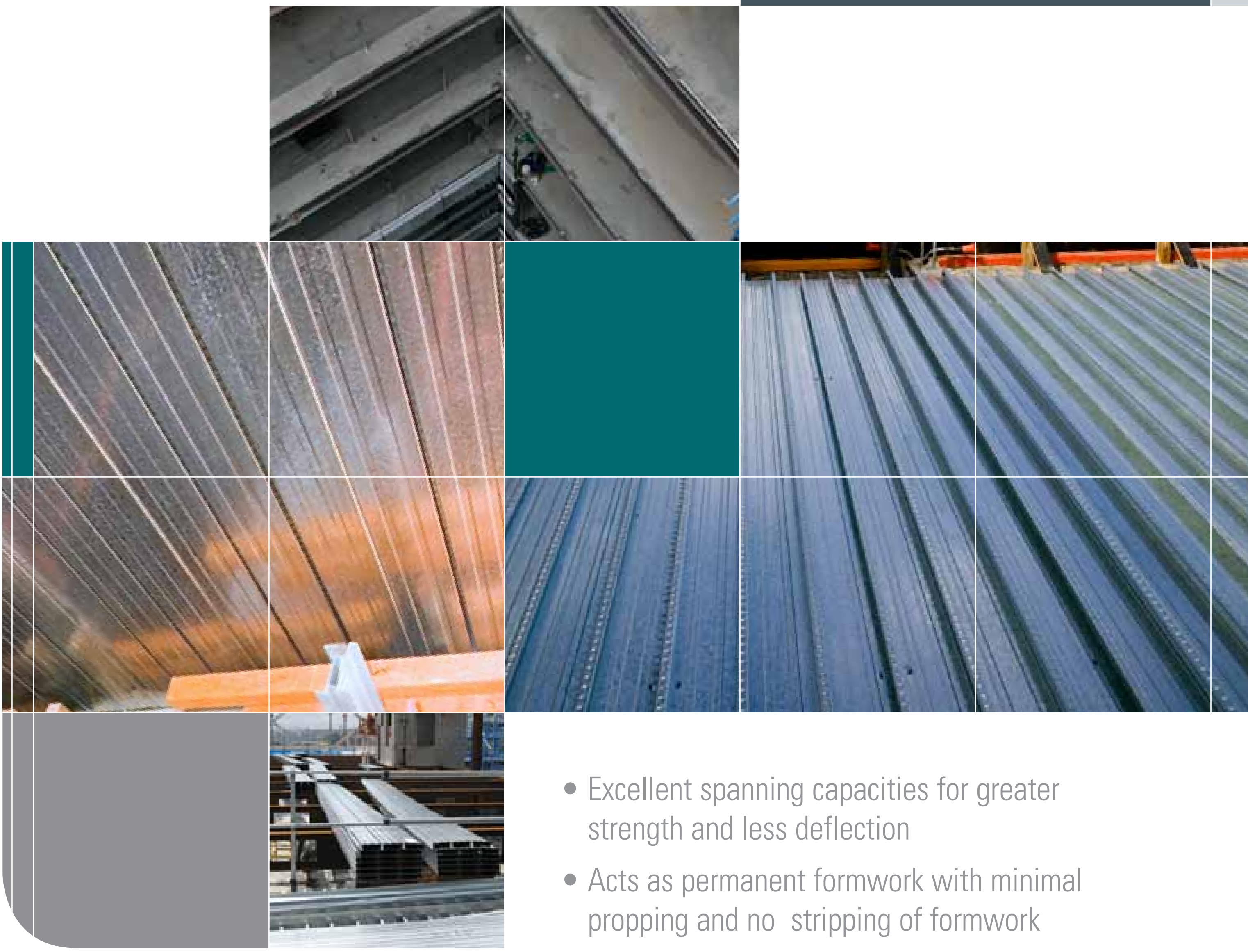
Lysaght Bondek®

Structural steel decking system Design and Construction Manual



- Excellent spanning capacities for greater strength and less deflection
- Acts as permanent formwork with minimal propping and no stripping of formwork
- Fast and easy to install (590mm wide)
- Works as composite slab saving on concrete and reinforcement costs

AUSTRALIAN MADE

LYSAGHT

Preface

BlueScope Lysaght presents this new publication on LYSAGHT BONDEK®. We upgraded this document and design and construction information for the latest standards and construction practices.

- AS 3600:2009
- AS/NZS 1170.0:2002
- Simplified uniform arrangement for mesh and bars

Our newest release of supporting software and the Design and Construction Manual for BONDEK structural steel decking incorporates BlueScope Lysaght's latest research and development work. Improved design and testing methods have again pushed BONDEK structural steel decking to the forefront. New formwork tables are optimised for steel frame construction but are also suitable for concrete frame construction and masonry walls. Call Steel Direct on 1800 641 417 to obtain additional copies of the Design and Construction Manual and Users Guide for BONDEK Design Software. The software can be downloaded by visiting:

www.lysaght.com/bondekdesignsoftware

The following is an overview of this manual. It is structured to convey the subject in a comprehensive manner. This manual consists of eight sections. Section 1 presents the general introduction of the BONDEK and is followed by purpose and scope in Section 2. Formwork design in Section 3 discusses the concept of designing BONDEK as a formwork. Section 4 presents the concept of designing BONDEK as a composite floor slab while Section 5 discusses design of composite slab in fire. Design tables for steel framed construction are presented in Section 6. Construction and detailing issues are presented in Section 7. Relevant list of references are presented in Section 8. Finally, material specifications are documented in Appendix A.

We recommend using this manual's tables for typical design cases. If the appropriate table is not in this manual, try the LYSAGHT BONDEK design software, and LYSAGHT BONDEK design software user's guide, which are available separately through Steel Direct or contact your local technical representative.

These developments allow you to make significant improvements compared with the design methods we previously published for slabs using BONDEK.

Conditions of use

This publication contains technical information on the following base metal thicknesses (BMT) of LYSAGHT BONDEK:

- LYSAGHT BONDEK 0.6 mm thickness
- LYSAGHT BONDEK 0.75 mm thickness
- LYSAGHT BONDEK 0.9 mm thickness (Availability subject to enquiry)
- LYSAGHT BONDEK 1.0 mm thickness

Warranties

Our products are engineered to perform according to our specifications only if they are installed according to the recommendations in this manual and our publications. Naturally, if a published warranty is offered for the product, the warranty requires specifiers and installers to exercise due care in how the products are applied and installed and are subject to final use and proper installation. Owners need to maintain the finished work.

Warning

Design capacities presented in this Manual and LYSAGHT software are based on test results. They shall not be applicable to any similar products that may be substituted for LYSAGHT BONDEK. The researched and tested design capacities only apply for the yield stress and ductility of DECKFORM® steel strip supplied by BlueScope Steel and manufactured by BlueScope Lysaght to the LYSAGHT BONDEK profile specifications. For public safety only LYSAGHT BONDEK can be certified to comply with Australian, International standards and the Building Code of Australia in accordance with the product application, technical and specification provisions documented in this Design and Construction Manual.

Technical support

Contact Steel Direct on 1800 641 417 or your local BlueScope Lysaght Technical Sales Representative to provide additional information.

Contents

1.0 Introducing LYSAGHT BONDEK

LYSAGHT BONDEK is a highly efficient, versatile and robust formwork, reinforcement and ceiling system for concrete slabs. It is a profile steel sheeting widely accepted by the building and construction industry to offer efficiency and speed of construction.

New design rules have been developed for the design of LYSAGHT BONDEK acting as structural formwork for the construction of composite and non-composite slabs (where BONDEK is used as lost formwork). The rules for calculating moment capacities are based on testing performed at BlueScope Lysaght Research and Technology facility at Minchinbury.

The data obtained allowed us to include moment capacities in negative regions based on partial plastic design model. As a consequence, the span limits that previously applied to BONDEK have been increased by up to 8%.

The typical BONDEK profile and dimension of a cross section of composite slab is given in Figure 1.1 and 1.2 respectively. The section properties and the material specifications are given in Table 1.1 and 1.2 respectively.

LYSAGHT BONDEK is roll-formed from hot dipped, zinc coated, high tensile steel. The steel conforms to AS 1397, grade G550 with Z350 and Z450 coatings.

LYSAGHT BONDEK has superior spanning capacities. 1.0mm BMT LYSAGHT BONDEK can be used as a permanent formwork spanning up to 3.6m unpropped used in steel-framed construction. LYSAGHT BONDEK provides efficient reinforcement in slab construction for steel-framed buildings, concrete-framed buildings and in buildings with masonry load bearing walls. The excellent shear bond resistance developed between BONDEK ribs and concrete enables highly efficient composite action to be achieved in a composite BONDEK slab.

LYSAGHT BONDEK composites slabs can be designed to achieve a fire-resistance of up to 240 minutes. For fire resistance levels of 90 and 120 minutes, the BONDEK ribs contribute significantly to the resistance of the slab in fire.

Composite slabs incorporating LYSAGHT BONDEK can be designed in a number of ways:

- Using the design tables given in this manual.
- Calculate from first principles using the relevant Australian Standards, Eurocodes and data from the current LYSAGHT BONDEK design software.
- Contact Steel Direct on 1800 641 417 or your local BlueScope Lysaght Technical Sales Representative to provide additional information.

However, if in doubt you should get advice from a specialist where required.

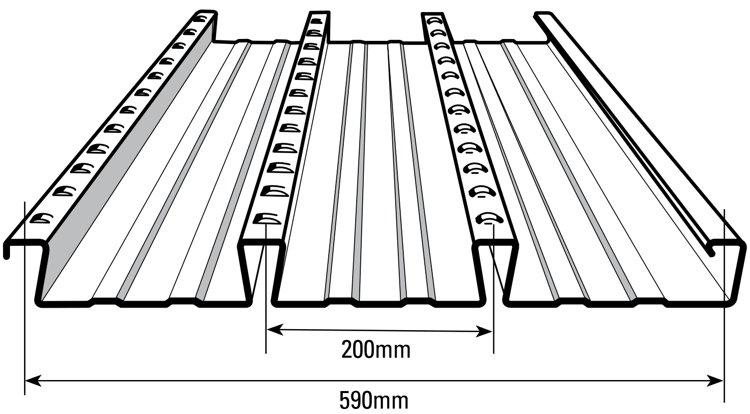


Figure 1.1
LYSAGHT BONDEK profile.

Design Advantages include:

- Excellent spanning capacities for greater strength and less deflection
- Acts as permanent formwork with minimal propping and no stripping of formwork face is required
- Fast and easy to install (590mm wide) with less handling required
- Works as reinforcement with composite slab saving on concrete and reinforcement costs
- Ribs at 200mm centres creating a safe working platform with slip resistant embossments on the ribs
- Advanced Design for Fire Resistance
- New BONDEK design software gives added flexibility and ease of design
- Backed by a BlueScope Steel warranty
- Nationwide technical support

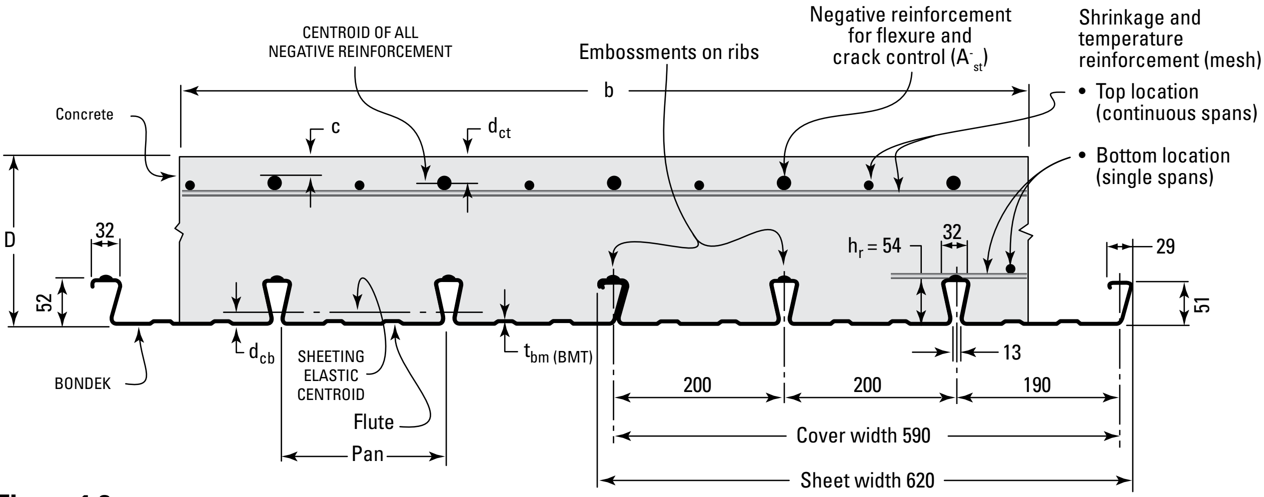


Figure 1.2

BONDEK dimensions (2 sheets shown)

(Fire reinforcement is not shown, see Chapter 5)

Table 1.1

LYSAGHT BONDEK section properties

	Thickness BMT(mm)	Cross-sectional area of BONDEK A_{sh}(mm²/m)	Sheeting Elastic Centroid d_{cb} (mm)
1.0 BMT BONDEK	1.0	1678	15.5
0.9 BMT BONDEK	0.9	1503	15.4
0.75 BMT BONDEK	0.75	1259	15.3
0.6 BMT BONDEK	0.6	1007	15.2

Table 1.2

Material specification (based on Z350)

Thickness (mm)	Mass kg/m²	Mass kg/m	Yeild Striegth MPa	Coverage m²/t
0.6	8.52	5.03	550	117.31
0.75	10.50	6.20	550	95.24
0.9	12.48	7.36	550	80.16
1.0	13.79	8.14	550	72.50

2.0 Purpose and scope of this publication

As stated in the Preface and Introduction, the purpose of this Manual is to facilitate the design of LYSAGHT BONDEK in its use as formwork (with and without propping) and within concrete slabs for both steel-framed and concrete-framed buildings.
It has been developed in accordance with the latest Australian Standards. The Manual includes the following information:

- Formwork Design and Spanning Tables (Section 3)
- Composite Slab Design (Section 4)
- Design for Fire (Section 5)
- Design Tables – Steel-framed construction (Section 6)
- Construction and Detailing (Section 7)

Section 6 gives tabulated solutions for composite slabs in typical design situations.

Use this Manual's tables for typical design cases. If the appropriate table is not in this Manual, try the LYSAGHT BONDEK design software, which is available from the website, at: wwww.lysaght.com/bondekdesignsoftware, to assist in designing other cases. If none of these options provides a suitable solution, contact Steel Direct on 1800 641 417 or your local BlueScope Lysaght Technical Sales Representative to provide additional information.

The information presented by the tabulated solutions of Sections 3 and 6 is intended for guidance only. This information is to be used only in conjunction with a consulting structural engineer.

3. Formwork design

3.1 Introduction

The installation of LYSAGHT BONDEK follows traditional methods for quick and easy installation. It is available in long lengths so large areas can be quickly and easily covered to form a safe working platform during construction. LYSAGHT BONDEK provides a cover width of 590 mm, which allows quick installation.

Formwork design calculations are covered in this section-geometric layout considerations are generally covered in Section 7 (Construction and Detailing).

Our design tables may be used to detail BONDEK acting as structural formwork, provided the following conditions are satisfied.

3.2 Recommended deflection limits

AS 3610:1995 Formwork for concrete, defines five classes of surface finish (numbered 1 to 5) covering a broad range of applications.

We recommend a deflection limit of span/240 for the design of composite slabs in which good general alignment is required, so that the soffit has a good visual quality when viewed as a whole. We consider span/240 to be suitable for a Class 3 and 4 surface finish and, in many situations, Class 2. Where alignment affects the thickness of applied finishes (for example vermiculite), you may consider a smaller limit of span/270 to be more suitable.

We consider span/130 to be a reasonable maximum deflection limit appropriate for profile steel sheeting in situations where visual quality is not significant (Class 5).

The design rules presented may be used for deflection limits other than those stated above however, for deflection greater than span/130, you may contact our information service.

3.3 Loads for design

LYSAGHT BONDEK shall be designed as formwork for two stages of construction according to AS 3610:1995 and AS 2327.1:2003.

Stage I

Prior to the placement of the concrete:

- during handling and erection of the formwork; and
- once the formwork is erected but prior to the placement of the concrete.

When a live load due to stacked materials can be adequately controlled on the site at less than 4 kPa, the reduced design live load shall be clearly indicated on the formwork documentation. (1 kPa in tables from Section 3.4).

Stage II

During placement of the concrete up until the concrete has set (until f_{cm} reaches 15 MPa and concrete is able to act flexurally to support additional loads such as stacked materials).

NOTE: No loads from stacked materials are allowed until the concrete has set.

- Different pattern loading shall be considered, including when one formwork span only is loaded - with live loads, loads due to stacked materials and wet concrete. The LYSAGHT BONDEK has sufficient capacity for a concentrated point load of 2.0 kN for all spans and BMT. It is not necessary to perform formwork capacity checks for concentrated loads.

3.4 Use of spanning tables

The spanning tables presented in Section 3.5 are based on the following assumptions and constraints. The reader needs to ensure that the particular situation being designed falls within these assumptions and constraints.

1. These tables can be used for different types of construction (steel-frame, concrete-frame, masonry wall supports) provided BONDEK sheets are securely fixed to all permanent and temporary supports at every pan.
   - Suitable secure fixing methods should be used such as spot welds, self drilling screws or drive nails.
   - Temporary props are equally spaced within each slab span.

   There are two sets of formwork tables:
   - Ratio of two adjacent slab spans equal 1:1 that is L/L=1
   - The ratio of the longer slab span (L_l) to the shorter slab span (L_s) does not exceed 1.2, that is $L_l/L_s \leq 1.2$
2. The tables shall be used for normal density concrete (2400 kg/m^3).
3. The lines of support shall extend across the full width of the sheeting and have a minimum bearing 50 mm at the ends of the sheets and 100 mm at intermediate supports over which sheeting is continuous, including at props. 25 mm minimum bearing length at the ends of sheets is acceptable in concrete frame construction.
4. The tables are based on the following maximum construction loads:
   - Workmen and equipment = 100 kg/m^2
   - Mounting of concrete = 300 kg/m^2 over an area of 1.6 x 1.6 m and zero over the remainder.
   - Stacking of material on BONDEK sheets before placement of concrete only = 100 kg/m^2. This load shall be clearly indicated on the formwork documentation and controlled on-site. Use LYSAGHT BONDEK design software for higher loads.
5. Tables developed based on maximum BONDEK length is 19,500 mm. (Check availability of local lengths.)
6. No loads from stacked materials are allowed until the concrete has set.
7. The sheets shall not be spliced or jointed.
8. Allowance for the weight of reinforcement as well as the effect of ponding has been taken into account.
9. Supports shall be effectively rigid and strong to support construction loads.
10. The sheeting shall not have cantilever portions.
11. Wet concrete deflection of BONDEK = L/240 or L/130, where L is the distance between centres of props or permanent supports.
12. The information contained in the publication is intended for guidance only. This information to be used only in conjunction with a consulting structural engineer.
13. Further details can be sought from the BlueScope Lysaght publication LYSAGHT BONDEK Design Manual or contact Steel Direct on 1800 641 417 or your local BlueScope Lysaght Technical Sales Representative to provide additional information. .

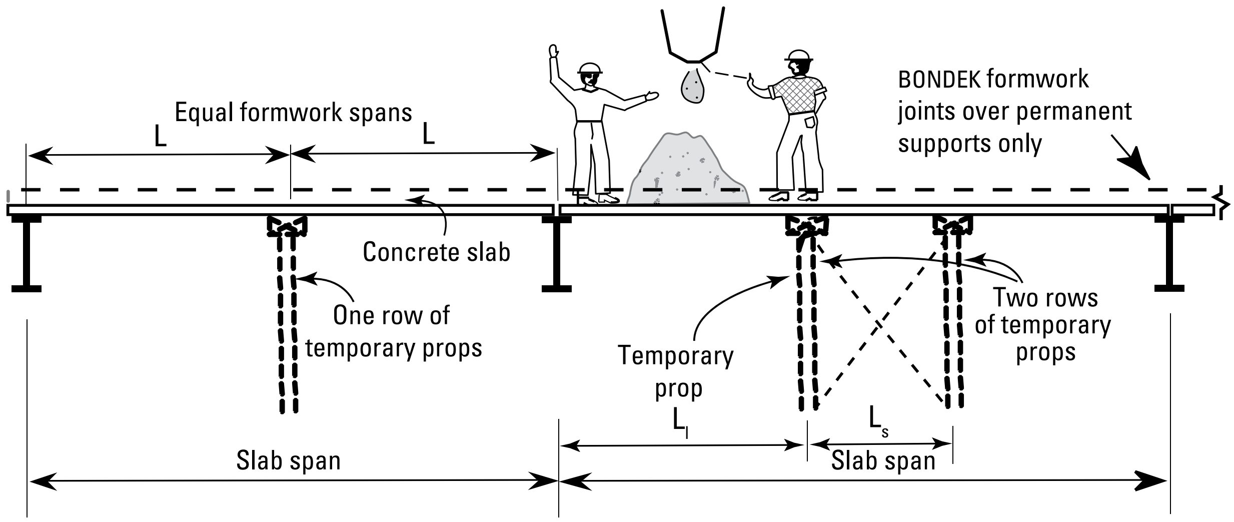


Figure 3.1a
LYSAGHT BONDEK formwork for concrete frame

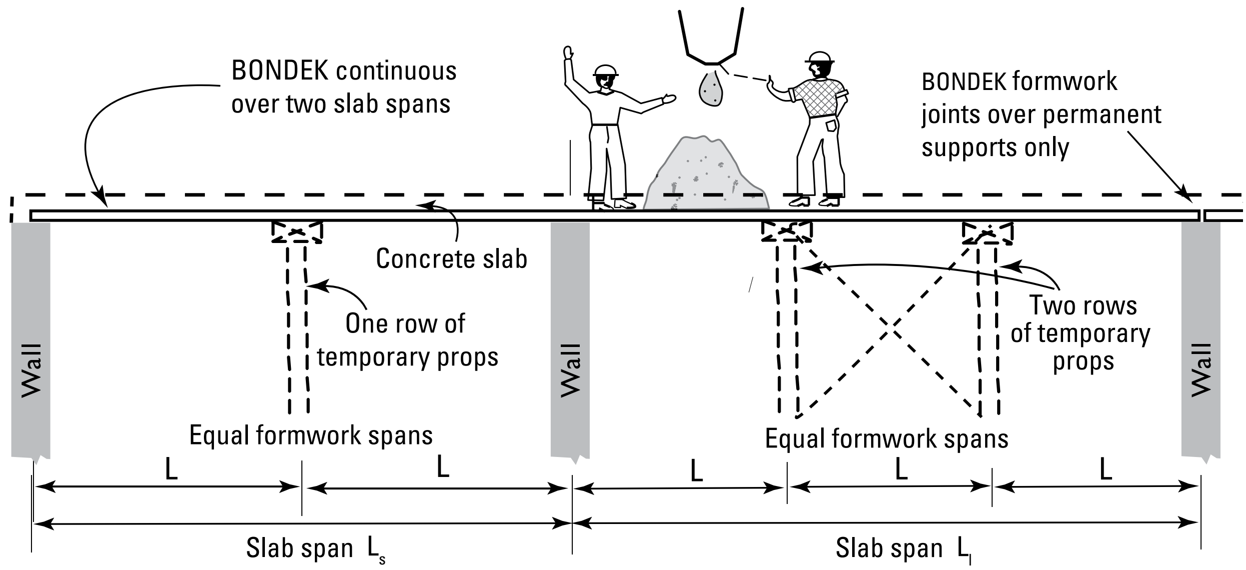


Figure 3.1b
LYSAGHT BONDEK formwork for masonry

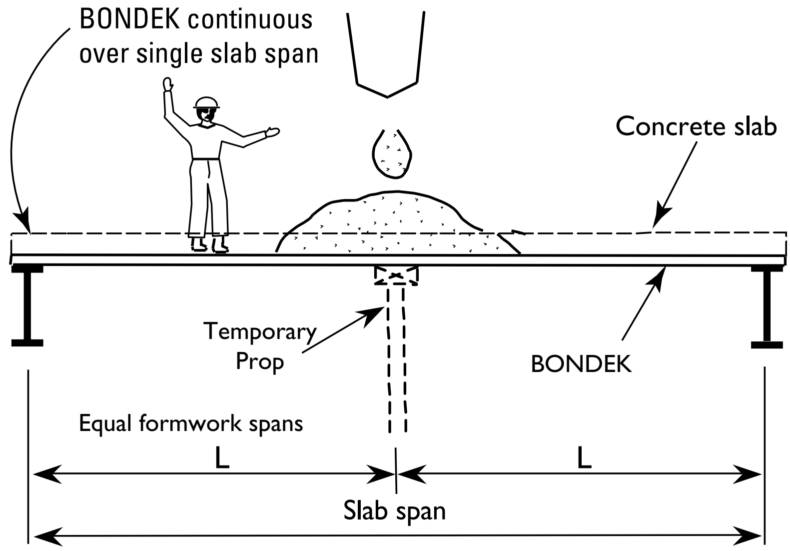


Figure 3.1c
LYSAGHT BONDEK formwork for steel frame

3.5 LYSAGHT BONDEK maximum slab spans

Maximum slab spans, mm
BONDEK sheets continuous over single slab span
Formwork deflections limits L/240 (Visual appearance important)

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2000	4950	7350	2150	5850	8150	2250	6300	8700	2350	6500	9050
110	1900	4750	7150	2050	5700	7900	2200	6100	8450	2250	6350	8800
120	1800	4650	6900	2000	5550	7700	2150	5950	8250	2200	6150	8550
130	1750	4500	6650	1950	5400	7500	2100	5800	8050	2150	6000	8350
140	1700	4400	6400	1900	5300	7300	2050	5650	7850	2100	5900	8100
150	1650	4300	6200	1850	5200	7100	2000	5550	7600	2050	5750	7900
160	1600	4250	6050	1750	5050	6900	1900	5450	7400	2000	5650	7700
170	1550	4150	5850	1750	5000	6750	1850	5300	7250	1950	5550	7500
180	1550	4050	5700	1700	4900	6550	1850	5200	7050	1900	5400	7350
190	1500	4000	5550	1650	4750	6400	1800	5100	6900	1850	5300	7200
200	1450	3900	5400	1600	4650	6250	1750	5000	6750	1850	5200	7050
210	1400	3850	5300	1550	4550	6150	1700	4900	6600	1800	5050	6900
220	1400	3800	5200	1550	4450	6000	1650	4800	6500	1750	5000	6800
230	1350	3750	5050	1500	4350	5900	1650	4700	6400	1700	4900	6650
240	1350	3700	4950	1500	4300	5800	1600	4600	6250	1700	4800	6550
250	1300	3600	4850	1450	4200	5650	1600	4550	6150	1650	4750	6450

Maximum slab spans, mm
BONDEK sheets continuous over single slab span
Formwork deflections limits L/130 (Visual appearance not important)

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2100	4800	7200	2550	5900	8850	2700	7100	10000	2800	7700	10000
110	2050	4700	7050	2500	5750	8650	2650	6900	10000	2700	7450	10000
120	2000	4550	6850	2450	5600	8400	2550	6700	9850	2650	7300	10000
130	1950	4450	6700	2350	5450	8200	2500	6550	9650	2600	7100	10000
140	1950	4350	6550	2300	5350	8050	2450	6400	9450	2550	6950	9800
150	1900	4250	6400	2250	5250	7850	2400	6250	9250	2500	6800	9600
160	1850	4200	6300	2200	5100	7700	2350	6100	9100	2450	6650	9450
170	1800	4100	6150	2200	5000	7550	2300	6000	8900	2400	6500	9250
180	1800	4050	6050	2150	4950	7400	2250	5900	8750	2350	6400	9100
190	1750	3950	5950	2100	4850	7250	2250	5750	8650	2300	6250	8950
200	1750	3900	5850	2050	4750	7150	2200	5650	8500	2250	6150	8800
210	1700	3850	5750	2050	4700	7050	2150	5550	8350	2250	6050	8700
220	1700	3750	5650	2000	4600	6900	2150	5500	8250	2200	5950	8550
230	1650	3700	5550	2000	4550	6800	2100	5400	8100	2200	5850	8450
240	1650	3650	5500	1950	4450	6700	2050	5300	7950	2150	5750	8350
250	1600	3600	5400	1900	4400	6600	2050	5250	7850	2100	5650	8200

NOTES:
1. These are formwork selection tables only. Maximum slab spans in these tables shall be designed by a qualified structural engineer.
2. Use LYSAGHT BONDEK design software for support widths other than 100mm.
3. 1 kPa Live Load due to stacked materials is used - this shall be indicated on formwork documentation and controlled on-site.
4. The availability of 0.9 mm BMT BONDEK is subject to enquiry.
5. Refer to General Engineering Notes Section 3.1 when using these tables.

Maximum slab spans, mm
BONDEK sheets continuous over 2 slab spans
Formwork deflections limits L/240 (Visual appearance important)
Equal slab spans

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2450	4900	7350	2900	5550	8350	3150	5900	8900	3250	6150	9250
110	2350	4750	7150	2850	5400	8100	3050	5750	8650	3150	5950	8950
120	2300	4650	6950	2750	5250	7850	2950	5600	8400	3050	5800	8750
130	2250	4500	6800	2700	5100	7650	2900	5450	8200	3000	5650	8500
140	2200	4400	6600	2650	5000	7500	2800	5350	8000	2950	5550	8300
150	2150	4250	6400	2600	4850	7300	2750	5200	7800	2850	5400	8100
160	2100	4150	6200	2500	4750	7100	2700	5050	7600	2800	5250	7900
170	2050	4000	6050	2500	4600	6950	2650	4950	7400	2750	5150	7700
180	2000	3900	5900	2450	4500	6750	2600	4800	7250	2700	5000	7550
190	2000	3800	5750	2350	4400	6600	2550	4700	7100	2650	4900	7350
200	1950	3700	5600	2300	4300	6450	2500	4600	6950	2600	4800	7200
210	1900	3650	5450	2250	4200	6300	2450	4500	6800	2500	4700	7100
220	1900	3550	5350	2200	4100	6200	2400	4450	6650	2500	4600	6950
230	1850	3450	5200	2150	4050	6050	2350	4350	6550	2450	4550	6850
240	1800	3400	5100	2150	3950	5950	2300	4300	6450	2400	4450	6700
250	1800	3350	5000	2100	3900	5850	2250	4200	6300	2350	4400	6600

Maximum slab spans, mm
BONDEK sheets continuous over 2 slab spans
Formwork deflections limits L/130 (Visual appearance not important)
Equal slab spans

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2400	4800	7200	2950	5900	8850	3550	7050	10000	3850	7300	10000
110	2350	4700	7050	2850	5750	8650	3450	6850	10000	3700	7100	10000
120	2250	4550	6850	2800	5600	8400	3350	6700	10000	3650	6950	10000
130	2200	4450	6700	2700	5450	8200	3250	6550	9800	3550	6800	10000
140	2150	4350	6550	2650	5350	8050	3200	6400	9600	3450	6650	10000
150	2100	4250	6400	2600	5250	7850	3100	6250	9400	3400	6550	9800
160	2100	4200	6300	2550	5100	7700	3050	6100	9200	3300	6400	9600
170	2050	4100	6150	2500	5000	7550	3000	6000	9000	3250	6300	9450
180	2000	4050	6050	2450	4950	7440	2950	5900	8850	3200	6200	9300
190	1950	3950	5950	2400	4850	7250	2850	5750	8650	3100	6100	9150
200	1950	3900	5850	2350	4750	7150	2800	5650	8500	3050	6000	9000
210	1900	3850	5750	2350	4700	7050	2750	5550	8350	3000	5900	8850
220	1850	3750	5650	2300	4600	6900	2750	5500	8250	2950	5800	8750
230	1850	3700	5550	2250	4550	6800	2700	5400	8100	2900	5750	8650
240	1800	3650	5500	2200	4450	6700	2650	5300	7950	2850	5650	8500
250	1800	3600	5400	2200	4400	6600	2600	5250	7850	2800	5600	8400

NOTES:
1. These are formwork selection tables only. Maximum slab spans in these tables shall be designed by a qualified structural engineer..
2. Use LYSAGHT BONDEK design software for support widths other than 100mm.
3. 1 kPa Live Load due to stacked materials is used - this shall be indicated on formwork documentation and controlled on-site.
4. The availability of 0.9 mm BMT BONDEK is subject to enquiry.
5. Refer to General Engineering Notes Section 3.1 when using these tables.

Maximum slab spans, mm
BONDEK sheets continuous over 3 or more slab spans
Formwork deflections limits L/240 (Visual appearance important)
Equal slab spans

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2450	4900	7350	2700	5550	8350	2900	5900	8900	3000	6150	9250
110	2350	4750	7150	2600	5400	8100	2800	5750	8650	2900	5950	8950
120	2300	4650	6950	2550	5250	7850	2750	5600	8400	2850	5800	8750
130	2200	4500	6800	2500	5100	7650	2650	5450	8200	2750	5650	8500
140	2100	4400	6600	2450	5000	7500	2600	5350	8000	2700	5550	8300
150	2050	4250	6400	2350	4850	7300	2500	5200	7800	2600	5400	8100
160	2000	4150	6200	2300	4750	7100	2450	5050	7600	2550	5250	7900
170	1950	4000	6050	2250	4600	6950	2400	4950	7400	2500	5150	7700
180	1900	3900	5900	2150	4500	6750	2350	4800	7250	2450	5000	7550
190	1850	3800	5750	2100	4400	6600	2300	4700	7100	2400	4900	7350
200	1800	3700	5600	2050	4300	6450	2250	4600	6950	2350	4800	7200
210	1750	3650	5450	2050	4200	6300	2200	4500	6800	2300	4700	7100
220	1700	3550	5350	2000	4100	6200	2150	4450	6650	2250	4600	6950
230	1650	3450	5200	1950	4050	6050	2100	4350	6550	2200	4550	6850
240	1650	3400	5100	1900	3950	5950	2050	4300	6450	2150	4450	6700
250	1600	3350	5000	1850	3900	5850	2050	4200	6300	2150	4400	6600

Maximum slab spans, mm
BONDEK sheets continuous over 3 or more slab spans
Formwork deflections limits L/130 (Visual appearance not important)
Equal slab spans

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2400	4800	7200	2950	5900	8850	3450	7050	10000	3550	7300	10000
110	2350	4700	7050	2850	5750	8650	3350	6850	10000	3500	7100	10000
120	2250	4550	6850	2800	5600	8400	3250	6700	10000	3400	6950	10000
130	2200	4450	6700	2700	5450	8200	3200	6550	9800	3300	6800	10000
140	2150	4350	6550	2650	5350	8050	3150	6400	9600	3250	6650	10000
150	2100	4250	6400	2600	5250	7850	3050	6250	9400	3200	6550	9800
160	2100	4200	6300	2550	5100	7700	3000	6100	9200	3150	6400	9600
170	2050	4100	6150	2500	5000	7550	2950	6000	9000	3050	6300	9450
180	2000	4050	6050	2450	4950	7440	2900	5900	8850	3000	6200	9300
190	1950	3950	5950	2400	4850	7250	2850	5750	8650	2950	6100	9150
200	1950	3900	5850	2350	4750	7150	2800	5650	8500	2900	6000	9000
210	1900	3850	5750	2350	4700	7050	2750	5550	8350	2900	5900	8850
220	1850	3750	5650	2300	4600	6900	2750	5500	8250	2850	5800	8750
230	1850	3700	5550	2250	4550	6800	2700	5400	8100	2800	5750	8650
240	1800	3650	5500	2200	4450	6700	2650	5300	7950	2750	5650	8500
250	1800	3600	5400	2200	4400	6600	2600	5250	7850	2700	5600	8400

NOTES:
1. These are formwork selection tables only. Maximum slab spans in these tables shall be designed by a qualified structural engineer.
2. Use LYSAGHT BONDEK design software for support widths other than 100mm.
3. 1 kPa Live Load due to stacked materials is used - this shall be indicated on formwork documentation and controlled on-site.
4. The availability of 0.9 mm BMT BONDEK is subject to enquiry.
5. Refer to General Engineering Notes Section 3.1 when using these tables.

Maximum slab spans, mm
BONDEK sheets continuous over 2 slab spans
Formwork deflections limits L/240 (Visual appearance important)
Slabs spans ratio up to 1:1.2

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2400	4900	7250	2750	5350	8000	2950	5700	8550	3050	5950	8900
110	2350	4650	7000	2700	5200	7800	2850	5550	8300	3000	5750	8650
120	2300	4450	6700	2600	5050	7600	2800	5400	8100	2900	5600	8400
130	2200	4300	6500	2550	4900	7400	2700	5250	7900	2850	5450	8150
140	2150	4150	6250	2500	4750	7150	2650	5100	7650	2750	5300	7950
150	2100	4050	6050	2450	4600	6950	2600	4950	7450	2700	5150	7700
160	2050	3900	5900	2350	4500	6750	2500	4800	7250	2600	5000	7550
170	2000	3800	5700	2300	4350	6550	2450	4700	7050	2550	4900	7350
180	1950	3700	5550	2250	4250	6400	2400	4600	6900	2500	4800	7200
190	1900	3600	5400	2200	4150	6250	2350	4500	6750	2450	4700	7050
200	1850	3500	5300	2150	4050	6100	2300	4400	6600	2400	4600	6900
210	1800	3450	5150	2100	4000	6000	2250	4300	6450	2350	4500	6750
220	1750	3350	5050	2050	3900	5850	2200	4200	6350	2300	4400	6650
230	1750	3300	4950	2000	3800	5750	2150	4150	6250	2250	4350	6500
240	1700	3200	4850	1950	3750	5650	2150	4050	6100	2200	4250	6400
250	1650	3150	4750	1950	3700	5550	2100	4000	6050	2200	4200	6300

Maximum slab spans, mm
BONDEK sheets continuous over 2 slab spans
Formwork deflections limits L/130 (Visual appearance not important)
Slabs spans ratio up to 1:1.2

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2350	4750	7150	2900	5850	8750	3500	6800	10000	3650	7050	10000
110	2300	4650	6950	2850	5700	8550	3400	6600	9950	3550	6850	10000
120	2250	4500	6800	2750	5550	8350	3300	6450	9700	3450	6700	10000
130	2200	4450	6650	2700	5400	8150	3200	6300	9500	3400	6550	9850
140	2150	4300	6500	2650	5300	7950	3150	6200	9300	3300	6400	9650
150	2100	4250	6350	2600	5200	7800	3100	6050	9100	3250	6300	9450
160	2050	4150	6250	2500	5050	7600	3000	5950	8450	3200	6150	9250
170	2000	4050	6100	2450	4950	7450	2950	5850	8750	3150	6050	9100
180	2000	4000	6000	2450	4900	7350	2900	5750	8600	3100	5950	8950
190	1950	3950	5900	2400	4800	7200	2850	5650	8500	3050	5850	8800
200	1900	3850	5800	2350	4700	7050	2800	5550	8350	3000	5750	8650
210	1900	3800	5700	2300	4650	6950	2750	5450	8200	2950	5700	8550
220	1850	3750	5650	2250	4550	6850	2700	5400	8100	2900	5600	8400
230	1850	3700	5550	2250	4500	6750	2650	5300	8000	2850	5500	8300
240	1800	3650	5450	2200	4400	6650	2600	5250	7850	2850	5450	8150
250	1800	3600	5400	2150	4350	6550	2550	5150	7750	2800	5350	8050

NOTES:
1. These are formwork selection tables only. Maximum slab spans in these tables shall be designed by a qualified structural engineer.
3. Use LYSAGHT BONDEK design software for support widths other than 100mm.
4. 1 kPa Live Load due to stacked materials is used - this shall be indicated on formwork documentation and controlled on-site.
5. The availability of 0.9 mm BMT BONDEK is subject to enquiry.
6. Refer to General Engineering Notes Section 3.1 when using these tables.

Maximum slab spans, mm
BONDEK sheets continuous over 3 or more slab spans
Formwork deflections limits L/240 (Visual appearance important)
Slabs spans ratio up to 1:1.2

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2350	4900	7250	2600	5350	8000	2800	5700	8550	2900	5950	8900
110	2250	4650	7000	2550	5200	7800	2700	5550	8300	2800	5750	8650
120	2150	4450	6700	2450	5050	7600	2650	5400	8100	2750	5600	8400
130	2100	4300	6500	2400	4900	7400	2550	5250	7900	2650	5450	8150
140	2000	4150	6250	2300	4750	7150	2500	5100	7650	2600	5300	7950
150	1950	4050	6050	2250	4600	6950	2400	4950	7450	2500	5150	7700
160	1900	3900	5900	2200	4500	6750	2350	4800	7250	2450	5000	7550
170	1850	3800	5700	2150	4350	6550	2300	4700	7050	2400	4900	7350
180	1800	3700	5550	2050	4250	6400	2250	4600	6900	2350	4800	7200
190	1750	3600	5400	2000	4150	6250	2200	4500	6750	2300	4700	7050
200	1700	3500	5300	2000	4050	6100	2150	4400	6600	2250	4600	6900
210	1650	3450	5150	1950	4000	6000	2100	4300	6450	2200	4500	6750
220	1650	3350	5050	1900	3900	5850	2050	4200	6350	2150	4400	6650
230	1600	3300	4950	1850	3800	5750	2000	4150	6250	2100	4350	6500
240	1550	3200	4850	1800	3750	5650	2000	4050	6100	2050	4250	6400
250	1550	3150	4750	1800	3700	5550	1950	4000	6050	2050	4200	6300

Maximum slab spans, mm
BONDEK sheets continuous over 3 or more slab spans
Formwork deflections limits L/130 (Visual appearance not important)
Slabs spans ratio up to 1.1.2

Slab depth D (mm)	0.6 BMT Bondek No of props per span			0.75 BMT Bondek No of props per span			0.9 BMT Bondek No of props per span			1.0 BMT Bondek No of props per span		
	0	1	2	0	1	2	0	1	2	0	1	2
100	2350	4750	7150	2900	5850	8750	3350	6800	10000	3450	7050	10000
110	2300	4650	6950	2850	5700	8550	3250	6600	9950	3350	6850	10000
120	2250	4500	6800	2750	5550	8350	3150	6450	9700	3300	6700	10000
130	2200	4450	6650	2700	5400	8150	3100	6300	9500	3200	6550	9850
140	2150	4300	6500	2650	5300	7950	3050	6200	9300	3150	6400	9650
150	2100	4250	6350	2600	5200	7800	2950	6050	9100	3100	6300	9450
160	2050	4150	6250	2500	5050	7600	2900	5950	8450	3000	6150	9250
170	2000	4050	6100	2450	4950	7450	2850	5850	8750	2950	6050	9100
180	2000	4000	6000	2450	4900	7350	2800	5750	8600	2900	5950	8950
190	1950	3950	5900	2400	4800	7200	2750	5650	8500	2850	5850	8800
200	1900	3850	5800	2350	4700	7050	2700	5550	8350	2850	5750	8650
210	1900	3800	5700	2300	4650	6950	2700	5450	8200	2800	5700	8550
220	1850	3750	5650	2250	4550	6850	2650	5400	8100	2750	5600	8400
230	1850	3700	5550	2250	4500	6750	2600	5300	8000	2700	5500	8300
240	1800	3650	5450	2200	4400	6650	2550	5250	7850	2650	5450	8150
250	1800	3600	5400	2150	4350	6550	2500	5150	7750	2600	5350	8050

NOTES:
1. These are formwork selection tables only. Maximum slab spans in these tables shall be designed by a qualified structural engineer.
2. Use LYSAGHT BONDEK design software for support widths other than 100mm.
3. 1 kPa Live Load due to stacked materials is used - this shall be indicated on formwork documentation and controlled on-site.
4. [shaded] The availability of 0.9 mm BMT BONDEK is subject to enquiry.
5. Refer to General Engineering Notes Section 3.1 when using these tables.

4. Composite slab design

4.1 Introduction

Considerable research into the behaviour of composite slabs has been performed in the past years. The efficiency of the composite slab depends on the composite action between the steel sheeting and concrete slab. The experiments indicated that the shear bond strength at the interface between the steel sheet and the surrounding concrete is the key factor in determining the behaviour of composite slabs.

The adhesion bond between the sheeting and the concrete can play a part in this behaviour. However, following the breakdown of the adhesion bond, slip is resisted by mechanical interlock and friction developed between the steel sheeting and the surrounding concrete. The mechanical interlock and friction depend upon the shape of the rib, thickness of the sheet and size and frequency of the embossments.

This chapter explains the parameters upon which our design tables are based. Solutions to your design problems may be obtained by direct reference to the current version of our LYSAGHT BONDEK design software.

The design solutions are based on linear elastic analysis according to AS 3600:2009 Clause 6.2 and partial shear connection theory. Data about composite performance of LYSAGHT BONDEK slabs have been obtained from full-scale slab tests, supplemented by slip-block tests.

Use the appropriate LYSAGHT design software in other cases (concrete grades, environmental classifications, fire ratings, moment redistribution, etc.).

The tables provide solutions for steel-frame (or other narrow supports like masonry walls) provided the following conditions are satisfied.

4.2 Design loads

4.2.1 Strength load combinations

For strength calculations, design loads for both propped and unpropped construction shall be based on the following load combinations.

Load combinations and pattern loading shall be considered according to AS 3600:2009 Clause 2.4 including pattern loads according to Clause 2.4.4.

As per AS 3600:2009: $1.2\ (G_c + G_{sh} + G_{sdl}) + 1.5\ Q$

For bending (composite) and shear capacity in positive (with top outer fibre of concrete in compression) areas as per EN 1994-1-1:2005.

$1.35\ (G_c + G_{sh} + G_{sdl}) + 1.5\ Q$

where G_c = self weight of concrete; G_{sh} = self weight of sheeting;
G_{sdl} = superimposed dead load (partitions, floor tiles, etc.) Q = live load

4.2.2 Serviceability load combinations

Our load tables are based on deflections due to loading applied to the composite slab according to AS 3600:2009 Clause 2.4 including pattern loads according to Clause 2.4.4. Load combinations for crack control have been worked out in accordance AS 3600:2009 Clause 9.4.1.

4.2.3 Superimposed dead load

The maximum superimposed dead load (G_{sdl}) assumed in our design tables is 1.0 kPa. Use LYSAGHT BONDEK design software for other G_{sdl} loads.

4.3 Design for strength

4.3.1 Negative bending regions

a) Negative bending strength

For the bending strength design in negative moment regions, the presence of the sheeting in the slab is ignored and the slab shall be designed as conventional reinforced concrete solid slab. For this purpose, use the provisions of AS 3600:2009, Clause 9.1.

The minimum bending strength requirement of AS 3600:2009, Clause 9.1.1 shall be satisfied.

b) Shear strength

The strength of a slab in shear shall be designed as per the guidelines outlined in Clause 9.2 of AS 3600:2009. The Design tables are based on these guidelines.

4.3.2 Positive bending regions

a) Positive bending strength

Positive bending capacity shall be calculated as per EN 1994-1-1:2005 Clause 9.7.2. It takes into consideration partial shear connection theory and the design tables have been developed in accordance with it.

b) Shear strength

The positive shear capacity can be calculated as per EN 1992-1-1:2004 Clause 4.3.2.3. Partial shear connection theory is used for the contribution of BONDEK.

4.4 Design for durability and serviceability

4.4.1 Exposure classification and cover

The exposure classification used in design tables for BONDEK slabs is A1 as defined in AS 3600:2009, Clause 4.3. Use BONDEK software for all other classifications.

The minimum concrete cover (c) to reinforcing steel, measured from the slab top face, shall comply with AS 3600:2009, Table 4.10.3.2.

4.4.2 Deflections

Deflections are calculated using method given in AS 3600:2009 Clause 8.5.3.

4.4.3 Crack control

The Design tables have been developed based on advanced requirements for crack control as per Clause 9.4.1 of AS 3600:2009. It is important to use minimum bar diameters in negative areas to minimise total depth of reinforcement. Bar diameters 16mm and 20mm cannot be used with these tables. It is recommended that the small reinforcing bars be suitably distributed over the negative moment region not exceeding the spacing requirement as specified in AS 3600:2009 Clause 9.4.1. Use LYSAGHT BONDEK design software to design slabs with bars other than 12mm.

4.5 Detailing of conventional reinforcement

Conventional tensile reinforcement in negative moment regions must be detailed in accordance with relevant requirements for one way slabs.

Pattern 1

Negative-moment regions must be designed to satisfy the requirements of AS 3600:2009 Clause 9. The composite slab negative-moment regions can be treated as solid reinforced-concrete sections.

Pattern 2

When live loads exceed twice the dead load, at least one third of negative reinforcement must continue over a whole span.

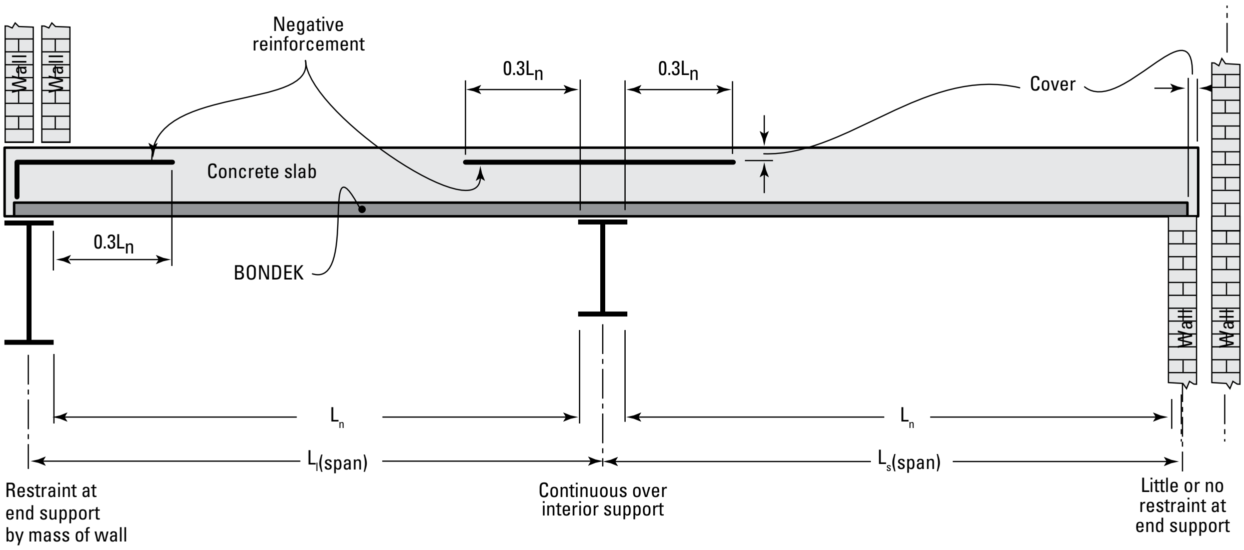


Figure 4.1
Pattern 1 for conventional reinforcement

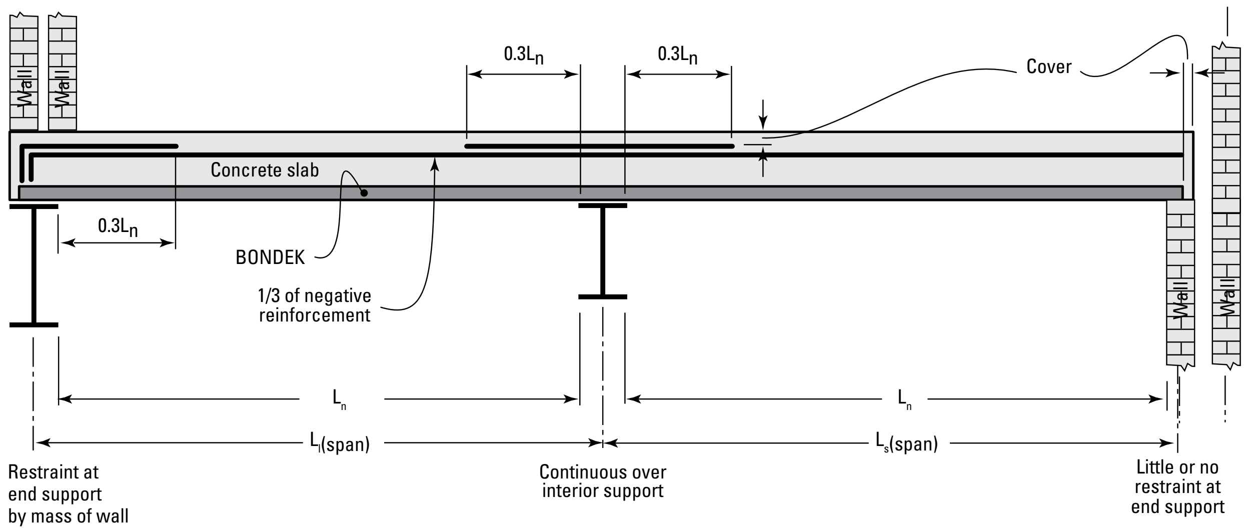


Figure 4.2
Pattern 2 for conventional reinforcement when imposed load exceeds twice the dead load

4.6 Use of tables given in Section 6

The design solutions given in the tables presented in Section 6 is based on the design principles given in this section and the following assumptions and constraints. Other constraints are stated in Section 6.1. The reader needs to ensure that the particular situation being designed falls within these assumptions and constraints.

1. The concrete manufacture and materials satisfy the requirements of AS 3600:2009, Clause 17.
2. The lines of support extend across the full width of the sheeting and have a minimum bearing of 50mm at the ends of the sheets, and 100mm minimum at intermediate supports over which sheeting is continuous.
3. The ratio of the longer slab span (L_l) to the shorter slab span (L_s) of any two adjacent spans does not exceed 1.2, that is $L_l / L_s \leq 1.2$.
4. The slab has a uniform cross-section.
5. The design loads for serviceability and strength design must be uniformly-distributed and static in nature.
6. The bending moments at the supports are only caused by the action of vertical loads applied to the slab.
7. The geometry of the steel sheeting profile must conform to the dimensions and tolerances shown on our production drawings. Sheeting with embossments less than the specified lower characteristic value shall not be used compositely unless the value of longitudinal shear resistance is revised.
8. Material and construction requirements for conventional reinforcing steel shall be in accordance with AS 3600:2009, Clause 17.2 and the design yield stress, (f_{sy}), shall be taken from AS 3600:2009, Table 3.2.1, for the appropriate type and grade of reinforcement, and manufacturers' data.
9. BONDEK shall not be spliced, lapped or joined longitudinally in any way.
10. The permanent support lines shall extend across the full width of the slab.
11. Similar to the requirement in AS 2327.1, Clause 4.2.3, composite action shall be assumed to exist between the steel sheeting and the concrete once the concrete in the slab has attained a compressive strength of 15 MPa, that is $f'_{cj} \geq 15$ MPa. Prior to the development of composite action during construction (Stage 4 defined in AS 2327.1), potential damage to the shear connection shall be avoided; and no loads from stacked materials are allowed.
12. Detailing of conventional tensile reinforcement over negative moment regions shall be arranged in accordance with the Figures 4.1 and 4.2. Refer to AS 3600:2009, Clause 9.1.3 for more information on detailing of tensile reinforcement in one-way slab.
13. Only LYSAGHT BONDEK profiles can be used with this manual. High design value of longitudinal shear strength of composite slab, $\tau_{u,Rd}$, responsible for composite performance are achieved due to the advanced features of LYSAGHT BONDEK.

5. Design for fire

5.1 Introduction

During the design of composite floor slabs exposed to fire, it is essential to take into account the effect of elevated temperatures on the material properties. The composite slabs should be assessed with respect to structural adequacy, thermal insulation and integrity. The minimum required thickness of composite slab to satisfy the insulation and integrity criterion is presented in Section 5.3. Design of slabs for the structural adequacy is presented in Section 5.4.

This Section discusses the parameters relating to the exposure of the soffit to fire, upon which our design tables are based. Solutions to your design problems may be obtained by direct reference to either our design tables, or our LYSAGHT BONDEK design software. Software will give more economical results. BONDEK composite slabs are designed based on AS 3600:2009 Clause 5.3.1b and EN 1994.1.2:2005 Clause 4.4 suplimented with test data and thermal response modelling.

Our fire design tables may be used to detail BONDEK composite slabs when the soffit is exposed to fire provided the following conditions are satisfied:

1. The composite slab acts as a one-way element spanning in the direction of the sheeting ribs for both room temperature and fire conditions.
2. The fire design load is essentially uniformly distributed and static in nature
3. Transverse reinforcement for the control of cracking due to shrinkage and temperature effects is provided.
4. Adequate detailing of slab jointing, edges, slab holes and cavities (for penetrating, embedded or encased services) to provide the appropriate fire resistance period. Alternatively the local provision of suitable protection (such as fire spray material) will be necessary.
5. Reinforcement conforms to Section 5.5 of this manual.

5.2 Fire resistance periods

Five fire cases, 60, 90, 120, 180 and 240 minutes, are considered. In each fire case the fire resistance periods for structural adequacy, integrity and insulation are taken to be equal duration. Fire resistance period up to two hours are provided in the design tables. It is recommended to use LYSAGHT BONDEK design software for fire resistance period up to four hours and alternative locations for fire reinforcement.

5.3 Design for insulation and integrity

Minimum required overall depth, D of BONDEK slabs for insulation and integrity for various fire resistance periods is given in Table 5.1.

Table 5.1

Fire resistance period Minutes	Normal density concrete D (mm)
60	90
90	100
120	120
180	140
240	175

5.4. Design for structural adequacy

5.4.1 Design loads

Use AS/NZS 1170.0:2002, Clause 4.2.4, together with design load for fire, $W_f = 1.0G + \psi_l Q$.

5.4.2 Design for strength

In any specific design of a composite floor slab exposed to fire, it is essential the strength reduction factors account for the adverse effect of elevated temperatures on the mechanical properties of concrete and steel as well as a strength of shear bond capacity. The strength and structural adequacy must be checked in all potentially critical cross-sections for the given period of fire exposure considering the strength reduction factors. Fire tests on composite slabs incorporating BONDEK profiled steel sheeting have been conducted at the Centre for Environmental Safety and Risk Engineering, the Victoria University of Technology.

The tests have been used to validate the finite element analysis result for temperatures of the slab for different fire periods. Subsequent tests were performed to evaluate shear bond capacities of BONDEK profiled sheeting during fire.

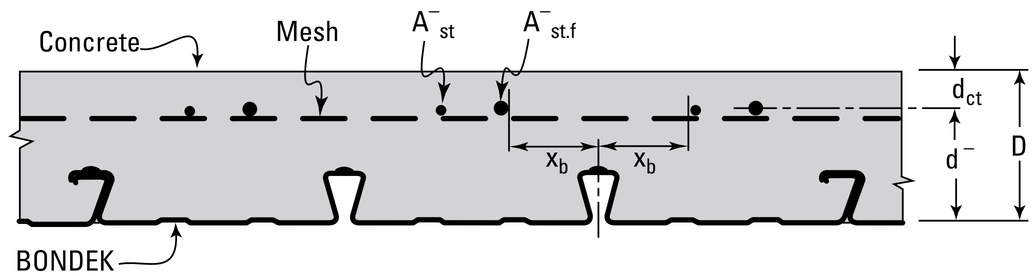
Test results revealed that shear bond capacity in fire (composite action) is the governing parameter. Composite performance is the critical parameter during fire, therefore the location of the embossments is crucial. As the embossments are located on top of ribs, BONDEK has superior composite performance during fire. BONDEK ribs or part of the ribs are sufficiently cool to act as effective fire reinforcement.

No additional fire reinforcement is normally necessary for typical BONDEK composite slabs with fire resistance up to 90 minutes. Small amounts fire reinforcement may be necessary for 120 minutes fire resistance.

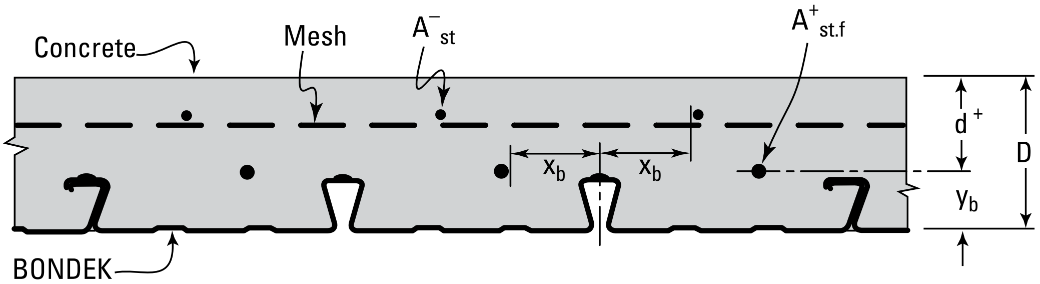
5.5 Reinforcement for fire design

The arrangement of additional fire reinforcement for fire design is shown in Figure 5.1.

- Some additional reinforcement may be necessary in some rare cases, in addition to any mesh and negative reinforcement required by our tables for composite slab design.
- D500L reinforcement is ignored in our design tables as fire reinforcement at all locations where significant elongation of reinforcement is expected
- The location of reinforcement $A^-_{st.f}$ for Fire detail 1 is in a single top layer at a depth of d_{ct} below the slab top face (refer to Figure 5.1). This detail is applicable to continuous slabs only, this option is used for interior spans in our design tables.
- The location of reinforcement $A^+_{st.f}$ for Fire detail 2 is in a single bottom layer at a distance of y_b above the slab soffit (refer to Figure 5.1). This option is used for single spans and end spans of continuous slabs in our design tables.
- The cross-sectional area of the additional reinforcement for fire design is designated $A^+_{st.f}$ in our tables (D500N with bar diameter = 12 mm or less).
- The negative reinforcement (A^-_{st}) and the additional fire reinforcement ($A^+_{st.f}$ or $A^-_{st.f}$ as applicable), shall be located as shown in Figure 5.1 & 5.2.
- Location of mesh is at bottom for single spans and top for continuous spans. (See also Figure 1.2)



Fire Detail 1



Fire Detail 2

Figure 5.1
Details of reinforcement for fire design

The longitudinal bars which make up $A^{+}_{st.f}$ should be located within the zone shown in Figure 5.2.

x_b = 85 mm minimum
y_b = 60 mm average

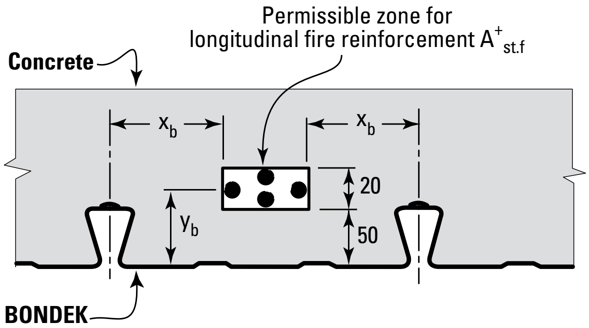


Fig. 5.2
Permissible zone for location of longitudinal fire reinforcement for Fire Detail 2.

NOTES:

1. Fire option 1 (Top location of additional fire reinforcement) is used in design tables for interior spans.
   Fire option 2 (Bottom) is used in design tables for simple and end spans.
2. Recommended bottom location of fire reinforcement is chosen for practical reasons (to place fire bars on transverse bars laid on top of BONDEK ribs). Lower location of fire bars with cover down to 20mm from soffit may give more economical results - please consult BlueScope Lysaght Research & Technology. Design tables are based on location as shown above in Figure 5.2.

6. Design tables - steel-framed construction

6.1 Use of design tables

The design parameters specific for each table are given in the tables:

- Spans: single, continuous, end or interior
- Spans: centre-to-centre (L)
- Thickness of the slab (D)
- Characteristic imposed 'live' load (Q)

The rest of parameters are common for all tables and listed below:

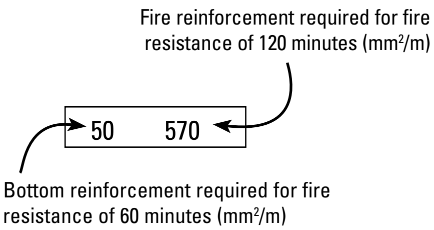
- More than four spans for continuous spans
- Concrete grade: f'_c = 32 MPa
- Type of construction: steel-frame construction or equivalent
- Density of wet concrete: 2400 kg/m^3
- LYSAGHT BONDEK used as a structural deck with thickness 0.6, 0.75 , 0.9 or 1.0mm BMT (0.9 mm available subject to enquiry)
- Minimum 100 mm width of permanent supports
- A1 exposure classification (20 mm cover for negative reinforcement)
- Composite slab deflection limits: L/250 for total loads and L/500 for incremental deflection
- Crack control required
- 1 kPa of superimposed dead load (G_{sdl}) in addition to self weight
- Reinforcement D500N for negative and fire reinforcement with maximum 12mm bar diameter
- Location of negative reinforcement as shown on Fig. 1.2
- Location of fire reinforcement as shown on Fig. 6.1 and Fig. 6.2
- Shrinkage mesh as in the Table 6.1 for minor degree of crack control
- Formwork with at least one temporary support per span assumed (fully supported conditions)

NOTES:

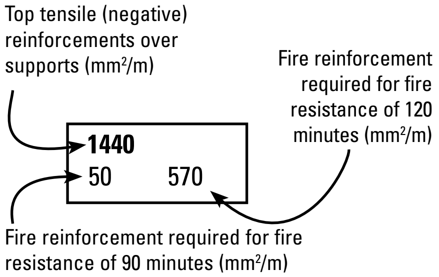
- Slab is designed for unit width (1.0m width)
- Negative and fire reinforcement shown in tables is in addition to shrinkage mesh specified in Table 6.1. If negative fire reinforcement is required, at least one bar per LYSAGHT BONDEK rib should be placed. Smaller bar diameter may result in less negative and fire reinforcement.
- ψs=0.7, ψl=0.4

6.2 Interpretation of table solutions

KEY - Single Spans



KEY - Continuous Spans



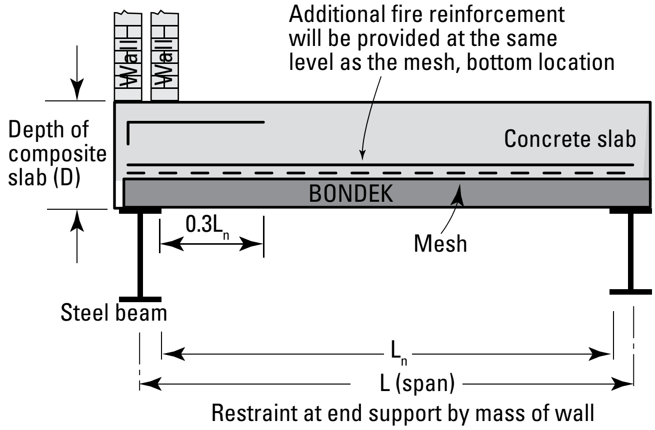


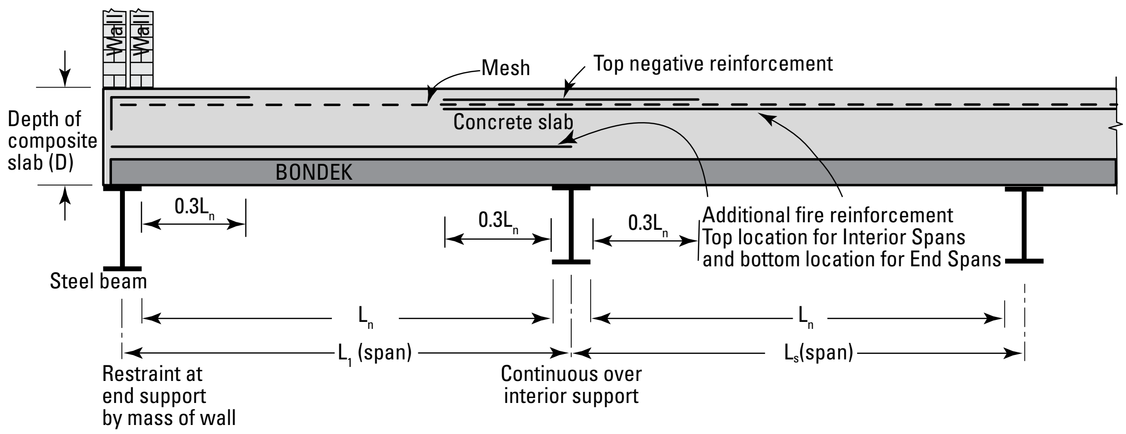
Fig. 6.1 LYSAGHT BONDEK for single spans.

Notes:

1. Areas without cells mean that a design solution is not possible based on input parameters and design options presented in this manual. Contact BlueScope Lysaght Research & Technology for further options.
2. Single spans do not require top tensile reinforcement, relevant cells are not shown.
3. All spans are centre-to-centre.
4. A dash (-) means no fire reinforcement is necessary.
5. N/A means a design solution with this particular fire rating is not possible.
6. Top tensile/negative reinforcement is additional to shrinkage mesh area

Table 6.1
Mesh sizes to be used with design tables

Depth	Mesh
100	SL62
120	SL62
140	SL72
160	SL82
180	SL82



Note: 1/3 top negative reinforcement shall continue all over the span if ratio of live load to total dead load is more than 2.

Fig. 6.2 LYSAGHT BONDEK continuous spans.

6.3 Single span tables

Single Spans 100 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1		Q=2.5 G_{sdl}=1		Q=3.5 G_{sdl}=1		Q=5.0 G_{sdl}=1		Q=7.5 G_{sdl}=1	
1400	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
1600	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
1800	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
2000	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
2200	-	N/A	-	N/A	-	N/A	-	N/A	40	N/A
2400	-	N/A	-	N/A	-	N/A	40	N/A	140	N/A
2600	-	N/A	20	N/A	70	N/A	130	N/A		
2800	50	N/A	100	N/A	150	N/A				
3000	130	N/A								
3200										

Single Spans 120 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1		Q=2.5 G_{sdl}=1		Q=3.5 G_{sdl}=1		Q=5.0 G_{sdl}=1		Q=7.5 G_{sdl}=1	
1800	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	20
2200	-	-	-	-	-	-	-	30	-	80
2400	-	-	-	30	-	50	-	90	-	150
2600	-	50	-	80	-	110	-	150	-	220
2800	-	100	-	130	-	170	-	220	60	300
3000	-	160	-	190	-	230	50	290		
3200	-	220	30	260	60	300				
3400	40	280	80	330						
3600	100	350								
3800										

Single Spans 140 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1		Q=2.5 G_{sdl}=1		Q=3.5 G_{sdl}=1		Q=5.0 G_{sdl}=1		Q=7.5 G_{sdl}=1	
2200	-	-	-	-	-	-	-	-	-	-
2400	-	-	-	-	-	-	-	-	-	10
2600	-	-	-	-	-	-	-	20	-	70
2800	-	-	-	10	-	40	-	70	-	130
3000	-	30	-	60	-	90	-	120	-	190
3200	-	80	-	110	-	140	-	180	20	260
3400	-	130	-	160	-	200	10	250		
3600	-	180	-	220	20	260				
3800	10	240	40	280						
4000	60	300								
4200										

Single Spans 160 mm slab depth

Floor loading: Q imposed ‘live’ (kPa) G_{sdl} permanent superimposed ‘dead’ (kPa)

Span (mm)	Q=1.5 G_{sdl}=1		Q=2.5 G_{sdl}=1		Q=3.5 G_{sdl}=1		Q=5.0 G_{sdl}=1		Q=7.5 G_{sdl}=1	
2400	-	-	-	-	-	-	-	-	-	-
2600	-	-	-	-	-	-	-	-	-	-
2800	-	-	-	-	-	-	-	-	-	*10*
3000	-	-	-	-	-	-	-	*10*	-	*60*
3200	-	-	-	-	-	*20*	-	*60*	-	*110*
3400	-	*20*	-	*40*	-	*70*	-	*110*	-	*180*
3600	-	*60*	-	*90*	-	*120*	-	*170*	-	*240*
3800	-	*110*	-	*140*	-	*180*	-	*230*		
4000	-	*160*	-	*200*	-	*240*				
4200	-	*220*	*20*	*260*						
4400	*20*	*260*								
4600										

Single Spans 180 mm slab depth

Floor loading: Q imposed ‘live’ (kPa) G_{sdl} permanent superimposed ‘dead’ (kPa)

Span (mm)	Q=1.5 G_{sdl}=1		Q=2.5 G_{sdl}=1		Q=3.5 G_{sdl}=1		Q=5.0 G_{sdl}=1		Q=7.5 G_{sdl}=1	
3000	-	-	-	-	-	-	-	-	-	*10*
3200	-	-	-	-	-	-	-	*10*	-	*50*
3400	-	-	-	-	-	*20*	-	*50*	-	*110*
3600	-	*20*	-	*40*	-	*70*	-	*100*	-	*160*
3800	-	*60*	-	*90*	-	*110*	-	*150*	-	*220*
4000	-	*110*	-	*140*	-	*170*	-	*210*		
4200	-	*140*	-	*180*	-	*210*	*20*	*260*		
4400	-	*190*	-	*230*	*20*	*260*				
4600	-	*240*	*40*	*280*						
4800	*50*	*300*								
5000										

6.4 Interior span tables

Interior Spans 100 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
1400	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*
1600	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*
1800	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*
2000	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**210** - *N/A*
2200	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**180** - *N/A*	**290** - *N/A*
2400	**170** - *N/A*	**170** - *N/A*	**170** - *N/A*	**240** - *N/A*	**380** - *N/A*
2600	**170** - *N/A*	**170** - *N/A*	**210** - *N/A*	**310** - *N/A*	**470** - *N/A*
2800	**170** - *N/A*	**170** - *N/A*	**270** - *N/A*	**380** - *N/A*	**580** - *N/A*
3000	**170** - *N/A*	**200** - *N/A*	**330** - *N/A*	**470** - *N/A*	**700** - *N/A*
3200	**180** - *N/A*	**250** - *N/A*	**400** - *N/A*	**560** - *N/A*	**830** - *N/A*
3400	**220** - *N/A*	**310** - *N/A*	**480** - *N/A*	**660** - *N/A*	**980** - *N/A*
3600	**260** - *N/A*	**360** - *N/A*	**560** - *N/A*	**770** - *N/A*	
3800	**310** - *N/A*	**420** - *N/A*	**650** - *N/A*	**890** - *N/A*	
4000	**370** - *N/A*	**490** - *N/A*	**750** - *N/A*		
4200	**420** - *N/A*	**560** - *N/A*			
4400	**470** - *N/A*				
4600	**530** - *N/A*				
4800					

Interior Spans 120 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
1600	210 - -	210 - -	210 - -	210 - -	210 - -
1800	210 - -	210 - -	210 - -	210 - -	210 - -
2000	210 - -	210 - -	210 - -	210 - -	210 - -
2200	210 - -	210 - -	210 - -	210 - -	210 - -
2400	210 - -	210 - -	210 - -	210 - -	270 - -
2600	210 - -	210 - -	210 - -	220 - -	340 - -
2800	210 - -	210 - -	210 - -	280 - -	430 - -
3000	210 - -	210 - -	250 - -	340 - -	510 - -
3200	210 - -	210 - -	300 - -	410 - -	610 - -
3400	210 - -	230 - -	360 - -	490 - -	720 - -
3600	210 - -	280 - -	420 - -	570 - -	830 - -
3800	240 - -	330 - -	490 - -	660 - -	960 - -
4000	290 - -	380 - -	570 - -	760 - -	1100 - -
4200	330 - -	440 - -	640 - -	860 - -	
4400	370 - -	490 - -	720 - -	960 - -	
4600	420 - -	550 - -	810 - -		
4800	480 - -	620 - -	900 - -		
5000	530 - -	690 - -			
5200	590 - -				
5400					

Interior Spans 140 mm slab depth
Floor loading: Q imposed ‘live’ (kPa) G_{sdl} permanent superimposed ‘dead’ (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
1800	210 - -	210 - -	210 - -	210 - -	210 - -
2000	210 - -	210 - -	210 - -	210 - -	210 - -
2200	210 - -	210 - -	210 - -	210 - -	210 - -
2400	210 - -	210 - -	210 - -	210 - -	210 - -
2600	210 - -	210 - -	210 - -	210 - -	230 - -
2800	210 - -	210 - -	210 - -	210 - -	300 - -
3000	210 - -	210 - -	210 - -	230 - -	370 - -
3200	210 - -	210 - -	210 - -	290 - -	450 - -
3400	210 - -	210 - -	250 - -	350 - -	530 - -
3600	210 - -	210 - -	300 - -	420 - -	620 - -
3800	210 - -	230 - -	360 - -	490 - -	720 - -
4000	210 - -	280 - -	420 - -	570 - -	830 - -
4200	240 - -	320 - -	490 - -	650 - -	940 - -
4400	270 - -	370 - -	550 - -	730 - -	1060 - -
4600	320 - -	420 - -	620 - -	830 - -	1190 - -
4800	360 - -	480 - -	700 - -	930 - -	
5000	410 - -	540 - -	780 - -	1030 - -	
5200	460 - -	600 - -	870 - -		
5400	520 - -	660 - -	960 - -		
5600	580 - -	730 - -			
5800	640 - -				
6000	700 - -				

Interior Spans 160 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
2000	200 - -	200 - -	200 - -	200 - -	200 - -
2200	200 - -	200 - -	200 - -	200 - -	200 - -
2400	200 - -	200 - -	200 - -	200 - -	200 - -
2600	200 - -	200 - -	200 - -	200 - -	200 - -
2800	200 - -	200 - -	200 - -	200 - -	200 - -
3000	200 - -	200 - -	200 - -	200 - -	250 - -
3200	200 - -	200 - -	200 - -	200 - -	310 - -
3400	200 - -	200 - -	200 - -	240 - -	390 - -
3600	200 - -	200 - -	200 - -	300 - -	460 - -
3800	200 - -	200 - -	200 - -	360 - -	550 - -
4000	200 - -	200 - -	250 - -	430 - -	640 - -
4200	200 - -	220 - -	290 - -	490 - -	730 - -
4400	200 - -	260 - -	340 - -	570 - -	830 - -
4600	230 - -	310 - -	400 - -	640 - -	930 - -
4800	270 - -	360 - -	450 - -	730 - -	1050 - -
5000	310 - -	410 - -	520 - -	810 - -	1170 - -
5200	360 - -	470 - -	580 - -	910 - -	1300 - -
5400	410 - -	530 - -	650 - -	1010 - -	
5600	460 - -	590 - -	720 - -	1110 - -	
5800	510 - -	650 - -	790 - -	1430 - *10*	
6000	570 - -	720 - -	870 - -		

Interior Spans 180 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
2000	250 - -	250 - -	250 - -	250 - -	250 - -
2200	250 - -	250 - -	250 - -	250 - -	250 - -
2400	250 - -	250 - -	250 - -	250 - -	250 - -
2600	250 - -	250 - -	250 - -	250 - -	250 - -
2800	250 - -	250 - -	250 - -	250 - -	250 - -
3000	250 - -	250 - -	250 - -	250 - -	250 - -
3200	250 - -	250 - -	250 - -	250 - -	250 - -
3400	250 - -	250 - -	250 - -	250 - -	320 - -
3600	250 - -	250 - -	250 - -	250 - -	390 - -
3800	250 - -	250 - -	250 - -	300 - -	460 - -
4000	250 - -	250 - -	250 - -	360 - -	540 - -
4200	250 - -	250 - -	250 - -	420 - -	610 - -
4400	250 - -	250 - -	290 - -	480 - -	700 - -
4600	250 - -	270 - -	340 - -	550 - -	790 - -
4800	250 - -	310 - -	390 - -	620 - -	890 - -
5000	270 - -	360 - -	450 - -	700 - -	990 - -
5200	310 - -	410 - -	500 - -	780 - -	1100 - -
5400	360 - -	460 - -	560 - -	860 - -	1220 - -
5600	410 - -	520 - -	630 - -	950 - -	1340 - -
5800	450 - -	570 - -	700 - -	1050 - -	1470 - *10*
6000	510 - -	630 - -	770 - -	1150 - -	

6.5 End span tables

End Spans 100 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
1400	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*
1600	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*
1800	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*
2000	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**240** *- N/A*
2200	**170** *- N/A*	**170** *- N/A*	**170** *- N/A*	**210** *- N/A*	**330** *- N/A*
2400	**170** *- N/A*	**170** *- N/A*	**190** *- N/A*	**270** *- N/A*	**420** *- N/A*
2600	**170** *- N/A*	**170** *- N/A*	**250** *- N/A*	**350** *- N/A*	**520** *- N/A*
2800	**170** *- N/A*	**220** *- N/A*	**310** *- N/A*	**430** *- N/A*	**640** *- N/A*
3000	**190** *- N/A*	**270** *- N/A*	**380** *- N/A*	**520** *- N/A*	**1000** *- N/A*
3200	**240** *- N/A*	**330** *- N/A*	**460** *- N/A*		
3400	**290** *- N/A*	**400** *10 N/A*	**550** *20 N/A*		
3600	**350** *20 N/A*	**740** *30 N/A*			
3800	**410** *50 N/A*				
4000					

End Spans 120 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
1600	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*
1800	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*
2000	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*
2200	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**230** *-* *-*
2400	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**300** *-* *-*
2600	**210** *-* *-*	**210** *-* *-*	**210** *-* *-*	**250** *-* *-*	**380** *-* *-*
2800	**210** *-* *-*	**210** *-* *-*	**230** *-* *-*	**320** *-* *-*	**470** *-* *20*
3000	**210** *-* *-*	**210** *-* *10*	**290** *-* *-*	**390** *-* *20*	**570** *-* *50*
3200	**210** *-* *20*	**250** *-* *30*	**350** *-* *30*	**470** *-* *50*	**680** *10* *90*
3400	**230** *-* *50*	**310** *-* *40*	**410** *-* *50*	**550** *-* *80*	**920** *30* *120*
3600	**270** *-* *80*	**360** *-* *70*	**490** *-* *80*	**640** *20* *110*	
3800	**320** *-* *100*	**420** *10* *90*	**560** *20* *110*		
4000	**370** *10* *130*	**490** *20* *120*			
4200	**430** *30* *160*				
4400	**1200** *-* *160*				
4600					

End Spans 140 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
1800	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*
2000	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*
2200	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*
2400	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*
2600	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*	**260** *- -*
2800	**210** *- -*	**210** *- -*	**210** *- -*	**210** *- -*	**340** *- -*
3000	**210** *- -*	**210** *- -*	**210** *- -*	**270** *- -*	**410** *- 20*
3200	**210** *- -*	**210** *- -*	**240** *- -*	**340** *- 10*	**500** *- 40*
3400	**210** *- 10*	**210** *- 40*	**300** *- 20*	**410** *- 40*	**590** *- 70*
3600	**210** *- 50*	**260** *- 50*	**360** *- 40*	**480** *- 60*	**690** *20 100*
3800	**230** *- 80*	**310** *- 70*	**420** *- 70*	**560** *10 90*	**800** *30 130*
4000	**280** *- 100*	**370** *- 80*	**490** *10 90*	**650** *30 120*	
4200	**330** *20 120*	**430** *20 100*	**570** *30 120*	**740** *40 150*	
4400	**370** *30 130*	**480** *30 120*	**630** *40 140*		
4600	**420** *40 150*	**550** *40 150*			
4800	**480** *60 180*				
5000	**1230** *60 180*				
5200					

End Spans 160 mm slab depth

Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
2000	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*
2200	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*
2400	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*
2600	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*
2800	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**220** *-* *-*
3000	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**290** *-* *-*
3200	**200** *-* *-*	**200** *-* *-*	**200** *-* *-*	**230** *-* *-*	**360** *-* *20*
3400	**200** *-* *-*	**200** *-* *10*	**200** *-* *30*	**290** *-* *10*	**440** *-* *40*
3600	**200** *-* *20*	**200** *-* *40*	**230** *-* *50*	**350** *-* *40*	**530** *-* *60*
3800	**200** *-* *60*	**220** *-* *70*	**280** *-* *60*	**420** *-* *60*	**620** *10* *90*
4000	**200** *10* *100*	**270** *-* *80*	**340** *-* *70*	**500** *10* *80*	**720** *30* *120*
4200	**230** *20* *110*	**310** *10* *100*	**400** *10* *80*	**570** *20* *100*	**810** *40* *140*
4400	**270** *30* *130*	**360** *20* *110*	**460** *20* *100*	**650** *40* *130*	**1070** *60* *170*
4600	**320** *40* *140*	**420** *30* *130*	**530** *40* *130*	**740** *50* *160*	
4800	**370** *60* *160*	**480** *40* *140*	**600** *50* *150*	**1460** *70* *180*	
5000	**420** *70* *180*	**550** *60* *160*	**670** *70* *180*		
5200	**480** *90* *200*	**610** *70* *190*			
5400	**540** *100* *220*				
5600					

End Spans 180 mm slab depth
Floor loading: Q imposed 'live' (kPa) G_{sdl} permanent superimposed 'dead' (kPa)

Span (mm)	Q=1.5 G_{sdl}=1	Q=2.5 G_{sdl}=1	Q=3.5 G_{sdl}=1	Q=5.0 G_{sdl}=1	Q=7.5 G_{sdl}=1
2000	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*
2200	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*
2400	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*
2600	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*
2800	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*
3000	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*
3200	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**300** *- -*
3400	**250** *- -*	**250** *- -*	**250** *- -*	**250** *- -*	**370** *- 20*
3600	**250** *- -*	**250** *- -*	**250** *- 10*	**300** *- 20*	**440** *- 40*
3800	**250** *- 10*	**250** *- 20*	**250** *- 40*	**360** *- 40*	**520** *- 60*
4000	**250** *- 40*	**250** *- 60*	**290** *- 60*	**420** *- 60*	**610** *10 90*
4200	**250** *- 60*	**270** *- 80*	**340** *- 70*	**480** *10 80*	**690** *30 110*
4400	**250** *20 100*	**310** *10 90*	**400** *10 80*	**560** *20 100*	**790** *40 130*
4600	**280** *30 120*	**370** *20 100*	**460** *20 100*	**630** *40 120*	**890** *60 160*
4800	**330** *40 130*	**420** *30 120*	**520** *40 120*	**720** *50 150*	**1000** *80 190*
5000	**370** *60 150*	**480** *40 130*	**590** *50 150*	**800** *70 170*	
5200	**430** *70 170*	**540** *60 150*	**660** *70 170*	**890** *90 200*	
5400	**480** *80 190*	**600** *70 180*	**730** *80 200*		
5600	**540** *100 210*	**670** *90 200*			
5800	**600** *110 230*	**1840** *110 230*			
6000	**1230** *110 230*				
6000					

7. Construction and detailing

The construction of LYSAGHT BONDEK composite slabs follows simple, familiar and widely-accepted building practice. Workers can readily acquire the skills necessary to install BONDEK formwork and finish the composite slab. Construction workers will normally be supplied with fully detailed drawings showing the direction of the ribs, other reinforcement and all supporting details.

7.1 Safety

BONDEK is available in long lengths, so large areas can be quickly and easily covered to form a safe working platform during construction. One level of formwork gives immediate protection from the weather, and safety to people working on the floor below. The minimal propping requirements provide a relatively open area to the floor below.

The bold embossments along the top of the ribs of BONDEK enhance safety by reducing the likelihood of workers slipping.

It is commonsense to work safely, protecting yourself and workmates from accidents on the site. Safety includes the practices you use; as well as personal protection of eyes and skin from sunburn, and hearing from noise. For personal safety, and to protect the surface finish of BONDEK, wear clean dry gloves. Don't slide sheets over rough surfaces or over each other. Always carry tools, don't drag them.

Occupational health and safety laws enforce safe working conditions in most locations. Laws in every state require you to have fall protection which includes safety mesh, personal harnesses and perimeter guardrails where they are appropriate. We recommend that you adhere strictly to all laws that apply to your site.

BONDEK is capable of withstanding temporary construction loads including the mass of workmen, equipment and materials all in accordance with AS 3610:1995. However, it is good construction practice to ensure protection from concentrated loads, such as barrows, by use of some means such as planks and/or boards.

7.2 Care and storage before installation

BONDEK is delivered in strapped bundles. If not required for immediate use, stack sheets or bundles neatly and clear of the ground, on a slight slope to allow drainage of water. If left in the open, protect with waterproof covers.

7.3 Installation of BONDEK sheeting on-site

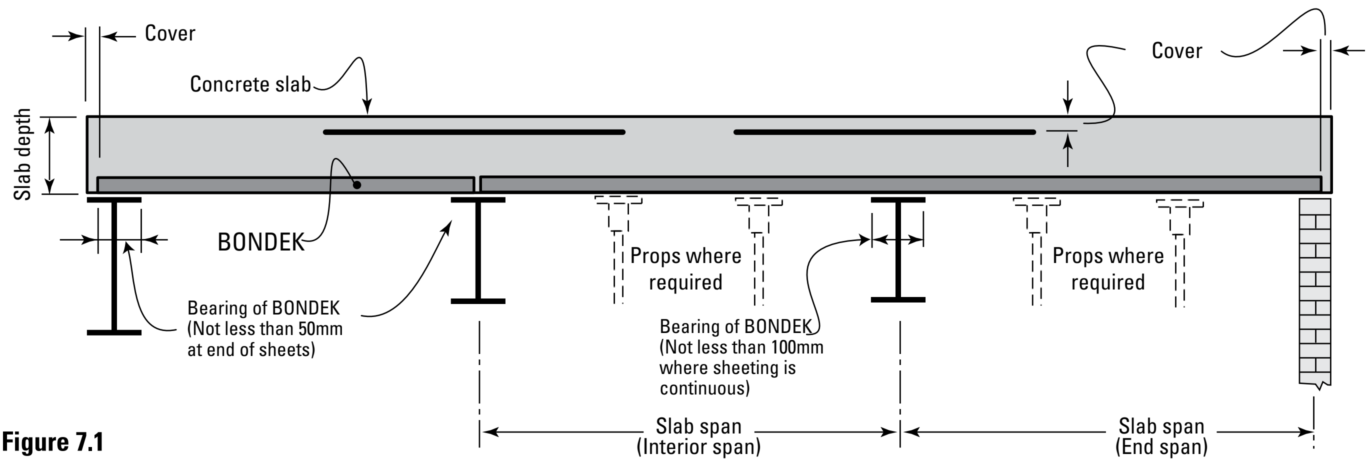


Figure 7.1
BONDEK Installation guidelines

7.3.1 Propping

Depending on the span of a BONDEK slab, temporary propping may be needed between the slab supports to prevent excessive deflections or collapse of the formwork. A typical diagram for the installation of BONDEK is depicted in Figure 7.1.

BONDEK formwork is normally placed directly on prepared propping. Props shall stay in place during the laying of BONDEK formwork, the placement of the concrete, and until the concrete has reached the strength of 15 MPa.

Propping generally consists of substantial timber or steel bearers supported by vertical props. The bearers shall be continuous across the full width of BONDEK formwork.

Propping shall be adequate to support construction loads and the mass of wet concrete. The number of props you need for given spans is shown in our tables.

7.3.2 Laying

BONDEK shall be laid with the sheeting ribs aligned in the direction of the designed spans. Other details include the following:

- The slab supports shall be prepared for bearing and slip joints as required.
- Lay BONDEK sheets continuously over each slab span without any intermediate splicing or jointing.
- Lay BONDEK sheets end to end. Centralise the joint at the slab supports. Where jointing material is required the sheets may be butted against the jointing material.
- Support BONDEK sheets across their full width at the slab support lines and at the propping support lines.
- For the supports to carry the wet concrete and construction loads, the minimum bearing is 50mm for ends of BONDEK sheets, and 100 mm for intermediate supports over which the sheeting is continuous. It may be reduced to 25mm for concrete band beams as shown in Figure 7.5.
- In exposed applications, treat the end and edges of the BONDEK sheets with a suitable edge treatment to prevent entry of moisture.

7.3.3 Interlocking of sheets

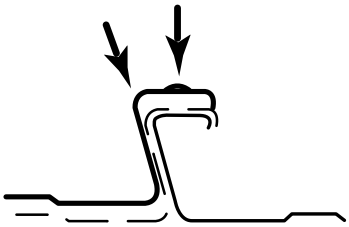
Overlapping ribs of BONDEK sheeting are interlocked. Either of two methods can be used in most situations, though variations may also work.

In the first method, lay adjacent sheets loosely in place. Place the female lap rib overlapping the male lap rib of the previous sheet and apply foot pressure, or a light kick, to the female lap rib (Figure 7.2).

In the second method, offer a new sheet at an angle to one previously laid, and then simply lower it down, through an arc (see Figure 7.2).

If sheets don't interlock neatly (perhaps due to some damage or distortion from site handling or construction practices) use screws to pull the laps together tightly (see Section 7.3.9, Fastening side-lap joints).

Method 1
Position BONDEK sheet parallel with previously-laid sheet. Interlock sheets by applying pressure to either position.



Method 2
Position BONDEK sheet at an angle. Interlock sheets by lowering sheet through an arc.

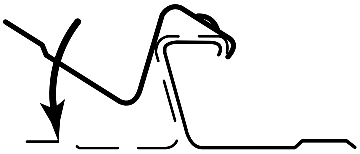


Figure 7.2
Two methods of interlocking two adjacent BONDEK sheets

7.3.4 Securing the sheeting platform

BONDEK shall be securely fixed to supporting structures using:

- weights;
- screws or nails into the propping bearers; or
- Spot welding

Take care if you use penetrating fasteners (such as screws and nails) because they can make removal of the props difficult, and perhaps result in damage to the BONDEK.

7.3.5 Installing BONDEK on steel frames

BONDEK may be installed directly on erected structural steelwork.

General fastening of BONDEK

To provide uplift resistance or lateral restraint, the sheeting may be fixed to the structural steel using spot welds, or fasteners such as drive nails or self-drilling screws.

At a movement joint, the sheeting is not continuous over the support. If one sheet is fastened at the joint, the other is not.

Place the fixings (fasteners and spot welds) in the flat areas of the pans adjacent to the ribs or between the flutes. The frequency of fixings depends on wind or seismic conditions and good building practice.

One fixing system is as follows.

- At the end of sheets: use a fixing at every rib (Figure 7.3).
- At each intermediate slab support over which the sheeting is continuous: use a fixing at the ribs on both edges (Figure 7.3).
- Fix BONDEK with drive nails, self-drilling screws or spot welds.
- Drive nails should be powder-activated, steel nails 4mm nominal diameter, suitable for structural steel of 4 mm thickness or greater.
- For structural steel up to 12mm thick, use 12-24 x 38mm self-drilling self-tapping hexagon head screws.
- For structural steel over 12mm thick, pre-drill and use 12-24 x16mm hexagon head screws.
- Spot welds should be 12mm minimum diameter. Use 3.25mm diameter cellulose, iron powder AC/DC high penetration electrodes. Surfaces to be welded shall be free of loose material and foreign matter. Where the BONDEK soffit or the structural steelwork has a pre-painted surface, securing methods other than welding may be more appropriate. Take suitable safety precautions against fumes during welding zinc coated products.

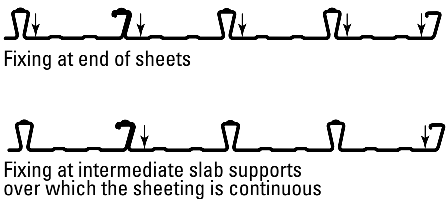


Figure 7.3
Positions for fixing BONDEK sheet to steel framing

Fastening composite beams

In projects of composite beam construction the BONDEK sheeting shall be fastened in accordance with AS 2327, Clause 9.2 (Composite beams with slabs incorporating profiled steel sheets). This provision requires a fixing in each pan at each composite beam.

Stud welding through the sheet has been considered a suitable securing method for the sheeting in a composite beam; however some preliminary fixing by one of the methods mentioned above is necessary to secure the sheeting prior to the stud welding. Stud welding should comply with the requirements of AS 1554, Part 2 and AS 2327, Part 1. Some relevant welding requirements are:

- Zinc coating on sheeting not to exceed Z450;
- Mating surfaces of steel beam and sheeting to be cleaned of scale, rust, moisture, paint, overspray, primer, sand, mud or other contamination that would prevent direct contact between the parent material and the BONDEK;
- Welding shall be done in dry conditions by a certified welder;
- For pre-painted BONDEK sheets, special welding procedures may be necessary; and
- For sheets transverse to beams, stud welding shall be between pan flutes to ensure there is no gap between mating surfaces.

Note: Welding may void warranty as well as damaging steel support.

7.3.6 Installing BONDEK on brick supports

Brick walls are usually considered to be brittle and liable to crack from imposed horizontal loads. Thermal expansion and contraction, long-term shrinkage, creep effects and flexural deflection of concrete slabs may be sufficient to cause such cracking.

To prevent the cracking, BONDEK slabs are not usually installed directly on brick supports, although this is not always the case in earthquake construction.

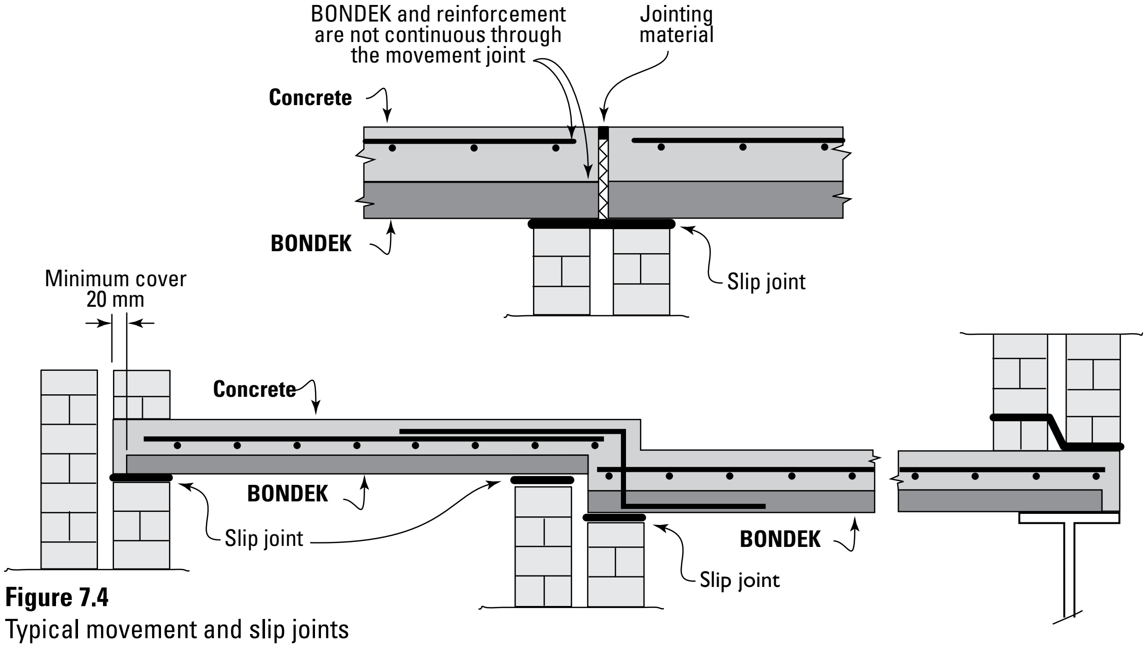


Figure 7.4
Typical movement and slip joints

Slip joints

Generally, a slip joint is provided between BONDEK and masonry supports (Figure 7.4).

- No fasteners are used between BONDEK and its support at a slip joint.
- Slip joint material may be placed directly in contact with the cleaned surface of steelwork.
- The top course of masonry should be level, or finished with a levelled bed of mortar to provide an even bearing surface. Lay the top courses of bricks with the frogs facing down.
- The width of a slip joint should not extend beyond the face of the slab support.
- The slip joint material shall have adequate compressive strength to avoid it being compressed into irregularities of the mating surfaces and thus becoming a rigid joint.

Slip joint material shall allow movement to occur, usually by allowing flow under pressure or temperature, however it shall not run or solidify. Generically, the materials are a non-rotting, synthetic carrier impregnated with a neutral synthetic or petroleum-based material. Typical slip joint material is Alcor (a bitumen coated aluminium membrane).

NOTE: Earthquake zones will require special detailing

7.3.7 Installing BONDEK on concrete-frames

When used in concrete-frame construction, the BONDEK sheeting is discontinuous through the supports (Figure 7.5).

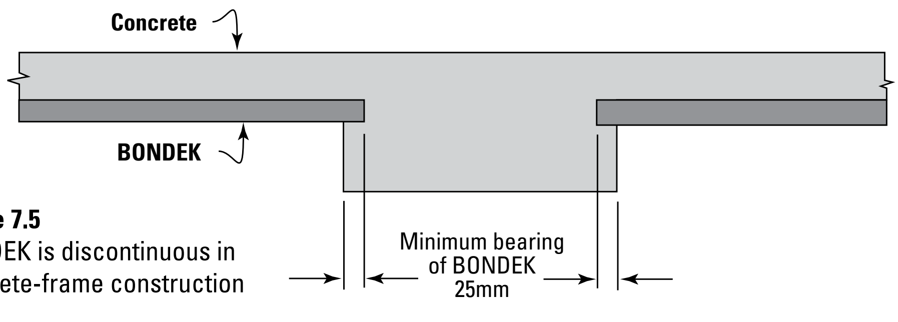


Figure 7.5
BONDEK is discontinuous in concrete-frame construction

7.3.8 Provision of construction and movement joints

Joints used between BONDEK slabs generally follow accepted construction practices. Construction joints are included between slabs for the convenience of construction. Movement joints allow relative movement between adjoining slabs. The joints may be transverse to, or parallel with, the span of the BONDEK slab. Movement joints need a slip joint under the BONDEK sheeting. (Figure 7.4).

Joints typically use a non-rotting, synthetic carrier impregnated with a neutral synthetic or petroleum based material like Malthoid (a bitumen impregnated fibre-reinforced membrane). Sometimes a sealant is used in the top of the joint for water tightness.

The BONDEK sheeting and any slab reinforcement are not continuous through a joint.

Design engineers generally detail the location and spacing of joints because joints effect the design of a slab.

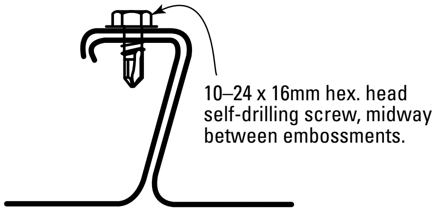


Figure 7.6
Fixing at a side lap

7.3.9 Fastening side-lap joints

If BONDEK sheeting has been distorted in transport, storage or erection, side-lap joints may need fastening to maintain a stable platform during construction, to minimise concrete seepage during pouring, and to gain a good visual quality for exposed soffits (Figure 7.6).

7.3.10 Cutting and fitting Edgeform

Edgeform is a simple C-shaped section that simplifies the installation of most BONDEK slabs. It is easily fastened to the BONDEK sheeting, neatly retaining the concrete and providing a smooth top edge for quick and accurate screeding. We make it to suit any slab thickness.

Edgeform is easily spliced and bent to form internal and external corners of any angle and shall be fitted and fully fastened as the sheets are installed. There are various methods of forming corners and splices. Some of these methods are shown in Figures 7.7 and 7.8.

Fasten Edgeform to the underside of unsupported BONDEK panels every 300mm. The top flange of Edgeform shall be tied to the ribs every 600mm (or less if aesthetics are required) with straps formed on-site using builder's strapping 25mm x 1.0 mm (Figures 7.7 and 7.8). Use 10–16 x 16mm self-drilling screws.

Make sure that the zinc coating on Edgeform matches the corrosion protection requirements of your job.

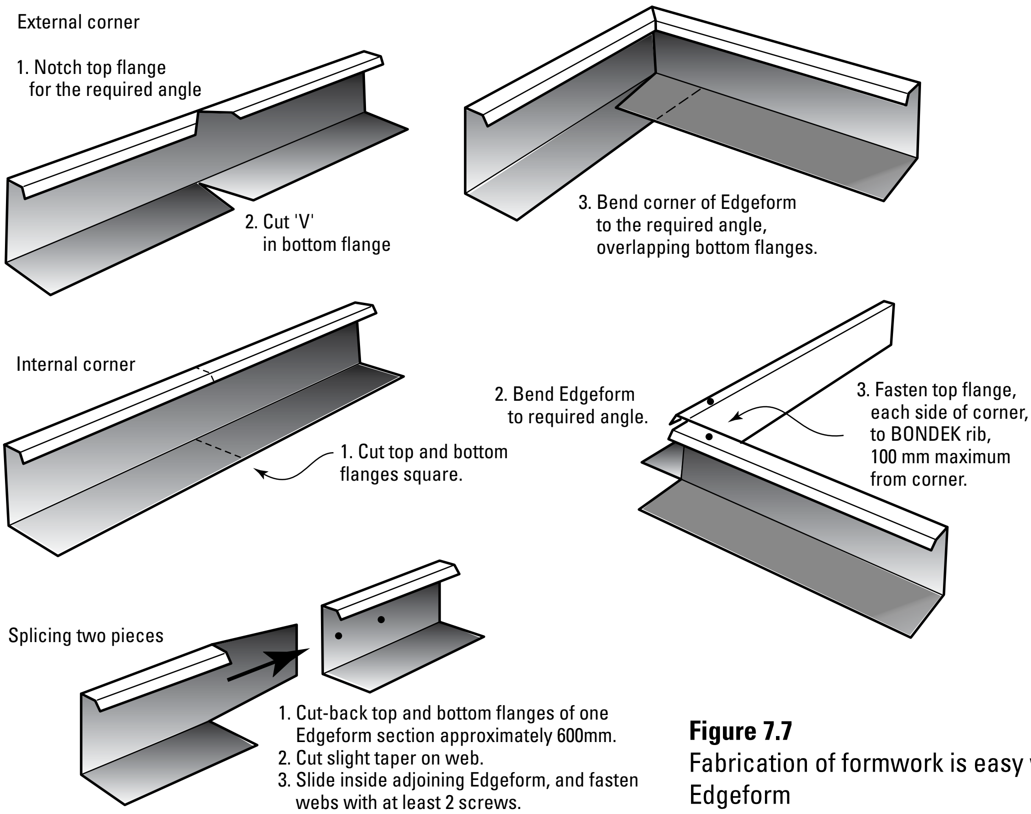


Figure 7.7
Fabrication of formwork is easy with Edgeform

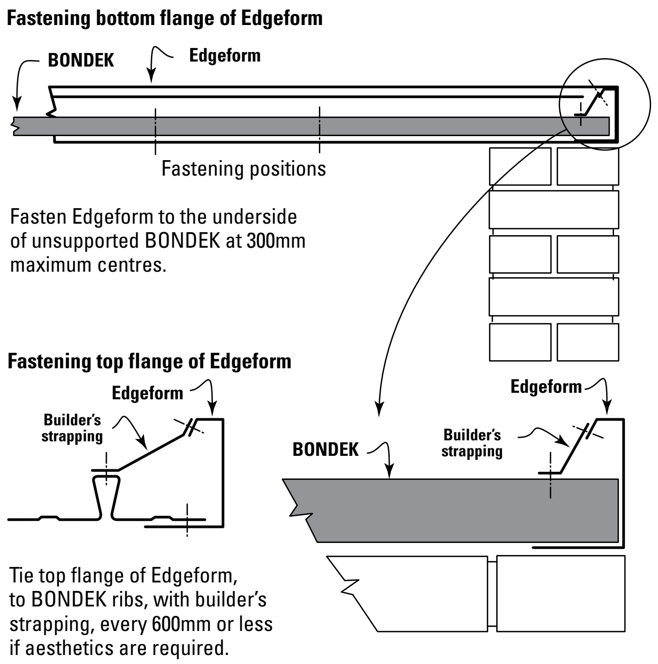


Figure 7.8
Typical fastening of Edgeform to BONDEK

7.3.11 Cutting of sheeting

It is easy to cut LYSAGHT BONDEK sheets to fit. Use a power saw fitted with an abrasive disc or metal cutting blade. Initially lay the sheet with its ribs down, cut through the pans and part-through the ribs, then turn over and finish by cutting the tops of the ribs.

7.3.12 Items embedded in slabs

Generally use items in a manner which complies with AS 3600:2009, Clause 17.4, and Clause 17.5. Included are pipes and conduits, sleeves, inserts, holding-down bolts, chairs and other supports, plastic strips for plasterboard attachment, contraction joint material and many more.

Table 7.1

Location of items within the slab (Figure 7.9)

Items	Location
Pipes parallel with the ribs and other items	• Between the ribs; and • below the top-face reinforcement; and • above the pans and flutes of the BONDEK
Pipes across the ribs	In the space between the top-face and bottom-face reinforcements (if there is no bottom-face reinforcement, above the top of the ribs)

Minimise the quantity and size of holes through BONDEK sheeting, by hanging services from the underside of BONDEK using accessories such as BON-NUT® and BONWEDGE®.

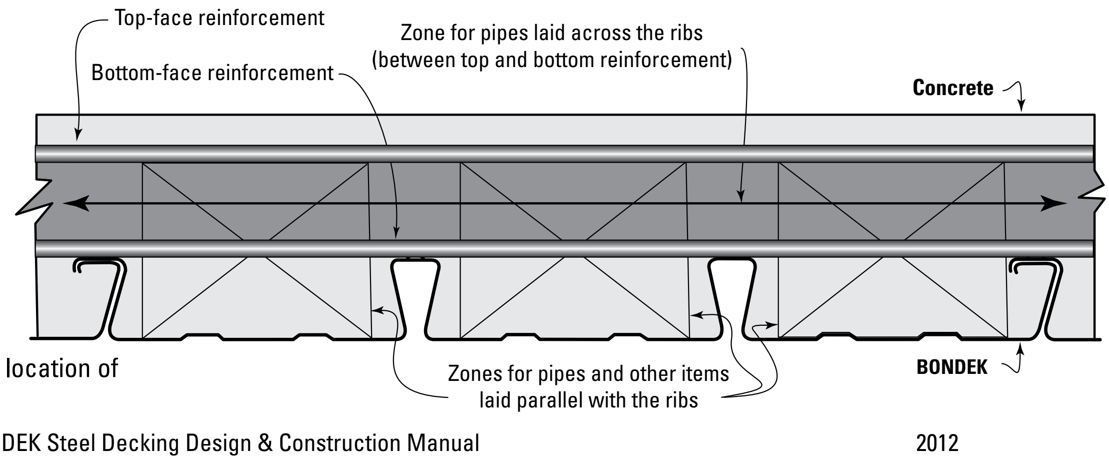


Figure 7.9 Zones for the location of holes through BONDEK

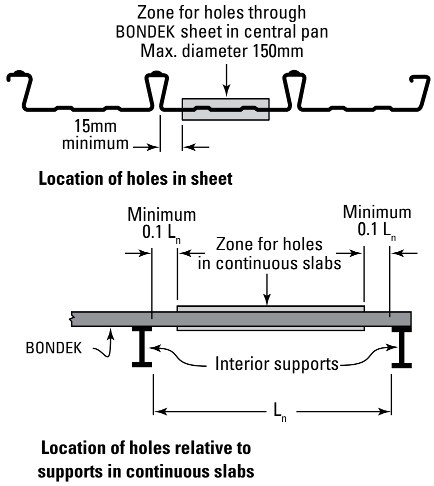


Figure 7.11
Penetration through BONDEK sheets.

7.3.13 Holes in sheeting

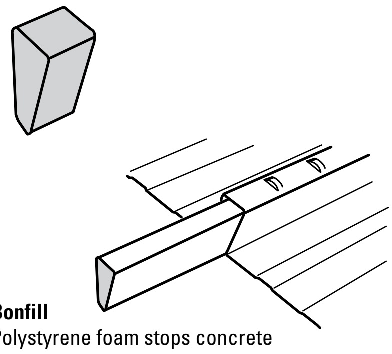
BONDEK acts as longitudinal tensile reinforcement similarly to conventional bar or fabric reinforcement does in concrete slabs. Consequently, holes in BONDEK sheets, to accommodate pipes and ducts, reduce the effective area of the steel sheeting and can adversely effect the performance of a slab.

Some guidelines for holes are: (Figure 7.11)

- Place holes in the central pan of any sheet, with a minimum edge distance of 15mm from the rib gap.
- Holes should be round, with a maximum diameter of 150mm.
- For slabs designed as a continuous slab: space holes from an interior support of the slab no less than one tenth of a clear span.

Note: In the event of BONDEK ribs being cut for larger penetrations, sufficient reinforcing steel and detailing is required to replace lost BONDEK ribs. Attention to propping at these locations is essential.

End plug
Polyethylene end plug stops
concrete and air from entering
end of BONDEK ribs.



Bonfill
Polystyrene foam stops concrete
and air entering ends of ribs.
Stock length: 1200mm
Required: 300mm per sheet of BONDEK

7.3.14 Sealing

Seepage of water or fine concrete slurry can be minimised by following common construction practices. Generally gaps are sealed with waterproof tape, or Bonfill (Figure 7.10) or by sandwiching contraction joint material between the abutting ends of BONDEK sheet. If there is a sizeable gap you may have to support the waterproof tape.

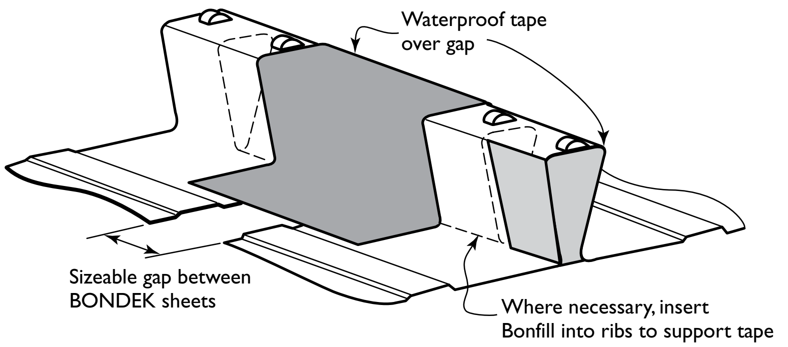


Figure 7.10
Typical sealing of BONDEK
Use waterproof tape to seal joints in BONDEK sheets

7.3.15 Inspection

BONDEK sheeting acts as longitudinal tensile reinforcement.

The condition of sheeting should be inspected before concrete is poured.

We recommend regular qualified inspection during the installation, to be sure that the sheeting is installed in accordance with this publication and good building practice.

7.4 Positioning and support of reinforcement

Reinforcement in slabs carries and distributes the design loads and to control cracking. Reinforcement is generally described as transverse and longitudinal in relation to span, but other reinforcement required for trimming may be positioned in other orientations. Figure 7.12 shows a typical cross-section of a BONDEK composite slab and associated terms.

Reinforcement shall be properly positioned, lapped where necessary to ensure continuity, and tied to prevent displacement during construction. Fix reinforcement in accordance with AS 3600:2009, Clause 17.2.5 (Fixing).

To ensure the specified minimum concrete cover, the uppermost layer of reinforcement shall be positioned and tied to prevent displacement during construction (Section 4.4 of this Manual).

Splicing of conventional reinforcement shall be in accordance with AS 3600:2009, Clause 13.2 (Splicing of reinforcement).

Where fabric is used in thin slabs, or where fabric is used to act as both longitudinal and transverse reinforcement, pay particular attention the required minimum concrete cover and the required design reinforcement depth at the splices-splice bars are a prudent addition.

Always place chairs and spacers on pan areas. Depending upon the type of chair and its loading, it may be necessary to use plates under chairs to protect the BONDEK, particularly where the soffit will be exposed. Transverse reinforcement may be used for spacing or supporting longitudinal reinforcement.

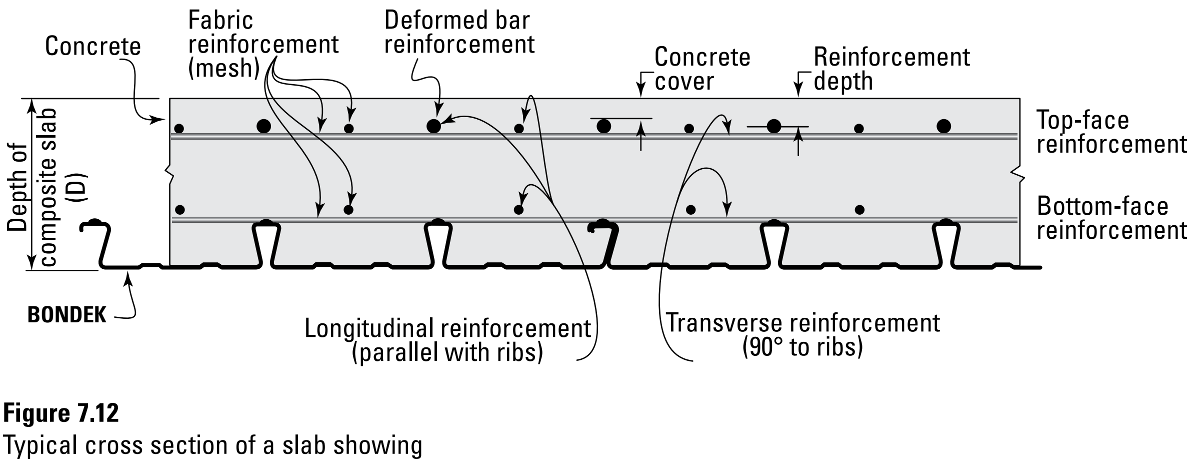


Figure 7.12
Typical cross section of a slab showing common terms.

7.4.1 Transverse reinforcement

Transverse reinforcement is placed at right-angles to the ribs of LYSAGHT BONDEK. Deformed bar or fabric reinforcement may be used. In most applications the transverse reinforcement is for the control of cracks caused by shrinkage and temperature effects, and for locating longitudinal reinforcement.

For ease of construction, reinforcement for control of cracking due to shrinkage and temperature effects is usually fabric reinforcement. It may be located anywhere within the depth of the slab if total thickness does not exceed 250mm. Two layers would be necessary for thicker slabs. Design tables presented in this manual can be used if mesh is located as shown in Figure 7.12

7.4.2 Longitudinal reinforcement

Longitudinal reinforcement is positioned to carry design loads in the same direction as the ribs of LYSAGHT BONDEK. Deformed bar or fabric reinforcement may be used.

Top-face longitudinal reinforcement is usually located over interior supports of the slab and extends into approximately a third of the adjoining spans.

Bottom-face longitudinal reinforcement is located between supports of the slab but, depending upon the detailing over the interior supports, it may be continuous, lapped, or discontinuous. Bottom-face longitudinal reinforcement may be placed on top of or below transverse reinforcement.

Location of top and bottom-face longitudinal reinforcement in elevated temperatures requires special design. (Refer Section 5 of this Manual)

7.4.3 Trimmers

Trimmers are used to distribute the design loads to the structural portion of the slab and/or to control cracking of the concrete at penetrations, fittings and re-entrant corners. Deformed bar or fabric reinforcement may be used.

Trimmers are sometimes laid at angles other than along or across the span, and generally located between the top and bottom layers of transverse and longitudinal reinforcement. Trimmers are generally fixed with ties to the top and bottom layers of reinforcement.

7.5 Concrete

7.5.1 Specification

The concrete is to have the compressive strength as specified in the project documentation and the materials for the concrete and the concrete manufacture should conform to AS 3600:2007.

7.5.2 Concrete additives

Admixtures or concrete materials containing calcium chloride or other chloride salts shall not be used. Chemical admixtures including plasticisers may be used if they comply with AS 3600:2009, Clause 17.

7.5.3 Preparation of sheeting

Before concrete is placed, remove any accumulated debris, grease or any other substance to ensure a clean bond with the LYSAGHT BONDEK sheeting. Remove ponded rainwater.

7.5.4 Construction joints

It is accepted building practice to provide construction joints where a concrete pour is to be stopped. Such discontinuity may occur as a result of a planned or unplanned termination of a pour. A pour may be terminated at the end of a day's work, because of bad weather or equipment failure. Where unplanned construction joints are made, the design engineer shall approve the position.

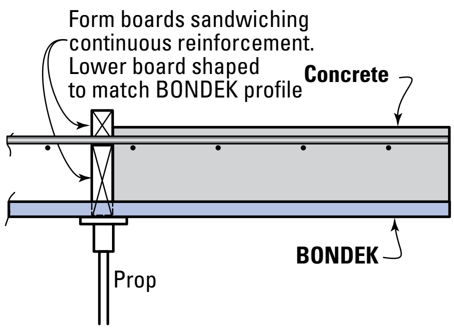
In certain applications, the addition of water stops may be required, such as in roof and balcony slabs where protection from corrosion of reinforcement and sheeting is necessary.

Construction joints transverse to the span of the LYSAGHT BONDEK sheeting are normally located at the mid-third of a slab span and ideally over a line of propping. Locate longitudinal construction joints in the pan (Figure 7.13).

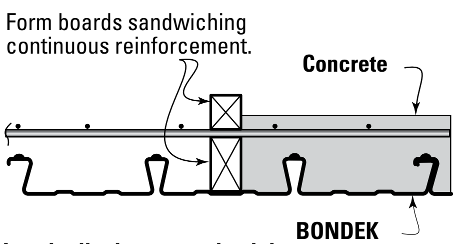
It may be necessary to locate joints at permanent supports where sheeting terminates. This is necessary to control formwork deflections since formwork span tables are worked out for uniformly distributed loads (UDL) applied on all formwork spans.

Form construction joints with a vertical face - the easiest technique is to sandwich a continuous reinforcement between two boards.

Prior to recommencement of concreting, the construction joint shall be prepared to receive the new concrete, and the preparation method will depend upon the age and condition of the old concrete. Generally, thorough cleaning is required to remove loose material, to roughen the surface and to expose the course aggregate.



Transverse construction joint



Longitudinal construction joint

Figure 7.13
Typical construction joint

7.5.5 Placement of concrete

The requirements for the handling and placing of the concrete are covered in AS 3600:2009, Clause 17.1.3.

The concrete is placed between construction joints in a continuous operation so that new concrete is placed against plastic concrete to produce a monolithic mass. If the pouring has to be discontinued for any more than approximately one hour, depending on the temperature, a construction joint may be required.

Start pouring close to one end and spread concrete uniformly, preferably over two or more spans. It is good practice to avoid excessive heaping of concrete and heavy load concentrations. When concrete is transported by wheel barrows, the use of planks or boards is recommended.

During pouring, the concrete should be thoroughly compacted, worked around ribs and reinforcement, and into corners of the edge forms by using a vibrating compactor. Ensure that the reinforcement remains correctly positioned so that the specified minimum concrete cover is achieved.

Unformed concrete surfaces are screeded and finished to achieve the specified surface texture, cover to reinforcement, depths, falls or other surface detailing.

Surfaces which will be exposed, such as Edgeform and exposed soffits, should be cleaned of concrete spills while still wet, to reduce subsequent work.

7.5.6 Curing

After placement, the concrete is cured by conventional methods, for example, by keeping the slab moist for at least seven days, by covering the surface with sand, building paper or polythene sheeting immediately after it has been moistened with a fine spray of water. Follow AS 3600:2009, Clause 17.1.5 (Curing and protection of concrete) and good building practice. Be particularly careful when curing in very hot or very cold weather.

Until the concrete has cured, it is good practice to avoid concentrated loads such as barrows and passageways with heavy traffic.

7.5.7 Prop removal

Various factors affect the earliest time when the props may be removed and a slab is initially loaded. Methods of calculating times and other guides are given in AS 3610:1995, Clause 5.4.3 (Stage III of construction - Formwork stripping and after placement of concrete).

7.6 Finishing

7.6.1 Soffit and Edgeform finishes

For many applications, BONDEK gives an attractive appearance to the underside (or soffit) of a composite slab, and will provide a satisfactory ceiling - for example, in car parks, under-house storage and garages, industrial floors and the like. Similarly, Edgeform will give a suitable edging. Additional finishes take minimal extra effort.

Where the BONDEK soffit is to be the ceiling, take care during construction to minimise propping marks (refer to Installation - Propping), and to provide a uniform surface at the side-laps (refer to Installation - Fastening side-lap joints).

Exposed surfaces of BONDEK soffit and Edgeform may need cleaning and/or preparation for any following finishes. The cleaning preparations are shown in Table 7.2.

Table 7.2 Preparation of soffits and Edgeform

Prepainted soffit or edge	• Remove all protective plastic strips from rolled corners. • Concrete seepage marks and dirt may be removed by washing with water. For stubborn stains, use a mild solution of pure soap or non-abrasive detergent in warm water. • Grease or oil deposits may be removed by washing as described above. For stubborn deposits contact us for advice. Never use abrasive or solvent type cleaners (like turps, petrol or kerosene) on pre-painted steel.
Galvanised soffit or edge	• Light corrosion marks indicated by white to grey staining due to wet bundles may be removed with a kerosene rag. If this is unsatisfactory, then wire brushing may be necessary. Take care not to unnecessarily remove any of the zinc coating. If zinc coating is removed, a suitable paint system must be used. • Grease or oil deposits may be removed with a kerosene rag. For stubborn deposits, use paint thinners. • Concrete seepage marks and dirt to be removed by washing as described above.

7.6.2 Painting

Various painting systems are available for use with zinc coatings to provide a decorative finish and/or to provide an appropriate corrosion protection system.

There are recommendations suitable for painting soffits and edges in Painting zinc-coated or ZINCALUME® steel sheet (BlueScope Lysaght technical information booklet). Field (on-site) painting systems from that booklet are summarised in Table 7.3.

The performance of a paint system is influenced by the quality of preparation and application - closely follow the paint manufacturer's instructions.

For painted soffits, it may be preferable to cover the gaps of the ribs prior to painting. BONSTRIP snaps into the gaps of the ribs of the BONDEK sheeting and produces an attractive appearance (Figure 7.14).

The gap at the side-lap joint can be filled with a continuous bead of silicon sealant prior to painting.

Note: Overpainting will void any warranties issued by BlueScope Steel. Paint manufacturers' approved applicators provide the performance warranty for overpainted products. Refer BlueScope Steel Technical Bulletin TB-2 for further information.

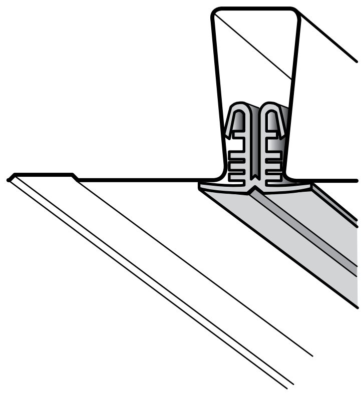


Figure 7.14
BONSTRIP makes an attractive cover for the gaps formed by BONDEK ribs.

Table 7.3 Painting BONDEK soffits and EDGEFORM

Exposure classification (AS 3600)	Primer		Finish	
	Type	Application	Type	Application
A1 & A2	Water-borne acrylic (1 coat)	Brush	Water-borne acrylic (2 coats)	Brush
B1	2-pack etch primer (1 coat)	Brush or spray	Alkyd (2 coats)	Brush or spray
			Oleoresinous/micaceous iron oxide (2 coats)	Brush or spray
	Zinc dust/zinc oxide (1 coat)	Brush or spray	Zinc dust/zinc oxide (1 coat)	Brush or spray
			Alkyd (2 coats)	Brush or spray
			Oleoresinous/micaceous iron oxide (2 coats)	Brush or spray
B2	2-pack etch primer (1 coat)	Brush or spray	High build vinyl (2 coats)	Spray
			2-pack polyurethane (2 coats)	Brush or spray

7.6.3 Plastering

Finishes such as vermiculite plaster can be applied directly to the underside of BONDEK with the open rib providing a positive key. With some products it may be necessary to treat the galvanised steel surface with an appropriate bonding agent prior to application.

Plaster-based finishes can be trowelled smooth, or sprayed on to give a textured surface. They can also be coloured to suit interior design requirements.

7.6.4 Addition of fire protective coating

Where a building is being refurbished, or there is a change of occupancy and floor use, you may need to increase the fire resistance of the BONDEK composite slabs. This may be achieved by the addition of a suitable fire-protection material to the underside of the slabs. The open ribs of BONDEK provide a positive key to keep the fire spray in position. Such work is beyond the scope of this manual.

7.7 Suspended ceilings and services

7.7.1 Plasterboard

A BONDEK soffit may be covered with plasterboard by fixing to battens or direct fixing using BONSTRIP.

Option 1

Steel ceiling battens can be fixed directly to the underside of the slab using powder-actuated fasteners. The plasterboard is then fixed to ceiling battens in the usual way (Figure 7.15).

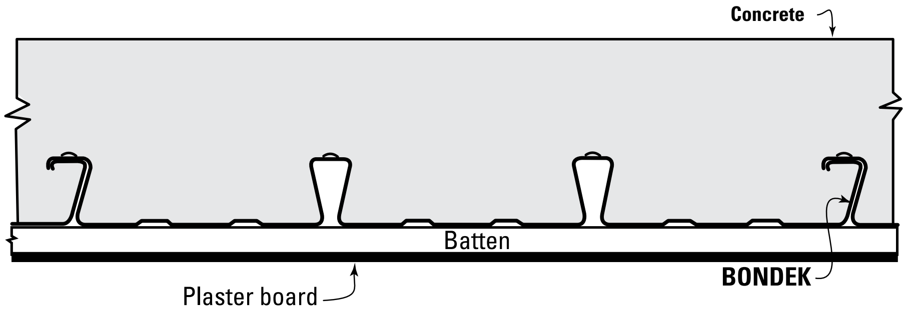
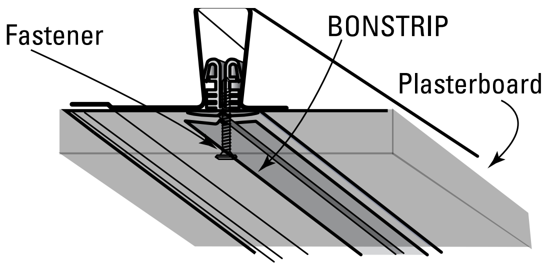


Figure 7.15
Fixing plasterboard to BONDEK.

Option 2:



Direct fix to BONSTRIP
Plasterboard may also be screwed directly into BONSTRIP using appropriate fasteners.

Figure 7.16

Note: With this detail attention to formwork, deflection limitations and service routes is critical.

7.7.2 Suspended ceiling

Ceilings are easily suspended from BONDEK slabs using M6 Bon-nut suspension nuts, or BONWEDGE suspension brackets which comply with the load capacity requirements of AS 2785. Threaded rods or wire hangers are then used to support the ceiling. Alternatively, hangers may be attached to eyelet pins powder-driven into the underside of the slab, or to pigtail hangers inserted through pilot holes in the BONDEK sheeting before concreting (Figure 7.21).

7.7.3 Suspended services

Services such as fire sprinkler systems, piping and ducting are easily suspended from BONDEK slabs using Bon-nut suspension nuts which comply with the load capacity requirements of AS 2118 (Figure 7.21).

7.8 Fire stopping detailing

7.8.1 At reinforced block walls

When using BONDEK with reinforced block walls the bearing length is often reduced to 25mm absolute minimum to allow adequate bearing prior to core filling from the deck level and continuation of wall reinforcement. (An alternative is to provide holes through pans over every blockwork core.) The BONDEK sheets still require fixing to the support structure. To maintain the fire rating level (FRL) of the (often reinforced) blockwork, the Bonfill can be displaced relative to the end of the BONDEK sheets as shown in Fig 7.17 to maintain the minimum through wall FRL requirement.

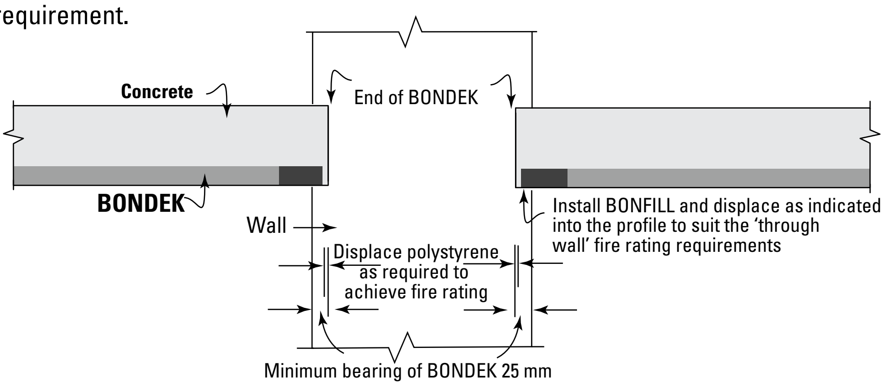


Figure 7.17 BONDEK fire detail at reinforced block walls7

7.8.2 Fire collars

BONDEK with its flat pan profile allows easy integration of proprietary fire collars that maintain the fire rating level through service penetrations as shown in Fig 7.18. They are generally up to 150mm diameter and are installed between the composite BONDEK ribs. Fire collars are fixed pre-pour usually by the plumbing contractor with screws to the BONDEK pan which is cut out after the pour is complete with the fire collar cast in place.

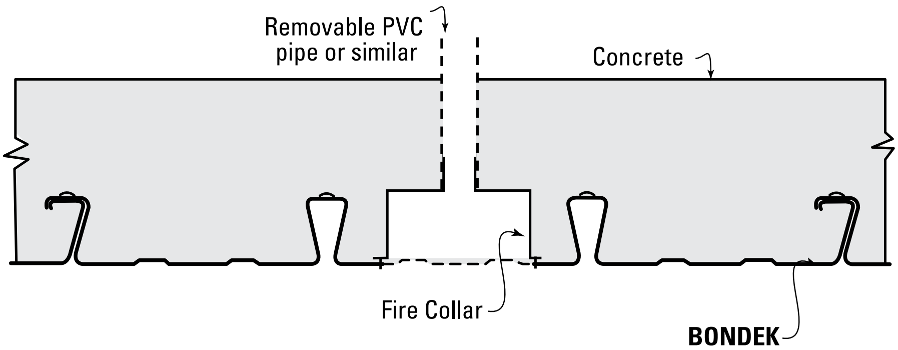


Figure 7.18
Proprietary fire collar fixed to BONDEK pan

7.9 BONDEK in post tensioned concrete-framed construction

7.9.1 BONDEK PT clip (post tensioned)

BONDEK is commonly used as permanent formwork in post tensioned (PT) solutions. The post tensioning clip locks into the BONDEK pan providing a secure anchoring point for the post tensioning duct chairs to be fixed onto. These clips will not move or dislodge during a concrete pour which is crucial for the post tensioning profile shape and structural performance.
In particular central location of tendons between BONDEK ribs is necessary to achieve desired fire rating - presence of BONDEK will not affect fire performance of PT slabs for up to 3 hours fire rating.

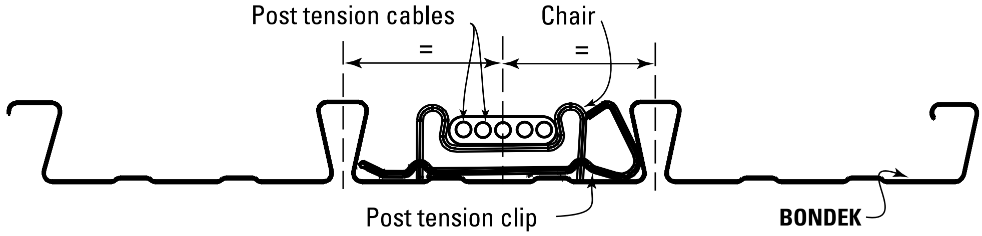


Figure 7.19
PT clip and chair assist in the correct positioning of post tensioning duct/cables.

7.9.2 BONDEK rib removal at PT anchor points or stressing pans

With post tensioned solutions dead and live anchor points can be located within slabs at a point over the BONDEK profile. To position bursting reinforcement or to install a stressing pan within a slab a short length of BONDEK rib is sometimes removed using a grinder or plasma cutter on site. This provides better end anchorage zone stress distribution to avoid stress concentrations between ribs. This zone where the rib is removed is sealed (usually with tape) before placing the post tensioning end termination component. (Refer to Sealing, Section 7.3.14 and Figure 7.10).

7.9.3 Positioning of PT duct/cables in transverse direction

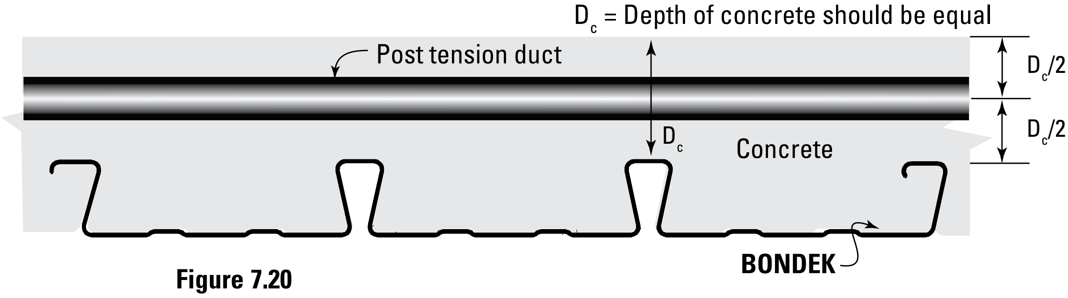


Figure 7.20
Positioning of PT duct/cables in transverse direction

Notes:
1. Position transverse duct/cables equidistant between top of BONDEK ribs and the surface of the concrete.
2. Equidistant location of duct/cables is necessary at BONDEK open ribs and side lap joint locations to ensure uniform compression stress across composite slab depth.

7.10 Architectural matters

Where structural decking soffits are visible and in particular where BRITEWITE® prepainted finishes are employed, special care must be taken when lifting, handling, storing on-site and laying this product. The underside is intended as an aesthetic feature of the installed product. For this reason, the following architectural aims need to be considered.

Rib Alignment: Or "registration" of ribs between adjacent spans. Be careful to align the BONDEK ribs where sheets meet over supporting beams so that when viewing the exposed product from the underside, the product presents uniform shadow lines between bays. Ensure that the sheets are laid in accordance with Section 7.3.2 end to end (or butting against jointing material) and have the ribs aligned.

Fixing: No activities should be carried out on the topside of the installed BONDEK that might have adverse affects on the bottom side, such as puddle welding or penetrating the deck with fasteners in locations where they will be visible from the underside. Securing the decking plan to the supporting structure as recommended in Section 7.3 will prevent movement of sheets and reduce slurry leakage under the sheets during pouring and vibration of the concrete.

Slurry leakages: During the concrete pour ensure there is no concrete leakage which might cause unsightly stains on the underside paint finish. Refer to Section 7.3.14 regarding sealing at ends and laps and Section 7.3.9 regarding side lap fixing. Foam tape should be utilised under the deck edges over the supporting structure (particularly in concrete frames) to minimise leakage under the sheets.

Handling: Section 7.2 covers care and storage before installation. With architectural finishes such as BRITEWITE®, which has plastic CORSTRIP® or Spot-stik® (or equivalent) applied to the decking soffit, special care is still required to minimise scratching and marking prior to placement. (i.e. during transport, site storage and handling of bundles and placement of individual sheets).

Visual quality:

a) Prop marking - Care should be taken to minimise prop marking through maintaining the quality of temporary propping support surfaces and adopting deflection ratio limitations in accordance with Section 3.2. Care in controlling construction live loads such as workman, mounding of concrete and stacked materials will also improve the visual quality.

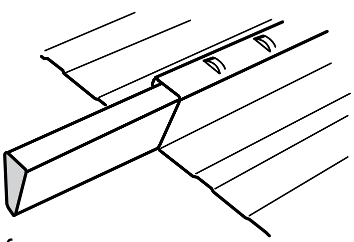
b) Side lap - Refer section 7.3.9 where visual quality of exposed soffits can be enhanced with side lap fixing.

Finishing: Section 7.3.14 covers gap sealing of the decking profile and jointing details. Utilising waterproof tape, BONFILL, and end plugs will control seepage of water or fine concrete slurry.

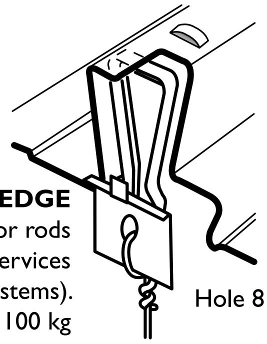
Protective films: BRITEWITE® is DECKFORM® steel prepainted with a SURFMIST® colour finish and has a CORSTRIP® protective film applied prior to roll forming. Store out of direct sunlight for ease of removal. It is generally installed before CORSTRIP® removal which tends to come off in narrow strips and typically has to be cut away from the laps and supports with a blade.

The removal of protective film can be made easier and soffit finish improved through the use of Spot-stik® coating (or equivalent) applied only to the flat pan of the profile during roll forming. The BRITEWITE® is supplied with a backing coat to prevent scuffing of the SURFMIST® colour soffit finish prior to roll forming. Spot-stik® coating (or equivalent) is subject to enquiry and currently only available in NSW on permanent formwork applications.

7.11 Accessories



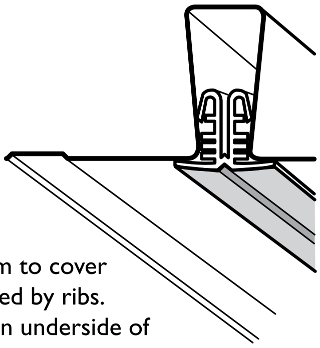
Bonfill
Polystyrene foam stops concrete and air entering ends of ribs.
Stock length: 1200 mm
Required: 300 mm per sheet of BONDEK.



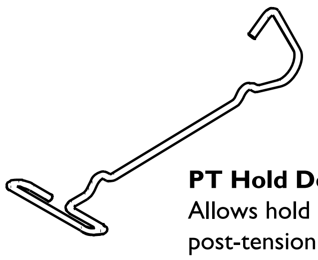
BONWEDGE
Lightweight bracket for rods to suspend ceilings or services (other than fire sprinkler systems).
Max. load: 100 kg

Hole 8 mm diameter

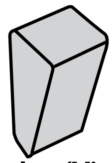
Configuration	Loading	Safe load (kN)
Single BONWEDGE	Eccentric	1.0
Double BONWEDGE	Eccentric	1.3
Double BONWEDGE	Central	1.7



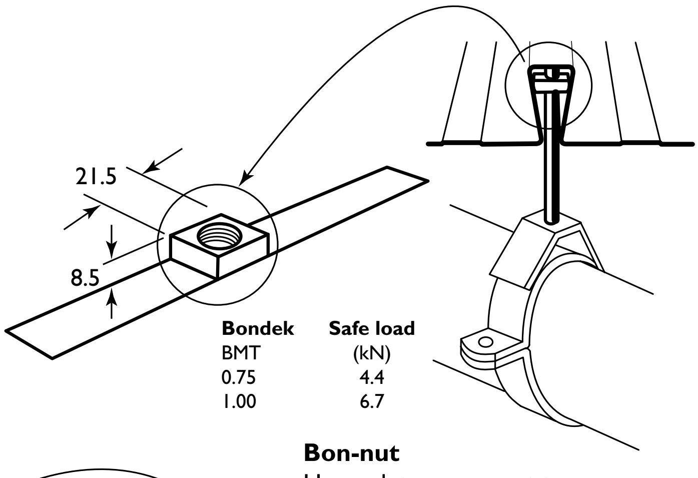
Bonstrip
Plastic trim to cover gaps formed by ribs.
Used when underside of BONDEK forms an exposed ceiling.
Stock length: 3000 mm.
Allows plasterboard to be fixed to BONDEK.



PT Hold Down clip
Allows hold down of post-tensioning ducts.

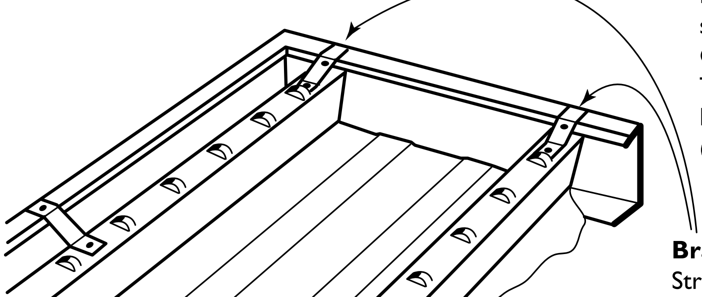


End plug (Vic., NSW & Qld)
Polyethylene end plug minimises concrete slurry seeping through.



Bondek BMT	Safe load (kN)
0.75	4.4
1.00	6.7

Bon-nut
Heavy duty square nut to suspend ceilings or services.
Glued to a paper strip it makes insertion easy.
Threads: M8, M10 and M12.
M6 is available for light loads only (2.7 kN or less)



Brackets from builders strapping
Straps formed on-site using builders strapping to secure top flange of the Edgeform.
25 mm x 1.0 mm fixed with self drilling, hex. head Tek® screws with drill point, 10-16 x 16
Required: one every 600 mm or less if aesthetics are required.

Edgeform
A galvanised section that creates a permanent formwork at the slab edges—cut, mitred and screwed on site.
1.0mm BMT - up to 145mm slab depth
1.2mm BMT - 150 - 175mm slab depth

Figure 7.21
BONDEK accessories

8. References

- AS/NZS 1170.0:2002 General principles

- AS/NZS 1170.1:2002 Permanent, imposed and other actions

- AS 1397:2011 Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium

- AS 1530.4:2005 Methods for fire tests on building materials, components and structures - Fire-resistance tests of elements of building construction

- AS 2327.1:2003 Composite structures - Simply supported beams

- AS 3600:2009 Concrete structures

- AS/NZS 4600:2005 Cold-formed steel structures

- AS 3610:1995 Formwork for concrete

- AS 3610 Supp 2 :1996 Formwork for concrete - Commentary

- Bennetts, I.D., Proe, D., Patrick, M. & Poon, S.L., Composite slabs incorporating BONDEK II sheeting designed for fire resistance in accordance with AS 3600, Report No. BHP/ENG/R/91/003/PS64R, BHP Research, Melbourne Laboratories, November 1991

- EN 1994-1-1:2005 Design Of Composite Steel And Concrete Structures - Part 1-1: General Rules And Rules For Buildings

- EN 1994-1-2:2005 Design of Composite Steel and Concrete Structures - Part 1-2: General Rules - Structural Fire Design

- EN 1992-1-1:2004 Design of Concrete Structures - Part 1: General Rules and Rules for Buildings

- Bennetts, I.D., Filonov, A. A., "Investigation of the behaviour of composite slabs in fire", Australian Structural Engineering Conference, 11-14 September, 2005, Newcastle, Engineers Australia

Appendix A: Material specifications

LYSAGHT BONDEK sheets are readily available, custom-cut, in any length from 600mm up to 19,500mm (length tolerance +0, -10mm) Ask us about longer lengths up to a maximum of 25,000mm. To maximise speed of installation and get better performance, use lengths of BONDEK that cover multiple spans.

Sheeting

LYSAGHT BONDEK is available in the following gauges base metal thicknesses (BMT) 0.6, 0.75, 0.9* and 1.0mm. It is roll-formed from hot dipped, zinc coated, high tensile zinc HI-TEN® steel. The steel conforms to AS 1397, grade G550 and is available in Z350 and Z450* coatings (350g/m² or 450 g/m² zinc coating distributed between both sides ie. 175 or 225 g/m² per side).

In special circumstances LYSAGHT BONDEK may be obtained:

- in other base metal thickness
- with non-standard zinc coating mass
- with a prepainted finish to the underside, called BRITEWITE®

Concrete specification

ρ_c= 2400 kg/m³ (normal density)

See Table A1 for strengths.

Table A1 Concrete strengths

Exposure Classification	Minimum concrete compressive strength
A1 & A2	f'_c = 25 MPa
B1	f'_c = 32 MPa
B2	f'_c = 40 MPa

Reinforcement specification

- For negative and fire reinforcement D500N grade is used.
- For shrinkage D500L reinforcement is used.

Our design tables assume the use of D500N 12mm diameter bars for negative and fire reinforcement. If you want to use other grades or diameters, run the BONDEK software. The diameter of reinforcing bars should not exceed 20mm.

Shear connectors

Refer to AS 2327.1 to design composite steel beams.

* Availability is subject to enquiry.

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Where we recommend use of third party materials, ensure you check the manufacturer's requirements. Adjacent construction elements of the building that would normally be required in that particular situation are not always shown. Accordingly aspects of a diagram not shown should not be interpreted as meaning these construction or design details are not required. You should check the relevant Codes associated with the construction or design.

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