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Insulated Concrete Forms

Engineering User Manual

for Domestic Building



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Insulated Concrete Forms

ZEGO Pty Limited

A.B.N: 43 095 885 868

ZEGO® “Magu” DOMESTIC CONSTRUCTION MANUAL

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Version 1.0

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Our Ref: ZEGO_Construction_Manual 2-10-01

Date: 26/09/2001

Mr Robert Evans
ZEGO Pty Limited
15 Stanstons Road
MIDDLE DURAL NSW 2158

Dear Mr Evans

STRUCTURAL DESIGN CERTIFICATE ZEGO "MAGU" DOMESTIC CONSTRUCTION MANUAL

I certify that the structural engineering Specifications, Drawings and Charts in this ZEGO® "Magu" Domestic Construction Manual have been prepared in compliance with the relevant structural provisions of the Building Code of Australia, the Codes listed below and the generally accepted principles of structural mechanics, to sustain the most adverse combination of loads as covered by the above Codes, to which structures covered by this Manual are reasonably likely to be subjected, provided the construction is/has been carried out in accordance with this Manual, the Codes referred to therein, and recognised good practice.

The Codes are the following.

- AS 1170.1:1989 "SAA Loading Code Part 1: Dead and Live Loads and Load Combinations"
- AS 4055:1992 "Wind Loads for Housing"
- AS 3600:2001 "Concrete Structures"
- AS 3700:1998 "Masonry Structures"
- AS 1720.1:1997 "Timber Structures Part 1: Design Methods" (for timber nailing plates at tops of walls).

R.S. HEMPHILL BSc, BE (Hons), FIEAust, CPEng (NPER-3 No 30234), RPEQ (No 1056)

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1. GENERAL

1.1 DESCRIPTION OF THE MAGU SYSTEM

The ZEGO Pty Limited Magu Wall System comprises Insulated Concrete Forms (ICF's) filled with concrete. After pouring, the ZEGO® "Magu" ICF's remain as permanent formwork and as wall insulation. The forms superficially resemble hollow concrete block masonry but in fact are fundamentally different.

- The concrete fill plus any reinforcement comprises the complete wall structure, with no structural contribution required from the ZEGO® "Magu" ICF's.
- A Magu ICF unit has a horizontal void space as well as a vertical one, so that on completion of pouring concrete, a concrete grid within the ZEGO® "Magu" ICF cores is formed, with horizontal cores as well as vertical ones.
- A Magu wall is thus a pure concrete structure and is designed in accordance with conventional concrete design principles.

The ZEGO® "Magu" ICF unit is shown on Drawings 01-01 and 01-02, and its application in a domestic home is illustrated on Drawing 02-01.

The ZEGO® "Magu" System when designed and constructed in accordance with ZEGO Specifications, complies with the relevant Australian Standards referenced in the Structural Provisions of the Building Code of Australia Volumes 1 and 2.

A notable advantage of the ZEGO® "Magu" System is its ease of adaptation on site, as the ZEGO® ICF's are easily cut and worked on a nominal 50mm grid. Unlike most non-traditional building systems, no complicated ordering and scheduling, shop drawing or off site fabrication is required.

1.2 SCOPE OF APPLICATION

The ZEGO® "Magu" System is applicable for any structure provided the wall incorporating the System is proportioned, designed and constructed in accordance with the Building Code of Australia (BCA) and the relevant Australian Standards as described below, to suit the conditions for which the application is intended. The System was developed in Germany over 40 years ago and is widely used in that country. ZEGO Pty Limited holds the license to manufacture and distribute in Australia and its territory.

1.3 STRUCTURAL BASIS OF THE SYSTEM

The structural integrity of a Magu System wall comes entirely from the core filling concrete plus any reinforcement, and structural design is based on normal reinforced concrete design principles, as codified in AS 3600 "Concrete Structures". Reinforcement cover is determined in accordance with the reinforced masonry provisions of AS 3700 "Masonry Structures", for the following reasons.

- AS 3600 durability requirements do not include the situation where concrete is placed against totally protective permanent formwork.
- The core filling of ZEGO® "Magu" ICF's is similar in dimensions and conformation to that of hollow block masonry.
- ZEGO® "Magu" ICF's provide total protection to core concrete and its reinforcement, in a similar manner to that provided by hollow block masonry.

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1.4 DISCLAIMER

This Manual is written to assist Architects, Designers, Engineers, Owners, Builders and Building Inspectors to determine the correct reinforcement and other data for domestic houses using ZEGO Pty Limited "Magu" Insulated Concrete Formwork Polystyrol "F" units. It also contains general information for initial guidance in commonly met and straightforward situations. Neither ZEGO Pty Limited nor its Consultants have any knowledge or control over the manner in which this information might be used, and cannot be aware of specific situations where it might be used. The Authors, Editors and Publishers of this Publication shall not be held liable or responsible in any way whatsoever and expressly disclaim any liability or responsibility for any loss or damage consequences incurred as a result of any kind of use of this Publication. Use of this Manual and the inclusion of a Certificate as to the compliance of its contents with various Codes does not absolve Building Designers, Project managers and others directly connected with and having responsibility for specific projects from their statutory or common law responsibilities. Accordingly, it is strongly recommended that where a possibility exists that any erroneous use of ZEGO Pty Limited "Magu" ICF's or of this Manual could result in significant losses, the advice of a Structural Engineer should be sought.

1.5 BASIS OF MANUAL

Below are listed Australian Standards and Codes used in the preparation of this Manual, and assumed complied with in the use of ZEGO Pty Limited "Magu" ICF's.

AS 1170.1:1989	SAA Loading Code part 1: Dead and live loads and load combinations
AS 4055:1992	Wind loads for housing
AS 3600:2001	Concrete Structures
AS 3700:1998	Masonry Structures
BCA 1996	Building Code of Australia 1996 Structural Provisions

Codes referenced in the Text are expressed as their code number only eg AS 3600:2001 Concrete Structures is referred to simply as AS 3600.

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1.6 SCOPE

1.6.1 Buildings Covered

While the ZEGO® "Magu" system is suitable for larger scale residential and commercial construction, the specific engineering details herein have been prepared for domestic houses. Larger scale buildings can quite simply be engineered by a suitably qualified and experienced structural engineer, using AS 3600 Concrete Structures. Further details and guidance are given in the Appendix.

The buildings covered by this Manual are restricted to buildings complying with all of the following.

- Buildings within Australia or governed entirely by Australian Codes and Standards.
- Class 1 buildings as defined in the Building Code of Australia (i.e. either free standing domestic houses or terrace or townhouse developments with single title of each unit extending from ground to roof).
- Single storey buildings, or two story buildings having a floor live load requirement under AS 1170.1 of 1.5 kPa distributed and 1.8 kN concentrated.
- Buildings covered by AS 4055 Clause 6. (Large domestic houses of more than two storeys or of unusual design should be checked for compliance with this provision)
- Buildings with roofs of trussed construction with roof trusses spanning between outer walls and not applying loads to internal walls
- Buildings with upper floors of timber or concrete, having mass not exceeding 360 kg per square metre (3.60 kPa, equivalent to 150 concrete slab).
- Upper storey internal walls of lightweight construction resulting in a distributed load not exceeding 0.4 kPa, unless these walls are continuous through both storeys.
- Located outside Tropical Cyclone regions as designated in AS 1170.2: 1989 SAA Loading Code Part 2: Wind Loads. (Sites within 50 km of the coastline from Bundaberg Queensland around the northern coastline to Shark Bay Western Australia).
- Located outside Alpine or Sub Alpine regions as designated in AS 1170.3:1990 SAA Loading Code Part 3: Snow Loads. (Sites in Tableland areas of NSW, Victoria and Tasmania should be checked for compliance with this provision)
- Located such that the Earthquake Design Category as specified in AS 1170.4:1993 SAA Loading Code Part 4: Earthquake Loads is H1 or H2 (Sites on 5 metres or more of soft alluvium in Bundaberg, Tennant Creek, Adelaide and adjacent ranges, and in Western Australia should be checked for compliance with this provision)

Buildings not complying with the above, in fact almost any building, can be built using the ZEGO® "Magu" system, however the services of a Structural Engineer will be required, to design the structure in accordance with AS 3600.

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1.6.2 Scope of Manual

The Manual covers the design of loadbearing and non loadbearing walls in domestic houses, that are not required to be fire rated unless noted.

The Manual does not cover the determination of wind loading for the site, this being more properly left to the Owner, the Builder or the local authority.

1.7 USE OF MANUAL - IMPORTANT NOTE FOR BUILDING INSPECTORS

1.7.1 Valid Only for Genuine ZEGO® “Magu” ICF’s

This Manual is valid only when Genuine ZEGO® “Magu” ICF’s as shown are used as formwork to set the dimensions and configuration of the structural concrete. Other formwork products may have significant differences in dimensions and conformation to ZEGO® “Magu” ICF’s and it is thus essential that only ZEGO® “Magu” ICF’s be used. The Certification at the head of this Manual is not valid for other products.

ZEGO® “Magu” ICF’s are readily identified as to genuine source by the logo stamps on each ICF unit. These stamps comprise a circle 38 mm in diameter embossed at intervals along the top face of the ICF unit and inscribed with the words www.zego.com.au as shown below. If this stamp is not present, the construction should be rejected.



1.7.2 Manual to be Read in its Entirety

This Manual if used as an aid to design and construction is intended to be read and understood in its entirety

1.7.3 Qualifications of Designer/Builder

This Manual if used as an aid in design and construction is intended for use by those with a general knowledge of sound domestic construction practice, and with a responsible attitude to construction.

1.7.4 Silence of the Manual

The apparent omission of reference to members, components, materials, workmanship and the like including items not shown but necessary for the construction, shall not be taken to mean they are not required. The Manual is written on the basis that users will have sufficient knowledge and experience to include all such items in their design documents and to ensure that they comply with the current Building Act, current SAA Codes and recognised correct practice.

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1.8 TERMINOLOGY AND STRUCTURAL ACTIONS

1.8.1 Wind Loadings

Although wind loadings are based on AS 4055, the “W” system as used in the Building Code of Australia Volume 2 Table 1.1.1. is also referenced. This system is widely understood in the industry and is more intuitive and easily remembered than the N and C system used in AS 4055. Correspondence between the BCA “W” system and AS 4055 is as follows.

BCA “W” SYSTEM		AS 4055	
Non Cyclonic	Cyclonic	Non Cyclonic	Cyclonic
W28		N1	
W33		N2	
W41N	W41C	N3	C1
W50N	W50C	N4	C2
W60N	W60C	N5	C3
W70N	W70C	N6	C4

1.8.2 Wall Types and Load Widths

External Loadbearing Walls are walls which carry roof or upper floor loads as axial loads, and being external, are also subject to full lateral loads from wind.

Internal Loadbearing Walls are lower storey walls which carry upper floor loads. Being internal, they carry no roof loads. They are subject to reduced lateral loads from wind, that can result from differential pressures within the building.

Internal non loadbearing walls are walls that are relieved from carrying roof loads by trusses spanning overhead between exterior walls, or are relieved from carrying upper floor loads by the capacity of the floor structure to span across these walls between designated loadbearing walls. They are subject to reduced lateral loads from wind, that can result from differential pressures within the building. Any non loadbearing wall needs to be protected from unintentional subjection to loads from above by provision of a movement gap or other isolation from the overhead structure.

In referencing Tables for reinforcement and lintel design, it is necessary to refer to quantities “dimension ‘a’ and Dimension ‘s’”. **Dimension ‘a’** is the tributary load width of a roof, and **Dimension ‘s’** is the tributary load width of a floor, both as shown on Drawing 02-02.

1.9 ZEGO DESIGN SUPPORT

ZEGO Pty Limited offers Design Support, particularly for large and / or repetitive projects. Detailed consideration of specific cases can yield economies that may not be possible solely through the application of this Manual.

1.10 LAYOUT OF THE MANUAL

After the general commentary of this section, the Manual contains the design and construction specification, then an Appendix containing engineering information for the structural design of domestic buildings outside the scope of the Manual, and for commercial buildings. Then follows Drawings, and lastly the Design Tables for specific Wind Loadings and Roofing Materials.

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2. SPECIFICATION

2.1 GENERAL

2.1.1 SCOPE

This Specification covers design and construction of ZEGO® “Magu” ICF walls in domestic buildings, together with other parts of the buildings directly related to wall construction and specifically mentioned herein.

2.1.2 MATERIALS & WORKMANSHIP

All materials, workmanship and construction generally shall comply with the Building Code of Australia and statutory federal, state and local government requirements.

2.1.3 RELATED DOCUMENTS

This Specification includes the Drawings 03-01 to 03-10, and other documents referenced in the Specification.

2.1.4 QUALIFICATIONS AND TRAINING OF BUILDER

The builder of the ZEGO® “Magu” ICF walls shall receive instruction and training in the construction of ZEGO® “Magu” ICF walls from ZEGO Pty Limited or from persons authorised in writing by ZEGO Pty Limited, and shall hold a valid General Builder’s License, Trade Contactor’s License or Owner Builder’s License.

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2.2 DESIGN

2.2.1 CAPABILITY OF DESIGNER

Design shall be carried out by a person with capability in the preparation of Specifications and Drawings for domestic houses, sufficient for submission to and approval by the Local Authority.

2.2.2 REQUIRED MANUALS FOR DESIGN

In addition to this Manual, the **Designer will require to refer to AS 1684.2:1999 “Residential timber framed construction Part 2 Non cyclonic areas” Section 8 for the determination of racking forces for bracing design.**

2.2.3 LOADS

2.2.3.1 Roof dead loading is categorised as either Tile or Sheet.

Tile means terracotta or concrete tiles plus battens plus 13mm plasterboard or 19 mm hardwood ceiling lining, total mass 90 kg/sq m.

Sheet means metal sheet roofing, plus battens plus 13 mm plasterboard or 19 mm hardwood ceiling lining, total mass 40 kg/sq m. (It includes metal tiles).

2.2.3.2 Wind loading is categorised according to the classification system used in the Building Code of Australia Volume 2 Table 1.1.1, as W28, W33, 41N or W41C. The Wind Classification shall be obtained from the local authority having jurisdiction.

2.2.3.3 Suspended Floor loading

Lightweight floors comprise timber or steel framing plus strip tongue and groove or structural sheet, or a lightweight proprietary flooring system, of total mass not exceeding 50 kg/sq m, plus a live load of 1.5 kPa (150 kg/sq m) distributed load and 180 kg concentrated load.

Heavy floors comprise concrete or heavy proprietary floors, of total mass not exceeding 360 kg/sq m, (equivalent to a 150 mm thick concrete slab) plus a live load of 2.0 kPa (200 kg/sq m) distributed load and 180 kg concentrated load. *(The increased live loading with the “heavy floor” allows for use in home unit buildings, as well as single domestic houses).*

2.2.3.4 Racking forces for bracing design shall be determined from AS 1684.2:1999 “Residential timber framed construction Part 2 Non cyclonic areas” Section 8 Tables 8.1 to 8.5. Equivalence of the “N” wind classification system used in AS 1684 with the “W” system is shown in Section 1.8.1 of this Manual.

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2.2.4 PARTS OF THE STRUCTURE OTHER THAN WALLS.

2.2.4.1 Foundations shall be designed to AS 2870:1996 "Residential slabs and footings - construction" for "equivalent construction" of masonry veneer, or to a recognised equivalent. The edge foundation detail shall accommodate the construction as shown on Drawing 03-03.

2.2.4.2 Floors shall frame into walls as shown on Drawing 03-04. Walls supporting beams or bearers collecting load from abnormally large load areas, such as might, for example, require a steel Universal beam, should be checked by a Structural Engineer.

2.2.4.3 Roof trusses or framing members frame onto tops of walls as shown on Drawing 03-04. Connection and tiedown for girder trusses or roof beams collecting load from abnormally large load areas should be checked by a Structural Engineer

2.2.5 DRAWINGS REQUIRED.

To ensure proper quantity takeoff for ordering of concrete and reinforcement, to ensure the confidence and hence rapid approval by the Local Authority, and to ensure correct construction, prepare elevations **for each wall**, showing openings and reinforcement, to 1:50 or larger scale. A plan on the ground floor slab showing Starter Bars is also recommended, to ensure that the concrete contractor places these correctly, particularly internal Starter Bars for Bracing Walls. Local Authorities will also normally require details as shown on Drawings 03-01 to 03-10 of this manual, plus a Wind Bracing Diagram for each wind direction and each floor, showing wind racking loads and the bracing walls resisting these. *(Other documentation normally required include Specifications for all trades, 1:100 general plans of each story and roof, 1:100 or 1:50 elevations and sections, foundation and floor structural plans, and waterproofing/weatherproofing details).*

2.2.6 SELECTION OF ZEGO® "Magu" ICF SERIES

ZEGO® "Magu" Insulated Concrete Forms ICF are available in three nominal thicknesses, as follows.

Nominal Thickness	150 series	200 series	250 series
Actual ICF unit Thickness	143	190	238
Concrete core thickness	80	100	148
Concrete volume per square metre	0.0662 m ³ /m ²	0.0833 m ³ /m ²	0.1245 m ³ /m ²

These ZEGO® "Magu" ICF units are shown on Drawings 01-01 and 01-02. *Generally, 150 series ICF's are suitable for interior walls, and exterior walls with low wind loads and small openings, not exceeding 2 metres wide. 200 series ICF's are generally recommended for exterior walls in domestic houses. While they require more concrete than 150 walls, they also require less reinforcement, and the concrete is much more easily placed. The principal application for 250 series ICF's is in commercial construction.*

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2.2.7 REINFORCEMENT IN WALLS

2.2.7.1 Reinforcement in walls generally shall be determined from the Design Tables for the particular Wind Load Classification and Roofing Material applicable eg W33 Sheet, to be placed as shown on Drawing 03-01. The reinforcement required is listed in the Tables.

2.2.7.2 Lintels shall be determined from the Table for Lintel and Jamb Reinforcement for the particular Wind Load Classification, Roofing Material and wall series (ie 150 or 200) applicable. The Lintel Tables for Lower Storey Lintels apply only to lightweight (framed) floors of dead load not exceeding 50 kg/sq m (0.50 kPa) and Live Load 1.5 kPa (as for domestic houses), and not supporting bearers. For concrete floors, lintels should be downturned beams incorporated in the floor, designed and reinforced appropriately.

2.2.7.3 Reinforcement at Openings serves two purposes: to pick up the reaction forces for tiedown at each end of a lintel, and to pick up horizontal wind forces imposed on jambs by door or window panes filling the opening.

While Tables list jamb reinforcement for openings up to 6 metres wide, it is assumed that the maximum opening with a door or window pane exerting wind load onto the jamb is 3 metres. Wider openings are assumed to be permanent, or to have doors mounted in such a way that load is not transferred to the jamb (eg separate jambs are provided, or the door has side frames transferring loads direct to the floor and roof planes).

Jamb reinforcement shall be determined from the Table for Lintel and Jamb Reinforcement for the particular Wind Load Classification and Roofing Material applicable.

2.2.7.4 Interior walls are all of the same design unless they are bracing walls. That design is listed at the lower section of each Design Table.

2.2.7.5 Bracing walls are provided sufficient to resist the Racking Forces determined from Section 2.1.2.4 above.

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2.3. MATERIALS & COMPONENTS

2.3.1 Insulated Concrete Forms shall be ZEGO® “Magu” expanded “Styropor ‘F’ ” stamped with the circular logo as shown on Drawing 01-01, “www.zego.com.au” inscribed in a circle.

2.3.2 Concrete shall be in accordance with AS 3600:2001,
28 day strength $f'c = 20$ MPa,
Slump 120 mm,
Maximum aggregate size
5 mm for 150 series ICF's,
10 mm for 200 and 250 series ICF's.

Admixtures may be used with the following provisos.

- The admixture shall provide a genuine benefit to concrete strength, durability, workability and/or economy
- The admixture shall cause no adverse affect to concrete strength, concrete or reinforcement durability, or concrete workability and shall not result in increased pressure on forms that could lead to damage or deformation.

Obtain from the Manufacturer test results for 7 day and 28 day strengths, to demonstrate compliance with this clause.

2.3.3 Reinforcement shall be in accordance with AS 3600:2001, and shall be plain grade 250R, 6mm diameter for ligatures and shall be deformed grade 400Y or 500N, 12mm diameter for straight and cogged (“L”) bars. Lengths, shapes and pin diameters are shown on Drawing 03-04.

2.3.4 Timber nailing plates for fixing trusses at tops of walls shall be visually graded sawn timber to AS 1720.1”1997 “Timber structures Part 1: design methods” to the sizes and “F” grades shown on Drawing 03-08 and in the Design tables.

2.3.5 Bolts holding down timber nailing plates shall be Powers Australia “Excalibur” Screw-Bolt Anchors”.

2.3.6 Renders to AS CA27 or Supacoat www.supacoat.com.au or other approved render system. Consult manufacturer of other systems for their approval and work method statements.

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2.4 CONSTRUCTION

2.4.1 Preliminaries

Do not commence work before obtaining all statutory approvals, and comply with all statutory requirements for licensing, signage on site, environmental safeguards and the like. Prevent escape off site of Polystyrol pieces and fragments - catch, bag and remove off site to authorised tip. The EPS Blocks, as well as concrete floor slabs generally, are highly reflective of sunlight, producing an environment similar to a snowfield. Ensure all personnel are adequately protected against the sun, and in particular that eyes are protected by good quality skiing sunglasses.

Pay all insurances and obtain certificates.

2.4.2 Concrete Foundation and Floor Slab.

- Provide drawing 03-03, layout of Starter Bars, plan layout of Starter Bars and 100 x 50 timber Starter Bar templates to concrete floor and foundation contractor.
- Check turnup of moisture vapour barrier as shown on Drawing 03-03, prior to Contractor's placement of reinforcement.
- Check location of Starter Bars before Contractor places concrete. Tolerance of position of Starter Bars 5 mm in any direction.
- Attend on site while concrete is being placed and ensure that any movement of Starter Bars is rectified.
- If after pouring and initial set, it is found that any Starter Bars have been misplaced or omitted, straight Y12 bars may be drilled for and epoxy'd in, to an embedment depth of 125 mm and projecting starter length of 300 mm.

2.4.3 Lowest ZEGO® ICF Course

- Lay epoxy damp course to manufacturer's directions to seal against moisture vapour barrier or other approved DPC to AS 2904.
- Install Termite Treatment to AS 3660 and BCA Housing Provisions.
- ZEGO® "Magu" ICF's are laid with the male "nodules" and ZEGO logo facing upwards.
- Cut base of lower ZEGO® "Magu" ICF to contour of slab or footing.
- Lay two (2) courses over full plan area including across the door and window and openings to ensure bond. (The ICF's in these openings will be later cut out to form openings.)
- Plumb up from floor slab window and door opening setouts.
- Lay the third course leaving openings for doors and windows as required.
- Wedge ICF's level with timber or foam wedges maximum 20 mm.
- Apply ENERFOAM 42, RAMSET FOMOFILL, HILTI CF126, Power FASTENERS TriggerFoam or other appropriate proprietary foam as adhesive and gap filler to the side of ICF's even when hard on the surface. Apply around wedges to avoid shifting when pouring concrete. Leave areas where ICF's will be cut out later to save on materials. These foam adhesives are for filling and bonding to limit movement and slurry leakage when concreting.
- Maximum gap filling with foam under ICF 20 mm.
- After adhesive foam has cured cut out the door, window and passageways as required. This will allow access to tie wire the vertical steel reinforcement to the starter bars.
- Fill in the cut ends of the ICF's with off cuts and seal with adhesive foam.

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2.4.4 Lower Storey wall

- Do not construct if winds exceed, or are likely to exceed, 70 km per hour during the period of ICF laying, concrete pouring or concrete initial set. (*A 70 km/hour wind is a "fresh to strong gale" which noticeably impedes walking progress, breaks twigs off trees and may break off large branches*).
- Gauge courses as required prior to laying.
- Erect wall braces at 1800 centres or closer for column walls and plumb to ensure the wall itself is laid plumb. *Proprietary wall braces such as Wall Brace Australia Pty Limited are available for purchase or hire www.wallbraceaustralia.com.au*. Lay ZEGO® "Magu" ICF's course by course, retaining against wall brace using 2 strands of 1.25 mm annealed tie wire at each trestle horizontally and every two courses i.e. 600 vertically, tie wire holding small piece of steel or timber inside block. Stability of wall during concrete pouring is essential.
- At wall corners and intersections knock out ICF unit face shells to ensure core concrete when poured is monolithic and continuous around corners and across the intersections, as shown on Drawings 03-05, 03-09 and 03-10.
- Lay to course below lintel course.
- Lay horizontal sill reinforcement and lower bond beam reinforcement (Drawings 03-04, 03-05, 03-06 and 03-08). Drop in vertical reinforcement, using cone guides to ensure they remain centrally in the ICF cores.
- Cover to reinforcement to internal sides of ICF's 10 mm. Side does not include the 10mm fillets above and below cross webs - bars may be placed against these.
- Fabricate lintels on the ground, ensuring "SH" ligatures are properly positioned around horizontal bars and are correctly placed within the ICF's. Cut away portions of cross webs as shown on Drawing 03-07. Erect lintels in position. Lay rest of lintel course.
- Lay horizontal top bond beam bars.
- Pour concrete in accordance with AS 3600, ensuring concrete is migrating horizontally along the wall, completely filling all voids and not segregating. Ensure complete filling is by natural flow of the concrete from no higher than 2700mm. Do not use vibrators, rods, tamping or other mechanical means that could damage the ICF face shells or cross webs. Pour at the rate of 3 courses (900 mm) pr hour per pass eg 2700mm high 3 hours minimum. On reaching the top, drop in type "U" bars to enclose the bond beam bars, wait for 15 to 30 minutes to enable the concrete to settle, then top off and rod the topping down 600 mm only for the depth of the bond beam or ring beam into the rest of the pour. If a single storey, steel trowel for a smooth finish. If another storey is to be constructed, rough screed off.

2.4.5 Upper Storey Wall.

- Ensure there is a minimum 300 starter bar extension for vertical bar laps.
- Place blockouts for bearers and joists
- Use hammer with soft blows to break excess concrete slurry from male nodules and remove rubble with blower and screwdriver to allow next course to be laid.
- Lay ZEGO® "Magu" ICF's and reinforcement, fabricate lintels and pour concrete as for the lower floor.
- Steel trowel the top for a smooth finish.

2.4.6 Truss nailing plate

Fix Nailing Plate to tops of walls to support roof framing as shown on Drawings 03-04 and 03-08, using Excalibur Screw Bolts embedded 60 mm into concrete. **END**

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APPENDIX 'A'

ENGINEERING INFORMATION

A1 STRUCTURAL BASIS OF THE SYSTEM.

The structural integrity of a ZEGO® "Magu" Insulated Concrete Form (ICF) System wall comes entirely from the core filling concrete plus any reinforcement, and structural design is based on normal reinforced concrete design principles, as codified in AS 3600 "Concrete Structures". As the configuration of the concrete closely resembles concrete core filling in hollow block masonry construction, AS 3700 "Masonry Structures" is referenced for guidance in some matters.

The structural concrete dimensions are as shown on Drawing 01-01 and 01-02, and Section 2.2.5 of the Specification.

A2 GENERAL APPROACH

Many of the structures best suited to the ZEGO® "Magu" ICF system are relatively small and low cost. It is important that a "heavy engineering" approach to these structures is not used where it is not appropriate. For example, in many cases unreinforced walls are satisfactory and reinforcing bars generally do not exceed Y12 or N12 in size, as explained below.

A3 COVER AND PLACEMENT OF REINFORCEMENT

Reinforcement cover is determined in accordance with the reinforced masonry provisions of AS 3700 "Masonry Structures", for the following reasons.

- AS 3600 durability requirements do not include the situation where concrete is placed against totally protective permanent formwork.
- The core filling of ZEGO® "Magu" ICF's is similar in dimensions and conformation to that of hollow block masonry.
- ZEGO® "Magu" ICF's plus the waterproof exterior coating provide total protection to core concrete and its reinforcement, in a similar manner to that provided by hollow block masonry with a full waterproof coating.

Table 5.1 of AS 3700 Item 3 for units fully protected by a waterproof coating specifies a minimum cover to reinforcement of 5 mm. For the ZEGO® "Magu" ICF system, 10 mm is used.

Vertical reinforcement is placed centrally in 150 and 200 series ZEGO® "Magu" ICF walls. A proprietary cone guide is available to ensure central positioning of bars in the core. For 250 series walls, bars could be placed in two layers near the sides of cores, provided a means of correct positioning can be assured.

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A4 BAR SIZES

It is found in lintel design that for 150 and 200 series ZEGO® "Magu" ICF walls, 2-Y16 bars results in k_u exceeding 0.4 and for 150 series, in an inadequate gap for concrete placement. For the 150 and 200 series, bar size is thus limited to Y12 or N12.

A5 UNREINFORCED WALL PANELS

AS 3600 Section 15 "Plain Concrete Members" is invoked for the design of domestic structures, on the basis that a crack will not induce collapse. The approach can also be invoked for other structures.

A crack will not induce collapse for the following reasons.

- The unreinforced wall panel is surrounded by reinforced elements, vertically at corners and opening jambs and horizontally at bond beams.
- There is no net tension in the wall, roof uplift being carried by the bond beam and transferred by it to tiedown reinforcement.
- Unreinforced masonry panels are a universally accepted form of construction, rules for their design being covered in AS 3700 "Masonry Structures". The concrete in ZEGO® "Magu" ICF's can be thought of as concrete masonry with concrete mortar.

A check of unreinforced wall panels to AS 3700 gives the same result as the use of AS 3600.

A6 LOADBEARING WALLS SUPPORTING CONCRETE FLOORS

A6.1 Unreinforced Walls

Taking unreinforced walls as being equivalent to concrete masonry, capacity can be determined from AS 3700 Clause 7.3. It is suggested that unreinforced loadbearing walls supporting concrete construction should be restricted to the following.

- Support of not more than one concrete floor
- Walls to be 200 or 250 series ZEGO® "Magu" ICF's except for lightly loaded domestic situations where 150 series may be used
- No possibility of vehicle impact
- Walls with frequent returns, intersections or buttresses and with straight lengths not exceeding 8 metres for domestic construction and 3 metres for commercial construction.

A6.2 Reinforced Walls

Design in accordance with AS 3600 Section 11.

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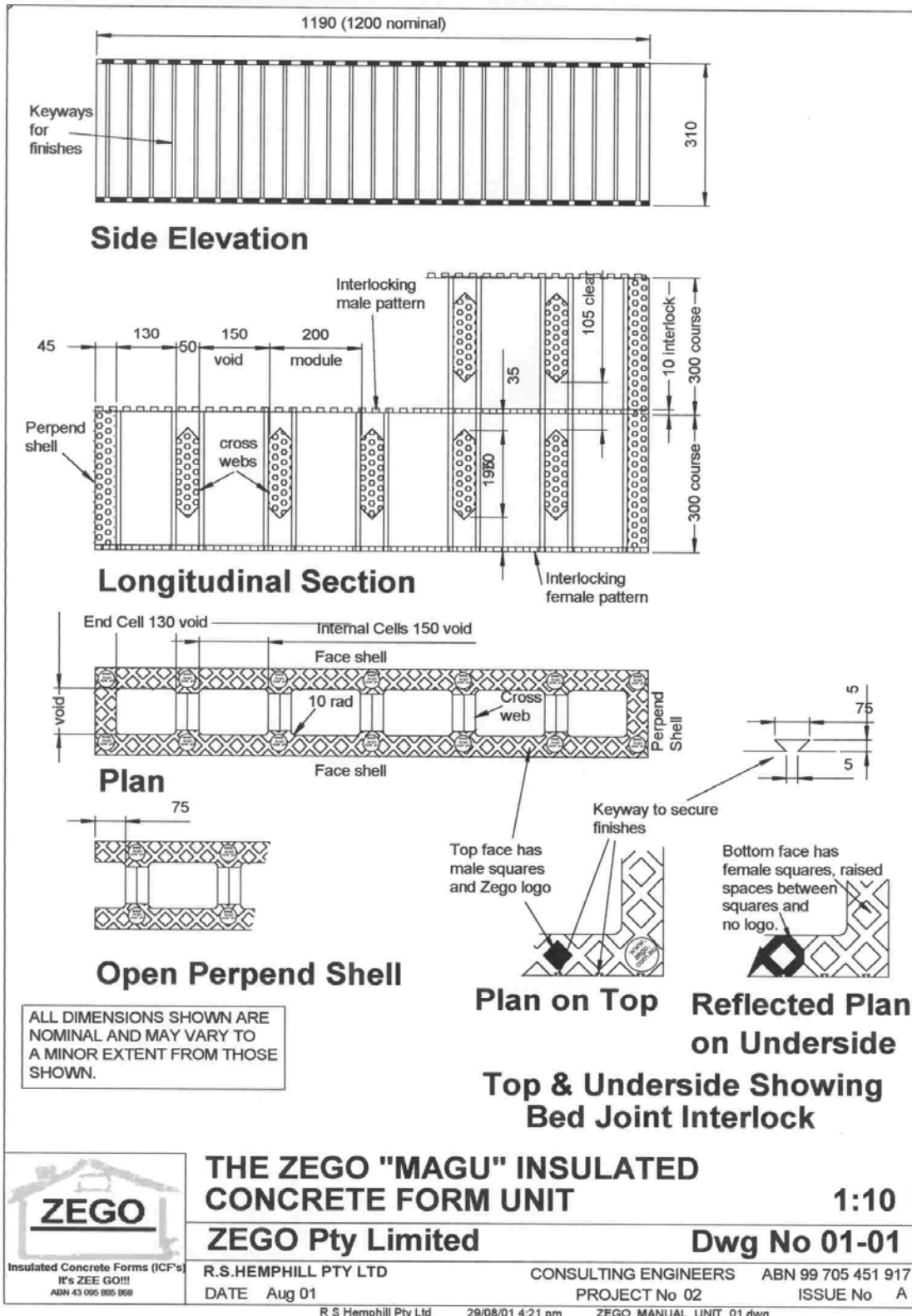
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THE ZEGO "MAGU" INSULATED CONCRETE FORM UNIT

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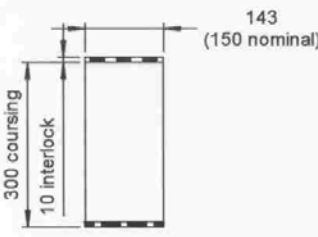
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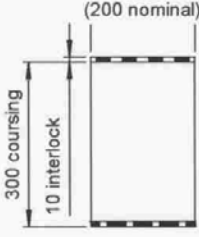
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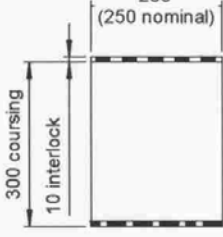
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150 Series



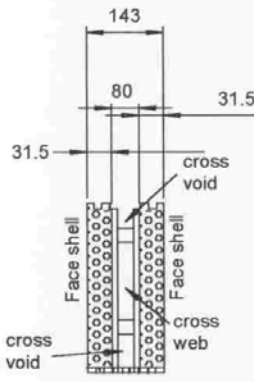
200 Series



250 Series

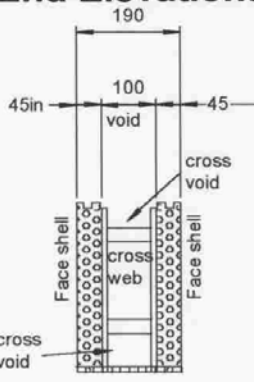
Sizes are based on a manufacturing module of 47.6 mm, ie 47.6 mm x 3 = 142.8, rounded 143 for the 150 series, 47.6 x 4 = 190.4, rounded 190 for the 200 series, and 47.6 x 5 = 238 for the 250 series.

End Elevations



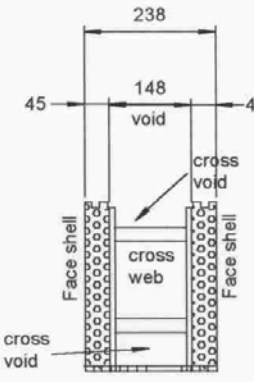
150 Series

0.0662 cubic metres of concrete per square metre of wall; or 1 cubic metre of concrete will fill 15.1 square metres of wall.



200 Series

0.0833 cubic metres of concrete per square metre of wall; or 1 cubic metre of concrete will fill 12.0 square metres of wall.



250 Series

0.1245 cubic metres of concrete per square metre of wall; or 1 cubic metre of concrete will fill 8.0 square metres of wall.

ALL DIMENSIONS SHOWN ARE NOMINAL AND MAY VARY TO A MINOR EXTENT FROM THOSE SHOWN.


USE OF 150, 200 & 250 SERIES

150 Series: Domestic Construction external walls in low wind areas, not more than 2 stories and with upper floor timber or light steel framed; internal walls generally except for severe cyclonic wind areas.

200 series: Domestic including concrete upper floors, and commercial construction.

250 series: Commercial construction, and domestic construction subjected to high wind loads.

Sections - 150, 200 and 250 series



ZEGO
Insulated Concrete Forms (ICF's)
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**THE ZEGO "MAGU" INSULATED
CONCRETE FORM UNIT**

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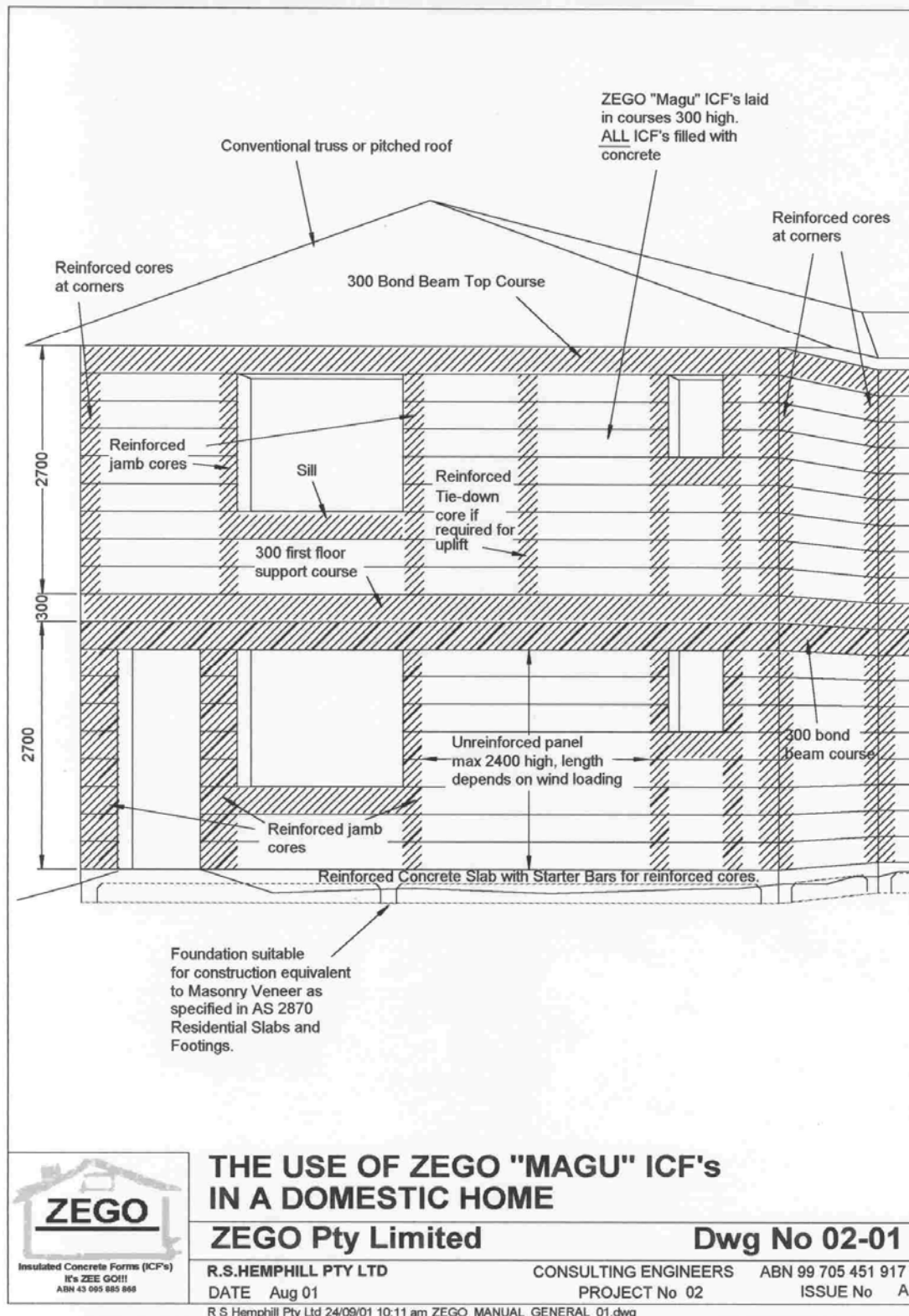
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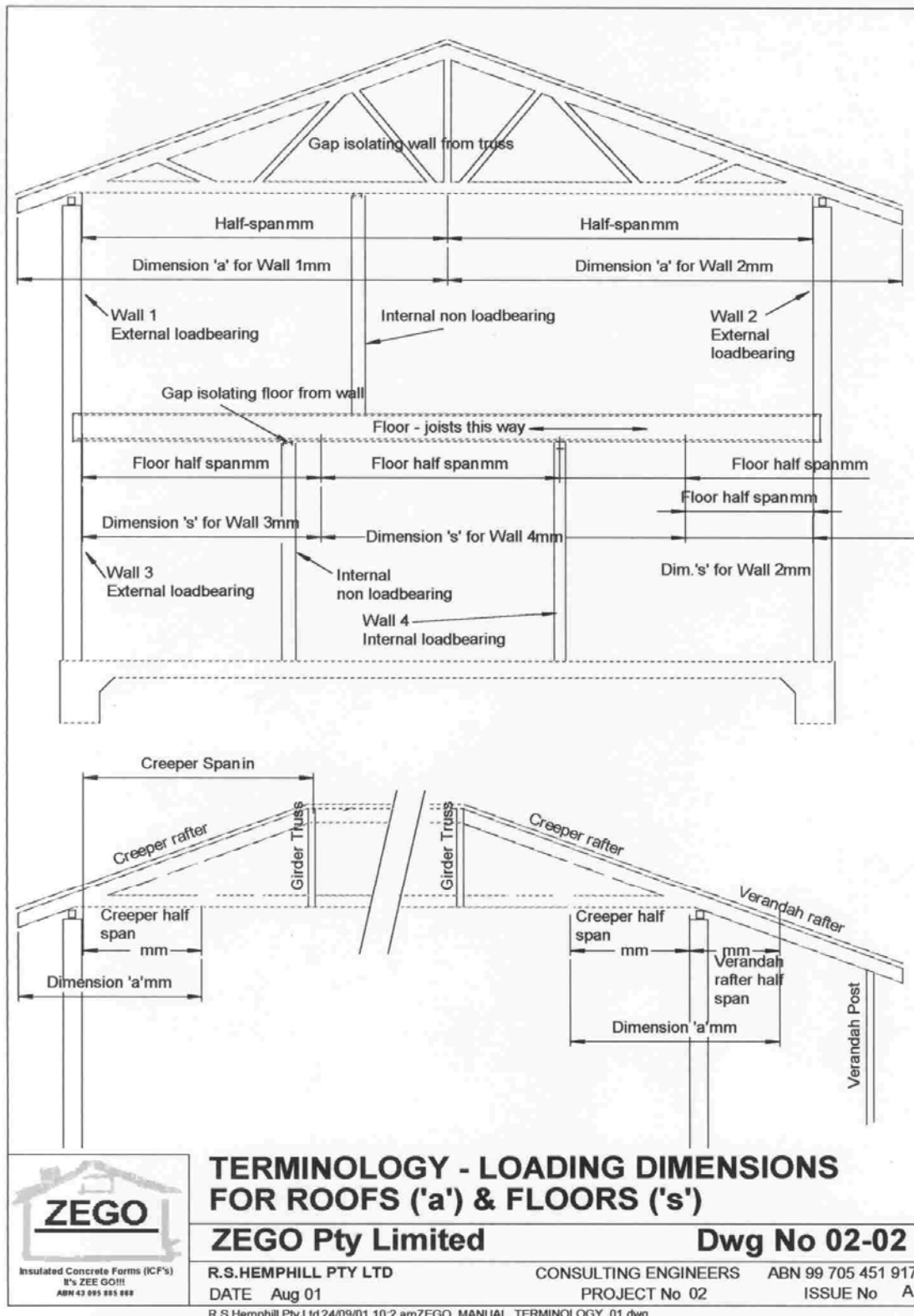
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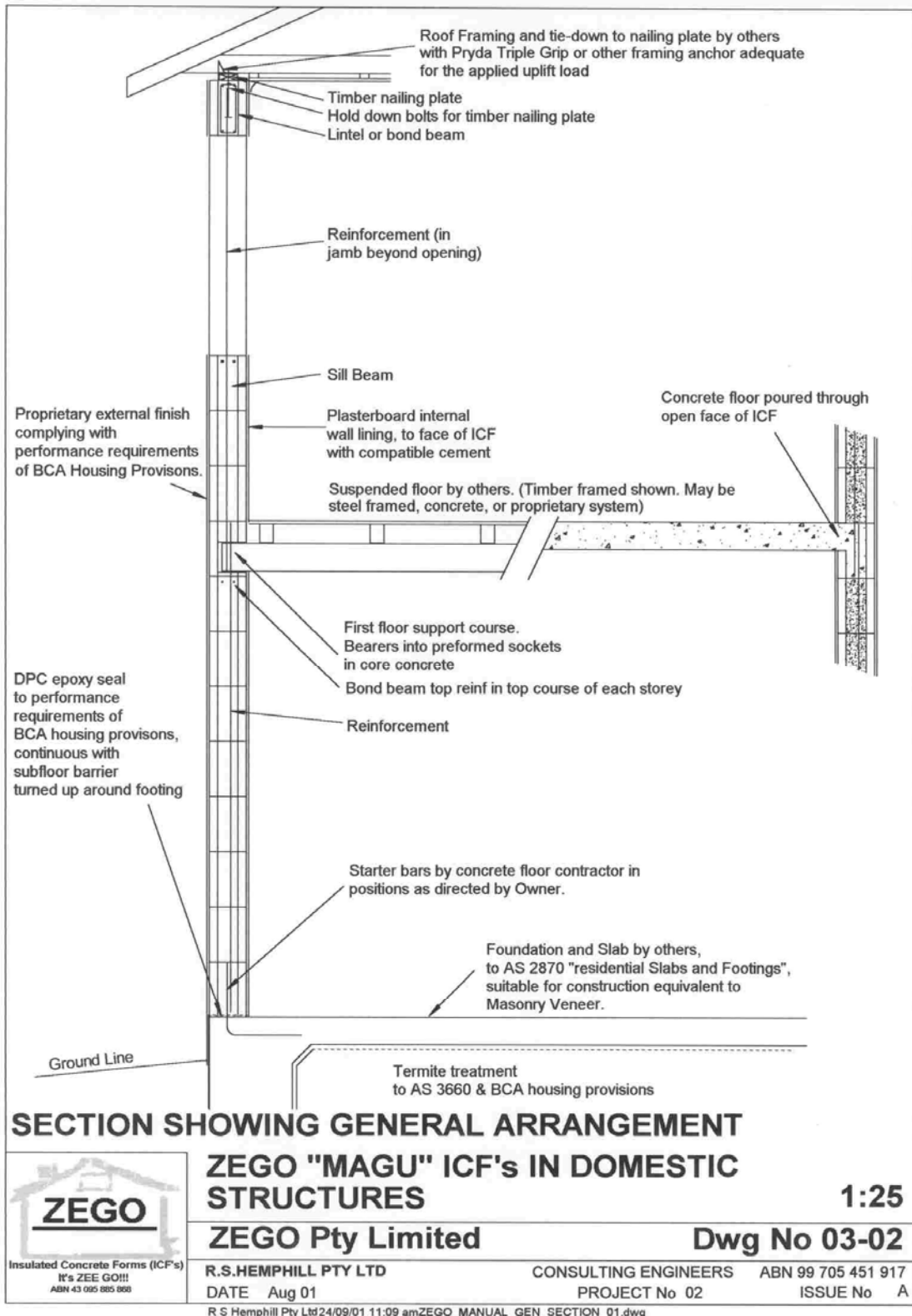
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<p>Technical Notes</p> <p>All concrete work & reinforcement to be to AS 3600 Concrete $f_c = 20$ MPa, slump 100 mm, max aggregate size 10 mm generally, 5 mm for 150 series Reinforcement Plain R Grade for ligatures, Y or N grade for bars noted Y Minimum cover 10 mm, concrete is entirely protected by ICF's Refer Specification for complete requirements.</p>	<p>Construction Notes</p> <p>Safety - comply with all OH & S requirements. Environment - prevent escape off site of polystyrene pieces and fragments. Bag & dispose of to authorised tip. Use of hot wire cutting recommended for accuracy of cutting and ease of cleanup. Use power vacuum to clean up after cutting or chasing walls. When concreting, ensure each course is properly filled before moving up to the next course. Ensure complete filling is by natural flow of the concrete. Do not rod, vibrate, tamp or use any hard compaction tool as these may damage or rupture the ICF's.</p>	
<p>ELEVATION SHOWING GENERAL ARRANGEMENT</p>		
	<p>ZEGO "MAGU" ICF's IN DOMESTIC STRUCTURES</p> <p>ZEGO Pty Limited</p> <p>R.S. HEMPHILL PTY LTD DATE Aug 01</p>	<p>1:50</p> <p>Dwg No 03-01</p> <p>CONSULTING ENGINEERS ABN 99 705 451 917 PROJECT No 02 ISSUE No A</p>
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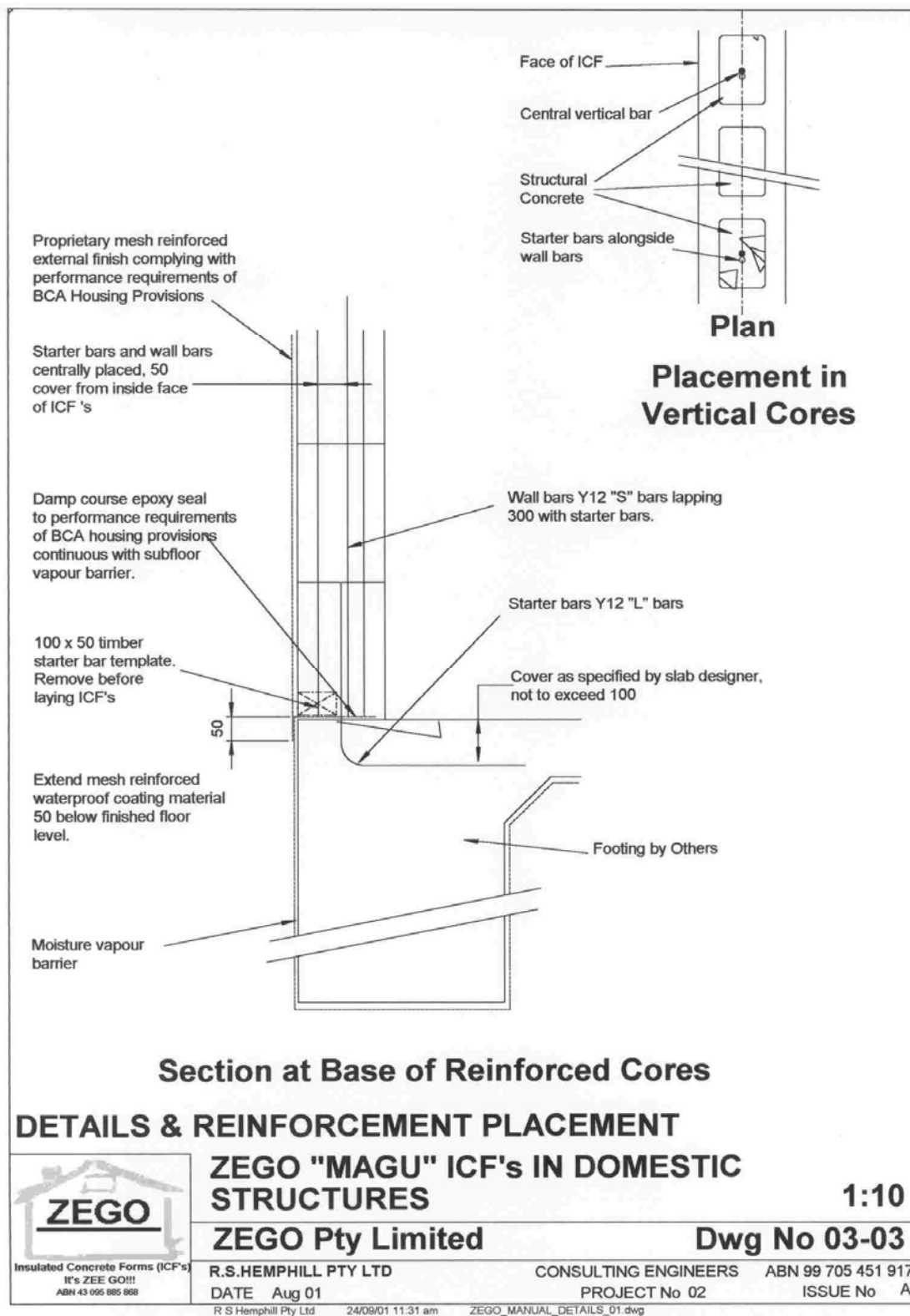
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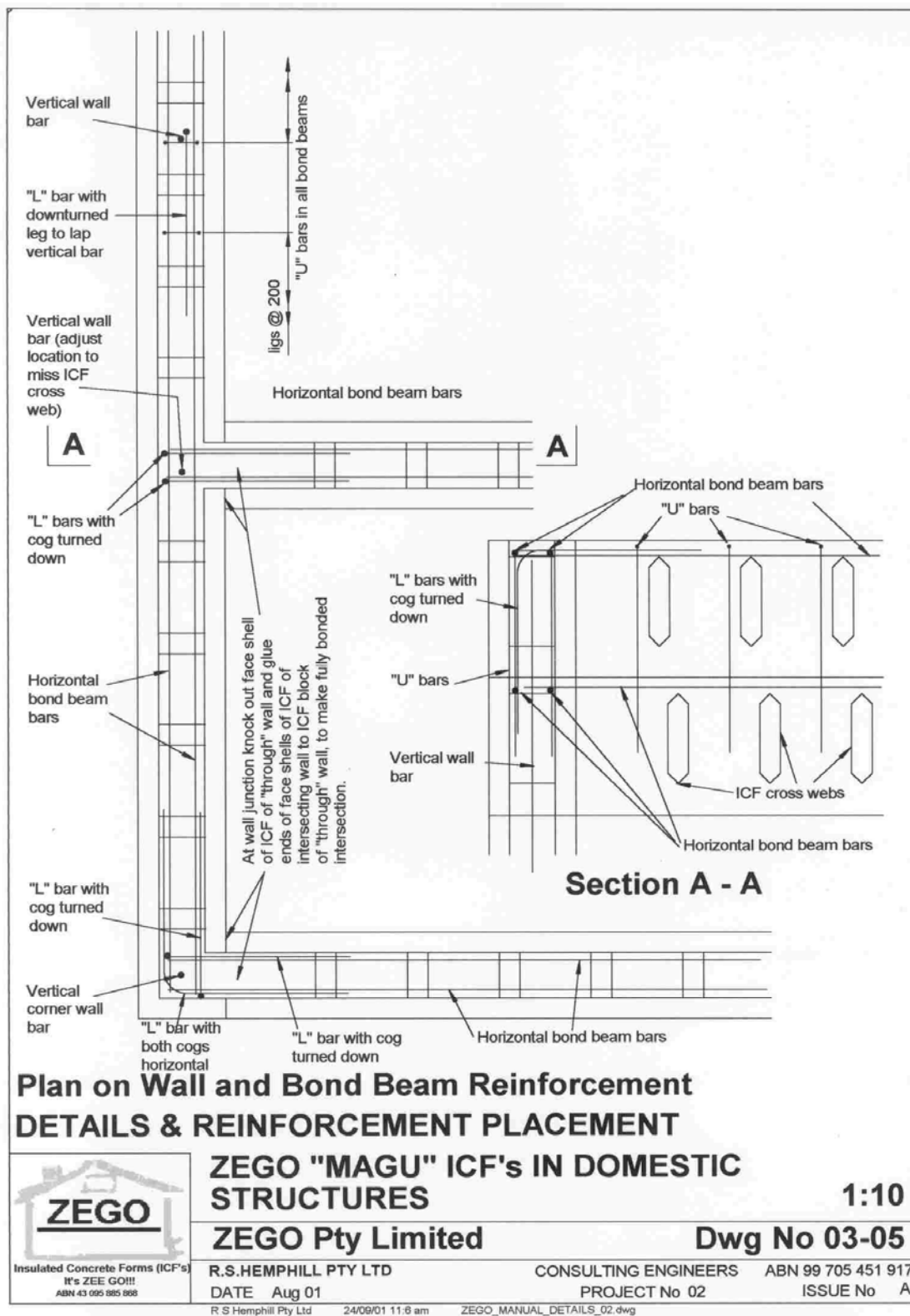
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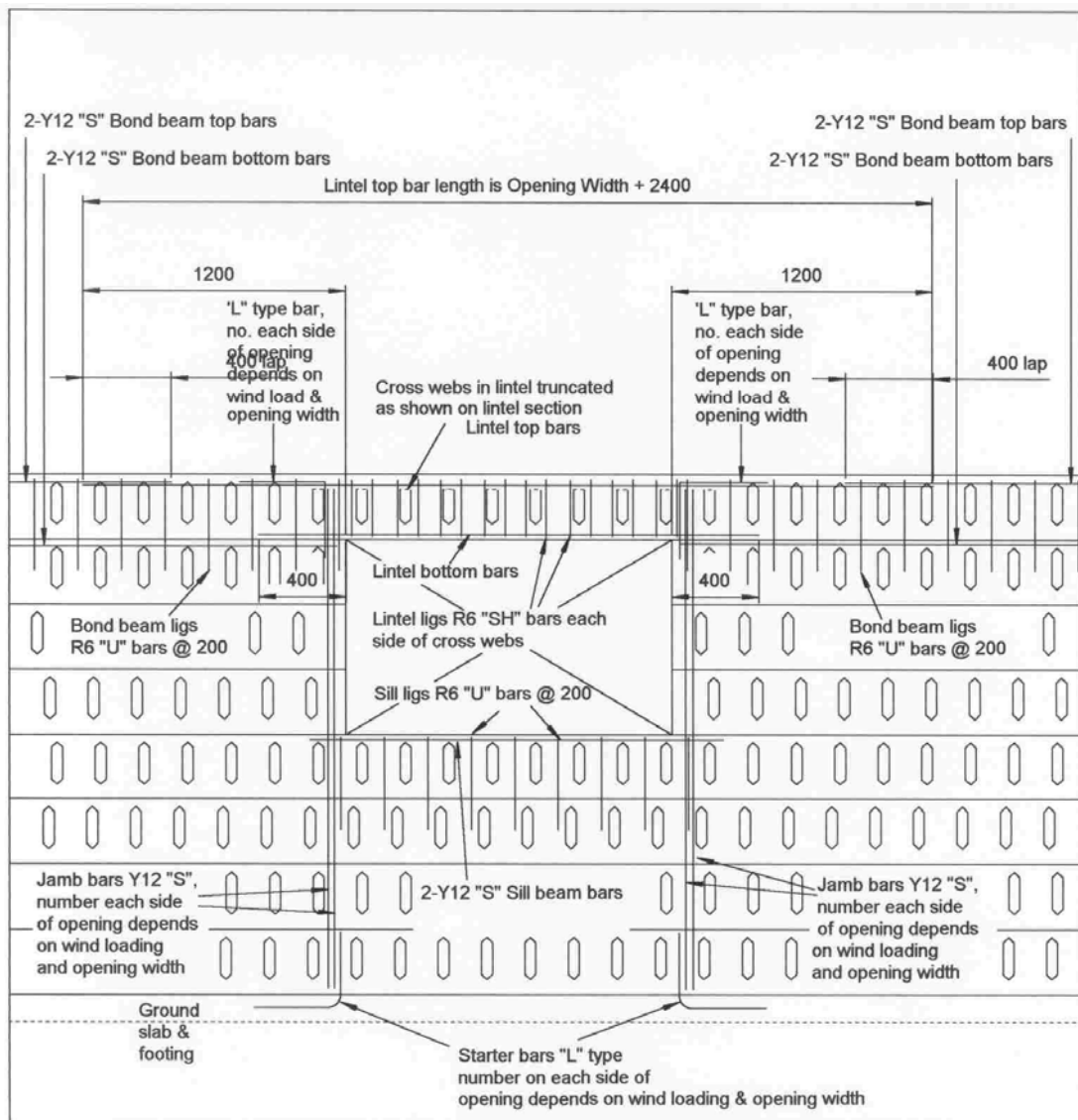
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Reinforcement at Openings

DETAILS & REINFORCEMENT PLACEMENT



ZEGO "MAGU" ICF's IN DOMESTIC STRUCTURES

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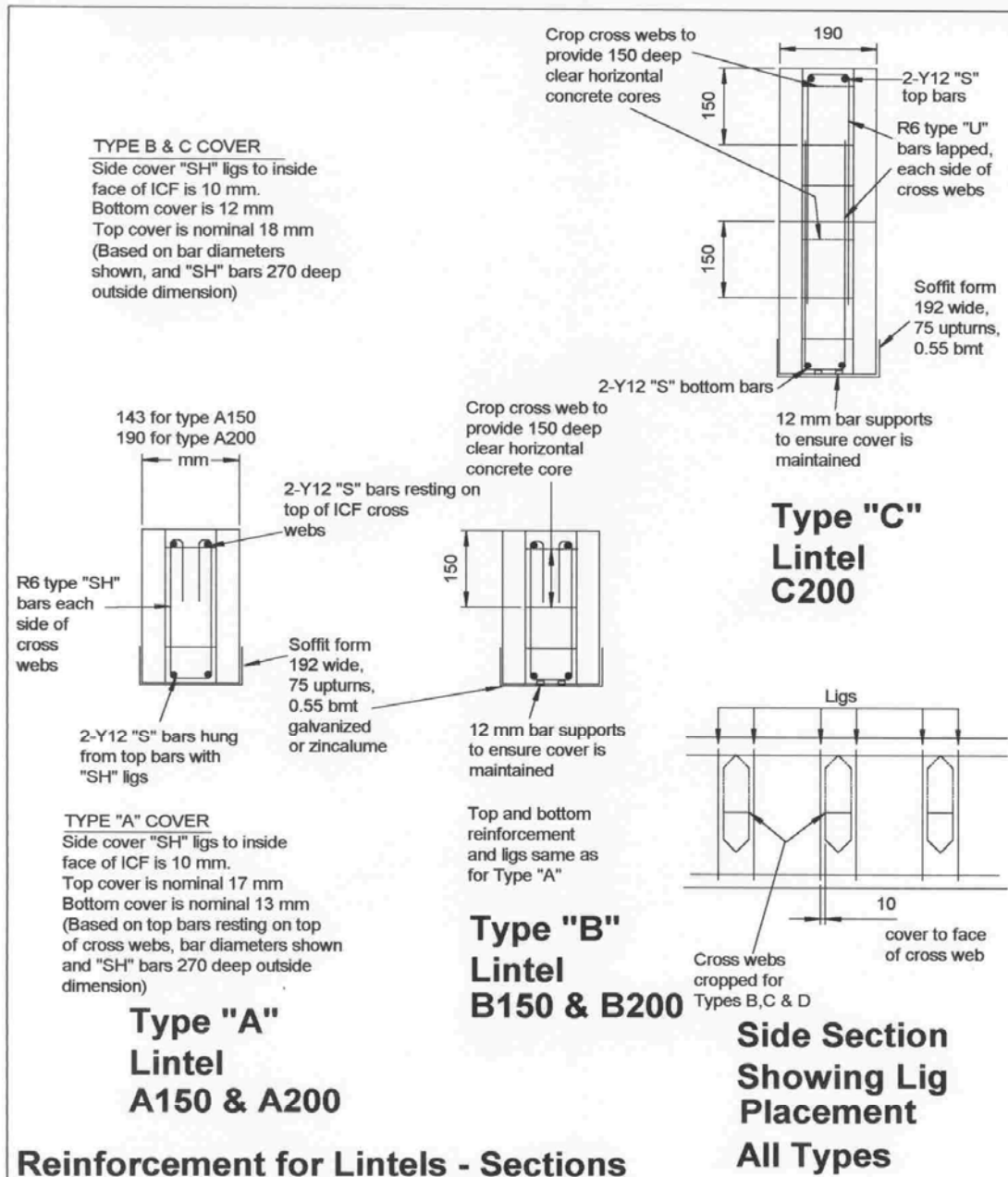
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DETAILS & REINFORCEMENT PLACEMENT



ZEGO "MAGU" ICF's IN DOMESTIC STRUCTURES

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Timber nailing top plate 90 x 45 F5 pine anchored with 8 mm Excalibur Screw Bolt @ 1200

Type "A"

Timber nailing top plate 90 x 45 F5 pine anchored with 8 mm Excalibur Screw Bolt @ 600

Type "B"

Timber nailing top plate 100 x 75 F14 h'wood anchored with 8 mm Excalibur Screw Bolt @ 600

Type "C"

Nailing Plate at Tops of Walls Types A, B & C

May be used with 150 or 200 series ICF blocks

2-Y12 "S" bars resting on top of cross web

Section Detail - Sill

Jamb reinforcement as required for specific wind load and opening width max 2 bars per cell

ICF butts into door/window frame and forms concrete seal

Pressed metal door or window frame

Concrete thoroughly worked into space behind frame to ensure frame is firmly keyed to wall

Plan Detail - Jamb

Reinforcement for Sills and Jambs

Nailing Plate at Tops of Walls

DETAILS & REINFORCEMENT PLACEMENT



ZEGO "MAGU" ICF's IN DOMESTIC STRUCTURES

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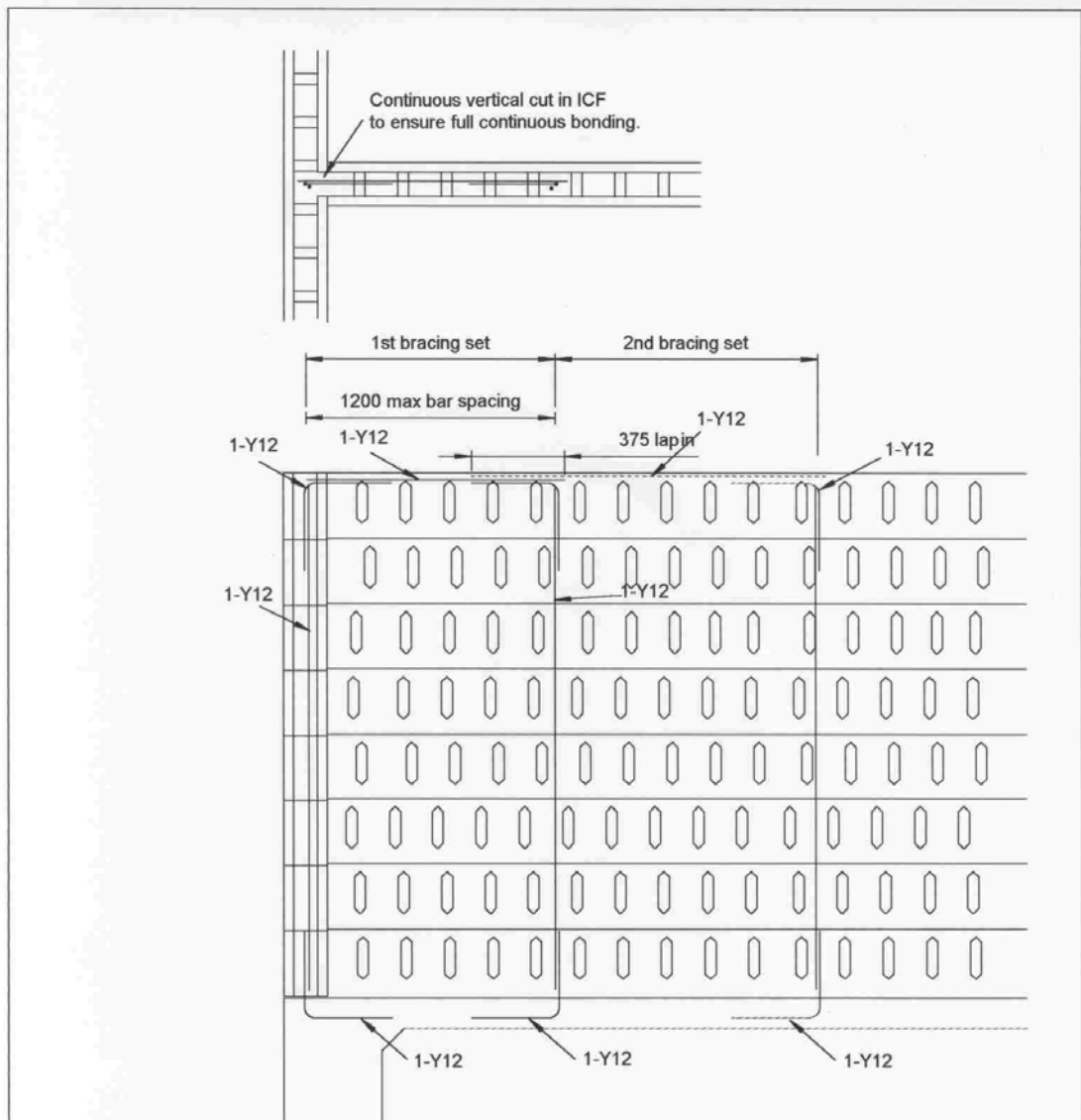
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Bracing Set - Vertical Reinforcement Y12 @ 1200
Capacity 11 kN (working); 16.5 kN (ultimate) for each
1200 section. (ie for 2 braces as shown, capacity
22 kN (working); 33 kN (ultimate))

BRACING WALL DETAILS



**ZEGO "MAGU" ICF's IN DOMESTIC
STRUCTURES**

1:25

ZEGO Pty Limited

Dwg No 03-09

R.S. HEMPHILL PTY LTD

CONSULTING ENGINEERS

ABN 99 705 451 917

DATE Aug 01

PROJECT No 02

ISSUE No A

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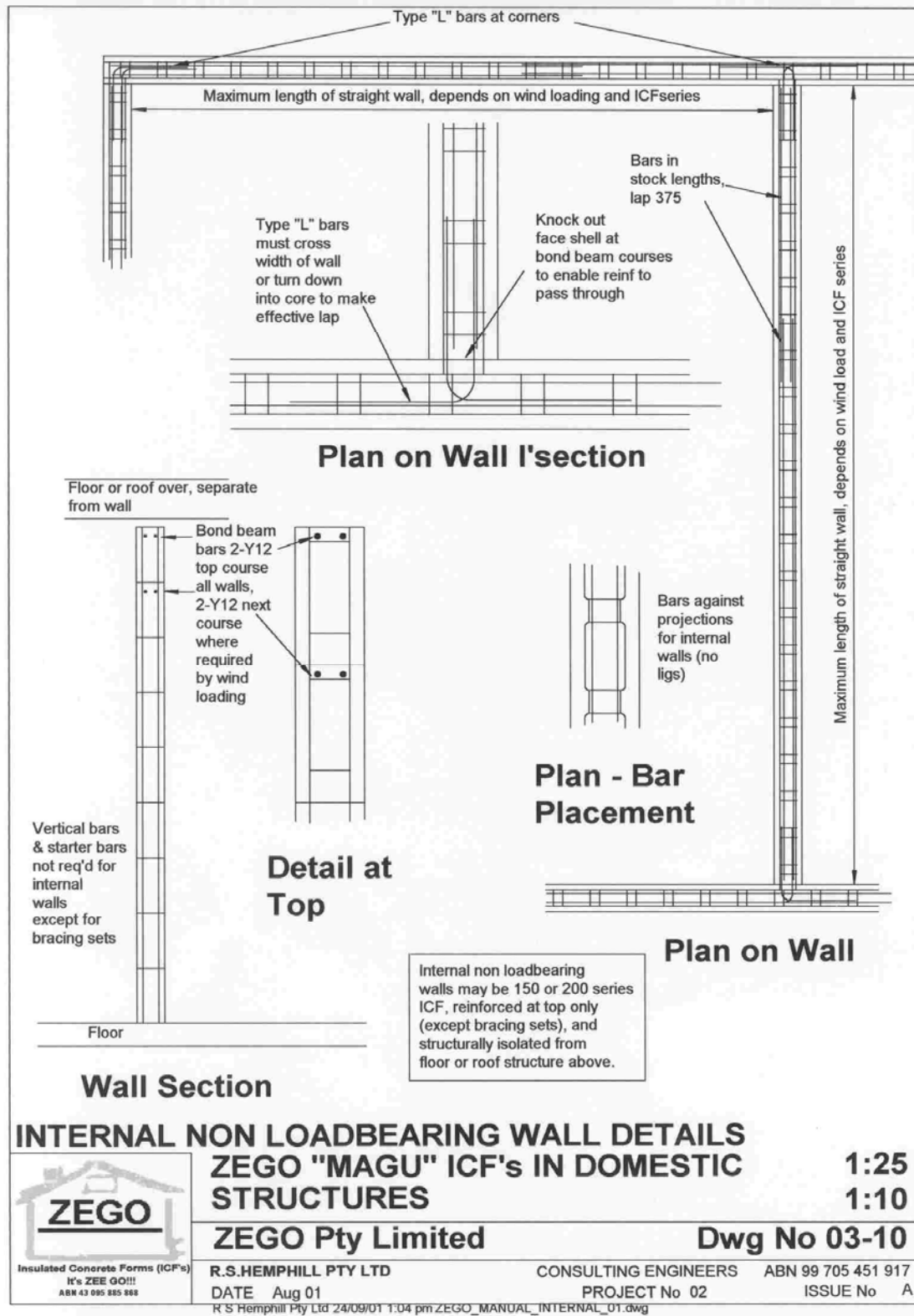
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MAXIMUM SURCHARGE LOADING ON TOP OF WALL 5.0 kPa

WALL TYPE 'A'

WALL TYPE 'B'

PLAN OF WALL

IMPORTANT: Remove polystyrene from internal webs - essential to ensure weephole drainage. Remove polystyrene on exposed face. Retain polystyrene on backfill face.

Geofabric suitable for the backfill used. A needle punched non woven continuous filament of 100% polyester 150 gms / sq m & permeability 200 litres/sq m/sec is suitable.

BACKFILL

Backfill shall be permeable, bulk density not exceeding 1800 kg/cu.m, as follows.
 Clean sand or gravel, cohesion 0 kPa, Internal angle of friction 30 degrees; or
 Sandy silt, cohesion 5 kPa, Internal angle of friction 20 degrees.
 Backfill as follows.
 Allow concrete wall to cure for at least 10 days under suitable curing conditions
 Compact backfill with lightweight hand operated equipment eg Wacker Packer or walk behind non vibratory trench roller. Keep compaction equipment at least 100 mm from back of wall.

REINFORCEMENT NOTES

- 1) Main reinforcement as tabulated is starter bars, vertical wall bars and type 'B' footing top bars.
- 2) Horizontal wall reinforcement is Y12@300 unless exposure conditions or quality of finish are critical in which case use Y12@200 average spacing
- 3) Vertical contraction joints @9m preferably, 12m max

REINFORCEMENT AND FOOTING BASE WIDTH

MAX HT 'H'	MAIN REINF.	BASE WIDTH 'B'	
		WALL TYPE 'A'	WALL TYPE 'B'
900	Y12@200	450	450
1200	Y12@200	600	500
1500	Y12@200	800	650
1800	Y12@100	1000	800
2100	Y16@100	1200	900

DESIGN OPTIONS

Interior or tanked applications may be used without weepholes provided adequate backfill drainage is provided.

To increase durability in aggressive environments use concrete $f_c = 32$ MPa and reinforcement minimum Y12 @ 200 each way.

ZEGO "MAGU" ICF's IN RETAINING WALLS

1:25

ZEGO Pty Limited Dwg No 04-01

R.S. HEMPHILL PTY LTD CONSULTING ENGINEERS ABN 99 705 451 917

DATE Aug 01 PROJECT No 02 ISSUE No A

Rs Hemphill Pty Ltd 2/10/01 2:11pm ZEGO_MANUAL_RETWALL_01.dwg

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DESIGN TABLES FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W28
ROOFING MATERIAL	TILE

EXTERIOR WALLS

Maximum vertical reinforcement spacing in plain walls (1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	6m
Vertical reinforcement at all wall intersections (1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	Yes
Vertical reinforcement at roof girder truss locations (1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	Yes
Bond beams, top course each storey 2-Y12 top of top course, refer Drawing 03-04	Yes
Openings - Jamb reinforcement All opening widths (Single bar each side of opening , no starters)	1-Y12
Openings - Sills - reinforcement (2-Y12 top of top course, refer Drawing 03-08)	Yes
Openings - Lintels: Refer Lintel Table for this wind loading and roofing material.	
Nailing Plate at top of wall Refer Drawing 03-08	Type "A"
Bracing Walls: AS 1684 Wind Classification equivalent Determine Wind Load Bracing Forces in accordance with AS 1684.2:1999 "Residential Timber Framed Construction" for each floor and each wind direction and provide bracing sets to resist these forces, as shown on Drawing 03-09.	N1

INTERIOR WALLS

Maximum straight length of wall	8 m
Vertical reinforcement at all wall intersections (1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	Yes
Bond beams, top course each storey 2-Y12 top of top course, refer Drawing 03-10	Yes
Openings - Jamb Reinforcement All opening widths (Single bar each side of opening , no starters)	1-Y12
Openings - Lintels (Refer Drawing 03-07)	Type "A"

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LINTELS FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W28
ROOFING MATERIAL	TILE

LINTELS

UPPER STOREY		
LINTEL TYPE (REFER DRAWING 03-07)	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
A150	2.50	7.20
	5.00	3.20
	6.00	1.60
B150	4.20	7.20
	6.00	2.20
A200	2.70	7.20
	5.00	3.80
	6.00	2.50
B200	4.20	7.20
	6.00	2.50
C200	6.00	7.20

LOWER STOREY				
MAXIMUM DIMENSION 's' metres (REFER DRAWING 02-02)	LINTEL TYPE	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)	
1.20	A150, A200	1.60	7.20	
		2.40	3.80	
		3.00	2.20	
2.40	B150, B200	3.00	7.20	
	A150, A200	1.30	7.20	
3.60		B150, B200	2.20	1.20
	4.80	A150, A200	3.00	7.20
1.00			7.20	
1.60			1.20	
6.00	B150, B200	2.60	7.20	
		3.00	5.00	
		C200	3.00	7.20
7.20	A150, A200	1.40	0.00	
		3.00	0.00	
6.00	A150, A200	1.10	0.00	
		B150, B200	2.80	0.00
			C200	3.00
7.20	A150, A200	0.90	0.00	
		B150, B200	2.30	0.00
			C200	3.00

NOTES:

Maximum opening width upper storey 6.0 m if jambs do not take wind load from a supported door or window.
Maximum opening width upper storey 3.0 m if jambs are required to take wind load from a supported door or window.
Maximum load width lower storey in a loadbearing wall 3.0 m

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DESIGN TABLES FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W28
ROOFING MATERIAL	SHEET
EXTERIOR WALLS	
Maximum vertical reinforcement spacing in plain walls (1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	6m
Vertical reinforcement at all wall intersections (1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	Yes
Vertical reinforcement at roof girder truss locations (1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	Yes
Bond beams, top 2 courses each storey 2-Y12 top of top course, 2-Y12 top of next course from top, ligs R6 type "U" @ 200, refer Drawing 03-04.	Yes
Openings - Jamb reinforcement Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Openings - Sills - reinforcement (2-Y12 top of top course, refer Drawing 03-08)	Yes
Openings - Lintels: Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Nailing Plate at top of wall Refer Drawing 03-08	Type "B"
Bracing Walls: AS 1684 Wind Classification equivalent Determine Wind Load Bracing Forces in accordance with AS 1684.2:1999 "Residential Timber Framed Construction" for each floor and each wind direction and provide bracing sets to resist these forces, as shown on Drawing 03-09.	N1
INTERIOR WALLS	
Maximum straight length of wall	8 m
Vertical reinforcement at all wall intersections (1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	Yes
Bond beams, top course each storey 2-Y12 top of top course, refer Drawing 03-10	Yes
Openings - Jamb Reinforcement All opening widths (Single bar each side of opening , no starters)	1-Y12
Openings - Lintels (Refer Drawing 03-07)	Type "A"

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LINTELS AND JAMB REINFORCEMENT FOR DOMESTIC HOUSES TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W28
ROOFING MATERIAL	SHEET

LINTELS

UPPER STOREY			LOWER STOREY				
LINTEL TYPE (REFER DRAWING 03-07)	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)	MAXIMUM DIMENSION 's' metres (REFER DRAWING 02 02)	LINTEL TYPE	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)	
A150	5.00	7.20	1.20	A150, A200	2.60	7.20	
	6.00	3.60				3.00	5.00
B150	5.40	7.20		B150, B200	3.00	7.20	
	6.00	5.00	2.40	A150, A200	1.80	7.20	
A200	5.50	7.20				2.40	1.20
	6.00	6.00		B150, B200	3.00	7.20	
B200	5.50	7.20	3.60	A150, A200	1.20	7.20	
	6.00	6.00				1.50	1.20
C200	6.00	6.00		B150, B200	3.00	7.20	
			4.80	A150, A200	1.40	0.00	
				B150, B200	3.00	0.00	
			6.00	A150, A200	1.10	0.00	
					B150, B200	2.80	0.00
					C200	3.00	0.00
			7.20	A150, A200	0.90	0.00	
					B150, B200	2.30	0.00
					C200	3.00	0.00

NOTES:

Maximum opening width upper storey 6.0 m if jambs do not take wind load from a supported door or window.

Maximum opening width upper storey 3.0 m if jambs are required to take wind load from a supported door or window.

Maximum load width lower storey in a loadbearing wall 3.0 m

JAMB REINFORCEMENT

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)
2	6.00	3.60
	3.00	3.60
	2.00	7.20
3	6.00	7.20

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DESIGN TABLES FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W33
ROOFING MATERIAL	TILE
EXTERIOR WALLS	
Maximum vertical reinforcement spacing in plain walls (1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam).	6m
Vertical reinforcement at all wall intersections (1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam).	Yes
Vertical reinforcement at roof girder truss locations (1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam).	Yes
Bond beams, top 2 courses each storey 2-Y12 top of top course, 2-Y12 top of next course from top, ligs R6 type "U" @ 200, refer Drawing 03-04.	Yes
Openings - Jamb reinforcement Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Openings - Sills - reinforcement (2-Y12 top of top course, refer Drawing 03-08)	Yes
Openings - Lintels: Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Nailing Plate at top of wall Refer Drawing 03-08	Type "B"
Bracing Walls: AS 1684 Wind Classification equivalent Determine Wind Load Bracing Forces in accordance with AS 1684.2:1999 "Residential Timber Framed Construction" for each floor and each wind direction and provide bracing sets to resist these forces, as shown on Drawing 03-09.	N2
INTERIOR WALLS	
Maximum straight length of wall	8 m
Vertical reinforcement at all wall intersections (1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	Yes
Bond beams, top course each storey 2-Y12 top of top course, refer Drawing 03-10	Yes
Openings - Jamb Reinforcement All opening widths (Single bar each side of opening , no starters)	1-Y12
Openings - Lintels (Refer Drawing 03-07)	Type "A"

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LINTELS AND JAMB REINFORCEMENT FOR DOMESTIC HOUSES TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W33
ROOFING MATERIAL	TILE

LINTELS

UPPER STOREY			LOWER STOREY				
LINTEL TYPE (REFER DRAWING 03-07)	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)	MAXIMUM DIMENSION 's' metres (REFER DRAWING 02-02)	LINTEL TYPE	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)	
A150	2.50	7.20	1.20	A150, A200	1.60	7.20	
	5.00	3.20			2.40	3.80	
	6.00	1.60			3.00	2.20	
B150	4.20	7.20		B150, B200	3.00	7.20	
	6.00	2.20			2.40	A150, A200	1.30
A200	2.70	7.20		2.20		1.20	
	5.00	3.80		B150, B200		3.00	7.20
	6.00	2.50				3.60	A150, A200
B200	4.20	7.20		1.60			1.20
	6.00	2.50	B150, B200	2.60			7.20
C200	6.00	7.20		3.00	5.00		
				4.80	A150, A200	1.40	0.00
			B150, B200		3.00	0.00	
			6.00	A150, A200	1.10	0.00	
				B150, B200	2.80	0.00	
					C200	3.00	0.00
			7.20	A150, A200	0.90	0.00	
				B150, B200	2.30	0.00	
					C200	3.00	0.00

NOTES:

Maximum opening width upper storey 6.0 m if jambs do not take wind load from a supported door or window.

Maximum opening width upper storey 3.0 m if jambs are required to take wind load from a supported door or window.

Maximum load width lower storey in a loadbearing wall 3.0 m

JAMB REINFORCEMENT 150 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
2	6.00	2.40
	3.00	2.40
	1.00	7.20
3	6.00	7.20
	3.00	7.20

JAMB REINFORCEMENT 200 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
2	6.00	6.00
	3.00	6.00
	2.00	7.20
3	6.00	7.20
	3.00	7.20

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DESIGN TABLES FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W33
ROOFING MATERIAL	SHEET
EXTERIOR WALLS	
Maximum vertical reinforcement spacing in plain walls	
Dimension 'a' up to 4.8 m	6m
Dimension 'a' 4.8 m to 7.2 m	5m
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Vertical reinforcement at all wall intersections	Yes
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Vertical reinforcement at roof girder truss locations	Yes
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Bond beams, top 2 courses each storey	Yes
2-Y12 top of top course, 2-Y12 top of next course from top, ligs R6 type "U" @ 200, refer Drawing 03-04.	
Openings - Jamb reinforcement	
Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing materal.	
Openings - Sills - reinforcement	Yes
(2-Y12 top of top course, refer Drawing 03-08)	
Openings - Lintels:	
Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing materal.	
Nailing Plate at top of wall	Type "B"
Refer Drawing 03-08	
Bracing Walls: AS 1684 Wind Classification equivalent	N2
Determine Wind Load Bracing Forces in accordance with AS 1684.2:1999 "Residential Timber Framed Construction" for each floor and each wind direction and provide bracing sets to resist these forces, as shown on Drawing 03-09.	
INTERIOR WALLS	
Maximum straight length of wall	8 m
Vertical reinforcement at all wall intersections	Yes
(1-Y12 straight bar, lap 1-Y12 staright bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	
Bond beams, top course each storey	Yes
2-Y12 top of top course, refer Drawing 03-10	
Openings - Jamb Reinforcement	
All opening widths	1-Y12
(Single bar each side of opening , no starters)	
Openings - Lintels	Type "A"
(Refer Drawing 03-07)	

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LINTELS AND JAMB REINFORCEMENT FOR DOMESTIC HOUSES TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W33
ROOFING MATERIAL	SHEET

LINTELS

UPPER STOREY		
LINTEL TYPE (REFER DRAWING 03-07)	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)
A150	4.50	7.20
	6.00	3.60
B150	5.40	7.20
	6.00	5.00
A200	4.70	7.20
	6.00	5.60
B200	5.50	7.20
	6.00	6.00
C200	6.00	7.20

LOWER STOREY			
MAXIMUM DIMENSION 's' metres (REFER DRAWING 02 02)	LINTEL TYPE	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)
1.20	A150, A200	2.60	7.20
		3.00	5.00
	3.00	B150, B200	3.00
2.40	A150, A200	1.80	7.20
		2.40	1.20
3.60	A150, A200	3.00	7.20
		1.20	7.20
	1.80	B150, B200	3.00
4.80	A150, A200	3.00	7.20
		1.40	0.00
	3.00	B150, B200	3.00
6.00	A150, A200	1.10	0.00
		2.80	0.00
	3.00	C200	3.00
7.20	A150, A200	0.90	0.00
		2.30	0.00
	3.00	B150, B200	3.00

NOTES:

Maximum opening width upper storey 6.0 m if jambs do not take wind load from a supported door or window.
Maximum opening width upper storey 3.0 m if jambs are required to take wind load from a supported door or window.
Maximum load width lower storey in a loadbearing wall 3.0 m

JAMB REINFORCEMENT 150 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)
2	1.00	7.20
3	6.00	2.40
	3.00	3.60
	1.00	7.20
4	6.00	4.80
	3.00	6.00
	2.00	7.20

JAMB REINFORCEMENT 200 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02 02)
2	6.00	2.40
	3.00	2.40
	1.00	7.20
3	6.00	3.60
	3.00	3.60
	2.00	7.20
4	6.00	6.00
	3.00	7.20

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ZEGO® Insulated Concrete Form (ICF) Construction Manual

Version 1.0

R S Hemphill Pty Ltd

ZEGO Pty Limited

DESIGN TABLES FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W41N
ROOFING MATERIAL	Tile
EXTERIOR WALLS	
Maximum vertical reinforcement spacing in plain walls	
Dimension 'a' up to 4.0 m	6m
Dimension 'a' 4.0 m to 5.4 m	5m
Dimension 'a' 5.4 m to 7.2 m	4m
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Vertical reinforcement at all wall intersections	Yes
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Vertical reinforcement at roof girder truss locations	Yes
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Bond beams, top 2 courses each storey	Yes
2-Y12 top of top course, 2-Y12 top of next course from top, ligs R6 type "U" @ 200, refer Drawing 03-04.	
Openings - Jamb reinforcement	
Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Openings - Sills - reinforcement	Yes
(2-Y12 top of top course, refer Drawing 03-08)	
Openings - Lintels:	
Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Nailing Plate at top of wall	Type "B"
Refer Drawing 03-08	
Bracing Walls: AS 1684 Wind Classification equivalent	N3
Determine Wind Load Bracing Forces in accordance with AS 1684.2:1999 "Residential Timber Framed Construction" for each floor and each wind direction and provide bracing sets to resist these forces, as shown on Drawing 03-09.	
INTERIOR WALLS	
Maximum straight length of wall	8 m
Vertical reinforcement at all wall intersections	Yes
(1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	
Bond beams, top course each storey	Yes
For 150 series walls: 2-Y12 top of top course, 2-Y12 top of next course from top, no ligs required (Refer Drawing 03-10)	
For 200 series walls: 2-Y12 top of top course only, refer Drawing 03-10	
Openings - Jamb Reinforcement	
All opening widths	
(Single bar each side of opening , no starters)	
Openings - Lintels	1-Y12
(Refer Drawing 03-07)	
	Type "A"

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LINTELS AND JAMB REINFORCEMENT FOR DOMESTIC HOUSES TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W41N
ROOFING MATERIAL	TILE

LINTELS

UPPER STOREY		
LINTEL TYPE (REFER DRAWING 03-07)	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
A150	2.50	7.20
	5.00	3.20
	6.00	1.60
B150	4.20	7.20
	6.00	2.20
A200	2.70	7.20
	5.00	3.80
	6.00	2.50
B200	4.20	7.20
	6.00	2.50
C200	6.00	7.20

LOWER STOREY			
MAXIMUM DIMENSION 's' metres (REFER DRAWING 02-02)	LINTEL TYPE	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
1.20	A150, A200	1.60	7.20
		2.40	3.80
		3.00	2.20
	B150, B200	3.00	7.20
		2.40	
2.40	A150, A200	1.30	7.20
		2.20	1.20
		3.00	7.20
3.60	A150, A200	1.00	7.20
		1.60	1.20
		2.60	7.20
	B150, B200	3.00	5.00
		C200	7.20
4.80	A150, A200	1.40	0.00
	B150, B200	3.00	0.00
6.00	A150, A200	1.10	0.00
	B150, B200	2.80	0.00
	C200	3.00	0.00
7.20	A150, A200	0.90	0.00
	B150, B200	2.30	0.00
	C200	3.00	0.00

NOTES:

Maximum opening width upper storey 6.0 m if jambs do not take wind load from a supported door or window.
Maximum opening width upper storey 3.0 m if jambs are required to take wind load from a supported door or window.
Maximum load width lower storey in a loadbearing wall 3.0 m

JAMB REINFORCEMENT 150 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
2	2.00	1.20
3	3.00	1.20
	2.00	3.60
4	6.00	3.60
	3.00	3.00
	2.00	6.00
	1.00	7.20

JAMB REINFORCEMENT 200 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
2	3.00	1.20
	2.00	3.60
	1.00	7.20
3	6.00	2.40
	3.00	2.40
	2.00	6.00
4	6.00	3.60
	3.00	4.80
	2.00	7.20

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DESIGN TABLES FOR DOMESTIC HOUSES

TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W41N
ROOFING MATERIAL	Sheet
EXTERIOR WALLS	
Maximum vertical reinforcement spacing in plain walls	
Dimension 'a' up to 2.4 m	6m
Dimension 'a' 2.4 m to 6.0 m	4m
Dimension 'a' 6.0 m to 7.2 m	3m
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Vertical reinforcement at all wall intersections	Yes
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Vertical reinforcement at roof girder truss locations	Yes
(1-Y12 type "L" starter bar, lap 1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam).	
Bond beams, top 2 courses each storey	Yes
2-Y12 top of top course, 2-Y12 top of next course from top, ligs R6 type "U" @ 200, refer Drawing 03-04.	
Openings - Jamb reinforcement	
Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Openings - Sills - reinforcement	Yes
(2-Y12 top of top course, refer Drawing 03-08)	
Openings - Lintels:	
Refer Lintel and Jamb Reinforcement Table for this wind loading and roofing material.	
Nailing Plate at top of wall	Type "C"
Refer Drawing 03-08	
Bracing Walls: AS 1684 Wind Classification equivalent	N3
Determine Wind Load Bracing Forces in accordance with AS 1684.2:1999 "Residential Timber Framed Construction" for each floor and each wind direction and provide bracing sets to resist these forces, as shown on Drawing 03-09.	
INTERIOR WALLS	
Maximum straight length of wall	8 m
Vertical reinforcement at all wall intersections	Yes
(1-Y12 straight bar, lap 1-Y12 straight bar at first floor, lap 1-Y12 "L" bar into bond beam. Floor starter bars not required)	
Bond beams, top course each storey	Yes
For 150 series walls: 2-Y12 top of top course, 2-Y12 top of next course from top, no ligs required (Refer Drawing 03-10)	
For 200 series walls: 2-Y12 top of top course only, refer Drawing 03-10	
Openings - Jamb Reinforcement	
All opening widths	1-Y12
(Single bar each side of opening , no starters)	
Openings - Lintels	Type "A"
(Refer Drawing 03-07)	

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LINTELS AND JAMB REINFORCEMENT FOR DOMESTIC HOUSES TO BCA VOLUME 2 "HOUSING PROVISIONS"

For reinforcement bar types, dimensions and laps refer Drawing 03-04.

WIND LOAD CLASSIFICATION	W41N
ROOFING MATERIAL	SHEET

LINTELS

UPPER STOREY		
LINTEL TYPE (REFER DRAWING 03-07)	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
A150	2.50	7.20
	5.00	3.60
	6.00	3.00
B150	5.40	7.20
	6.00	5.00
A200	2.60	7.20
	5.20	3.60
	6.00	3.10
B200	5.40	7.20
	6.00	5.70
C200	6.00	7.20

LOWER STOREY			
MAXIMUM DIMENSION 's' metres (REFER DRAWING 02-02)	LINTEL TYPE	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
1.20	A150, A200	2.50	7.20
	B150, B200	3.00	5.00
2.40	A150, A200	1.80	7.20
	B150, B200	2.40	1.20
3.60	A150, A200	3.00	7.20
	B150, B200	1.20	7.20
4.80	A150, A200	1.80	1.20
	B150, B200	3.00	7.20
6.00	A150, A200	1.40	0.00
	B150, B200	3.00	0.00
7.20	A150, A200	1.10	0.00
	B150, B200	2.80	0.00
	C200	3.00	0.00

NOTES:

Maximum opening width upper storey 6.0 m if jambs do not take wind load from a supported door or window.

Maximum opening width upper storey 3.0 m if jambs are required to take wind load from a supported door or window.

Maximum load width lower storey in a loadbearing wall 3.0 m

JAMB REINFORCEMENT 150 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
2	1.00	4.80
3	3.00	1.20
4	6.00	1.20
	3.00	1.20
	2.00	4.80
5	1.00	7.20
	2.00	7.20

JAMB REINFORCEMENT 200 SERIES

NUMBER OF Y-12 JAMB BARS	MAXIMUM OPENING WIDTH, metres	MAXIMUM DIMENSION 'a' metres (REFER DRAWING 02-02)
2	6.00	1.20
	3.00	1.20
	1.00	4.80
3	6.00	1.20
	3.00	1.20
	2.00	4.80
4	1.00	7.20
	6.00	2.40
5	3.00	2.40
	2.00	7.20
	2.00	7.20

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