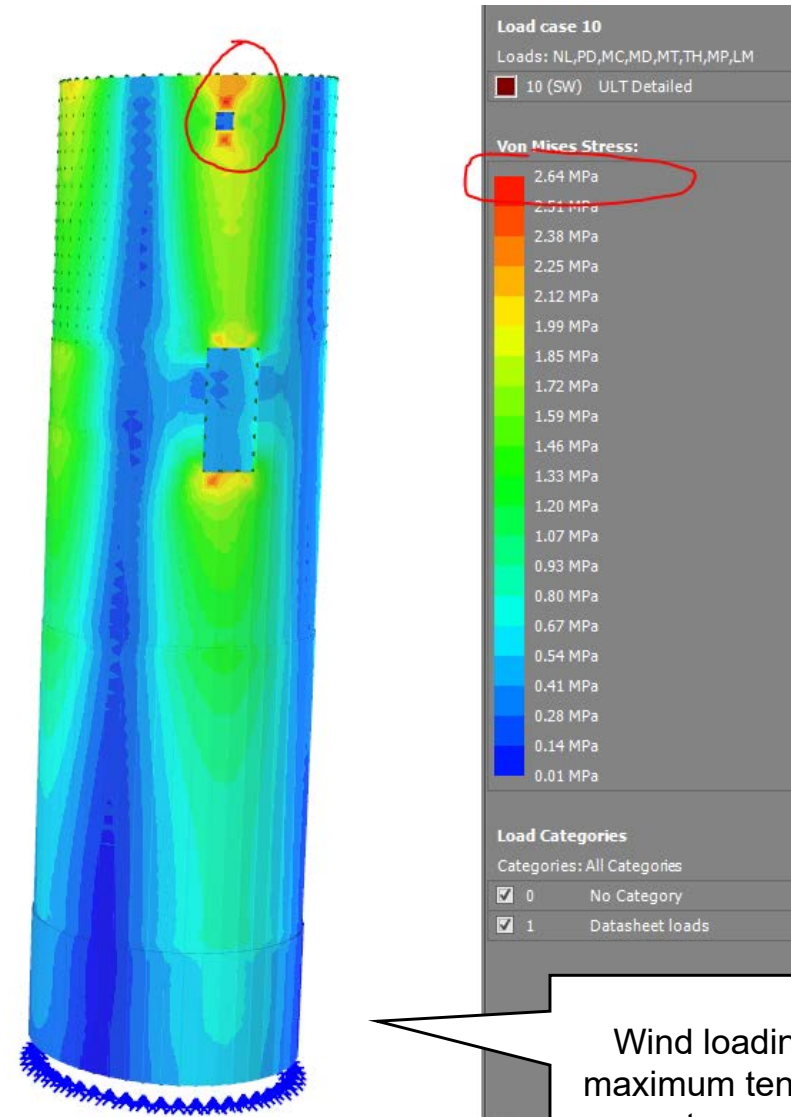


STRUCTURAL ANALYSIS

EARTHQUAKE AND WIND LOADING



Earthquake
loading maximum
tensile stress



Wind loading
maximum tensile
stress

EXECUTIVE SUMMARY

KEY FINDINGS

- 120 year old tower that is well beyond design life of 50 years
- Tower has deteriorated
- It has several defects including
 - Carbonated concrete
 - Reinforcement corrosion

Several potential failure mechanisms for structure of this age and conditions:

- Concrete crushing due to compressive failure
- Exceeding flexural tensile stress capacity
- Concrete shear failure
- Progressive collapse failure

- Results of load assessment:

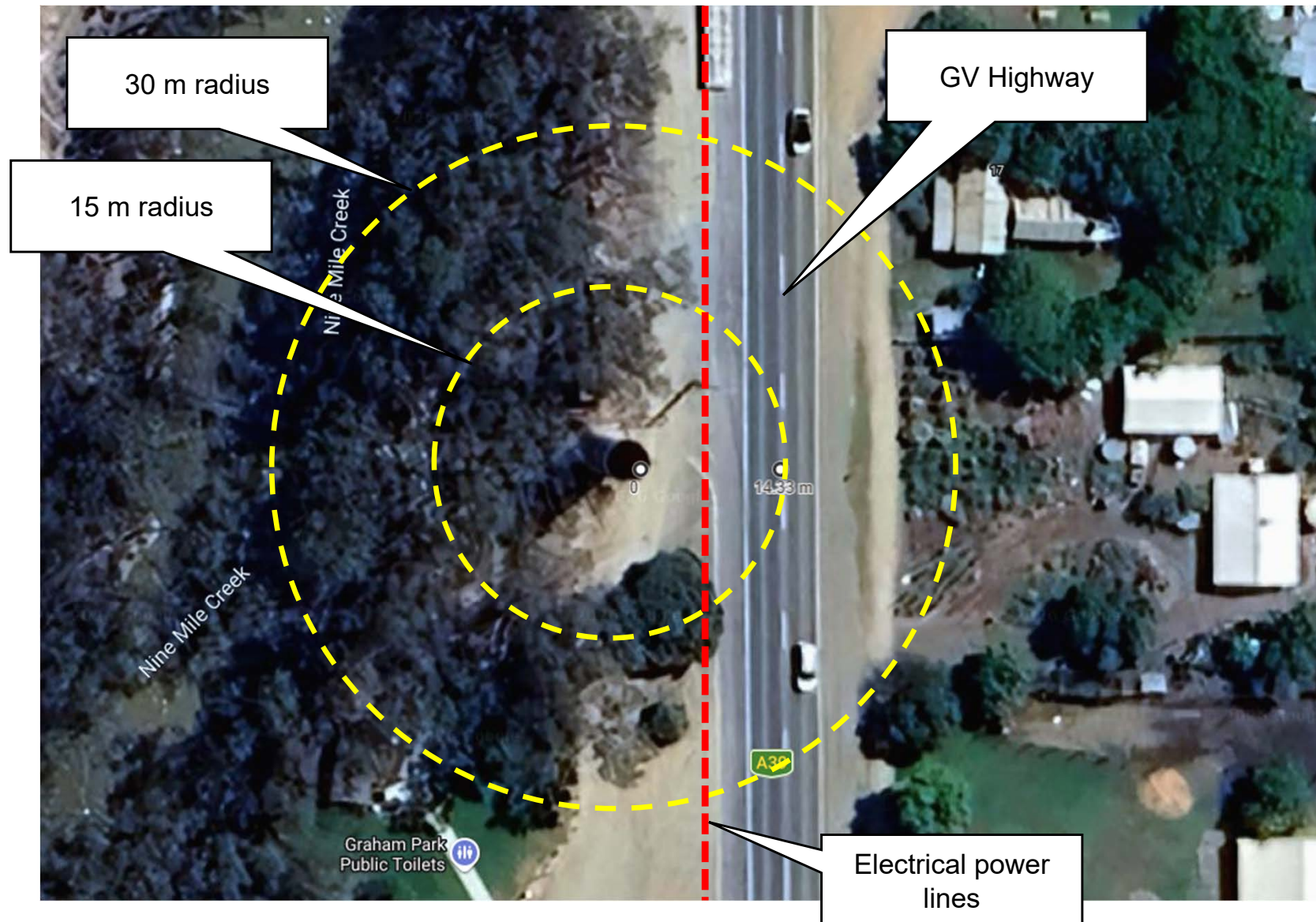
Event	Details	Tensile Stresses Generated
Earthquake	1 in 1000 year	4.67MPa
Wind Pressures	1 in 500 year (162 km/h)	2.64MPa
Tower Structural Capacity	No reinforcement contribution	2.32MPa

Conclusion:

- Wunghnu tower is in very poor condition
- Numerous defects confirming Duratec assessment and report
- High likelihood of collapse under both:
 - Ultimate Earthquake and
 - Ultimate Wind Loading
- The structure is unsafe to remain erect

WHAT HAPPENS IF COLLAPSE OCCURS?

PARTIAL OR COMPLETE



QUESTIONS AND DISCUSSION

ANY QUESTIONS ON THE STRUCTURAL ASSESSMENT

