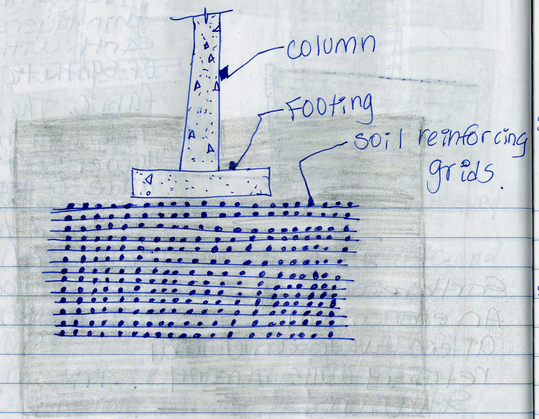
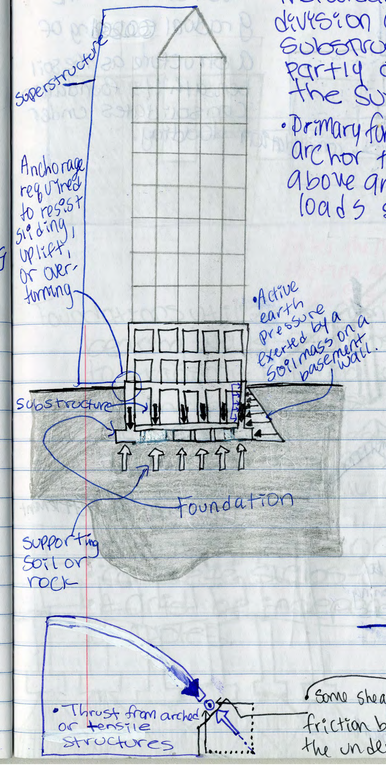


Foundation Systems

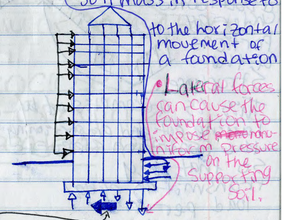
The foundation is the lowest division of a building, its substructure, constructed partly or wholly below the surface of the ground.

- Primary function - to support and anchor the superstructure above and transmit its loads safely into the earth.

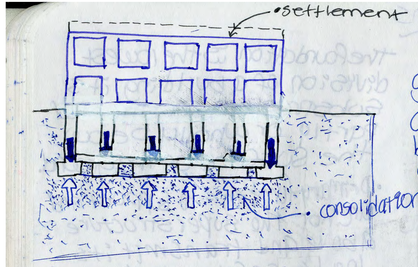


The principal loads on a foundation are the combination of dead and live loads acting vertically on the superstructure.

- Passive earth pressure is developed by a soil mass in response to to the horizontal movement of a foundation

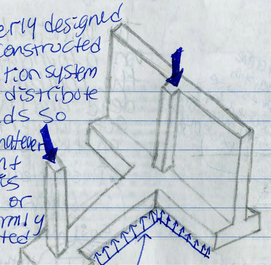


- Lateral forces can cause the foundation to impose ~~[illegible]~~ pressure on the supporting soil.
- Some shear resistance is provided by the friction between the foundation and the underlying soil.



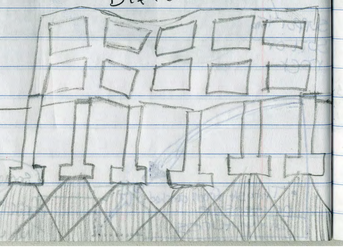
Settlement is the gradual subsiding of a structure as the soil beneath its foundation consolidates under loading.

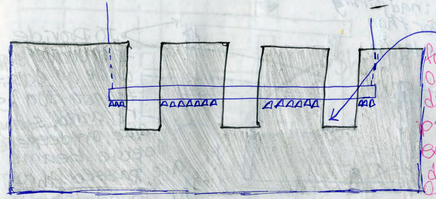
A properly designed and constructed foundation system should distribute its loads so that whatever settlement occurs is minimal or is uniformly distributed under all portions of the structure.



This is accomplished by laying out and proportioning the foundation supports so that they transmit an equal load per unit area to the supporting soil or rock without exceeding its bearing capacity.

Differential settlement





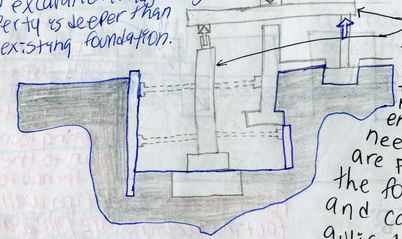
- Another method for providing temporary support is to dig intermittent pits under the existing foundation down to the level of the new footings.

After the new foundation wall and footing sections are placed, additional pits are dug until the entire wall has been replaced.

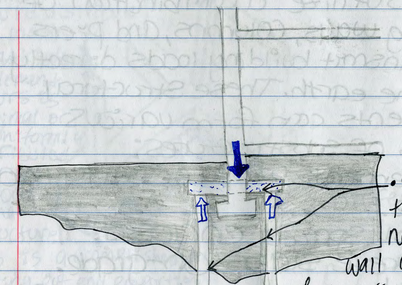
Foundations utilize a combination of bearing walls, columns, and piers to transmit building loads directly to the earth. These structural elements can form various types of substructures:

- Basements wholly or partly below grade.
- Crawl spaces enclosed.
- Concrete slabs-on-grade.
- A grid of independent piers or poles.

Underpinning refers to the process of rebuilding or strengthening the foundation of an existing building, or extending it when a new excavation is adjoining property is deeper than the existing foundation.

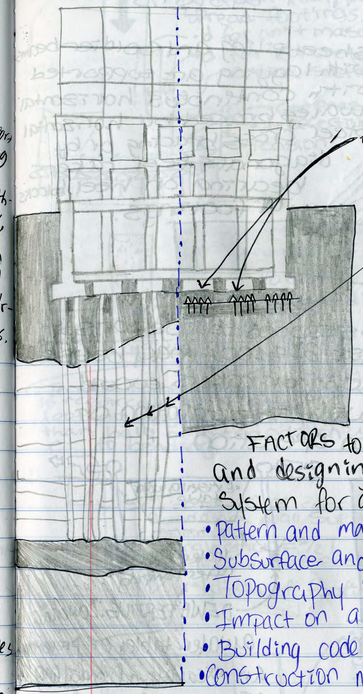


- To provide temporary support while an existing foundation is repaired, strengthened, or deepened, needle beams are passed through the foundation wall and carried by hydraulic jacks and shores.



- An alternative to extending a new foundation wall and placing new footings is to construct piles or caissons on either side of the existing foundation, remove a section of foundation wall, and replace the section with a reinforced concrete pile cap.

Types of foundations systems.

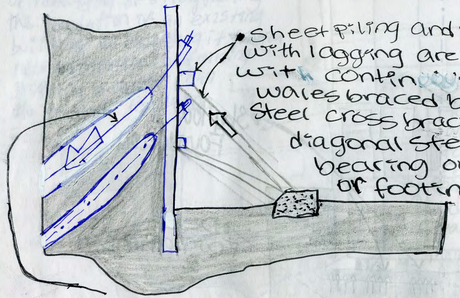


- Shallow Foundation
- Deep Foundations

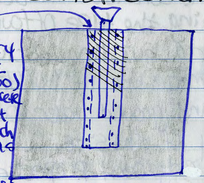
Factors to consider in selecting and designing the type of foundation system for a building include:

- Pattern and magnitude of building loads.
- Subsurface and ground water conditions.
- Topography of the site.
- Impact on adjacent properties.
- Building code requirements.
- Construction method and risk.

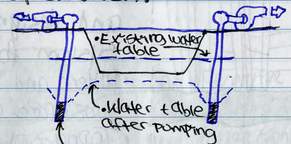
Excavation support systems



- Sheet piling and soldier beams with lagging are supported with continuous horizontal wales braced by horizontal steel cross bracing or by diagonal steel rakers bearing on heel blocks or footings.
- Tiebacks secured to rock or soil anchors (CSI 315100) may be used if crossbracing or rakers would interfere with the excavation or construction operation.

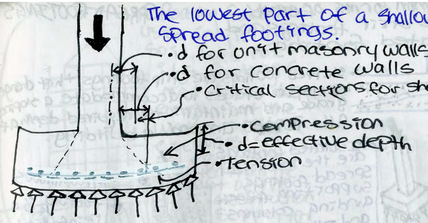


- A slurry wall (CSI 31 56 00) is a concrete wall cast in a trench to serve as sheeting and often as a permanent foundation wall.



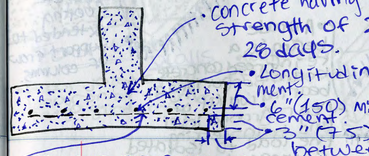
- Existing water table
- Water table after pumping

DEWATERING: Lowering a water table or preventing an excavation from filling with ground water. Accomplished by driving perforated tubes (wellpoints) into the ground to collect water from the surrounding area so it can be pumped away.

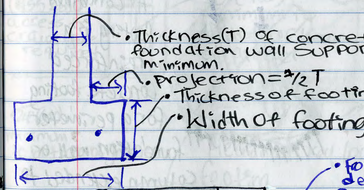


The lowest part of a shallow foundation are spread footings.

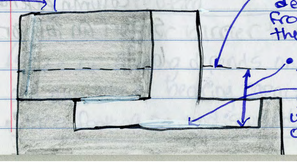
- d for unit masonry walls
- d for concrete walls
- Critical sections for shear
- Compression
- d = effective depth
- Tension



- Concrete having a minimum compressive strength of 2500 psi (17 kPa) at 28 days.
- Longitudinal temperature reinforcement
- 6" (150) minimum above steel reinforcement.
- 3" (75) minimum clearance between reinforcing bars and concrete surface.
- Tensile reinforcement is required when a spread footing projects more than half of the foundation wall thickness and is subject to bending.



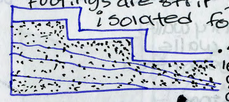
- Thickness (T) of concrete or unit masonry foundation wall supporting two floors: 8" (205) minimum.
- Projection = 1/2 T
- Thickness of footing = T
- Width of footing = 2T



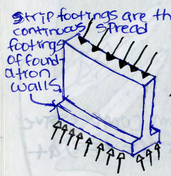
- Frostline is the average depth at which soil is frozen or frost penetrates the ground.
- 12" (305)
- To minimize settlement, footings should always rest on stable, undisturbed soil free of organic material.

SPREAD FOOTINGS

The most common forms of spread footings are strip footings and isolated footings.

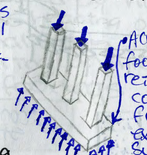


• Stepped footings are strip footings that change levels in stages to accommodate a sloping grade and maintain the required depth at all points around a building.



Strip footings are the continuous spread footings of foundation walls.

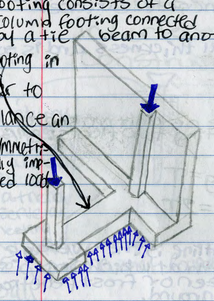
• Isolated footings are the individual spread footings supporting freestanding columns and piers.

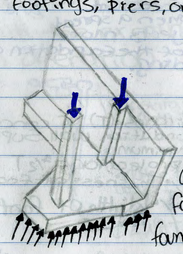


• A continuous footing is a reinforced concrete footing extended to support a row of columns.

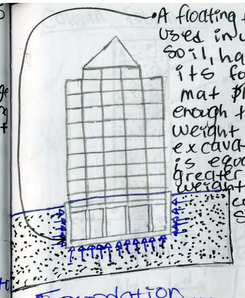
• A grade beam is a reinforced concrete beam supporting a bearing wall at or near ground level and transferring the load to isolated footings, piers, or piles.

• A cantilever or strap footing consists of a column footing connected by a tie beam to another footing in order to balance an asymmetrically imposed load.



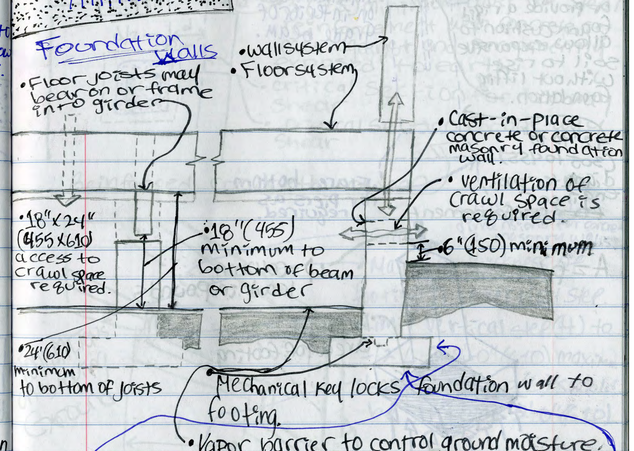


A combined footing is a reinforced concrete footing for a perimeter foundation wall or column extended to support an interior column load.

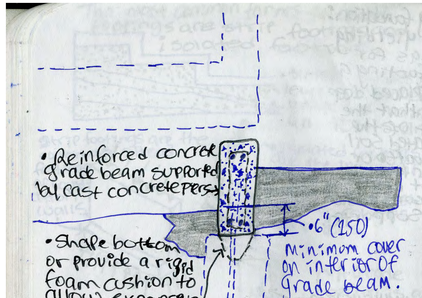


• A floating foundation: Used in yielding soil, has for its footing a mat placed deep enough that the weight of the excavated soil is equal to or greater than the weight of the construction supported.

Foundation Walls



• Size of footing depends on foundation wall load and allowable bearing capacity of the underlying soil.
• Place footing on undisturbed soil below frostline.



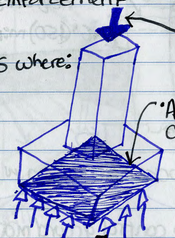
• Reinforced concrete grade beam supported by cast concrete piers.

• Shape bottom or provide a rigid foam cushion to allow expansive soil to rise without lifting foundation.

• 6" (150) minimum cover on interior of grade beam.

12" to 18" (305 to 455) diameter piers; engineer ~~the~~ reinforcement

• Flared bottom for piers as required.



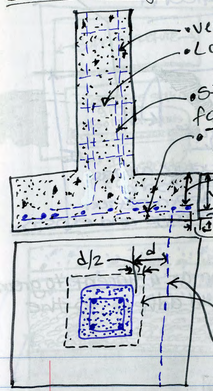
$A = P/S$ where:

• P = column load in pounds

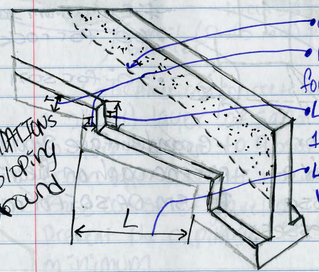
• A = contact area of footing

S = soil bearing capacity in PSF; 1 PSF = 0.0479 kpa

Column Footings



Reinforced concrete column



• Utilize modular dimensions for concrete masonry walls.

Stepped footings change levels in stages to accommodate a sloping grade and maintain the required depth at all points around a building.