Index D22600 Series Carbon Fiber Reinforced Polymer (CFRP) Concrete Piles

Design Criteria

ACI 440.4R-04; AASHTO LRFD Bridge Design Specifications, 6th Edition; Structures Design Guidelines (SDG); Structures Detailing Manual (SDM)

Design Assumptions and Limitations

Developmental Design Standard Index D22600 is the lead standard for the Square CFRP Prestressed Concrete Pile standard series which includes Developmental Design Standard Indexes D22600 through D22624. Use this standard with Developmental Design Standard Indexes D22601, D22614, and D22624.

Standard piles are designed to have 1,000 psi uniform compression after prestress losses without any applied loads to offset tensile stresses that occur during typical driving. The modulus of elasticity of each strand type used in the indexes can be found below.

Table 1 Strand Modulus of Elasticity

CFRP Strand Diameter	Modulus of Elasticity
0.5"	18,000 ksi
0.6"	22,481 ksi

The piles are designed to have 0.0 psi tension using a load factor of 1.5 times the pile self-weight during pick-up, storage and transportation as shown in the "Table of Maximum Pile Pick-Up and Support Lengths" on the standard.

Plan Content Requirements

Insert the entire ***Developmental Design Standards*** Index, received from the Central Office monitor, into the appropriate component plan set in accordance with ***PPM***, Volume 2, Section 3.8.

In the Structures Plans:

Show and label the piles on the Foundation Layout, End Bent, Intermediate Bent, Pier, Footing, Typical Section and other sheets as required.

Complete the following "Data Table", using the "20600 Pile Data Table" cell, in accordance with ***SDG*** 3.5 and ***SDM*** 11.4 and include it in the contract plans with the "Foundation Layout" sheets. Modify table and notes as required to accommodate the required number of piles, piers and/or bents, use of Test Piles and instrumentation. When not enough space is available on one plan sheet, continuations of the Data Table and/or separate pile cut-off elevation tables are acceptable. See Introduction I.3 for more information regarding use of Data Tables.

For projects without Test Piles change data table column heading "TEST PILE LENGTH (ft.)" to "PILE ORDER LENGTH (ft.)".

PILE DATA TABLE																									Table Date 01/01/12
INSTALLATION CRITERIA								DESIGN CRITERIA									PILE CUT-OFF ELEVATIONS								
PIER or BENT NUMBER	PILE SIZE (in.)	NOMINAL BEARING RESISTANCE (tons)	NOMINAL UPLIFT RESISTANCE (tons)	MINIMUM TIP ELEVATION (ft.)	TEST PILE LENGTH (ft.)	REQUIRED JET ELEVATION (ft.)	REQUIRED PREFORM ELEVATION (ft.)	FACTORED DESIGN LOAD (tons)	FACTORED DESIGN UPLIFT LOAD (tons)	DOWN DRAG (tons)	TOTAL SCOUR RESISTANCE (tons)	NET SCOUR RESISTANCE (tons)	100-YEAR SCOUR ELEVATION (ft.)	LONG TERM SCOUR ELEVATION (ft.)	Ø COMPRESSION	Ø UPLIFT	PILE 1	PILE 2	PILE 3	PILE 4	PILE 5	PILE 6	PILE 7	PILE 8	PILE 9

$$\frac{\text{Factored Design Load} + \text{Net Scour Resistance} + \text{Down Drag}}{\text{Ø}} \leq \text{Nominal Bearing Resistance}$$

TENSION RESISTANCE – The ultimate side friction capacity that must be obtained below the 100 year scour elevation to resist pullout of the pile (Specify only when design requires tension capacity).

TOTAL SCOUR RESISTANCE – An estimate of the ultimate static side friction resistance provided by the scourable soil.

NET SCOUR RESISTANCE – An estimate of the ultimate static side friction resistance provided by the soil from the required preformed or jetting elevation to the scour elevation.

100-YEAR SCOUR ELEVATION – Estimated elevation of scour due to the 100 year storm event.

LONG TERM SCOUR ELEVATION – Estimated elevation of scour used in design for extreme event loading.

PILE INSTALLATION NOTES [Notes Date 7-01-13]:

Contractor to verify location of all utilities prior to any pile installation activities.

Minimum Tip Elevation is required for lateral stability.

When a required jetting elevation is shown, the jet shall be lowered to the elevation and continue to operate at this elevation until the pile driving is completed. If jetting or preforming elevations differ from those shown on the table, the Engineer shall be responsible for determination of the required driving resistance.

No jetting will be allowed without the approval of the Engineer.

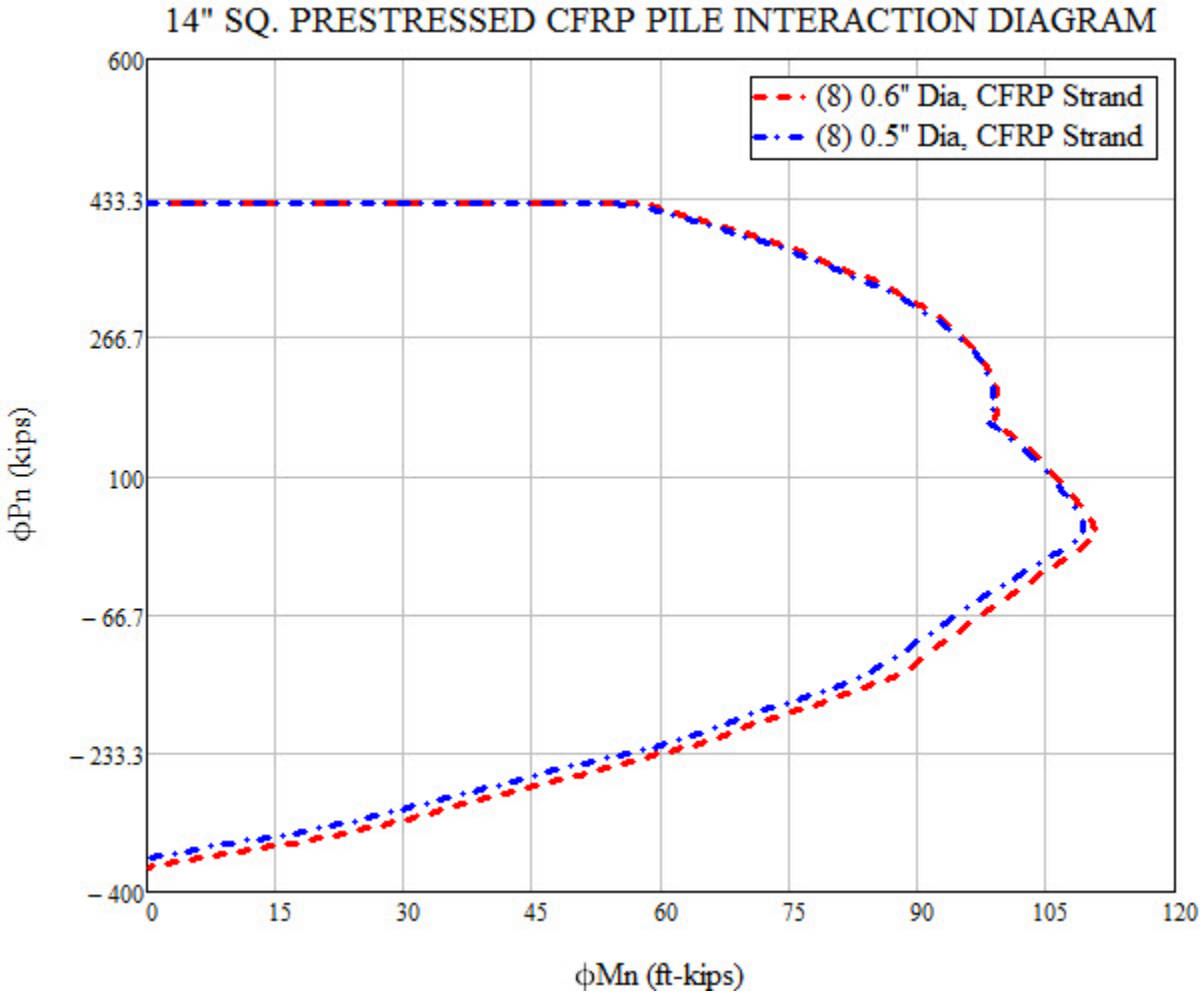
The Contractor should not anticipate being allowed to jet piles below the 100-year scour elevation or required jet elevation, whichever is deeper.

At each Bent, pile driving is to commence at the center of the Bent and proceed outward.

Payment

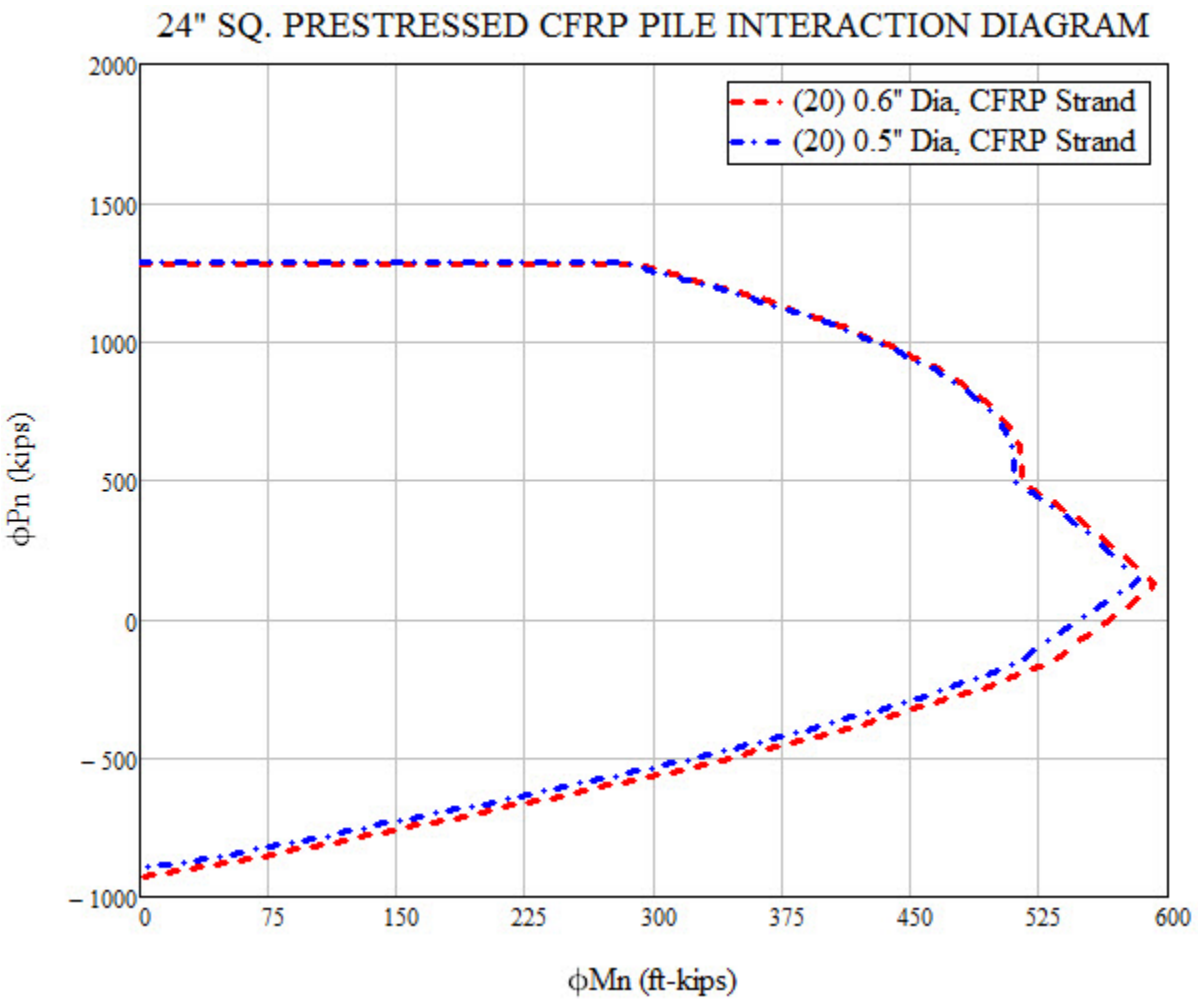
Item number	Item description	Unit Measure
455-34-AA	Prestressed Concrete Piling	LF

Design Aids



Design Assumptions:

- Concrete compressive strength f'c = 6 ksi.
- Modulus of elasticity of prestressing strands, See Table 1.
- Resistance factor Φ based on ACI 440.4R-04
  (0.65 compression controlled, 0.85 tension controlled)
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Developmental Design Standard Index 22614.



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- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Developmental Design Standard Index 22624.