



# ENGINEERED FOUNDATIONS

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Department of Public Works

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# ENGINEERED FOUNDATIONS

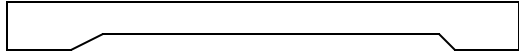
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- What is an engineered foundation.
  - A Foundation Design Developed by a Trained Professional (Engineer)
- Types of Foundations (All of which can be engineered)
  - Slab on Grade
  - Pier and Beam
  - Post Tension
  - Footing & Stem Wall
  - Grade Beam

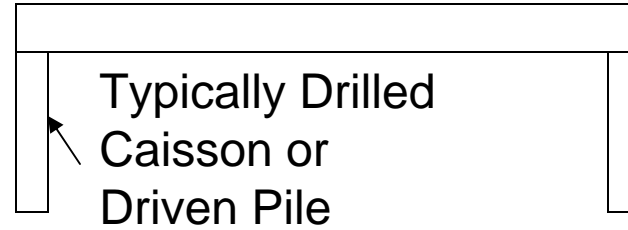
(These are the most common but others exist)

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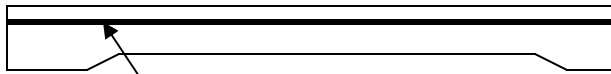
Slab on Grade



Pier & Beam

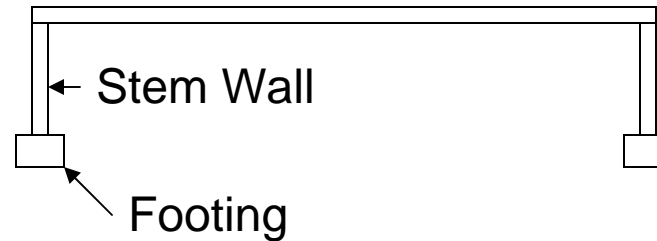


Post Tension

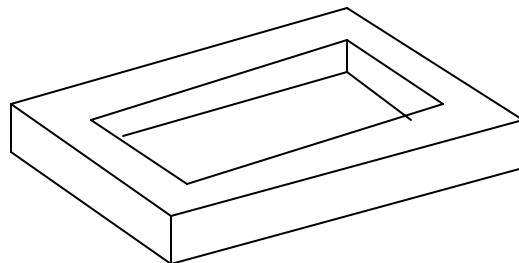


Cable Placed in Concrete and Tensioned after Curing

Footing & Stem Wall



Grade Beam



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- Forces to be considered in foundation design
  - Bearing Capacity
    - Capacity of Soils to Support Loads
  - Lateral Loads
    - Wind and Expansive Soils Forces
  - Uniform Loads
    - Exterior Load Bearing Walls
  - Point Loads
    - Beam Loads on Columns

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## □ Bearing Capacities

### ■ Bearing Capacities are based on Soil Characteristics

#### □ Types of Soils

##### ➤ Sands & Gravels

➤ Drains Water Easily

➤ High Strength

##### ➤ Silts

➤ Highly Erodible

➤ Poor Drainage Characteristic

##### ➤ Clays

➤ Does Not Allow Water to Drain

➤ Typically Highly Expansive

(Soil Characteristics are so complex an entire discipline has been developed - Geotechnical Engineering)



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## □ Soil Characteristic

### ■ LL- Liquid Limit

- The measure of the amount of water before the soil structure becomes unstable.

### ■ PL- Plastic Limit-

- The measure of the ability of soil to be rolled into threads of 1/8" in diameter.

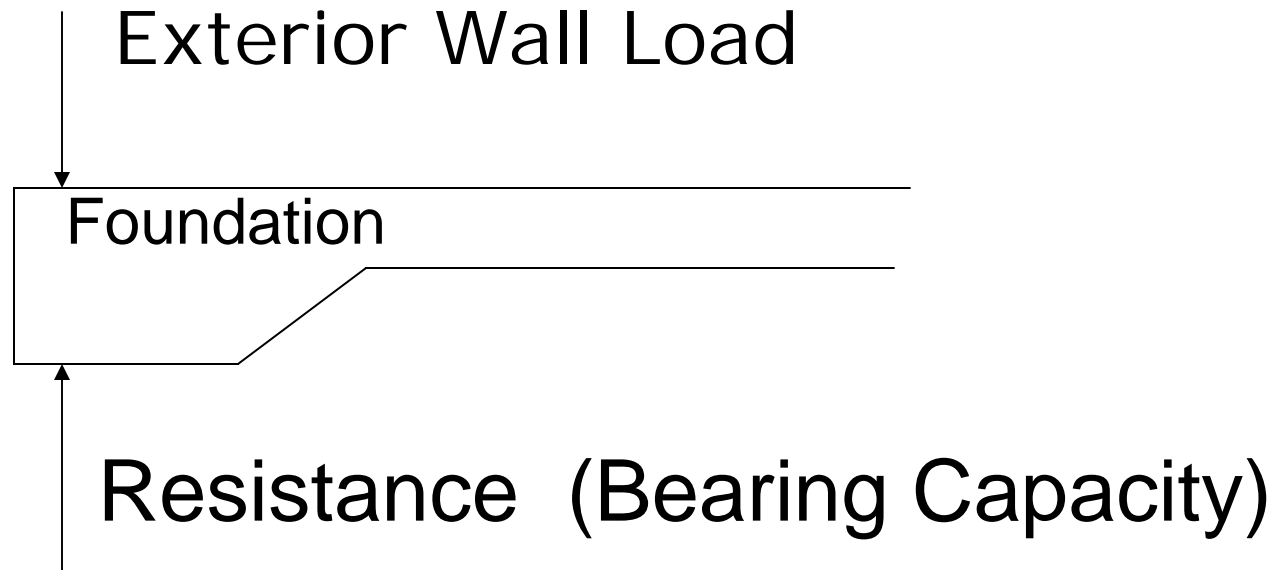
### ■ PI-Plasticity Index

- An indicator of the potential swell of a type of soil

### ■ $PI = LL - PL$

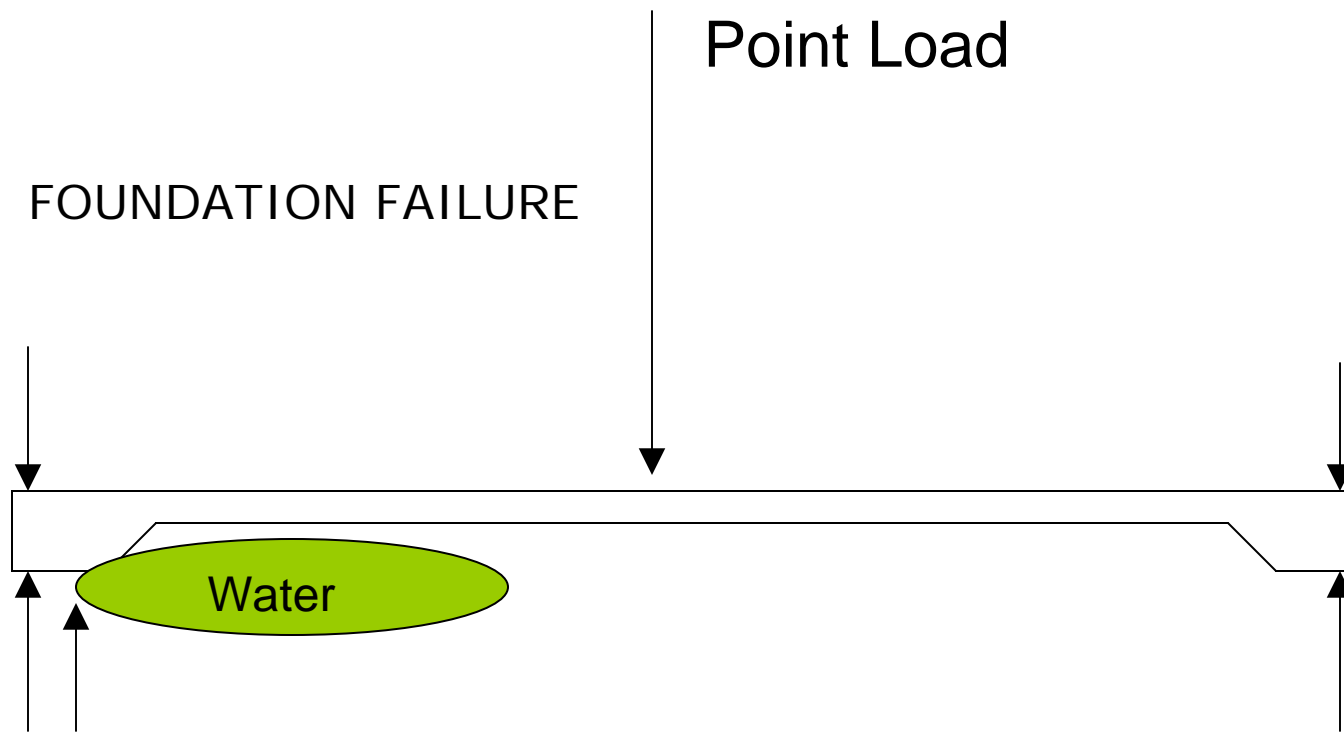
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## □ Causes of Failures

- Water Seeps Into Clays Which Results in Expansion
- Soils Dry Out Which Results in Contraction of Soil
- Additional Loads from Weather Events are Placed on Structure (Ice, Wind, Etc)
- Root Expansion
- Plumbing Leaks
- Poorly compacted building pad

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## □ Solutions for Failed Foundations

- Installation of Drip System to Continually Wet Soil (not recommended)
- Compaction Grouting/Pressure Grouting
  - Slab Jacking/Mud Jacking
- Excavate Under Perimeter, Jack and Place New Grade Beams
- Steel Piers or Under Pinning
  - Helical Pier
  - Caissons
- Failures Vary From Minor to Major

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- Cost to Repair Failed Foundations
  - Cost of repairs are dependent on extent of failure
  - Minor repairs cost can be as much as \$5,000.00
  - Major Repairs cost are usually over \$10,000.00 and can be tens of thousands of dollars

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- Building inspections compromise to full foundation requirement
  - 1,799 square sqft and below, single story homes no engineered foundation required
    - This is due to several considerations.
      1. Typically smaller homes are a square or rectangular foot print which moves more uniformly .
      2. Lower end homes with little profit margin.
  - 1 Boring per 3 acres and PI below 20, no engineered foundation required
- Typical cost for a 2,200 sqft post tension foundations.
  - Tendons-           \$3,500
  - Design-            \$1,500
  - Total    \$5,000

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## □ Summation

- A foundation supports the rest of the structure
- The greatest expense in most peoples lives is the purchase of a new home. Do we want to place the future homeowners at risk.
- All “after the fact” repairs are extremely expensive and may only provide a short term solution (future failures).
- It has been suggested that by providing a builders warrant the new home owner would be protected. Home warranty companies are like insurance they will try to deflect all responsibility.

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## □ Summation Continued

- Steel Piers or Under Pinning is extremely expensive and only repairs the foundation. Typically there is additional work in drywall, plumbing, brick facade and roofing which will need repaired
- **Builders will build where the PROFIT is the greatest regardless of any other factor.**