Project		**Job. Ref.**			
Structural Calculations					
Calc by.	Date	Chck'd by:	Date	App'd by:	Date
KK	07.11.2022	MK	07.11.2022	MP	

Garden Annexe Cradle

Project		Job. Ref.			
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Calc by.	Date	Chck'd by:	Date	App'd by:	Date
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1 General Notes

- These calculations and details are to be read in conjunction with all relevant Architect's and Engineer's drawings and specifications.
- Any dimensions stated in the calculations are for design purposes ONLY, and must not be used for ordering lengths of components. The contractor is to be responsible for obtaining all accurate site dimensions.

2 Construction Notes

- Any deviation from the design assumptions is to be reported to the Architect/Engineer prior to commencement of works.
- The temporary stability of the structure during all stages of the construction work is the responsibility of the Contractor. Contractor must ensure new steel beams and lintels are propped during construction until dead load at upper level have taken place prior to removing props.
- All new steelwork is to be Grade S275, unless noted otherwise in the calculations. Normal paint finish to be thoroughly wire brushed and painted with two coats of Zinc Phosphate primer. All damaged areas of paintwork are to be touched up after erection of the steelwork. All bolts are to be Grade 8.8, unless noted otherwise, and all welds are to be 6mm continuous fillet type, unless noted otherwise. All steels exposed to cavities and/or built into inner skin of external cavity wall to be painted with two coats of high build bituminous paint on site. Moment and splice connections are contractor's design responsibility.
- The contractor is expected to understand and follow the Construction (Design and Management) Regulations with regard to safety on site, even though they may not be legally applicable.
- Contractor must ensure that existing structure propped adequately during installation of new beams until the beams are in place and resting on padstones and adequately dry packed prior to removing props.

3 Codes and standards

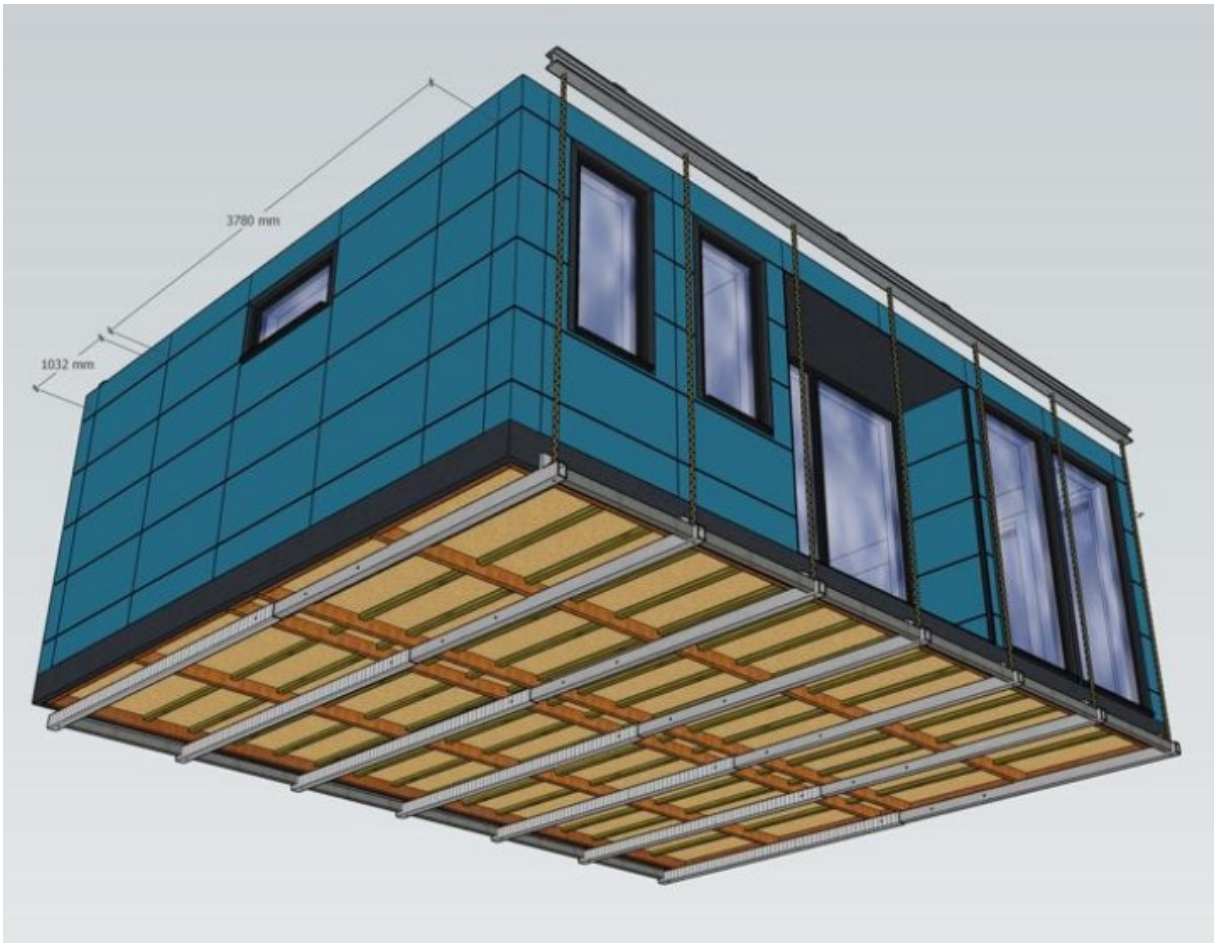
The structure will be designed in accordance with Building Regulations and Eurocodes. the principal of which are listed below:

Building Regulations 2010	Approved Document A – Structure
BS 648:1964	Schedule of Weights of Building materials
BS EN 1990 to 1999 National Annexes	Eurocode: Basis of Structural Design and Eurocodes 1 to 9. with

4 Design loads

The loads coming from particular parts of supported structure should not exceed the values given below:

Item	Loading
WALLS	0.85 kN/m2
FLOOR	0.70 kN/m2
FLAT ROOF	0.85 kN/m2
LIVE LOAD	0.20 kN/m2



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1. Timber floor reactions analysis

Floor span					2,55	/2	=	1,28 m
Dead loads:	0,7	x	1,275	=	0,89	kN/m		
Live load:	0,20	x	1,275	=	0,26	kN/m		

TIMBER BEAM ANALYSIS & DESIGN TO EN1995-1-1:2004

In accordance with EN1995-1-1:2004 + A2:2014 and Corrigendum No.1 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 1.7.04

Analysis results

Design moment	M = **0.276** kNm	Design shear	F = **1.304** kN
Total load on member	W_{tot} = **11.901** kN		
Reactions at support A	R_{A_max} = **0.875** kN	R_{A_min} = **0.875** kN	
Unfactored permanent load reaction at support A	$R_{A\_Permanent}$ = **0.499** kN		
Unfactored variable load reaction at support A	$R_{A\_Variable}$ = **0.135** kN		
Reactions at support B	R_{B_max} = **2.363** kN	R_{B_min} = **2.363** kN	
Unfactored permanent load reaction at support B	$R_{B\_Permanent}$ = **1.346** kN		
Unfactored variable load reaction at support B	$R_{B\_Variable}$ = **0.364** kN		
Reactions at support C	R_{C_max} = **1.730** kN	R_{C_min} = **1.730** kN	
Unfactored permanent load reaction at support C	$R_{C\_Permanent}$ = **0.986** kN		
Unfactored variable load reaction at support C	$R_{C\_Variable}$ = **0.266** kN		
Reactions at support D	R_{D_max} = **1.963** kN	R_{D_min} = **1.963** kN	
Unfactored permanent load reaction at support D	$R_{D\_Permanent}$ = **1.119** kN		
Unfactored variable load reaction at support D	$R_{D\_Variable}$ = **0.302** kN		
Reactions at support E	R_{E_max} = **1.730** kN	R_{E_min} = **1.730** kN	
Unfactored permanent load reaction at support E	$R_{E\_Permanent}$ = **0.986** kN		
Unfactored variable load reaction at support E	$R_{E\_Variable}$ = **0.266** kN		
Reactions at support F	R_{F_max} = **2.363** kN	R_{F_min} = **2.363** kN	
Unfactored permanent load reaction at support F	$R_{F\_Permanent}$ = **1.346** kN		
Unfactored variable load reaction at support F	$R_{F\_Variable}$ = **0.364** kN		
Reactions at support G	R_{G_max} = **0.875** kN	R_{G_min} = **0.875** kN	
Unfactored permanent load reaction at support G	$R_{G\_Permanent}$ = **0.499** kN		
Unfactored variable load reaction at support G	$R_{G\_Variable}$ = **0.135** kN		

Timber section details

Breadth of section	b = **47** mm	Depth of section	h = **225** mm
Number of sections	N = **2**	Breadth of member	b_b = **94** mm
Timber strength class	**C24**		

Member details

Service class of timber	**1**	Load duration	**Medium-term**
Length of span 1	L_{s1} = **1290** mm		
Length of span 2	L_{s2} = **1116** mm		
Length of span 3	L_{s3} = **1116** mm		
Length of span 4	L_{s4} = **1116** mm		
Length of span 5	L_{s5} = **1116** mm		

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Length of span 6 L_{s6} = **1290** mm
Length of bearing L_b = **100** mm

Compression perpendicular to grain - cl.6.1.4

Design compressive stress $\sigma_{c.90.d}$ = **0.251** N/mm^2 Design compressive strength $f_{c.90.d}$ = **1.538** N/mm^2

PASS - Design compressive strength exceeds design compressive stress at bearing

Bending - cl 6.1.6

Design bending stress $\sigma_{m.d}$ = **0.349** N/mm^2 Design bending strength $f_{m.d}$ = **14.769** N/mm^2

PASS - Design bending strength exceeds design bending stress

Shear - cl.6.1.7

Applied shear stress τ_d = **0.138** N/mm^2 Permissible shear stress $f_{v.d}$ = **2.462** N/mm^2

PASS - Design shear strength exceeds design shear stress

Deflection - cl.7.2

Deflection limit δ_{lim} = **5.160** mm Total final deflection δ_{fin} = **0.057** mm

PASS - Total final deflection is less than the deflection limit

2. Steel RHS section

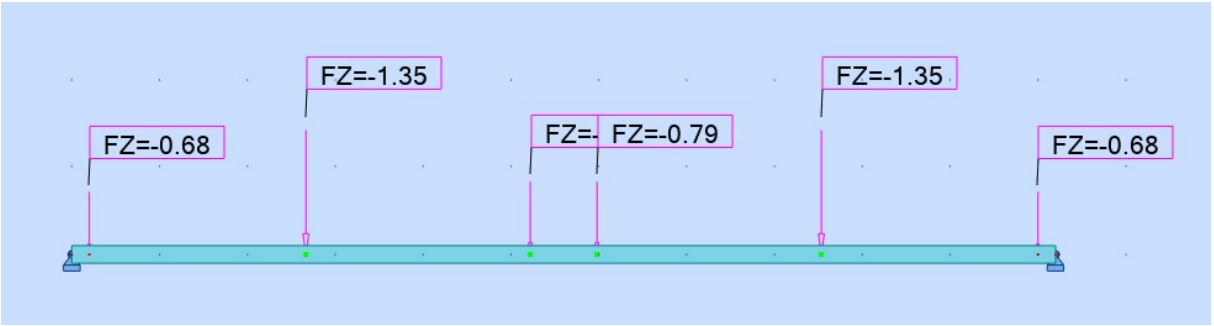

Figure: Dead loads

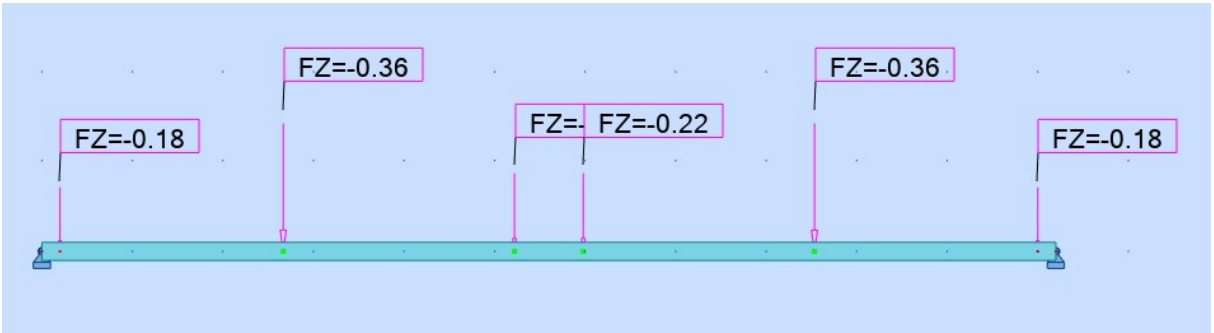

Figure: Live loads

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Check 100x75x8:

Member	Section	Material	Lay	Laz	Ratio	Case	Ratio(uy	Case (uy)	Ratio(uz	Case (uz)
1 Beam_1	100x75x8	S275	154.65	195.94	0.38	3 ULS /1/	0.00		1.20	6 SLS /1/

Incorrect section.

Check RHS 120x80x8:

Member	Section	Material	Lay	Laz	Ratio	Case	Ratio(uy	Case (uy)	Ratio(uz	Case (uz)
1 Beam_1	RHSH 120x80	S275	131.16	181.89	0.26	3 ULS /1/	0.00		0.78	6 SLS /1/

Correct section - use RHS 120x80x8 S275

STEEL DESIGN

CODE: *BS-EN 1993-1:2005/NA:2008/A1:2014, Eurocode 3: Design of steel structures.*

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 1 Beam_1 **POINT:** 2 **COORDINATE:** x = 0.50 L = 2.80 m

---

LOADS:

Governing Load Case: 3 ULS /1/ 1*1.35 + 2*1.50

MATERIAL:

S275 (S275) fy = 275.00 MPa

SECTION PARAMETERS: RHSH 120x80x8

h=120 mm	gM0=1.00	gM1=1.00	
b=80 mm	Ay=1152 mm2	Az=1728 mm2	Ax=2880 mm2
tw=8 mm	Iy=5250000 mm4	Iz=2730000 mm4	Ix=5870000 mm4
tf=8 mm	Wply=111000 mm3	Wplz=82600 mm3	

INTERNAL FORCES AND CAPACITIES:

My,Ed = 8.09 kN*m

My,pl,Rd = 30.52 kN*m

My,c,Rd = 30.52 kN*m

Mb,Rd = 30.52 kN*m

Class of section = 1

 

LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 312.21 kN*m	Curve,LT - d	XLT = 1.00
Lcr,upp=5.60 m	Lam_LT = 0.31	fi,LT = 0.50	XLT,mod = 1.00

BUCKLING PARAMETERS:

 About y axis:

 About z axis:

VERIFICATION FORMULAS:

Section strength check:

My,Ed/My,c,Rd = 0.26 < 1.00 (6.2.5.(1))

Global stability check of member:

My,Ed/Mb,Rd = 0.26 < 1.00 (6.3.2.1.(1))

LIMIT DISPLACEMENTS

 ***Deflections (LOCAL SYSTEM):***

uy = 0 mm < uy max = L/250.00 = 22 mm Verified

Governing Load Case: 1 DL1

uz = 17 mm < uz max = L/250.00 = 22 mm Verified

Governing Load Case: 6 SLS /1/ 1*1.00 + 2*1.00

u inst,y = 0 mm < u inst,max,y = L/360.00 = 16 mm Verified

Governing Load Case:

u inst,z = 3 mm < u inst,max,z = L/360.00 = 16 mm Verified

Governing Load Case: 1*2

Displacements (GLOBAL SYSTEM): *Not analyzed*

Section OK !!!

3. Steel chain calculation

Specifications of Chain DIN 763

Size d mm	Dimensions t mm	Dimensions b mm	Weight kg/100 m	Working Load kg	Test Load kn	Breaking Load kn
3	26	12	15	55	1.05	3.2
4	32	16	27	100	2	6
5	35	20	43	160	3.15	10
6	42	24	63	224	4.5	14
7	49	28	86	300	6	18
8	52	32	110	400	8	25
9	59	36	141	530	10.5	32
10	65	40	175	630	12.5	40
11	72	44	211	790	15.8	47.5
12	78	48	255	940	18.8	56.5
13	82	52	295	1000	21.2	63
16	100	64	445	1600	33	100
18	113	70	565	2120	42.3	127
19	119	72	625	2370	47.3	142
20	120	75	700	2500	50	160
22	127	82	855	3170	63.3	190
25	140	88	1090	4090	81.7	245
Note	Please contact us for more specifications.					

Total weight of annexe calculation:

Floor loads:
DL: 7.04 x 5.39 x 0.70 = 26.56 kN
LL: 7.04 x 5.39 x 0.20 = 7.59 kN

Ceiling:
DL: 7.04 x 5.39 x 0.85 = 32.25 kN

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External walls
Long: 7.04 x 2.70 x 0.85 x 2 = 32.31 kN
Short: 5.39 x 2.70 x 0.85 x 2 = 24.74 kN

RHS Rails:

0.226 x 5.60 x 7 = 8.86 kN

Total DL: 26.56 + 32.25 + 32.31 + 24.75 + 8.86 = 124.72 kN

Safety factors:
DL: 1.35
LL: 1.50

124.72 x 1.35 = 168.37 kN
7.59 x 1.50 = 11.39 kN

Total loads: 179.76 kN

65x40mm chain tested load: 12.5 kN

Total number of chains used: 14

14 x 12.50 kN = 175 kN < 179.76 kN failed - check 78x48 chain

78x48mm chain tested load: 18.8 kN

14 x 18.8 = 263.2 kN > 179.76 kN passed - use 78x48 DIN 763 chain

Utilisation ratio: 179.76 / 263.2 = 0.68