

211053

Rhydolodog

Structural Calculations

at

Rhydoldog Estate
Rhayader
Powys
LD6 5HB

Details prepared by:

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Project reference: 211053
Project title: Structural Calculations

Design Code

Design for timber is based on: Eurocode 5: Design of timber structures
Design for steel is based on: Eurocode 3: Design of steel structures

Note:

The following calculations are for approximations of the actual cabin / tree arrangements. They were necessary in order to determine the impact of tree attachment bolts (TABs).

They demonstrate that a TAB has the ability to comfortably support a 50 - 60 kN load, which is sufficient for loads at the outer corners of the cabins.

Mid-span beam loads will be more than a TAB can support and it is proposed that these will be supported by a cut tree if one is conveniently located or by alternative arrangements.

A cut tree of the order of 300mm in diameter has the capacity to carry well in excess of 200 kN.

In the event that cut trees and TABs are not conveniently located there is still the option of constructing a support which will avoid excessive excavation using small diameter steel props fixed to the bedrock using a steel pin.

The design and construction of supports will be different for each cabin and final details will be worked out on site at each location, but we are confident that a structural solution can be found which minimises extensive excavation and disturbance to the natural habitats of animals and insect life.

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Project	Rhydoldog Estate	Made by	Date	Job No
Client	Rhydolodog	DB	14-9-21	211053
Description	Load breakdown for structural timber	Checked	Revision	Page No
		DB	-	2

Loading

Load breakdown for shallow pitched roof

Roof pitch = 20 °

		Characteristic	Factor	Design	
Dead	Cedar shingles	0.20	1.35	0.27	kN/m ²
	Battens, counter battens, breatable membrane & sarking	0.20	1.35	0.27	kN/m ²
	Rafters & insulation	0.30	1.35	0.41	kN/m ²
Live	Snow / wind	0.75	1.5	1.13	kN/m ²
	$w_{1,1}' =$	1.45	$w_{1,1} =$	2.07	kN/m ²
	Load on plan	$w_1' =$	$w_1 =$	2.20	kN/m ²

Load breakdown for steeply pitched roof

Roof pitch = 72 °

		Characteristic	Factor	Design	
Dead	Cedar shingles	0.20	1.35	0.27	kN/m ²
	Battens, counter battens, breatable membrane & sarking	0.2	1.35	0.27	kN/m ²
	Rafters & insulation	0.2	1.35	0.27	kN/m ²
	Ceiling & services	0.15	1.35	0.20	kN/m ²
Live	Snow	0.75	1.5	1.13	kN/m ²
	$w_{2,1}' =$	1.5	$w_{2,1} =$	2.14	kN/m ²
	Load on plan	$w_2' =$	$w_2 =$	6.92	kN/m ²

Load breakdown for internal timber floor

		Characteristic	Factor	Design	
Dead	Flooring	0.15	1.35	0.20	kN/m ²
	Ceiling and services	0.15	1.35	0.20	kN/m ²
	250 x 75 flooring joists @600 crs & insulation	0.3	1.35	0.41	kN/m ²
Live	Domestic	1.5	1.5	2.25	kN/m ²
	$w_{3,1}' =$	2.1	$w_{3,1} =$	3.06	kN/m ²
	Load on plan	$w_3' =$	$w_3 =$	3.06	kN/m ²

Load breakdown for external balcony floor

		Characteristic	Factor	Design	
Dead	Flooring	0.15	1.35	0.20	kN/m ²
	Ceiling and services	0.15	1.35	0.20	kN/m ²
	250 x 75 flooring joists @600 crs	0.22	1.35	0.30	kN/m ²
Live	Balcony loading	2.5	1.5	3.75	kN/m ²
	$w_{3,1}' =$	3.02	$w_{3,1} =$	4.45	kN/m ²
	Load on plan	$w_3' =$	$w_3 =$	4.45	kN/m ²

Load breakdown for stud wall

		Characteristic	Factor	Design	
Dead	Cedar cladding	0.28	1.35	0.38	kN/m ²
	Sarking	0.175	1.35	0.24	kN/m ²
	Studs & insulation	0.24	1.35	0.32	kN/m ²
Live	Plasterboarded, skim & services	0.15	1.35	0.20	kN/m ²
	$w_{4,1}' =$	0.84	$w_{4,1} =$	1.14	kN/m ²
	Height of walls	4		4	
	Load on plan	$w_4' =$	$w_4 =$	4.54	kN/m

Load breakdown for masonry

Density	$\gamma =$	20 kN/m ³
Thickness	$t =$	0.15 m
Characteristic load	$w_5' = \gamma t =$	3 kN/m ²
Design load	$w_5 = 1.35 w_5' =$	4.05 kN/m ²

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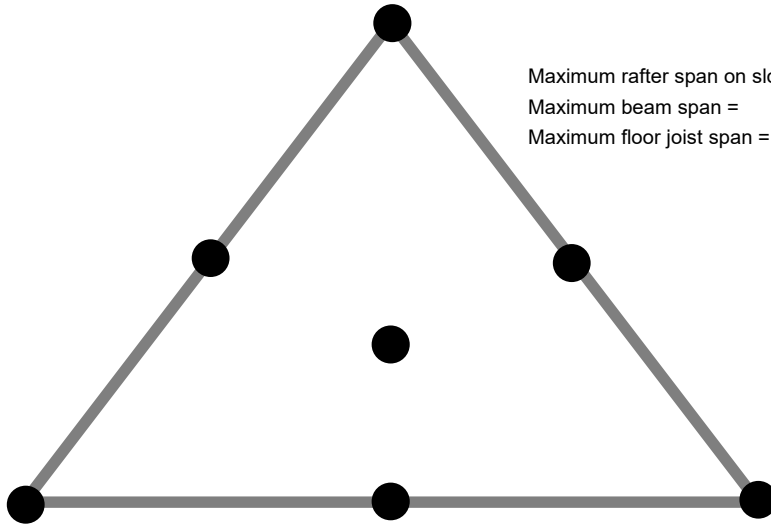
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Project	Rhydoldog Estate	Made by	Date	Job No
Client	Rhydolodog	DB	14-9-21	211053
Description	Total weight of building: Bath House & The Tit	Checked	Revision	Page No
		DB	-	3

Bath House

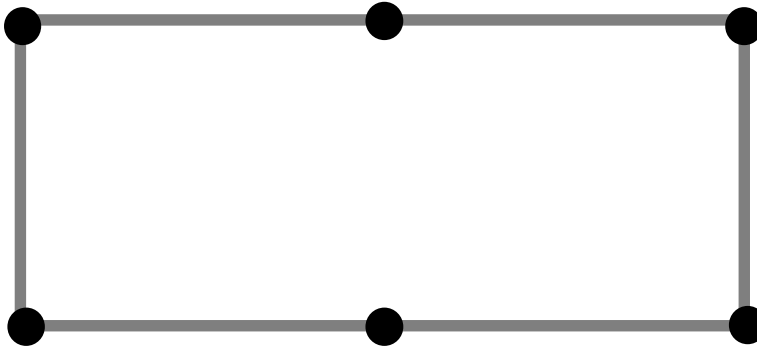


Maximum rafter span on slope= 4 m
 Maximum beam span = 6 m
 Maximum floor joist span = 5 m

Roof area	55 m ²	Unit load	4.56	Total load	251	Note unit load based on average roof slope
Floor area	50 m ²		4.45		223	
Wall length	52 m		4.54		236	
		Total =			710	

Minimum number of supports = 7
 Estimated average load per support = 101 kN

The Tit



Maximum rafter span on slope= 3 m
 Maximum beam span = 4 m
 Maximum floor joist span = 4.5 m

Roof area	48 m ²	Unit load	2.44	Total load	117	Note unit load based on average roof slope	
Floor area	96 m ²		4.45		427		Two floors
Wall length	19 m		4.54		88		
		Total =			632		kN

Minimum number of supports = 6
 Estimated average load per support = 105 kN

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Project	Rhydoldog Estate	Made by	Date	Job No
Client	Rhydodlog	DB	14-9-21	211053
Description	Loads on trees: Cut & Bolted	Checked	Revision	Page No
		DB	-	4

Permissible timber stresses

Assume C24

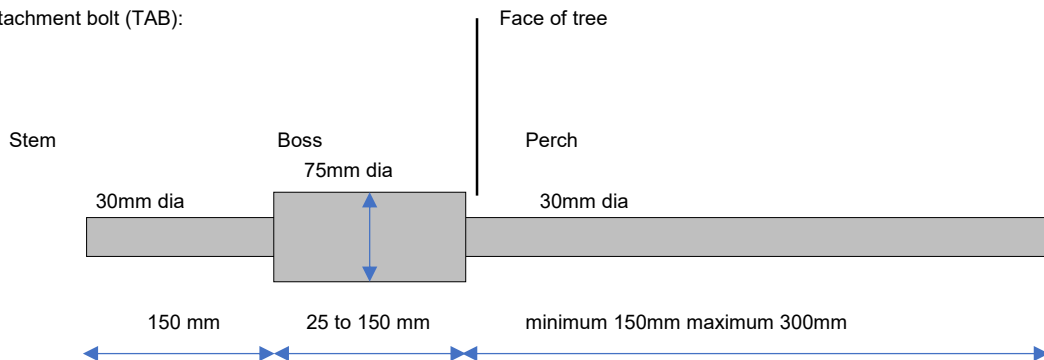
Bending parallel to grain =	7.5 N/mm ²
Tension parallel to grain =	4.5 N/mm ²
Compression parallel to grain =	7.9 N/mm ²
Compression perpendicular to grain (min) =	1.9 N/mm ²
Shear parallel to grain =	0.71 N/mm ²
Modulus of elasticity (mean) =	10800 N/mm ²

Assume trees with a minimum diameter of 300mm

Loads bearing onto cut stump:

Load =	105 kN
Plan area =	70695 mm ²
Compressive stress =	1.49 N/mm ²
Permissible =	7.9
Ratio actual ÷ permissible =	0.19
Factor of safety =	5.32

Loads bearing onto tree attachment bolt (TAB):



Load =	105 kN	52.5 kN
Plan area =	11250 mm ²	11250 mm ²
Compressive stress =	9.33 N/mm ²	4.67 N/mm ²
Permissible =	7.9	7.9
Ratio actual ÷ permissible =	1.18	0.59
Factor of safety =	0.85	1.69
	Fails	OK