

13 34 00 PRE-ENGINEERED FABRIC SHADE STRUCTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. A State of California-licensed contractor shall be responsible for the design, construction documents, permitting, fabrication, supply, and erection of the work specified herein, including foundations. The final work product delivered to the Owner shall match the dimensions and appearance of the shade structures shown on the drawings, including the requirements cited on the drawings and in this specification.

1.3 QUALITY ASSURANCE

- A. Fabrication and erection are limited to contractors with proven experience meeting the following minimum requirements.
 - 1. Specialty shade structure contractors shall have at least 12 years' experience in the design, engineering, manufacture, and erection of fabric shade structures, engineered to California Building Code requirements with similar scope, and a successful construction record of in-service performance to be demonstrated as a part of bid submittal requirements.
 - 2. Manufacturer shall have a City of Irvine Approved Fabricator license and be accredited by the IAS (International Accreditation Service) for Structural Steel Fabrication under CBC 2022, Section 1704.2.5.2.
 - 3. The fabric shade structure contractor shall have a Corporate Quality Control program (manual), which describes their complete quality assurance program.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fabric shade structure(s) shown on the drawings in relation to the property survey and existing structures and verify locations by field measurements prior to erection of the fabric shade structure(s).

1.5 WARRANTY

- A. The successful bidder shall provide a 12-month warranty on all labor and materials.
- B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years on fabric and 10 years on the structural integrity of the steel, from the date of substantial completion.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.1 GENERAL

A. Structures

- 1. (PLAY-1) The (1) 15 ft. x 30 ft. 2-post hypar sail cantilever shade structures shall have 10 ft. /13 ft. 9 in. entry heights and structural columns shall be a minimum HSS 10 x 10 x 0.5 and the cantilevered arms HSS 10 x 6 x 0.375.
 - 2. (PLAY-2) The (1) 27 ft. x 24 ft. 6 in. x 25 ft x 15 ft. 4-point hypar sail structure shall have 10 ft. and 16 ft. entry heights and structural columns shall be a minimum of HSS 10.75 x 0.365.
 - 3. (PLAY-3) The (1) 14 ft. x 15 ft. 1 in. x 21 ft. x 27 ft. 4-point hypar sail structure shall have 10 ft. and 16 ft. entry heights and structural columns shall be a minimum of HSS 8.625 x 0.322 for 10 ft. entry heights and HSS 10.75 x 0.365 for 16 ft. entry heights.
 - 4. (PLAY-4) The (1) 24 ft. 9 in. x 16 ft.10 in. x 21 ft. 9 in. x 10 ft. 4-point hypar sail structure shall have 10 ft. and 16 ft. entry heights and structural columns shall be a minimum of HSS 8.625 x 0.322 for 10 ft. entry heights and HSS 10.75 x 0.365 for 16 ft. entry heights.
 - 5. (SC-1 to SC-20) The (20) 15 ft. x 30 ft. 2-post full-hip cantilever shade structures shall have 10 ft. entry heights and structural columns shall be a minimum HSS 10 x 10 x 0.375 and the cantilevered arms HSS 10 x 6 x 0.375.
- B. The fabric shade structure(s) shall conform to the current adopted version of the California Building Code 2022.

- C. All fabric shade structures shall be designed and engineered to meet the applicable requirements of the current edition of the California Building Code (CBC) and companion requirements of ASCE 7, including any additional Owner requirements and supplemental provisions. All fabric shade structures shall be designed and engineered to meet the minimum of 110mph Wind Load, Risk Category II, Exposure C, and Seismic (earthquake) Load based on Seismic Design Category D, Seismic Risk Category II, and a Live Load of 5 PSF and shall further be engineered with a zero-wind pass-through factor on the fabric. When ASD Steel Design Method is used based on CBC Section 1605A.3.1, the load combinations for Dead Load + 0.75 Live Load + 0.75 Wind Load, and 0.6 Dead Load + Wind Load must be analyzed with no exceptions.
- D. Steel:
1. All steel members of the fabric shade structure shall be designed in strict accordance with the requirements of the "American Institute of Steel Construction" (AISC) Specifications and the "American Iron and Steel Institute" (AISI) Specifications for Cold-Formed Members and manufactured in a IAS- (International Accreditation Service) accredited facility for Structural Steel Fabrication under CBC Section 1704.2.5.2.
 2. All connections shall have a maximum internal sleeving tolerance of 0.0625" using high-tensile strength steel sections with a minimum sleeve length of 6".
 3. All non-hollow structural steel plates, shapes and bars shall comply with ASTM A36 ($F_y = 36$ ksi, $F_u = 58$ ksi). All square and rectangular hollow structural steel members shall comply with ASTM A1085 ($F_y = 50$ ksi, $F_u = 65$ ksi). All galvanized steel tubing shall be triple-coated for rust protection using an in-line electroplating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.

E. Bolts:

1. All structural field connections of the shade structure shall be designed and made with high-strength bolted connections using ASTM A-325, Grade B.
2. Where applicable, all stainless-steel bolts shall comply with ASTM F-593, Alloy Group 1 or 2. All bolt fittings shall include rubber washers for water-tight seal at the joints. All nuts shall comply with ASTM F-594, Alloy Group 1 or 2.

F. Welding:

1. All shop-welded connections of the fabric shade structure shall be designed and performed in accordance with the requirements of the "American Welding Society" (AWS) Specifications. Structural welds shall be made in compliance with the requirements of the "pre-qualified" welded joints, where applicable and by certified welders. No onsite or field welding shall be permitted.
2. All full penetration welds shall be continuously inspected by an independent inspection agency and shall be tested to the requirements of the CBC.

G. Powder Coating:

1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance with solvent cleaning SSPC-SP1. Solvents such as water, mineral spirits, xylol, and toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning, and prior to surface preparation, shall be executed according to Power Tool Cleaning SSPC-SP3, utilizing wire brushes, abrasive wheels, needle gun, etc.
2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance with commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, and other foreign material.
3. Powder coating shall be sufficiently applied (minimum 3 mils thickness) and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests, as defined by the American Society of Testing Materials.
4. Raw powder used in the powder coat process shall have the following characteristics:

- a. Specific gravity: 1.68 +/- 0.05
 - b. Theoretical coverage: 114 +/- 4ft²/mil
 - c. Mass loss during cure: <1%
 - d. Maximum storage temperature: 80°F
 - e. Interpon® 800 is a high-durability TGIC powder coating designed for exterior exposure. Tested against the most severe specifications, Interpon® 800 gives significantly improved gloss retention and resistance to color change.
5. When the fabric shade structure(s) will be located within 15 miles of the ocean or standing body of water, rust protection undercoat primer such as a zinc rich primer suitable for exterior marine environments will be required on all structures. Primer shall be fused only and then top coated with the selected powder coat to ensure proper inter-coat adhesion.
- a. The primer's attributes shall be:

1) Specific gravity (g/ml):	2.37
2) Coverage at 1.0 mil (ft ² /lb):	81.6
3) Adhesion: ASTM D-3359:	5B
4) Flexibility: ASTM D-552:	Pass 1/8"
5) Pencil hardness: ASTM D-3363:	H-2H
6) Impact resistance (in.lb): ASTM D-2794: Dir & Rev, 120 in-lbs	
7) Salt spray resistance: ASTM B-117:	2000 hours
8) Humidity resistance: ASTM D-4585:	2000 hours
9) 60° Gloss: ASTM D-523:	50 ~ 70
10) Cure schedule (metal temp):	10min @ 200°C (390°F) 25min @ 135°C (275°F)
11) Film thickness range (mils):	2.0 ~ 3.0

Tension Cable: Steel cable is determined based on calculated engineering loads.

H. Tension Cable

1. Steel wire rope cable is determined based on calculated engineering loads. Standard cabling is galvanized. Stainless steel cabling is required when hot dip galvanized frame or primer frame are required.
 - a. 0.25" (nominal) galvanized 7x19 strand core wire rope shall be used for tension loads up to 4,500 lbs.
 - b. 0.375" (nominal) galvanized 7x19 strand core wire rope shall be used for tension loads up to 9,000 lbs.
 - c. 0.5" (nominal) galvanized 6x19 strand core wire rope shall be used for tension loads up to 13,500 lbs.

I. Fabric Roof Systems

1. UV Shade Fabric

- a. UV shade fabric shall be minimum a UV-stabilized, high-density polyethylene (HDPE), by Multiknit® or approved equal. Fabric Properties:
 - 1) Life Expectancy: minimum 10 years with continuous exposure to the sun
 - 2) Fading: minimum fading after 5 years (3 years for Red)
 - 3) Fabric Mass: 5.31 oz/yd² ~ 5.6 oz/yd² (180gsm ~ 190gsm)
 - 4) Fabric Width: 9.8425 feet (3m)
 - 5) Roll Length: 164.04 feet (50m)
 - 6) Roll Dimensions: 62.99 inches x 16.5354 inches (160cm x 42cm)
 - 7) Roll Weight +/- 66 lbs. (+/- 30kg)
 - 8) Minimum Temp: -13°F (-25°C)
 - 9) Maximum Temp: +176°F (80°C)
- b. Fabric shall meet the following flame spread and fire propagation tests:
 - 1) ASTM E-84
 - 2) NFPA 701 Test Method 2
 - 3) California's Office of the State Fire Marshal, Registered Flame-Resistant Product

2. Stitching and Thread:

- a. All sewing seams are to be double-stitched.
- b. The thread shall be GORE® TENARA® mildew-resistant sewing thread, manufactured from 100% expanded PTFE (Teflon™). Thread shall meet or exceed the following:
 - 1) Flexible temperature range
 - 2) Very low shrinkage factor
 - 3) Extremely high strength, durable in outdoor climates
 - 4) Resists flex and abrasion of fabric
 - 5) Unaffected by cleaning agents, acid rain, mildew, salt water, and is unaffected by most industrial pollutants.
 - 6) Treated for prolonged exposure to the sun.
 - 7) Rot resistant.

3. Shade and UV Factors:

- a. Minimum shade protection and UV screen protection factors shall be as follows for the noted general color types:

<u>Color UV</u>	<u>Block %</u>	<u>Shade %</u>
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Blue	85%	80%~86%
Green	85%	79%~86%
Red	86%	80%~83%
Silver	81%	80%~85%
Sand	92%	80%~84%
Terracotta	82%	80%~83%
Yellow	89%	80%~82%

PART 3 EXECUTION

3.1 INSTALLATION

- A. The installation of fabric shade structures shall be performed by personnel with demonstrated experience in the erection of tensioned fabric structures.
- B. The installation shall comply with the manufacturer's instructions for assembly, installation, and erection, per approved drawings.
- C. Concrete:
 1. Unless noted otherwise for foundations by the foundation design engineer, the concrete specification for footings and/or piers shall meet a minimum 2,500 psi 28- day strength.
 2. Concrete work shall be executed in accordance with the latest edition of American Concrete Building Code ACI 318.
 3. Concrete shall comply with the following:
 - a. Aggregate: Hard rock
 - b. Slump: 3 ~ 5 inch
 - c. Portland Cement shall conform to ASTM C150.
 - d. Aggregate shall conform to ASTM C33.
 4. All reinforcement shall conform to ASTM A-615 grade 60.
 5. Reinforcing steel shall be detailed, fabricated, and placed in accordance with the latest ACI Detailing Manual and Manual of Standard Practice.
 6. The contractor shall not pour any concrete when the daily ambient temperature is to be below 55 degrees Fahrenheit.
- D. Foundations:
 1. All anchor rods set in new concrete shall comply with ASTM F1554, Grade 55.
 2. All anchor bolts shall be Hot-Dip Galvanized.

3. Drilled pier foundations and full rebar cages shall be drilled, set, and poured as per project foundation design engineer's requirements. The following footing sizes are typical and anticipated but shall be confirmed by manufacturer and structural engineer by way of signed structural shop drawings submitted to the owner for approval.
 - a. (PLAY-1) The (1) 15 ft. x 30 ft. 2-post hypar sail cantilever shade structure shall have minimum recessed base plated foundations of 13 ft. deep x 3 ft. diameter for all foundations.
 - b. (PLAY-2) The (1) 27 ft. x 24 ft. 6 in. x 25 ft x 15 ft. 4-point hypar sail structure shall have minimum recessed base plated foundations of 10 ft. deep x 2 ft. 6 in. diameter for all foundations,
 - c. (PLAY-3) The (1) 14 ft. x 15 ft. 1 in. x 21 ft. x 27 ft. 4-point hypar sail structure shall have minimum recessed base plated foundations of 8 ft. deep x 2 ft. 6 in. diameter for all foundations.
 - d. (PLAY-4) The (1) 24 ft. 9 in. x 16 ft.10 in. x 21 ft. 9 in. x 10 ft. 4-point hypar sail structure shall have minimum recessed base plated foundations of 8 ft. deep x 2 ft. – 6 in. wide for the 10 ft. entry heights, and 12 ft. deep x 2 ft. 6 in. diameter for all foundations.
 - e. (SC-1 to SC-20) The (20) 15 ft. x 30 ft. 2-post full-hip cantilever shade structures shall have minimum recessed base plated foundations of 10 ft. deep x 2 ft. 6 in. diameter for all foundations.
4. In the absence of an Owner supplied geotechnical report specifying foundation design parameters, the drilled pier foundations shall be designed in accordance with the prescriptive soils design properties set forth in the applicable building code provisions.

END OF SECTION