



Seismolock **GRC**

Restrengthening System

TECHNICAL MANUAL 2017

Seismolock is the new solution for retrofit earthquake strengthening to brick, block and concrete structures.

The SEISMOLOCK® strengthening system consists of glass-fibre reinforcing in plaster. It is based upon the preparation and application of its component parts in accordance with the Manufacturers Manual. The Manual has been prepared in accordance with recognised practice and to comply with the standards referred to in the Manual. The Manufacturer accepts no liability for the system unless it has been used in accordance with the Manufacturers Manual and specifications. The suitability of the system or any particular application is a matter of choice by the specifying authority or person. The Manufacturer assumes no liability for consequential damages. All claims will be considered and determined in accord with the laws of New Zealand.

The Manufacturer is undertaking continuing product research and systems development. Please ensure that you have the latest Technical information.

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1.0 INTRODUCTION TO THE SEISMOLOCK® STRENGTHENING SYSTEM

Many older brick and masonry buildings now must be structurally upgraded or face an early retirement at the hands of the demolition contractors. Other buildings, such as those damaged by earthquakes need to be strengthened as part of their reinstatement to safe habitable buildings.

The SEISMOLOCK® Strengthening System offers a simple and economical alternative to traditional strengthening methods.

The SEISMOLOCK® System utilises a proprietary polypropylene fibre reinforced plaster, a specially formulated acrylic resin and a high-tensile strength fibreglass mesh to provide a thin coat plaster that will strengthen existing brick and masonry walls to resist earthquake loads.

The SEISMOLOCK® Plaster is formulated to provide a strong bond to the surface of a masonry wall while the embedded layers of fibreglass mesh provide the tensile strength to resist in-plane shear loads and face loads on brick and masonry walls.

The Liquid SEISMOLOCK® Resin is added to the plaster mix on-site to aid bond strength and the curing process.

The SEISMOLOCK® Fibreglass Mesh is specific to the SEISMOLOCK® System and no substitute mesh type should be considered. The mesh is applied to the plaster in one or more layers so that a finished SEISMOLOCK® thickness of 8, 11, 14, 17, or 20mm corresponds to 1, 2, 3, 4, or 5 layers of fibreglass mesh, respectively.

The Plaster Mix can be applied by trowel, hopper gun, or plaster pump. The mesh is laid against the wet plaster and embedded into the surfaces by trowel. The on-site mixing and application of the SEISMOLOCK® System must be carried out in accordance with the instructions and to the specifications as detailed in this design manual.

All the components of the SEISMOLOCK® System must comply with the manufacturer's specifications and be supplied by the manufacturer or an authorised distributor.

The detailed engineering analysis set out in this Design Manual will show you how you can design and use the SEISMOLOCK® Strengthening System for single or double skin constructions with the application of the system to one or both sides of a wall. The SEISMOLOCK® System will enhance the ability of masonry or brick construction to resist shear or face loads. Designers should ensure that the applicators comply with the manual and no product substitutions are allowed.

This manual is based on the SEISMOLOCK® Manual developed by Smith and Henry Consulting Engineers, and updated by KRTA Limited in 1991. Updates to current codes and procedures were carried out in 2011. SEISMOLOCK® Strengthening Systems Ltd is able to offer Design and Technical services for the SEISMOLOCK® Strengthening System through Resene Construction Limited. Designers who wish to make use of this service should contact SEISMOLOCK® Strengthening Systems Ltd. Alternatively, you may engage Resene Construction Limited on a normal consulting basis.

1.0 INTRODUCTION TO THE SEISMOLOCK® STRENGTHENING SYSTEM

This manual is intended to be used by people with a thorough understanding of structural principles and a good knowledge of the applicable loading codes. It is likely that the Territorial Authority will require a Design Producer Statement (PS1) from a Chartered Professional Engineer as part of any building consent application.

The Australia/New Zealand Loading Standard AS/NZS 1170 “Structural Design Actions” and specifically Part 5 “Earthquake Actions - New Zealand” have been used in the preparation of this manual.

The SEISMOLOCK® System has been carefully researched by engineers experienced in strengthening masonry buildings against earthquake loads. In preparing this Design Manual, we have presented the information in easy-to-use sections, but with sound technical background information to allow the Designer to extend the system into more innovative applications.

Contact our toll-free phone service at NZ 0800 114 400 or email help@reseneconstruction.co.nz for any additional information or technical assistance you may need.

2.0 DESIGN PHILOSOPHY

2.1 Ductility

The concept of ductility is a key principle in seismic-resistant design. In general terms, ductility is the ability to a structural member to continue to resist loads even after initial failure (or yield) and thus avoid collapse. Energy is dissipated as the material yields; a well-designed ductile structure dissipates energy in specific selected locations. In contrast, a structure likely to fail in a brittle manner has no opportunity to dissipate energy. Ductile structures provide greatly improved resistance to collapse and safety. Modern codes allow ductile structures to be designed to lower forces than non-ductile structures.

The ductility of a structure or system is given a rating known as the Ductility Factor (μ) which varies from 6.0 or more for a well detailed steel frame to 1.0 for a brittle structure which will have no remaining capacity to resist seismic loads once its yield capacity is reached.

Unreinforced masonry on its own is inherently brittle, making it especially vulnerable to earthquakes.

Securing and strengthening masonry such that displacements occurring in response to an earthquake are within tolerable levels (i.e. only minor cracking and damage) requires a limited ductile or nominally ductile approach, with earthquake design coefficients selected accordingly.

Table 2.1 shows ductility factors for SEISMOLOCK® systems for various forms of structure. The values for the SEISMOLOCK® system are based on the characteristics of the glass fibre reinforcement which, while having reasonable elasticity, has a very high yield stress, and thus is able to remain in the elastic range with only moderate displacements for high earthquake loads, and thus remains compatible with the masonry substrate.

Action	Wall Type	SEISMOLOCK®	Ductility Factor μ	
In-Plane Loads (Shear Wall)	All	Single face or both faces	1.5	Nominally Ductile
Face Loads	Solid	Both faces	2.0	Limited Ductile
		One face	1.25	Nominally Ductile
	Cavity	Both faces	1.5	Nominally Ductile
		One face	1.0	Elastic

Table 2.1: Ductility Factors for SEISMOLOCK® Systems on Unreinforced Masonry Walls

Different countries have different methods of formulating seismic design coefficients. Refer to the design codes for the specific country for the design coefficients.

2.0 DESIGN PHILOSOPHY

2.2 Structural Actions

Unreinforced masonry walls/partitions require strengthening to resist both face loading (loads normal to the plane of the wall) and in-plane shear (ie shear wall action). The SEISMOLOCK® strengthening system is suitable for both these loading considerations and this design guide presents easy step-by-step calculation processes.

2.3 Face Loading

2.3.1 Solid Walls, Double-Sided application

Under face loading, the SEISMOLOCK® strengthened walls usually span vertically between two horizontal diaphragms, though they can also be designed to span horizontally between two return walls, or as cantilevers. It's greatly preferred to install SEISMOLOCK® on both sides of the wall being strengthened, though not necessarily for the entire length of the wall. Intermittent strengthening along a wall can support the unstrengthened intermediate panels.

2.3.2 Cavity Walls

Cavity walls may also be strengthened for face loading, subject to application of SEISMOLOCK® to both faces of the wall. Prior to application of SEISMOLOCK®, new cavity ties will be required in the form of 10mm dowels epoxied into both skins at the appropriate spacing. Alternatively, suitable proprietary ties can be used.

The basis of strengthening cavity walls for face loading is that, at any one point in time, for one strengthened skin of brickwork, the SEISMOLOCK® layer will be in tension and the brick will be in compression, regardless of the direction of shaking during an earthquake. The other skin of brickwork will be ineffective to resist earthquake loads, and the SEISMOLOCK® layer on this skin will act only as an overall membrane to hold the brickwork intact. When the direction of shaking reverses, the respective roles of the two strengthened brick skins also reverse.

Calculations are therefore based on the strengthened capacity of each skin separately with only one skin acting at a time, and not on the overall thickness of the combined wall.

Comment: These calculations comprise a conservative assumption. The capacity of the cavity wall to resist face loads is likely to be significantly higher than as described above if significant shear transfer between skins can occur.

2.3.3 Single-Sided Application

Under some circumstances, application of SEISMOLOCK® to one side only of a solid masonry wall can be effective in strengthening a wall for face loading, though this is never as efficient as double-sided application.

2.0 DESIGN PHILOSOPHY

The preferred condition for effective single-sided application is that the SEISMOLOCK[®] layer is continuous past either both upper and lower horizontal supporting diaphragms, or spaced across the return walls in a manner such that the span of the SEISMOLOCK[®] sections can be considered continuous. Alternatively, if the horizontal diaphragms are constructed of reinforced concrete, the SEISMOLOCK[®] may be bonded in with the reinforcing steel to achieve fixity to the diaphragm. Figure 4.3 illustrates the effective structural actions.

Single-sided application is very limited in situations where continuity past the horizontal diaphragms or return walls, or fixity to concrete floor diaphragms, can not be achieved. In this situation, most of the moment capacity of the wall section is inherent in the masonry itself due to dead load compression. The principal feature of the SEISMOLOCK[®] layer is thus to prevent sliding shear failure, in order to ensure that the wall remains intact and the full effectiveness of the dead load compression can be mobilised.

2.4 In-Plane Loads

2.4.1 Shear Wall Action

A SEISMOLOCK[®]-strengthened wall has significant and useful ability to act as a primary shear wall to stabilise the building as a whole.

First, the design actions for each wall must be assessed by normal structural analysis methods, based on the relative stiffness of the various shear walls, to find the design shears, overturning moments, and restoring moments for the wall.

Restoring moments determined by using 90% of the dead load at the appropriate lever arm as required for stability are recommended and have been used in this manual. AS/NZS 1170.0:2002 allows full dead load and a proportion of the live load to be used when designing for strength. It is recommended this only be used where designers are confident that the loadings are accurate and will be present. Axial load is relevant only in as far as it contributes to restoring moments.

This design guide requires the user to select a SEISMOLOCK[®] system that will achieve the necessary shear capacity for the wall, and then check the chosen system for in-plane bending actions. If the in-plane bending requirements are not met, the user has the option of selecting a stronger SEISMOLOCK[®] system or meeting the moment demand by adding steel reinforcing bars at the extreme ends of each wall panel.

2.4.2 SEISMOLOCK[®] Membrane Action

Analysis of a SEISMOLOCK[®] section for in-plane (shear wall) actions differs from normal reinforced concrete methods. The thinness of the SEISMOLOCK[®] layer requires analysis by membrane theory, examining principal stresses at critical sections of the layer. This complex analysis has been carried out in advance by the developers of SEISMOLOCK[®], such that users need refer only to several easy-to-use charts for selection of the appropriate system.

2.0 DESIGN PHILOSOPHY

2.4.3 Combination of SEISMOLOCK® and Reinforcing Steel

The in-plane moments generated by shear wall action may be resisted by the actions of the SEISMOLOCK® alone if the required system is consistent with that required for shear, or they can be resisted by a combination of reinforcing steel and SEISMOLOCK®.

The fibreglass mesh used in SEISMOLOCK® has a Modulus of Elasticity (Young's Modulus) (EP) approximately 15% (Weft) and 7.5% (Warp) of that of steel, but has a yield point approximately 2.2 times that of high yield (grade 500) reinforcing steel. Reinforcing steel, however, has a high post-yield ductility.

Note: Warp - longitudinal fibres
Weft - transverse fibres

If reinforcing steel is added to the SEISMOLOCK® shear wall to enhance the moment capacity, the steel will yield well before the SEISMOLOCK® fibreglass reaches its limit. The design charts assume that the wall is strained to the limit of the SEISMOLOCK®, hence extending the steel well past its first yield strain. As the loading is cyclic, the steel will also be subjected to reversal of these strains, and normal confinement requirements must be provided to prevent premature bar buckling. The relative economics of providing adequately confined reinforcing steel or a heavier grade of SEISMOLOCK® is a matter for the designer to assess.

2.5 Axial Loads

2.5.1 General

Axial loads do not play a major role in the SEISMOLOCK® system design except in the case of face loading on a single-sided application.

2.5.2 Face Loaded Cases

For double-sided applications, the effect of axial loads on the wall is ignored. The benefits obtained from consideration of dead load compression of the brickwork are insignificant in comparison with the strength gained from the SEISMOLOCK®. Additionally, with slender walls, even quite marginal deflections may cause significant loss of the lever arm of the dead load compression, such that the perceived benefit is not achieved.

For single-sided applications, particularly for simple spans, axial load has a very significant beneficial effect and the use of 0.9G is recommended (i.e. 90% of calculated dead load).

2.0 DESIGN PHILOSOPHY

2.5.3 In-Plane Loaded Cases (Shear Walls)

Dead load contribution should be taken into account when assessing restoring moments and shear walls, such that:

$$(\text{Design Moment}) = (\text{Seismic Moment}) - (\text{Restoring Moment})$$

It is recommended that only 90% of the dead load be used when calculating restoring moments.

As with face loading, the influence of vertical loading on stresses within the effective section is negligible and may be ignored.

2.6 Material Factors

The SEISMOLOCK® Strengthening System is a form of Glass Reinforced Cement (GRC). The mesh is manufactured with a special alkali-resistant fibreglass which has an additional protective coating. This is to limit the effects of embrittlement which can occur in 'standard' GRC in a moist environment. The alkali-resistant mesh means that SEISMOLOCK® retains its initial mechanical properties in the long term. In formulating the design charts the reliable strength of the fibreglass has been limited to 75% of the first yield; this keeps the fibreglass well below the brittle failure threshold.

For external use, or where dampness is transmitted through the brickwork, the SEISMOLOCK® strengthening system should be coated with a finishing plaster and then painted, to reduce the chances of any long-term loss of strength. Plaster systems Multiplast or Finarlie finishing plasters are ideal as finishing coats, and should be painted with two coats of 100% acrylic paint.

SEISMOLOCK® should not be used below the building's DPC (damp-proof course) or within any region suspected to have rising dampness, or other moisture sources in the brickwork if there is no DPC. For foundation connections, steel reinforcing should be used, which itself should be protected from rusting by galvanising, epoxy coating, use of stainless steel, or by adequate inside and outside cover mortar (concrete).

Recent research published in New Zealand concludes that the quality and integrity of existing clay brick masonry work is extremely variable, with a wide range of mechanical properties measured.

Where site-specific data is not available, we suggest the following properties can be used in preliminary design.

- Mass of brick masonry: typical value 18 kN/m³. Range: 14 – 22 kN/m³
- Compressive strength of brick masonry: 4.0 MPa.
- Modulus of elasticity: typical value 2.0 GPa. Range: 0.4 – 4.0 GPa. (NB modern concrete masonry E = 15 GPa.) It must be remembered that using a lower value for E is not necessarily conservative in the design of SEISMOLOCK® to resist face loads.

We emphasise these values are for preliminary design only. We recommend site testing prior to final design.

Where a section of brick masonry has lost its integrity, this should be restored before applying the SEISMOLOCK®.

2.0 DESIGN PHILOSOPHY

2.7 Strength Reduction Factor

The strength reduction factor, ϕ , is a measure of the reliability of a material's strength, workmanship, and similar properties. In the Design Manual, the use of $\phi = 0.85$ for flexure and $\phi = 0.75$ for shear have been adopted from NZS 4230:2004 and are used in situations where the SEISMOLOCK® controls the ultimate loads.

However, in some cases, the brickwork controls the eventual failure, usually by crushing. In these cases the variability of the brickwork is important, and may be beyond the control of the designer; hence $\phi = 0.65$ has been adopted for these situations. The designer should ensure that the strength reduction factor selected is appropriate for the design.

2.8 Fibreglass Mesh Direction Factor

Walls will most often span vertically under face loading, in which case the most effective orientation of the fibreglass mesh is with the straight weft strands aligned vertically.

Flexural strength of the shear walls is also greatest with a vertical weft direction.

There may be instances, however, where it is effective for walls to span horizontally between piers or return walls. Such walls may also be required to resist in-plane shear loads.

A factor, β , is therefore introduced to account for the anisotropic properties of the fibreglass mesh. Refer to Table 2.2 below.

In all cases the design moment M_I is divided by β . ie $M_I = M_U / (\phi * \beta)$

Face Loading Span Direction	Fibreglass Weft Direction	Factor for Flexural Design Under:	
		Face Loading	Shear Wall Action
Vertical	Vertical	1.0	1.0
Horizontal	Vertical	0.8	1.0
Horizontal	Horizontal	1.0	0.8

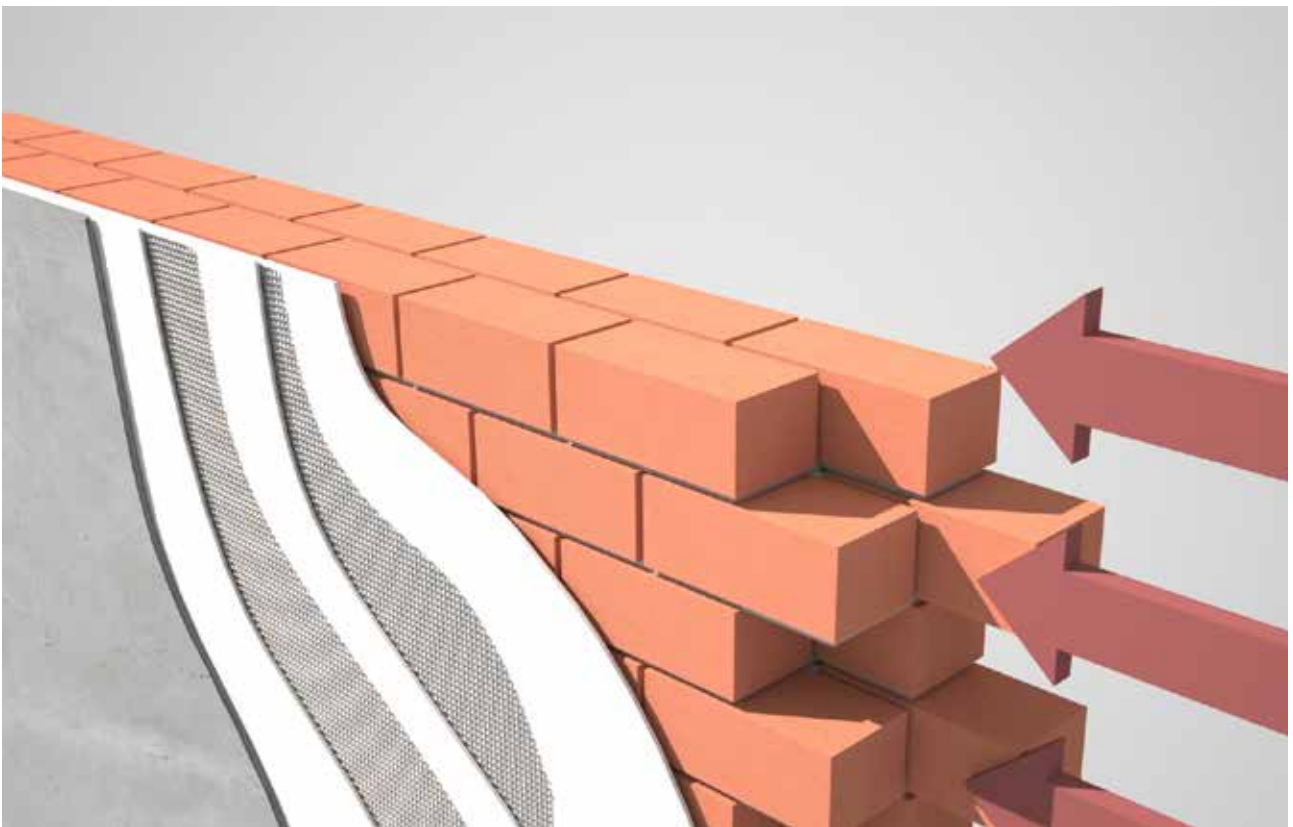
Table 2.2: Fibreglass Mesh Direction Factor,

3.0 GLOSSARY OF SYMBOLS

Symbol	Meaning
*	Multiplication sign
Asprov	Reinforcing area provided
Asreq	Reinforcing area required
Cp	Horizontal design action coefficient (from NZS1170.5 clause 5.2 or Fph/Wp from clause 8.5 for parts)
d	Reinforcing steel lever arm
DB	Brickwork density [kN/m ³]
Em	Modulus of elasticity for brick masonry (Young's Modulus) kN/m ² (kPa)
Ep	Modulus of elasticity for SEISMOLOCK [®] (Young's Modulus)
Fd	Design axial stress on wall
fm	Ultimate strength of masonry
fy	Reinforcing steel yield stress
G	Dead load
GT	Reliable dead load at top of wall
H	Height between lateral supports
L	Length of wall panel
Ls	Length of SEISMOLOCK [®] strengthened section of wall
Lu	Length of unstrengthened section of wall
M1, M2, M3	Moment capacities at different sections of wall
Mc	Characteristic moment (equivalent simply supported moment)
Mi	Ideal moment capacity
Mi(SEISMOLOCK [®])	Mi for SEISMOLOCK [®] system alone
Mis	Mi for reinforcing steel alone
Mmp	Moment capacity of masonry and SEISMOLOCK [®]
Mp	Moment capacity of SEISMOLOCK [®]
Mu	Ultimate design moment, ϕ Mi
Muot	Overturning moment
Mur	Restoring moment (based on 0.9G)
Sw	Self-weight of part wall height
Tb	Total thickness of brick = tb1 + tb2
tb1, tb2	Thickness of individual brick skins of cavity construction
tm	Total masonry thickness
Vi	Ideal shear capacity
Vu	Ultimate design shear
w	unit weight of wall
wc	Unit lateral load derived from characteristic moment
wi	Ideal unit lateral load
β	Mesh direction factor
μ	Ductility factor
ϕ	Strength reduction factor

SHEAR WALL ACTION

4.1



4.1 SHEAR WALL ACTION

Refer also to Section 2 for Design Philosophy and Section 5 for guidance on load determination.

4.1 Shear Wall Action (Proforma 1)

1. Select a trial length of SEISMOLOCK® application, L
2. Identify brick wall thickness, t_m .
3. Determine design shear V_u by normal structural analysis methods.
4. Determine V_i where:
 - $V_i = V_u / \phi$
 - ϕ = Strength Reduction Factor
 - = 0.75 for shear
5. Calculate shear per unit length V_i/L .
6. Determine design overturning moment M_{uot} by normal structural analysis.
7. Determine righting moment M_{ur} utilising 0.9G only.
8. Calculate design moment $M_u - M_{uot} - M_{ur}$.
9. Calculate ideal moment $M_i = M_u / (\phi * \beta)$
where $\phi = 0.85$ for flexure
 β = fibreglass mesh direction factor (refer Table 2.2)
10. Determine moment/shear interaction coefficient $M_i / (V_i * L)$
11. Enter Chart 1A with V_i/L and $M_i / (V_i * L)$ as ordinates to determine the SEISMOLOCK® system required to resist shear loads.

Note: Although one ordinate contains the term M_i , this chart does not verify that the system is structurally sufficient for moment actions. The presence of M_i in this ordinate is to account for the influence that moment has on shear-carrying capacity as a consequence of membrane principal stresses.
12. Determine the modulus of elasticity for the original brickwork. E_m is ideally determined by test. Figure 4.1 gives some existing test results. Also see section 2.6 above.
13. Determine the value $t_m * E_m$, where:
 t_m = thickness of the original masonry wall before application of SEISMOLOCK®
14. Calculate M_i / L^2 , where:
 $M_i = M_u / (\phi * \beta)$ where $\phi = 0.85$ for flexure, β from Table 2.2.
15. Use Chart 1B with $t_m * E_m$ and M_i / L^2 as ordinates to determine the required SEISMOLOCK® system to resist moment action in the absence of any vertical reinforcing steel in the tension zones.
16. Select the SEISMOLOCK® system to be used. If the system selected by step 15 matches that determined by step 11, then this is the required SEISMOLOCK® system and additional reinforcement is unnecessary.

4.1 SHEAR WALL ACTION

If the system selected by Step 15 is less than the system selected by step 11, then the step 11 system must be used.

If the system selected by step 15 is greater than the system selected by step 11, then the designer may choose to use the heavier system (step 15) or alternatively may use the system from step 11 with the addition of reinforcing steel for the difference between M_i (total) and M_i (SEISMOLOCK®) as determined by Chart 1B, using steps 17 to 24 (refer also Section 2).

Alternatively the designer may adjust L to seek a balanced SEISMOLOCK® system by repeating steps 1 to 16.

If the selected SEISMOLOCK® system is insufficient to resist flexure, determine flexural steel by steps 17 to 24.

17. Determine $M_i(\text{SEISMOLOCK}^\circ)/L_2$ for chosen SEISMOLOCK® system from Chart 1B and ordinate $t_m \cdot E_m$.
18. Calculate $M_i(\text{SEISMOLOCK}^\circ) = (M_i(\text{SEISMOLOCK}^\circ)/L_2) \cdot L_2$.
19. Determine excess moment demand to be provided by reinforcing steel $M_{is} = M_i$ from step 9 and $M_i(\text{SEISMOLOCK}^\circ)$ from step 18.
20. Choose reinforcing steel yield stress, f_y .
21. Identify reinforcing steel lever arm, d .
22. Calculate steel area at each end of wall, $A_s = M_{is}/(f_y \cdot d)$.
23. Choose steel reinforcing bar size and number to be provided.
24. Calculate area of reinforcing bars provided.

Note:

- Excess moment demand M_{is} is provided for by the steel couple only without allowance for compression in the masonry or SEISMOLOCK®.
- Confinement steel must be provided to prevent buckling of bars in the compression zone.
- Bars shall be deformed.
- Mild steel or high tensile steel may be used. i.e. Grade 30DE or 500E.
- Transfer of loads from the SEISMOLOCK® strengthened brick wall to the reinforcing, and from the reinforcing to the structure and foundations below need to be designed and detailed.

4.1 SHEAR WALL ACTION

SEISMOLOCK[®] Design Proforma 1 In-Plane Loads (Shear Wall Action)

Project

Project:

No:

Wall Identification:

Storey Reference:

Page No:

Date:

- | | | | |
|-----|--|--|---|
| 1. | Chosen Length | $L =$ _____ | m |
| 2. | Brick Thickness | $t_m =$ _____ | m |
| 3. | Design Shear | $V_u =$ _____ | kN |
| 4. | Ideal Shear | $V_i = V_u/\phi =$ _____ | kN/m |
| | where $\phi = 0.75$ | | |
| 5. | Shear Coefficient | $V_i/L =$ _____ | kN/m |
| 6. | Overturning Moment | $M_{uot} =$ _____ | kNm |
| 7. | Righting Moment | $M_{ur} =$ _____ | kNm |
| 8. | Design Moment | $M_u =$ _____ | kNm |
| 9. | Ideal Moment | $M_i = M_u/(\phi * \beta) =$ _____ | kNm |
| | where $\phi = 0.8$ | | |
| | $\beta =$ Table 2.2 | | |
| 10. | Moment Coefficient | $M_i/(V_i * L) =$ _____ | m |
| 11. | SEISMOLOCK [®] System for Shear | <input type="text" value="mm"/> <input type="text" value="sides"/> | From Design Chart 1A |
| 12. | Modulus of Elasticity for Brick Masonry | $E_m =$ _____ | kN/m ² |
| 13. | Stiffness Coefficient t_m^* | $E_m =$ _____ | kN/m |
| 14. | Moment Coefficient | $M_i/L^2 =$ _____ | kNm/m ² |
| 15. | SEISMOLOCK [®] System for Flexure | <input type="text" value="mm"/> <input type="text" value="sides"/> | From Design Chart 1B |
| 16. | Selected SEISMOLOCK [®] System | <input type="text" value="mm"/> <input type="text" value="sides"/> | Shall not be less than value from step 11 |

Calculate reinforcing steel if selected SEISMOLOCK[®] system is insufficient to resist flexure.

- | | | |
|-----|---|---|
| 17. | SEISMOLOCK [®] Flexural Ordinate $M_i(\text{SEISMOLOCK}^{\text{®}})/L^2 =$ _____ | kNm/m ² |
| | | From Chart 1B for chosen SEISMOLOCK [®] system |
| 18. | SEISMOLOCK [®] Moment Capacity $M_i(\text{SEISMOLOCK}^{\text{®}}) =$ _____ | kNm |
| 19. | Excess Moment Demand Excess $M_{is} =$ _____ | kNm (Design M_i) -
(M_i for Chosen SEISMOLOCK [®] System) |
| 20. | Steel Yield Stress $f_y =$ _____ | MPa |

4.1 SHEAR WALL ACTION

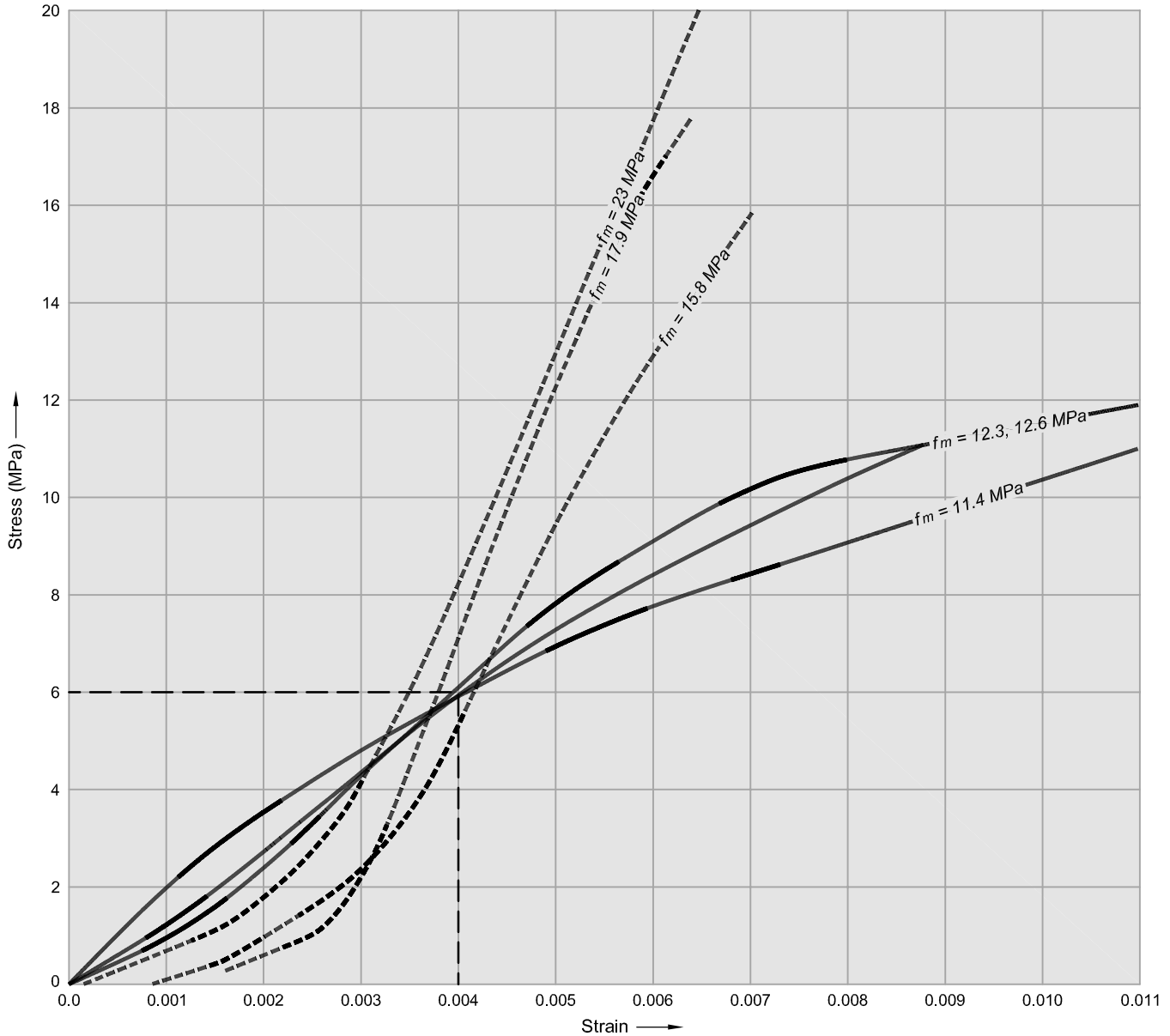
21. Steel Group Lever Arm $d = \text{_____} \text{ m}$
22. Steel Area Per Group Required $A_{Sreq} = \text{_____} \text{ mm}^2 \text{ Mis}/(f_y * d)$
23. Reinforcing Provided

No.	Dia
-----	-----
24. Reinforcing Area Provided $A_{Sprov} = \text{_____} \text{ mm}^2 \text{ Mis}/(f_y + d)$

Note: Reinforcing steel must be fully confined. Refer applicable Concrete Design Code.

4.1 SHEAR WALL ACTION

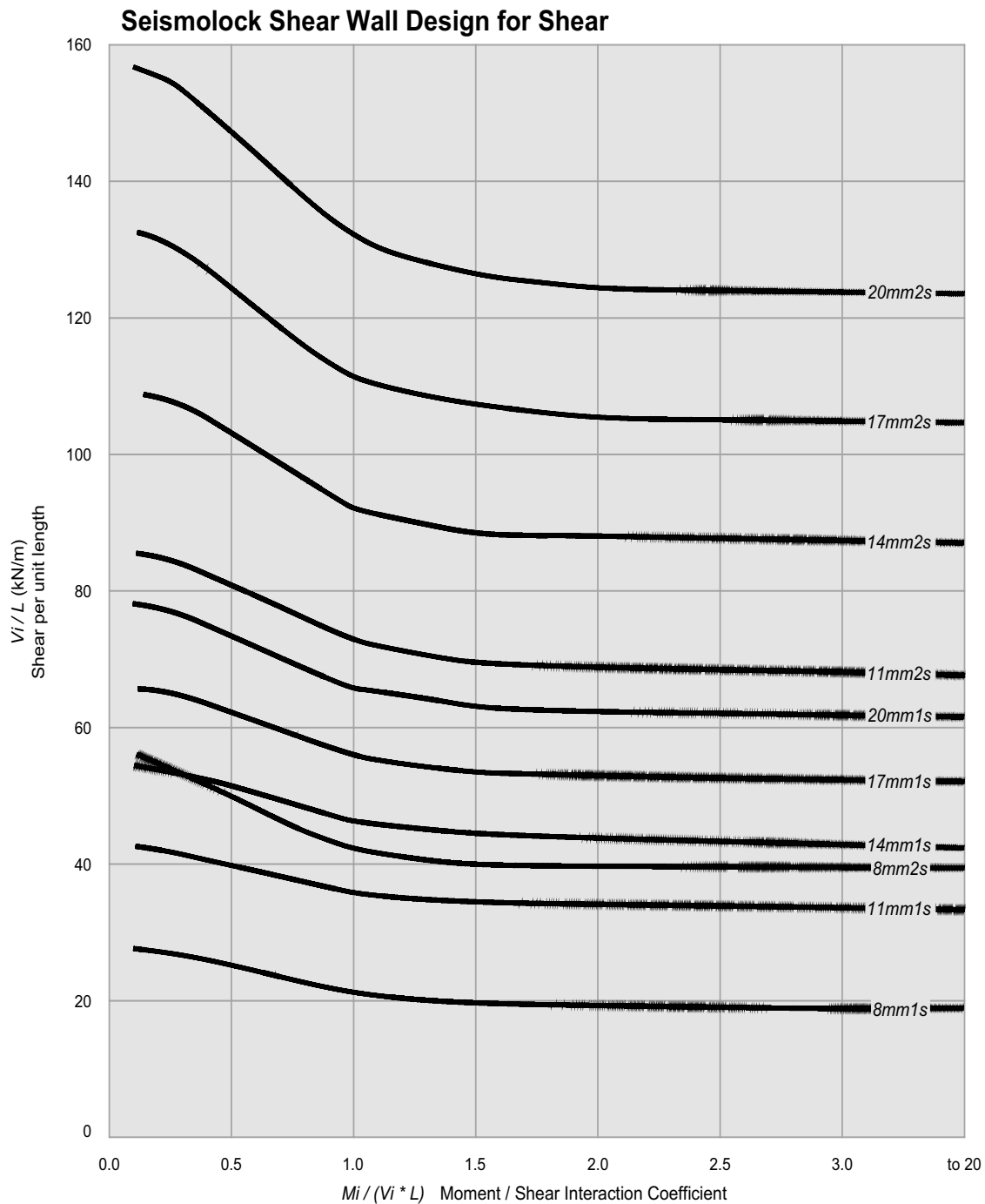
Actual Stress/Strain Curves for Brickwork (From tests on two N.Z. Buildings)



Example calculation for modulus of elasticity:

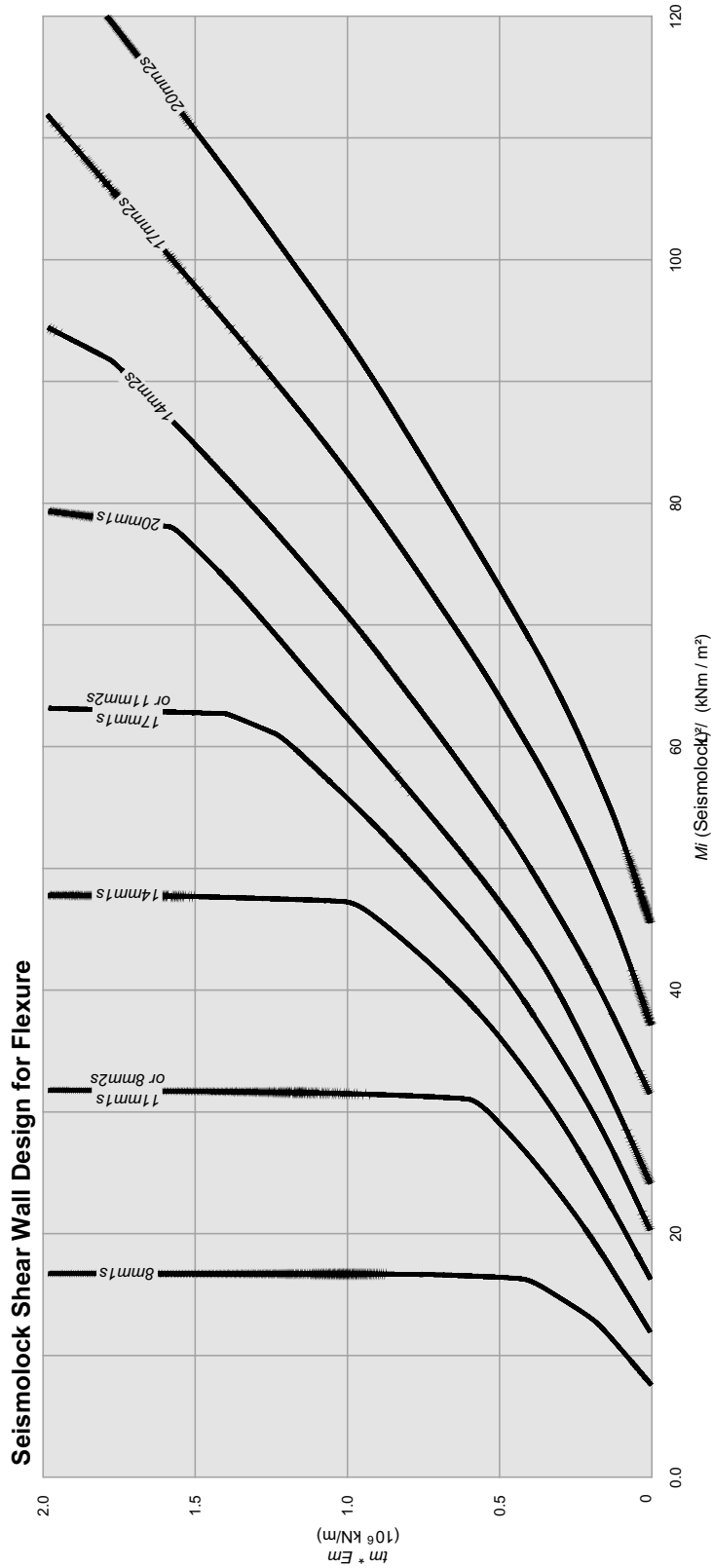
$$E_m = \frac{\text{Stress}}{\text{Strain}} = \frac{6.0\text{MPa}}{0.004} = 1500\text{MPa} = 1.5 \times 10^6 \text{ kPa (kN/m}^2\text{)}$$

4.1 SHEAR WALL ACTION



NOTE: 14mm1s = 14mm Seismolock thickness one side of wall.
14mm2s = 14mm Seismolock thickness two sides of wall.

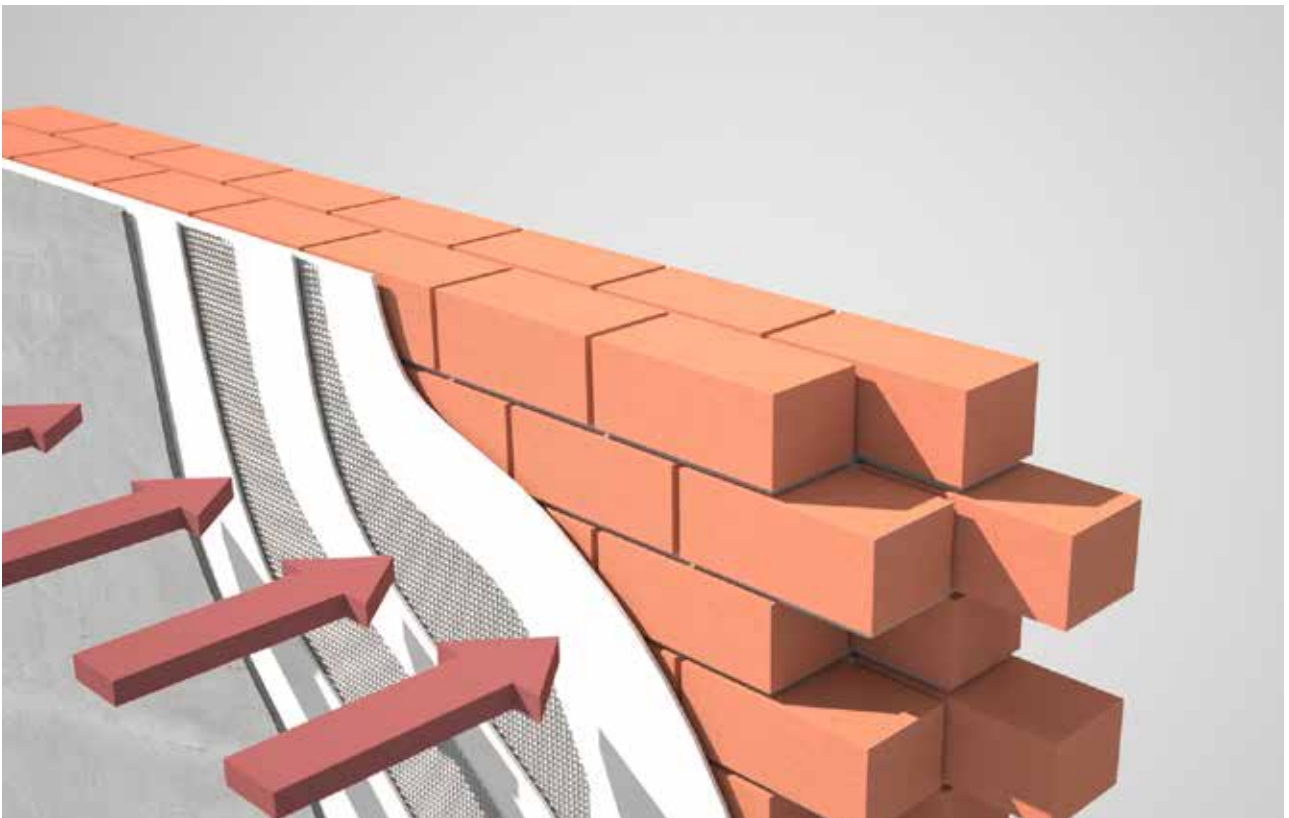
4.1 SHEAR WALL ACTION



NOTE: 14mm1s = 14mm Seismolock thickness one side of wall.
14mm2s = 14mm Seismolock thickness two sides of wall.

FACE LOADED SOLID WALL

4.2



4.2 FACE LOADED SOLID WALL

4.2 Face Loading, Solid Wall - SEISMOLOCK® Both Sides (Proforma 2)

The proforma assumes the wall spans top to bottom between elements which provide the necessary lateral restraint.

1. Identify panel height, H.
2. Identify panel width, L.
3. Decide whether SEISMOLOCK® is to be applied to whole of the wall or in intermittent panels, based on architectural or other non-structural considerations. Nominate the length of the panel to be strengthened, Ls. If applied to whole of wall Ls = L and Lu = 0.
4. Calculate the unstrengthened panel length Lu = L - Ls. The designer must prove the unstrengthened wall has the capacity to span the length Lu between the SEISMOLOCK® strengthened sections. Typically a length to thickness ratio of 8 or less will have sufficient strength. For ratios above 8 strengths should be calculated.
5. Identify brick wall thickness, tm.
6. Determine brickwork density, DB.
7. Calculate unit weight of brickwork, w.
8. Determine the earthquake lateral force coefficient, Cp. This is normally calculated from NZS 1170.5 Section 8.
9. Calculate the horizontal loading on the panel, wh. Use the total panel length to allow for contributing loads from both the strengthened and unstrengthened sections.
10. Calculate the maximum face loading bending moment per metre of strengthened panel.
11. Calculate the ideal bending moment incorporating the fibreglass mesh direction factor from Table 2.2.
12. Use Chart 2A with ordinates tm and Mi to determine the required SEISMOLOCK® system to provide the required moment capacity.
13. Calculate the maximum face loading shear force per metre of the strengthened panel.
14. Calculate the ideal shear force.
15. Use Chart 2B to identify the required SEISMOLOCK® system to provide the required shear capacity.
16. Select the SEISMOLOCK® system to be used. This will be the larger of the SEISMOLOCK® systems identified in steps 12 and 15.

4.2 FACE LOADED SOLID WALL

SEISMOLOCK® Design Proforma 2 Face Loaded Solid Wall, SEISMOLOCK® Both Sides

Project:

Wall Identification:

Storey Reference:

Project No:

Page No:

Date:

1.	Panel Height	H = _____ m
2.	Total Panel Length	L = _____ m
3.	Length of Strengthened Panel	Ls = _____ m
4.	Length of Unstrengthened Panel	Lu = _____ m
6.	Brickwork Density	DB = _____ kN/m ³
7.	Unit Weight of Wall	w = _____ kN/m ² DB*tm
8.	Horizontal Design Coefficient (EQ)	Cp = _____ From NZS 1170.5 Refer Glossary Pg9
9.	Horizontal Loading on Panel	wh = _____ kN/m Cp*w*L
10.	Maximum Face Loading Bending Moment	Mu = _____ kNm/m wh*H ² /(8*Ls)
11.	Ideal Bending Moment	Mi = _____ kNm/m Muφ*β) where φ = 0.85 β = Table 2.2
12.	SEISMOLOCK® System for Flexure	= <input type="text" value=""/> mm Chart 2A
13.	Maximum Face Loading Shear Force	Vu = _____ kN/m wh*H/(2*Ls)
14.	Ideal Shear Force	Vi = _____ kN/m Vuφ where φ = 0.75
15.	SEISMOLOCK® System for Shear	= <input type="text" value=""/> mm Chart 2B
16.	Selected SEISMOLOCK® System	= <input type="text" value=""/> mm Larger of 12 and 15

4.2 FACE LOADED SOLID WALL

Chart 2A: Face loaded Solid Wall SEISMOLOCK® Both Faces - Moment Capacity

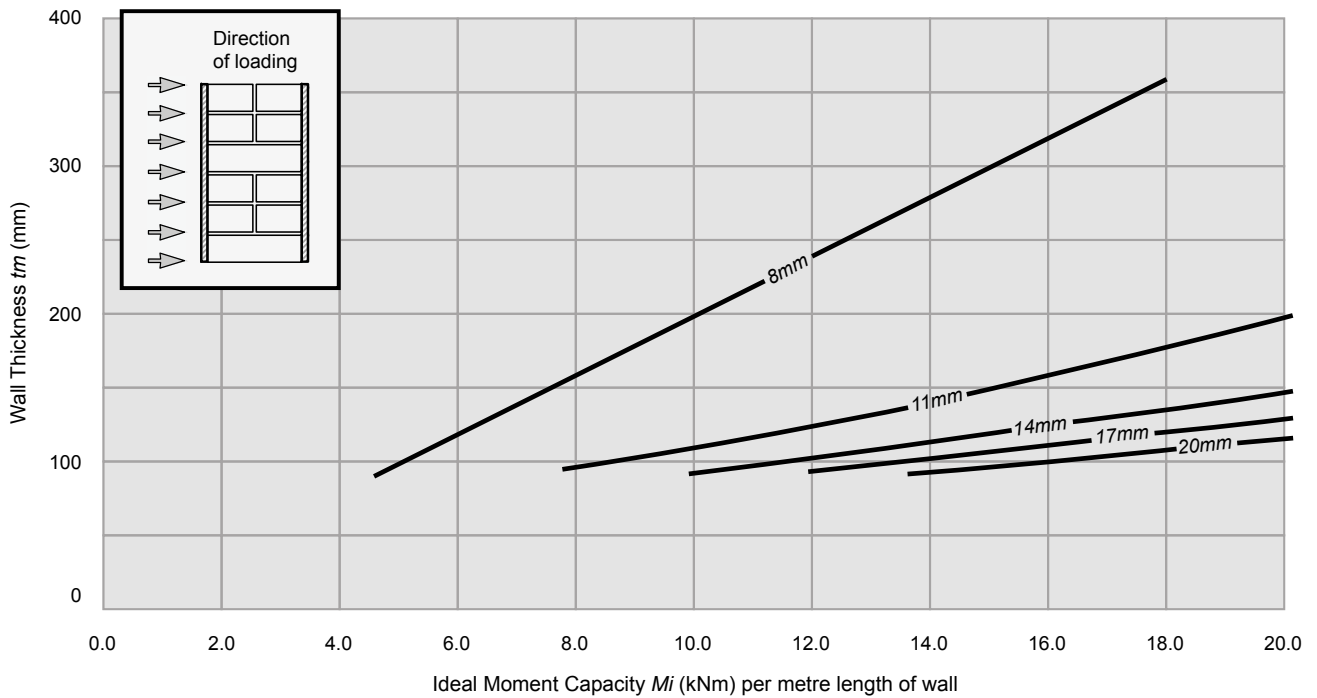
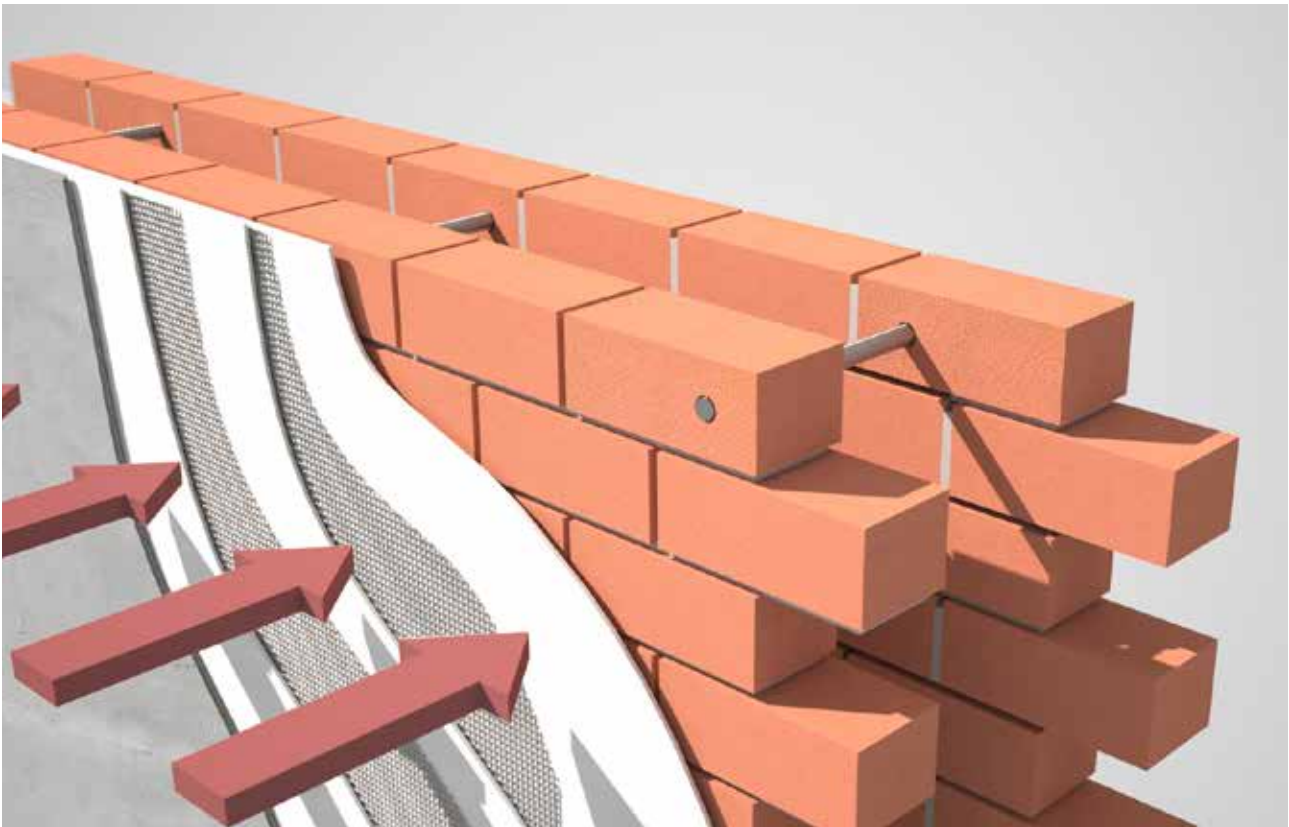


Chart 2B: Face loaded Solid Wall SEISMOLOCK® Both Faces - Shear Capacity

Ideal Shear Capacity V_i (kN) per metre length of wall					
Thickness of Existing Brick (mm)	Seismolock Thickness (each side wall)				
	8mm	11mm	14mm	17mm	20mm
All	31.0	51.4	71.8	92.2	112.7

FACE LOADED CAVITY WALL 4.3



4.3 FACE LOADED CAVITY WALL

4.3 Face Loading Cavity Wall - SEISMOLOCK® Both Sides (Proforma 3)

This proforma assumes the wall spans top to bottom between elements which provide the necessary lateral restraint and that the full length of the panel is SEISMOLOCK® strengthened.

1. Identify panel height between lateral supports.
2. Identify thickness of outer brick skin.
3. Identify thickness of inner brick skin.
4. Calculate combined thickness of both skins excluding cavity.
5. Determine brickwork density.
6. Calculate unit weight of brick wall.
7. Determine the earthquake lateral force coefficient. This is normally calculated from NZS 1170.5 Section 8.
8. Calculate the horizontal loading per square metre of wall for the combined load from both skins.
9. Calculate the maximum face loading bending moment per metre length of wall.
10. Calculate the ideal bending moment incorporating the fibreglass mesh direction factor from Table 2.2.
11. Determine the ultimate strength of the masonry from test data.
12. Determine the modulus of elasticity of the masonry from test data.
13. From f_m and E_m determine which Chart 3A to 3F is to be used (interpolate between charts for intermediate values of f_m and E_m). Determine SEISMOLOCK® system required for outer skin thickness t_b and ideal moment M_i .
14. Repeat step 13 for inner skin.

Notes:

- The designer must ensure design documentation provides for upgrading of cavity ties to allow transfer of compression loads between the brickwork skins unless it can be proved that existing ties are adequate.
- Each skin separately must be able to withstand total μ . For each skin in turn use Chart 3A to 3F to determine SEISMOLOCK® system for that skin. Interpolate between charts for intermediate values of f_m and E_m .
- Determine f_m and E_m of existing wall through testing. Indicative strength values for preliminary assessments are given in the NZSEE publication "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes", Section 10. Considerable variation in these parameters is common and a conservative approach is recommended.
- The designer must ensure suitable connection details are provided to transfer loads from the SEISMOLOCK® strengthened wall to elements providing lateral restraint at the top and bottom.

4.3 FACE LOADED CAVITY WALL

SEISMOLOCK® Design Proforma 3 Face Loaded Cavity Wall, SEISMOLOCK® Both Sides

Project:

Wall Identification:

Storey Reference:

Project No:

Page No:

Date:

1. Panel Height	H = _____ m
2. Thickness of Outer Brick Skin (see Notes)	tb1 = _____ m
3. Thickness of Inner Brick Skin (see Notes)	tb2 = _____ m
4. Combined Thickness of Both Skins (excluding Cavity)	Tb = _____ m tb1 + tb2
5. Unit Density of Brickwork	DB = _____ kN/m ³
6. Unit Weight of Wall	w = _____ kN/m ² DB*Tb
7. Design EQ Coefficient	Cp = _____ From NZS 1170.5
8. Horizontal Loading	wh = _____ kN/m ² Cp*w
9. Maximum Face Loading Bending Moment	Mu = _____ kNm/m wh*H ² /8
10. Ideal Bending Moment	Mi = _____ kNm/m Mu/(*β) where = 0.65 β = Table 2.2
11. Ultimate Strength of Masonry	fm = _____ MPa
12. Modulus of Elasticity of Masonry	Em = _____ GPa
13. Selected SEISMOLOCK® System for Outer Skin	= <input type="text" value="mm"/> (See Chart 3A to 3F)
14. Selected SEISMOLOCK® System for Inner Skin	= <input type="text" value="mm"/> (See Chart 3A to 3F)

Notes:

This method is applicable to cavity walls double-sided application only. Refer to Proforma 2 for solid wall double-sided application, or Proformas 4 or 5 for solid wall single-sided application.

4.3 FACE LOADED CAVITY WALL

Chart 3A: Face Loaded, Cavity Wall, Seismolock Both Sides
Face Loaded, Solid Wall, Seismolock on Tension Face

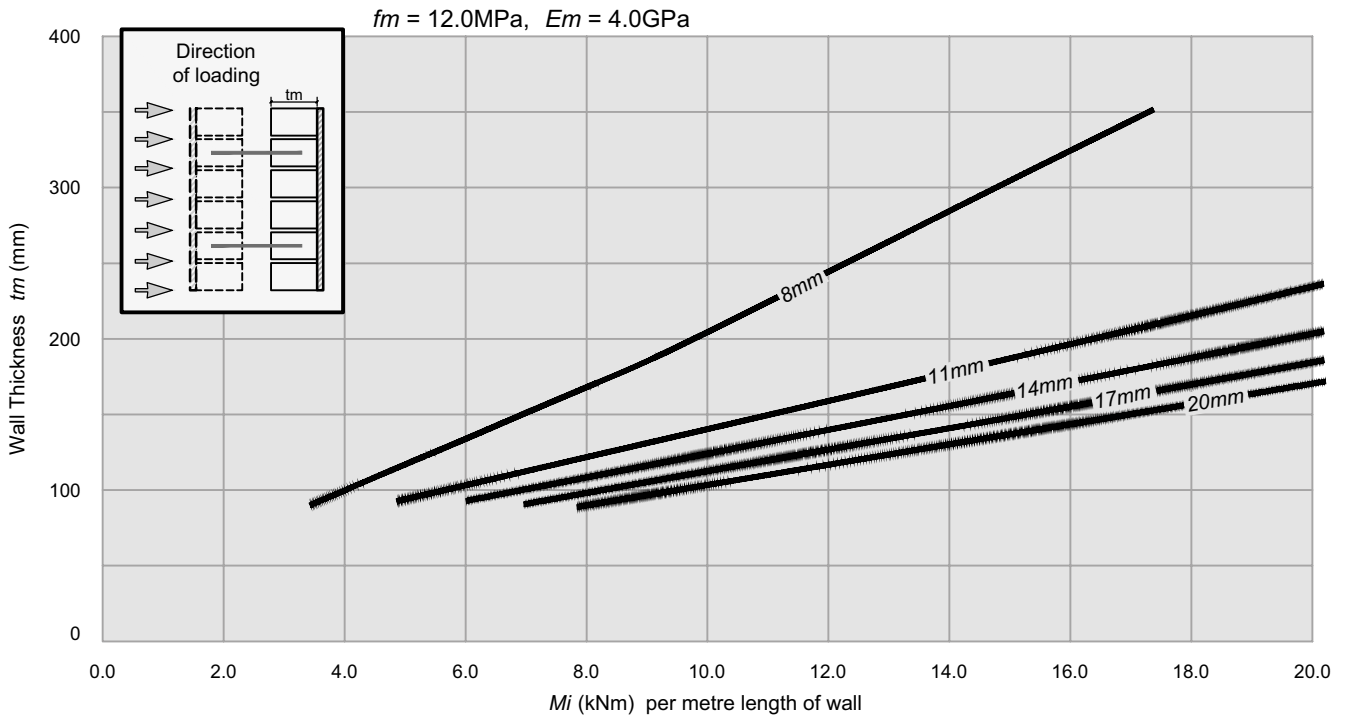
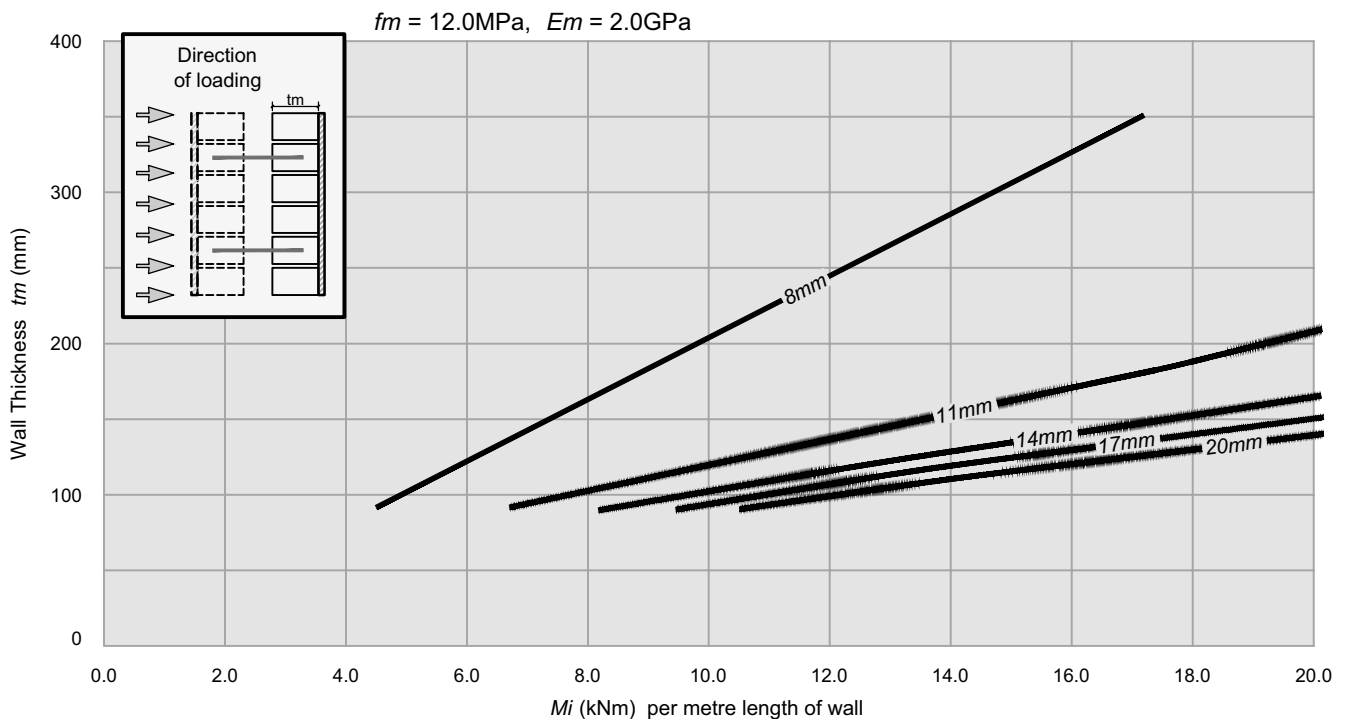
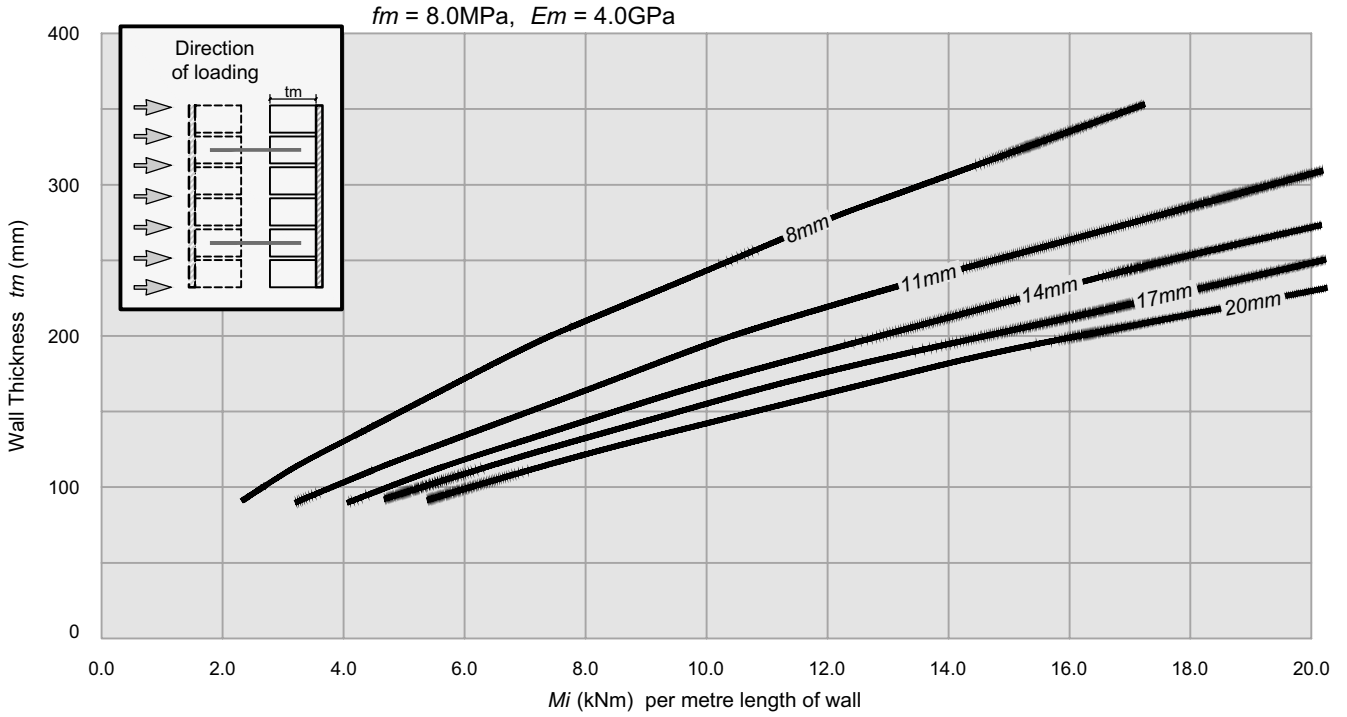


Chart 3B: Face Loaded, Cavity Wall, Seismolock Both Sides
Face Loaded, Solid Wall, Seismolock on Tension Face

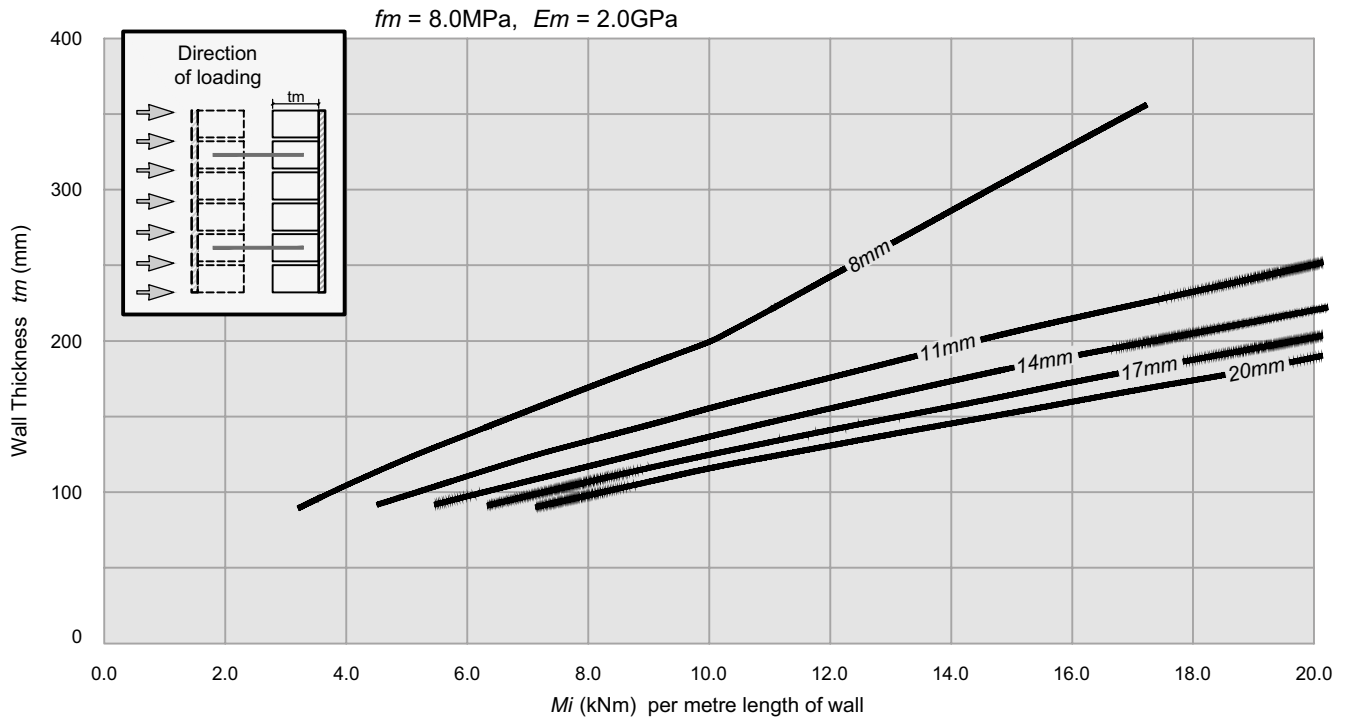


4.3 FACE LOADED CAVITY WALL

**Chart 3C: Face Loaded, Cavity Wall, Seismolock Both Sides
Face Loaded, Solid Wall, Seismolock on Tension Face**



**Chart 3 D: Face Loaded, Cavity Wall, Seismolock Both Sides
Face Loaded, Solid Wall, Seismolock on Tension Face**



4.3 FACE LOADED CAVITY WALL

Chart 3E: Face Loaded, Cavity Wall, Seismolock Both Sides
Face Loaded, Solid Wall, Seismolock on Tension Face

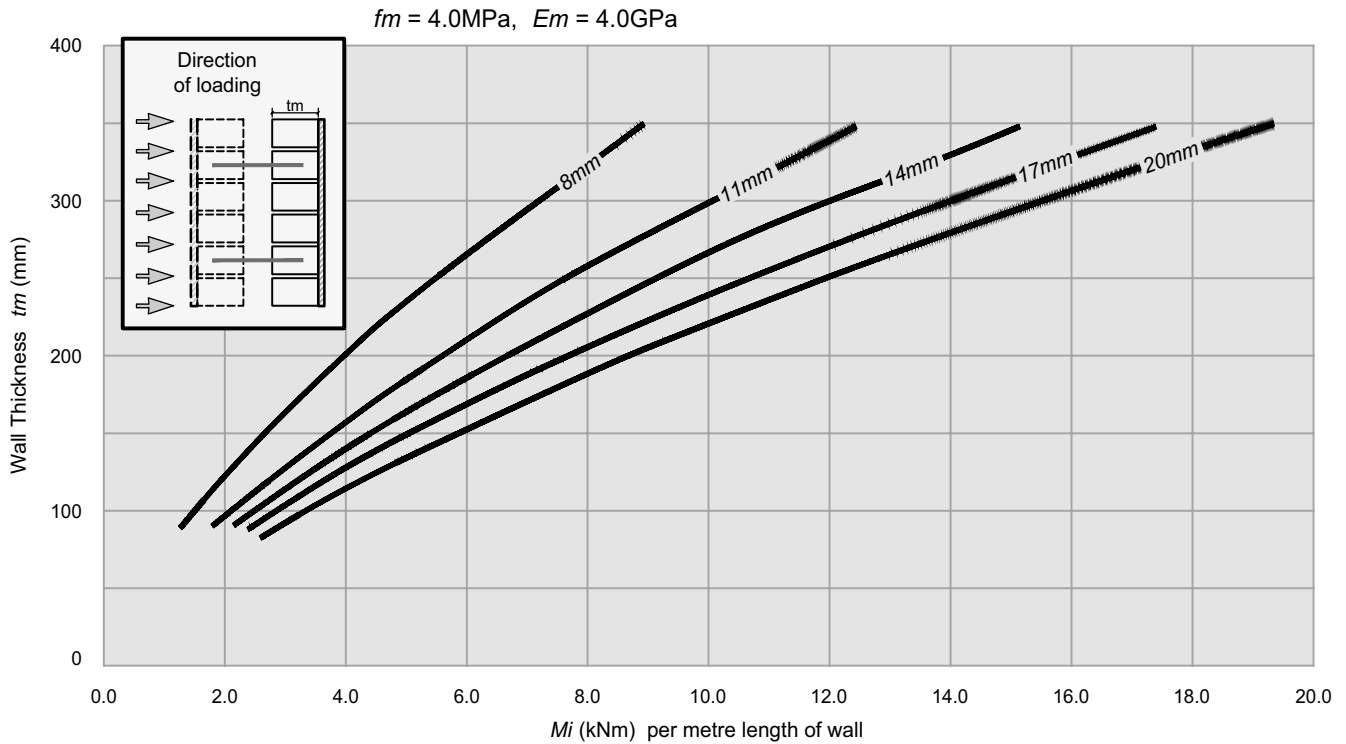
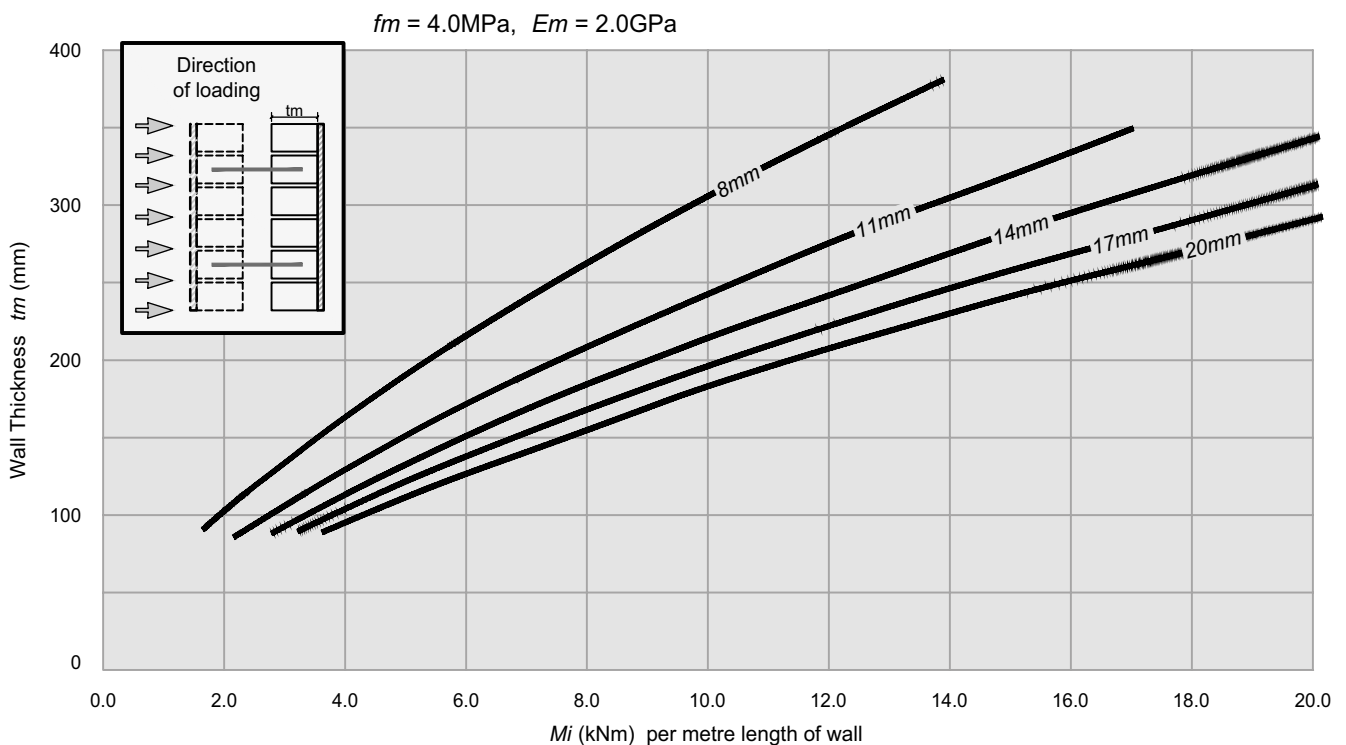
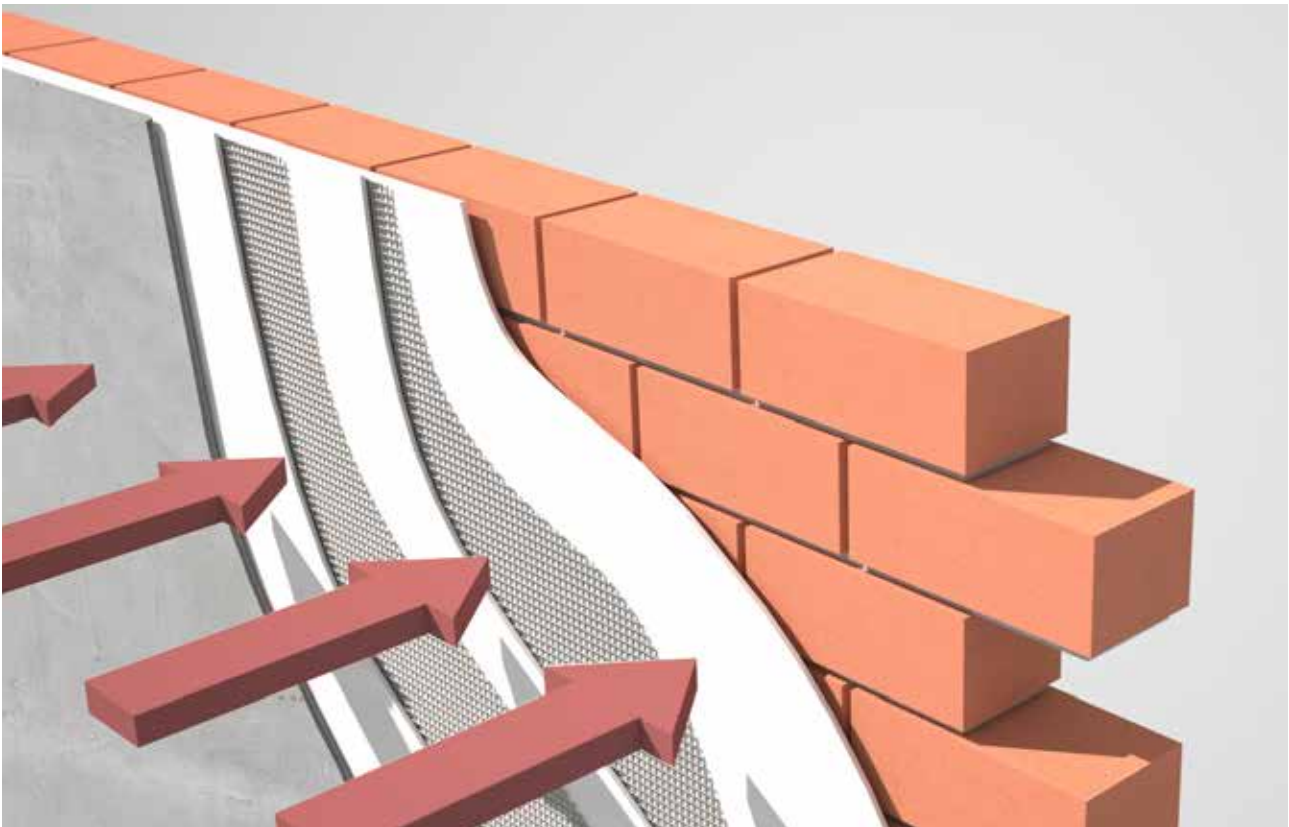


Chart 3F: Face Loaded, Cavity Wall, Seismolock Both Sides
Face Loaded, Solid Wall, Seismolock on Tension Face



FACE LOADED SINGLE SIDE APPLICATION 4.4



4.4 FACE LOADING SOLID WALL, SINGLE-SIDED APPLICATION

4.4 Face Loading Solid Wall, Single-Sided Application, Simple Span (Proforma 4)

This proforma assumes the wall spans top to bottom between elements which provide the necessary lateral restraint and that the full length of the panel is SEISMOLOCK® strengthened.

These walls have relatively low capacities and as such are more applicable to situations where reduction in the earthquake design loadings is permitted.

1. Identify panel height between lateral supports, H.
2. Determine the thickness of the masonry wall at each station, tm.
3. Determine the brick wall density DB.
4. Determine the earthquake lateral force coefficient, Cp. This is normally calculated from NZS 1170.5 Section 8.
5. Determine wall lateral loading from: $w_i = C_p * DB * t_m / \phi$
6. Determine reliable dead load applied to the wall at the level of the top lateral support, GT.
7. Consider three critical stations of the wall, being top, bottom and approximately mid-point. Determine the self-weight of the section of the wall from the station being analysed to the level of the top lateral support.
8. Calculate the design axial stress at each station from $0.9 * (GT + Sw) / (L * t_m)$.
9. Nominate a trial SEISMOLOCK® thickness to be provided.
10. From Chart 4 determine the moment at each station corresponding to the onset of tension stresses.

Note that for top and bottom stations the curve for no SEISMOLOCK® should be used.

For infill partitions with zero externally applied dead load ($GT = 0$) then M1 will also be zero and the wall will behave as a propped cantilever. The intermediate station M2 will then be above mid-height.

11. Calculate the characteristic (equivalent simply supported) ideal moment capacity of the wall

$$M_c = \frac{M_1}{2} - M_2 + \frac{M_3}{2}$$

12. Calculate the ideal lateral load carrying capacity, wc, for the wall

$$w_c = M_c * 8 / H$$

13. Compare wc with wi

If wc is less than wi, then wall has insufficient ability to withstand face loadings with single-sided, simple span application. To match wc to wi will require a revised concept, which may be one or a combination of the following:

- Single-sided, continuous span (Section 4.5)
- Double-sided application (Section 4.2)
- Provision of wall thickenings or pilasters

4.4 FACE LOADING SOLID WALL, SINGLE-SIDED APPLICATION

Notes:

- See Figure 4.2 for a diagram of the structural actions.
- This analysis technique is based on the load required to initiate the onset of tension in the brickwork. Designers may extend the analysis to allow significant brickwork cracking with all compression being in the SEISMOLOCK® and a consequential increase in lever arm. Designers are cautioned that for this alternative analysis there can be significant loss of moment capacity due to P-delta effects. Deflections must be assessed and P-delta moments allowed for.
- The designer must ensure suitable connections are designed and detailed to transfer loads from the SEISMOLOCK® strengthened wall to the elements providing lateral restraint at the top and bottom.

4.4 FACE LOADING SOLID WALL, SINGLE-SIDED APPLICATION

**SEISMOLOCK® Design Proforma 4
Face Loading, Solid Wall, Simple Span**

See Figure 4.2 for diagram of structural actions

Project:
Wall Identification:
Storey Reference:

Project No:
Page No:
Date:

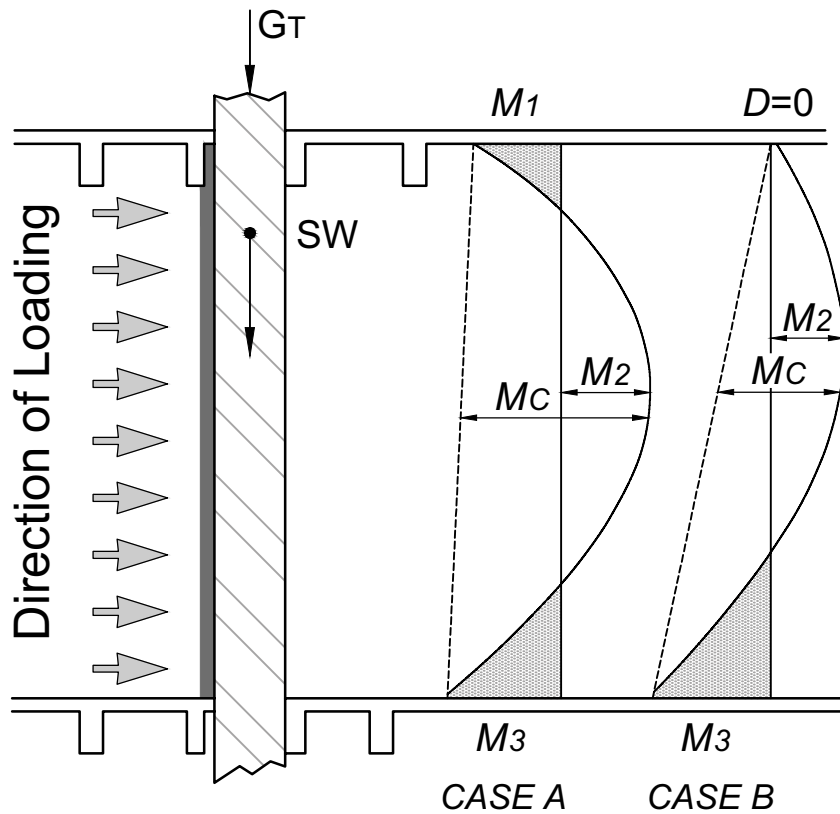
- | | | |
|-----|---|--|
| 1. | Panel Height | H = _____ m |
| 2. | Brick Thickness | tm = _____ m |
| 3. | Brick Density | DB = _____ kN/m ³ |
| 4. | Design Coefficient | Cp = _____ |
| 5. | Required Unit Lateral Load | wi = _____ kN/m ² (Cp*DB*tm)/
where = 0.65 |
| 6. | Reliable Dead Load
At top of wall @Station | GT = _____ kN/m
M1 @Station M2 @Station M3 |
| 7. | Self-Weight of Wall Above
Section Being Analysed | Sw = Zero kN/m _____ |
| 8. | Design Axial Stress
0.9*(GT+Sw)/(L*tm) | Fd = _____ MPa _____ |
| 9. | SEISMOLOCK® Thickness | tp = Zero _____ mm Zero |
| 10. | Wall Moment Capacity
(From Chart 4) | Mi/L- _____ kNm/m + _____ - _____ |
| 11. | Characteristic Moment | Mc = _____ kNm/m Mc = [(M1+M3)/2]-M2 |
| 12. | Capacity Lateral Load | wc = _____ kPa wc = Mc*8/H ² |
| 13. | Required Lateral Load
Delete where applicable | wi = _____ kPa From step 5
OK / Not OK |

Note:

Where GT = zero, then M1 is also zero and the wall behaves as a propped cantilever. The critical selection will then be above the mid-section (Case B on Figure 4.2).

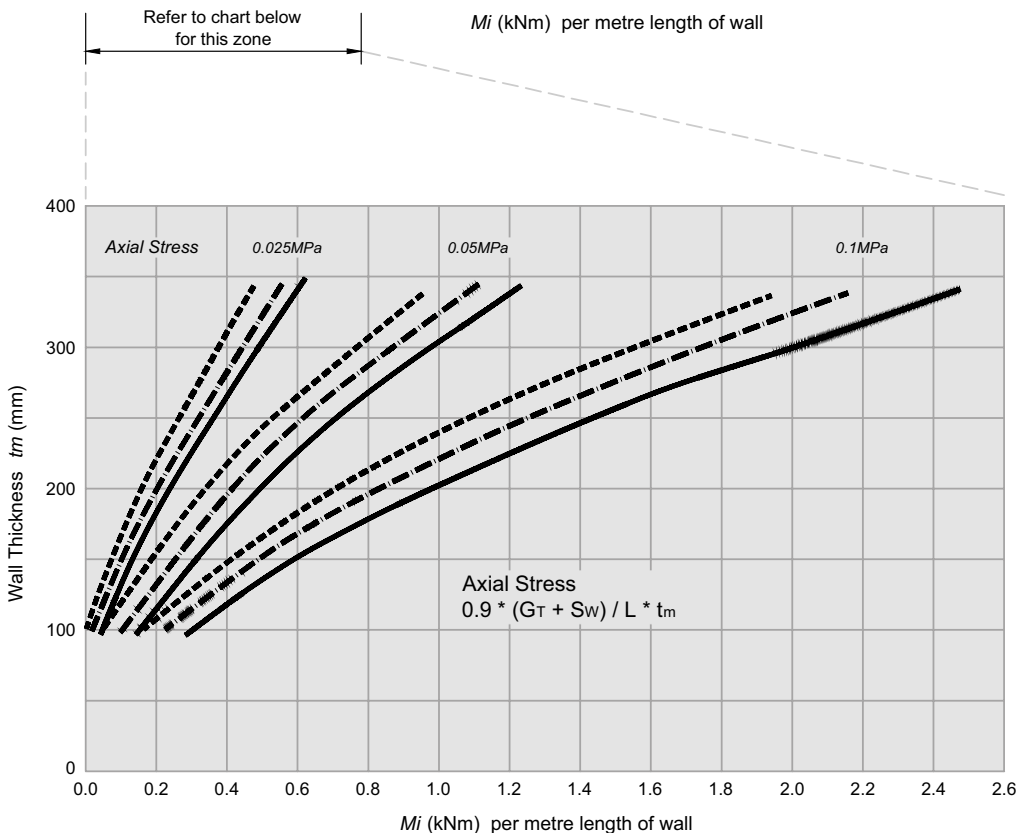
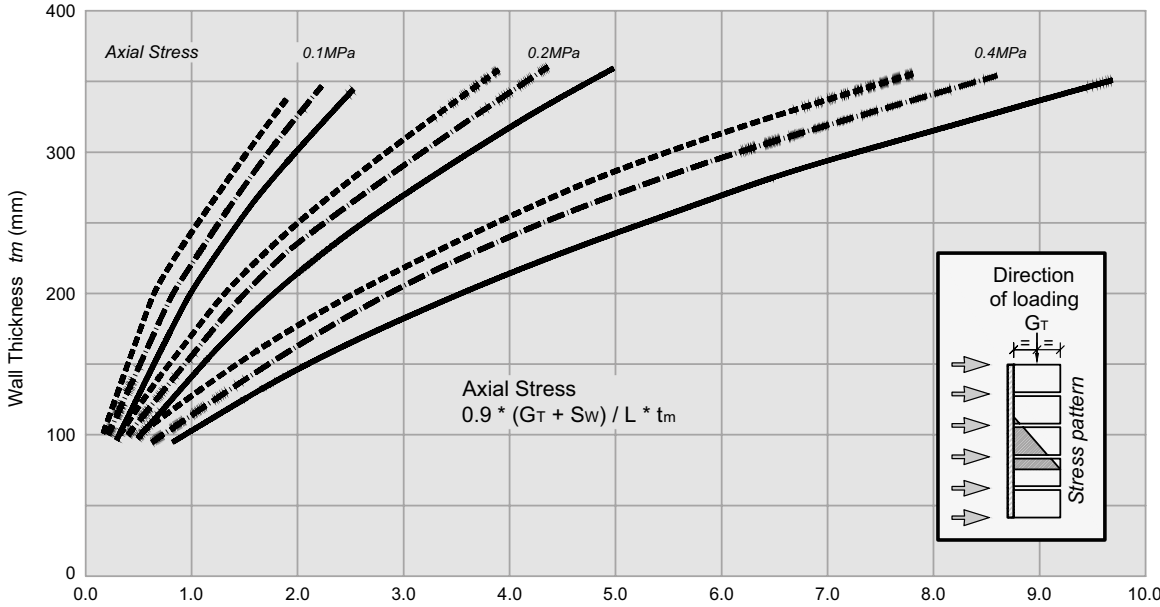
4.4 FACE LOADING SOLID WALL, SINGLE-SIDED APPLICATION

Figure 4.2: Face Loaded Wall SEISMOLOCK® One Face - Simple Span - Structural Actions



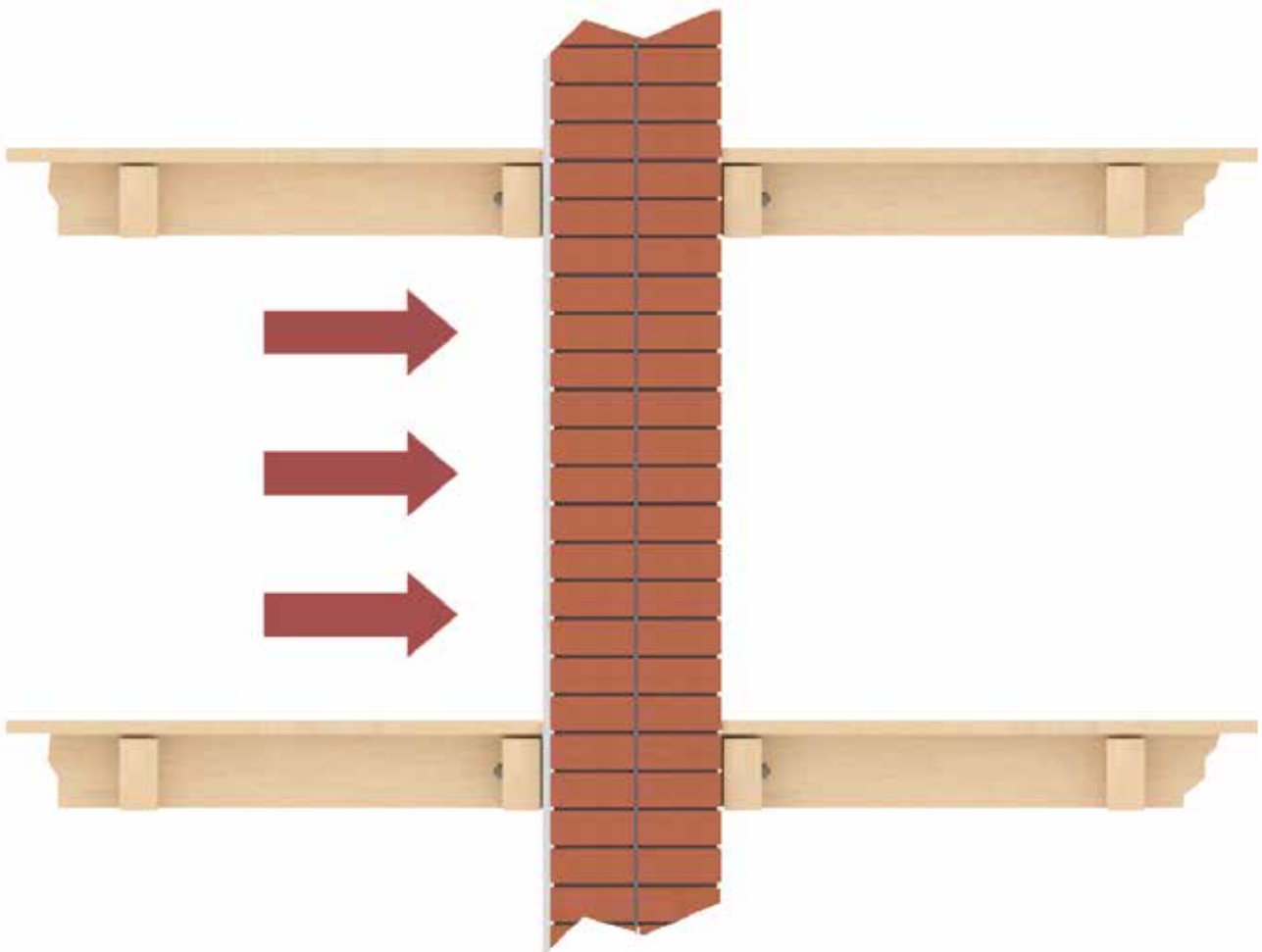
4.4 FACE LOADING SOLID WALL, SINGLE-SIDED APPLICATION

Chart 4: Face Loaded Wall SEISMOLOCK® Compression Face Only



- Masonry with no Polyplast
- .-.-.-.- Masonry with 8mm Polyplast
- Masonry with 20mm Polyplast

FACE LOADING SINGLE SIDE CONTINUOUS SPAN 4.5



4.5 FACE LOADING SINGLE SPAN CONTINUOUS SPAN

4.5 Face Loading Solid Wall, Single-Sided Application, Continuous Span (Proforma 5)

This proforma assumes the wall spans top to bottom between elements which provide the necessary lateral restraint and that the full length of the panel is SEISMOLOCK® strengthened, see Figure 4.3. It also requires moment capacity at the supports which is normally provided by the full height of the storey above and below being SEISMOLOCK® strengthened.

1. Identify panel height between lateral supports, H.
2. Determine the brick wall thickness, tm.
3. Determine the brick wall density, DB.
4. Determine the earthquake lateral force coefficient, Cp. This is normally calculated from NZS 1170.5 Section 8.
5. Determine the required ideal lateral loading
 $w_i = C_p * D_B * t_m * \phi$
 where $\phi = 0.65$
6. Determine the ultimate strength of the masonry, fm, from test data.
7. Determine the modulus of elasticity of the masonry, Em, from test data.
8. Select a trial SEISMOLOCK® thickness, tp.
9. From Charts 3A to 3F determine $M_i = M_{mp}$ per metre length of wall.
10. Determine the reliable dead load applied to the wall at the level of the top lateral support, G1.
11. Calculate the reliable axial stress at the top, mid-height and bottom of the wall, F_{d1} , F_{d2} , F_{d3} .
12. Calculate the minor moment capacity at the top, mid-height and bottom of the wall using Chart 4.
13. Calculate the characteristic (equivalent simply supported) ideal moment capacity of the wall for load direction A
 $M_{cA} = M_{mp} + M_2$
14. Calculate the characteristic (equivalent simply supported) ideal moment capacity of the wall for load direction B

$$MC = MMP + \frac{M_1}{2} + \frac{M_3}{2}$$
15. Calculate the ideal lateral load carrying capacity of the wall for load direction A
 $w_{cA} = M_{cA} * 8 / H^2$
16. Calculate the ideal lateral load carrying capacity of the wall for load direction B
 $w_{cB} = M_{cB} * 8 / H^2$
17. Compare wc to wi. If wc is less than, or significantly greater than, wi select amended SEISMOLOCK® system and repeat steps 8 to 17.

4.5 FACE LOADING SINGLE SPAN CONTINUOUS SPAN

Notes:

- Refer to Figure 4.3 for diagrams of loadings and moment diagrams.
- Ensure building and strengthening scheme are suitable to provide continuity of the SEISMOLOCK® system past (or into) horizontal diaphragms at each level or alternatively past suitably spaced and strengthened return walls. Check that diaphragms have sufficient stiffness to provide required support.

4.5 FACE LOADING SINGLE SPAN CONTINUOUS SPAN

SEISMOLOCK® Design Proforma 5 Face Loading, Solid Wall, Continuous Span

See Figure 4.3

Project

Wall Identification:

Storey Reference:

Project No:

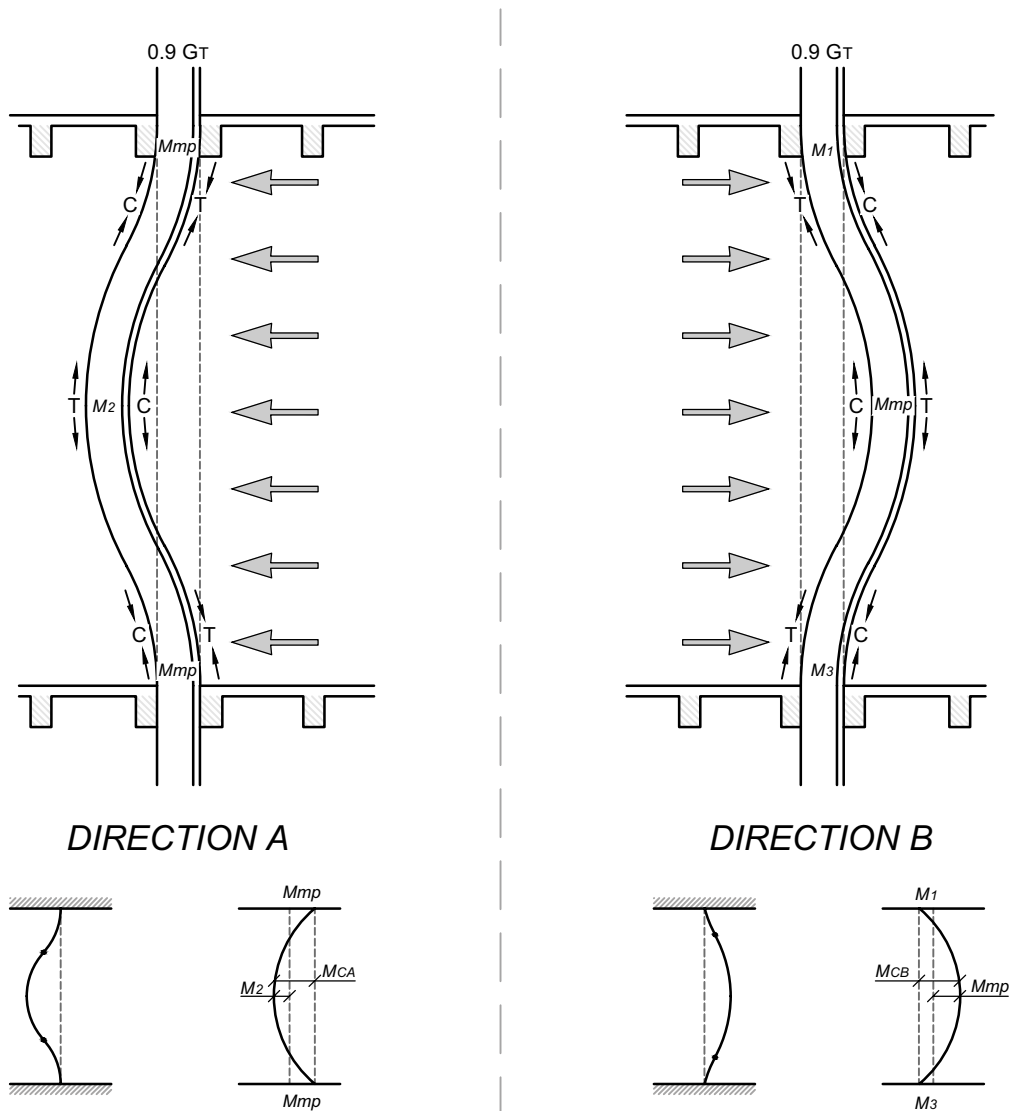
Page No:

Date:

- | | | | |
|-----|--------------------------------------|---|--|
| 1. | Panel Height | H = _____ m | |
| 2. | Brick Thickness | t m = _____ m | |
| 3. | Brick Density | DB = _____ kN/m ³ | |
| 4. | Design Coefficient | C _p = _____ | |
| 5. | Required Unit Lateral Load | w _i = _____ kPa(C _p *DB*t _m)/ | |
| | where = 0.65 | | |
| 6. | Ultimate Strength of Masonry | f _m = _____ MPa | |
| 7. | Modulus of Elasticity of Masonry | E _m = _____ GPa | |
| 8. | Trial SEISMOLOCK® System | t _p = _____ mm | |
| 9. | Major Moment Capacity | M _{mp} _____ kNm/mMi/L from Chart 3A to 3F | |
| 10. | Reliable Dead Load | GT = _____ kN/m | |
| | At top of wall | | |
| 11. | a. Reliable Axial Stress, Top | F _{d1} = _____ kPa | |
| | b. Reliable Axial Stress, Mid-Height | F _{d2} = _____ kPa | |
| | c. Reliable Axial Stress, Bottom | F _{d3} = _____ kPa | |
| 12. | a. Minor Moment Capacity, Top | M ₁ = _____ kNm/m | From Chart 4 - use Proforma 4 as a guide. |
| | b. Minor Moment Capacity, Mid-Height | M ₂ = _____ kNm/m | From Chart 4 use Proforma 4 as a guide. |
| | c. Minor Moment Capacity, Bottom | M ₃ = _____ kNm/m | From Chart 4 - use Proforma 4 as a guide. |
| 13. | Characteristic Moment Direction A | M _{cA} = _____ kNm/mM _{mp} + M ₂ | |
| 14. | Characteristic Moment Direction B | M _{cB} = _____ kNm/mM _{mp} + (M ₁ + M ₃)/2 | |
| 15. | Unit Load Capacity - Direction A | w _{cA} = _____ kPa | w _c = M _{cA} *8/H ² |
| 16. | Unit Load Capacity - Direction B | w _{cB} = _____ kPa | w _c = M _{cB} *8/H ² |
| 17. | Required Ideal Unit Load | w _i = _____ kPa | From step 5 |
| | Delete where applicable | OK / Not OK | |

4.5 FACE LOADING SINGLE SPAN CONTINUOUS SPAN

Figure 4.3: Face Loaded Wall, SEISMOLOCK® One Face, Continuous Span - Structural Actions



M_{mp} = Moment due to Seismolock / brick couple
 $M_1 M_2 M_3$ = Moment for onset of tension in the brickwork taking account of precompression from 0.9 G

5.0 LOAD DETERMINATION

5.1 General

1. The shears and moments generated in a SEISMOLOCK® strengthened wall acting as a shear wall shall be determined by normal structural analysis methods based on the relative stiffness of the contributing components. Where all resisting elements are masonry walls the stiffness may be based either on the bare walls or on the SEISMOLOCK® strengthened walls. Where SEISMOLOCK® strengthened walls are being used in conjunction with other materials (eg concrete walls) then stiffness should be based on the strengthened properties with assumed SEISMOLOCK® system.
2. Determination of face loads should be based on “Parts and Portions” sections of the relevant loadings code being used.
3. For buildings in New Zealand, loads should be established in accordance with NZS 1170.5 Structural Design Actions - Earthquake actions. Recommended ductility factors for the SEISMOLOCK® walls are given in Table 2.1.
4. From NZS 1170.5 current code requirements for lateral force coefficients can be established. These are the current code requirements for new buildings. These coefficients give the level of strength required to meet 100% of new building standards (100% NBS).

5.2 Strengthening Level

A building is earthquake prone under the Building Act 2004 if, having regard to its condition and to the ground on which it is built, and because of its construction, the building will in a moderate earthquake be likely to collapse, causing injury or death to persons within that, or any other property, or damaging other property. At present buildings that do not meet more than one-third of current code standards are regarded as “earthquake prone”. This then means owners of earthquake prone buildings are required to take some action in accordance with rules and timetables set by Territorial Authorities - generally to bring them up to at least one third of code within a certain number of years. Some Authorities are enforcing a minimum strengthening level higher than one-third of code.

Every Territorial Authority is required under the Building Act 2004 to have an “Earthquake Prone Building” policy. It will therefore be necessary to obtain the required minimum strengthening requirements from the appropriate Territorial Authority.

These Territorial Authority levels define the minimum level required. In most circumstances it is advantageous to design to higher than the minimum levels for various reasons including the following:

- Safety of the building’s occupants and of passers-by.
- Lower risk of damage to the building during a seismic event

5.0 LOAD DETERMINATION

- It is easier to get tenants for buildings with higher earthquake strengths, and rents are higher
 - Insurance premiums are generally lower for buildings strengthened to higher levels
 - If the building is only a small amount above its present-day minimum requirements, a small increase to building code seismic load requirements can instigate additional strengthening requirements.
- It is recommended that strengthening be to as near 100% NBS as possible, with a minimum of 67% NBS.

Note:

A building with 33% NBS has approximately 20 times the risk of its strength being exceeded due to earthquake actions. This reduces to approximately three times for a building with 67% NBS

6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM

6:1 SCOPE:

This specification covers the preparation of the masonry walls, the application of Seismolock plaster and reinforcing mesh in order to strengthen the walls to resist earthquake forces.

6:2 MATERIALS:

The Seismolock plaster, Reinforcing mesh, and Resins are available from:
Resene Construction Systems
121 Diana Drive
Glenfield
Auckland
New Zealand
Ph: 444-6440
Fax: 444-9561

6:3 SUBSTRATE PREPARATION:

Seismolock plaster is designed to be applied to a dry surface. Do not wet down the masonry surfaces before the application of Seismolock, and do not apply the plaster to surfaces which are wet from rain or overnight dew.

Surfaces must be free from oil, paint, dirt, lichen growth and similar substances which will inhibit the bond of the Seismolock to the substrate. Any loose or unsound materials must be removed back to a solid substrate.

Remove existing paint coatings, and any soft plasters such as Gypsum or Lime based plasters. Cement based, plasters may remain, subject to the Engineer's approval, provided it is well bonded to the substrate.

On smooth dense surfaces or glazed bricks, the surface must be scabbled to provide adequate bond for the Seismolock.

Ensure the substrate is thoroughly cleaned and dry before the Seismolock is applied.

6:4 PLASTER PREPARATION:

Each 20kg bag of Seismolock must be mixed with 1 litre of Seismolock Resin and 4.5 litres of clean potable water.

Depending on weather conditions and the method of application, a slight variation in the quantity of water may be required. Place all the water and resin for the mix into a bin (a 50 litre rubbish bin is ideal) and add, while stirring with a powered whisk, all of the Seismolock plaster.

6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM

Do not over mix the plaster.

Do not mix more plaster than you can use in 1/2 hour.

Do not reactivate the mix with water once it begins to set. Discard any plaster that has been mixed for more than 1/2 hour, or has begun to set.

6:5 PLACING:

Seismolock can be applied by trowel, hopper gun or plaster pump.

For the initial coat, apply the plaster at least 5mm thick and slightly wider than the fibreglass mesh.

Cut the fibreglass mesh to length and lay against the wet Seismolock. Wipe the mesh into the plaster surface with a steel trowel, embedding the mesh just below the surface.

Continue to apply the plaster and fibreglass mesh along the wall, and ensure that each strip of mesh overlaps the adjacent strip by at least 150mm.

If multiple layers of fibreglass mesh are specified, allow the preceding mesh and plaster coat to reach the initial set stage before applying the subsequent coat.

When the final coat of plaster has been applied it should be allowed to reach its initial set and then be retrowelled to provide a smooth dense surface.

Plan the work programme so that a complete wall section is completed in one day.

6:6 CONSTRUCTION JOINTS:

Where a break in the work is necessary, at least 500mm of fibreglass mesh should be left exposed and the Seismolock tapered back, where it is behind the portion of mesh to be left exposed. Subsequent layers of Seismolock and fibreglass mesh should stop at least 500mm short of the preceding layer so that a staggered joint is formed. See figure 6:1.

When forming construction joints it is important that either:-

- (a) The preceding layers of Seismolock are allowed to dry out so that there is adequate suction available for subsequent layers of Seismolock or
- (b) The preceding layers of Seismolock are raked so that adequate bond is provided for subsequent layers of Seismolock.

Lap the next day's work into the exposed fibreglass mesh.

Construction joints should be formed at locations approved by the Engineer.

6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM

6:7 THICKNESS:

5mm is the minimum plaster thickness for the first coat over the substrate.

Subsequent mesh and plaster coats need to be 3mm to 5mm thick.

Therefore a finished Seismolock thickness of 8, 11, 14,17 or 20mm corresponds to 1, 2, 3, 4 or 5 layers of Fibreglass mesh respectively.

6:8 CURING:

Freshly placed Seismolock plaster should be protected from temperature extremes, frost, rain, sun and drying winds.

The plaster should be protected from completely drying out for at least 48 hours.

No plaster should be mixed or placed while the temperature is below 5°C and not expected to increase above this temperature during the day.

It is not recommended that plaster be mixed or placed when the temperature is likely to be above 35° C.

Seismolock plaster contains specially selected resins which require a temperature in excess of 10° C to film form. The plaster should not be cured in a wet environment for any extended period of time as the Resins are designed to aid the curing of the plaster.

6:9 PROTECTION:

For external use, or in areas where the Seismolock is going to be subject to dampness, a coating should be provided so that the Seismolock is kept dry.

A conventional plaster coat or Multiplast or Finarlie Finishing Plasters can be used to provide a finished surface and these surfaces should be painted with at least two coats of 100% Acrylic paint.

If a finished plaster surface is not required then in damp conditions the Seismolock plaster must also be painted with at least two coats of 100% Acrylic paint.

Ensure all polypropylene fibres are laid as flat as possible before painting.

Ensure that the paint coverage is fully continuous over exposed fibres.

6.10 COVERAGE:

1 square metre/bag - 10mm thickness of plaster cover.

6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM

6:1 1 STORAGE:

Bags of Seismolock and rolls of fibreglass mesh must be stored in a dry area, preferably off the floor on a timber pallet or timber dunnage.

Rotate the plaster stock to ensure that the oldest material is used first.
Plaster stock that is older than 6 months, should be discarded.

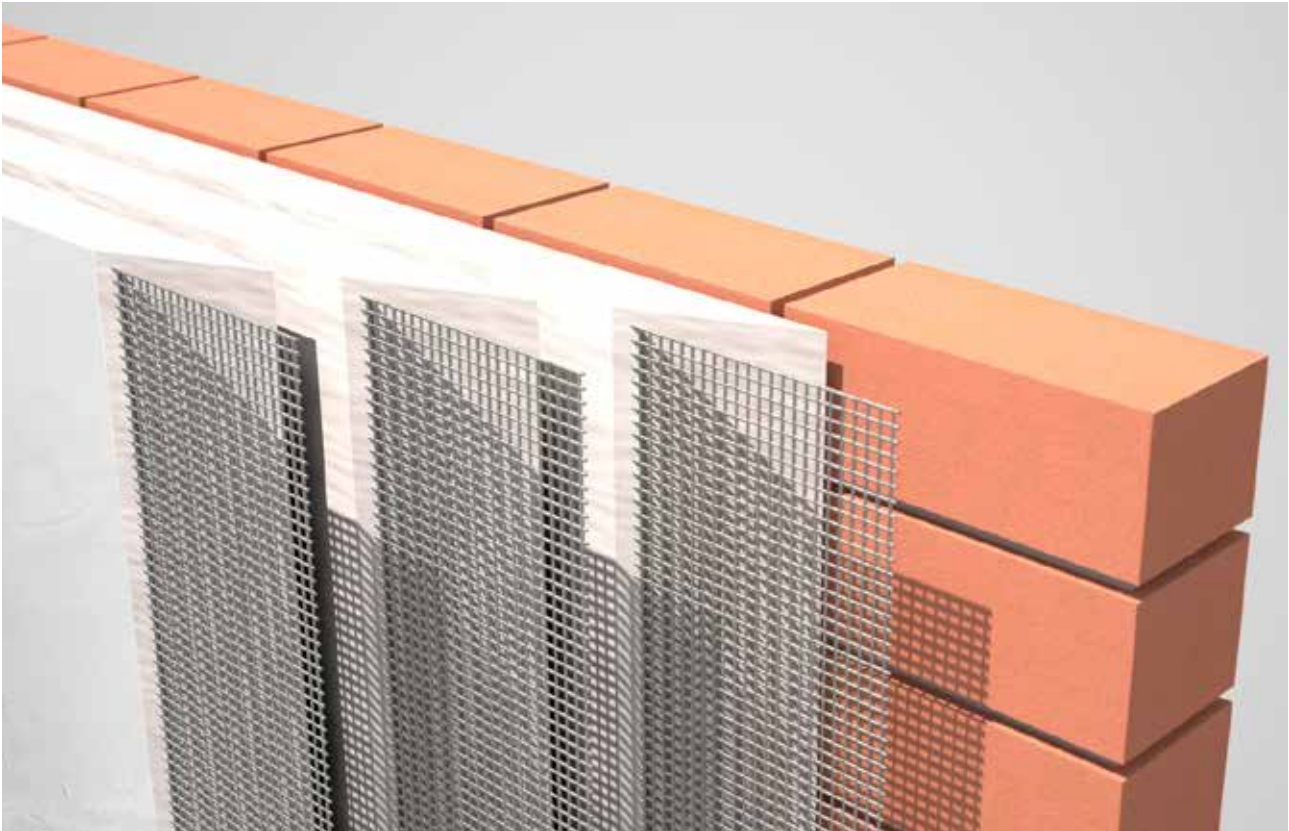
6:12 HEALTH & SAFETY:

Seismolock plaster dust is an irritant, and paper dust protection masks should be worn while it is being mixed. The wet plaster is alkaline and prolonged skin contact should be avoided.

6:13 TECHNICAL ADVICE:

For technical advice please call Resene Construction Systems 0800 50 70 40

6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM



6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM

SHORT FORM SPECIFICATION SEISMOLOCK STRENGTHENING SYSTEM

SCOPE:

The supply, preparation and application of the Seismolock plaster and Seismolock fibreglass mesh system to brick and masonry walls and structural elements, to increase the capacity of a structure to resist earthquake loadings.

MATERIALS:

The plaster products of the Seismolock Strengthening System shall be manufactured by Seismolock Strengthening Systems Ltd. The other components of the system shall be supplied by Seismolock Strengthening Systems Ltd., and shall meet their quality requirements.

APPLICATION:

The Seismolock Strengthening System shall only be applied by tradesmen experienced in the application of plaster and plastering products.

Tradesmen applying the system shall make themselves aware of the application requirements as detailed in the Seismolock Strengthening System Design Manual and any additional requirements of the Engineer.

All work to be carried out in a tradesman like manner in full accordance with the current installation instructions.

6.0 SPECIFICATION FOR THE SEISMOLOCK STRENGTHENING SYSTEM

BRICK SHEAR TESTS:

(a) Average quality Demolition Bricks. I	
No mesh samples	3.31 Mpa ± 0.57
2 mesh samples	2.89 Mpa ± 0.64
(b) New Bricks	
No mesh samples	3.26 Mpa ± 0.65
2 mesh samples	3.27 Mpa ± 0.32

BRICK BOND TESTS:

Tested at 28 days in accordance with NZS 421 OP 1981 Appendix A.

Average quality Demolition Bricks.

a) No mesh samples:- All samples failed due to shearing of the bricks themselves.
Bond at least 1794 ± 481 KPa.

lb) 2 mesh samples:- All samples failed due to shearing along the mesh line.
Bond = 1234 ± 227 KPa

TENSILE TESTS

Tested in accordance with B.S. 18 "Methods for Tensile Testing of Metals".

(a) No mesh samples: - 1.63 ± 0.19 MPa.

lb) Tested in Warp direction.

1 mesh samples 5.35 ± 0.65 MPa.
2 mesh samples 7.58 ± 1.66 MPa.
3 mesh samples 9.25 ± 1.00 MPa

(c) Tested in Weft direction

1 mesh samples 3.92 ± 0.99 MPa.
2 mesh samples 5.76 ± 0.33 MPa.
3 mesh samples 7.32 ± 0.74 MPa

TENSILE SPLITTING STRENGTH:

Tested in accordance with NZS 3112 Part 2 1986.

1st crack 2.1 ± 0.4 MPa.
Ultimate 2.7 ± 0.46 MPa.

7.0 TEST RESULTS

COMPRESSIVE STRENGTH

Tested at 28 days in accordance with NZS 3112 Part 2 1986
Compressive Strength 26.0MPa

DENSITY:

Tested at 28 days in accordance with NZS 3112 Part 2 1986.
Wet Density 2090 kg/m³
Dry Density 1 695 kg/m³

YOUNGS MODULUS:

Tested at 28 days in accordance with NZS 3112 Part 2 1986.
Youngs Modulus 9.5GPa

BOND TO REINFORCING:

32mm diameter deformed reinforcing bars embedded 200mm into a 150mm diameter cylinder. '
Withdrawal load = 135.2 kN *

FLEXURAL STRENGTH:

Tested at 28 days in accordance with A.S.T.M. C293-79 "Flexural Strength" of Concrete.
Samples contained 1 layer of mesh and were loaded at third points.

Modulus of Rupture:-
Warp Direction 9.65 MPa
Weft Direction 1 1.16 MPa

HYDROSTATIC PERMEABILITY:

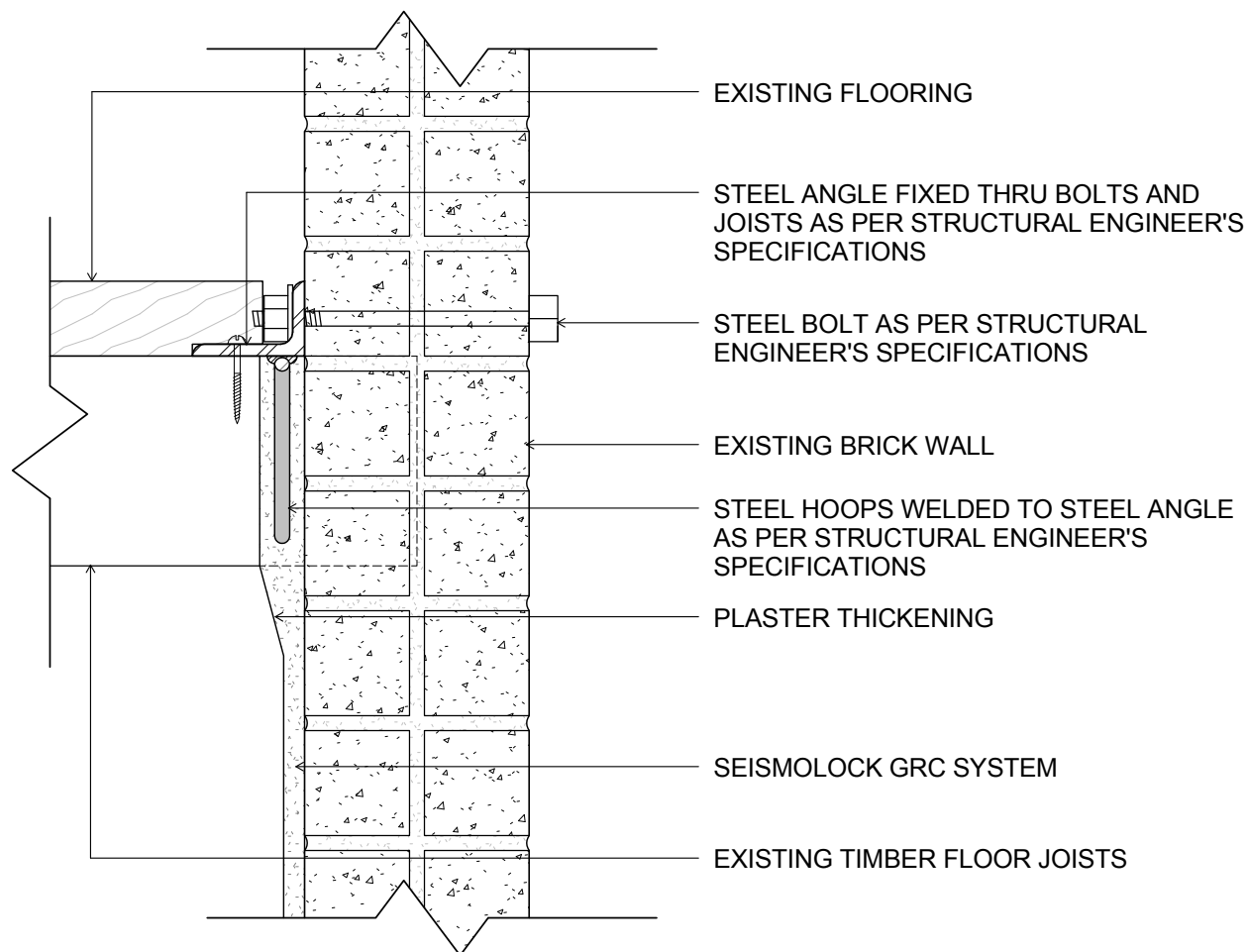
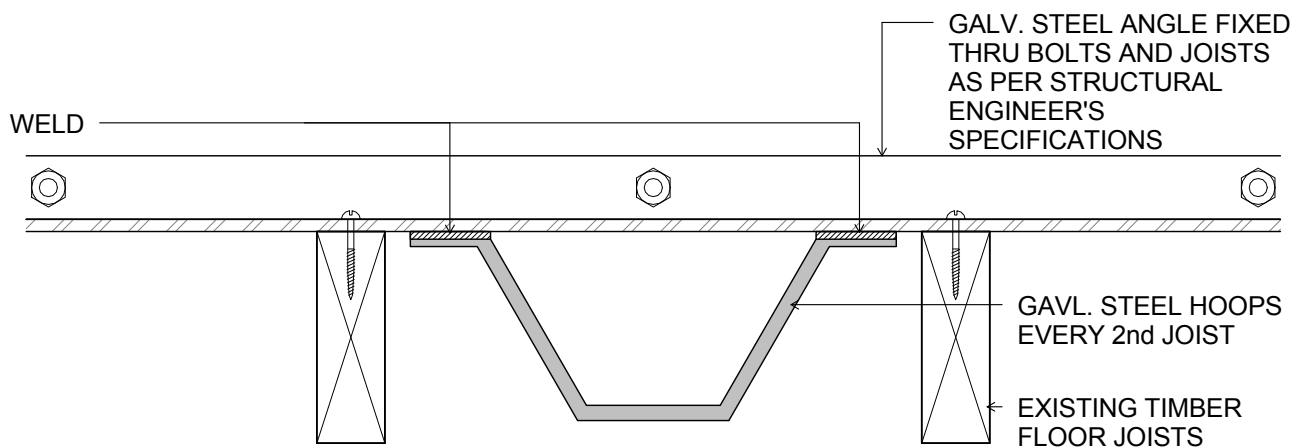
200mm head of water over a 10mm thickness of Seismolock.
Loss of Head : 1 mm after 24 hours.

FIBREGLASS MESH:

Thickness	0.6096 mm	
Weight	0.407 kg/mm	
	Weft	Warp
Area	58.1 mm ² /m	54.6mm ² /m
Ultimate Tensile Strength	67.1 KN/m	60 KN/m
	1155 MPa	1100Mpa
Modulus of Elasticity	30G Pa	15 GPa

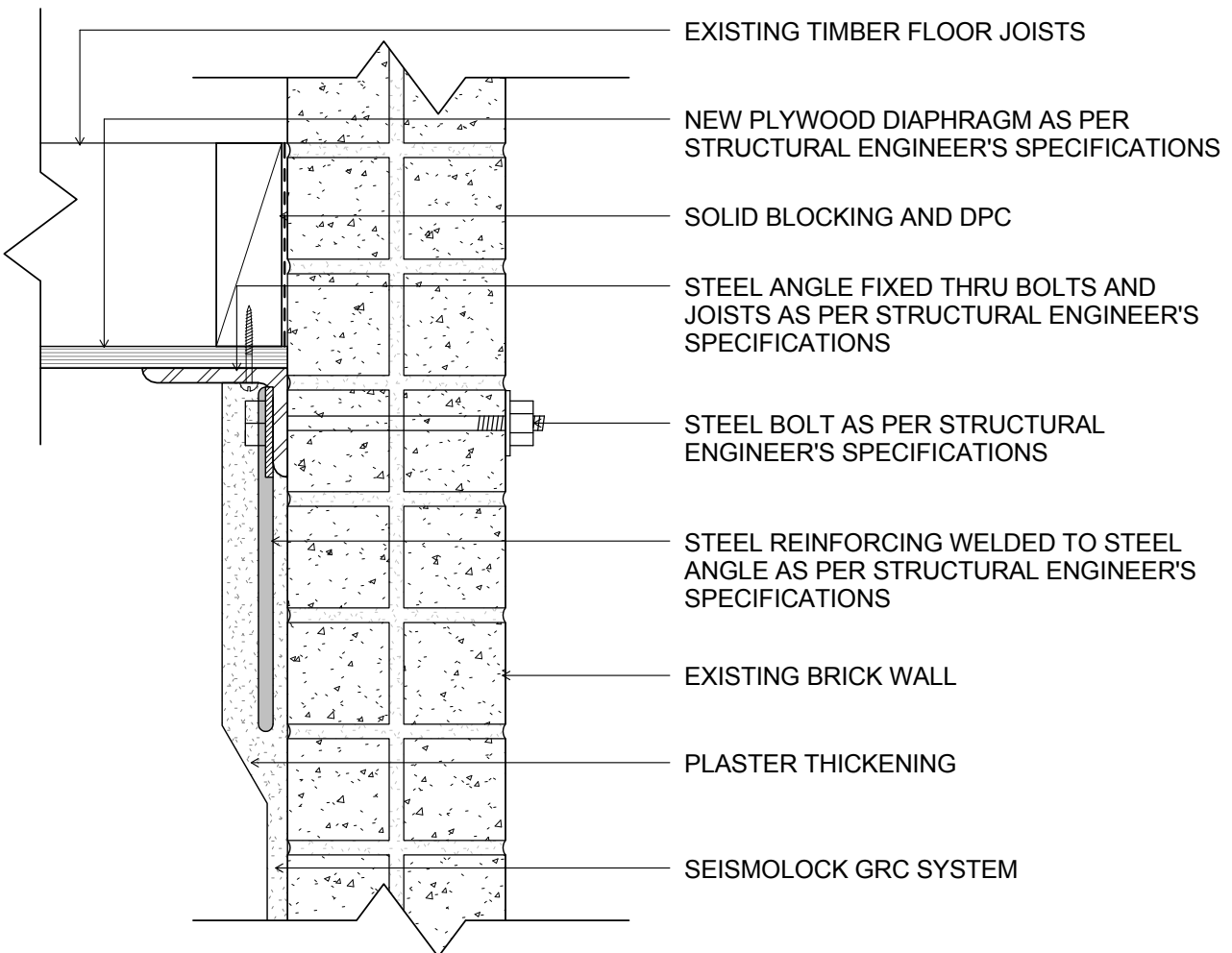
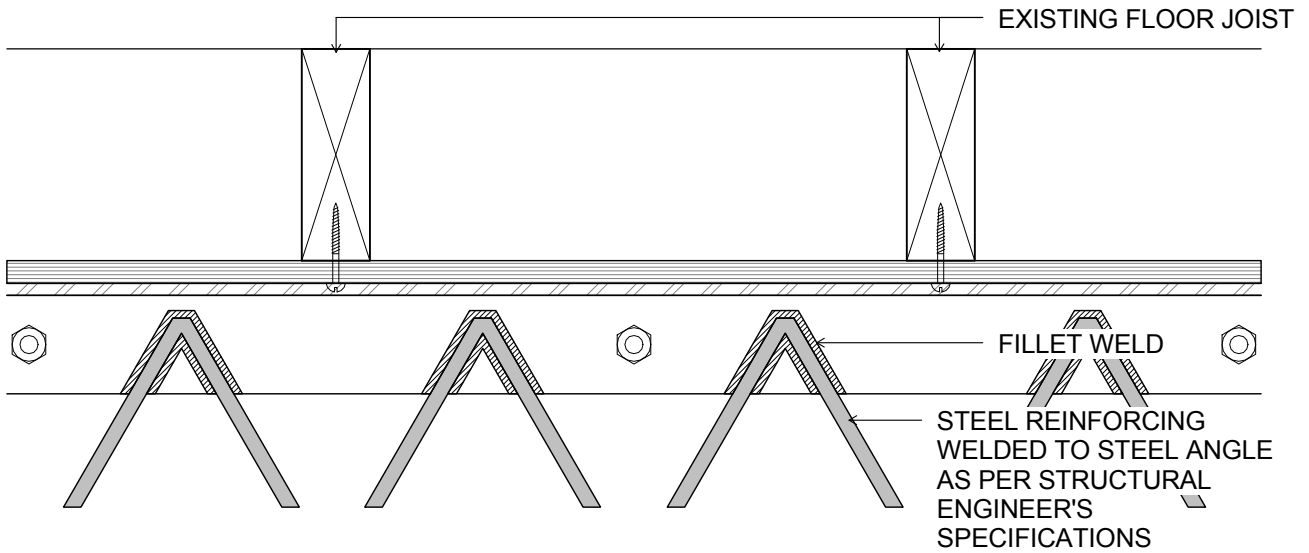
8.0 EXAMPLE DETAILS

TIMBER FLOOR CONNECTION DETAIL



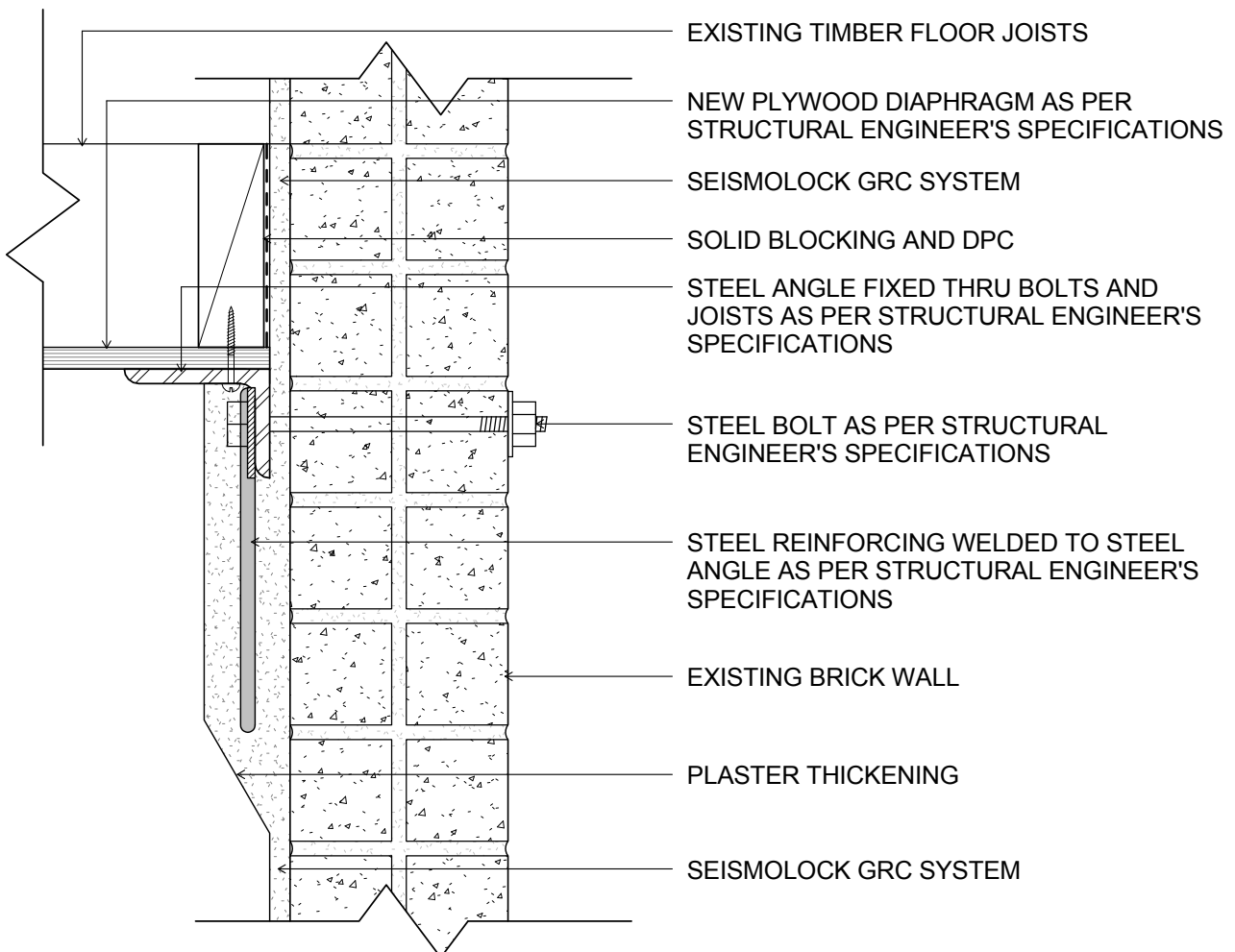
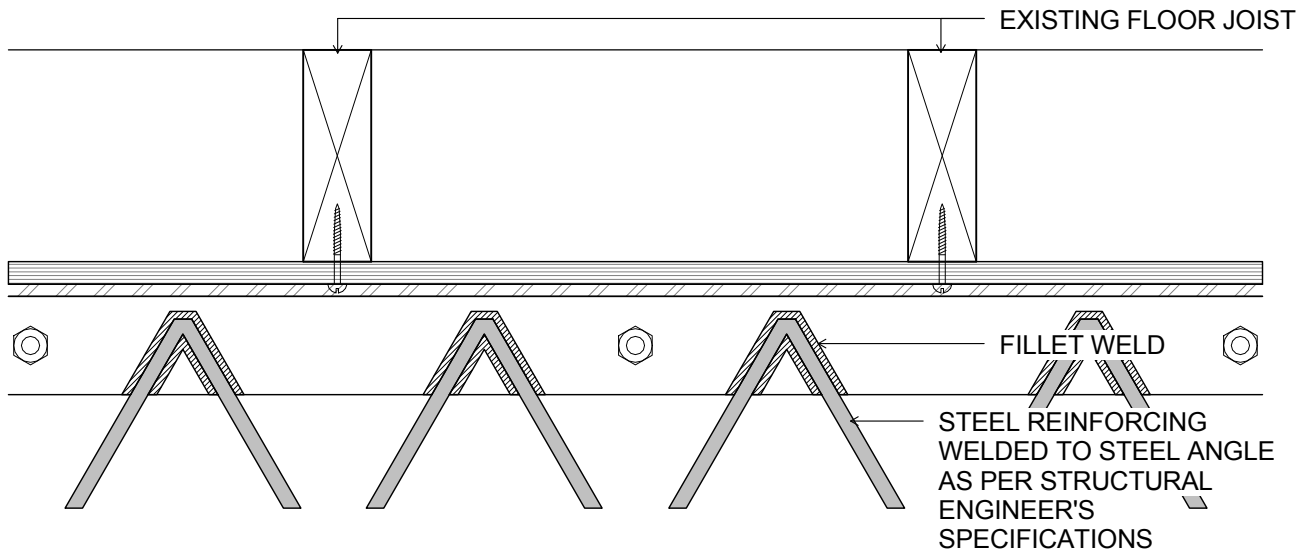
8.0 EXAMPLE DETAILS

TIMBER FLOOR CONNECTION DETAIL



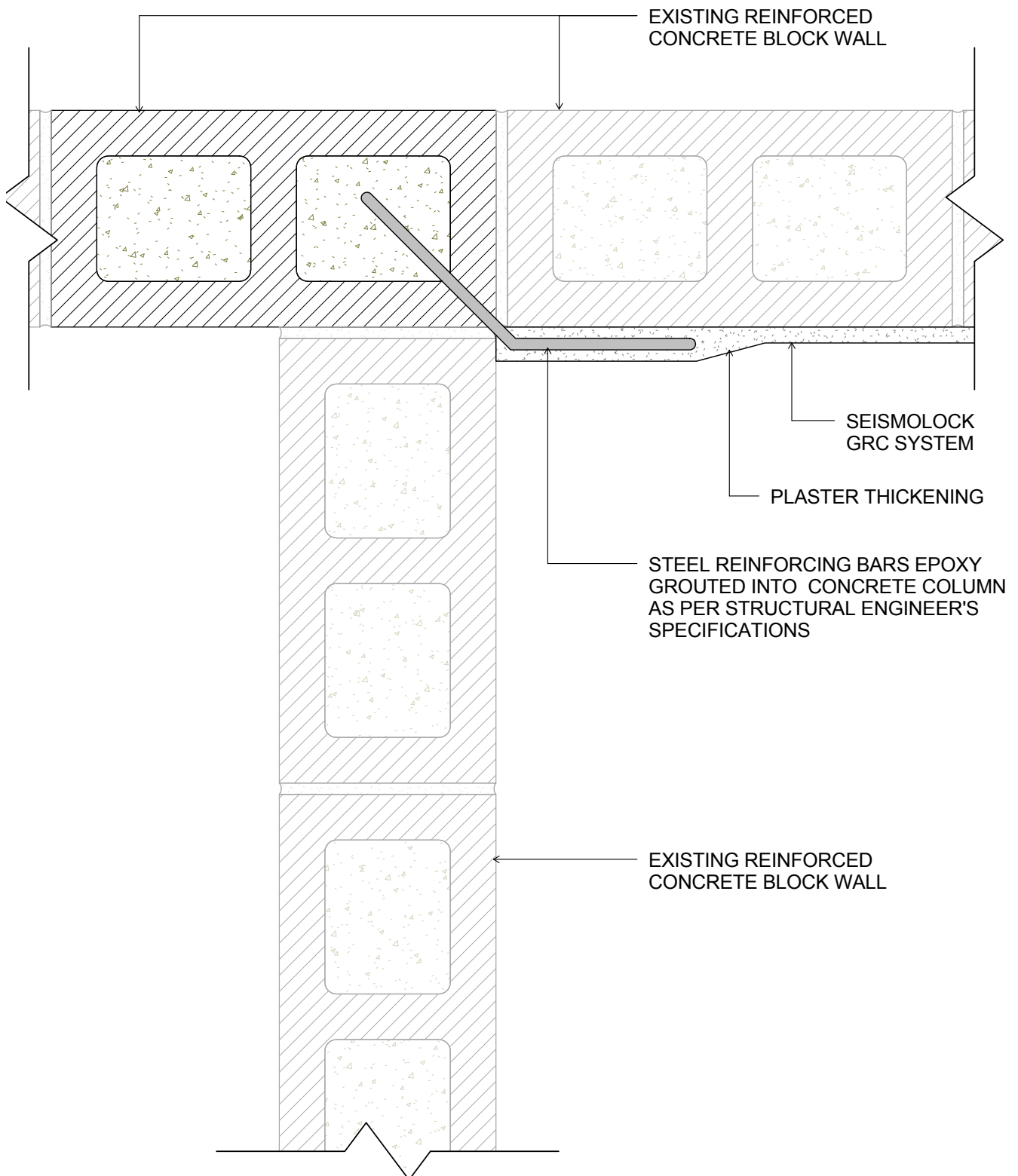
8.0 EXAMPLE DETAILS

TIMBER FLOOR CONNECTION DETAIL



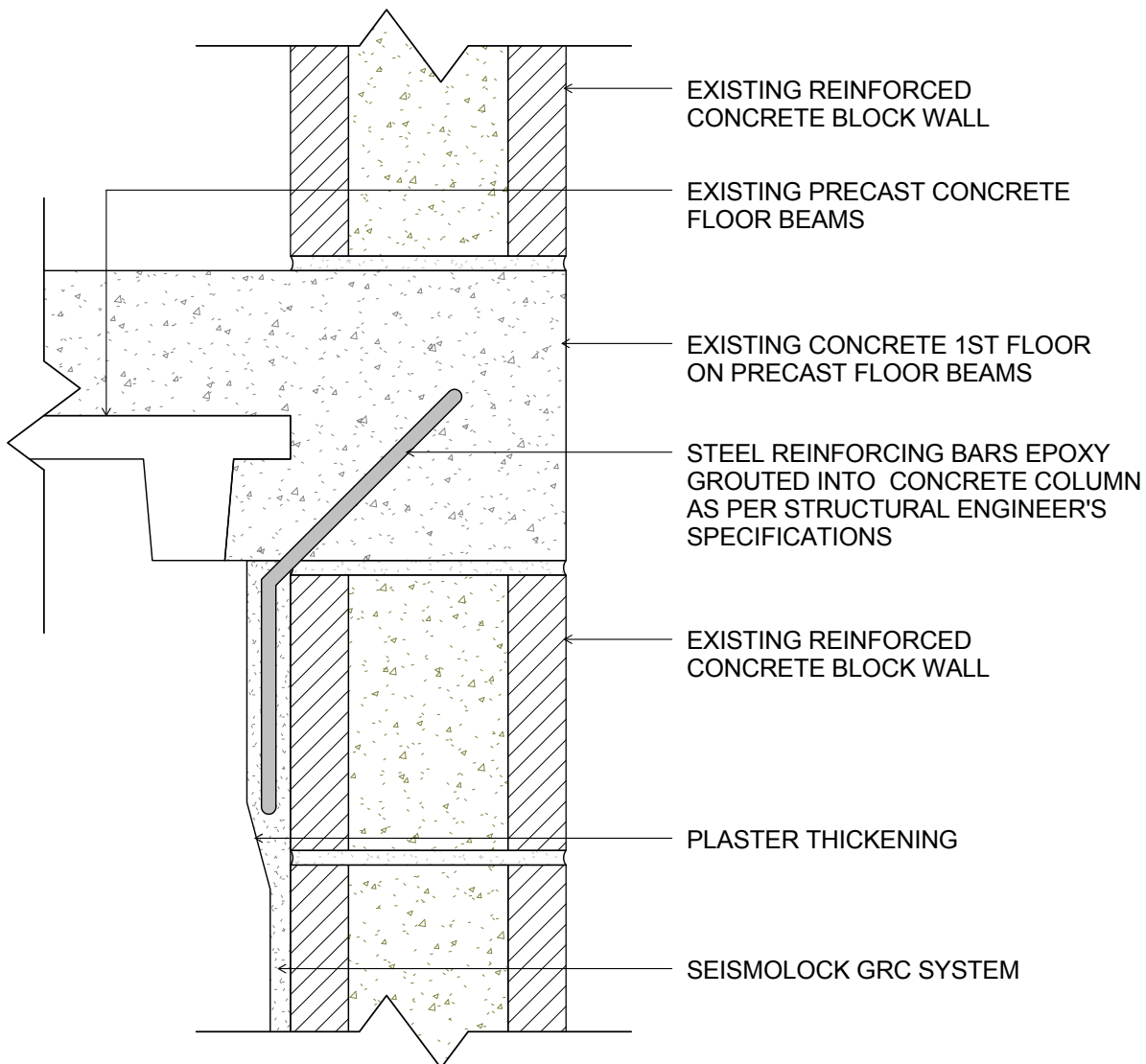
8.0 EXAMPLE DETAILS

COLUMN DETAILS



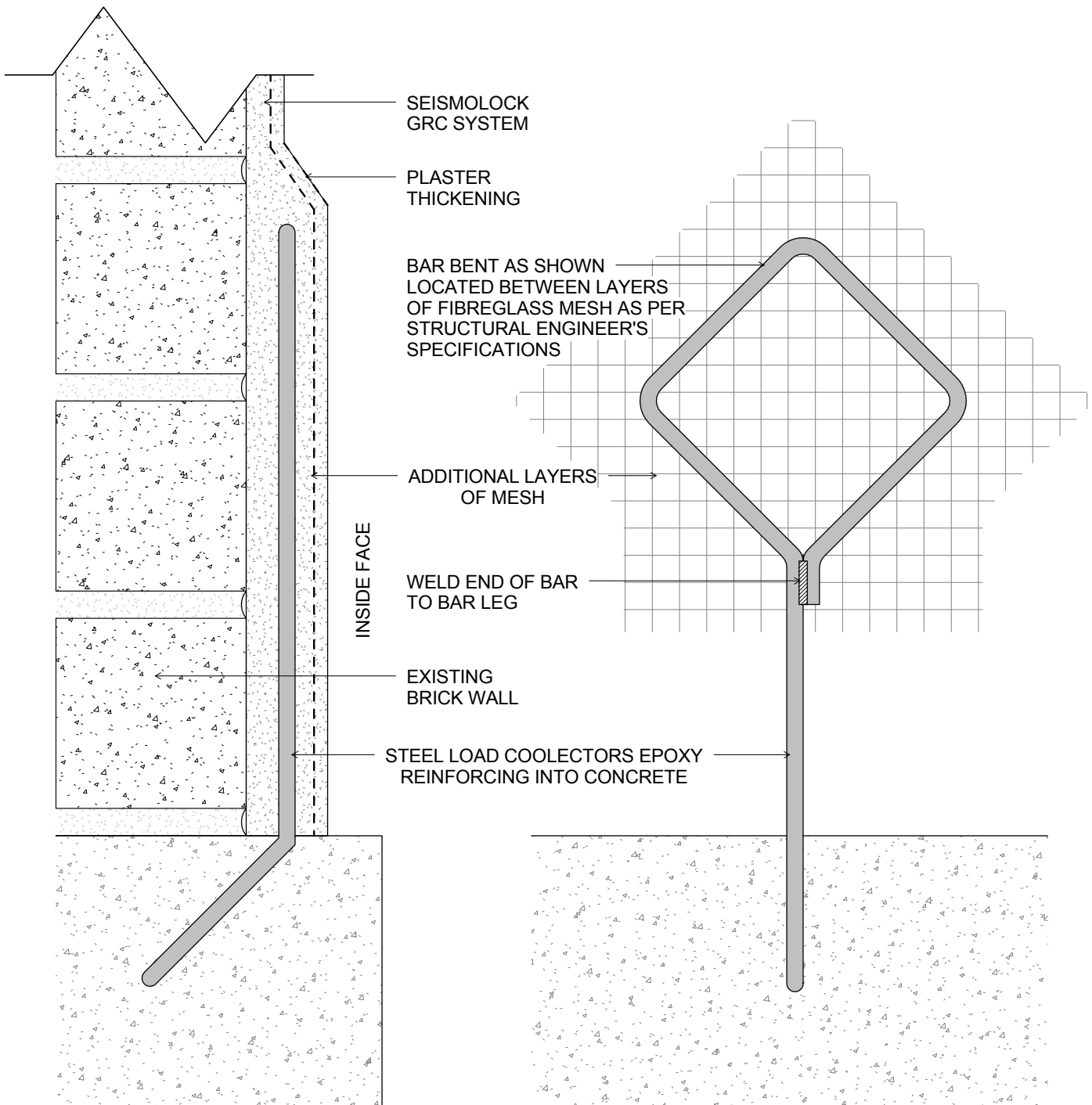
8.0 EXAMPLE DETAILS

CONCRETE FLOOR DETAIL



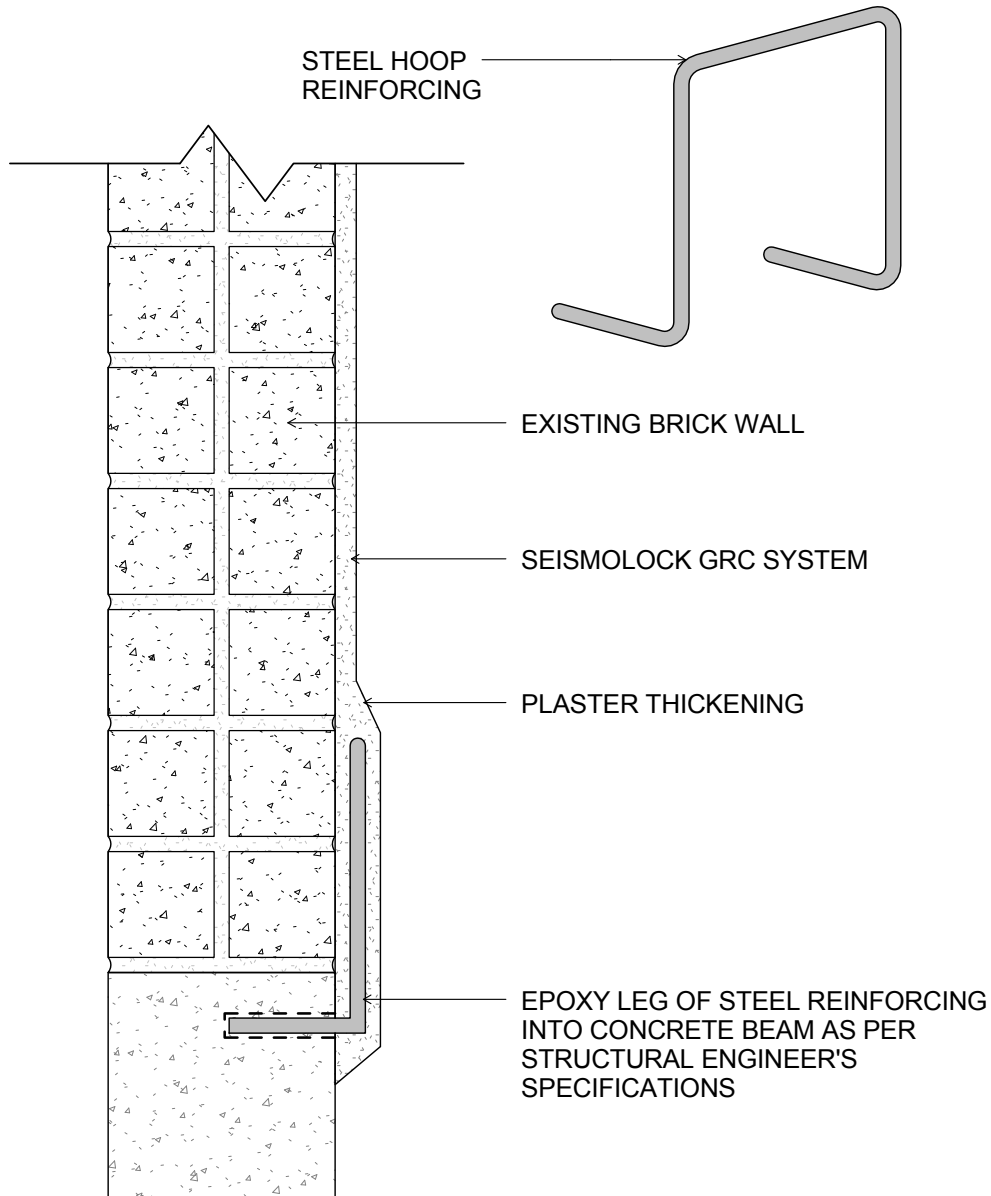
8.0 EXAMPLE DETAILS

CONCRETE FLOOR CONNECTION DETAIL



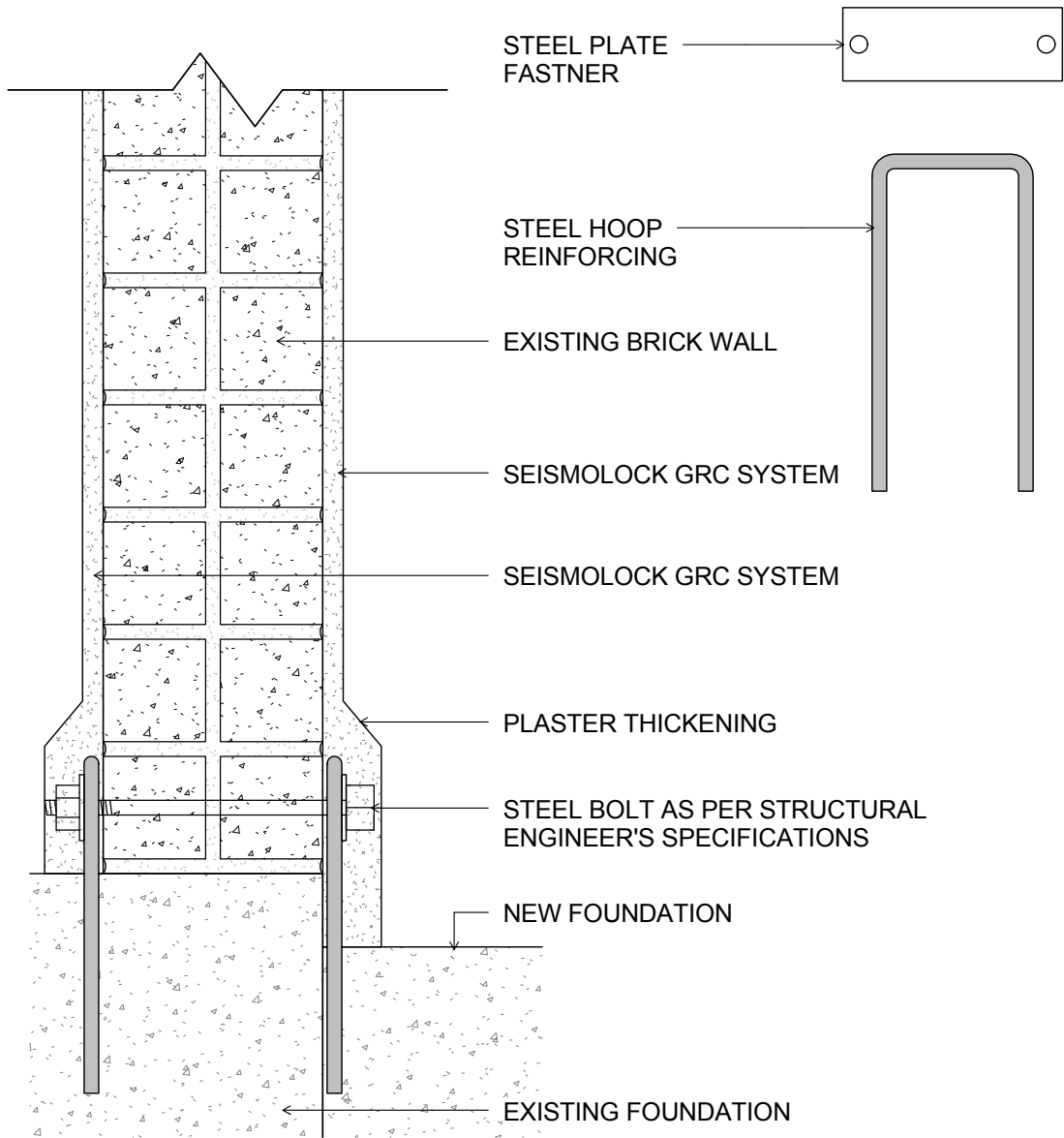
8.0 EXAMPLE DETAILS

FOUNDATION DETAIL



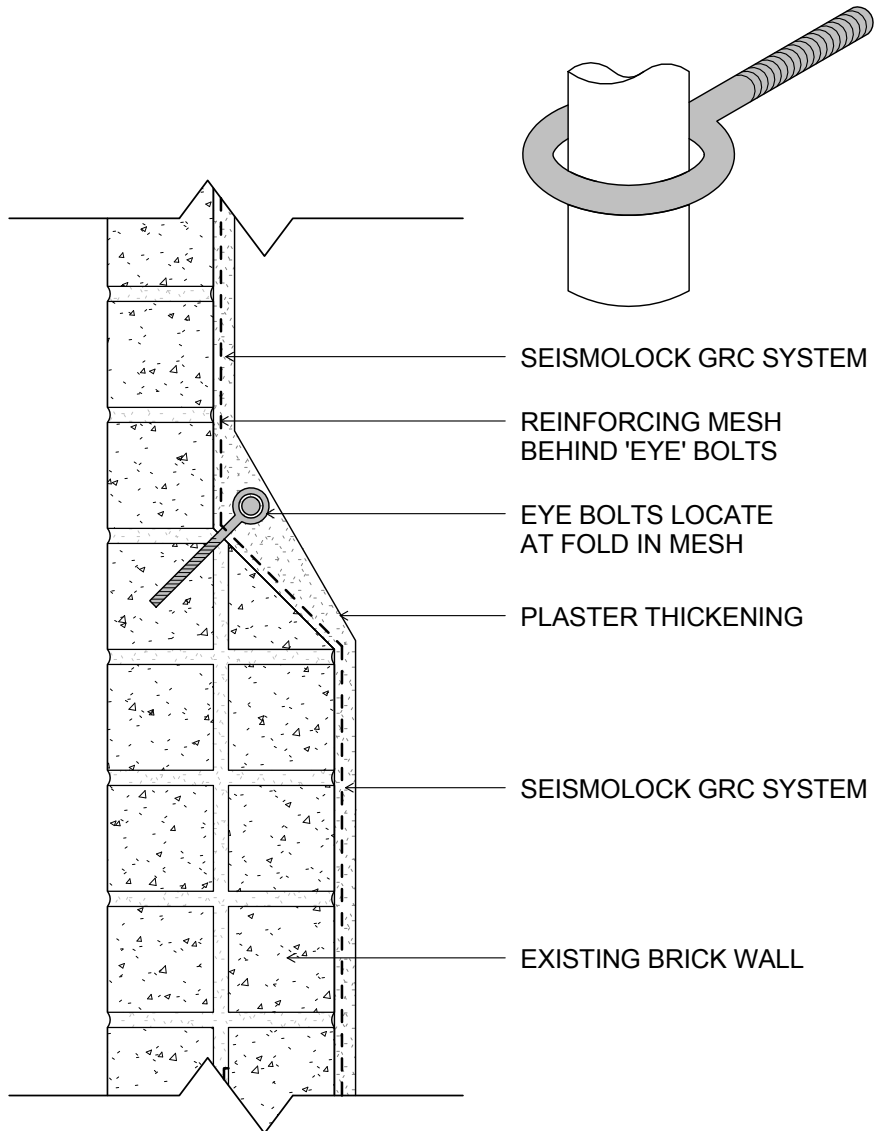
8.0 EXAMPLE DETAILS

FOUNDATION DETAIL



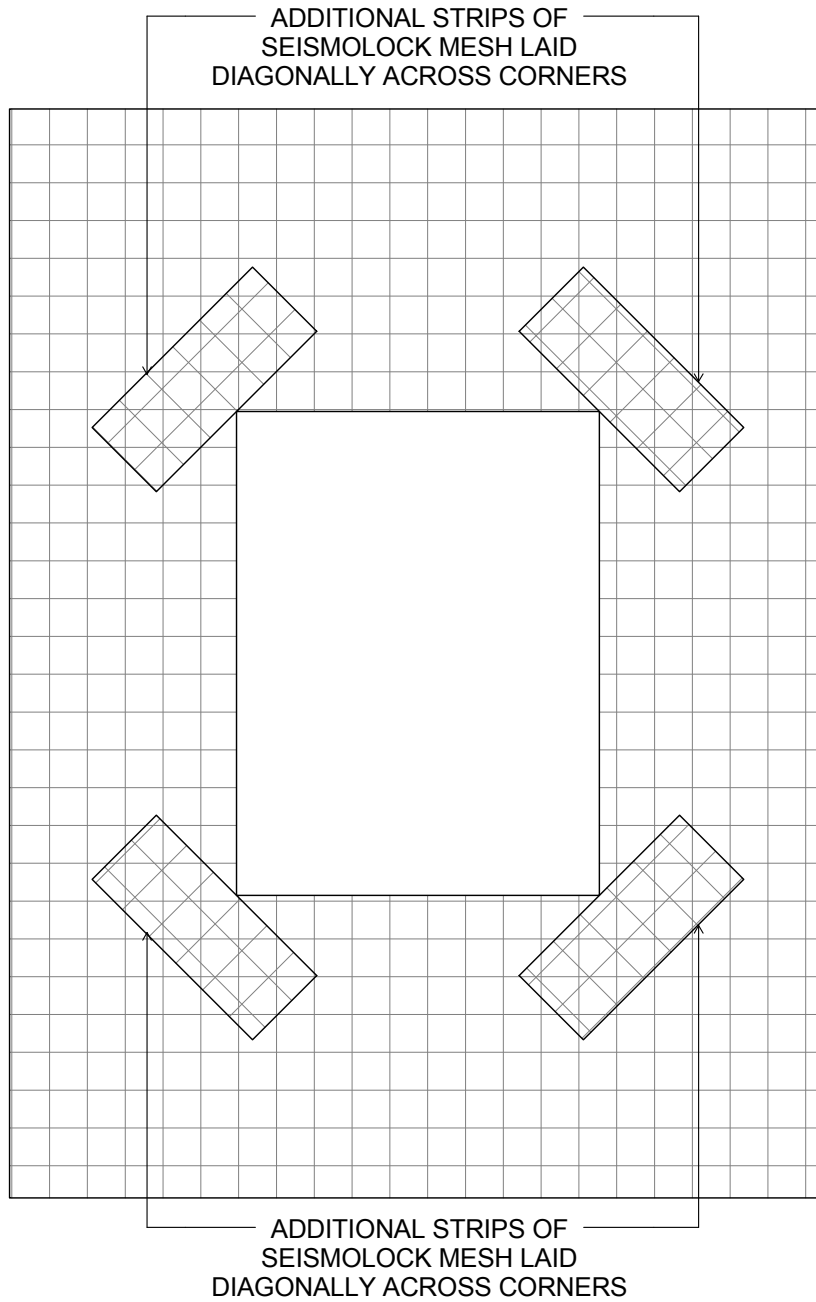
8.0 EXAMPLE DETAILS

WALL JUNCTION DETAIL



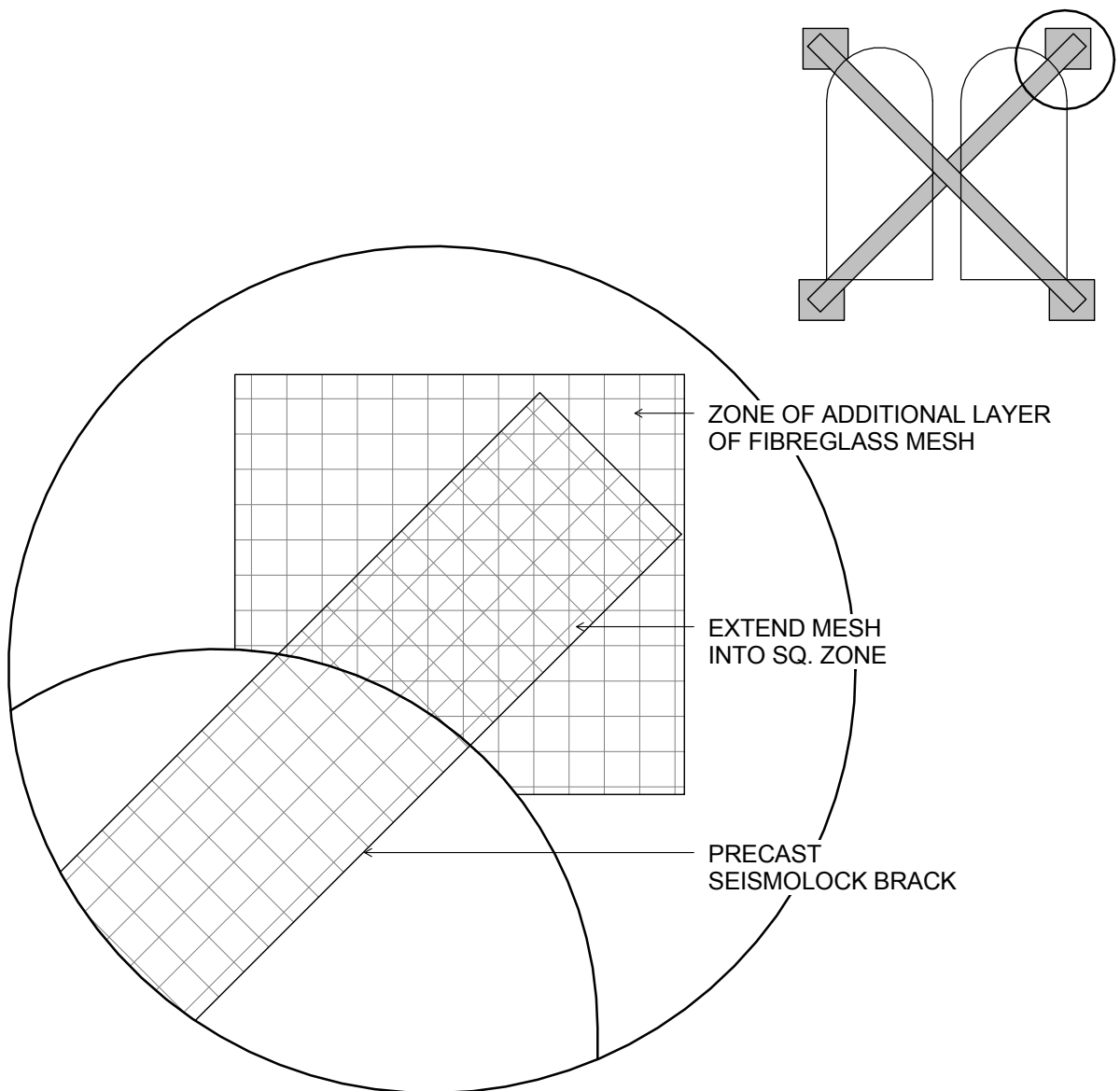
8.0 EXAMPLE DETAILS

WINDOW DETAIL



8.0 EXAMPLE DETAILS

PRECAST SEISMOLOCK BRACING DETAIL



8.0 EXAMPLE DETAILS

Previous Project Completed in Seismolock (Polyplast) in New Zealand and Australia

Project Name/Location	Size of Project	Comments
Armadillo restaurant, Wellington	140m ² x 3 mesh	Strengthening of internal tenancy walls.
Northern Steamship House - Auckland	50m ² x 2 mesh 150m ² x 4 mesh	Construction of shear walls as part of a securing project on a Heritage Building
Dulux NZ Administration block- Seaview Wellington	220m ² 5 mesh	Strengthening of exterior brick walls.
New Plymouth Fire Station	200m ² x 2 mesh	strengthening of columns/ beams engine garage area
St Joseph's Church - Picton	200m ² x 2 mesh	Strengthen brick buttress and tower. Provision of shear walls to church
Napier Fire Station	200m ² x 1 mesh	Tying concrete masonry infill panels to reinforced concrete beams and finishing with 200m ² insulclad
Waipukurau Fire Station	100m ² x 1 mesh	As for Napier Fire Station
Waikato District Council - Hamilton	100m ² x 2 mesh	Exterior brick walls and Council office concrete masonry basement
Hutt Recreation Ground - Lower Hutt	300m ² x 2 mesh	Strengthening of interior walls and finishing with tiles and Coloplast
Newcommon House - Newcastle	175m ² x 1 mesh	Securing and repair of brick walls
Chen House - Australia	200m ² x 2 mesh	Repairs to cracked brick walls and securing of building. Finished with 200m ² of Colorplast
Claremont House - Newcastle	100m ² x 1 mesh 50m ² x 2 mesh	Extensive cracking to exterior brick walls
Adamstown Church	500m ² x 2 mesh	Extensive cracking repaired on concrete block basement walls

8.0 EXAMPLE DETAILS

Previous Project Completed in Seismolock (Polyplast) in New Zealand and Australia

Project Name/Location	Size of Project	Comments
Whanganui Opera House Dome, Whanganui	550m ²	1 x layer mesh, stainless steel ties & Seismolock Strengthening of Opera House Ceiling Dome
Kiwi Bacon Building North Road, Auckland	600m ²	2 x layers mesh & Seismolock Strengthening to existing interior double skin brick walls
Colonial Inn Motel Christchurch	800m ²	2 x layers mesh & Seismolock Strengthening to URM concrete block
Wellington Settling tanks Wellington	1200m ²	2 x layers mesh & Seismolock to concrete tanks
Peel St, Building Gisborne	240m ²	1 x layer mesh & Seismolock Strengthening
Alexander Library Whanganui	800m ²	1 x layer mesh & s/s ties in conjunction with Seismolock Strengthening
Hastings Art Gallery Hastings	150m ²	2 x layers of mesh, steel corner reinforcement with Seismolock Strengthening



Whanganui Opera House Dome

9.0 SEISMOLOCK® MATERIAL SAFETY DATA SHEET

PSL SEISMOLOCK RENDER

ROCKCOTE RESENE LTD TRADING AS RESENE CONSTRUCTION SYSTEMS

Version No.3.8

Safety Data Sheet according to HSNO Regulations

Issue Date: 12/12/2016

Print Date: 12/12/2016

L.GHS.NZL.EN

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

Product Identifier

Product name	PSL SEISMOLOCK RENDER
Synonyms	Not Available
Proper shipping name	CORROSIVE SOLID, N.O.S. (contains calcium hydroxide)
Other means of identification	Not Available

Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses	Use according to manufacturer's directions.
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Details of the supplier of the safety data sheet

Registered company name	ROCKCOTE RESENE LTD TRADING AS RESENE CONSTRUCTION SYSTEMS
Address	32-50 VOGEL STREET New Zealand LOWER HUTT New Zealand
Telephone	+64 4 577 0500
Fax	+64 4 577 3327
Website	www.resene.co.nz
Email	Not Available

Emergency telephone number

Association / Organisation	Not Available
Emergency telephone numbers	0800737363
Other emergency telephone numbers	Not Available

CHEMWATCH EMERGENCY RESPONSE

Primary Number	Alternative Number 1	Alternative Number 2
+800 2436 2255	+800 2436 2255	+612 9186 1132

Once connected and if the message is not in your preferred language then please dial 01


SECTION 2 HAZARDS IDENTIFICATION

Classification of the substance or mixture

Considered a Hazardous Substance according to the criteria of the New Zealand Hazardous Substances New Organisms legislation. Classified as Dangerous Goods for transport purposes.

Classification [1]	Specific target organ toxicity - single exposure Category 2, Acute Aquatic Hazard Category 3, Metal Corrosion Category 1, Skin Corrosion/Irritation Category 1C
Legend:	1. Classified by Chemwatch; 2. Classification drawn from CCID EPA NZ; 3. Classification drawn from EC Directive 1272/2008 - Annex VI
Determined by Chemwatch using GHS/HSNO criteria	8.2C, 8.9B, 9.1D, 8.1A

Label elements

GHS label elements	
SIGNAL WORD	DANGER

Hazard statement(s)

H371	May cause damage to organs.
H402	Harmful to aquatic life
H290	May be corrosive to metals.

Continued...

9.0 SEISMOLOCK® MATERIAL SAFETY DATA SHEET

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PSL SEISMOLOCK RENDER

H314 Causes severe skin burns and eye damage.

Precautionary statement(s) Prevention

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

Precautionary statement(s) Response

P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

Precautionary statement(s) Storage

P405 Store locked up.

Precautionary statement(s) Disposal

P501 Dispose of contents/container in accordance with local regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
1305-62-0	3-6	calcium hydroxide
14808-60-7	20-40	graded sand
65997-15-1	40-60	portland cement
14808-60-7	<0.1	silica crystalline - quartz

SECTION 4 FIRST AID MEASURES

NZ Poisons Centre 0800 POISON (0800 764 766) | NZ Emergency Services: 111

Description of first aid measures

Eye Contact	<p>If this product comes in contact with the eyes:</p> <ul style="list-style-type: none"> ▶ Immediately hold eyelids apart and flush the eye continuously with running water. ▶ Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. ▶ Continue flushing for at least 15 minutes. ▶ Transport to hospital or doctor if it is necessary. ▶ Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact	<p>If skin or hair contact occurs:</p> <ul style="list-style-type: none"> ▶ Immediately flush body and clothes with large amounts of water, using safety shower if available. ▶ Quickly remove all contaminated clothing, including footwear. ▶ Wash skin and hair with running water. ▶ Transport to hospital, or doctor if it is necessary.
Inhalation	<ul style="list-style-type: none"> ▶ If dust is inhaled remove from contaminated area. ▶ Transport to hospital, or doctor in event of irritation. <p>▶ Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).</p>
Ingestion	<ul style="list-style-type: none"> ▶ For advice, contact a Poisons Information Centre or a doctor at once. ▶ Urgent hospital treatment is likely to be needed. ▶ If swallowed do NOT induce vomiting.

Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5 FIREFIGHTING MEASURES

Extinguishing media

▶ Water spray or fog.

Special hazards arising from the substrate or mixture

Fire Incompatibility None known.

Advice for firefighters

Fire Fighting ▶ Alert Fire Brigade and tell them location and nature of hazard.

Fire/Explosion Hazard ▶ Non combustible.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Continued...

9.0 SEISMOLOCK® MATERIAL SAFETY DATA SHEET

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PSL SEISMOLOCK RENDER

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Spills	▶ Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
---------------	--

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

Safe handling	▶ Avoid all personal contact.
Other information	▶ Store in original containers.

Conditions for safe storage, including any incompatibilities

Suitable container	▶ As supplied by manufacturer.
Storage incompatibility	Calcium hydroxide ▶ produces explosive decomposition on contact with maleic anhydride ▶ may form explosive compounds or explode on contact with ammonium salts, phosphorus, nitroethane, nitromethane, nitroparaffins or nitropropane; salts may be shock-sensitive ▶ is incompatible with acids ▶ attacks some metals and coatings ▶ forms salts with nitroparaffins in the presence of water which are explosive when dried.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
New Zealand Workplace Exposure Standards (WES)	calcium hydroxide	Calcium hydroxide	5 mg/m ³	Not Available	Not Available	Not Available
New Zealand Workplace Exposure Standards (WES)	graded sand	Silica-Crystalline, Quartz	0.2 Respirable dust mg/m ³	Not Available	Not Available	Not Available
New Zealand Workplace Exposure Standards (WES)	portland cement	Portland cement	10 mg/m ³	Not Available	Not Available	The value for inhalable dust containing no asbestos and less than 1% free silica.
New Zealand Workplace Exposure Standards (WES)	silica crystalline - quartz	Silica-Crystalline, Quartz	0.2 Respirable dust mg/m ³	Not Available	Not Available	Not Available

EMERGENCY LIMITS


Ingredient	Material name	TEEL-1	TEEL-2	TEEL-3
calcium hydroxide	Calcium hydroxide	1 mg/m ³	240 mg/m ³	1,500 mg/m ³
graded sand	Silica, crystalline-quartz; (Silicon dioxide)	0.075 mg/m ³	33 mg/m ³	200 mg/m ³
silica crystalline - quartz	Silica, crystalline-quartz; (Silicon dioxide)	0.075 mg/m ³	33 mg/m ³	200 mg/m ³

Ingredient	Original IDLH	Revised IDLH
calcium hydroxide	Not Available	Not Available
graded sand	N.E. / N.E.	50 mg/m ³
portland cement	N.E. / N.E.	5,000 mg/m ³
silica crystalline - quartz	N.E. / N.E.	50 mg/m ³

MATERIAL DATA

For calcium hydroxide:
In the absence of reports of adverse effects from exposure and the recognised lesser alkalinity of the alkaline earths compared with the the alkali hydroxides the relatively high value of TLV-TWA is recommended.

Exposure controls

Appropriate engineering controls	Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard.
Personal protection	
Eye and face protection	▶ Chemical goggles.

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Skin protection	See Hand protection below
Hands/feet protection	<ul style="list-style-type: none"> ▶ Wear chemical protective gloves, e.g. PVC. ▶ Neoprene rubber gloves
Body protection	See Other protection below
Other protection	<ul style="list-style-type: none"> ▶ Overalls.
Thermal hazards	Not Available

Respiratory protection

Type AX-P Filter of sufficient capacity.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	powder		
Physical state	Solid	Relative density (Water = 1)	Not Available
Odour	Not Available	Partition coefficient n-octanol / water	Not Available
Odour threshold	Not Available	Auto-ignition temperature (°C)	Not Available
pH (as supplied)	Not Available	Decomposition temperature	Not Available
Melting point / freezing point (°C)	Not Available	Viscosity (cSt)	Not Available
Initial boiling point and boiling range (°C)	Not Available	Molecular weight (g/mol)	Not Available
Flash point (°C)	Not Available	Taste	Not Available
Evaporation rate	Not Available	Explosive properties	Not Available
Flammability	Not Available	Oxidising properties	Not Available
Upper Explosive Limit (%)	Not Available	Surface Tension (dyn/cm or mN/m)	Not Applicable
Lower Explosive Limit (%)	Not Available	Volatile Component (%vol)	0
Vapour pressure (kPa)	Not Available	Gas group	Not Available
Solubility in water (g/L)	Immiscible	pH as a solution (1%)	Not Available
Vapour density (Air = 1)	Not Available	VOC g/L	0

SECTION 10 STABILITY AND REACTIVITY

Reactivity	See section 7
Chemical stability	<ul style="list-style-type: none"> ▶ Unstable in the presence of incompatible materials.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

Inhaled	Inhalation of dusts, generated by the material during the course of normal handling, may be damaging to the health of the individual. Effects on lungs are significantly enhanced in the presence of respirable particles.		
Ingestion	The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion. The material has NOT been classified by EC Directives or other classification systems as 'harmful by ingestion'.		
Skin Contact	The material can produce chemical burns following direct contact with the skin. Skin contact is not thought to have harmful health effects (as classified under EC Directives); the material may still produce health damage following entry through wounds, lesions or abrasions. Skin contact may result in severe irritation particularly to broken skin. Open cuts, abraded or irritated skin should not be exposed to this material		
Eye	The material can produce chemical burns to the eye following direct contact. Eye contact with calcium hydroxide may result in severe irritation and pain.		
Chronic	Cement contact dermatitis (CCD) may occur when contact shows an allergic response, which may progress to sensitisation. Chronic exposure to calcium hydroxide may result in narrowing of the esophagus, with difficulty in swallowing. Overexposure to respirable dust may cause coughing, wheezing, difficulty in breathing and impaired lung function. Prolonged or repeated skin contact may cause drying with cracking, irritation and possible dermatitis following.		
PSL SEISMOLOCK RENDER	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">TOXICITY</td> <td style="width: 50%; text-align: center;">IRRITATION</td> </tr> </table>	TOXICITY	IRRITATION
TOXICITY	IRRITATION		

Continued...

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	Not Available	Not Available
calcium hydroxide	TOXICITY	IRRITATION
	Dermal (rabbit) LD50: >2500 mg/kg ^[1]	Eye (rabbit): 10 mg - SEVERE
	Oral (rat) LD50: >2000 mg/kg ^[1]	
graded sand	TOXICITY	IRRITATION
	Not Available	Not Available
portland cement	TOXICITY	IRRITATION
	Not Available	Not Available
silica crystalline - quartz	TOXICITY	IRRITATION
	Not Available	Not Available

Legend: 1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2.* Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances

CALCIUM HYDROXIDE	The material may produce severe irritation to the eye causing pronounced inflammation.
PORTLAND CEMENT	The following information refers to contact allergens as a group and may not be specific to this product.
SILICA CRYSTALLINE - QUARTZ	WARNING: For inhalation exposure <u>ONLY</u> : This substance has been classified by the IARC as Group 1: CARCINOGENIC TO HUMANS The International Agency for Research on Cancer (IARC) has classified occupational exposures to respirable (<5 um) crystalline silica as being carcinogenic to humans .
CALCIUM HYDROXIDE & PORTLAND CEMENT	Asthma-like symptoms may continue for months or even years after exposure to the material ceases.
GRADED SAND & PORTLAND CEMENT	No significant acute toxicological data identified in literature search.

Acute Toxicity	☐	Carcinogenicity	☐
Skin Irritation/Corrosion	✓	Reproductivity	☐
Serious Eye Damage/Irritation	☐	STOT - Single Exposure	✓
Respiratory or Skin sensitisation	☐	STOT - Repeated Exposure	☐
Mutagenicity	☐	Aspiration Hazard	☐

Legend: ✗ – Data available but does not fill the criteria for classification
✓ – Data required to make classification available
☐ – Data Not Available to make classification

SECTION 12 ECOLOGICAL INFORMATION

Toxicity

Ingredient	Endpoint	Test Duration (hr)	Species	Value	Source
calcium hydroxide	LC50	96	Fish	160mg/L	4
calcium hydroxide	EC50	1.5	Algae or other aquatic plants	66mg/L	4
calcium hydroxide	NOEC	48	Crustacea	33.3mg/L	2

Legend: Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data

Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark.
Prevent, by any means available, spillage from entering drains or water courses.
DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
	No Data available for all ingredients	No Data available for all ingredients

Bioaccumulative potential

Ingredient	Bioaccumulation
	No Data available for all ingredients

Continued...

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Mobility in soil

Ingredient	Mobility
	No Data available for all ingredients

SECTION 13 DISPOSAL CONSIDERATIONS

Waste treatment methods

Product / Packaging disposal	
	<ul style="list-style-type: none"> ▶ DO NOT allow wash water from cleaning or process equipment to enter drains. ▶ Recycle wherever possible.

Ensure that the disposal of material is carried out in accordance with Hazardous Substances (Disposal) Regulations 2001.

SECTION 14 TRANSPORT INFORMATION

Labels Required

	
Marine Pollutant	NO
HAZCHEM	2X

Land transport (UN)

UN number	1759				
UN proper shipping name	CORROSIVE SOLID, N.O.S. (contains calcium hydroxide)				
Transport hazard class(es)	<table border="1"> <tr> <td>Class</td> <td>8</td> </tr> <tr> <td>Subrisk</td> <td>Not Applicable</td> </tr> </table>	Class	8	Subrisk	Not Applicable
Class	8				
Subrisk	Not Applicable				
Packing group	III				
Environmental hazard	Not Applicable				
Special precautions for user	<table border="1"> <tr> <td>Special provisions</td> <td>223; 274</td> </tr> <tr> <td>Limited quantity</td> <td>5 kg</td> </tr> </table>	Special provisions	223; 274	Limited quantity	5 kg
Special provisions	223; 274				
Limited quantity	5 kg				

Air transport (ICAO-IATA / DGR)

UN number	1759														
UN proper shipping name	Corrosive solid, n.o.s. * (contains calcium hydroxide)														
Transport hazard class(es)	<table border="1"> <tr> <td>ICAO/IATA Class</td> <td>8</td> </tr> <tr> <td>ICAO / IATA Subrisk</td> <td>Not Applicable</td> </tr> <tr> <td>ERG Code</td> <td>8L</td> </tr> </table>	ICAO/IATA Class	8	ICAO / IATA Subrisk	Not Applicable	ERG Code	8L								
ICAO/IATA Class	8														
ICAO / IATA Subrisk	Not Applicable														
ERG Code	8L														
Packing group	III														
Environmental hazard	Not Applicable														
Special precautions for user	<table border="1"> <tr> <td>Special provisions</td> <td>A3A803</td> </tr> <tr> <td>Cargo Only Packing Instructions</td> <td>864</td> </tr> <tr> <td>Cargo Only Maximum Qty / Pack</td> <td>100 kg</td> </tr> <tr> <td>Passenger and Cargo Packing Instructions</td> <td>860</td> </tr> <tr> <td>Passenger and Cargo Maximum Qty / Pack</td> <td>25 kg</td> </tr> <tr> <td>Passenger and Cargo Limited Quantity Packing Instructions</td> <td>Y845</td> </tr> <tr> <td>Passenger and Cargo Limited Maximum Qty / Pack</td> <td>5 kg</td> </tr> </table>	Special provisions	A3A803	Cargo Only Packing Instructions	864	Cargo Only Maximum Qty / Pack	100 kg	Passenger and Cargo Packing Instructions	860	Passenger and Cargo Maximum Qty / Pack	25 kg	Passenger and Cargo Limited Quantity Packing Instructions	Y845	Passenger and Cargo Limited Maximum Qty / Pack	5 kg
Special provisions	A3A803														
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Passenger and Cargo Maximum Qty / Pack	25 kg														
Passenger and Cargo Limited Quantity Packing Instructions	Y845														
Passenger and Cargo Limited Maximum Qty / Pack	5 kg														

Sea transport (IMDG-Code / GGVSee)

UN number	1759				
UN proper shipping name	CORROSIVE SOLID, N.O.S. (contains calcium hydroxide)				
Transport hazard class(es)	<table border="1"> <tr> <td>IMDG Class</td> <td>8</td> </tr> <tr> <td>IMDG Subrisk</td> <td>Not Applicable</td> </tr> </table>	IMDG Class	8	IMDG Subrisk	Not Applicable
IMDG Class	8				
IMDG Subrisk	Not Applicable				

Continued...

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Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

SECTION 15 REGULATORY INFORMATION

Safety, health and environmental regulations / legislation specific for the substance or mixture

This substance is to be managed using the conditions specified in an applicable Group Standard

HSR Number	Group Standard
HSR002542	Construction Products (Corrosive [B.2C]) Group Standard 2006

CALCIUM HYDROXIDE(1305-62-0) IS FOUND ON THE FOLLOWING REGULATORY LISTS

New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals
New Zealand Inventory of Chemicals (NZIoC)

New Zealand Workplace Exposure Standards (WES)

GRADED SAND(14808-60-7) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals

New Zealand Inventory of Chemicals (NZIoC)
New Zealand Workplace Exposure Standards (WES)

PORTLAND CEMENT(65997-15-1) IS FOUND ON THE FOLLOWING REGULATORY LISTS

New Zealand Inventory of Chemicals (NZIoC)

New Zealand Workplace Exposure Standards (WES)

SILICA CRYSTALLINE - QUARTZ(14808-60-7) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals

New Zealand Inventory of Chemicals (NZIoC)
New Zealand Workplace Exposure Standards (WES)

Location Test Certificate

Subject to Regulation 55 of the Hazardous Substances (Classes 1 to 5 Controls) Regulations, a location test certificate is required when quantity greater than or equal to those indicated below are present.

Hazard Class	Quantity beyond which controls apply for closed containers	Quantity beyond which controls apply when use occurring in open containers
Not Applicable	Not Applicable	Not Applicable

Approved Handler

Subject to Regulation 56 of the Hazardous Substances (Classes 1 to 5 Controls) Regulations and Regulation 9 of the Hazardous Substances (Classes 6, 8, and 9 Controls) Regulations, the substance must be under the personal control of an Approved Handler when present in a quantity greater than or equal to those indicated below.

Class of substance	Quantities
Not Applicable	Not Applicable

Refer Group Standards for further information

Tracking Requirements

Not Applicable

National Inventory	Status
Australia - AICS	Y
Canada - DSL	Y
Canada - NDSL	N (portland cement; silica crystalline - quartz; calcium hydroxide; graded sand)
China - IECSC	Y
Europe - EINEC / ELINCS / NLP	Y
Japan - ENCS	N (portland cement)
Korea - KECI	Y
New Zealand - NZIoC	Y
Philippines - PICCS	N (portland cement)
USA - TSCA	Y
Legend:	Y = All ingredients are on the inventory N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing(see specific ingredients in brackets)

SECTION 16 OTHER INFORMATION

Other information

Ingredients with multiple cas numbers

Name	CAS No
calcium hydroxide	1305-62-0, 1332-69-0

Continued...

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silica crystalline - quartz | 14808-60-7, 122304-48-7, 122304-49-8, 12425-26-2, 1317-79-9, 70594-95-5, 87347-84-0

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment.

Definitions and abbreviations

PC – TWA: Permissible Concentration-Time Weighted Average
PC – STEL: Permissible Concentration-Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit,
IDLH: Immediately Dangerous to Life or Health Concentrations
OSF: Odour Safety Factor
NOAEL: No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index

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Technical Data Sheet

PSL Seismolock Render

Description:

Seismolock is a thin fibre-reinforced plaster designed to structurally upgrade existing URM (unreinforced masonry) buildings to resist earthquake loads. The system is easily applied and provides a simple and economical alternative to traditional strengthening methods, thereby reducing construction time and site disruption. The use of this product needs to be specified by an engineer when using it to achieve earthquake strengthening.

Typical Use:

Flushing concrete block, brick and concrete. Seismolock Render provides earthquake strengthening properties.

Expectation:

Seismolock Render will adhere well to clean, dry concrete and brick and will dry and cure well in a thin coat. Thermoplast Render will provide good durability for an indefinite period depending on the life of the substrate.

Limitations:

Do not apply less than 3mm per coat or more than 8mm in one coat. Requires over-coating with finishing textures for external walls only. Seismolock is designed to be applied to DRY substrates. Do not wet down masonry or brick surfaces before the application of Seismolock and do not apply Seismolock to surfaces which are wet from rain or overnight dew. Brick, concrete block and masonry surfaces must be free of oil, paint, dirt and lichen growth.

Technical Data:

Mix ratio:	20kg plaster requires approx. 6L of water
Coverage:	10mm thick, Approx 1m ² , subsequent coats 3mm thick
Substrates:	Brick, concrete, concrete block, stone
Abrasive strength:	Excellent
Vapour flow rate:	29.46g/m ² d
Mean Resistance:	3.75MNs/g

Surface Preparation:

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Any loose or unsound surface material must be hacked off back to a solid base. The surface of glazed bricks must be removed with a scabbling tool to ensure a good plaster bond. On smooth dense concrete surfaces, a suitable key must be applied to provide a suitable bond for the Seismolock plaster. Where required, corner beads or any depth gauge beads must be in place prior to the plaster application.

Application:

Render is applied not less than 5mm thick with a steel trowel. Apply with firm pressure doubling back with more plaster to achieve a flat uniform finish. Plastering techniques like screeding, floating and scraping can be used to achieve desired flatness as required.

5mm is the minimum plaster thickness for the first coat over any substrate. When using seismolock with embedded layers of fibreglass mesh, the first coat is 5mm thick with subsequent plaster coats 3mm thick.

One mesh plaster system - 8mm
Two mesh plaster system - 11mm
Three mesh plaster system - 14mm
Four mesh plaster system - 17mm
Five mesh plaster system - 20mm

Plastering

The plaster mix can be applied to the wall by trowel, hopper gun or plaster pump. The plaster is applied in strips about one metre wide and the mesh is laid against the wet Seismolock and then trowelled into the surface of the plaster.

Note: Ensure the fibreglass mesh is laid into the wet plaster in the direction specified by the designer. Generally the mesh is laid in vertical drops, but for some design cases the mesh is laid in horizontally.

The plaster and mesh application is continued in strips along the wall with each new layer of mesh overlapping the preceding one by at least 150mm. If multiple layers of fibreglass mesh are specified, allow the preceding mesh and plaster coat to at least reach the Initial set stage before applying the next coat of plaster. Try and organise your work so that whole wall areas are completed in one day. When an area can't be completed in one day a CONSTRUCTION JOINT must be formed to allow the next day's work to be lapped into the previous reinforced mesh coats. The diagram below shows how to form a construction joint with at least 500mm of fibreglass mesh exposed at each layer with a stepped or staggered system to ensure adequate bond and continuity at the joint.

Curing:

Do not let Seismolock dry out for the first 48 hours. Protect newly applied Seismolock from temperature extremes and rain for at least 24 hours. Apply Seismolock plaster only when the

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temperature is between so to 35° and will be in that range for the 24 hour period after application. Aim to work on the shaded areas of the building, avoiding walls in direct sunlight.

Clean up:

Wash equipment and spills as soon as possible with water.

Environmental and Safety

Ensure washing water does not enter waterways. Wet waste can be soaked into land or disposed of in trade waste. The powder is an irritant and paper dust masks are advised when handling. The wet compound is Alkaline and prolonged skin contact should be avoided. Wear rubber gloves, dust mask and safety glasses when handling product.

Material Safety Data Sheets are available on request.