DESIGN GUIDE - FLOORING SYSTEMS

This guide is an extract from the Dimond Structural Systems Manual and it is to be read in conjunction with the full Dimond Structural Systems Manual available at www.dimond.co.nz under the Architects/Specifiers section. This guide will not be updated by Dimond and it is intended that the user updates this guide using the current Dimond Structural Systems Manual on our website.

Dimond

90-104 Felton Mathew Ave
P.O. Box 18 071
Glen Innes, Auckland
0800 346 663
www.dimond.co.nz

Mike Klemick BE (Civil)
National Specification Manager

DDI +64 9 521 8744
M +64 27 595 3076
E mike.klemick@fb.co.nz

Dimond

Dimond, a division of Fletcher Steel Ltd

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3.0 SCOPE OF USE

Dimond Flooring Systems use a roll-formed profiled galvanised steel sheet as a component in reinforced concrete floor systems. The sheet provides both permanent formwork and positive tensile reinforcement in one way reinforced concrete slab construction over concrete block walls, poured concrete beams, steel beams or timber beams, which are subject to environmental limitations referenced to the appropriate grade of material selected.

It is critical to product performance that the loads applied, spans, formwork material thickness and overall slab thickness are designed within the appropriate Limit State Loads and limitations published in this manual.

Before commencing a project using a Dimond Flooring System, the user must refer to the information within this manual and all sections as appropriate, ensuring relevant information is available to the end user. Failure to observe this information may result in a significant reduction in product performance. Dimond accepts no liability whatsoever for products which are used otherwise than in accordance with these recommendations.

The information contained within Flooring Systems is only applicable to Dimond Flooring Systems – it cannot be assumed to apply to similar products from other manufacturers.

USE OUTSIDE THE STATED GUIDELINES

If the need arises to use the Dimond Flooring System outside the limitations and procedures given in this manual or if there exists any doubt on product handling or use, written approval should be obtained from Dimond for the specific project, before the project is commenced.

3.1 DURABILITY

3.1.1 SCOPE

The Dimond Flooring Systems described in this manual are subject to the environments in which they are used and the type of coating used as outlined in detail in this section.

3.1.2 COATING MATERIAL SPECIFICATIONS

Dimond Flooring Systems are manufactured from galvanised coil in grade Z 275 ie 275 g/m^2 total galvanised zinc coating weight.

Grade Z 275 usually requires a three-month lead time from date of order to supply for all thicknesses and quantities. Other grades of zinc coating are available. Please contact Dimond for guidance.

3.1.3 ENVIRONMENTS

3.1.3.1 GENERAL

The durability of galvanised zinc coated products is dependent on:

- The environment it will be installed in.
- The grade or weight of the zinc coating used.
- The degree and extent of the maintenance that will be undertaken over the life of the product.

Performance of galvanised zinc coated flooring products is affected by:

- The cumulative effects of the weather to either the underside surface or moisture ingress of the top surface.
- The amount of dust (which can hold moisture) that settles on the product.
- Any other wind-blown deposits that may settle on the product, promoting corrosion.
- Proximity to the ground in subfloor areas with little or no ventilation.

Condensation or other deposits should be prevented from accumulating on the Dimond Flooring System underside by providing adequate ventilation. A protective barrier must be provided if dampness is possible on the underside of the steel flooring sheet. Refer 3.1.5.

3.1.3.2 LIMITATIONS ON USE

The use of galvanised steel flooring sheet should be avoided:

- In areas where high concentrations of chemicals are combined with a high humidity, unless an appropriate protective coating system is applied to the underside surface and fully maintained for the design life of the structure. In this situation the system remains wet for long periods of time, causing a rapid consumption of the galvanised zinc coating and eventual red rusting of the base metal.
- Where the galvanised surface is being exposed to continuous moisture, without a chance for the surface to dry out, unless an appropriate protective coating system is applied to the underside surface and fully maintained for the design life of the structure. For example, where used as the cover slab of a water tank.
- In or near marine environments, where the prevailing wind carries marine salts, unless an appropriate protective coating system is applied to the underside surface and fully maintained for the design life of the structure.
- In areas surrounding chemical or industrial storage buildings where any chemical attack may lessen the life of the structure or wind-driven chemical fumes may attack the galvanised coating, unless an appropriate protective coating system is applied to the underside surface and fully maintained for the design life of the structure. Please call 0800 Roofspec (0800 766 377) to discuss.
- When in contact with or laid directly on ground.
- When in contact with timber and especially treated timber such as CCA (copper chrome arsenic) without the use of an isolating material such as Malthoid (DPC) between the timber and galvanised steel flooring sheet.
- When used in sub-floor areas with less than 450mm ground clearance.
- When used in sub-floor areas where ventilation does not comply with NZS 3604 Clause 6.14.

Chemical admixtures may only be used with Dimond Flooring Systems if they are compatible with galvanised steel.

Where the top surface of the slab is exposed to moisture, use of the Dimond Flooring System without an appropriate coating system (which is fully maintained for the design life of the structure) and/or adequate crack control to the top surface of the concrete slab should be avoided. Moisture seeping through cracks which are not effectively sealed or which do not have adequate crack control can combine with oxygen to the extent that corrosion of the galvanised steel sheet may occur. For guidance on methods of protection refer to Section 3.1.5 Durability Statement.

3.1.4 NZBC COMPLIANCE

Past history of use of Dimond Flooring Systems indicate that provided the product use and maintenance is in line with the guidelines of this manual, Dimond Flooring Systems can reasonably be expected to meet the performance criteria in Clause B1 Structure and B2 Durability of the New Zealand Building Code for a period of not less than 50 years, provided they are kept free from moisture.

Dimond Flooring Systems designed using the Fire Design Sections 3.3.6 and 3.4.6 of this manual and HERA Reports R4-82 and R4-131 as appropriate will meet the performance criteria in Clauses C3 and C4 of the New Zealand Building Code.

Unless noted otherwise in the Noise Control Sections (3.3.7 and 3.4.7), Dimond Flooring Systems designed using this manual that are stated to achieve Sound Transmission Class (STC) and Impact Insulation Class (IIC) of 55 meet the requirements of the current New Zealand Building Code (NZBC) Clause G6.

Where products used in Dimond Flooring Systems are manufactured by other suppliers, compliance to the NZBC should be checked with that product's manufacturer.

3.1.5 DURABILITY STATEMENT

The use of Dimond Flooring Systems is limited to dry and non corrosive environments. It is the responsibility of the designer to assess the durability requirements of the flooring slab. Consideration must be given to minimum concrete cover of the reinforcement and NZS 3101 provides guidance in this area.

Dimond can, for specific job locations, give advice on the performance of the Dimond galvanised zinc coated flooring system. Call Dimond on 0800 Roofspec.

When using Dimond Flooring Systems in areas as stated in Limitations of Use, achieving the required durability of the system is dependent on adhering to the following:

1. For protection of the galvanised underside surface:
   An application of a suitable paint system to the galvanised surface exposed on the underside of the floor. Specifications for specific locations can be obtained from Ameron Coatings 0800 263 766 or Akzo Nobel Coatings Limited 0800 808 807.
2. Where the top surface requires protection to suppress moisture entering the concrete one of the following methods is needed:
   - Design reinforcement in the slab for "Strong Crack Control" as outlined in HERA Report R4-113 Section 3.3 Control of Cracking and Leaks.
   - Provide the minimum necessary reinforcement in the slab *and* apply a suitable proprietary waterproofing agent (either mixed into the concrete before pouring or sprayed onto the top surface after curing).
   - Provide the minimum necessary reinforcement in the slab *and* apply a proprietary waterproofing membrane.
3. Where the top surface requires protection to prevent moisture entering the concrete one of the following methods is needed:
   - Provide the minimum necessary reinforcement in the slab *and* apply a proprietary waterproofing membrane.
   - Provide reinforcement in the slab for "Strong Crack Control" (outlined in HERA Report R4-113 Section 3.3 Control of Cracking and Leaks) *and* apply a suitable waterproofing agent (either mixed into the concrete before pouring or sprayed onto the top surface after curing).

3.1.6 MAINTENANCE

Dimond Flooring Systems require a minimum degree of maintenance to ensure expected performance is achieved. Careful maintenance can extend the useful life of the Dimond Flooring System.

As a guide the following should be carried out as often as is needed (this could be as often as every three months).

a) Keep surfaces clean and free from continuous contact with moisture, dust and other debris. This includes areas such as exposed undersides, eg decks or subfloors.

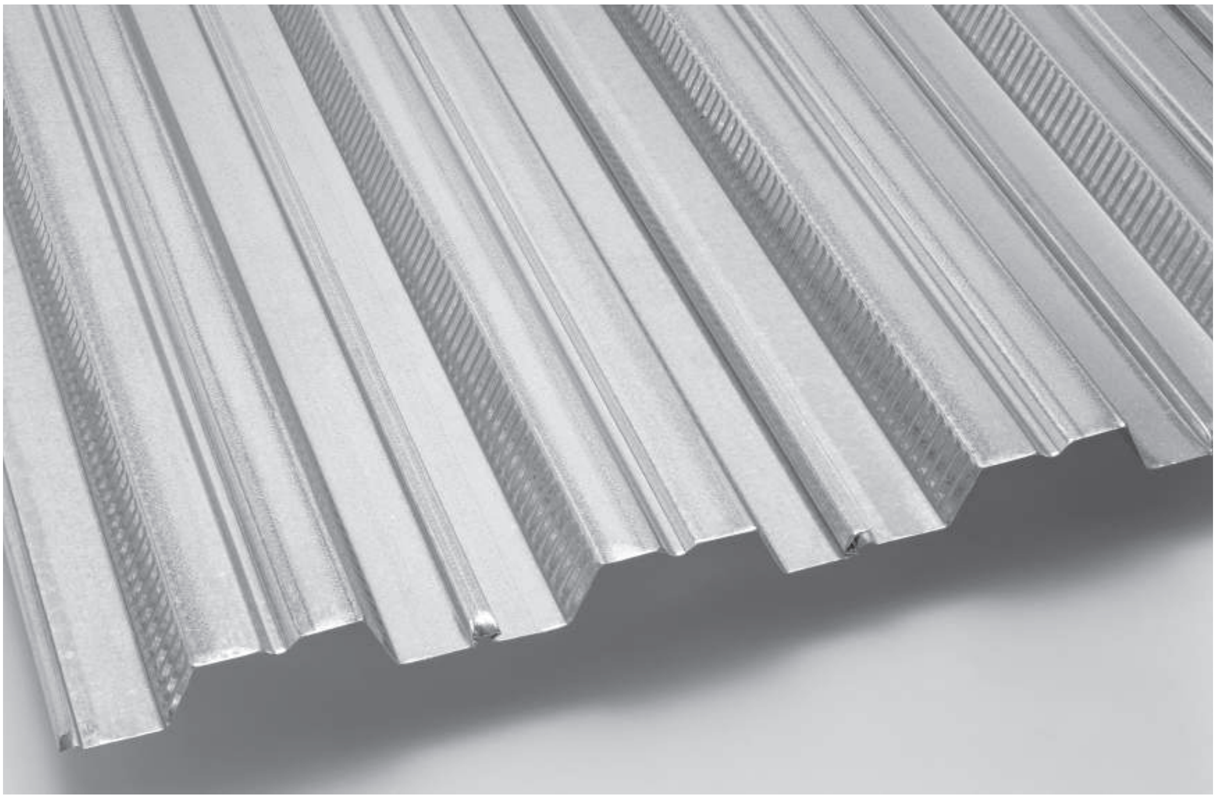
b) Any surface cracking exposed to possible water ingress is fully sealed. Similarly ponding of water on exposed top surfaces must be avoided to ensure durability requirements are met.

c) Regular maintenance should include a washdown programme to remove all the accumulated dirt or salt buildup on all the galvanised surfaces with a soft brush and plenty of clean water or by water blasting at 15 MPa (2000 psi).

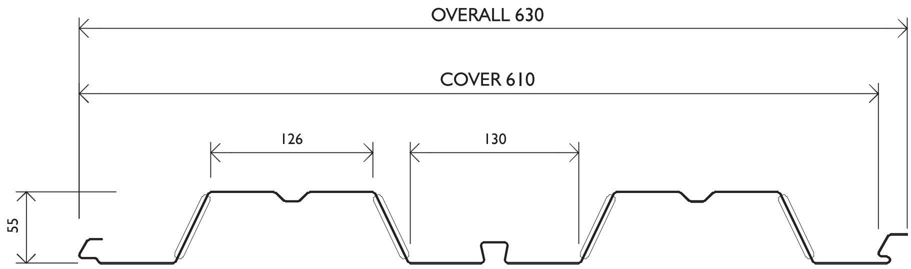
d) Periodically inspect the Dimond Flooring System. At the first sign of any underside corrosion, the affected areas should be cleaned down, spot primed and then repainted to an appropriate paint manufacturer's recommendations.

Any cases of severe damage or corrosion must be reported to the design engineer.

DESIGN GUIDE – HIBOND FLOORING



Hibond – Nominal Dimensions



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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.

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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 663	2 x SE82	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	HD12 @ 250	HD12 @ 250	HD12 @ 150	HD12 @ 150
190	180	HD12 @ 200	HD12 @ 200	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
125	110	HD12 @ 250	HD12 @ 250
135	120	HD12 @ 200	HD12 @ 200
145	130	HD12 @ 200	HD12 @ 200
155	140	HD12 @ 175	HD12 @ 175
165	150	HD12 @ 150	HD12 @ 150
175	160	HD12 @ 150	HD12 @ 150
185	170	HD12 @ 125	HD12 @ 125
195	180	HD12 @ 125	HD12 @ 125
205	190	HD12 @ 125	HD12 @ 125
215	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 higher strength concrete - therefore specific design to NZS 3101 is required.

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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 $w = L/2 + b_l$ 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_l = 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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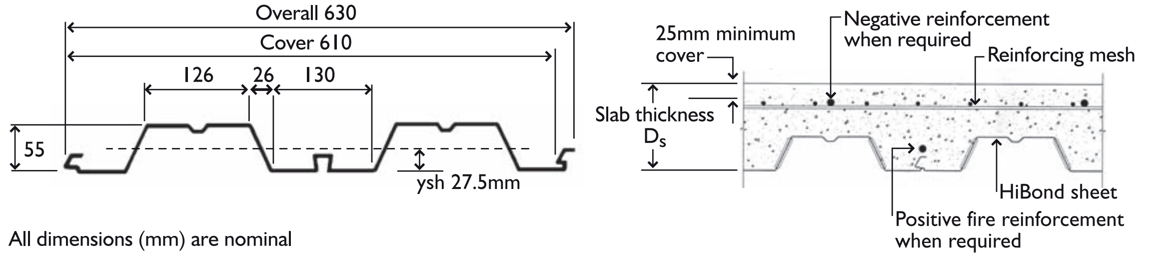
3.3.3 HIBOND SECTION PROPERTIES



All dimensions (mm) are nominal

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	M_c^- kNm	Web Crushing Strength P_w, kN End Support	Internal Support
0.75 0.95	0.085 0.108	1058 1340	550 520	5.46 8.93	6.51 9.71	14.52 21.34	29.05 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	Multispan I_m
0.75 0.95	$F_w / 29.05 + M^- / 6.51 < 1.43$ $F_w / 42.68 + M^- / 9.71 < 1.56$	45.1 71.6	0.493 0.605	0.391 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/m^3 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:

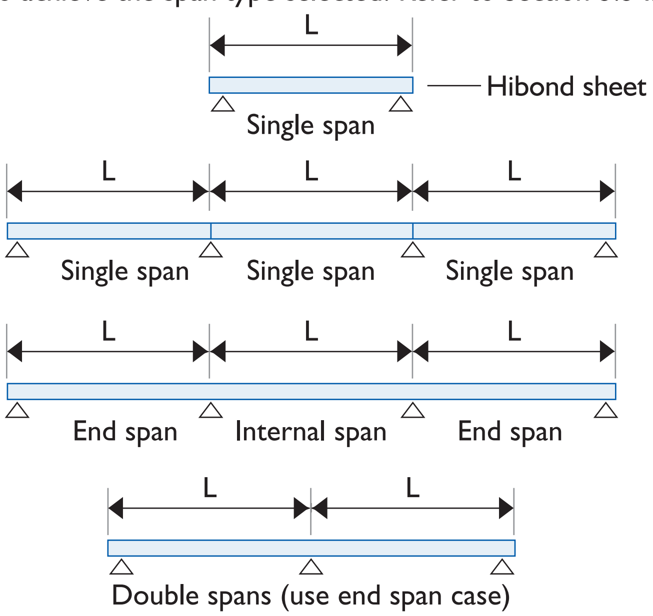
   a) L/180 maximum due to dead load (G) only.

   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.



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

3.3.5 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:

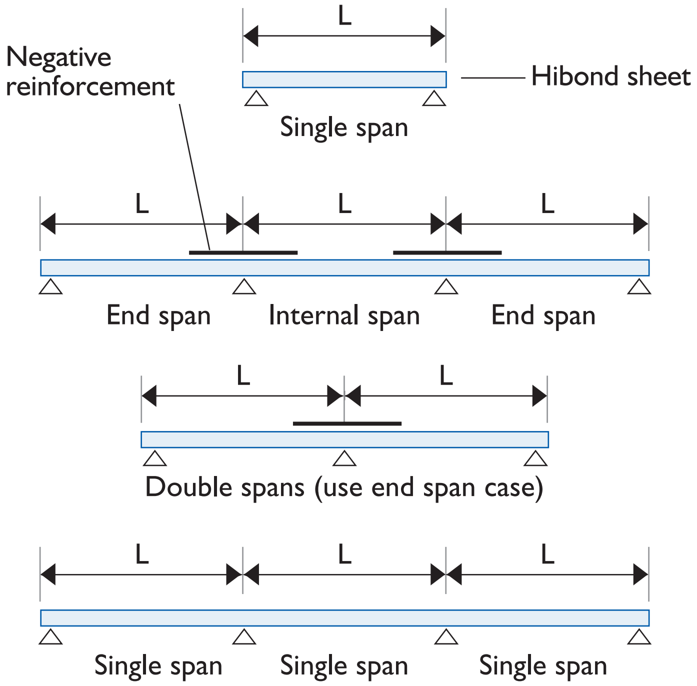
    – – – – Commercial offices, open plan with few small partitions (damping ratio = 0.025)

    ·········· 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.

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

Dimond

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 (mm²/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

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

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	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

3.3.10 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,

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

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 $3600 / 4 + 450 = 1350$mm 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,

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

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 $= 3600 / 4 + 450 = 1350$mm 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 composite slab to the centroid of the Hibond sheet
= 150 + 82.5 + 75 = 307mm

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),

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

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,

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

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,

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

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,

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

This is converted into an equivalent superimposed load,

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

Therefore garage slab must be increased to 120mm as,

$$4.3\text{ kPa} > 3.3\text{ kPa} \qquad \therefore \text{O.K}$$

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,

$\delta_p = 0.015\ P_Q\ L^3 / E_s\ I$ 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 $w = L/2 + b_l$ 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_l = 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 δ_{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 $\therefore$ 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

$= 65 + 27.5 \{(182 + 130) / (182 + 126)\}$
$= 93\text{mm}$
$\geq$ the minimum of 66mm ∴ 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 $G + \psi_l Q$ under fire emergency conditions (clause 4.2.4 AS/NZS 1170.0). This gives,

w = uniformly distributed load
$= G + G_{SDL} + \psi_l Q$
$= (2.24 \times 1.05 + 0.5) + 0.4 \times 4.0 = 4.45$ 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,

$u_1 = 46\text{mm},\ u_2 = 98\text{mm},\ u_3 = 31\text{mm}$

where u_1, u_2 and u_3 are the position of reinforcement bars

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

and,

$\gamma = 1 / (1 / 46^{0.5} + 1 / 98^{0.5} + 1 / 31^{0.5})$
$= 2.34$

where γ is the coefficient used to calculate temperature of the reinforcing bars

Continued on next page

3.3.10 DESIGN EXAMPLES *(3.3.10.4 continued)*

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

$\theta_s = 900 - 350\,\gamma = 81°C$

and at 60 minutes,

$\theta_s = 1175 - 350\,\gamma = 356°C$

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

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

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

$f_{yr\theta} = f_y \{(720 - T) / 470\}$ where $f_{yr\theta}$ 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 ($R_{T\theta}$) at an elevated temperature is,

$R_{T\theta} = A_s f_{yr\theta} = 123 \times 494 \times 10^{-3} = 60.7$ 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

$a = R_{T\theta} / (0.85 f'_c b)$
$= 60.7 \times 10^3 / (0.85 \times 25 \times 1000) = 2.8$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

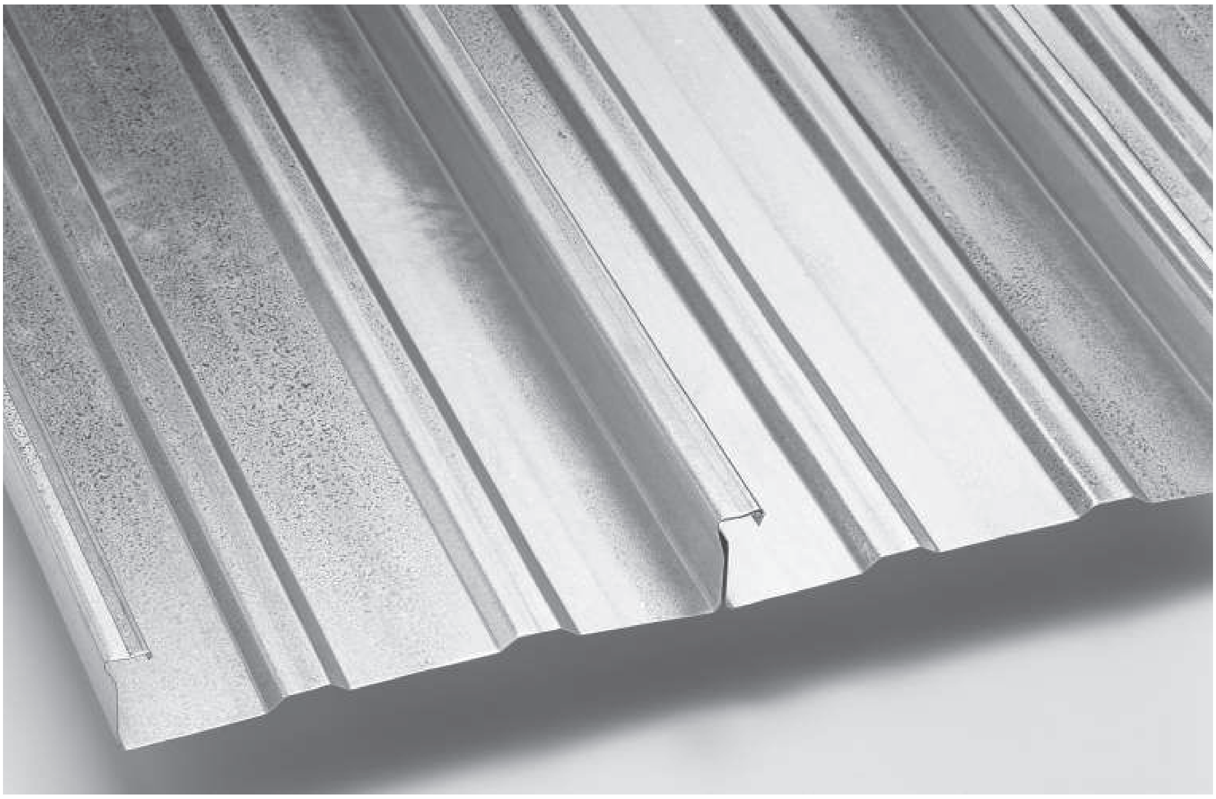
and,

where M_n is the nominal flexural strength of the section

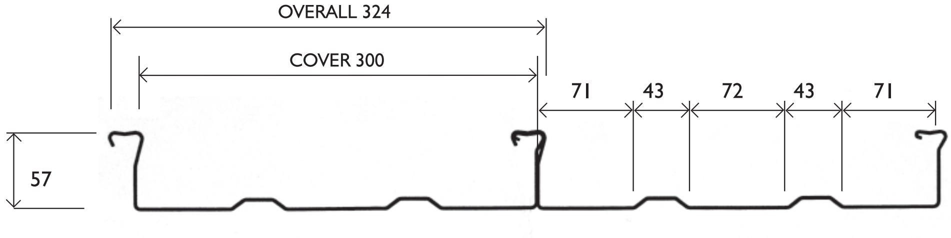
$\phi M_n = 1.0 \times 60.7 \times 10^{-3} \times 87.6 = 5.32$ kNm/m
$\geq M^* = 3.76$ kNm/m width $\therefore$ O.K.

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

DESIGN GUIDE – FLATDECK FLOORING



Flatdeck – Nominal Dimensions



Dimond

3.4.2 DESIGN CONSIDERATIONS

Formwork

Where Flatdeck sheet is used as formwork, the profile provides resistance to wet concrete (G) and construction loads (Q). Maximum formwork spans given in Section 3.4.4.1 Flatdeck Formwork Tables are based on design checks for bending, web crushing, vertical shear, combined actions and deflection.

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

Composite Slab

Design capacity of the Flatdeck Flooring System is largely dependent on interaction between the concrete and the Flatdeck sheet commonly referred to as shear bond. Shear bond is a combination of chemical bond between the concrete and the Flatdeck sheet and mechanical bond between the concrete and the vertical ribs of the Flatdeck sheet. This allows tension forces to be transferred from the concrete into the Flatdeck 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 1.2 (dead load) + 1.5 (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 3.4.5 Flatdeck Composite Slab Load Span Tables.

Fire Design

Fire resistance for the Flatdeck 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 Flatdeck floor slab to prevent flames passing through cracks formed in the slab (integrity) and limiting the temperature increase on the unexposed side of the Flatdeck 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, except that for Flatdeck the contribution of that portion of the steel decking rib that is embedded into the slab and therefore shielded from direct exposure to the fire, is calculated by determining the temperature due to conduction of heat from the exposed pan of the decking.

The rib element is subdivided into 10 elements and the temperature of each element is determined using the method from HERA Report R4-131 Slab Panel Method (3rd edition). The strength at elevated temperature (yield strength as function of temperature) is also determined in accordance with this report. The contribution of each element to the overall moment capacity of the slab is calculated in accordance with normal reinforced concrete design procedures.

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 3.4.6 Fire Design Tables.

Continued on next page

3.4.2 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 Flatdeck 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 Flatdeck 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 3.4.5 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

3.4.2 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 663	2 x SE82	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	HD12 @ 250	HD12 @ 250	HD12 @ 150	HD12 @ 150
190	180	HD12 @ 200	HD12 @ 200	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 3.4.5, 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 3.4.5 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
125	110	HD12 @ 250	HD12 @ 250
135	120	HD12 @ 200	HD12 @ 200
145	130	HD12 @ 200	HD12 @ 200
155	140	HD12 @ 175	HD12 @ 175
165	150	HD12 @ 150	HD12 @ 150
175	160	HD12 @ 150	HD12 @ 150
185	170	HD12 @ 125	HD12 @ 125
195	180	HD12 @ 125	HD12 @ 125
205	190	HD12 @ 125	HD12 @ 125
215	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 3.4.5, 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 3.4.5 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.

Continued on next page

3.4.2 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 3.4.5 Flatdeck Composite Slab Load Span Tables).
- To increase the fire resistance of the floor slab (refer Section 3.4.6 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 Flatdeck 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 3.4.10 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 Flatdeck 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 $w = L/2 + b_l$ 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_l = 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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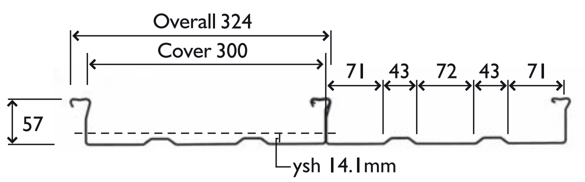
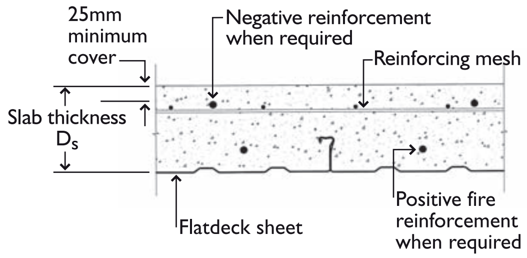
3.4.3 FLATDECK SECTION PROPERTIES



All dimensions (mm) are nominal



FLATDECK 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
0.75	0.095	1180	550	4.2	2.73
0.95	0.119	1495	550	5.10	3.61

Thickness mm	Shear Strength P_v kN	Second Moment of Area 10^6mm^4 Single Span $I\,x^{+ve}$	Second Moment of Area 10^6mm^4 Multispan $I\,x^{-ve}$	Web Crushing Strength P_w kN End Support	Web Crushing Strength P_w kN Internal Support
0.75	95.1	0.503	0.369	68.3	90.5
0.95	123.6	0.670	0.502	95.0	126.5

Notes

1. Design strength p_y is 0.84 x ultimate tensile strength.
2. ysh is the distance from the bottom of the Flatdeck sheet to the neutral axis.

Continued on next page

3.4.3 FLATDECK SECTION PROPERTIES *continued*

0.75mm FLATDECK 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	2.63	13.4	8.3	59.0	61.7	6.3	5.3	37.4	46.2	9.9	6.8
120	2.86	17.2	10.6	64.2	67.0	7.8	6.6	39.8	49.3	12.5	8.6
130	3.09	21.6	13.3	69.3	72.2	9.5	8.0	42.0	52.3	15.6	10.7
140	3.32	26.8	16.4	74.4	77.4	11.4	9.6	44.2	55.2	19.1	13.0
150	3.55	32.7	20.0	79.5	82.6	13.4	11.4	46.3	57.9	23.1	15.7
160	3.78	39.5	24.0	84.6	87.8	15.6	13.3	48.3	60.6	27.6	18.7
170	4.01	47.1	28.6	89.7	93.0	18.1	15.4	50.2	63.2	32.6	22.0
180	4.24	55.6	33.7	94.7	98.1	20.7	17.8	52.1	65.7	38.1	25.7
190	4.47	65.0	39.3	99.8	103.2	23.5	20.2	54.0	68.1	44.3	29.8
200	4.70	75.5	45.5	104.8	108.3	26.5	22.9	55.8	70.5	51.0	34.2

0.95mm FLATDECK 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	2.65	14.0	8.8	59.9	63.1	7.5	6.1	40.8	50.0	10.7	7.5
120	2.88	17.9	11.2	65.1	68.5	9.3	7.6	43.5	53.4	13.6	9.4
130	3.12	22.5	14.0	70.3	73.8	11.3	9.3	46.0	56.8	16.6	11.7
140	3.35	27.8	17.3	75.5	79.1	13.5	11.2	48.4	59.9	20.6	14.3
150	3.58	33.9	21.0	80.6	84.4	16.0	13.3	50.8	63.0	24.9	17.2
160	3.81	40.8	25.2	85.7	89.6	18.7	15.6	53.0	66.0	29.7	20.4
170	4.04	48.6	29.9	90.8	94.8	21.6	18.1	55.2	68.9	35.1	24.0
180	4.27	57.3	35.2	95.9	100.0	24.8	20.9	57.3	71.6	41.0	28.0
190	4.50	67.0	41.1	101.0	105.1	28.2	23.9	59.4	74.4	47.6	32.5
200	4.73	77.7	47.5	106.0	110.3	31.8	27.0	61.4	77.0	54.7	37.3

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 Flatdeck section.
5. I_{cr} is the second moment of area of the cracked composite Flatdeck 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 Flatdeck slab for gross section.
8. Y_{cr} is the distance from top of slab to neutral axis of the composite Flatdeck slab for the cracked section.

3.4.4 FORMWORK DESIGN

3.4.4.1 FLATDECK FORMWORK TABLES

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

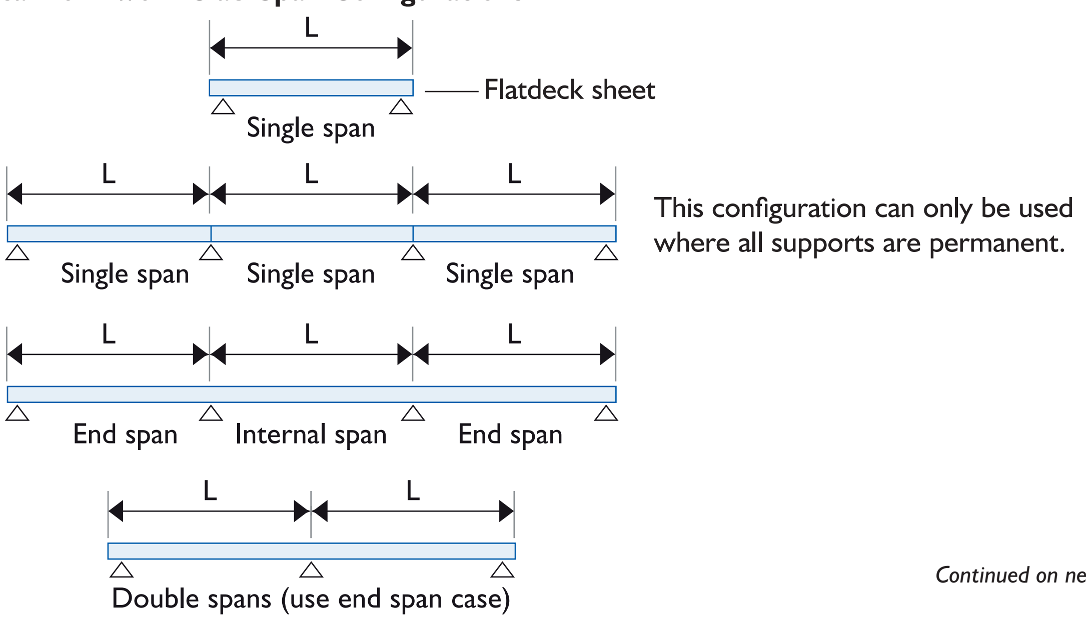
The following notes apply to the formwork tables in this section.

1. D_s is the overall thickness of the slab.
2. Slab weights (G) are based on a wet concrete density of 2400 kg/m^3 with no allowance for ponding.
3. A construction load (Q) of 1.5 kPa is incorporated in these tables.
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 Flatdeck Formwork Properties table in Section 3.4.3.
6. These tables are based on minimum bearing of Flatdeck sheet given in Section 3.4.4.3.
7. Deflection limits incorporated in these tables are L/180 maximum due to dead load (G) only.

   These limits are represented in the 'Allow' (allowable) column of the Flatdeck Formwork Tables. The 5mm limit should be referred to where soffit deflection is to be reduced.
8. For intermediate values, linear interpolation is permitted.
9. As a guide, formwork deflections of around 15mm under dead load (G) should be expected within the extent of the tables. Construction loads (Q) will increase deflections.
10. The design span of the formwork relates closely to site installation. If the Flatdeck 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



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3.4.4.1 FLATDECK FORMWORK TABLES *continued*

0.75mm FLATDECK 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	2.68	0.11	2300	1950	2700	2200	2700	2050
120	2.92	0.12	2200	1900	2650	2150	2650	2000
130	3.15	0.13	2200	1900	2550	2100	2550	2000
140	3.39	0.14	2150	1850	2500	2050	2500	1950
150	3.63	0.15	2100	1800	2450	2050	2450	1900
160	3.86	0.16	2050	1800	2400	2000	2400	1900
170	4.10	0.17	2000	1750	2350	2000	2350	1850
180	4.33	0.18	2000	1750	2350	1950	2300	1850
190	4.57	0.19	1950	1700	2300	1900	2300	1800
200	4.80	0.20	1900	1700	2250	1900	2250	1800
210	5.04	0.21	1900	1700	2200	1900	2200	1750
220	5.27	0.22	1850	1650	2200	1850	2150	1750
230	5.51	0.23	1850	1650	2150	1850	2150	1750
240	5.74	0.24	1800	1650	2100	1800	2100	1700
250	5.98	0.25	1800	1600	2100	1800	2100	1700
260	6.22	0.26	1750	1600	2050	1800	2050	1700
270	6.45	0.27	1750	1600	2000	1750	2000	1650
280	6.69	0.28	1700	1600	2000	1750	2000	1650
290	6.92	0.29	1700	1550	1950	1750	1950	1650
300	7.16	0.30	1650	1550	1950	1750	1950	1650

0.95mm FLATDECK 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	2.71	0.11	2500	2050	3000	2350	2950	2200
120	2.94	0.12	2450	2000	2900	2300	2900	2150
130	3.18	0.13	2400	2000	2850	2250	2850	2150
140	3.41	0.14	2350	1950	2800	2250	2800	2100
150	3.65	0.15	2300	1900	2750	2200	2700	2050
160	3.89	0.16	2250	1900	2700	2150	2650	2050
170	4.12	0.17	2200	1850	2650	2150	2600	2000
180	4.36	0.18	2150	1850	2600	2100	2550	2000
190	4.59	0.19	2150	1800	2550	2050	2550	1950
200	4.83	0.20	2100	1800	2500	2050	2500	1950
210	5.06	0.21	2050	1800	2450	2000	2450	1900
220	5.30	0.22	2050	1750	2400	2000	2400	1900
230	5.53	0.23	2000	1750	2400	2000	2350	1850
240	5.77	0.24	2000	1750	2350	1950	2350	1850
250	6.00	0.25	1950	1700	2300	1950	2300	1850
260	6.24	0.26	1900	1700	2250	1900	2250	1800
270	6.47	0.27	1900	1700	2250	1900	2250	1800
280	6.71	0.28	1850	1650	2200	1900	2200	1800
290	6.95	0.29	1850	1650	2200	1850	2200	1750
300	7.18	0.30	1850	1650	2150	1850	2150	1750

3.4.5 FLATDECK 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 7.2m for all span configurations. For continuous design, negative reinforcement requirements are presented for double or end spans and internal spans.

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 Flatdeck slab thickness and span configuration as formwork. Refer to Section 3.4.4.1 Flatdeck Formwork Tables to determine formwork span capabilities.

6. 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 variation to the above configurations requires specific design.

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

   8.9 H16@200

   where:
   8.9 = Superimposed load kPa
   H16@200 = H16 negative reinforcing (saddle bars) placed at 200mm centres to achieve the superimposed load

Continued on next page

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES *continued*

8. Steel areas in the double or end and internal span tables are calculated based on H16 reinforcing bars (i.e. 16mm 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.

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

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

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

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

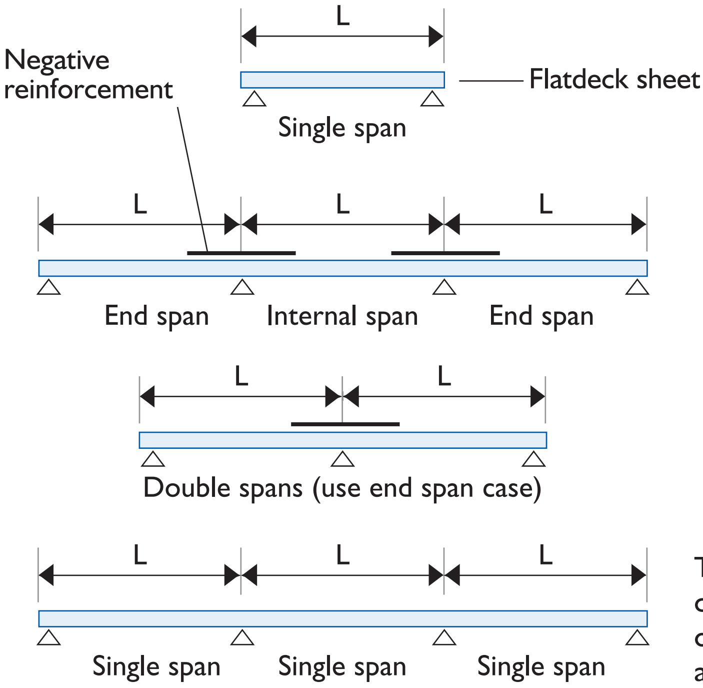
    – – – – Commercial offices, open plan with few small partitions (damping ratio = 0.025)

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

    Specific design is required for other floor uses. Refer Section 3.4.8 Floor Vibration.

13. 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 3.4.2.

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES continued

0.75mm FLATDECK – 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	18.6	20.3	21.8	–	–	–	–	–	–	–
2200	16.0	17.3	18.8	20.3	21.8	–	–	–	–	–
2400	13.9	15.2	16.4	17.7	19.0	20.3	21.6	–	–	–
2600	12.2	13.4	14.4	15.6	16.7	17.8	19.0	20.2	21.3	–
2800	10.9	11.8	12.8	13.8	14.8	15.8	16.9	17.9	18.9	20.0
3000	9.7	10.6	11.5	12.4	13.3	14.2	15.1	16.0	17.0	17.9
3200	8.8	9.5	10.3	11.1	11.9	12.8	13.6	14.4	15.3	16.1
3400	7.9	8.6	9.3	10.1	10.8	11.6	12.3	13.1	13.8	14.6
3600	7.1	7.8	8.5	9.2	9.8	10.5	11.2	11.9	12.6	13.3
3800	6.5	7.1	7.8	8.3	9.0	9.6	10.2	10.9	11.5	12.1
4000	5.9	6.5	7.1	7.6	8.2	8.8	9.4	9.9	10.5	11.1
4200	5.4	5.9	6.5	7.0	7.5	8.1	8.6	9.1	9.7	10.2
4400	4.6	5.4	6.0	6.4	6.9	7.4	7.9	8.4	8.9	9.4
4600	3.7	5.0	5.5	5.9	6.4	6.8	7.3	7.7	8.3	8.8
4800	2.9	4.2	5.1	5.4	5.9	6.3	6.8	7.3	7.7	8.1
5000	2.3	3.4	4.6	5.0	5.5	5.9	6.3	6.7	7.1	7.5
5200	1.7	2.7	3.8	4.7	5.1	5.5	5.9	6.2	6.6	7.0
5400	–	2.1	3.1	4.4	4.7	5.1	5.4	5.8	6.1	6.5
5600	–	1.6	2.4	3.4	4.4	4.7	5.0	5.4	5.7	6.0
5800	–	–	1.9	2.8	4.1	4.4	4.7	5.0	5.3	5.6
6000	–	–	–	2.2	3.1	4.1	4.4	4.6	4.9	5.2
6200	–	–	–	1.7	2.5	3.4	4.1	4.4	4.6	4.9
6400	–	–	–	–	1.9	2.8	3.7	4.0	4.3	4.6
6600	–	–	–	–	–	2.2	3.0	3.7	4.1	4.3
6800	–	–	–	–	–	1.7	2.4	3.3	3.8	4.1
7000	–	–	–	–	–	–	1.9	2.7	3.5	3.7
7200	–	–	–	–	–	–	–	2.1	2.9	3.5

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES continued

0.75mm FLATDECK – 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	18.6	20.3	21.8	–	–	–	–	–	–	–
2200	16.0	17.3	18.8	20.3	21.8	–	–	–	–	–
2400	13.9	15.2	16.4	17.7	19.0	20.3	21.6	–	–	–
2600	12.2	13.4	14.4	15.6	16.7	17.8	19.0	20.2	21.3	–
2800	10.9	11.8	12.8	13.8	14.8	15.8	16.9	17.9	18.9	20.0
3000	9.7	10.6	11.5	12.4	13.3	14.2	15.1	16.0	17.0	17.9
3200	8.8	9.5	10.3	11.1	11.9	12.8	13.6	14.4	15.3	16.1
3400	7.7	8.6	9.3	10.1	10.8	11.6	12.3	13.1	13.8	14.6
3600	6.5	7.8	8.5	9.2	9.8	10.5	11.2	11.9	12.6	13.3
3800	5.1	6.9	7.8	8.3	9.0	9.6	10.2	10.9	11.5	12.1
4000	4.0	5.5	7.1	7.6	8.2	8.8	9.4	9.9	10.5	11.1
4200	3.1	4.4	5.9	7.0	7.5	8.1	8.6	9.1	9.7	10.2
4400	2.3	3.4	4.7	6.2	6.9	7.4	7.9	8.4	8.9	9.4
4600	1.7	2.6	3.7	5.0	6.5	6.8	7.3	7.7	8.3	8.8
4800	–	1.9	2.9	4.0	5.3	6.3	6.8	7.3	7.7	8.1
5000	–	–	2.2	3.2	4.3	5.5	6.3	6.7	7.1	7.5
5200	–	–	1.6	2.4	3.4	4.5	5.8	6.2	6.6	7.0
5400	–	–	–	1.8	2.6	3.6	4.7	5.8	6.1	6.5
5600	–	–	–	–	2.0	2.8	3.8	4.9	5.7	6.0
5800	–	–	–	–	–	2.2	3.0	4.0	5.0	5.6
6000	–	–	–	–	–	1.6	2.3	3.2	4.1	5.2
6200	–	–	–	–	–	–	1.7	2.5	3.3	4.2
6400	–	–	–	–	–	–	–	1.8	2.6	3.4
6600	–	–	–	–	–	–	–	–	2.0	2.7
6800	–	–	–	–	–	–	–	–	–	2.1
7000	–	–	–	–	–	–	–	–	–	1.5
7200	–	–	–	–	–	–	–	–	–	–

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.75mm FLATDECK – 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	**21.1** H16@300	**22.9** H16@300								
2200	**18.1** H16@250	**19.7** H16@300	**21.2** H16@300	**22.9** H16@300						
2400	**15.8** H16@250	**17.2** H16@250	**18.5** H16@300	**19.9** H16@300	**21.4** H16@300	**22.8** H16@300				
2600	**13.9** H16@250	**15.1** H16@250	**16.3** H16@250	**17.6** H16@300	**18.8** H16@300	**20.1** H16@300	**21.3** H16@300			
2800	**12.4** H16@250	**13.4** H16@250	**14.5** H16@250	**15.6** H16@250	**16.7** H16@300	**17.8** H16@300	**18.9** H16@300	**20.1** H16@300	**21.3** H16@300	**22.0** H16@300
3000	**11.1** H16@200	**12.1** H16@250	**13.0** H16@250	**14.0** H16@250	**15.0** H16@250	**16.0** H16@250	**17.0** H16@300	**18.1** H16@300	**19.1** H16@300	**20.2** H16@300
3200	**10.0** H16@200	**10.9** H16@200	**11.8** H16@250	**12.7** H16@250	**13.6** H16@250	**14.5** H16@250	**15.4** H16@200	**16.3** H16@250	**17.3** H16@250	**18.2** H16@250
3400	**8.6** H16@200	**9.9** H16@200	**10.7** H16@200	**11.5** H16@250	**12.3** H16@250	**13.2** H16@250	**14.0** H16@200	**14.8** H16@250	**15.7** H16@250	**16.5** H16@250
3600	**7.1** H16@200	**9.0** H16@200	**9.7** H16@200	**10.5** H16@200	**11.3** H16@200	**12.0** H16@250	**12.8** H16@200	**13.5** H16@250	**14.3** H16@250	**15.1** H16@250
3800	**5.8** H16@200	**7.5** H16@200	**8.9** H16@200	**9.6** H16@200	**10.3** H16@200	**11.0** H16@200	**11.7** H16@200	**12.4** H16@250	**13.1** H16@250	**13.8** H16@250
4000	**4.8** H16@200	**6.3** H16@200	**7.9** H16@200	**8.9** H16@200	**9.5** H16@200	**10.1** H16@200	**10.8** H16@200	**11.4** H16@200	**12.1** H16@200	**12.7** H16@200
4200	**3.9** H16@200	**5.2** H16@200	**6.6** H16@200	**8.2** H16@200	**8.7** H16@200	**9.3** H16@200	**9.9** H16@200	**10.5** H16@200	**11.2** H16@200	**11.8** H16@200
4400	**3.1** H16@200	**4.3** H16@200	**5.5** H16@200	**6.9** H16@200	**8.1** H16@200	**8.6** H16@200	**9.2** H16@200	**9.8** H16@200	**10.3** H16@200	**10.9** H16@200
4600	**2.5** H16@200	**3.5** H16@200	**4.6** H16@200	**5.8** H16@200	**7.2** H16@200	**8.0** H16@200	**8.5** H16@200	**9.1** H16@200	**9.7** H16@200	**10.2** H16@200
4800	**1.9** H16@200	**2.8** H16@200	**3.7** H16@200	**4.8** H16@200	**6.1** H16@200	**7.4** H16@200	**8.0** H16@200	**8.5** H16@200	**9.0** H16@200	**9.5** H16@200
5000	**1.4** H16@200	**2.2** H16@200	**3.0** H16@200	**4.0** H16@200	**5.3** H16@200	**6.5** H16@200	**7.4** H16@200	**7.9** H16@200	**8.4** H16@200	**8.9** H16@200
5200		**1.6** H16@200	**2.4** H16@200	**3.5** H16@200	**4.4** H16@200	**5.5** H16@200	**6.6** H16@200	**7.2** H16@200	**7.8** H16@200	**8.3** H16@200
5400			**2.1** H16@200	**2.8** H16@200	**3.7** H16@200	**4.7** H16@200	**5.7** H16@200	**6.4** H16@200	**6.9** H16@200	**7.5** H16@200
5600			**1.6** H16@200	**2.3** H16@200	**3.0** H16@200	**3.9** H16@200	**4.8** H16@200	**5.7** H16@200	**6.1** H16@200	**7.3** H16@100
5800				**1.8** H16@200	**2.5** H16@200	**3.2** H16@200	**4.1** H16@200	**5.0** H16@200	**5.5** H16@200	**6.8** H16@100
6000					**1.9** H16@200	**2.6** H16@200	**3.9** H16@100	**4.2** H16@200	**4.8** H16@200	**6.4** H16@100
6200						**2.1** H16@200	**3.2** H16@100	**3.5** H16@200	**4.3** H16@200	**5.9** H16@100
6400						**1.5** H16@200	**2.6** H16@100	**3.3** H16@100	**3.6** H16@200	**5.2** H16@100
6600							**2.0** H16@100	**2.7** H16@100	**3.7** H16@100	**4.5** H16@100
6800							**1.7** H16@100	**2.4** H16@100	**3.1** H16@100	**3.8** H16@100
7000								**1.8** H16@100	**2.5** H16@100	**3.2** H16@100
7200									**2.0** H16@100	**2.6** H16@100

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.75mm FLATDECK – 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	**20.0** H16@300	**21.7** H16@300	**23.4** H16@300							
2200	**17.1** H16@300	**18.6** H16@300	**20.1** H16@300	**21.6** H16@300	**23.1** H16@300					
2400	**15.0** H16@300	**16.2** H16@300	**17.5** H16@300	**18.8** H16@300	**20.2** H16@300	**21.4** H16@300	**22.8** H16@300			
2600	**13.2** H16@300	**14.3** H16@300	**15.4** H16@300	**16.6** H16@300	**17.7** H16@300	**18.9** H16@300	**20.1** H16@300	**21.3** H16@300	**22.6** H16@300	
2800	**11.6** H16@250	**12.7** H16@300	**13.7** H16@300	**14.7** H16@300	**15.8** H16@300	**16.8** H16@300	**17.9** H16@300	**19.0** H16@300	**20.1** H16@300	**21.2** H16@300
3000	**10.5** H16@250	**11.3** H16@250	**12.3** H16@300	**13.2** H16@300	**14.1** H16@300	**15.1** H16@300	**16.0** H16@300	**17.0** H16@300	**18.0** H16@300	**19.1** H16@300
3200	**9.4** H16@250	**10.2** H16@250	**11.1** H16@250	**11.9** H16@300	**12.8** H16@300	**13.6** H16@300	**14.5** H16@300	**15.4** H16@300	**16.3** H16@300	**17.2** H16@300
3400	**8.3** H16@250	**9.3** H16@250	**10.1** H16@250	**10.8** H16@250	**11.6** H16@300	**12.4** H16@300	**13.2** H16@300	**14.0** H16@300	**14.8** H16@300	**15.6** H16@300
3600	**6.4** H16@200	**8.3** H16@250	**9.2** H16@250	**9.9** H16@250	**10.6** H16@250	**11.3** H16@250	**12.0** H16@300	**12.8** H16@300	**13.5** H16@300	**14.3** H16@300
3800	**5.2** H16@200	**6.8** H16@200	**8.4** H16@250	**9.1** H16@250	**9.7** H16@250	**10.4** H16@250	**11.0** H16@250	**11.7** H16@250	**12.4** H16@300	**13.1** H16@300
4000	**4.2** H16@200	**5.6** H16@200	**7.2** H16@200	**8.3** H16@250	**8.9** H16@250	**9.5** H16@250	**10.1** H16@250	**10.8** H16@250	**11.4** H16@250	**12.0** H16@250
4200	**3.4** H16@200	**4.6** H16@200	**5.9** H16@200	**7.4** H16@200	**8.2** H16@250	**8.8** H16@250	**9.4** H16@250	**9.9** H16@250	**10.5** H16@250	**11.1** H16@250
4400	**2.7** H16@200	**3.7** H16@200	**4.9** H16@200	**6.2** H16@200	**7.6** H16@200	**8.1** H16@250	**8.7** H16@250	**9.2** H16@250	**9.7** H16@250	**10.3** H16@250
4600	**2.1** H16@200	**2.9** H16@200	**4.0** H16@200	**5.1** H16@200	**6.4** H16@200	**7.5** H16@200	**8.0** H16@250	**8.5** H16@250	**9.1** H16@250	**9.6** H16@250
4800	**1.5** H16@200	**2.3** H16@200	**3.2** H16@200	**4.2** H16@200	**5.3** H16@200	**6.6** H16@200	**7.5** H16@200	**8.0** H16@200	**8.5** H16@200	**8.9** H16@250
5000		**1.7** H16@200	**2.5** H16@200	**3.4** H16@200	**4.6** H16@200	**5.7** H16@200	**7.0** H16@200	**7.5** H16@200	**7.9** H16@200	**8.3** H16@200
5200			**1.8** H16@200	**2.9** H16@200	**3.8** H16@200	**4.8** H16@200	**5.9** H16@200	**7.0** H16@200	**7.4** H16@200	**7.8** H16@200
5400			**1.5** H16@200	**2.3** H16@200	**3.1** H16@200	**4.0** H16@200	**5.5** H16@100	**6.0** H16@200	**6.9** H16@200	**7.3** H16@200
5600				**1.7** H16@200	**2.5** H16@200	**3.2** H16@200	**4.6** H16@100	**5.6** H16@100	**6.1** H16@200	**6.8** H16@200
5800					**1.8** H16@200	**2.6** H16@200	**3.8** H16@100	**4.7** H16@100	**5.8** H16@100	**6.2** H16@200
6000						**2.0** H16@200	**3.1** H16@100	**3.9** H16@100	**4.9** H16@100	**5.9** H16@100
6200							**2.5** H16@100	**3.2** H16@100	**4.1** H16@100	**5.0** H16@100
6400							**1.8** H16@100	**2.6** H16@100	**3.3** H16@100	**4.3** H16@100
6600								**1.9** H16@100	**2.6** H16@100	**3.6** H16@100
6800								**1.5** H16@100	**2.2** H16@100	**3.0** H16@100
7000									**1.6** H16@100	**2.3** H16@100
7200										**1.7** H16@100

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES continued

0.95mm FLATDECK – 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	19.8	21.5	23.1	–	–	–	–	–	–	–
2200	16.9	18.4	19.8	21.2	22.7	–	–	–	–	–
2400	14.6	15.9	17.1	18.6	19.8	21.1	22.4	–	–	–
2600	13.0	14.1	15.2	16.3	17.4	18.6	19.7	20.9	22.1	–
2800	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.6	19.6	20.6
3000	10.3	11.2	12.0	12.9	13.9	14.8	15.7	16.6	17.5	18.5
3200	9.2	10.0	10.8	11.7	12.5	13.3	14.1	14.9	15.8	16.6
3400	8.3	9.1	9.8	10.5	11.3	12.0	12.8	13.5	14.3	15.1
3600	7.5	8.2	8.9	9.6	10.3	10.9	11.6	12.3	13.0	13.7
3800	6.9	7.5	8.1	8.7	9.4	10.0	10.6	11.2	11.9	12.5
4000	6.3	6.8	7.4	8.0	8.6	9.2	9.7	10.3	10.9	11.5
4200	5.7	6.3	6.8	7.3	7.9	8.4	8.9	9.5	10.0	10.5
4400	5.2	5.8	6.2	6.7	7.2	7.7	8.2	8.7	9.2	9.7
4600	4.2	5.3	5.7	6.2	6.7	7.1	7.6	8.0	8.5	9.0
4800	3.4	4.8	5.3	5.7	6.1	6.6	7.0	7.4	7.9	8.3
5000	2.7	3.9	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.8
5200	2.1	3.1	4.4	4.9	5.2	5.6	6.0	6.5	6.8	7.2
5400	1.6	2.5	3.6	4.5	4.8	5.2	5.7	6.0	6.4	6.7
5600	–	1.9	2.9	4.0	4.6	4.9	5.3	5.6	5.9	6.2
5800	–	–	2.3	3.3	4.3	4.6	4.9	5.2	5.5	5.8
6000	–	–	1.7	2.6	3.6	4.3	4.5	4.8	5.1	5.4
6200	–	–	–	2.1	3.0	4.0	4.2	4.5	4.8	5.0
6400	–	–	–	1.6	2.4	3.3	3.9	4.2	4.4	4.7
6600	–	–	–	–	1.8	2.6	3.6	3.9	4.1	4.4
6800	–	–	–	–	–	2.1	2.9	3.6	3.8	4.1
7000	–	–	–	–	–	1.6	2.3	3.2	3.6	3.8
7200	–	–	–	–	–	–	1.8	2.6	3.4	3.6

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES continued

0.95mm FLATDECK – 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	19.8	21.5	23.1	–	–	–	–	–	–	–
2200	16.9	18.4	19.8	21.2	22.7	–	–	–	–	–
2400	14.6	15.9	17.1	18.6	19.8	21.1	22.4	–	–	–
2600	13.0	14.1	15.2	16.3	17.4	18.6	19.7	20.9	22.1	–
2800	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.6	19.6	20.6
3000	10.3	11.2	12.0	12.9	13.9	14.8	15.7	16.6	17.5	18.5
3200	9.2	10.0	10.8	11.7	12.5	13.3	14.1	14.9	15.8	16.6
3400	8.3	9.1	9.8	10.5	11.3	12.0	12.8	13.5	14.3	15.1
3600	7.2	8.2	8.9	9.6	10.3	10.9	11.6	12.3	13.0	13.7
3800	5.9	7.5	8.1	8.7	9.4	10.0	10.6	11.2	11.9	12.5
4000	4.7	6.3	7.4	8.0	8.6	9.2	9.7	10.3	10.9	11.5
4200	3.7	5.1	6.8	7.3	7.9	8.4	8.9	9.5	10.0	10.5
4400	2.8	4.0	5.5	6.7	7.2	7.7	8.2	8.7	9.2	9.7
4600	2.1	3.2	4.4	5.8	6.7	7.1	7.6	8.0	8.5	9.0
4800	1.6	2.4	3.5	4.7	6.1	6.6	7.0	7.4	7.9	8.3
5000	–	1.8	2.7	3.8	5.0	6.1	6.5	6.9	7.3	7.8
5200	–	–	2.1	3.0	4.1	5.3	6.0	6.5	6.8	7.2
5400	–	–	1.5	2.3	3.2	4.3	5.5	6.0	6.4	6.7
5600	–	–	–	1.7	2.5	3.5	4.5	5.6	5.9	6.2
5800	–	–	–	–	1.9	2.7	3.7	4.7	5.5	5.8
6000	–	–	–	–	–	2.1	2.9	3.9	4.9	5.4
6200	–	–	–	–	–	1.5	2.3	3.1	4.0	5.0
6400	–	–	–	–	–	–	1.7	2.4	3.2	4.2
6600	–	–	–	–	–	–	–	1.8	2.6	3.4
6800	–	–	–	–	–	–	–	–	1.9	2.7
7000	–	–	–	–	–	–	–	–	–	2.1
7200	–	–	–	–	–	–	–	–	–	1.5

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.95mm FLATDECK – 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	**22.6** H16@250	**24.4** H16@300								
2200	**19.3** H16@250	**20.8** H16@250	**22.4** H16@300							
2400	**16.7** H16@250	**18.1** H16@250	**19.5** H16@250	**21.0** H16@300	**22.4** H16@300					
2600	**14.8** H16@200	**16.0** H16@250	**17.2** H16@250	**18.4** H16@250	**19.7** H16@300	**21.0** H16@300	**22.2** H16@300			
2800	**13.1** H16@200	**14.2** H16@250	**15.3** H16@250	**16.4** H16@250	**17.5** H16@250	**18.5** H16@300	**19.8** H16@300	**20.9** H16@300	**22.1** H16@300	
3000	**11.8** H16@200	**12.7** H16@200	**13.7** H16@250	**14.7** H16@250	**15.7** H16@250	**16.7** H16@250	**17.7** H16@250	**18.7** H16@250	**19.8** H16@250	**20.8** H16@300
3200	**10.6** H16@200	**11.5** H16@200	**12.4** H16@200	**13.3** H16@250	**14.2** H16@250	**15.1** H16@250	**16.0** H16@250	**16.9** H16@250	**17.8** H16@250	**18.8** H16@250
3400	**9.3** H16@200	**10.4** H16@200	**11.2** H16@200	**12.0** H16@200	**12.9** H16@200	**13.7** H16@250	**14.5** H16@250	**15.4** H16@250	**16.2** H16@250	**17.1** H16@250
3600	**7.7** H16@200	**9.5** H16@200	**10.2** H16@200	**11.0** H16@200	**11.7** H16@200	**12.5** H16@200	**13.3** H16@250	**14.1** H16@250	**14.8** H16@250	**15.6** H16@250
3800	**6.3** H16@200	**8.2** H16@200	**9.4** H16@200	**10.1** H16@200	**10.8** H16@200	**11.5** H16@200	**12.2** H16@200	**12.9** H16@200	**13.6** H16@250	**14.3** H16@250
4000	**5.2** H16@200	**6.8** H16@200	**8.6** H16@200	**9.3** H16@200	**9.9** H16@200	**10.6** H16@200	**11.2** H16@200	**11.8** H16@200	**12.5** H16@200	**13.2** H16@200
4200	**4.3** H16@200	**5.7** H16@200	**7.2** H16@200	**8.5** H16@200	**9.1** H16@200	**9.7** H16@200	**10.3** H16@200	**10.9** H16@200	**11.5** H16@200	**12.2** H16@200
4400	**3.5** H16@200	**4.7** H16@200	**6.0** H16@200	**7.6** H16@200	**8.5** H16@200	**9.0** H16@200	**9.6** H16@200	**10.1** H16@200	**10.7** H16@200	**11.3** H16@200
4600	**2.8** H16@200	**3.9** H16@200	**5.0** H16@200	**6.4** H16@200	**7.6** H16@200	**8.4** H16@200	**8.9** H16@200	**9.4** H16@200	**9.9** H16@200	**10.5** H16@200
4800	**2.2** H16@200	**3.1** H16@200	**4.2** H16@200	**5.3** H16@200	**6.7** H16@200	**7.5** H16@200	**8.2** H16@200	**8.7** H16@200	**9.2** H16@200	**9.7** H16@200
5000	**1.7** H16@200	**2.5** H16@200	**3.4** H16@200	**4.4** H16@200	**5.6** H16@200	**6.6** H16@200	**7.3** H16@200	**7.9** H16@200	**8.6** H16@200	**9.2** H16@200
5200		**2.0** H16@200	**2.8** H16@200	**3.7** H16@200	**4.7** H16@200	**5.8** H16@200	**6.4** H16@200	**7.1** H16@200	**7.7** H16@200	**8.3** H16@200
5400			**2.2** H16@200	**3.0** H16@200	**3.9** H16@200	**4.9** H16@200	**5.8** H16@200	**6.4** H16@200	**6.9** H16@200	**7.4** H16@200
5600			**1.6** H16@200	**2.4** H16@200	**3.4** H16@200	**4.3** H16@200	**5.2** H16@200	**5.6** H16@200	**6.1** H16@200	**7.5** H16@100
5800				**2.1** H16@200	**2.8** H16@200	**3.6** H16@200	**4.5** H16@200	**5.0** H16@200	**5.5** H16@200	**7.1** H16@100
6000				**1.6** H16@200	**2.3** H16@200	**3.0** H16@200	**3.8** H16@200	**4.4** H16@200	**4.8** H16@200	**6.6** H16@100
6200					**1.7** H16@200	**2.4** H16@200	**3.6** H16@100	**3.9** H16@200	**4.3** H16@200	**6.2** H16@100
6400						**1.9** H16@200	**3.0** H16@100	**3.8** H16@100	**3.8** H16@200	**5.6** H16@100
6600							**2.4** H16@100	**3.2** H16@100	**3.9** H16@100	**4.8** H16@100
6800							**1.9** H16@100	**2.6** H16@100	**3.3** H16@100	**4.1** H16@100
7000								**2.0** H16@100	**2.7** H16@100	**3.4** H16@100
7200									**2.4** H16@100	**3.0** H16@100

3.4.5 FLATDECK COMPOSITE SLAB LOAD SPAN TABLES *continued*

0.95mm FLATDECK – INTERNAL 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	**21.3** H16@300	**23.0** H16@300								
2200	**18.2** H16@300	**19.7** H16@300	**21.2** H16@300	**22.6** H16@300						
2400	**15.7** H16@300	**17.0** H16@300	**18.5** H16@300	**19.8** H16@300	**21.1** H16@300	**22.4** H16@300				
2600	**14.0** H16@250	**15.1** H16@300	**16.2** H16@300	**17.4** H16@300	**18.6** H16@300	**19.8** H16@300	**21.0** H16@300	**22.1** H16@300		
2800	**12.4** H16@250	**13.4** H16@250	**14.5** H16@300	**15.5** H16@300	**16.6** H16@300	**17.6** H16@300	**18.6** H16@300	**19.7** H16@300	**20.8** H16@300	**21.9** H16@300
3000	**11.1** H16@250	**12.0** H16@250	**12.9** H16@250	**13.9** H16@300	**14.9** H16@300	**15.7** H16@300	**16.7** H16@300	**17.7** H16@300	**18.6** H16@300	**19.6** H16@300
3200	**10.0** H16@250	**10.8** H16@250	**11.6** H16@250	**12.5** H16@250	**13.3** H16@300	**14.2** H16@300	**15.1** H16@300	**16.0** H16@300	**16.8** H16@300	**17.8** H16@300
3400	**8.5** H16@200	**9.8** H16@250	**10.6** H16@250	**11.4** H16@250	**12.2** H16@250	**12.9** H16@250	**13.7** H16@300	**14.5** H16@300	**15.3** H16@300	**16.1** H16@300
3600	**6.9** H16@200	**8.9** H16@200	**9.7** H16@250	**10.4** H16@250	**11.1** H16@250	**11.8** H16@250	**12.5** H16@250	**13.3** H16@250	**14.0** H16@300	**14.7** H16@300
3800	**5.7** H16@200	**7.4** H16@200	**8.8** H16@200	**9.5** H16@250	**10.2** H16@250	**10.8** H16@250	**11.5** H16@250	**12.2** H16@250	**12.8** H16@250	**13.5** H16@250
4000	**4.6** H16@200	**6.1** H16@200	**7.8** H16@200	**8.7** H16@200	**9.3** H16@250	**10.0** H16@250	**10.6** H16@250	**11.2** H16@250	**11.8** H16@250	**12.4** H16@250
4200	**3.7** H16@200	**5.0** H16@200	**6.5** H16@200	**8.0** H16@200	**8.6** H16@200	**9.2** H16@250	**9.7** H16@250	**10.3** H16@250	**10.9** H16@250	**11.4** H16@250
4400	**3.0** H16@200	**4.1** H16@200	**5.3** H16@200	**6.8** H16@200	**8.0** H16@200	**8.5** H16@200	**9.0** H16@250	**9.5** H16@250	**10.1** H16@250	**10.6** H16@250
4600	**2.3** H16@200	**3.3** H16@200	**4.4** H16@200	**5.6** H16@200	**7.0** H16@200	**7.9** H16@200	**8.3** H16@200	**8.8** H16@200	**9.3** H16@250	**9.8** H16@250
4800	**1.8** H16@200	**2.6** H16@200	**3.6** H16@200	**4.6** H16@200	**5.9** H16@200	**7.2** H16@200	**7.8** H16@200	**8.2** H16@200	**8.7** H16@200	**9.1** H16@200
5000		**2.0** H16@200	**2.8** H16@200	**3.8** H16@200	**4.9** H16@200	**6.1** H16@200	**7.2** H16@200	**7.6** H16@200	**8.1** H16@200	**8.6** H16@200
5200			**2.2** H16@200	**3.0** H16@200	**4.0** H16@200	**5.0** H16@200	**6.2** H16@200	**7.2** H16@200	**7.6** H16@200	**8.0** H16@200
5400			**1.6** H16@200	**2.4** H16@200	**3.2** H16@200	**4.1** H16@200	**5.4** H16@200	**6.6** H16@200	**7.1** H16@200	**7.5** H16@200
5600				**1.7** H16@200	**2.8** H16@200	**3.6** H16@200	**4.6** H16@200	**5.6** H16@200	**6.7** H16@200	**7.0** H16@200
5800					**2.2** H16@200	**3.0** H16@200	**3.8** H16@200	**4.7** H16@200	**6.3** H16@100	**6.6** H16@200
6000					**1.6** H16@200	**2.4** H16@200	**3.5** H16@100	**3.9** H16@200	**5.4** H16@100	**6.2** H16@100
6200						**1.7** H16@200	**2.9** H16@100	**3.7** H16@100	**4.5** H16@100	**5.8** H16@100
6400						**1.1** H16@200	**2.2** H16@100	**3.0** H16@100	**3.8** H16@100	**4.6** H16@100
6600							**1.6** H16@100	**2.3** H16@100	**3.1** H16@100	**3.9** H16@100
6800								**1.7** H16@100	**2.4** H16@100	**3.2** H16@100
7000									**1.7** H16@100	**2.4** H16@100
7200										**2.1** H16@100

Dimond

3.4.6 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 7.2m 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 4 below.

The following notes apply to the Flatdeck 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. 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.
   - 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 Flatdeck 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.
   - Contribution to fire resistance from the Flatdeck steel decking has been included as noted in Section 3.4.2 Design Considerations.
4. 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 12 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.
5. 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.
6. 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 3.4.5. Therefore these fire resistance rating tables must be used in conjunction with Section 3.4.5 Flatdeck 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

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200
110	3	no additional reinforcing										***120***	114	104	93	82	71	58	
		H10 every 3rd pan												***120***	116	108	97	88	78
		H12 every 3rd pan													***120***	117	108	98	88
		H12 every 2nd pan															***120***	112	102
		H16 every 3rd pan																***120***	112
		H16 every 2nd pan																	***120***
	4	no additional reinforcing									***120***	116	105	94	83	71	57		
		H10 every 3rd pan											***120***	117	108	97	87	77	
		H12 every 3rd pan												***120***	117	108	97	87	77
		H12 every 2nd pan														***120***	111	102	92
		H16 every 3rd pan															***120***	111	101
		H16 every 2nd pan																	***120***
	5	no additional reinforcing							***120***	113	100	88	75	60					
		H10 every 3rd pan									***120***	112	100	89	77				
		H12 every 3rd pan										***120***	110	99	88	76			
		H12 every 2nd pan											***120***	113	102	91	80		
		H16 every 3rd pan												***120***	112	101	90		
		H16 every 2nd pan														***120***	111	101	90
		H12 every pan														***120***	115	105	95
		H16 every pan																	***120***

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																	
			2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600
120	3	no additional reinforcing										≥120	114	105	94	83	72	60		
		H10 every 3rd pan												≥120	117	108	99	89	80	
		H12 every 3rd pan													≥120	117	109	99	90	81
		H12 every 2nd pan															≥120	113	104	95
		H16 every 3rd pan																≥120	114	105
		H16 every 2nd pan																		≥120
	4	no additional reinforcing									≥120	116	106	95	84	73	59			
		H10 every 3rd pan											≥120	118	109	99	89	79		
		H12 every 3rd pan												≥120	118	109	99	89	78	
		H12 every 2nd pan														≥120	113	104	94	85
		H16 every 3rd pan															≥120	113	104	95
		H16 every 2nd pan																	≥120	116
	5	no additional reinforcing							≥120	113	101	89	76	62						
		H10 every 3rd pan									≥120	113	102	90	79					
		H12 every 3rd pan										≥120	112	101	90	79				
		H12 every 2nd pan											≥120	114	104	94	83			
		H16 every 3rd pan												≥120	114	103	93			
		H16 every 2nd pan														≥120	114	105	95	85
		H12 every pan														≥120	118	108	99	89
		H16 every pan																		≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																			
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800
130	3	no additional reinforcing												≥120	113	104	93	83	72	59		
		H10 every 3rd pan														≥120	116	108	98	89	80	
		H12 every 3rd pan															≥120	117	109	99	90	81
		H12 every 2nd pan																	≥120	113	105	96
		H16 every 3rd pan																		≥120	114	106
		H16 every 2nd pan																				≥120
		H12 every pan																				
	4	no additional reinforcing											≥120	115	105	94	83	72	59			
		H10 every 3rd pan													≥120	117	108	99	89	79		
		H12 every 3rd pan														≥120	117	109	99	90	80	
		H12 every 2nd pan																≥120	113	104	95	86
		H16 every 3rd pan																	≥120	114	105	96
		H16 every 2nd pan																			≥120	117
		H12 every pan																				≥120
	5	no additional reinforcing									≥120	112	100	88	75	62						
		H10 every 3rd pan											≥120	112	101	91	80					
		H12 every 3rd pan												≥120	111	101	90	80				
		H12 every 2nd pan													≥120	114	105	95	85			
		H16 every 3rd pan														≥120	114	105	94	84		
		H16 every 2nd pan																≥120	116	107	97	88
		H12 every pan																≥120	119	110	101	92
		H16 every pan																				≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200
140	3	no additional reinforcing												≥120	111	101	91	81	70	57			
		H10 every 3rd pan														≥120	115	106	97	88	79		
		H12 every 3rd pan															≥120	116	108	98	89	81	
		H12 every 2nd pan																	≥120	112	104	95	87
		H16 every 3rd pan																		≥120	114	106	96
		H16 every 2nd pan																				≥120	118
		H12 every pan																					≥120
		H16 every pan																					
	4	no additional reinforcing											≥120	112	103	92	81	70	57				
		H10 every 3rd pan													≥120	115	107	97	88	78			
		H12 every 3rd pan														≥120	116	108	98	89	80		
		H12 every 2nd pan																≥120	112	104	95	86	77
		H16 every 3rd pan																	≥120	113	105	96	87
		H16 every 2nd pan																			≥120	117	109
		H12 every pan																				≥120	112
		H16 every pan																					≥120
	5	no additional reinforcing								≥120	119	109	98	86	74	60							
		H10 every 3rd pan											≥120	111	100	89	79						
		H12 every 3rd pan												≥120	110	100	90	79					
		H12 every 2nd pan													≥120	113	104	94	84				
		H16 every 3rd pan														≥120	114	104	94	85			
		H16 every 2nd pan																≥120	116	107	98	89	
		H12 every pan																	≥120	110	102	93	84
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400
150	3	no additional reinforcing											≥120	117	108	98	88	78	67				
		H10 every 3rd pan														≥120	112	104	95	86	77		
		H12 every 3rd pan															≥120	113	105	96	88	79	
		H12 every 2nd pan																≥120	118	110	102	94	86
		H16 every 3rd pan																		≥120	112	104	96
		H16 every 2nd pan																				≥120	117
		H12 every pan																					≥120
	4	no additional reinforcing										≥120	119	110	100	89	79	67					
		H10 every 3rd pan													≥120	113	105	95	86	76			
		H12 every 3rd pan														≥120	114	106	96	88	78		
		H12 every 2nd pan															≥120	118	110	102	93	85	76
		H16 every 3rd pan																	≥120	112	104	95	86
		H16 every 2nd pan																			≥120	116	109
		H12 every pan																			≥120	119	112
		H16 every pan																					≥120
	5	no additional reinforcing								≥120	116	106	95	83	71	56							
		H10 every 3rd pan										≥120	118	108	98	88	77						
		H12 every 3rd pan											≥120	117	108	98	88	78					
		H12 every 2nd pan													≥120	112	103	94	84				
		H16 every 3rd pan														≥120	112	103	94	84			
		H16 every 2nd pan																≥120	115	107	98	89	
		H12 every pan																≥120	118	110	101	93	84
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600	6800
160	3	no additional reinforcing										≥120	113	104	94	85	74	62					
		H10 every 3rd pan												≥120	117	110	101	92	83	74			
		H12 every 3rd pan													≥120	118	111	103	94	85	77		
		H12 every 2nd pan															≥120	116	108	100	92	84	76
		H16 every 3rd pan																≥120	118	110	102	94	86
		H16 every 2nd pan																			≥120	116	108
		H12 every pan																			≥120	118	111
		H16 every pan																					≥120
	4	no additional reinforcing									≥120	115	106	96	86	75	63						
		H10 every 3rd pan											≥120	118	110	102	92	83	74				
		H12 every 3rd pan												≥120	119	111	103	94	85	76			
		H12 every 2nd pan														≥120	116	108	100	91	83		
		H16 every 3rd pan															≥120	118	110	102	93	85	
		H16 every 2nd pan																		≥120	115	108	99
		H12 every pan																		≥120	117	110	103
		H16 every pan																					≥120
	5	no additional reinforcing							≥120	113	102	91	79	67									
		H10 every 3rd pan									≥120	114	105	95	85	74							
		H12 every 3rd pan										≥120	115	106	96	86	76						
		H12 every 2nd pan											≥120	118	110	100	91	82					
		H16 every 3rd pan												≥120	119	111	101	92	83				
		H16 every 2nd pan															≥120	114	106	97	88		
		H12 every pan															≥120	116	109	100	92	84	76
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600	6800	7000	7200
180	3	no additional reinforcing									≥120	113	105	95	85	75	64						
		H10 every 3rd pan											≥120	118	110	102	93	85	76				
		H12 every 3rd pan												≥120	119	112	104	95	87	79			
		H12 every 2nd pan														≥120	117	110	102	94	86	78	
		H16 every 3rd pan															≥120	119	112	104	96	89	
		H16 every 2nd pan																		≥120	118	111	104
		H12 every pan																			≥120	113	107
		H16 every pan																					≥120
	4	no additional reinforcing								≥120	115	107	97	87	77	65							
		H10 every 3rd pan										≥120	119	111	103	94	85	76					
		H12 every 3rd pan												≥120	113	105	96	87	79				
		H12 every 2nd pan													≥120	117	110	102	94	86	78		
		H16 every 3rd pan															≥120	112	104	96	88		
		H16 every 2nd pan																	≥120	117	110	103	95
		H12 every pan																		≥120	113	106	99
		H16 every pan																					≥120
	5	no additional reinforcing						≥120	114	104	93	82	70	55									
		H10 every 3rd pan								≥120	116	107	98	88	78								
		H12 every 3rd pan									≥120	116	108	98	88	79							
		H12 every 2nd pan											≥120	112	104	95	86	77					
		H16 every 3rd pan												≥120	113	104	96	87					
		H16 every 2nd pan														≥120	117	110	101	93	85		
		H12 every pan															≥120	112	105	97	89	81	
		H16 every pan																				≥120	119

3.4.6 FIRE DESIGN TABLES *continued*

0.75mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600	6800	7000	7200
200	3	no additional reinforcing										≥120	112	103	94	84	74	63					
		H10 every 3rd pan												≥120	117	110	101	93	84	76			
		H12 every 3rd pan													≥120	118	111	103	95	87	79		
		H12 every 2nd pan															≥120	116	109	102	94	86	79
		H16 every 3rd pan																≥120	119	112	105	97	89
		H16 every 2nd pan																			≥120	118	112
		H12 every pan																				≥120	114
		H16 every pan																					≥120
	4	no additional reinforcing									≥120	114	106	96	86	76	65						
		H10 every 3rd pan											≥120	118	111	103	94	85	76				
		H12 every 3rd pan													≥120	112	105	96	88	79			
		H12 every 2nd pan														≥120	117	110	102	94	86	79	
		H16 every 3rd pan																≥120	112	105	97	89	
		H16 every 2nd pan																		≥120	118	111	104
		H12 every pan																			≥120	114	107
		H16 every pan																					≥120
	5	no additional reinforcing							≥120	113	103	93	82	70	56								
		H10 every 3rd pan									≥120	116	108	98	88	79							
		H12 every 3rd pan										≥120	116	108	99	90	81						
		H12 every 2nd pan												≥120	113	105	96	87	79				
		H16 every 3rd pan													≥120	115	107	98	89				
		H16 every 2nd pan															≥120	119	111	104	96	88	
		H12 every pan																≥120	114	107	99	91	84
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																	
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400
110	3	no additional reinforcing												***120***	117	108	98	89	79	68
		H10 every 3rd pan														***120***	117	109	99	90
		H12 every 3rd pan															***120***	116	108	98
		H12 every 2nd pan																***120***	118	110
		H16 every 3rd pan																	***120***	118
		H16 every 2nd pan																		***120***
	4	no additional reinforcing											***120***	118	109	98	88	78	67	
		H10 every 3rd pan													***120***	117	108	98	89	79
		H12 every 3rd pan														***120***	116	107	97	88
		H12 every 2nd pan															***120***	118	109	100
		H16 every 3rd pan																***120***	117	108
		H16 every 2nd pan																		***120***
	5	no additional reinforcing									***120***	113	101	90	78	66				
		H10 every 3rd pan										***120***	119	110	99	88	77			
		H12 every 3rd pan											***120***	117	107	96	86	75		
		H12 every 2nd pan												***120***	118	108	98	88	78	
		H16 every 3rd pan													***120***	116	106	95	85	
		H16 every 2nd pan															***120***	114	104	94
		H12 every pan															***120***	117	108	98
		H16 every pan																		***120***

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																	
			2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600
120	3	no additional reinforcing												≥120	118	110	100	91	81	71
		H10 every 3rd pan														≥120	118	111	102	93
		H12 every 3rd pan															≥120	118	110	101
		H12 every 2nd pan																	≥120	113
		H16 every 3rd pan																		≥120
		H16 every 2nd pan																		
	4	no additional reinforcing											≥120	119	110	100	91	81	70	58
		H10 every 3rd pan													≥120	118	110	101	92	83
		H12 every 3rd pan														≥120	118	109	100	91
		H12 every 2nd pan																≥120	112	103
		H16 every 3rd pan																	≥120	112
		H16 every 2nd pan																		≥120
	5	no additional reinforcing									≥120	114	104	92	81	69				
		H10 every 3rd pan											≥120	112	101	91	81			
		H12 every 3rd pan											≥120	119	110	99	89	79		
		H12 every 2nd pan													≥120	111	101	92	82	
		H16 every 3rd pan													≥120	119	110	100	90	
		H16 every 2nd pan															≥120	118	109	99
		H12 every pan																≥120	112	103
		H16 every pan																		≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000
130	3	no additional reinforcing														≥120	118	110	101	91	82	72	61
		H10 every 3rd pan																≥120	119	111	103	94	85
		H12 every 3rd pan																	≥120	118	111	102	94
		H12 every 2nd pan																			≥120	114	106
		H16 every 3rd pan																				≥120	114
		H16 every 2nd pan																					≥120
	4	no additional reinforcing													≥120	119	110	101	91	81	71	59	
		H10 every 3rd pan															≥120	119	111	102	93	84	75
		H12 every 3rd pan																≥120	118	110	101	93	84
		H12 every 2nd pan																		≥120	113	105	96
		H16 every 3rd pan																			≥120	113	105
		H16 every 2nd pan																					≥120
	5	no additional reinforcing											≥120	114	104	93	82	71	57				
		H10 every 3rd pan													≥120	112	102	92	82	72			
		H12 every 3rd pan														≥120	111	101	91	81			
		H12 every 2nd pan															≥120	112	103	94	84		
		H16 every 3rd pan																≥120	112	102	93	83	
		H16 every 2nd pan																		≥120	112	103	93
		H12 every pan																		≥120	114	106	97
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400
140	3	no additional reinforcing													≥120	117	109	100	91	81	72	61	
		H10 every 3rd pan															≥120	118	110	102	94	85	77
		H12 every 3rd pan																≥120	118	110	102	94	86
		H12 every 2nd pan																	≥120	121	113	106	98
		H16 every 3rd pan																			≥120	114	107
		H16 every 2nd pan																					≥120
		H12 every pan																					
		H16 every pan																					
	4	no additional reinforcing												≥120	118	109	100	91	81	71	59		
		H10 every 3rd pan														≥120	118	110	102	93	84	75	
		H12 every 3rd pan															≥120	118	110	101	93	84	76
		H12 every 2nd pan																	≥120	113	105	97	89
		H16 every 3rd pan																		≥120	113	105	97
		H16 every 2nd pan																				≥120	116
		H12 every pan																				≥120	118
		H16 every pan																					≥120
	5	no additional reinforcing										≥120	113	103	92	82	70	57					
		H10 every 3rd pan												≥120	112	102	92	83	73				
		H12 every 3rd pan												≥120	119	110	101	91	82				
		H12 every 2nd pan														≥120	112	104	94	85	76		
		H16 every 3rd pan															≥120	112	103	94	85		
		H16 every 2nd pan																	≥120	113	104	95	87
		H12 every pan																	≥120	115	107	99	90
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			2600	2800	3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600
150	3	no additional reinforcing													≥120	115	107	98	89	80	70	59	
		H10 every 3rd pan															≥120	116	109	101	92	84	76
		H12 every 3rd pan																≥120	116	109	101	93	85
		H12 every 2nd pan																		≥120	112	105	97
		H16 every 3rd pan																			≥120	113	106
		H16 every 2nd pan																					≥120
	4	no additional reinforcing												≥120	116	108	98	89	80	69	57		
		H10 every 3rd pan														≥120	117	109	100	92	83	74	
		H12 every 3rd pan															≥120	116	109	101	92	84	75
		H12 every 2nd pan																≥120	119	112	104	96	88
		H16 every 3rd pan																		≥120	113	105	97
		H16 every 2nd pan																				≥120	115
		H12 every pan																				≥120	118
		H16 every pan																					≥120
	5	no additional reinforcing										≥120	111	101	91	80	69	55					
		H10 every 3rd pan											≥120	119	110	101	91	82	72				
		H12 every 3rd pan												≥120	118	109	100	91	81				
		H12 every 2nd pan														≥120	112	103	94	85	76		
		H16 every 3rd pan															≥120	112	103	94	85		
		H16 every 2nd pan																	≥120	113	105	96	88
		H12 every pan																	≥120	115	107	99	91
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			3000	3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600	6800	7000
160	3	no additional reinforcing												≥120	113	105	95	87	77	68	55		
		H10 every 3rd pan														≥120	114	107	99	90	82	74	
		H12 every 3rd pan															≥120	114	108	99	91	83	75
		H12 every 2nd pan																≥120	118	111	104	96	88
		H16 every 3rd pan																	≥120	119	112	105	97
		H16 every 2nd pan																				≥120	116
		H12 every pan																				≥120	118
		H16 every pan																					≥120
	4	no additional reinforcing											≥120	113	105	96	87	77	67				
		H10 every 3rd pan													≥120	114	107	98	90	81	73		
		H12 every 3rd pan														≥120	115	107	99	91	82		
		H12 every 2nd pan															≥120	118	110	103	95	87	79
		H16 every 3rd pan																≥120	118	111	104	96	88
		H16 every 2nd pan																			≥120	114	108
		H12 every pan																			≥120	117	110
		H16 every pan																					≥120
	5	no additional reinforcing								≥120	117	109	99	88	78	67							
		H10 every 3rd pan										≥120	117	109	99	90	80						
		H12 every 3rd pan											≥120	116	108	99	89	80					
		H12 every 2nd pan												≥120	118	110	102	93	84	76			
		H16 every 3rd pan													≥120	118	110	102	93	84			
		H16 every 2nd pan																≥120	112	104	96	88	
		H12 every pan																≥120	114	107	99	91	83
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600	6800	7000	7200
180	3	no additional reinforcing												≥120	114	106	97	89	80	70	59		
		H10 every 3rd pan														≥120	116	109	101	93	85	77	
		H12 every 3rd pan															≥120	116	109	102	94	86	79
		H12 every 2nd pan																	≥120	113	106	99	91
		H16 every 3rd pan																		≥120	114	108	100
		H16 every 2nd pan																				≥120	118
		H12 every pan																					≥120
	4	no additional reinforcing											≥120	115	107	98	89	80	70	59			
		H10 every 3rd pan													≥120	116	109	101	93	85	76		
		H12 every 3rd pan														≥120	116	110	102	94	86	78	
		H12 every 2nd pan																≥120	113	106	98	91	83
		H16 every 3rd pan																	≥120	114	107	100	92
		H16 every 2nd pan																			≥120	118	111
		H12 every pan																				≥120	113
		H16 every pan																					≥120
	5	no additional reinforcing								≥120	119	111	102	92	82	71	59						
		H10 every 3rd pan										≥120	119	111	103	93	84	75					
		H12 every 3rd pan											≥120	119	111	102	93	85	76				
		H12 every 2nd pan													≥120	113	106	97	89	81			
		H16 every 3rd pan														≥120	114	106	98	90			
		H16 every 2nd pan																≥120	116	109	101	93	86
		H12 every pan																≥120	118	111	104	96	89
		H16 every pan																					≥120

3.4.6 FIRE DESIGN TABLES *continued*

0.95mm FLATDECK FLOOR SLAB – FIRE RESISTANCE RATINGS (minutes) FOR GRADE 500 REINFORCING STEEL

SLAB THICKNESS D_s (mm)	Q kPa	FIRE REINFORCING STEEL	SPAN OF FLATDECK SLAB (L) mm																				
			3200	3400	3600	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	6000	6200	6400	6600	6800	7000	7200
200	3	no additional reinforcing													≥120	113	106	97	89	80	71	60	
		H10 every 3rd pan															≥120	116	109	101	93	86	78
		H12 every 3rd pan																≥120	116	110	102	95	87
		H12 every 2nd pan																		≥120	113	107	100
		H16 every 3rd pan																			≥120	115	109
		H16 every 2nd pan																					≥120
	4	no additional reinforcing												≥120	114	107	98	90	81	71	60		
		H10 every 3rd pan														≥120	116	110	102	94	86	78	
		H12 every 3rd pan															≥120	117	110	103	95	87	79
		H12 every 2nd pan																	≥120	114	107	100	92
		H16 every 3rd pan																		≥120	115	109	101
		H16 every 2nd pan																				≥120	119
		H12 every pan																					≥120
	5	no additional reinforcing									≥120	119	111	102	93	83	73	61					
		H10 every 3rd pan												≥120	112	104	95	87	78				
		H12 every 3rd pan												≥120	119	112	104	96	87	79			
		H12 every 2nd pan														≥120	115	108	100	91	83	75	
		H16 every 3rd pan															≥120	116	109	101	92	84	
		H16 every 2nd pan																	≥120	118	112	104	97
		H12 every pan																		≥120	114	107	100
		H16 every pan																					≥120

3.4.10 DESIGN EXAMPLES

3.4.10.1 EXAMPLE: FORMWORK

A 230mm overall thickness slab is required to span 4800mm c/c between permanent supports using the Flatdeck sheet as permanent formwork only. Two alternatives are available in design.

a) Using 0.75mm Flatdeck from Section 3.4.4.1, select the formwork span capabilities for a 230mm overall thickness slab, i.e.

single	1850mm
double or end	2150mm
internal	2150mm

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

2 x 2150 + 2150 = 6450mm
≥ the required span of 4800mm ∴ O.K.

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

b) Using 0.95mm Flatdeck from Section 3.4.4.1, select the formwork span capabilities for a 230mm overall thickness slab, i.e.

single	2000mm
double or end	2400mm
internal	2350mm

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

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

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

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3.4.10 DESIGN EXAMPLES *continued*

3.4.10.2 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 3.4.5, select the double or end span superimposed load and negative reinforcement for a 0.75mm Flatdeck slab of 110mm overall thickness, with one row of props at midspan. This gives,

$$\text{superimposed load} = 7.1 \text{ kPa}$$
$$\geq G_{SDL} + Q = 1.8 \text{ kPa} \quad \therefore \text{ O.K.}$$

Minimum mesh requirement throughout the Flatdeck slab from Section 3.4.2 Additional Reinforcement assuming a minor degree of crack control is one layer of 665 mesh at minimum cover.

From Section 3.4.5 0.75mm Flatdeck – Double and End Spans, the area of negative reinforcement required over the internal support is H16 bars at 200mm c/c.

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

For the living area floor use a 0.75mm Flatdeck slab of 110mm overall thickness with one row of props at midspan. A 665 mesh is required throughout the slab plus H16 x 2700mm longitudinal top reinforcement at 200mm c/c, laid atop the mesh at minimum cover, over the internal support.

Garage Floor
From Section 3.4.5, select the double or end span superimposed load and negative reinforcement for a 0.75mm Flatdeck slab of 110mm overall thickness, with one row of props at midspan. This gives,

$$\text{superimposed load} = 7.1 \text{ kPa}$$
$$\geq G_{SDL} + Q = 2.5 \text{ kPa} \quad \therefore \text{ O.K.}$$

Minimum mesh requirement throughout the Flatdeck slab from Section 3.4.2 Additional Reinforcement assuming a minor degree of crack control is one layer of 665 mesh at minimum cover.

From Section 3.4.5 0.75mm Flatdeck – Double and End Spans, the area of negative reinforcement required over the internal support is H16 bars at 200mm c/c.

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

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3.4.10 DESIGN EXAMPLES *(3.4.10.2 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 100mm, the effective load width is,

b_m = effective load width
= $b_o + 2 (D_s - 57)$ — where D_s is the overall depth of Flatdeck composite slab
= 100 + 2 x (110 – 57) = 206mm — b_o is the width of the concentrated load
d_s = 110 – 14 = 96mm

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 Flatdeck
= 50 + 96 + 75 = 221mm — composite slab to the centroid of the Flatdeck sheet

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

b_{er} = effective width of the slab in shear
= $b_m + a (1 - a / L)$
= 206 + 221 x (1 – 221 / 3600)
= 413mm

Applied shear at 221mm from the central support per 413mm width is,

V^* = design shear force for strength
= $1.4\ G\ (0.625\ L - 221) + 1.6\ P_Q\ (2L - aL/(L - a)) / (2L)$ — where P_Q is the point live load
= $1.4 \times 2.64 \times 10^{-6} \times 413 \times 2029 + 1.6 \times 13.0\ (2 \times 3600 - 221 \times 3600/(3600 - 221)) / (2 \times 3600)$
= 23.2 kN/413mm

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 1180mm²/m from formwork properties table, Section 3.4.3 Flatdeck Section Properties,

$V_c = 0.632\ (f_{cu} A_p / 250\ d_s)^{0.333}\ (400 / d_s)^{0.25}$
$= 0.632 \times (1.54)^{0.333} \times (4.17)^{0.25}$
= 1.04 MPa

Vertical shear capacity (V_v),

$V_v = 300\ d_s\ v_c$
$= 300 \times 96 \times 1.04 \times 10^{-3}$ = 30.0 kN/trough
= 30.0 x 413 / 300 = 41.3 kN/413mm
$\geq V^*$ = 23.2 kN/413mm ∴ O.K.

Continued on next page

3.4.10 DESIGN EXAMPLES *(3.4.10.2 continued)*

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

$$u = 4\{b_o + (D_s - 57) + d_s\}$$
$$= 4 \times (100 + 53 + 96) = 996\text{mm}$$

Applied shear over critical perimeter area is,

$$V^* = 1.4\,G + 1.6\,P_Q$$
$$= 1.4 \times 249^2 \times 2.63 \times 10^{-6} + 1.6 \times 13.0$$
$$= 21.0\text{ kN}$$

Punching shear capacity (V_p),

$$V_p = u\,(D_s - 57)\,v_c$$
$$= 996 \times 53 \times 1.04 \times 10^{-3} = 54.9\text{ kN}$$
$$\geq V^* = 21.0\text{ kN} \qquad \therefore \text{O.K.}$$

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,

$$\frac{P_Q\,(15000 - L^{1.1})\,L}{14\,(-0.16\,L^2 + 3200\,L - 3.52 \times 10^6)}$$
$$= 13 \times 24.61 \times 10^6 / (14 \times 5.93 \times 10^6)$$
$$= 3.85\text{ kPa}$$

Section 3.4.5 0.75mm Flatdeck – 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 = 7.1 kPa
$= G_{SDL} + Q = 3.85$ kPa $\qquad \therefore$ O.K.

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

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

$$b_{eb} = 206 + 1.333 \times 1800 \times (1 - 0.5)$$
$$= 1406\text{mm}$$

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
$= 1.6 \times 0.094 \times 3600 \times 13 / 1406$
$= 5.0$ kNm/m

This is converted into an equivalent superimposed load,

$G_{SDL} + Q = 5.0 \times 10^6 / (0.063 \times 1.6 \times 3600^2)$
$= 3.8$ kPa
≤ 7.1 kPa (from Section 3.4.5, 0.75mm Flatdeck Composite Slab Load Span Tables Double and End Spans) $\therefore$ O.K.

Continued on next page

3.4.10 DESIGN EXAMPLES *(3.4.10.2 continued)*

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

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

$$= 13000 / 6371 = 2.04\ \text{kPa}$$

Section 3.4.5 0.75mm Flatdeck – 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,

superimposed load = 7.1 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 $I_{av} = 9.9 \times 10^6$ mm^4/m from Section 3.4.3 (medium term), the imposed deflection under the point load at midspan (δ_p) is,

$\delta_p = 0.015\ P_Q\ L^3 / E_s\ I$ where E_s is the Modulus of Elasticity of the Flatdeck sheet and I is the second moment of area
$= 0.015 \times 13.0 \times 3600^3 / (205 \times 10^3 \times 9.9 \times 1406)$
$= 3.2$mm (L / 1125)
$\leq$ the limit of L / 350 ∴ O.K.

In summary, for the garage floor use a 0.75mm Flatdeck slab of 110mm overall thickness with one row of props at midspan. A 665 mesh is required throughout the slab plus H16 x 2700mm longitudinal top reinforcement at 200mm c/c, laid atop the mesh at minimum cover, over the internal support.

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

$M^*_{trans} = P^*\ b_{eb} / (15w)$ where $w = L/2 + b_l$ 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_l = 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.

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3.4.10 DESIGN EXAMPLES *continued*

3.4.10.3 EXAMPLE: INSTITUTIONAL BUILDING DEFLECTION

A heavy equipment floor in a hospital is required to form a single span of 5200mm given a long term superimposed load of 4.0 kPa.

Using Section 3.4.5 0.75mm Flatdeck – Single Spans Long term superimposed loads table, select the single span superimposed load for a 0.75mm Flatdeck slab of 160mm overall thickness, with two rows of props at midspan (Section 3.4.4.1). This gives,

superimposed load = 4.5 kPa
$\geq G_{SDL} + Q = 4.0$ kPa ∴ O.K.

Although this configuration lies in the region of the table where vibration is not critical with a minimum damping ratio of 0.025 (commercial offices, open plan with few small partitions), 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 0.75mm Flatdeck slab of 160mm overall thickness, refer Section 3.4.3 Flatdeck Section Properties for long term superimposed loads,

$G = 3.78$ kPa, $I_{av} = 18.7 \times 10^6$ mm^4/m

Hence $G + (G_{SDL} + Q) = 3.78 + 4.0 = 7.78$ kPa

and δ_{G+Q} = Combined dead and superimposed load deflection at midspan
$= 5 \times 7.78 \times 5200^4 / (384 \times 205 \times 10^9 \times 18.7)$
$= 19.3$mm (or $L_{ss}/269$)
$>$ the limit of $L_{ss}/400$ ∴ No good

The deflection of the 0.75mm Flatdeck slab of 160mm overall thickness is greater than the limit of $L_{ss}/400$, therefore a greater slab thickness is required.

Try a 0.75mm Flatdeck slab of 200mm overall thickness Section 3.4.3 Flatdeck Section Properties gives (for long term superimposed loads),

$G = 4.7$ kPa, $I_{av} = 34.2 \times 10^6$ mm^4/m

Hence $G + (G_{SDL} + Q) = 4.7 + 4.0 = 8.7$ kPa

and δ_{G+Q} $= 5 \times 8.7 \times 5200^4 / (384 \times 205 \times 10^9 \times 34.2)$
$= 11.8$mm (or $L_{ss}/440$)
$\leq$ the limit of $L_{ss}/400$ ∴ O.K.

Therefore, use a 0.75mm Flatdeck slab of 200mm overall thickness with two rows of props at third points and, assuming a minor degree of crack control, use 662 mesh at minimum cover throughout.

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3.4.10 DESIGN EXAMPLES *continued*

3.4.10.4 EXAMPLE: COMMERCIAL OFFICE FIRE RESISTANCE

A banking chamber floor is required over continuous spans of 3000mm c/c with a fire resistance rating of 60 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 3.4.5 gives a medium term superimposed load well in excess of 4.5 kPa for a 3000mm span with a Flatdeck 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 3.4.5 Flatdeck – Single Spans Medium term superimposed loads, a 0.75mm Flatdeck slab with one row of props at midspan (from Section 3.4.4.1) may be used. Assuming a minor degree of crack control and to provide nominal continuity reinforcement over the internal supports, from Section 3.4.2 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 may 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 3.4.5 0.75mm Flatdeck – Double and End Spans, the area of negative reinforcement required over the first internal support is H16 bars at 250mm c/c.

Length of reinforcement required is $3000 / 4 + 450 = 1200$mm each side of the support centre line.

Internal Spans

From Section 3.4.5 0.75mm Flatdeck – Internal Spans, the area of negative reinforcement required over the other internal supports is H16 bars at 250mm c/c.

Length of reinforcement required is $3000 / 4 + 450 = 1200$mm each side of the support centre line.

The fire resistance rating (FRR) is checked from Section 3.4.6 Fire Design Tables. For a 0.75mm Flatdeck slab of 120mm overall thickness with live load Q = 4.0 kPa (0.5 kPa superimposed dead load is assumed in the Fire Design tables) and 3000mm span the FRR for various fire reinforcing steel configurations can be checked.

The beneficial effect of the Flatdeck ribs encased in concrete is taken into consideration when calculating the Fire Resistance Ratings of the Flatdeck composite slab.

Using Flatdeck and no additional reinforcing this gives

FRR $\geq$ 120 minutes
$\geq$ the required 60 minutes $\therefore$ O.K.

Therefore use a 0.75mm Flatdeck slab of 120mm overall thickness with one row of props at midspan – no additional bottom reinforcement is required to achieve the required Fire Resistance Rating. In terms of top steel, 665 mesh is required throughout the slab plus H16 x 2400mm longitudinal top reinforcement at 250mm c/c over all internal supports, laid atop the mesh at minimum cover.

A detailed methodology of the fire resistance calculation is given in the Hibond design examples in Section 3.3.10.4 Example: Commercial Office Fire Resistance.

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3.4.10 DESIGN EXAMPLES *(3.4.10.4 continued)*

This method uses HERA Report R4-82 to satisfy Insulation, Stability and Integrity criteria, except that for Flatdeck the contribution of that portion of the steel decking rib that is embedded into the slab and therefore shielded from direct exposure to the fire, is calculated by determining the temperature due to conduction of heat from the exposed pan of the decking.

The rib element is subdivided into 10 elements and the temperature of each element is determined using the method from HERA Report R4-131 Slab Panel Method (3rd edition). The strength at elevated temperature (yield strength as function of temperature) is also determined in accordance with this report. The contribution of each element to the overall moment capacity of the slab is calculated in accordance with normal reinforced concrete design procedures.