Index 455-101 Series Square CFRP & SS Prestressed Concrete Piles

Design Criteria

AASHTO LRFD Bridge Design Specifications; ***Structures Detailing Manual (SDM)***; ***Structures Design Guidelines (SDG)***; ***Fiber Reinforced Polymer Guidelines (FRPG)***

Design Assumptions and Limitations

Index 455-101 is the lead standard for the Square CFRP & SS Prestressed Concrete Pile standard series which includes Indexes 455-101 through 455-130. Use this standard with Indexes 455-102, 455-003, 455-112, 455-114, 455-118, 455-124 and 455-130.

Standard piles are designed to have 1000 psi uniform compression after prestress losses without any applied loads to offset tensile stresses that occur during typical driving.

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

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" 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 ***FDM* 115** 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 01/01/16

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.)	Ø COMPRESSION	Ø UPLIFT	PILE 1	PILE 2	PILE 3	PILE 4	PILE 5	PILE 6	PILE 7

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

UPLIFT 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 uplift 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.

PILE INSTALLATION NOTES (Notes Date 11-01-20):

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.

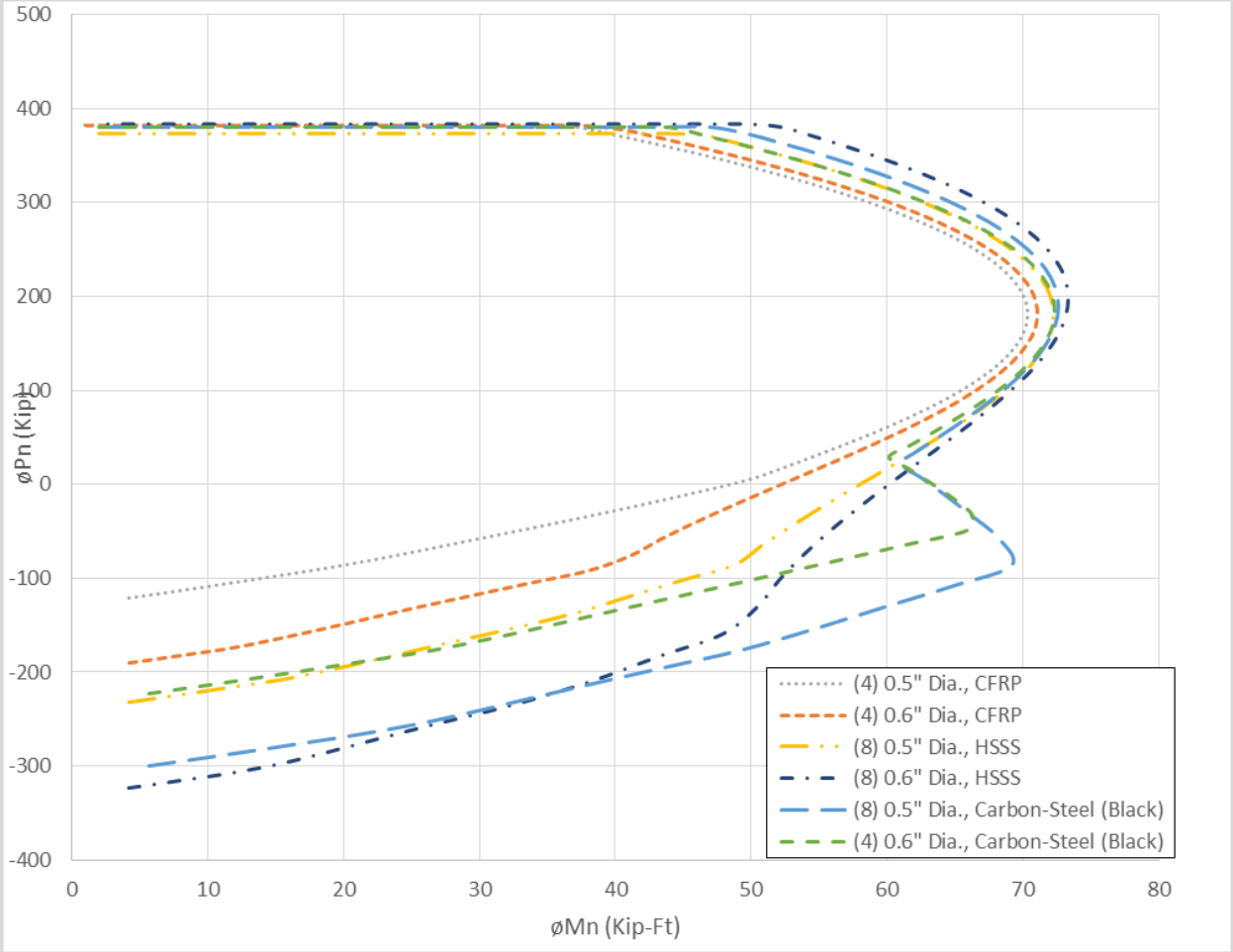
For pile groups, pile driving is to commence at the center of the group and proceed outward.

When using embedded guages for dynamic testing, tip guages are required in 10% of the piles, minimum 1 per bent or pile footing.

Payment

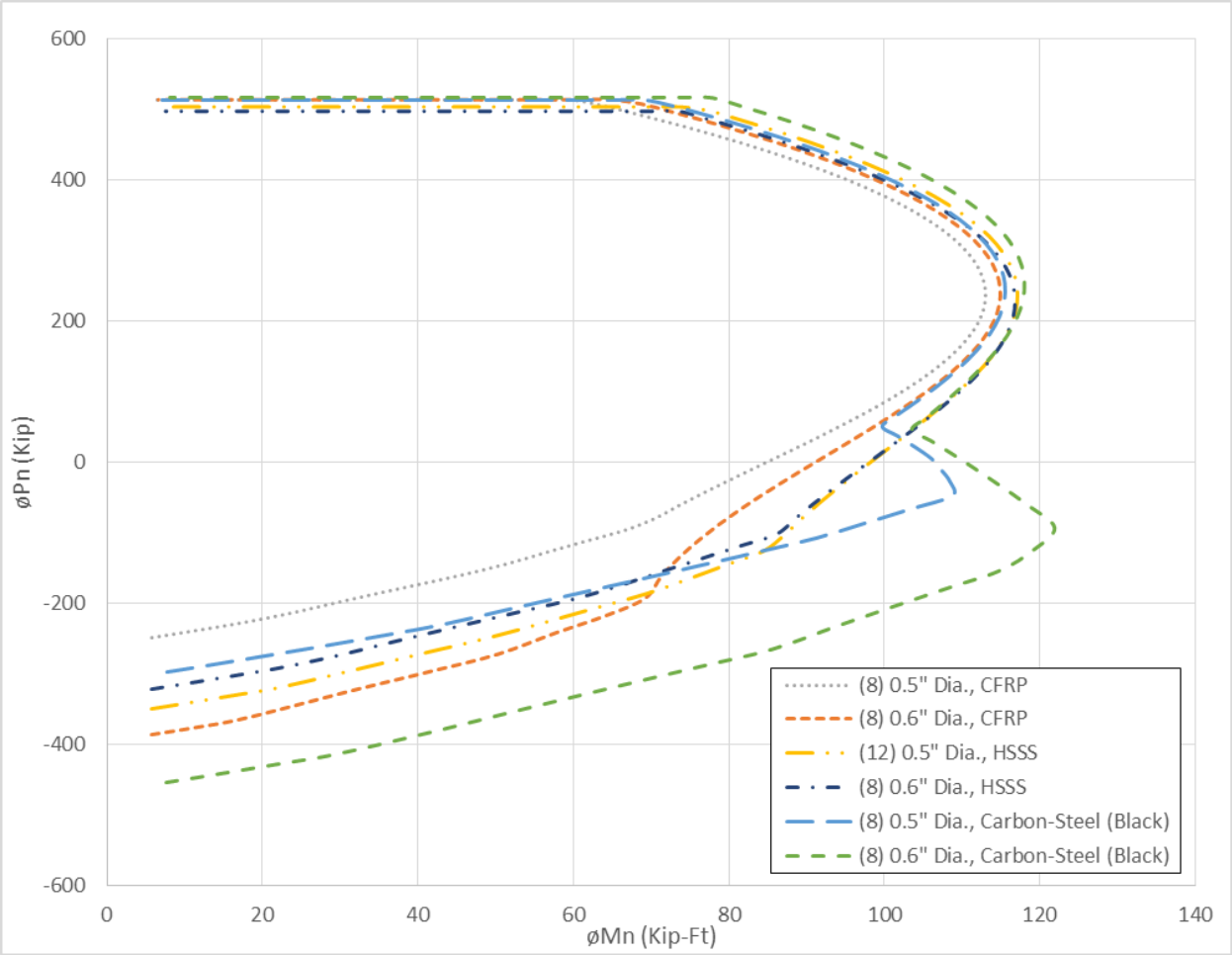
Item number	Item Description	Unit Measure
455-34-ABB	Prestressed Concrete Piling (CFRP or SS)	LF

Design Aids



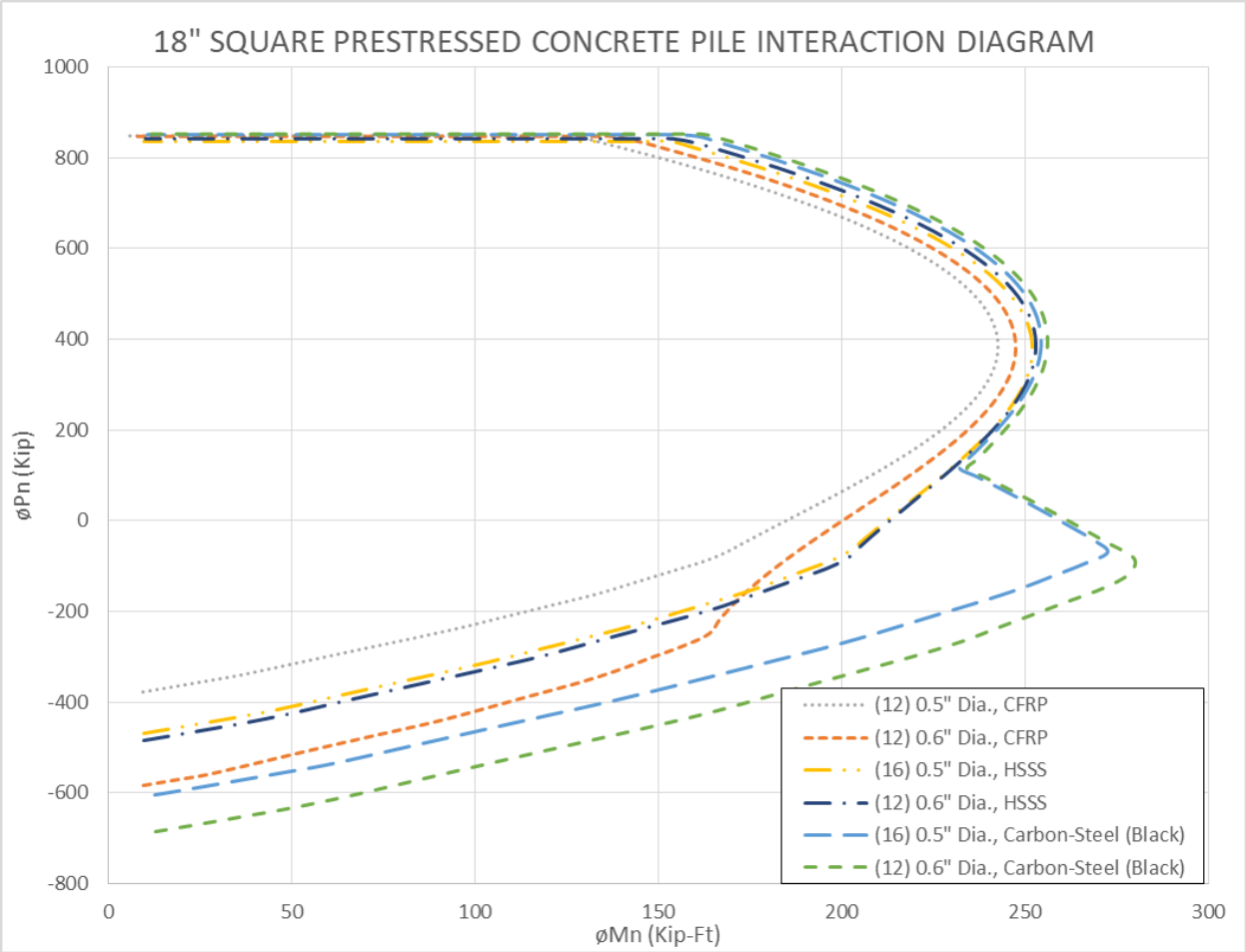
Design Assumptions:

- Concrete compressive strength (f_c') = 6 ksi.
- Modulus of elasticity of prestressing strands, E_p= 18,000 ksi (1/2” CFRP), 22,480 ksi (0.6” CFRP) 23,500 ksi (HSSS) and 28,500 ksi (Carbon Steel).
- Resistance Factors (ǿ) based on ACI 440.4R for CFRP strands, (0.75 compression controlled, 0.75 tension controlled); AASHTO LRFD 5.5.4.2.1 for Carbon Steel strands (0.75 compression controlled, 1.0 tension controlled); and SDG guidelines for HSSS strands (0.75 compression and 0.75 tension controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond to those indicated in Index 455-112 for CFRP and HSSS and Index 455-012 for Carbon Steel.



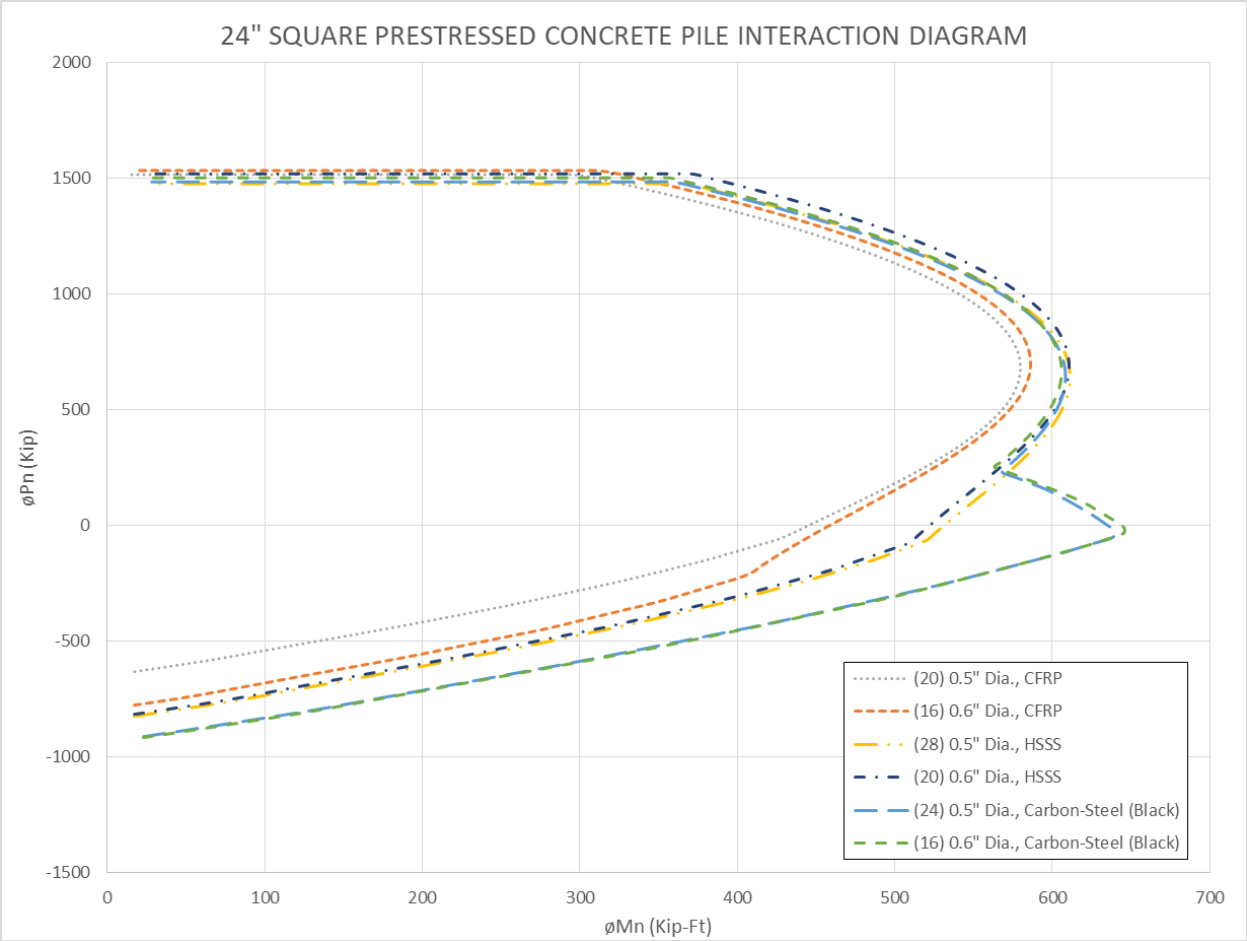
Design Assumptions:

- Concrete compressive strength (f_c') = 6 ksi.
- Modulus of elasticity of prestressing strands, E_p= 18,000 ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP) 23,500 ksi (HSSS) and 28,500 ksi (Carbon Steel).
- Resistance Factors (ǿ) based on ACI 440.4R for CFRP strands, (0.75 compression controlled, 0.75 tension controlled); AASHTO LRFD 5.5.4.2.1 for Carbon Steel strands (0.75 compression controlled, 1.0 tension controlled); and SDG guidelines for HSSS strands (0.75 compression and 0.75 tension controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond to those indicated in Index 455-114 for CFRP and HSSS and Index 455-014 for Carbon Steel.



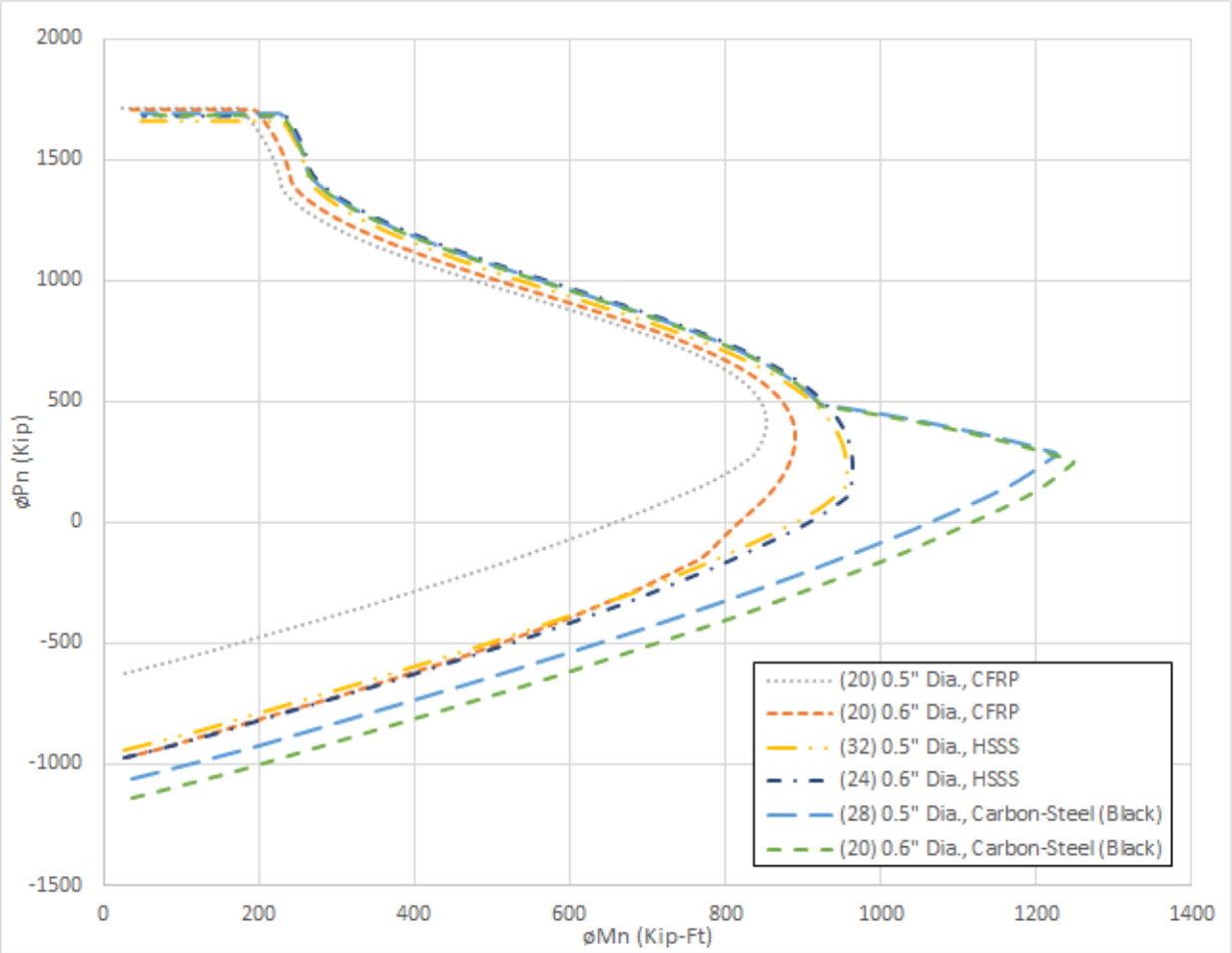
Design Assumptions:

- Concrete compressive strength (f_c') = 6 ksi.
- Modulus of elasticity of prestressing strands, E_p= 18,000 ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP) 23,500 ksi (HSSS) and 28,500 ksi (Carbon Steel).
- Resistance Factors (ǿ) based on ACI 440.4R for CFRP strands, (0.75 compression controlled, 0.75 tension controlled); AASHTO LRFD 5.5.4.2.1 for Carbon Steel strands (0.75 compression 0.75 controlled, 1.0 tension controlled); and SDG guidelines for HSSS strands (0.75 compression and tension controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond to those indicated in Index 455-118 for CFRP and HSSS and Index 455-018 for Carbon Steel.



Design Assumptions:

- Concrete compressive strength (f_c') = 6 ksi.
- Modulus of elasticity of prestressing strands, E_p= 18,000 ksi (1/2” CFRP), 22,480 ksi (0.6” CFRP) 23,500 ksi (HSSS) and 28,500 ksi (Carbon Steel).
- Resistance Factors (ǿ) based on ACI 440.4R for CFRP strands, (0.75 compression controlled, 0.75 tension controlled); AASHTO LRFD 5.5.4.2.1 for Carbon Steel strands (0.75 compression 0.75 controlled, 1.0 tension controlled); and SDG guidelines for HSSS strands (0.75 compression and tension controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond to those indicated in Index 455-124 for CFRP and HSSS and Index 455-024 for Carbon Steel.



Design Assumptions:

- Concrete compressive strength (f_c') = 6 ksi.
- Modulus of elasticity of prestressing strands, E_p= 18,000 ksi (1/2” CFRP), 22,480 ksi (0.6” CFRP) 23,500 ksi (HSSS) and 28,500 ksi (Carbon Steel).
- Resistance Factors (ǿ) based on ACI 440.4R for CFRP strands, (0.75 compression controlled, 0.75 tension controlled); AASHTO LRFD 5.5.4.2.1 for Carbon Steel strands (0.75 compression controlled, 1.0 tension controlled); and SDG guidelines for HSSS strands (0.75 compression and 0.75 tension controlled).
- All piles assumed to have spiral ties.
- Strand sizes and strand patterns used to create interaction curves correspond to those indicated in Index 455-130 for CFRP and HSSS and Index 455-030 for Carbon Steel.