

Why does CT use so many CIDH piles?

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Three Questions

When does Caltrans use....

...Small diameter CIDH vs. small diameter driven piles?

...Pile groups with small diameter piles vs. large diameter piles or shafts?

...CISS vs. CIDH Piles?



Who Does What?

- Geotechnical designer responsible for vertical load design (*usually controls pile length*)
- Bridge designer responsible for lateral design (*usually controls pile diameter*)
- These roles are unique to Caltrans
- Relationships are changing with LRFD design code

Integrated in LRFD Code


$$\gamma Q_i \leq \phi R_n$$

Small Diameter Driven vs. CIDH piles?

Typically a constructability decision

Design Considerations

- Driven pile are simpler/quicker to design than a CIDH pile
- Driven piles have limited penetration into bedrock where CIDH piles can be designed and constructed deep into bedrock

Construction Considerations

- Noise
- Vibration
- Fabrication
- Capacity Verification

Comparison of Pile Group & Column Shafts

- Pile groups typically used in competent soil where the lateral support of soil on the pile is substantial.
- The lateral support on small diameter piles are greatly reduced in soft or liquefiable soils.
- Seismic deformation demand generates large lateral displacements in the pile group due to liquefaction or soft soil conditions.

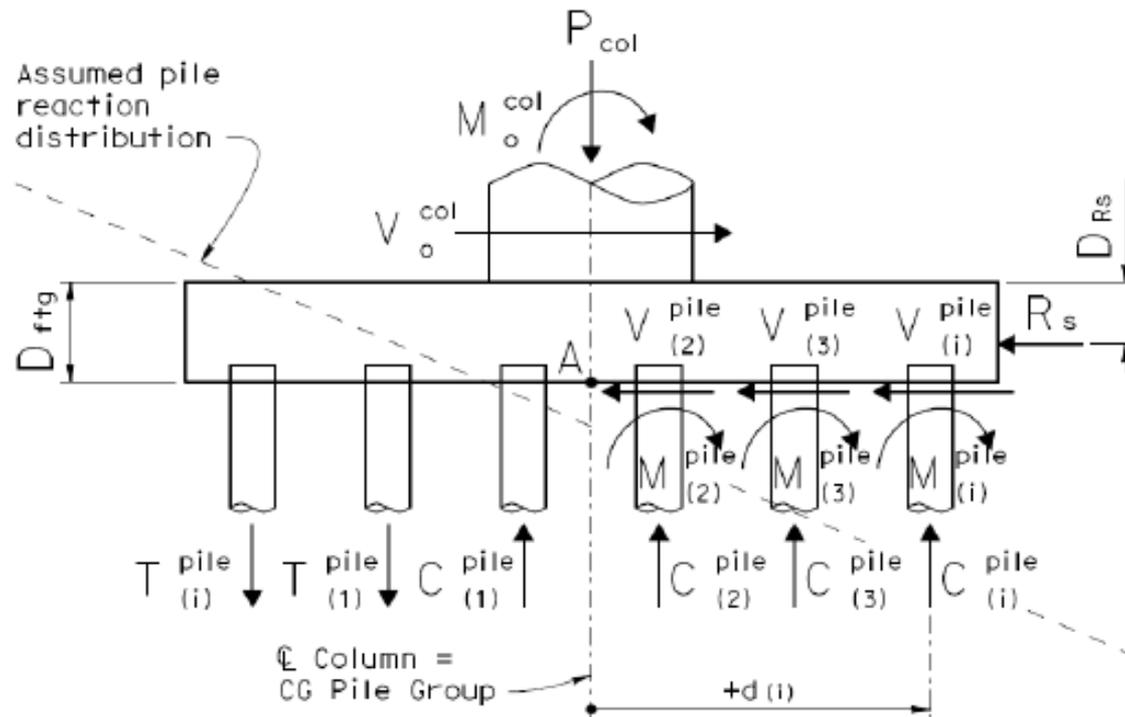
Comparison of Pile Group & Column Shafts

- Small diameter piles in a group may experience damages due to large lateral movements.
- Inspection of damage is difficult.
- Keeping damage out of the pile group and contained in the column would require the pile diameter be increased substantially, or to use large diameter column shafts.

Comparison of Pile Group & Column Shafts

- Where scour is of concern, column shafts are better than pile groups, as there is no need to deep excavation and shoring in order to place the cap below the scour depth.

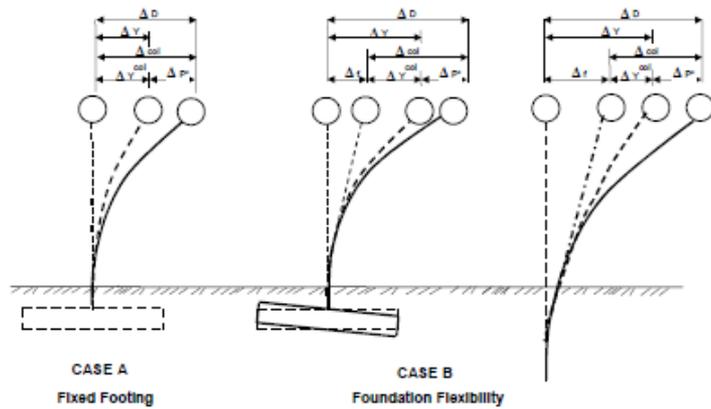
EQ 101 – Pile Cap Resistance



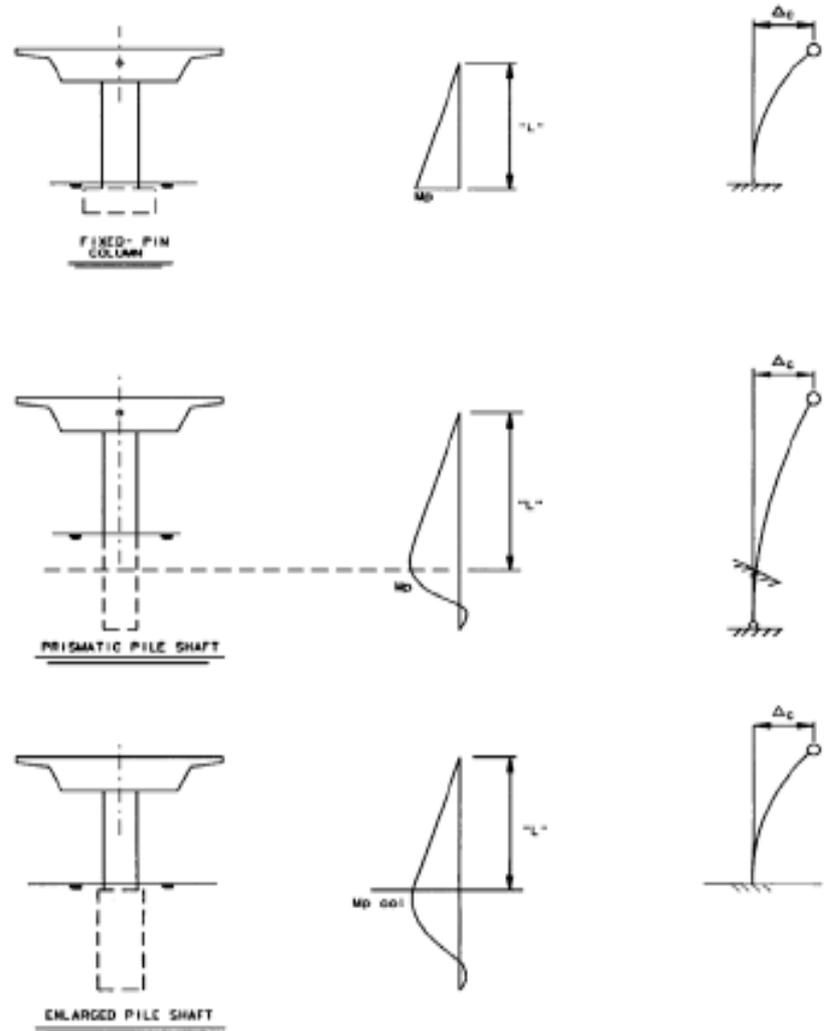
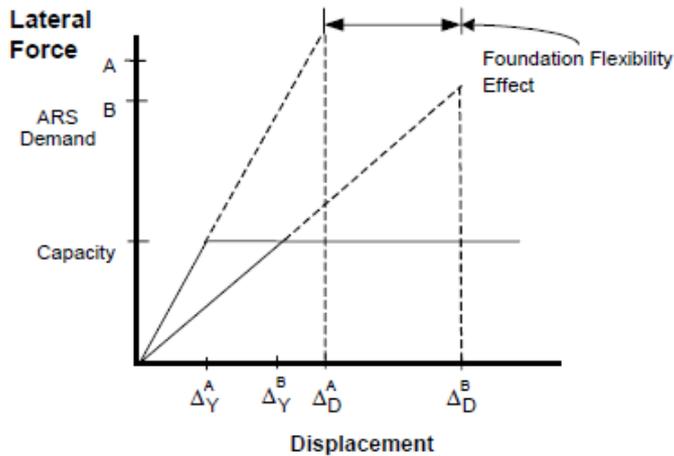
Pile shears and moments shown on right side only, left side similar
Effects of footing weight and soil overburden not shown

Figure 7.7.1-1 Footing Force Equilibrium

EQ 101-Foundation Flexibility



Note: For a cantilever column with fixed base, $\Delta_Y^{col} = \Delta_Y$
 Δ_P^* = Portion of the plastic displacement capacity Δ_P



EQ 101 - Column Ductility

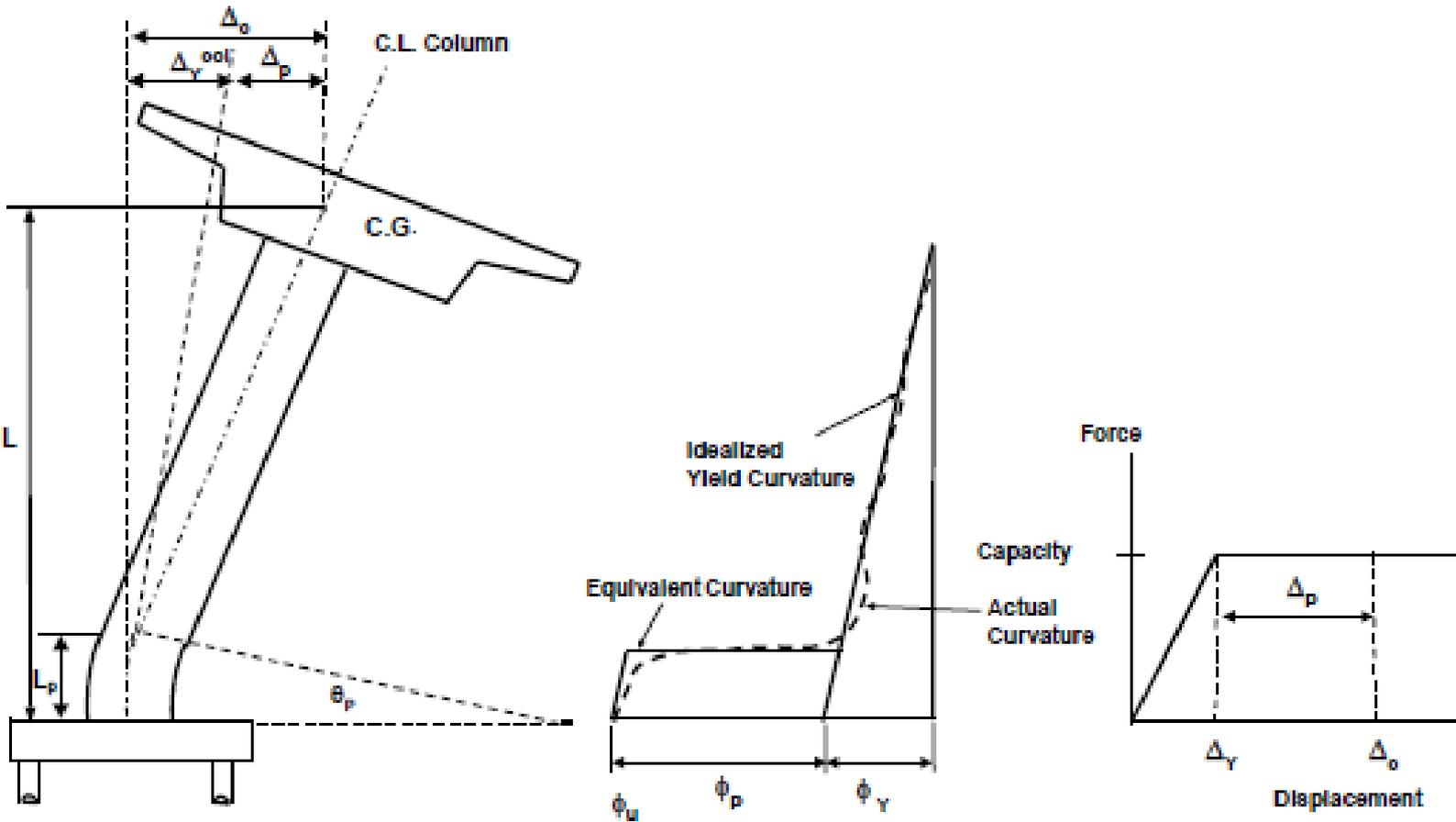


Figure 3.1.3-1 Local Displacement Capacity – Cantilever Column with Fixed Base

Comparison of CISS & CIDH Piles

- CISS piles and CIDH piles with permanent casing provide higher stiffness than CIDH piles without casing.
- Environmental constraints such as limitations on vibration and noise levels limit the use of the CISS option.
- Often CISS piles need rock sockets to provide enough skin friction for geotechnical capacity.
- Shear design of rock sockets is very challenging, specially considering the higher chances of construction anomaly in that portion of the shaft.

Ongoing Pile Improvement Efforts

- Pile shaft research
 - Shortening cage over lap in Type II shafts
 - Composite behavior for cased pile shafts
 - Flowability of concrete in pile shafts
- Standardizing large diameter pile cross sections
- Project Risk Management/Quality Management
 - Constructability Reviews
 - Foundation Recommendations will consider risk evaluation