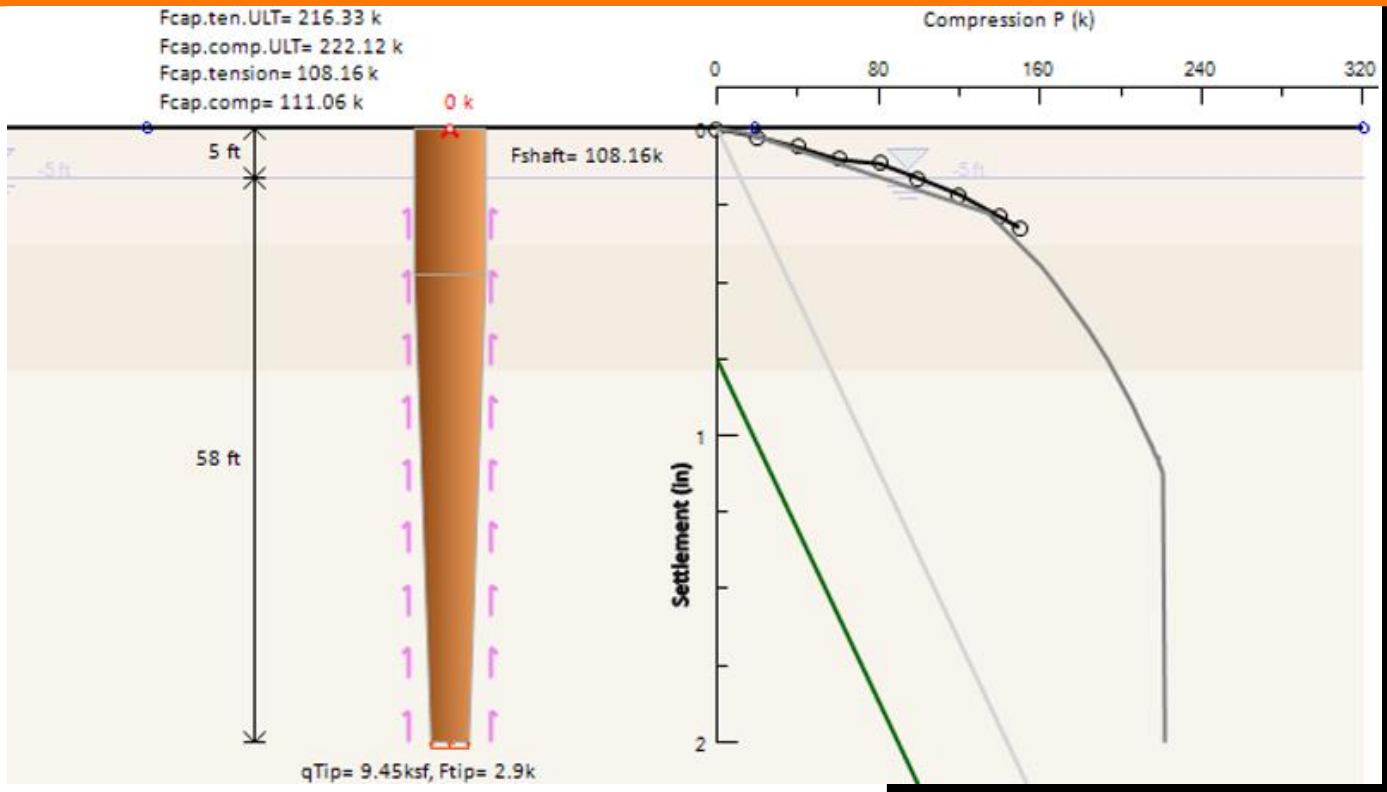
DEEP EXCAVATION

GEOTECHNICAL SOFTWARE & ENGINEERING

Axial Load Tests on Different Driven Pile Types

Axial Load Test Records – Settlements Prediction And Measured Values



DeepFND
Foundation Piles
Design Software

HelixPile
Helical Piles
Design Software

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INTRODUCTION: DEEPFND – FOUNDATION PILES DESIGN SOFTWARE HELIXPILE – HELICAL PILES DESIGN SOFTWARE

DeepFND and HelixPile are two similar, powerful software programs for the design and evaluation pile foundations. The programs can perform structural and geotechnical, lateral, and axial analysis of any foundation pile (single piles, pile groups and pile rafts).

The only difference between the two programs is the available pile types. DeepFND can design all pile sections and pile types (helical and non-helical – drilled, driven, caissons, micropiles, CFA piles and more), whereas HelixPile can design only helical piles.

Available Helical Pile Types (Both Programs): Steel pipes, Square solid and square hollow piles with unlimited helical plate configurations.

Available Non-Helical Pile Types (DeepFND Only): Circular, rectangular, circular Hollow, Octagon, Reinforced Concrete Piles, Steel Beams (Pipes, H Beams, Rectangular Hollow Sections, Channel Sections), Composite Sections, Belled Bottom Piles, Timber Piles (Wood) and more.

Pile Installation Methods: Helical Piles, Drilled, Driven, Caissons, Micropiles, Continuous Flight Auger (CFA Piles), Drilled-In-Displacement Piles.

Analysis Methods: Vesic 1974, Meyerhoff/Hansen, Eurocode 7, Spangler/Handy, Brinch/Hansen and more.

Bearing Capacity Equations: General and Helicap Equations (Helical Piles), FHWA GEC8 (CFA Piles), GEC10 (Drilled Piles), AASHTO-Norlund (Driven Piles) and more.

Lateral Pile Methods and PY Soil Models: Exact lateral loads or pushover analysis. Implemented PY Models: API and Reese Models (Sands), Soft and Stiff Models (Clays), Weak Model (Rocks).

Settlements and Pile Criteria: Option to perform settlement analysis and calculate structural capacities from pile acceptance criteria (Davisson's, Butler-How, NYC code and more).

Structural Codes: ACI, AISC. ASD, LRFD, EUROCODES 2, 3 and 8, AS, CN and more.

Geotechnical Codes: AASHTO LRFD, EUROCODE 7, CN, DIN, BSEN and more.

Printed Reports: Reports exported in PDF and Word

Model Creation: Graphical (interactive interface), model wizard.

DeepFND Features and Capabilities

DeepFND is a powerful software for the design and analysis of any pile type. Perform Structural and Geotechnical design of any pile (Single Piles, Pile Groups and Pile Rafts), Lateral and Vertical Analysis of piles in a unique software package!

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HelixPile Features and Capabilities

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A. INTRODUCTION TO THE CASE STUDY – SOIL PROPERTIES

The purpose of this document is to examine the DeepFND software pile settlements prediction for driven piles in clay, in comparison with axial load tests, performed on different pile types. Static compression load tests were performed on steel pipes (Case 1), on a rectangular concrete pile (Case 2) and on a tapered timber pile (Case 3), that were driven at the site. The measured pile capacities from the static load tests were compared to predicted pile capacities from the software program DeepFND.

The stratigraphy in the load tests area consists of medium stiff to very stiff, overconsolidated clays. Figure 1 presents the undrained shear strength measurements that were obtained using the laboratory unconfined compression (UC) test and field vane shear test (VST). Table 1 and Table 2 below present the soil properties and stratigraphy that has been estimated and used within the DeepFND software for the load test simulation.

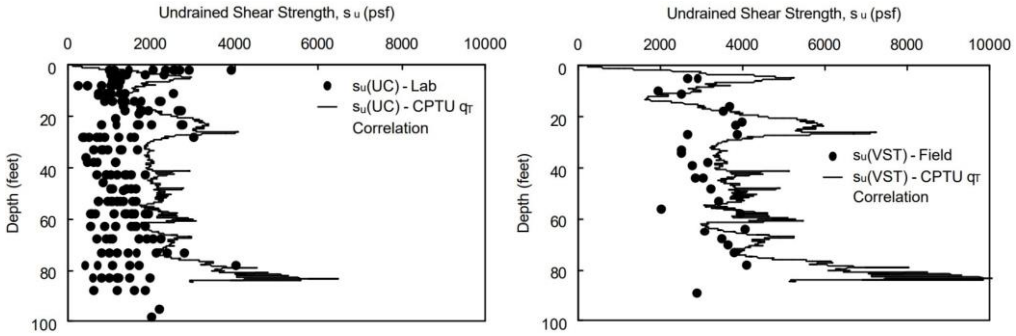

Figure 1: Laboratory values of Su (UC) and Su (VST) and Comparison with the CPTU Estimation

Table 1: Soil properties.

Soil Layer	Soil Type	General properties						
		ϕ' (deg)	Su (psf)	γ (pcf)	γ_{dry} (pcf)	E_{LOAD} (ksf)	E_{RELOAD} (ksf)	e50
C1	Stiff Clay	-	2400	122	122	1110	3330	0.055
C2	Very Stiff Clay	-	3500	128	128	1700	5100	0.005
C3	Stiff Clay	-	2100	121	121	1030	3090	0.006

Table 2: Stratigraphy.

Soil Layer	Elevation (ft)	OCR	Ko
C1	0	2	0.751
C2	-12	3	0.92
C3	-25	3	0.92

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B. DEEPFND SOFTWARE – SOIL TYPES AND BORINGS

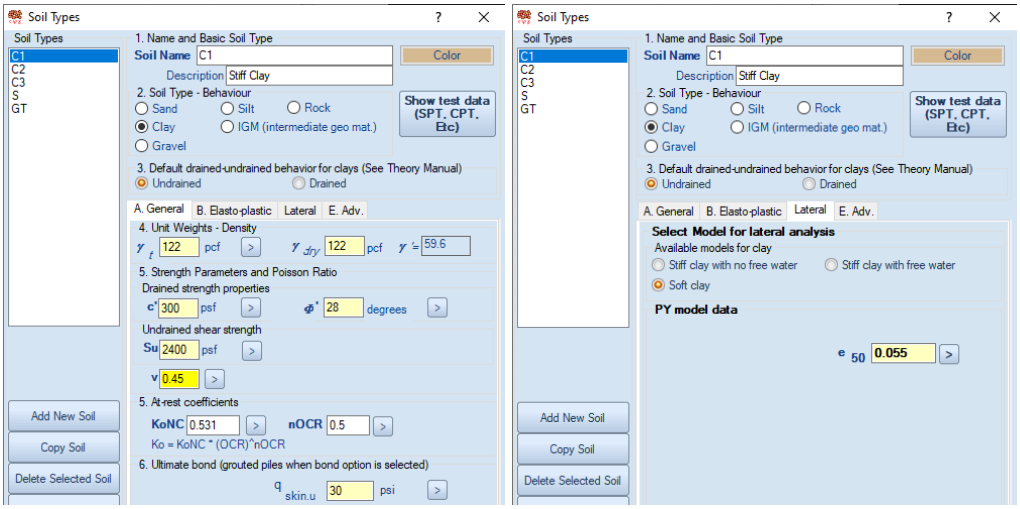

Figure 2: General soil properties – Top Clay Layer (Soil C1)

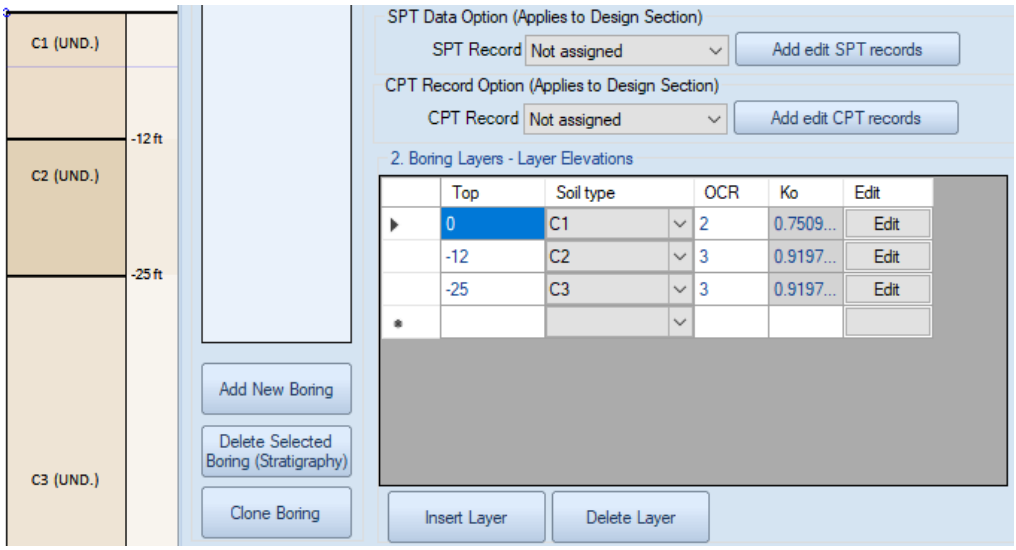

Figure 3: Soil Layers

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C.1. CASE 1: DRIVEN STEEL PIPE PILES – PILE SECTION PROPERTIES

The load tests were conducted on steel pipes (PP14x0.281 , Fy = 45 ksi), driven to 53.5 ft depth. The pipes were taped with steel plates. Figures 2 and 3 present the pile type and length, and the pile section properties respectively.

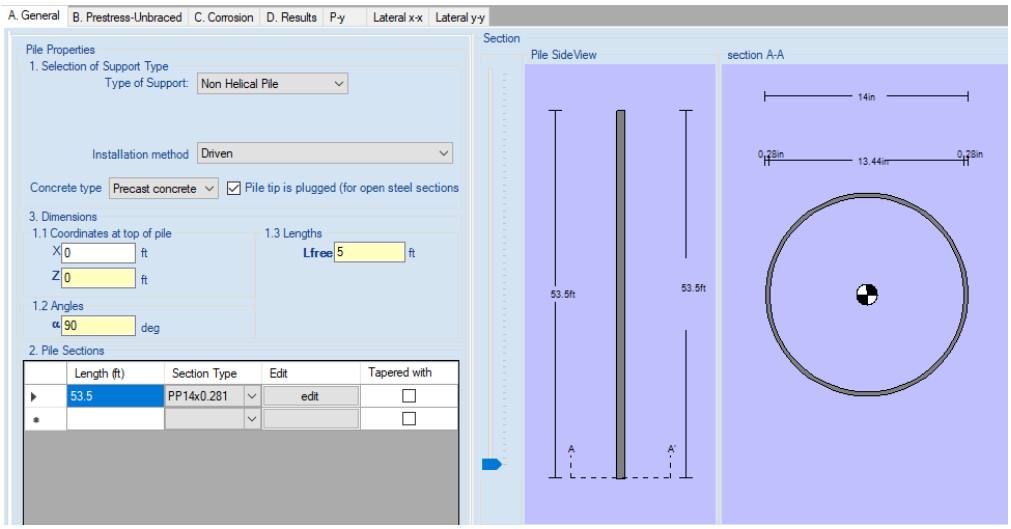


Figure 3: Pile Type, Position and Dimensions

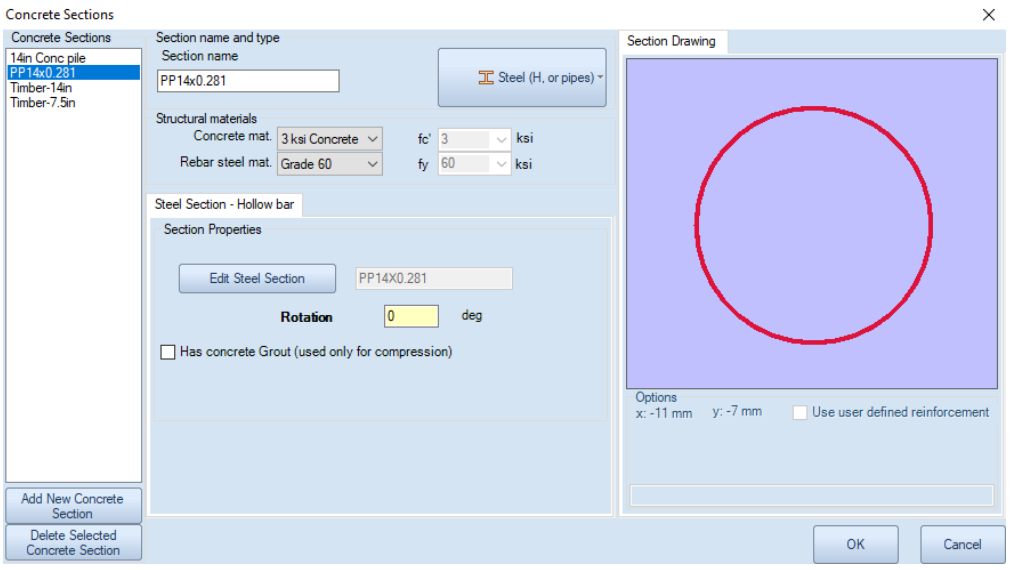
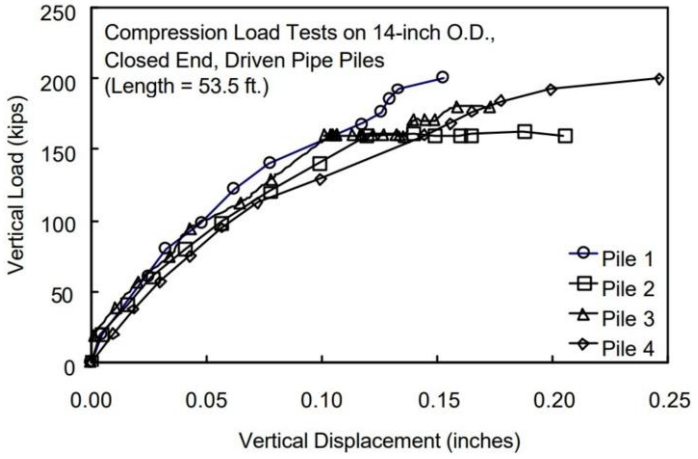


Figure 4: Pile Section Properties

C.2. CASE 1: AXIAL LOAD TEST AND SOFTWARE SETTLEMENTS ESTIMATION

Figure 4 presents the axial load test results for each one of the 4 piles. Figure 5 presents the DeepFND estimated settlements, in comparison to the axial load test for the examined Pile 3.



Steel Pipe 3	
Load (kips)	DZ (in)
0	0
20	0.004
40	0.014
60	0.025
80	0.031
100	0.05
120	0.065
140	0.08
160	0.109
180	0.155

Figure 4: Axial Load Test Results on 14-inch Steel Pipes

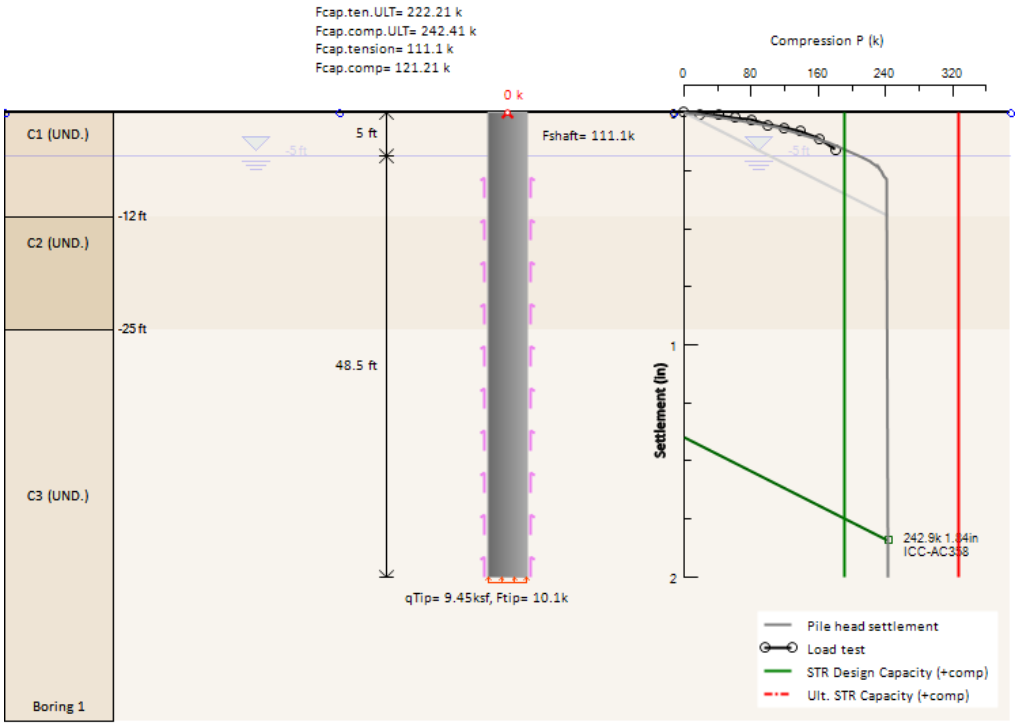


Figure 5: DeepFND Pile Settlements and Load Test for Pile 3 (Steel Pipe PP14x0.281)

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D.1. CASE 2: DRIVEN CONCRETE PILES – PILE SECTION PROPERTIES

A load test was conducted on a concrete pile (14in x 14in Rectangular RC section), driven to 82 ft depth. Figures 6 and 7 present the pile type and length, and the pile section properties respectively.

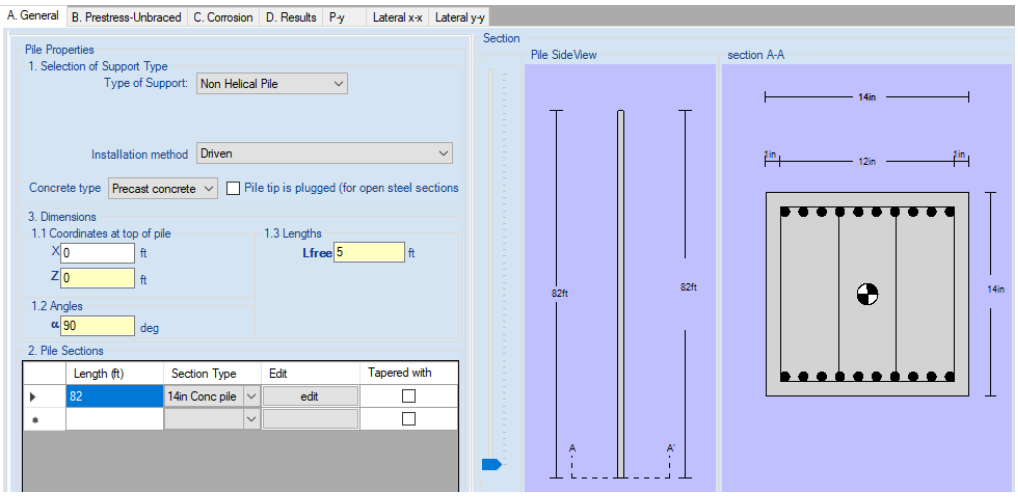

Figure 6: Pile Type, Position and Dimensions

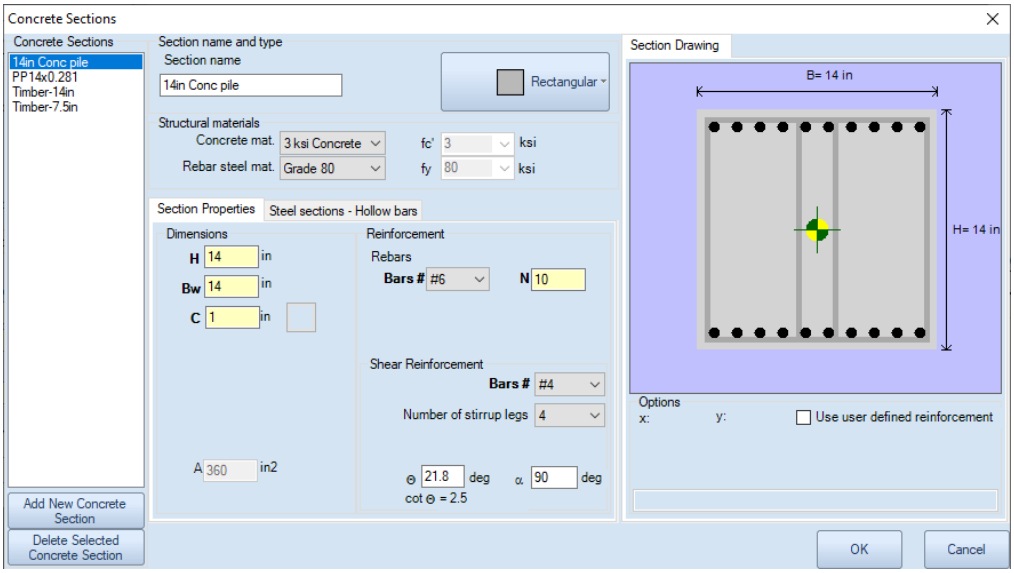

Figure 7: Pile Section Properties

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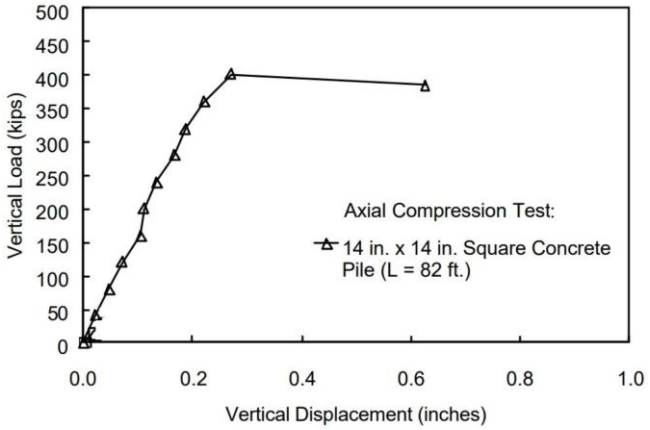
D.2. CASE 2: AXIAL LOAD TEST AND SOFTWARE SETTLEMENTS ESTIMATION

Figure 8 presents the axial load test results for the concrete pile. Figure 9 presents the DeepFND estimated settlements, in comparison to the axial load test for the examined concrete pile.



Rectangular Concrete Pile	
Load (kips)	DZ (in)
0	0
50	0.029
100	0.061
150	0.099
200	0.114
250	0.144
300	0.179
350	0.216
400	0.273

Figure 8: Axial Load Test Results on the rectangular Concrete Pile

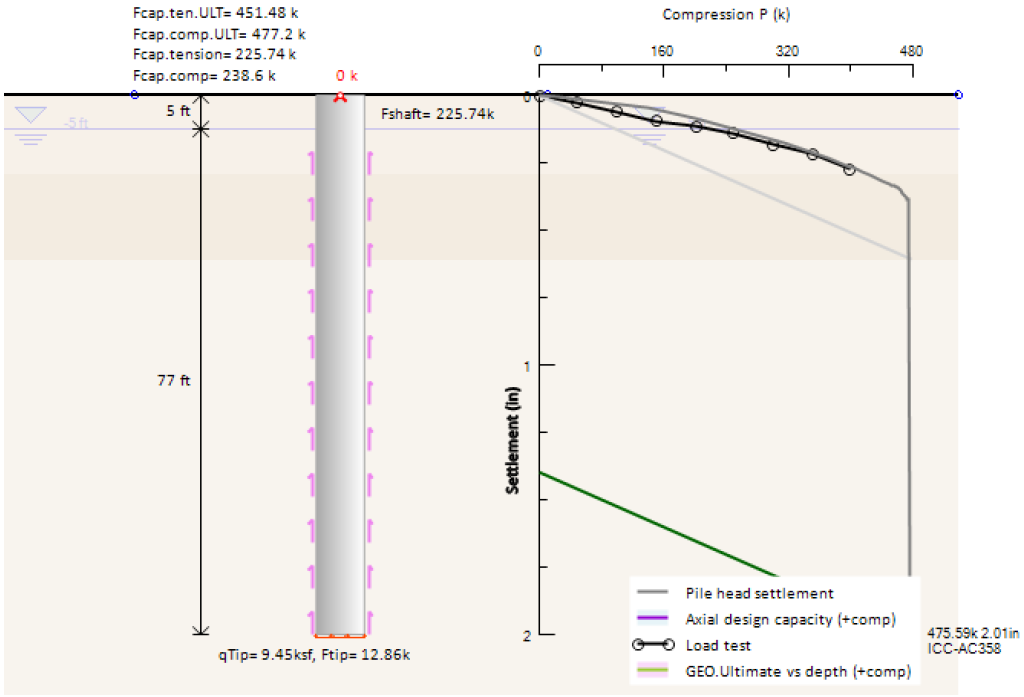


Figure 9: DeepFND Pile Settlements and Load Test for examined Concrete Pile

E.1. CASE 3: DRIVEN TAPERED DRIVEN PILES – PILE SECTION PROPERTIES

A load test was conducted on a tapered timber pile (14in to 7.5in Timber section), driven to 63 ft depth. Figures 10 and 11 present the pile type and length, and the pile section properties respectively.

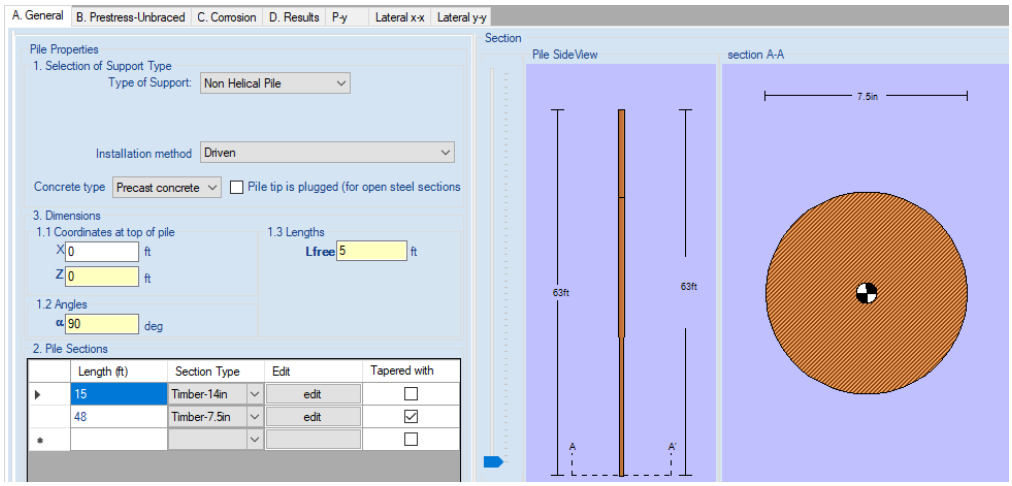


Figure 10: Pile Type, Position and Dimensions

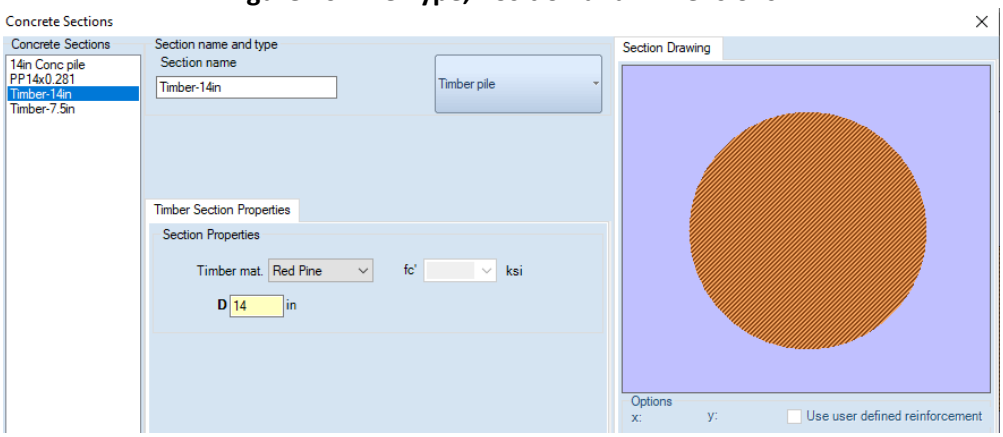


Figure 11.1: Pile Section Properties (14in Timber Pile)

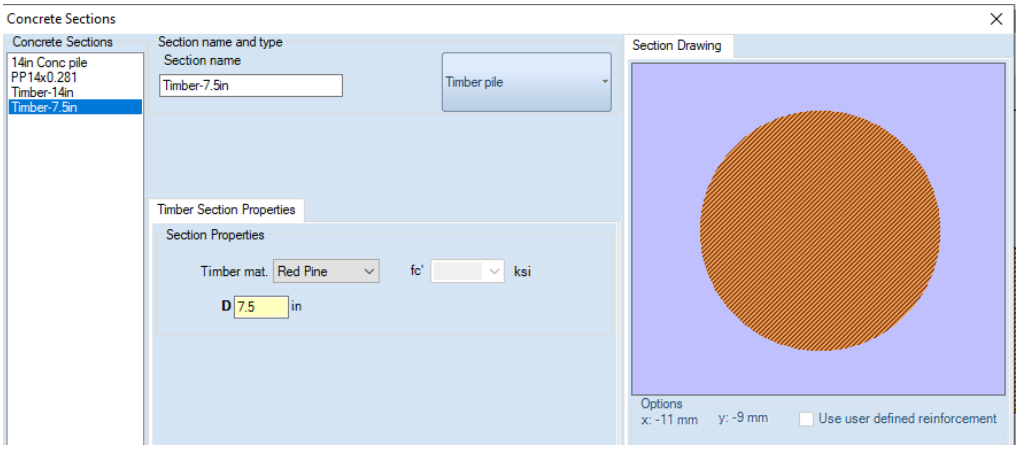
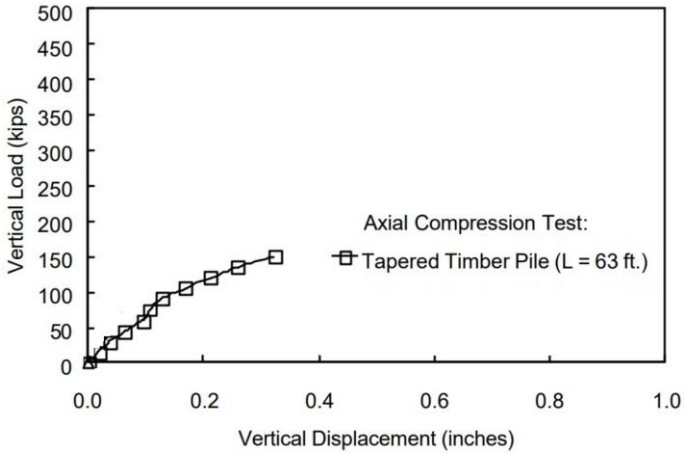


Figure 11.1: Pile Section Properties (7.5in Timber Pile)

E.2. CASE 3: AXIAL LOAD TEST AND SOFTWARE SETTLEMENTS ESTIMATION

Figure 12 presents the axial load test results for the timber pile. Figure 13 presents the DeepFND estimated settlements, in comparison to the axial load test for the examined timber pile.



Tapered Timber Pile	
Load (kips)	DZ (in)
0	0
20	0.029
40	0.063
60	0.099
80	0.116
100	0.16
120	0.215
140	0.286
150	0.324

Figure 12: Axial Load Test Results on the tapered Timber Pile

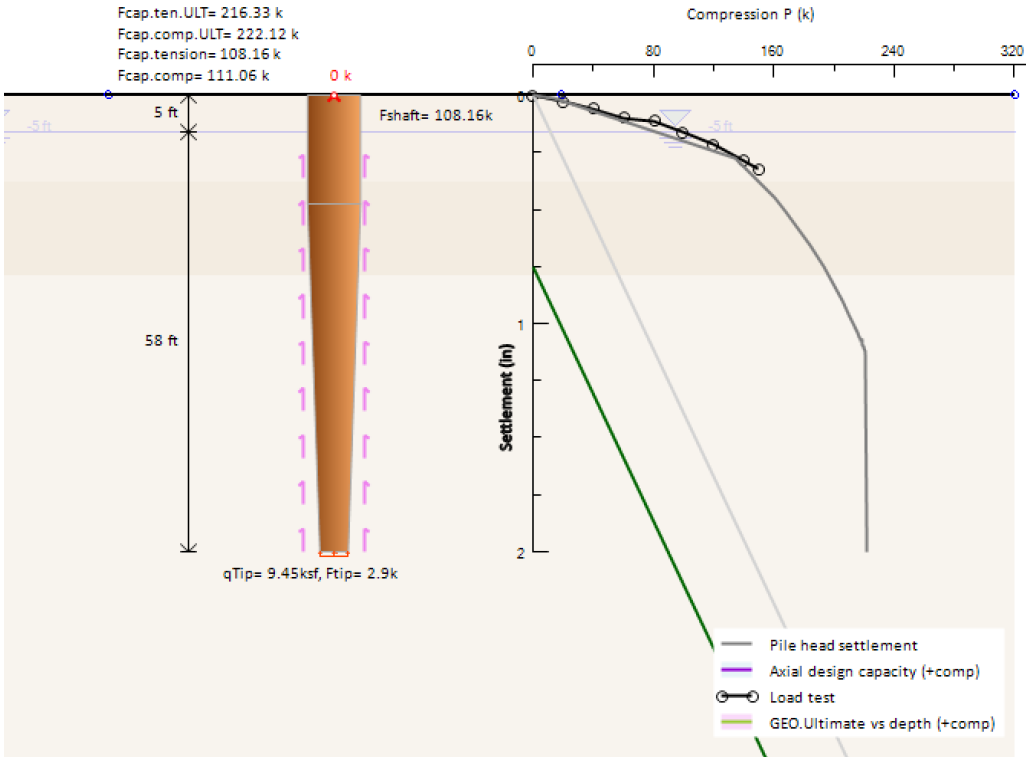


Figure 13: DeepFND Pile Settlements and Load Test for examined Timber Pile

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