3.3 SPECIFIC DESIGN – HIBOND FLOORING

3.3.1 INTRODUCTION

The Hibond Flooring System has been designed to comply with BS 5950 using the relevant load combinations therein and the relevant clauses of the New Zealand Building Code. Detailed analysis and comprehensive physical testing have enabled load/span tables to be established using the limit states design philosophy.

Data presented in this manual is intended for use by structural engineers. Use of the Hibond Flooring System in applications other than uniformly distributed loads or outside the scope of this manual will require specific design.

A design yield strength of 550 MPa for 0.75mm base metal thickness (BMT) Hibond and 520 MPa for 0.95mm BMT Hibond has been used.

A minimum 28 day compressive strength of 25 MPa for high grade concrete has been assumed.
A minimum Hibond flooring slab thickness of 110mm has been used in this manual, in accordance with BS 5950.

The self weight of the Hibond Flooring System (including the concrete) has been included in the load tables.

3.3.2 DESIGN CONSIDERATIONS

Formwork

Where Hibond sheet is used as formwork, the trapezoidal shape of the profile provides resistance to wet concrete (G) and construction loads (Q). Maximum formwork spans given in Section 3.3.4.1 Hibond Formwork Tables are based on design checks for bending, web crushing, vertical shear, combined actions and deflection.

Hibond sheets must be laid in one continuous length between permanent supports. Short sheets of Hibond must never be spliced together to achieve the span between temporary or permanent supports.

Composite Slab

Design capacity of the Hibond Flooring System is largely dependent on interaction between the concrete and the Hibond sheet commonly referred to as shear bond. Shear bond is a combination of chemical bond between the concrete and the Hibond sheet and mechanical bond between the concrete and the embossments in the webs of the Hibond sheet. This allows tension forces to be transferred from the concrete into the Hibond sheet.

Capacities for the Ultimate Limit State were derived for positive bending, shear bond, vertical shear and negative bending as appropriate. Each of these values was back substituted into the design combinations for the applied actions using 1.4 (dead load) + 1.6 (superimposed load).

The minimum resulting superimposed load, from all actions (including deflections), was used in the tables.

Appropriate imposed floor actions (Q) should be determined in accordance with AS/NZS 1170.1. All superimposed dead load (G_{SDL}) is then added to the imposed action (Q) to give a design superimposed load (G_{SDL} + Q) expressed in kPa for direct comparison with the tabulated data in Section 3.3.5 Hibond Composite Slab Load Span Tables.

Fire Design

Fire resistance for the Hibond Flooring System may be achieved by several methods. These include placement of additional reinforcement, spray-on insulation retardant, placement of suspended ceilings, and increasing the overall slab thickness. We have considered placement of additional reinforcement in the fire design tables.

This method is based on resistance to collapse (stability), the ability of the Hibond floor slab to prevent flames passing through cracks formed in the slab (integrity) and limiting the temperature increase on the unexposed side of the Hibond floor slab (insulation).

The fire design tables are based on design checks for bending (shear is rarely critical), in accordance with NZS 3101, based on the load combination $G + \psi_\ell Q$ for single spans which are effective in fire emergency conditions (where ψ_ℓ is the factor for determining quasi-permanent values for long term actions). Full design methodology is provided in HERA Report R4-82.

The fire design tables include a superimposed dead load (G_{SDL}) of 0.5 kPa in order that an imposed action (Q) can be compared directly with the tables in Section 3.3.6 Fire Design Tables.

Continued on next page

3.3.2 DESIGN CONSIDERATIONS *continued*

Additional Reinforcement

Mesh Reinforcement

Mesh reinforcement is placed at minimum cover (according to durability requirements outlined in NZS 3101 Section 3.11) in order to provide:

- Control of cracks caused by shrinkage during curing.
- Nominal continuity reinforcement over supporting members where a floor is designed as a series of simply supported Hibond floor slabs.

For propped construction consideration should be given to increasing nominal continuity reinforcement over supports as crack widths will increase when props are removed. Guidance on crack width tolerances is given in NZS 3101 and HERA Report R4-113.

Consideration should be given to orientating the top bar of the mesh to be parallel to the span of the steel sheet. This will provide the optimum nominal continuity from the mesh.

The following guide features mesh sizes for various slab thicknesses based on the degrees of crack control recommended in AS 3600 in conjunction with the exposure classification, concrete strengths and cover to reinforcing in NZS 3101.

These guidelines do not cover special requirements for reinforcement at locations where the slab is subject to high stresses due to deformation compatability (for example around columns).

Where NZS 3101 requires explicit crack control, this must be specifically determined by the design engineer.

1. For composite slabs fully enclosed within a building except during construction (generally exposure classification A1)

AS 3600 Criteria Design Slab Thickness DS (mm)	Minor		Moderate		Strong	
	Non-Ductile	Super Ductile	Non-Ductile	Super Ductile	Non-Ductile	Super Ductile
110	665	SE62	663	SE82	2 x 663	2 x SE82
120	665	SE62	2 x 665	2 x SE62	2 x 663	2 x SE82
130	665	SE62	2 x 665	2 x SE62	HD12 @ 250	HD12 @ 250
140	663	SE82	2 x 663	2 x SE82	HD12 @ 200	HD12 @ 200
150	663	SE82	2 x 663	2 x SE82	HD12 @ 175	HD12 @ 175
160	663	SE82	2 x 663	2 x SE82	HD12 @ 175	HD12 @ 175
170	663	SE82	2 x 663	2 x SE82	HD12 @ 150	HD12 @ 150
180	2 x 665	2 x SE62	HD12 @ 250	HD12 @ 250	HD12 @ 150	HD12 @ 150
190	2 x 665	2 x SE62	HD12 @ 200	HD12 @ 200	HD12 @ 100	HD12 @ 100
200	2 x 665	2 x SE62	HD12 @ 200	HD12 @ 200	HD12 @ 100	HD12 @ 100

Note:

a. For nominal continuity reinforcement over supporting members where a floor is designed as a series of simply supported Hibond floor slabs, use the 'minor' column in the table above.

b. Where ductile steel reinforcing bars (eg H16@200) are used the maximum area of longitudinal top steel required is the **greater** of 75% of the area of transverse steel required in the table above or the amount of longitudinal steel required for continuity from the load span tables in Section 3.3.5 or that determined by specific design. Reinforcing bars are Grade 500 to AS/NZS 4671.

c. Super Ductile wire mesh is based on a minimum 500MPa tensile wire.

Continued on next page

3.3.2 DESIGN CONSIDERATIONS *continued*

2. For composite slabs in exposure classification A2 moderate or strong crack control is always required.

Required Slab Thickness (mm)	AS 3600 Criteria Design Slab Thickness DS (mm)	Moderate		Strong	
		Non-Ductile	Super Ductile	Non-Ductile	Super Ductile
120	110	2 x 665	2 x SE62	2 x 663	2 x SE82
130	120	2 x 665	2 x SE62	HD12 @ 250	HD12 @ 250
140	130	2 x 665	2 x SE62	HD12 @ 200	HD12 @ 200
150	140	2 x 663	2 x SE82	HD12 @ 175	HD12 @ 175
160	150	2 x 663	2 x SE82	HD12 @ 175	HD12 @ 175
170	160	2 x 663	2 x SE82	HD12 @ 150	HD12 @ 150
180	170	2 x 663	2 x SE82	HD12 @ 150	HD12 @ 150
190	180	HD12 @ 250	HD12 @ 250	HD12 @ 125	HD12 @ 125
200	190	HD12 @ 200	HD12 @ 200	HD12 @ 125	HD12 @ 125
210	200	HD12 @ 200	HD12 @ 200	HD12 @ 100	HD12 @ 100

Note:

a. To illustrate the effect of exposure classification on crack control requirements the slab thickness has been increased by 10mm to meet the minimum cover requirements of NZS 3101. This assumption means that longitudinal top steel requirements over supporting members can be designed using the load span tables in Section 3.3.5, provided that the extra thickness is treated purely as superimposed dead load and the composite slab is designed to the original design slab thickness.

b. Where ductile steel reinforcing bars (eg H16@200) are used the maximum area of longitudinal top steel required is the **greater** of 75% of the area of transverse steel required in the table above or the amount of longitudinal steel required for continuity from the load span tables in Section 3.3.5 or that determined by specific design. Reinforcing bars are Grade 500 to AS/NZS 4671.

3. For composite slabs in exposure classification B1 strong crack control is always required.

Required Slab Thickness (mm)	AS 3600 Criteria Design Slab Thickness DS (mm)	Strong	Strong Ductile
120	110	HD12 @ 250	HD12 @ 250
130	120	HD12 @ 200	HD12 @ 200
140	130	HD12 @ 200	HD12 @ 200
150	140	HD12 @ 175	HD12 @ 175
160	150	HD12 @ 150	HD12 @ 150
170	160	HD12 @ 150	HD12 @ 150
180	170	HD12 @ 125	HD12 @ 125
190	180	HD12 @ 125	HD12 @ 125
200	190	HD12 @ 125	HD12 @ 125
210	200	HD12 @ 100	HD12 @ 100

Note:

a. To illustrate the effect of exposure classification on crack control requirements the slab thickness has been increased by 15mm to meet the minimum cover requirements of NZS 3101. This assumption means that longitudinal top steel requirements over supporting members can be designed using the load span tables in Section 3.3.5, provided that the extra thickness is treated purely as superimposed dead load and the composite slab is designed to the original design slab thickness.

b. Ductile requirements have been provided for this exposure classification to provide the flexibility that longitudinal bars could be used in conjunction with the above for negative steel requirements.

c. Where ductile steel reinforcing bars (eg H16@200) are used the maximum area of longitudinal top steel required is the **greater** of 75% of the area of transverse steel required in the table above or the amount of longitudinal steel required for continuity from the load span tables in Section 3.3.5 or that determined by specific design. Reinforcing bars are Grade 500 to AS/NZS 4671.

d. Composite slabs in exposure classification B2 and C will require a thicker slab than those for B1 above and a higher strength concrete – therefore specific design to NZS 3101 is required.

3.3.2 DESIGN CONSIDERATIONS *continued*

Ductile Reinforcement

Ductile reinforcement (to elongation requirements of BS 4449) may also be required in the following instances:

- To gain full continuity over supporting members in continuous spans (refer Section 3.3.5 Hibond Composite Slab Load Span Tables).
- To increase the fire resistance of the floor slab (refer Section 3.3.6 Fire Design Tables).
- To distribute loads around openings in the floor slab.
- To provide negative reinforcement necessary for floor slabs used as cantilevers (where the contribution of the Hibond sheet is neglected in design).
- Where a point load is not fixed in position and can occur anywhere on the floor slab (for example car parks), placement of transverse reinforcement is required throughout the slab (minimum area as for line loads).
- When used as transverse reinforcement to distribute point loads and line loads; and resist transverse bending in the composite slab as a result of point loads (refer Section 3.3.10 Design Examples). The following two cases need to be considered.

$P_Q \leq 7.5$ kN

For a discrete point load ≤ 7.5 kN it is practical to use 2 – H10 transverse bars over the effective width of the Hibond slab (b_{eb} – refer BS 5950: Part 4 Clause 6.7) centred about the point load.

Where line loads perpendicular to the direction of slab span are present (≤ 7.5 kN/m), transverse reinforcing bars with a minimum cross sectional area of $2(D_s - 55)$ mm^2 per metre of load length (over the effective width of the line load) is required.

This equates to: H10 @ 400mm centres for composite slabs 110-150mm
H12 @ 400mm centres for composite slabs 160-200mm

Line loads running parallel to the span should be treated as a series of discrete point loads.

$P_Q > 7.5$ kN

For a discrete point load > 7.5 kN, transverse reinforcement is required to satisfy the following moment resistance.

$M^*_{trans} = P^* b_{eb} / (15w)$ where $w = L/2 + b_1$ and $w \ngtr L$

Where M^*_{trans} = Factored bending moment in the transverse direction
P^* = Factored concentrated point load
b_{eb} = Effective width of slab
L = Span of composite slab
b_1 = Concentrated load length in direction of slab span

Where line loads perpendicular to the direction of slab span are present (> 7.5 kN/m), P^* is represented as a factored load per metre and b_{eb} is taken as equal to one metre.

Line loads running parallel to the span should be treated as a series of discrete point loads.

This requirement is based on recommendations from the Composite Deck Design Handbook by Heagler RB, Luttrell LD and Easterling WS; published by The Steel Decking Institute, Illinois 1997.

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3.3.2 DESIGN CONSIDERATIONS *continued*

Noise Control
Design guidance on Sound Transmission Class (STC) and Impact Insulation Class (IIC) values for Hibond Flooring Systems has been obtained through physical testing. This is covered in detail in Section 3.3.7 Noise Control.

Floor Vibration
As a guide to designers, the limits expressed in the composite slab design tables represent the maximum span of the Hibond floor slab recommended for in-service floor vibration of an open plan commercial office floor with a low damping ratio (few small partitions) and a residence with higher damping (many full height partitions). Specific design is required to check other types of floor use. This represents the slab response of a person traversing the floor, but does not account for the dynamic response of the supporting structure.

For further information, including a design example, refer Section 3.3.8 Floor Vibration.

Thermal Insulation
Design guidance on thermal resistance (R) values for Hibond floor slabs to NZS 4218 is covered in Section 3.3.9 Thermal Insulation.

In Floor Heating
Where in floor heating is to be used in a Hibond composite slab, consideration should be given to the structural impact of placing heating systems within the compression zone of the floor slab. For example the overall slab thickness could be increased to compensate for any loss of structural integrity caused by the inclusion of in floor heating.

Two systems are commonly available:

- Water, utilising polybutylene tubes up to 20mm outside diameter and spaced as closely as 200mm with minimum 25mm top cover.
- Electrical, utilising wires up to 8mm outside diameter and spaced as closely as 100mm.

Both systems are typically attached directly to the top of the shrinkage mesh, in a pattern determined by the wall layout above the floor in question.

The in floor heating system must not be used to cure the slab as it will cause excessive cracking.

Hibond Design Wizard
Dimond offers the Hibond Design Wizard available as a complimentary CD for engineers and specifiers. (Call 0800 775 777 to order your copy.)

The Hibond Design Wizard is a comprehensive design tool composed of a preliminary design module and a detailed design module. It covers a range of composite designs with Hibond floor slabs and composite secondary/primary beams, providing rapid design solutions and evaluation of alternatives.

The Wizard includes flooring scenarios for unpropped, propped and pre-cambered design along with full strength and serviceability checks and vibration design.

For further design assistance call 0800 Roofspec (0800 766 377).

Although the Hibond Design Wizard is a comprehensive design aid, it is intended that the design engineer check, detail and make amendments as necessary in order to approve the design for construction and to ensure compliance with the relevant codes of practice in relation to building.

Continued on next page

3.3.2 DESIGN CONSIDERATIONS *continued*

Composite Beam Design

The use of the composite beam design concept can result in significant strength and stiffness gains over non-composite beam design. Composite beam design uses shear connectors to interconnect the Hibond floor slab and the beam. Shear connectors are typically 19mm diameter x 100mm long nominal.

The shear connection between the Hibond floor slab and the beam resists slipping at the interface, resulting in an interaction between the two members. This allows compressive forces to develop in the Hibond floor slab and tensile forces to develop in the beam.

The strength achieved in the composite beam is generally dependent on the strength of the shear connection provided between the Hibond floor slab and the beam. It is assumed that the shear connection is ductile.

Three types of construction are commonly used with composite beams.

Unpropped

- Where composite slab, secondary and primary beams are all constructed in an unpropped condition.
- Unpropped construction generally uses larger member sizes. However construction time is minimised, and on this basis unpropped construction is preferred.
- The composite slab is poured to level for unpropped construction.

Propped

- Where secondary and primary beams are propped during construction. The composite slab is usually propped but may also be unpropped.
- Propped construction results in more efficient member sizes. However access to sub-trades is restricted until props have been removed.
- The composite slab is poured to level for propped construction.

Pre-cambered

- Where secondary and/or primary beams are fabricated with a pre-camber. The composite slab is unpropped for this type of construction.
- Pre-cambered construction provides member size efficiency and minimal soffit deflection and is effective on large spans.
- Pre-cambered construction requires the composite slab to be poured to constant thickness.

For further and concise information regarding composite beam construction refer to HERA Report R4-107 Composite Floor Construction Handbook.

3.3.2.1 DESIGN LIMITATIONS

Where Hibond floor slab is greater than 200mm overall thickness, the Hibond sheeting must be used as formwork only and the floor slab designed using additional positive reinforcement.

Cantilevers
Where Hibond sheet is used in cantilever situations, a propping line is required at the sheet ends to ensure a stable working platform is achieved during construction and pouring of the concrete (refer to Section 3.3.4.2 Propping).

As a guide, propping of the Hibond sheet is not required for cantilevers with a clear over-hang of,

300mm for 0.75mm Hibond
400mm for 0.95mm Hibond.

These cantilever spans assume:

- The Hibond sheets are securely fixed to the edge supporting member and the adjacent internal supporting member in accordance with Section 3.3.4.3 Bearing and Fixing Requirements.
- That Hibond edge form at the end of the cantilever is secured with one self-drilling screw (or rivet) per Hibond pan along with edge form support straps as detailed in Section 3.3.13.2 Edge Form Support Strap.

Additional ductile negative reinforcement is required to be designed to support all cantilevered floor slabs.

Pre-Cambering of Hibond Sheet
Pre-cambering of the Hibond sheet will result in less overall deflections of the composite slab. This is achieved by installing props which are higher than the supporting structure.

Caution is required when using pre-cambered Hibond sheet as the concrete must be poured to constant thickness, as flat screeding will result in less than the minimum design slab thickness at mid-span.

In any case the pre-camber must not exceed span/350.

Timber Structure
Hibond is not intended for use on permanent timber supporting beams unless the beams have been specifically engineered to ensure undue deflection due to moisture, long-term creep or shrinkage does not affect the concrete floor performance.

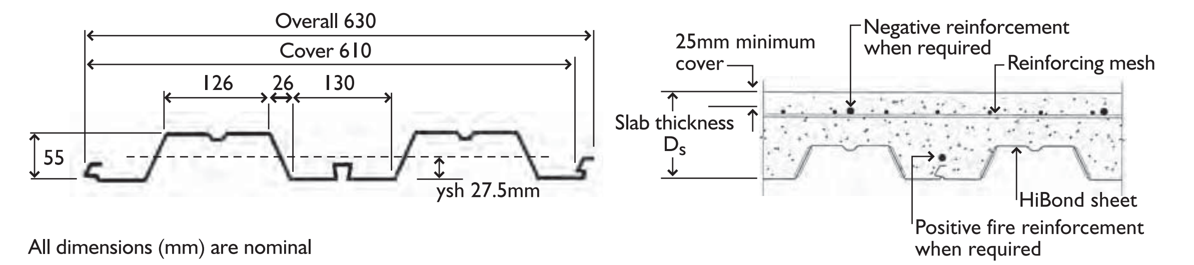
When the Hibond sheet is in contact with timber, refer to Section 3.1.3.2 Limitations on Use.

Shear connectors into timber require specific design. These could include galvanised coach screws or reinforcing bar epoxy glued into timber beams and turned into slab.

Two Way Slabs
The Hibond floor slab is made specifically for use in one way slab construction. However, specific design as a two way slab may be carried out to NZS 3101, provided the concrete strength contribution below the Hibond ribs, in the transverse direction, is ignored in the design.

Bridge Structures
Hibond is not intended to be used in bridge structures other than as permanent formwork, unless specifically designed for that purpose.

3.3.3 HIBOND SECTION PROPERTIES



HIBOND FORMWORK PROPERTIES (PER METRE WIDTH)

Thickness mm	Weight kN/m	Cross Sectional Area A_p mm^2	Design Strength p_y MPa	Bending Strengths M_c^+ kNm	Bending Strengths M_c^- kNm	Web Crushing Strength P_w, kN End Support	Web Crushing Strength P_w, kN Internal Support
0.75	0.085	1058	550	5.46	6.51	14.52	29.05
0.95	0.108	1340	520	8.93	9.71	21.34	42.68

Thickness mm	Bending/Web Crushing Interaction Equation at Internal Support Limited by:	Shear Strength P_v kN	Second Moment of Area $10^6 mm^4$ Single Span I_s	Second Moment of Area $10^6 mm^4$ Multispan I_m
0.75	$F_w / 29.05 + M^- / 6.51 < 1.43$	45.1	0.493	0.391
0.95	$F_w / 42.68 + M^- / 9.71 < 1.56$	71.6	0.605	0.448

Notes

1. Design strength p_y is 0.84 x ultimate tensile strength.
2. Shear strength values P_v are derived from calculation as per BS 5950.
3. All other values are derived from test results.
4. F_w is the reaction or concentrated load on Hibond rib.
5. M^- is the negative bending moment in the Hibond sheet formwork at the internal support.
6. ysh is the distance from the bottom of the Hibond sheet to the neutral axis.

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3.3.3 HIBOND SECTION PROPERTIES *continued*

0.75mm HIBOND COMPOSITE SLAB PROPERTIES (PER METRE WIDTH)

D_s mm	Weight kN/m	I_g 10^6mm^4 medium	I_g 10^6mm^4 long	Y_g mm medium	Y_g mm long	I_{cr} 10^6mm^4 medium	I_{cr} 10^6mm^4 long	Y_{cr} mm medium	Y_{cr} mm long	I_{av} 10^6mm^4 medium	I_{av} 10^6mm^4 long
110	1.99	8.9	5.7	49.1	51.9	4.4	3.7	32.6	40.3	6.6	4.7
120	2.22	11.6	7.3	53.9	56.9	5.5	4.7	35.0	43.4	8.6	6.0
130	2.45	14.7	9.3	58.7	61.8	6.8	5.8	37.3	46.4	10.8	7.5
140	2.68	18.5	11.6	63.6	66.7	8.3	7.1	39.5	49.3	13.4	9.3
150	2.91	22.8	14.2	68.4	71.7	10.0	8.5	41.5	52.0	16.4	11.4
160	3.14	27.9	17.3	73.3	76.6	11.8	10.1	43.5	54.6	19.8	13.7
170	3.37	33.6	20.8	78.2	81.6	13.7	11.8	45.4	57.2	23.7	16.3
180	3.60	40.1	24.7	83.1	86.6	15.9	13.7	47.3	59.6	28.0	19.2
190	3.83	47.4	29.1	88.0	91.5	18.2	15.8	49.1	62.0	32.8	22.4
200	4.06	55.6	34.0	93.0	96.5	20.7	18.0	50.8	64.3	38.2	26.0

0.95mm HIBOND COMPOSITE SLAB PROPERTIES (PER METRE WIDTH)

D_s mm	Weight kN/m	I_g 10^6mm^4 medium	I_g 10^6mm^4 long	Y_g mm medium	Y_g mm long	I_{cr} 10^6mm^4 medium	I_{cr} 10^6mm^4 long	Y_{cr} mm medium	Y_{cr} mm long	I_{av} 10^6mm^4 medium	I_{av} 10^6mm^4 long
110	2.01	9.4	6.1	50.1	53.4	5.2	4.3	35.6	43.6	7.3	5.2
120	2.24	12.1	7.8	54.9	58.4	6.6	5.4	38.3	47.1	9.3	6.6
130	2.47	15.4	9.9	59.8	63.4	8.1	6.8	40.8	50.4	11.8	8.3
140	2.70	19.3	12.3	64.7	68.4	9.9	8.3	43.2	53.6	14.6	10.3
150	2.93	23.8	15.1	69.5	73.4	11.9	9.9	45.6	56.6	17.8	12.5
160	3.16	29.0	18.3	74.5	78.4	14.0	11.8	47.8	59.5	21.5	15.1
170	3.39	34.9	21.9	79.4	83.5	16.4	13.9	49.9	62.4	25.7	17.9
180	3.62	41.6	26.0	84.3	88.5	19.0	16.1	52.0	65.1	30.3	21.1
190	3.86	49.1	30.6	89.2	93.5	21.9	18.6	54.0	67.8	35.5	24.6
200	4.09	57.5	35.8	94.2	98.5	24.9	21.2	56.0	70.4	41.2	28.5

Notes

1. D_s is the overall thickness of the slab.
2. Slab weights are based on a dry concrete density of 2350 kg/m^3 with no allowance for ponding.
3. Section properties are presented in terms of equivalent steel units as follows:
   (a) Medium term superimposed loads are based on ⅔ short term and ⅓ long term load (ie modular ratio = 10) and apply to buildings of normal usage.
   (b) Long term superimposed loads are based on all loads being long term (ie modular ratio = 18) and apply to storage loads and loads which are permanent in nature.
4. I_g is the second moment of area of the gross composite Hibond section.
5. I_{cr} is the second moment of area of the cracked composite Hibond section.
6. I_{av} is the average value of gross (I_g) and cracked (I_{cr}) sections to be used for deflection calculations.
7. Y_g is the distance from top of slab to neutral axis of the composite Hibond slab for gross section.
8. Y_{cr} is the distance from top of slab to neutral axis of the composite Hibond slab for the cracked section.

3.3.4 FORMWORK DESIGN

3.3.4.1 HIBOND FORMWORK TABLES

Maximum formwork spans for slab thicknesses between 110mm and 300mm are provided in the following tables.

The following notes apply to the formwork tables in this section.

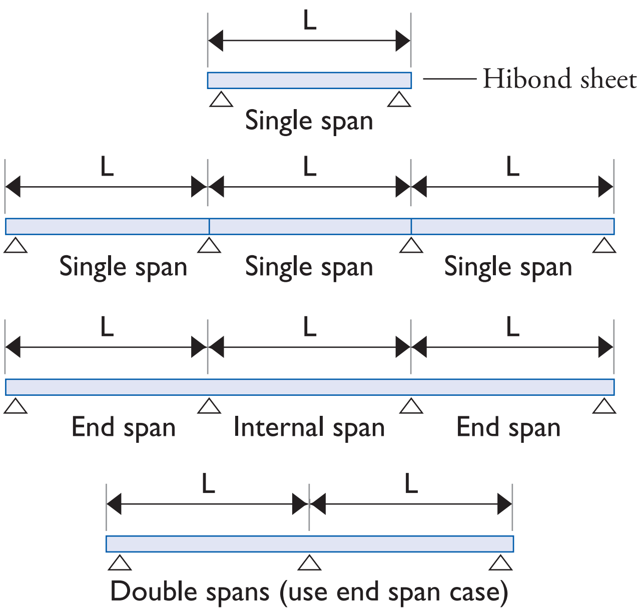
1. D_s is the overall thickness of the slab.
2. Slab weights (G) are based on a wet concrete density of 2400 kg/m³ with no allowance for ponding.
3. A construction load (Q) taken from BS 5950 is incorporated in these tables. This provides for a minimum of 1.5 kPa and for spans (L) less than 3000mm, 4500/L kPa has been used.
4. L is the maximum span measured centre to centre between permanent or temporary supports.
5. Use of the double or end span tables and internal span tables assumes,
   - All spans have the same slab thickness.
   - The end span is within plus 5% or minus 10% of the internal span and that the end and internal spans are both designed using the appropriate load span table.
   - Double spans are within 10% of each other and the slab design is based on the largest span.
   - Internal spans are within 10% of each other and the slab design is based on the largest internal span.

   Any variations to the above configurations require specific design using the Hibond Formwork Properties table in Section 3.3.3.
6. These tables are based on minimum bearing of Hibond sheet given in Section 3.3.4.3.
7. It should be noted that double or end span capabilities may be less than single spans as the interaction of bending and web crushing create a worse case.
8. Deflection limits incorporated in these tables are as follows:
   a) L/180 maximum due to dead load (G) only.
   b) D_s/10 maximum, to avoid concrete ponding problems.

   These limits are represented in the 'Allow' (allowable) column of the Hibond Formwork Tables. The 5mm limit column should be referred to where soffit deflection is to be reduced.
9. For intermediate values, linear interpolation is permitted.
10. As a guide, formwork deflections of around 15 mm under dead load (G) should be expected within the extent of the tables. Construction loads (Q) will increase deflections.
11. The design span of the formwork relates closely to site installation. If the Hibond sheet is designed as an end span or internal span, the minimum nominal sheet length for construction should be noted clearly in the design documentation to ensure that appropriate sheet lengths are used by the installer to achieve the span type selected. Refer to Section 3.5 Installation.

Typical Formwork Slab Span Configurations

This configuration can only be used where all supports are permanent.



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Dimond

3.3.4.1 HIBOND FORMWORK TABLES *continued*

0.75mm HIBOND FORMWORK SPAN CAPABILITIES

D_s mm	Slab Weight kPa	Concrete Quantity m^3/m^2	Maximum Span (L) mm Single		Double or End		Internal	
			Allow.	5mm limit	Allow.	5mm limit	Allow.	5mm limit
110	2.03	0.0825	2500	2050	2800	2450	3150	2950
120	2.26	0.0925	2500	2000	2800	2350	3050	2850
130	2.50	0.1025	2500	1950	2750	2300	2900	2800
140	2.74	0.1125	2500	1900	2650	2250	2750	2700
150	2.97	0.1225	2400	1900	2550	2200	2600	2600
160	3.21	0.1325	2350	1850	2450	2150	2500	2500
170	3.44	0.1425	2300	1800	2350	2150	2400	2400
180	3.68	0.1525	2250	1800	2250	2100	2300	2300
190	3.91	0.1625	2200	1750	2150	2050	2250	2250
200	4.15	0.1725	2150	1750	2100	2050	2150	2150
210	4.38	0.1825	2150	1700	2000	2000	2100	2100
220	4.62	0.1925	2100	1700	1950	1950	2000	2000
230	4.85	0.2025	2050	1650	1900	1900	1950	1950
240	5.09	0.2125	2000	1650	1850	1850	1900	1900
250	5.32	0.2225	2000	1600	1800	1800	1850	1850
260	5.56	0.2325	1950	1600	1750	1750	1800	1800
270	5.79	0.2425	1900	1600	1700	1700	1750	1750
280	6.03	0.2525	1900	1550	1650	1650	1700	1700
290	6.26	0.2625	1850	1550	1600	1600	1650	1650
300	6.50	0.2725	1850	1550	1600	1600	1650	1650

0.95mm HIBOND FORMWORK SPAN CAPABILITIES

D_s mm	Slab Weight kPa	Concrete Quantity m^3/m^2	Maximum Span (L) mm Single		Double or End		Internal	
			Allow.	5mm limit	Allow.	5mm limit	Allow.	5mm limit
110	2.05	0.0825	2650	2200	2900	2500	3700	3050
120	2.29	0.0925	2650	2100	2850	2450	3650	2950
130	2.52	0.1025	2600	2050	2850	2400	3650	2850
140	2.76	0.1125	2600	2000	2850	2350	3650	2800
150	2.99	0.1225	2600	2000	2850	2300	3600	2750
160	3.23	0.1325	2500	1950	2800	2250	3500	2700
170	3.46	0.1425	2450	1900	2750	2200	3400	2650
180	3.70	0.1525	2400	1850	2700	2150	3300	2600
190	3.93	0.1625	2350	1850	2650	2150	3200	2550
200	4.17	0.1725	2300	1800	2600	2100	3100	2550
210	4.40	0.1825	2300	1800	2550	2100	3050	2500
220	4.64	0.1925	2250	1750	2500	2050	2950	2450
230	4.88	0.2025	2200	1750	2450	2000	2850	2450
240	5.11	0.2125	2150	1750	2400	2000	2800	2400
250	5.35	0.2225	2150	1700	2400	2000	2700	2400
260	5.58	0.2325	2100	1700	2350	1950	2650	2350
270	5.82	0.2425	2100	1650	2300	1950	2600	2350
280	6.05	0.2525	2050	1650	2300	1900	2500	2300
290	6.29	0.2625	2000	1650	2250	1900	2450	2300
300	6.52	0.2725	2000	1600	2250	1900	2400	2250

3.3.4.2 PROPPING

Where spans require propping of the Hibond sheet as shown in 3.3.4.1, adequately braced propping must be installed prior to laying the Hibond sheets and shall be designed to support wet concrete and construction loads. Refer to Section 3.5 Installation for further information.

Propping loads are given below for all slab thicknesses considered in Section 3.3.4.1.

PROPPING LOADS

Thickness mm	Serviceability (Safe) Load	Ultimate (Strength) Load
0.75	17.6 kN/m	25.5 kN/m
0.95	23.5 kN/m	34.3 kN/m

The Hibond sheet must be supported by continuous propping lines parallel to the permanent supports. The minimum width required for bearers is 100mm.

Propping lines must remain in place until:
- The concrete has reached a compressive strength of 20 MPa where construction loads are applied.
- The concrete is fully cured where full design loads are applied.

Refer to NZS 3109 for further details.

3.3.4.3 BEARING AND FIXING REQUIREMENTS

It is the responsibility of the design engineer to determine the bearing and fixing requirements for the Hibond Flooring System specific to each case.

Minimum bearing requirements for different span types are shown below.

The Hibond sheet does not require as much bearing as the composite slab. However the issue of sheet hold down, prior to the placement of the concrete, may determine Hibond bearing requirements.

MINIMUM BEARING REQUIREMENTS

	Bearing of Hibond Slab		Bearing of Hibond Sheet	
	Slab End	**Continuous**	**Sheet End**	**Continuous**
Steel beam	50mm	100mm	30mm	100mm
In situ concrete beam or wall	50mm	100mm	30mm	N/A
Concrete block	70mm	100mm	30mm	N/A

Where steel beams are the main support system, Hibond sheets can be fixed to supports by shear connectors (shear studs) welded through the Hibond sheet (refer also to 3.5 Installation). Shear studs should be placed as close to the middle of each Hibond pan as practicable. Where there is more than one shear stud per pan it is desirable to stagger them diagonally across the width of the beam. Hibond sheets can also be fixed to supports with self-drilling screws or powder-actuated fasteners.

Fixing into the edge of concrete block is not recommended as any breakout of the edge will reduce the effective support.

Where insufficient or inadequate support is available for the Hibond sheet, temporary bearers and props can be used to support the ends. Nails can be driven through the Hibond sheet into timber bearers to provide temporary hold down. Hibond sheets must be continuous when laid over temporary supports.

Where the Hibond sheet is used with tilt slab construction, it is common to fix the Hibond sheet to a steel angle which is bolted to the tilt slab.

While technically a Hibond floor slab does not require support along the edge (edge bearing), it is standard practice to tie the edges of the slab to the support structure. Edge bearing requirements follow that of the end bearing as shown in the minimum bearing requirements table.

Refer to Section 3.5 Installation for further information on:
- Side lap crimping.
- Placement of end caps and edge forms.

3.3.4.4 PENETRATIONS

Penetrations of up to 250mm x 250mm square may be formed as part of the slab construction by formwork or polystyrene infill with the addition of 2 – H12 reinforcing bars laid in each adjacent Hibond sheet pan, the remaining Hibond sheet being cut away after curing.

Penetrations larger than 250mm x 250mm will require additional reinforcement to control cracking and provide structural integrity and may also require independent supporting beams to the design engineer's specific design.

The area of Hibond removed for penetrations must be replaced by an equivalent strength of reinforcement.

If cutting of the Hibond sheet is required prior to pouring the concrete, temporary propping is required to maintain the integrity of the sheet.

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES

Superimposed loads (G_{SDL} + Q) are presented for slab thicknesses between 110mm and 200mm and over a range of spans between 2.0m and 6.0m for single spans. For continuous design, negative reinforcement requirements are presented for double or end spans and internal spans, with an extended range of spans to 7.0m for the latter.

The following Notes apply to the composite slab load span tables in this Section.

1. Span types
   L_{ss} is the clear single span between permanent supports plus 100mm.
   L is the double/end or internal span measured centre to centre between permanent supports.

2. The design superimposed load combination is G_{SDL} + Q and must not be greater than the superimposed loads given in the tables.

3. a) Medium term superimposed loads are based on $^2/_3$ short term and $^1/_3$ long term (i.e. modular ratio = 10) and apply to buildings of normal usage.

   b) Long term superimposed loads are based on all loads being long term (i.e. modular ratio = 18) and apply to storage loads and loads which are permanent in nature.

4. Deflection limits incorporated into these tables are as follows:

   a) L/350 or 20mm maximum due to superimposed load (G_{SDL} + Q).

   b) L/250 maximum due to superimposed load plus prop removal (G + G_{SDL} + Q).

   The designer shall be satisfied that these limits are adequate for the application considered, otherwise additional deflection checks must be made.

5. Propping requirements depend on the Hibond slab thickness and span configuration as formwork. Refer to Section 3.3.4.1 Hibond Formwork Tables to determine formwork span capabilities.

6. The double or end span and internal span tables allow for 10% moment redistribution where negative bending governs (typically thinner slabs on end spans), bounded by the shear bond value where this governs.

7. Some values shown in the double or end span tables are less than corresponding values given in the single span tables. This situation arises as,

   a) Negative bending capacity has been limited to avoid compression failure of the concrete in compression at the internal support.

   b) Shear bond is proportional to vertical shear which is higher for a double span than a single span. Also the shear bond span for an end span must be taken as the full span length using BS5950 Part 4 (when normally the span between points of contraflexure would be used).

Continued on next page

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES *continued*

8. Use of the double or end span tables and internal span tables assumes,
   - All spans have the same slab thickness.
   - The end span is within plus 5% or minus 10% of the internal span and that the end and internal spans are both designed using the appropriate load span table.
   - Double spans are within 10% of each other and the slab design is based on the largest span.
   - Internal spans are within 10% of each other and the slab design is based on the largest internal span.

   Any variations to the above configurations require specific design.

9. Example: For a 0.75mm Hibond slab of 130mm overall slab thickness on a double span of 3800mm we have the following:

4.3 H12@200

   where:

4.3	=	Superimposed load kPa
H12@200	=	H12 negative reinforcing (saddle bars) placed at 200mm centres to achieve the superimposed load.

10. Steel areas in the double or end and internal span tables are calculated based on H12 reinforcing bars (12mm diameter grade 500 to AS/NZS 4671) placed at 25mm top cover (A1 exposure classification – NZS 3101). Areas for other bar types, covers and sizes require specific design.

11. Negative reinforcement must be placed on top of the mesh parallel with the Hibond ribs at spacings indicated in the tables for the span and slab thickness considered.

12. Negative reinforcement must extend at least 0.25 of the largest span plus 450mm each side of the centre line of the support.

13. The same negative reinforcing is required for both propped and unpropped construction.

Continued on next page

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES *continued*

14. Vibration limits expressed as maximum spans in the tables refer to:

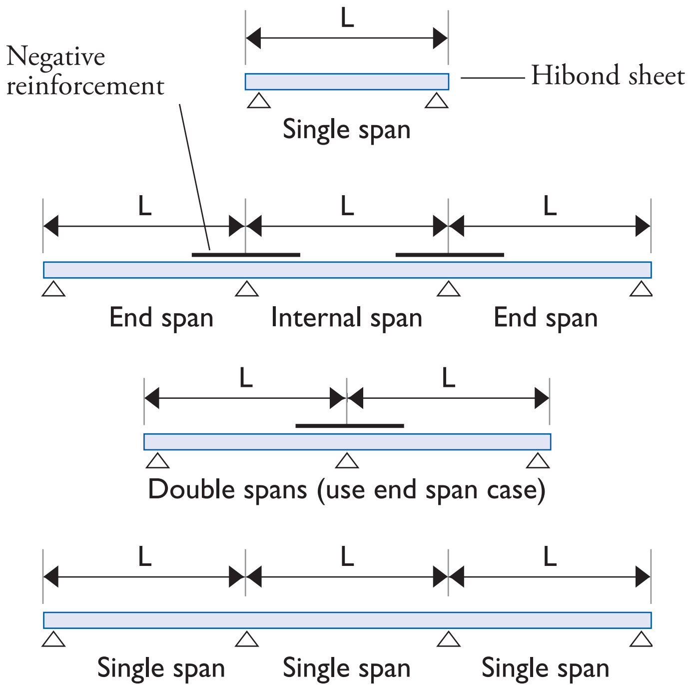
    – – – – Commercial offices, open plan with few small partitions (damping ratio = 0.025)

    ·········· Residences with many full height partitions (damping ratio = 0.05)

    Specific design is required for other floor uses. Refer Section 3.3.8 Floor Vibration.

15. For intermediate values, linear interpolation is permitted.

Typical Composite Slab Span Configurations



This configuration requires nominal continuity reinforcement to be placed over the supports as described for a minor degree of crack control for Mesh Reinforcement in Section 3.3.2.

Dimond

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES continued

0.75mm HIBOND – SINGLE SPANS
Medium term superimposed loads (kPa)

L_{ss} mm	Slab thickness (D_s) mm 110	120	130	140	150	160	170	180	190	200
2000	16.2	19.6	21.0							
2200	13.3	16.1	17.2	19.3	21.4					
2400	11.2	13.5	14.3	16.0	17.7	19.5	21.4			
2600	9.5	11.4	12.1	13.5	14.9	16.4	17.9	19.4	20.8	
2800	8.2	9.8	10.4	11.5	12.7	13.9	15.1	16.3	17.5	18.8
3000	7.1	8.5	9.0	9.9	10.9	11.9	12.9	13.9	14.8	15.9
3200	6.2	7.4	7.8	8.6	9.4	10.3	11.1	11.9	12.7	13.6
3400	5.5	6.5	6.9	7.5	8.2	8.9	9.6	10.3	10.9	11.6
3600	4.9	5.8	6.1	6.6	7.2	7.8	8.4	8.9	9.5	10.1
3800	4.4	5.2	5.4	5.9	6.4	6.9	7.4	7.8	8.3	8.7
4000	4.0	4.7	4.8	5.3	5.7	6.1	6.5	6.9	7.2	7.6
4200	3.6	4.2	4.3	4.7	5.1	5.4	5.8	6.1	6.3	6.7
4400	2.9	3.8	3.9	4.2	4.5	4.8	5.1	5.4	5.6	5.8
4600	2.3	3.3	3.6	3.8	4.1	4.3	4.6	4.8	5.0	5.1
4800	1.8	2.6	3.2	3.5	3.7	3.9	4.1	4.3	4.4	4.5
5000		2.0	2.9	3.2	3.3	3.5	3.7	3.8	3.9	4.0
5200		1.6	2.3	2.9	3.0	3.2	3.3	3.4	3.5	3.6
5400			1.8	2.6	2.8	2.9	3.0	3.1	3.1	3.1
5600				2.1	2.5	2.6	2.7	2.7	2.8	2.8
5800				1.6	2.3	2.4	2.5	2.5	2.5	2.5
6000					1.8	2.2	2.2	2.2	2.2	2.2

0.75mm HIBOND – SINGLE SPANS
Long term superimposed loads (kPa)

L_{ss} mm	Slab thickness (D_s) mm 110	120	130	140	150	160	170	180	190	200
2000	16.2	19.6	21.0							
2200	13.3	16.1	17.2	19.3	21.4					
2400	11.2	13.5	14.3	16.0	17.7	19.5	21.4			
2600	9.5	11.4	12.1	13.5	14.9	16.4	17.9	19.4	20.8	
2800	8.2	9.8	10.4	11.5	12.7	13.9	15.1	16.3	17.5	18.8
3000	7.1	8.5	9.0	9.9	10.9	11.9	12.9	13.9	14.8	15.9
3200	6.2	7.4	7.8	8.6	9.4	10.3	11.1	11.9	12.7	13.6
3400	5.4	6.5	6.9	7.5	8.2	8.9	9.6	10.3	10.9	11.6
3600	4.3	5.7	6.1	6.6	7.2	7.8	8.4	8.9	9.5	10.1
3800	3.4	4.6	5.4	5.9	6.4	6.9	7.4	7.8	8.3	8.7
4000	2.6	3.6	4.8	5.3	5.7	6.1	6.5	6.9	7.2	7.6
4200	2.0	2.8	3.9	4.7	5.1	5.4	5.8	6.1	6.3	6.7
4400		2.2	3.1	4.2	4.5	4.8	5.1	5.4	5.6	5.8
4600		1.6	2.4	3.3	4.1	4.3	4.6	4.8	5.0	5.1
4800			1.8	2.6	3.5	3.9	4.1	4.3	4.4	4.5
5000				2.0	2.8	3.5	3.7	3.8	3.9	4.0
5200					2.1	2.9	3.3	3.4	3.5	3.6
5400					1.6	2.3	3.0	3.1	3.1	3.1
5600						1.7	2.4	2.7	2.8	2.8
5800							1.8	2.5	2.5	2.5
6000								2.0	2.2	2.2

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.75mm HIBOND – DOUBLE AND END SPANS

Medium and Long Term Superimposed Loads (kPa) and Negative Reinforcement (mm²/m width)

	Slab Thickness (D_s) mm									
L (mm)	110	120	130	140	150	160	170	180	190	200
2000	**12.9** H12@300	**15.7** H12@250	**16.8** H12@300	**18.8** H12@250	**21.0** H12@300					
2200	**10.7** H12@250	**12.9** H12@250	**13.8** H12@250	**15.4** H12@250	**17.1** H12@300	**18.9** H12@250	**20.8** H12@250			
2400	**8.9** H12@250	**10.8** H12@250	**11.5** H12@250	**12.8** H12@250	**14.2** H12@250	**15.6** H12@250	**17.1** H12@250	**18.6** H12@250	**20.1** H12@250	
2600	**7.6** H12@250	**9.1** H12@250	**9.7** H12@250	**10.8** H12@250	**11.9** H12@250	**13.1** H12@250	**14.3** H12@250	**15.5** H12@250	**16.7** H12@250	**17.9** H12@250
2800	**6.4** H12@250	**7.8** H12@250	**8.3** H12@250	**9.2** H12@250	**10.1** H12@250	**11.1** H12@250	**12.1** H12@250	**13.0** H12@250	**14.0** H12@250	**15.0** H12@250
3000	**5.3** H12@250	**6.8** H12@200	**7.2** H12@250	**7.9** H12@250	**8.7** H12@250	**9.5** H12@250	**10.3** H12@250	**11.1** H12@250	**11.9** H12@250	**12.7** H12@250
3200	**4.5** H12@250	**5.9** H12@200	**6.2** H12@250	**6.9** H12@250	**7.5** H12@250	**8.2** H12@250	**8.9** H12@250	**9.5** H12@250	**10.2** H12@250	**10.8** H12@250
3400	**3.8** H12@250	**5.0** H12@200	**5.5** H12@200	**6.0** H12@250	**6.6** H12@250	**7.1** H12@250	**7.7** H12@250	**8.2** H12@250	**8.7** H12@250	**9.3** H12@250
3600	**3.2** H12@250	**4.3** H12@200	**4.9** H12@200	**5.3** H12@250	**5.8** H12@250	**6.3** H12@250	**6.7** H12@250	**7.2** H12@250	**7.6** H12@250	**8.0** H12@250
3800	**2.7** H12@250	**3.6** H12@200	**4.3** H12@200	**4.7** H12@200	**5.1** H12@200	**5.5** H12@250	**5.9** H12@250	**6.3** H12@250	**6.6** H12@250	**7.0** H12@250
4000	**2.2** H12@250	**3.1** H12@200	**3.9** H12@200	**4.2** H12@200	**4.5** H12@200	**4.9** H12@200	**5.2** H12@250	**5.5** H12@250	**5.8** H12@250	**6.1** H12@250
4200	**1.9** H12@250	**2.6** H12@200	**3.5** H12@200	**3.8** H12@200	**4.0** H12@200	**4.3** H12@200	**4.6** H12@200	**4.9** H12@250	**5.1** H12@250	**5.3** H12@250
4400		**2.2** H12@200	**3.0** H12@200	**3.4** H12@200	**3.6** H12@200	**3.9** H12@200	**4.1** H12@200	**4.3** H12@200	**4.5** H12@250	**4.7** H12@250
4600		**1.8** H12@200	**2.5** H12@200	**3.1** H12@200	**3.3** H12@200	**3.5** H12@200	**3.7** H12@200	**3.8** H12@200	**4.0** H12@200	**4.1** H12@250
4800			**2.1** H12@200	**2.8** H12@200	**2.9** H12@200	**3.1** H12@200	**3.3** H12@200	**3.4** H12@200	**3.5** H12@200	**3.6** H12@200
5000			**1.8** H12@200	**2.4** H12@200	**2.7** H12@150	**2.8** H12@200	**3.0** H12@200	**3.0** H12@200	**3.1** H12@200	**3.2** H12@200
5200				**2.1** H12@200	**2.4** H12@150	**2.6** H12@200	**2.7** H12@200	**2.7** H12@200	**2.8** H12@200	**2.8** H12@200
5400				**1.8** H12@200	**2.2** H12@150	**2.3** H12@150	**2.4** H12@200	**2.4** H12@200	**2.5** H12@200	**2.5** H12@200
5600					**2.0** H12@150	**2.1** H12@150	**2.2** H12@150	**2.2** H12@200	**2.2** H12@200	**2.2** H12@200
5800					**1.7** H12@150	**1.9** H12@150	**2.0** H12@150	**2.0** H12@150	**2.0** H12@200	**2.0** H12@200
6000						**1.8** H12@150	**1.8** H12@150	**1.8** H12@150	**1.8** H12@200	**1.8** H12@200

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.75mm HIBOND – INTERNAL SPANS

Medium and Long Term Superimposed Loads (kPa) and Negative Reinforcement (mm^2/m width)

	Slab Thickness (D_s) mm									
L (mm)	110	120	130	140	150	160	170	180	190	200
2000	**17.2** H12@250	**22.4** H12@200								
2200	**14.0** H12@250	**18.2** H12@200	**21.6** H12@200							
2400	**11.5** H12@250	**15.1** H12@200	**18.3** H12@200	**20.5** H12@200	**21.3** H12@200	**19.3** H12@200	**19.8** H12@200	**20.3** H12@200		
2600	**9.6** H12@250	**12.6** H12@200	**15.5** H12@200	**16.7** H12@200	**17.2** H12@200	**17.6** H12@200	**18.1** H12@200	**18.5** H12@200	**18.9** H12@200	**19.0** H12@200
2800	**8.1** H12@250	**10.7** H12@200	**13.3** H12@200	**14.8** H12@200	**15.8** H12@200	**16.2** H12@200	**16.6** H12@200	**16.9** H12@200	**17.3** H12@200	**17.6** H12@200
3000	**6.9** H12@250	**9.1** H12@200	**11.4** H12@200	**12.8** H12@200	**14.2** H12@200	**14.9** H12@200	**15.3** H12@200	**15.6** H12@200	**15.9** H12@200	**16.2** H12@200
3200	**5.9** H12@250	**7.8** H12@200	**9.8** H12@200	**11.2** H12@200	**12.3** H12@200	**13.6** H12@200	**14.1** H12@200	**14.4** H12@200	**14.7** H12@200	**15.0** H12@200
3400	**5.1** H12@250	**6.7** H12@200	**8.5** H12@200	**9.8** H12@200	**10.8** H12@200	**11.8** H12@200	**12.9** H12@200	**13.4** H12@200	**13.6** H12@200	**13.9** H12@200
3600	**4.4** H12@250	**5.9** H12@200	**7.4** H12@200	**8.7** H12@200	**9.5** H12@200	**10.4** H12@200	**11.3** H12@200	**12.2** H12@200	**12.7** H12@200	**12.9** H12@200
3800	**3.8** H12@250	**5.1** H12@200	**6.5** H12@200	**7.7** H12@150	**8.4** H12@200	**9.2** H12@200	**10.0** H12@200	**10.8** H12@200	**11.5** H12@200	**12.0** H12@200
4000	**3.3** H12@250	**4.5** H12@200	**5.7** H12@200	**6.9** H12@150	**7.5** H12@200	**8.2** H12@200	**8.9** H12@200	**9.5** H12@200	**10.2** H12@200	**10.8** H12@200
4200	**2.8** H12@250	**3.9** H12@200	**5.0** H12@200	**6.2** H12@150	**6.7** H12@150	**7.3** H12@200	**7.9** H12@200	**8.5** H12@200	**9.0** H12@200	**9.6** H12@200
4400	**2.5** H12@250	**3.4** H12@200	**4.4** H12@200	**5.5** H12@150	**6.1** H12@150	**6.6** H12@200	**7.1** H12@200	**7.6** H12@200	**8.0** H12@200	**8.5** H12@200
4600	**2.1** H12@250	**3.0** H12@200	**3.9** H12@200	**4.8** H12@150	**5.5** H12@150	**5.9** H12@150	**6.4** H12@200	**6.8** H12@200	**7.2** H12@200	**7.6** H12@200
4800	**1.9** H12@250	**2.6** H12@200	**3.4** H12@200	**4.3** H12@150	**5.0** H12@150	**5.4** H12@150	**5.8** H12@150	**6.1** H12@200	**6.4** H12@200	**6.8** H12@200
5000	**1.6** H12@250	**2.3** H12@200	**3.0** H12@200	**3.8** H12@150	**4.5** H12@150	**4.9** H12@150	**5.2** H12@150	**5.5** H12@200	**5.8** H12@200	**6.1** H12@200
5200		**2.0** H12@200	**2.7** H12@200	**3.4** H12@150	**4.1** H12@150	**4.4** H12@150	**4.7** H12@150	**5.0** H12@150	**5.2** H12@200	**5.5** H12@200
5400		**1.8** H12@200	**2.3** H12@200	**3.0** H12@150	**3.8** H12@150	**4.1** H12@150	**4.3** H12@150	**4.5** H12@150	**4.7** H12@200	**4.9** H12@200
5600		**1.5** H12@200	**2.1** H12@200	**2.7** H12@150	**3.3** H12@150	**3.7** H12@150	**3.9** H12@150	**4.1** H12@150	**4.3** H12@200	**4.4** H12@200
5800			**1.8** H12@200	**2.4** H12@150	**3.0** H12@150	**3.4** H12@150	**3.6** H12@150	**3.7** H12@150	**3.9** H12@150	**4.0** H12@200
6000			**1.6** H12@200	**2.1** H12@150	**2.7** H12@150	**3.1** H12@150	**3.3** H12@150	**3.4** H12@150	**3.5** H12@150	**3.6** H12@200
6200				**1.8** H12@150	**2.4** H12@150	**2.9** H12@150	**3.0** H12@150	**3.1** H12@150	**3.2** H12@150	**3.3** H12@150
6400				**1.6** H12@150	**2.1** H12@150	**2.6** H12@150	**2.8** H12@150	**2.8** H12@150	**2.9** H12@150	**3.0** H12@150
6600					**1.9** H12@150	**2.3** H12@150	**2.5** H12@150	**2.6** H12@150	**2.7** H12@150	**2.7** H12@150
6800					**1.6** H12@150	**2.1** H12@150	**2.4** H12@150	**2.4** H12@150	**2.4** H12@150	**2.5** H12@150
7000						**1.8** H12@150	**2.2** H12@150	**2.2** H12@150	**2.2** H12@150	**2.2** H12@150

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES continued

0.95mm HIBOND – SINGLE SPANS
Medium term superimposed loads (kPa)

L_{ss} mm	Slab thickness (D_s) mm									
	110	120	130	140	150	160	170	180	190	200
2000	17.8	21.7								
2200	14.7	17.8	19.1	21.4						
2400	12.3	14.9	15.9	17.8	19.8	21.9				
2600	10.5	12.6	13.5	15.0	16.7	18.4	20.1	21.9		
2800	9.0	10.9	11.5	12.8	14.2	15.6	17.1	18.5	19.9	21.4
3000	7.8	9.4	10.0	11.1	12.2	13.4	14.6	15.8	16.9	18.2
3200	6.9	8.2	8.7	9.6	10.6	11.6	12.6	13.6	14.5	15.6
3400	6.1	7.3	7.6	8.4	9.2	10.1	10.9	11.8	12.6	13.4
3600	5.4	6.4	6.8	7.5	8.1	8.9	9.6	10.3	10.9	11.7
3800	4.9	5.8	6.0	6.6	7.2	7.8	8.4	9.0	9.6	10.2
4000	4.4	5.2	5.4	5.9	6.4	6.9	7.5	7.9	8.4	8.9
4200	4.0	4.7	4.9	5.3	5.7	6.2	6.6	7.0	7.4	7.8
4400	3.3	4.2	4.4	4.8	5.2	5.5	5.9	6.3	6.6	6.9
4600	2.7	3.8	4.0	4.3	4.6	5.0	5.3	5.6	5.8	6.1
4800	2.1	3.0	3.6	3.9	4.2	4.5	4.8	5.0	5.2	5.4
5000	1.6	2.4	3.3	3.6	3.8	4.1	4.3	4.5	4.7	4.8
5200		1.9	2.8	3.3	3.5	3.7	3.9	4.0	4.2	4.3
5400			2.2	3.0	3.2	3.4	3.5	3.6	3.7	3.9
5600			1.7	2.5	2.9	3.1	3.2	3.3	3.4	3.5
5800				2.0	2.7	2.8	2.9	3.0	3.0	3.1
6000				1.5	2.2	2.6	2.7	2.7	2.7	2.8

0.95mm HIBOND – SINGLE SPANS
Long term superimposed loads (kPa)

L_{ss} mm	Slab thickness (D_s) mm									
	110	120	130	140	150	160	170	180	190	200
2000	17.8	21.7								
2200	14.7	17.8	19.1	21.4						
2400	12.3	14.9	15.9	17.8	19.8	21.9				
2600	10.5	12.6	13.5	15.0	16.7	18.4	20.1	21.9		
2800	9.0	10.9	11.5	12.8	14.2	15.6	17.1	18.5	19.9	21.4
3000	7.8	9.4	10.0	11.1	12.2	13.4	14.6	15.8	16.9	18.2
3200	6.9	8.2	8.7	9.6	10.6	11.6	12.6	13.6	14.5	15.6
3400	5.9	7.3	7.6	8.4	9.2	10.1	10.9	11.8	12.6	13.4
3600	4.9	6.4	6.8	7.5	8.1	8.9	9.6	10.3	10.9	11.7
3800	3.9	5.3	6.0	6.6	7.2	7.8	8.4	9.0	9.6	10.2
4000	3.0	4.2	5.4	5.9	6.4	6.9	7.5	7.9	8.4	8.9
4200	2.4	3.3	4.6	5.3	5.7	6.2	6.6	7.0	7.4	7.8
4400	1.8	2.6	3.6	4.8	5.2	5.5	5.9	6.3	6.6	6.9
4600		2.0	2.9	3.9	4.6	5.0	5.3	5.6	5.8	6.1
4800		1.5	2.2	3.1	4.2	4.5	4.8	5.0	5.2	5.4
5000			1.7	2.4	3.3	4.1	4.3	4.5	4.7	4.8
5200				1.9	2.6	3.5	3.9	4.0	4.2	4.3
5400					2.0	2.8	3.5	3.6	3.7	3.9
5600					1.5	2.2	3.0	3.3	3.4	3.5
5800						1.7	2.3	3.0	3.0	3.1
6000							1.8	2.5	2.7	2.8

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.95mm HIBOND – DOUBLE AND END SPANS

Medium and Long Term Superimposed Loads (kPa) and Negative Reinforcement (mm^2/m width)

	Slab Thickness (D_s) mm									
L (mm)	**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**	**190**	**200**
2000	**14.2** H12@250	**17.3** H12@200	**18.6** H12@250	**20.9** H12@250						
2200	**11.4** H12@250	**14.3** H12@200	**15.3** H12@250	**17.1** H12@250	**19.1** H12@250	**21.2** H12@250				
2400	**9.3** H12@250	**11.9** H12@200	**12.7** H12@250	**14.3** H12@250	**15.8** H12@250	**17.5** H12@250	**19.2** H12@250	**20.9** H12@250		
2600	**7.7** H12@250	**10.1** H12@200	**10.8** H12@250	**12.0** H12@250	**13.3** H12@250	**14.7** H12@250	**16.1** H12@250	**17.5** H12@250	**18.9** H12@250	**20.0** H12@250
2800	**6.4** H12@250	**8.4** H12@200	**9.2** H12@200	**10.3** H12@250	**11.3** H12@250	**12.5** H12@250	**13.6** H12@250	**14.8** H12@250	**15.9** H12@250	**17.2** H12@250
3000	**5.3** H12@250	**7.1** H12@200	**8.0** H12@200	**8.9** H12@200	**9.8** H12@200	**10.7** H12@200	**11.7** H12@200	**12.6** H12@250	**13.5** H12@250	**14.6** H12@200
3200	**4.5** H12@250	**6.0** H12@200	**7.0** H12@200	**7.7** H12@200	**8.5** H12@200	**9.3** H12@200	**10.1** H12@200	**10.9** H12@200	**11.6** H12@200	**12.5** H12@200
3400	**3.8** H12@250	**5.1** H12@200	**6.1** H12@200	**6.8** H12@200	**7.4** H12@200	**8.1** H12@200	**8.8** H12@200	**9.4** H12@200	**10.0** H12@200	**10.7** H12@200
3600	**3.2** H12@250	**4.3** H12@200	**5.4** H12@200	**6.0** H12@200	**6.5** H12@200	**7.1** H12@200	**7.7** H12@200	**8.2** H12@200	**8.7** H12@200	**9.3** H12@200
3800	**2.7** H12@250	**3.7** H12@200	**4.8** H12@200	**5.3** H12@200	**5.8** H12@200	**6.3** H12@200	**6.7** H12@200	**7.2** H12@200	**7.6** H12@200	**8.1** H12@200
4000	**2.2** H12@250	**3.1** H12@200	**4.1** H12@200	**4.7** H12@200	**5.1** H12@200	**5.6** H12@200	**6.0** H12@200	**6.3** H12@200	**6.7** H12@200	**7.1** H12@200
4200	**1.9** H12@250	**2.6** H12@200	**3.5** H12@200	**4.2** H12@200	**4.6** H12@200	**5.0** H12@200	**5.3** H12@200	**5.6** H12@200	**5.9** H12@200	**6.3** H12@200
4400		**2.2** H12@200	**3.0** H12@200	**3.8** H12@200	**4.1** H12@200	**4.4** H12@200	**4.7** H12@200	**5.0** H12@200	**5.3** H12@200	**5.5** H12@200
4600		**1.9** H12@200	**2.6** H12@200	**3.4** H12@150	**3.7** H12@150	**4.0** H12@200	**4.2** H12@200	**4.5** H12@200	**4.7** H12@200	**4.9** H12@200
4800			**2.2** H12@200	**2.9** H12@150	**3.4** H12@150	**3.6** H12@150	**3.8** H12@200	**4.0** H12@200	**4.2** H12@200	**4.4** H12@200
5000			**1.8** H12@200	**2.5** H12@150	**3.1** H12@150	**3.3** H12@150	**3.4** H12@200	**3.6** H12@200	**3.7** H12@200	**3.9** H12@200
5200				**2.1** H12@150	**2.8** H12@150	**3.0** H12@150	**3.1** H12@150	**3.2** H12@200	**3.3** H12@200	**3.5** H12@200
5400				**1.8** H12@150	**2.4** H12@150	**2.7** H12@150	**2.8** H12@150	**2.9** H12@150	**3.0** H12@200	**3.1** H12@200
5600					**2.1** H12@150	**2.5** H12@150	**2.6** H12@150	**2.6** H12@150	**2.7** H12@150	**2.8** H12@200
5800					**1.7** H12@150	**2.2** H12@150	**2.3** H12@150	**2.4** H12@150	**2.4** H12@150	**2.5** H12@150
6000						**2.0** H12@150	**2.1** H12@150	**2.2** H12@150	**2.2** H12@150	**2.2** H12@150

3.3.5 HIBOND COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.95mm HIBOND – INTERNAL SPANS

Medium and Long Term Superimposed Loads (kPa) and Negative Reinforcement (mm^2/m width)

	Slab Thickness (D_s) mm									
L (mm)	110	120	130	140	150	160	170	180	190	200
2000	**17.2** H12@250	**22.4** H12@200								
2200	**14.0** H12@250	**18.2** H12@200	**23.0** H12@200							
2400	**11.5** H12@250	**15.1** H12@200	**19.1** H12@200	**22.8** H12@150						
2600	**9.6** H12@250	**12.6** H12@200	**16.0** H12@200	**19.3** H12@150	**21.5** H12@150					
2800	**8.1** H12@250	**10.7** H12@200	**13.6** H12@200	**16.5** H12@150	**18.4** H12@150	**19.4** H12@200	**19.9** H12@200	**20.3** H12@200		
3000	**6.9** H12@250	**9.1** H12@200	**11.6** H12@200	**14.1** H12@150	**15.8** H12@150	**17.5** H12@150	**18.3** H12@150	**18.7** H12@200	**19.1** H12@200	**19.5** H12@200
3200	**5.9** H12@250	**7.8** H12@200	**10.0** H12@200	**12.2** H12@150	**13.8** H12@150	**15.2** H12@150	**16.7** H12@150	**17.4** H12@150	**17.7** H12@200	**18.0** H12@200
3400	**5.1** H12@250	**6.7** H12@200	**8.7** H12@200	**10.6** H12@150	**12.1** H12@150	**13.3** H12@150	**14.6** H12@150	**15.8** H12@150	**16.5** H12@150	**16.8** H12@200
3600	**4.4** H12@250	**5.9** H12@200	**7.6** H12@200	**9.3** H12@150	**10.7** H12@150	**11.7** H12@150	**12.8** H12@150	**13.9** H12@150	**14.9** H12@150	**15.6** H12@150
3800	**3.8** H12@250	**5.1** H12@200	**6.6** H12@200	**8.1** H12@150	**9.5** H12@150	**10.4** H12@150	**11.3** H12@150	**12.2** H12@150	**13.1** H12@150	**14.1** H12@150
4000	**3.3** H12@250	**4.5** H12@200	**5.8** H12@200	**7.2** H12@150	**8.5** H12@150	**9.3** H12@150	**10.1** H12@150	**10.8** H12@150	**11.6** H12@150	**12.5** H12@150
4200	**2.8** H12@250	**3.9** H12@200	**5.1** H12@200	**6.3** H12@150	**7.6** H12@150	**8.3** H12@150	**9.0** H12@150	**9.7** H12@150	**10.3** H12@150	**11.1** H12@150
4400	**2.5** H12@250	**3.4** H12@200	**4.5** H12@200	**5.6** H12@150	**6.8** H12@150	**7.5** H12@150	**8.1** H12@150	**8.7** H12@150	**9.2** H12@150	**9.9** H12@150
4600	**2.1** H12@250	**3.0** H12@200	**4.0** H12@200	**5.0** H12@150	**6.0** H12@150	**6.7** H12@150	**7.3** H12@150	**7.8** H12@150	**8.3** H12@150	**8.8** H12@150
4800	**1.9** H12@250	**2.6** H12@200	**3.5** H12@200	**4.4** H12@150	**5.4** H12@150	**6.1** H12@150	**6.6** H12@150	**7.0** H12@150	**7.4** H12@150	**7.9** H12@150
5000	**1.6** H12@250	**2.3** H12@200	**3.1** H12@200	**3.9** H12@150	**4.8** H12@150	**5.6** H12@150	**6.0** H12@150	**6.3** H12@150	**6.7** H12@150	**7.1** H12@150
5200		**2.0** H12@200	**2.7** H12@200	**3.5** H12@150	**4.3** H12@150	**5.1** H12@150	**5.4** H12@150	**5.8** H12@150	**6.1** H12@150	**6.4** H12@150
5400		**1.8** H12@200	**2.4** H12@200	**3.1** H12@150	**3.8** H12@150	**4.6** H12@150	**5.0** H12@150	**5.2** H12@150	**5.5** H12@150	**5.8** H12@150
5600		**1.5** H12@200	**2.1** H12@200	**2.7** H12@150	**3.4** H12@150	**4.2** H12@150	**4.5** H12@150	**4.8** H12@150	**5.0** H12@150	**5.3** H12@150
5800			**1.9** H12@200	**2.4** H12@150	**3.1** H12@150	**3.8** H12@150	**4.2** H12@150	**4.4** H12@150	**4.6** H12@150	**4.8** H12@150
6000			**1.6** H12@200	**2.2** H12@150	**2.7** H12@150	**3.4** H12@150	**3.8** H12@150	**4.0** H12@150	**4.2** H12@150	**4.4** H12@150
6200				**1.9** H12@150	**2.4** H12@150	**3.0** H12@150	**3.5** H12@150	**3.7** H12@150	**3.8** H12@150	**4.0** H12@150
6400				**1.7** H12@150	**2.2** H12@150	**2.7** H12@150	**3.2** H12@150	**3.4** H12@150	**3.5** H12@150	**3.6** H12@150
6600					**1.9** H12@150	**2.4** H12@150	**3.0** H12@150	**3.1** H12@150	**3.2** H12@150	**3.3** H12@150
6800					**1.7** H12@150	**2.1** H12@150	**2.7** H12@150	**2.9** H12@150	**2.9** H12@150	**3.0** H12@150
7000						**1.9** H12@150	**2.4** H12@150	**2.6** H12@150	**2.7** H12@150	**2.8** H12@150

3.3.6 FIRE DESIGN TABLES

INTRODUCTION

Fire resistance ratings are given for slab thicknesses between 110mm and 160mm, plus 180mm and 200mm slabs, for single spans between 2.0m and 6.0m with live loads of 3 kPa to 5 kPa.

Fire resistance ratings can also be adjusted for loads of 1.5 kPa and 2.5 kPa, refer Note 5 below.

The following notes apply to the Hibond flooring fire design tables in this section.

1. The fire resistance ratings tabulated are equivalent times in minutes of exposure to the standard fire test (NZS/BS 476) that satisfy the criteria for insulation, integrity and stability based on simply supported spans. Fire resistance ratings shown in ***bold italics*** are limited by insulation criteria. The beneficial effects of continuous spans and/or negative reinforcement at supports may be accounted for by specific design.
2. L is the span measured centre to centre between permanent supports.
3. Spans of up to 4.0m do not require any supplementary fire reinforcing steel to achieve a Fire Resistance Rating (FRR) of up to 30 minutes. Spans greater than 4.0m **require** supplementary fire reinforcing steel as outlined in the following tables.
4. The fire resistance ratings given are based on the following conditions. If design conditions differ from the following, specific design will be required.
   - The minimum cover to the fire reinforcement is 25mm to the bottom of the profile and 40mm to the side of the rib.
   - A superimposed dead load (G_{SDL}) of 0.5 kPa has been included. Where G_{SDL} is greater than 0.5 kPa specific design to HERA Report R4-82 is required.
   - The self weight of the Hibond slab is based on a concrete density of 2350 kg/m^3 and an allowance of 5% for concrete ponding during construction.
   - The long term live load factor (AS 1170.0) used for 5 kPa live load is 0.6. For all other live loads 0.4 has been used.
   - Specified concrete strength, f'_c = 25 MPa and Type A aggregate.
   - Reinforcement is grade 500 to AS/NZS 4671 and is assumed to be continuous over the length of the clear span.
   - Design moment capacity of the concrete slab is calculated in accordance with NZS 3101 and any contribution from the Hibond steel is neglected.
5. Live loads less than 3 kPa.
   - For a live load of 2.5 kPa, increase FRR by 4 minutes for the corresponding live load, span and slab thickness published for the 3 kPa live load, provided that the fire resistance rating is not limited by insulation criteria.
   - For a live load of 1.5 kPa, increase FRR by 10 minutes for the corresponding live load, span and slab thickness published for the 3 kPa live load, provided that the fire resistance rating is not limited by insulation criteria.
6. For intermediate values linear interpolation is permitted provided that the two values are within the extent of the tables. For example, interpolation can be used to derive the fire resistance ratings for 170mm and 190mm overall slab thicknesses. No interpolation is permitted between 30 minutes and the tabulated values – in this case the next greater steel content given in the fire design tables must be used.
7. Fire resistance ratings have been provided for spans up to where a value of G_{SDL} + Q = 1.5 kPa can be achieved from the Load Span tables in Section 3.3.5. Therefore these fire resistance rating tables must be used in conjunction with Section 3.3.5 Hibond Composite Slab Load Span Tables as satisfaction of fire resistance rating does not always ensure the load capacity and deflection criteria are met.

Continued on next page

Dimond

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm														
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800
110	3	H10 every 3rd pan	***71***	69	57	46											
		H12 every 3rd pan				***71***	61	51									
		H12 every 2nd pan							***71***	62	53	46					
		H16 every 3rd pan								***71***	66	57	50				
		H16 every 2nd pan												***71***	65	58	52
		H12 every pan													***71***	67	60
		H16 every pan															***71***
	4	H10 every 3rd pan	***71***	62	50												
		H12 every 3rd pan			***71***	64	54	44									
		H12 every 2nd pan						***71***	63	54	46						
		H16 every 3rd pan							***71***	67	58	50					
		H16 every 2nd pan											***71***	64	57	51	
		H12 every pan												***71***	66	59	53
		H16 every pan															***71***
	5	H10 every 3rd pan	55														
		H12 every 3rd pan	***71***	68	55	44											
		H12 every 2nd pan				***71***	62	52									
		H16 every 3rd pan					***71***	64	54	45							
		H16 every 2nd pan								***71***	66	58	50				
		H12 every pan									***71***	66	58	51	45		
		H16 every pan														***71***	***71***

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200
120	3	H10 every 3rd pan	***86***	73	61	50													
		H12 every 3rd pan			***86***	76	65	55	46										
		H12 every 2nd pan					***86***	84	75	66	57	50							
		H16 every 3rd pan							***86***	79	70	62	54	47					
		H16 every 2nd pan										***86***	84	77	70	63	56	50	
		H12 every pan											***86***	85	78	71	65	59	53
		H16 every pan																	***86***
	4	H10 every 3rd pan	80	67	54	43													
		H12 every 3rd pan		***86***	81	69	58	48											
		H12 every 2nd pan					***86***	77	68	59	51								
		H16 every 3rd pan						***86***	81	72	63	55	48						
		H16 every 2nd pan									***86***	85	77	70	63	56	49		
		H12 every pan										***86***	85	78	71	64	58	52	46
		H16 every pan																	***86***
	5	H10 every 3rd pan	61	47															
		H12 every 3rd pan	***86***	73	61	49													
		H12 every 2nd pan			***86***	78	67	57	48										
		H16 every 3rd pan				***86***	81	70	60	51									
		H16 every 2nd pan							***86***	81	72	64	56	49					
		H12 every pan								***86***	80	72	64	57	50	44			
		H16 every pan														***86***	79	73	66

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																	
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400
130	3	H10 every 3rd pan	90	77	64	53														
		H12 every 3rd pan	***105***	103	91	79	68	58	49											
		H12 every 2nd pan				***105***	97	88	78	69	61	53								
		H16 every 3rd pan					***105***	101	92	83	74	66	58	51						
		H16 every 2nd pan								***105***	104	96	88	81	74	67	60	54	48	
		H12 every pan									***105***	102	95	88	81	75	68	62	57	51
		H16 every pan																***105***	99	94
	4	H10 every 3rd pan	84	70	58	47														
		H12 every 3rd pan	***105***	97	84	73	62	52												
		H12 every 2nd pan			***105***	101	91	81	72	63	55	47								
		H16 every 3rd pan					***105***	95	85	76	67	59	52							
		H16 every 2nd pan								***105***	97	89	82	74	67	60	54	48		
		H12 every pan								***105***	104	96	89	82	75	68	62	56	50	45
		H16 every pan															***105***	99	93	87
	5	H10 every 3rd pan	65	52																
		H12 every 3rd pan	92	78	65	54														
		H12 every 2nd pan		***105***	94	83	72	62	53	44										
		H16 every 3rd pan			***105***	97	86	75	65	56	48									
		H16 every 2nd pan						***105***	95	86	78	69	62	54	47					
		H12 every pan						***105***	102	93	85	77	69	62	55	49				
		H16 every pan												***105***	98	91	85	78	72	66

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																			
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800
140	3	H10 every 3rd pan	93	79	67	56	46															
		H12 every 3rd pan	118	105	94	82	71	61	52	44												
		H12 every 2nd pan		***125***	120	110	100	90	81	72	64	56	49									
		H16 every 3rd pan			***125***	123	114	104	95	86	77	69	61	54	47							
		H16 every 2nd pan						***125***	122	115	107	99	92	84	77	70	64	58	52	46		
		H12 every pan							***125***	119	112	105	98	91	84	78	72	65	60	54	49	44
		H16 every pan													***125***	120	114	108	103	97	92	86
	4	H10 every 3rd pan	87	73	61	50																
		H12 every 3rd pan	112	100	88	76	65	55	46													
		H12 every 2nd pan		***125***	115	104	94	84	75	66	58	50										
		H16 every 3rd pan			***125***	118	108	98	89	80	71	63	55	48								
		H16 every 2nd pan						***125***	117	109	101	93	85	78	71	64	57	51	46			
		H12 every pan						***125***	121	114	107	99	92	85	78	72	65	59	53	48		
		H16 every pan												***125***	120	114	108	102	96	91	85	80
	5	H10 every 3rd pan	69	56	44																	
		H12 every 3rd pan	96	82	70	58	48															
		H12 every 2nd pan	122	110	98	87	76	66	57	48												
		H16 every 3rd pan	***125***	123	112	101	90	80	70	61	52											
		H16 every 2nd pan				***125***	118	109	100	91	82	74	66	59	52	45						
		H12 every pan				***125***	123	114	106	97	89	81	74	67	60	53	47					
		H16 every pan									***125***	123	116	109	103	96	90	83	77	71	65	60

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																				
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000
150	3	H10 every 3rd pan	95	82	69	58	48																
		H12 every 3rd pan	≥120	108	96	85	74	64	55	46													
		H12 every 2nd pan			≥120	112	102	93	84	75	66	59	51	45									
		H16 every 3rd pan				≥120	116	107	98	89	80	72	64	57	50								
		H16 every 2nd pan							≥120	117	109	102	94	87	80	73	67	60	55	49			
		H12 every pan								≥120	114	107	100	94	87	80	74	68	62	57	52	47	
		H16 every pan														≥120	116	111	105	100	94	89	84
	4	H10 every 3rd pan	90	76	64	52																	
		H12 every 3rd pan	115	102	90	79	68	58	49														
		H12 every 2nd pan		≥120	117	107	97	87	78	69	61	53	46										
		H16 every 3rd pan				≥120	111	101	92	83	74	66	58	51									
		H16 every 2nd pan							≥120	112	104	96	88	81	74	67	61	54	49				
		H12 every pan							≥120	117	109	102	95	88	81	75	68	62	56	51	46		
		H16 every pan													≥120	117	111	105	100	94	88	83	78
	5	H10 every 3rd pan	73	59	47																		
		H12 every 3rd pan	99	86	73	62	51																
		H12 every 2nd pan	≥120	113	102	91	80	70	60	52	44												
		H16 every 3rd pan		≥120	116	105	94	84	74	65	56	48											
		H16 every 2nd pan					≥120	113	104	95	86	78	70	63	56	49							
		H12 every pan					≥120	117	109	101	93	85	78	70	63	57	51	45					
		H16 every pan										≥120	119	113	106	100	94	88	81	76	70	64	59

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																				
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000
160	3	H10 every 3rd pan	97	84	71	60	50																
		H12 every 3rd pan	≥120	110	98	87	76	66	57	48													
		H12 every 2nd pan			≥120	114	104	95	86	77	69	61	53	47									
		H16 every 3rd pan				≥120	118	109	100	91	83	74	67	59	52	46							
		H16 every 2nd pan							≥120	119	112	104	97	89	82	76	69	63	57	51	46		
		H12 every pan								≥120	116	109	103	96	89	83	77	70	65	59	54	49	44
		H16 every pan														≥120	119	113	108	102	97	92	87
	4	H10 every 3rd pan	92	78	66	55	45																
		H12 every 3rd pan	117	105	93	81	71	60	51														
		H12 every 2nd pan		≥120	119	109	99	90	80	71	63	55	48										
		H16 every 3rd pan				≥120	113	104	94	85	77	69	61	54	47								
		H16 every 2nd pan							≥120	114	106	99	91	84	77	70	63	57	51	46			
		H12 every pan							≥120	119	111	104	97	90	84	77	71	65	59	54	48		
		H16 every pan													≥120	119	114	108	102	97	91	86	81
	5	H10 every 3rd pan	76	62	50																		
		H12 every 3rd pan	102	89	76	65	54	45															
		H12 every 2nd pan	≥120	116	105	94	83	73	64	55	47												
		H16 every 3rd pan		≥120	118	108	97	87	77	68	60	52											
		H16 every 2nd pan					≥120	116	107	98	90	82	74	66	59	46							
		H12 every pan						≥120	112	104	96	88	81	74	67	60	54	48					
		H16 every pan											≥120	116	110	103	97	91	85	79	74	68	63

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																				
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000
180	3	H10 every 3rd pan	100	87	75	64	53	44															
		H12 every 3rd pan	≥120	113	101	90	80	70	60	52	44												
		H12 every 2nd pan			≥120	117	108	99	90	81	72	65	57	50	44								
		H16 every 3rd pan					≥120	113	104	95	87	78	71	63	56	50							
		H16 every 2nd pan								≥120	115	108	101	93	87	80	73	67	61	56	50		
		H12 every pan								≥120	119	113	106	99	93	87	80	74	68	63	58	53	48
		H16 every pan															≥120	117	112	106	101	96	91
	4	H10 every 3rd pan	96	82	70	59	48																
		H12 every 3rd pan	≥120	108	97	85	75	65	55	47													
		H12 every 2nd pan			≥120	113	103	94	85	76	67	60	52	45									
		H16 every 3rd pan				≥120	117	108	99	90	81	73	65	58	51								
		H16 every 2nd pan							≥120	118	110	103	96	88	81	75	68	62	56	50	45		
		H12 every pan								≥120	115	108	101	95	88	82	75	69	63	58	53	48	
		H16 every pan														≥120	118	112	107	101	96	91	86
	5	H10 every 3rd pan	81	67	55	44																	
		H12 every 3rd pan	107	94	82	70	59	50															
		H12 every 2nd pan		≥120	110	99	89	79	69	60	52	45											
		H16 every 3rd pan			≥120	113	103	93	83	74	65	57	50										
		H16 every 2nd pan						≥120	112	104	95	87	80	72	65	58	52	46					
		H12 every pan						≥120	117	109	101	94	87	79	73	66	60	54	48				
		H16 every pan												≥120	115	109	103	97	91	86	80	75	69

3.3.6 FIRE DESIGN TABLES *continued*

0.75mm AND 0.95mm HIBOND COMPOSITE SLAB – FIRE RESISTANCE RATINGS (minutes)

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF HIBOND SLAB (L) mm																				
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000
200	3	H10 every 3rd pan	103	90	78	66	56	46															
		H12 every 3rd pan	≥120	115	104	93	83	73	63	55	47												
		H12 every 2nd pan				≥120	110	101	92	84	75	67	60	53	47								
		H16 every 3rd pan					≥120	115	107	98	90	82	74	66	59	53	47						
		H16 every 2nd pan								≥120	118	111	104	96	90	86	77	70	64	59	53	48	
		H12 every pan									≥120	115	109	102	96	89	83	77	72	66	61	56	51
		H16 every pan																≥120	114	109	104	99	94
	4	H10 every 3rd pan	99	85	73	62	51																
		H12 every 3rd pan	≥120	111	100	89	78	68	59	50													
		H12 every 2nd pan			≥120	116	106	97	88	79	71	63	55	49									
		H16 every 3rd pan					≥120	111	102	93	85	77	69	62	55	48							
		H16 every 2nd pan								≥120	114	106	99	92	85	78	72	66	60	54	49		
		H12 every pan								≥120	118	111	104	98	91	85	79	73	67	61	56	51	46
		H16 every pan															≥120	115	110	105	100	94	89
	5	H10 every 3rd pan	85	72	59	48																	
		H12 every 3rd pan	111	98	86	75	64	54	45														
		H12 every 2nd pan		≥120	113	103	93	83	74	65	56	49											
		H16 every 3rd pan			≥120	117	107	97	88	79	70	62	54	47									
		H16 every 2nd pan						≥120	116	108	100	92	84	77	70	63	57	51	45				
		H12 every pan							≥120	113	105	98	91	84	77	71	64	58	53	47			
		H16 every pan												≥120	119	113	108	102	96	90	85	80	74

3.3.7 NOISE CONTROL

3.3.7.1 SCOPE

This section provides guidelines for specifiers and constructors who require noise control systems for residential applications such as separate multi-unit dwellings or single dwellings, commercial applications such as retail spaces, offices and institutional buildings. It is not intended that these guidelines replace the need for specialist acoustic design to meet the specified sound insulation performance for the building.

A Hibond Noise Control System consists of a Hibond concrete slab with a selected USG ceiling system, GIB® standard plasterboard ceiling linings, selected floor coverings and the specific inclusion of a cavity absorber. It must be noted that the floor covering is an essential aspect of the performance of the system.

The information in this section is based on laboratory testing carried out by the University of Auckland, Acoustics Testing Service. The test data was analysed and acoustic opinions provided where required.

Acoustic opinions for the Hibond Noise Control System are contained in Report Rp002 R00_2006476 by Marshall Day Acoustics Limited. This report is available on request for use as a producer statement supporting an alternative solution to the New Zealand Building Code.

The systems set out in this publication provide the stated sound transmission loss performances under laboratory conditions or by opinion. However in practical applications on site there is a significant element of subjectivity to interpreting noise levels within rooms. No matter how low a sound level might be, if it is intrusive upon a person's privacy, then it is likely to cause annoyance. No practical system can guarantee complete sound insulation and completely satisfy everyone.

For more specific information about the fundamentals of sound, its propagation, noise control and detailing, reference should be made to the HERA Acoustic Guide, *HERA Report R4-121*.

3.3.7.2 FACTORS AFFECTING NOISE CONTROL

Layout Planning
A complete noise control solution is a synthesis of detailing and planning. Hibond Noise Control specifications only provide details of the floor/ceiling system components. The following recommendations will help ensure better noise control is achieved.

- Avoid positioning continuous steel beams under non-carpeted floors.
- Avoid positioning services in ceiling spaces of habitable rooms.
- Non-carpeted service areas should be placed adjacent to each other (vertically and horizontally).
- Locate noise sensitive bedrooms away from noise emission areas such as plant rooms, toilets etc.

Flanking
Overall noise control performance of the building is dependent on the surrounding structure having the same or greater performance than the Hibond Noise Control System. Special care in both design and construction must be taken at expansion joints, service penetrations and the junctions of Hibond floor/ceilings to walls and structural members to ensure that flanking transmission does not unduly degrade the sound insulation performance.

Continued on next page

3.3.7.2 FACTORS AFFECTING NOISE CONTROL *continued*

Substitution

Do not substitute! Hibond Noise Control Systems are not generic. It is most important that only the specified components are used when installing Hibond Noise Control Systems. Otherwise, the system performance may not meet the published ratings and may fail to meet customer satisfaction.

Substitution is not in accordance with Hibond Flooring System recommendations and is undertaken at the risk of the owner, specifier and builder.

For the Hibond Flooring System components, refer Section 3.3.13 Hibond Components.

For components supplied by other manufacturers including additional information on specifications, performance, installation, supply and costing etc, refer to manufacturers and distributors' information.

Various	Floor coverings (refer descriptions in Section 3.3.7.4 System Specifications)
USG (09 636 3680)	Strongback Channel (DJ38 or DJ75) Furring Strap (FS37) Furring Channel (FC37) Perimeter Channel (PC24)
Potter Interior Systems Ltd (0800 768 837)	Sound Isolation Clip (ST001) 2.5mm diameter galvanised wire Masonry suspension anchor (for wire attachment to composite slab)
Tasman Insulation (0800 802 287)	Fibreglass Insulation Blanket (density 9 kg/m^3 minimum) Kawool (density 96 kg/m^3)
Winstone Wallboards Ltd (0800 100 442)	13mm GIB® standard plasterboard
Bostik New Zealand Ltd (04 567 5119)	Bostik Ultraset Adhesive

Quality Control

When designing or building Hibond Noise Control Systems, strict attention to the specification, construction and workmanship is required. If the system is not constructed to the recommended details, sound insulation performance will be significantly degraded.

A documented process for checking materials and workmanship should be implemented as part of design and construction. It is recommended that in any multi-unit building at an early stage of the contract, a demonstration apartment be finished to second fix with door and ceilings in place and the airborne and impact sound performance tested and a pass achieved before the completion of any subsequent units.

In order to eliminate "weak spots", the Hibond Noise Control System must be fully completed for a particular room, including floor coverings, junctions of floor coverings to partitions, ceiling cavities, suspension systems, ceiling linings, light fittings and junctions of the Hibond Flooring System with walls or steel beams and partitions. Failure to observe these requirements will render the systems ineffective.

Continued on next page

3.3.7.2 FACTORS AFFECTING NOISE CONTROL *continued*

Laboratory versus Site Testing
All Sound Transmission Class (STC) and Impact Insulation Class (IIC) values for Hibond Noise Control Systems in this publication are from test reports and corresponding acoustic opinions. The laboratory tested constructions replicate site installations as closely as practicable. However laboratory testing does not address sound flanking paths at the floor/ceiling to wall junctions, which can reduce the sound insulation performance.

It is prudent to allow a 5 point reduction for Field Sound Transmission Class (FSTC) and Field Impact Insulation Class (FIIC) when compared to laboratory test results. This reduced performance is reflected in the lesser requirement of FSTC 50 and FIIC 50 for field testing verification in NZBC Clause G6.

The test frequency range was between 100 and 4000 Hertz. Tests were carried out in accordance with vertification method G6/VM1 including both the ASTM standards and the corresponding ISO 140 requirements.

Impact sound insulation testing was carried out for the Hibond Flooring System and indicative IIC values for various floor coverings are listed in the appropriate system specification (refer 3.3.7.4). A carpet or sufficiently resilient floor covering to achieve FIIC 50 (minimum) is required throughout the serviceable life of the building, where carpet or resilient floor covering is specified as part of the system.

The term ***indicative*** refers to a difference from the test arrangement in *ISO140/VI-1978(E) Laboratory measurements of impact sound insulation of floors, clause 5.2 Test specimen setout.* This clause prescribes a sample size of not less than 10 square metres with edge conditions as similar as possible to normal construction practice. The tested samples of floor coverings were approximately 600x600mm with free edges.

Building Services
Downlights and flush-mounted lighting boxes must be acoustically tested and approved as suitable for the specific application in order to ensure that the sound insulation performances are not compromised. All ceiling penetrations have the potential to reduce performance. Plumbing pipe work installed using bends with generous radii, smooth bores and tapered joints will reduce the generation of plumbing noise caused by turbulence. The transfer of plumbing noise may be reduced by isolating elements such as the use of resilient pipe clips and heavy pipe wraps. Plumbing systems designed to prevent excessive pressure, water hammer, splashing, thermal movement of pipes, aeration or appliance noise will complement Hibond Noise Control Systems by reducing the noise generated by these installations.

Continued on next page

3.3.7.3 SYSTEM SELECTION

Selecting a System
When selecting a Hibond Noise Control System the following questions should be considered.

1. The Market Sector and Zone, which best describes the situation.
2. Is code compliance necessary?
3. What will the occupants find satisfactory?

If code compliance is necessary, then a system with a STC and IIC rating of at least 55 must be selected.

If code compliance is not required for the floor ceiling, then occupant satisfaction must be assessed and the performance specified accordingly.

It should be noted that code compliance may not constitute satisfaction. The building code should be treated as a minimum standard. Many people will not be satisfied by a system that merely satisfies NZBC Clause G6 (STC and IIC 55). For this reason Hibond Noise Control Systems offer the option of many differently performing systems including those which considerably exceed building code requirements.

The following guide shows relative perception of loudness and sound insulation performance:

- 1dB increase in insulation = very difficult to perceive change in sound level.
- 3dB increase in insulation = just perceivable change in sound level.
- 5dB increase in insulation = clearly noticeable decrease in sound level.
- 10dB increase in insulation = sound heard through construction is approximately half as loud.
- 20dB increase in insulation = sound heard through construction is approximately quarter as loud.
- The addition of an extra layer of 13mm GIB® standard plasterboard could increase the system performance by 3 STC points and 2 IIC points.

Some STC and IIC values in this document are based upon acoustic opinions and have a margin of error of +/– 2dB for STC and +/– 3dB for IIC.

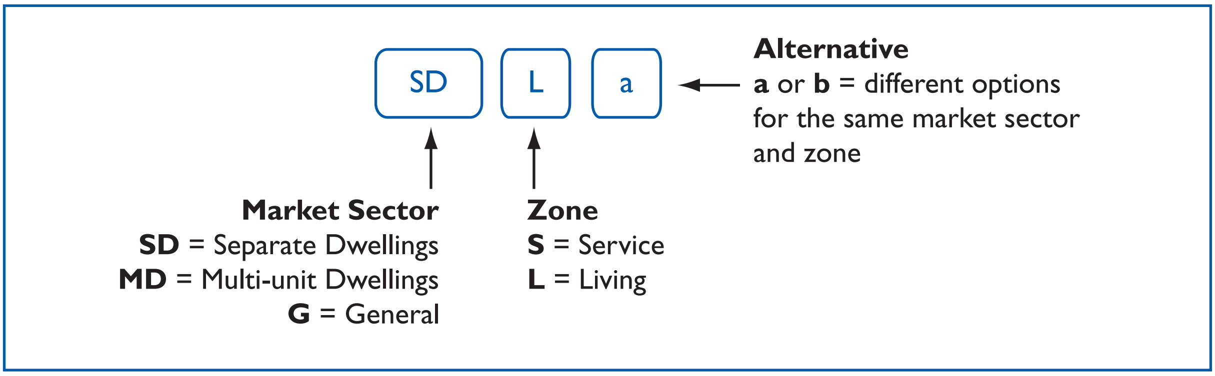
Call Dimond on 0800 Roofspec (0800 766 377) for further information on sound insulation performance for composite slabs other than 120mm overall thickness.

Continued on next page

3.3.7.3 SYSTEM SELECTION *continued*

System Specification Reference
Reference codes for each system are marked on the top right hand corner of each system specification. The intent of the specification reference is to allow designers to include a single unique code on a contract drawing. It is a quick concise means of identifying a system comprised of a number of subsystems and components. These codes are:

System reference example: SDLa



The system specification codes contain certain items which have the following particular meanings:

General: Use of Hibond in non-specific applications including garages, retail spaces without ceilings and other spaces without ceiling linings.

Separate Dwelling: A typical New Zealand house which is a single dwelling on a section and isolated from other buildings.

Multi-unit Dwelling: A residential occupancy in a multi-unit building requiring compliance with NZBC Clause G6.

Living Zone: Habitable rooms such as kitchens, bedrooms, lounge, dining room and study.

Service Zone: Non-habitable rooms such as laundries, bathrooms, showers and toilets.

3.3.7.4 SYSTEM SPECIFICATIONS

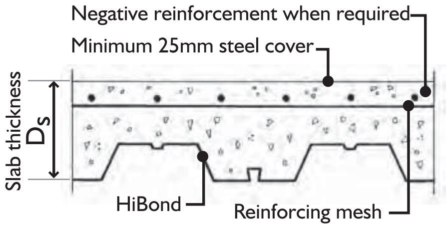
HIBOND (OR FLATDECK) FLOOR FOR GENERAL MARKET

System Specification Reference
G

Airborne Sound Insulation
STC 42
Sound Transmission Class

Acoustic Opinion No.
Rp002 R00_2006476
Hibond Test ID Nos.
T601/T609

Typical Section



Description

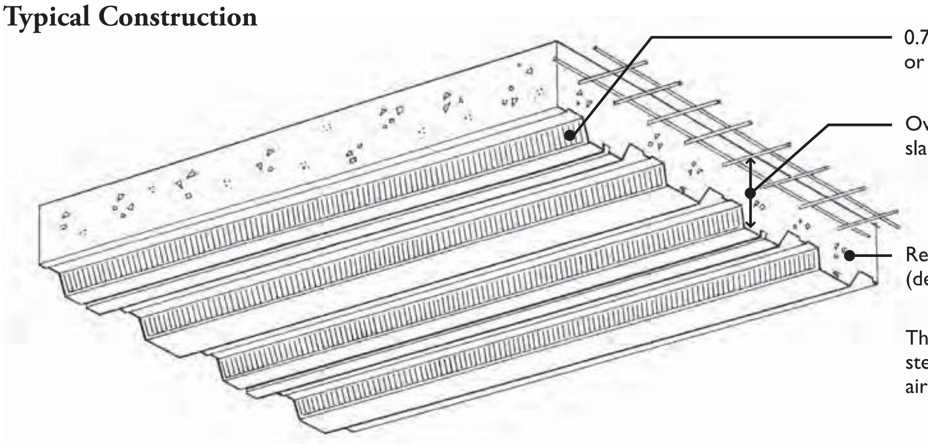
0.75 or 0.95mm Hibond or Flatdeck steel sheeting, with overall slab thickness as indicated below.

Sound Transmission Class (STC)

STC	Description of System	Test ID or Opinion No.
40	0.75 or 0.95mm Hibond with 110mm overall thickness	Rp002 R00_2006476
42	0.75 or 0.95mm Hibond with 120mm overall thickness	T601T1
44	0.75 or 0.95mm Hibond with 130mm overall thickness	Rp002 R00_2006476
44	0.75 or 0.95mm Hibond with 140mm overall thickness	Rp002 R00_2006476
46	0.75 or 0.95mm Hibond with 150mm overall thickness	Rp002 R00_2006476
47	0.75 or 0.95mm Hibond with 160mm overall thickness	Rp002 R00_2006476
48	0.75 or 0.95mm Hibond with 170mm overall thickness	Rp002 R00_2006476
49	0.75 or 0.95mm Hibond with 180mm overall thickness	Rp002 R00_2006476
50	0.75 or 0.95mm Hibond with 190mm overall thickness	Rp002 R00_2006476
51	0.75 or 0.95mm Hibond with 200mm overall thickness	Rp002 R00_2006476

Note: This system does not comply with the requirements of the NZBC Clause G6 for airborne sound insulation (STC).

Typical Construction



Impact Insulation Class (IIC)
for various floor coverings on a slab with an overall slab thickness (D_S) of 120mm

IIC	Floor Covering Option	Hibond Test ID
23	Bare slab	T609-15
40	15mm strip timber on Bostic Ultraset adhesive	T609-57
42	6mm cork flooring	T609-13
43	Gerfloor Taralay Comfort Vinyl 3.1mm thick	T601-3
44	15mm strip timber on 1mm polyethylene foam	T609-44
66	Carpet, nylon or wool 40oz without underlay	Rp002 R00_2006476
67	Carpet, wool 60oz without underlay	Rp002 R00_2006476
71	Wool or nylon carpet plus 8mm foam underlay	Rp002 R00_2006476

Notes

1. The acoustic opinion has a margin of error of +/- 3 IIC points. IIC tests other than for bare slab are indicative with a margin for error of +/- 3 IIC points. Refer Section 3.3.7.2 Factors Affecting Noise Control: Laboratory versus Site Testing.
2. This system can not comply with NZBC Clause G6 for impact insulation class where IIC values shown are less than 55.
3. A quality assurance process must be implemented for all floor coverings.
4. In service zones, the performance requirement of NZBC Clause E3 – Internal Moisture must be properly considered and fully detailed.
5. Bostik Ultraset adhesive to be placed with a two layer application to achieve a dry film thickness not less than 1.9mm. All other adhesives to be thin layer applications in accordance with the manufacturers' instructions.

3.3.7.4 SYSTEM SPECIFICATIONS *continued*

HIBOND (OR FLATDECK) FLOOR/CEILING FOR SEPARATE DWELLING IN LIVING ZONE

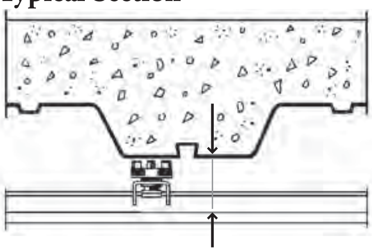
System Specification Reference
SDL

Airborne Sound Insulation
STC 54
Sound Transmission Class

Acoustic Opinion No.
Rp002 R00_2006476
Hibond Test ID Nos.
T609-19

Note this system does not comply with the requirements of the NZBC Clause G6 for airborne sound insulation (STC).

Typical Section



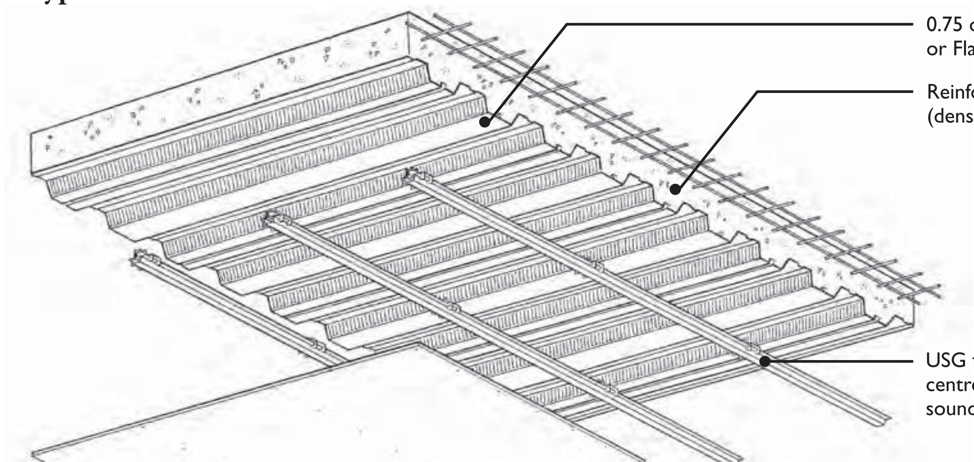
Description

0.75 or 0.95mm Hibond or Flatdeck steel sheeting with 120mm overall thickness concrete slab. Potters Direct Fix Clip ceiling system with Potters sound isolation clips. USG furring channel at 600mm centres (max). 1 layer of 13mm GIB® standard plasterboard.

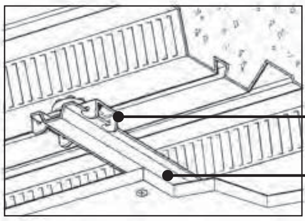
Increased Performance

The addition of an extra layer of 13mm GIB® standard plasterboard could increase STC rating by 3 points and IIC rating by 2 points.

Typical Construction



Typical Fixing



The junction between the plasterboard ceiling and walls must be airtight.

Impact Insulation Class (IIC)
for various floor coverings on a slab with an overall slab thickness (D_S) of 120mm

IIC	Floor Covering Option	Hibond Test ID or Opinion No.
39	Bare slab	Rp002 R00_2006476
46	15mm strip timber on Bostic Ultraset adhesive	Rp002 R00_2006476
47	6mm cork flooring	Rp002 R00_2006476
49	Gerfloor Taralay Comfort Vinyl 3.1mm thick	Rp002 R00_2006476
47	15mm strip timber on 1mm polyethylene foam	Rp002 R00_2006476
60	Carpet, nylon or wool 40oz without underlay	Rp002 R00_2006476
62	Carpet, wool 60oz without underlay	Rp002 R00_2006476
66	Wool or nylon carpet plus 8mm foam underlay	Rp002 R00_2006476

Notes

1. The acoustic opinion has a margin of error of +/- 3 IIC points.
2. This system can not comply with NZBC Clause G6 for impact insulation class where IIC values shown are less than 55.
3. A quality assurance process must be implemented for all floor coverings.
4. In service zones, the performance requirement of NZBC Clause E3 – Internal Moisture must be properly considered and fully detailed.
5. Bostik Ultraset adhesive to be placed with a two layer application to achieve a dry film thickness not less than 1.9mm. All other adhesives to be thin layer applications in accordance with the manufacturers' instructions.

3.3.7.4 SYSTEM SPECIFICATIONS *continued*

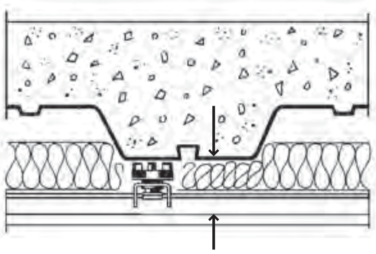
System Specification Reference
MDLa

Airborne Sound Insulation
STC 61
Sound Transmission Class

Acoustic Opinion No.
Rp002 R00_2006476
Hibond Test ID Nos.
T609-18

HIBOND (OR FLATDECK) FLOOR/CEILING FOR MULTI-UNIT DWELLING IN LIVING ZONE – Alternative a

Typical Section



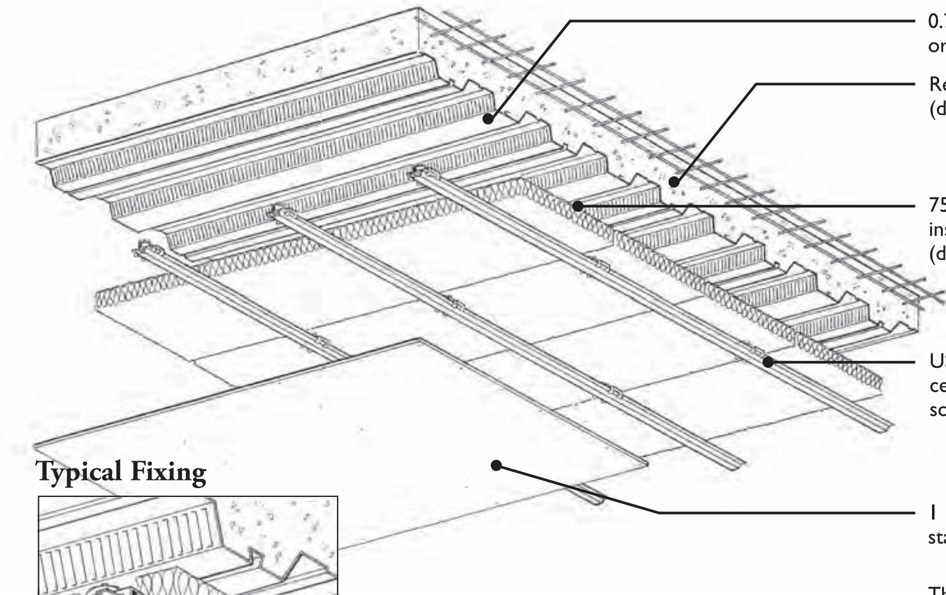
Description

0.75 or 0.95mm Hibond or Flatdeck steel sheeting with 120mm overall thickness concrete slab. 75mm thick R1.8 Pink Batts insulation blanket (density 9kg/m^3 min). Potters Direct Fix Clip ceiling system with Potters sound isolation clips. USG furring channel at 600mm centres (max). 1 layer of 13mm GIB® standard plasterboard.

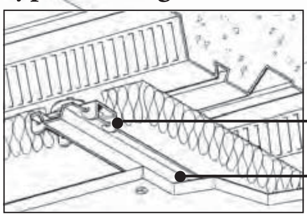
Increased Performance

The addition of an extra layer of 13mm GIB® standard plasterboard could increase STC rating by 3 points and IIC rating by 2 points.

Typical Construction



Typical Fixing



The junction between the plasterboard ceiling and walls must be airtight.

Impact Insulation Class (IIC)
for various floor coverings on a slab with an overall slab thickness (D_s) of 120mm

IIC	Floor Covering Option	Hibond Test ID or Opinion No.
42	Bare slab	Rp002 R00_2006476
54	15mm strip timber on Bostic Ultraset adhesive	Rp002 R00_2006476
56	6mm cork flooring	Rp002 R00_2006476
56	Gerfloor Taralay Comfort Vinyl 3.1mm thick	Rp002 R00_2006476
57	15mm strip timber on 1mm polyethylene foam	Rp002 R00_2006476
67	Carpet, nylon or wool 40oz without underlay	Rp002 R00_2006476
69	Carpet, wool 60oz without underlay	Rp002 R00_2006476
73	Wool or nylon carpet plus 8mm foam underlay	Rp002 R00_2006476

Notes
1. The acoustic opinion has a margin of error of +/- 3 IIC points.
2. This system can not comply with NZBC Clause G6 for impact insulation class where IIC values shown are less than 55.
3. A quality assurance process must be implemented for all floor coverings.
4. In service zones, the performance requirement of NZBC Clause E3 – Internal Moisture must be properly considered and fully detailed.
5. Bostik Ultraset adhesive to be placed with a two layer application to achieve a dry film thickness not less than 1.9mm. All other adhesives to be thin layer applications in accordance with the manufacturers' instructions.

3.3.7.4 SYSTEM SPECIFICATIONS *continued*

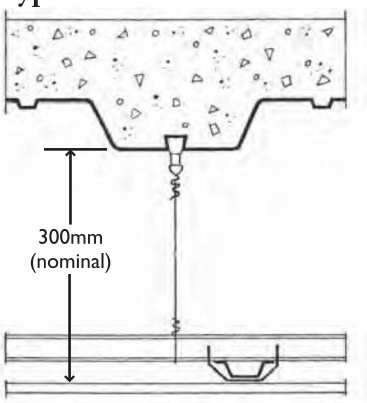
HIBOND (OR FLATDECK) FLOOR/CEILING FOR MULTI-UNIT DWELLING IN LIVING ZONE – Alternative b

System Specification Reference
MDLb

Airborne Sound Insulation
STC 59
Sound Transmission Class

Acoustic Opinion No.
Rp002 R00_2006476
Hibond Test ID Nos.
T609-22

Typical Section



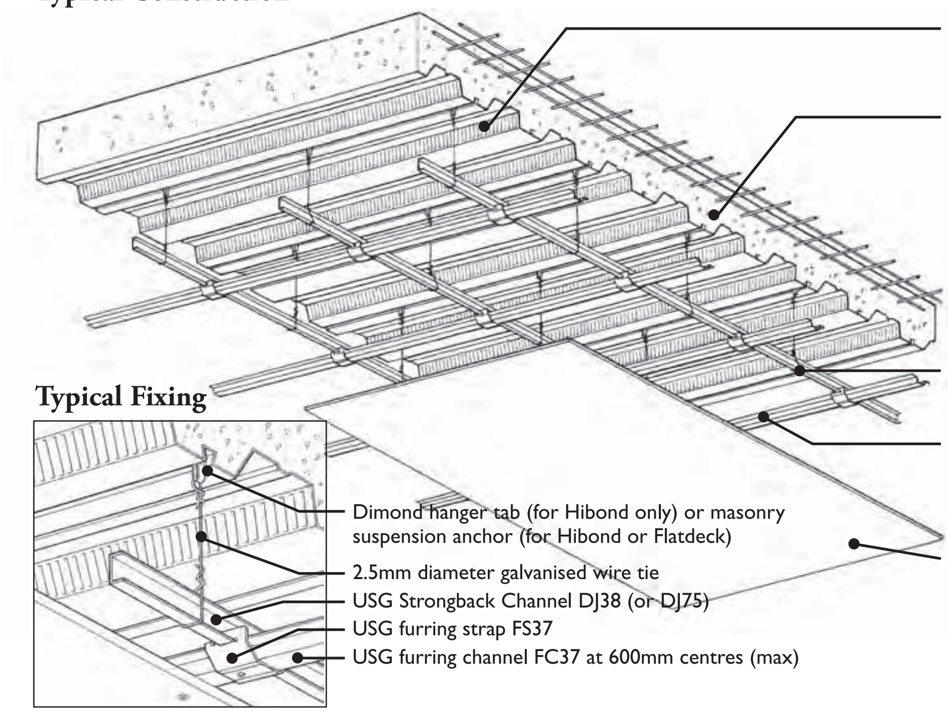
Description

0.75 or 0.95mm Hibond or Flatdeck steel sheeting with 120mm overall thickness concrete slab. USG Donn Screw Fix suspended ceiling system. USG furring channel at 600mm centres (max). 1 layer of 13mm GIB® standard plasterboard.

Increased Performance

The addition of an extra layer of 13mm GIB® standard plasterboard could increase STC rating by 3 points and IIC rating by 2 points.

Typical Construction



The junction between the plasterboard ceiling and walls must be airtight.

Impact Insulation Class (IIC)
for various floor coverings on a slab with an overall slab thickness (D_S) of 120mm

IIC	Floor Covering Option	Hibond Test ID or Opinion No.
35	Bare slab	Rp002 R00_2006476
51	Ceramic tile on Bostic Ultraset adhesive	Rp002 R00_2006476
50	15mm strip timber on Bostic Ultraset adhesive	Rp002 R00_2006476
52	6mm cork flooring	Rp002 R00_2006476
52	Gerfloor Taralay Comfort Vinyl 3.1mm thick	Rp002 R00_2006476
63	Carpet, nylon or wool 40oz without underlay	Rp002 R00_2006476
65	Carpet, wool 60oz without underlay	Rp002 R00_2006476
69	Wool or nylon carpet plus 8mm foam underlay	Rp002 R00_2006476

Notes
1. The acoustic opinion has a margin of error of +/- 3 IIC points.
2. This system can not comply with NZBC Clause G6 for impact insulation class where IIC values shown are less than 55.
3. A quality assurance process must be implemented for all floor coverings.
4. In service zones, the performance requirement of NZBC Clause E3 – Internal Moisture must be properly considered and fully detailed.
5. Bostik Ultraset adhesive to be placed with a two layer application to achieve a dry film thickness not less than 1.9mm. All other adhesives to be thin layer applications in accordance with the manufacturers' instructions.

3.3.7.4 SYSTEM SPECIFICATIONS *continued*

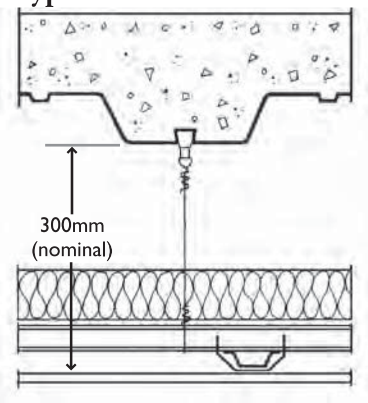
HIBOND (OR FLATDECK) FLOOR/CEILING FOR MULTI-UNIT DWELLING IN SERVICE ZONE

System Specification Reference
MDS

Airborne Sound Insulation
STC 61
Sound Transmission Class

Acoustic Opinion No.
Rp002 R00_2006476
Hibond Test ID Nos.
T609-23

Typical Section



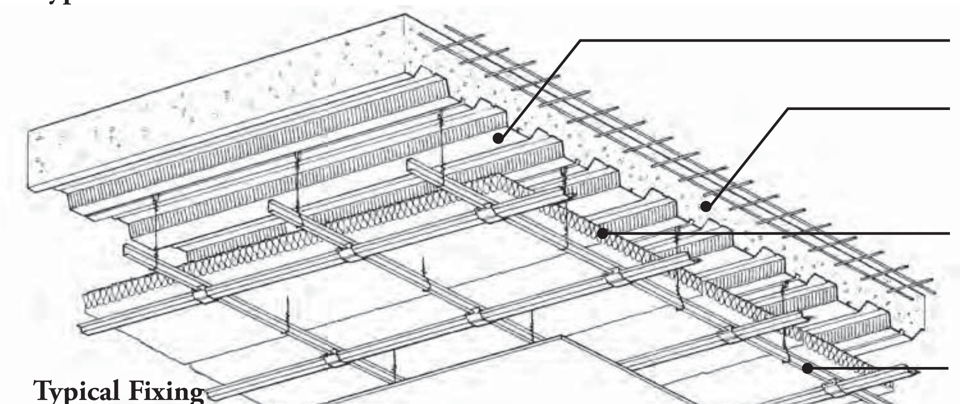
Description

0.75 or 0.95mm Hibond or Flatdeck steel sheeting with 120mm overall thickness concrete slab. 75mm thick R1.8 Pink Batts insulation blanket (density 9 kg/m^3 min). USG Donn Screw Fix suspended ceiling system. USG furring channel at 600mm centres (max). 1 layer of 13mm GIB® standard plasterboard.

Increased Performance

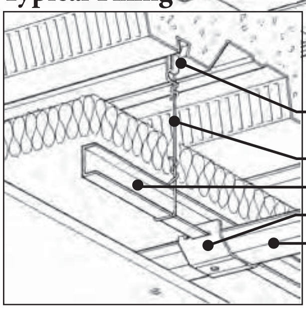
The addition of an extra layer of 13mm GIB® standard plasterboard could increase STC rating by 3 points and IIC rating by 2 points.

Typical Construction



The junction between the plasterboard ceiling and walls must be airtight.

Typical Fixing



Impact Insulation Class (IIC)
for various floor coverings on a slab with an overall slab thickness (D_S) of 120mm

IIC	Floor Covering Option	Hibond Test ID or Opinion No.
43	Bare slab	Rp002 R00_2006476
55	Ceramic tile on Bostic Ultraset adhesive	Rp002 R00_2006476
62	15mm strip timber on Bostic Ultraset adhesive	Rp002 R00_2006476
64	6mm cork flooring	Rp002 R00_2006476
66	Gerfloor Taralay Comfort Vinyl 3.1mm thick	Rp002 R00_2006476
75+	Carpet, nylon or wool 40oz without underlay	Rp002 R00_2006476
75+	Carpet, wool 60oz without underlay	Rp002 R00_2006476
75+	Wool or nylon carpet plus 8mm foam underlay	Rp002 R00_2006476

Notes

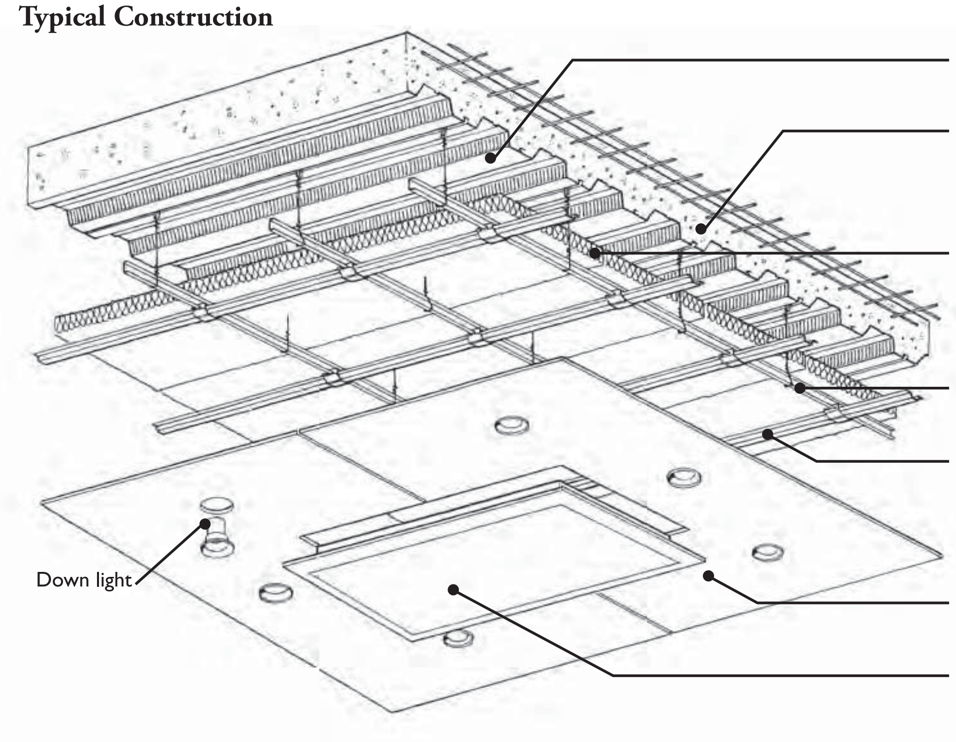
1. The acoustic opinion has a margin of error of +/- 3 IIC points.
2. This system can not comply with NZBC Clause G6 for impact insulation class where IIC values shown are less than 55.
3. A quality assurance process must be implemented for all floor coverings.
4. In service zones, the performance requirement of NZBC Clause E3 – Internal Moisture must be properly considered and fully detailed.
5. Bostik Ultraset adhesive to be placed with a two layer application to achieve a dry film thickness not less than 1.9mm. All other adhesives to be thin layer applications in accordance with the manufacturers' instructions.

3.3.7.4 SYSTEM SPECIFICATIONS *continued*

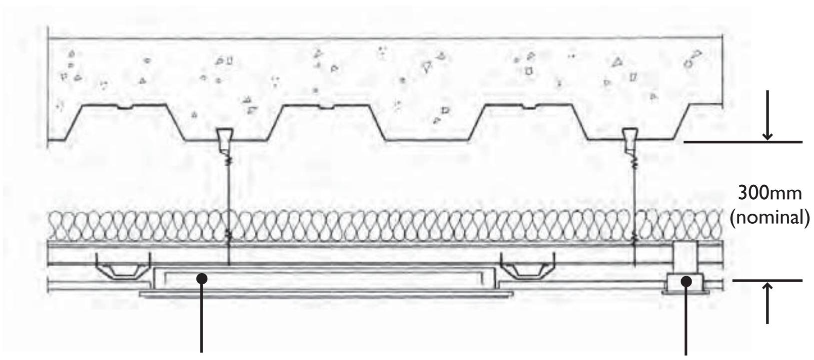
LIGHT FITTING PENETRATIONS IN CEILING LININGS

The light fittings shown below reduce the sound insulation performance of the floor/ceiling system. For each of the Hibond or Flatdeck floor/ceiling systems MDLb and MDS the impact sound insulation is reduced by a minimum of 1 IIC point and the airborne sound insulation is reduced by a minimum of 2 STC points.

Typical Construction



Typical Section



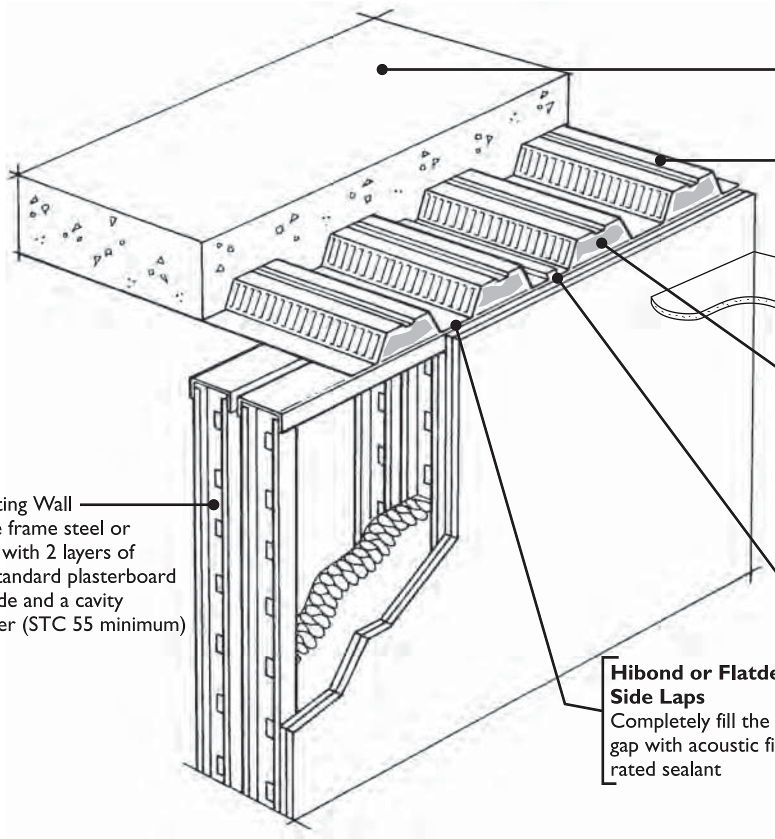
Notes

1. Downlights and light trough penetrations through the ceiling are permissible in Hibond or Flatdeck Flooring Systems MDLb and MDS (illustrated) but not permitted in SDL and MDLa.
2. The illustration represents the extent of light fitting penetrations per $10m^2$ of ceiling lining. If the extent of light fitting penetrations exceeds the proportion illustrated, the sound insulation performance of the Hibond or Flatdeck system may be reduced.
3. The junction between the plasterboard ceiling and walls must be airtight.

3.3.7.4 SYSTEM SPECIFICATIONS *continued*

TOP OF INTER-TENANCY SEPARATING WALL TO UNDERSIDE OF HIBOND OR FLATDECK FLOOR SLAB

This detail provides guidance on how to complete the voids between the top of the wall and the underside of the Hibond or Flatdeck Flooring System.



Notes

1. This construction detail only applies to separating walls with a STC of 55dB or more. For light single stud walls with one layer of plasterboard each side, the top track/plate must be spaced off from and not connected (isolated) to the slab soffit.
2. This construction detail requires a suspended ceiling with one layer of 13mm GIB® standard plasterboard as a ceiling lining. The junction between the plasterboard ceiling and the walls must be airtight.
3. With **Hibond**, if there is no suspended ceiling both layers of 13mm GIB® standard plasterboard wall lining each side must be scribed around the ribs and sealed airtight with an acoustic fire rated sealant. The mineral fibre Kaowool (density 96 kg/m^3) is required to fill the void above the wall and between the Hibond steel sheeting ribs.
4. With **Flatdeck**, if there is no suspended ceiling, the small voids and side laps must be sealed airtight as described in the detail above.

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE

The following construction details are a complete reproduction of the appendix: Recommended construction details from the HERA Acoustic Guide HERA Report R4-121.

SYSTEM PERFORMANCE [A.1]

General [A.1.1]
The following details are designed to be cost effective solutions to common detailing needs for good acoustic performance in steel framed buildings with concrete floor slabs. These solutions, if fully implemented, without substitution of specified products or rearrangement or alteration, will ensure that the use of structural steel framing does not adversely affect the acoustic performance of the building system.

No matter what transmission loss is being sought the steel isolation details shown herein apply. They cover 11 areas within steel framed buildings where acoustic detailing is most important, including areas not involving a structural steel member.

Details 3, 4, 8, 9, 10 and 11 require any structural steel member within an apartment to be inside a framing system that does not contact the steel. While this is slightly more expensive to provide than simply fixing the framing for the lining directly to the steel, it is required for acoustic isolation to any specified level. There is an additional benefit, however, in that it also makes the linings a more effective radiation barrier in the event of a severe fire, even though these linings do not carry a specified fire resistance rating. This will raise the damage threshold of the steel frame in fire and will typically mean that no additional passive fire protection will be required to the beam or the column member. The cost saving from eliminating the need for this passive material will be greater than the increased cost of acoustically isolating the linings from the steel section.

Explanation of notes on performance [A.1.2]
In each case the objective/intent of the detail is provided so that the designer can identify the essential components of the construction and their relationship to one another. In this way any change that might compromise that intent can be avoided. It will become self evident that every detail acoustically isolates particular components from each other. Often this will be isolating the steel structure or the floor slab from the linings.

Details 3, 4, 5, 8, 9, 10 and 11 in the following section contain the note:

- The steel member does not reduce the acoustic performance of the building system when this detail is used.

Where details carry this note, the objective/intent is to ensure that the presence of the structural steel member does not adversely affect the impact and airborne sound insulation performance of the building system. Furthermore, transmission of building noise from services will be reduced.

It is essential to implement a detailed acoustic design to meet the specified sound insulation performance (NZBC minimum or better quality). The following details form part of this acoustic design.

Continued on next page

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

Notes on floor/ceiling performance [A.1.3]
These details are designed to give isolation sufficient to achieve the impact sound insulation provisions of the New Zealand Building Code when used in conjunction with a floor/ceiling system that achieves the airborne sound insulation provisions of the New Zealand Building Code. The concrete slab thickness and concrete density in these details is either determined by testing or must comply with G6/AS1. For concrete and composite concrete on steel deck slab systems not in G6/AS1, consult the manufacturer or an acoustic specialist.

(Note that most proprietary concrete floor systems have never been laboratory tested for airborne or impact sound insulation.)

Verification methods [A.1.4]
Any floor covering that does not comply with that shown in the following details must have a preconstruction sample tested on site for impact insulation performance in accordance with verification method G6/VM1.

Overall system [A.1.5]
The overall system including the ceiling system, structure and building fabric performs to provide impact sound insulation and not just the upper floor covering.

CHECKLIST OF CONSTRUCTION DETAILS [A.2]

- Quality assurance procedures must be implemented to make sure that the system is built exactly as specified.
- All structural steel beams must be isolated from ceiling and wall lining systems.
- All structural steel columns must be isolated from wall lining systems.
- Ceiling suspension systems must not be rigid systems; they must be USG Donn Screw fix suspended ceiling systems.
- A fibreglass or polyester bulk fibre sound absorber must be placed in the ceiling cavity beneath all hard tiled floor surfaces.
- Consider layout of rooms and if practical do not locate tiled floor surfaced rooms over or adjacent to habitable rooms.
- It is advantageous to have a building layout to provide dissimilar room volumes and shape on either side of an inter-tenancy wall or floor.
- Service ducts must be insulated against sound and vibration.
- Isolating brackets must be used for service pipework.
- Sprinkler pipes must use resilient supports and not be connected rigidly to the structural steel beams within ceiling cavities.
- Airconditioning return air grilles must not compromise the performance of the inter-tenancy wall or floor/ceiling system.

(The following details 1-11 incorporate these requirements where they are applicable.)

ACKNOWLEDGEMENT [A.3]
The principal author of these details is Ken McGunnigle of Prendos Limited.

Continued on next page

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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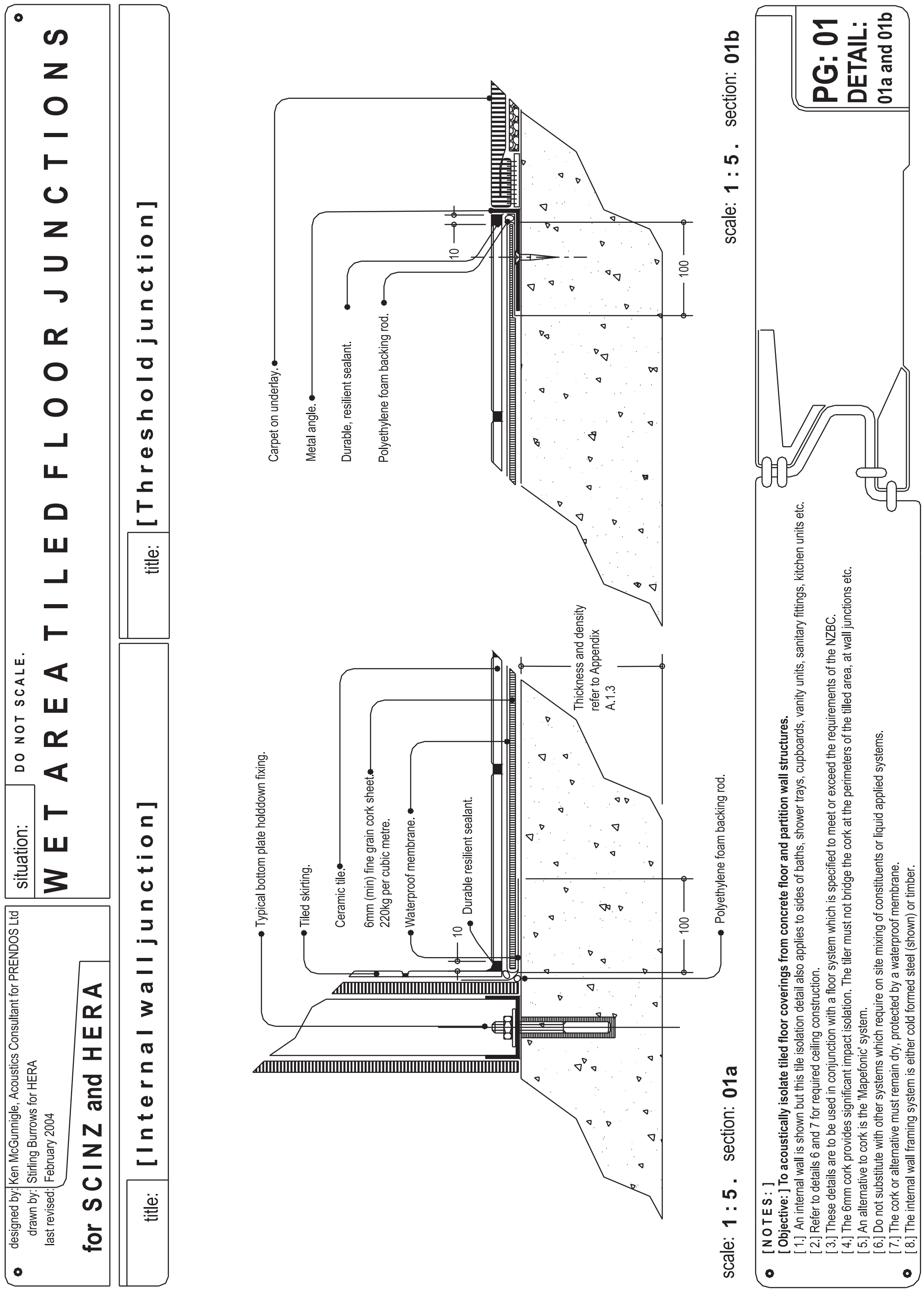

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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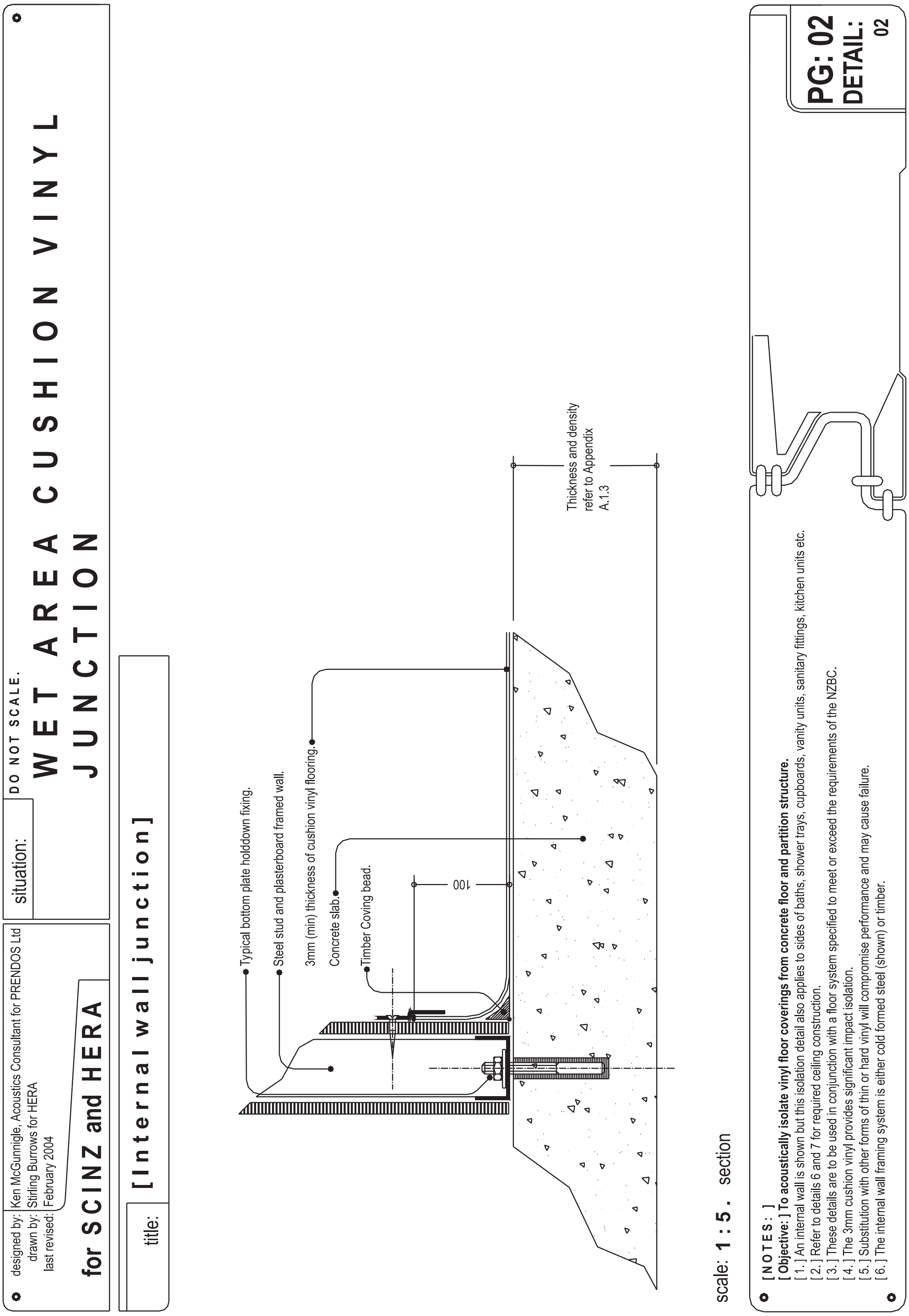

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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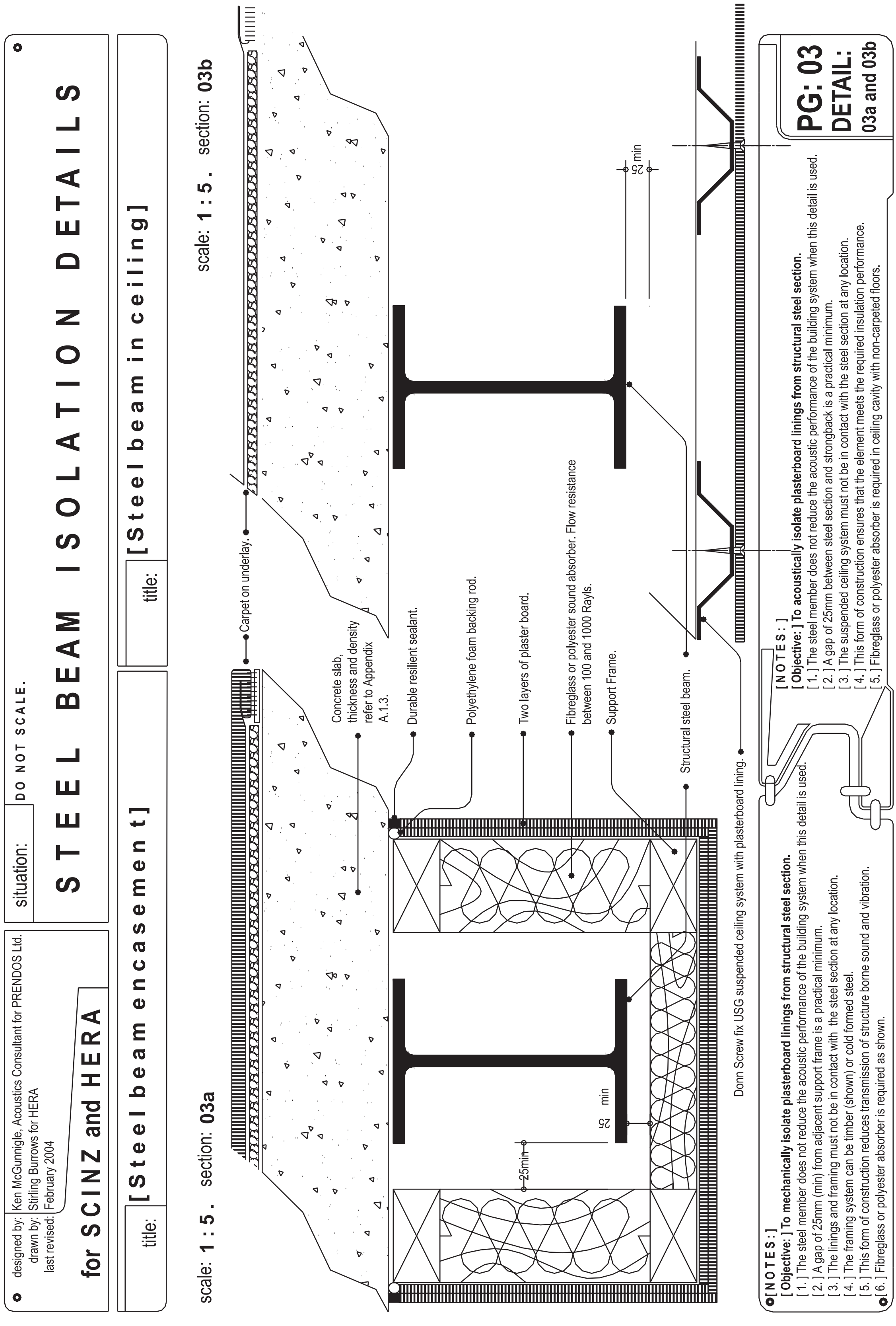

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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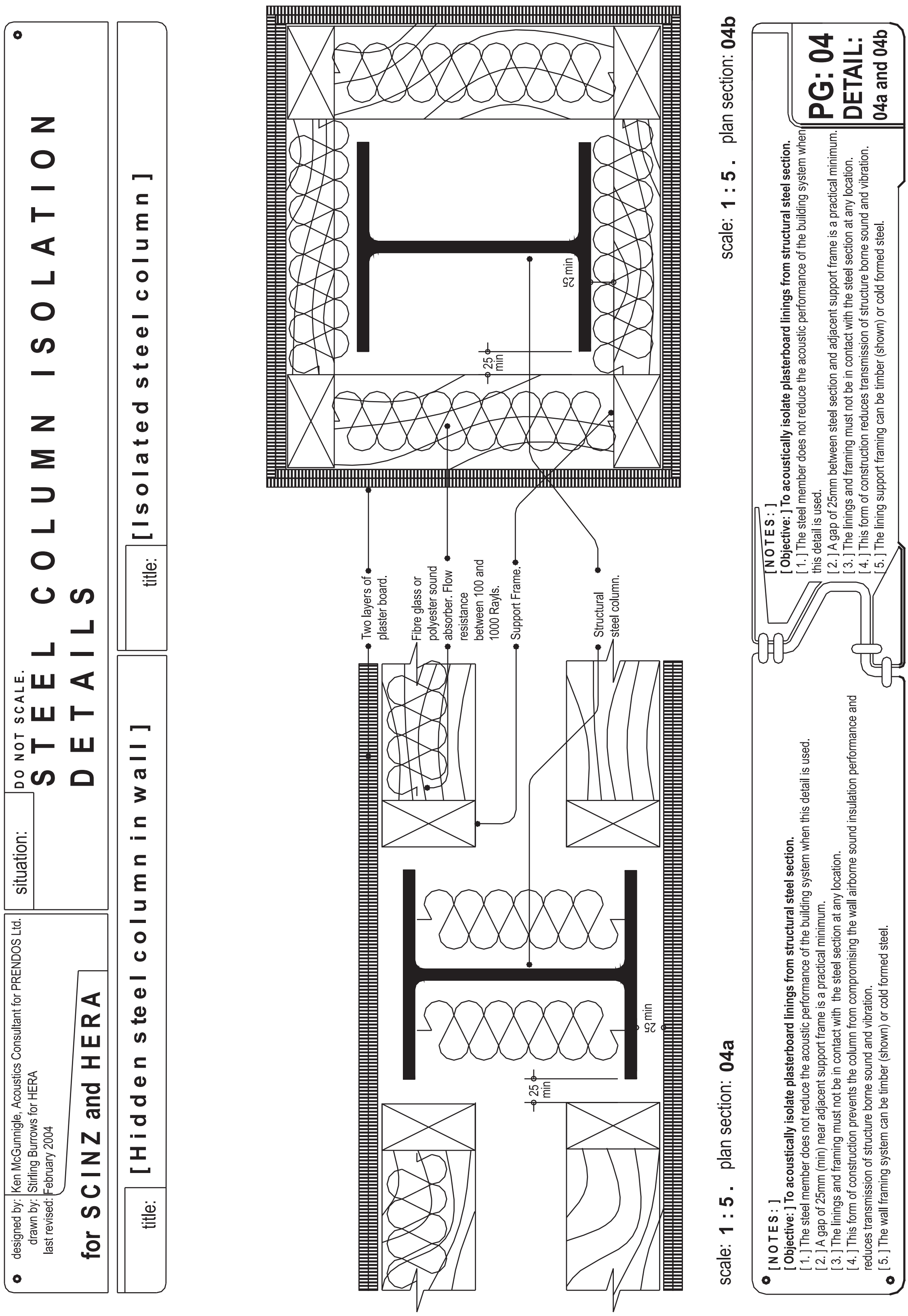

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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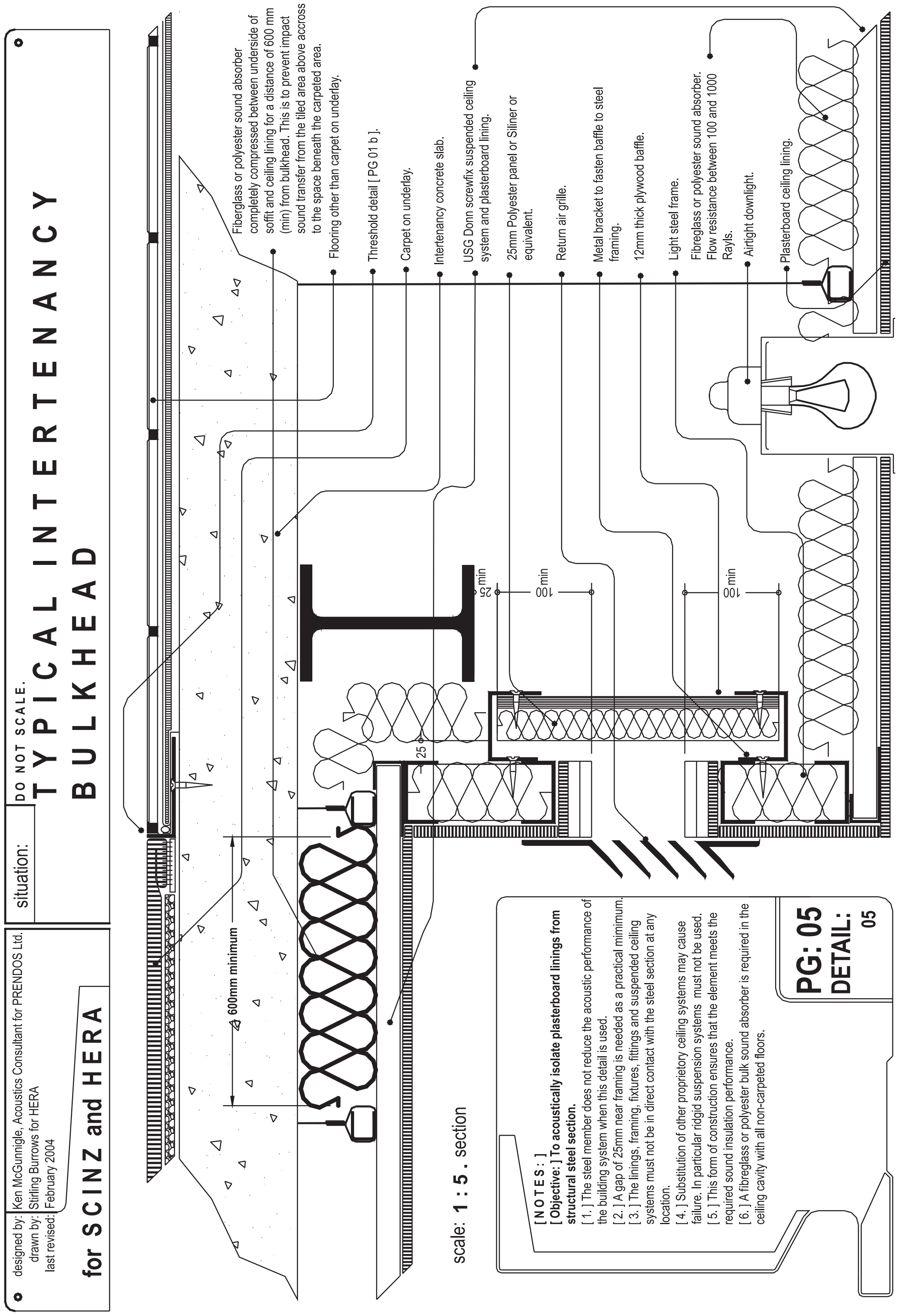

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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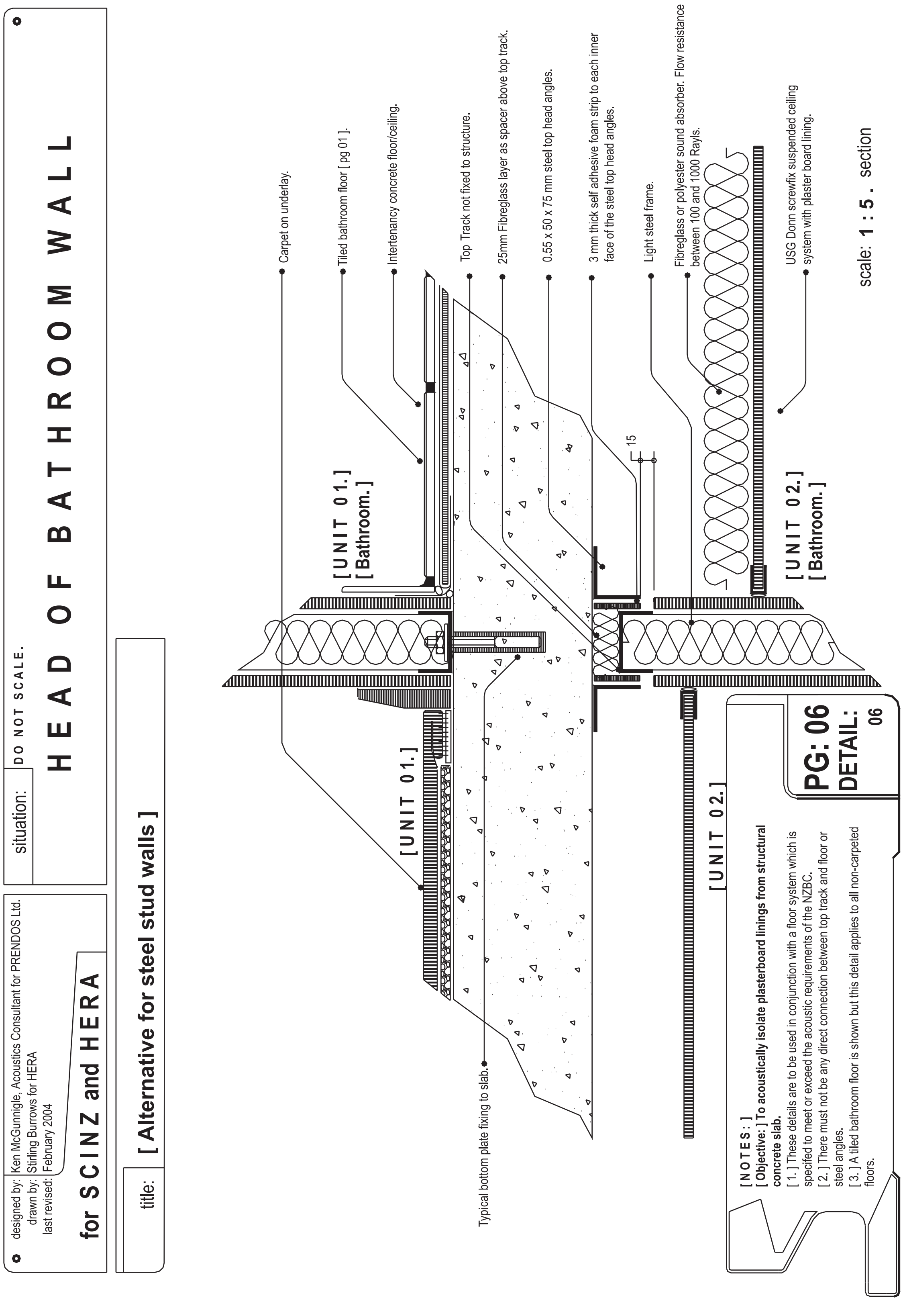

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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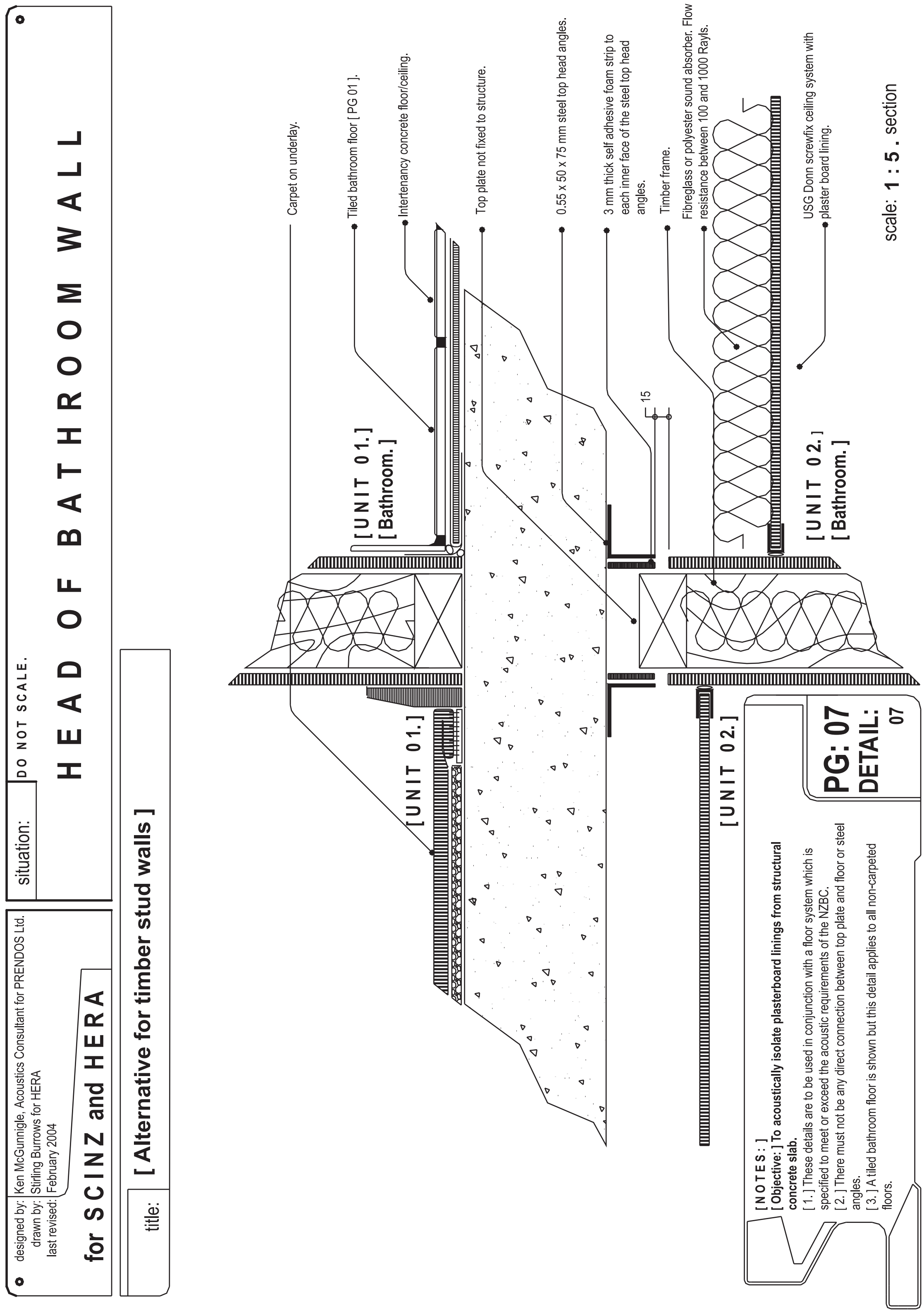

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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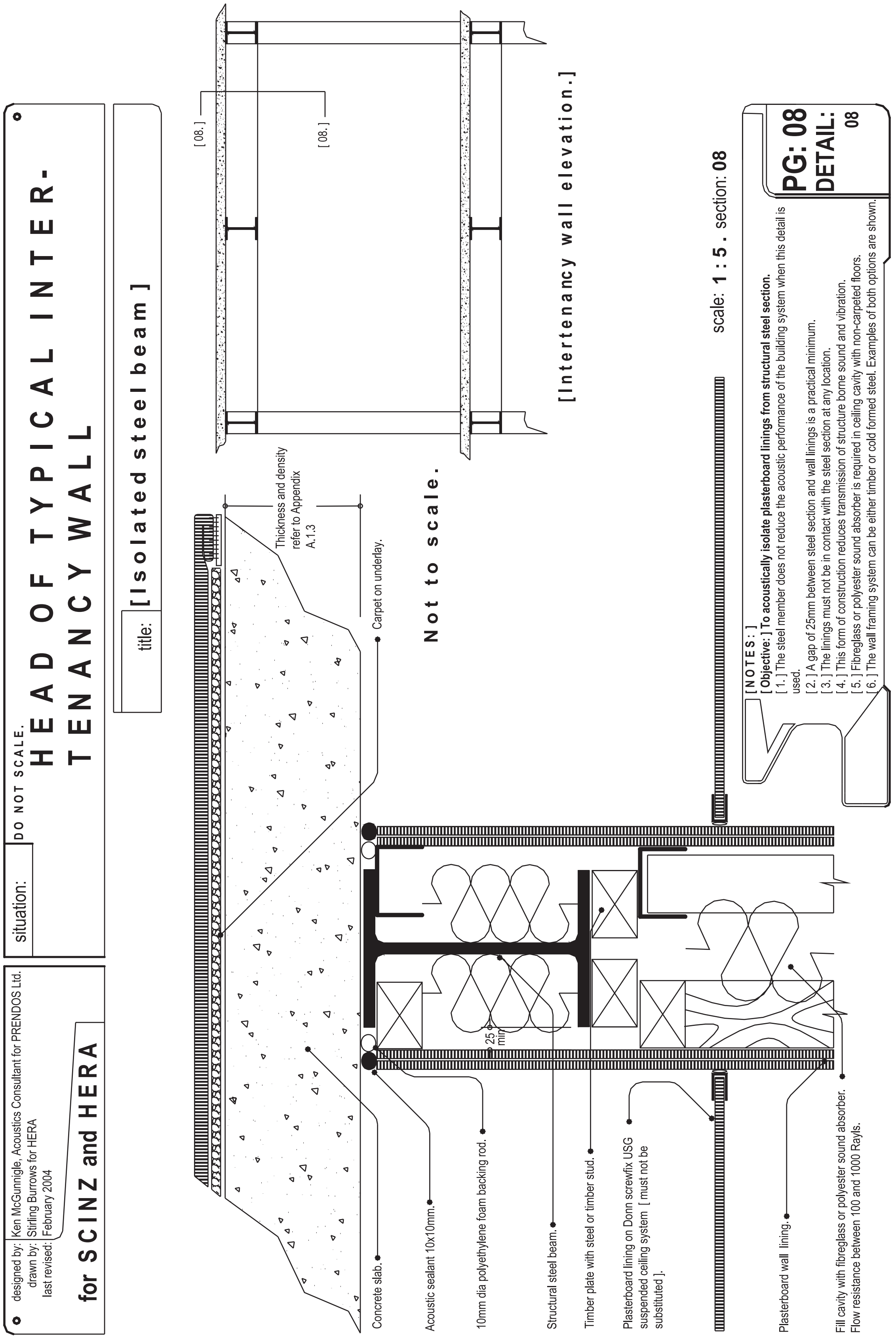

Dimond

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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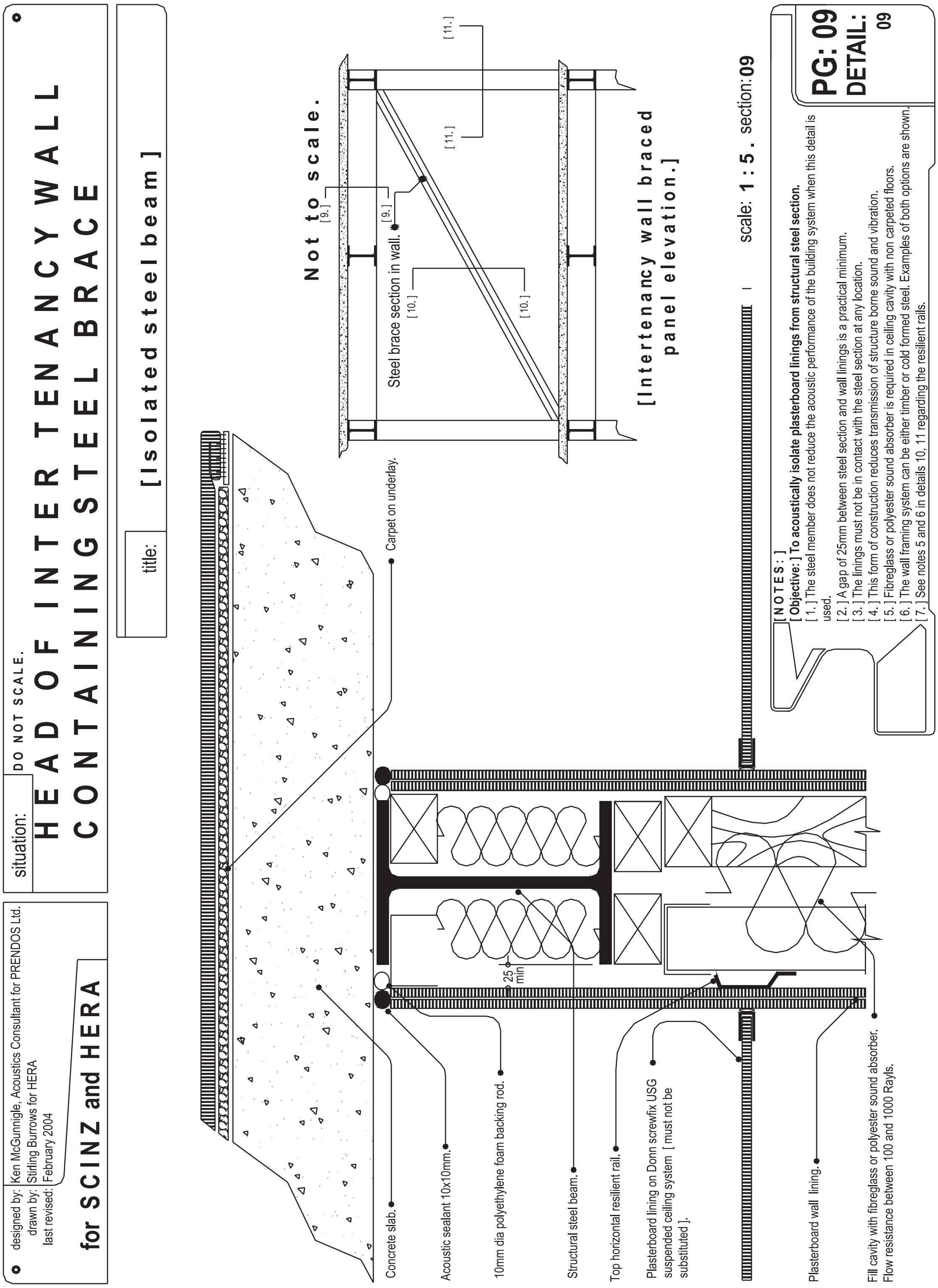

Dimond

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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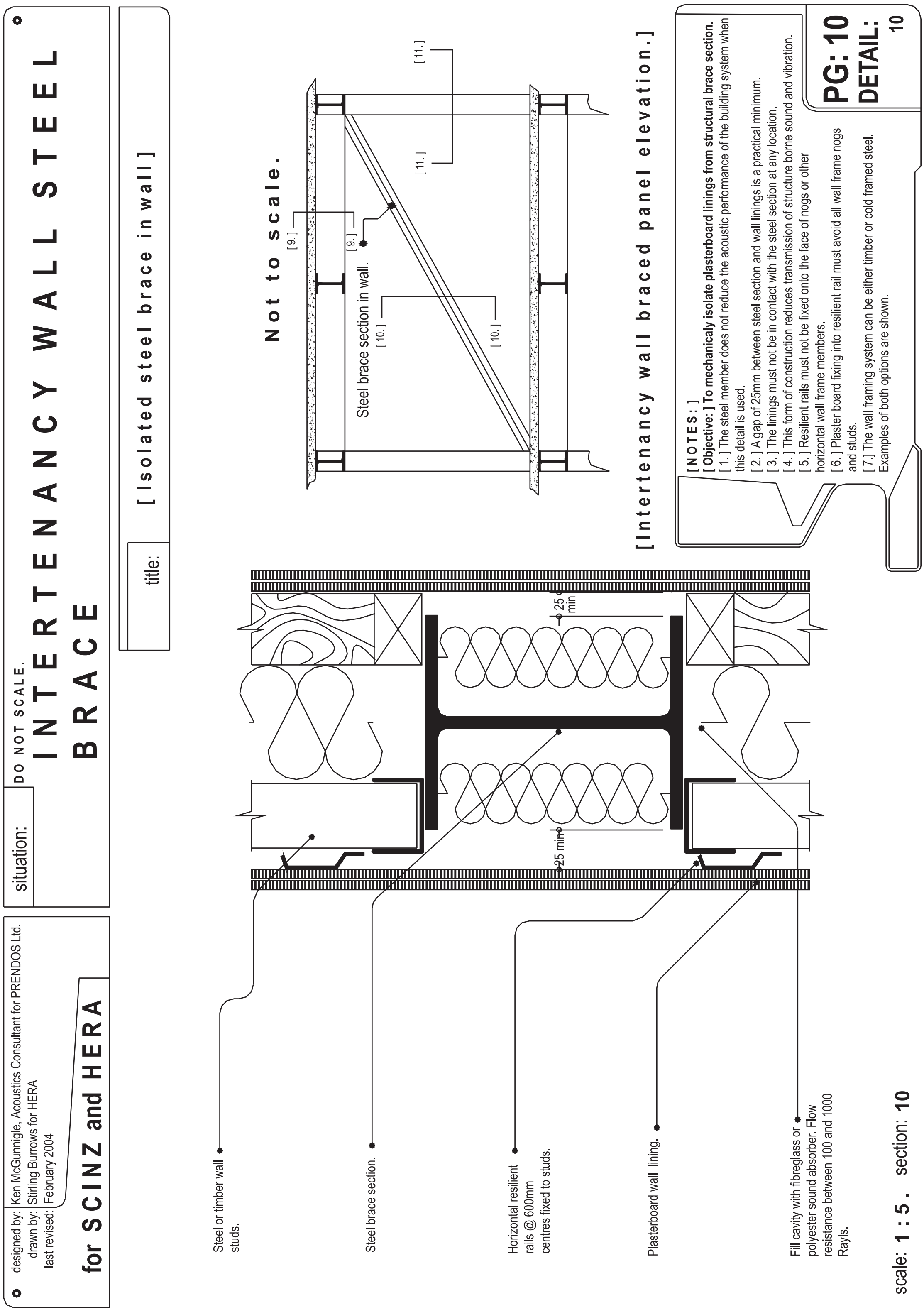

3.3.7.5 CONSTRUCTION DETAILS FROM HERA ACOUSTIC GUIDE *continued*

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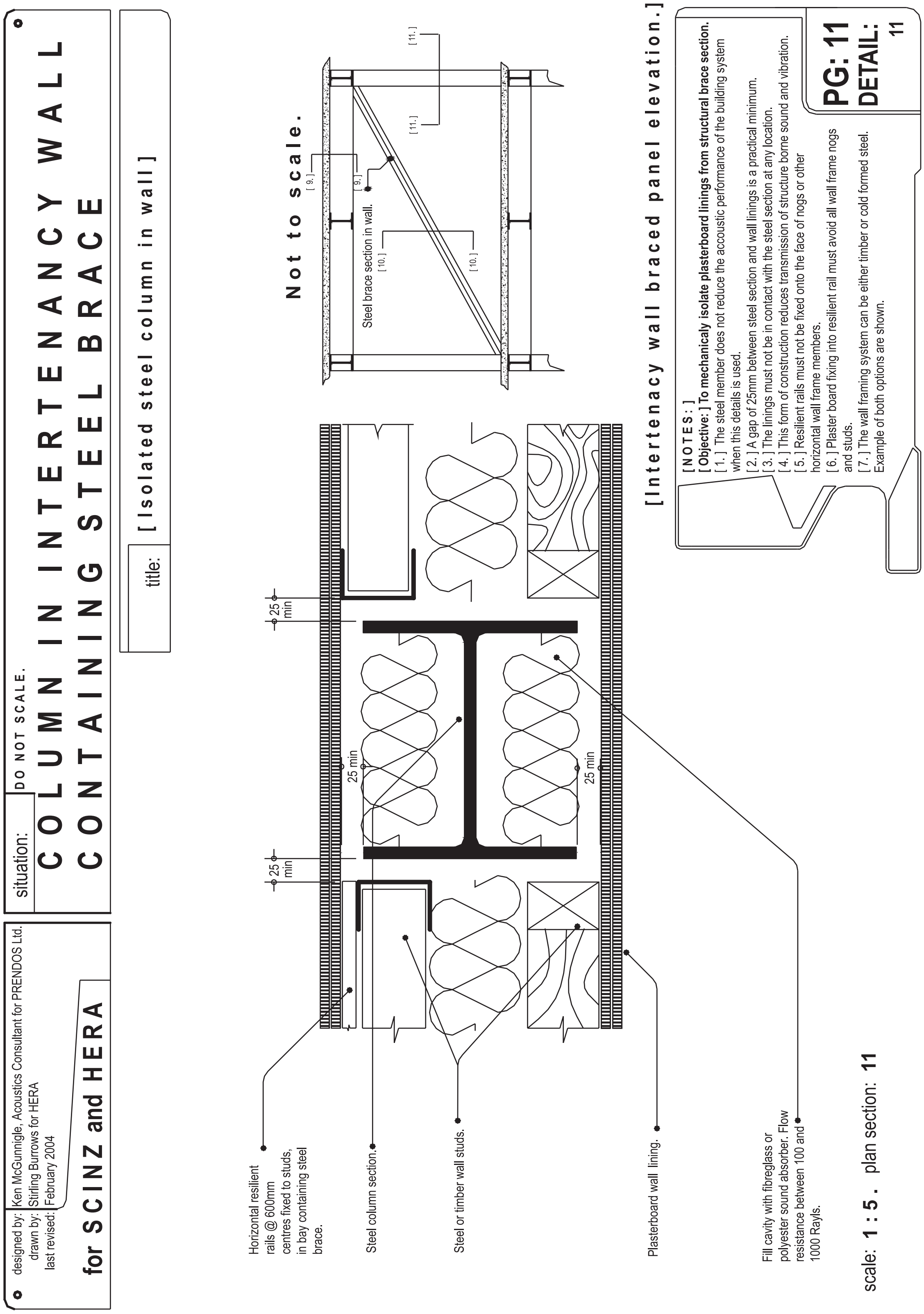
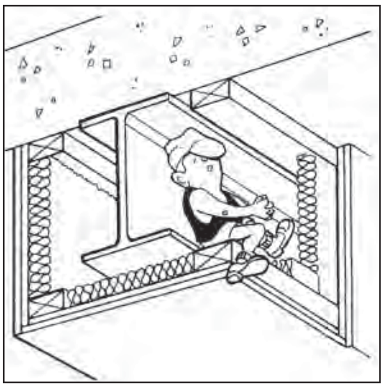
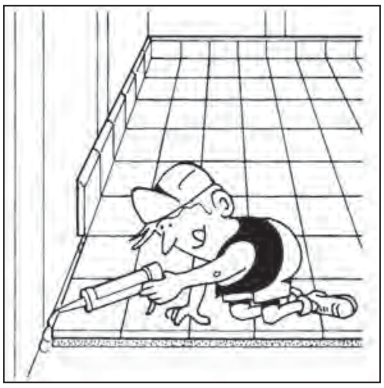


3.3.7.6 NOISE CONTROL DO'S & DON'TS

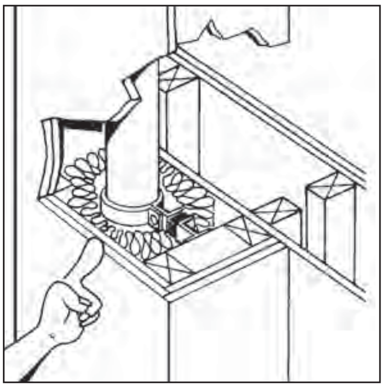


DO isolate steel beams.

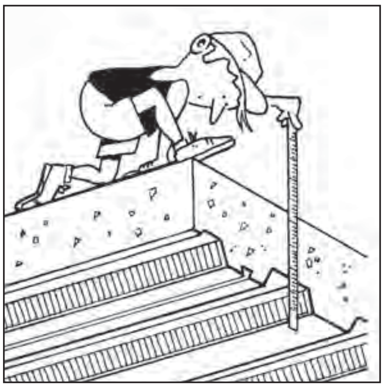


DO isolate tiles from floors and walls.

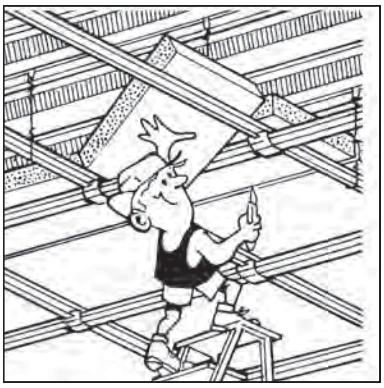
DO read the Hibond manual before you start.



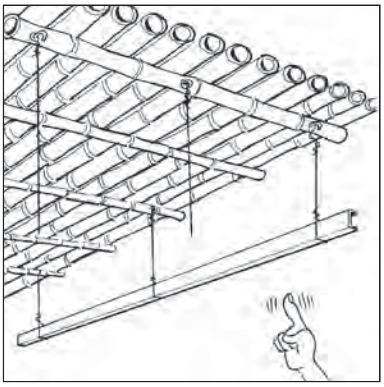
DO isolate pipes and services such as toilet waste.



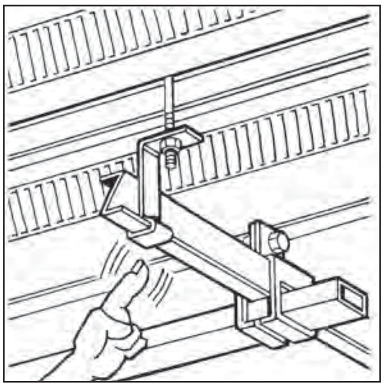
DO ensure correct concrete thickness and quality assurance.



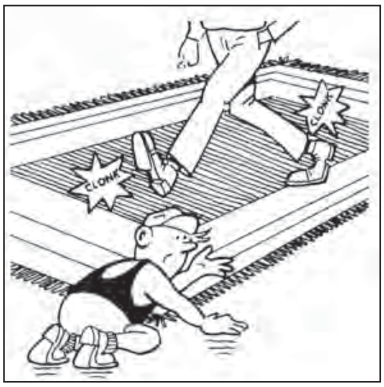
DON'T substitute polystyrene blocks as alternative sound infill.



DON'T substitute other structural products for Hibond.



DON'T use anything other than USG or Potters suspended ceiling components.



DON'T use floor coverings that haven't been tested.

3.3.7.7 GLOSSARY OF ACOUSTIC TERMS

Absorption: The ability of a material to dissipate sound energy.

Acoustic: Concerned with the sense of hearing and includes both reverberant and transmitted sound energy.

Airborne Sound: Sound energy transmitted through the air.

dB: The abbreviation for the sound pressure level measurement decibel. A decibel is a tenth of the logarithmic ratio Bel.

Flanking: The situation whereby sound energy is transmitted around a sound insulated wall or floor/ceiling.

IIC: The abbreviation for "Impact Insulation Class". A single figure descriptor for the structure borne insulation capability of a wall or floor/ceiling.

Structure Borne Sound: Sound energy transmitted through a solid, e.g. the building structure or service pipes.

ISO: The abbreviation for The International Organisation for Standardisation. The name has its origins in the Greek word "isos" meaning equal.

Noise: Subjective sound, merely heard, usually unwanted, contains listener information and may be annoying.

Reverberation: The continuation of sound reflections in a space after the sound source has ceased.

Sound: An audible air vibration from a source which is detected by the sense of hearing.

STC: The abbreviation for "Sound Transmission Class", a single figure descriptor for the continuous airborne sound insulation capability of a wall or floor/ceiling over the speech frequency range. In general the higher the STC the better the performance. The third octave range used is 125 to 4000 Hz.

Subjectivity: Related to interpretation of acoustic input by the brain and the auditory sense organ rather than to direct physical phenomena.

Transmission Loss: The difference in the reverberant sound pressure levels between source and receiving rooms on opposite sides of a wall or floor/ceiling.

3.3.8 FLOOR VIBRATION

It is important to note that the subject of floor vibration is complicated in nature. It is not a precise science and assessment of parameters such as floor damping ratio, ambient floor loads and possible future uses of the floor can be highly subjective in reality – what is acceptable for one occupant may not be acceptable for another.

All structures may be subject to vibration from human activity or mechanical oscillation, with increasing thresholds of acceptance from floors used in operating rooms through offices/residences to shopping malls/dance halls and floors used for group rhythmic activities.

Resonance occurs when the frequency of the dynamic loadings on the floor approaches the natural frequency of vibration of the floor system. The effect of resonance may result in damage to finishes and structure alike and therefore it must be considered in the assessment of floor vibration. The natural frequency of Hibond floor slabs will typically fall within the 4 to 12 Hz frequency range.

Design for walking vibration considers the control of peak floor accelerations through damping provided by the floor panel along with the floor panel mass and stiffness. Design for rhythmic vibration considers control of peak floor accelerations by increasing the natural frequency of the floor to more than 20% above the driving frequency of the activity along with controlling higher mode effects using the floor panel mass and damping.

For a detailed explanation of floor vibration, reference should be made to HERA Report R4-141 and HERA Report R4-113 Session 3.4.

The best way to illustrate the design process for floor vibration is by example using the procedures outlined in HERA Report R4-141 and HSSS2000 (HERA Steel Structures Seminar 2000).

A vibration check is required for a 0.75mm Hibond floor to satisfy the criteria for vibration due to walking. The Hibond floor will support an open plan office with only low damping available from demountable partitions. It has a single span, L, between blockwork walls of 5m and an overall thickness of 150mm.

This example covers the vibration characteristics of the composite floor slab only. It assumes the floor spans between rigid supports such as concrete or block walls. If the slab is supported on flexible supports such as steel beams then a further vibration check needs to be made for the combined slab/beam system using, for example, the Hibond Design Wizard (refer Section 3.3.2 Design Considerations) or the HERA NZFI-Vib2 programme (refer HERA Report R4-141). However the vibration check that follows provides a method of checking whether the slab itself is adequate. Note that the first indication that the floor selected may be vibration sensitive can be seen from the dashed line on the Hibond Composite Slab Load Span Tables in Section 3.3.5.

Continued on next page

3.3.8 FLOOR VIBRATION *continued*

In order to assess the vibration criteria of the slab we need to know its natural frequency of vibration and its peak acceleration under a constant walking force. The *natural floor frequency* is assessed from the static deflection of the floor under ambient load conditions, which requires the longitudinal floor stiffness to be calculated.

Longitudinal floor stiffness $D_{par} = E_sI_x$

where E_s = Young's modulus for steel = 205 GPa

I_x = gross transformed second moment of area of slab in the direction of span

= 34×10^6 mm^4/m

calculated from first principles using steel/concrete dynamic

modular ratio $n = E_s/(1.35E_c)$ (Refer HSSS2000)

= 205 / (1.35 x 24)

= 6.3

where E_c = 24 GPa = Modulus of Elasticity for concrete (from NZS 3101)

Therefore $D_{par} = E_sI_x$ = $205 \times 34 \times 10^6$

= 6.97×10^9 $kNmm^2/m$

Static deflection of slab = $\Delta = 5 \times w \times L^4 / (384 \times E_sI_x)$

Total static UDL, w = 0.35 + 0.2 + 2.91 = 3.46 kN/m

where 0.35 = ambient live load (Refer HERA Report R4-141 Table 5)

0.2 = ambient superimposed dead load (Refer HERA Report R4-141 Table 5)

2.91 = dead load slab excluding ponding of wet concrete (Refer Section 3.3.3 Hibond Section Properties)

therefore, midspan deflection under this UDL,

$\Delta = 5 \times 3.46 \times 5^4 \times 10^9/(384 \times 6.97 \times 10^9)$

= 4.0mm

Natural floor frequency, $f_n = 0.18 \times (g/\Delta)^{0.5}$ (Refer HSSS2000)

where g = acceleration due to gravity = $9810mm/sec^2$

= $0.18 \times (9810/4.0)^{0.5}$

= 8.9 Hz < 9 Hz so no minimum stiffness check required

Continued on next page

3.3.8 FLOOR VIBRATION *continued*

To calculate the *peak acceleration* of the floor under a constant walking force we must calculate the effective weight of the floor that is being vibrated by first estimating the effective floor panel width,

$B = C \times [D_{perp}/D_{par}]^{0.25} \times L$ (Refer HSSS2000)

where D_{par} = 6.97×10^9 kNmm²/m as before

D_{perp} = transverse floor stiffness = E_sI_y

C = transverse flexural continuity factor

I_y = transformed tranverse second moment area based on concrete cover only

therefore, $I_y = 1000 \times (150 - 55)^3 / 12 / 6.3$

$= 11.34 \times 10^6$ mm⁴/m

and $D_{perp} = 205 \times 11.34 \times 10^6$

$= 2.32 \times 10^9$ kNmm²/m

Using C = transverse flexural continuity factor = 2.0, based on transverse continuity,

then $B = C \times [D_{perp}/D_{par}]^{0.25} \times L$

$= 2.0 \times [2.32/6.97]^{0.25} \times L$

$= 1.52 \times L$

B must be less than L or the actual transverse width available. Therefore use B = L = 5.0m.

Now calculate effective floor panel weight, $W = wBL$ (Refer HSSS2000)

$= 3.46 \times 5.0 \times 5.0$

$= 86.5$ kN

Estimated peak acceleration ratio, a_p (expressed as a % of g)

$= P_0 \times e^{-0.35 f_n} / (\beta x W)$ (Refer HSSS2000)

where P_0 = constant walking force = 0.29 kN (From HERA Report R4-141 Table 4)

β = floor damping ratio = 0.025 (From HERA Report R4-141 Table 4)

Therefore $a_p = P_0 \times e^{-0.35 f_n} / (\beta x W)$

$= (0.29 \times e^{-0.35 \times 8.9}) / (0.025 \times 86.5)$

$= 0.60$ %g

The values we have for f_n and a_p must now be compared with the acceptable criteria of graph line C shown in Figure 1 of HERA Report R4-141. If the point plotted on this graph from these two values is below the line C then vibration criteria are acceptable. Alternatively, we can interpret acceptable peak acceleration, a_0 from the graph line (already expressed as a % of g) as follows:

for natural frequency f_n between 4 and 8 Hz: $a_0 < 0.5$ %g

for natural frequency $f_n > 8$ Hz, the equation of the line is $\log a_0 < \log f_n - 1.2041$

In this case $f_n = 8.9$ Hz > 8

therefore $\log a_0 = \log 8.9 - 1.2041$

which gives $a_0 = 0.56$ %g.

$a_p > a_0$ therefore the slab is unsatisfactory for vibration, and either a shorter span, thicker floor or greater damping must be used.

For example, if the damping is improved by providing more small demountable, uniformly distributed partitions then the damping ratio β can be increased:

Thus if $\beta = 0.03$,

then $a_p = 0.29 \times e^{-0.35 \times 8.9} / (0.03 \times 86.5)$

$= 0.50$ %g

$< a_0 = 0.56$ %g and floor can be considered acceptable for vibration.

3.3.9 THERMAL INSULATION

For Hibond floors to comply with the requirements of NZS 4218 using the method of calculation described in NZS 4214, it is generally necessary to add some form of insulation to the floor system. The table below indicates the thermal resistance (R value) that can be expected from the Hibond floor slab.

Hibond Floor Slab (Note 1)		Inside Surface	Outside Surface R Value (m^2 °C/W)		Perimeter (Note 2)	Total R Value (m^2 °C/W)	
Thickness (mm)	R Value (m^2 °C/W)	R Value (m^2 °C/W)	Exposed	Enclosed Perimeter	R Value (m^2 °C/W)	Exposed	Enclosed Perimeter
110	0.04	0.15	0.08	0.16	0.12	0.27	0.47
150	0.06	0.15	0.08	0.16	0.12	0.29	0.49
200	0.08	0.15	0.08	0.16	0.12	0.31	0.51

Note 1: The R value is for the floor slab only, excluding any top surface covering.

Note 2: The perimeter R value is based on a 150mm hollow concrete block wall with 1 in 3 cores filled, and 10% of the wall area as open ventilation.

Compliance with NZS 4218 generally requires a floor R value of 1.3m^2 °C/W excluding the top surface floor covering. The additional R value necessary is usually achieved by treating the underside of the Hibond with a suitable insulation material. Expanded polystyrene (EPS) is recommended, with the following R values:

40mm EPS: R = 1.1m^2 °C/W
30mm EPS: R = 0.8m^2 °C/W

For inter-tenancy floors, or for second storey floors where energy conservation in a room is desired, a sensible objective is to achieve an R value of 1.9m^2 °C/W for the floor-ceiling construction. As a general guide, the additional insulation can be achieved with a combination of enclosed air space between the ceiling and the Hibond, and insulation blanket.

Typical R values are:

Enclosed ceiling air space:	R = 0.3m^2 °C/W for heat flow up.
50mm insulation blanket:	R = 1.0m^2 °C/W
75mm insulation blanket:	R = 1.5m^2 °C/W
100mm insulation blanket:	R = 2.0m^2 °C/W

Example
Using a 110mm overall thickness slab, over an enclosed subfloor perimeter to achieve required 1.3m^2 °C/W.

R value of 110mm Hibond floor	= 0.47
Add 40mm EPS	
R value	= 1.10
Total R value	= 1.57m^2 °C/W > 1.3 $\therefore$ O.K.

3.3.10 DESIGN EXAMPLES

3.3.10.1 EXAMPLE: FORMWORK

A 250mm overall thickness slab is required to span 4800mm c/c between permanent supports using the Hibond sheet as permanent formwork only. Two alternatives are available in design.

a) Using 0.75mm Hibond from Section 3.3.4.1, select the formwork span capabilities for a 250mm overall thickness slab, i.e.

single	2000mm
double or end	1800mm
internal	1850mm

Using two rows of props, there are two end spans and one internal span. The maximum span of Hibond in this configuration is,

1850 + 2 x 1800 = 5450mm
≥ the required span of 4800mm ∴ O.K.

Therefore 0.75mm Hibond with two rows of props at third points may be considered.

b) Using 0.95mm Hibond from Section 3.3.4.1, select the formwork span capabilities for a 250mm overall thickness slab, i.e.

single	2150mm
double or end	2400mm
internal	2700mm

Using one row of props, there are two end spans only. The maximum span of Hibond in this configuration is,

2 x 2400 = 4800mm
≥ the required span of 4800mm ∴ O.K.

Therefore 0.95mm Hibond with one row of props at midspan may also be considered.

Continued on next page

3.3.10 DESIGN EXAMPLES *continued*

3.3.10.2 EXAMPLE: RESIDENTIAL AND POINT LOADS

A suspended slab in a residential dwelling is required to achieve a double span of 2 x 3600mm in each of the living and garage areas.

Living area loading,

live load, Q	1.5 kPa
superimposed dead load, G_{SDL}	0.3 kPa
design superimposed load, $G_{SDL} + Q$	1.8 kPa

Garage loading,

live load, Q	2.5 kPa
or point live load, P_Q	13.0 kN

Living Area Floor

From Section 3.3.5, select the double or end span superimposed load and negative reinforcement for a 0.75mm Hibond slab of 110mm overall thickness, with one row of props at midspan. This gives,

superimposed load = 3.2 kPa
$\geq G_{SDL} + Q =$ 1.8 kPa $\therefore$ O.K.

Minimum mesh requirement throughout the Hibond slab from Section 3.3.2 Additional Reinforcement assuming a minor degree of crack control is one layer of 665 mesh at minimum cover.

From Section 3.3.5 0.75mm Hibond – Double and End Spans, the area of negative reinforcement required over the internal support is H12 bars at 250mm c/c.

Length of reinforcement required is 3600 / 4 + 450 = 1350mm each side of the support centre line.

For the living area floor use a 0.75mm Hibond slab of 110mm overall thickness with one row of props at midspan. A 665 mesh is required throughout the slab plus H12 x 2700mm longitudinal top reinforcement at 250mm c/c, laid atop the mesh at minimum cover, over the internal support.

Garage Floor

From Section 3.3.5, select the double or end span superimposed load and negative reinforcement for a 0.75mm Hibond slab of 110mm overall thickness, with one row of props at midspan. This gives,

superimposed load = 3.2 kPa
$\geq G_{SDL} + Q =$ 2.5 kPa $\therefore$ O.K.

Minimum mesh requirement throughout the Hibond slab from Section 3.3.2 Additional Reinforcement assuming a minor degree of crack control is one layer of 665 mesh at minimum cover.

From Section 3.3.5 0.75mm Hibond – Double and End Spans, the area of negative reinforcement required over the internal support is H12 bars at 250 m c/c.

Length of reinforcement required = 3600 / 4 + 450 = 1350mm each side of the support centre line.

Continued on next page

3.3.10 DESIGN EXAMPLES *(3.3.10.2 continued)*

For the 13.0 kN point load, detailed checks are required using BS 5950: Part 4 Section 6. Please note that this point load check method is only valid for spans between 2.0m and 5.0m, due to the use of empirically derived formulae.

Vertical Shear: The critical load position occurs when the edge of the 13 kN point load is at a distance d_s from the edge of the support. Given a load width, b_o of 300mm, the effective load width is,

b_m = effective load width
= $b_o + 2(D_s - 55)$ where D_s is the overall depth of Hibond composite slab
= 300 + 2 x (110 – 55) = 410mm b_o is the width of the concentrated load
ds = 110 – 27.5 = 82.5mm

The distance between the centre lines of the point load and nearer support (*a*), given a support width of, say, 150mm is,

a = $b_o / 2 + d_s$ + support width / 2 where d_s is the distance from the top of the Hibond
= 150 + 82.5 + 75 = 307mm composite slab to the centroid of the Hibond sheet

Assuming the load is centred at least $b_{er} / 2$ from the slab edge, the effective width of resisting Hibond slab is,

b_{er} = effective width of the slab in shear
= $b_m + a(1 - a / L)$
= 410 + 307 x (1 – 307 / 3600)
= 690mm

Applied shear at 307mm from the central support per 690mm width is,

V* = design shear force for strength
= $1.4\ G\ (0.625\ L - 307) + 1.6\ P_Q\ (2L - aL/(L - a)) / (2L)$ where P_Q is the point live load
= $1.4 \times 1.99 \times 10^{-6} \times 690 \times 1940 + 1.6 \times 13.0\ (2 \times 3600 - 307 \times 3600/(3600 - 307))/(2 \times 3600)$
= 23.5 kN / 690mm

Design concrete shear stress (V_c) from BS 8110 may be calculated using specified cube compressive strength of concrete, f_{cu} of 1.25 specified compressive strength of concrete, f'_c = 31.25 MPa and A_p of 1058mm²/m from formwork properties table, Section 3.3.3 Hibond Section Properties,

$V_c = 0.632\ (f_{cu}\ A_p / 250\ d_s)^{0.333}\ (400 / d_s)^{0.25}$
$= 0.632 \times (1.60)^{0.333} \times (4.85)^{0.25}$
= 1.10 MPa

Vertical shear capacity (V_v),

$V_v = 156\ d_s\ v_c$
$= 156 \times 82.5 \times 1.10 \times 10^{-3}$ = 14.1 kN/rib
= 14.1 x 690 / 305 = 31.9 kN/690mm
≥ V* = 23.5 kN/690mm ∴ O.K.

Continued on next page

3.3.10 DESIGN EXAMPLES *(3.3.10.2 continued)*

Punching Shear: Assuming the load is centred at least $b_m/2$ from the slab edge, the critical perimeter (u) for the Hibond slab is,

$u = 4\{b_o + (D_s - 55) + d_s\}$
$= 4 \times (300 + 55 + 82.5) = 1750\text{mm}$

Applied shear over critical perimeter area is,

$V^* = 1.4\,G + 1.6\,P_Q$
$= 1.4 \times 438^2 \times 1.99 \times 10^{-6} + 1.6 \times 13.0$
$= 21.3\text{ kN}$

Punching shear capacity (V_p),

$V_p = u\,(D_s - 55)\,v_c$
$= 1750 \times 55 \times 1.10 \times 10^{-3} = 106\text{ kN}$
$\geq V^* = 21.3\text{ kN}$ ∴ O.K.

Shear Bond: It is assumed in this calculation that the slab is fixed to the supports on at least three sides. An empirical formula is used to convert the point live load (P_Q) into a superimposed load.

Hence $G_{SDL} + Q$ equates to,

$$\frac{P_Q\,(19000 - 3\,L)}{0.00743\,(-0.393\,L^2 + 3200\,L - 3.52 \times 10^6)}$$

$G_{SDL} + Q = 13.0 \times 8200 / (0.00743 \times 2.91 \times 10^6)$
$= 4.9\text{ kPa}$

Section 3.3.5 0.75mm Hibond – Single Spans Medium term superimposed loads table is then used for all span conditions for shear bond calculations (i.e. single spans, double or end spans, internal spans) to compare empirically derived $G_{SDL} + Q$ to available superimposed load,

superimposed load = 4.9 kPa
$\geq G_{SDL} + Q = 4.9$ kPa ∴ O.K.

Negative Bending: Assuming the load is centred at least $b_{eb} / 2$ from the slab edge, the effective width of resisting Hibond slab (b_{eb}) is,

$b_{eb} = b_m + 2\,a\,(1 - a / L)$ *single spans*
or $b_{eb} = b_m + 1.333\,a\,(1 - a / L)$ *continuous*

Maximum bending occurs when the point load is at midspan. Thus the effective width is,

$b_{eb} = 410 + 1.333 \times 1800 \times (1 - 0.5)$
$= 1610\text{mm}$

The applied bending moment for strength (M*) over the internal support due to the point load is,

$M^* = 1.6\,M_Q / b_{eb}$ where M_Q is the design live load moment
$= 1.6 \times 0.094 \times 3600 \times 13.0 / 1610$
$= 4.37\text{ kNm/m}$

This is converted into an equivalent superimposed load,

$G_{SDL} + Q = 4.37 \times 10^6 / (0.063 \times 1.6 \times 3600^2)$
$= 3.3\text{ kPa}$
> 3.2 kPa (from Section 3.3.5 0.75mm Hibond Composite Slab Load Span Tables Double and End Spans) ∴ No good

Therefore garage slab must be increased to 120mm as,

4.3 kPa > 3.3 kPa ∴ O.K

Negative bending is generally critical for point loads on thin slabs over continuous spans.

Continued on next page

3.3.10 DESIGN EXAMPLES *(3.3.10.2 continued)*

Positive Bending: Using an empirical formula to convert the point live load into a superimposed load,

$$G_{SDL} + Q = \frac{1000\ P_Q}{(0.00247\ L^2 - 14.65\ L + 27100)}$$

$$= 13000 / 6371 = 2.04\ kPa$$

Section 3.3.5 0.75mm Hibond – Single Spans Medium term superimposed loads is then used for all span conditions for positive bending calculations (i.e. single spans, double or end spans, internal spans) to compare empirically derived $G_{SDL} + Q$ to available superimposed load for the 120mm Hibond composite slab,

superimposed load = 5.8 kPa
$\geq G_{SDL} + Q = 2.04$ kPa ∴ O.K.

Positive bending is rarely critical.

Deflection: It is assumed the 13.0 kN point load is of short term duration and deflection is not likely to cause damage to finishes. However to illustrate the methodology, using b_{eb} in bending and $I_{av} = 8.6 \times 10^6\ mm^4/m$ from Section 3.3.3 (medium term), the imposed deflection under the point load at midspan (δ_p) is,

$\delta_p = 0.015\ P_Q\ L^3 / E_s\ 1$ where E_s is the Modulus of Elasticity of the Hibond sheet and I is the second moment of area

$= 0.015 \times 13.0 \times 3600^3 / (205 \times 10^3 \times 8.6 \times 1610)$
$= 3.2$mm (L / 1125)
$\leq$ the limit of L / 350 ∴ O.K.

In summary, for the garage floor use a 0.75mm Hibond slab of 120mm overall thickness with one row of props at midspan. A 665 mesh is required throughout the slab plus H12 x 2700mm longitudinal top reinforcement at 200mm c/c, laid atop the mesh at minimum cover, over the internal support. It would be sensible to adopt this configuration over the living area floor also, for practicality.

Transverse Reinforcement: In this example as $P_Q > 7.5$ kN (13.0 kN), ductile transverse reinforcement is required to be provided to satisfy the following moment resistance.

$M^*_{trans} = P^*\ b_{eb} / (15w)$ where $w = L/2 + b_1$ and $w \not> L$

Where M^*_{trans} = Factored bending moment in the transverse direction
P^* = Factored concentrated point load
b_{eb} = Effective width of slab
L = Span of composite slab
b_1 = Concentrated load length in direction of slab span

This requirement is based on recommendations from the Steel Decking Institute, Illinois, to resist transverse bending in the composite slab as a result of the concentrated load.

Continued on next page

3.3.10 DESIGN EXAMPLES *continued*

3.3.10.3 EXAMPLE: INSTITUTIONAL BUILDING DEFLECTION

A heavy equipment floor in a hospital is required to form a single span of 4800mm given a long term superimposed load of 3.5 kPa.

Using Section 3.3.5 0.75mm Hibond – Single Spans long term superimposed loads table, select the single span superimposed load for a 0.75mm Hibond slab of 150mm overall thickness, with one row of props at midspan (Section 3.3.4.1). This gives,

superimposed load = 3.5 kPa
$\geq G_{SDL} + Q = 3.5$ kPa ∴ O.K.

This configuration borders the region of the table where vibration becomes critical (with a minimum damping ratio of 0.025; commercial offices, open plan with few small partitions) and the equipment is likely to be vibration sensitive. Therefore resonance checks are required using specific design.

Alternatively, the slab thickness may be increased for the purposes of this example to, say, 180mm using 0.75mm Hibond with two rows of props at third points, or 180mm using 0.95mm Hibond with one row of props at midspan. This would provide better dampening to the floor, however the equipment is likely to be vibration sensitive and therefore a detailed vibration analysis of the floor would be required by the design engineer.

Deflection of the floor is to be minimised by reducing the allowable limit from $L_{ss}/250$ to $L_{ss}/400$.
For this limit, deflection is made up of two components. Dead load deflection from prop removal is (for one or two props),

$5\ G\ L_{ss}^4 \,/\, (384\ E_s\ I)$

and the superimposed load deflection is,

$5\ (G_{SDL} + Q)\ L_{ss}^4 \,/\, (384\ E_s\ I)$

For the 0.95mm Hibond slab of 180mm overall thickness, refer Section 3.3.3 Hibond Section Properties for long term superimposed loads,

$G = 3.62$ kPa, $I_{av} = 21.1 \times 10^6$ mm^4/m

Hence $G + (G_{SDL} + Q) = 3.62 + 3.5 = 7.12$ kPa

and δ_{G+Q} = Combined dead and superimposed load deflection at midspan
$= 5 \times 7.12 \times 4800^4 \,/\, (384 \times 205 \times 10^9 \times 21.1)$
= 11mm (or $L_{ss}/435$)
$\leq$ the limit of $L_{ss}/400$ ∴ O.K.

For a 0.75mm Hibond slab of 190mm overall thickness Section 3.3.3 Hibond Section Properties gives (for long term superimposed loads),

$G = 3.83$ kPa, $I_{av} = 22.4 \times 10^6$ mm^4/m

Hence $G + (G_{SDL} + Q) = 3.83 + 3.5 = 7.33$ kPa

and $\delta_{G+Q} = 5 \times 7.33 \times 4800^4 \,/\, (384 \times 205 \times 10^9 \times 22.4)$
= 11mm (or $L_{ss}/435$)
$\leq$ the limit of $L_{ss}/400$ ∴ O.K.

Therefore, use a 0.75mm Hibond slab of 190mm overall thickness with two rows of props at third points and, assuming a minor degree of crack control is required, use 662 mesh at minimum cover throughout, *or* a 0.95mm Hibond slab of 180mm overall thickness with one row of props at midspan and, assuming a minor degree of crack control is required, use 662 mesh at minimum cover throughout.

Continued on next page

3.3.10 DESIGN EXAMPLES *continued*

3.3.10.4 EXAMPLE: COMMERCIAL OFFICE FIRE RESISTANCE

A banking chamber floor is required over continuous spans of 2600mm c/c with a fire resistance rating of 49 minutes.

Office loading (medium term),

live load, Q	4.0 kPa
superimposed dead load, G_{SDL}	0.5 kPa
design superimposed load, G_{SDL} + Q	4.5 kPa

In terms of structural ability, Section 3.3.5 gives medium term superimposed loads well in excess of 4.5 kPa over a 2600mm span for a Hibond slab of 120mm overall thickness.

If the floor is designed as a series of single spans, nominal continuity reinforcement is required over the internal supports. From Section 3.3.5 Hibond – Single Spans Medium term superimposed loads, a 0.75mm Hibond slab with one row of props at midspan (from Section 3.3.4.1) may be used, or an unpropped (from Section 3.3.4.1) 0.95mm Hibond slab may also be used. Assuming a minor degree of crack control and to provide nominal continuity reinforcement over the internal supports, from Section 3.3.2 Additional Reinforcement, 665 mesh is required at minimum cover over the entire floor area.

This configuration may lead to unsightly cracking of the slab and therefore longitudinal steel at minimum cover over the supports and a moderate or strong degree of crack control could be considered.

As an alternative, the floor may be designed as a continuous slab by providing full continuity reinforcement over the internal supports.

End Spans
From Section 3.3.5 0.95mm Hibond – Double and End Spans, the area of negative reinforcement required over the first internal support is H12 bars at 200mm c/c.

The length of reinforcement required is 2600 / 4 + 450 = 1100mm each side of the support centre line.

Internal Spans
From Section 3.3.5 0.95mm Hibond – Internal Spans, the area of negative reinforcement required over the other internal supports is H12 bars at 200mm c/c.

The length of reinforcement required is 2600 / 4 + 450 = 1100mm each side of the support centre line.

The fire resistance rating (FRR) is checked from Section 3.3.6 Fire Design Tables, for a 0.75mm Hibond slab of 120mm overall thickness using H12 reinforcement every third Hibond pan. This gives,

FRR = 69 minutes
≥ the required 49 minutes ∴ O.K.

Therefore, use an unpropped 0.95mm Hibond slab of 120mm overall thickness with H12 longitudinal bottom reinforcement every third pan at 25mm bottom cover and 40mm cover to the side of the Hibond rib. In terms of top steel, 665 mesh is required throughout the slab plus H12 x 2200mm longitudinal top reinforcement at 200mm c/c over all internal supports, laid atop the mesh at minimum cover.

Continued on next page

3.3.10 DESIGN EXAMPLES *(3.3.10.4 continued)*

Detailed calculation of the fire resistance rating for the preceding example.

Insulation Criteria: The minimum effective thickness for 49 minutes is 66mm for Type A aggregate, using HERA Report R4-82 Section 5. The effective thickness (h_e) for the 120mm Hibond composite slab is,

$h_e = h_1 + 0.5\, h_2 \{(l_1 + l_2) / (l_1 + l_3)\}$ — where h_1 is the depth of concrete above the top of Hibond (D_s – 55), h_2 is the depth of Hibond sheet (55mm) and l_1, l_2 and l_3 are profile dimensions of the Hibond sheet

$= 65 + 27.5 \{(182 + 130) / (182 + 126)\}$
$= 93$mm
$\geq$ the minimum of 66mm $\quad \therefore$ O.K.

Stability and Integrity Criteria: For the Hibond composite slab, integrity criteria are satisfied if the stability requirements are met. It is assumed the Hibond slab acts as a series of single spans in the calculation of stability. The load combination is G + ψ_ℓQ under fire emergency conditions (clause 4.2.4 AS/NZS 1170.0). This gives,

w = uniformly distributed load
$= G + G_{SDL} + \psi_\ell Q$
$= (2.24 \times 1.05 + 0.5) + 0.4 \times 4.0 = 4.45$ kPa
5% ponding applied to self weight, G

producing a design bending moment,

$M^* = w\, L^2 / 8$
$= 4.45 \times 2600^2 \times 10^{-6} / 8$
$= 3.76$ kNm/m width of Hibond slab

The required fire resistance rating is greater than 30 minutes, therefore any contribution to the moment capacity of the slab from the Hibond steel is neglected, and supplementary "fire" reinforcement is provided. The slab moment capacity is calculated using a strength reduction factor of $\phi = 1.0$ and the effective yield stress is based on the temperature of the reinforcement (refer NZS 3101).

Consider H12 reinforcement (f_y = 500 MPa) placed every third pan (A_s = 123mm²/m width) at 25mm bottom cover and 40mm cover to the side of the Hibond rib. Using HERA Report R4-82 Section 6,

$u_1 = 46$mm, $u_2 = 98$mm, $u_3 = 31$mm — where u_1, u_2 and u_3 are the position of reinforcement bars

$u_1 + u_2 = 144 \leq 5\, u_3 = 155 \quad \therefore$ O.K.
u_1 or u_2 = 46 or 98 $\leq 4\, u_3 = 124 \quad \therefore$ O.K.

and,

$\gamma = 1 / (1 / 46^{0.5} + 1 / 98^{0.5} + 1 / 31^{0.5})$ — where γ is the coefficient used to calculate temperature of the reinforcing bars
$= 2.34$

Continued on next page

3.3.10 DESIGN EXAMPLES *(3.3.10.4 continued)*

The temperature in the reinforcement (u_s) at 30 minutes is given by,

$u_s = 900 - 350\,g = 81°C$

and at 60 minutes,

$u_s = 1175 - 350\,g = 356°C$

For a fire resistance of 49 minutes the temperature by linear interpolation is,

$u_s = 81 + 19 / 30 \times (356 - 81) = 255°C$

The effective yield stress of the reinforcement for $250°C < u_s \leq 720°C$ is,

$f_{yru} = f_y \{(720 - T) / 470\}$ where f_{yru} is the yield strength of elevated temperature and f_y is the lower characteristic yield strength of non-prestressed reinforcement

$= 500 \times \{(720 - 255) / 470\} = 494$ MPa

Hence the moment capacity of the slab for reinforcement (R_{Tu}) at an elevated temperature is,

$R_{Tu} = A_s f_{yru} = 123 \times 494 \times 10^{-3} = 60.7$ kN/m

Where A_s = Area of non-prestressed tension reinforcement
= $113 / (3 \times 0.305) = 123$mm^2/m width (= H12 every 3rd Hibond pan)

and,

where a is the depth of equivalent rectangular stress block
b is the width of concrete compression face
d is the distance from extreme compression fibre to the centroid of the non pre-stressed tension reinforcement

$a = R_{Tu} / (0.85\, f'_c\, b)$
$= 60.7 \times 10^3 / (0.85 \times 25 \times 1000) = 2.8$mm
$d = 120 - 31 = 89$mm

Hence internal lever arm between centroids of compression and tension resultant forces (jd) is,

$jd = d - 0.5\,a = 87.6$mm

and,

where M_n is the nominal flexural strength of the section

$\Phi M_n = 1.0 \times 60.7 \times 10^{-3} \times 87.6 = 5.32$ kNm/m
$\geq M^* = 3.76$ kNm/m width $\therefore$ O.K.

Hence H12 reinforcement every third Hibond pan will achieve a fire resistance rating of greater than 49 minutes for insulation, instability and integrity.

3.3.11 MATERIAL SPECIFICATION

Dimond Hibond and accessories are manufactured from galvanised steel coil produced to AS 1397:2001.

	Thickness BMT mm	Steel Grade MPa	Min. Zinc Weight g/m^2
Hibond sheeting	0.75 & 0.95	G550	Z 275
End cap	0.55	G250	Z 275
Closure strip	0.55	G250	Z 275
Edge form	1.15	G250	Z 275
Hanger tab	1.55	G250	Z 275

BMT – Base Metal Thickness

Tolerances
Length -0mm +10mm
Sheet cover width -1mm +5mm
Maximum manufactured length of Hibond sheet 18m.

3.3.12 SHORT FORM SPECIFICATION – HIBOND FLOORING

The flooring system will be Dimond **(1)** mm Hibond manufactured from G550 grade steel, with a 275 g/m^2 galvanised zinc weight. The minimum nominal sheet length to be used in construction shall be .... m, in accordance with the design formwork spans.

Edge forms and end caps should be used in accordance with Dimond recommendations.

Specify concrete thickness, and number of rows of propping during construction.

Mesh and any additional reinforcement bar size and spacing should be referred to the design engineer's drawings.

Choose from:

(1) 0.75, 0.95

3.3.13 HIBOND COMPONENTS

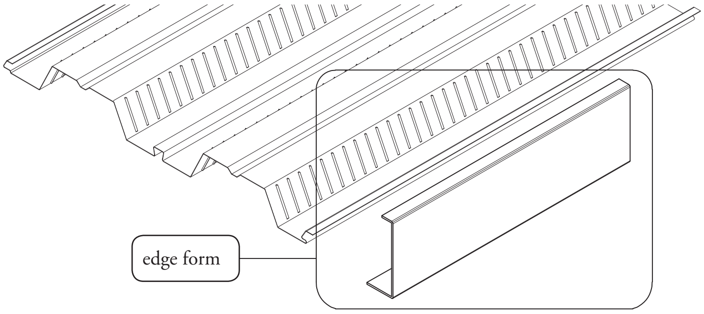
3.3.13.1 EDGE FORM

Manufactured from 1.15mm Base Metal Thickness (BMT) galvanised steel in 6m lengths, providing an edge to screed the concrete to the correct slab thickness.

Standard sizes are from 110mm to 200mm in 10mm height increments.

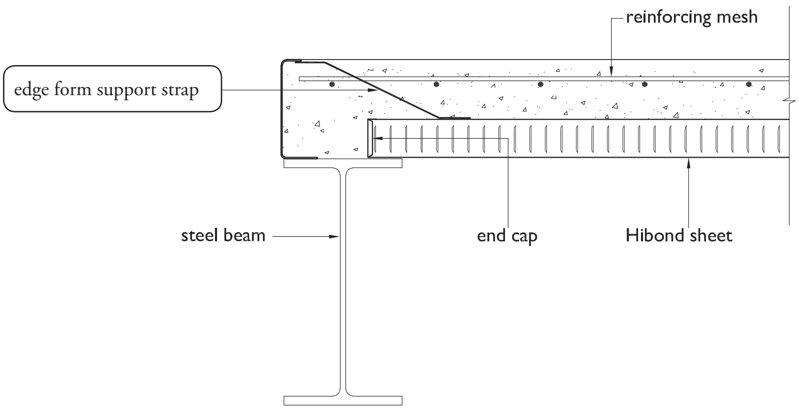
The foot of the edge form is fixed to the structure by self-drilling metal screws or powder actuated fasteners.

The Hibond sheeting may sit on this foot and be fixed to the edge form by rivets or self-drilling metal screws.



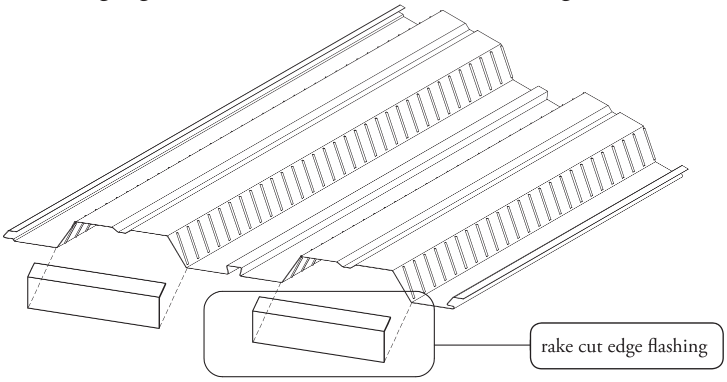
3.3.13.2 EDGE FORM SUPPORT STRAP

The top edge is restrained from outward movement (when the concrete is being placed) by a specifically designed 30 x 0.55mm galvanised metal edge form support strap, which is fixed to the Hibond or structure. The straps are normally at 600mm centres.



3.3.13.3 RAKE CUT EDGE FLASHINGS

Manufactured from 0.55mm BMT galvanised steel in 55mm x 30mm x 3m lengths which are cut to suit on site (as shown). Rake cut edge flashings are used in place of end caps to close off the end of Hibond sheets when they are cut on an angle or curve. These are cut to length then fixed to the Hibond sheet with 1 fastener per rib (10 gauge – 16 x 16mm hex head self-drilling screw).



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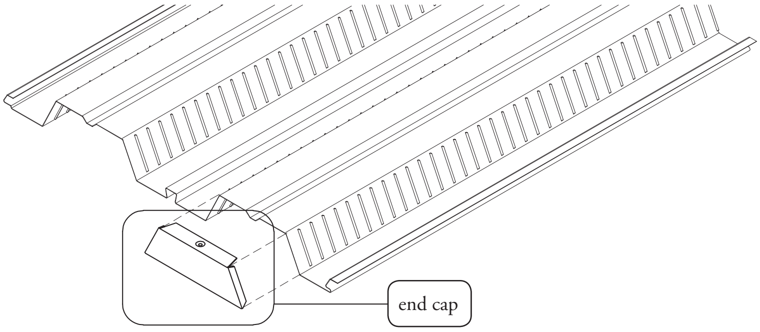
3.3.13 HIBOND COMPONENTS *continued*

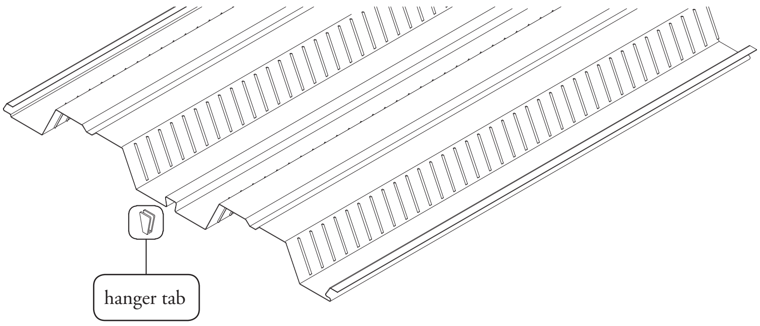
3.3.13.4 END CAPS

Manufactured from 0.55mm BMT galvanised steel, end caps are used to blank off the ribs (to prevent concrete leakage) at the end of each Hibond sheet, or where openings are created in the deck. The cap should be secured to the Hibond by 10 gauge – 16 x16mm hex head self-drilling screws.



3.3.13.5 HANGER TABS

Manufactured from 1.55mm BMT galvanised steel, the tabs provide a suspension point for ceiling systems, pipework, ducting or electrical trays onto the underside of the Hibond sheet. The hanger tab is attached by inserting it into, and parallel to the dovetail groove running down the centre of each Hibond sheet. It is then rotated through 90º and sits down in the groove. The serviceability (safe) load for a standard hanger is 1.25 kN.



3.3.14 HIBOND CAD DETAILS

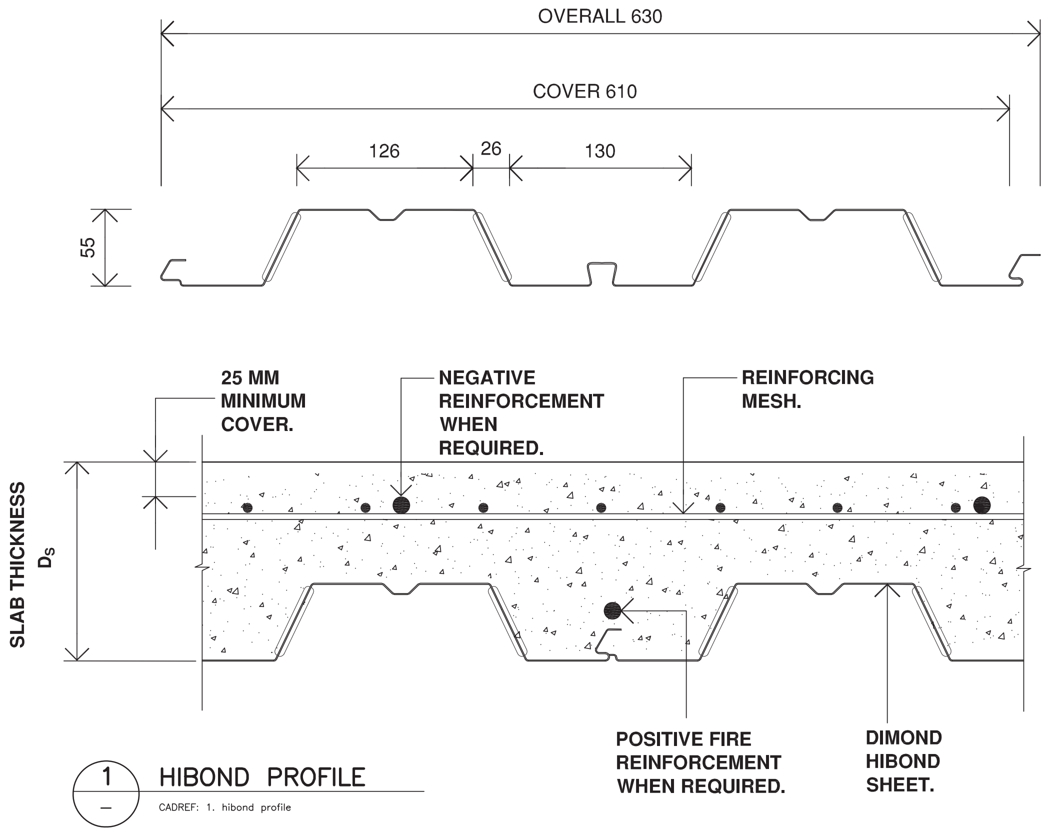
Hibond CAD details are shown in this section. For the latest Hibond CAD details, please download from the Dimond website **www.dimond.co.nz**. Follow the steps below:

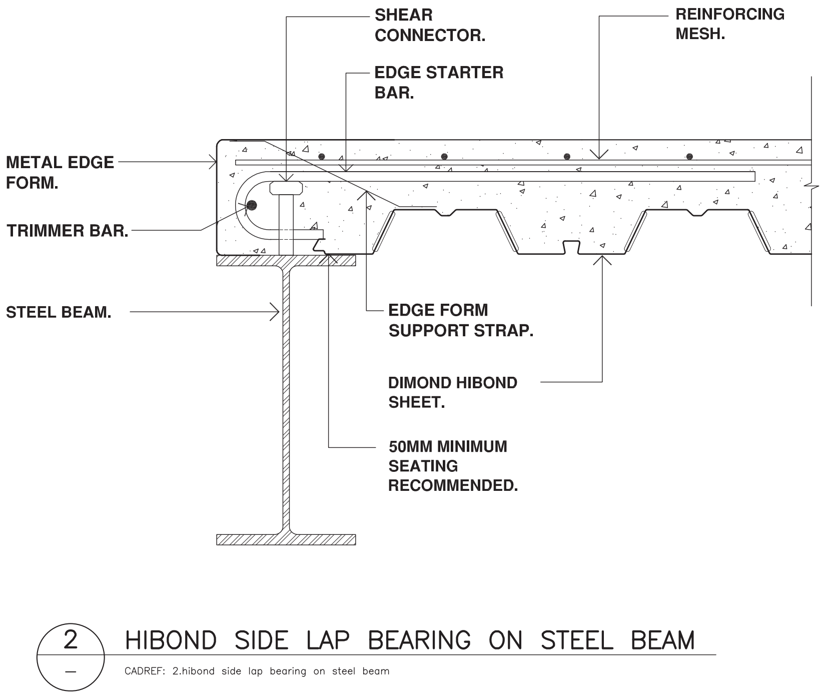
1. Log in to the Architects/Specifiers section.
2. Click on the green "Structural Systems Manual" button.
3. Click on the "Download CAD details" button.
4. Select from product list shown to view CAD details available for that product.

Please note all of these details are to be used as a guide only and are not intended for construction. Specific design details are required to be provided by the design engineer.

3.3.14 HIBOND CAD DETAILS *continued*

Not to scale





3.3.14 HIBOND CAD DETAILS *continued*

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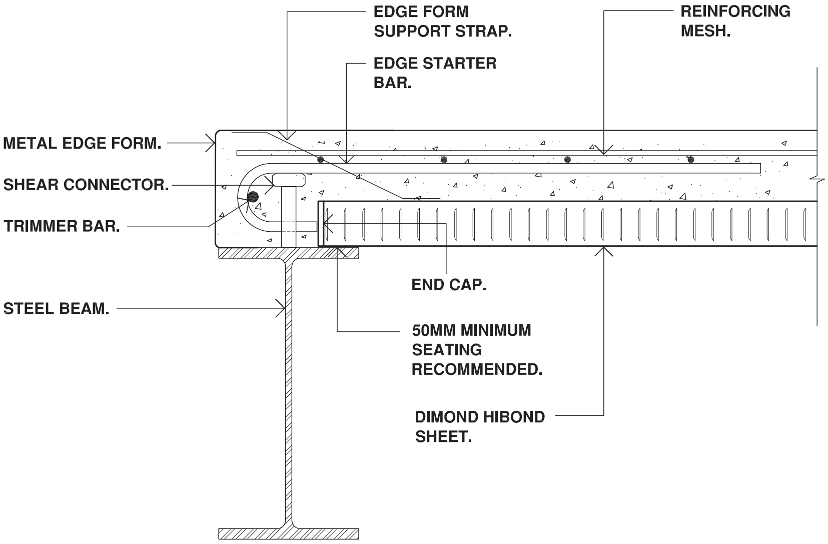
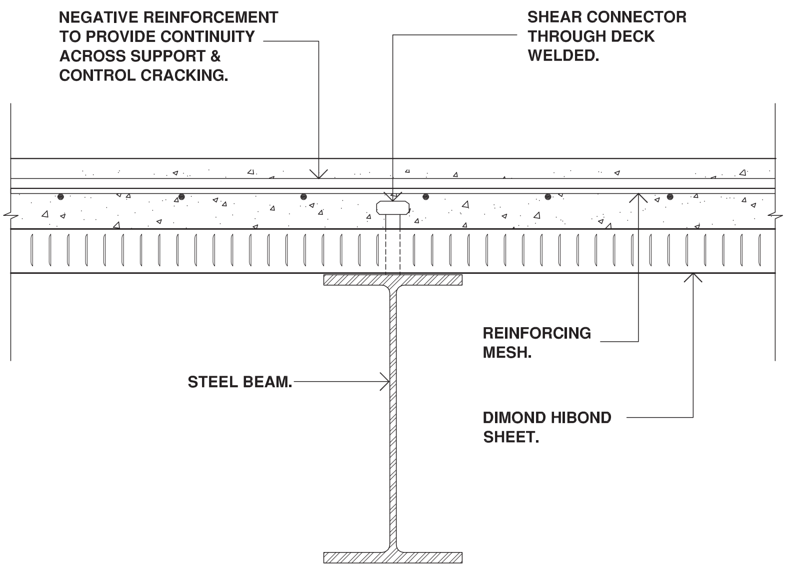


3 – HIBOND END BEARING ON STEEL BEAM

CADREF: 3.hibond end bearing on steel beam



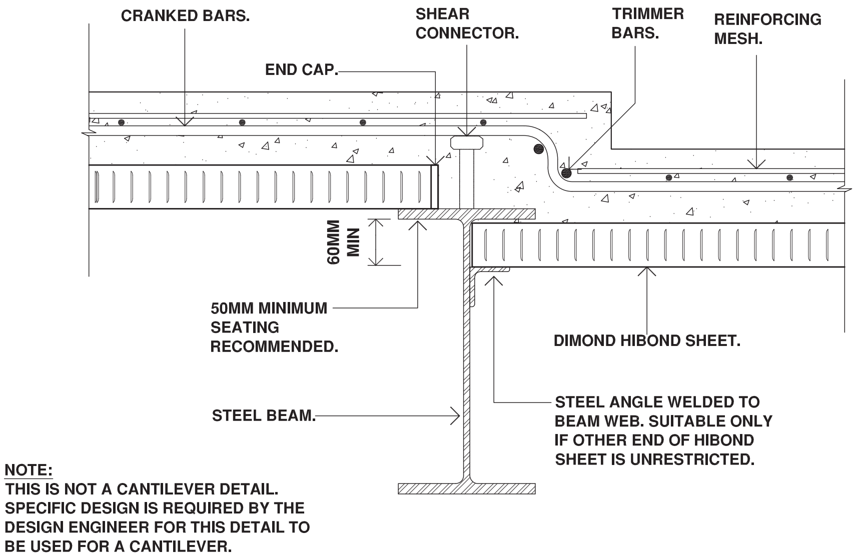
4 – HIBOND INTERNAL BEARING ON STEEL BEAM

CADREF: 4.hibond internal bearing on steel beam

Dimond

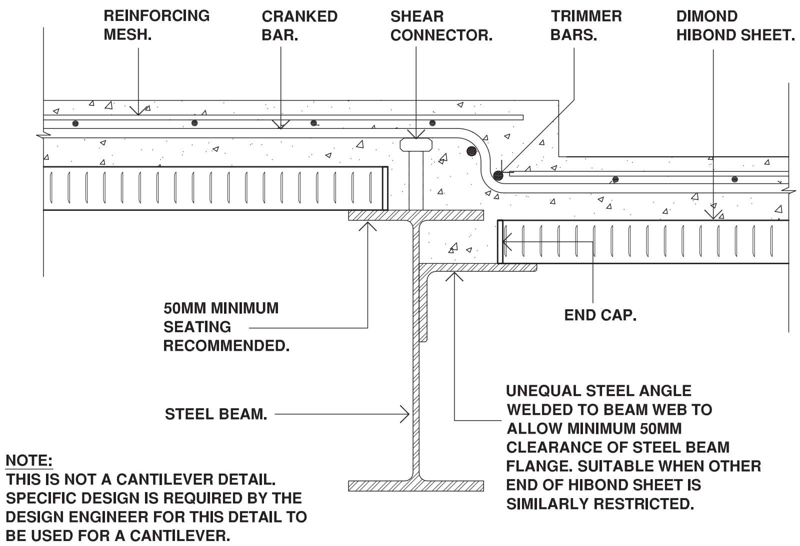
3.3.14 HIBOND CAD DETAILS *continued*

Not to scale



5 — HIBOND INTERNAL STEP DOWN ON STEEL BEAM – OPTION 1

CADREF: 5. hibond step down on steel beam – option 1

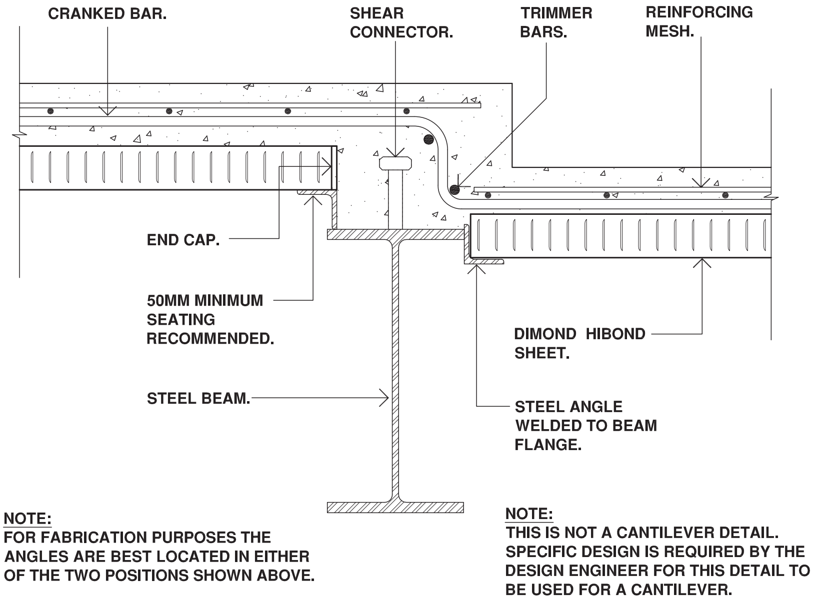


6 — HIBOND INTERNAL STEP DOWN ON STEEL BEAM – OPTION 2

CADREF: 6.hibond step down on steel beam – option 2

3.3.14 HIBOND CAD DETAILS *continued*

Not to scale

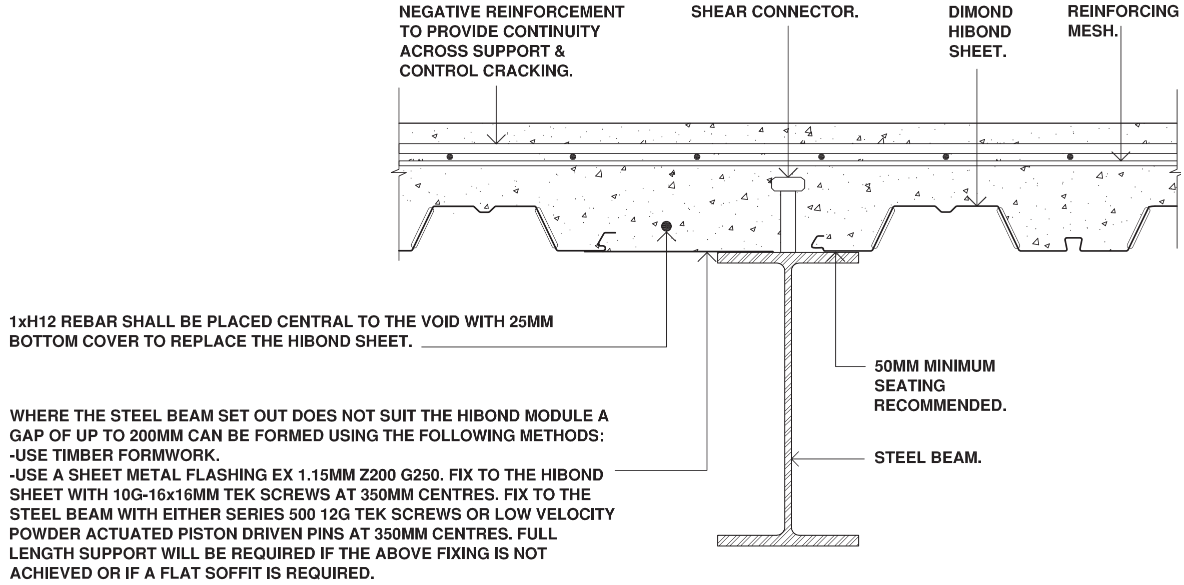


7 — HIBOND INTERNAL STEP DOWN ON STEEL BEAM – OPTION 3

CADREF: 7.hibond step down on steel beam – option 3

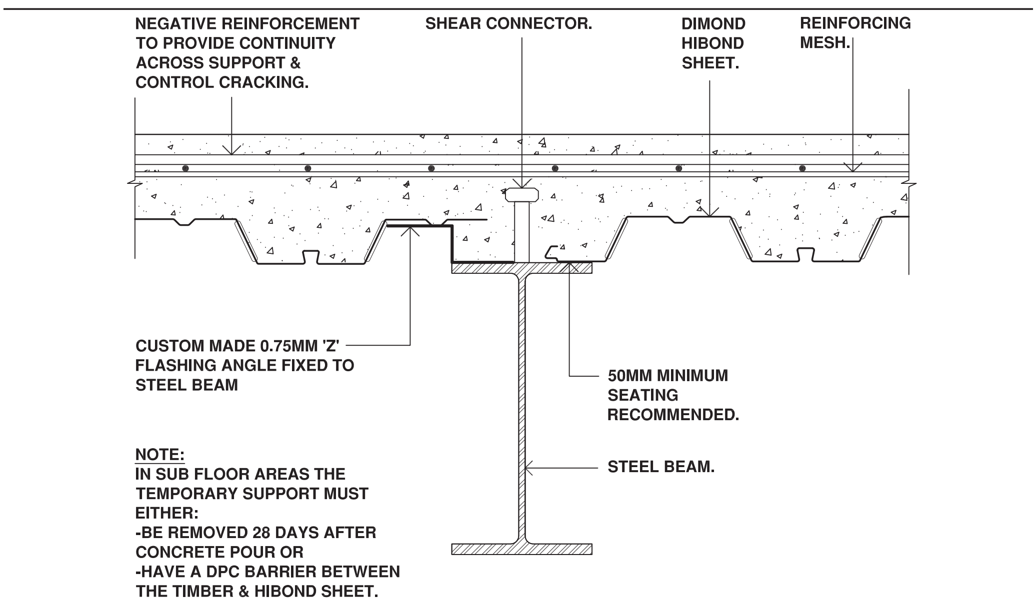
3.3.14 HIBOND CAD DETAILS *continued*

Not to scale



8 — HIBOND SIDE LAP BEARING ON STEEL BEAM – OPTION 1

CADREF: 8.hibond side lap bearing on steel beam – option 1

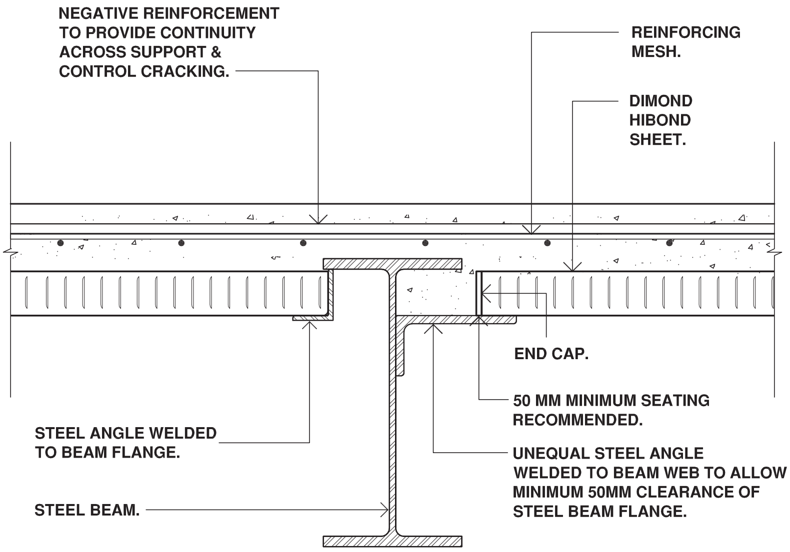


9 — HIBOND SIDE LAP BEARING ON STEEL BEAM – OPTION 2

CADREF: 9.hibond side lap bearing on steel beam – option 2

3.3.14 HIBOND CAD DETAILS *continued*

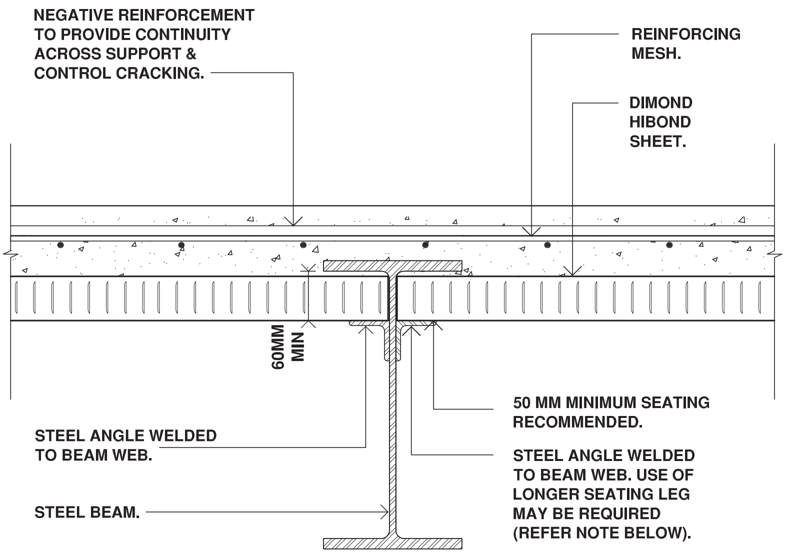
Not to scale



NOTE:
-THIS DETAIL CONTAINS TWO OPTIONS (SHOWN EACH SIDE OF THE BEAM) TO ACHIEVE AN INTERNAL SET DOWN.
-THIS DETAIL IS SUITABLE WHEN THE OTHER END OF THE HIBOND SHEET IS SIMILARLY RESTRICTED.
-FOR FABRICATION PURPOSES THE EQUAL ANGLE IS BEST LOCATED AS SHOWN.
-THE COST BENEFITS OF COMPOSITE BEAM ACTION AND ADDITIONAL FIRE RATING OF THE BEAM SHOULD BE CONSIDERED TO OFFSET THE INITIAL EXPENSE OF THE UNEQUAL ANGLE OPTION SHOWN IN THIS DETAIL.

10 – HIBOND INTERNAL SET DOWN ON STEEL BEAM – OPTION 1

CADREF: 10.hibond internal set down on steel beam – option 1



NOTE:
-THIS DETAIL IS SUITABLE ONLY IF THE OTHER END OF THE HIBOND SHEET IS UNRESTRICTED.

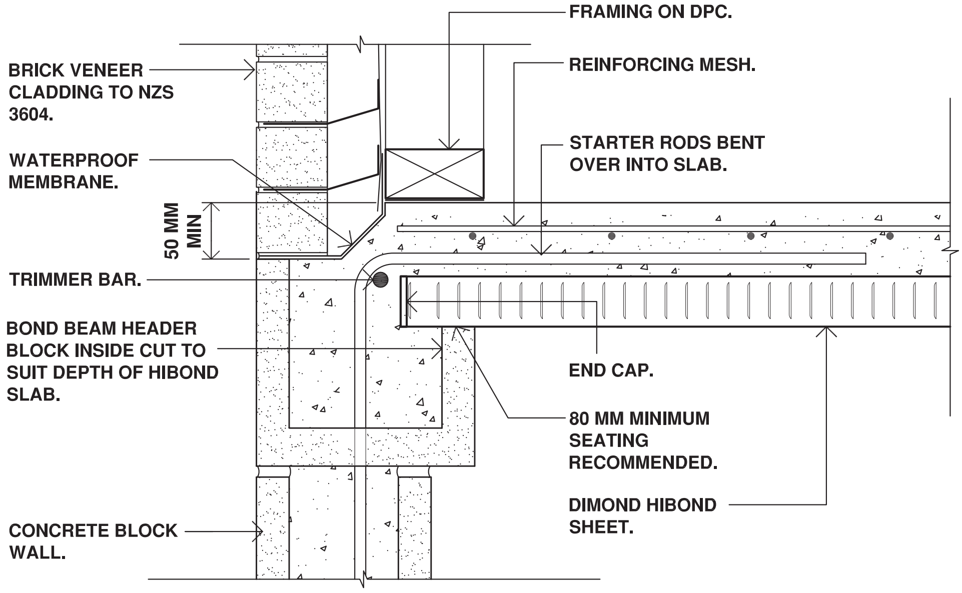
11 – HIBOND INTERNAL SET DOWN ON STEEL BEAM – OPTION 2

CADREF: 11.hibond internal set down on steel beam – option 2

Dimond

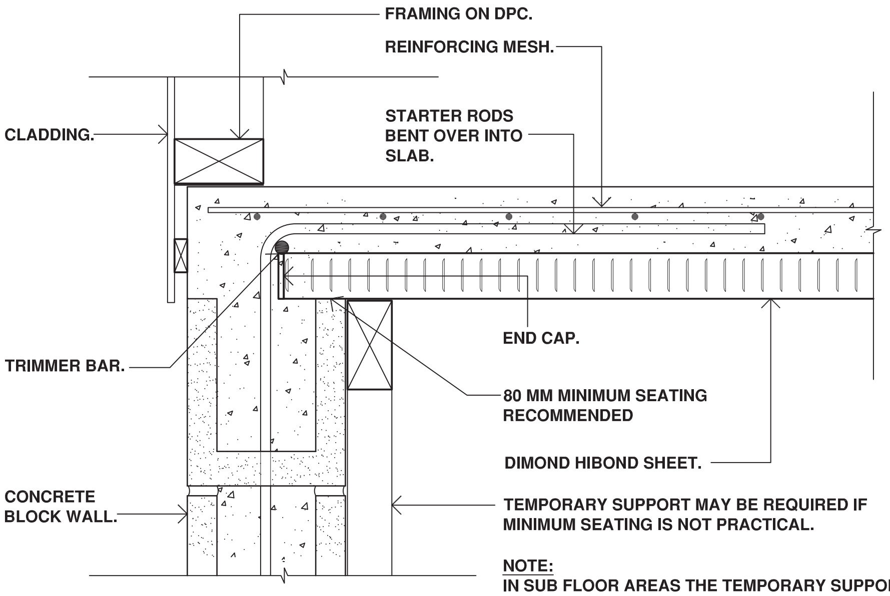
3.3.14 HIBOND CAD DETAILS *continued*

Not to scale



12 HIBOND ON MASONRY BLOCK WITH BRICK VENEER

CADREF: 12.hibond on masonry block with brick veneer



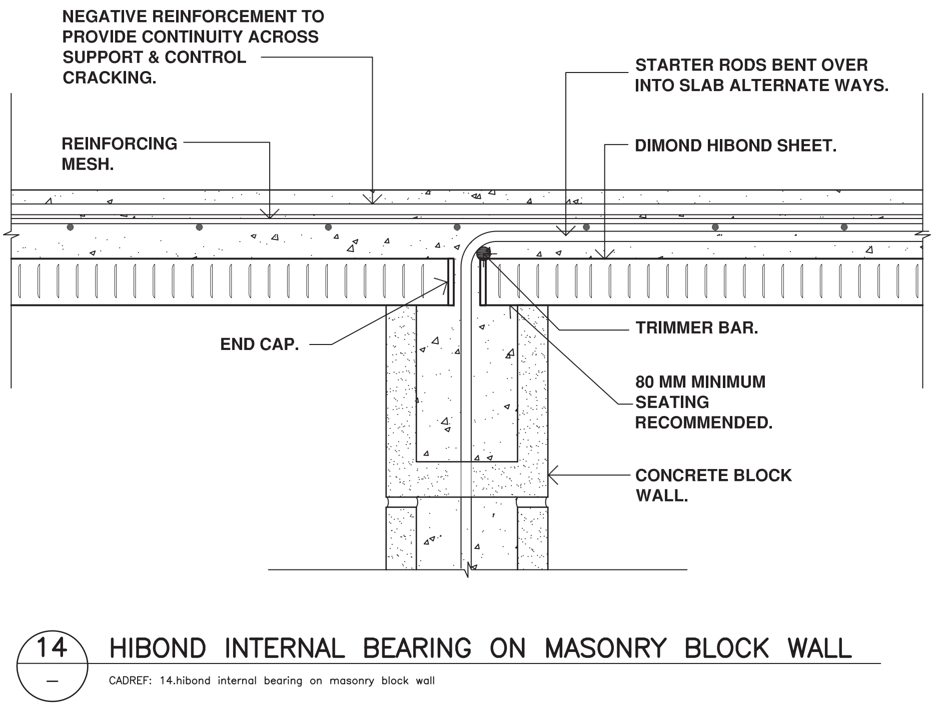
NOTE:
IN SUB FLOOR AREAS THE TEMPORARY SUPPORT MUST EITHER:
-BE REMOVED 28 DAYS AFTER THE CONCRETE POUR, OR
-HAVE A DPC BARRIER BETWEEN THE TIMBER AND HIBOND SHEET.

13 HIBOND ON MASONRY BLOCK WITH TIMBER WALL

CADREF: 13.hibond on masonry block with timber wall

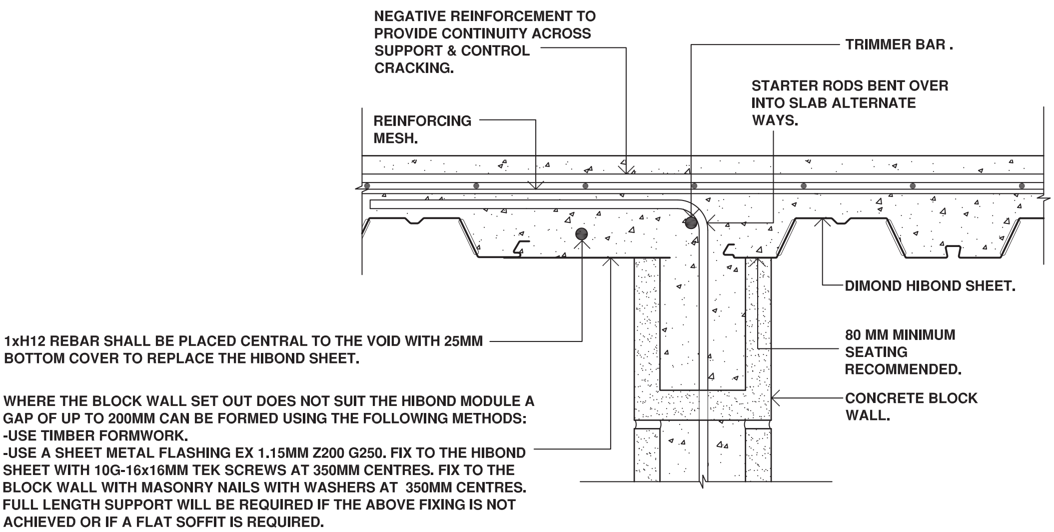
3.3.14 HIBOND CAD DETAILS *continued*

Not to scale



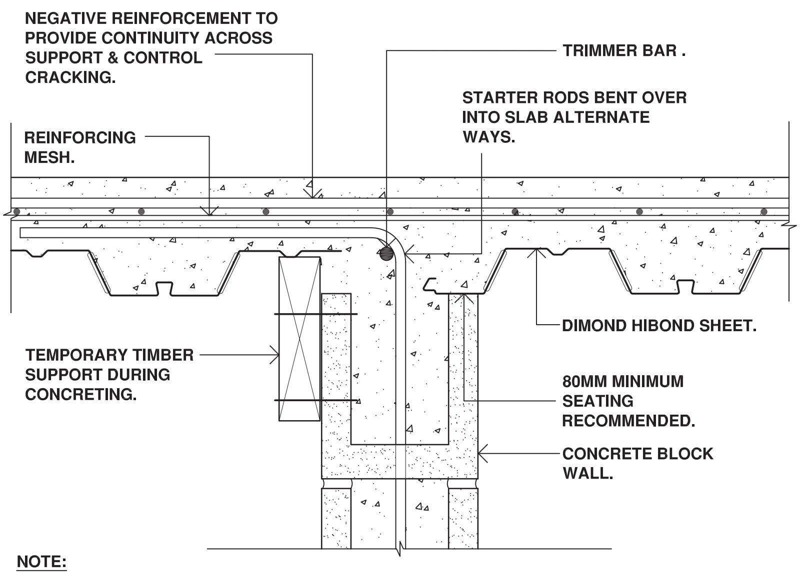
3.3.14 HIBOND CAD DETAILS *continued*

Not to scale



15 — HIBOND SIDE LAP BEARING ON MASONRY BLOCK WALL – OPTION 1

CADREF: 15.hibond side lap bearing on masonry block wall



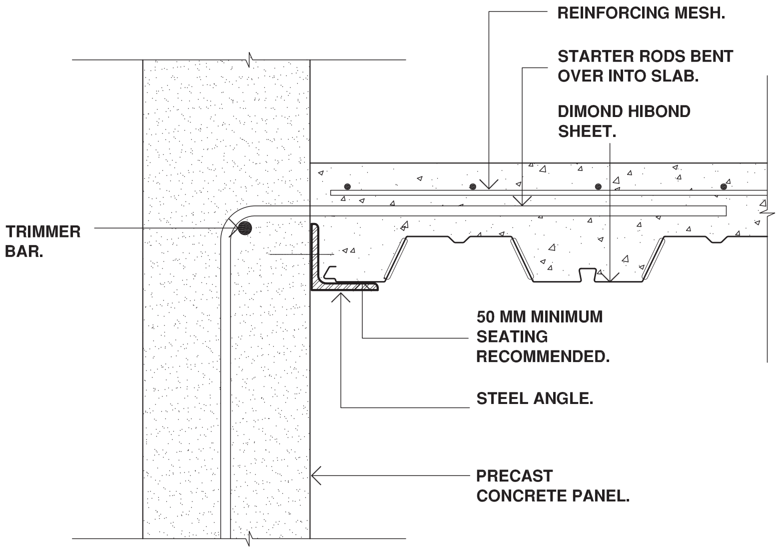
NOTE:
IN SUB FLOOR AREAS THE TEMPORARY SUPPORT MUST EITHER:
-BE REMOVED 28 DAYS AFTER CONCRETE POUR, OR
-HAVE A DPC BARRIER BETWEEN THE TIMBER AND HIBOND SHEET.

16 — HIBOND SIDE LAP BEARING ON MASONRY BLOCK WALL – OPTION 2

CADREF: 16.hibond side lap bearing on masonry block wall

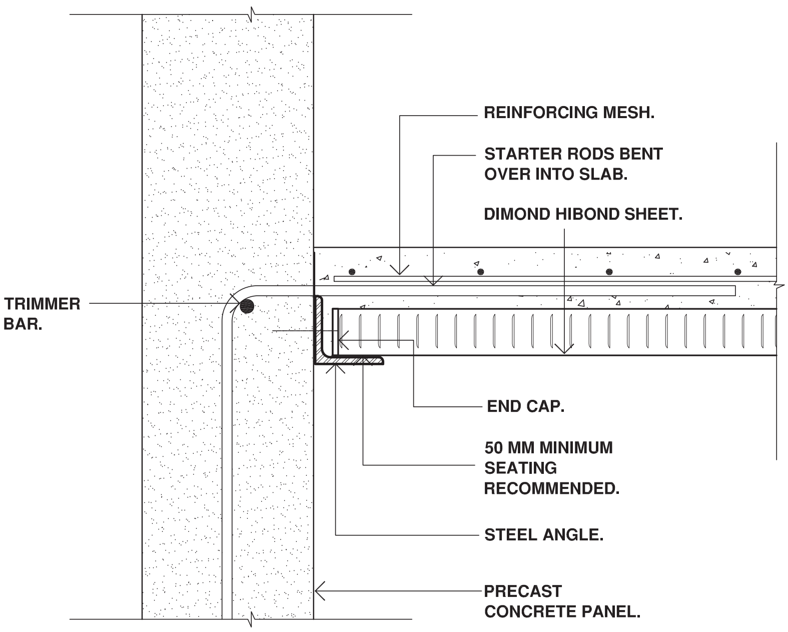
3.3.14 HIBOND CAD DETAILS *continued*

Not to scale



17 – HIBOND SIDE LAP BEARING ON TILT SLAB

CADREF: 17.hibond side lap bearing on tilt slab



18 – HIBOND END BEARING ON TILT SLAB

CADREF: 18.hibond end bearing on tilt slab