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.)".
# Standard Plans Instructions

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

**Topic No. 625-010-003**  
**FY 2020-21**

## Pile Data Table

|---------------------|----------------|----------------------------------|---------------------------------|-------------------------------|----------------------|---------------------------|----------------------------|---------------------------|-------------------------------|-------------------------------|----------------------------|-----------------------------|-----------------------------|---------------------|--------|--------|--------|--------|--------|--------|--------|

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**Uplift Resistance** - The ultimate pile friction capacity that must be obtained below the 100-year flood elevation to resist uplift of the pile (usually 1 in. when design resistance uplift capacity).  
**Total Scour Resistance** - An estimate of the ultimate static side friction resistance provided by the Scour Elevations.  
**Net Scour Resistance** - An estimate of the ultimate static side friction capacity provided by the Scour Elevations.  
**Ind-Year Scour Elevation** - Estimated elevation of scour due to the 100-year storm event.

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**Pile Installation Notice** (Notes Code 9-2032).  
Contractor to verify location of all utilities prior to any pile installation activities.  
Minimum Top Elevation is required for lateral stability.  
When reporting piling operations in zones where utilities are known, the piling takes place in the elevation of the soil, and the utility will be in the area.  
The Engineer is responsible for determination of the required lateral resistance.  
For those piles, pile driving is to commence at the center of the group and proceed outward.

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Ft = foot; in = inch; T = ton; P =psi; lb = pound; gal = gallon; m3 = cubic meter; m = meter; kN = kilonewton; A = area; V = volume; m/s = meter per second; ft/s = feet per second; mm = millimeter; % = percentage; ° = degree; kPa = kilopascal; mbar = millibar; RPM = revolutions per minute; MPa = megapascal; psi = pounds per square inch; Hz = hertz; ft = feet; m = meters; kPa = kilopascals; MPa = megapascals; Hz = hertz.
## Payment

<table>
<thead>
<tr>
<th>Item number</th>
<th>Item Description</th>
<th>Unit Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>455-34-ABB</td>
<td>Prestressed Concrete Piling (CFRP or SS)</td>
<td>LF</td>
</tr>
</tbody>
</table>
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) & 28,500 ksi (Carbon-Steel).
- Resistance factors $\phi$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have equal axes.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-112 for CFRP & 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), 33,500 ksi (HSSS) & 28,500 ksi (Carbon-Steel).
- Resistance factors based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.2.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spudcues.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-112 for CFRP & HSSS and Index 455-012 for Carbon-Steel.
Design Assumptions:

- Concrete compressive strength $f_c = 6$ ksi
- Modulus of elasticity of prestressing strands, $E_y = 18,000$ ksi (1/2" CFRP), 22,400 ksi (0.6" CFRP), 23,500 ksi (HSSS), & 28,500 ksi (Carbon-Steel)
- Resistance factors $\phi$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled); and AASHTO LRFD 5.5.4.21 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have equal ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-118 for CFRP & 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), 22,430 ksi (0.6" CFRP), 23,500 ksi (HSSS), & 28,500 ksi (Carbon-Steel).
- Resistance factors $\phi$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.11 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spirals ties.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-124 for CFRP & HSSS and Index 455-034 for Carbon-Steel.
Design Assumptions:
- Concrete compressive strength $f_c = 6$ ksi
- Modulus of elasticity of prestressing strands, $E_y = 18,000$ ksi (1/2" CFRP), 22,480 ksi (0.6" CFRP), 23,500 ksi (HSSS), & 38,500 ksi (Carbon-Steel)
- Resistance factors $f$ based on ACI 440.4R for CFRP strands (0.65 compression-controlled, 0.85 tension-controlled), and AASHTO LRFD 5.5.4.1.1 for HSSS & Carbon-Steel strands (0.75 compression-controlled, 1.0 tension-controlled).
- All piles assumed to have spirals.
- Strand sizes and strand patterns used to create interaction curves correspond with those indicated in Index 455-130 for CFRP & HSSS and Index 455-030 for Carbon-Steel.