

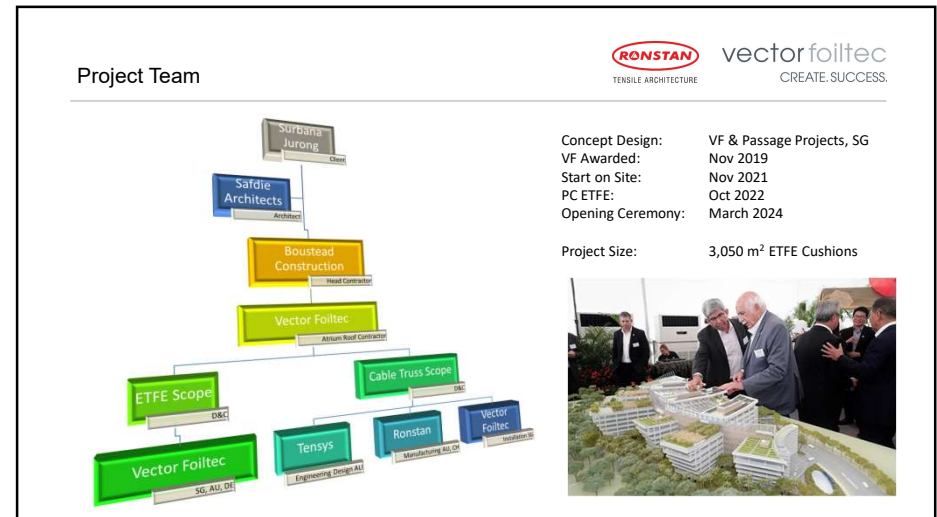
1



2



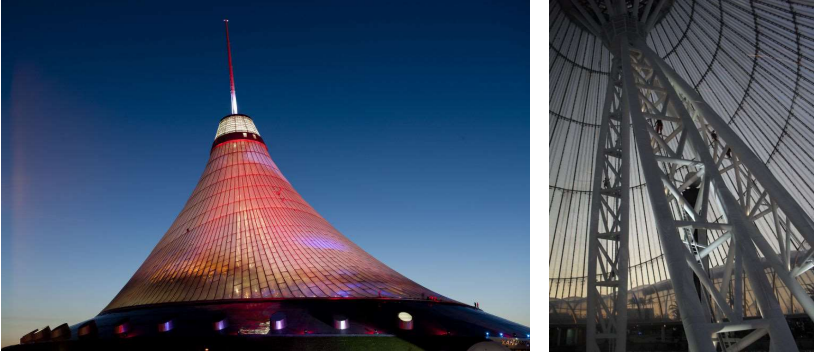
3



4

ETFE Reference Projects

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.



Khan Shatyr Entertainment Centre, KZ
Foster Architects

21,850sqm ETFE Cushions

5

ETFE Reference Projects

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.



Komodo Dragon Enclosure, London Zoo
Wharmby Kozdon Architects

180sqm ETFE Cushions

6

ETFE Reference Projects

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.




ATF Building, Washington DC, USA
Safdie Architects

1,580sqm ETFE Cushions

7

ETFE Reference Projects

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.



Jewel, SG
Safdie Architects

5,800sqm ETFE Cushions & Single Layer

8

SJ General Arrangement

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

- 3,050 m² ETFE
- 3 x roof elements
- Pretensioned Cable Trusses
- Custom design & manufacture
- Custom Print Pattern
- Span Varies 25-40m
- Cushions 4.2m wide

9

Preliminary Concept

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Slip cable forces between vertical and top chord cables = 15 kN (unfactored)
Requirement 6 x M16 A4-80 tension bolts on connection. Structural connection requirement in the order of 250 - 300mm curved connection block

Cable Truss Structural Sizing

Image courtesy of Tensys

10

Design Development

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Hand-drawn sketches include notes such as "16-26", "16-29", "CANTER FIND NO MOVEMENT", and "16-26".

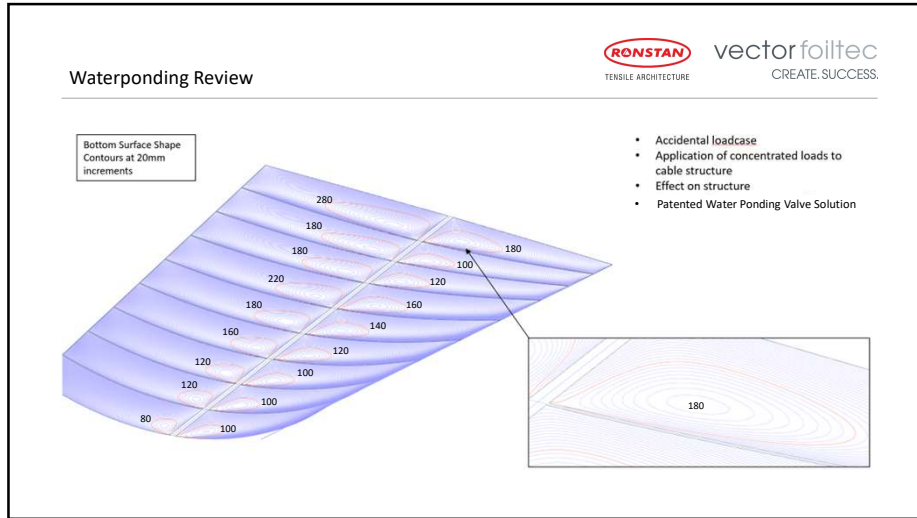
11

Rainwater Drainage

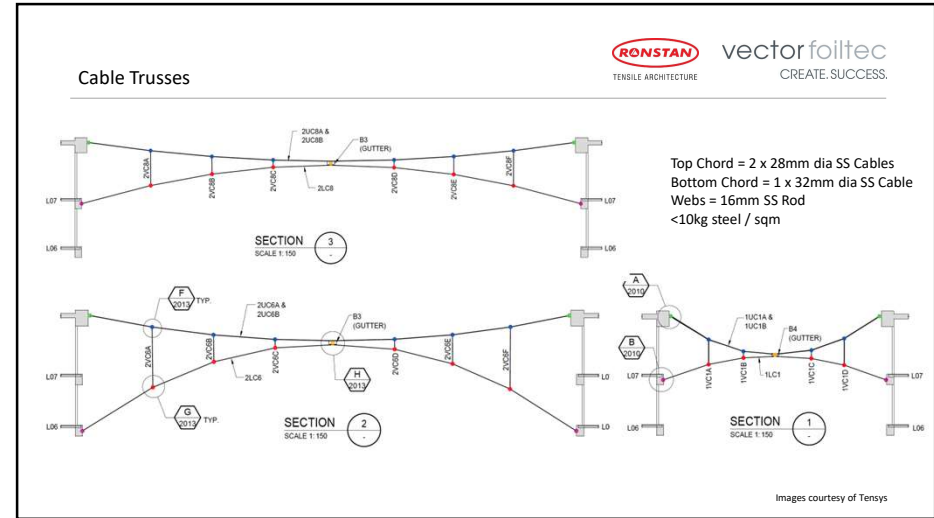
RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

330mm/hr Design Rainfall, 1,300sqm roof draining to single point

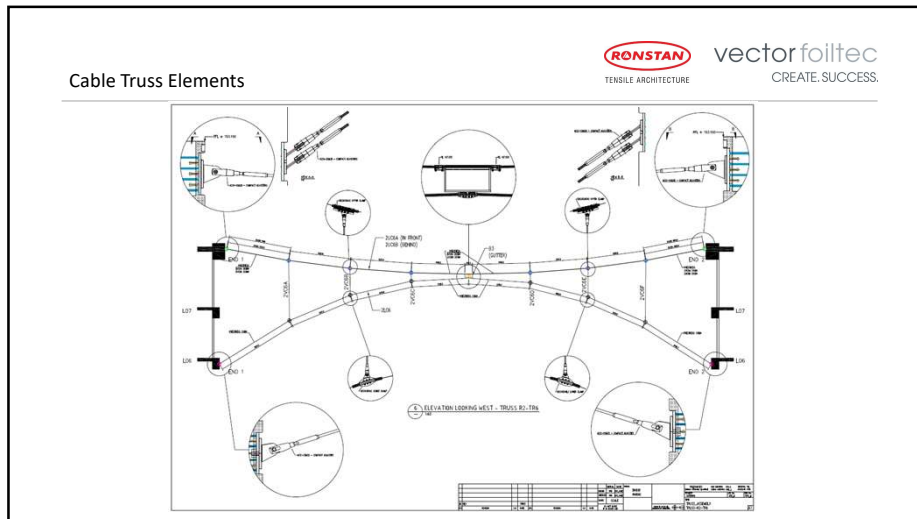
12



13



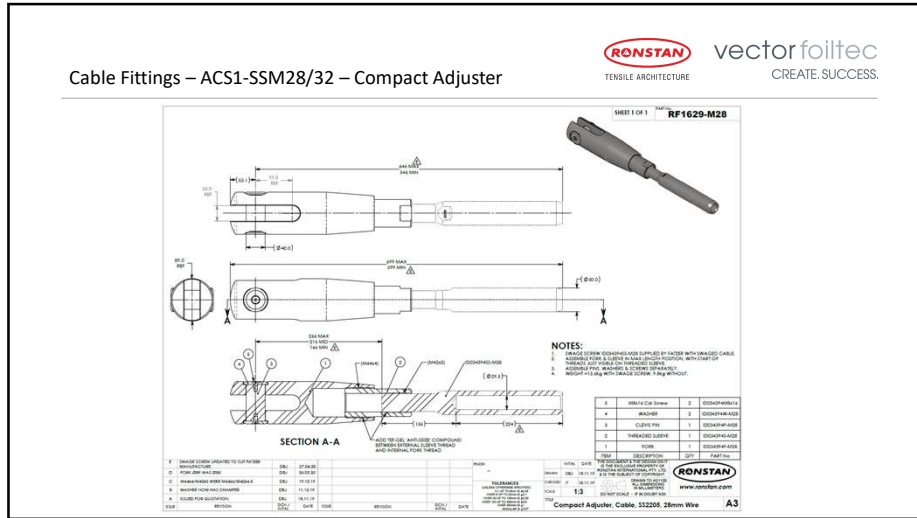
14



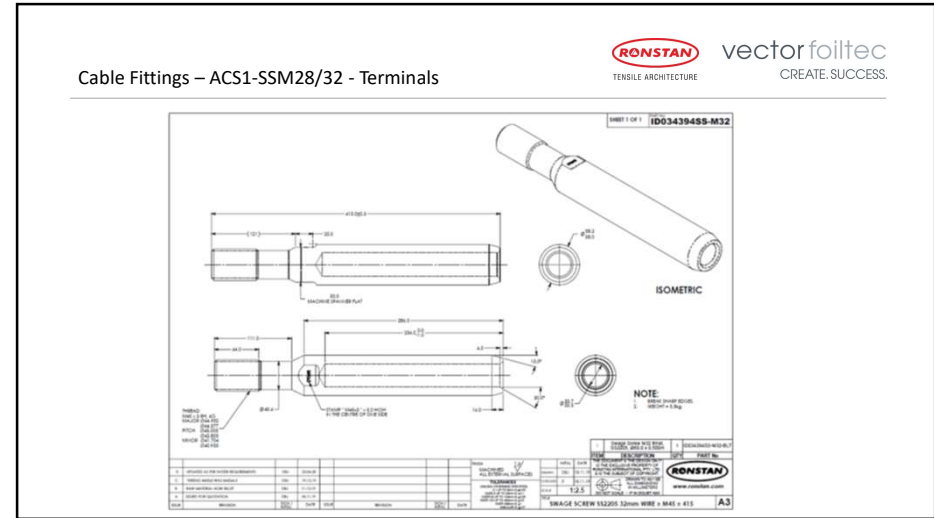
15



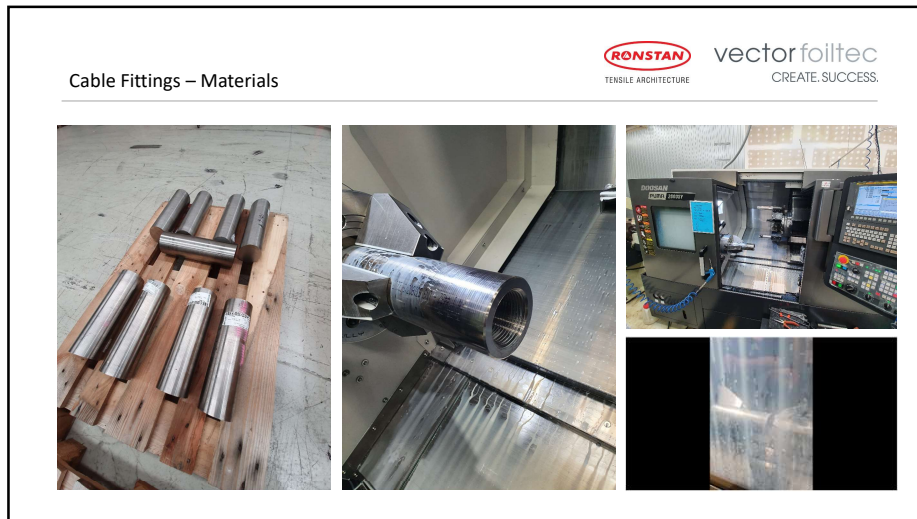
16



17



18



19



20

Cable – Open Spiral Strand (OSS)

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

21

Cable Fabrication

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Part No.	Length	Qty	Length	Qty	Length
1	20.000	1	20.000	1	20.000
2	20.000	1	20.000	1	20.000
3	20.000	1	20.000	1	20.000
4	20.000	1	20.000	1	20.000
5	20.000	1	20.000	1	20.000
6	20.000	1	20.000	1	20.000
7	20.000	1	20.000	1	20.000
8	20.000	1	20.000	1	20.000
9	20.000	1	20.000	1	20.000
10	20.000	1	20.000	1	20.000
11	20.000	1	20.000	1	20.000
12	20.000	1	20.000	1	20.000
13	20.000	1	20.000	1	20.000
14	20.000	1	20.000	1	20.000
15	20.000	1	20.000	1	20.000
16	20.000	1	20.000	1	20.000
17	20.000	1	20.000	1	20.000
18	20.000	1	20.000	1	20.000
19	20.000	1	20.000	1	20.000
20	20.000	1	20.000	1	20.000
21	20.000	1	20.000	1	20.000
22	20.000	1	20.000	1	20.000
23	20.000	1	20.000	1	20.000
24	20.000	1	20.000	1	20.000
25	20.000	1	20.000	1	20.000
26	20.000	1	20.000	1	20.000
27	20.000	1	20.000	1	20.000
28	20.000	1	20.000	1	20.000
29	20.000	1	20.000	1	20.000
30	20.000	1	20.000	1	20.000
31	20.000	1	20.000	1	20.000
32	20.000	1	20.000	1	20.000
33	20.000	1	20.000	1	20.000
34	20.000	1	20.000	1	20.000
35	20.000	1	20.000	1	20.000
36	20.000	1	20.000	1	20.000
37	20.000	1	20.000	1	20.000
38	20.000	1	20.000	1	20.000
39	20.000	1	20.000	1	20.000
40	20.000	1	20.000	1	20.000
41	20.000	1	20.000	1	20.000
42	20.000	1	20.000	1	20.000
43	20.000	1	20.000	1	20.000
44	20.000	1	20.000	1	20.000
45	20.000	1	20.000	1	20.000
46	20.000	1	20.000	1	20.000
47	20.000	1	20.000	1	20.000
48	20.000	1	20.000	1	20.000
49	20.000	1	20.000	1	20.000
50	20.000	1	20.000	1	20.000
51	20.000	1	20.000	1	20.000
52	20.000	1	20.000	1	20.000
53	20.000	1	20.000	1	20.000
54	20.000	1	20.000	1	20.000
55	20.000	1	20.000	1	20.000
56	20.000	1	20.000	1	20.000
57	20.000	1	20.000	1	20.000
58	20.000	1	20.000	1	20.000
59	20.000	1	20.000	1	20.000
60	20.000	1	20.000	1	20.000
61	20.000	1	20.000	1	20.000
62	20.000	1	20.000	1	20.000
63	20.000	1	20.000	1	20.000
64	20.000	1	20.000	1	20.000
65	20.000	1	20.000	1	20.000
66	20.000	1	20.000	1	20.000
67	20.000	1	20.000	1	20.000
68	20.000	1	20.000	1	20.000
69	20.000	1	20.000	1	20.000
70	20.000	1	20.000	1	20.000
71	20.000	1	20.000	1	20.000
72	20.000	1	20.000	1	20.000
73	20.000	1	20.000	1	20.000
74	20.000	1	20.000	1	20.000
75	20.000	1	20.000	1	20.000
76	20.000	1	20.000	1	20.000
77	20.000	1	20.000	1	20.000
78	20.000	1	20.000	1	20.000
79	20.000	1	20.000	1	20.000
80	20.000	1	20.000	1	20.000
81	20.000	1	20.000	1	20.000
82	20.000	1	20.000	1	20.000
83	20.000	1	20.000	1	20.000
84	20.000	1	20.000	1	20.000
85	20.000	1	20.000	1	20.000
86	20.000	1	20.000	1	20.000
87	20.000	1	20.000	1	20.000
88	20.000	1	20.000	1	20.000
89	20.000	1	20.000	1	20.000
90	20.000	1	20.000	1	20.000
91	20.000	1	20.000	1	20.000
92	20.000	1	20.000	1	20.000
93	20.000	1	20.000	1	20.000
94	20.000	1	20.000	1	20.000
95	20.000	1	20.000	1	20.000
96	20.000	1	20.000	1	20.000
97	20.000	1	20.000	1	20.000
98	20.000	1	20.000	1	20.000
99	20.000	1	20.000	1	20.000
100	20.000	1	20.000	1	20.000

22

Cable Fabrication - Guaging

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

23

Dropper Rods

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE.SUCCESS.

24

RONSTAN vector foilitec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Clamps – Initial Thoughts – Fabricated - Variable Angles

Sheet 1 of 2: Jorong M36 top clamp
Sheet 2 of 2: Jorong M24 bottom cl

25

RONSTAN vector foilitec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Clamps – Key Requirements / Initial Brief/Concept

- X
- X
- X
- X
- X
- X
- GET FROM ANGUS>
- X
- X
- X
- X
- X
- X
- X

vector foilitec
CREATE.SUCCESS.

ISSUED FOR COSTING
Not for Construction Approval

LOWER CABLE CLAMP FOR $\alpha = 68^\circ$
SCALE 1:2

LOWER CABLE CLAMP FOR $\alpha = 86^\circ$
SCALE 1:2

LOWER CABLE CLAMP 3D VIEW
SCALE 1:2

PROPOSED LOWER CABLE CLAMPING DETAIL 2
SURBANA JURONG ETFE
CABLE NET, SINGAPORE
PE 0719 854018 030320

26

RONSTAN vector foilitec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Clamps – Key Requirements / Costing / Initial Brief

vector foilitec
CREATE.SUCCESS.

ISSUED FOR COSTING
Not for Construction Approval

LOWER CABLE TO Ø16 ROD CLAMPING DETAILS
SCALE 1:2
PROVIDE TO ARCHITECTS (SPECIFICATIONS TO MATCH CABLE FITTINGS)
QTY: ROOF 1 = 20, ROOF 2 = 16, ROOF 3 = 18 = 54 TOTAL

PROPOSED LOWER CABLE CLAMPING DETAIL 1
SURBANA JURONG ETFE
CABLE NET, SINGAPORE
PE 0719 854018 030320

Images courtesy of Tensys

27

RONSTAN vector foilitec
TENSILE ARCHITECTURE CREATE.SUCCESS.

Clamps – 1st Gen. Cast Cable - Bottom

vector foilitec
CREATE.SUCCESS.

ISSUED FOR COSTING
Not for Construction Approval

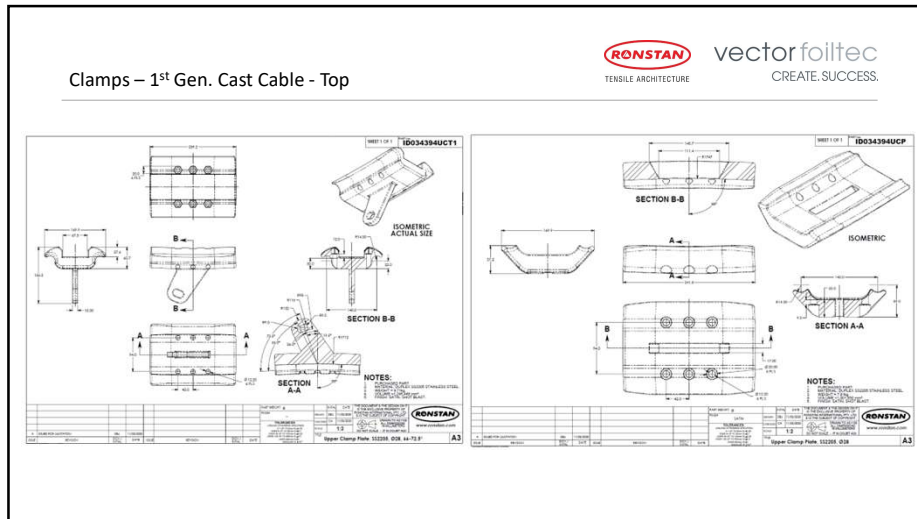
ISOMETRIC

SECTION A-A

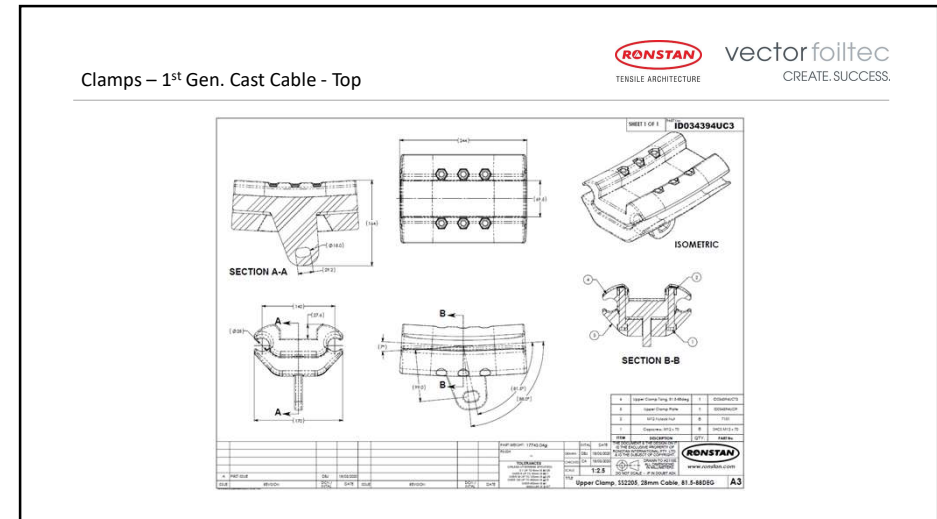
NOTES:
1. MATERIAL: 304 STAINLESS STEEL
2. FINISH: POLISHED
3. SURFACE TREATMENT: PASSIVATION
4. TOLERANCES: UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE TO BE HOLD TO ±0.10mm

Lower Clamp, Right Hand, 512205, Ø32, 72.5-81.8" A3

28



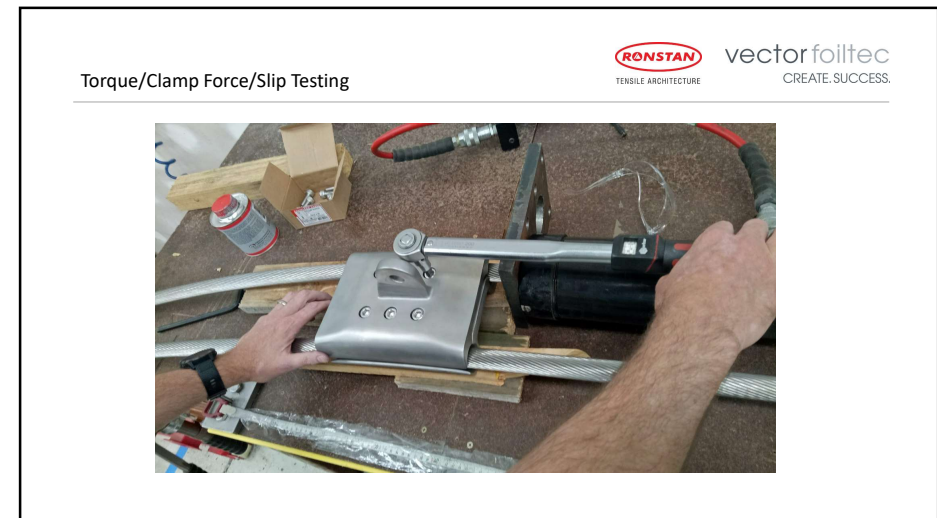
29




30



31




32




vector foiltec
CREATE. SUCCESS.

Logistical Challenge



Compact Adjuster Body -	Australia
Threaded Swage Terminal -	Switzerland
Open Spiral Strand -	Switzerland
Cable Manufacture -	Switzerland
Dropper Rods -	Australia
Clamps -	China
QA/QC -	AUS/CH/CN
ETFE -	Germany

33




vector foiltec
CREATE. SUCCESS.

QA / QC - Summary

ID034394
Surbana Jurong Cable Net
ITP/DA Summary
Date: 23/05/23

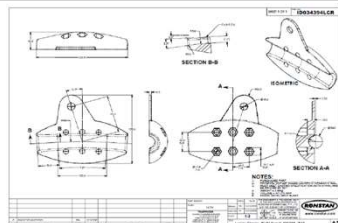

Component	QA/QC Document	Works Described	Verification (Attached sample documents noted in Italic)
1 Fork Assemblies	ITP Reports	Raw Material Procurement Internally Fabricated Components Outplant Processes Purchased Components Assembly/Packing	1.1 ITP 1.1.1 - Surbana - Level 1 Fork Assembly ITP 001 (Rev A) 1.2 Material Certificates 1.3 Inspection Reports , 1.3.1 - Sample QA Inspection Report - ID034294F - M32
2 Rod Assemblies	ITP Reports	Raw Material Procurement Internally Fabricated Components Outplant Processes Purchased Components Assembly/Packing	2.1 ITP 2.1.1 - Surbana - Level 1 Rod Assembly ITP 002 (Rev A) 2.2 Material Certificates 2.3 Inspection Reports 2.3.1 - Sample QA Inspection Report - Rod Assembly 2.3.2 - Sample QA Inspection Report - Threaded Rod
3 Swaged Cable Assembly - No Forks	Production Plan Quality Control Plan/ITP	FLC Coil Rope - Round wire - Z Shaped Wire - Internal Threads	3.1 Combined Text Certificate/ Inspection Reports 3.1.1 - Ronstan Production Plan Sample 2022-09-12 3.1.2 - Ronstan Quality Control Plan & Inspection Test Plan Sample -J022-09-12
4 Complete Cable Assembly - (Swaged Cable Assembly with forks)	Reports	Mechanical Testing (External)	4.1 Test Reports/ Accreditation 4.1.1 - ID034294 20mmx120mm Cable & M16 SS Rod Test sample Report.
5 Complete Rod Assembly	Reports	Mechanical Testing (External)	5.1 Test Reports/Accreditation 5.1.1 - Combined Report with Above
6 Clamp Components	ITP/ Material Certificate Reports	Material Composition Production Plan Dimensional Checks NDT Report	6.1 Material Certificates - Refer ITP below 6.2 Production Plan 6.2.1 - ID034294 Ronstan Production Plan 6.3 Inspection Test Report (Combined Material Certificate) 6.3.1 - S2K200 - 078 example 6.4 Inspection Reports 6.4.1 - NDT Report of Radio Graphie - Sample 6.4.2 - NDT Company Certification 6.4.3 - NDT Testing Officer Certification

34




vector foiltec
CREATE. SUCCESS.

QA / QC - Dimensional





35



vector foiltec
CREATE. SUCCESS.

QA / QC - Mechanical Tests



CERTIFICATE OF BREAK TEST

CERTIFICATE NO: BV11531336.1
Customer: Ronstan International
Address: 19 Park View, Braeside VIC 3195
Date of Report: 08/06/2021
Order No.: 11031336
Date of Test: 13/05/2021
Test Equipment: 300514
Location of Test: BV Melbourne Workshop
Customer's P/O: ID034394


In Service Date: N/A
Test Spec./Standard: AS1866.1, AS3359, AS49H1

DESCRIPTIONS MARKS	NO. TESTED	CALCULATED WLL (kN)	ACTUAL RL (kN)	REMARKS TEST LOAD
ARS-SS-M16 16mm 316SS Tension rod assembly c/w SS2205 Adjustable Fork Each End CBL 571N Length: 1m	1	97	130.27	Pass
ACS1-SS-M28 28mm 316SS Cable Assembly c/w Swaged Adjustable Fork Each End CBL 596kN Length: 3.5m	1	596	874.95	Pass
ACS1-SS-M32 32mm 316SS Cable Assembly c/w Swaged Adjustable Fork Each End CBL 759kN Length: 4m	1	709	844.53	Pass

NB: Complies with break testing requirements of the above referenced standards;
Visual Examination: Pass
Surface Finish: Self

36

QA/QC – ITP’s – Example – Dropper Rods.

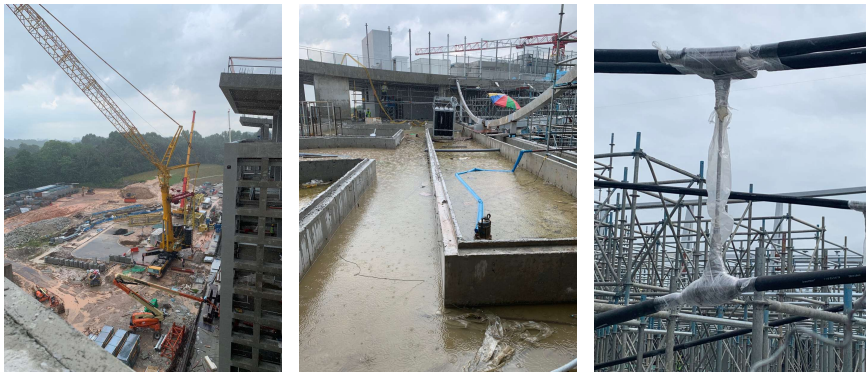
Project: SG Surbana Jurong Cable Truss Project ID: 034394 ITP No.: 002 Prepared: CA Rev: A Date: 05/2/2020		INSPECTION AND TEST PLAN FOR: ROD ASSEMBLIES ID034394-RA							
REF	OPERATION OR STAGE OF WORK	REFERENCE DOCUMENTATION	INSPECTIONS / VERIFICATION	INSPECTION: WHO					
	WORK DESCRIPTION	REQUIREMENT / STANDARD / SPECIFICATION	ACCEPTANCE CRITERIA	INSPECTION / TEST PERFORMED	STAGE / FREQUENCY	RECORDS / CHECKLISTS	OPERATOR	ENGINEER	CLIENT
1	Raw material procurement.	As specified on drawings.	3.1 Inspection certificate to EN10204	Conforming with specifications.	Visual and dimensional check	100%	Mill cert	X	W
2	Internally Fabricated Components.	As specified on drawings.	Drawing No. ID034394FM16 etc.	Fabricated as per drawings.	Visual and dimensional check	100%	Inspection Report	X	W
3	Surface Finishing Processes.	As specified on drawings.	Drawing No. ID034394R1 thru R88	As per the drawings and sample.	Visual check	100%	Inspection Report	X	W
4	Purchased Components. (Threaded Rod & Screws)	As specified on drawings.	Drawings / Specification	Conforming with Order requirements and specifications.	Visual check	100%	Inspection Report	X	W
5	Assembly / Packing.	As specified on drawings.	Drawings / Specification					X	W

W = Witness Point; H = Hold Point; S = Surveillance or monitoring; X = Self inspection by performer of work.
 Hold Point – A 'hold' point defines a point beyond which work may not proceed without the authorisation of a designated authority.
 Witness Point – A 'witness' point provides a party (such as the builder, engineer, architect, client, or supervisor) with the opportunity to witness the inspection or test or aspect of the work, at their discretion.
 Surveillance – Intermittent monitoring of any stage of the work in progress.
 Self Inspection – Where the supervisor of the team performing the work verifies the quality progressively via checklists.

Visual & Performance Mockup




Site Installation

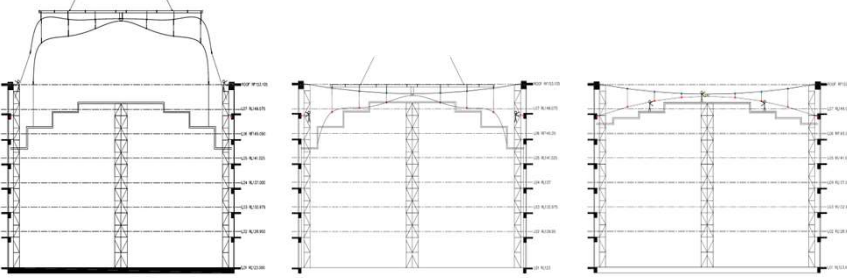


Site Installation




vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.

Installation Methodology



- Preinstallation
- Craned jig
- Birdcage Scaffold

- Top chord secured
- Gutter placed and positioned

- Bottom chord secured
- Truss pretensioned
- Gutter welded in place


41


vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.


Site Installation




42


vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.


Cable Terminations



43


vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.

Central Gutter Arrangement



44

Air Inflation

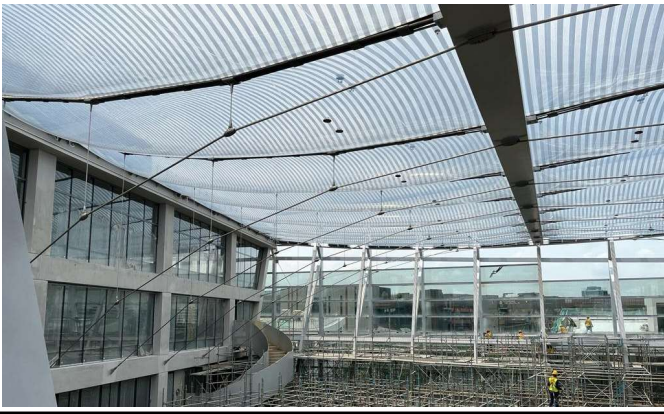
RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.



45

Case Study: Surbana Jurong

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.



46

Completed Project

RONSTAN vector foiltec
TENSILE ARCHITECTURE CREATE. SUCCESS.



World Architecture Festival 2023 – Best Office Building & World Building of the Year finalist

47