



PROVO TABERNACLE TEMPLE FOUNDATION

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OBJECTIVE

- ✦ Design a constructible, lasting, and cost efficient foundation for the restoration of the Provo Tabernacle Temple.

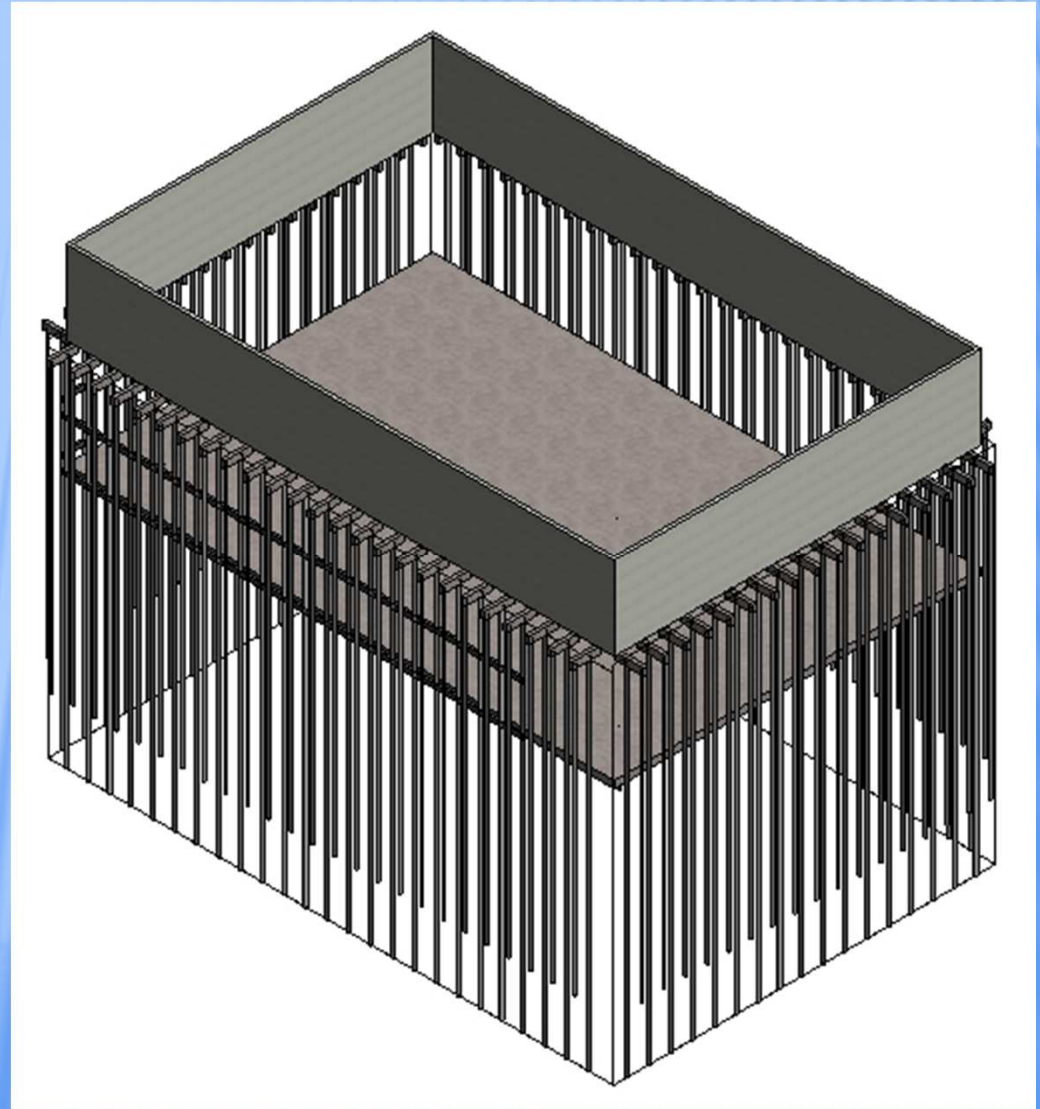


CONSTRAINTS

- × Support walls during excavation
- × Current Foundation is unsuitable
- × Add 2 basement floors
 - + Preserve space
 - + Under existing walls
- × Water table at 15 ft
 - + Dewatering during construction
 - + Long-term waterproofing/dewatering
 - + Building uplift

FINAL DESIGN PROCESS

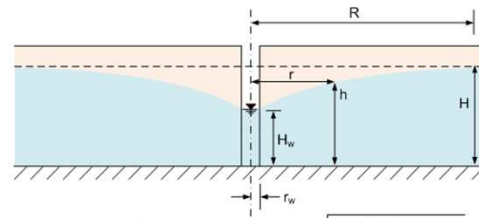
- × Construction dewatering
- × Remove old foundation
- × Build underpinning system
- × Excavation/Soil retention
- × Waterproofing
- × Mat foundation
- × Foundation walls



CONSTRUCTION DEWATERING

Construction Dewatering - Unconfined Aquifer

Brigham Young University - CE En 594R



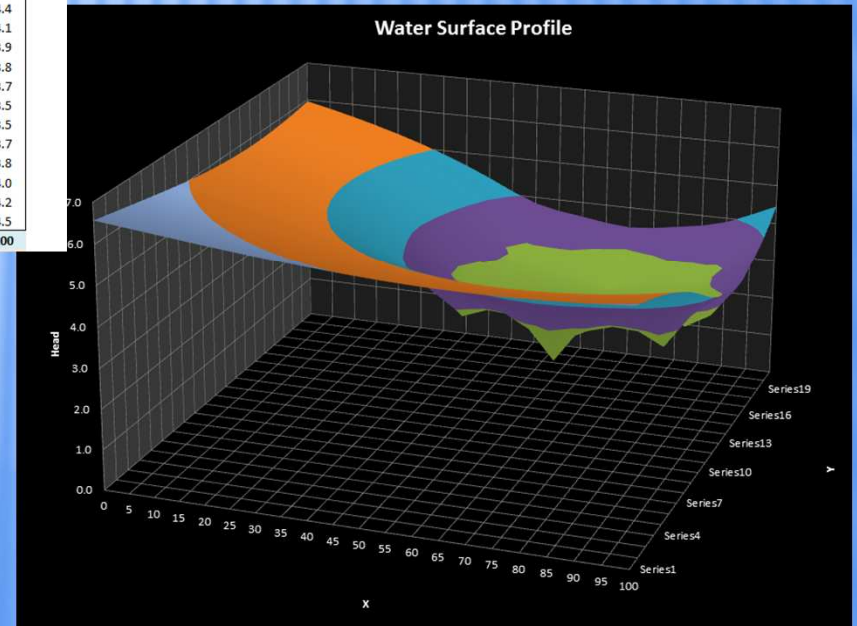
k: 0.505 [cm/s] xmin: 0 [m] Design h: 3.0488 [m]
 k: 0.00505 [m/s] xmax: 100 [m] Max h: 2.9 [m]
 H: 9.756 [m] ymin: 0 [m] Total Q: 0.41 [m³/s]
 R: 750 [m] ymax: 100 [m] 6493.2 [gal/min]

Build Wells

$$h = \sqrt{H^2 - \frac{1}{\pi k} \sum_{i=1}^n q_i \ln(R/r_i)}$$

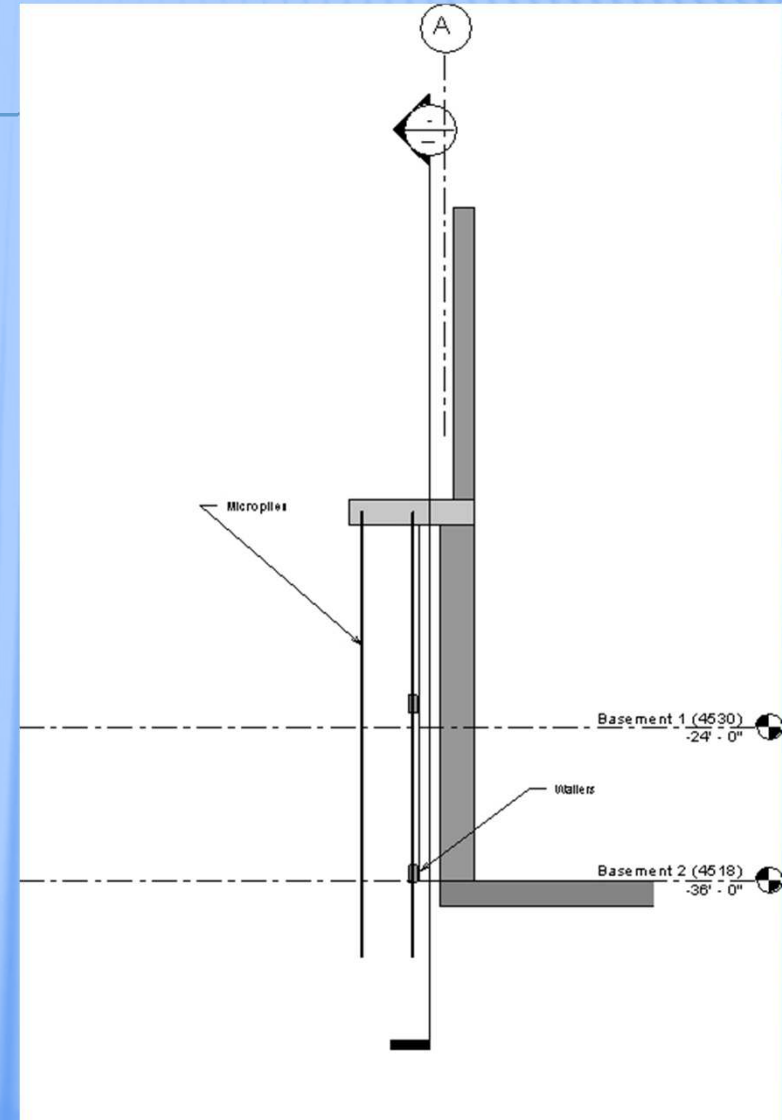
100	6.6	6.5	6.4	6.4	6.3	6.2	6.2	6.1	6.1	6.0	6.0	5.9	5.9	5.9	5.9	5.9	5.9	5.9	6.0	6.0	6.1	
95	6.5	6.4	6.3	6.3	6.2	6.1	6.1	6.0	5.9	5.9	5.8	5.8	5.8	5.8	5.7	5.8	5.8	5.8	5.8	5.8	5.9	5.9
90	6.4	6.3	6.3	6.2	6.1	6.0	5.9	5.9	5.8	5.7	5.7	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.7	5.7	5.8
85	6.3	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.6	5.5	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.5	5.6	5.7
80	6.3	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.3	5.4	5.4	5.5
75	6.2	6.1	6.0	5.9	5.8	5.6	5.5	5.4	5.3	5.2	5.1	5.0	5.0	4.9	4.9	4.9	5.0	5.0	5.1	5.2	5.3	5.3
70	6.1	6.0	5.9	5.8	5.6	5.5	5.4	5.2	5.1	5.0	4.8	4.8	4.7	4.6	4.6	4.7	4.7	4.8	4.9	5.0	5.1	5.1
65	6.1	5.9	5.8	5.7	5.5	5.4	5.2	5.0	4.9	4.7	4.6	4.5	4.4	4.3	4.3	4.3	4.4	4.5	4.6	4.7	4.9	4.9
60	6.0	5.9	5.7	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.2	4.1	4.0	3.9	3.9	3.9	4.0	4.1	4.3	4.4	4.7	4.7
55	5.9	5.8	5.7	5.5	5.3	5.1	4.9	4.6	4.3	4.0	3.8	3.7	3.6	3.4	3.3	3.4	3.6	3.7	3.8	4.1	4.4	4.4
50	5.9	5.7	5.6	5.4	5.2	5.0	4.7	4.4	4.0	3.5	3.1	3.2	3.1	2.8	2.9	2.9	3.2	3.2	3.1	3.7	4.1	4.1
45	5.9	5.7	5.5	5.3	5.1	4.9	4.6	4.2	3.8	3.2	2.7	2.9	2.9	2.6	2.4	2.7	2.9	2.8	2.5	3.4	3.9	3.9
40	5.8	5.7	5.5	5.3	5.0	4.8	4.5	4.1	3.7	3.2	2.9	2.8	2.8	2.7	2.6	2.7	2.8	2.8	2.9	3.3	3.8	3.8
35	5.8	5.6	5.4	5.2	5.0	4.7	4.4	4.0	3.5	3.1	2.9	2.8	2.7	2.7	2.6	2.7	2.7	2.7	2.8	3.2	3.7	3.7
30	5.8	5.6	5.4	5.2	5.0	4.7	4.4	3.9	3.4	2.6	2.6	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.4	2.7	3.5	3.5
25	5.8	5.6	5.4	5.2	5.0	4.7	4.4	3.9	3.4	2.6	2.6	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.4	2.8	3.5	3.5
20	5.8	5.6	5.5	5.2	5.0	4.7	4.4	4.0	3.6	3.1	2.8	2.7	2.7	2.6	2.6	2.6	2.6	2.7	2.8	3.2	3.7	3.7
15	5.8	5.7	5.5	5.3	5.1	4.8	4.5	4.1	3.7	3.3	2.9	2.8	2.7	2.5	2.4	2.5	2.7	2.7	2.9	3.3	3.8	3.8
10	5.9	5.7	5.5	5.3	5.1	4.9	4.6	4.3	3.9	3.4	2.5	2.8	2.8	2.5	1.5	2.5	2.8	2.7	2.4	3.5	4.0	4.0
5	5.9	5.8	5.6	5.4	5.2	5.0	4.7	4.5	4.1	3.7	3.2	3.2	3.0	2.9	3.0	3.2	3.2	3.2	3.5	3.8	4.2	4.2
0	6.0	5.8	5.7	5.5	5.3	5.1	4.9	4.7	4.4	4.1	3.8	3.7	3.6	3.5	3.5	3.5	3.6	3.7	3.9	4.2	4.5	4.5
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	

Water Surface Profile



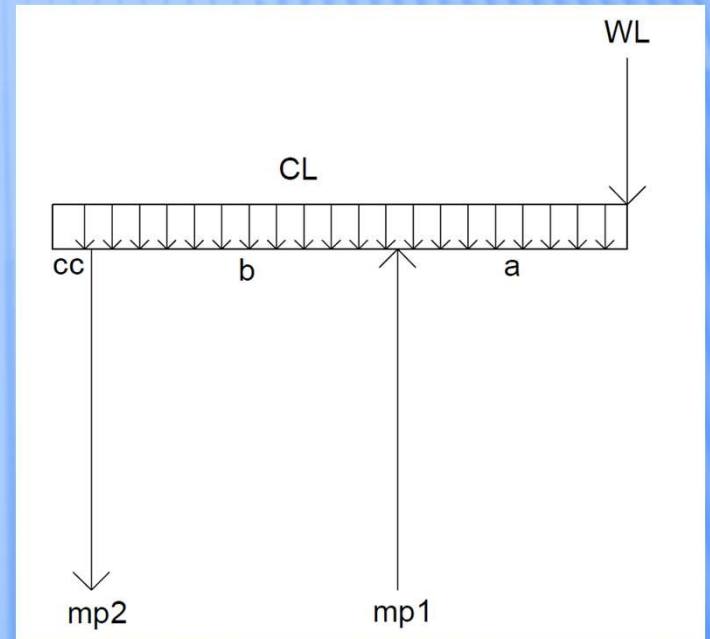
UNDERPINNING

- × Micropiles
 - + No Vibration
 - + High Capacity
- × Underpinning
 - + Conserve space
 - + Supports existing walls

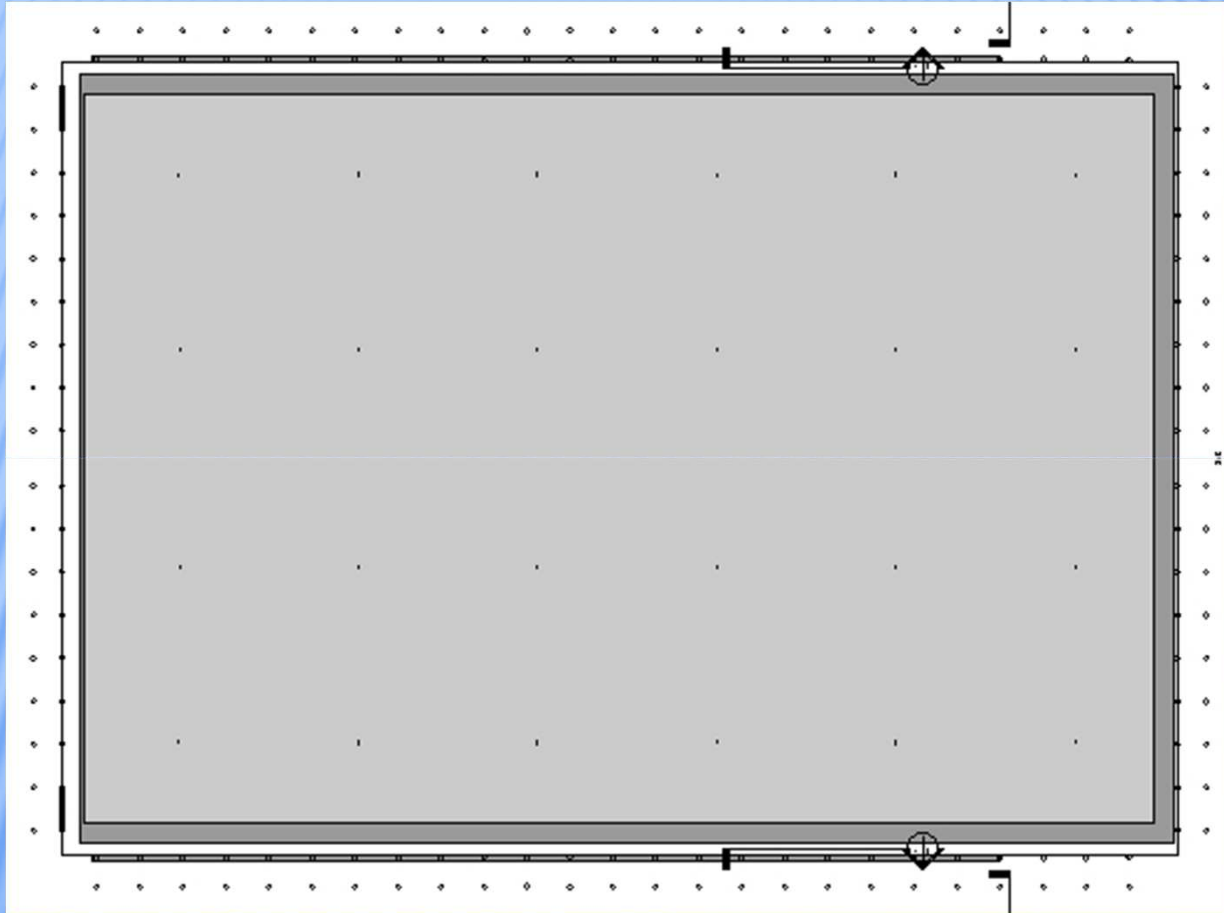


UNDERPINNING-DESIGN

- × Demands of mp1 and mp2
- × Length
- × Diameter
- × Type
 - + Type B for mp2
 - + Type A for mp1
 - × Keep steel casing to weld walers
 - × Required for lateral support

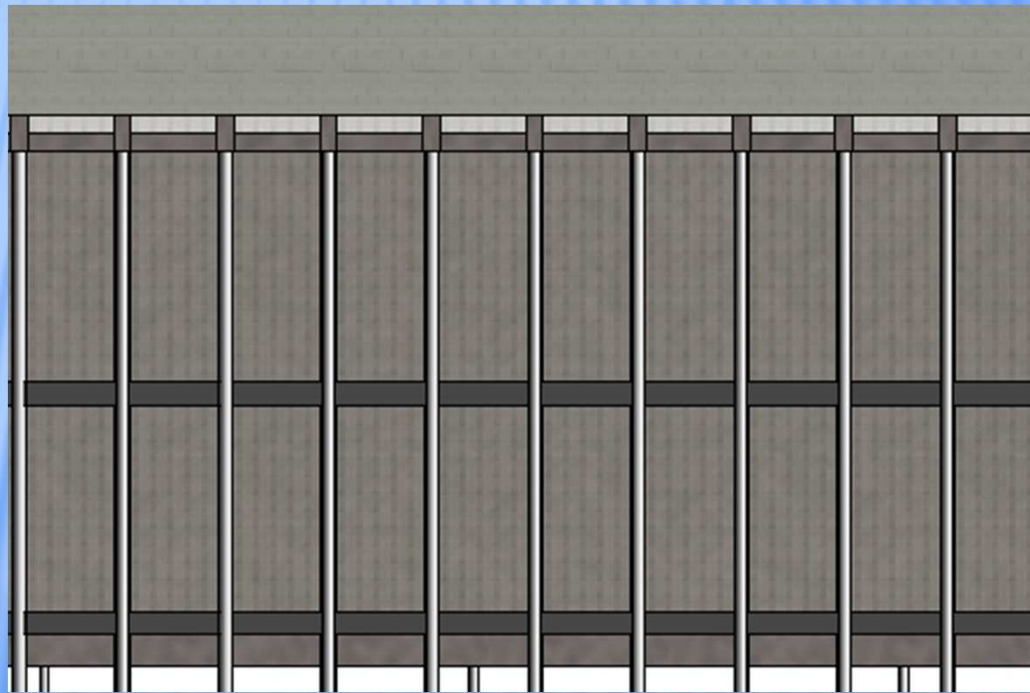


PLAN VIEW OF MICROPILES



EXCAVATION

- × Walers welded to micropiles
- × Netting
- × Soil pins
- × Anchors



DRAINAGE

- × Soil type makes drainage layer unnecessary
- × Designed to be waterproof and withstand lateral soil and water pressure
- × Pipe system underneath mat foundation
- × Permanent backup pump system

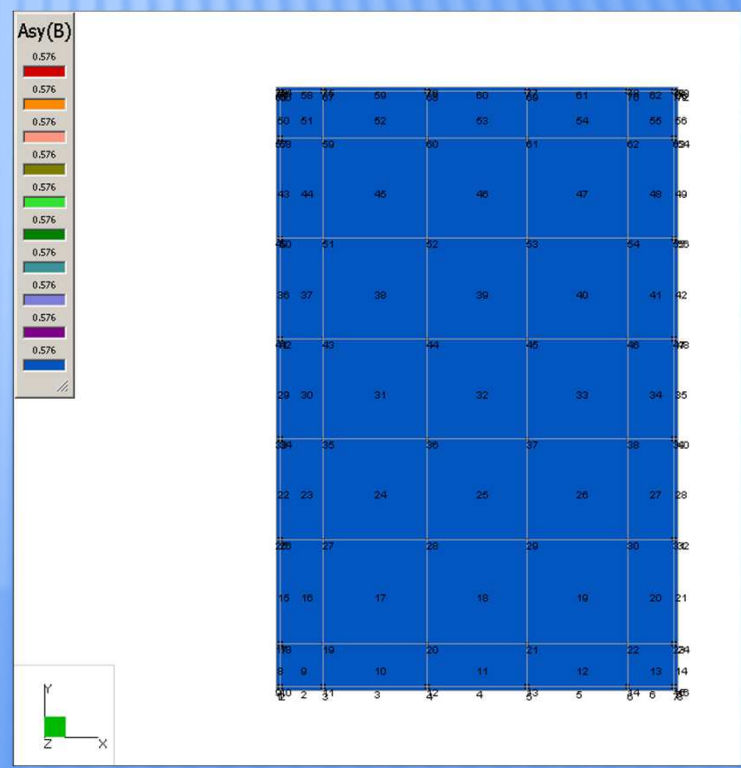
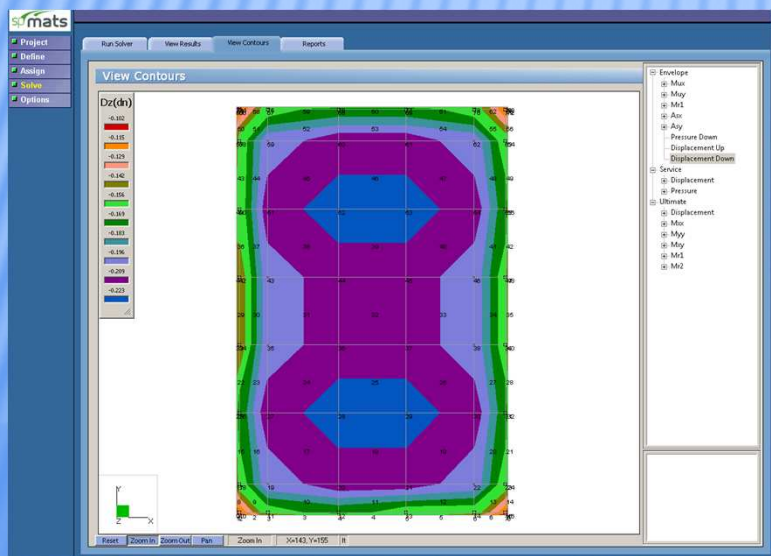
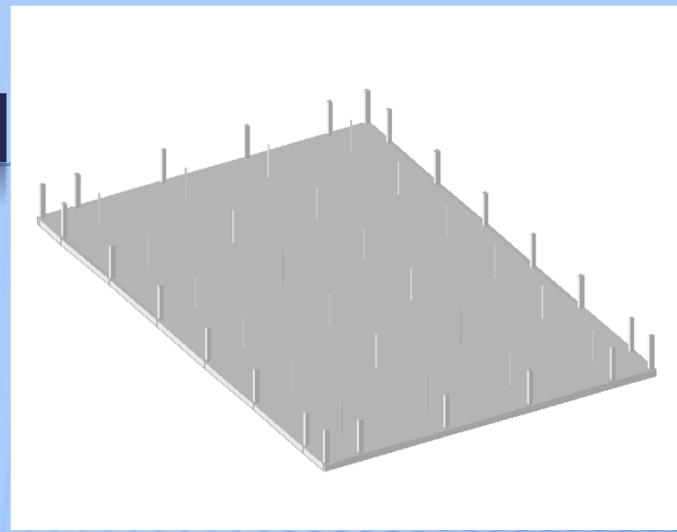
WATERPROOFING

- × Bentonite polymer alloy sheets
 - + Can be applied to blindside walls
 - + Bentonite clay expands when wet to fill in cracks and voids of concrete
 - + Self Healing



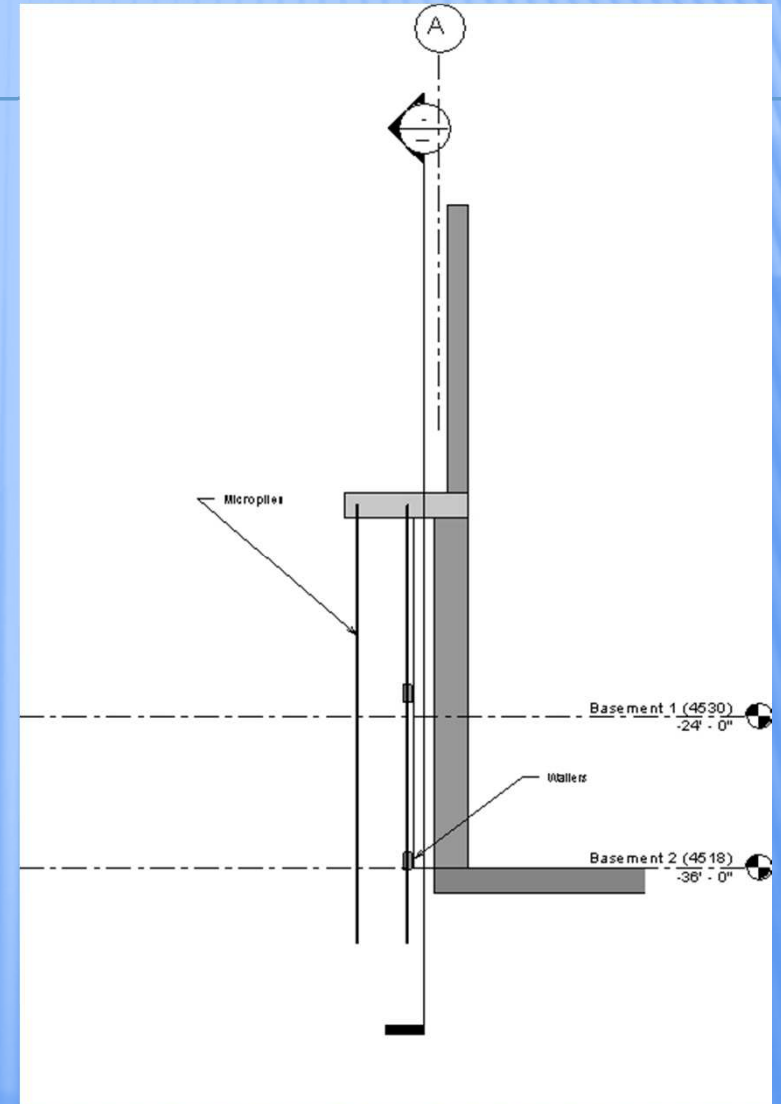
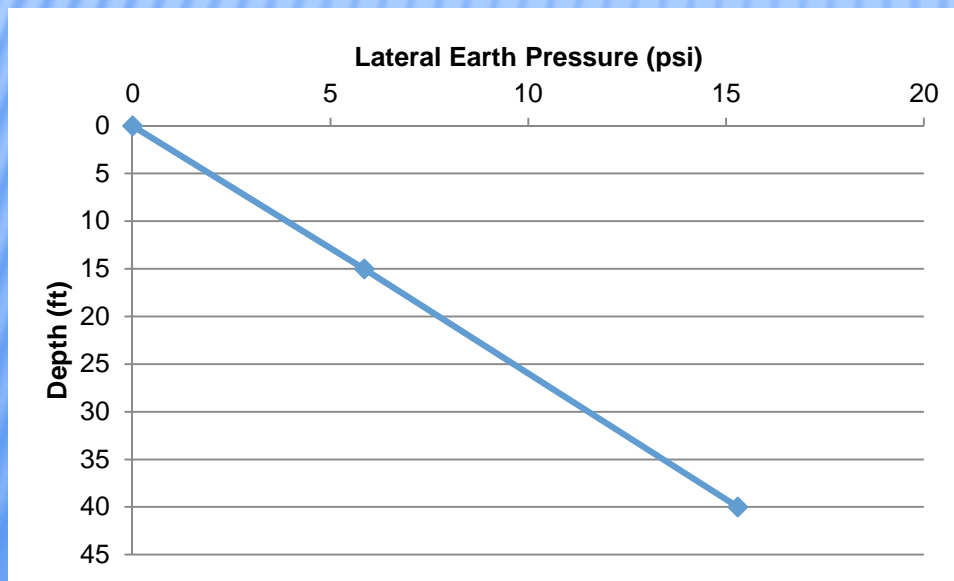
MAT FOUNDATION

- ✘ Below footing
 - ✘ program images
- ✘ Micropiles
- ✘ Thickness
- ✘ Reinforcement

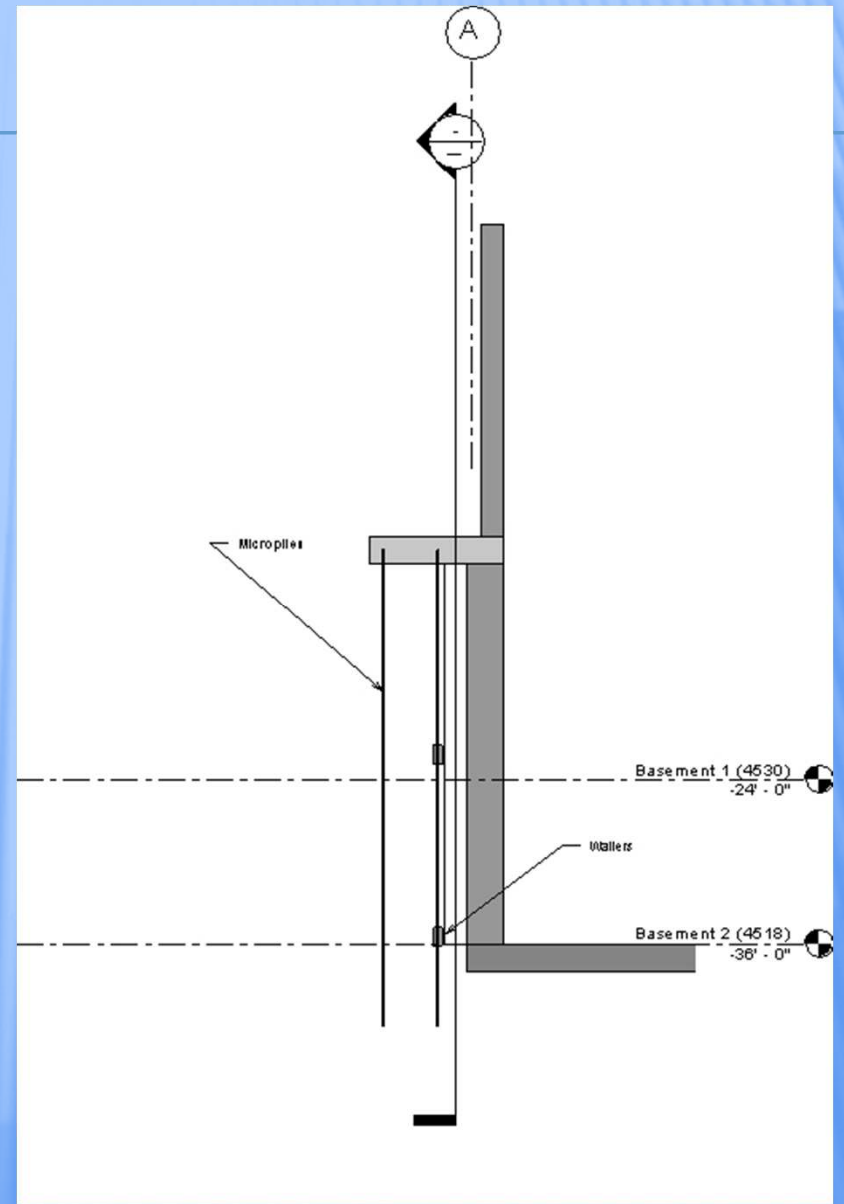
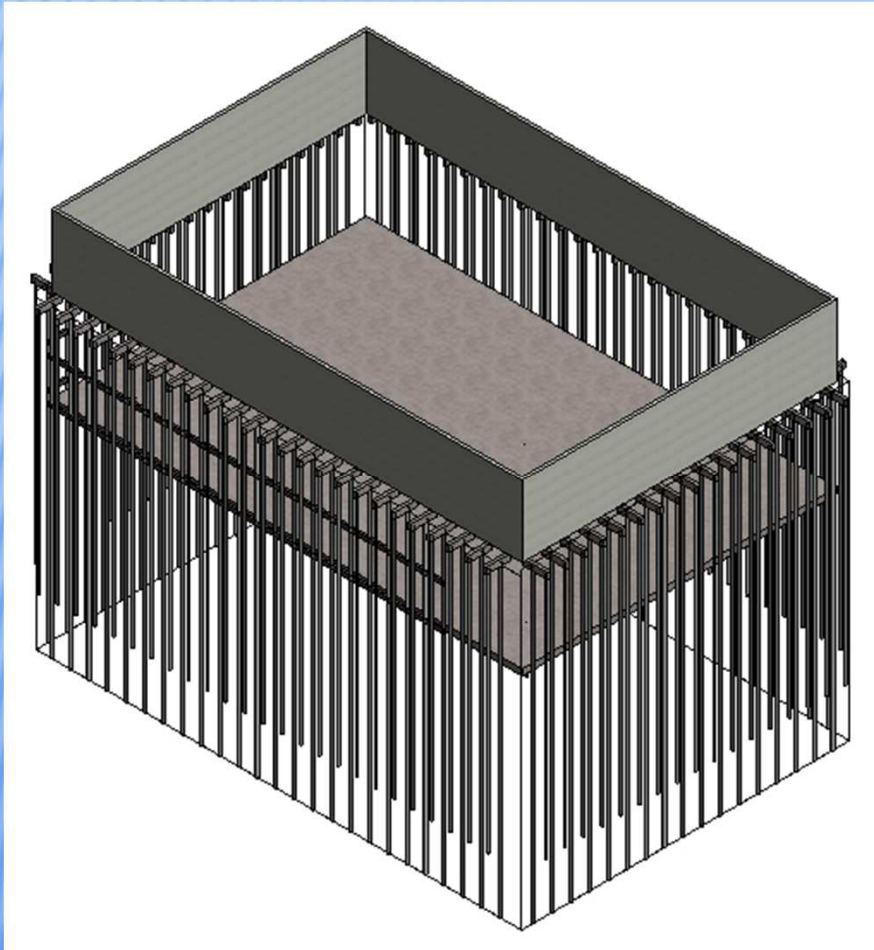


FOUNDATION WALL

- × Reinforcement
- × Size
- × Lateral pressures



FINAL DESIGN



QUESTIONS?
