Prefabricated Lightweight Timber Ground Floor Systems R&D Project

Dr Alastair Woodard
Timber ground floor construction is far from a new concept; what is new, original and innovative is the ‘delivery method’ and the ‘market offering’

Prefabricated timber ground floor systems delivered by Australia’s Frame & Truss manufacturing sector
Benefits: Flood Prone Areas - High & Dry
Benefits: Reactive Clays - Adjustable

CRACKING UP!

Prefabricated Lightweight Timber Ground Floor Systems
Benefits: Sloping Sites – Lighter on the Land
Benefits: Sloping Sites – Lighter on the Land

Prefabricated
Lightweight
Timber
Ground Floor Systems
Pre-investigation of builder’s views on raised timber sub-floor construction
Findings

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Prefabricated Lightweight Timber Ground Floor Systems

![Image of houses and construction site]
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For the volume builders ‘COST’ is a major factor

- Not necessarily though for everyone
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**Timber Industry needs to match what the concrete sector offers**  
– supply & install
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<td><strong>Thermal Performance</strong> – all were concerned about sub floors achieving the appropriate energy rating</td>
<td><strong>Need to identify cost effective insulation solutions for sub-floors</strong></td>
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<td><strong>Low-lying areas</strong> – Council requirement is to build at least 600mm above flood level - many builders just use a deeper more massive slab</td>
<td><strong>Need to investigate at what slab thickness that TSFs become a more cost effective option</strong></td>
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<td><strong>Promotion of timber sub-floors</strong> – general feeling was that the timber industry was simply not supporting its product whilst the concrete industry was</td>
<td><strong>Investigate what promotion industry should be doing to protect remaining market share (for new homes and alterations &amp; additions)</strong></td>
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<td><strong>New ‘Waffle Pod’ slabs</strong> – are providing an even easier way to do slab on ground (slabs sit straight on ground no excavation for beams)</td>
<td><strong>Timber industry need also to investigate new, innovative, construction options</strong></td>
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**Currently some real issues for waffle pods – attitudes to ‘cost’ are changing**
Findings

 Builders in Australia currently prefer slab-on-ground to suspended timber floor systems; slabs today represent over 95% of the new residential market in some states.

 Builders have concerns with traditional ‘built-on-site joist & bearer timber systems’ particularly because of
 • the multiple trades and contracts required and
 • the longer construction periods compared to the slab-on-ground alternative.

 Builders today are used to, and want, –
 ‘one contract, to deliver a working platform, on a site, on a specific date, for a specific cost’.

 This is the challenge for a successful take-up of easy-to-install, cost effective lightweight timber ground floor systems.
Findings – Key Issues

Key issues to address include

• **offering a total system** that includes the **prefabricated timber floor**, the **supporting system** (with a number of options depending on site conditions) and a simple, effective and quick installation process;

• developing an **approach that has broad supply channel potential** – an approach that does not require specialists to deliver;

• securing engagement and **participation by the truss and frame sector – design / fabrication / install** – this provides a whole new value-added product line to manufacturers and a next step towards further prefabrication offerings (fully finished wall systems, fabricated roof modules etc.).
# Project Activities & Timelines

## Part A
**Review**
- Critical review of what has been tried in regards prefab floor systems in the past and report on what is needed and how industry should/could respond

## Part B
### Design
- Designing optimised floor system solutions
- Designing pre-fabricated floor support methods
- Design Analysis
- Designing on-site installation techniques and procedures

### Lab Testing
- Project administration - FWPA contract & milestones
- Elemental and Full size testing of floor panel options for performance
- Elemental and Full size testing of between-panel jointing requirements
- Elemental and Full size testing of pre-fabricated floor support and tie-down
- Testing of in-shop floor insulation installation options

### Pilot
- Full size testing of on-site installation techniques and procedures
- Construction of a full-sized home floor
- Preparation of copy for FWPA Technical Manual
- Launch
- Final Report and AFFR
Stage 2: Design Optimisation

I. Optimised panel floor systems
   (including floor insulation)

II. Floor support systems

III. Onsite installation approaches
Optimised Floor Systems

Prefabricated Panelised Flooring Configuration Options
- optimised around
  • delivery & installation considerations
  • structural performance and materials cost,
  • utilising the current range of commonly available structural flooring products, both
    o solid sawn and
    o engineered (plywood, particleboard, LVL, I-beams and floor trusses);
Optimised Floor Systems

Delivery & installation considerations

• Anything up to 3m wide OK – over 3.1m: travel restrictions. **Utilise 2.7m wide panel**
• Semi-truck trays 11-12m long – cranes 12m reach (500kg) OK to use to place
• The optimum maximum length for panels that can be carried on a normal flat back truck with a Hiab crane is 9m
Optimised Floor Systems: S-Type

S1: Bearers
190x35mm F17 or LVL

Floor Joists:
140x45mm F17 or LVL @ 450mm crs

S2: Bearers
240x45mm LVL

(Area: 19.4m²)

(Area: 24.3m²)

S3: Bearers
290x45mm LVL

(Area: 29.2m²)
Optimised Floor Systems: I and T-type

Assumption - floor joist span the long distance

**E1:** Joists (@450mmcrs): 240 deep I-beams

**E2:** Joists (@450mmcrs): 300 deep I-beams

**E3:** Joists (@450mmcrs): 360 deep I-beams

(Area: 12.2m²)

(Area: 14.6m²)

(Area: 17.0m²)
Optimised Floor Systems - Insulation

Insulation Options

- Bulk: Glasswool, Rockwool, Polyester
- Cellular Foil Laminate
- Concertina Foil
- Expanded Polystyrene
- Foam Spray
Stage 2: Design Optimisation

I. Optimised floor systems (including floor insulation)

II. Floor support systems

III. Onsite installation approaches
Floor Support Systems

sloping sites, a braced adjustable steel pier approach is very effective allowing levels to be easily achieved (a range of proprietary products exist with different approaches to adjustment and levelling).

flat sites the adjustable steel pier can be used or a set-height precast pier product may prove more cost effective (typically minimum of 400mm high to meet building regulations).
Floor Support Systems – Floor to Ground

Uni-Piers are available in two sizes:
- Builders Grade – (65 x 65 x 2mm SHS posts)
- Heavy Grade – (75 x 75 x 2.5mm SHS posts)

Bearer Support
- Faing Bracket (welded to bearer plate/anchop)

Bearer Plate
- Loadbearing with integral anchop

Fastenings
- Where loadbearing, use 8.14 x 20 x 22
- Bulldex Metal Tek self-drilling screws. Where non-loadbearing, use 4.4 x 20 x 22
- Metal fix or use recommended fixing bolt for high wind categories.

Base Plate
- Welded to pier
- Bolt to concrete pad or cast into concrete, plate acts as anchor.

Uni-Piers are Hot Dipped Galvanised and are suitable for Timber or Steel bearers.

Adjustable Steel Piers

Uni-Pier
Advanta-Pier
Floor Support Systems - Footings

Bored Concrete Pier
(Lightweight external wall)

Conventional Strip Footing
(Heavyweight veneer external wall)
Stage 3: Testing

1. Elemental testing
2. Full panel testing
3. Installation Testing
**Proposed Test Configurations and Aims:**

**Test 1: Panel Bounce**
Utilise one single panel and a movable bearer to test perceived/actual panel bounce

**Test 2: Panel Assembly – long edge connection**
Test cantilevered flooring and in-fill floor connection options
Investigate stitching beam installation
Investigate floor to pier tie-down requirements
Test panel bounce

**Test 3: Internal support performance**
Test internal support pier tie-down requirements
Test panel bounce

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CE: cantilever edge flooring  RE: rebate edge flooring
See Test 2 Panel Connections Drawing – explains flooring edge details

**Test Panel Thoughts**
BRANZ Full Panel Testing (NZ)
Installation Testing: Bowens (Aust)
Stage 4: Pilot Phase

I. ‘Full size home floor’ with builder

II. FWPA Technical Advisory Manual
Full Size Home Floor

Prefabricated Lightweight Timber Ground Floor Systems

Pad Footing Layout & Sub-floor Bracing Detail

Title: Prefab Floor System Construction Details
Project: Swenrick Constructions “Harris@Heathcote”
Detail: Pad Footing Layout & Sub-floor Bracing Detail

Drawn: CS
Checked: RT & RS
Date: Nov 2012
Version: 2e
Page: 4 of 4
Full Size Home Floor

2x90x45 pine fixed on flat to table floor (allows lift for fork access)

400mm high braced verticals set to provide accurate right-angle
**Full Size Home Floor**

**PANEL 6**

**Framing**
- B1A 2@200x42 LVL15
  (1 only per Panel)
- B3 2/360x42 LVL15 nail lam.
- PosiStruts PS4536
- SB 170x35 LVL15 strongback

**Lifting points**
Before flooring, fit inverted joist hangers over lifting trusses as shown.
Immediately after floor is laid drill pairs of 70mm holes as shown max 250mm from face of bearer. Wipe off any glue & retain plug for refitting after final lifting.

**Flooring**
4.5 sheets, cut from sheets A, B, C, D & half sheet shared with Panel 5 as shown. Final floor size must not exceed dimensions given.

**Edge finishes:**
- FE flush with framing
- RE 35mm rebate edge
- CE 45mm cantilever edge

**Label**
Permanent mark each panel with Panel number & lettered corner(s) as shown.

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Full Size Home Floor
Full Size Home Floor

Installation
February 2013
Full Size Home Floor

Adjustable pier installation
Full Size Home Floor

Floor panel site installation
Full Size Home Floor

Floor panel site installation
Full Size Home Floor
Full Size Home Floor

Floor panel site installation
Technical Advisory Manual

Written for frame and truss manufacturers
- Introduction
- Selecting a system
- Design
- Fabrication
- Installation
- Case Study
Market Implementation Strategy

Aim is to manage the introduction so that industry provides a quality solution right from the start. Suggested activities include:

- work closely with Frame & Truss Manufacturers Association;
- Information seminars to be held in each state;
- identify 2-3 innovative and quality F&T manufacturers in each state (Vic, NSW & Qld at least);
- form a small implementation group of these key companies;
- assist companies in understanding the concepts and touting for some jobs in their states;
- assist companies on each job, seeing what we can learn and updating the technical advisory manual;
- work with Pryda, MiTek, Multinail to include in their software;
- further promote the concepts with builders and designers;
- then once we have a number of jobs completed in each state - then starting to share the information more broadly.
Lots of Benefits

• Best construction option for: sloping sites, low lying areas, poor soil conditions
• Guaranteed quality due to manufacture in a controlled factory environment
• Reduced material waste and zero on-site waste
• Ease of floor insulation installation
• Increased on-site construction speed (floor & plumbing)
• Simplified plumbing installation (no jack hammering)
• Post construction adjustment (highly reactive clays)
• Extension of concept to indoor-outdoor living and offering prefabricated timber decks and screens
• Lots of opportunities for additional frame & truss value-add: pre-ink-jetting wall frame positions, pre-cutting holes for plumbers, pre-installing plumbing pipes, fittings or shower bases, pre-fitting waterproof flooring & linings

Prefabricated timber ground floor systems
Information Seminars

Detailed information seminars to be held in August

Monday 26th August:        QLD Seminar - Brisbane

Wednesday 28th August:    NSW Seminar - Sydney

Friday 30th August:       Vic Seminar - Melbourne
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