

Foundation Design of a Soft Soil Site Development

Department of Civil and Resource Engineering

Introduction

The West Hants Municipality wishes to redevelop/repurpose a vacant property to construct a residential building. A suitable foundation design is needed for buildings of different sizes on a site that has challenging soil conditions.

Location: West Hants, Nova Scotia
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Design Process

Geotechnical Site Investigation

- Borehole and Test Pits Records.
- Geotechnical Laboratory & Field Tests.
- Soil Classification.
- Soil Stratigraphy Models.
- SPT-Values Analysis.
- Optimum Building Layout.
- Underlying Soil Properties.

Building Design

- 3, 5, and 7 Story Building Option.
- Column Loads using the NBCC 2015.
- S-Frame Analysis.

Foundation Options

Shallow on Engineered Fill & Shallow on Till

- Foundation Layout.
- Strip Footing & Spread Footing Design.
- Bearing Capacity vs. Footing Size.
- Settlement vs. Footing Size.
- Structural Requirements.
- Slab on Grade Design.

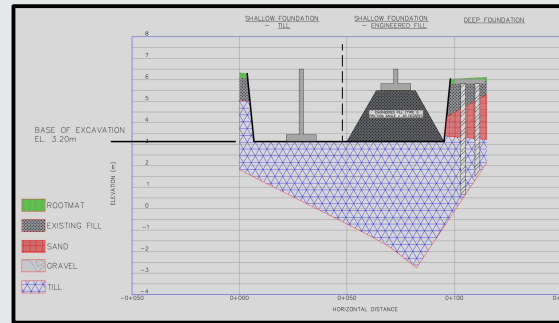
Deep Foundation

- Pile Layout.
- Steel vs. Concrete Piles.
- Pile Depth vs. Bearing Capacity.
- Settlement vs Pile Dimension and Depth.
- Pile Cap Design.
- Structural Slab Design.

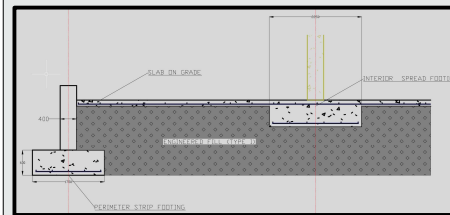
Details of Design



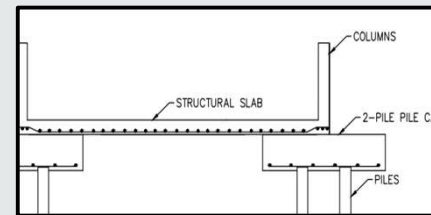
Aerial View of Property Including Optimum Building Layout



Foundation Options on Site Stratigraphy (Foundation Details NTS)



Shallow Foundation Options on Site Stratigraphy: Shallow on Till Layer and Shallow on Engineered Fill (Footings NTS)



Deep Foundation Option on Site Stratigraphy: Deep Foundation with Structural Slab (Drawing NTS)

Cost and Revenue Analysis

- 1% Property Tax Rate.
- 25 Units per Floor.
- Monthly Rent fee of \$1400.

Storey Height	Total Building Cost for Favored Foundation	Realized Revenue	Cost Recovery (Years)
3	11,700,000	1,390,000	8.42
5	19,380,000	2,310,000	8.37
7	26,700,000	3,660,000	7.29

Conclusion and Recommendations

Shallow Foundation

- The shallow foundation on Till was eliminated.
- Organic Matter & Topsoil were replaced with Engineered Fill.
- Strip Footings to Support the Perimeter Walls.
- Spread Footing Dimensions: 1.65 x 1.65, 1.9 x 1.9, 2.25 x 2.25 at 2.7 m depth.
- Favored foundation option for the 5 and 7-story building.

Deep Foundation

- 2 Pile Pile-Cap placed at each column.
- Piles are driven or bored into the underlying rock (31 meters).
- Pile Dimension of 0.6m for driven or 0.8m for bored.
- Pile Cap Dimensions: 4.8 x 2.4 x 1 m for driven and 4.8 x 3.2 x 1.5 m for bored.
- Favored foundation option for the 3-story building.

Sustainability Considerations

1. Material Accessibility - Where are key materials coming from?

- Local Concrete Batch Plant – Annapolis Valley Ready Mix
- Structural Fill (Type I) - St. Croix Quarry, Dexter Construction

2. Property Maximization - How to utilize the space available.

- Small-Scale Structure(s) - Plan for the development of smaller residential structures on areas of the site with poor soil conditions.
- Developing green space and parking areas.

References

- Canadian Geotechnical Society. (2006). Canadian Foundation Engineering Manual -4th Edition
- Concrete Design Handbook (2016), CSA A23.3
- Property Tax Rates. (2021). <https://data.novascotia.ca>
- Handbook of Steel Construction - 12th Edition CSA S16:19