◆ **DAVID SMITH ASSOCIATES LLP** ◆ **Consulting Structural & Civil Engineers** ◆
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F A O Dylan Smith

23rd July 2024 JB/24/55099/CS

Dear Dylan

RE: SPLASH POOL, RUSHDEN – ROOF ASSESSMENT

Thank you for your request for us to carry out a design assessment with regards to the above project. We confirm we have visited the above property on 11th July 2024. The scope of our services was to carry out a design assessment of the existing roof structure. The purpose of the design assessment was to assess the existing structural roof for the installation of solar PV panels.

In principle, this is a multi-bay single storey steel framed with infill masonry panels. The steel frames are comprised of steel trusses with a 31m span supported by steel columns at 5.625m centres. The frames are braced laterally with diagonal roof bracing members.

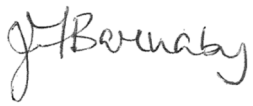
The existing metal sheeting on the 31m trusses is supported by steel purlins (PFC 180 x 75) spaced at approximately 1700 mm centres and spanning between the trusses. Refer to typical Photographs in Appendix A of this report.

The proposed loading was supplied by yourselves and can be found in Appendix B of this report.

The design assessment shows that the existing roof structure can safely support the proposed new loading without effecting the existing structure and its relevant safety factors. A copy of our load assessment can be found in Appendix C of this report.

We trust the above is satisfactory for your immediate requirements. However, should you require any further information, please do not hesitate to contact the above office.

Yours sincerely



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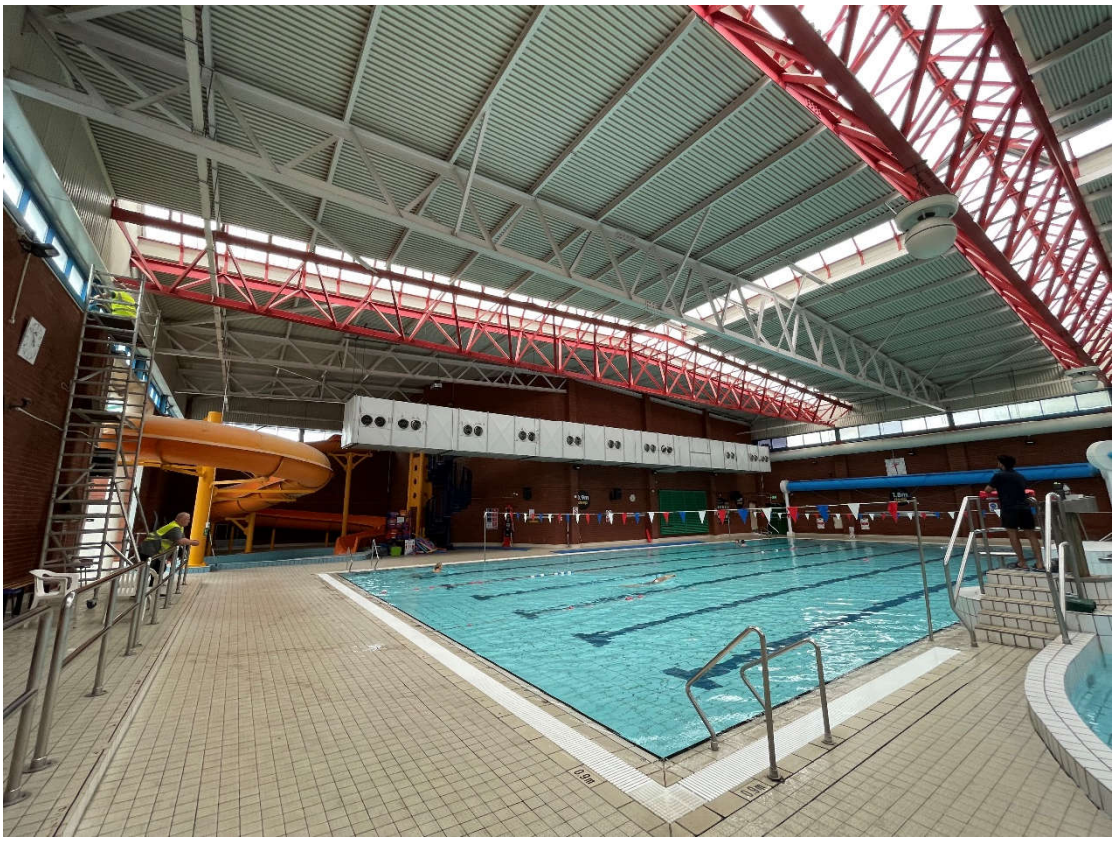
A P P E N D I X A

Typical Photographs



Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

A P P E N D I X B

Proposed Loading

Residential / Commercial

DMEGC SOLAR

N-Type

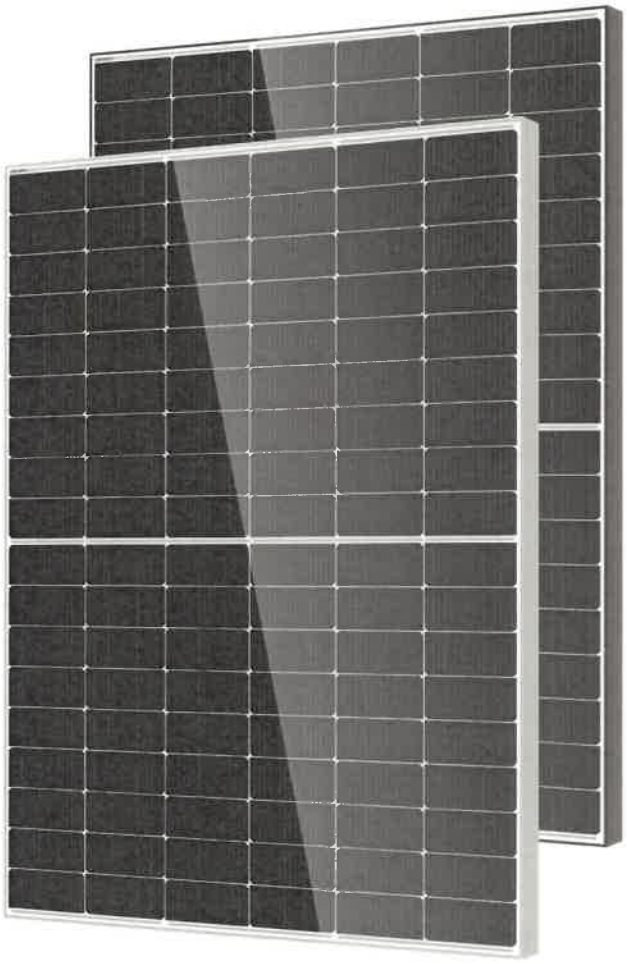
MONO-FACIAL MODULE

Type: DMXXXM10T-54HSW/HBW

PRODUCT 20 YEARS WARRANTY

Power Range: 420 - 435 W

Max. Efficiency: 22.28 %



Better Performance

Our modules perform better on sunny and hot days thanks to its optimized temperature coefficient.

Excellent Low Light Performance

Our modules can also provide higher power output under low light conditions, such as sunset, cloudy, or dawn.

Excellent Quality

More than 40 years' experience of manufacturing and intensive quality tests above the IEC standard ensures reliable modules and a secured investment.

Assumption of Environmental, Social and Governance Responsibility (ESG)

DMEGC stands for his responsibility. Production is certified according to SA 8000 (ILO standards).

High-quality service

We provide a customer-oriented and localized services, covering pre-sale, sale and after-sales.

Certifications

SA 8000	ILO Standards. Social responsibility standards
ISO 9001	Quality management system
ISO 14001	Environmental management system
ISO 45001	Occupational health and safety management system
ISO 50001	Energy management system

DE 50188598

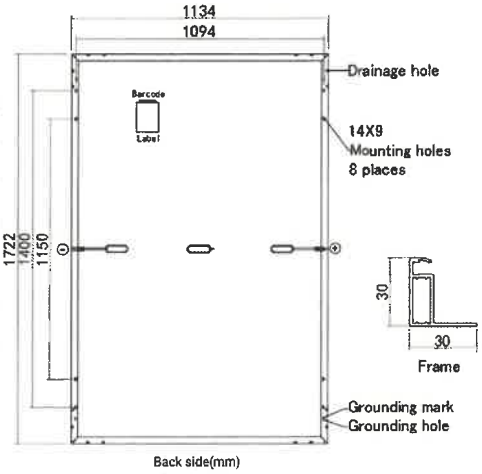
SolarPower Europe Member

A member of Hengdian Group

DMXXXM10T-54HSW/HBW

Module Specification

Cell Type	N -type Mono-crystalline , 108 (6x18)
Dimensions (mm)	1722 x 1134 x 30
Weight (kg)	21.2
Front Cover	3.2 mm tempered solar glass with anti -reflective coating
Rear Cover	Backsheet
Junction Box	3 Diodes, IP68 according to IEC 62790
Cables	4 mm²solar cable, 1.1 m or Customized Length
Connector Type	PV-ZH202B or MC4 (1000V) PV-ZH202B or MC4-EVO 2A (1500V)



Electrical Specifications[1]

Module Type	DM420M10T-54HSW/HBW DM420M10T-54HSW/HBW -V		DM425M10T-54HSW/HBW DM425M10T-54HSW/HBW-V		DM430M10T-54HSW/HBW DM430M10T-54HSW/HBW -V		DM435M10T-54HSW/HBW DM435M10T-54HSW/HBW -V	
Testing Condition	STC[2]	NMOT[3]	STC	NMOT	STC	NMOT	STC	NMOT
Maximum Power (Pmax/W)	**420**	316	**425**	320	**430**	323	**435**	327
Maximum Power Current (Imp/A)	13.14	10.54	13.20	10.59	13.27	10.64	13.34	10.70
Maximum Power Voltage (Vmp/V)	32.01	30.01	32.21	30.20	32.41	30.39	32.61	30.57
Short-circuit Current (Isc/A)	13.78	11.12	13.83	11.16	13.88	11.21	13.93	11.25
Open-circuit Voltage (Voc/V)	38.39	36.47	38.58	36.65	38.77	36.83	38.96	37.01
Module Efficiency STC (%)	**21.51**		**21.76**		**22.02**		**22.28**	

[1] Measurements according to IEC 60904-3, Measurement tolerance: ISC: ±4 %,VOC: ± 3 %,
[2] STC (Standard Test Condition): Radiation 1000 W/m², Module temperature 25℃, AM = 1.5
[3] NMOT: Radiation 800 W/m², Ambient temperature 20℃, AM = 1.5, Wind Speed 1 m/s

Certifications and Warranty

Certifications	IEC 61215, IEC 61730
	Ammonia Corrosion Test: IEC 62716
	Salt Mist Corrosion Test: IEC 61701
	PID (IEC TS 62804); LeTID (IEC TS 63342)
	Dust & Sand (IEC 60068)
WEEE Registration No.	DE 50188598
Product Warranty	20 years
Peak Power Warranty	30 years linear warranty

1.) First year: min. 99 % 2.) From the 2nd year: Max. 0.4 % degradation annually. 3.) Min. 87.4 % in the 30th year.

Operating conditions

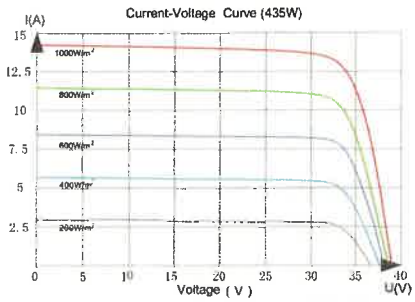
Operating Temperature (℃)	-40 to +85
Maximum System Voltage(V)	1000V/1500V DC (IEC)
Overcurrent protection rating (A)	25
Power Performance Tolerance (%)	0 / +3
Protection class	II
Max. Test Load, Push/Pull (Pa)	Snow 5400 / Wind 2400
Max. Design Load, Push/Pull (Pa)	3600 / 1600

Temperature Characteristics

Nominal Module Operating Temperature (NMOT)	45 ± 2 ℃
Temperature Coefficient of Pmax (%/ ℃)	-0.31
Temperature Coefficient of Voc (%/ ℃)	-0.25
Temperature Coefficient of Isc (%/ ℃)	+0.060

Packaging

Container	40' HQ
Pallet Dimensions(mm)	1770× 1140 × 1250
Pieces per Pallet	36
Pieces per Container	936



Statement: The installation instructions and the warranty conditions must be followed Due to technological progress, product parameters will be adjusted accordingly.When signing the contract, the latest data of the company shall prevail

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Hengdian Industrial Zone, Dongyang City Zhejiang Province, China 322118
Tel: 0086-579-8658-8825 Fax: 0086-579-8655-4845
E-mail: solar@dmegc.com.cn, Website: www.dmegcsolar.com

All information in this data sheet corresponds to EN 50380.Changes and errors excepted.
Status: 09/2023, Document: **EN_DS-M10T-54HSW/HBW-202309_3**

A P P E N D I X C

Load Assessment

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ROOF INSPECTION
SPLASH POOL
RUSHDEN

STRUCTURAL CALCULATIONS

.

Prepared by: **OAM / HBJ**

Date: **JULY 2024**

Reference: **24 / 55099**

DSA LLP VAT REG : 443 6613 95

Eur Ing **David Smith** BSc(Hons), C.Eng, MICE, FIStructE, CMaPS, MFPWS, FCABE, ACIArb,
Hitesh Jethwa BSc Eng (Hons), I.Eng, IMIStructE **Steven Ainge** B.Eng (Hons), I.Eng, IMIStructE
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Design Notes **Job Ref: 24/55099**

RE: ROOF INSPECTION, SPLASH POOL, RUSHDEN

The following calculations are in respect of our clients brief relating to **specific structural elements listed on the following page(s).** No responsibility is accepted in respect of other elements of the building. Any assumed bearing stresses must be confirmed on site to the satisfaction of the Building Control Officer.

Dimensions have been obtained from information provided and where no figured dimensions have been provided, scaling has been used. **Dimensions indicated on the following calculations are for design purposes only and must not be used for constructional purposes. All dimensions for construction are to be obtained by site measurements prior to manufacture / building**.

Appended sketches are to demonstrate certain features of the design and are not intended as working drawings. Where shown, details are intended to identify the main structural features. It is assumed that the work will be carried out by experienced and competent personnel, therefore exhaustive detailing is not required.

Where constructional connection details are indicated on these calculations, these shall not be varied. Any proposed changes should be substantiated by calculation, submitted and approved in writing by the Engineer before fabrication is commenced.

Where Building Control approval is required it is essential that this be obtained before the works proceed or materials are ordered. The contractor must ensure the stability of each element, and overall stability of the construction is maintained until all the works are completed.

REFERENCES

British Standards and Codes of Practice indicated below have been used in the preparation of these calculations - all constructional details must be in accordance with all relevant clauses contained in these same standards, associated standards or manufacturer's recommendations and details and normal good practice.

Loadings	[BS 6399 - Part 1:1996, Part 2:1997, Part 3:1988] [BS 648:1964]
Concrete	[BS 8110 - Part 1:1997, Part 3:1985] [BS 8007 : 1987]
Foundations	[BS 8004:1986] [BS 8002 : 1994]
Timber	[BS 5268 - Part 2:2002]
Masonry	[BS 5628 - Part 1:2005, Part 2:2005, Part 3:2005]
Industrial Floor Slabs	[Concrete Society Technical Report 34 (2nd Edition)] [C & CA Technical Report 550] [BCA Tech Note 11]
Steelwork	[BS 5950 - Part 1:2000, Part 3:1990, Part 5:1987, Part 8:1990] [BS 2853:1957]

ISSUE RECORD

Prep. by	Chkd by	Documents / Sheets / Drawings Issued	Description of Relating Structural Elements	Issue Date
OAM		Structural calculations Pages 1-15	ASSESSMENT OF EXISTING ROOF STEELWORKS.	22/07/2024

HEALTH & SAFETY

Where appropriate, the Client will be the/or appoint a, Principal Designer to act on his behalf who will ensure that where applicable the "Construction (Design and Management) Regulations 2015" are adhered to.

The Principal Contractor must at all times ensure safe working practices, maintain the integrity of the existing structures and conform to all the appropriate requirements of the Health and Safety Executive including the "Construction (Design and Management) Regulations 2015".

The working methods of any hazardous operations must first be discussed with the Principal Designer and the designer prior to commencement.

Below are identified hazards that are either impractical or uneconomic to eliminate at the design stage. The list is not exhaustive and must be read in conjunction with the main contractors own Health & Safety policy.

Hazard	Solution/Precaution/Sequence
Demolition and creation of new openings	To be carried out in accordance with prepared demolition statement ensuring structural integrity of existing building at all times. Openings should follow published procedure in Building Research Establishment publication GBG20 "Removing internal loadbearing walls in older dwellings".
Scaffolds	Scaffolds erected and used in accordance with BS5973. Scaffolds and propping must be inspected by a qualified person before use and at least once per week to ensure they are fit for use.
Personnel working at height	Works to be properly supervised with personnel provided with safe working platforms.
Lifting	Adequate means for moving and positioning elements to be available. Handling and construction to be carried out in accordance with relevant HSE 7 BS guidelines. Individuals are not to manually lift more than 25kg.
Deep excavation	No one shall enter an excavation deeper than 1.2m without adequately designed temporary shoring being in place. Where foundations are deeper than 2.5m they should be constructed in two pours.
Open trenched footings	Access to unattended trenches to be protected.

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Job Ref: 24/55099

RE: ROOF INSPECTION, SPLASH POOL, RUSHDEN

Dimensions

1. **All dimensions for construction to be obtained by site measurements prior to manufacture / building**

Steelwork Specifications

1. Unless noted otherwise, all steelwork to be Grade S275 to BS 5950-2. All materials to comply with BS 5950:2000 and to B.S.C.A. 1/89 - National Structural Steelwork Specification.

2. Unless noted otherwise, all steelwork to be shot blasted to SA 2.5 or mechanically wire brushed to remove all surface contamination, rust or millscale and have 2 coats of zinc phosphate primer applied to achieve a minimum dry film thickness of 75 microns per coat, prior to site delivery.

3. Grade 4.6 bolts to BS4190 and Grade 8.8 bolts to BS3692.

4. Unless stated otherwise, all structural connections to have minimum of 2 bolts. Minimum bolt size for any connection to be M16 Grade 8.8 bolts.

5. Fire surround to all steelwork as per Architects/Local Authority requirements but generally cased in a layer of 12.5mm thick plasterboard and skim.

6. For steel within an external wall cavity (this includes shelf angles and plates supporting external skins that are welded to the bottom flange of beams) the steel should be shot blasted to SA2½ and use 450µm coat of solvent free epoxy applied. Alternatively, the steel may be galvanized to a thickness of 85µm and 200µm of heavy duty bitumen applied in two coats.

General Notes

Works to be carried out regarding installation of new beams/lintels

All works should be carried out by a competent contractor/builder familiar and experienced with the procedures.

1. All works to comply with current British EN Standards and Building Regulations and to be to good building practice.

2. All new steelwork to be to BS EN 10025 1993: Minimum Grade S275 unless noted otherwise.

3. Any bolts to be Grade 8.8 and zinc plated with washers and nuts.

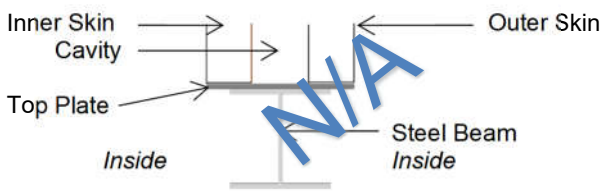
4. All mortar to be 1: 1: 6 (cement: lime: sand) unless noted otherwise.

5. Where new steelwork or other fabricated components are specified, site dimensions must be undertaken by the builder/fabricator to ensure an accurate fit and adequate clearance, etc.

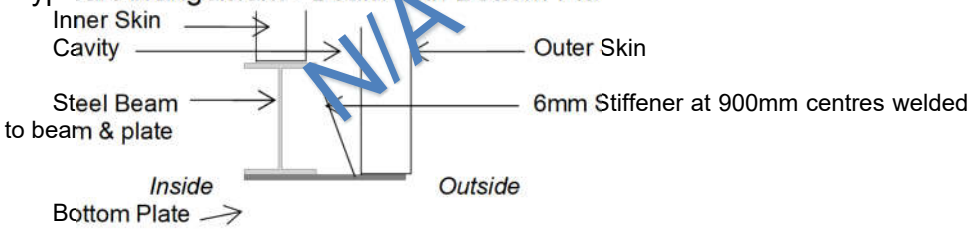
6. Unless noted otherwise, generally steel beam is to be installed so that its centerline coincides with centerline of the wall it is supporting. In case of cavity walls, this will generally be centerline of the overall thickness of the wall including the thickness of the inner skin, cavity and outer-skin (See also Note 8 for variations).

7. Where multiple beams/lintels are indicated to support existing walls, the exact number of beams/lintel is to be determined by the builder on site to suit thickness of wall(s) prior to commencing works in that area and ordering/fabrication of materials. Report immediately to DSA for further advice if site conditions differ to that indicated on the drawings/details.

8. Scenarios for supporting external walls on single beam:
   (a) Typical Arrangement - Beam with Top Plate



(b) Typical Arrangement - Beam with Bottom Plate



9. Where steel beams bear into walls at right angles, fully surround the beam with brickwork to prevent any rotation of the beam.

10. Where steel beams/lintels are required to be concealed within floor/ceiling void, the contractor must take measurements of floor/ceiling void and review the size of beam/lintel specified on the drawings prior to ordering/fabrication of material. Report to DSA for further advice if the specified beam/lintel size cannot be concealed within the floor/ceiling zone due to existing site details.

11. Where walls are to be removed:

a) Fully support wall over the new beams by needling through the wall and supporting needles on Acrow props. Number of needles and props required will depend on the existing structural format, loading and site conditions. Contractor/Builder to be responsible for the necessary temporary works.

b) When wall is supported cut out openings and prepare piers and padstones. Ensure padstone size and full bearing lengths as specified are achieved.

c) Install steel beams and shim / dry pack beams as necessary onto padstones to ensure full load transfer.

d) To minimize cracking of the walls above, preload the new beams by using machined steel folding wedges rammed home.
If the beam is not preloaded there is a risk of initial cracking to the walls above as the load is transferred but this will not be progressive.

e) After preloading the beams dry pack the gap between existing wall and the beam using a minimum thickness of 30mm of sand and cement 3:1 mixed to just bind and then rammed home to ensure a fully packed joint for the full width of the beam/wall.

f) Leave props in place for at least 7 days until the packing is cured.

Exact arrangement of works to suit site specific conditions; if in doubt, Contractor/Builder to contact DSA for further advice prior to commencing of works and ordering/fabrication of materials.

D S A

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Job Title	Job No.
ROOF INSPECTION, SPLASH POOL, RUSHDEN	24/55099

Compliance with BS EN 1090-1:2009 +A1:2011
Execution of steel structures and aluminium structures.
Requirements for conformity assessment of structural components
CE Marking of Fabricated Structural Steelwork

DERIVATION OF EXECUTION CLASS

Table A.1 - Categorisation of Consequence Classes

Example of categorisation of building type and occupancy	Consequence Class
Single occupancy house not exceeding 4 storeys.	**1**

Table A.1 - Definition of Consequence Classes

Description	Consequence Class
Medium consequence for loss of human life; economic, social or environmental consequences considerable Example Residential and office buildings, public buildings where consequences of failure are medium (e.g. an office building)	**CC2**

Table B.1 - Suggested Criteria for Service Categories

Criteria	Categories
Buildings and components designed for quasi static actions only (Example: Buildings)	**SC1**

Table B.2 - Suggested Criteria for Production Categories

Criteria	Categories
Welded components manufactured from steel grade products below S355	**PC1**

Table B.3 - Recommended Matrix for Determination of Execution Classes

Consequence classes	**CC2**
Service categories	**SC1**
Production categories	**PC1**
Execution Class	**EXC2**

a EXC4 should be applied to special structures or structures with extreme consequences of a structural failure as required by national provisions

Execution Class	**EXC2**

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Project No:	24/55099	Sheet No:	1
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

DIMENSIONS IN THESE CALCULATIONS ARE ONLY APPROXIMATE AND THE CONTRACTOR MUST CHECK THE LATEST ARCHITECTURAL DRAWINGS AND MEASURE UP ON SITE BEFORE ORDERING ANY MATERIALS.NO WORK SHOULD START BEFORE THE CALCULATIONS HAVE BEEN RECEIVED AND APPROVED BY THE LA BUILDING CONTROL.

EXISTING ROOF		**SLS**				**ULS**	
0.7 mm external metal profile sheet	=	0.100	KN/m2	x	1.4=	0.140	KN/m2
150 mm insulation	=	0.000	KN/m2	x	1.4=	0.000	KN/m2
0.4 mm internal metal profile sheet		0.000	KN/m2	x	1.4=	0.000	KN/m2
Services	=	0.150	KN/m2	x	1.4=	0.210	KN/m2
		0.250	KN/m2			0.350	KN/m2
PURLIN		0.050			1.4=	**0.070**	KN/m2
		0.300				**0.420**	KN/m2
IMPOSED	=	0.600	KN/m2	x	1.6=	0.960	KN/m2
TOTAL	=	**0.900**	KN/m2			**1.380**	KN/m2
DESIGN FOR UDL =		**0.900**	KN/m2		1.53	**1.38**	KN/m2
WIND LOAD							
	=	0.660	KN/m2	x	1.4=	0.924	KN/m2
		SEE PAGE	2	-	7		
PV PANELS							
NEW ROOF							
MAIN		0.300	KN/m2				
PV PANELS	=	0.150	KN/m2	x	1.4=	0.210	KN/m2
	SUM(0.300 to 0.150)=	**0.450**	KN/m2				
IMPOSED	=	**0.600**	KN/m2		1.050	KN/m2	

(1.050-0.900)*100/0.900= **16.67 % INCREASED**

go to page 8

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DIMENSIONS IN THESE CALCULATIONS ARE ONLY APPROXIMATE AND THE CONTRACTOR MUST CHECK THE LATEST ARCHITECTURAL DRAWINGS AND MEASURE UP ON SITE BEFORE ORDERING ANY MATERIALS.

CHECKING EXISTING PURLINS

EX-P1

SITE SURVEY			FOR CAL.		ASSUMED		Grade S275
Max span =	5.625	m	DL=	0.470 KNm2	DL=	0.470* 1.7=	0.80 KN/m'
Cover =	1.7	m	LL=	0.600 KNm2	LL=	1.7*0.600=	1.02 KN/m'

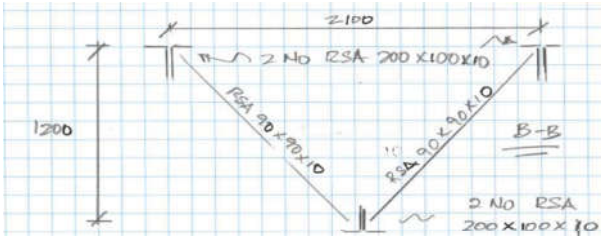
Local capacity	PASS	0.235
Overall buckling 1	PASS	0.274
Overall buckling 2	PASS	0.672
Deflection (dead)=	PASS	1/ 1251
Deflection(live)=	PASS	1/ 1188
Deflection (d+l)=	PASS	1/ 609

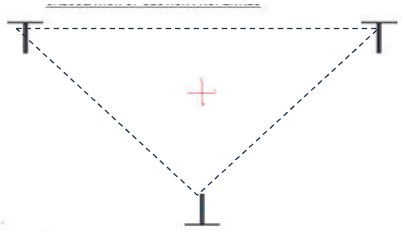
EXISTING ROOF PURLINS ARE CONSIDERED

SEE PAGE 3 - 5

CHECKING EXISTING MAIN FRAMES TRIANGULAR TRUSS)

					ASSUMED		Grade S275	
Max span =	30.6	m	DL=	0.470 KNm2	DL=	0.470* 5.625=	2.64 KN/m'	MULTI SPAN
Cover =	5.625	m	LL=	0.600 KNm2	LL=	5.625*0.600=	3.38 KN/m'	WORST CASE FRAME





Local capacity	PASS	0.698	Deflection (dead)=	PASS	1/ 1105
Overall buckling 1	PASS	0.663	Deflection(live)=	PASS	1/ 863
Overall buckling 2	PASS	0.698	Deflection (d+l)=	PASS	1/ 484

Unfactored dead load deflection= 27.69 mm

Unfactored live load deflection= **35.45** mm

STEEL FRAMES ARE ADEQUATE TO SUPPORT THE EXTRA LOADING FROM THE SOLAR PENELS

SEE PAGE 6 - 9

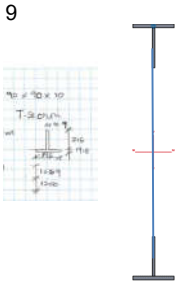
VERTICAL TRUSSES

Local capacity	PASS	0.781	Deflection (dead)=	PASS	1/ 711
Overall buckling 1	PASS	0.742	Deflection(live)=	PASS	1/ 555
Overall buckling 2	PASS	0.934	Deflection (d+l)=	PASS	1/ 312

Unfactored dead load deflection= 42.99 mm

Unfactored live load deflection= **55.04** mm

STEEL FRAMES ARE ADEQUATE TO SUPPORT THE EXTRA LOADING FROM THE SOLAR PENELS



SEE PAGE 10 - 13

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Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

DESIGN OF STEEL BEAM, SIMPLY SUPPORTED

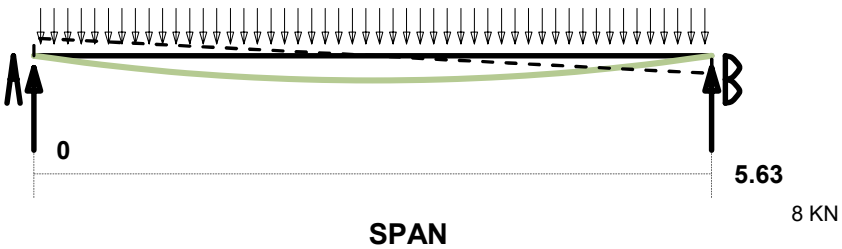
H rolled section S275
Calculation in accordance with BS 5950: 1: 2000

LOCATION= **EX-P1**

Loads are unfactored

Wd= **0.45** KN/m2
Wl= **0.60** KN/m2

Span= **5.63** m
Cover= **1.70** m



SPAN

12 KNm

Load on beam	unfactored	factored	Partial safety factor for load
Dead+s/w=	0.968 KN/m'	1.36 KN/m'	dead= 1.4
Live=	1.02 KN/m'	1.63 KN/m'	live= 1.6
	1.99 KN/m'	2.99 KN/m'	

Reaction

RA=	5.6 KN	**8.4** KN
RB=	5.6 KN	**8.4** KN
Shear zero at		X= 2.81 m
Maximum Bending Moment		**Mx =** **11.8** KNm

					factor
Maximum BM for check	M LT=	10.9 KNm	Local capacity	PASS	0.235
Maximum BM about axis Y	MY=	0.11 KNm	Overall buckling 1	PASS	0.274
Axial compressive load	Fc=	1.0 KN	Overall buckling 2	PASS	0.672
Shear force in x axis	Fv=	8.4 KN	Deflection (dead)=	PASS	1/ 1251
Beam span	L=	5.63 m	Deflection(live)=	PASS	1/ 1188
Effective length about axis X	LX eff=	5.63 m	Deflection (d+l)=	PASS	1/ 609
Effective length about axis Y	LYeff=	5.63 m	Fully restraint for Ly& LX <1.		
Limiting span/deflection (live)	=	**360.0** or 14 mm			
	z rep=	43 cm3			

Section properties

Section size (Ref. No= **411**) **180X75 20.3 kg PFC S275**

Depth of steel section	D=	180 mm					
Width of section	B=	75 mm		Pcy=	80 KN		
Thickness of web	t=	6 mm		Mcx=	48.4 KNm		
Thickness of flange	T=	10.5 mm		Mcy=	14.25 KNm		93.867
Root radius	r=	12 mm		Mb L=	16.9 KNm		
Second moment of area x-x	Ix=	1370 cm4		Mlt=	**0.925**	Pcy=	79.586 KN
Second moment of area y-y	Iy=	146 cm4					
Plastic modulus x-x	Sx=	176 cm3	Sx eff=	149.31	cm3		
Plastic modulus y-y	Sy=	51.8 cm3	Sy eff=	26.23	cm3		
Area of section	Ag=	25.9 cm2	An=	21.58	cm2	ke=	1.2

DEFLECTION

			unfactored
Unfactored dead load deflection=	4.49 mm	E UDL=	0.97 KN/m'
Unfactored live load deflection=	**4.73** mm	E UDL=	1.02 KN/m'
Unfactored dead+ live load def =	9.23 mm	E UDL=	1.99 KN/m'
Span/def. ratio for dead load=	1252		
Span/def. ratio for live load=	**1188**	**>360**	
Span/def. ratio fordead+ live load=	610		

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Project No:	24/55099	Sheet No:	4
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

CONTINUE OF EX-P1

Strength of steel Clause 3.1.1

Design strength **(Grade S 275)**
for thickness of 10.5 mm **py= 275** N/mm2 py= **275.0** N/mm2 pyw= py
Young's Modulus **E=** 205 KN/mm2

Classification of cross section (clause 3.5.2) TABLE 11 rolled section

Constant (table 11 note b) ε = 1.000 class 1 class 2 class 3
Outstand of flange b= 75 mm plastic compac semi compact
Ratio b/T= 7.14 b/Tlim= 9.00 10.00 15.00
The classification is based on the outsatnd element **The section is class1 plastic**
r1 =min(1.0,max(-0.1,Fc/(dxtxpyw)))= 0.00 r2=Fc/(Agxpyw)= 0.001
Depth between fillets d= 135 mm TABLE 11 rolled section
ratio d/t= 22.50 class 1 class 2 class 3
40 ε = 40 d/tlim= 79.64 99.33 119.66
The classification is based on the general web condition **The section is class1 plastic**

Shear capacity CL 4.2.3

Shear area Av y= 1080 mm2 (t x D)
Shear capacity (0.6pyA) Pvy= 178 KN
Shear force Fvy= 8.4 KN Fvy/Pvy= 0.05 **SHEAR PASS OK**

Moment Capacity

Elastic modulus Zx= 152 cm3 Mcx1= 41.8
Plastic modulus Sx= 176 cm3 Mcx2= 48.4
Moment capacity for section Mcx= **48** KNm

Elastic modulus Zy= 28.8 cm3 Mcy1= 7.92
Plastic modulus Sy= 52 cm3 mcy2= 14.25
Moment capacity for section Mcy= **14** KNm

Local capacity check Clause 4.8.3.2

$\frac{F}{Ag.\ py} + \frac{Mx}{Mcx} + \frac{My}{Mcy} = <=1$

0.001 + 0.226 + 0.008 = **0.235** **LOCAL CAPACITY IS SATISFIED**

restraint/effective length Clause 4.31 to 4.3.5 TABLE 13

Effective length Le lt1= 5625 mm normal condition
Effective length Lelt2= 5625 mm
L e lt= 5625 mm

Radius of gyration y-y ry= 2.38 cm
rx= 7.27 cm
Lam'y= 236.3
La'mx= 77.4

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Project No:	24/55099	Sheet No:	5
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

CONTINUE OF EX-P1

Buckling resistance Clause 4.8.3.3.1

Compressive strength:perry strust formula from Appendex C.1

Limiting slenderness	lam 0=	17.16		py=	275	N/mm2
For buckling about y-y			λ L0=		34.80	TABLE 16
Robertson constant for section						
	a=	5.5	for table 23	c		
Perry factor	eta=	1.21				
Euler strength	pe=	36	N/mm2			
Factor	phi=	177	N/mm2			
Compressive strength	pcy=	**30.7**	N/mm2			

	Lam'y=	236.3	La'mx=	77.37		Lamy/x=	15.447
Slenderness of section	Lamda=	236.3				Lamx/x=	5.057
Torsional index	x=	15.3					
	N=	0.5					
Slenderness factor	v=	0.53	from Table 19				
	β w =	1.0					
Buckling parameter	u=	0.946					
Equivalent slenderness	lamlt=	117.9					
Buckling strength (Table 16)	pb=	96	N/mm2	for lamlt=	120	py=	275
Buckling resisrance moment	Mb=	17	KNm				
	Mb L=	17	KNm				
	Mry=	14	KNm				
	Pc=	79.59	KN				
	Pcy=	79.59	KN				

$$\frac{Fc}{PC} + W_x \frac{x\ Mx}{Py\ Zx} + W_y \frac{y\ My}{py\ Zy} = \leq 1$$

$W_x = 0.95$

$W_y = 0.95$

0.013 + 0.248 + 0.013 = **0.274** **The interaction formula is satisfied**

$$\frac{Fc}{Pcy} + W \frac{LT\ M\ lt}{Mb} + W_y \frac{y\ My}{py\ Zy} = \leq 1$$

0.013 + 0.647 + 0.013 = **0.672** **The interaction formula is satisfied**

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Project No:	24/55099	Sheet No:	6
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

DESIGN OF STEEL BEAM, SIMPLY SUPPORTED

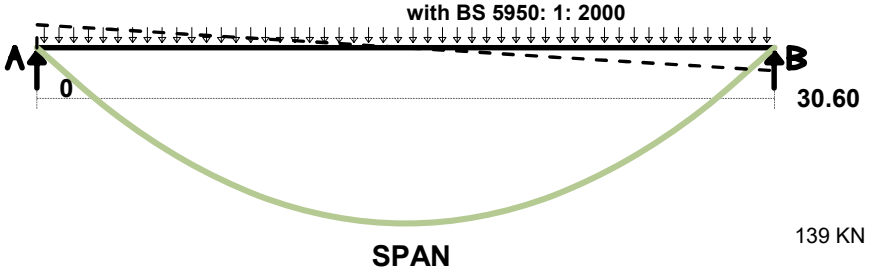
H rolled section S275

LOCATION= **TRIANGULAR TRUSS**

Calculation in accordance with BS 5950: 1: 2000

Loads are unfactored

Wd= **2.64** KN/m2
Wl= **3.38** KN/m2



SPAN

Span= **30.60** m
Cover= **1.00** m

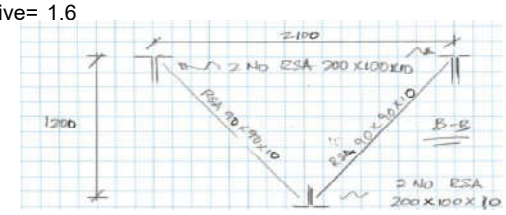
Load on beam	unfactored	factored
Dead+s/w=	2.64 KN/m'	3.70 KN/m'
Live=	3.38 KN/m'	5.41 KN/m'
	6.02 KN/m'	9.10 KN/m'

1,066 KNm

Partial safety factor for load
dead= 1.4
live= 1.6

Reaction

RA=	92.1 KN	**139.3** KN
RB=	92.1 KN	**139.3** KN
Shear zero at		X= 15.30 m
Maximum Bending Moment		**Mx =** **1066** KNm



					factor
Maximum BM for check	M LT=	986 KNm	Local capacity	**PASS**	0.698
Maximum BM about axis Y	MY=	0.00 KNm	Overall buckling 1	**PASS**	0.663
Axial compressive load	Fc=	1.0 KN	Overall buckling 2	**PASS**	0.698
Shear force in x axis	Fv=	139.3 KN	Deflection (dead)=	**PASS**	1/ 1105
Beam span	L=	30.60 m	Deflection(live)=	**PASS**	1/ 863
Effective length about axis X	LX eff=	30.60 m	Deflection (d+l)=	**PASS**	1/ 484
Effective length about axis Y	LYeff=	30.60 m	Fully restraint for Ly& LX <1.		
Limiting span/deflection (live)	=	**360.0** or 14 mm			
	z rep=	4736 cm3			

Section properties

Section size (Ref. No= **100**) **TRIANGULAR TRUSS** **S275**

Depth of steel section	D=	**1200**	mm				
Width of section	B=	**2100**	mm	Pcy=	3915	KN	
Thickness of web	t=	**10**	mm	Mcx=	1413	KNm	
Thickness of flange	T=	**10**	mm	Mcy=	2475	KNm	7850
Root radius	r=	**500**	mm	Mb L=	1413	KNm	
Second moment of area x-x	Ix=	**5E+05**	cm4	Mlt=	**0.925**	Pcy=	3915 KN
Second moment of area y-y	Iy=	**1E+06**	cm4				
Plastic modulus x-x	Sx=	**7290**	cm3	Sx eff=	6167.69	cm3	
Plastic modulus y-y	Sy=	**12200**	cm3	Sy eff=	10866.57	cm3	
Area of section	Ag=	**174**	cm2	An=	145.00	cm2	ke= 1.2

DEFLECTION

			unfactored	
Unfactored dead load deflection=	27.69	mm	E UDL=	2.64 KN/m'
Unfactored live load deflection=	**35.45**	mm	E UDL=	3.38 KN/m'
Unfactored dead+ live load def =	63.1	mm	E UDL=	6.02 KN/m'
Span/def. ratio for dead load=	1105			
Span/def. ratio for live load=	**863**	**>360**		
Span/def. ratio fordead+ live load=	485			

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Project No:	24/55099	Sheet No:	7
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

CONTINUE OF TRIANGULAR TRUSS

Strength of steel Clause 3.1.1

Design strength **(Grade S 275)**
for thickness of 10 mm **py= 225** N/mm2 py= **225.0** N/mm2 pyw= py
Young's Modulus **E=** 205 KN/mm2

Classification of cross section (clause 3.5.2) TABLE 11 rolled section

Constant (table 11 note b) ε = 1.106 class 1 class 2 class 3
Outstand of flange b= 2100 mm plastic compac semi compact
Ratio b/T= 210.0 b/Tlim= 9.95 11.06 16.58
The classification is based on the outsatnd element **The section is class 3 semi compact**
r1 =min(1.0,max(-0.1,Fc/(dxtxpyw)))= 0.00 r2=Fc/(Agxpyw)= 3E-04
Depth between fillets d= 1200 mm TABLE 11 rolled section
ratio d/t= 120.0 class 1 class 2 class 3
40 ε = 44.22 d/tlim= 88.40 110.48 132.60
The classification is based on the general web condition **The section is class2 compact**

Shear capacity CL 4.2.3

Shear area Av y= 174 mm2 (t x D)
Shear capacity (0.6pyA) Pvy= 23 KN
Shear force Fvy= 139.3 KN Fvy/Pvy= 5.93 **HIGH SHEAR LOAD**

Moment Capacity

Elastic modulus Zx= **6280** cm3 Mcx1= 1413
Plastic modulus Sx eff= 6168 cm3 Mcx2= 1388
Moment capacity for section Mcx= **1413** KNm

Elastic modulus Zy= **11000** cm3 Mcy1= 2475
Plastic modulus Sy eff= 10867 cm3 mcy2= 2445
Moment capacity for section Mcy= **2475** KNm

Local capacity check Clause 4.8.3.2

$$\frac{F}{Ag.\,py} + \frac{Mx}{Mcx} + \frac{My}{Mcy} = <=1$$

0.000 + 0.698 + 0.000 = **0.698** **LOCAL CAPACITY IS SATISFIED**

restraint/effective length Clause 4.31 to 4.3.5 TABLE 13

Effective length Le lt1= 30600 mm normal condition
Effective length Lelt2= 30600 mm
L e lt= 30600 mm

Radius of gyration y-y ry= 853 cm
rx= 552 cm
Lam'y= 3.6
La'mx= 5.5

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Project No:	24/55099	Sheet No:	8
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

CONTINUE OF TRIANGULAR TRUSS

Buckling resistance Clause 4.8.3.3.1

Compressive strength:perry strust formula from Appendex C.1

Limiting slenderness	lam 0=	18.97		py=	235	N/mm2
For buckling about y-y			λ L0=		37.10	TABLE 16
Robertson constant for section						
	a=	5.5	for table 23	c		
Perry factor	eta=	0.00				
Euler strength	pe=	65840	N/mm2			
Factor	phi=	33033	N/mm2			
Compressive strength	pcy=	**225.0**	N/mm2			

	Lam'y=	3.6	La'mx=	5.54	Lamy/x=	0.2697	
Slenderness of section	Lamda=	5.5			Lamx/x=	0.4168	
Torsional index	x=	13.3					
	N=	0.5					
Slenderness factor	v=	1.00	from Table 19				
	β w =	1.0					
Buckling parameter	u=	0.848					
Equivalent slenderness	lamlt=	4.7					
Buckling strength (Table 16)	pb=	235	N/mm2	for lamlt=	25	py=	235
Buckling resisrance moment	Mb=	1413	KNm				
	Mb L=	1413	KNm				
	Mry=	2475	KNm				
	Pc=	3915	KN				
	Pcy=	3915	KN				

$$\frac{Fc}{PC} + W_x \frac{x\ Mx}{Py\ Zx} + W_y \frac{y\ My}{py\ Zy} = \le 1$$

W_x = 0.95

W_y = 0.95

0.000 + 0.663 + 0.000 = **0.663** **The interaction formula is satisfied**

$$\frac{Fc}{Pcy} + W_{LT} \frac{LT\ M\ lt}{Mb} + W_y \frac{y\ My}{py\ Zy} = \le 1$$

0.000 + 0.698 + 0.000 = **0.698** **The interaction formula is satisfied**

CALCULATION OF SECTION PROPERTIES

Tedds calculation version 2.0.07

Area

A = **174.00** cm^2

2nd moment of area

I_{uu} = **1.27×10⁶** cm^4 I_{vv} = **531.×10³** cm^4 I_{xx} = **531.×10³** cm^4 I_{yy} = **1.27×10⁶** cm^4

Radius of gyration

r_{uu} = **853.4** mm r_{vv} = **552.6** mm r_{xx} = **55.3** cm r_{yy} = **85.3** cm

Plastic section modulus (only shapes with all rectangles at 90 degs)

S_{xx} = **7.29×10³** cm^3 S_{yy} = **12.2×10³** cm^3

Distance to combined centroid

X_e = **0.1** mm Y_e = **741.6** mm

Distance to equal axis area (only shapes with all rectangles at 90 degs)

X_p = **0.1** mm Y_p = **1072.8** mm

Elastic section modulus

Z_{xx} = **6.28×10³** cm^3 Z_{yy} = **11.0×10³** cm^3

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Project No:	24/55099	Sheet No:	10
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

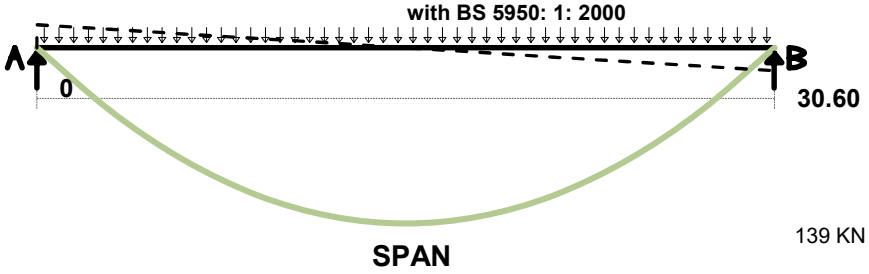
DESIGN OF STEEL BEAM, SIMPLY SUPPORTED

H rolled section S275
Calculation in accordance with BS 5950: 1: 2000

LOCATION= **VER-TRUSS**

Loads are unfactored

Wd= **2.64** KN/m2
Wl= **3.38** KN/m2



Span= **30.60** m
Cover= **1.00** m

SPAN

Load on beam	unfactored	**factored**		
			1,066 KNm	
			Partial safety factor for load	
Dead+s/w=	2.64 KN/m'	3.70 KN/m'	dead= 1.4	
Live=	3.38 KN/m'	5.41 KN/m'	live= 1.6	
	6.02 KN/m'	9.10 KN/m'		

Reaction

RA=	92.1 KN	**139.3** KN	
RB=	92.1 KN	**139.3** KN	
Shear zero at		X= 15.30 m	
Maximum Bending Moment		**Mx =** **1066** KNm	

					factor
Maximum BM for check	M LT=	986 KNm	Local capacity	PASS	0.781
Maximum BM about axis Y	MY=	0.00 KNm	Overall buckling 1	PASS	0.742
Axial compressive load	Fc=	1.0 KN	Overall buckling 2	PASS	0.934
Shear force in x axis	Fv=	139.3 KN	Deflection (dead)=	PASS	1/ 711
Beam span	L=	30.60 m	Deflection(live)=	PASS	1/ 555
Effective length about axis X	LX eff=	30.60 m	Deflection (d+l)=	PASS	1/ 312
Effective length about axis Y	LYeff=	3.06 m	Fully restraint for Ly& LX <1.		
Limiting span/deflection (live)	=	**360.0** or 14 mm			
	z rep=	4736 cm3			

Section properties

Section size (Ref. No= **100**) **VER-TRUSS** **S275**

Depth of steel section	D=	**1200** mm					
Width of section	B=	**195** mm		Pcy=	1597 KN		
Thickness of web	t=	**10.9** mm		Mcx=	1262 KNm		
Thickness of flange	T=	**19.8** mm		Mcy=	70.2 KNm		5868.3
Root radius	r=	**500** mm		Mb L=	1056 KNm		
Second moment of area x-x	Ix=	**3E+05** cm4		Mlt=	**0.925**	Pcy=	1597.3 KN
Second moment of area y-y	Iy=	**1830** cm4					
Plastic modulus x-x	Sx=	**5030** cm3	Sx eff=	5674.49	cm3		
Plastic modulus y-y	Sy=	**312** cm3	Sy eff=	188.66	cm3		
Area of section	Ag=	**107.7** cm2	An=	89.77	cm2	ke=	1.2

DEFLECTION

			unfactored	
Unfactored dead load deflection=	42.99 mm		E UDL=	2.64 KN/m'
Unfactored live load deflection=	**55.04** mm		E UDL=	3.38 KN/m'
Unfactored dead+ live load def =	98.0 mm		E UDL=	6.02 KN/m'
Span/def. ratio for dead load=	712			
Span/def. ratio for live load=	**556**	**>360**		
Span/def. ratio fordead+ live load=	312			

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Project No:	24/55099	Sheet No:	11
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

CONTINUE OF VER-TRUSS

Strength of steel Clause 3.1.1

Design strength **(Grade S 275)**
for thickness of 19.8 mm **py= 225** N/mm2 py= **225.0** N/mm2 pyw= py
Young's Modulus **E=** 205 KN/mm2

Classification of cross section (clause 3.5.2) TABLE 11 rolled section

Constant (table 11 note b) ε = 1.106 class 1 class 2 class 3
Outstand of flange b= 195 mm plastic compac semi compact
Ratio b/T= 9.8 b/Tlim= 9.95 11.06 16.58
The classification is based on the outsatnd element **The section is class1 plastic**
r1 =min(1.0,max(-0.1,Fc/(dxtxpyw)))= 0.00 r2=Fc/(Agxpyw)= 4E-04
Depth between fillets d= 1200 mm TABLE 11 rolled section
ratio d/t= 110.1 class 1 class 2 class 3
40 ε = 44.22 d/tlim= 88.40 110.48 132.56
The classification is based on the general web condition **The section is class 3 semi compact**

Shear capacity CL 4.2.3

Shear area Av y= 107.7 mm2 (t x D)
Shear capacity (0.6pyA) Pvy= 15 KN
Shear force Fvy= 139.3 KN Fvy/Pvy= 9.58 **HIGH SHEAR LOAD**

Moment Capacity

Elastic modulus Zx= **5610** cm3 Mcx1= 1262
Plastic modulus Sx= 5030 cm3 Mcx2= 1132
Moment capacity for section Mcx= **1262** KNm

Elastic modulus Zy= **201** cm3 Mcy1= 45.23
Plastic modulus Sy= 312 cm3 mcy2= 70.2
Moment capacity for section Mcy= **70** KNm

Local capacity check Clause 4.8.3.2

$\frac{F}{Ag.\ py} + \frac{Mx}{Mcx} + \frac{My}{Mcy} = <=1$

0.000 + 0.781 + 0.000 = **0.781** **LOCAL CAPACITY IS SATISFIED**

restraint/effective length Clause 4.31 to 4.3.5 TABLE 13

Effective length Le lt1= 30600 mm normal condition
Effective length Lelt2= 3060 mm
L e lt= 16830 mm

Radius of gyration y-y ry= **4.1** cm
rx= **56.4** cm
Lam'y= 74.6
La'mx= 54.3

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Project No:	24/55099	Sheet No:	12
Made By:	OAM	Revision:	
Date:	Jul-24	Checked By:	HJ

Project: ROOF INSPECTION, SPLASH POOL, RUSHDEN

CONTINUE OF VER-TRUSS

Buckling resistance Clause 4.8.3.3.1

Compressive strength:perry strust formula from Appendex C.1

Limiting slenderness	lam 0=	18.97		py=	235	N/mm2
For buckling about y-y			λ L0=		37.10	TABLE 16
Robertson constant for section						
	a=	5.5	for table 23	c		
Perry factor	eta=	0.31				
Euler strength	pe=	363	N/mm2			
Factor	phi=	350	N/mm2			
Compressive strength	pcy=	**148.3**	N/mm2			

	Lam'y=	74.6	La'mx=	54.26		Lamy/x=	5.6116
Slenderness of section	Lamda=	74.6				Lamx/x=	4.0793
Torsional index	x=	13.3					
	N=	0.5					
Slenderness factor	v=	0.79	from Table 19				
	β w =	1.0					
Buckling parameter	u=	0.848					
Equivalent slenderness	lamlt=	50.0					
Buckling strength (Table 16)	pb=	210	N/mm2	for lamlt=	50	py=	235
Buckling resisrance moment	Mb=	1056	KNm				
	Mb L=	1056	KNm				
	Mry=	70	KNm				
	Pc=	1597	KN				
	Pcy=	1597	KN				

$$\frac{Fc}{PC} + W\,\frac{x\,Mx}{Py\,Zx} + W\,\frac{y\,My}{py\,Zy} = <=1$$

W x= 0.95
W y= 0.95

0.001 + 0.742 + 0.000 = **0.742** **The interaction formula is satisfied**

$$\frac{Fc}{Pcy} + W\,\frac{LT\,M\,lt}{Mb} + W\,\frac{y\,My}{py\,Zy} = <=1$$

0.001 + 0.933 + 0.000 = **0.934** **The interaction formula is satisfied**

CALCULATION OF SECTION PROPERTIES

Tedds calculation version 2.0.07

Area

A = **107.72** cm^2

2nd moment of area

I_{uu} = **342.×10³** cm^4 I_{vv} = **1.83×10³** cm^4 I_{xx} = **342.×10³** cm^4 I_{yy} = **1.83×10³** cm^4

Radius of gyration

r_{uu} = **563.5** mm r_{vv} = **41.2** mm r_{xx} = **56.4** cm r_{yy} = **4.1** cm

Plastic section modulus (only shapes with all rectangles at 90 degs)

S_{xx} = **6.03×10³** cm^3 S_{yy} = **312.** cm^3

Distance to combined centroid

X_e = **0.0** mm Y_e = **-600.4** mm

Distance to equal axis area (only shapes with all rectangles at 90 degs)

X_p = **0.0** mm Y_p = **-600.4** mm

Elastic section modulus

Z_{xx} = **5.61×10³** cm^3 Z_{yy} = **201.** cm^3