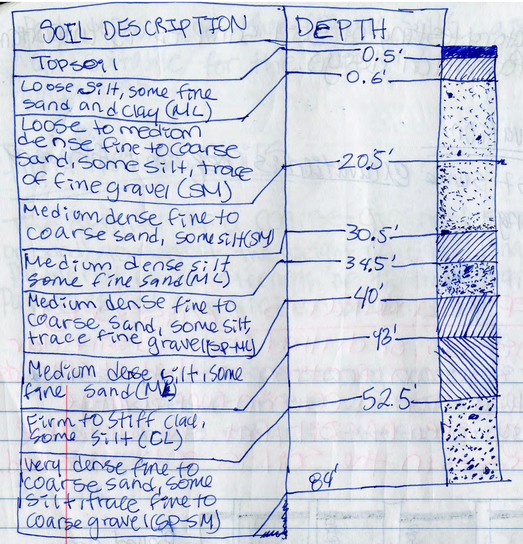


A typical log from a soil test boring indicating the type of soil in each stratum and the depth in feet at which it was found.

Foundations

Piles

A pile is distinguished from a caisson by being forcibly driven into the earth rather than drilled and poured.

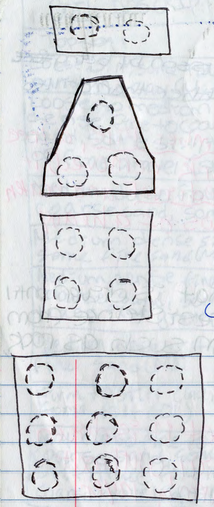
The simplest kind of pile is a timber pile, a tree trunk with its branches and bark removed; it is held small end down in a piledriver and beaten into the earth with repeated blows of a heavy mechanical hammer.

End bearing pile – A pile that is driven until its tip encounters firm resistance from a suitable bearing stratum such as rock, dense sands, or gravels.

Friction pile: A pile that it is driven only into softer material without encountering a firm bearing layer.

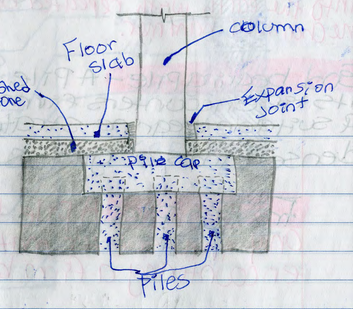
Pile Driving

Pile hammers are massive weights lifted by the energy of steam, compressed air, compressed hydraulic fluid, or a diesel explosion, then dropped against a block that is in firm contact with the top of the pile.

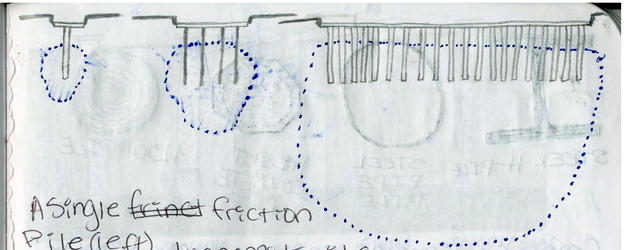


Clusters of two, three, four, and nine piles with their concrete caps, viewed from above. The caps are reinforced to transmit column loads equally into all the piles in the cluster, but the reinforcing steel has been omitted here for the sake of clarity.

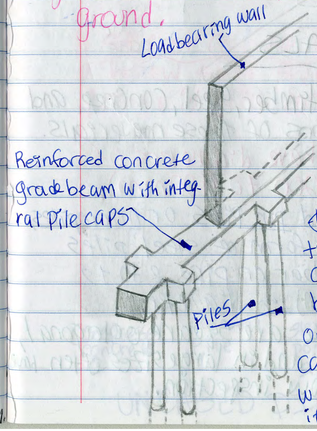
Friction piles work best in silty, clayey, and sandy soils.



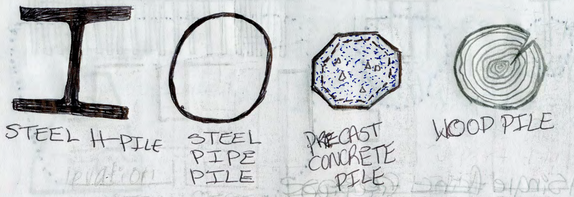
An elevation view of a pile cap, column, and floor slab.



A single ~~friact~~ friction pile (left) transmits its load into the earth as an equal shear pressure along the bulb profile indicated by the dotted line. As the size of the pile cluster increases, the piles act together to create a single larger bulb of higher pressure that reaches deeper into the ground.



In order to support a load bearing wall, pile caps are joined by a grade beam. The reinforcing in the grade beam is similar to that in any ordinary continuous concrete beam and has been omitted for clarity. In some cases, a concrete load bearing wall can be reinforced to act as its own grade beam.



Cross sections of common types of piles. Precast concrete piles may be square or round instead of the octagonal section shown here and may be hollow in the larger sizes.

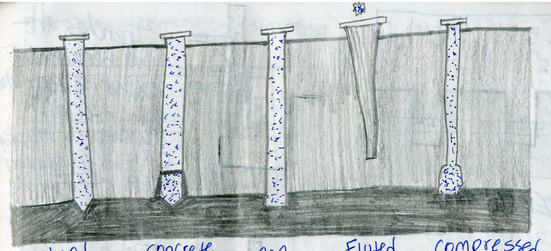
PILE MATERIALS

Piles may be made of timber, steel, concrete, and various combinations of those materials.

Steel pipe piles have diameters of 8 to 16 inches (200 to 400mm).

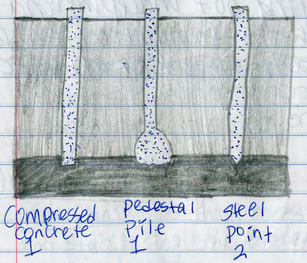
Minipiles, also called pin piles or micropiles, are a lightweight form of steel piles made from steel bar or pipe 2 to 12 inches (50 to 30mm) in diameter.

Precast concrete piles are square, octagonal, or round in section, and in large sizes often have open cores to allow inspection.



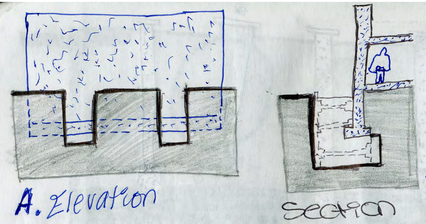
CASED PILES

A sitecast concrete pile is made by driving a hollow steel shell into the ground and filling it with concrete.

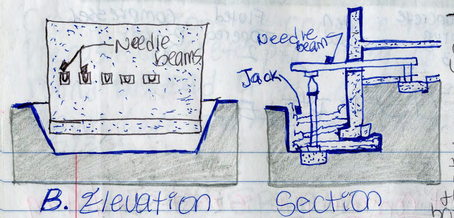


Some proprietary types of sitecast concrete piles.

UNCASED PILES

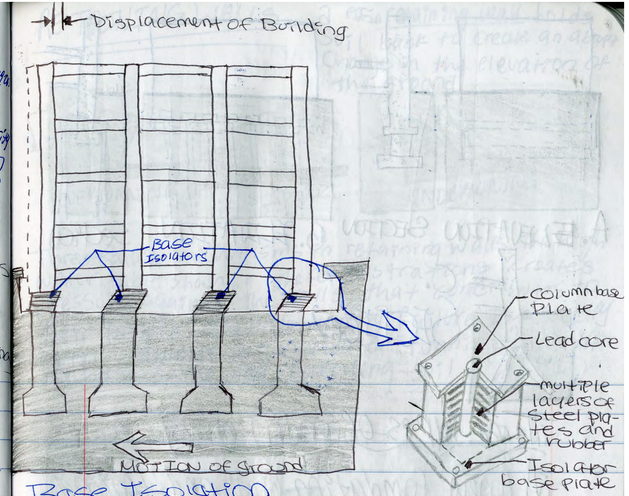


Trenches are dug beneath the existing foundation at intervals, leaving the majority of the foundation supported by the soil.



The foundations of an entire wall can be exposed at once by needling in which the wall is supported temporarily on needle beams threaded through holes cut in the wall.

Two methods of supporting a building while carrying out underpinning work beneath its foundation, each shown in both elevation and section.



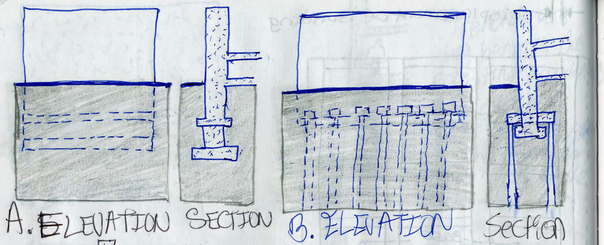
Base Isolation.

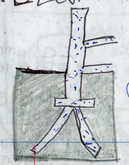
Seismic Base Isolation

In areas where strong earthquakes are common, buildings are sometimes placed on base isolators.

Underpinning

Underpinning is the process of strengthening and stabilizing the foundations of an existing building.





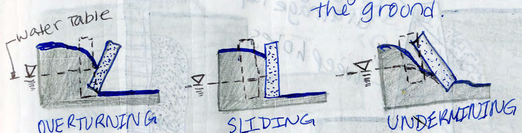
C. SECTION

Three types of underpinning

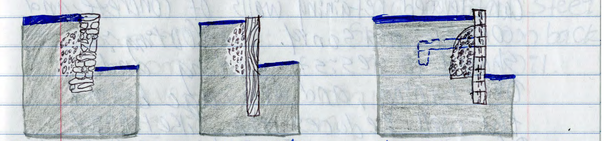
a) A new foundation wall and footing are constructed beneath the existing foundation.
b) New piles or caissons are constructed on either side of the existing foundation.
c) Minipiles are inserted through the existing foundation. Minipiles do not generally require excavation or temporary support of the building.

RETAINING WALLS

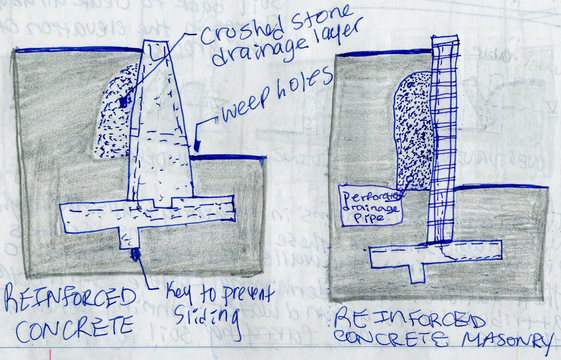
a ~~ret~~ retaining wall holds soil back to create an abrupt change in the elevation of the ground.



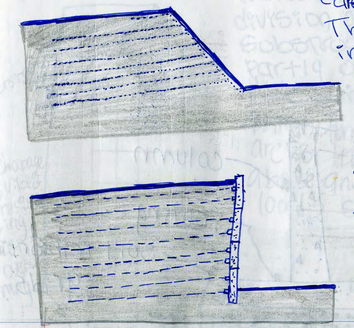
Three failure mechanisms in retaining walls. The high water table shown in these illustrations creates pressure against the walls that contributes to their failure. The undermining failure is directly attributable to groundwater running beneath the base of the wall, carrying soil with it.



Three types of simple ~~ret~~ retaining walls, usually used for heights not exceeding 3 feet (900mm)... with proper engineering design, any of these types of construction can be used for taller retaining walls.



Cantilevered retaining walls of concrete and concrete masonry. The footing is shaped to resist sliding and overturning, and drainage behind the wall reduces the likelihood of undermining. The pattern of steel reinforcing (broken lines) is designed to resist the tensile forces in the wall.



Two examples of earth reinforcing. The embankment in the top section was placed by alternating thin layers of earth with layers of synthetic mesh fabric. The retaining wall in the lower section is made of precast concrete panels fastened to long galvanized steel straps that run back into the soil.

Earth reinforcing: An economical alternative to conventional retaining walls in many situations.

Gabions are another form of earth retention in which corrosion-resistant wire baskets are filled with cobble- or boulder-sized rocks and then stacked to form retaining walls, slope protection and similar structures.