Piles, Caissons, Raft Foundations

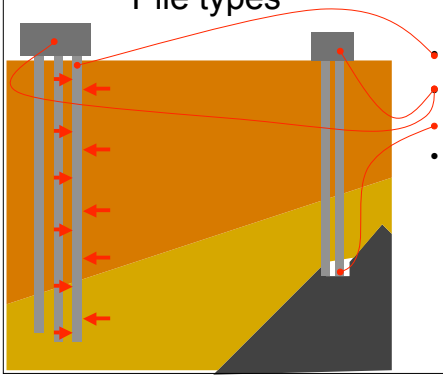
Deep Foundations

- When soil capable of carrying the building loads lies too deep for typical shallow foundations, we go deeper to find adequate bearing.
- Three types
  - End Bearing Piling / Friction Pile
  - Drilled Pier (caisson)
  - Raft (mat)

Piles

- Basically columns, driven into the earth
- Can be wood (treated), steel, concrete
- Usually driven in clusters 3 to 8
- Driven to bearing depth or to when driving force no longer moves column (point of refusal)
- Capped with concrete pile cap

Pile types

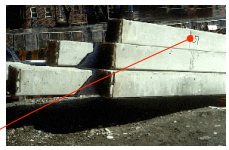


- Friction Pile
- Caps
- End Bearing

Round steel piles

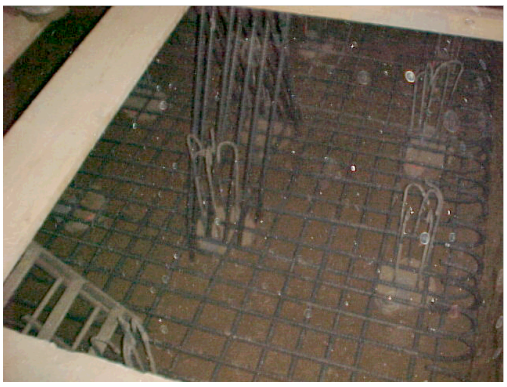
Hammer driver

Precast Piles



- Marked for driving depth
- Numbered to record what pile was driven to what depth

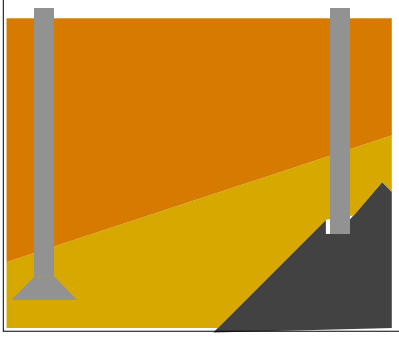
- Piles driven in clusters
- Piles broken / sawn off to prepare for pouring pile cap



Piles: relative installed costs

- Cast concrete in steel tube
  - 25 foot long end bearing $624.00 each
  - 50 foot long end bearing $1,145.00 each
- Precast pile
  - 50 foot long end bearing $800.00
  - 100 foot long end bearing $1,460.00
- Steel 'H' pile
  - 50 foot long end bearing $1,195.00
  - 100 foot long end bearing $3,425.00

Caissons



… are piers slowly drilled down to soil having adequate bearing for the load carried from the column to the caisson.

The caisson bottom can be belled for additional bearing area in soft soil, or socketed into the rock.

Caisson Drilling

- This Bell Auger has 'wings' that expand out of the cylinder to cut the bell shape at the bottom of the caisson.
- The pipes beside it are the shoring for the caisson to keep it from collapsing. They will be removed when the caisson is filled with concrete.

Caisson drilling

- Caissons are drilled into the earth with auger bits attached to the square drive shaft from the drilling rig… like drilling into wood

Cleaning augers

- The auger fills up with earth (here clay) and is withdrawn from the hole, swung to the side and spun at high speed.

Auger cleaning

- The clay flies off in all directions… don't study this up close

Caisson Shoring

- As the caisson is drilled deep into the earth, the chance of caving in the sides increase. Steel shoring tubes are slipped… or banged into the hole to stabilize the sides

Fill with concrete

- When the caisson reaches it's design depth, a funnel is placed at the top of the shoring. The funnel is connected to a fabric chute which keeps the concrete fill consolidated until it hits bottom.
- The shoring tubes are pulled up as the concrete is placed, allowing them to be re-used.

A pinch of steel at the top

- The upper portion of the caisson is often reinforced with steel to keep the sides from fracturing under heavy column loading
- The finished caisson gives few visual clues about it's overall height, in this case, 110 feet

Caissons - drilled piers

- Uses drilling rig with drill bits up to 7 feet diameter, can drill to depths of 200 feet.
- Low vibration process - doesn't rattle the neighbors
- Needs sleeves to prevent cave in until filled with concrete.

Caissons
Relative costs (each)

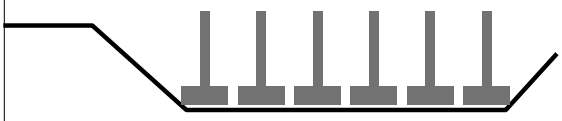
– 50 foot long, 2 foot dia (stable soil)
$2,200.00

– 50 foot long, 2 foot dia (wet soil)
$4,250.00

– 100 foot long, 4 foot dia (stable soil)
$13,375.00

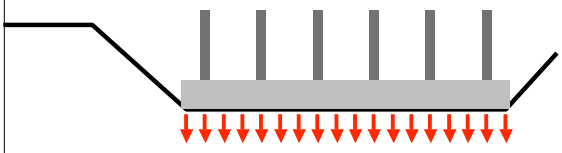
– 100 foot long, 4 foot dia (wet soil)
$17,800.00

Mat and Raft foundations



- When footings cover a large area of unstable soil, or become so large that they almost touch, a Mat foundation can be considered.

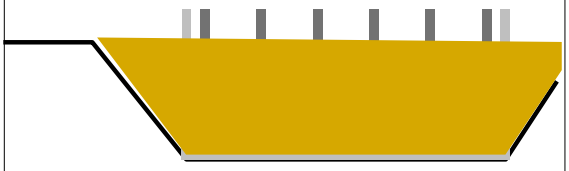
Many pads become one mat



- The mat foundation is a thick (4 to 12 feet!) pad, covering a wide area, designed and reinforced to transmit column loads to the soil uniformly

Raft Edge

Mat becomes raft



- Unstable soils having high groundwater conditions can demand an approach to foundations that adds virtually no extra weight to the soil.
- The monolithic footing and foundation shown here acts as a floating raft for the building above. When the weight of building is equal to the weight of the soil removed (displaced) by the raft, no extra weight is placed on the soil