TOGETHER, WE CAN RESTORE THE

# GREAT AUSTRALIAN DREAM

INTRODUCING A

- **SIMPLE**
- **SMART**
- **SUSTAINABLE**

SUCCESSOR TO STUD-FRAMING

**ffset BUILD®** *

- NEXT GENERATION
- LOWER COST COMFORT

**A PARTNERSHIP OFFER**
**TO GOVERNMENT AND INDUSTRY**

**FROM**


## TONY WALSH

**BUILDING CONSULTANT & BUILDER**

**Grad Dip Arch  CC1263P**

**AND**

## ROD GOWLAND

**CIVIL & STRUCTURAL ENGINEER**

**M Tech  CPEng 743197  CC1590Y**

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**0418 597 370**


* **Any method or technology that is expected or intended to supersede present day techniques**

Offset BUILD

- NEXT GENERATION
- LOWER COST COMFORT

## Concept Development

## Tony Walsh Grad Dip Arch

**Tony studied architecture at the T.C.A.E. (now UTAS), finishing with a major post-graduate study that created and evaluated a housing system based on a previously patented concept.**

**Over 35 years of building consultancy and 20 years 'on-the-tools', Tony has created buildings with early use of factory precast concrete panels, active and passive air and water based solar systems including movable insulation and vectored natural ventilation, earth berming, earth sheltering, and at-ground roof water collection.**

**After experimenting with partition walls between 2001-15, Tony sought Rod's advice and they became equal partners. The result - OffsetBUILD.**

## Engineering

## Rod Gowland M Tech

**Rod started his career in 1964 as a Cadet Engineer with Prahran City Council, Victoria. At night he studied at RMIT for an Associate Diploma of Civil Engineering. Later, he resumed his studies and graduated with a Master of Technology degree through Deakin University in 2005.**

**Rod is an experienced structural engineer and building designer with extensive theoretical and hands on construction expertise. For over 20 years he owned and operated his own engineering consultancy and building design/documentation business, specialising in the domestic and small commercial sector and employing up to 5 people.**

# Contents



**We dedicate OffsetBUILD to the memory of three pioneers who greatly influenced its development**

- **Graham Hanna,** an architect who was an inspiring housing design teacher
- **John Van Peelen**, a structural engineer who loved designing low cost homes and solving unusual structural problems
- **Bill Howroyd,** an architect who created pioneering low cost homes


**Thanks to**

Clarrie Pryor, Beverley, Jessica and Michael Walsh, Shane and Ruth Goelst, Chris Davis

- We spend more on building and maintaining homes than anything else
- We spend more now on homes than in the past, so we have less for other things
- Stud-framing is part of the reason why, for decades, home build cost has been rising faster than our ability to pay, increasing consumer pain and contributing to the housing affordability crisis
- How to lower build cost is not being seriously considered, when it should be an important issue

Stud-framing has served us well since the mid 1800s, but our needs have evolved, so we offer a next generation successor that delivers:

- Estimated **30%** lower build cost
- Estimated **50%** less labour cost
- **5-7%** more usable floor area
- Design flexibility like stud-framing
- Higher insulation capacity
- Low cost moderate thermal mass

# HOW?

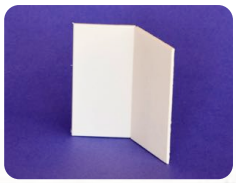
FIRST, A SIMPLE CONCEPT

# A Low-tech Invention

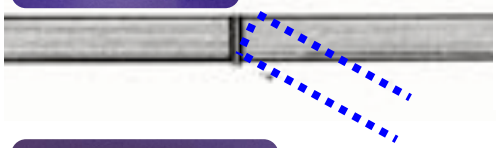
● OFFSET LAYERING ● HOW TO BUILD A COMPOSITE BOARD
● NOW, BUILD A HOME... ● MODEL

OffsetBUILD is based on a low-tech invention called Offset Layering
(Innovation Patent 2013101176)

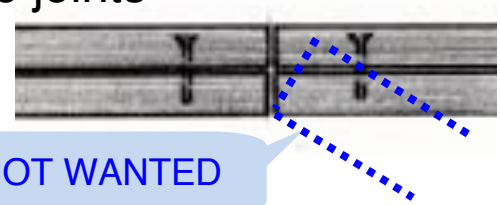
Offset Layering is an assembly and attachment method. It uses building boards that ● **TWO PEOPLE CAN LIFT**
● **ACCEPT ROBUST FACE & EDGE FIXINGS**



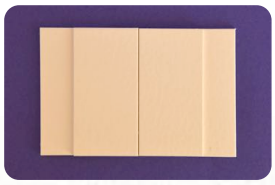
If boards are configured like this, they can **bend** at the joints



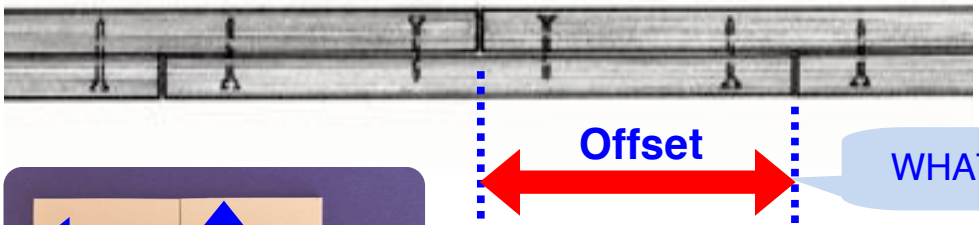
**Pin Joints**



NOT WANTED



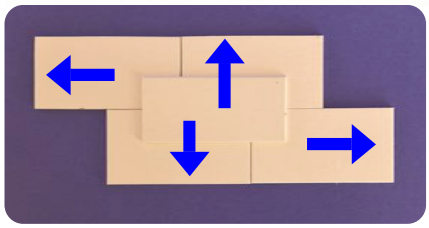
If boards are layered and attached with joints **offset** like this, they **resist bending**



**Stiff Joints**

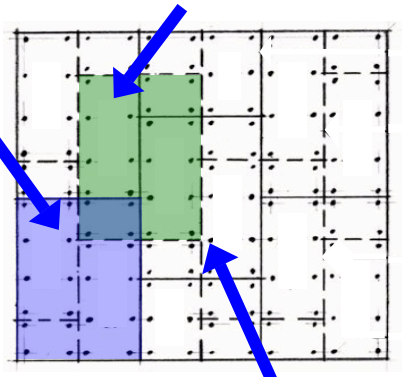
**Offset**

WHAT WE NEED



Back boards

Front boards



If layers of boards are attached with **joints offset in both directions** they become a thicker and larger **composite board** that transmits stresses between the layers to achieve **considerable stiffness and strength**

Attachments

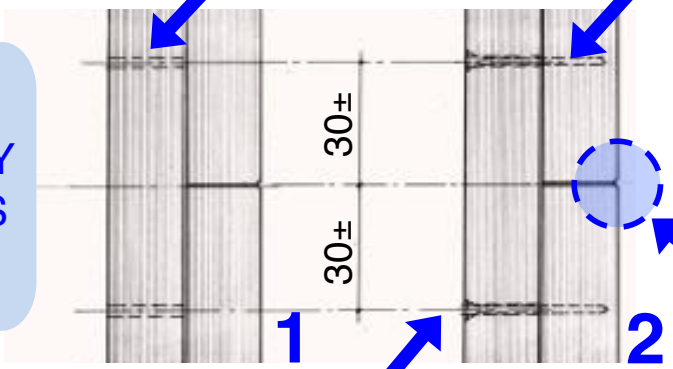
COMPOSITE BOARD WALL ASSEMBLY

# How to make a composite board

Into one layer, pre-drill tight clearance holes at 300mm spacing around edges and within the board body, then assemble layers with joints offset minimum 300mm in both directions

Insert particleboard screws to within 3mm of back face and flush finish (hidden side); or 2mm countersink, fill and flush off (cosmetic side)

IT REALLY IS THIS EASY




**Joints**

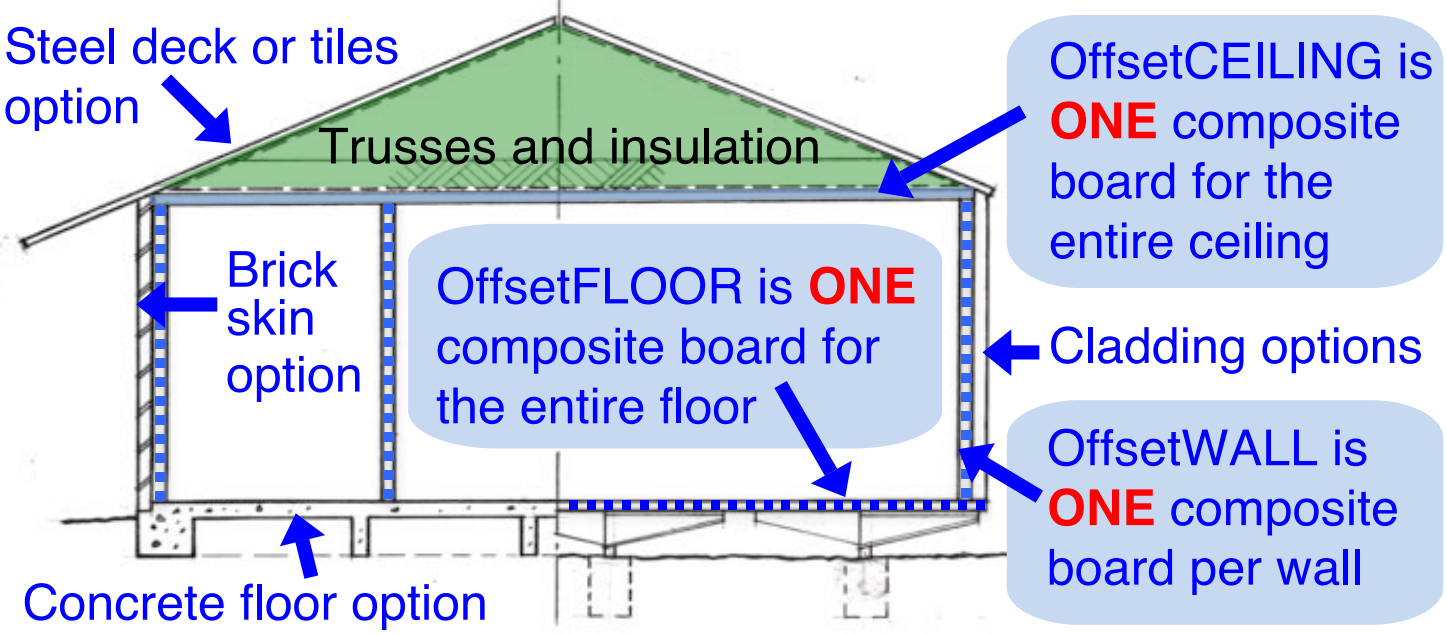
2mm bevel, fill and flush off

**The flush joint will not crack because nearby screws prevent movement**

If screws are inserted from the hidden side, cosmetic filling will not be necessary

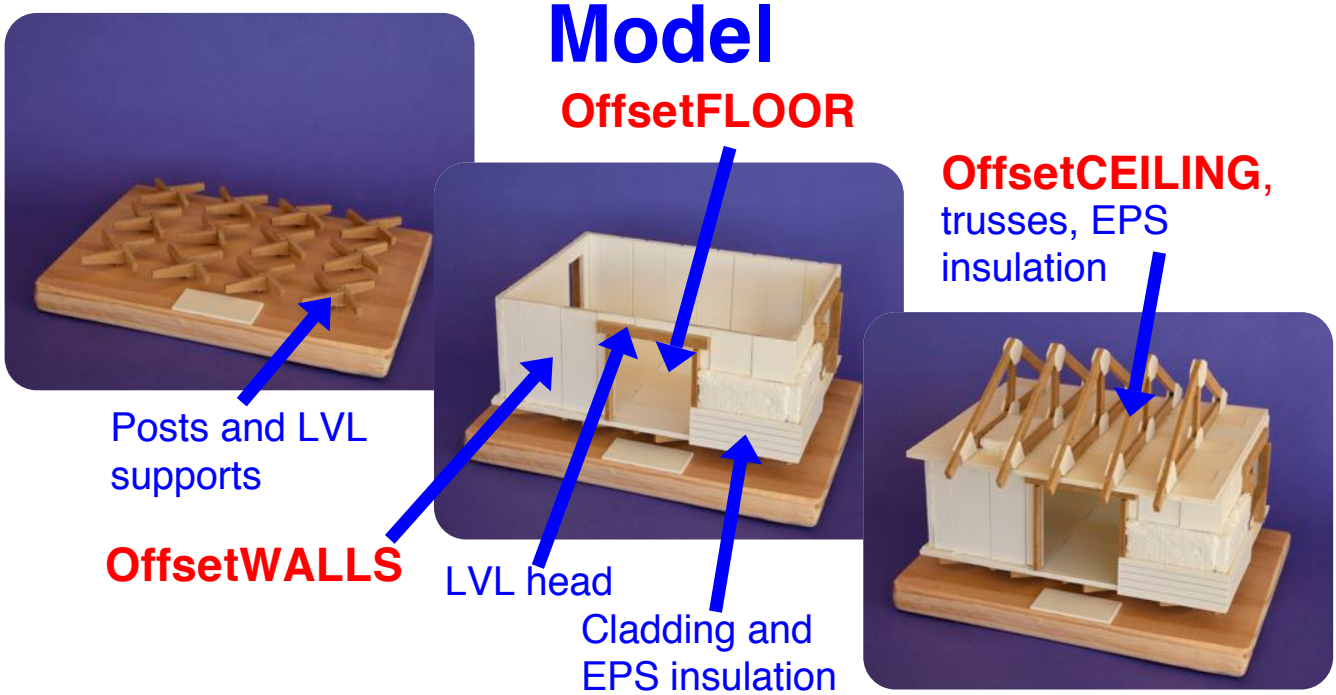
## NOW, build a home with composite boards

**NO bearers, floor joists, stud framing, plasterboard**




**ONE material and ONE process create structure, lining, insulation and thermal mass**

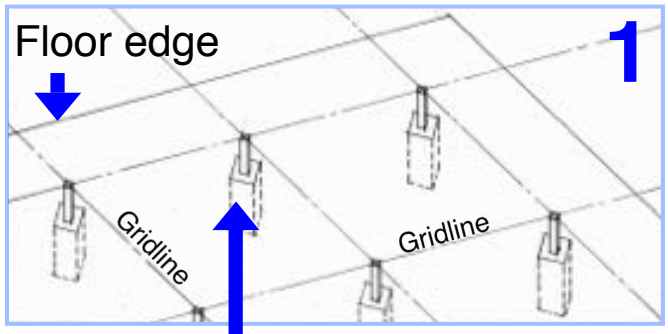
# Model




**FASTER, EASIER, LOWER COST**

# Build It Like This

- OffsetFLOOR
- OffsetWALL
- OffsetCEILING
- CONCRETE FLOOR
- BRICK SKIN
- WALL OPENING
- DOOR & FANLIGHT
- WALL CLADDING



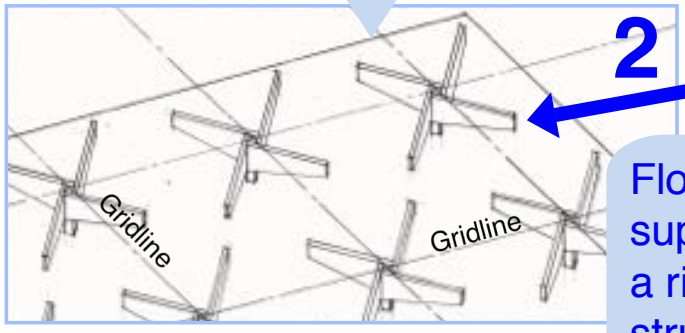

Assemble grid of metal tube posts set into concrete footings at variable grid spacing up to 2.2m to suit floor spanning capacity

**One Composite Board**

# OffsetFLOOR

**NO** bearers
**NO** joists

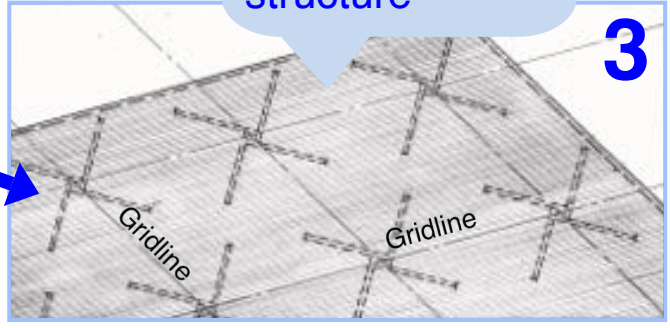
Laser set to level and screw LVL supports to each other & the posts



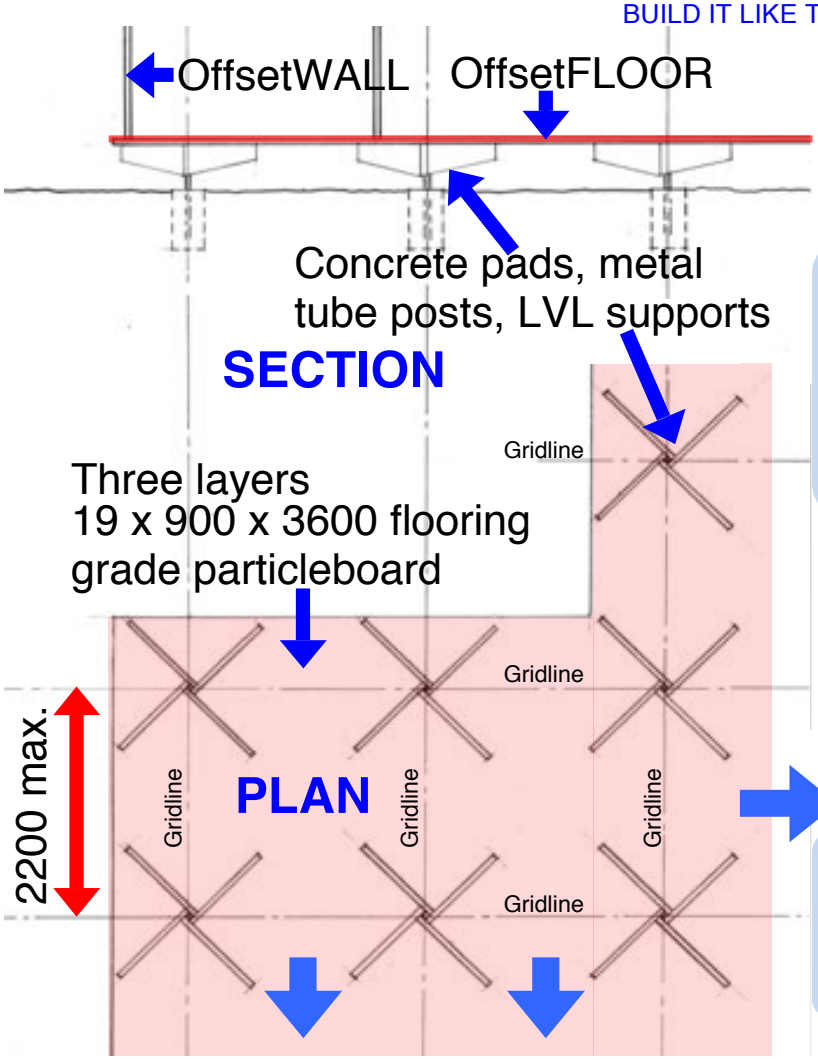

Floor layers & supports create a rigid integrated structure

Three layers of 19mm flooring grade particleboard 900 x 3600

- **Set each layer parallel**
- **Offset sides and ends**

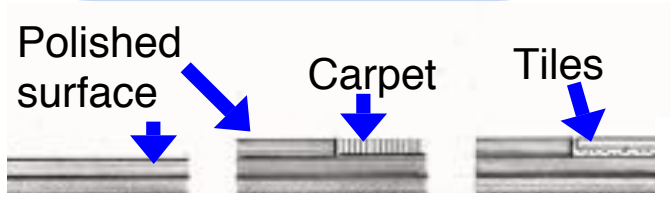


BUILD IT LIKE THIS




**ENGINEERING SOLUTION ON PAGE 17**

- Lower set
- Easier access
- Variable gridline spacing
- Any layout is possible
- Fewer footings
- Less worker risk




**OffsetFLOOR OPTIONS**

**Multiple layers create**

- More underfloor insulation
- Moderate thermal mass
- A single structural entity

## Materials Cost Comparisons

### Conventional Bearers and Joists Floor

**3.6m x 3.6m** **Cost: $116/m²**

| | | |
|---|---|---|
| CONCRETE FOR FOOTINGS: 9 footings | allow | 100 |
| POSTS: 9 off 75 x 75 x 2.5 x 800 long galv. RHS $31/m, and top brackets at $10 each | allow | 340 |
| BEARERS: 2 x 120 x 35 F17hwd @ $8.60/m | 21.6m | 186 |
| JOISTS: 120 x 35 F17Hwd @ $8.60/m | 40m | 344 |
| PARTICLEBOARD: Laminex Ind. 4 boards @ $46.35 | | 186 |
| UNDERFLOOR INSULATION: R2 11.8m² @ $19.23 | | 249 |
| SCREWS, BOLTS etc: | allow | 100 |
| **Total** | | **$1,505** |

### 3-Layer OffsetFLOOR

**3.6m x 3.6m** **Cost: $84/m²**

| | | |
|---|---|---|
| CONCRETE FOR FOOTINGS: 4 footings | allow | 50 |
| POSTS: 4 x 1m long 75 x 75 x 2.5 galv. RHS | $31/m | 124 |
| SUPPORTS: 400 x 45 LVL 16 @ $16.20 per support | | 259 |
| PARTICLEBOARD: Laminex Ind. 12 boards @ $46.35 | | 557 |
| SCREWS etc: | allow | 100 |
| **Total** | | **$1,090** |

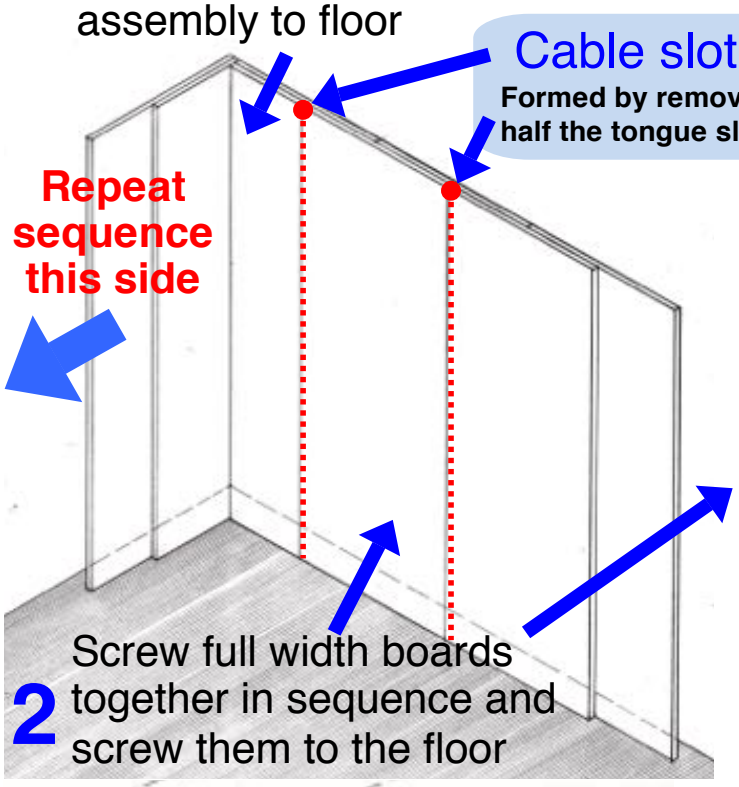
- **27%** less materials cost than bearers and joists floor
- **50%** estimated less labour cost than bearers and joists floor - more on rocky ground (fewer post holes)
- OffsetFLOOR without underfloor insulation matches insulation level of bearers and joists floor with underfloor insulation

## 1 Start Assembly at a Corner

For each side, screw a full width and half width board together, screw them together at the corner, check plumb both ways, and screw assembly to floor

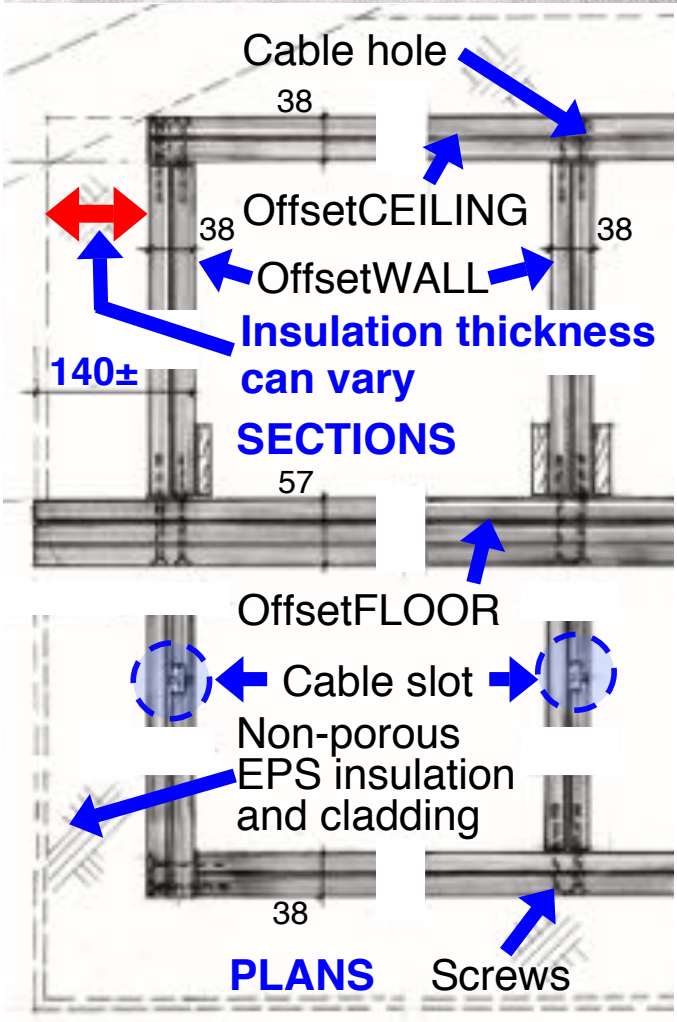
**One Composite Board Per Wall**

# OffsetWALL





**ENGINEERING SOLUTION ON PAGE 18**




- Load bearing wall
- Offsets resist insects and air leaks
- **NO** Studwork
- **NO** Plasterboard
- **NO** Cornice (optional)
- High non-porous insulation
- Moderate thermal mass
- **50dB** sound attenuation
- **NO** Bracing
- **NO** tie-downs

# Materials Cost Comparisons

## Conventional Stud-Frame Wall

**3.6m long x 2.5m high** **Cost: $36/m²**

| | | |
|---|---|---|
| STUDS, PLATES, NOGGINGS: 28m @ $3.38/lin.m | | 94 |
| PLASTERBOARD: 18m² @ $8.23/m² | | 148 |
| CORNICE: | allow | 30 |
| SKIRTING: | allow | 30 |
| FIXINGS, ADHESIVE, JOINT FILL | allow | 20 |
| **Total** | | **$322** |

## 2-Layer OffsetWALL

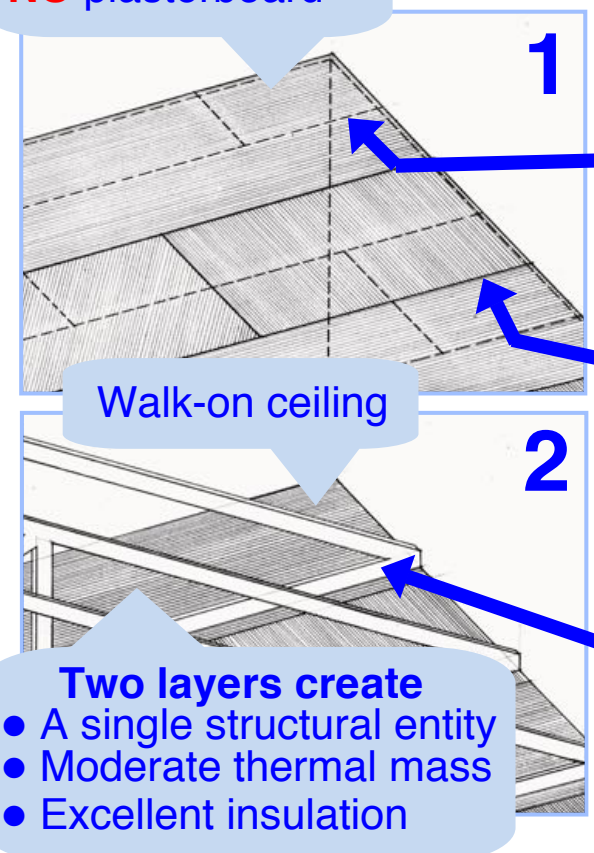
**3.6m long x 2.5m high** **Cost: $34/m²**

| | | |
|---|---|---|
| PARTICLEBOARD: 5.6 sheets @ $46.35/sheet | | 260 |
| SKIRTING: | allow | 30 |
| SCREWS, SEALANT, POLYFILLER: | allow | 20 |
| **Total** | | **$310** |

- **3%** less materials cost than stud-frame wall
- **50%** estimated less labour cost
- OffsetWALL is a thin 38mm internal, 140mm external; compared with brick veneer 110mm internal, 250mm external

  This creates more usable floor area worth about **$10,000 per 100m²**

**NO** furring channel
**NO** plasterboard




**Two layers create**
- A single structural entity
- Moderate thermal mass
- Excellent insulation

## One Composite Board
# OffsetCEILING

### Bottom layer (dashed lines)
- Fit on walls and temporary supports (not shown)
- Locate screw fix to walls

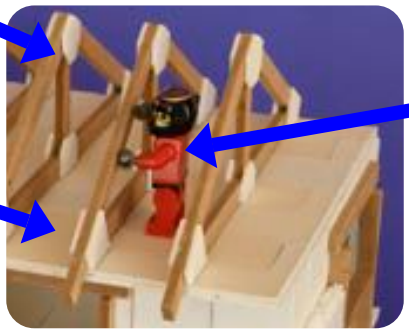
### Top layer (solid lines)
- Fit parallel to bottom layer with side and end offsets
- Screw fix to walls

### Pine Trusses @ 900mm spacing
- Fix trusses to OffsetCEILING from the underside with screws through pre-drilled holes in OffsetCEILING at 300CCS
- Fit 90mm thick EPS insulation between truss bottom chords (not shown)

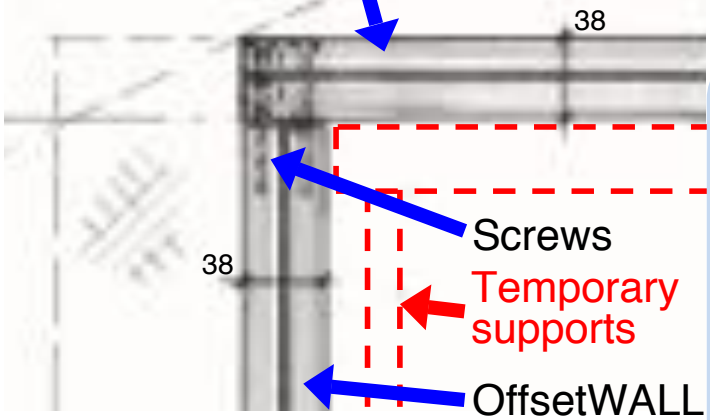
Trusses at 900CCS with EPS insulation between bottom chords

OffsetCEILING - 2 layers 19mm flooring grade particleboard. Screw attach from the top

**ENGINEERING SOLUTION ON PAGE 18**



Safer assembly on walk-on ceiling




**SECTION**

- Less overhead lifting and fixing
- Less working at heights hazard
- Faster assembly
- Structural, tough, stiff, cosmetic
- Precisely level with no undulations
- High insulation, airtight
- Moderate thermal mass

## Materials Cost Comparisons

### Conventional Plasterboard Ceiling

**3.6m x 3.6m** **Cost: $14/m²**

| | | |
|---|---|---|
| PLASTERBOARD: 13m² @ $8.23/m² | | 107 |
| FURRING CHANNEL & CLIPS: 29m @ $2/lin.m | | 58 |
| INSULATION: Not costed - more than OffsetCEILING | | |
| FIXINGS, ADHESIVE, JOINT FILL | allow | 20 |
| **Total** | | **$185** |

### OffsetCEILING

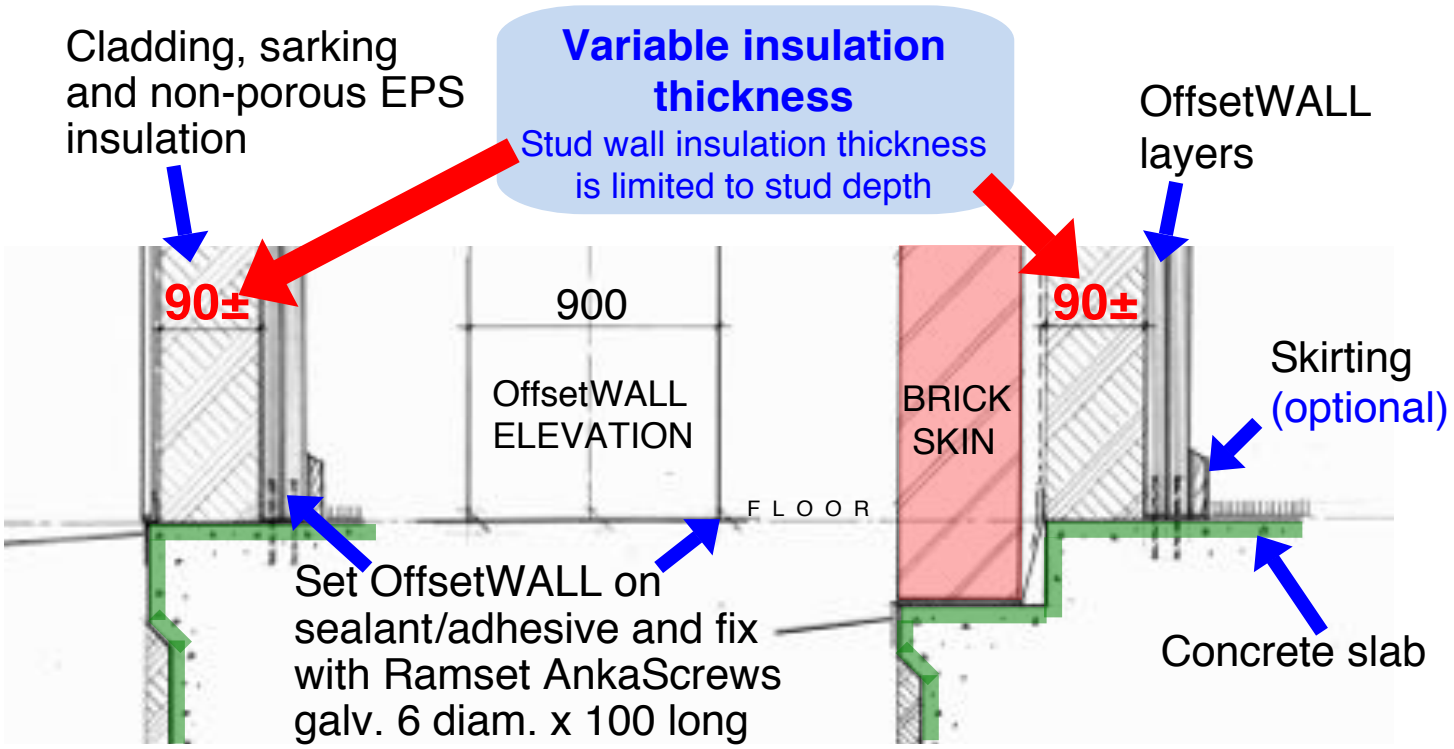
**3.6m x 3.6m** **Cost: $32/m²**

| | | |
|---|---|---|
| PARTICLEBOARD: 8 sheets @ $46.35/sheet | | 371 |
| SUPPORTS HIRE: | allow | 30 |
| INSULATION: Not costed - less than plasterboard | | |
| SCREWS, POLYFILLER: | allow | 20 |
| **Total** | | **$421** |

- Materials cost is **128%** more than plasterboard ceiling
- With similar insulation levels cost difference decreases
- Labour costs are similar
- Essential part of the integrated structure that enables considerably more savings elsewhere
- Adds more insulation, thermal mass and sound attenuation
- Plasterboard ceiling is a lining with less insulation, thermal mass & sound attenuation

**An economic low set option for a flat or gently sloping site**

# Concrete Floor

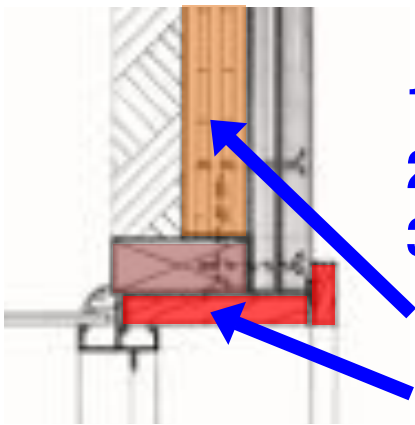



**WITH WALL CLADDING** **WITH BRICK SKIN**

**Fast and easy**

# Wall Opening

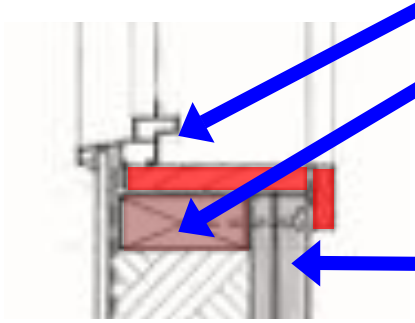
1. Fit surround/stiffeners & LVL head
2. Cut opening & re-use offcuts
3. Fit window/door



LVL head

Window/door, reveals, architraves

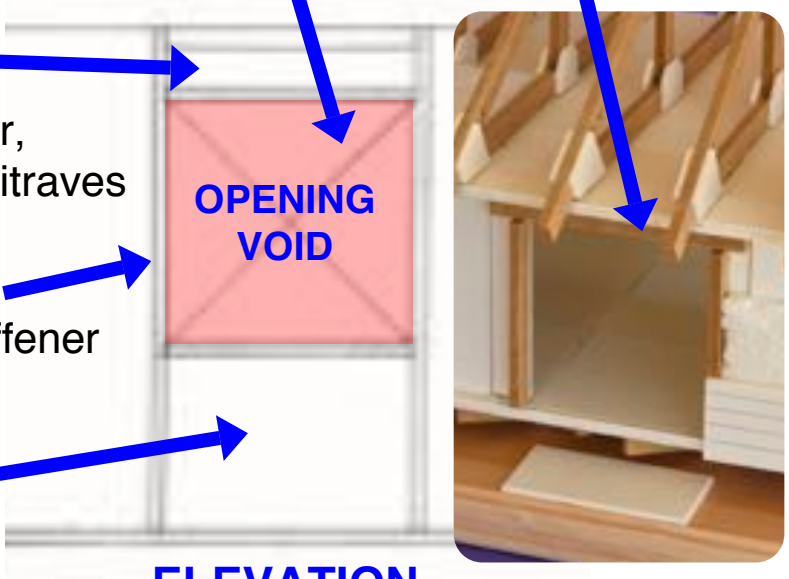
**SECTION - HEAD**



90 x 35 pine surround/stiffener

OffsetWALL

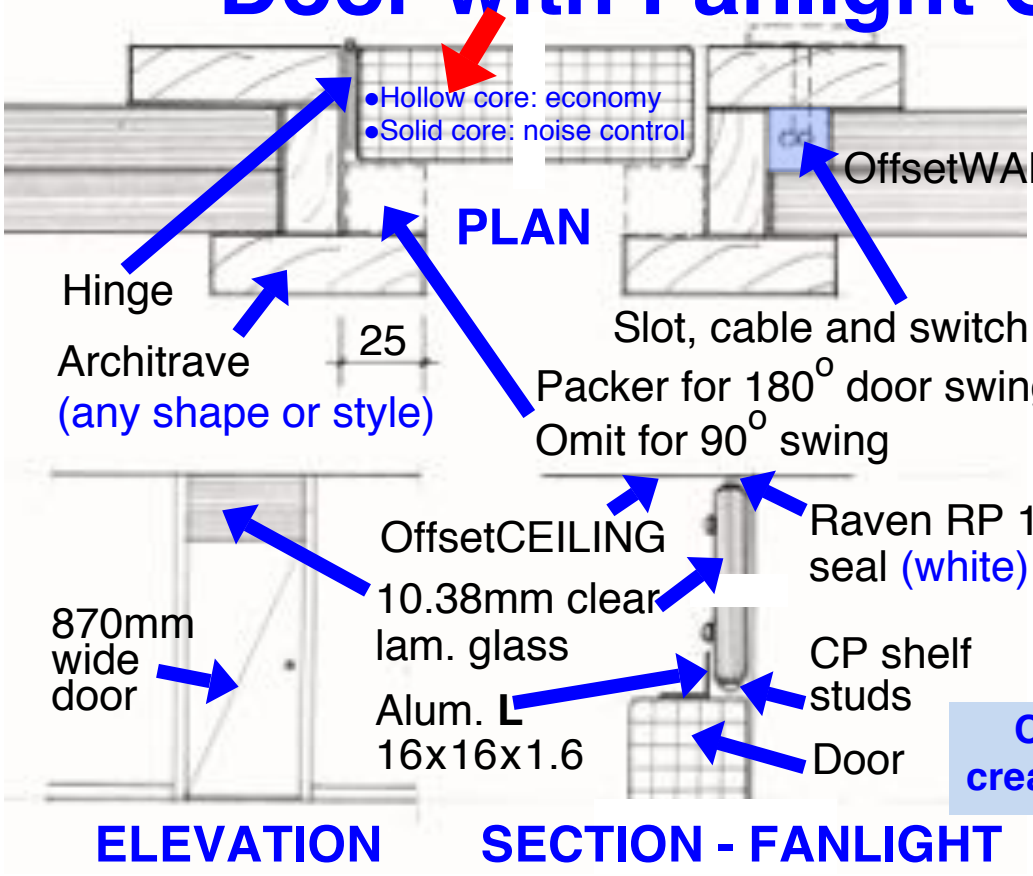
**SECTION - SILL**



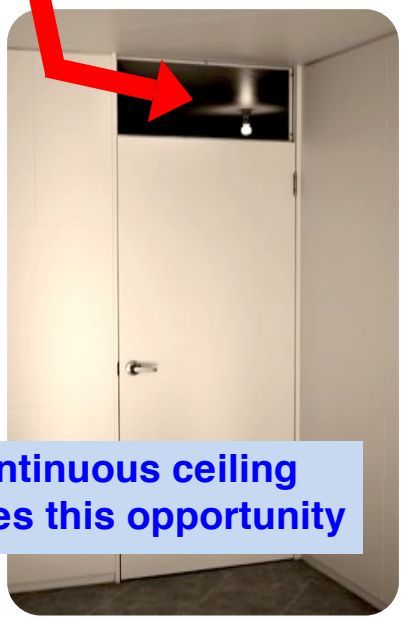

**ELEVATION**

**Conventional looking door, frame and architraves**

# Door with Fanlight Option




- Improves visual flow
- Lightens dark spaces

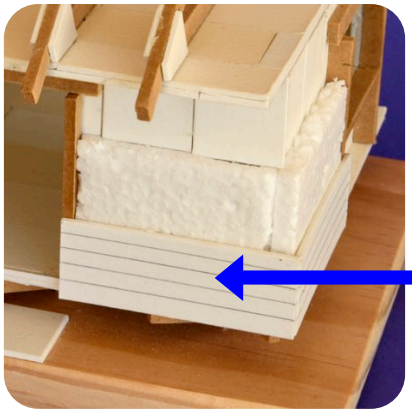


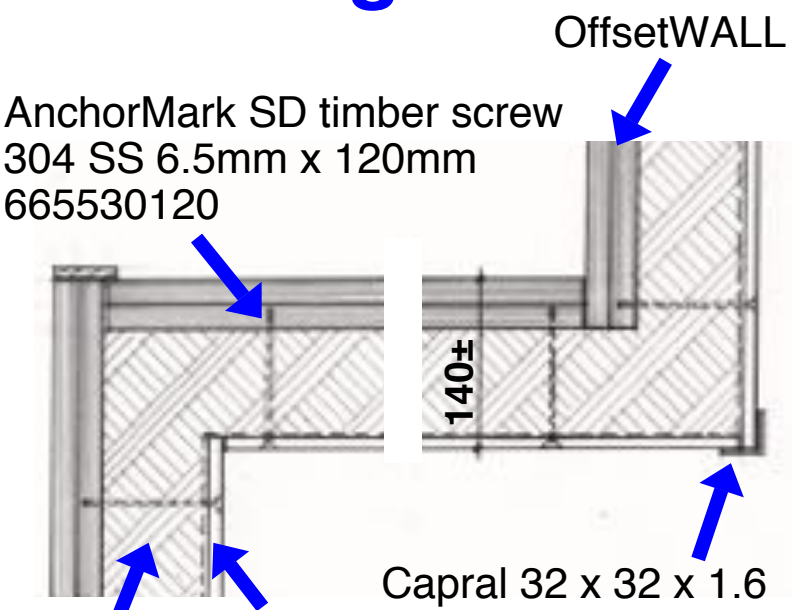
**Continuous ceiling creates this opportunity**

**Many options**

# Wall Cladding

- **NO** battens
- **NO** cavity
- **NO** insects
- **NO** vermin
- Gradual thermal gradient discourages condensation and mould growth






**PLAN-SECTIONS**
**Showing Internal & External Corner**

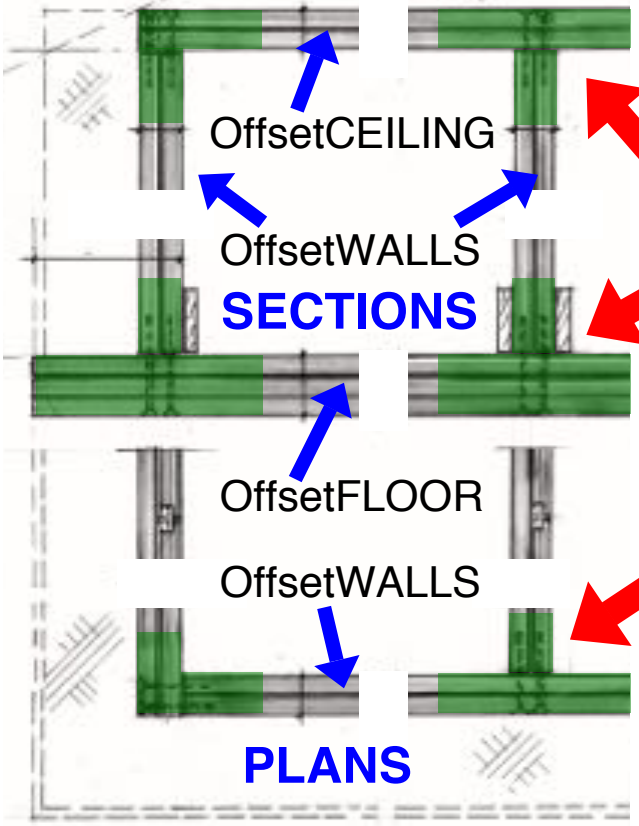
**CONSERVATIVE, FULLY RESOLVED**

# Clever Integrated Engineering

- ENGINEERING INTEGRATION
- TWO-STOREY BUILD
- PREFABRICATION
- BUILD CEILING AND ROOF ON THE FLOOR
- ENGINEERING ENDORSEMENT
- FLOOR WALLS & CEILING ENGINEERING SOLUTIONS

**The unique next generation OffsetBUILD advantage**

# Engineering Integration



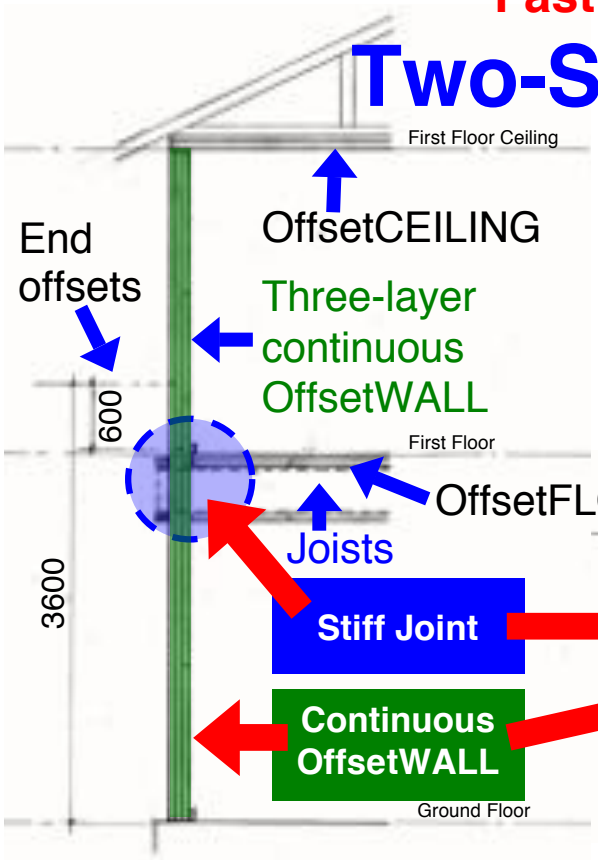

Stiff joints make **T or L beam zones** at all floor/walls/ceiling junctions and between the floor supports and floor, to create a **RIGID INTEGRATED SHELL** similar to a monocoque car body and like the box below

Without the lid
It will bend

With the lid
it is stiff

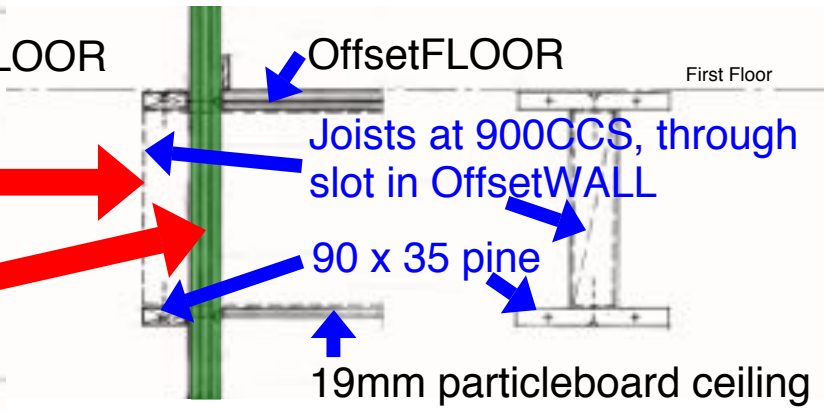
## Fast and efficient

# Two-Storey Build




### Two Structural Concepts

1. Continuous 2-storey wall
2. Stiff joint at floor joists/wall



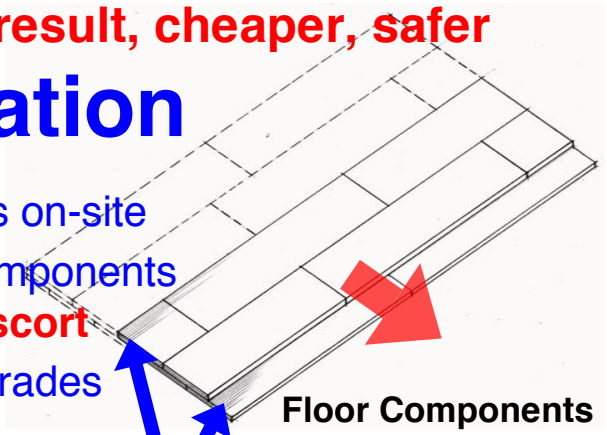

**SECTION** **DETAIL-SECTION** **ELEVATION FROM OUTSIDE**

## Logical, efficient, same end result, cheaper, safer

# Prefabrication

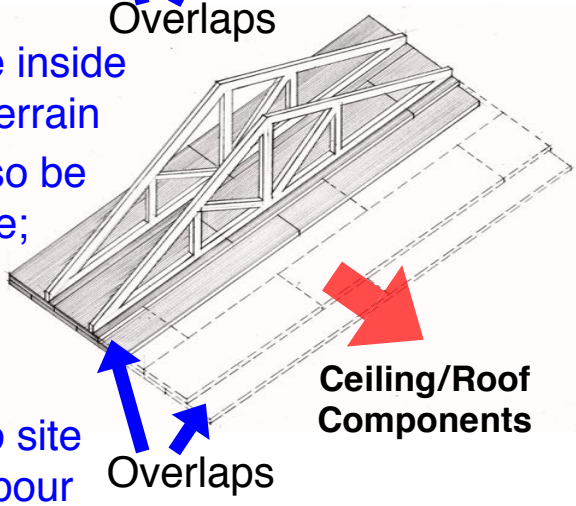
### SEQUENCE

1. Build shell in-factory and floor supports on-site
2. Dismantle shell at the overlaps into components **that do not need a road transport escort**
3. Re-assemble it on-site, then finishing trades



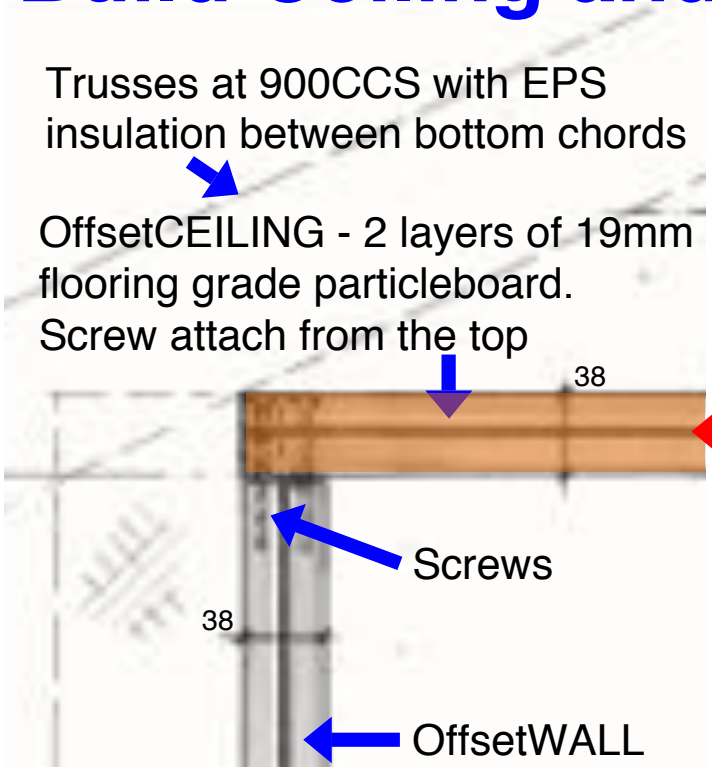

### STRATEGY

- In-factory location for trades that can be inside and avoid on-site rain, wind or difficult terrain
- On-site location for trades that could also be in-factory with maybe a small advantage; or those that cannot be in-factory
- **Remote area** or **developing country** strategy is to limit in-factory portion to boards preparation, then export them to site and assemble with local semi-skilled labour



## Less heavy lifting, safer, faster

# Build Ceiling and Roof on the Floor




**SECTION**

- **OffsetCEILING and the trusses are integrated structural units that act like inverted T beams**
- **The ceiling/roof assembly is a space frame that can be built on the floor or ground and then craned onto walls**
- Less overhead lifting and fixing
- Eliminates working at heights hazard
- Faster assembly

## Conservative, fully resolved

# Engineering Endorsement

- Particleboard and timber have similar structural properties
- Will OffsetBUILD, using flooring grade particleboard layers, be structurally sound?

**Rod Gowland**

**Civil & Structural Engineer**

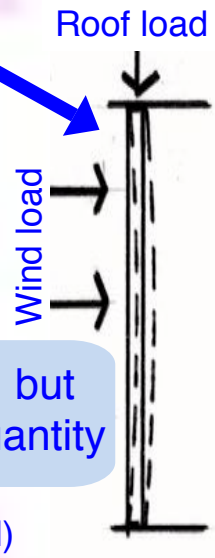
M Tech CPEng 743197 CC1590Y

**Answers Yes**

**OffsetBUILD creates an integrated shell that exceeds structural design requirements**

# To illustrate

- Consider a wall subject to vertical loading (roof) and horizontal loading (wind)
- Resistance to bending comes from **wall stiffness**
- Comparative calculations show




**Stud wall** (**90mm thick**: 90mm x 35mm pine studs at 600CCS)

N° of studs per metre $= \frac{1000}{600} = 1.67$ studs

For one stud $I = \frac{bd^3}{12} = \frac{35 \times 90^3}{12} = 2.126 \times 10^6 mm^4$

$\therefore$ I per metre $= 2.126 \times 10^6 \times 1.67 = \mathbf{3.55 \times 10^6 mm^4}$

Thinner, but more quantity

**OffsetWALL** (**38mm thick**: 2 layers 19mm flooring grade particleboard)

I per metre $= \frac{bd^3}{12} = \frac{1000 \times 38^3}{12} = \mathbf{6.58 \times 10^6 mm^4}$

**OffsetWALL is 1.8 times stiffer than a stud wall**

- All the structural concepts
  - **Integration**
  - **Two-storey build**
  - **Prefabrication**
  - **Build ceiling and roof on the floor**

  are based on sound engineering principles
- I have considered the possibility of creep within OffsetFLOOR (permanent small sags between supports)
  - The design eliminates cantilevers
  - The supports considerably reduce clear spans

  Creep will not be an issue
- Non-OffsetBUILD components are subject to the current codes, and there is generous provision for their inclusion

**OffsetBUILD is fully resolved and ready to prototype test**

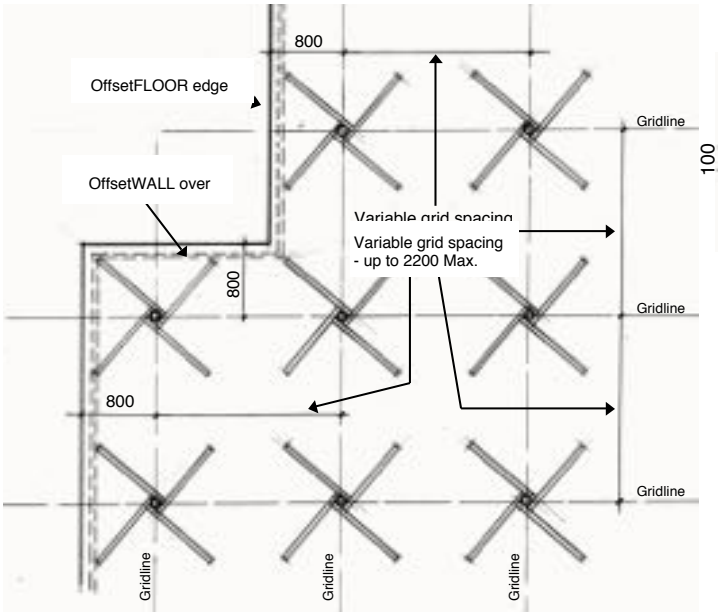
CLEVER INTEGRATED ENGINEERING


# Rod Gowland

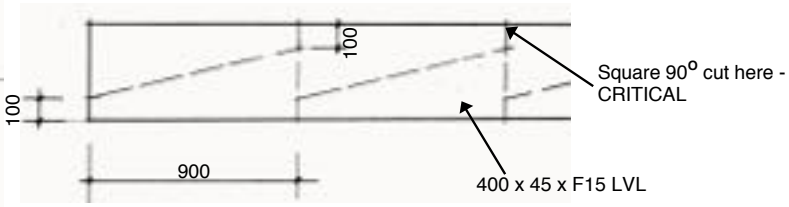
## Civil & Structural Engineer

M Tech MIEAust CPEng 743197 CC1590Y


# Floor Engineering Solution




## Sub-Floor LVL Supports Setout



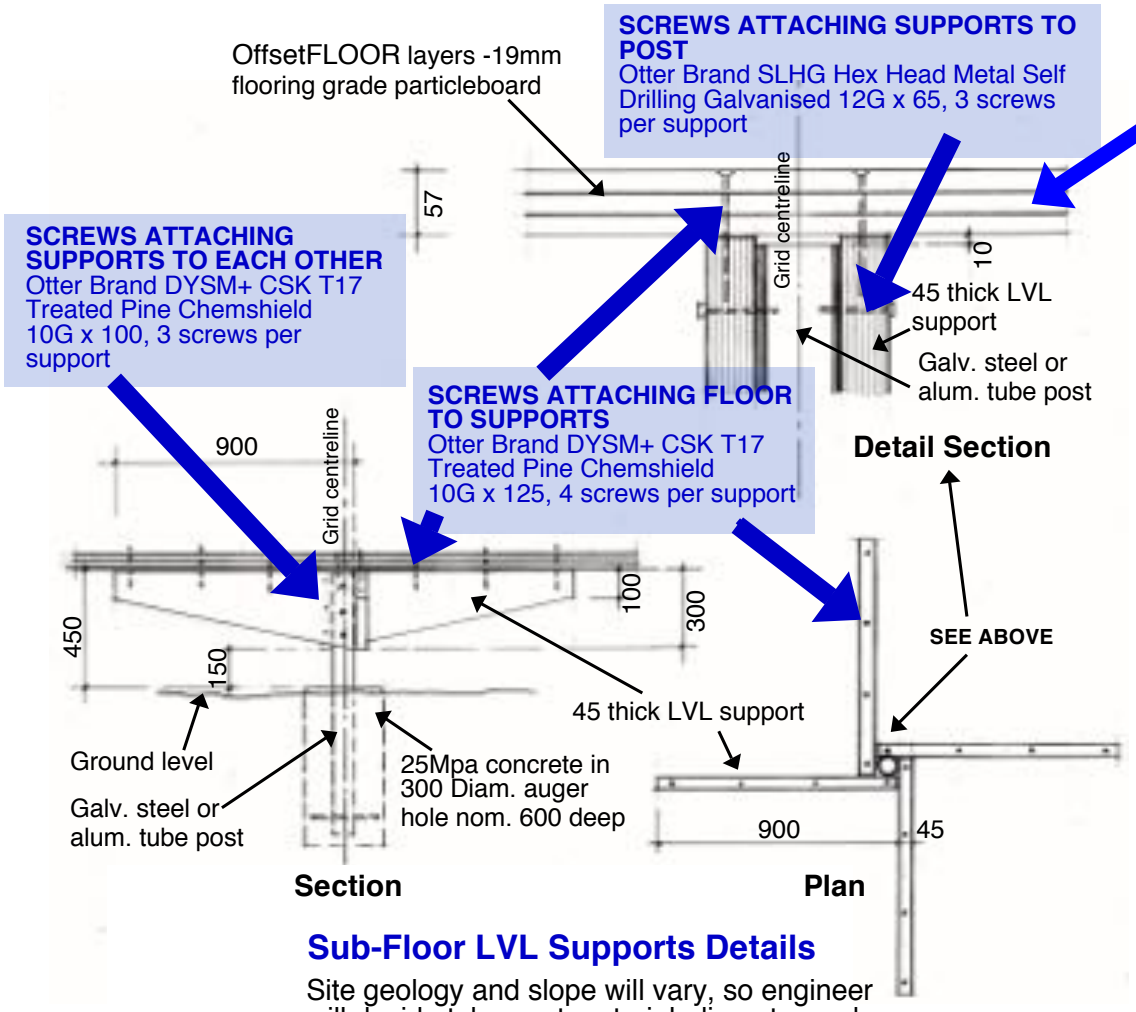

## LVL Supports Cutting Strategy

**SCREWS ATTACHING FLOOR LAYERS TO EACH OTHER**
Bottom layer/middle layer: 8-10G x 35mm particleboard, countersunk rib head, Phillips drive, Climacoat 3. Middle layer/ top layer: as above but 50mm long. Both layers: 300mm CCS around board edges at 20-30mm in from edge, and 300mm CCS both ways within the board body.

**SCREWS ATTACHING SUPPORTS TO POST**
Otter Brand SLHG Hex Head Metal Self Drilling Galvanised 12G x 65, 3 screws per support

**SCREWS ATTACHING SUPPORTS TO EACH OTHER**
Otter Brand DYSM+ CSK T17 Treated Pine Chemshield 10G x 100, 3 screws per support

**SCREWS ATTACHING FLOOR TO SUPPORTS**
Otter Brand DYSM+ CSK T17 Treated Pine Chemshield 10G x 125, 4 screws per support




## Sub-Floor LVL Supports Details

Site geology and slope will vary, so engineer will decide tube post material, diameter and wall thickness on a project basis

**Rod Gowland**

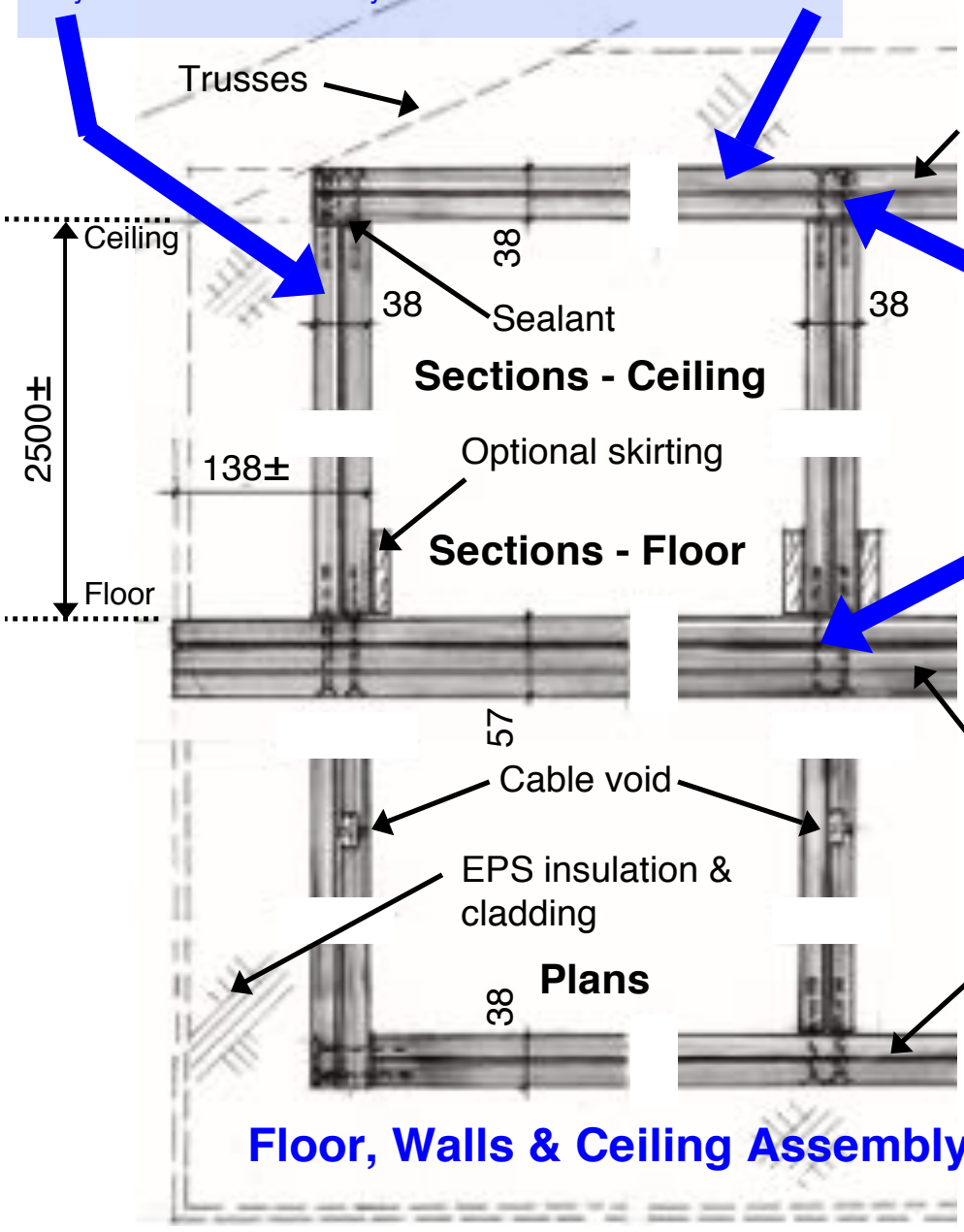
**Civil & Structural Engineer**

M Tech MIEAust CPEng 743197 CC1590Y

# Walls and Ceiling Engineering Solution

**SCREWS ATTACHING WALL & CEILING LAYERS TO EACH OTHER**

8-10G x 35mm particleboard, countersunk rib head, Phillips drive, Climacoat 3. Insert at 300mm CCS around board edges at 20-30mm in from edge, and 300mm CCS both ways within the board body.




**Floor, Walls & Ceiling Assembly**

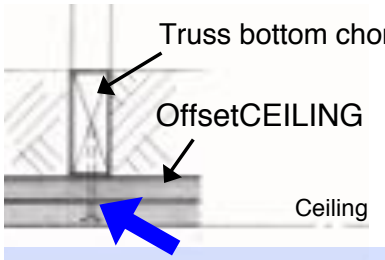
OffsetCEILING layers - 19mm flooring grade particleboard

**COMPOSITE BOARD ATTACHMENT SCREWS - ALL AT 300CCS Max.**

10-8G x 75mm particleboard, countersunk rib head, Phillips drive, Climacoat 3. Drill tight clearance holes in the insertion boards, and do NOT drill pilot holes in the attachment boards. For attaching floor to walls - all as above but 10G x 100mm

OffsetFLOOR layers - 19mm flooring grade particleboard

OffsetWALL layers - 19mm flooring grade particleboard




**TRUSS & OffsetCEILING ATTACHMENT**

10-8G x 75mm particleboard screws at 300mmCCS (follow same procedure as for attaching composite boards)

**LOWER COST YEAR-ROUND COMFORTABLE LIVING**

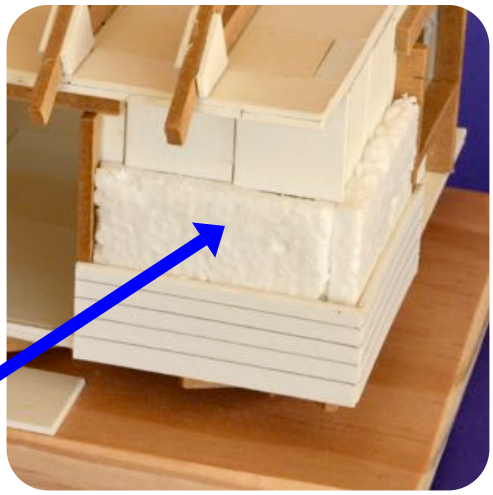
# Excellent Credentials

- THERMAL INSULATION
- MODERATE THERMAL MASS
- CONDENSATION CONTROL
- THERMAL ASSESSMENT
- NOISE CONTROL

**Inherent, generous and variable**

# Thermal Insulation

- Stud-framing materials are **low to moderate insulators**, but OffsetBUILD materials are **moderate to high insulators**, so it needs **less additional insulation**
- The insulation thickness a stud-frame home can receive is limited by framework thickness, and more is needed because stud-framing and plasterboard is poor insulation
- **OffsetBUILD allows insulation thickness choice**



**Introducing automatic, low cost**

# Moderate Thermal Mass Insulation

- Suitable thermal mass materials work like insulation
- They store and then re-radiate considerable energy, creating **comfortable conditions** and **reducing heating/cooling bills**


**Providing low cost moderate thermal mass will be the next VERY IMPORTANT industry challenge**

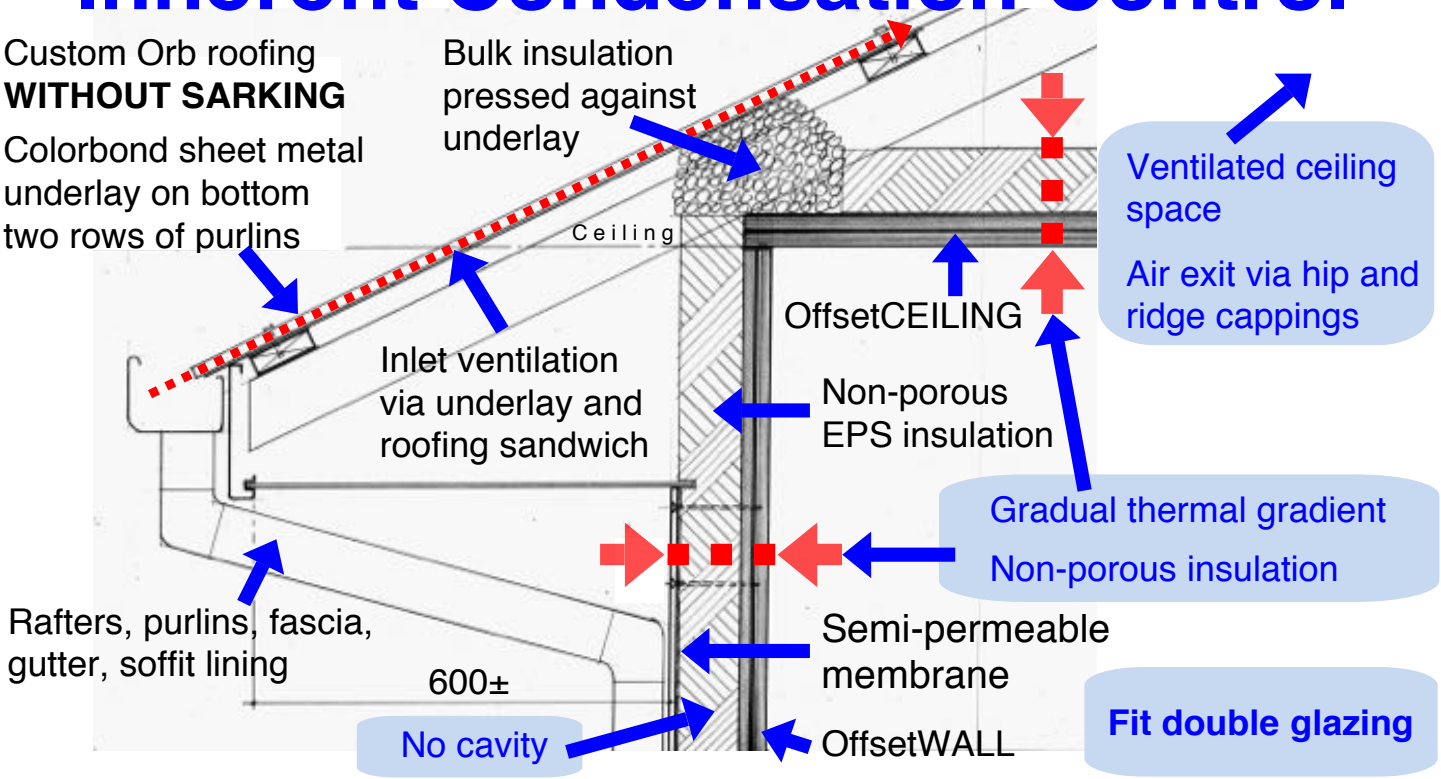
- Capacities vary widely and sometimes can be **too much** because energy may continue to re-radiate after it is needed

**USUALLY MODERATE THERMAL MASS IS A WISE CHOICE**

- Stud-frame lightweight cladding is low thermal mass
- Brick veneer is low thermal mass - the bricks are outside!
- OffsetBUILD is **moderate thermal mass** - inside and useful

## Solves condensation and mould problems

# Inherent Condensation Control




## Ceiling Space Ventilation & Gradual Thermal Gradient

## Lower cost comfort

# Thermal Assessment

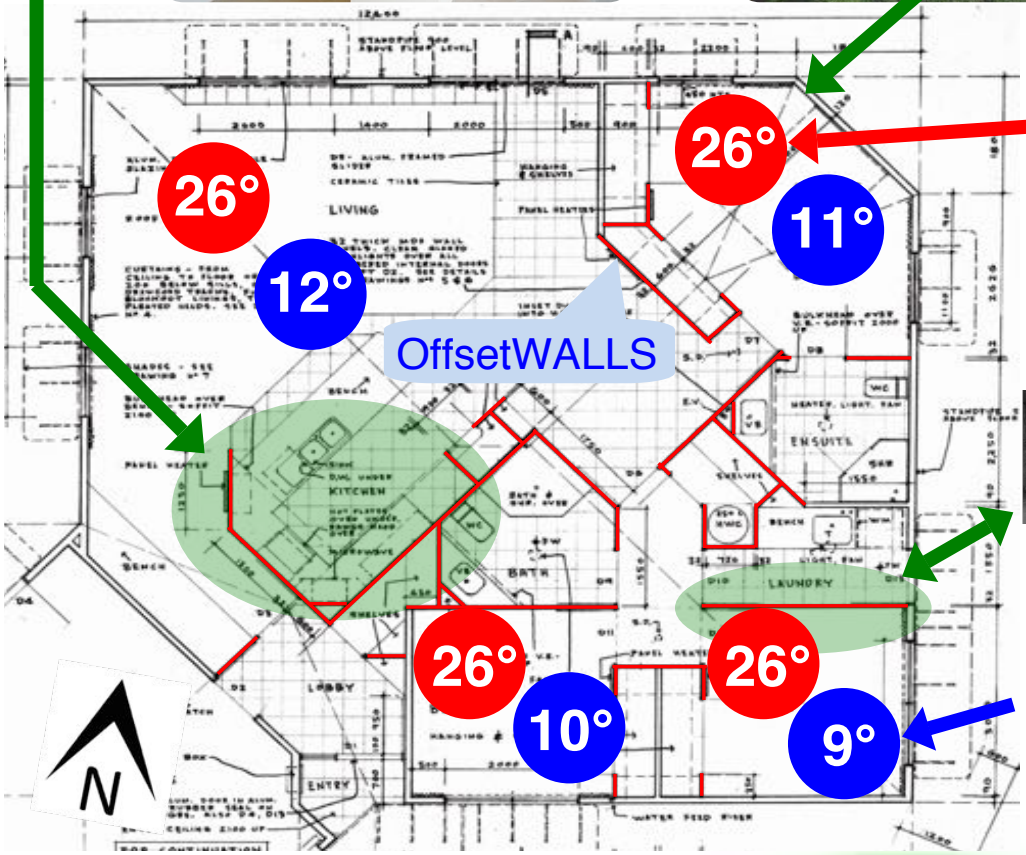
**Wayne Gorman**

**Thermal Performance Assessor**

VIC/BDAV 11/1346 CC256C

- Thermal performance is a product of OffsetBUILD, home design and its environment
- Thermal assessment software models room air temperature range on extreme hot and cold days

## So I modelled the home with prototype internal OffsetWALLS assuming the OffsetBUILD method




With no extra cooling, highest room temperatures on the **HOTTEST** day

With no extra heating, coolest room temperatures on the **COLDEST** night

- OffsetBUILD has
  - **High, inherent, non-porous thermal insulation**
  - **Automatic moderate thermal mass**
  - **Gradual thermal gradient/inherent condensation control**
  - **Zero air leakage** (offset board joints)

  all desirable qualities
- OffsetBUILD and energy conservation design creates homes that achieve year round comfortable conditions with little extra heating or cooling
- Moderate thermal mass lessens the discomfort threshold, and increases the comfortable conditions temperature range
- Gradual thermal gradient promotes healthy air quality by

**discouraging condensation & mould growth**

Quiet living

# Built-in Noise Control

- Sound attenuation through a floor, walls and ceiling is a direct function of their **mass**
- The more mass the sound encounters, the more it **attenuates** (loses volume)

- **OffsetBUILD floor, walls and ceiling is twice the mass of stud-frame/plasterboard**
- It attenuates at least **50dB**, both between rooms and outside noise

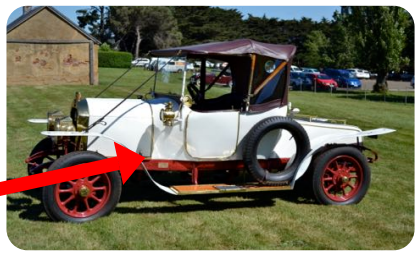
**RESPONSIBLE, COMPREHENSIVE**

# Big Picture Solutions

- INSPIRED BY NEXT GENERATION CAR DESIGN
- SUSTAINABILITY EMPHASIS
- FLOORING GRADE PARTICLEBOARD

Multi-purpose materials and integrated structure

# Inspired by Next Generation car design



- Early cars were luxury items with a **single purpose structural chassis** that carried the wheels, suspension, engine and bodywork

- They were expensive and impractical, until carmakers introduced **next generation** single shell (monocoque) **integrated multi-purpose bodywork**

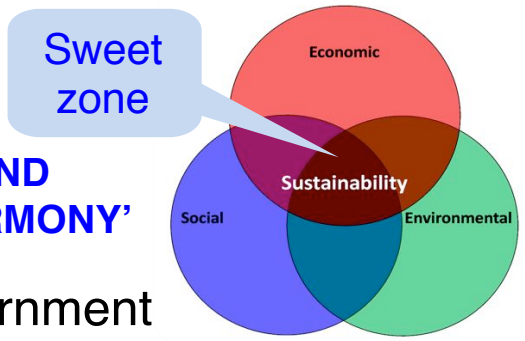
- **Our cars are affordable**
- **Our homes can become affordable**

## A National Construction Code objective

# Sustainability Emphasis

## Sustainability is the capacity to endure

- It has two meanings
  - **'ACHIEVE MORE WITH LESS'**
  - **'BUILD WITH ECONOMIC, SOCIAL AND ENVIRONMENTAL FACTORS IN HARMONY'**




- Sustainability is a bipartisan government policy response to global warming that is being progressively implemented within the National Construction Code (NCC)

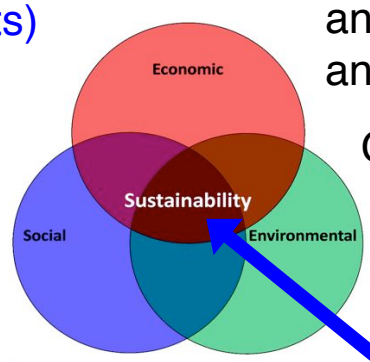
**NCC is set to raise the minimum required energy rating from 6 to 7 stars in 2022**

# OffsetBUILD will comply at lower cost

## Here is how

A building material has one or more of **FIVE** purposes
(A purpose is the reason why something exists)

**(1)** Structure
**(2)** Lining
**(3)** Insulation
**(4)** Thermal mass
**(5)** Watershield
**(exterior)**




A stud-frame wall has
- Studs and plates (structure)
- Plasterboard (lining)

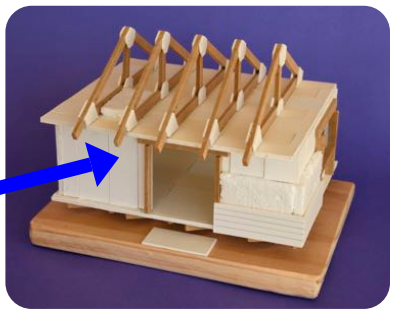
Each material has **ONE** purpose

**HOWEVER,** Sustainability outcomes are greatly improved if a material has **multiple** purposes

It reduces the need for materials and their associated labour costs and thus **improves productivity**

OffsetBUILD is **ONE** material and **ONE** process that creates a floor, walls and ceiling with

**ALL FOUR INTERIOR PURPOSES**
**(1) Structure**
**(2) Lining**
**(3) insulation**
**(4) Thermal mass**



## Composite boards: cheap, certified, readily available

# Flooring Grade Particleboard

Painted particleboard ceiling

38mm thick painted OffsetWALL supporting cupboards, shelves, splashback

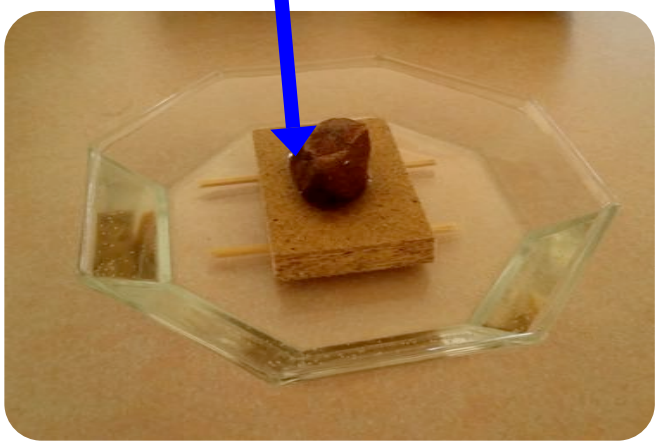
- Tough smooth surface
- Insulates like timber
- Accepts face & edge fixings
- Accepts woodworking tools
- Stiff and difficult to bend, so reflected light is even and uniform, allowing the use of tough low sheen paint
- Easy to repair
- Some variants resist termites
- Safe to work with, unlike fibreboard (MDF)

- Rated for up to 3 months rain exposure and copes well with full immersion

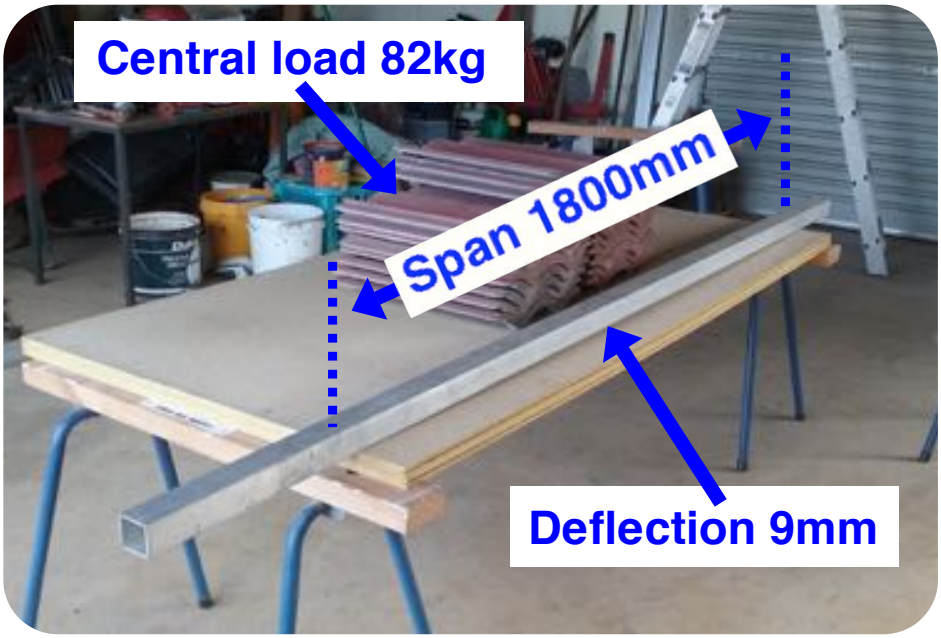
**24 hour full water immersion test on a Laminex Industries brand flooring grade particleboard sample - raw faces and edges**

- After immersion, length and width were unchanged. Edge thickness became 20mm, waning to 19mm in the middle
- After drying out, edge thickness returned to 19mm
- Surface smoothness did not change
- **Board edges are sealed with wax**
- **As a precaution, seal cuts with primer/undercoat**

**Sample size**
85.5mm x 58mm x 19mm



# • Multiple layers are tough and structural



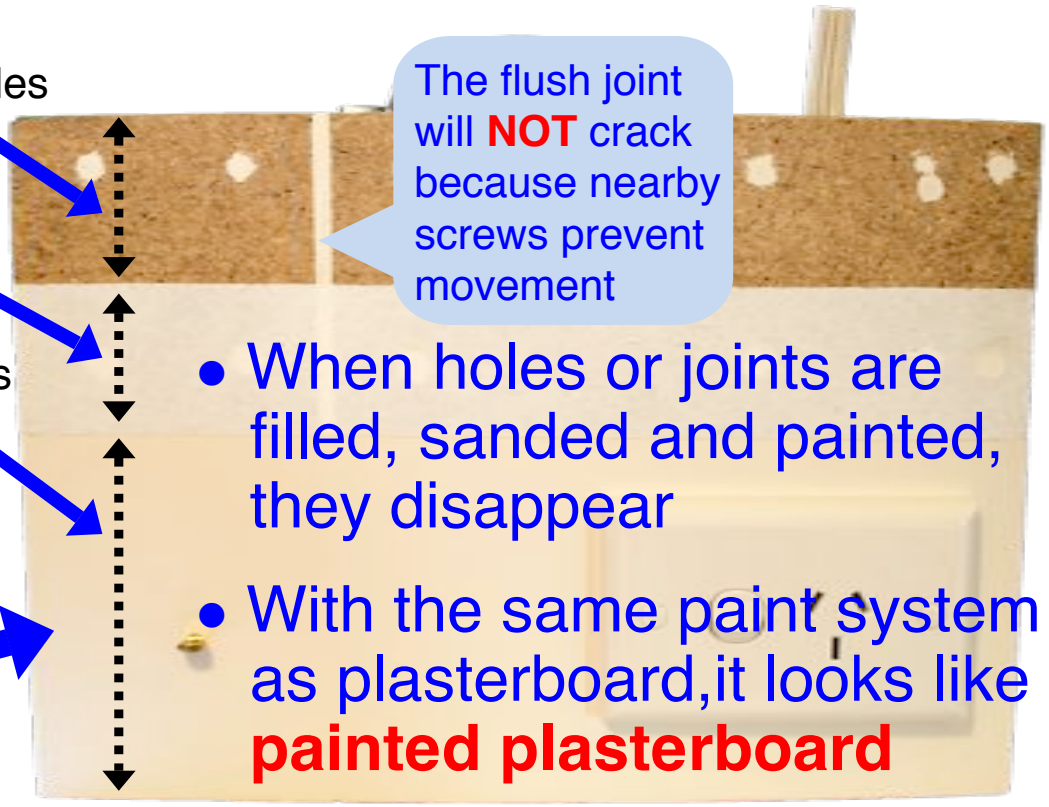

Load test on two layers of 19mm thick x 900mm wide flooring grade particleboard attached with 10G particleboard screws at 300mm CCS around the edges and within the body

Raw particleboard - joints and screw holes filled and sanded

Primer/undercoat

Low sheen topcoats

OffsetWALL TEST PANEL




- When holes or joints are filled, sanded and painted, they disappear
- With the same paint system as plasterboard,it looks like **painted plasterboard**

NEXT GENERATION

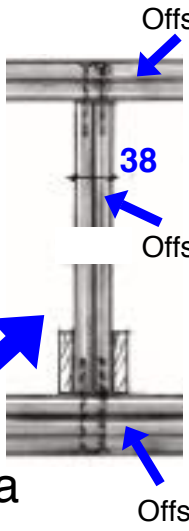
# Simple Smart Outcomes

● LOWER BUILD COST ● DESIGN FLEXIBILITY ● MORE ENERGY EFFICIENT ● MORE DURABLE ● BETTER ENVIRONMENT CARE ● HEALTH, SAFETY & COMFORT EMPHASIS ● BETTER UNIVERSAL (DISABLED) ACCESS

**OffsetBUILD delivers**

## Lower Build Cost

- Routine building approval process
- Simple assembly with cheap, certified, Australian Made readily available materials
- Minimal waste
- Estimated **30%** cheaper and **50%** less labour
- Suitable for low or high volume production
- Thinner walls create **5-7%** more usable floor area
- Build on-site or prefabricate in-workshop
- Fewer trades and less co-ordination

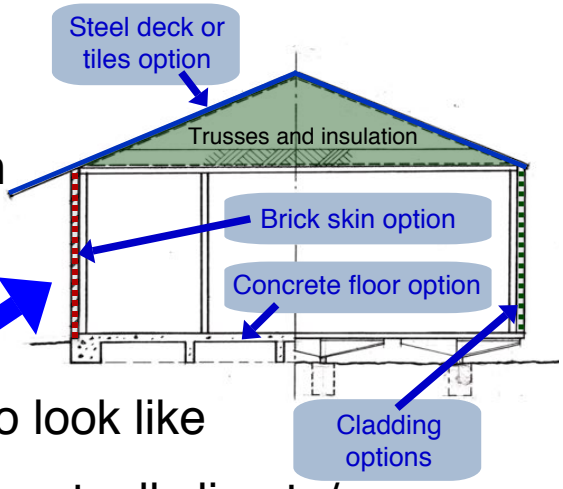



For a 120m$^2$ home, the area of a small bedroom

**OffsetBUILD delivers**

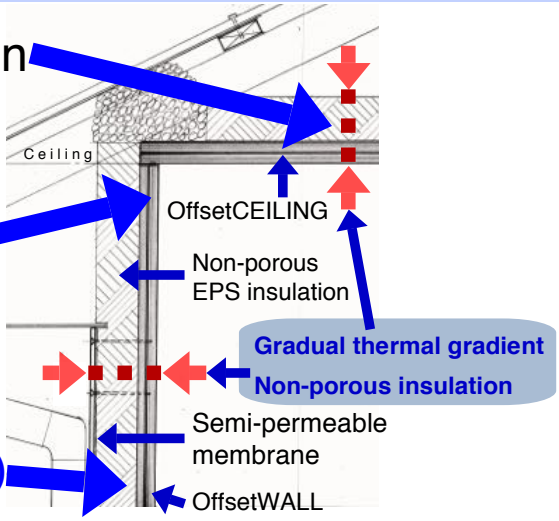
## Design Flexibility

- Non-modular and flexible
- Create any floor plan, one or two storeys, any roof and windows design
- Easy cables access, including retrofit
- Interior looks like plasterboard
- Exterior looks like what **YOU** want it to look like
- Suitable for multi-residential development, all climate/ bushfire/termite zones, remote areas and developing countries



## OffsetBUILD is
# More Energy Efficient

- High non-porous thermal insulation
- Airtight (offset board joints)
- Moderate thermal mass, placed internally for maximum effect
- Ventilated ceiling space
- Insulation thickness choice (walls)
- Accepts solar hot water, photovoltaics & double-glazing

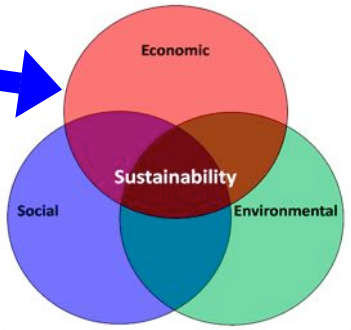



## OffsetBUILD is
# More Durable

- Resists tenant rage, arson, bushfires, termites, earthquakes, insects, vermin, birds, wind driven rain, air leaks, condensation and UV sunlight
- Resists cracking from thermal stress, freeze/thaw or foundation movement
- Tough and smooth surfaces that accept screws and holes anywhere
- Slashes maintenance/operational costs, especially public housing

## OffsetBUILD achieves
# Better Environment Care

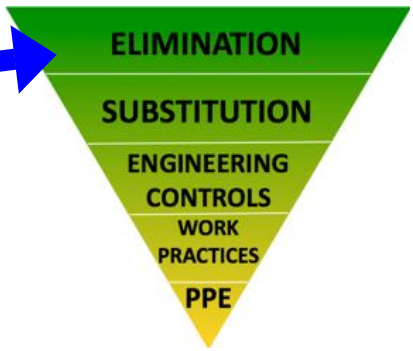
- Overall sustainability emphasis



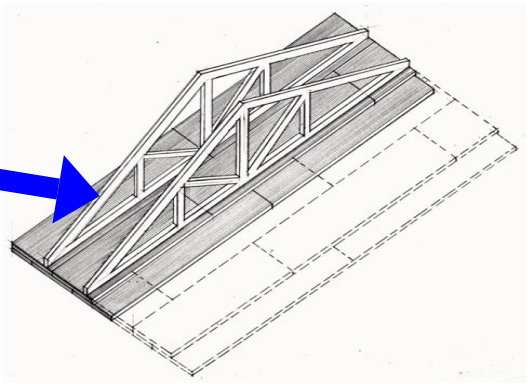

- Achieves good carbon capture and storage
- Boards can be recycled
- Australian made boards, using sustainable and low embodied energy downstream processing of residue (recycled) timber from plantation forests

## OffsetBUILD has better
# OH&S Health, Safety & Comfort Emphasis

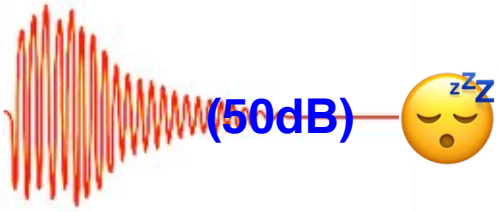
**OffsetBUILD moves Hierarchy of Hazard Controls closer to 'ELIMINATION'**




- Safer assembly on-ground, on a level floor or a walk-on ceiling
- Resists condensation and mould growth
- Low board weights
- Minimal overhead lifting and fixing
- Ideal for safer factory prefabrication



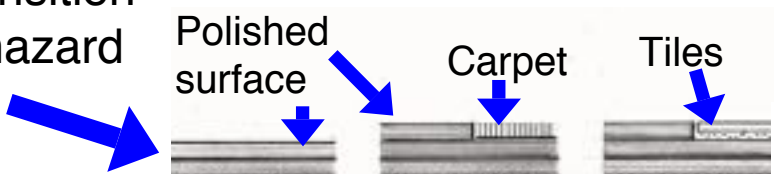
- Safe to build with, and live within - unlike fibreboard (MDF)
- Optional at floor-level ceiling and roof construction
- High sound attenuation



**OffsetBUILD achieves**

# Better Universal (Disabled) Access

- Fit grab rails anywhere, during build or retrofit
- Thin walls (38mm) create extra usable floor area for cost neutral wheelchair circulation space
- At-grade floor finish transition capacity removes trip hazard




**OffsetFLOOR OPTIONS**

LOWER BUILD COST

DESIGN FLEXIBILITY

MORE ENERGY EFFICIENT

MORE DURABLE

BETTER ENVIRONMENT CARE

HEALTH, SAFETY & COMFORT EMPHASIS

BETTER UNIVERSAL (DISABLED) ACCESS

**Together, we can introduce seven simple smart next generation outcomes that will help restore the Great Australian Dream**

# An OffsetBUILD home will look like the home next door both inside and outside, but deliver:

- Estimated 30% lower build cost
- Estimated 50% less labour cost
- 5-7% more usable floor area
- Design flexibility like stud-framing
- Higher insulation capacity
- 50dB noise attenuation
- Low cost moderate thermal mass
- Better environment care
- Inherent condensation & mould growth control
- Zero air leakage
- Inherent insect and vermin control
- Sustainability emphasis
- Better universal (disabled) access
- Better durability
- Safer on-site or factory build conditions

**“Simplicity is the ultimate sophistication”**
Leonardo da Vinci 1452-1519

# EXECUTIVE SUMMARY

**SIMPLE SOPHISTICATION**

OffsetBUILD is one simple, comprehensive, low-tech response to multiple, complex, inter-connected issues. Offering excellent homebuyer benefits, lower compliance cost and responsible sustainability, it's a market magnet.

## Simplicity is its strength and appeal

The market for low cost homes is huge, but now is very different to the mid 1800s world that birthed and developed stud-framing:

- Global warming is influencing regulator and buyer attitudes.
- It's difficult for stud-framing to meet increasing insulation, sustainability and safety regulations.
- Homebuyers are seeking better value and comfort and they will choose an innovative and sustainable product if it performs better than stud-framing.

With **5-7%** more usable floor area, an estimated **30%** lower build cost, inherent high thermal and sound insulation, low cost moderate thermal mass, design flexibility - and much, much more:

**We offer OffsetBUILD, a next generation, sustainable, lower build cost MARKET WINNER!**

# Comparison Tables

● BY BUILDING ELEMENT ● BY MATERIALS/LABOUR INPUTS
● BY TRADES/SKILLS VISITS

## Comparison by Building Element

| ELEMENT | Brick Veneer<br>Minimum energy rating<br>Low thermal mass | Lightweight Cladding<br>Minimum energy rating<br>Low thermal mass | OffsetBUILD<br>High energy rating<br>Moderate thermal mass |
|---|---|---|---|
| **Concrete Floor** | | | |
| - Cost | Slightly more | Same | **Same** |
| - Insulation quality | Good | Good | **Good** |
| - Usable thermal mass | High | High | **High** |
| **Timber floor** | | | |
| - Cost | More | More | **Less** |
| - Insulation value of fabric | Low | Low | **Moderate** |
| - Additional insulation | More needed | More needed | **Less needed** |
| - Usable thermal mass | Low | Low | **Moderate** |
| - Footing posts quantity | Same | Same | **Fewer** |
| - Ground to floor distance | Same | Same | **Less** |
| **Walls** | | | |
| - Cost | High | Lower | **Lowest** |
| - Usable thermal mass | Low | Low | **Moderate** |
| - Insulation value of fabric | Low | Low | **Moderate** |
| - Additional insulation | More needed | More needed | **Less needed** |
| - Sound insulation | Poor/moderate | Poor | **High** |
| - Durability | Fragile | Fragile | **Tough** |
| **Ceiling/Roof** | | | |
| - Cost | Same | Same | **Lower** |
| - Insulation value of fabric | Low | Low | **Moderate** |
| - Additional insulation | More needed | More needed | **Less needed** |
| - Usable thermal mass | Almost zero | Almost zero | **Moderate** |
| - Ceiling reflectivity | Can undulate | Can undulate | **Precisely level** |
| - Ceiling durability | Fragile | Fragile | **Tough** |
| - Walk-on ceiling | No | No | **Yes** |
| - Floor level assembly | No | No | **Optional** |
| - WHS risk | Same | Same | **Less** |
| **Fit Out** | | | |
| - Skirtings and cornice | Yes | Yes | **Optional** |
| - Fixings availability | Find a stud | Find a stud | **Anywhere** |

# Comparison by Materials/Labour Inputs

| INPUT | Brick Veneer<br>Minimum energy rating<br>Low thermal mass | Lightweight Cladding<br>Minimum energy rating<br>Low thermal mass | OffsetBUILD<br>High energy rating<br>Moderate thermal mass |
|---|---|---|---|
| **Concreter** | | | |
| - Timber floor strip footing | Yes | Possibly needed | **No** |
| - Timber floor footing posts | Same | Same | **Fewer** |
| - Concrete floor edge rebate | Yes | No | **No** |
| **Carpenter** | | | |
| - Joists/bearers/purlins | Yes | Yes | **No** |
| - Underfloor supports | No | No | **Yes** |
| - Flooring | Single layer | Single layer | **Two or more layers** |
| - Framing | Yes | Yes | **No** |
| - Boards assembly | No | No | **Yes** |
| - Cladding assembly | No | Yes | **Yes** |
| - Ceiling & roof assembly | Yes | Yes | **Yes** (floor option) |
| - Insulation | Same | Same | **Less needed** |
| **Bricklayer** | Yes | Possibly (foundations) | **No** (Optional brick skin) |
| **Plasterboard Fixer** | Yes | Yes | **No** |
| **Joiner/Fit Out** | Yes | Yes | **Yes** (Less extensive) |
| **Electrician** | Rough in, fit off | Rough in, fit off | **Single visit possible** |
| - Retrofit access | Difficult | Difficult | **Easy** |
| **Roofer** | Elevated | Elevated | **Floor level option** |
| **External Painter** | Very little | Extensive | **Extensive** |
| **Prefabrication** | Difficult | Feasible | **Ideal** |

# Comparison by Trades/Skills Visits

| TRADE | Brick Veneer<br>Minimum energy rating<br>Low thermal mass | Lightweight Cladding<br>Minimum energy rating<br>Low thermal mass | OffsetBUILD<br>High energy rating<br>Moderate thermal mass |
|---|---|---|---|
| Carpenter | **1** | **1** | **1** (more extensive) |
| Bricklayer | **1** | **-** | **-** |
| Plasterboard Fixer | **2** | **2** | **-** |
| Joiner/Fit Out | **1** | **1** | **1** (Less extensive) |
| Roofer | **1** | **1** | **1** (floor level option) |
| Electrician | **2** | **2** | **1** |
| External Painter | **-** | **1** | **1** |
| **Total visits** | **8** | **8** | **5** |

Fewer trades,
less co-ordination

# Complete Specification

**TITLE OF INVENTION** Offset Layering

**TECHNICAL FIELD** Construction


## ABSTRACT

Offset Layering is a combination of assembly and attachment techniques for building a composite structural element (floor, wall, ceiling roof) using multiple layers of rectangular panels such as, but not limited to, particleboard, medium density fibreboard or plywood. It enables transmission of stresses between the layers and across the joints, and creates a composite larger surface area structural element with a high level of rigidity, load bearing capacity and resistance to bending. The assembly technique is multiple layers of panels assembled so that abutting joints between panels in both directions in a layer are offset from abutting joints between panels in both directions in an adjacent layer or layers. The attachment technique is multiple layers of panels attached together on their faces, but not their edges, using mechanical fasteners, and supplemented if needed with localised zones of adhesive.


## DESCRIPTION

### Background Art

**[0001]** In response to global warming and market forces, the construction industry is adopting higher levels of energy efficiency, durability, ease of maintenance and prudent resource management. Affordability can be adversely impacted by construction methods that primarily rely on each construction element and associated labour inputs having a single role such as a structural element, cosmetic surface or lining, waterproof covering, thermal mass or insulation. Higher occupation health and safety standards, whilst welcome and necessary, can adversely impact affordability. The location split of construction effort between workshop or factory and construction site is a major influence on end build cost. Assembly and attachment techniques that rely on total surface application of adhesive and possibly the use of heat and pressure offer exciting design solutions but are not readily suited for use on a construction site.

**[0002]** A design response to the issues cited in [0001] can be to use and assemble construction elements and their associated labour inputs that have multiple roles, and to tailor the process to locations and methods that are as safe and efficient as possible. Offset Layering offers this design response opportunity.

### Summary of Invention

**[0003]** Offset Layering is an assembly technique [0004], and an attachment technique [0005] to improve the structural performance of a construction element, enable more construction location choice and promote better efficiency and safety.

**[0004]** The assembly technique is multiple layers of panels assembled so that abutting joints in both directions between panels in a layer are offset from abutting joints in both directions between panels in an adjacent layer or layers.

**[0005]** The attachment technique is multiple layers of panels attached together on their faces, but not their edges, using mechanical fasteners, and supplemented if needed with localised zones of adhesive.

**[0006]** The Offset Layering invention is the combination of the assembly and attachment techniques described within paragraph [0004] and paragraph [0005].

**[0007]** Offset Layering creates a larger area structural composite construction element such as but not limited to a floor, wall, ceiling, truss, or roof from multiple layers of smaller area rectangular panels such as but not limited to particleboard, medium density fibreboard or plywood.

**[0008]** Offset Layering allows stress to be transmitted between layers and across panel joints so that multiple layers resist the stress, not just the layer where the stress originates. It creates a larger area composite construction element with a high level of rigidity, load bearing capacity and resistance to bending.

**[0009]** The drawing **(Figure 1)** is a diagrammatic elevation or plan view of a two-layer Offset Layering construction element. It illustrates one example of the basic invention principles but the invention is adaptable to allow more than two layers and multiple board joint configurations. The following paragraphs all refer to the drawing contents.

**[0010]** The continuous straight lines **(1)** represent the nearest first layer or in view assembly of rectangular panels. There is a different panel represented on each side of the lines, and, apart from at the perimeter, the lines represent the joints between the panels and show that the panel edges are close together or touching each other.

**[0011]** The intermittent straight lines **(2)** represent the far side second layer or not in view assembly of rectangular panels. There is a different panel represented on each side of the lines, and the lines represent the joints between the panels and show that the panel edges are close together or touching each other. The far side of the nearest first layer is very close to or touching the nearest side of the far side second layer.

**[0012]** The relationship between the continuous straight lines **(1)** and the intermittent straight lines **(2)** represent the joint offsets between the panels in each layer.

**[0013]** The dots **(3)** represent the mechanical fasteners that attach and bond the two layers together. They can be driven in or inserted from either side. If the mechanical fastener is a screw the first layer will require a tight clearance hole, the second layer will be thick enough to satisfactorily accept full screw insertion and tensioning, the screw will be driven in to either flush or countersunk position, and the screw will be long enough to extend very close to but not break the outer surface of the second layer. If the mechanical fastener is a nail the second layer will be thick enough to accept full nail insertion, the nail will be driven in to either flush or countersunk position, and the nail will be long enough to extend very close to but not break the outer surface of the second layer. If the mechanical fastener is a rivet or a bolt/nut/washer both layers will require a tight clearance hole.

**[0014]** The intermittent line circles **(4)** represent the supplementary localised zones of adhesive between the panel layers. They are small dots of adhesive applied to one layer before assembly that will be squeezed and expand in area during the assembly process.

## CLAIMS

**1.** Multiple layers of panels assembled so that abutting joints between panels in both directions in a layer are offset from abutting joints between panels in both directions in an adjacent layer or layers.

**2.** Multiple layers of panels attached on their faces but not their edges using mechanical fasteners such as but not limited to nails, screws, nuts/bolts/washers or rivets and supplemented if needed with localised zones of adhesive.

**3.** A combination of the assembly and attachment techniques described within Claim 1 and Claim 2.

**4.** Primary use of mechanical fasteners but not adhesives to assemble smaller and inherently non-structural panels into a larger area structural element, but not to attach them to a structural element.

**5.** Assembly of inherently light weight panels that can be handled without the need for mechanical lifting help, into a larger surface area composite construction element that is one or more of but not limited to a structural element, cosmetic lining, heat and sound insulation or thermal mass.

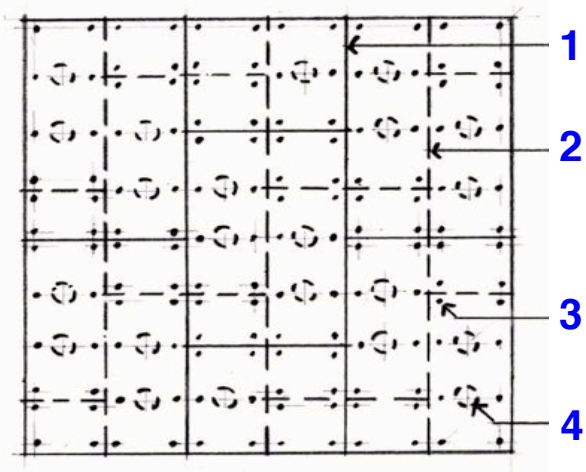



**Figure 1**

1981

2011

OffsetBUILD emerged from research dating from 1970, and trials with partition walls between 2001-15

Now, after a four-year collaboration between two experienced building professionals, OffsetBUILD is fully engineered and ready to build

With the Prime Minister describing housing affordability as a national crisis, and the regulator set to raise the required energy rating to 7 stars, we offer a timely solution, and partnership with government and industry to bring OffsetBUILD into quantity production

Offset BUILD®

- NEXT GENERATION
- LOWER COST COMFORT

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2019