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Component Toolkit

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2187 - Ty Unnos TSB Funded Research

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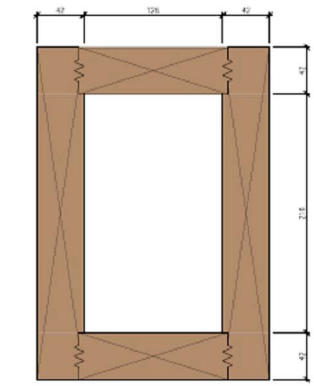
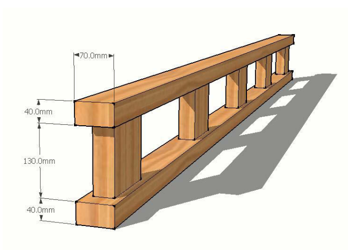
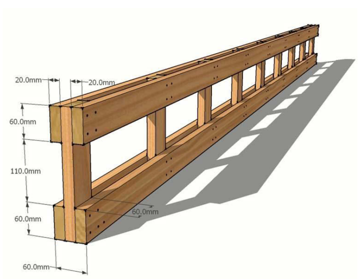
Contents

1.0 Introduction

This report is a guide to the Tŷ Unnos system and includes the principle limitations of the system. This report is limited to the Tŷ Unnos component system which is formed from box beams ladder beams and OSB diaphragms. This report does not include any information relating to the Tŷ Unnos modular or Tŷ Unnos TSB systems.

The information in this report is based on the testing and analysis of the components completed to date. Sections 3.0 and 4.0 detail the level of testing carried out to date and its relevance to the components as stand alone elements.

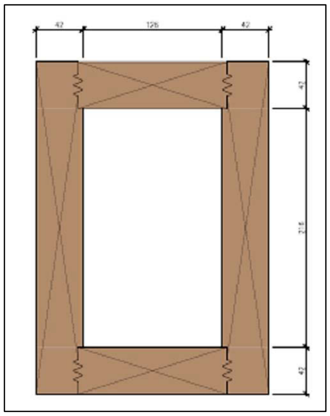
2.0 Tŷ Unnos Component Summary

	Picture	Typical Achievable Span	Typical Centres
200x200mm Box Beam		3.5 m	3.0 m
200x300mm Box Beam		4.8 m	3.0 m
Tŷ Unnos Elements Ladder Beam		3.1 m	400 mm
New Ladder Beam (Current Results)		2.2 m	300 mm
New Ladder Beam (Anticipated Results)		3.0 m	300 mm
Solid 50x200 mm C16 Joist		4.0 m	400 mm
Diaphragm Panels	For lateral stability approximately 1 No 1.2m long panel is required per 1.5m length of perpendicular two storey wall (plus roof).		

Typical spans and centres for Tŷ Unnos Components

The above table shows the typical spans and centres for each of the principle Tŷ Unnos components.

3.0 Box Beams



The Tŷ Unnos box beam is a rectangular hollow section formed from four solid timber sections jointed with glued joints. The solid timber sections can be jointed in the length of the beam to create beams longer than standard timber sizes. The web pieces can also be jointed along the length of the beam to create deeper beams. A typical box beam section is shown in the figure.

Box beams can be designed for a range of dimensions. It is possible to vary the beam depth, beam width, flange thickness and web thickness. Currently 200x200mm and 200x300mm box beams with 40mm thick webs and flanges have been used in projects. These beams have also been structurally tested to prove their capacities; 200x400mm beams have been tested.

The allowable spans of box beams are very dependent on the beam geometry and the building geometry. The table below shows some typical beam spans for domestic floor loading with beams at 3m centres. All of the beams are assumed to have 40mm thick flanges and webs.

Depth / Width	150mm	200mm	250mm	300mm
200	2.75 m	3.13 m	3.46 m	3.76 m
250	3.27 m	3.68 m	4.05 m	4.39 m
300	3.78 m	4.22 m	4.62 m	4.98 m
350	4.28 m	4.74 m	5.17 m	5.56 m
400	4.77 m	5.26 m	5.7 m	6.11 m

Table of allowable spans for different box beam dimensions for domestic floor loads

The table below shows some typical beam spans for roof loading with beams at 3m centres. All of the beams are assumed to have 40mm thick flanges and webs.

Depth / Width	150mm	200mm	250mm	300mm
200	3.14 m	3.56 m	3.93 m	4.15 m
250	3.73 m	4.2 m	4.62 m	5.01 m
300	4.31 m	4.81 m	5.26 m	5.68 m
350	4.88 m	5.41 m	5.89 m	6.34 m
400	5.44 m	5.99 m	6.5 m	6.97 m

Table of allowable spans for different box beam dimensions for roof loads

Currently the design of the box beams has been substantially proven by testing for the Tŷ Unnos Elements and TSB systems. The box beams are currently in the process of certification as separate components in their own right.

4.0 Ladder Beams

The Tŷ Unnos ladder beam is an engineered joist constructed from sections of timber in a ladder arrangement. The booms, top and bottom, are formed from two continuous sections. The rungs run between the booms, are formed from single sections and are positioned between the two boom sections. The gaps in the booms between rungs are in-filled with short timber sections (not shown in image)

All of the timber sections are 20x60mm in cross section and the spacings of the rungs are limited to 600mm. The depth of the joists can be varied to suit different applications within the range of 200 to 300mm.

The nailed version for the ladder beam was developed as part of the Tŷ Unnos TSB system and was tested as part of that systems certification process. A number of issues were encountered in this process and the full potential of the ladder beams was not realised. No certification of the ladder beams as a stand alone component has been completed to date.

The table below shows some typical joist spans for domestic floor loading at different joist centres and joist depths. All of the values are based on the TSB system testing

Depth / Centres	300mm	350mm	400mm	450mm
200	2.26 m	2.15 m	2.05 m	1.97 m
225	2.31 m	2.19 m	2.09 m	2.01 m
250	2.35 m	2.23 m	2.13 m	2.05 m
275	2.39 m	2.27 m	2.17 m	2.09 m
300	2.43 m	2.31 m	2.21 m	2.12 m

Table of allowable spans for different joist depths and centres under domestic loading

From the work done to date on these beams and the results from the TSB testing we anticipate that the beams will be able to span in the region of 3.0m at 300mm centres. This will require further testing to substantiate.

The ladder beams developed for the Tŷ Unnos Elements system use solid flanges 70x40mm with 140x40 rungs at 600m centres. The rungs are connected to the flanges with long screws into the rung side grain. These joists were tested as part of the Tŷ Unnos Elements system certification and can span up to 3.1m under domestic loading at 400mm centres. Part of the design of this joist is that it utilises composite action with the floor boarding. Therefore they require 18mm thick OSB above and below screwed to the joists at regular centres.

5.0 Diaphragm Panels

Stability for the Tŷ Unnos system is provided by diaphragm panels. These have been used for the Elements and TSB systems. They generally consist of 18m thick OSB screwed or nailed both sides of the wall box beams and ladder beams. Panels are typically 1.2m wide to match typical OSB board dimensions. Generally the fixings back to the wall structure are either nails or screws at 200mm centres around the full perimeter of the sheet.

There are numerous possible variations to the diaphragm panel design all covered by calculation methods in the Eurocodes. The OSB can be replaced with any suitable boarded material such as plywood. The pitch of the fixings into the wall structure can be changed to vary the panel capacity.

The requirements for diaphragm panels to provide stability is heavily dependent on the site wind loads. The table below gives the approximate maximum panel centres for different sites within Wales based on a six meter high structure with 1.2 m long diaphragm panels. The required number of panels is therefore the perpendicular wall length divided by the value from the table. For example a 10x5m building on plan 90km from the coast and 100m above sea level would require 5 panels parallel to the 5m wall and 3 panels (rounded up from 2.5) parallel to the 10m wall. This should be treated as a very approximate estimate.

Site Altitude Above Sea Level	Shortest Distance to Sea	Greater than 100 km	Up to 100 km	Up to 10 km
50m		2.4	2.2	2.0
100m		2.1	2.0	1.8
150m		1.9	1.8	1.6
200m		1.8	1.6	1.5
300m		1.5	1.4	1.3
400m		1.3	1.2	1.1

Table of maximum centres of diaphragm panels for different site locations in Wales

Diaphragm panels were tested as part of the Elements system certification. Although numerous issues were encountered during testing all of these have been subsequently resolved. However no further testing has been carried out to date.

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