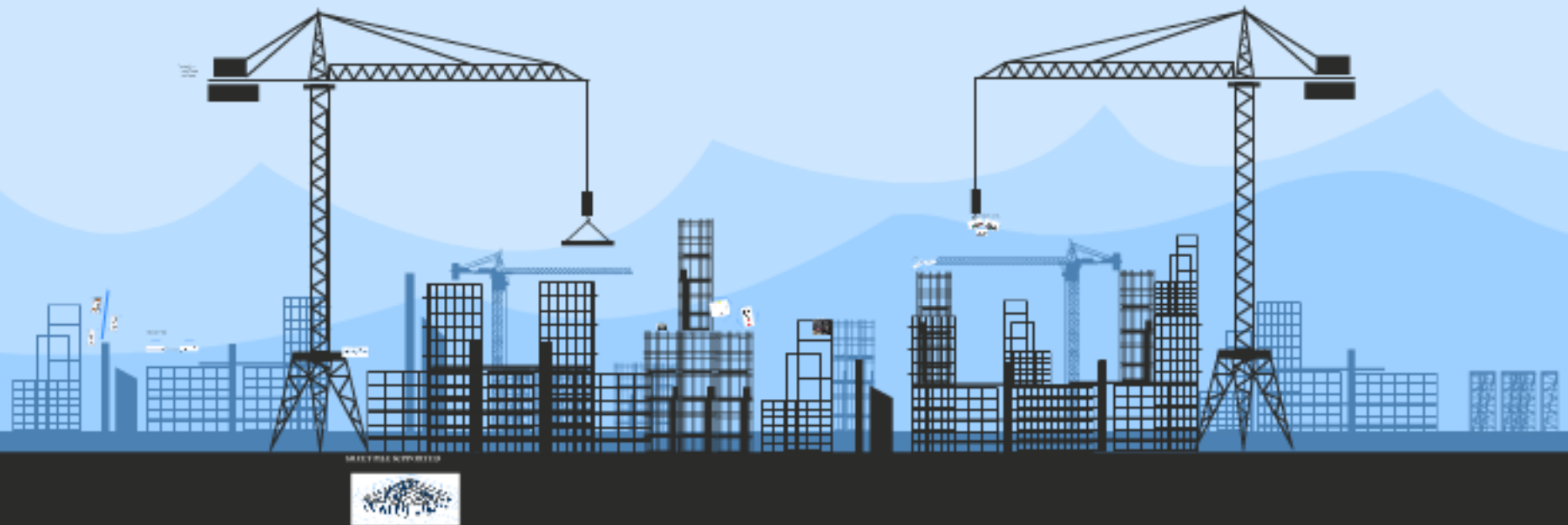


Graduation Project Report II

Deep Excavation for City Mall - Nablus



Soil Nailing

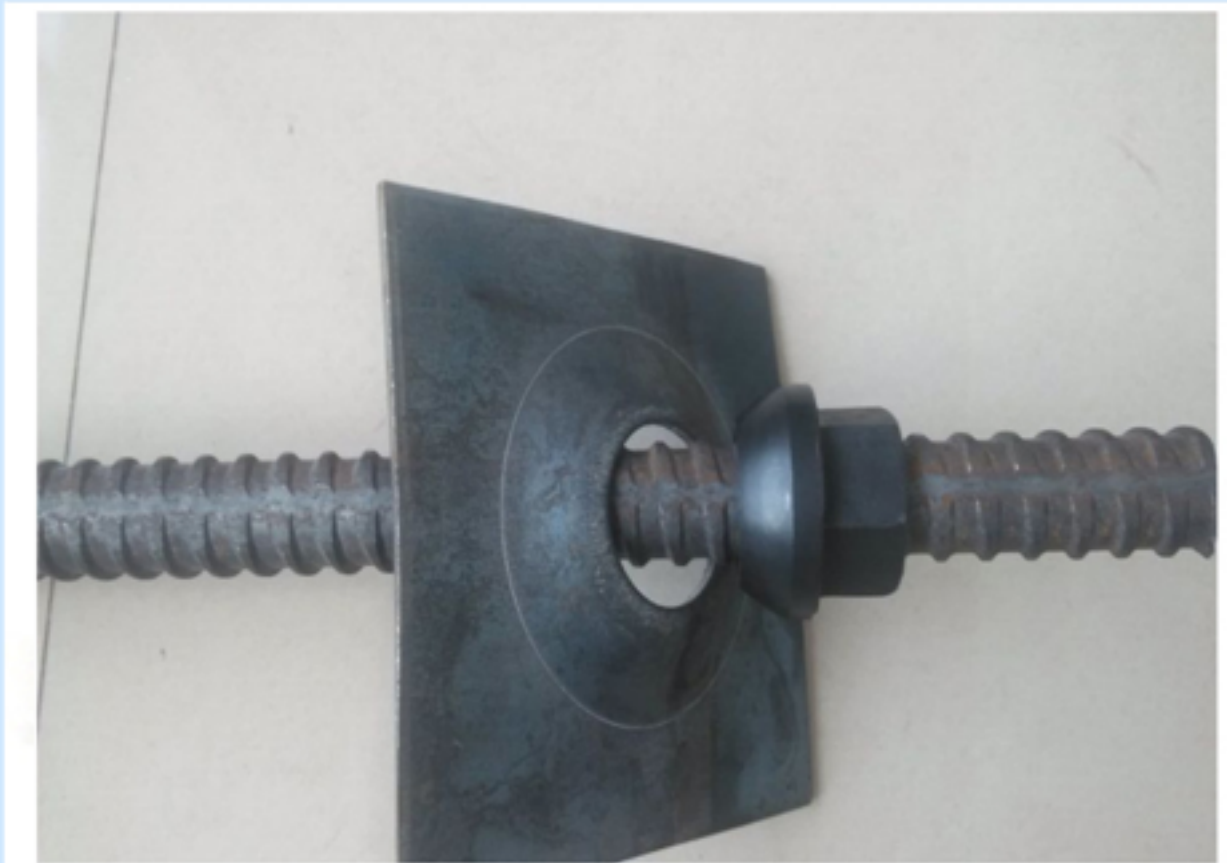


Nail Bars (Steel reinforcing bars)

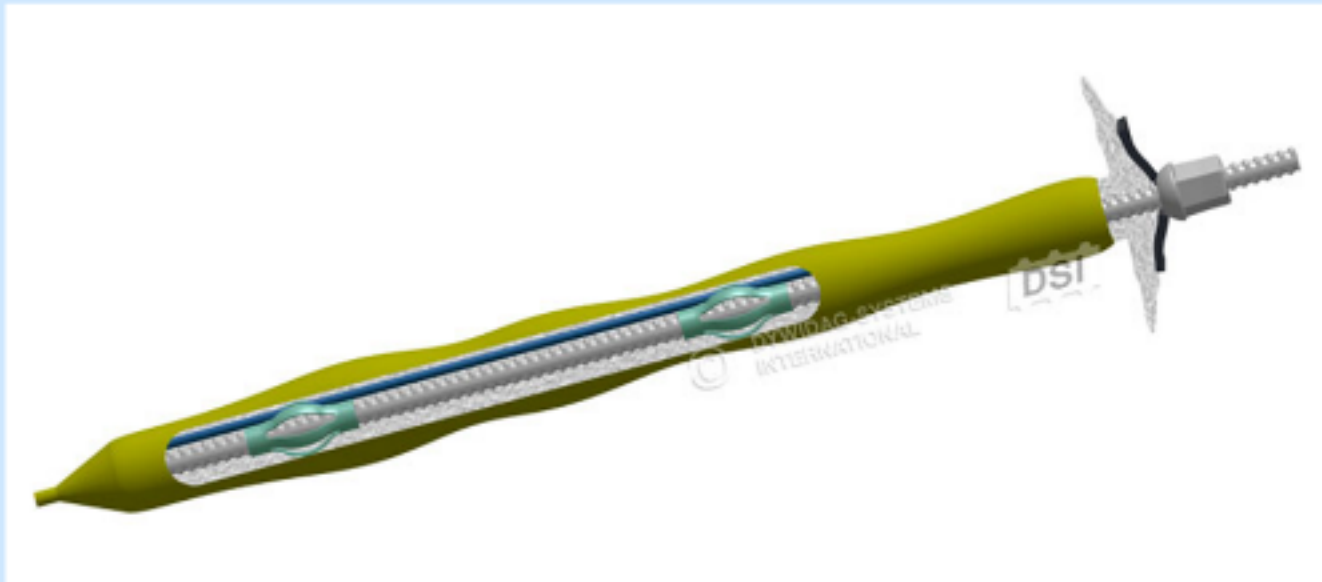


Nail Head (Consist of two main component)

1. Bearing plate
2. hex nut and washers



Grout



Centralizers



Corrosion Protection Elements

Double Corrosion Protection.

1. Single Barrier Protection.
2. Epoxy Coating.
3. Galvanizing.
4. Sacrificial Corrosion Allowance.
5. Borehole Grout.
6. Temporary and permanent facing

Drainage system



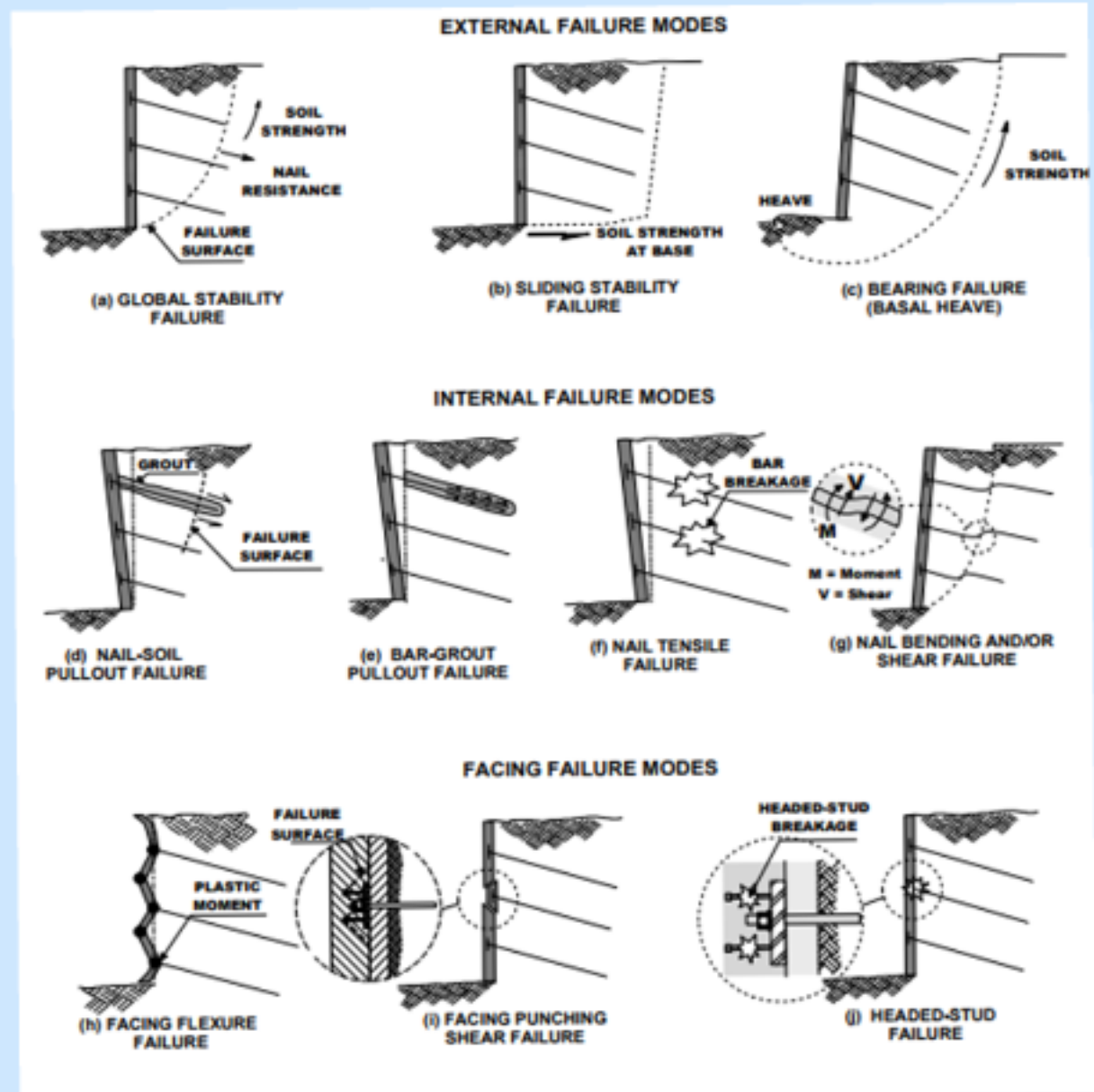
Modes of failure

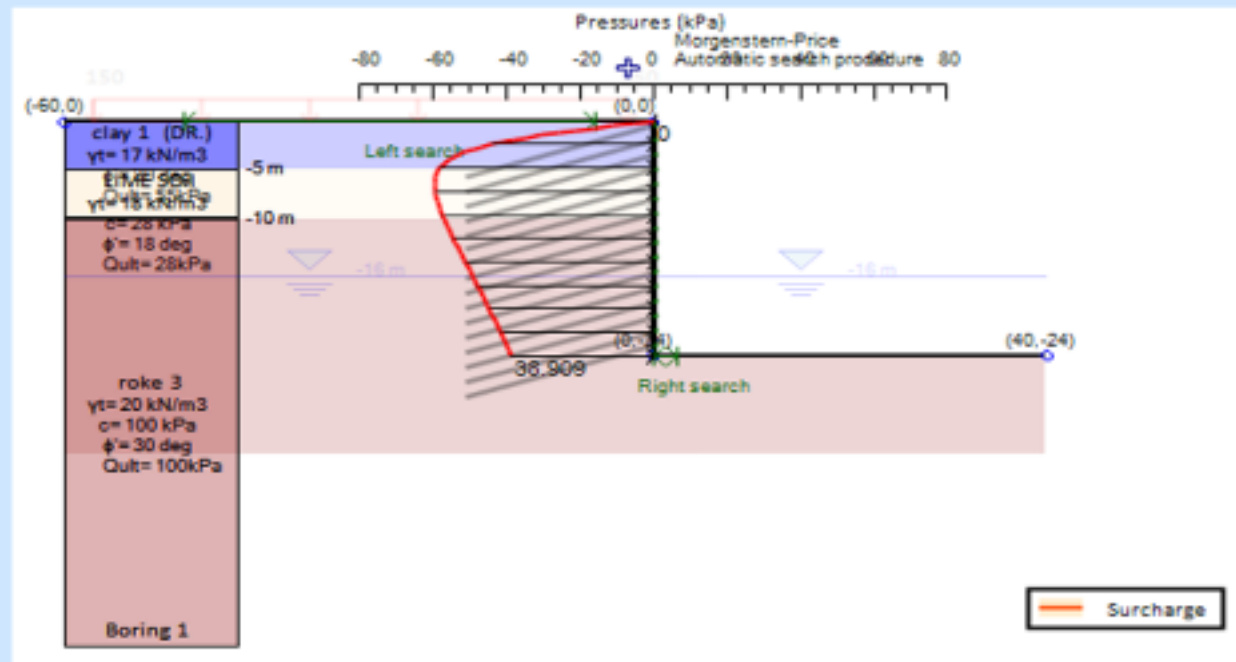
1. External failure mode (Failure surfaces not intersecting the nails)

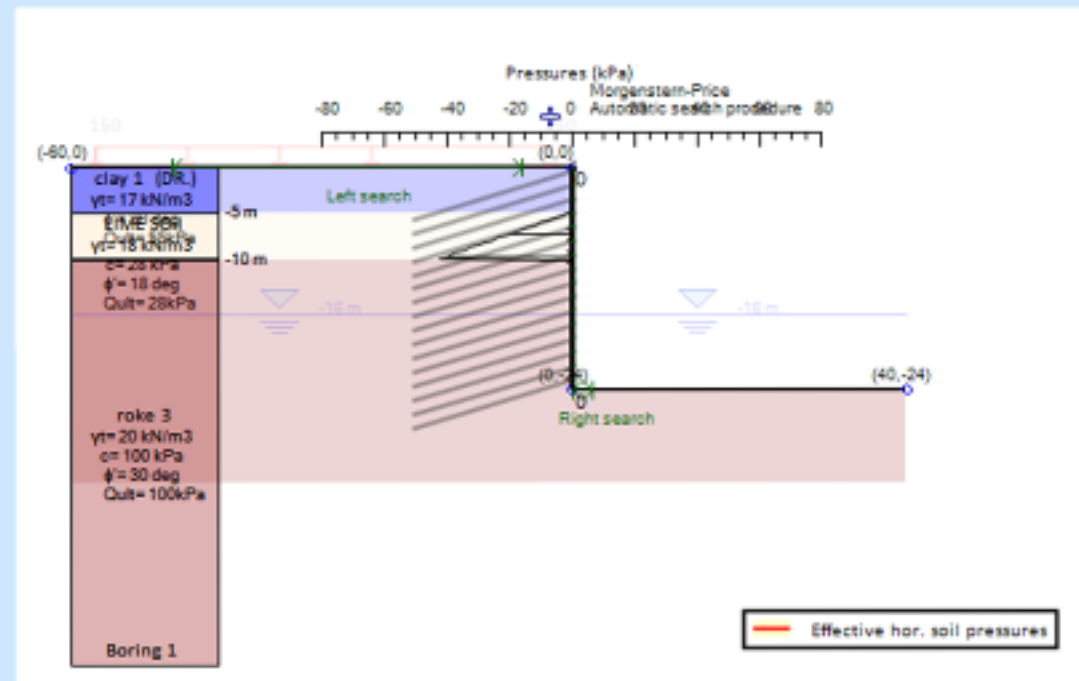
2. Internal failure mode (Surfaces intersecting all nails)

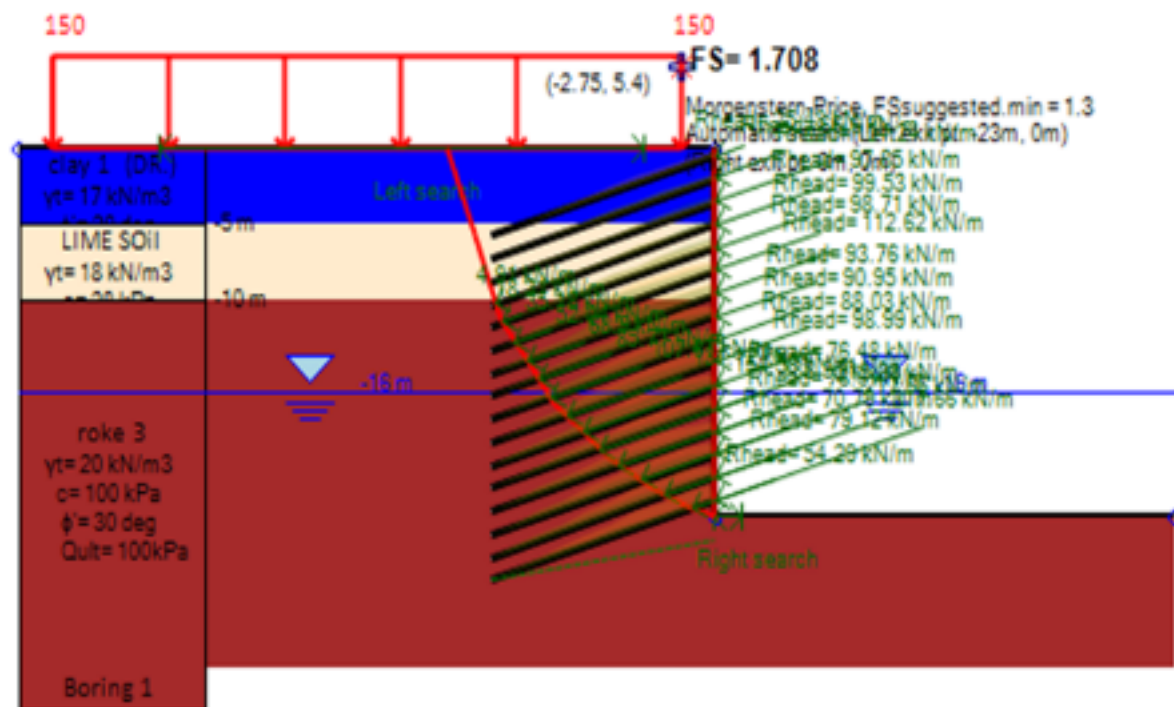
3. Facing failure mode

- Flexure Failure
- Punching Shear Failure
- Headed-Stud Tensile Failure









Manual calculations

Normalized allowable pull-out resistance μ

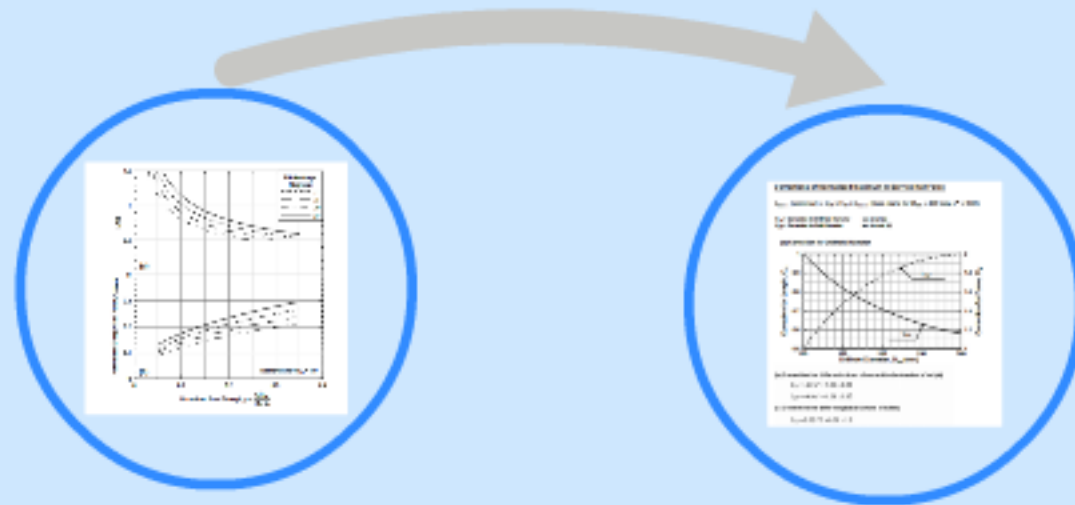
$$\mu = \frac{q_u D_{DH}}{FS_p \gamma S_H S_V}$$

q_u is the bond strength according to soil type and construction method the bond strength is selected

chohesionless soil, method of construction is Augured with silty fine sand

$q_u = 73 \text{ KPa (10.6 Psi)}$, $H = 24\text{m (78.74 ft)}$, $DDH = 15\text{cm (6 in)}$, FS_p typically = 2
 $18 \text{ KN/m}^2 (115.62 \text{ pcf})$, $S_H = 1.5\text{m (5 in)}$, $VH = 1.5\text{m (5 in)}$

$$\mu = (10.6 \times 144 \times 6 \times 1/12) / (2 \times 115.62 \times 5 \times 5) = 0.132$$



$$L/H = 1.05$$

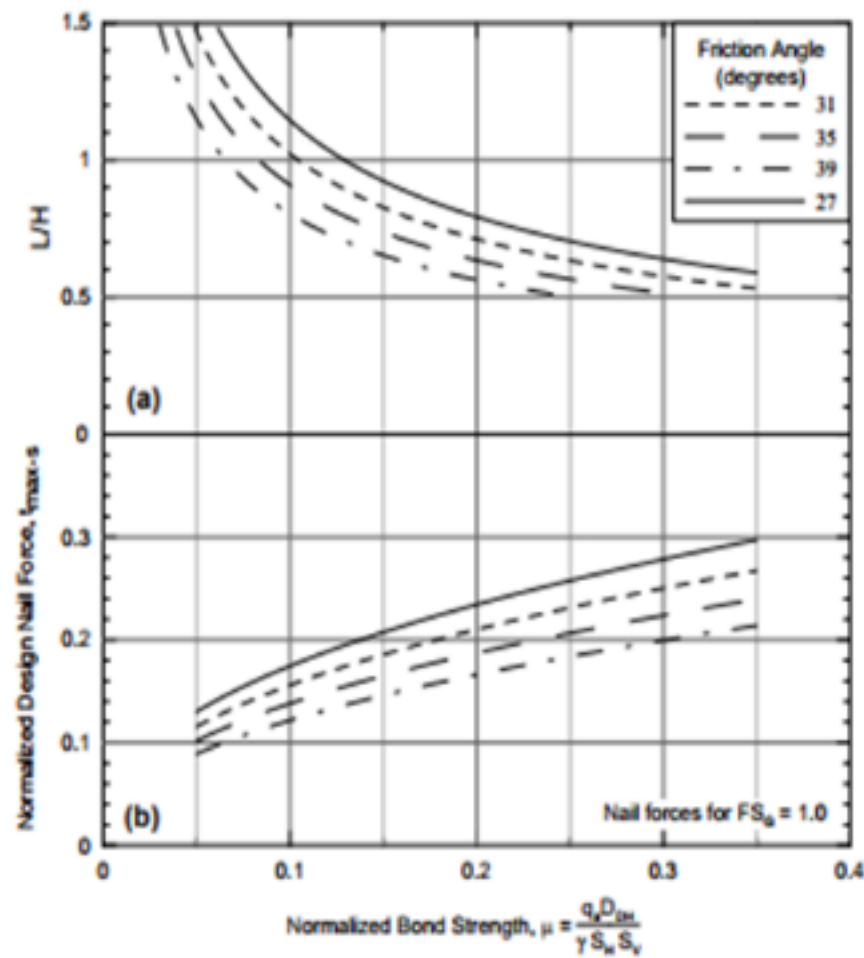
$$L = H \times 1.05 = 78.74 \text{ ft (24m)}$$

Using the correction factor from figure 4.7.17, from the interaction between the DDH and the curve $C1L = 0.83$

$$L_{corrected} = 1.05 \times 0.83 \times 78.74 = 83.6 \text{ ft (20.9m)}$$

In general

9 bars $\varnothing 36$, Wall thickness 30cm, Grout hole = 15cm, plate with 40"40"10 cm

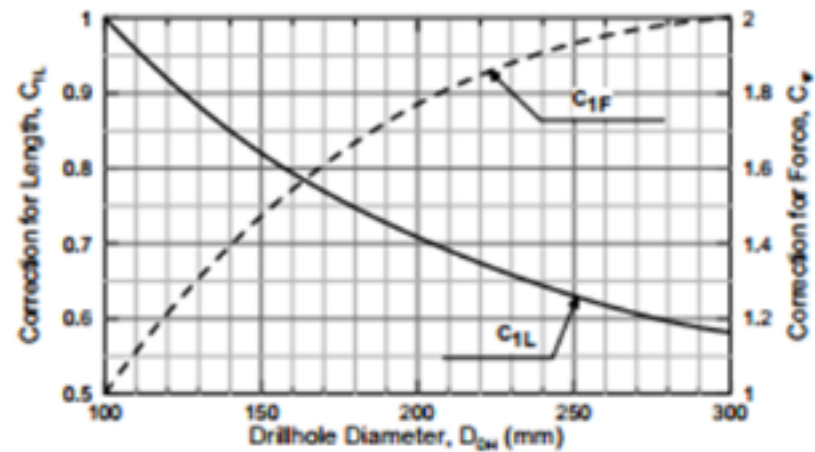


Corrections of Normalized Maximum In-Service Nail Force

$$t_{\text{max-}i} \text{ (corrected)} = C_{1F} \times C_{2F} \times t_{\text{max-}i} \text{ (from charts for } D_{\text{DH}} = 100 \text{ mm, } c^* = 0.02)$$

C_{1F} = Correction for Drillhole Diameter see chart (a)
 C_{2F} = Correction for Soil Cohesion see formula (b)

(a) Correction for Drillhole Diameter



(b) Correction for different values of normalized cohesion ($c^* = c/H$)

$$C_{1L} = -4.0 c^* + 1.09 \geq 0.85$$

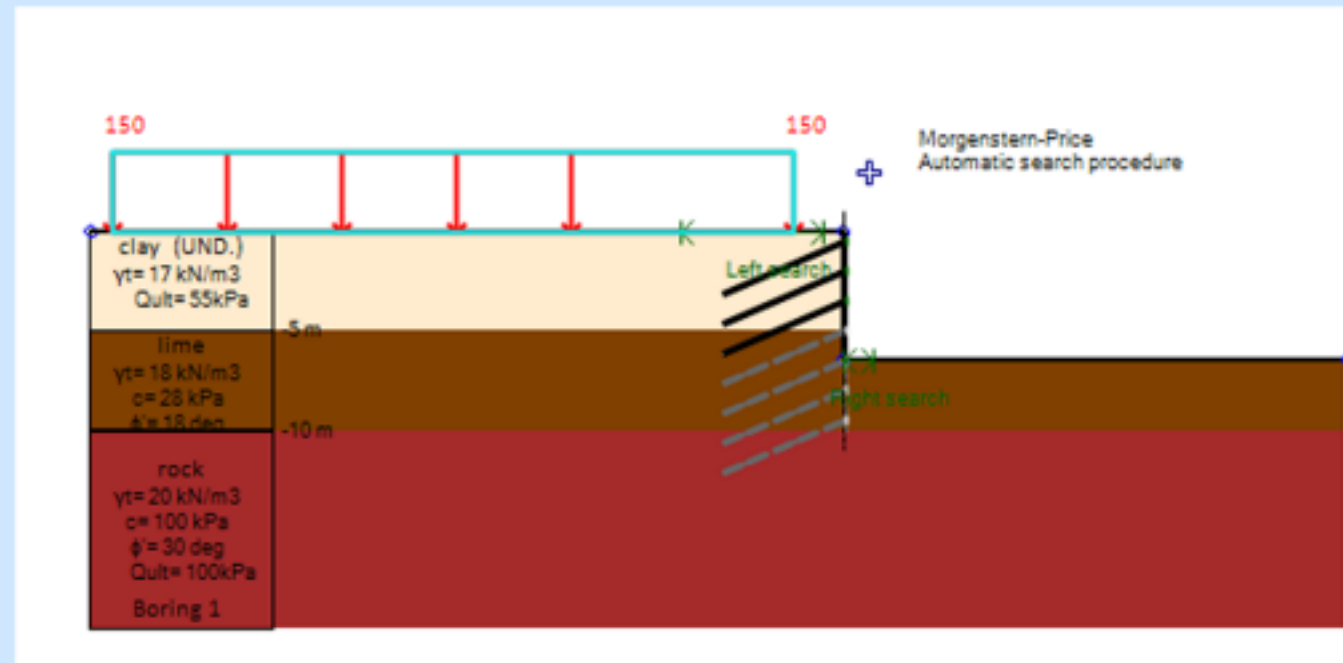
$$C_{2F} = -4.0 c^* + 1.09 \geq 0.85$$

(c) Correction for different global factors of safety

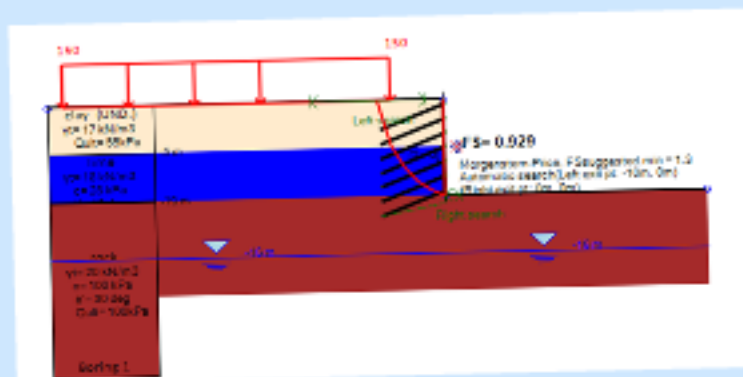
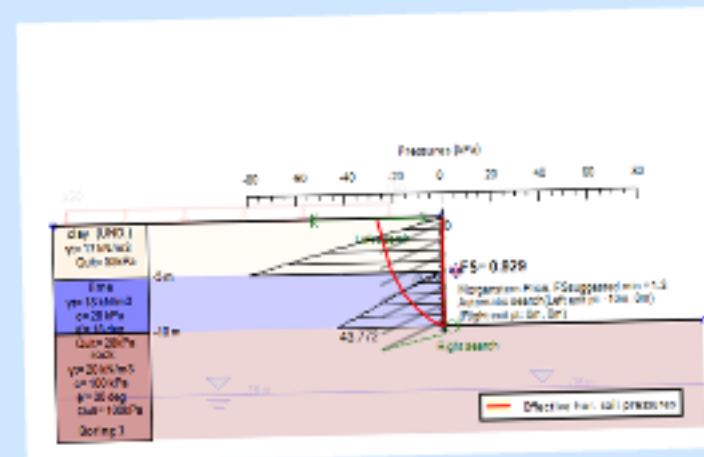
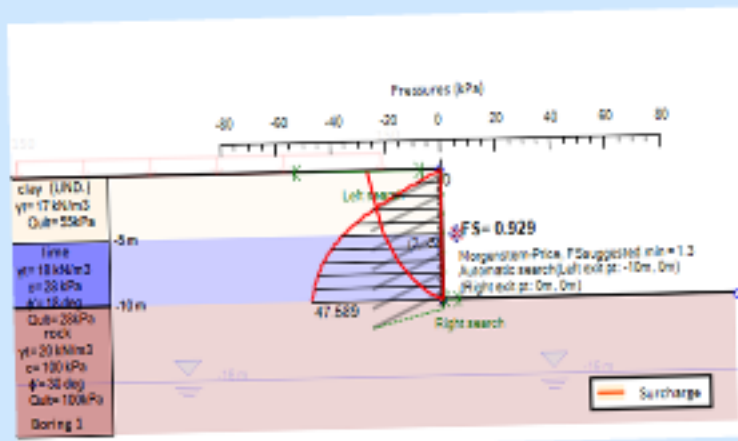
$$C_{1L} = 0.52 FS + 0.30 \geq 1.0$$

Simulation for the Western Side

- The area excavated for 10m depth.
- The 10m depth will be excavated in stages, in each stage an excavation of 1.5m depth will be performed and a nail with 10m length with 15 degree inclination installation.
- The horizontal spacing between the nails = the vertical spacing = 1.5m



Western Results from SNailPlus software

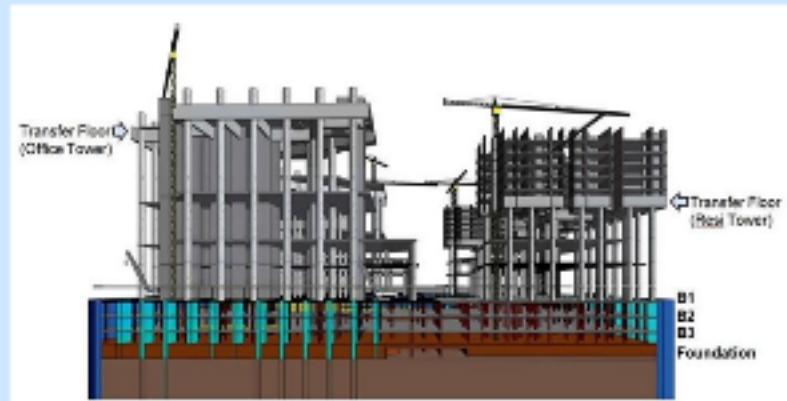
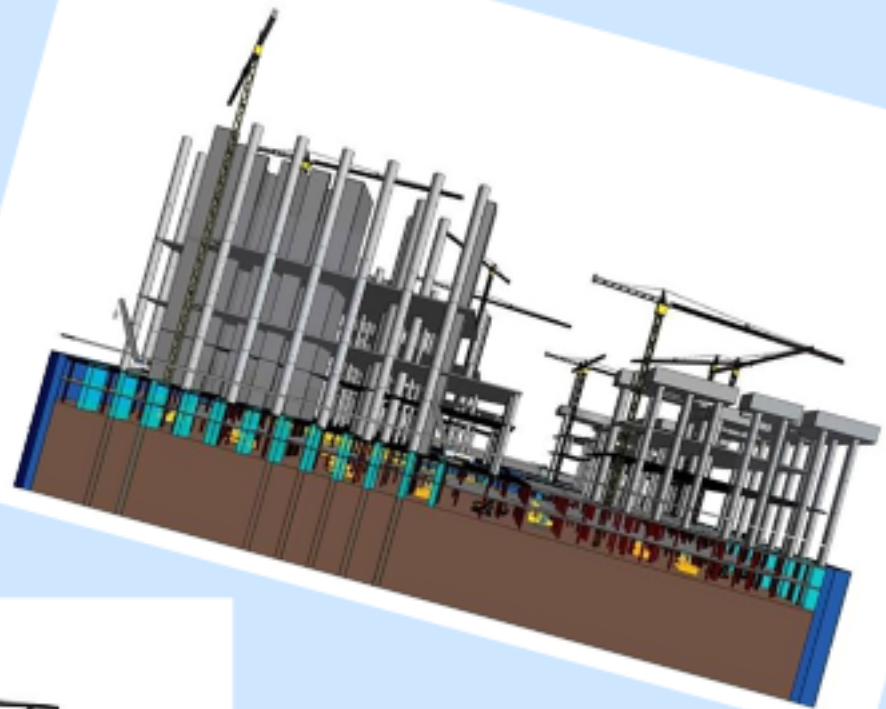
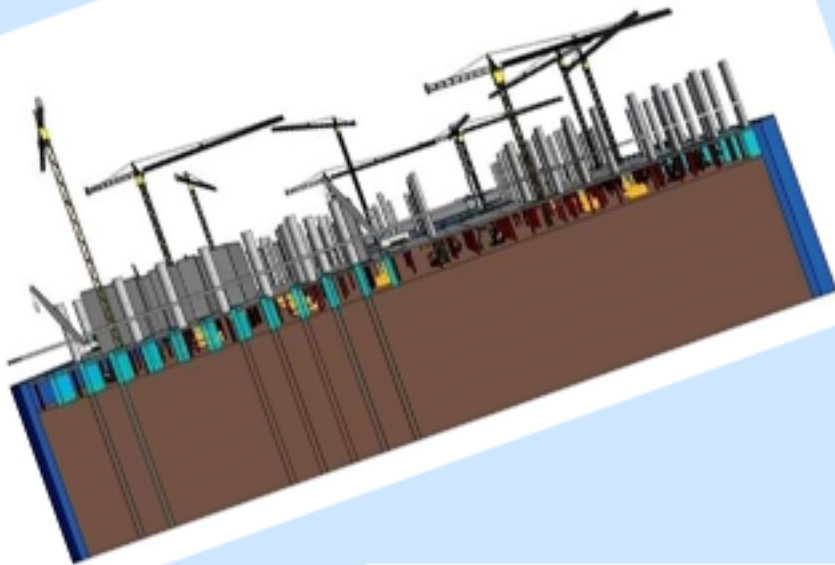


In general

8 bars $\varnothing 36$, Wall thickness 30cm,

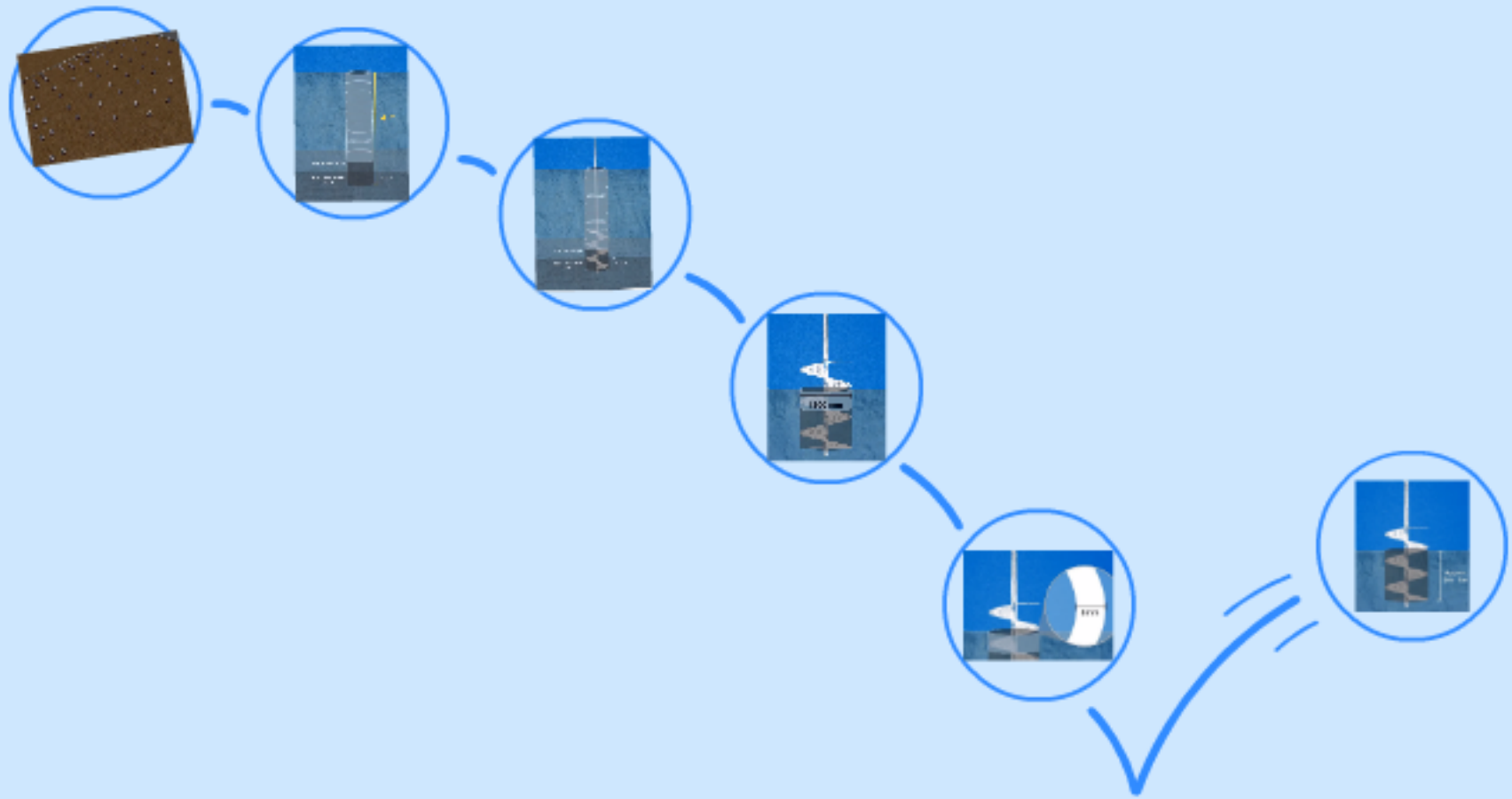
Grout hole = 15cm, plate with 40*40*10 cm

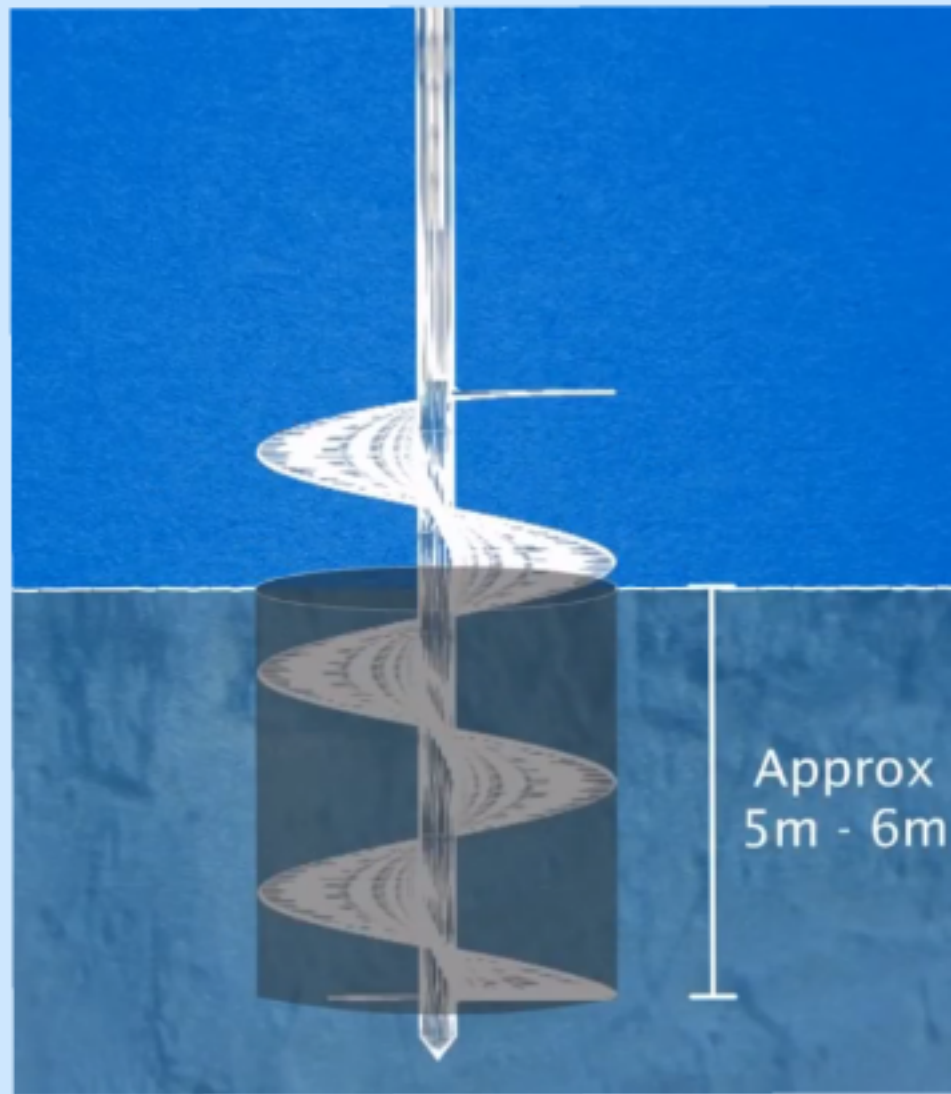
TOP - DOWN CONSTRUCTION

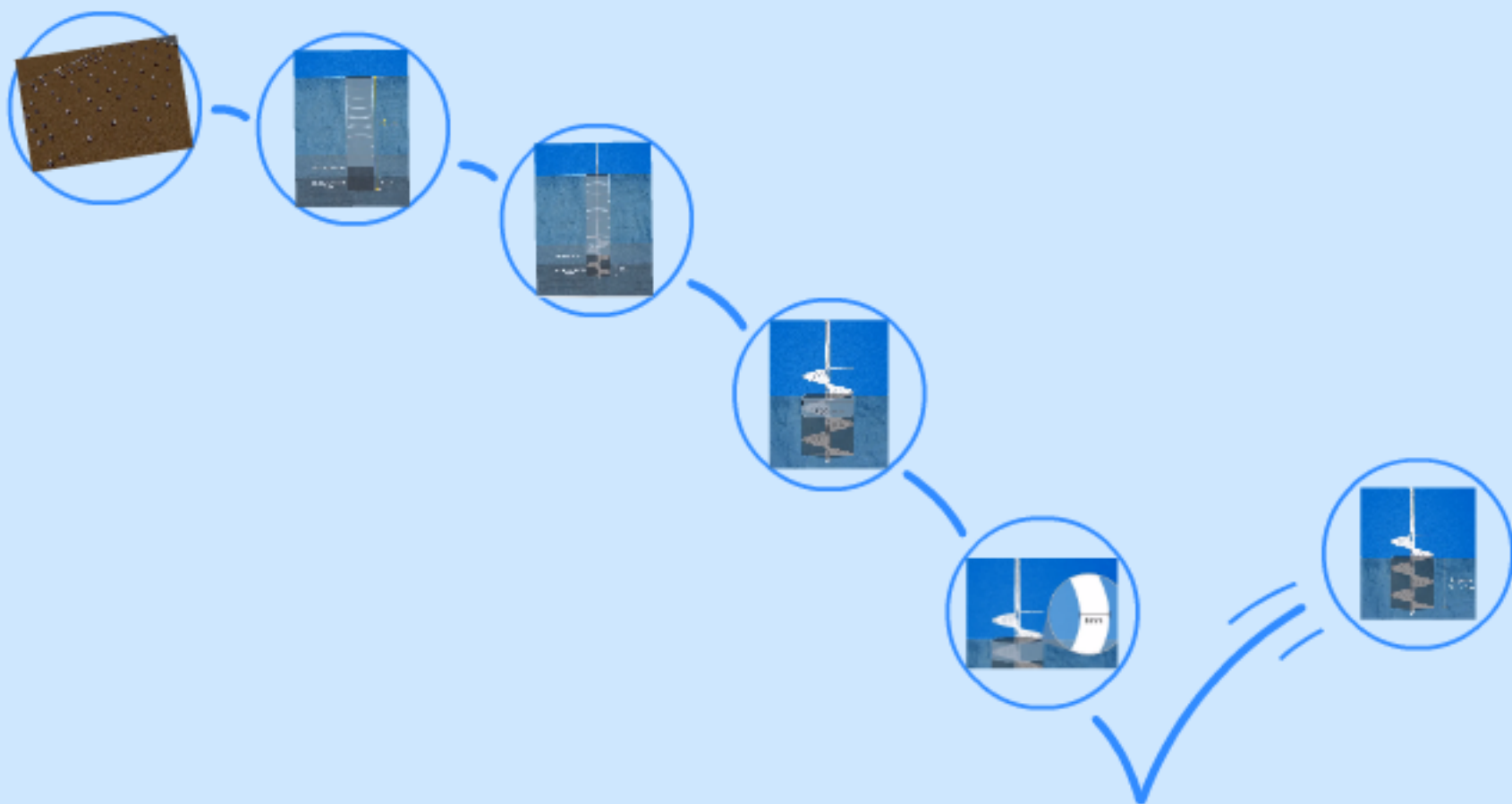


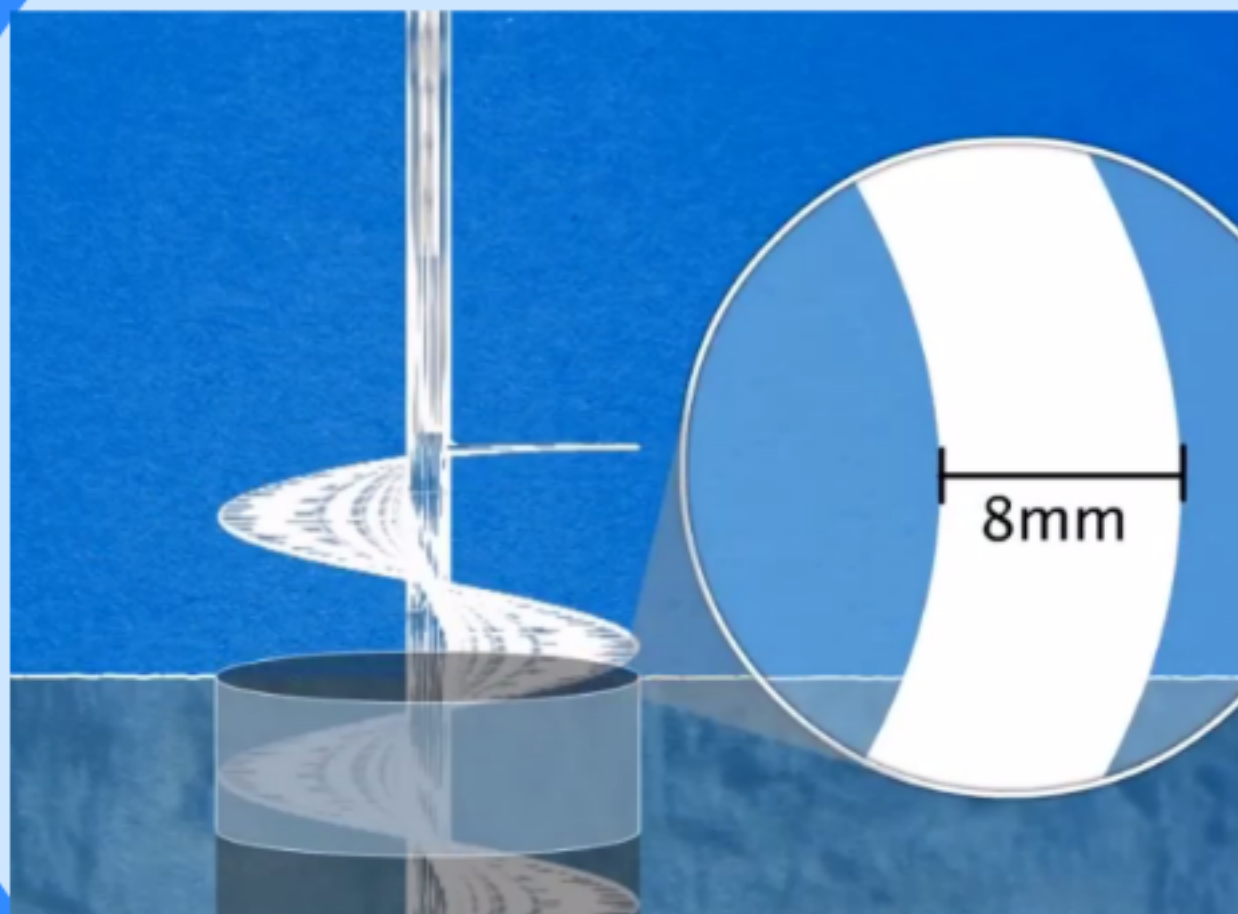
General Sequence of Top Down

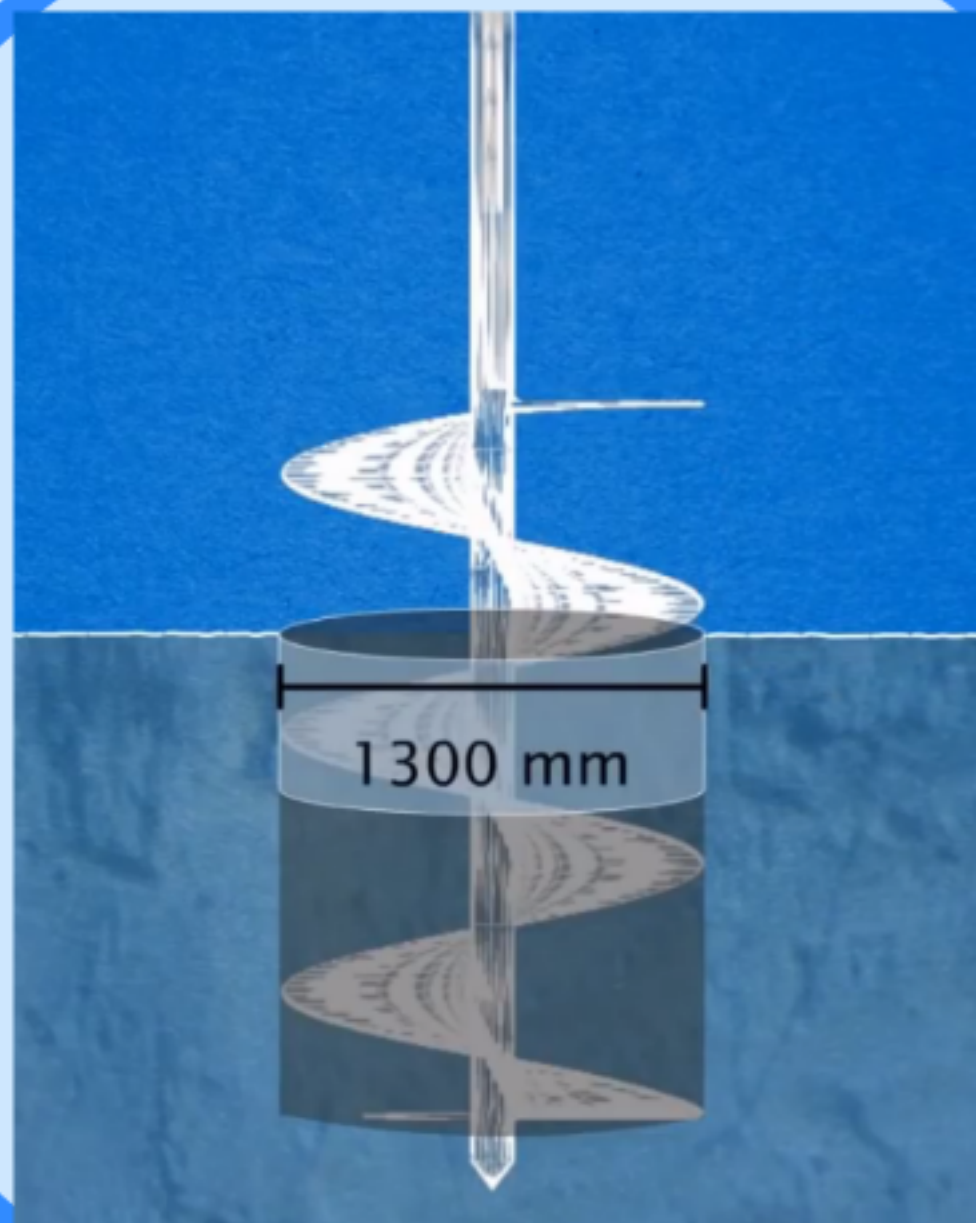
- 1. Casting of columns**
- 2. Installation of columns**
- 3. Completion of Ground Floor**
- 4. Excavation up to 2nd layer**
- 5. Completion of 2nd layer and then excavation up to bottom as sequence**
- 6. construction of raft**
- 7. slab completion**
- 8. Construction of retaining wall alonge all sides from raft to the Ground floor**

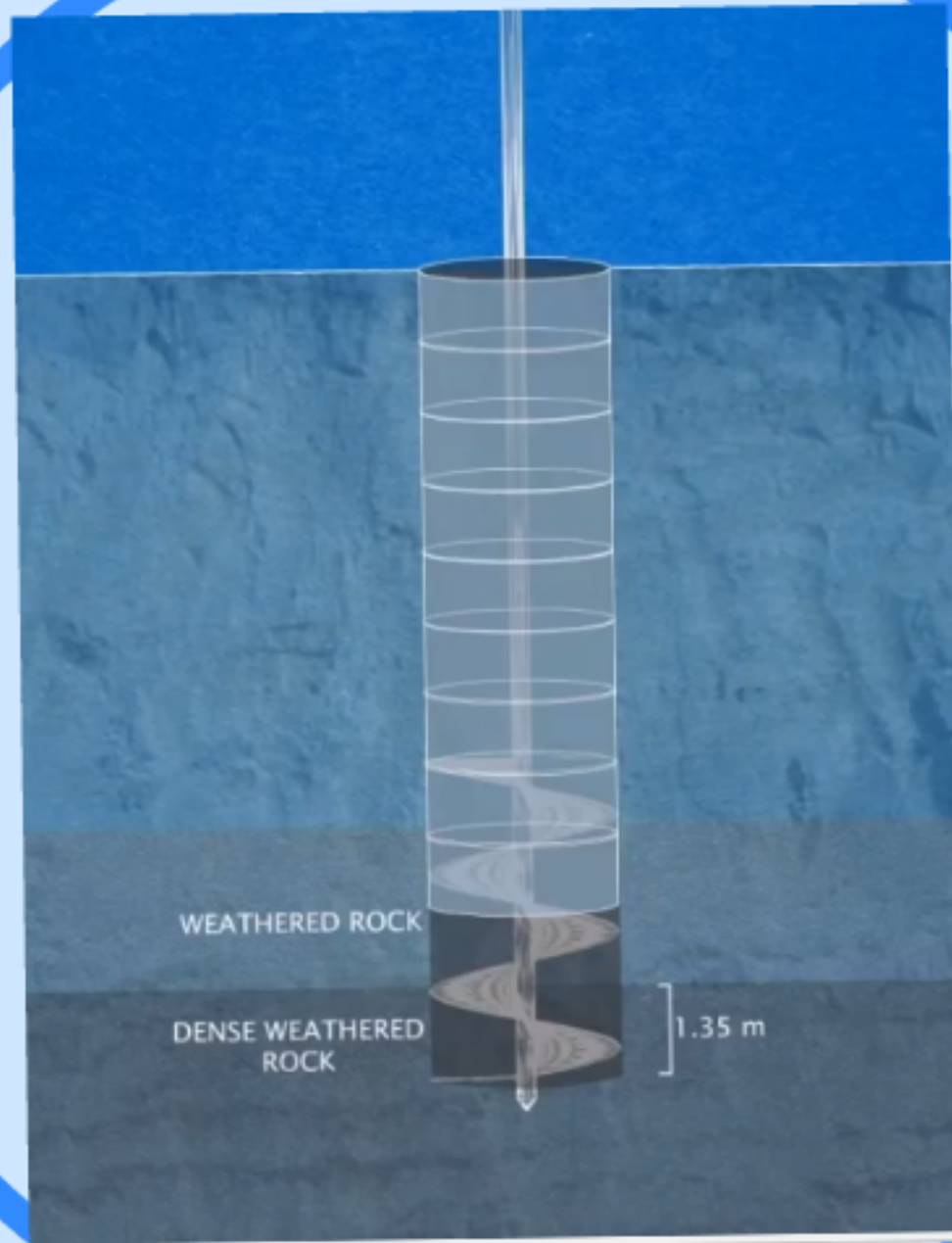


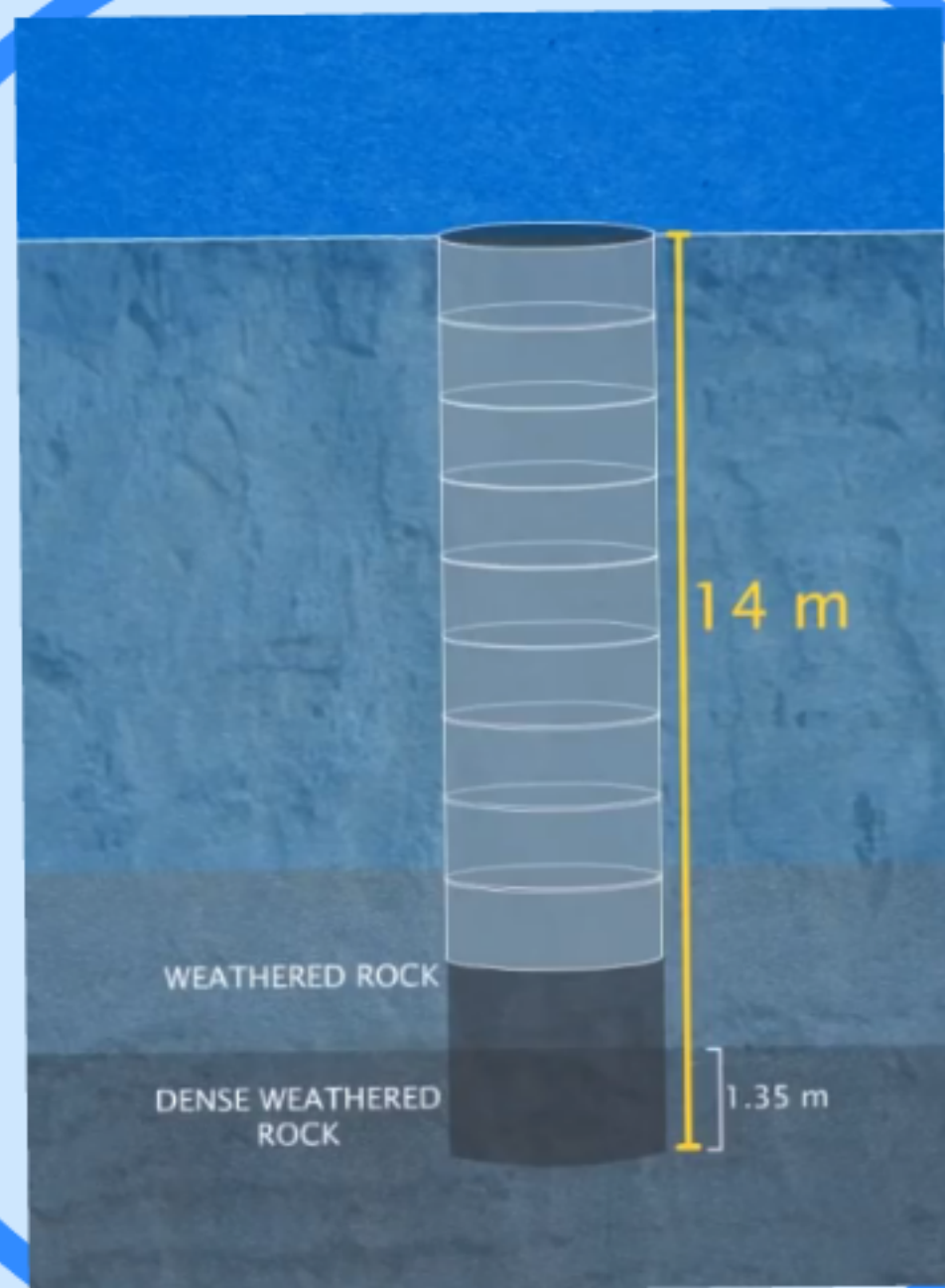


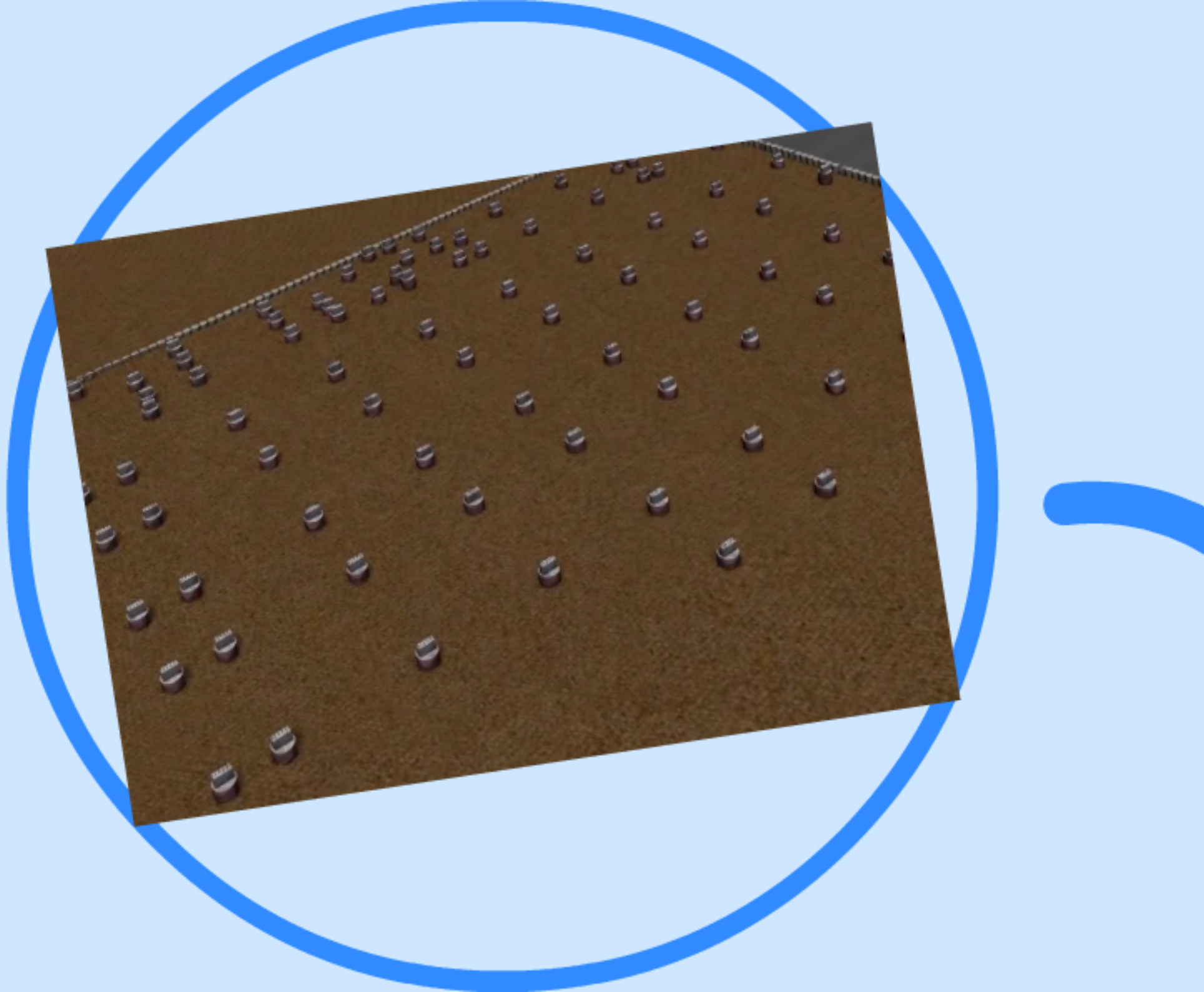


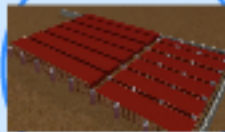


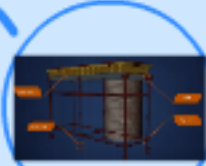
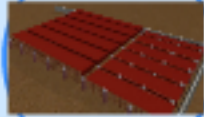




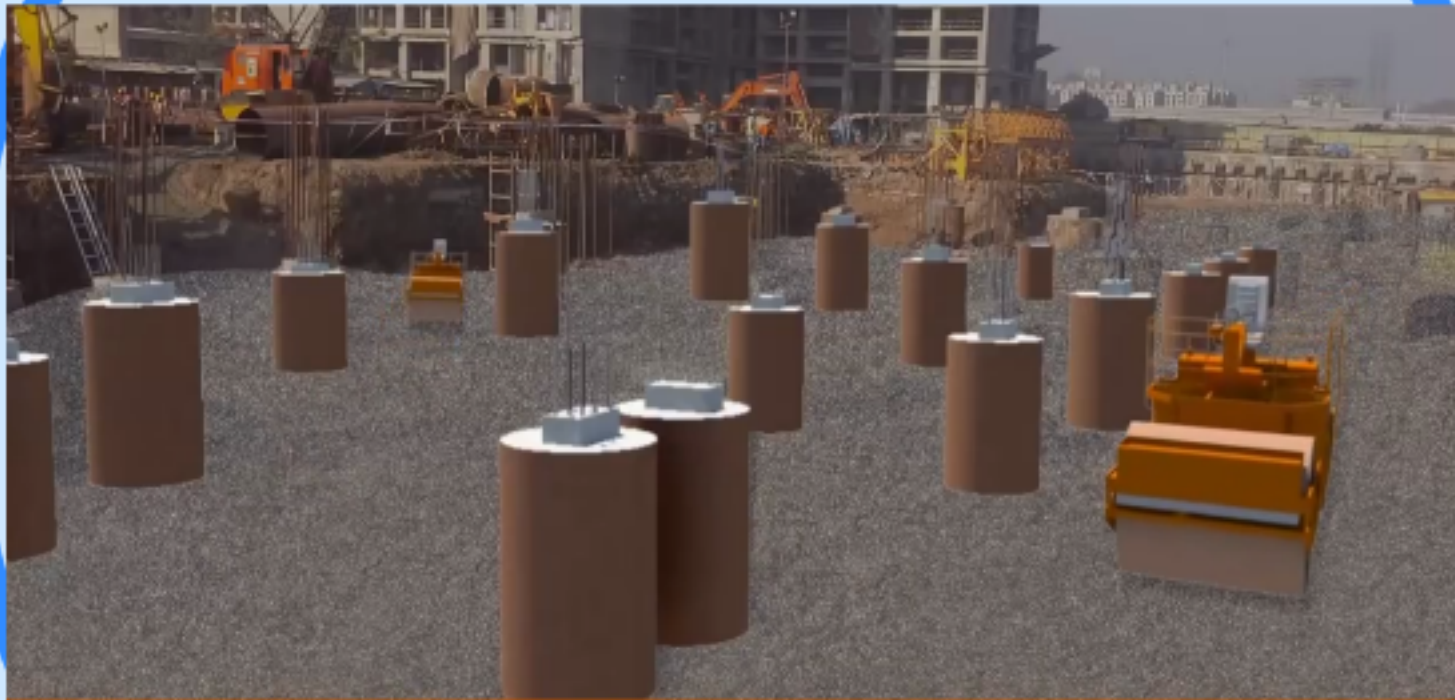


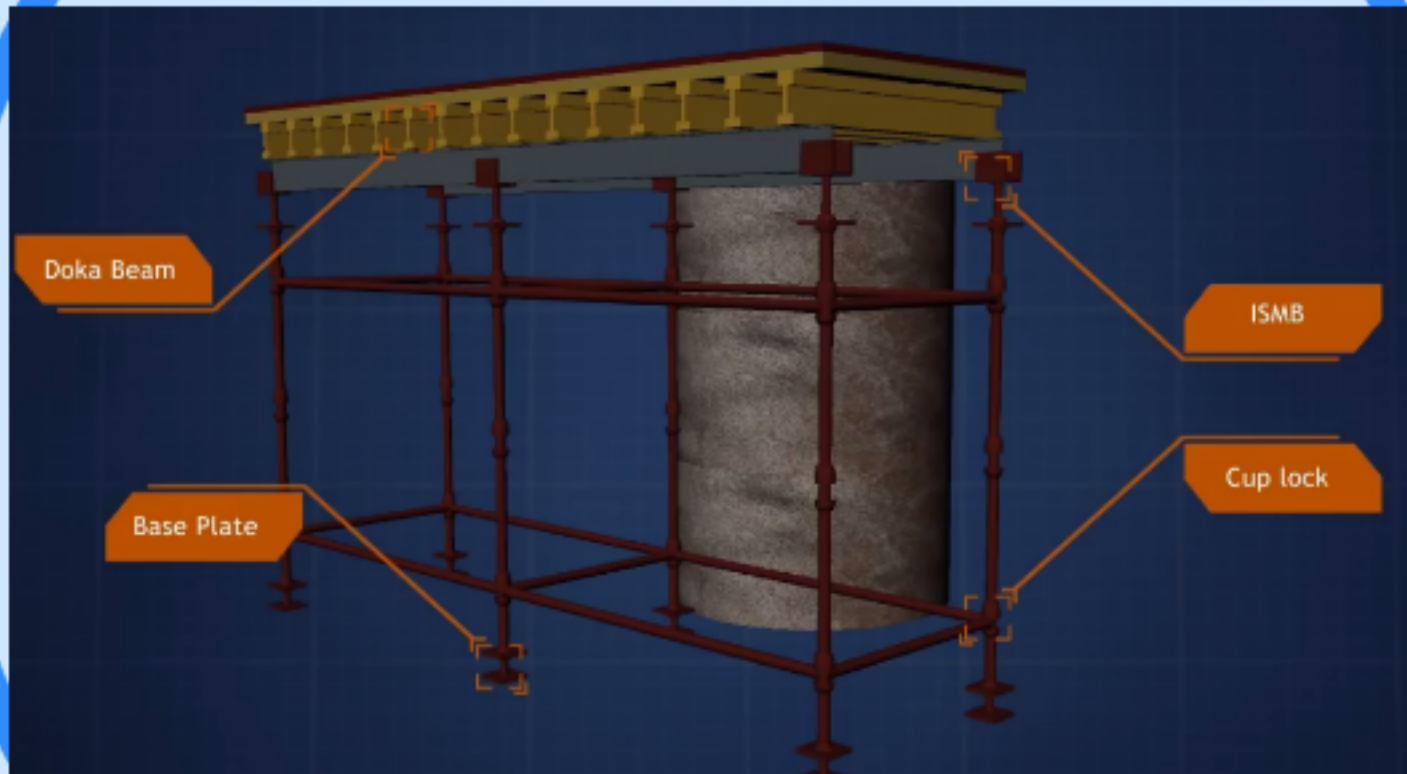


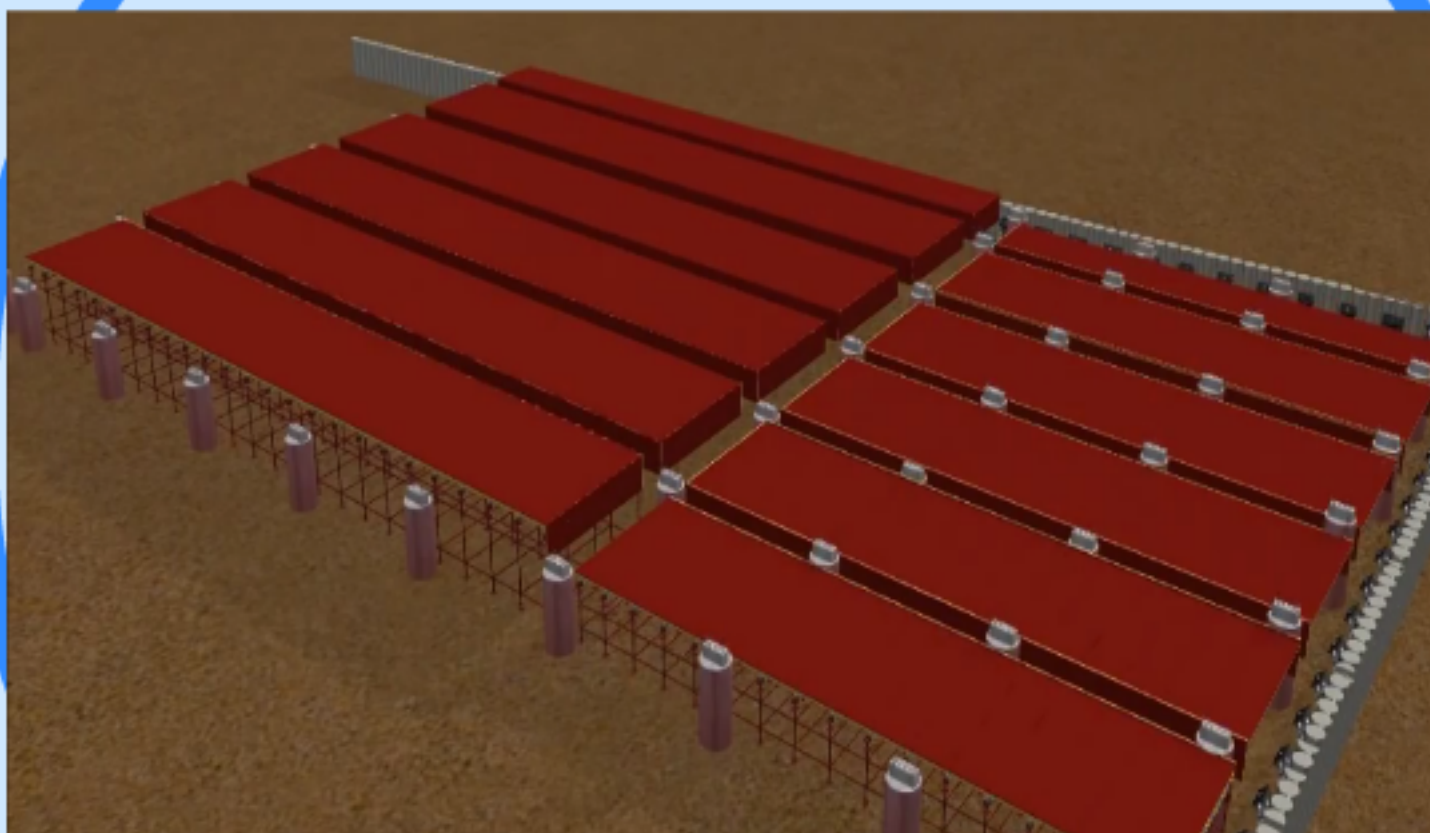


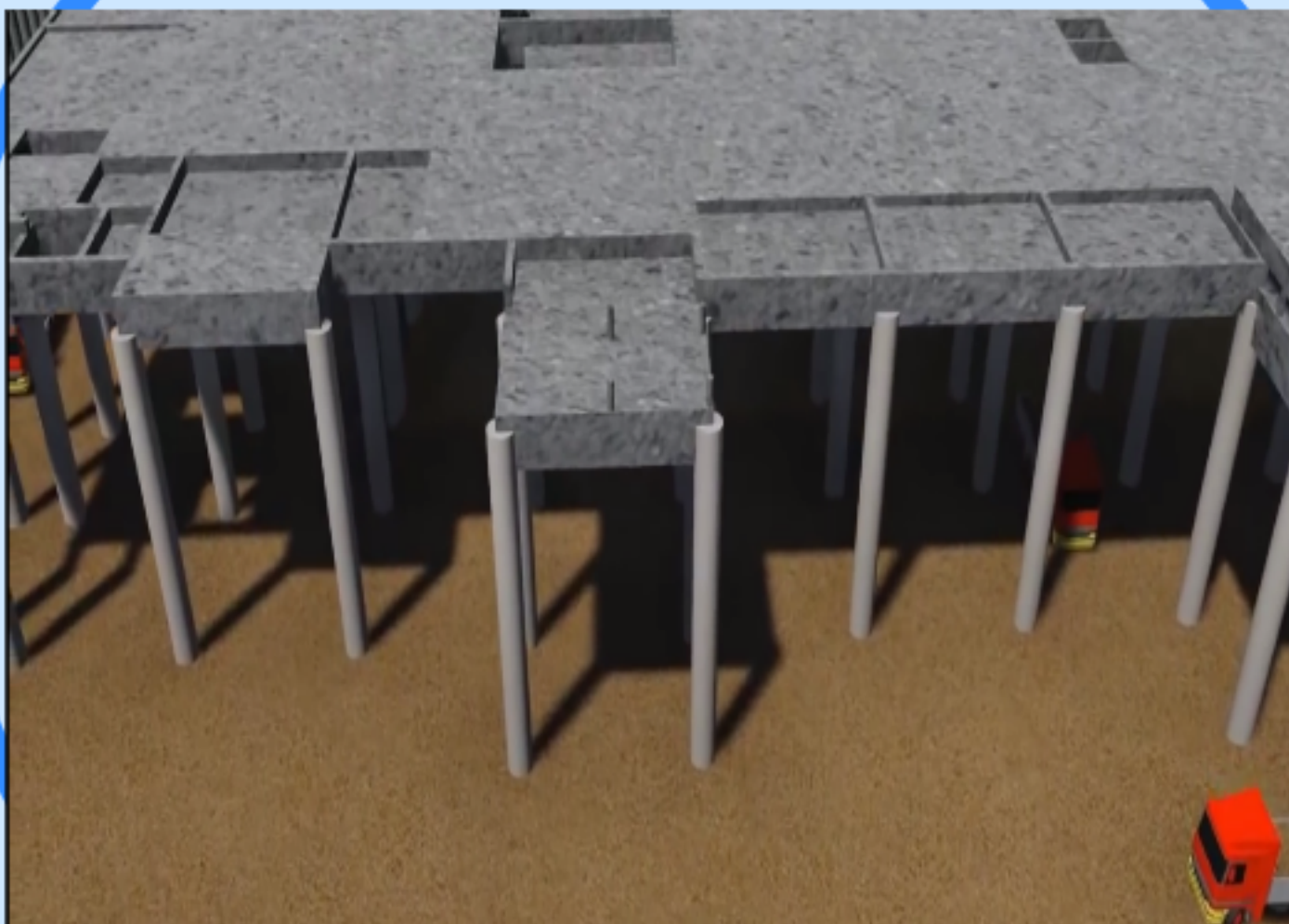


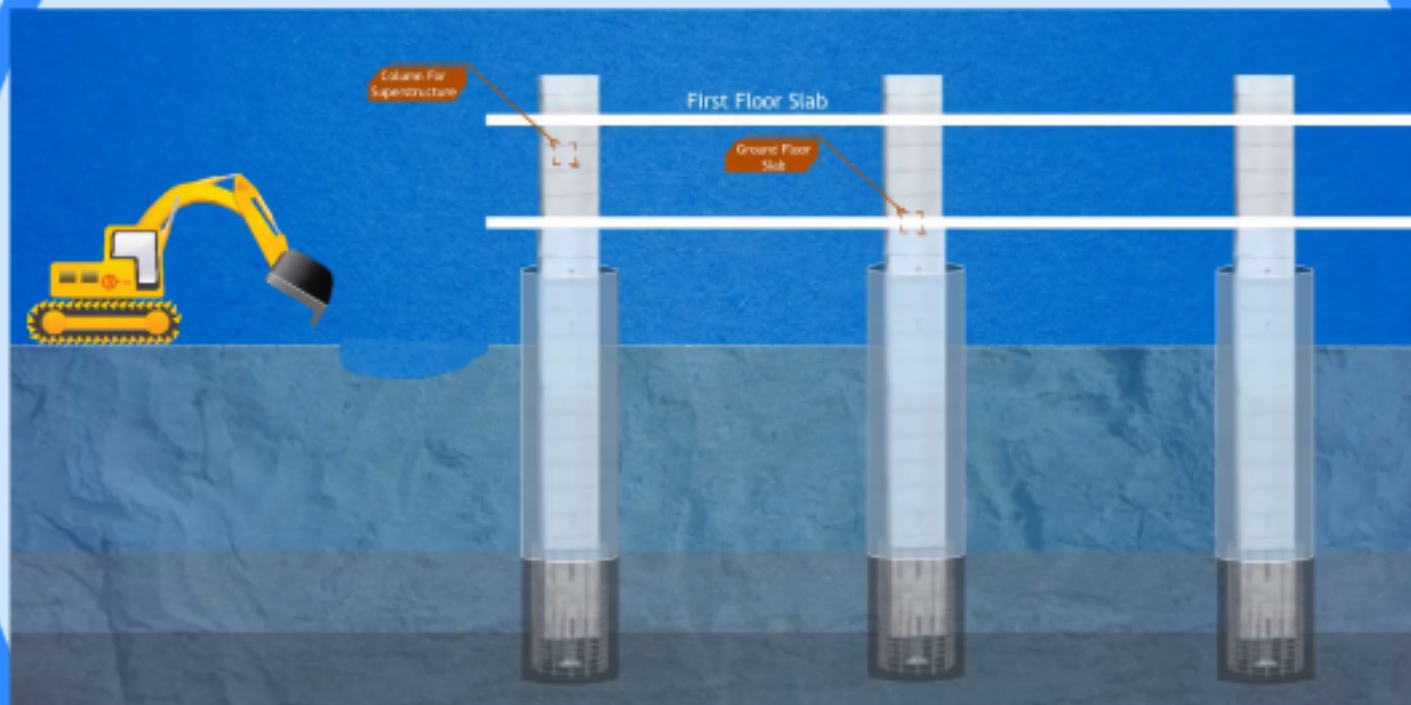




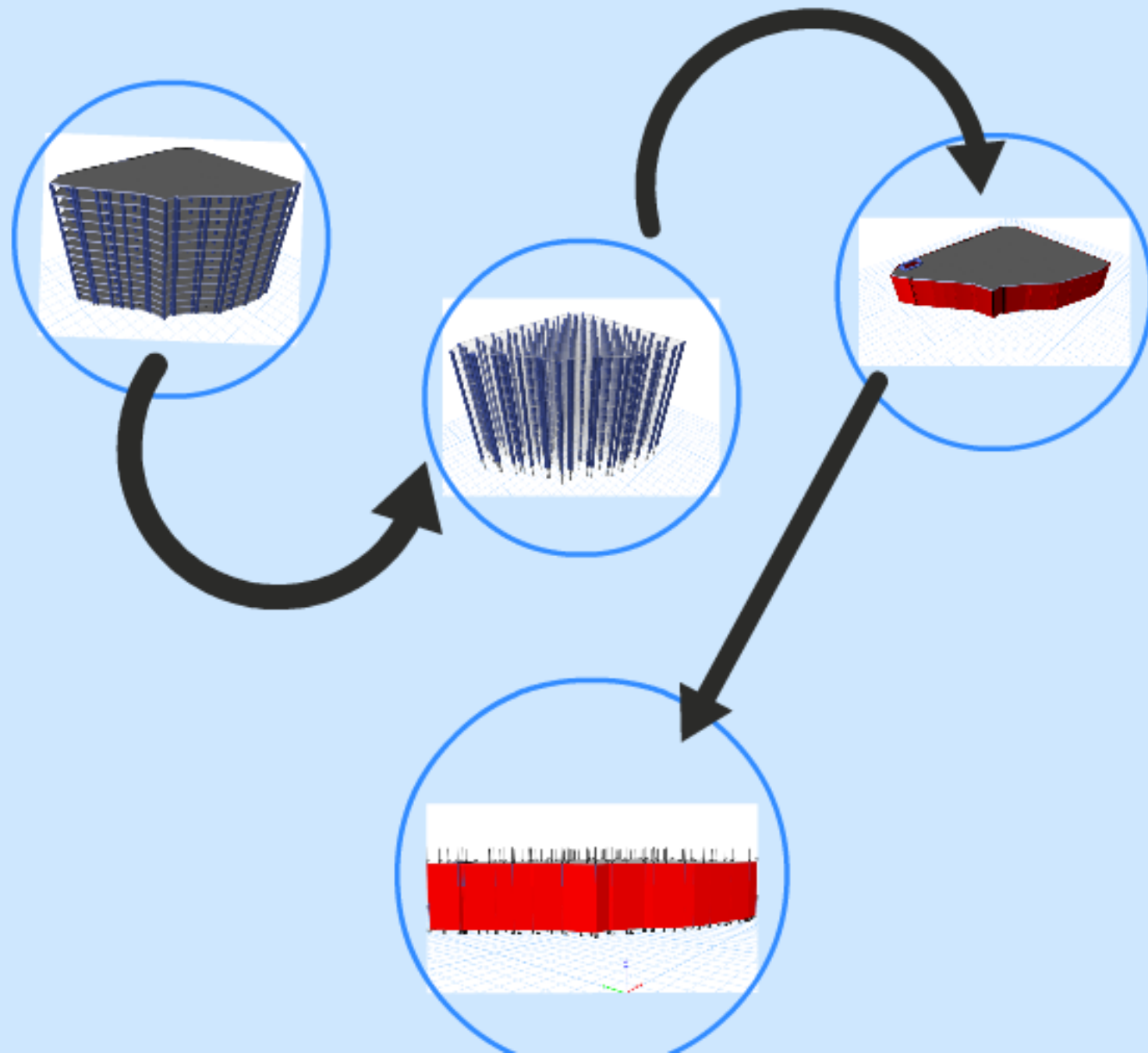




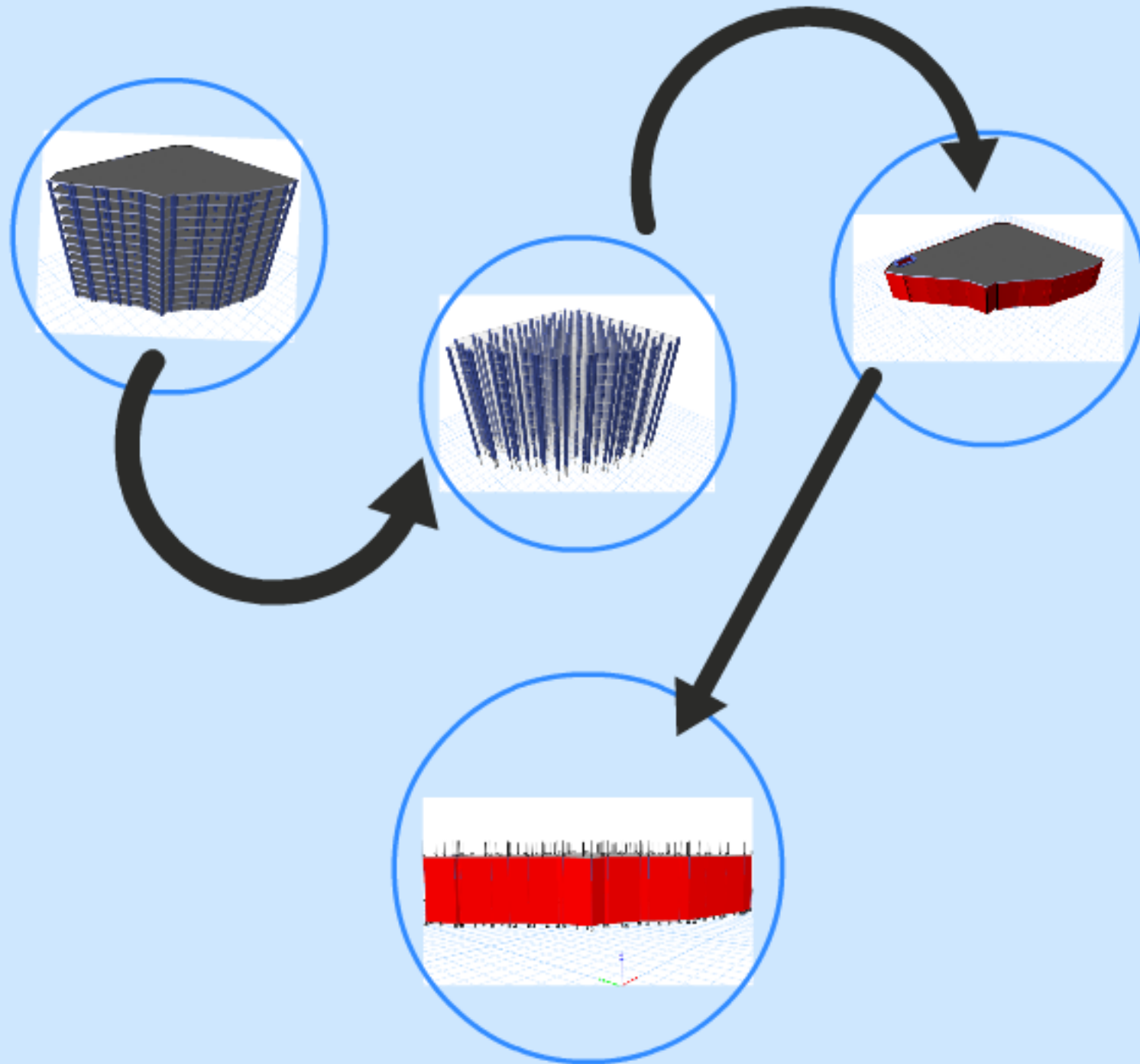


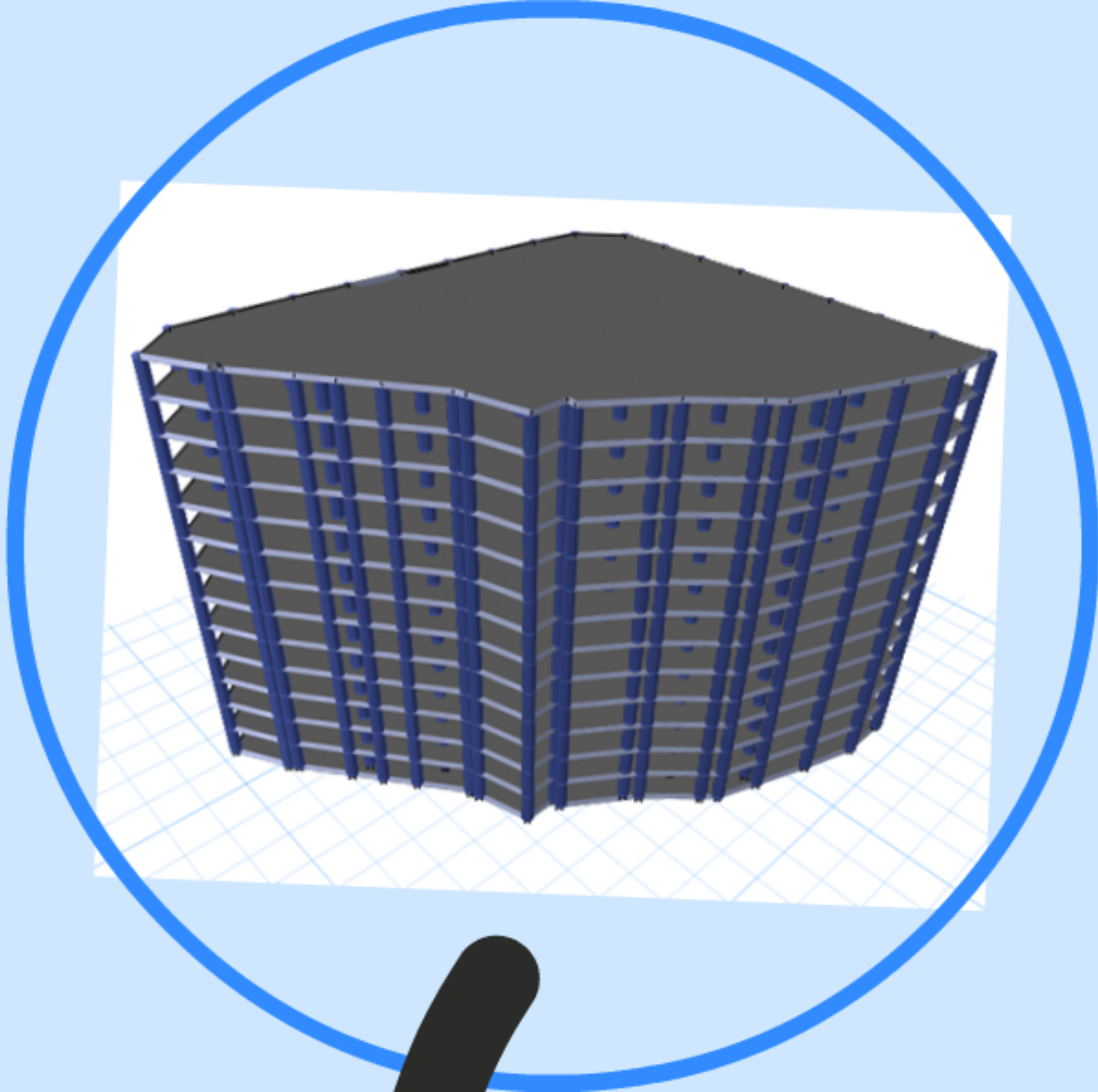


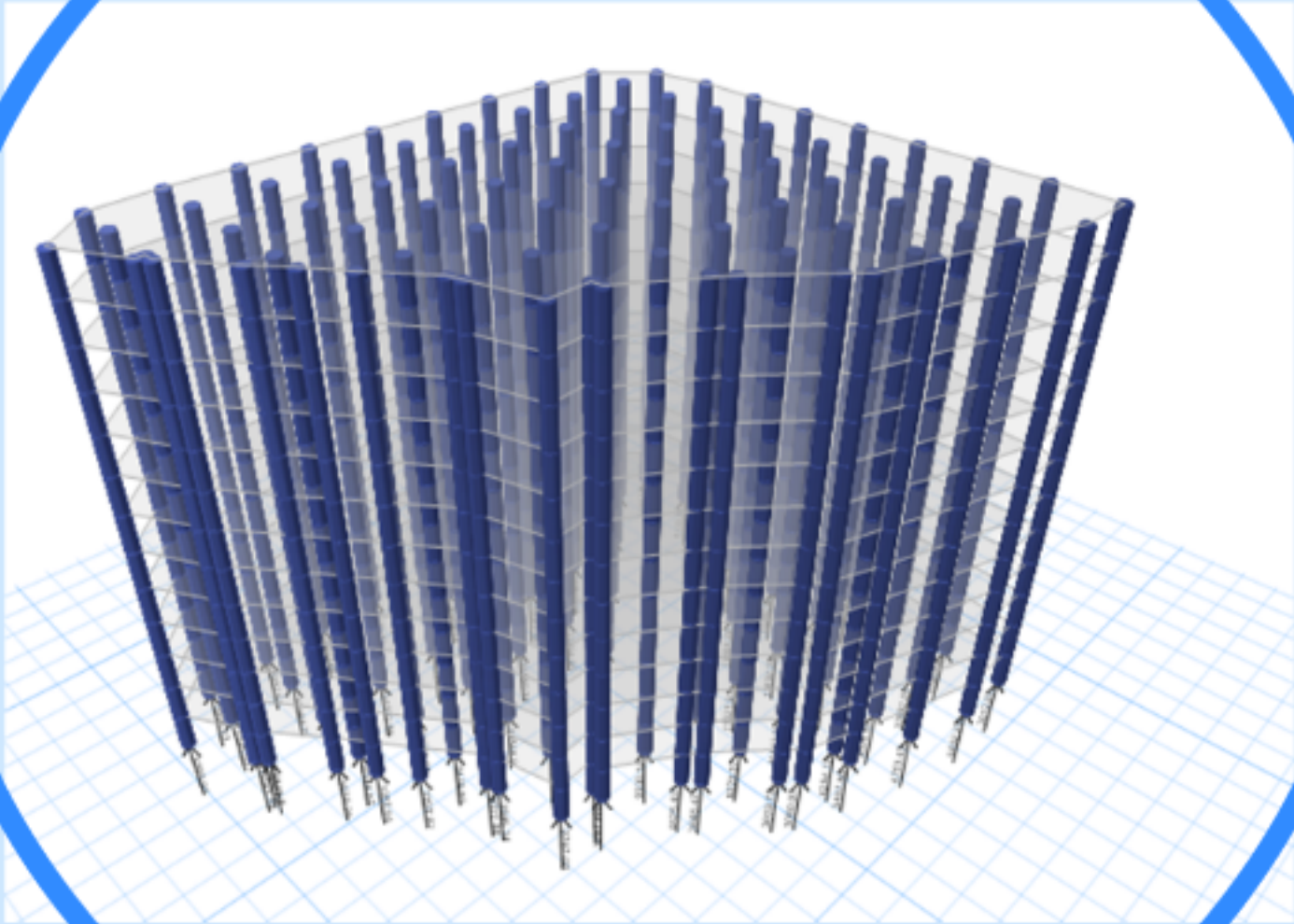
Analysis and Design of Top Down Construction System

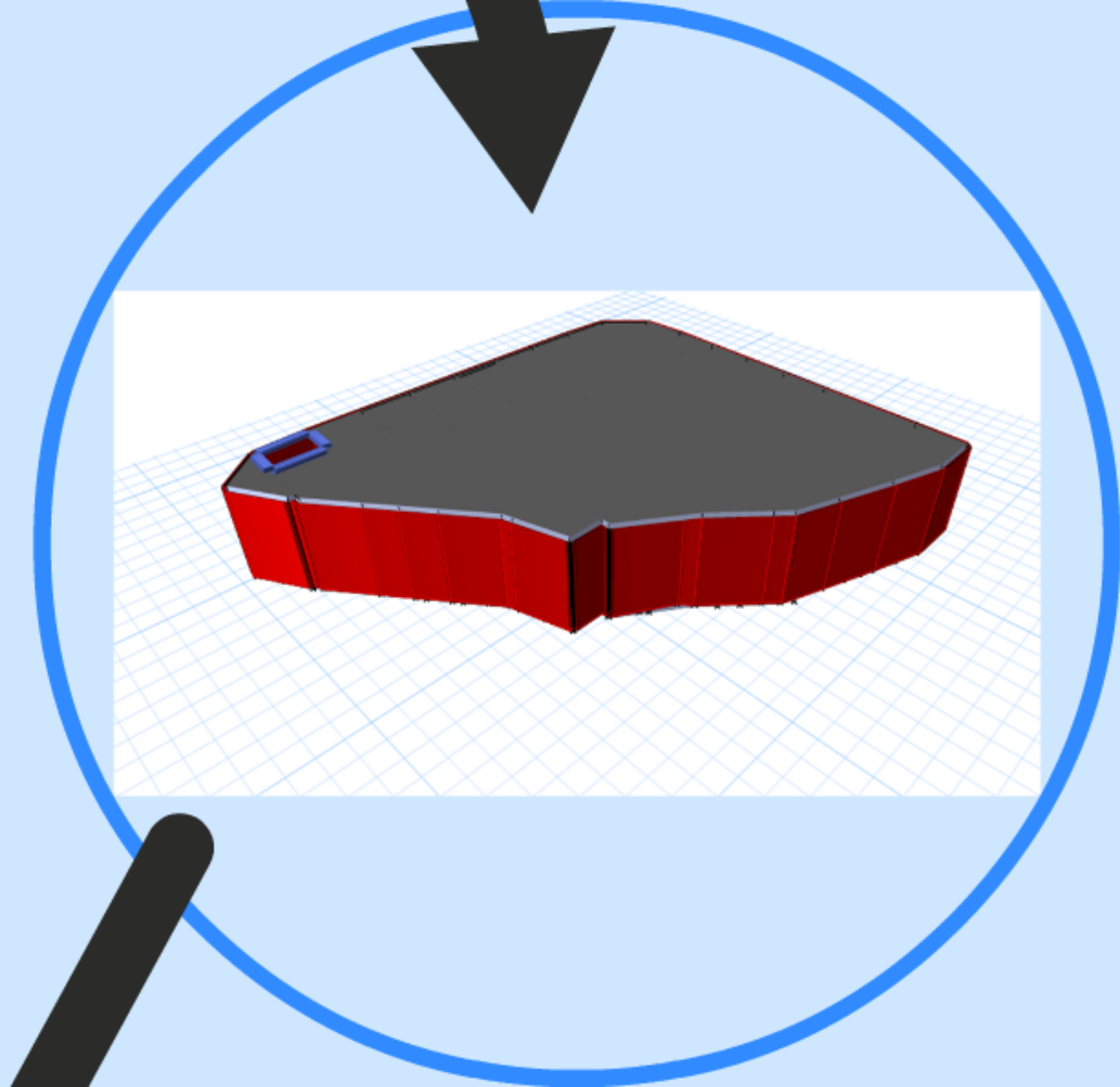


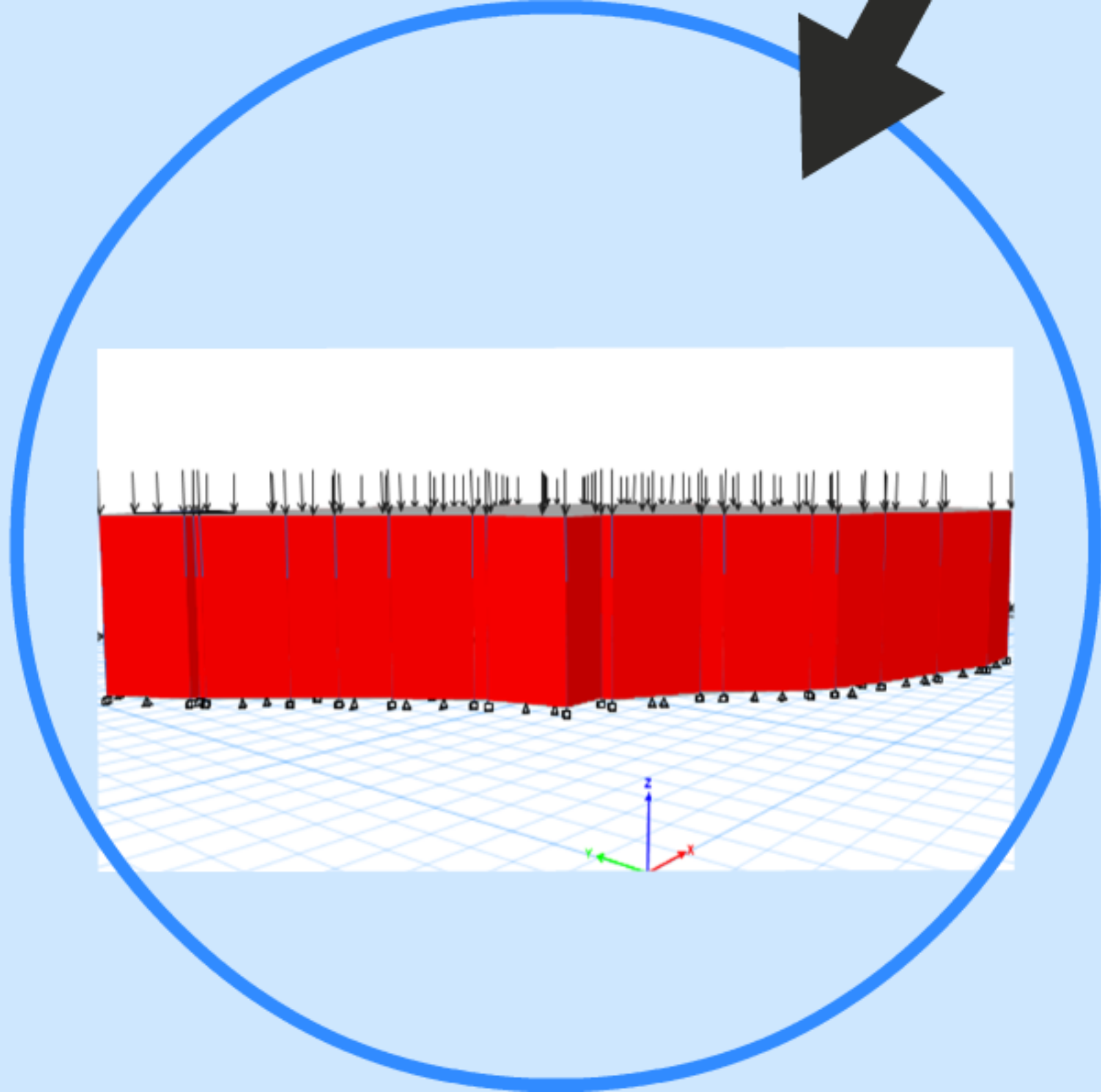
Analysis and Design of Top Down Construction System









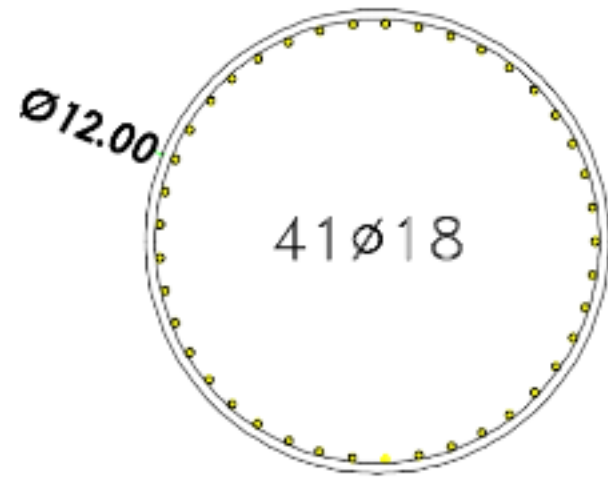


Structure Data

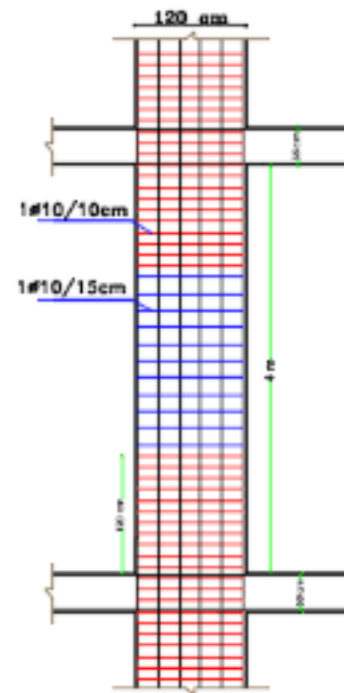
Name	Type	E (MPa)	Unit Weight (kN/m ³)	Design Strengths
Steel	Rebar	199947.98	76.9729	$F_y=413.69$ MPa $F_u=620.53$ MPa
Con-28	Concrete	24870	25	$F_c=28$ MPa

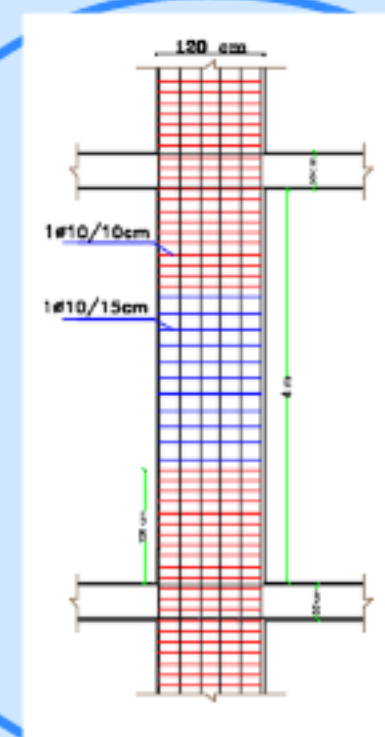


Name	Height m	Elevation m
Story3	4	12
Story2	4	8
Story1	4	4
Base	0	0



مقطع عرضي في العمود

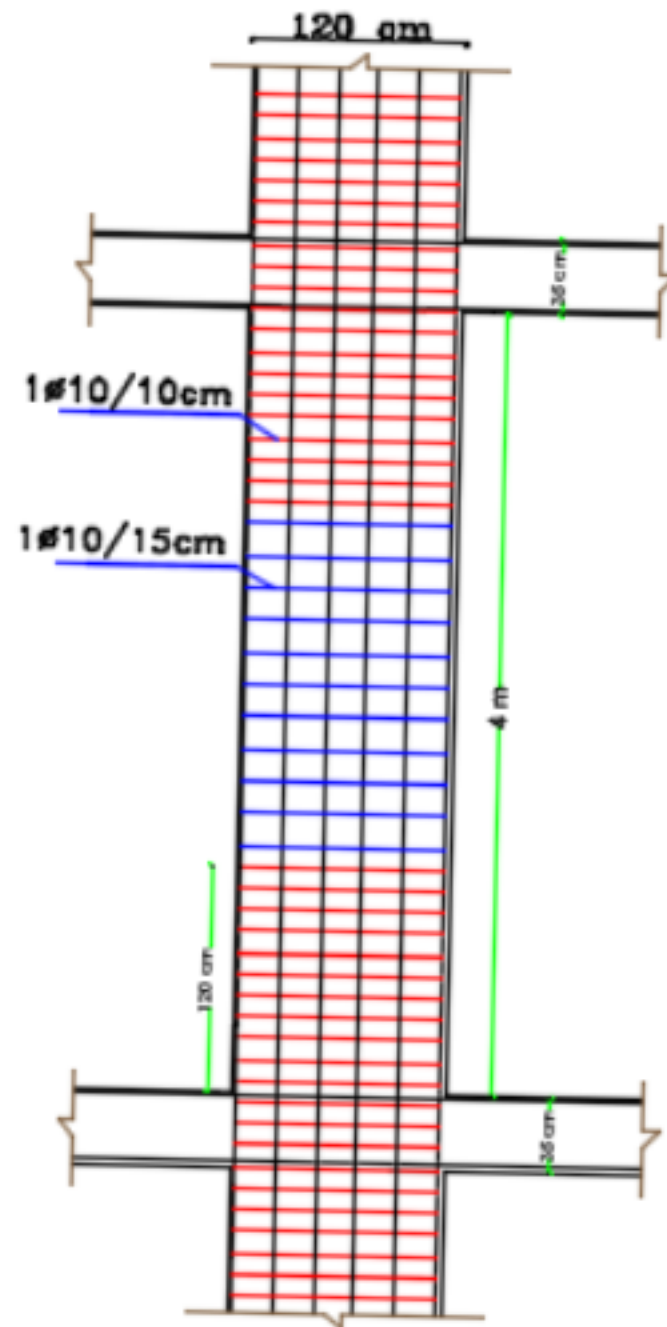




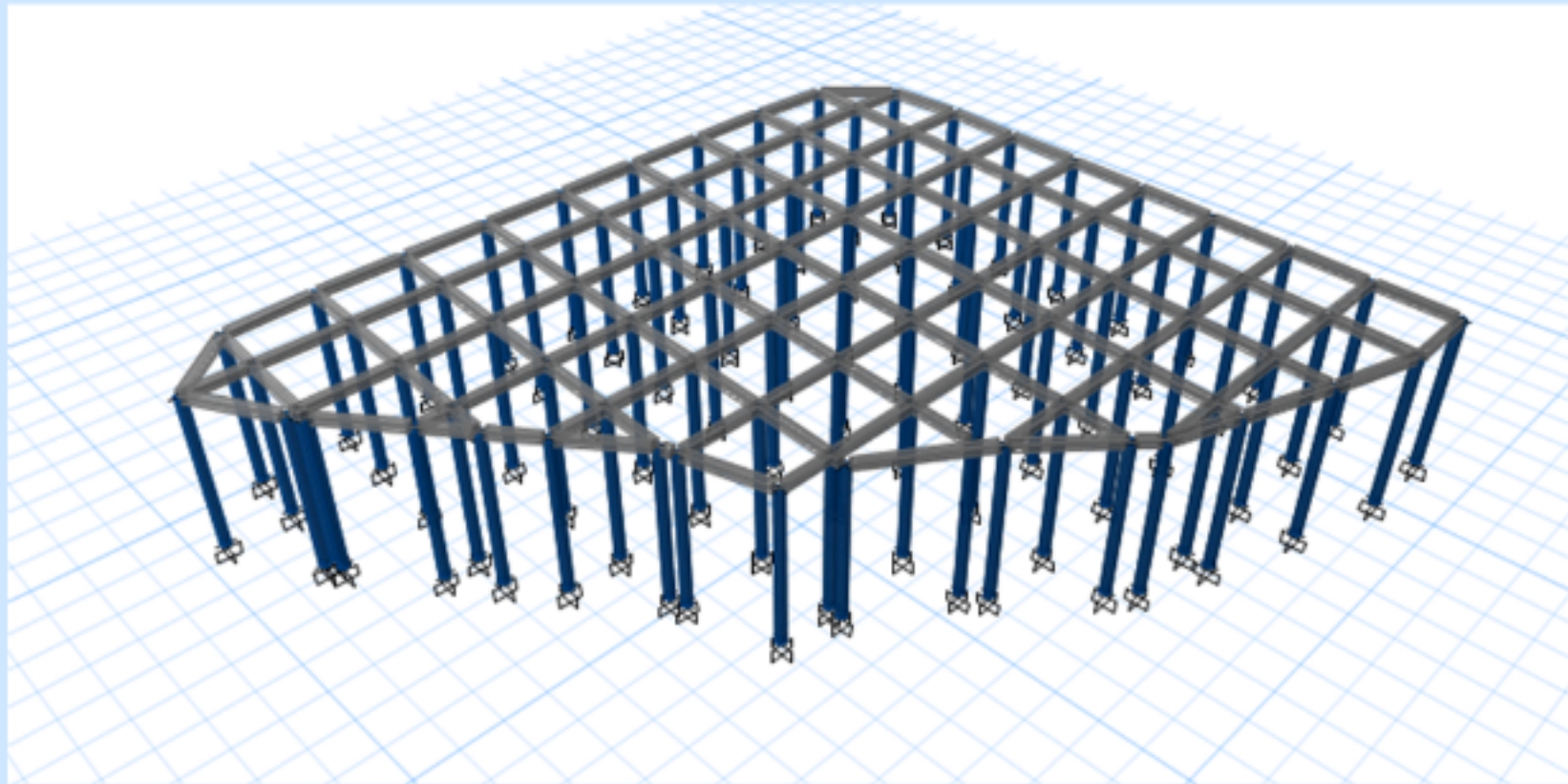
Ø12.00

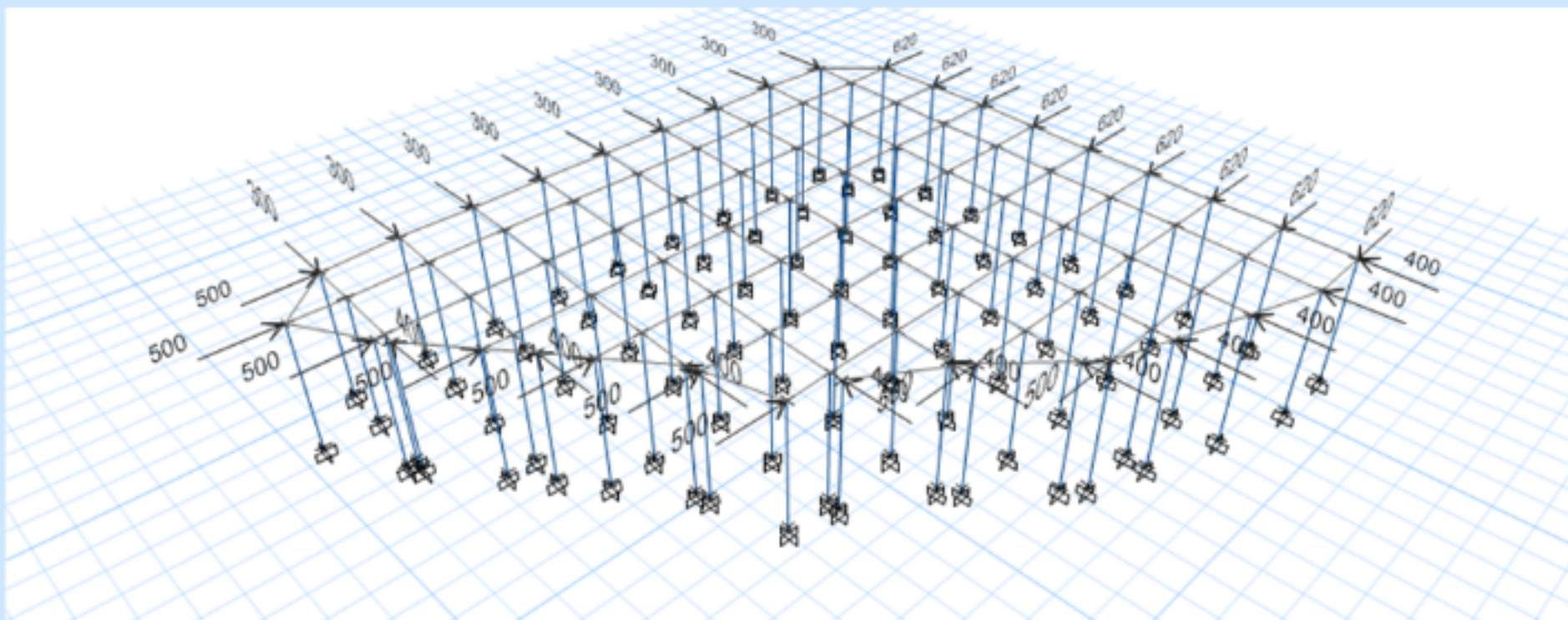
41Ø18

مقطع عرضي في العمود



SHEET PILE SUPPORTED





Structure Data

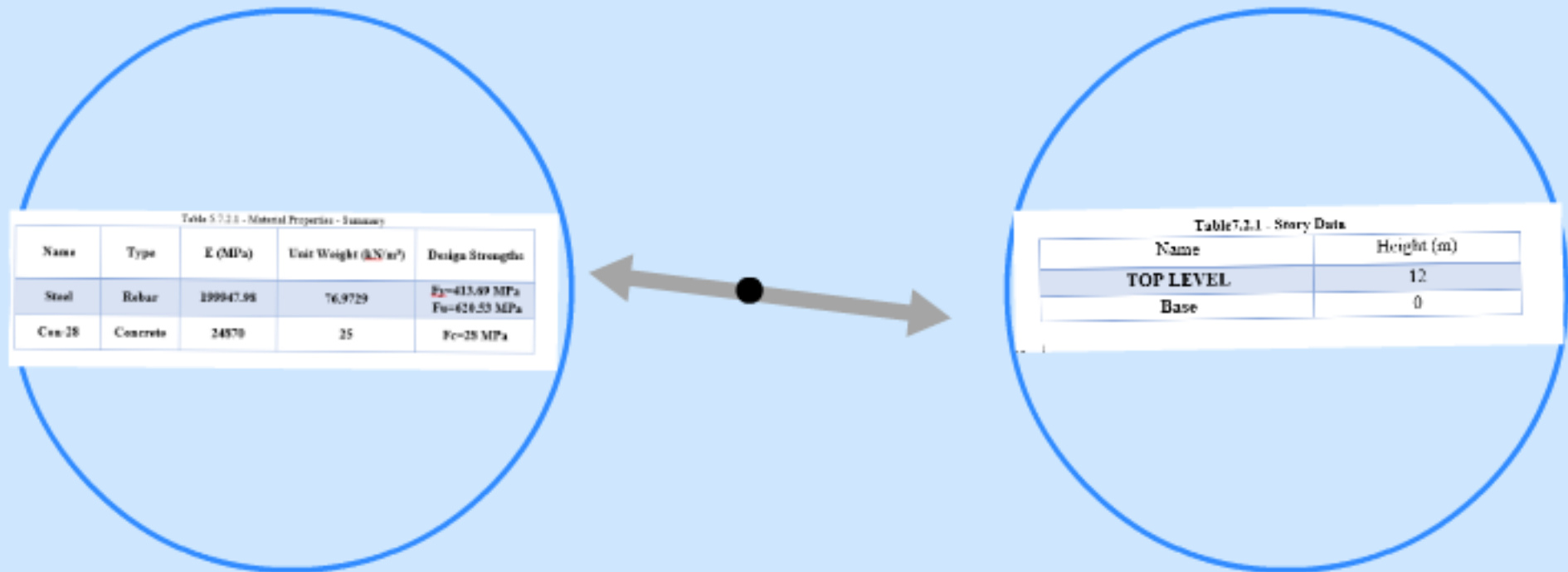
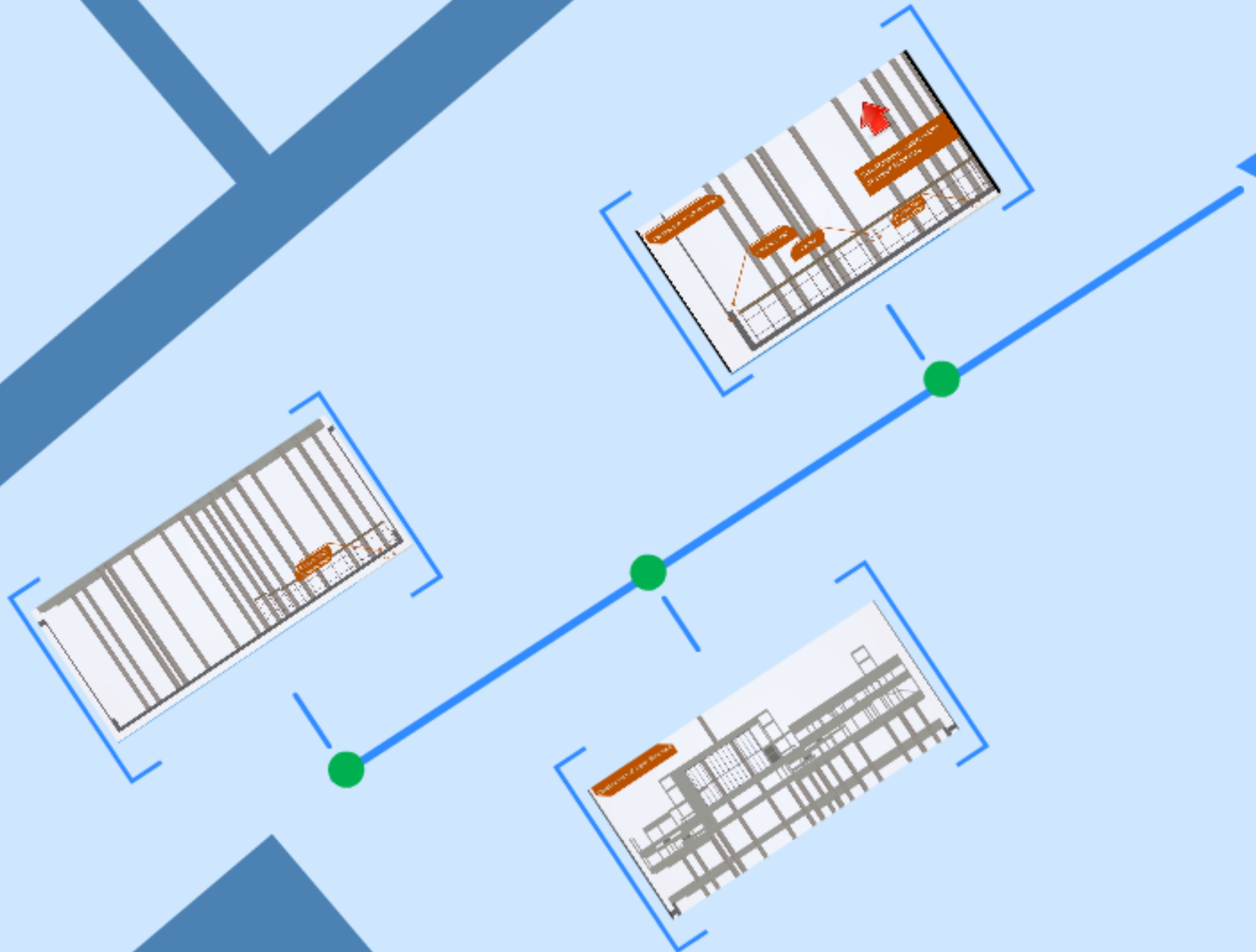


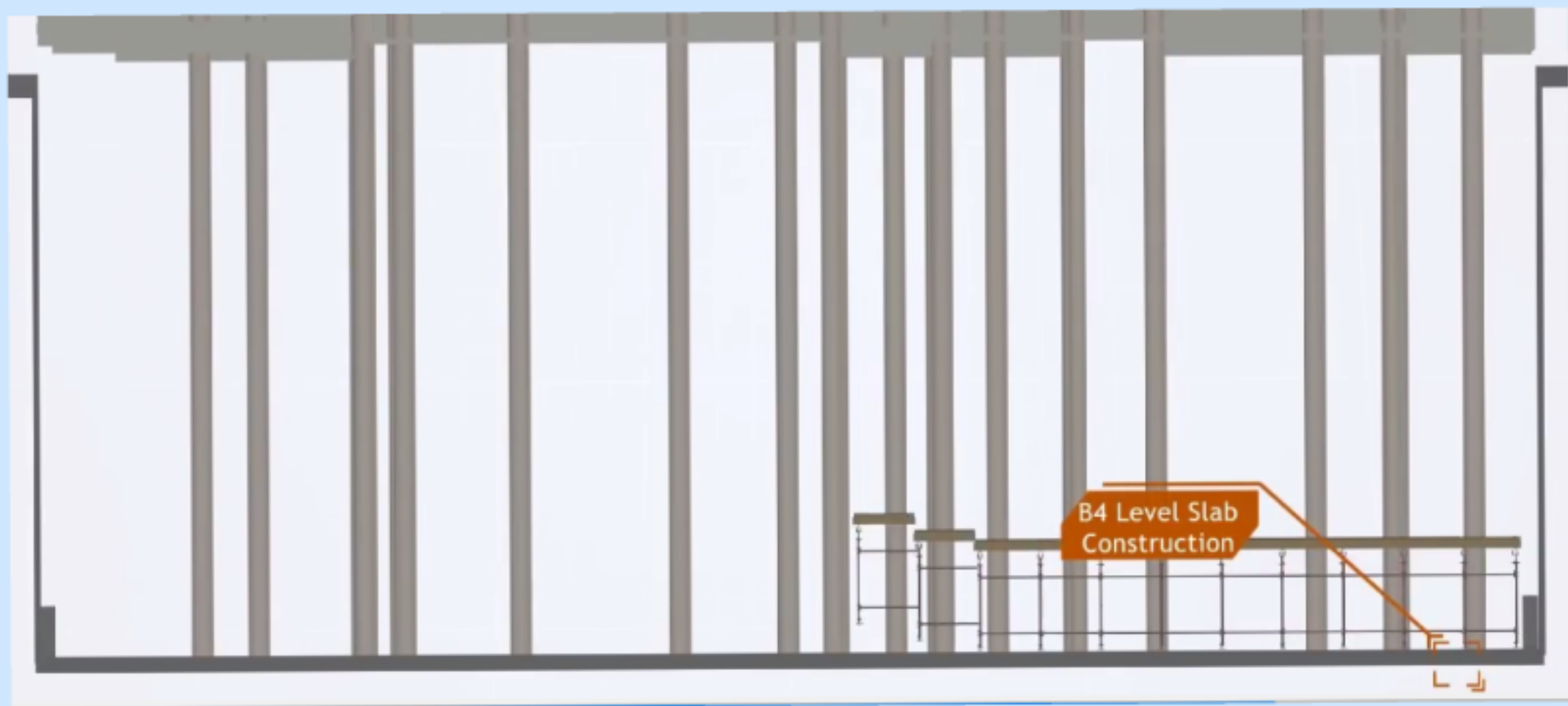
Table 5.7.2.1 - Material Properties - Summary

Name	Type	E (MPa)	Unit Weight (<u>kN</u> /m ³)	Design Strengths
Steel	Rebar	199947.98	76.9729	<u>Fy</u> =413.69 MPa Fu=620.53 MPa
Con-28	Concrete	24870	25	Fc=28 MPa

Table 7.2.1 - Story Data

Name	Height (m)
TOP LEVEL	12
Base	0





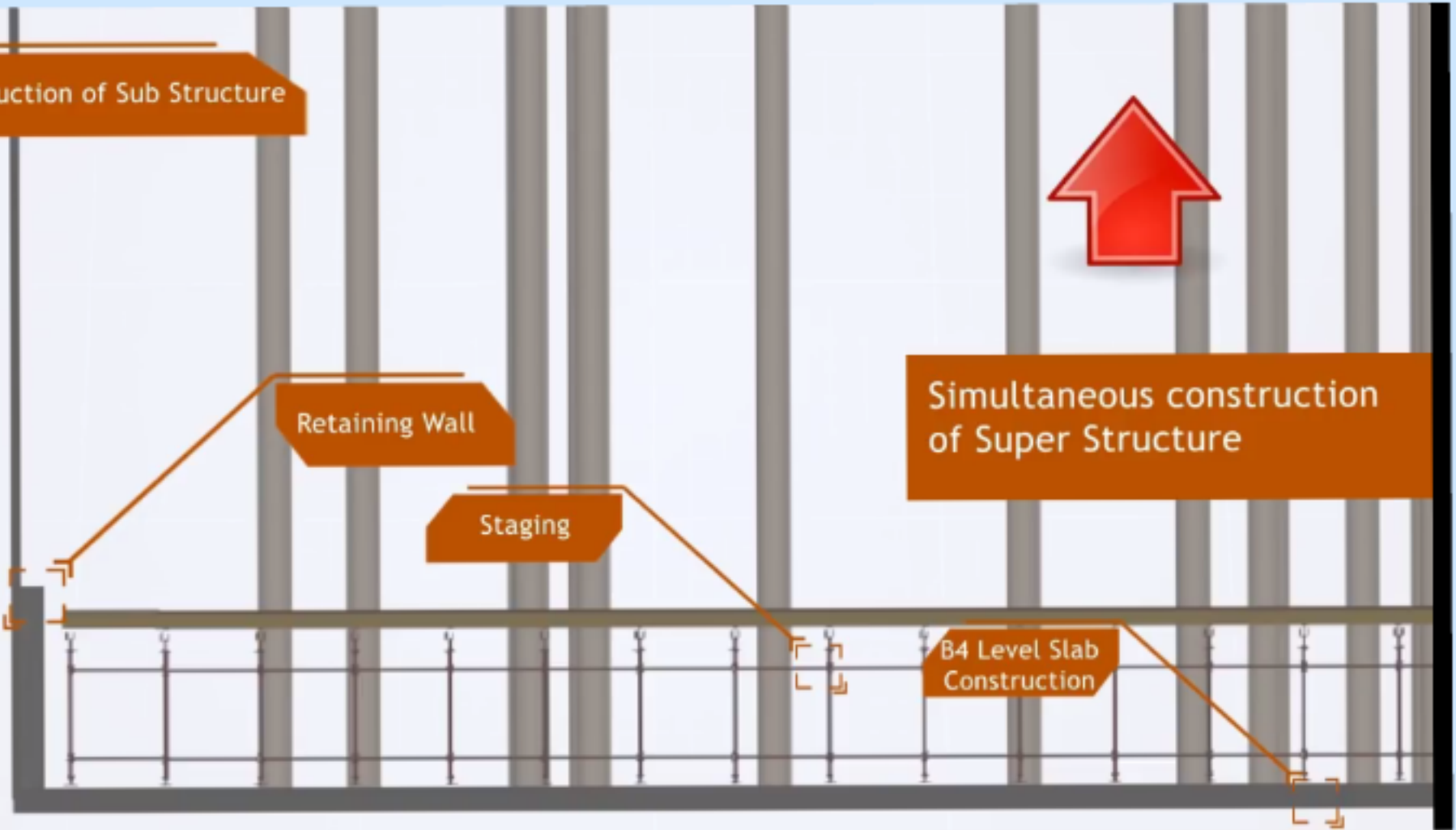
Construction of Sub Structure

Retaining Wall

Staging

Simultaneous construction
of Super Structure

B4 Level Slab
Construction



Construction of Super Structure



Prepared by :

- **Aseel Khateeb**
- **Aya Jararaa**