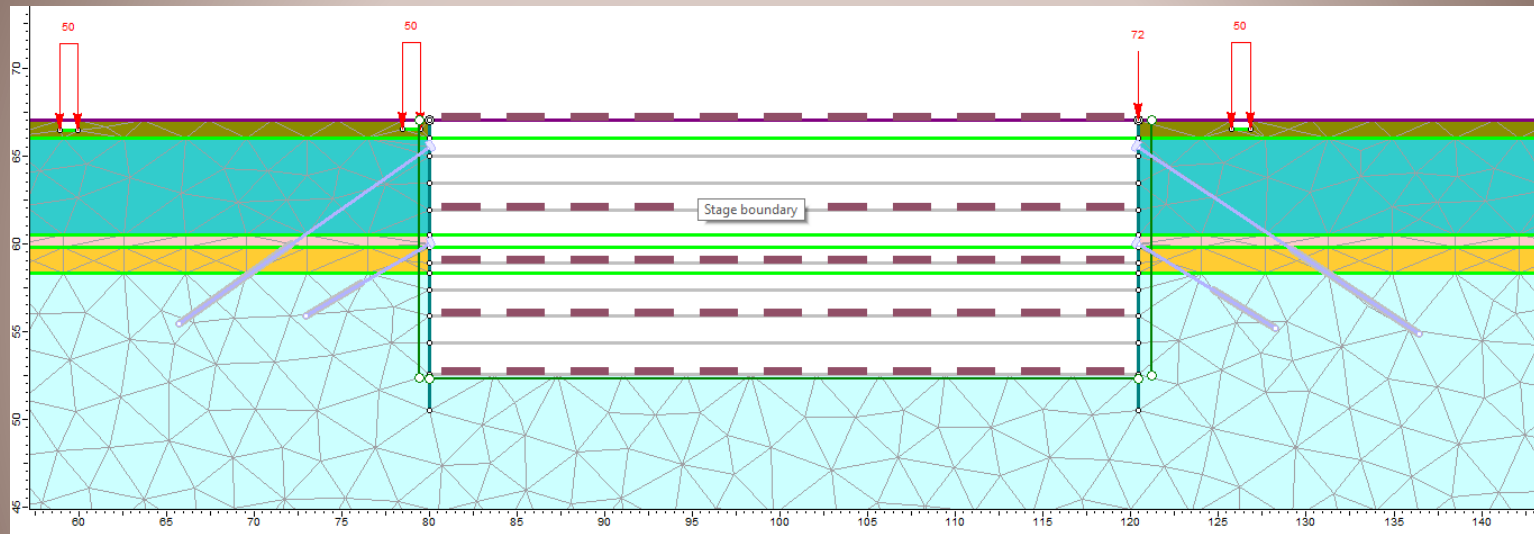


Deep Excavation



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Introduction

- **Excavation Works** – Defines as the process of excavation or digging.
- **Depth of excavation** for the foundation of a building or structure is the deciding factor , how the excavated boundary of the site needs to be supported.
- **Depth of excavation** also propose the extent of requirement of Site Investigation.



Basement/Excavation Depth

- Excavation depth is divided into three types which are shallow, medium and deep excavation depends upon the base and the foundation of the structure.
- Average Depth
 - - Shallow depth (up to 1.5m deep)
 - - Medium depth (between 1.5m to 3.0m)
 - - Deep (over 3.0m)



Geotechnical Investigation

- Geotechnical investigations obtain information on the **physical properties** of soil, rock and/or shallow groundwater around a site to assess suitability of material for construction and to allow accurate design of earthworks and foundations.



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Geotechnical Investigation

Quantum and Type of Investigation depends upon the following:

1. Depth of foundation/Excavation.

- -Shallow
- -Medium
- -Deep

2. Area of the site.



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Types of Geotechnical Investigation

Shallow and Medium Deep Foundation /Excavation

- To evaluate the bearing capacity, soil type for 0 to 3m (up to 1 basement) deep excavation, the type of investigation required is:

- **Dynamic Cone Penetration Test (DCPs)** – to get bearing capacity of the foundation
- **Test Pits/trenches** through Back hoe
- **Hand Augers** – to get soil samples to the required depth.



Types of Geotechnical Investigation

- **Deep Excavation** - To evaluate the bearing capacity, soil/rock type for excavation depth $> 3\text{m}$ (>1 basement) , the type of investigation required is:
- **Drilling/boring**, i.e. rotary, hollow-stem auger, continuous flight auger, coring.
- SPT – Standard Penetration Tests.

Geotechnical investigation should be undertaken in accordance with AS1726 Geotechnical Site Investigations.

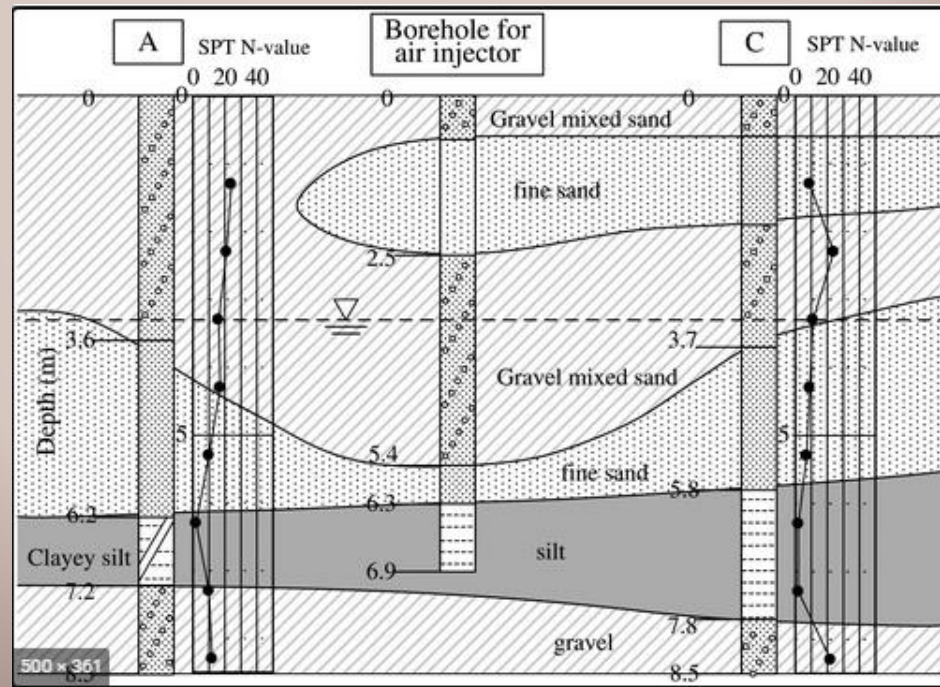


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Geological Soil/Rock Profile

- After all geotechnical site investigation, in-situ and laboratory test results, prepare geological soil/rock profile.
- Soil/Rock profile provides the engineer to what extent the foundation or depth of shoring Needs to keep for excavation.

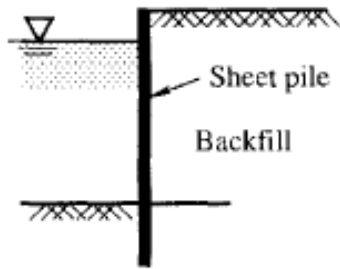


Type of Shoring

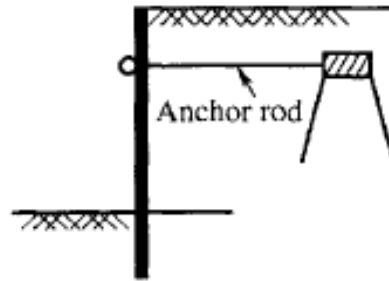
- Cantilever sheet piles
- Anchored bulkheads
- Braced sheeting in cuts
- Single cell cofferdams (Soldier pile)
- Cellular cofferdams, circular type (Contiguous pile)
- Cellular cofferdams (diaphragm)



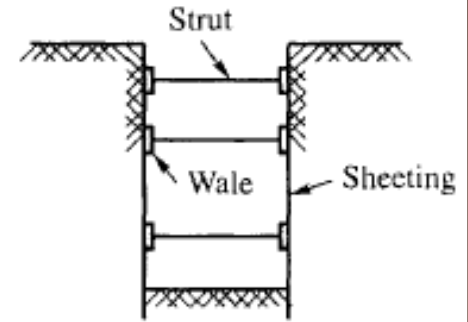
Type of Shoring



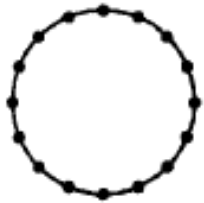
(a) Cantilever sheet piles



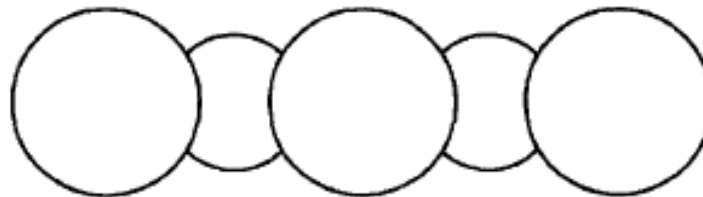
(b) Anchored bulk head



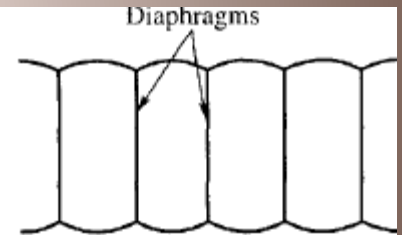
(c) Braced sheeting in cuts



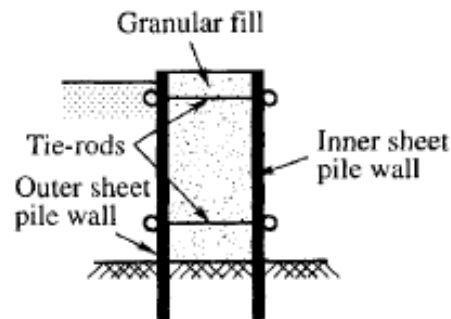
(d) Single cell cofferdam



(e) Cellular cofferdam



(f) Cellular cofferdam, diaphragm type



(g) Double sheet pile walls

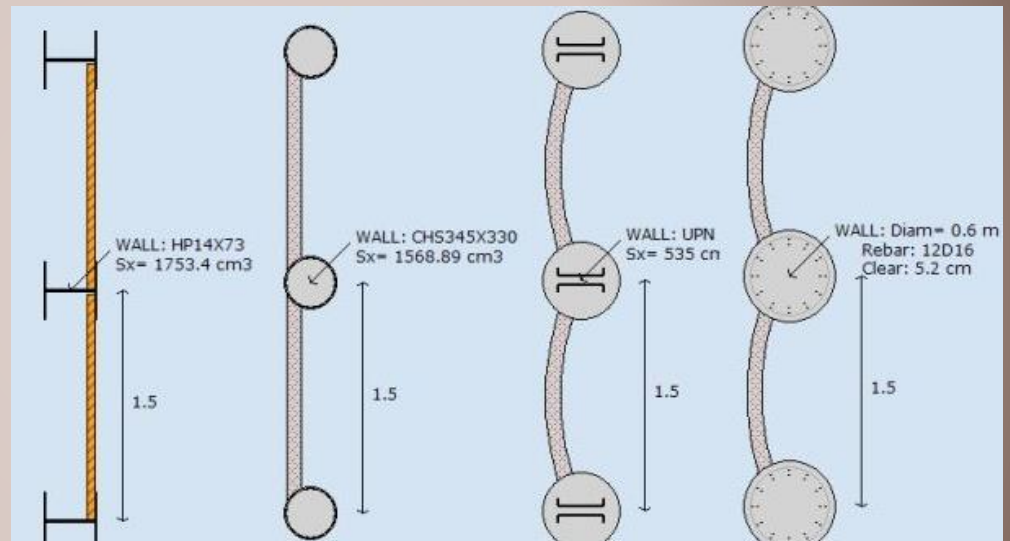


Soldier Pile Walls

- With soldier pile walls, the piles are fitted wider apart (up to 5 - 8 pile diameters), with the soil between piles subsequently retained.
- Generally used for temporary works, soldier pile walls are cost-effective and quick to construct. They can be designed as cantilever walls or by using additional lateral support from anchors or bracing.



Soldier Pile Walls

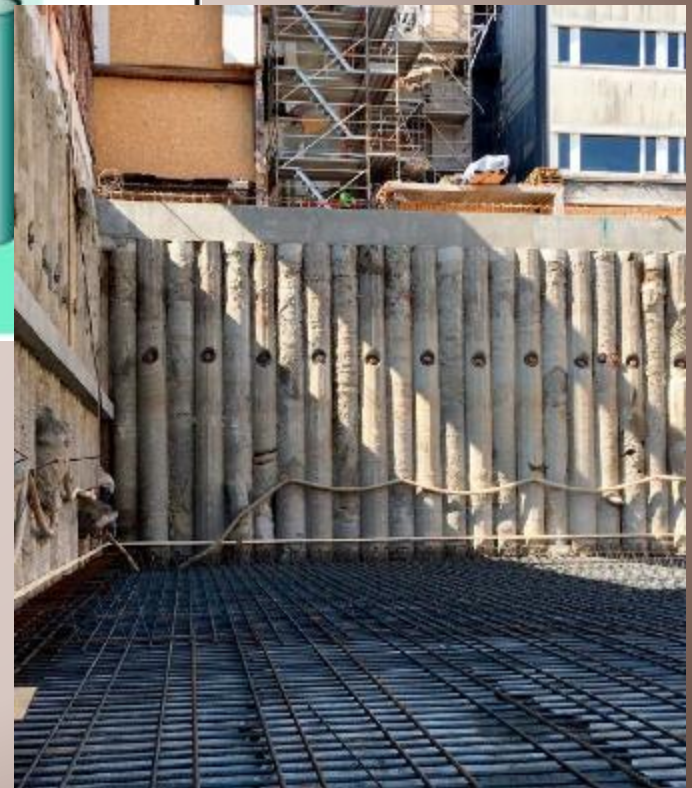
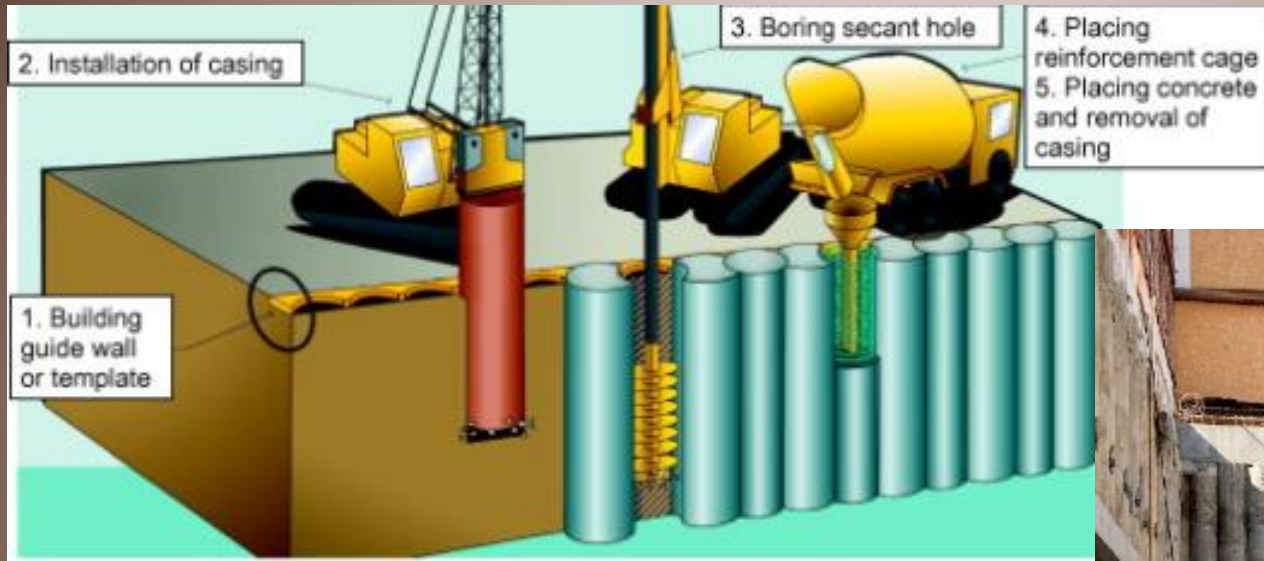


Contiguous Pile Walls

- This particular method involves installing the piles closely together, with only a small gap between them, exposing the retained soil. The exposed soil will, however, 'self-support' via a process known as 'soil arching', during the excavation process.
- If you choose this method, the retaining walls may be created either as cantilever walls or you can draw on additional lateral support from anchors or bracing. Contiguous pile walls are also suitable for a variety of soils, where groundwater lies below the maximum excavation depth.



Contiguous Pile Walls



Affect of Deep Excavation

- Deep Excavation affects the structures directly adjacent to them.
- Even dewatering draw down the water levels adjacent to excavation which ma cause settlement on adjacent property.



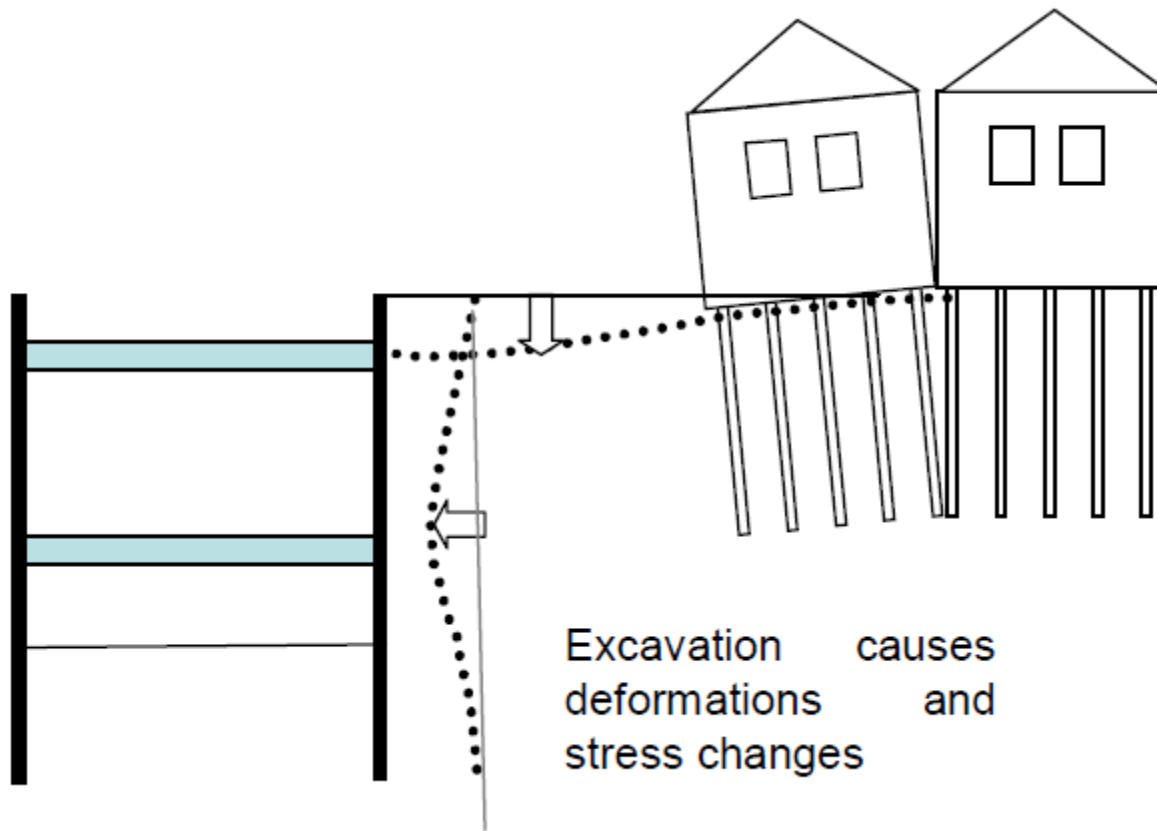
Affect of Deep Excavation

Therefore shoring system shall be designed taking the following affects into consideration:

- Determine green field displacements,
- Impose displacements onto building,
- Assess potential damage,
- Design measures if necessary.
- Even it is important to study the behavior of supporting structure (wall , shoring) during excavation.



Affect of Deep Excavation



Presence of building modifies soil deformations.

Excavation causes deformations and stress changes



Numerical Analysis

- To predict the behavior of soil/rock during excavation , it is important to perform numerical analysis.
- Thus, it helps for necessary planning to ensure the safety of nearby structures. However, accuracy of such analysis depends on the judicial estimation of soil parameters.



Numerical Analysis

- A finite element modelling is used to analyse the staged excavation (cross section) *and dewatering at the bulk level.*



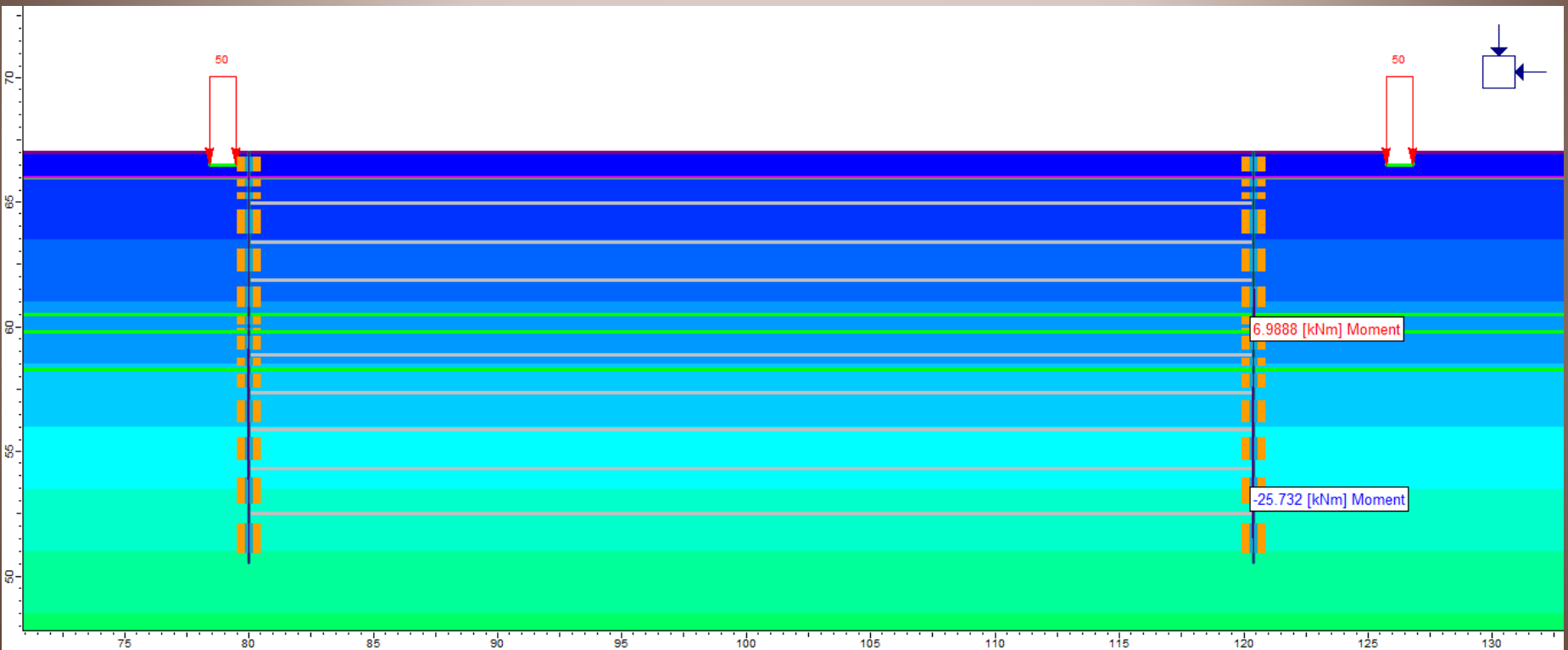
Excavation Sequence

- Installation of temporary excavation support walls, such as soldier pile and lagging, sheet piling, slurry walls, tangent or secant pile walls.
- Dewatering within the trench if required.
- Excavation and installation of temporary wall support elements such as struts or tiebacks.
- Complete construction of the walls and then the roof.
- Backfilling to final grade and restoring the ground surface.



Numerical Analysis

This Video is showing bending moments in the shoring with different stages of excavation



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THANK YOU

HAVE A NICE DAY AHEAD



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