metrotile
LIGHTWEIGHT ROOFING

STRUCTURAL ENGINEERING REPORT
8M SPAN RESIDENTIAL TRUSSES

PINNACLE
ADVICE YOU CAN BUILD ON

Client and Property Details

Property Address	N/A - Generic case study
Client Name	Metrotile UK Ltd
Client Address	Unit 3, Sheldon Business Park, Sheldon Corner, Chippenham, Wilts SN14 0RQ
Revision	1.0
Date	18th September 2012
Report Reference	C120708

Synopsis

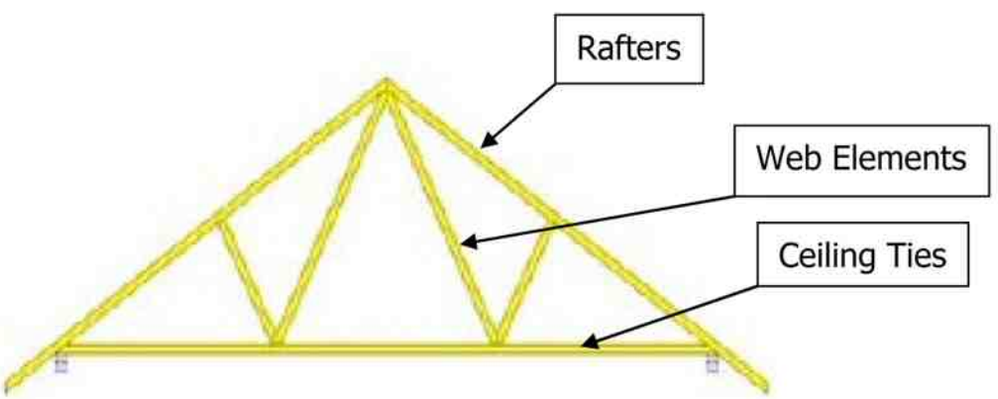
It was found that a weight saving of up to 25% by weight of timber roof trusses can be achieved by the use of light-weight Metrotile roofing as compared to industry standard concrete interlocking tiles when trusses were re-analysed using the reduced loads offered by Metrotile's system.

Brief

Pinnacle was asked on behalf of Metrotile UK Ltd to evaluate the potential weight savings in structural roof elements achieved by the substitution of concrete roof tiles by Metrotile's Lightweight Roofing system.

The case study was carried out for standard 8m span 26.5 degree pitch timber Fink trusses at 600mm centres as commonly encountered in the UK housing industry - see illustration below. The comparison was based on an initial design using concrete roof tiles as per specification tables in the timber British Standard BS 5268 part 3 as commonly used by designers within the industry. Further to this a computer analysis and design was carried out using the reduced loadings of the Metrotile system and the results compared.

Typical domestic truss configuration:

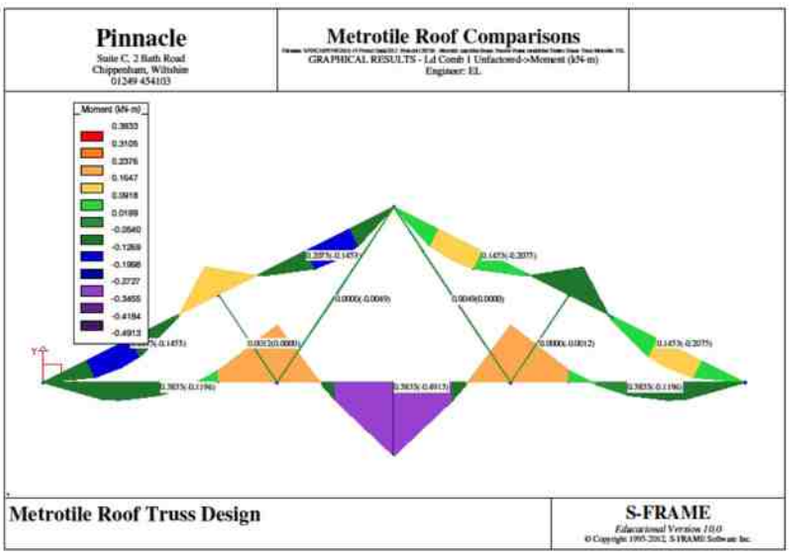


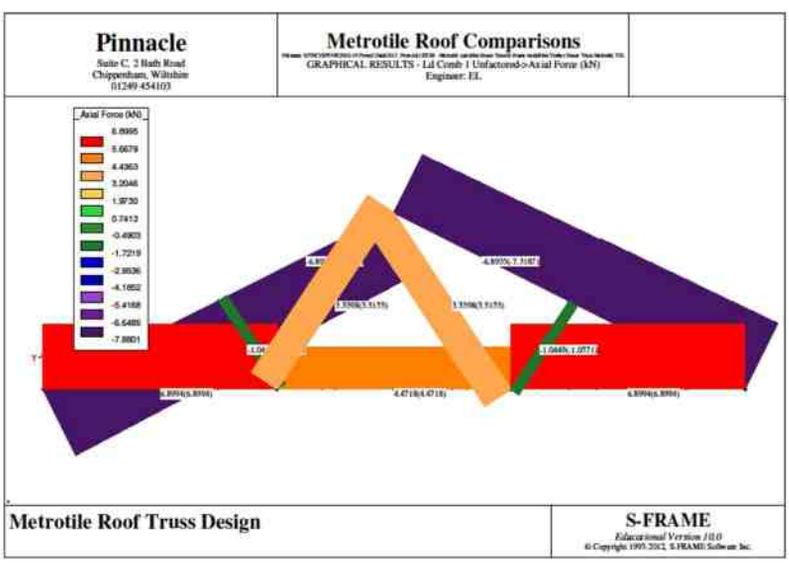
Roof Loadings

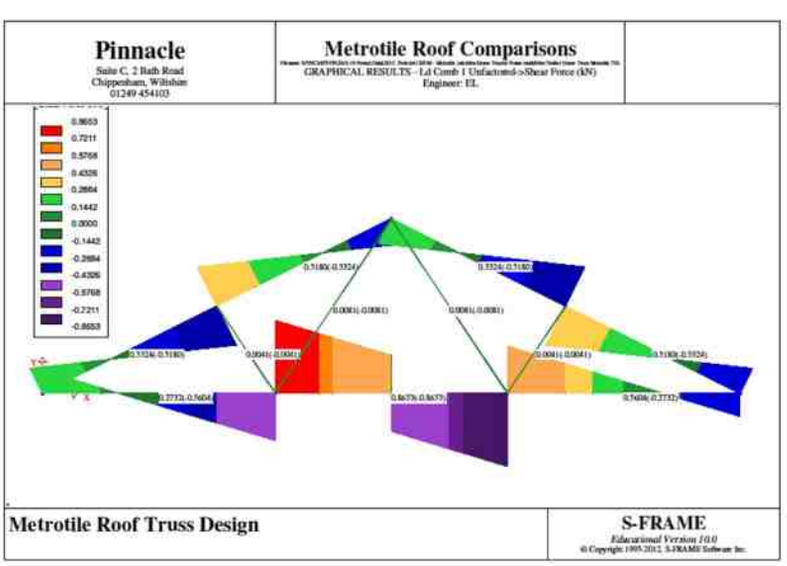
Concrete tiles/timber battens/felt underlay - **0.68** kN/m^2
VS
Metrotile 0.45mm tiles/timber battens/felt underlay - **0.11** kN/m^2

All other loads applied in accordance with BS 6399 part 1 and BS 5268 part 3:

Imposed/snow load	0.6 kN/m^2
Water tank allowance (point loads)	2x0.45 kN
Ceiling/insulation	0.25 kN/m^2
Loft accommodation	0.25 kN/m^2
Imposed point load on ceiling chord	0.9 kN







Analysis output from S-Frame software shows bending moments, axial forces and shears in the truss elements.

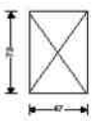
Tedds Pinnacle	Project: Metrotile Roofing Comparison				Job no.: 120708	
	Calcs for: 8m Truss Rafter - Metrotile Roof				Start page no./Revision: 1	
	Calcs by: EL	Calcs date: 18/09/2012	Checked by:	Checked date:	Approved by:	Approved date:

TIMBER MEMBER DESIGN TO BS5268-2:2002

TEDDS calculation version 1.5.07

Analysis results

Design moment in major axis M_x = 0.208 kNm
Design shear F = 0.518 kN
Design axial compression P = 7.455 kN



Timber section details

Breadth of section b = 47 mm — Depth of section h = 72 mm
Number of sections N = 1 — Breadth of beam b_b = 47 mm
Timber strength class C24

Member details

Service class of timber 1 — Load duration **Medium term**
Unbraced length in x-axis L_x = 2200 mm — Unbraced length in y-axis L_y = 300 mm Effective
length factor in x-axis K_x = 0.85 — Effective length factor in y-axis K_y = 0.85
Effective length in x-axis L_{ex} = 1870 mm — Effective length in y-axis L_{ey} = 255 mm
The beam is part of a load-sharing system consisting of four or more members

Lateral support - cl.2.10.8

Permiss.depth-to-breadth ratio 4.00 — Actual depth-to-breadth ratio 1.53
PASS - Lateral support is adequate

Slenderness ratio - cl.2.11.4

Slenderness ratio λ = 89.970 — Permissible slenderness ratio λ_{max} = 180
PASS - Slenderness ratio is less than permissible slenderness ratio

Bending parallel to grain

Permissible bending stress σ_{m_adm} = 12.066 N/mm² — Applied bending stress σ_{m_a} = 5.110 N/mm²
PASS - Applied bending stress is less than permissible bending stress

Compression parallel to grain

Permissible comp.stress σ_{c_adm} = 4.438 N/mm² — Applied compressive stress σ_{c_a} = 2.203 N/mm²
PASS - Applied compressive stress is less than permissible compressive stress

Members subject to axial compression and bending - cl.2.11.6

Comb.comp.and bending 0.997 < 1
PASS - Combined compressive and bending stresses are within permissible limits

Shear parallel to grain

Permissible shear stress τ_{adm} = 0.676 N/mm² — Applied shear stress τ_a = 0.230 N/mm²
PASS - Applied shear stress is less than permissible shear stress

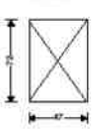
Tedds Pinnacle	Project: Metrotile Roofing Comparison				Job no.: 120708	
	Calcs for: 8m Truss Ceiling Tie - Metrotile Roof				Start page no./Revision: 1	
	Calcs by: EL	Calcs date: 18/09/2012	Checked by:	Checked date:	Approved by:	Approved date:

TIMBER MEMBER DESIGN TO BS5268-2:2002

TEDDS calculation version 1.5.07

Analysis results

Design moment in major axis M_x = 0.491 kNm
Design shear F = 0.865 kN
Design axial tension P = 4.472 kN



Timber section details

Breadth of section b = 47 mm — Depth of section h = 72 mm
Number of sections N = 1 — Breadth of beam b_b = 47 mm
Timber strength class C24

Member details

Service class of timber 1 — Load duration **Short term**
The beam is part of a load-sharing system consisting of four or more members

Lateral support - cl.2.10.8

Permiss.depth-to-breadth ratio 4.00 — Actual depth-to-breadth ratio 1.53
PASS - Lateral support is adequate

Bending parallel to grain

Permissible bending stress σ_{m_adm} = 14.479 N/mm² — Applied bending stress σ_{m_a} = 12.099 N/mm²
PASS - Applied bending stress is less than permissible bending stress

Tension parallel to grain

Permissible tensile stress σ_{t_adm} = 8.687 N/mm² — Applied tensile stress σ_{t_a} = 1.321 N/mm²
PASS - Applied tensile stress is less than permissible tensile stress

Members subject to axial tension and bending - cl.2.12.3

Comb.tension and bending 0.988 < 1
PASS - Combined tensile and bending stresses are within permissible limits

Shear parallel to grain

Permissible shear stress τ_{adm} = 1.172 N/mm² — Applied shear stress τ_a = 0.384 N/mm²
PASS - Applied shear stress is less than permissible shear stress

Worst case rafter and ceiling chord members designed using Tedds software.

Conclusions

It is immediately evident that the roof tile load is reduced from 69 kg/m^2 to 12 kg/m^2 when comparing the Metrotile roofing system with the standard concrete tile loads employed in BS 5268 tables B1 and B2 upon which the majority of residential roofs are designed. Roof truss weights are compared as follows:

Timber trusses at 600mm centres element section sizes comparison:

	Concrete Tile Roof	Metrotile Roof
Rafters	47x97 C24	47x72 C24
Web Elements	47x97 C24	47x72 C24
Ceiling Ties	47x97 C24	47x72 C24

Total Material Weight Savings:

Timber Truss weights:

Concrete Tile Roof	=	38.5 kgs
Metrotile Roof	=	28.7 kgs
% weight saving	**=**	**25%**

Report prepared by:

Ed Latham BEng MSc CEng MIStructE
Principal Engineer
Pinnacle

Unit 3, Sheldon Business Park
Sheldon Corner
Chippenham
Wiltshire
SN14 0RQ

01249 658514

sales@metrotile.co.uk

www.metrotile.co.uk

REPORT PRODUCED BY:

Pinnacle House
3 Meridian Way
Norwich
NR7 0TA

01603 702 010

enquiries@adviceyoucanbuildon.com

www.adviceyoucanbuildon.com