



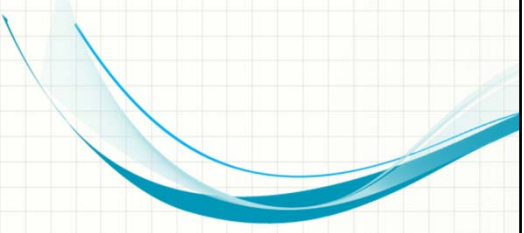
Design and Construction of Deep basements

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Chartered Engineer



Presentation Overview

- Design Considerations
- Retaining system Design
- Design of Dewatering system
- Decide on waterproofing system
- Decide on concrete properties/ Issues
- Construction Issues



Design Considerations



Design Consideration

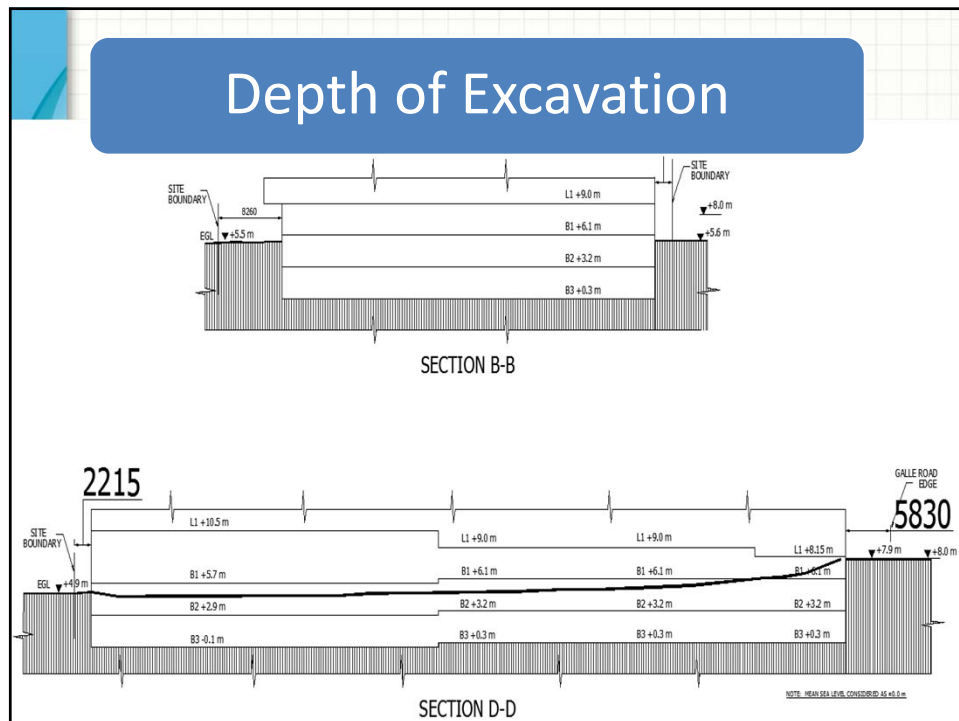
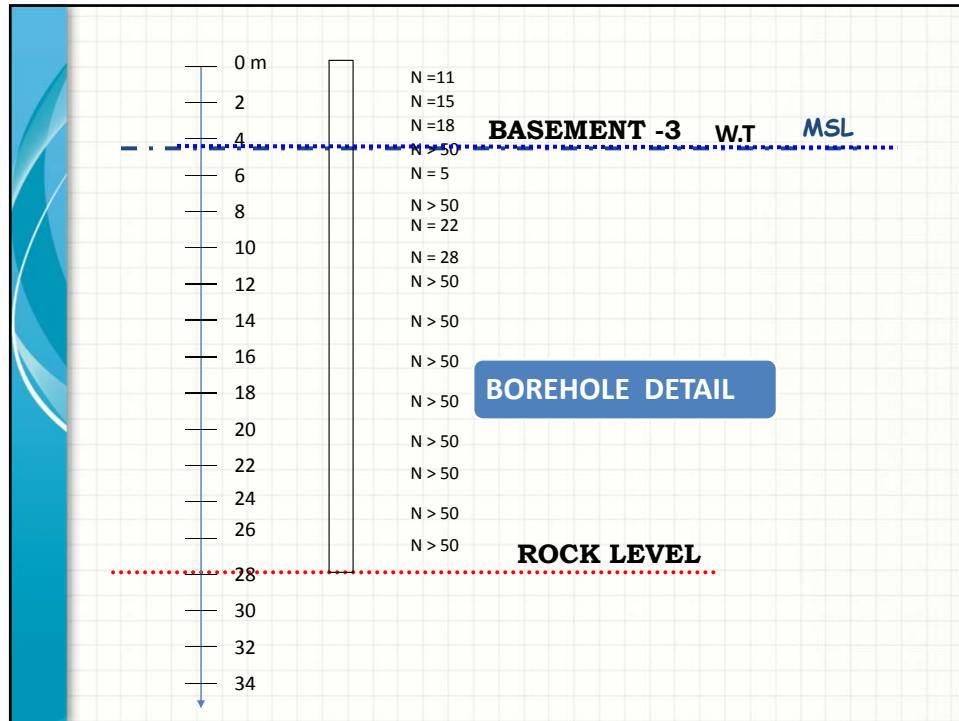
- Depth of excavation
- Nature of soil (type of soil and its permeability)
- Chemical content of the soil
- Water table (Permanent and Temporary)
- Adjacent structures
- Excavation Methodology
- Basement Details

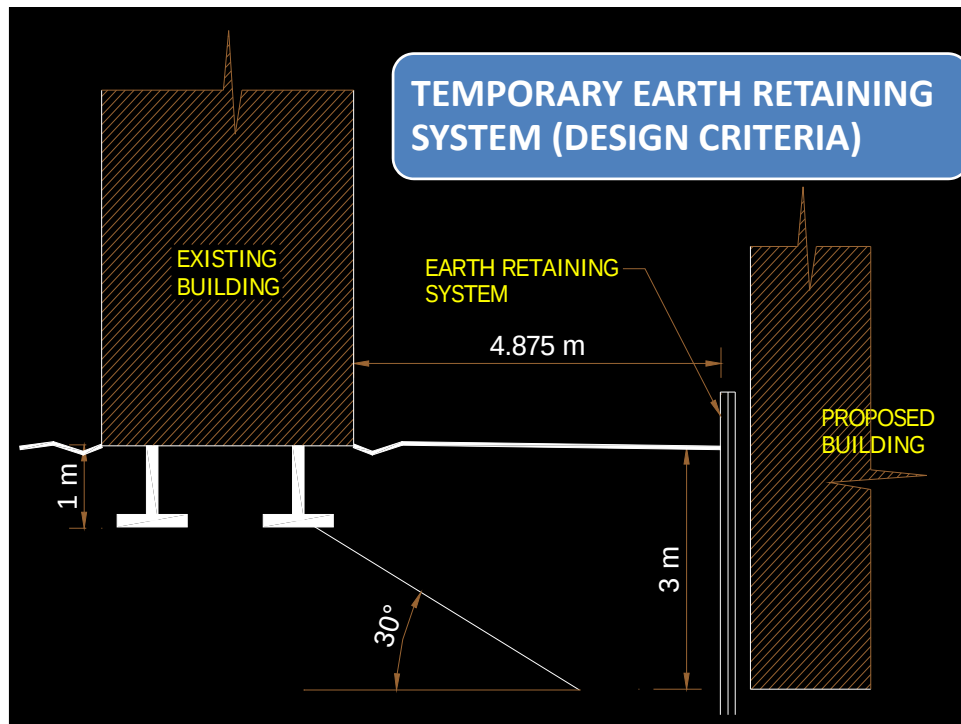
Subsurface Information

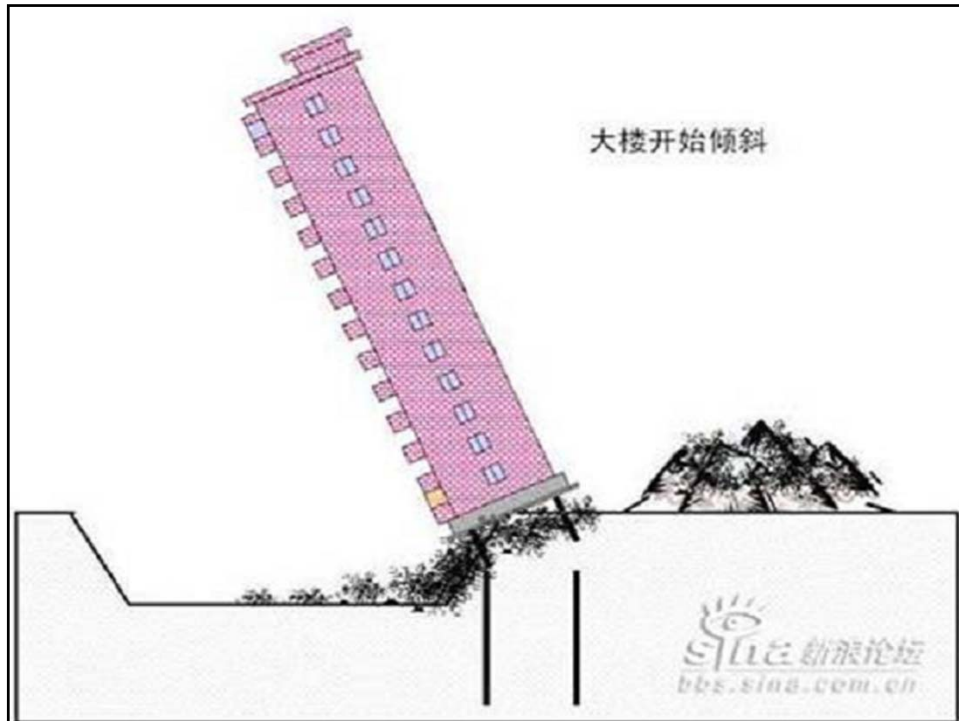
- **WATER TABLE**
- **FINE CLAYEY SAND WITH VERY HIGH SPT VALUES**
- **SOIL PERMEABILITY**
- **SULPHATE (% mass/mass as SO_3^{-2})**
- **CHLORIDES (mg/kg as Cl^{-1})**

■ ■ ACI Building Code 318

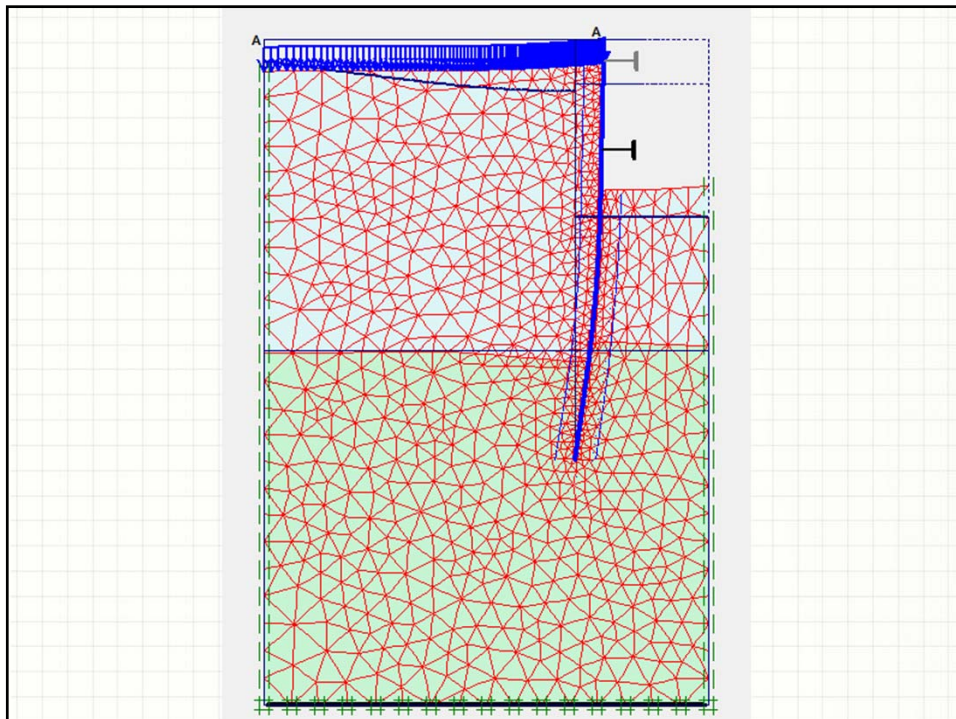
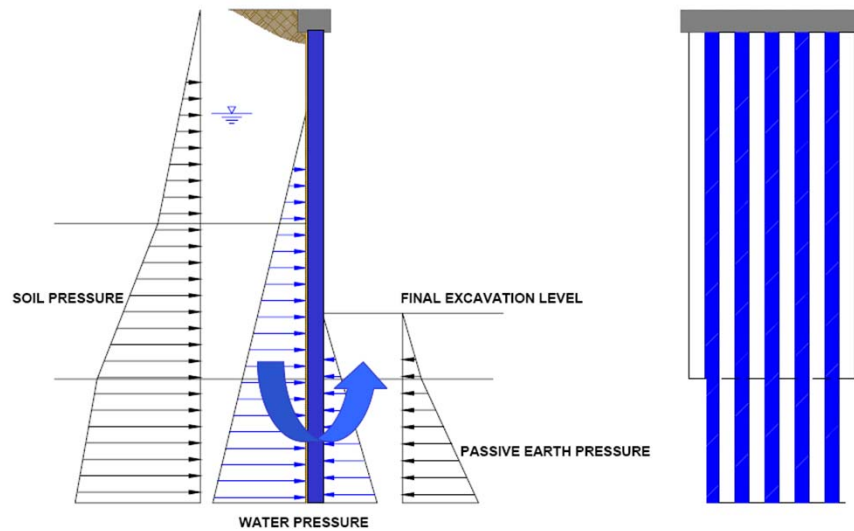
- Negligible attack: When the sulfate content is under 0.1 percent in soil, or under 150 ppm (mg/liter) in water, there shall be no restriction on the cement type and water/cement ratio.
- Moderate attack: When the sulfate content is 0.1 to 0.2 percent in soil, or 150 to 1500 ppm in water, ASTM Type II portland cement or portland pozzolan or portland slag cement shall be used, with less than an 0.5 water/cement ratio for normal-weight concrete.







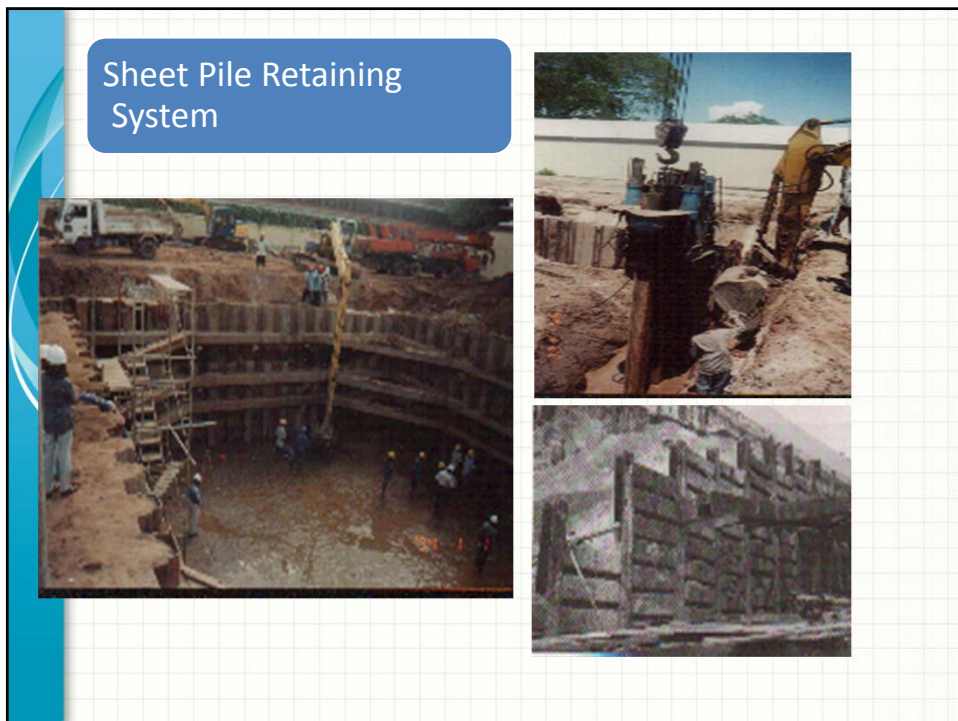
Analysis of Retaining system

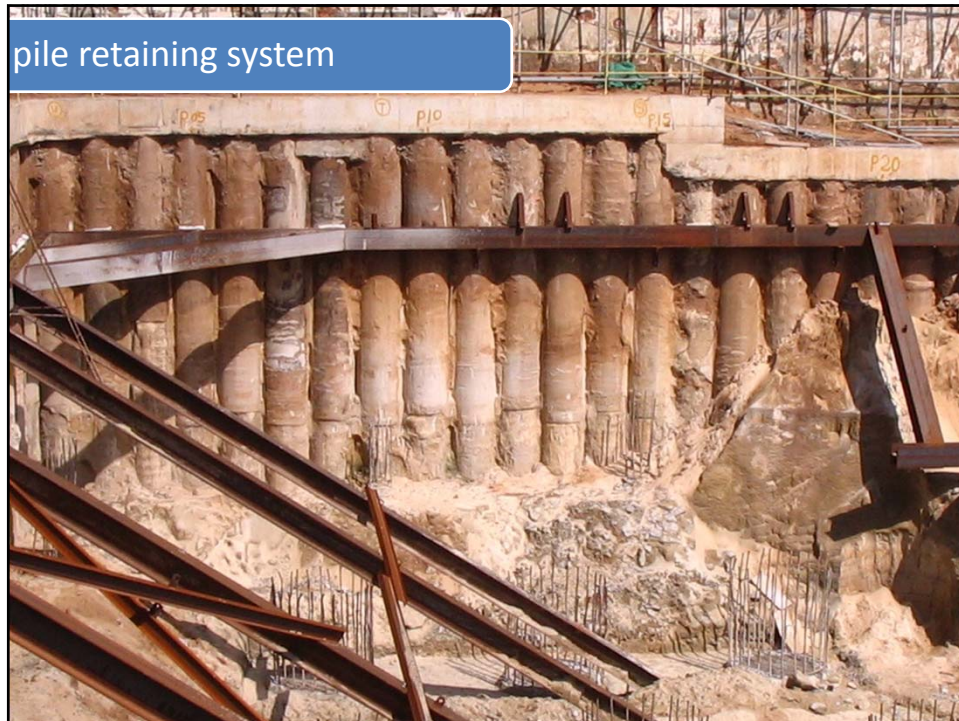


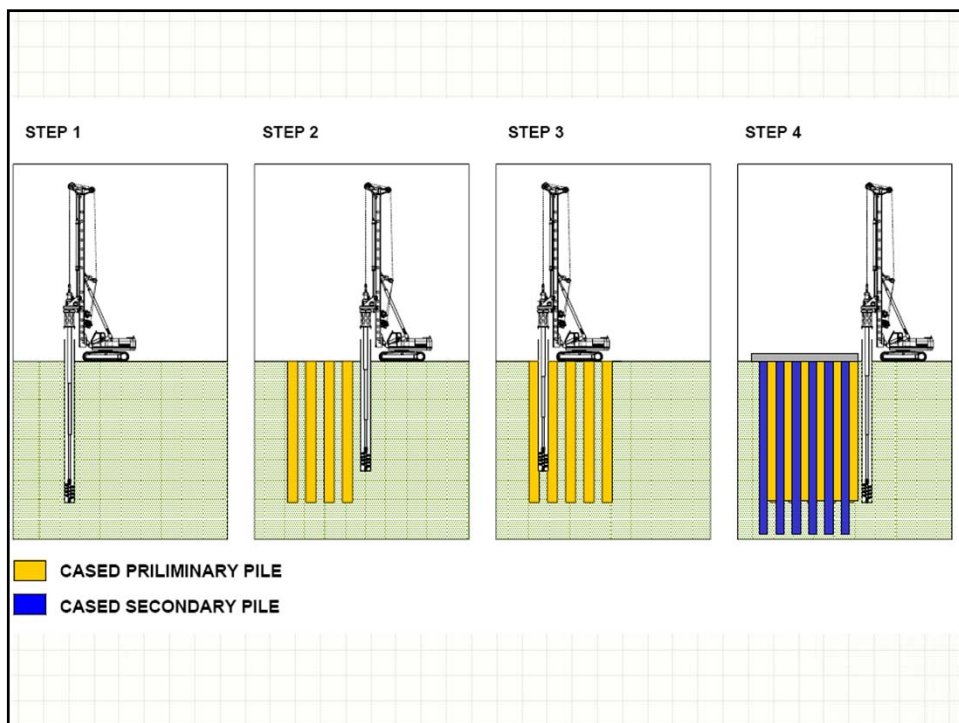
H-Iron Retaining System



Sheet Pile Retaining System











CHEMICAL GROUTING???

- STABILIZE THE SOIL BEYOND THE SHEET PILE LINE.
- MIXTURE OF CEMENT, WATER & SODIUM SILICATE.
- INJECTED TO SOIL IN 1-1.5m INTERVALS.



CHEMICAL GROUTING...

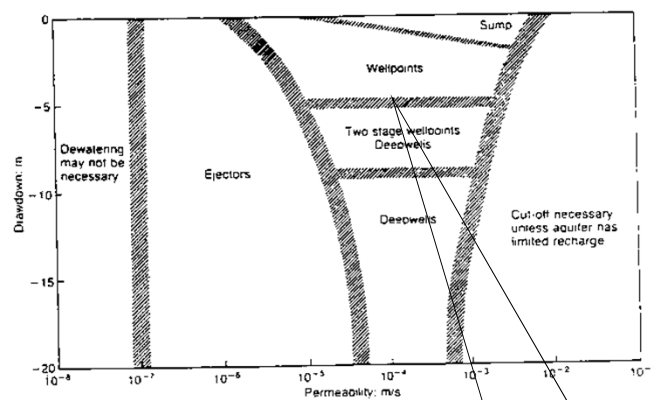


CHEMICAL GROUTING...

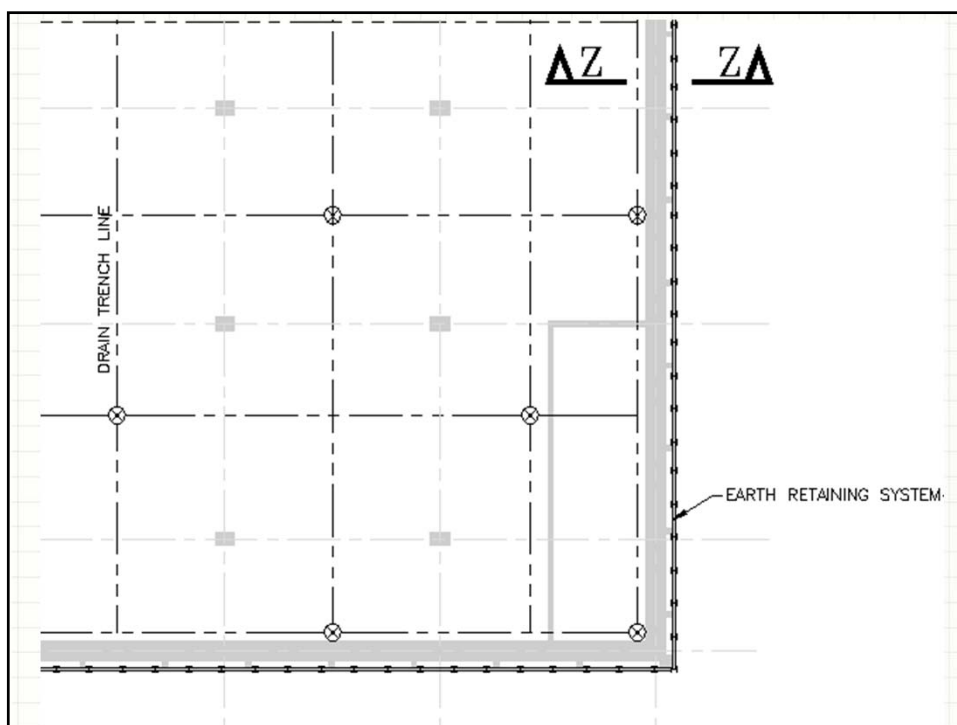
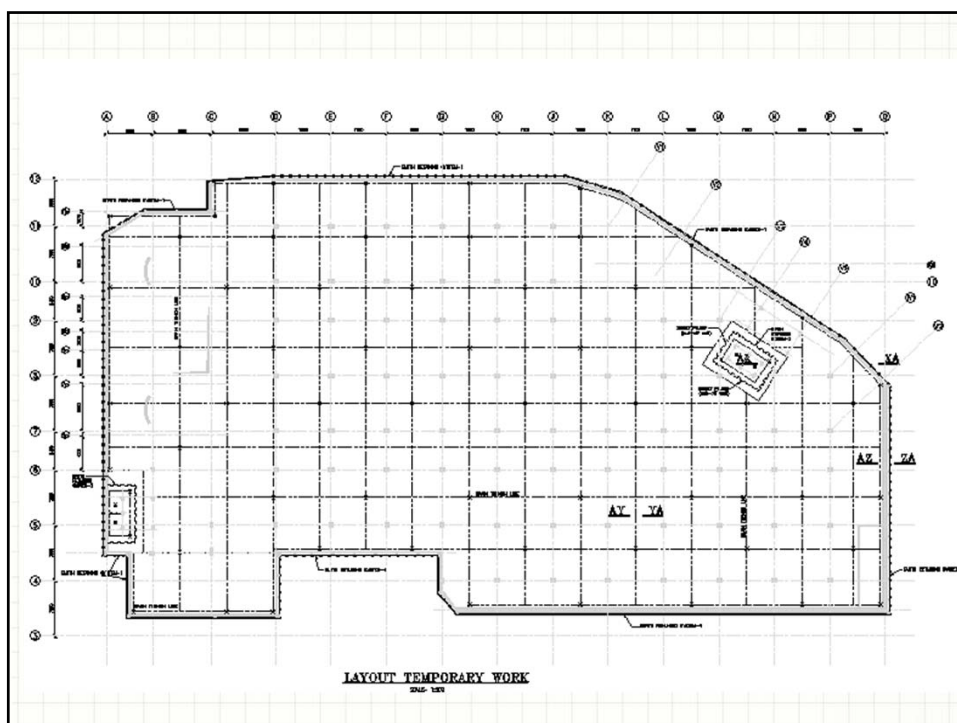




Dewatering Design Criteria

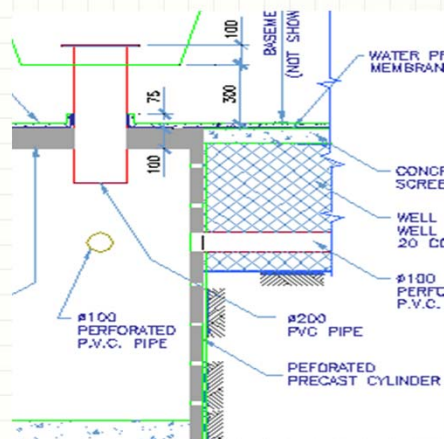


Site Permeability
 $1 \times 10^{-4} \text{ m/s}$





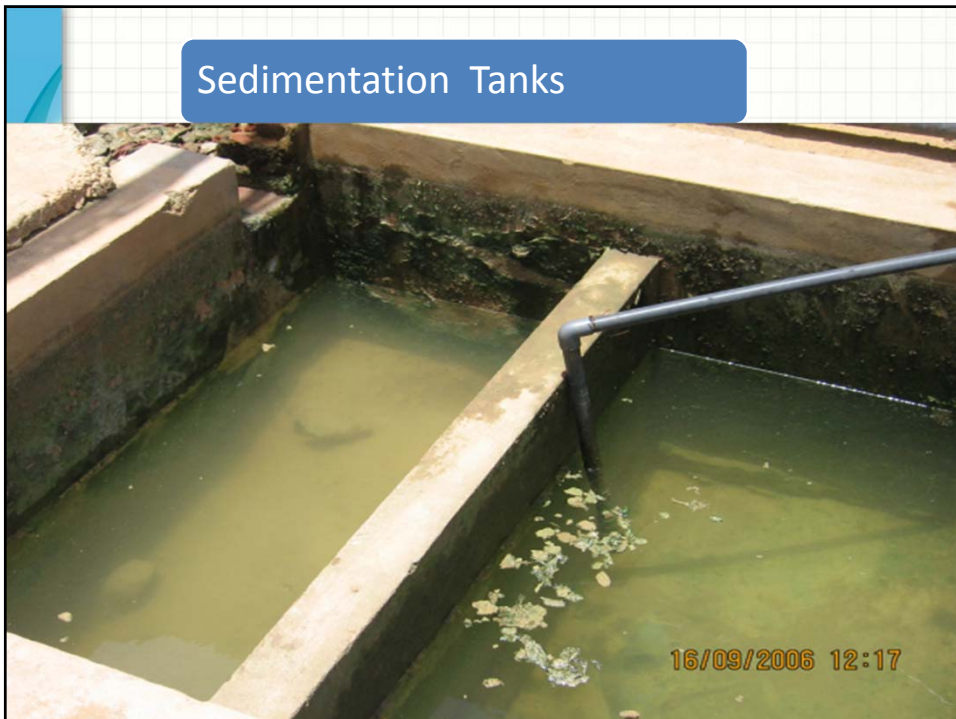
Surface Dewatering



Dewatering wells



Sedimentation Tanks

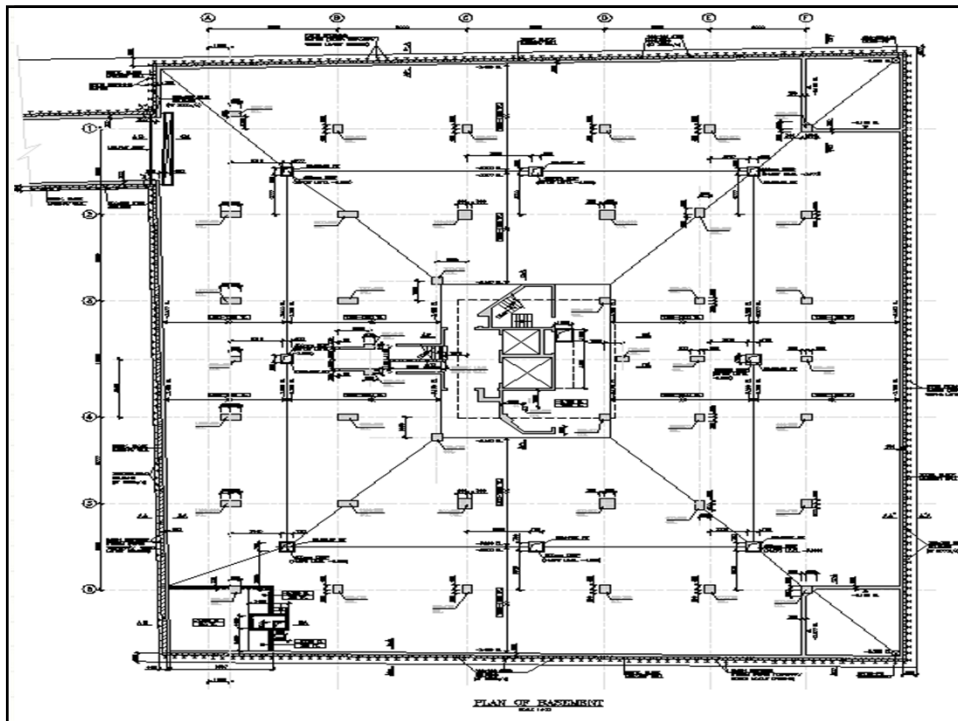


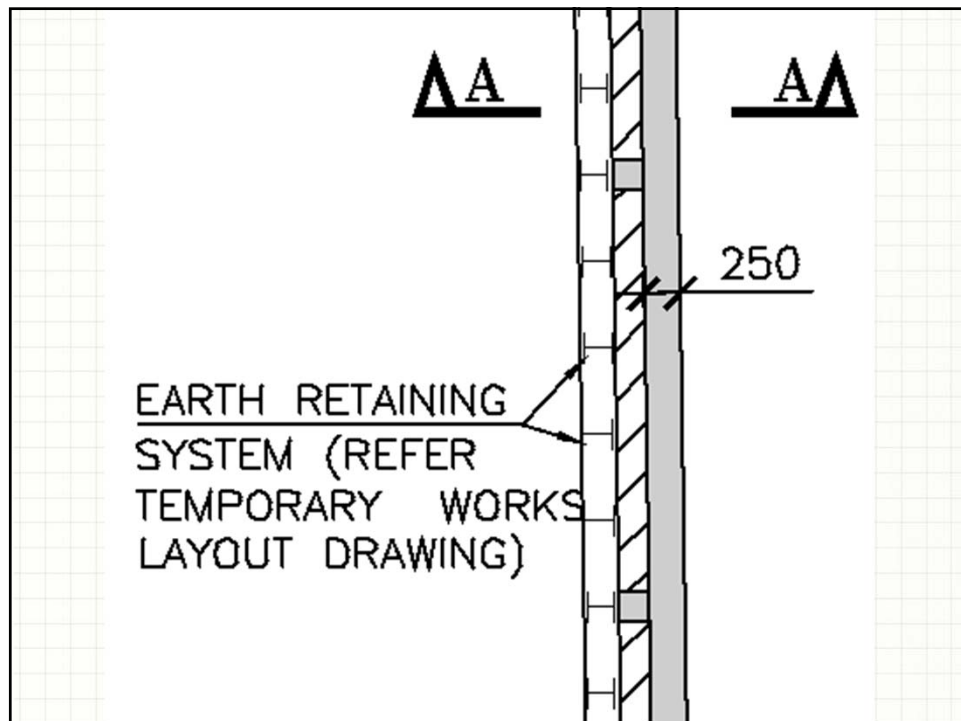
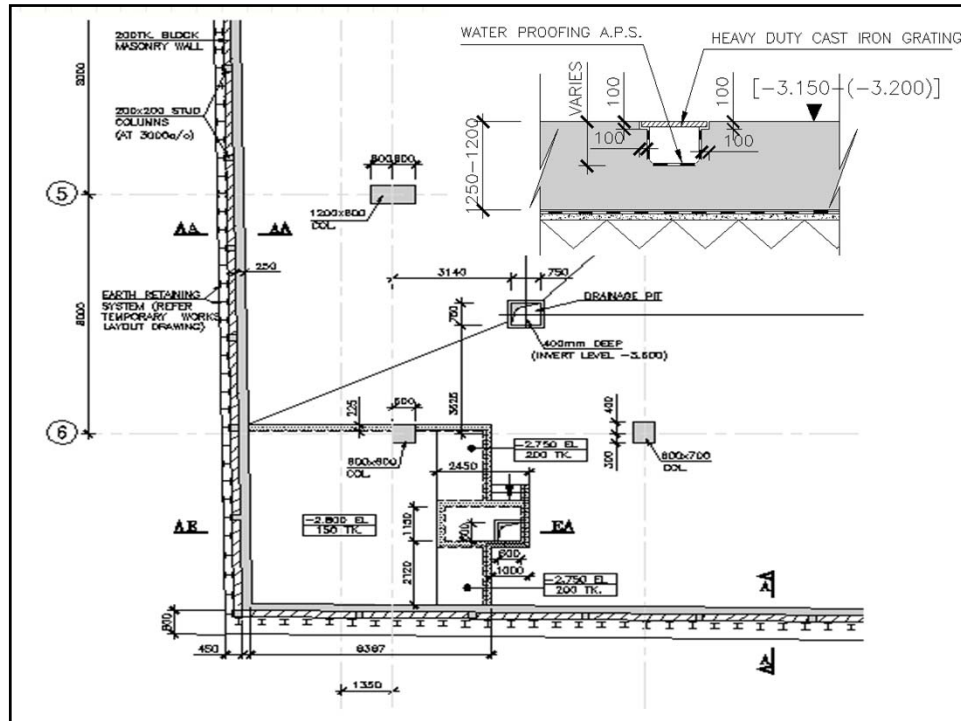


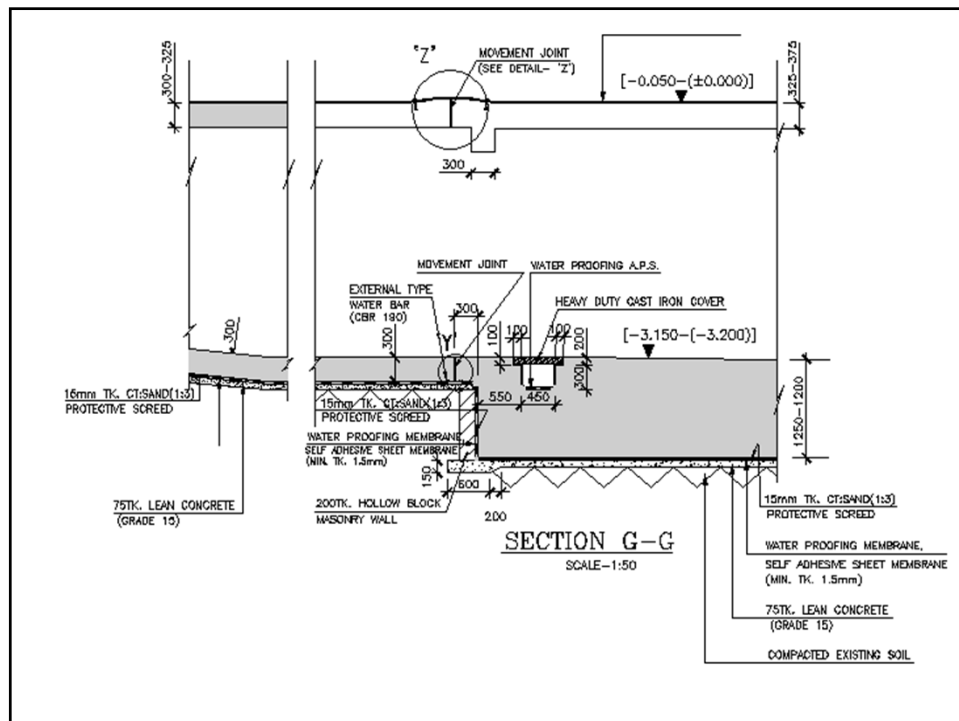
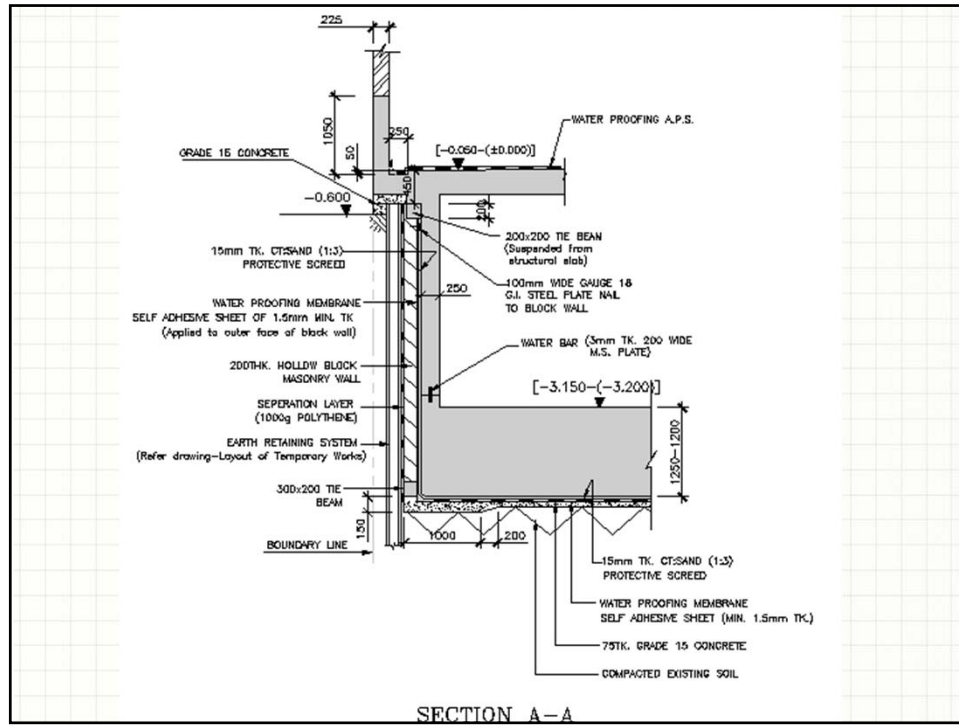


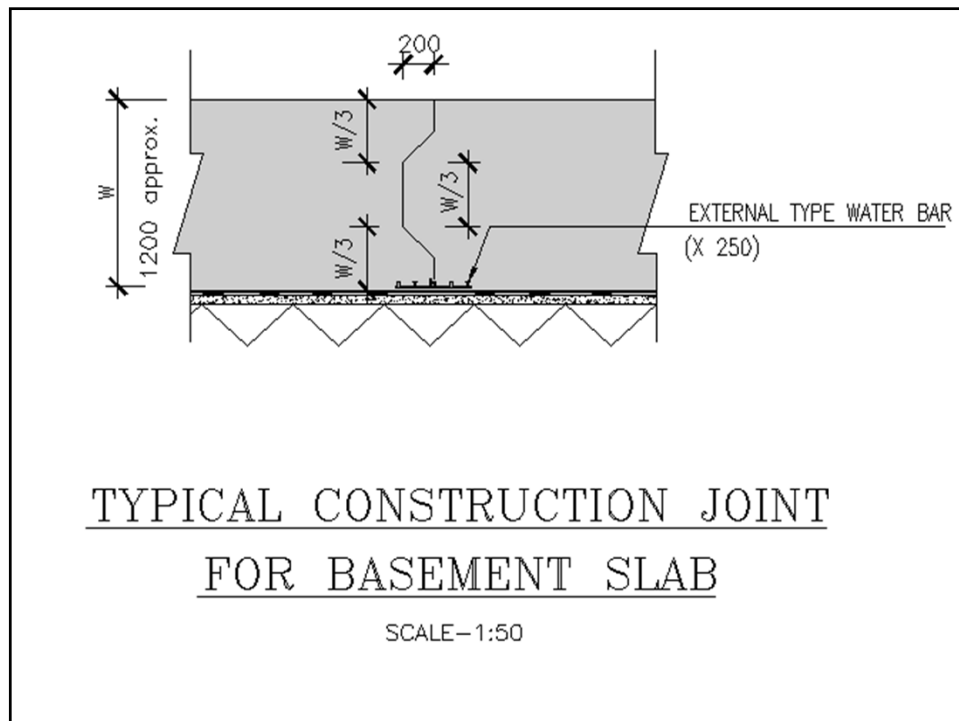
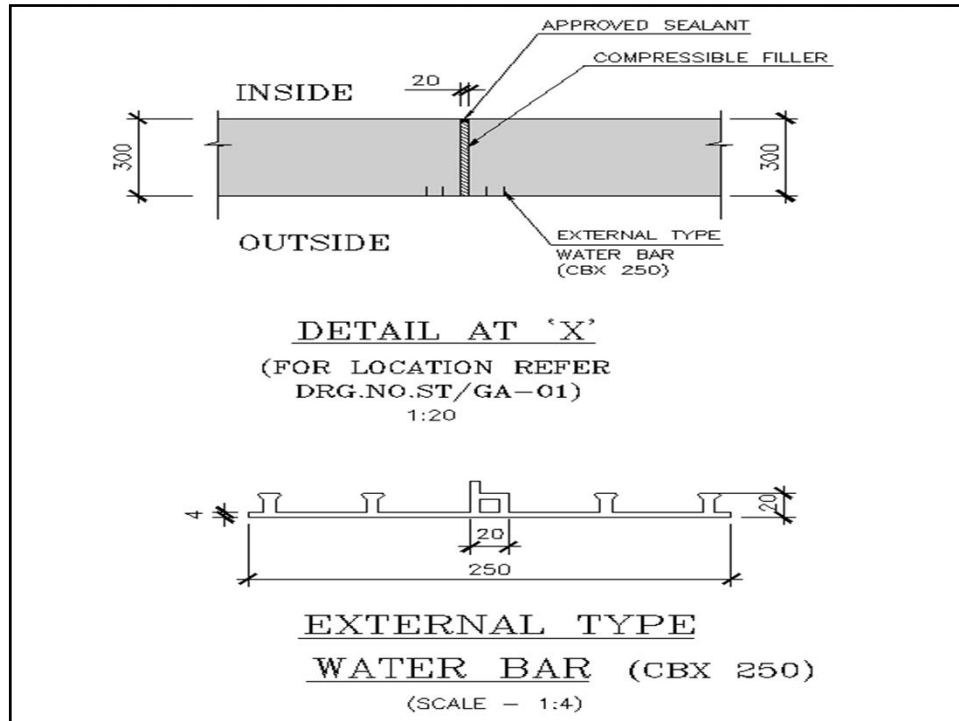


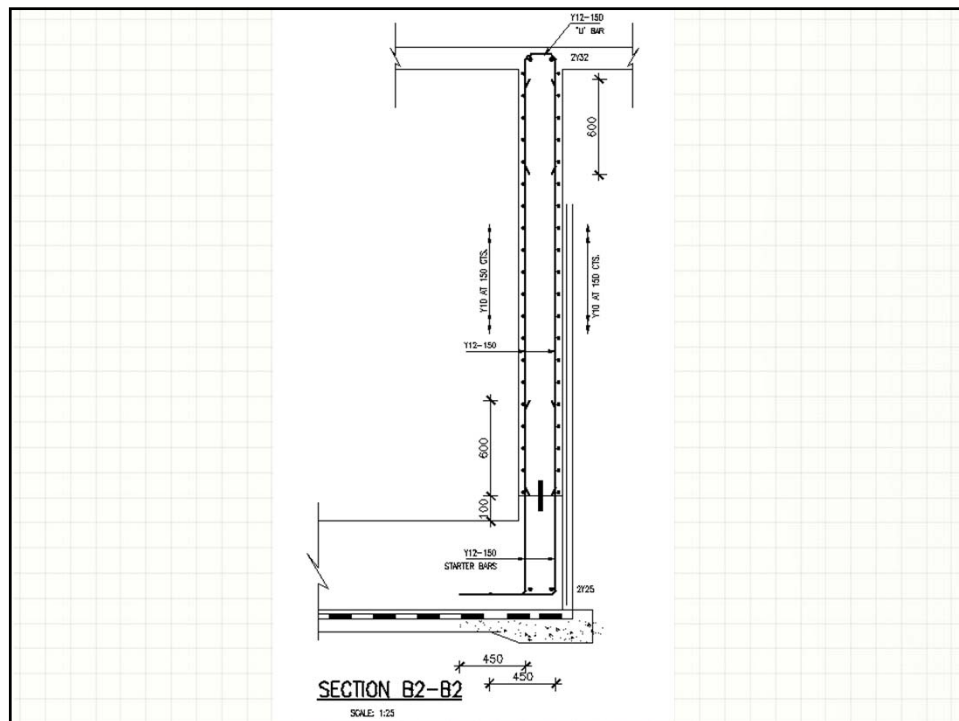
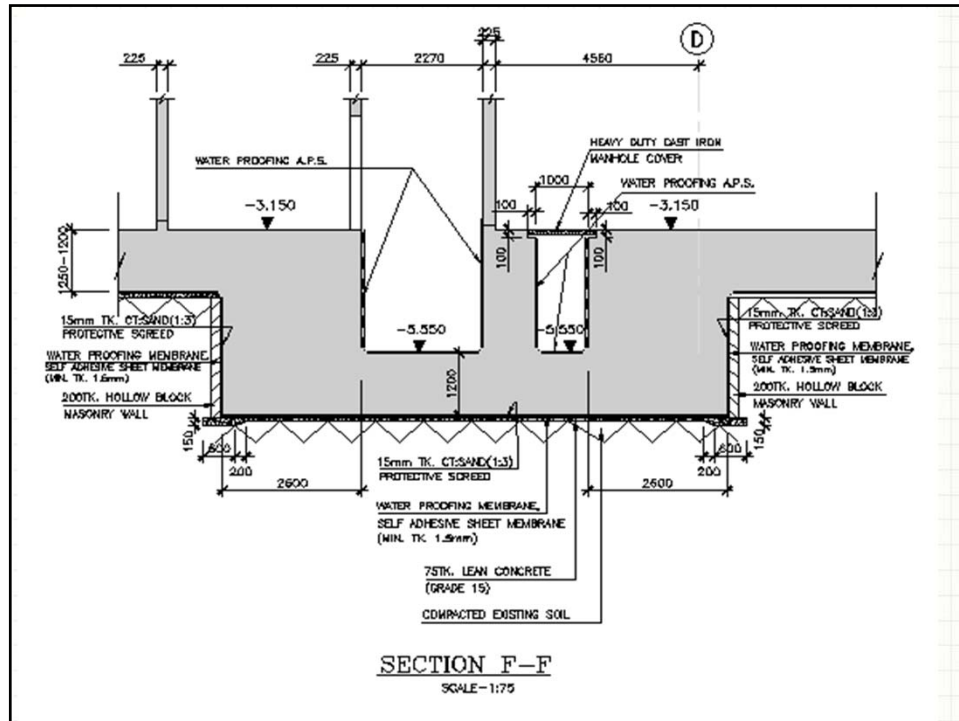
Basement Details

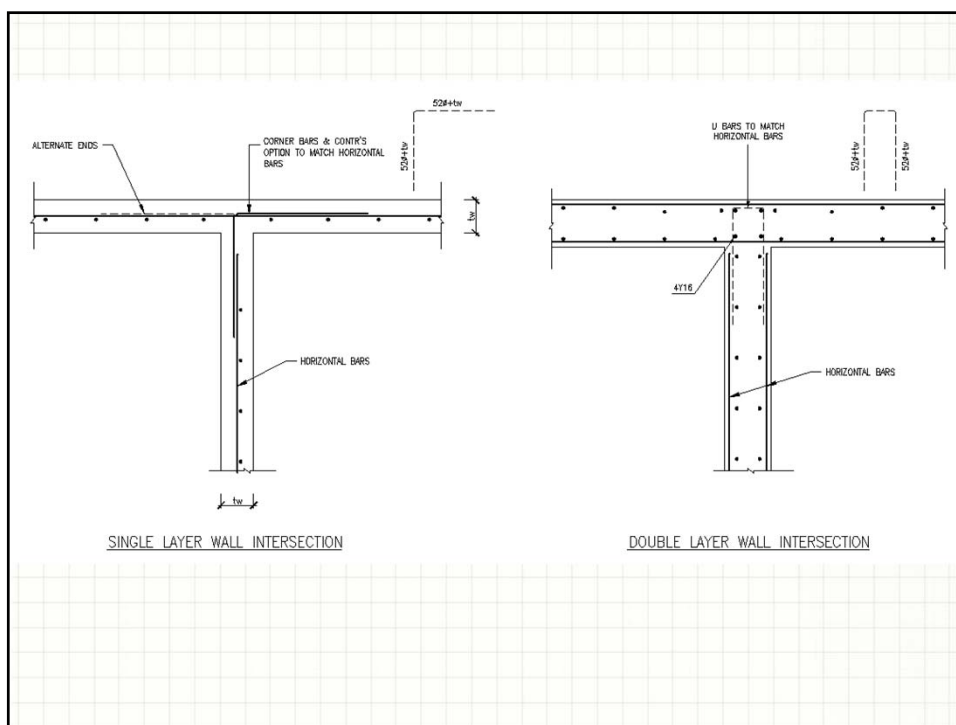
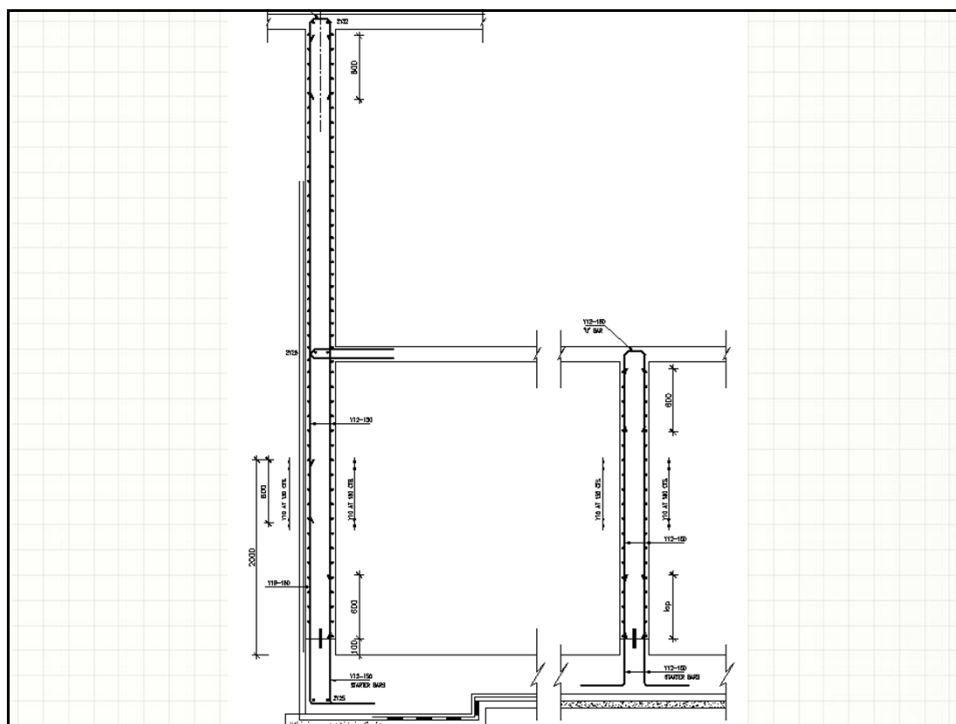














Temperature issues in thick elements

- Limit Peak Hydration Temperature to 70 C
- Limit Cement content to 400 Kg/m³
- Keep the initial placing temperature to 30 C
- Note do not cure till 4days (Protect concrete from rain)
- Use Mineral admixtures for to reduce the thermal gradient

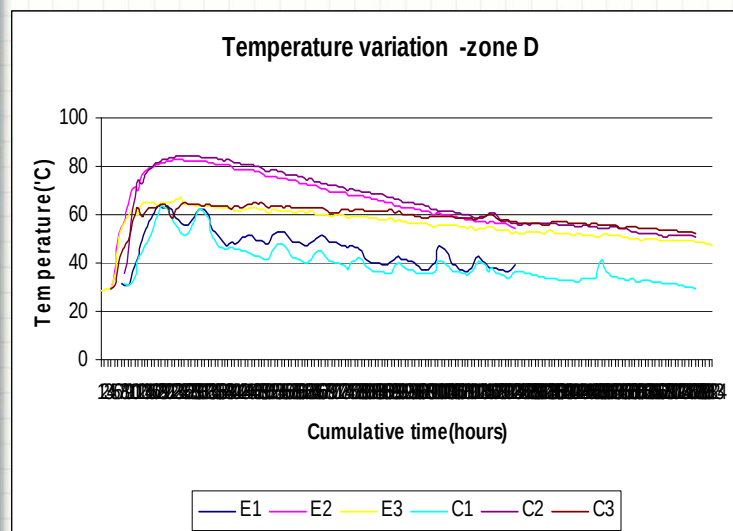
Measuring of temperature at CCR using Thermocouples



Measuring of temperature at CCR using Thermocouples.....



Metal wires



C1-Bottom point at the centre, C2- middle point at the centre, C3- top point at the centre,
E1- Bottom point at the Edge, E2-Middle point at the edge, E3- top point at the Edge

