

# THE FLOW HOUSE

LOT 1925 FALLS ROAD, HOVEA WESTERN AUSTRALIA.

## SPECIFICATION

0323 STRAW BALE.....02  
1.0 SCOPE OF WORKS  
2.0 PRODUCTS  
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06116 PLASTERING .....08  
1.0 GENERAL  
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# 0323

## STRAW BALE WALL PARTITIONS.

### 1 SCOPE OF WORK.

#### 1.1 AIMS

Responsibilities: Perform work described here and shown on drawings including but not limited to: Supply and Install load bearing and non-load bearing Straw Bale Walls consisting of generally steel, straw bale, jute mesh, timber framing, earth and limestone render as applicable to each of the listed wall types.

Requirement: Provide straw bale construction that continues to perform satisfactorily for a design life of 50 years. Provide any and all components of accessories for a complete installation.

Tolerance: The quality and dimensional accuracy of the straw bale finish is important to achieve required tolerances, refer to table in section 3.6.

Selections: Conform to the selections, unless special circumstances arise that require discussion and approval by architect.

Lead times: Lengthy lead time item. Availability dependant on seasons, to be checked prior to setting out bale stacking date.

#### 1.1 CROSS REFERENCES

##### GENERAL

Requirement: conform to the General requirements work section.

Associated work sections

Coordination: Coordinate with these other trades to resolve sequencing, scope and interface prior to starting work: Carpenter, Plasterer, concrete and steel contractor, electrician.

Associated work sections: This work section should be read in conjunction with all related sections of this specification and the preliminaries.

#### 1.2 INTERPRETATION

##### DEFINITIONS:

Application: For the purposes of this work section the definitions given below apply:

- Straw: The plant structure from grains (or grasses) between the root crown and the grain head.
- Straw bale: Compressed rectangular mass of the straw left over after grain heads are removed, bound with polypropylene twine.
- Australian straw bales: Two string, typically 900 mm long x 450 mm wide and between 350 mm and 450 mm high weighing between 16 kg to 20 kg.
- Load bearing construction: Where straw bale walls support the load from the roof and upper floor(s) through steel columns and box system within windows.
- Non load bearing construction: Where straw bale walls support only their own weight, such as in infill panels, within a timber framed structure.

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- Earth Render: Lime based plaster with sand externally, or earth render with grass fibres, soil and lime water internally.
  - Breathability: The ability of certain plasters to allow the passage of moisture vapour (rather than water) and air through to the straw bales.
  - Netting: Earth based jute mesh that is woven within the walls to create a surface for the render to adhere to.

### 1.3 INSPECTION

#### Notice

Inspection: Give 24 hours' notice so that inspection may be made of the following:

- Straw bales delivered to site.
- hold down and locating pins.
- Wall bale placement including pinning.
- Marking of windows and door locations.
- Door and window frames and/or lintels.
- Wall plate(s) at floor(s) and roof, including hold down and bracing.
- Expressed skirting joint to be placed at all floor junctions before preparing for wall plastering.
- Walls prepared for plastering before netting has been sewed into straw bale.
- Plastered walls.
- Control joints, ready for insertion of joint filler.

### 1.4 SAMPLES AND TEST PANELS

#### Straw bale samples

Requirement: Submit 5 bales illustrating the range of variation available, including texture, surface irregularities and shape.

Bale module: Prior to construction, a minimum of ten bales are required to be laid at random end to end and measured to provide an average bale length and height. Measurements are to be rounded to allow for tolerance when building.

Prototype: Provide construction of prototype showing 1m x 1m part of wall demonstrating all major junctions before commencing on site at a location nominated on site by the architect/superintendent.

Approval: Obtain approval of samples before continuing sampled work. Maintain the standard of approved samples through scope of works.

Plaster: Using the sample straw bale, construct a wall test panel and validate proposed plastering materials and procedures. Test panel required for both lime and earth plaster, refer to render specification.

Storage: Maintain on site, protected from moisture and other environmental factors, for the duration of the project.

## 1.5 TOLERANCES

Wall construction tolerances are to be conformed to throughout the duration of the project.

Tolerances table

Property	Tolerance criteria: Permitted deviation (mm)
Horizontal position of any wall bale specified or shown in plan at its base or at each storey level	± 25 mm
Deviation with a storey from a vertical line through the base of the member	± 20 mm per 3 m of height
Deviation from vertical in total height of building (from base)	± 20 mm
Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	± 20 mm
Deviation (bow) from line in plan in any length up to 10 m	Single curvature: ± 25 mm
Deviation from design wall thickness	- 10mm, + 20 mm

## 1.6 SUBMISSIONS

Holcim concrete slabs - Refer to structural engineer drawings.

Information on material supplied, finishing, moisture repellent.

Requirement: Structural engineer to submit certification from a professional engineer for the slab design.

Average Bale Size: Average Bale size to be submitted to a minimum for 2 weeks architect prior to wall installation.

Submit certificate from manufacture of confirmation of compaction of straw bales.

## 2 PRODUCTS

### 2.1 MATERIALS

Straw bales

Moisture content: Accept on site only straw bales with a moisture content less than 10% -14% (by weight).

Stabilisation: If on site stabilisation of moisture content to below 15% is proposed for bales delivered 'wet' or otherwise exposed to excessive moisture, submit details.

Baling: Contractor to ensure communication with the supplier prior to ordering to ensure all bales are compressed on moderate to high settings on a machinal baler. All bales to be three string bales to ensure structural stability.

### 2.2 COMPONENTS

Bale connector pins

Standard: To AS/NZS 4671.

Within wall panels: N12 reinforcing bar vertically.

At corners: R8 reinforcing bar bent into a 'U'.

Window and door frames, and wall plates

Material: Seasoned timber.

Connectors: Galvanized nails or bolts.

Lintels

General: Use earth, reinforced earth or concrete, steel, timber or proprietary lintels in accordance with the manufacturers' technical literature.

Type, sizing and support: Comply with the requirements of BCA clause 3.3.3.4.

Plaster reinforcing mesh

Wires: Use **jute mesh** of 1.2 mm nominal wire size with a 25 mm mesh grid.

Application: Fix to all faces of walls using medium gauge (2 mm) steel staples, or by 'sewing' with light gauge (1.5 mm) wire, at 450 mm nominal centres, and to frames and wall plates using clout nails.

Metal lath

Location: At door and window openings over (external) flashings and bent to lap 75 mm with the plaster reinforcing mesh.

Nailing blocks

Light weight applications: Use seasoned solid timber or proprietary fixings.

Flashings and damp-proof courses

Standard: To AS/NZS 2904.

### 3 EXECUTION

#### 3.1 GENERAL

Protection from contamination

**Storage:** All straw bales to be kept dry before, during and after construction. Bales to be stored on pallets to avoid absorption of water from the ground and covered in quality tarp protection from contamination and infestations.

**Concrete slabs:** Place straw bales on a **liquid applied waterproof membrane** over the prepared subgrade.

Unprotected walls: During construction, cover unprotected walls with tarpaulins and prevent water from ponding at the bases of the walls.

Cut bales: Use baling 'needles' to restring the part or parts of a bale being used before cutting the original strings. **Polypropylene baling twine is to be used to tie the bales back together. Refer to page 61 - 65 'The Straw Bale House' by Athena Steen, Bill Steen and David Bainbridge for needling technique.**

Trimming: During placement of straw bales, trim projecting straw where this would compromise cover to the reinforcement or minimum concrete thickness requirements.

Wall Bond

Type: Stretcher bond.

Gaps: Completely pack with gaps too small to accommodate a cut bale, **with a combination of loose straw and clay silt.**

Building in

Embedded items: Build into walls structural frames, door and window frames, pipes, conduits, pins and other hold-down and bracing elements as the construction proceeds.

### Wall plates

Positions: Provide a continuous wall plate to bearing walls, at framed floor and at roof bearing levels. Build-in as the work progresses. Anchor the floor and roof structures to the wall plates.

Construction at different rates or times

Monolithic structural action: If two or more adjoining sections of wall, including intersecting walls, are constructed at different rates or times, rake back or tie the intersections between those sections so that monolithic structural action is obtained in the completed work.

Temporary support

Requirement: If the final stability of the straw bale work is dependent on (structural) elements to be constructed later, provide temporary support or bracing.

## 3.2 DAMP-PROOF COURSES

Location

Location: Provide a damp-proof course below the bottom course of bales.

Height: Not less than:

- 150 mm above the adjacent finished ground level.
- 75 mm above the finished paved or concrete area.
- 50 mm above the finished paved or concreted area and protected from the direct effect of the weather.

Installation

Laying: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints. Step as necessary for stepped footings on sloping ground.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses and waterproof membranes.

## 3.3 FLASHINGS

Location

Location: Provide flashings and weathering's around all window and door openings.

Extent: Extend 75 mm along the face of the wall at all edges of an opening.

Installation

Fixing: Fix flashings to window and door frames and to their (bale) reveals and to the faces of the walls around the openings.

## 3.4 LAYING BALES

Laying

Drying: Do not lay units until they are at less than 15% moisture content.

Daily progress: Establish leads at corners. Step back incomplete walls do not tooth.

*Alignment: Masonry line to be strung between the braces to help align the walls as they go up. Allow for minimum misalignment and variation between these sections. Masonry line to be checked every few hours to keep the braces plumb and properly aligned.*

Voids at dissimilar materials: Pack with loose straw.

Joints: Full flush type, with no open joints.

Bond: Running bond. Overlap units 100 mm minimum, preferably half a bale.

Pre-compression: After completing bale laying, and before applying any structural loads, uniformly pre-compress the walls using 19 mm polyester strapping (1000 kg breaking load) and heavy-duty buckles.

Adjustment: For load bearing construction, compensate for variations in compressed bale height by packing up the top plate or boxing.

Refer to A300 Series of architectural documentation package for precise layout directions.

### 3.5 HOLDING-DOWN BOLTS

Detail

Cover (minimum) to face of bale: 75 mm.

Centres (mm): Refer to structural engineers' drawings.

Depth: To floor level

Limitation: Do not locate within 150 mm of end of wall.

### 3.6 TEMPORARY WORK

Plaster sample panel

Weather proofing, mopping and shoving as required to stabilise works during construction.

Removal: If not incorporated, demolish.

### 3.7 COMPLETION SUBMISSIONS

Maintenance manual

Submit a brief manual describing care and maintenance of the walling.

### 3.8 REPAIR

Damaged wall bales

Replacement: Replace bales that have become wet or are otherwise unacceptably damaged.

### 3.9 MAINTENANCE

Spare material

Plaster: Supply 100 kg of plaster dry ingredients.

Maintenance manual

Requirement: At the end of construction provide a maintenance manual including procedures for repair of plaster, replacement of straw bales that become wet, repair of cracks and repair and renewal of protective paint coating.

## 1 GENERAL

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### 1.1 AIMS

#### Responsibilities

General: Provide plaster finishes as follows:

- Resistant to impacts expected in use.

Free of irregularities.

- Consistent in texture and finish.

Firmly bonded to substrates for the expected life of the application.

- As a suitable substrate for the nominated final finish.

Selections: Conform to the Selections.

### 1.1 CROSS REFERENCES

#### General

General: Conform to the General requirements worksection.

#### Associated work sections

*Coordination: Coordinate with these other trades to resolve sequencing, scope and interface prior to starting work: Carpenter, Plasterer, concrete and steel contractor, electrician.*

*Associated work sections: This section is to be read in conjunction with all related sections of this specification and preliminaries.*

### 1.2 INSPECTION

#### Notice

Inspection: Give notice so inspection may be made of the following (a minimum of two working days shall be given):

1. Prototypes ready for inspection.
2. Substrates immediately before commencement of work.
3. Each completed coat before the application of subsequent coats.
4. Completed work before application of decorative finishes.

### 1.1 CONTRACT SAMPLES

In accordance with the preliminary general requirements, provide contract samples of the following:

- Prior to commencement of work under the contract, a sample panel of proprietary plaster, in a panel size of nominally 1800mm x 1800mm shall be built on site but away from work under the contract.
- Sample panels shall include all associated beads, angles and accessories.
- Obtain acceptance from the architect or superintendent prior to commencing construction of each type. If panel is rejected, contract shall construct other panels of each type until acceptance is obtained.

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## 2 PRODUCTS

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### 2.1 MATERIALS AND COMPONENTS

#### Accessories

**Beads:** All edge beads/ corner beads/ stop beads/ angle beads to external render shall be stainless steel or PVC to suit render thickness.

**Lath:** To be a proprietary product manufactured from raised expanded metal for use with plaster.

2. Mass/unit area:  $\geq 1.84 \text{ kg/m}^2$ .

Material thickness:  $\geq 0.70 \text{ mm}$ .

3. Mesh size:  $9.5 \times 28.6 \text{ mm}$ .

#### Admixtures

**Do not use** Plasticizers or workability agents **unless told otherwise by superintendent or architect.**

#### Aggregates

**Sand:** To be fine, sharp, well-graded sand with a clay content between 1% and 5%, and free from efflorescing salts.

**Sand grading for base coat plaster:** To the Sand gradation table.

#### Sand gradation table

Sieve size	Percent passing	
	Minimum	Maximum
4.75 mm	100	100
2.36 mm	90	100
1.18 mm	60	90
600 $\mu\text{m}$	35	70
300 $\mu\text{m}$	10	30
150 $\mu\text{m}$	0	5
75 $\mu\text{m}$	0	3

#### Colouring products

**General:** To be proprietary products manufactured for colouring **lime and earth render.**

#### Corrosion resistance and durability

**General:** Conform to the Corrosion resistance and durability table or proprietary products with metallic and/or organic coatings of equivalent corrosion resistance.

#### Corrosion resistance and durability table - Low corrosivity category

Situation	Metal lath, beads and embedded items
Internal	Galvanize after fabrication $300 \text{ g/m}^2$ Metallic-coated sheet Z275/AZ150
External	Galvanize after fabrication $300 \text{ g/m}^2$
	Stainless 316
	Powder-coated aluminium

#### Curing products

**General:** To be proprietary products manufactured for use with the plaster system.

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## Lime

Limes for building: To AS 1672.1.

Type N-Lime to be used within all mixes.

### Lime water

3 to 2 percent lime. To be used on walls prior render application.

### Lime putty

General: Prepare lime putty as follows:

Stand dry hydrate of lime to AS/NZS 1672.1 and water for a minimum of 24 hours or for as long as possible.

Stand quicklime and water for 14 days or more without drying out.

Metal lath: Expanded metal to AS 1397.

### Mixes

General: Select a mix ratio to suit the conditions of application in conformity to the Mixes table.

Measurement: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

Lime render mixing: Machine mix  $\geq 3 < 6$  minutes.

Earth render mixing: Hand mix.

Strength of successive coats: Ensure successive coats are no richer in binder than the coat to which they are applied.

### Control joint products

General: To be proprietary products manufactured for use with the plastering system and to accommodate the anticipated movement of the substrates and/or the plaster.

### Water

General: To be clean and free from any deleterious matter.

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## 1 EXECUTION

### 1.1 PREPARATION

#### Substrates

General: Plaster to ensure the below is complete prior to commencing work:

- Ensure straw bales have been trimmed with a hedge trimmer by straw bale contractor.
- Any wood that is to be plastered is covered with black felt paper and reinforced netting over.
- Expanded metal lath's around door, window and joints.
- Floor to be covered in drop cloths or similar which should be taped to floor.
- Tape and cover doors, windows, frames.

If framed or discontinuous, support members in full lengths without splicing.

If solid or continuous, excessive projections hacked off and voids and hollows filled with plaster stronger than the first coat and not weaker than the substrate.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not plaster substrates showing surface moisture.

Painted surfaces: Remove paint and hack the surface at close intervals.

Untrue substrates: If the substrate is not sufficiently true to ensure conformity with the thickness limits for the plaster system or has excessively uneven suction resulting from variations in the

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composition of the substrate, apply additional coats without exceeding the thickness limits for the substrate or system.

#### Beads

Location: Fix beads as follows:

Angle beads: At all external corners.

Drip beads: At all lower terminations of external plaster.

Movement control beads: At all movement control joints.

Stop beads: At all terminations of plaster and junctions with other materials or plaster systems.

Joints in beads: Use dowels to maintain alignment.

Mechanical fixing to substrate:  $\leq 300$  mm centres.

#### Bonding treatment

Curing: Keep continuously moist for  $\geq 5$  days and allow to dry before applying plaster coats.

Thickness: From  $\geq 3 < 6$  mm.

#### Embedded items

General: If there are water pipes and other embedded items, sheath them to permit thermal movement. Ensure embedded items conform to the Corrosion resistance and durability table.

#### Lath

Location:

Chases: If chases or recesses are 50 mm wide or greater, fix metal lath extending  $\geq 75$  mm beyond each side of the chase or recess.

*Fit metal lath to timber substrates: Typically.*

Installation:

General: Run the long way of the mesh across supports with strands sloping downwards and inwards from the intended face of the plaster.

Fixing: Mechanically fix at centres of 150 mm or less.

Laps: Tie with 1.25 mm galvanized wire  $\leq 150$  mm. Do not stop edges of sheets at corners but bend around.

On solid substrates: Space the lath 5 mm or more clear of the substrate.

Support spacing:  $\leq 400$  mm.

## 1.1 APPLICATION

### Plastering

*Fill obvious low spots in wall with compatible plaster or filler and let cure.*

Base coats:

*Apply each earth plaster coat by hand. Scratch-comb each base coat in two directions when it has stiffened.*

**Scratch Coats:**

*To be as thick as necessary to ensure all walls are as even as possible.*

*Check for cracks in each coat. Where visible force plaster up against substrate to allow for proper bonding to the wall and reapply plaster as necessary to achieve required finish.*

Metal lath: Press the plaster through the apertures of expanded metal lath and wings of beads.

Finishing treatments

Plain:

Bag: To be a finish mainly free from sand by rubbing the finish coat with a Hessian pad when it has set firm.

Steel trowel: To be a smooth dense surface by steel trowelling which is not glass-like and is free from shrinkage cracks and crazing.

Incidental work

General: Return plaster into reveals, beads, sills, recesses and niches. Plaster faces, ends, and soffits of projections in the substrate, such as string courses, sills, pilasters and corbels. Run throating on soffits of external projections neatly finished. Trim around openings. Plaster exposed inside of built-in cupboards.

Joining up

General: If joining up is required, ensure joints will be imperceptible in the finished work after decoration.

Control joints

General: Provide joints in the finish to coincide with control joints in the substrate. Ensure that the joint in the substrate is not bridged during plastering.

Depth: Extend the joint right through the plaster and reinforcement to the substrate.

Width: 3 mm, or the same width as the substrate joint, whichever is greater.

Damp-proof courses: Do not continue plaster across damp-proof courses.

Plastering on metal lath: Provide movement joints to divide the plastering area into rectangular panels  $\leq 10 \text{ m}^2$ .

V-joints: Provide V-joints, cut right through the plaster to the substrate, at the following locations:

Abutments with metal door frames.

Abutments with other finishes.

Junctions between different substrates.

Decorative joints

General: Apply decorative joints in the second coat of two coat work as follows: Refer to A3000 Series of documentation package.

Plaster thickness

General: Conform to the Plaster thickness table.

Plaster thickness table

Temperature

General: If the ambient temperature is  $\leq 10^\circ\text{C}$  or  $\geq 30^\circ\text{C}$  ensure that the temperature of mixes, substrates and reinforcement are, at the time of application,  $\geq 5^\circ\text{C}$  or  $\leq 35^\circ\text{C}$ .

1.1 TOLERANCES

General

Tolerances: Conform to the Tolerances table.

Tolerances table

Property	Tolerance criteria: Permitted deviation (mm)
Features <sup>1</sup> : Verticality in 2000 mm	$\pm 5\text{mm}$
Features: Horizontality in 2000 mm	$\pm 5\text{mm}$
Soffits: Horizontality in 2000 mm	$\pm 5\text{mm}$
Walls: Verticality in 2000 mm	$\pm 5\text{mm}$

Property	Tolerance criteria: Permitted deviation (mm)
Walls: Flatness <sup>2</sup> in 2000 mm	± 5mm
Radius of corners	Not applicable angled beads in corners.
Square reveals < 300 mm	± 5mm
Square reveals > 300 mm	± 5mm
<sup>1</sup> Features: Conspicuous horizontal or vertical lines including external corners, parapets, reveals, heads, sills, movement control joints and mouldings.	
<sup>2</sup> Flatness: Measured under a straightedge laid in any direction on a plane surface.	

## 1.2 COMPLETION

### Curing

General: Prevent premature or uneven drying out and protect from the sun and wind.

Keeping moist: If a proprietary curing agent is not used, keep the plaster moist as follows:

Base coats and single coat systems: Keep continuously moist for 2 days and allow to dry for 5 days before applying further plaster coats.

Finish coats: Keep continuously moist for 2 days.

## 1 SELECTIONS

### 1.1 SCHEDULES

#### Plastering construction schedule

Property	Code	
	A	B
Substrate material	Straw Bale interior wall	Straw bale exterior wall
First Coat	Sand, clay, grass fibres, soil and lime water. Clay silt between coats.	5 Parts Sand 1 Part Lime Putty
Second Coat	Sand, clay grass fibres, soil and lime water. Clay silt between coats.	3 Parts Sand 1 Part Lime Putty
Finish coat	Sand, clay, grass fibres, soil and lime water. Clay silt between coats.	1 ½ Part Sand 1 Part Lime putty
Finishing treatment	Wood float	Wood float

Portions of this trade section have been taken from 'The Straw Bale House' by Athena Steen, bill Steen and David Bainbridge. The book does not take precedent for this trade section and its contents is to be used as a guide only. Given the specialist nature of this section, contactor is to provide suggestions if an alternative approach is necessary, to be approved by architect or sub intendant prior to application.

All mixers are to be determined by plaster.