SOUTHERN AFRICAN INSTITUTE
OF STEEL CONSTRUCTION

Tass Engineering

KES Aquatic Centre, Steel Awards 2022

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THE PROJECT BRIEF

CLIENT: King Edward VII School

ARCHITECTS: Shed Design + Architecture

MAIN CONTRACTOR: Akhane Construction

Client Brief

Uncovered Ageing Pool

- Replacement of the uncovered pool and stands with covered arena while retaining the original 1927 northern entrance
- Achieve new design of 2,750m2 under roof including changing facilities, a multi-purpose area and two state of the art swimming pools for waterpolo / swimming

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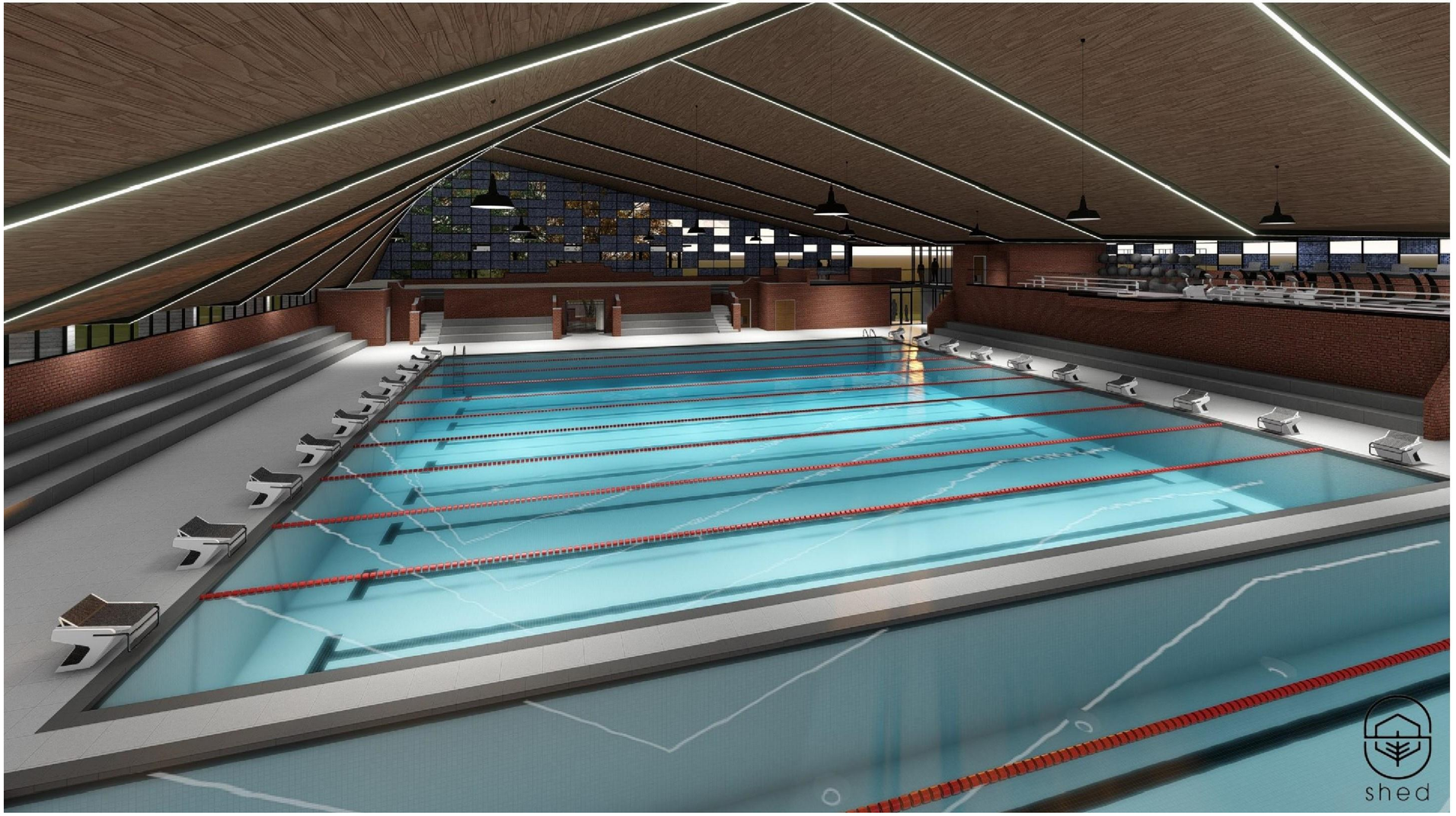

Architectural Conceptual Render
(Competition Stage)

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Architectural Schematic Render
(Post Co-ordinated Engineering Input)

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THE PROJECT OVERVIEW

PROJECT OVERVIEW

STRUCTURAL STEELWORK

Project Completed: December 2020

Steelwork Completed: Roof – June 2020; Rest – September 2020

Tonnage: 90 tons

Profiles used: Plate Girder | CHS Bracing | CRLC & UB Purlins | EA Sag Angles | SHS Façade Girts | RHS Façade Columns | UB Brick Lintels (built-in)

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PROJECT OVERVIEW

STRUCTURAL STEELWORK

Structural Engineer: WCSE

Steelwork Contractor: Tass Engineering

Steel Detailer: 3D Struct

Steel Merchant: CFLC – Allied Steelrode,

SHS / RHS – Macsteel / Tubecon

Plate Girder webs & Flanges – Fast Flame profiling

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PROJECT OVERVIEW

METAL CLADDING AND ROOFING

Project Completed: December 2020

Cladding Completed: August 2020

Cladding Material Used: Chromadek Z200

Cladding Profile: Zip-Tek 420

Cladding Area Coverage: 2,750m^2

Cladding Tonnage: 18.23t

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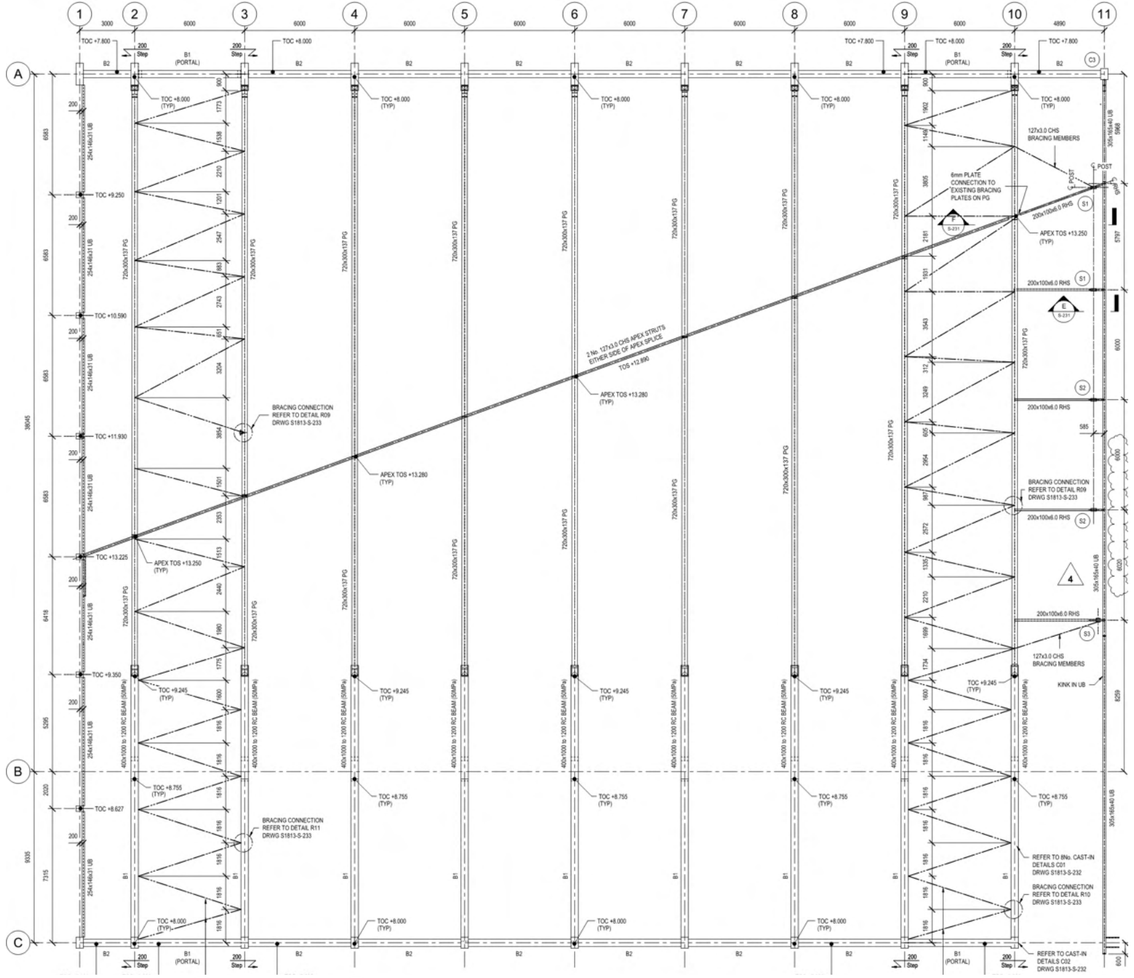
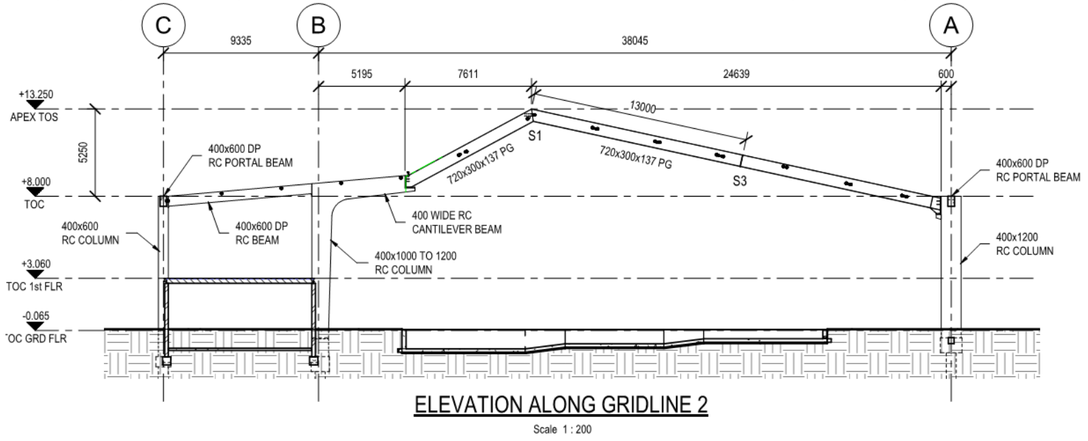
STRUCTURAL FRAMING

STRUCTURAL ENGINEER: WCSE

STEELWORK CONTRACTOR: Tass Engineering

STEEL DETAILER: 3D-Struct





ELEVATION ALONG GRIDLINE 2

Scale 1 : 200

Structural Framing Overview

- Roof split into repetitive RC eastern portal bay of 9.0m span by 8.0m height, and irregular long span portal steelwork roof over pools
- Apex is sliding on plan by 20m over full length of roof (360mm step per m run) but at same height of 13.25m above ground level
- Main span is 38m span between eastern RC portal and western RC column
- RC cantilever of 5m, then 720x300x137kg/m plate girder steel rafter spanning 33m
- Connection between RC and plate girder rafters are high moment connections using Peikko COPRA M39 Couplers – first of its kind in Africa – transferring up to 544kNm on the beam-to-rafter connection and 848kNm on the rafter-to-column connection
- Stability of main roof provided by two CHS braced bays and RC portal beams in these bays for north-south direction, and by double portal frames in the east-west direction
- Cold rolled lipped channel purlins take double curvature of roof surface to support Lambdaboard thermal & sound insulation and Zip-Tek 420 sheeting by GRS
- Over 1927 heritage northern entrance, RHS columns are used to support last bay at façade line, plus UB cantilever pulrins for entrance canopy
- Façade support girts are SHS elements between columns

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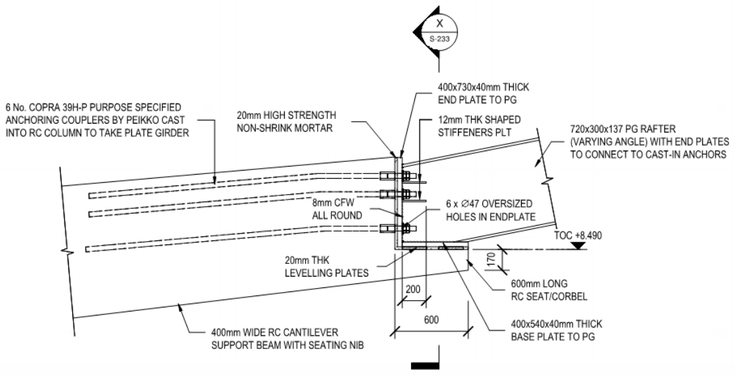
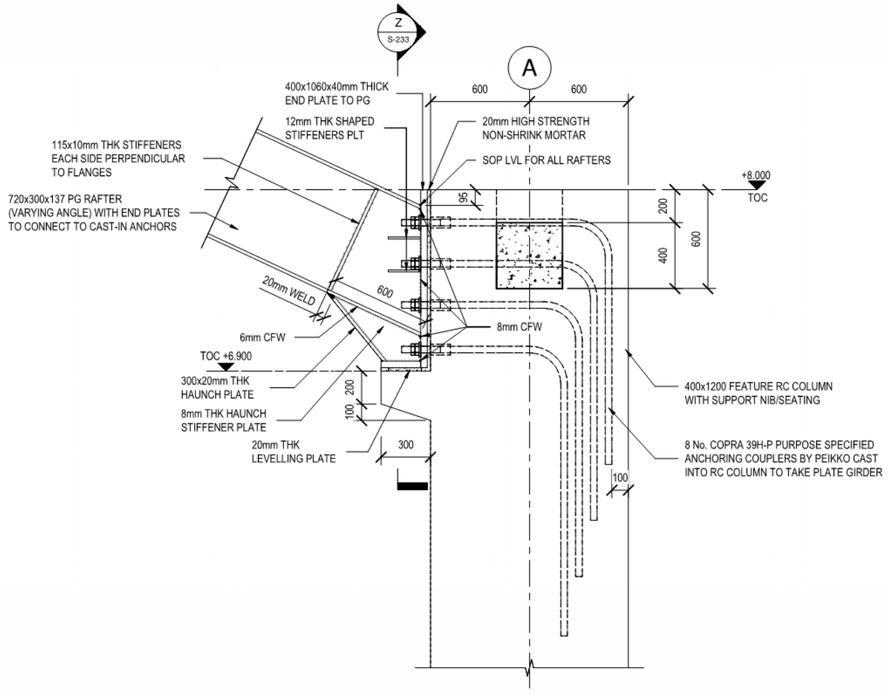


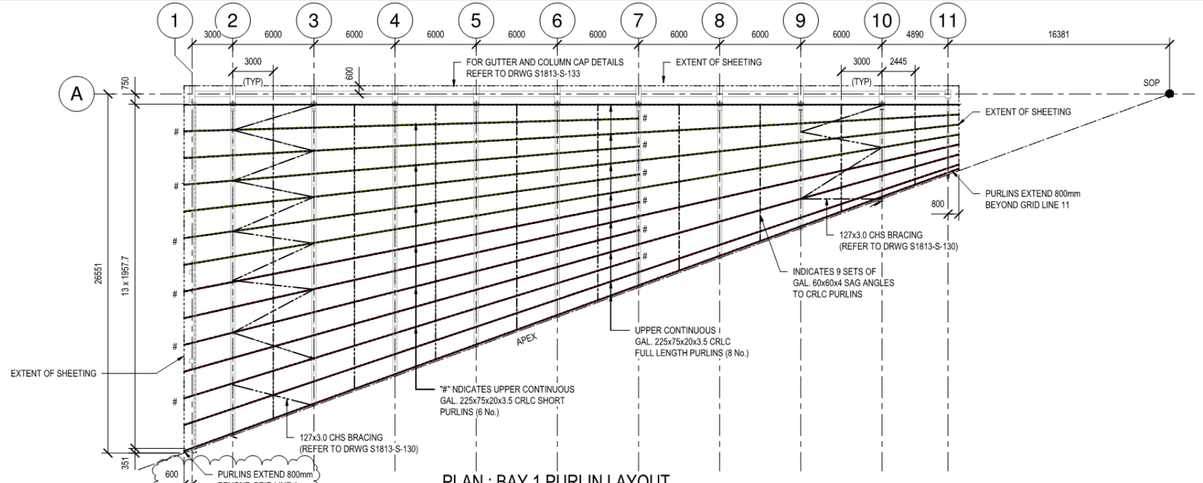
DETAIL C03 - CAST-IN ANCHOR REQUIREMENTS

Scale 1 : 25



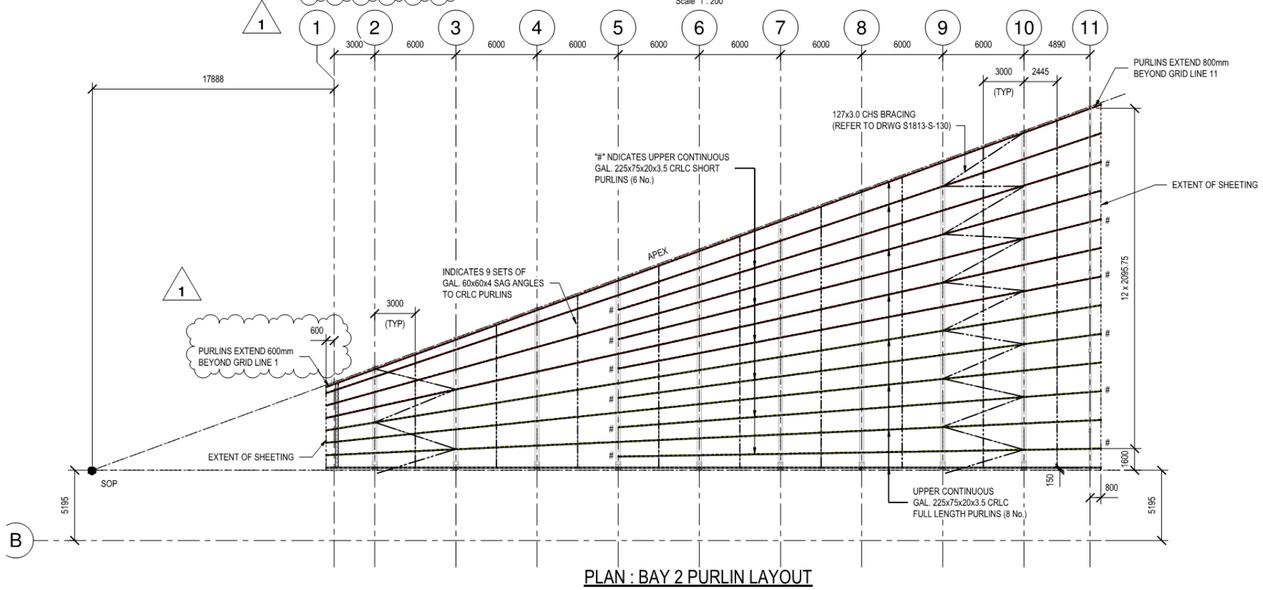
DETAIL C04 - CAST-IN ANCHOR REQUIREMENTS

Scale 1 : 20

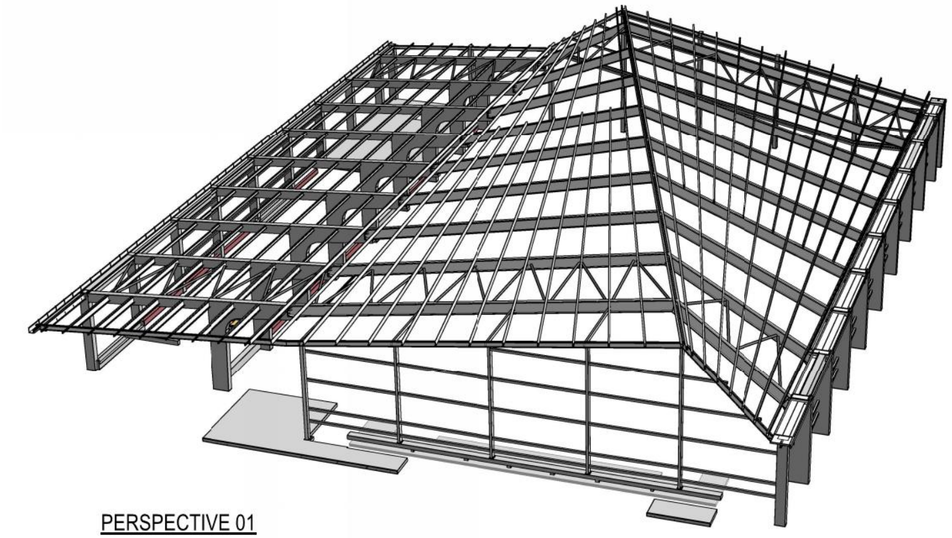


PLAN : BAY 1 PURLIN LAYOUT

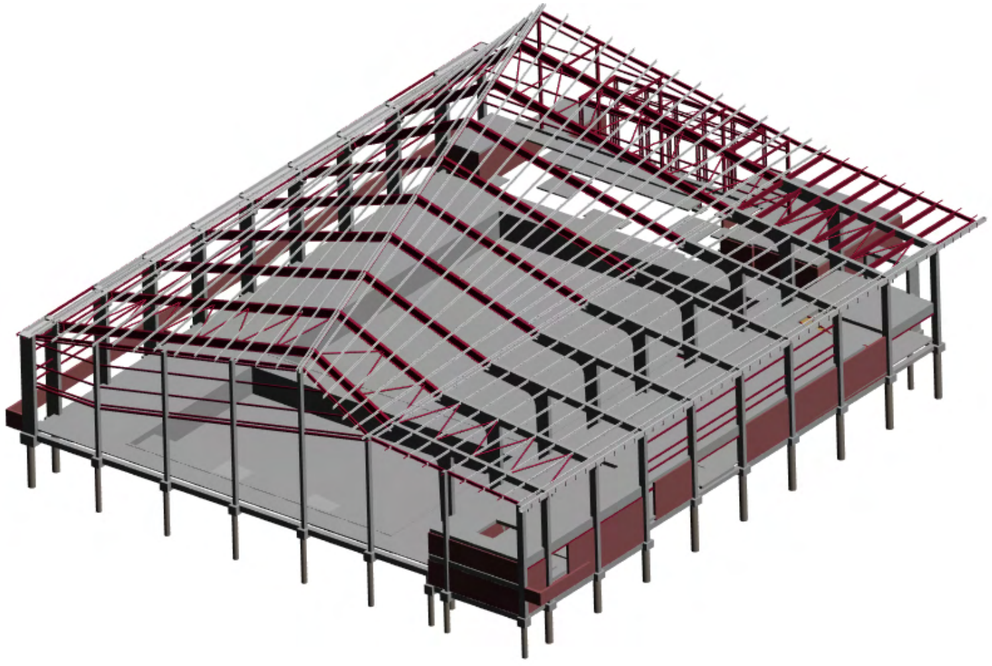
Scale 1 : 200

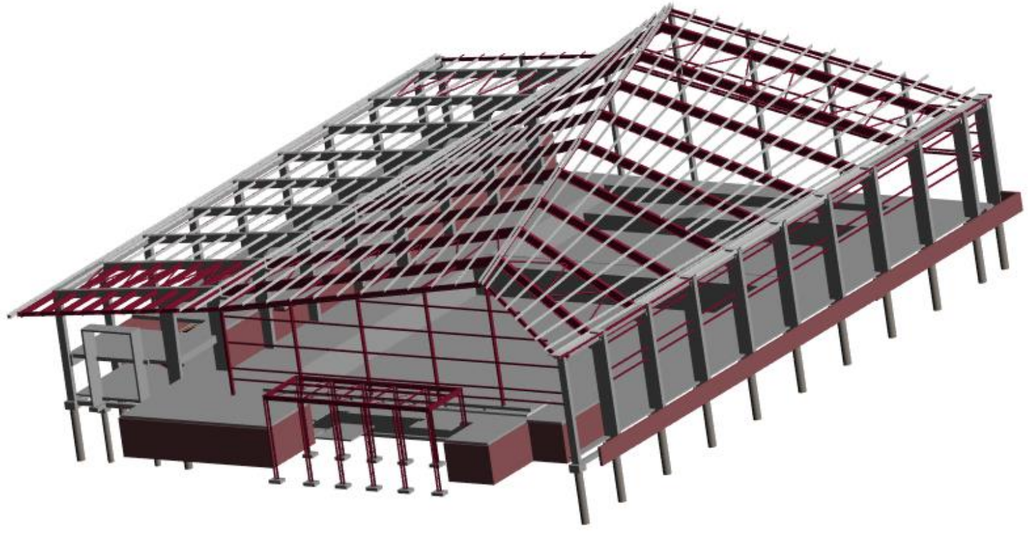


PLAN : BAY 2 PURLIN LAYOUT



PERSPECTIVE 01





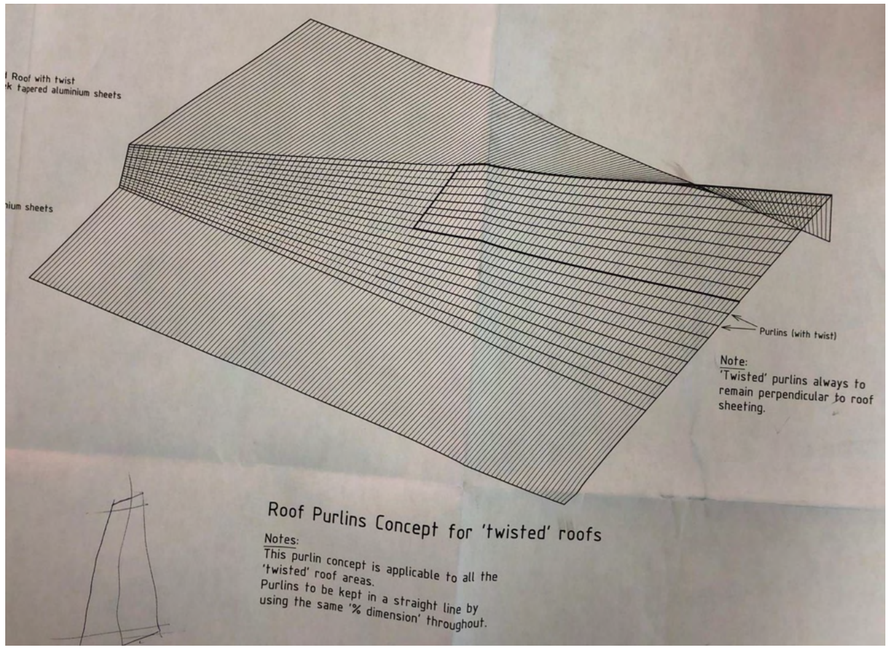
METAL CLADDING/ ROOFING

CLADDING MANUFACTURER: GRS Roofing

CLADDING ROLL FORMER / PROFILER: GRS Roofing

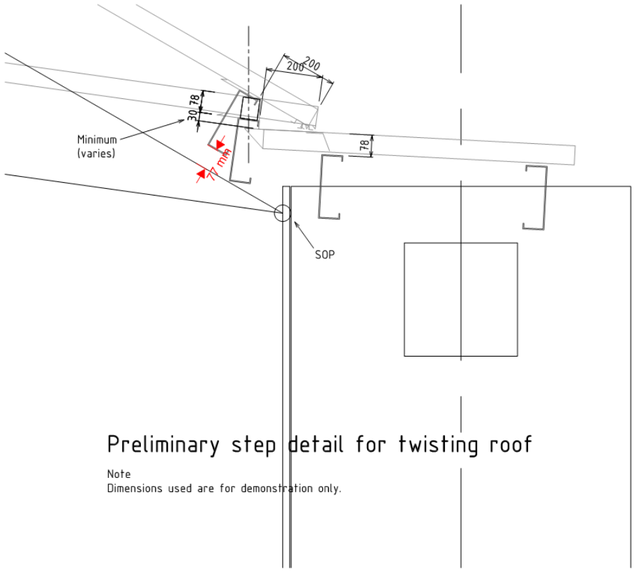
CLADDING/ ROOFING SUPPLIER: GRS Roofing

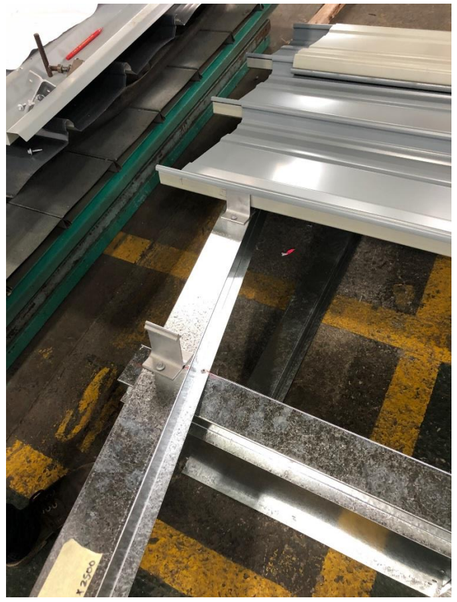
CLADDING/ ROOFING CONTRACTOR: Lowveld Roofing Solutions



Sheeting Journey

- Early-stage engagement with GRS Roofing to define sheeting constraints for double curvature
- Several workshops and proposal on tapered sheets, step requirements at critical junctions and purlin requirements
- GRS Zip-Tek 420 sheet proposed from Chromadek Z200 sheet
- Detailed sheeting drawings and details done by GRS in agreement with Architect and Structural Engineer
- Full scale worst bay mock-up done at GRS to confirm concealed fixing of Zip-Tek 420 sheet adequate to twist
- Over purlin integrated Lambdaboard acoustic and thermal insulation panels proposed by Architect reviewed and approved by GRS Roofing
- Insulation, sheeting and flashings installed by Lowveld Roofing Solutions





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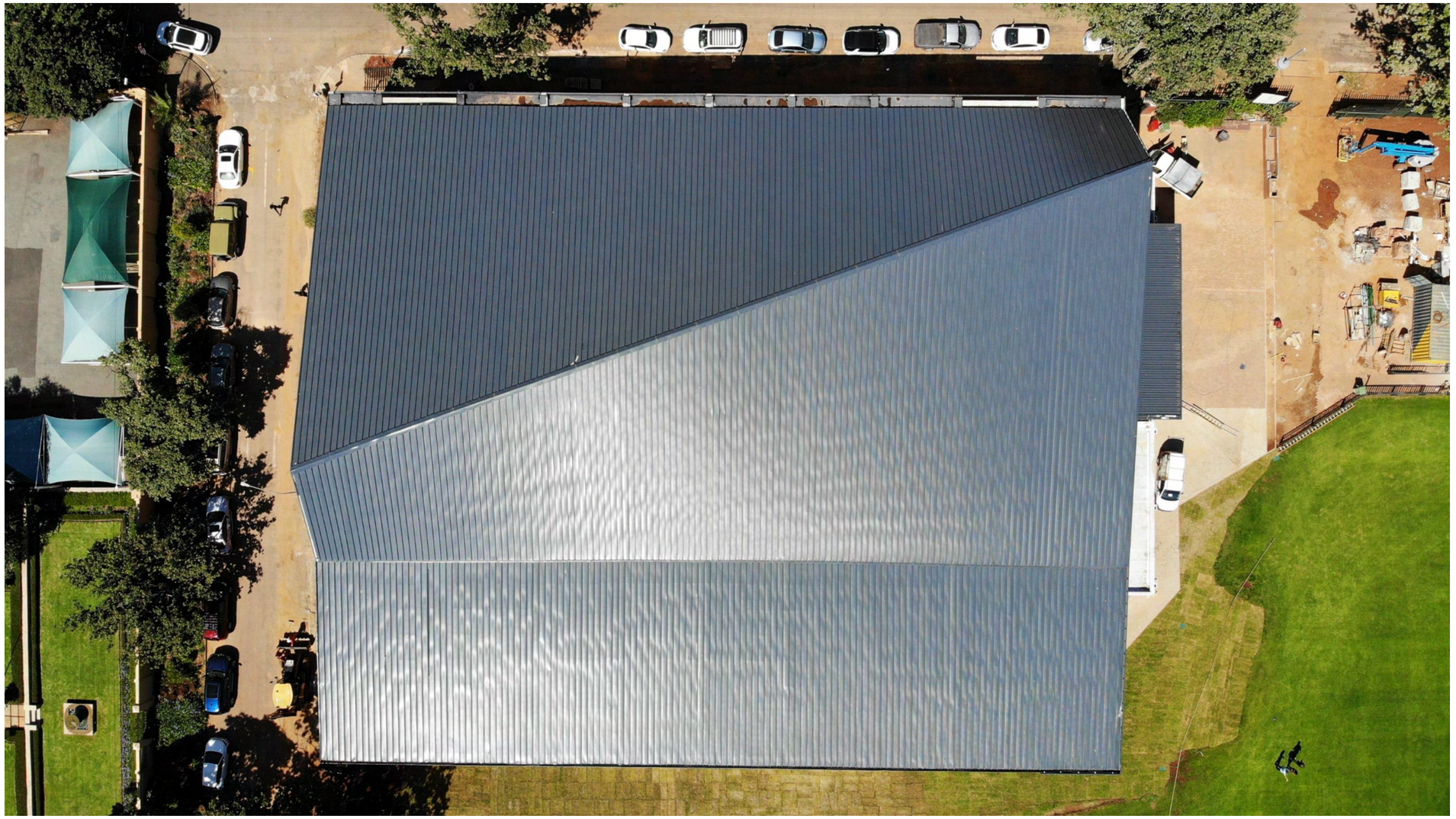

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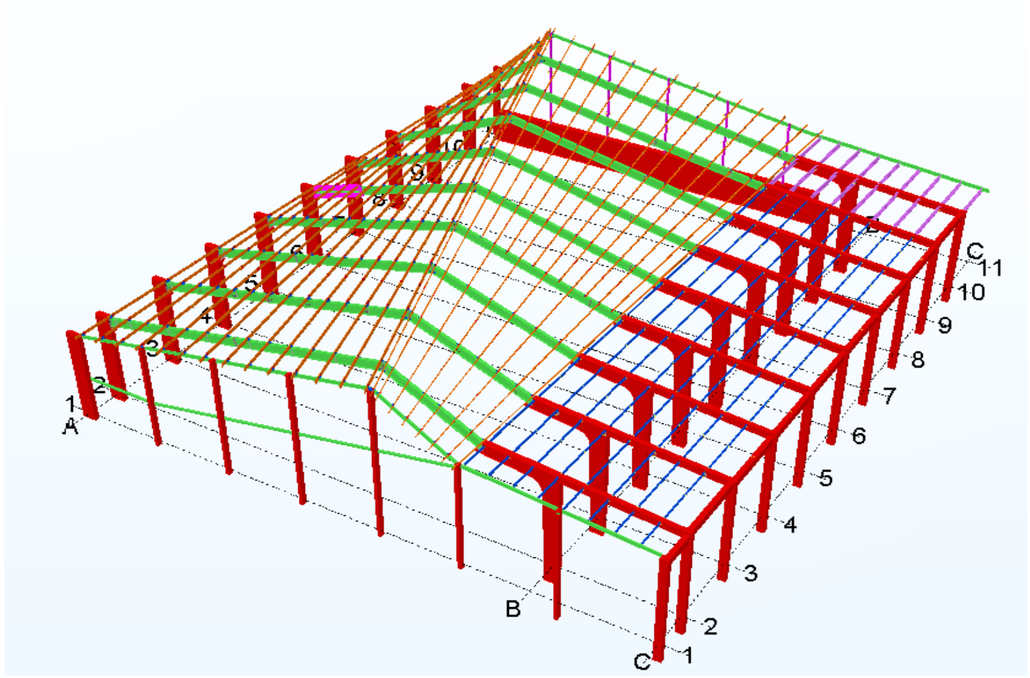
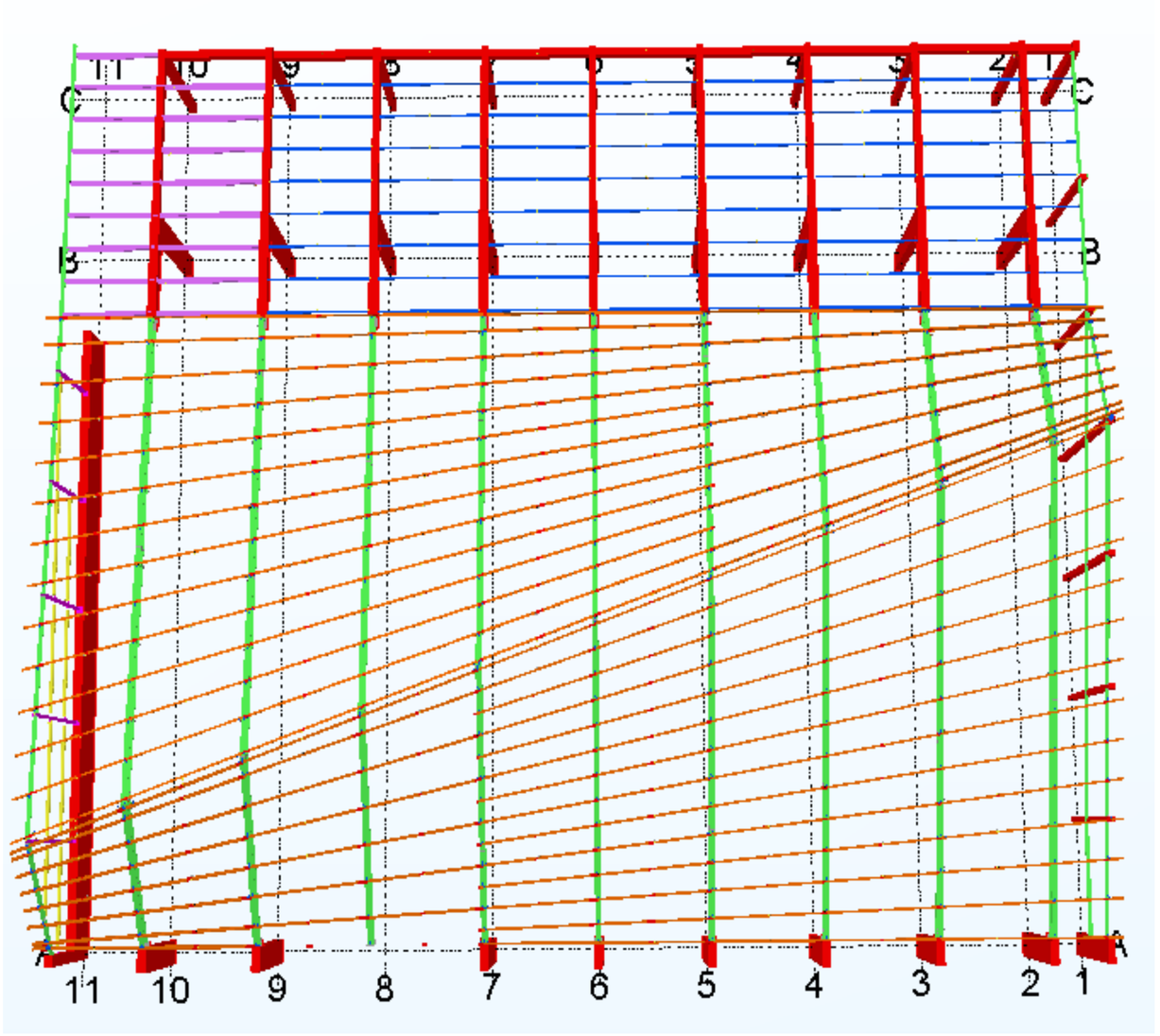
FABRICATION

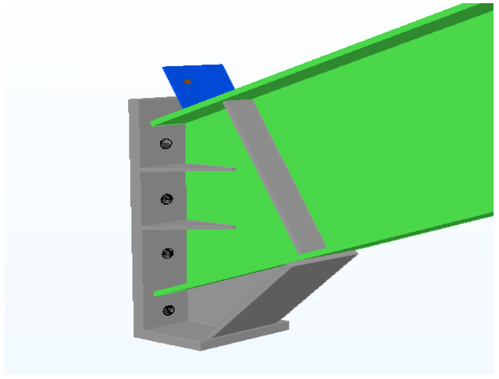
STEELWORK CONTRACTOR: Tass Engineering

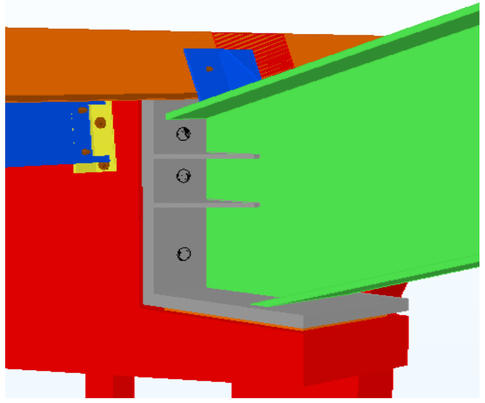
Fabrication Detailing

- Tekla Structures – 3D Model
- Detailer: Werner Herholdt (3D – Struct)









Shop Fabrication

Section size Overview:

- Plate Girders – PG720x300 (20mm Flange / 8mm Web)
- Purlins - CFLC225*75*20*3.5 (Min 200Mpa)
- Cantilever Purlins – UB406x178x54
- Rafter Cross Bracing & Tie beams - CHS127.0*3.0
- Façade support rails – SHS120x120x4 / RHS200x150x6
- Gable columns – RHS300x140x8
- Sag Bars - L60*60*4
- Gutters – 3mm Mild Steel

Plate Girder Web & Flange plates:

Material specification and specific design requirements:

- Plate Girders – Sub Merged Arc welding 8 – 10m Partial Penetration CFW
- Purlins - CFLC225*75*20*3.5 (Min 200Mpa)
- Welding requirements - AWS D1.1 / Only Certified Welders
- UB406x178x54 cantilever beams site welded to cast in plates

Plate Girder blanks completed:

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Plate Girder assemblies complete with welding in progress:

3mm Gutter shells bent up and ready for assembly:

Corrosion Protection

- Hidden steelwork & Plate girders – Sand blasted to SA2.5 /Type IA
- Architecturally exposed steelwork – Sand Blasted to SA3.0 / Type ED
- Purlins & Sags – CFLC Hot Dip Galvanized to Min 85 Microns
- Gutters – Hot Dip Galvanized
- All Bolts – Hot Dip Galvanized

Type - ED

External Decorative (exposed to the elements and not concealed)

Surface Preparation as per notes above			
Coat	**Material** Note 1 & 3	**Thickness** Note 2/ **microns**	**Application**
Primer	Zinc phosphate	75	Shop
Intermediate	Multipurpose undercoat	35	Shop
Finish	Alkyd Base Enamel (colour to Architect's requirements)	35 minimum	Site
Below Surface Bed (buried section)	Black Alkyd base enamel (when required)	70	Site

Type - IA

Internal Aggressive (internal and not concealed with aggressive swimming pool environment)

Surface Preparation as per notes above			
Coat	**Material** Note 1 & 3	**Thickness** Note 2/ **microns**	**Application**
Primer	Two-pack high build polyamide cured anticorrosive epoxy primer (e.g. SigmaCover 350 HS)	150	Shop
Finish	Two-component aliphatic acrylic polyurethane finish*1 (e.g. SigmaDur 550) (colour to Architect's	40 minimum	Site

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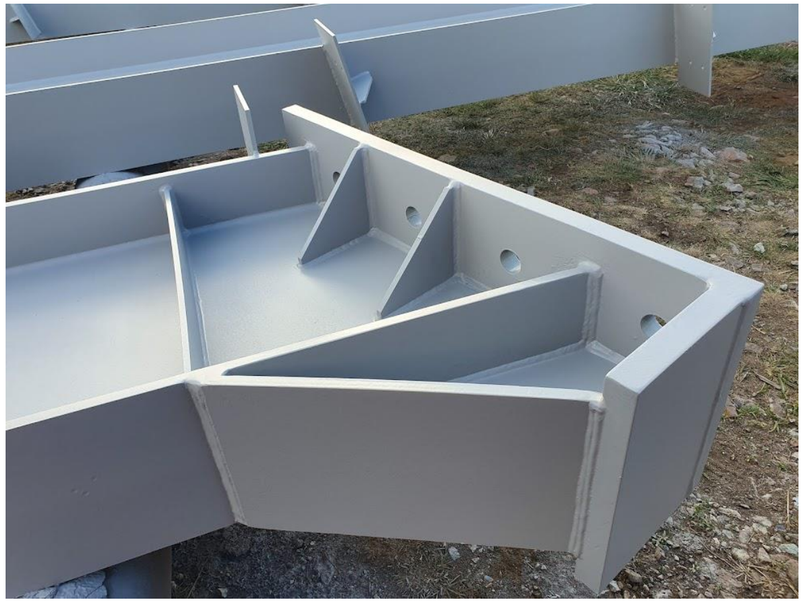
Steelwork complete and ready for site delivery:



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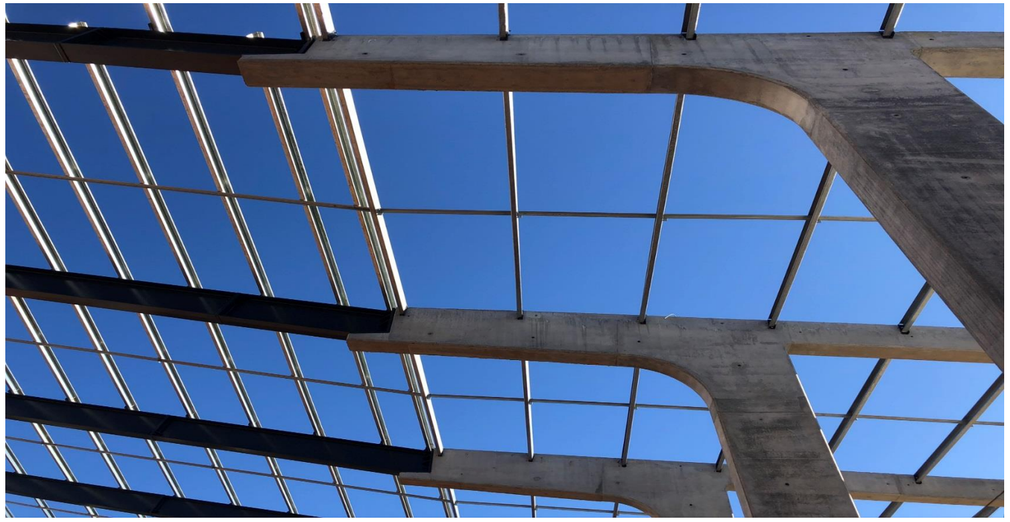
ERECTION / CONSTRUCTION / INSTALLATION

CONTRACTOR: Tass Engineering

Steelwork Erection

- Plate girder erection on 16th and 17th January 2020
- Cranes utilized:
- 25ton Mobile crane for offloading steelwork, stacking and infill work
- 160ton Mobile crane to lift Fully assembled Plate girder portal frames
- Assembled portal frame weight: 5.5 ton



- Bulk of remaining roof steelwork erected up to Covid lockdown in March 2020
- Last sections completed in May & June 2020 to main roof
- Due to program constraints the swimming pool construction commenced at the same time as the steel fabrication and corrosion protection.
- Scaffold platforms were constructed inside the swimming pool below each portal frame assembly to support the steelwork ahead of being lifted.
- Each portal frame is unique and hence great care had to be taken to ensure each assembly have been assembled and placed accurately.
- Due to space constraints on site, the erection crane had to be set up in the road.
- Concrete columns had to be cast extremely accurate with Peikko COPRA Couplers in place.

CHALLENGES AND SOLUTIONS

Design:

- Creating a sleek slender structural solution within a long-span irregular architectural space **= portalized plate girder solution to optimize structural depth**
- High moment portal connections at end of plate girders to RC supports that are visible and needed robust yet elegant solution **= Peikko cast-in COPRA coupler solution**
- Corrosion protection within aquatic environment = **specify aggressive coating system to plate girders and 85-micron min coating thickness to galvanized cold rolled sections**

Fabrication and Erection:

- CFLC material had to be SAE1008 with min 200MPa material grade. Since SAE1008 CQ material do not come with a material certificate, material samples from two coils were sent to Metlab to be tested. QC passed coils were allocated, quarantined and used specifically for KES.
- The minimum galvanized coating thickness requirement for the CFLC material were 85 microns. Due to the influence the material composition of thin gauge material has on the galvanized coating thickness, the code minimum acceptable thickness is 70 microns. Similar samples to the above were hot dip galvanized prior to rolling and manufacturing of the purlins to ensure the engineer's minimum thickness of 85 microns could be guaranteed.
- Detail modelling had to be done carefully due to the twist on purlins.
- High levels of quality control were required to ensure all steelwork have been fabricated accurately.

THE BENEFITS OF STEEL IN THIS APPLICATION

Why Steel?

- High strength to weight ratio ideal for long span roofs
- Off-site fabrication lends itself to the irregular components of the feature roof – itemized component design and fabrication
- Compatibility with regular support RC frame
- Speed of erection
- Competitive market locally
- Local skill set of subcontractors
- Aesthetic simplicity

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