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RESEARCH REPORT: RR 25251
(CSI # 08620)

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GENERAL APPROVAL – Renewal - Solatube Tubular Daylighting Device (TDD) Skylights

DETAILS

Solatube Tubular Daylighting Device (TDD) Skylights include:
- The Solatube Brighten Up® Series Models 160 DS, 290 DS daylighting systems.
- The Solatube Smart LED ™ System
- The Solatube SolaMaster® Series Models 330 DS-O, 330 DS-C, 750 DS-O and 750 DS-C daylighting systems. The "O" and "C" designation refers to Open (O) and Closed (C) ceiling configurations.
- The Solatube SkyVault® Series Model M74 DS

The TDD models by tube diameter size are:

- 10 inch diameter: 160 DS
- 14 inch diameter: 290 DS
- 10 inch diameter rooftop, 14 inch interior: Smart LED
- 21 inch diameter: 330 DS-O, 330 DS-C, 750 DS-O, 750 DS-C
- 29 inch diameter: M74 DS

These TDD models consist of three primary assemblies:

- the roof dome assembly
- reflective tube assembly
- diffuser assembly.

These assemblies are detailed in the attached Figures.

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1. Roof Dome Assembly

Primary components of the dome assembly are the dome, dome ring or tube ring and flashing.

1.1. A single dome manufactured from impact resistant acrylic polymer is utilized on Models 160 DS, Smart LED, 290 DS, 330 DS and 750 DS. The acrylic material is classified as CC2 when tested in accordance with ASTM D635. A single dome manufactured from monolithic polycarbonate panels is utilized on the Model M74 DS. The polycarbonate material is classified as CC1 when tested in accordance with ASTM D635.

1.2. A dome ring (160 DS, Smart LED & 290 DS) manufactured from impact resistant Acrylic polymer or tube ring (330 DS & 750 DS) manufactured from PVC, connects the inner reflective tube, inner dome and outer dome to the flashing. The acrylic and PVC material are classified as CC2 when tested in accordance with ASTM D635. A tube ring (M74 DS) manufactured from .018" thick aluminum sheet metal with a reflective coating, connects the inner reflective tube, inner dome, and outer dome to the curb cap assembly.

1.3. A powder coated steel dome edge protection band (160 DS, Smart LED, 290 DS, 330 DS and 750 DS) is utilized to protect the dome edge on installations on roof assemblies with fire classifications of A, B or C. A stainless steel dome edge protection band (M74 DS) is utilized to protect the dome edge on installations on roof assemblies with fire classifications of A, B or C.

1.4. Powder coated metal flashings are self-mounting and are available in pitched and flat configurations. For models 160 DS, Smart LED and 290 DS, the flat configuration is available in both 4 and 6 inch lengths. For models 330 DS and 750 DS, only flat configurations in 4, 8 and 11 inch lengths are available. A support flashing with integral curb cap is available for the 290 DS, 330 DS, 750 DS and M74 DS models. Also, a support flashing for non-corrugated metal roof is available for 330 DS and 750 DS

1.5. A cylindrical light collector assembly (M74 DS) is comprised of wire ropes, a cylinder assembly, a dome, clamps, retainers, and rivets. Wire ropes consist of stranded 3/32 inch diameter stainless steel ropes, utilized for bracing the height of the cylindrical light collector. The cylinder assemblies consist of 2 primary components: a metal reflector sheet in one half of the cylinder circumference and plastic glazing in the other half. The metal and plastic sheets are attached with a stainless steel cleat and rivets to assemble a cylinder shape.

The dome is manufactured from monolithic polycarbonate panels is utilized on the Model M74 DS. The polycarbonate glazing material is 0.05 inch thick Makrolon® SL with CC1 classification, as recognized in ICC-ES ESR 2728 evaluation report.

Two types of clamps: 4 stainless steel clamps attach the ropes to the top of the cylinder light collector at the dome, while 4 sheet steel clamps attach the wire ropes to the curb cap at the corners. A stainless steel retainer band is used in conjunction with the stainless steel clamps to secure the dome to the top of the cylinder.

2. Reflective Tube Assembly

Reflective tubes and angle adapters have a high reflectance interior tube finish and are manufactured from .015" thick aluminum for 160 DS, Smart LED and 290 DS, and .018" for 330 DS, 750 DS and M74 DS. Two inch wide polymer/foil tape is utilized at all joints between tube sections and at vertical seams of each tube for 160 DS, Smart LED, 290 DS, 330 DS, and 750 DS models. A metal belt and torsion spring clamp secure the interlocking joint assembly for M74 DS models.

2.1. Daylight Dimmer Assembly

A switch operated, electrically driven Daylight Dimmer Assembly is available for installation above the bottom tube on 160 DS, Smart LED and 290 DS and above the round-to-square for 330 DS / 750 DS. The Dimmer Assembly is used to restrict natural light from entering the room. The Daylight Dimmer Assembly is installed for the 160 DS, Smart LED, 290 DS, 330 DS and 750 DS models only. See Figure 5.

2.2. Light Kit Assembly

Switch operated, electric light kits are available for installation into the bottom tube for the 160 DS and 290 DS models only. The kits contain either an incandescent or fluorescent light bulb. See Figure 4.

3. Diffuser Assembly.

The Diffuser Assemblies (160 DS, Smart LED, 290 DS, 330 DS and 750 DS) are either single or dual glazed with acrylic, polycarbonate plastic or 0.16" thick tempered glass (160 DS, Smart LED, and 290 DS only). The plastic diffusers are classified as a CC2 plastic material when tested in accordance with ASTM D635. The plastic diffusers have a flame spread index not exceeding 200 and a smoke development index not exceeding 450 when tested in accordance with ASTM E 84.

These are mounted over the Ceiling Ring for aesthetic purposes

The ceiling ring is manufactured from injection molded impact resistant acrylic and is used to connect the reflective tubing and diffusers to the interior room ceiling.

Diffuser assemblies (M74 DS) are single glazed and are comprised of an acrylic prismatic panel diffuser, diffuser collar, and snap fit closed cell sponge rubber dress ring. The plastic diffuser panels are classified as a CC2 plastic material when tested in accordance with ASTM D635. The plastic diffusers have a flame spread index not exceeding 200 and a smoke development index not exceeding 450 when tested in accordance with ASTM E 84.

The diffuser assembly connects to the bottom of an extension tube utilizing a metal belt and torsion spring clamp secure the interlocking joint assembly.

The amplifier diffuser assemblies use a tube manufactured of sheet metal that transitions the diffuser from a 28-1/2 inch diameter to 36 inches.

Solatube International, Inc.
RE: Solatube Tubular Daylighting Devices.

The approval is subject to the following conditions:

1. Installation must comply with this report; the manufacturer's published installation instructions and 2014 City of Los Angeles Building Code Sections 2405 and 2610.

2. The maximum allowable loads are as described in Tables 1, 2, and 3 and attachment details, in Tables 4, 5, and 6.

3. The polycarbonate glazing material for model M74DS is 0.05 inch thick Makrolon SL and must be recognized in a current ICC-ES ESR 2728 evaluation report.

4. Solatube Tubular Daylighting Devices are produced in Vista, California, under a quality control program with inspections by Keystone Certification, Inc. (AA-612).

Table 1 Allowable Loads for the Models shown

Model No	Dia. (inch)	Dome Thickness (inch)	IBC, IRC	
			Wind Loads (psf)	Snow Load [5] (psf)
160 DS	10	0.125	+70 -60	+150
Smart LED				
290 DS	14	0.125		
330 DS-O[2]	21	0.168	+70 -70	
330 DS-C[2]	21	0.168		
750 DS-O	21	0.210		
750 DS-C	21	0.210		

Table 2 – M74 DS Curb Mounted Skylight Maximum Allowable Design Loads

Skylight Description			**Glazing Description**			**Wind Loads (psf)** [(1)]
Model Series	**Model No.**	**Dome Rise (inch)**	**Glazing Material**	**Glazing Thickness (inch)**	**Diameter (inch)**	
SkyVault (See Figures 1 & 3)	M74 DS	5-7/8 [(2)]	Makrolon-SL (ESR-2728)	0.118	28-1/2	+80 -80

[(1)] Positive (+) loads are directed inward; negative (-) are directed outward. All positive design pressures were tested to a safety factor of 3. All negative design pressures were tested to a safety factor of 2.

[(2)] Dome rise is the height measured from the top surface of the curb cap flashing to the top of the plastic dome.

Table 3 – Cylindrical Light Collector Maximum Allowable Design Loads

Description	Cylinder Assembly		Lateral Design Loads (psf) (1)
	Dome Cylinder Plastic (half circumference)	Cylinder Reflector (half circumference)	
SkyVault M74 DS with Cylindrical Light Collector (See Figures 2 & 4)	Makrolon-SL (ESR-2728) 0.093 inch thick	0.028 inch thick sheet steel	69.7

(1) Lateral loads were tested to a safety factor of 2.5 in accordance with IBC Section 1710.3.1.

Table 4 – M74 DS Curb and Fastener Schedule

Outside Curb Dimensions	Curb			Fastener (Curb Cap to Curb)		
	Material	Min. Thickness(1)	Properties (1)	Description	Qty.	Spacing
34-3/8" x 34-3/8"	2x8 Spruce-Pine-Fir	2" Nominal Wood Blocking	Specific Gravity, G=0.42	#8 x 2" Phillips truss head self-pierce sheet metal screw #10 x 2" wood screw	16	Spaced 2-1/2" and 10" on center from each corner for a total of four fasteners per side.
	33 ksi Steel (ASTM A653)	18 Gauge (0.0451")	F_y = 33 ksi F_u = 45 ksi	#10-16 SAE Grade 5 TEKS screw with minimum 3 threads past the curb substrate	16	Spaced 2-1/2" and 10" on center from each corner for a total of four fasteners per side.
	3105-H14 Aluminum	0.0508"	F_{tu} = 25 ksi F_{ty} = 22 ksi	#10-24 300 Series stainless steel sheet metal screw with minimum 3 threads past the curb substrate	16	Spaced 2-1/2" and 10" on center from each corner for a total of four fasteners per side.
	Normal Weight Concrete	4"	f'_c = 2,500 psi	3/16" ITW Tapcon Anchor (ESR-2202) with min. embedment of 1-1/2"	16	Spaced 2-1/2" and 10" on center from each corner for a total of four fasteners per side.

(1) Installation on a curb substrate with a lesser thickness or lesser mechanical properties may result in a lower wind load rating.

Table 5 – M74 DS Collector Assembly, Curb Installation Fastener Schedule

Outside Curb Dimensions	Curb			Fastener (Collector with Curb Cap to Curb)		
	Material	**Min. Thickness**(1)	**Properties** (1)	**Description**	**Qty.**	**Spacing**
34-3/8" x 34-3/8"	2x8 Spruce-Pine-Fir	2" Nominal Wood Blocking	Specific Gravity, G=0.42	#8 x 2" Phillips truss head self-pierce sheet metal screw #10 x 2" truss head screw	24	Spaced 2-1/2", 10" and 16-1/2" on center from each corner for a total of six fasteners per side.
	33 ksi Steel (ASTM A653)	18 Gauge (0.0451")	F_y = 33 ksi F_u = 45 ksi	#10-16 SAE Grade 5 TEKS screw with minimum 3 threads past the curb substrate	24	Spaced 2-1/2", 10" and 16-1/2" on center from each corner for a total of six fasteners per side.
	3105-H14 Aluminum	0.0508"	F_{tu} = 25 ksi F_{ty} = 22 ksi	#10-24 300 Series stainless steel sheet metal screw with minimum 3 threads past the curb substrate	24	Spaced 2-1/2", 10" and 16-1/2" on center from each corner for a total of six fasteners per side.
	Normal Weight Concrete	4"	f'_c = 2,500 psi	3/16" ITW Tapcon Anchor (ESR-2202) with min. embedment of 1-1/2"	24	Spaced 2-1/2", 10" and 16-1/2" on center from each corner for a total of six fasteners per side.

(1) Installation on a curb substrate with a lesser thickness or lesser mechanical properties may result in a lower wind load rating.

Table 6 – M74 DS Collector Assembly and Collector to Curb Cap Connection Details

Connection	Fastener (Collector to Curb Cap and Curb Cap to Curb)		
	Description	**Qty.**	**Locations**
M74 DS Wire Rope to M74 DS Dome Retainer Band Assembly	#10-24 x 1.25" hex washer head, stainless steel screw with a #10-24 aluminum rivet nut	4	Unions are attached at four locations equidistant along the circumference of the Dome Retainer Band.
	M74 DS Union	4	
M74 DS Dome Ring to M74 DS Dome Cylinder Back to M74 DS Cone Base	M74 DS Dome Ring	1	Eight rivets are placed along the upper edge of the Dome Cylinder Back to connect to the Dome Ring. Eight rivets are placed along the lower edge of the Dome Cylinder Back to connect to the Cone Base.
	M74 DS Dome Cylinder	1	
	M74 DS Cone Base	1	
	1/8" diameter x 1/4" Rivet	16	
M74 DS Dome Ring to M74 DS Stanchion to M74 DS Cross Beam to M74 DS Cone Base	M74 DS Dome Ring	1	Two rivets are placed at each end of each Stanchion to connect it to the Cone Base on the bottom and the Dome Ring and Cross Beam at the top. Two rivets are placed at each end of each Cross Beam to connect it to the Dome Ring and Cylinder Back on
	M74 DS Stanchion	2	
	M74 DS Cross Beam	2	
	M74 DS Cone Base	1	
	1/8" diameter x 1/4" Rivet	16	
M74 DS Cleat to M74 DS Cylinder Back	M74 DS Cleat	2	Nine rivets are placed along the edge of each Cleat to connect it to the Cylinder Back.
	M74 DS Cylinder Back	1	
	1/8" diameter x 1/4"	18	
M74 DS Reflector to M74 DS Cylinder Back	M74 DS Reflector	1	Two Rivets are placed along each vertical side of the reflector to connect it to the Cylinder Back.
	M74 DS Cylinder Back	1	
	1/8" diameter x 1/4"	4	
M74 DS Cylinder Assembly to M74 DS Curb Cap Flashing Assembly	M74 DS Cone Clamp	4	Clamps are located at four locations at the mid-point of each side of the M74 DS Curb Cap Flashing assembly with four Rivets per clamp.
	M74 DS Cone Base	1	
	M74 DS Curb Cap	1	
	1/8" diameter x 1/4" Rivet	16	

DISCUSSION

The report is in compliance with the 2014 City of Los Angeles Building Code.

The laminated film attached to the reflective tube assembly is classified as CC1 in accordance with ASTM D635-08.

Addressee to whom this Research Report is issued is responsible for providing copies of it, complete with any attachments indicated, to architects, engineers and builders using items approved herein in design or construction which must be approved by Department of Building and Safety Engineers and Inspectors.

This general approval of an equivalent alternate to the Code is only valid where an engineer and/or inspector of this Department has determined that all conditions of this Approval have been met in the project in which it is to be used.

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Attachment: Details Drawings (15 Pages)