

LYSAGHT® Structural Decking Systems



LYSAGHT



Emirates
Towers, UAE



Baiyoke Tower II,
Thailand

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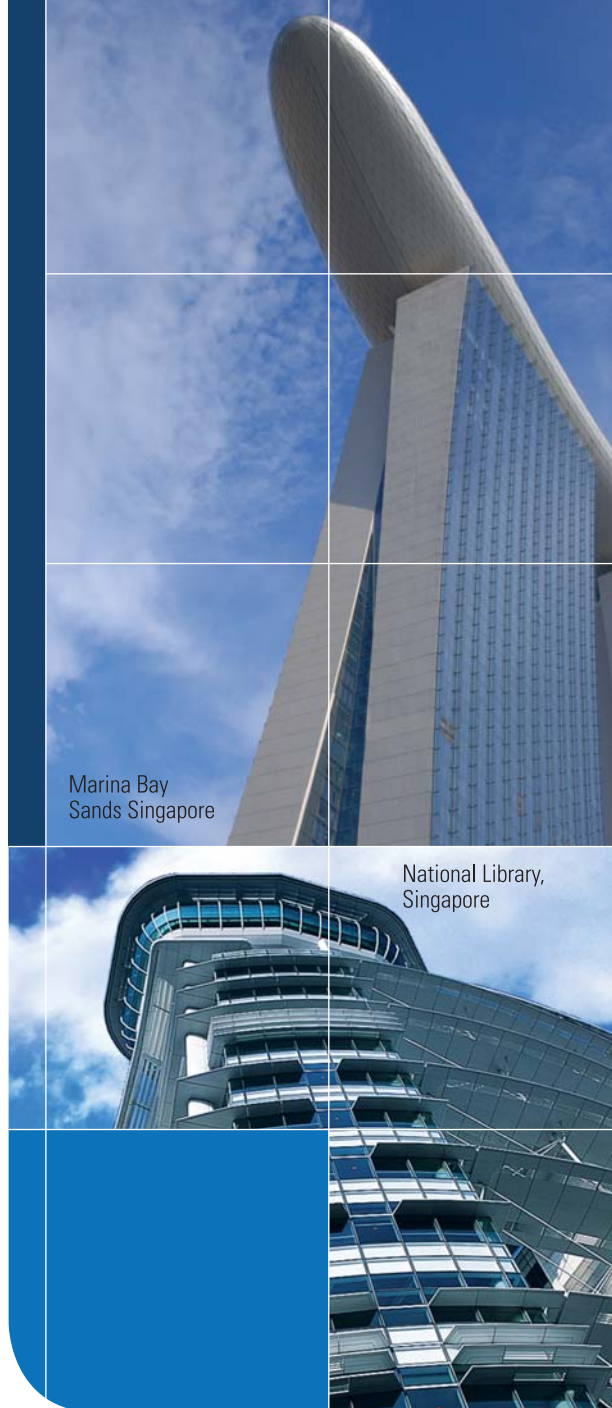
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ACCESSORIES

LYSAGHT® STRUCTURAL STEEL DECKING SOLUTIONS

Welcome to LYSAGHT® Structural Steel Decking Formwork and Installation Guide. We have simplified the work of engineers with this single book which replaces the two earlier publications - LYSAGHT® BONDEK® II Design and Construction Guide and LYSAGHT® POWERDEK® Design and Construction Guide. In addition, this guide book has been developed in accordance to the latest versions of relevant British Standards and includes advanced design of formwork and design for fire.

Extensive series of tests have been performed on LYSAGHT® structural steel decking systems, namely LYSAGHT® BONDEK® II and LYSAGHT® POWERDEK® steel decking profile, at Bluescope Lysaght Technology facility at Chester Hill, Sydney, Australia. This is to thoroughly investigate its structural behavior as formwork as well as longitudinal reinforcement in one-way composite slabs. LYSAGHT® BONDEK® II decking slabs and LYSAGHT® POWERDEK® slabs are fire-rated based on fire resistance tests performed at Victoria University of Technology.



Marina Bay Sands Singapore

National Library, Singapore

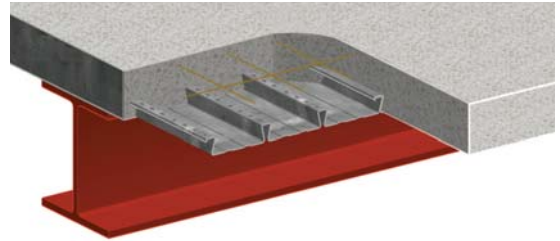
Features and Benefits

Features	Benefits	Value to the Developer
Prop-free formwork	Minimise input on project critical path.	Shorter period of construction
Thinner slab	Reduce load on existing columns and foundation.	Cost savings in construction
*PSB certified Fire-rated floor slab	Assurance for QP on the product performance	Building Safety Compliance.

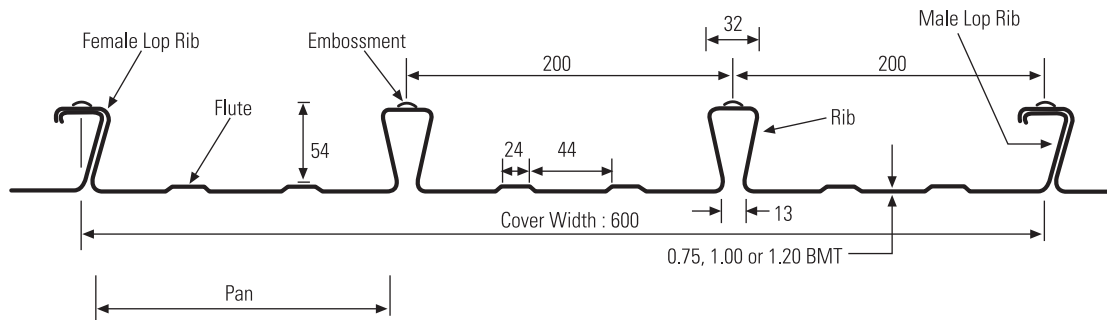
* Please contact BlueScope Lysaght Sales Consultant (Structural Decking) for more information.

LYSAGHT® BONDEK® II Structural Steel Decking System

Typical Unpropped span 2.6m - 3.8m



LYSAGHT® BONDEK® II STRUCTURAL STEEL PROFILE



Section Properties

Table 1: LYSAGHT® BONDEK® II structural steel profile section properties per metre of width

	Thickness	Grade	Section Modulus Area	Cross-sectional of Area	Second Moment	Weight
	BMT (mm)	(MPa)	$Z_x 10^3$ (mm ³ /m)	A_{sh} (mm ² /m)	$I_x 10^4$ (mm ⁴ /m)	(kg/m ²)
LYSAGHT® BONDEK® II Structural Steel Decking Profile	1.20*	500	20.03	2014	76.90	16.2
	1.00	550	16.69	1678	64.08	13.6
	0.75	550	12.50	1259	47.98	10.3

*Subject to availability

*subject to availability

DESIGN EFFICIENCY

The range of LYSAGHT® BONDEK® II steel decking profile gauges available (0.75mm, 1.0mm and 1.2mm) allows much closer matching of design requirements and deck performance. However, BlueScope Lysaght Singapore is able to offer non-standard thickness other than those stated above, subject to availability.

MATERIAL SPECIFICATION

LYSAGHT® BONDEK® II steel decking profile is roll-formed from hot

dipped, zinc-coated, high tensile steel from BlueScope Steel in base metal thickness (BMT) of 1.2, 1.0 and 0.75mm. The steel conforms to both AS 1397 and BS EN 10147.

Standard coating provided is Z275 (275g/m² minimum coating mass) or equivalent K18 (performance based). Special coating other than Z275 can also be requested for specific projects. Please contact BlueScope Lysaght Sales Consultant (Structural Decking) for more information on this.

Formwork Span 0.75 BMT									
Slab thickness (mm)	110	120	130	140	150	175	200	225	250
	No props								
Single Span (mm)	2300	2240	2180	2130	2080	1980	1890	1810	1740
Continuous Span (mm)	2530	2460	2400	2340	2290	2170	2070	1980	1910
	1 prop								
Single Span (mm)	3400	3600	3800	4000	4200	4350	4150	3970	3820
Continuous Span (mm)	4400	4800	4800	4690	4580	4350	4150	3970	3820
Formwork Span 1.0 BMT									
Slab thickness (mm)	110	120	130	140	150	175	200	225	250
	No props								
Single Span (mm)	2730	2670	2610	2550	2500	2390	2290	2210	2140
Continuous Span (mm)	3240	3170	3100	3030	2960	2810	2670	2560	2460
	1 prop								
Single Span (mm)	3400	3600	3800	4000	4400	4800	5350	5120	4920
Continuous Span (mm)	4600	5000	5200	5600	5930	5620	5350	5120	4920
Formwork Span 1.2 BMT									
Slab thickness (mm)	110	120	130	140	150	175	200	225	250
	No props								
Single Span (mm)	2890	2830	2750	2700	2640	2520	2420	2330	2250
Continuous Span (mm)	4000	3900	3810	3750	3660	3500	3360	3250	3100

FORMWORK

SPANNING CAPACITIES

New design rules have been developed for the design of LYSAGHT® BONDEK® II steel decking profile acting as a structural formwork for the construction of composite and non-composite slabs (where LYSAGHT® BONDEK® II steel decking profile is used as lost formwork). The rules for calculating moment capacities are based on testing performed at BlueScope Lysaght Technology facility at Chester Hill, Sydney, Australia.

The data obtained allowed us to include moment capacities in negative regions of the design model in accordance to BS 5950: Part 4: 1994 and reference document in this Standard: Technical Note 116: Design of profiled sheeting as permanent formwork. As a result, the span limits that previously applied to LYSAGHT® BONDEK® II decking profile in continuous spans have been increased by up to 12%.

COMPOSITE ACTION

LYSAGHT® BONDEK® II steel decking profile has a very high shear-bond capacity. Due to this, LYSAGHT® BONDEK® II profile slabs do not normally have limitations on imposed loads on typical spans unlike trapezoidal profiles.

ECONOMICAL DESIGN FOR FIRE

Fire tests conducted at Victoria University of Technology, Australia, showed that LYSAGHT® BONDEK® II steel decking profile has some

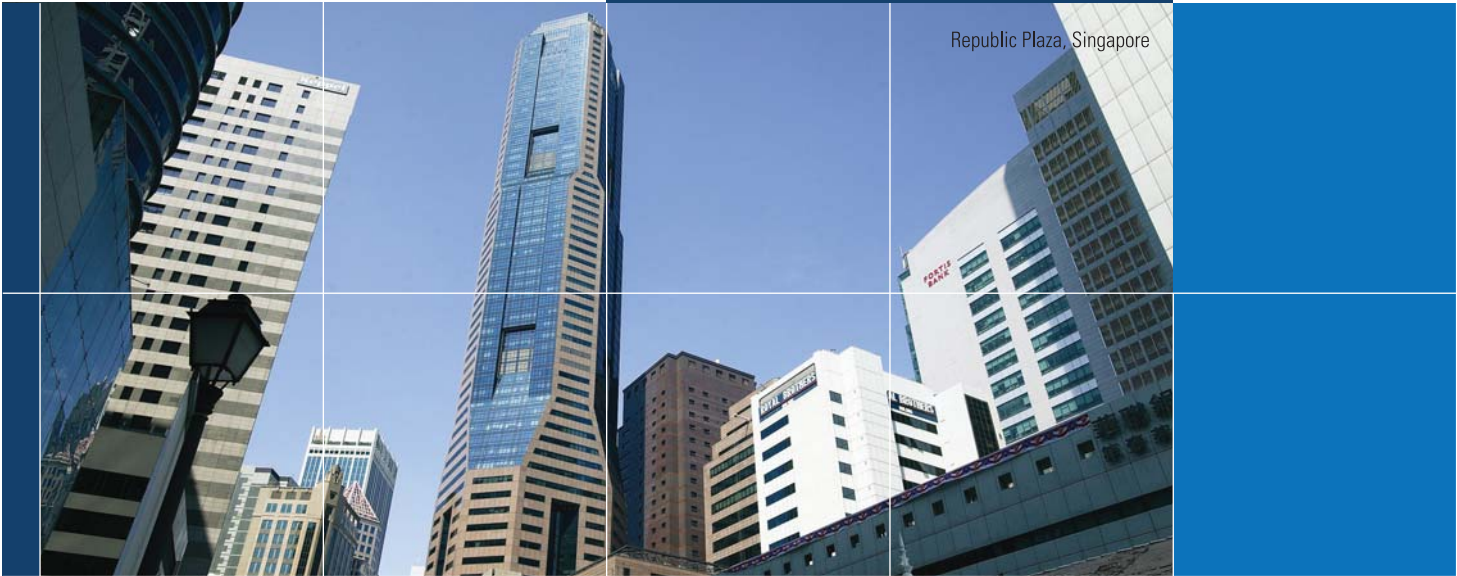
capacity in fire up to 120 minutes. Effective area of LYSAGHT® BONDEK® II profile is mainly concentrated in top flanges of the profile. Lap joints fully casted in concrete contribute more than dovetail ribs. Fire tests have been conducted to investigate temperatures within concrete body and within LYSAGHT® BONDEK® II profile sheeting itself as well as effect of elevated temperatures on shear bond capacity.

QUICKER AND TROUBLE-FREE INSTALLATION

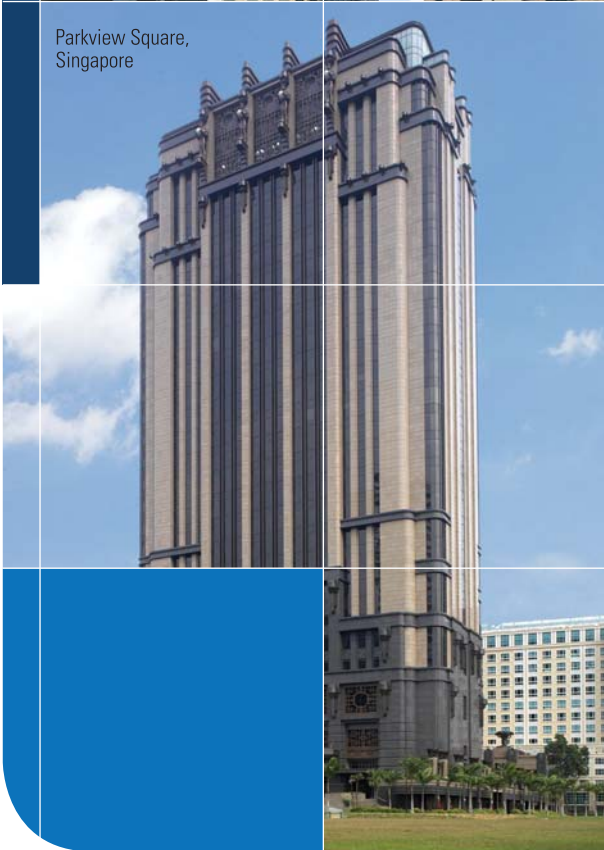
The installation of LYSAGHT® BONDEK® II structural steel decking systems follow simple, familiar and widely accepted practice. LYSAGHT® BONDEK® II steel decking profile is available in long lengths, so large areas can be quickly and easily covered to form a safe working platform during construction. The bold embossments along the top of the ribs of LYSAGHT® BONDEK® II steel decking profile enhances safety by reducing the likelihood of workers slipping.

TECHNICAL SUPPORT

Please contact BlueScope Lysaght if you require technical support services. Bluescope Lysaght Sales Consultants (Structural Decking) can also be reached to provide comprehensive design advice and information pertaining to the correct applications of LYSAGHT® BONDEK® II structural steel decking systems for engineers, architects and builders.



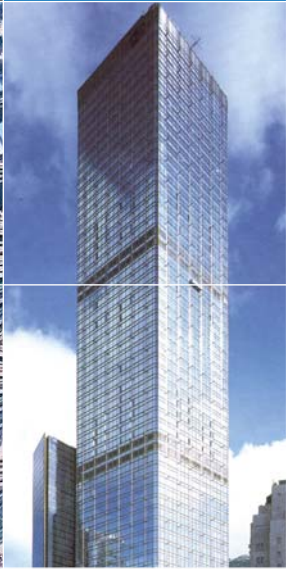
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Parkview Square, Singapore



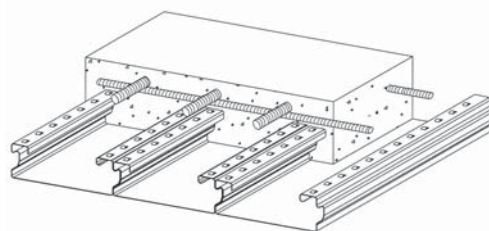
Petronas Twin Towers, Malaysia



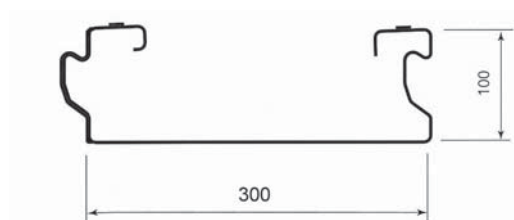
Cheung Kong Center, Hong Kong

LYSAGHT® POWERDEK® Structural Steel Decking System

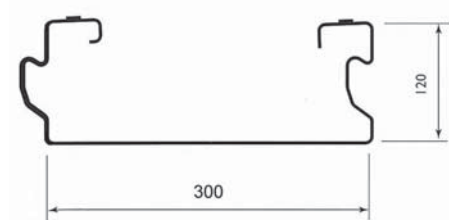
Typical Unpropped span 3.9m - 6.0m



LYSAGHT® POWERDEK® STRUCTURAL STEEL PROFILE



LYSAGHT® POWERDEK® 100 profile and dimensions



LYSAGHT® POWERDEK® 120 profile and dimensions

Section Properties

Table 2: LYSAGHT® POWERDEK® structural steel profile section properties per metre of width

	Base Metal Thickness (mm)	Grade (MPa)	Area (mm ² /m)	Self Weight (kg/m ²)	Effective Second Moment of Area (I _x ,mm ⁴ /m)	Effective Section Modulus (Z _x ,mm ³ /m)
LYSAGHT® POWERDEK® 100	1.0	550	2287	19.03	2115960	36390
	1.2	500	2715	22.62	2926700	51425
	1.5	450	3430	28.00	4218550	76100
LYSAGHT® POWERDEK® 120	1.2	500	2905	24.2	4467750	70600
	1.5	450	3630	29.6	6310920	98500

Notes:

Effective second moment of area varies depending on spans. Values in the table are given for maximum spans.

DESIGN EFFICIENCY

The large range of LYSAGHT® POWERDEK® 100 steel decking profile gauges available (1.5mm, 1.2mm and 1.0mm) and LYSAGHT® POWERDEK® 120 profile (1.5mm and 1.2mm) allows much closer matching of design requirements and deck performance.

MATERIAL SPECIFICATION

LYSAGHT® POWERDEK® 100 structural steel decking profile is roll-formed from hot dipped, zinc-coated, high tensile steel from BlueScope Steel, in base metal thickness (BMT) of 1.5mm, 1.2mm and 1.0 mm. LYSAGHT® POWERDEK® 120 decking profile is roll-formed from hot dipped, Aluminum / Zinc-coated, high tensile steel, in base metal thickness (BMT) of 1.5mm and 1.2mm.

The steel conforms to both AS 1397 and BS EN 10147. The grade of metal for the respective BMT are as follow :

- for 1.5 BMT, the grade of metal is G450 (450 MPa minimum yield strength)
- for 1.2 BMT, the grade of metal is G500 (500 MPa minimum yield strength)
- for 1.0 BMT, the grade of metal is G550 (550 MPa minimum yield strength)

Standard coating provided is Z275 (275g/m² minimum coating mass) or equivalent K18 (performance based). Special coating other than Z275 can also be requested for specific projects. Please contact BlueScope Lysaght Sales Consultant (Structural Decking) for more information on this. Punches on sides of embossments prevent formation of air pockets under flanges.

FORMWORK

SPANNING CAPACITIES

Long unpropped spanning capability is one of the major advantages of using LYSAGHT® POWERDEK® steel decking profile. It can span up to 6m with 1.5mm thickness of sheeting.

The superior spanning capacities achieved are due to several factors, which include:

- Unique structurally effective and stable profile.
- High tensile 450 to 550 MPa yield stress steel.

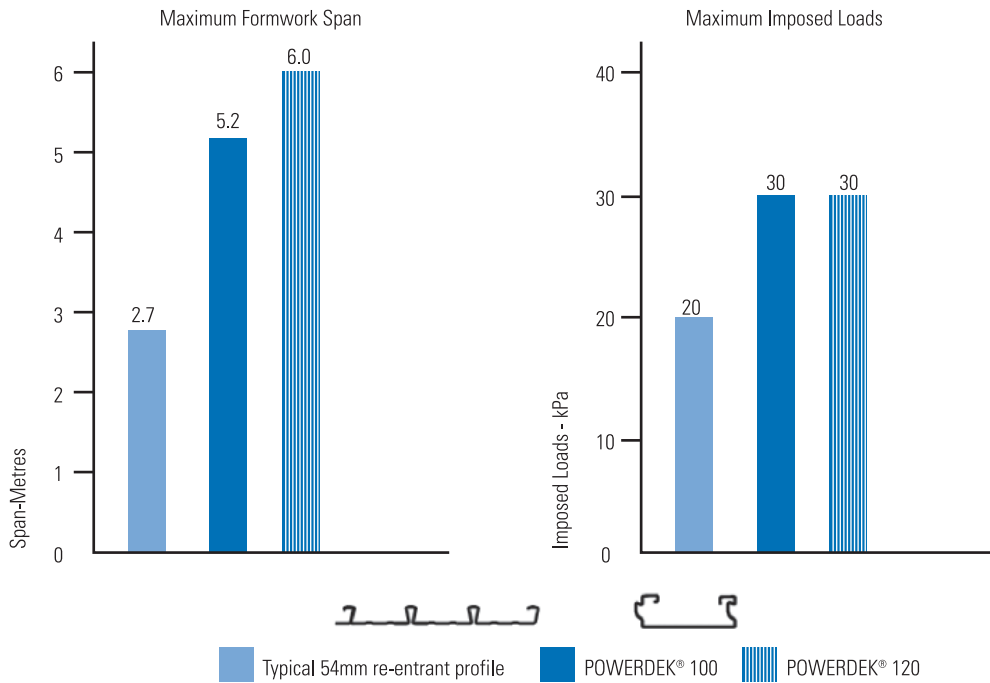


Fig 3.1 Formwork span and imposed loads for LYSAGHT® POWERDEK® steel decking profile

Table 3: Formwork Span for LYSAGHT® POWERDEK® profile

Formwork Span		No props				
		SPAN (mm)	Base Metal Thickness (BMT)	Slab Thickness (mm)		
				150	175	200
LYSAGHT® POWERDEK® 100	Single Span	1.0mm	3550	3380	3250	3010
	Double Span		3700	3520	3380	3130
	Single Span	1.2mm	4200	4010	3850	3590
	Double Span		4360	4170	4010	3730
	Single Span	1.5mm	4800	4660	4480	4150
	Double Span		5280	5050	4820	4500
LYSAGHT® POWERDEK® 120	Single Span	1.2mm	N.A.	N.A.	3530	3280
	Double Span		N.A.	N.A.	3680	3410
	Single Span	1.5mm	N.A.	N.A.	5000	4730
	Double Span		N.A.	N.A.	5470	5100

COMPOSITE ACTION

LYSAGHT® POWERDEK® structural steel decking profile has the highest shear-bond capacity among all known steel decking profiles. This allows withstanding very high imposed loads of up to 30kPa and more without additional conventional reinforcement.

ECONOMICAL DESIGN FOR FIRE

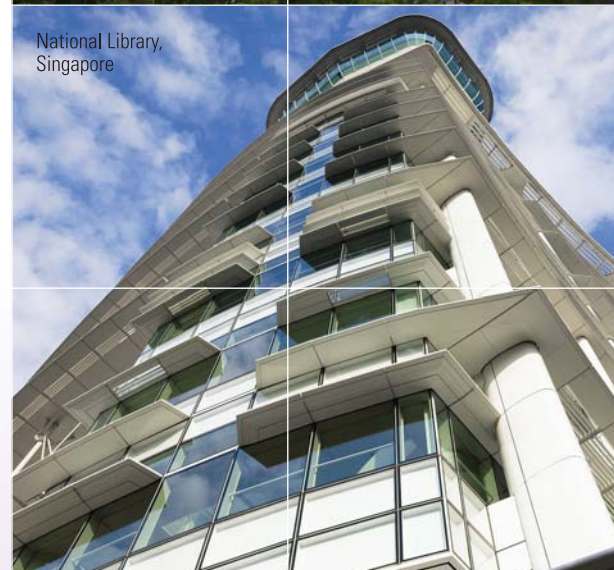
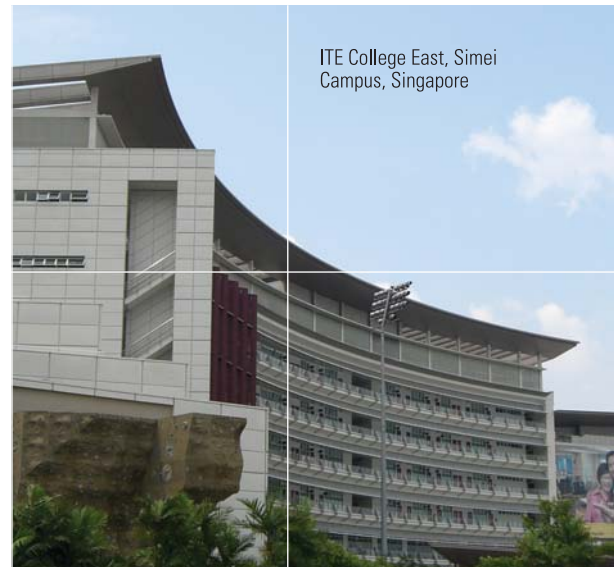
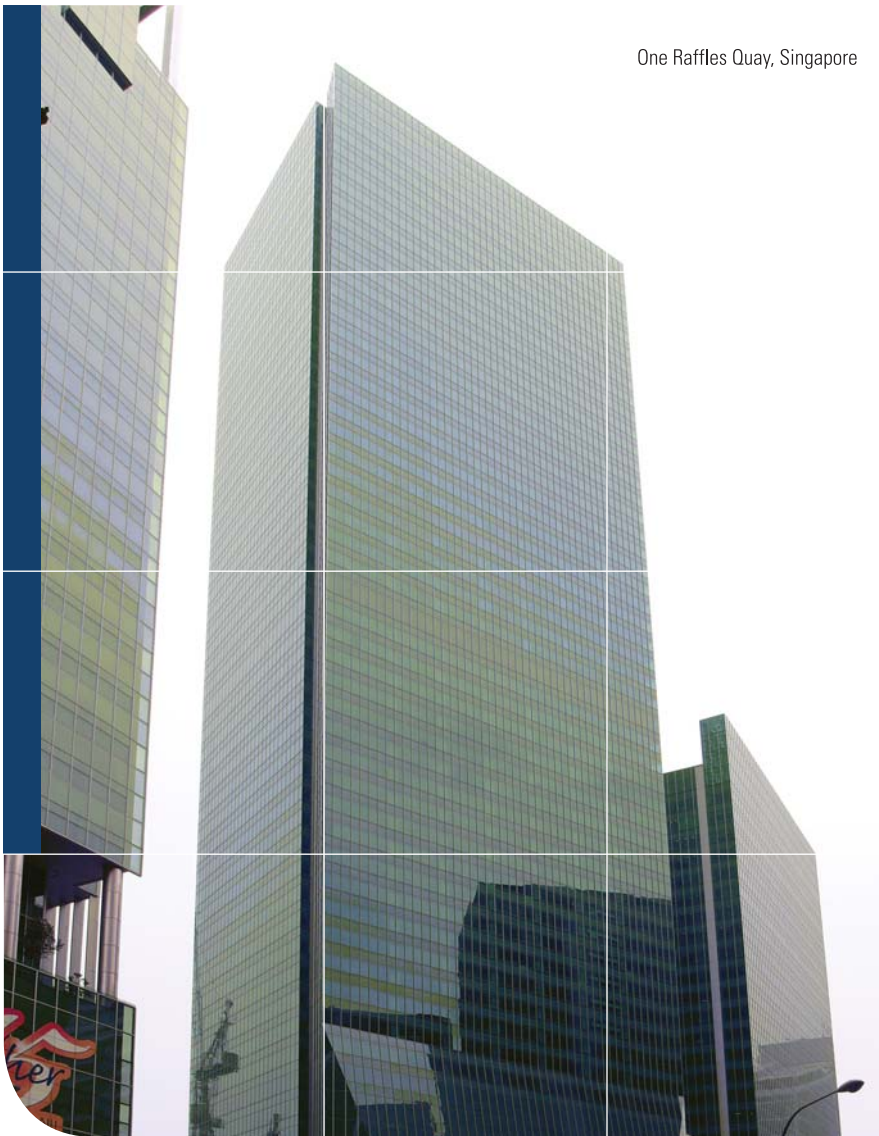
LYSAGHT® POWERDEK® structural steel decking profile has the best fire efficiency among all known structural decks. After 90 minutes of the standard fire test, LYSAGHT® POWERDEK® 100 profile in 1.5mm BMT has 1200mm² equivalent of fully effective steel per meter width. As a result, composite slabs with LYSAGHT® POWERDEK® profile will not require any additional fire reinforcement in most design cases.

QUICKER AND TROUBLE-FREE INSTALLATION

LYSAGHT® POWERDEK® structural steel decking profile requires minimal fixing of ribs during installation. Since no twist, rotation or sliding is necessary to lock sheets together, handling of the decking sheet is very simple.

TECHNICAL SUPPORT

Please contact BlueScope Lysaght if you require technical support services. Bluescope Lysaght Sales Consultants (Structural Decking) can also be reached to provide comprehensive design advice and information pertaining to the correct applications of LYSAGHT® POWERDEK® structural steel decking systems for engineers, architects and builders.



Formwork Design Stage

- LYSAGHT® BONDEK® II Decking Profile
- LYSAGHT® POWERDEK® Decking Profile

LYSAGHT® structural steel decking systems are designed to work as a formwork during construction stage. The formwork shall be designed in accordance to BS 5950: Part 4:1994 and BS 5950: Part 6:1996, Technical Note 116: Design of profile sheeting as permanent formwork. AS/NZS 4600:1996 may be used when British Standards are not sufficient.

The formwork spanning capacities tables in this manual can be used to detail LYSAGHT® structural steel decking systems acting as a structural formwork, provided that the following conditions are satisfied :

1. The support lines extend across the full width of the sheeting and have a minimum bearing of 50mm at the ends of the sheets when resting on steel or concrete and 70mm when resting on other materials such as brick, block or masonry wall.
2. The sheets continue within each slab span length without any overlaps or intermediate splicing or jointing longitudinally.
3. The sheets are designed as single or continuous span formwork.
4. The slab has a uniform cross section.
5. The formwork is not used as a restraint to supporting steel beams during construction. When necessary, restraint capacities can be analysed following first principles.
6. Separate consideration is given to sides of the sheeting where edges shall be restrained.
7. Profiled steel sheeting ends shall be securely fixed to the supporting structure.
8. The ratio of the longer slab span to the shorter slab span (L_L / L_S) of any two adjacent spans does not exceed 1.2 (ie. $L_L / L_S \leq 1.2$)
9. The supports are effectively rigid such that their vertical deflections during the construction phase can be ignored in design.
10. Maximum construction imposed load is 1.5 kPa, or 4.5/Slab span kPa for slab spans less than 3m. Construction imposed load can be applied on the steel deck formwork or recently formed slabs.
11. Maximum imposed storage load on the formwork is 4 kPa. This load shall not be applied on recently formed slabs.
12. Imposed construction loads shall not be applied to areas supporting storage loads and vice versa.

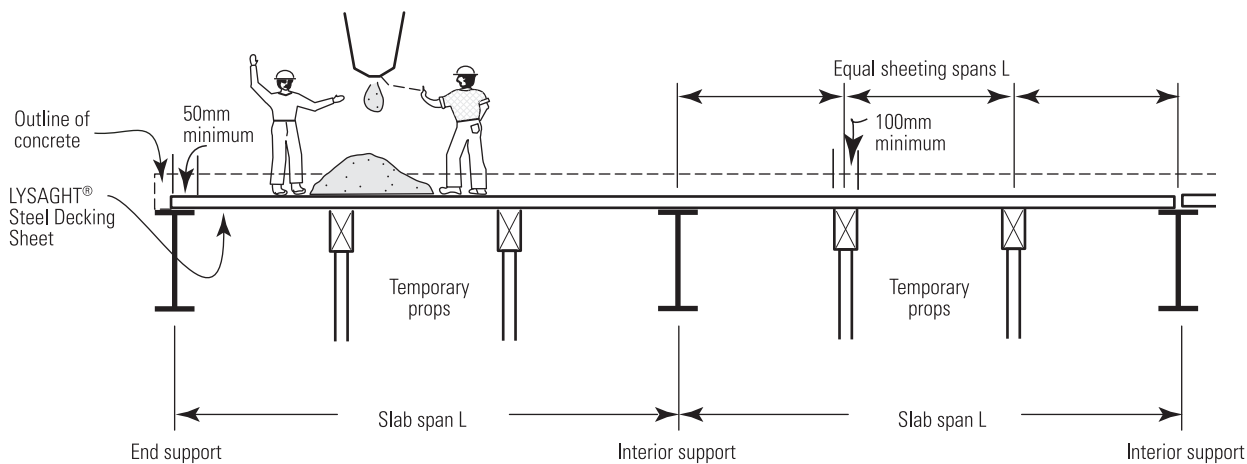


Fig 4.1 Formwork for LYSAGHT® structural steel decking systems

Table 4 - Factored load combinations for strength and deflection calculations

Construction Stage (see note 1)	Design Case (see note 2)	Sheeting Dead Load G_{sh} (see note 3)	Concrete Dead Load G_{dc}	Imposed Construction Loads Q_c	Imposed Storage Loads Q_s
Ia	Strength	1.4	-	1.6	-
Ib	Strength	1.4	-	-	1.6
IIa	Strength	1.4	1.4	1.6	-
IIb	Deflection	1.0	1.0	-	-

Notes:

1. Construction Stage 1 is defined as being prior to the placement of concrete, and Stage 2 as during the placement of concrete up until the concrete hardens.
2. G_{dc} includes an allowance for concrete ponding and the weight of steel reinforcement.
3. Both distributed and line load cases must be considered separately.

Deflection limits/loading parameters

BS 5950:Part 4: 1994 recommends that the sheeting deflection should not exceed $L/130$ (but $<30\text{mm}$) under its own weight plus the weight of wet concrete (including reinforcement) provided ponding is taken into account. In this publication, deflection limits of $L/130$ is adopted.

Composite Slab Design Stage

LYSAGHT® structural steel decking composite slabs shall be designed in accordance to BS 5950: Part 4: 1994, BS 8110: Part 1: 1997, BS 8110: Part 2: 1985, BS 4449: 1997. AS 3600-2001 may be used where relevant.

The design concept is based on "k" and "m" method. Data about shear-bond capacity have been obtained from full-scale tests and supplementary small-scale slip-block tests.

DESIGN METHODS

There are two ways you can design concrete slabs using LYSAGHT® structural steel decking systems :

a) Calculate from first principles using relevant British Standards and data from this manual and available through BlueScope Lysaght Malaysia and BlueScope Lysaght Technology Centre at Chester Hill, Sydney, Australia.

b) Run our software. This is also likely to produce a more economical design. Please contact BlueScope Lysaght Sales Consultant (Structural Decking) for a CD copy of the software or enquire for more information on this.

Our software can be used to design composite slabs with LYSAGHT® structural steel decking systems, provided that the following conditions are satisfied :

1. It is a common practice to design continuous slabs as a series of single spans. Minimum nominal reinforcement at intermediate supports shall be specified in this case in accordance to BS5950: Part 4: 1994, Clause 6.8. It shall be noted that nominal reinforcement will not prevent formation of wide cracks over supports - requirements of BS8110: Part 1: 1994, Clause 3.5.8 for crack control will not be satisfied. Increased slab thickness may be required in many instances when continuous slabs are designed as a series of simply supported spans.

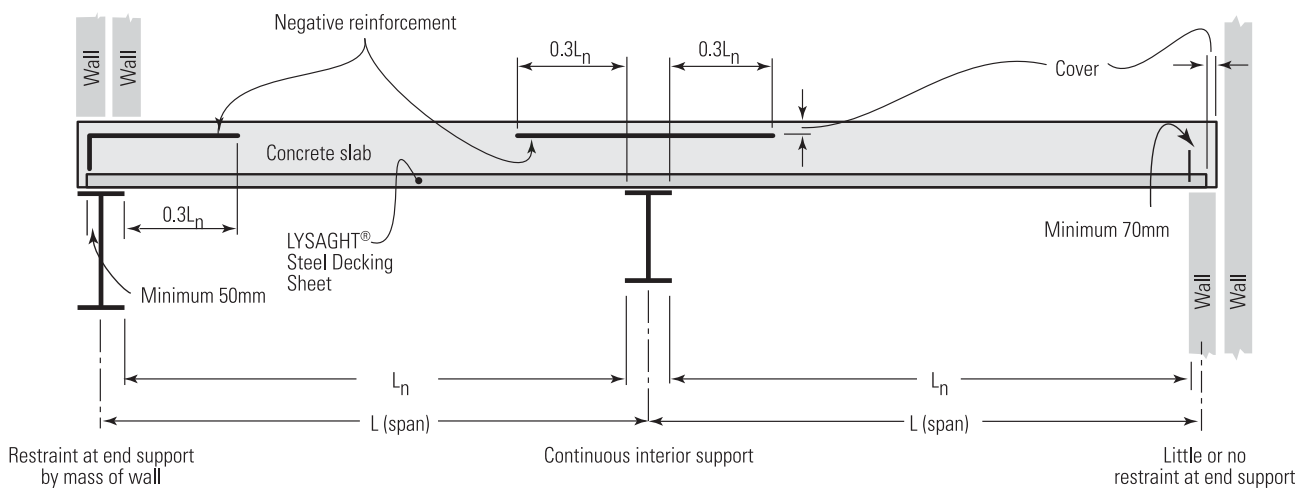


Fig 5.1 LYSAGHT® structural steel decking systems Pattern 1 for conventional (standard) reinforcement

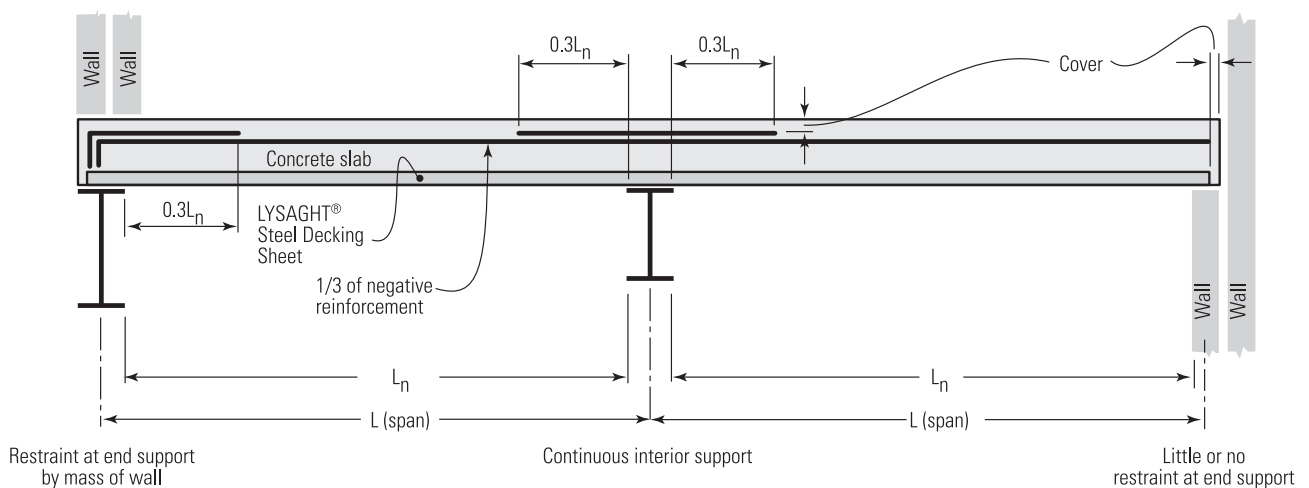


Fig 5.2 LYSAGHT® structural steel decking systems Pattern 2 for conventional reinforcement when imposed load exceeds twice the dead load

2. The ratio of longer slab span (L_L) to the shorter slab span (L_S) of any two adjacent spans does not exceed 1.2, that is $(L_L / L_S) \leq 1.2$.
3. The bending moments at the supports are only caused by the action of vertical loads applied to the slab.
4. The first interior span shall have the same thickness as the end span.
5. The geometry of the steel sheeting profile shall conform to the dimensions and tolerances shown on our production drawings. Sheeting with embossments of a depth less than that specified on these drawings shall not be used as composites unless the values of "k" and "m" are revised.
6. The specified concrete strength grade is in the range C30 to C40. The wet concrete density must be 2400kg/m^3 for normal weight concrete. The concrete shall follow the recommendations given in BS 8110.
7. Composite action must be assumed to exist between the steel sheeting and the concrete once the concrete in the slab has attained a compressive strength of 20 MPa. Prior to the development of composite action during construction, potential damage to the shear connection must be avoided, and maximum construction imposed loads shall be limited to 1.5 kPa.
8. Reinforcement Pattern 2 shall be used when imposed load exceeds twice the dead load.

REINFORCEMENT

Steel reinforcement is necessary to control shrinkage and temperature effects, as flexural negative reinforcement over supports and in some instances for fire engineering purposes. It shall comply with requirements of BS 4449:1997 for bars and with BS 4483:1998 for fabric. Reinforcement Grade 460B shall be specified.

SHEAR STUDS

Shear studs for composite beams may be specified with LYSAGHT® structural steel decking profiles concrete slabs as required by BS 5950:Part 3: section 3.1 where relevant. However, for LYSAGHT® POWERDEK® decking profile, strength reduction factors are not

applicable since it forms a solid slab. Shear studs shall not be considered when composite beams are not a design option, such as concrete frame buildings or composite slabs supported by masonry walls.

DESIGN FOR FIRE

LYSAGHT® structural steel decking profiles composite slabs shall be designed for fire conditions in accordance to BS 5950-8: 1990, BS 476-20: 1987 and BS 476-21: 1987.

Reduction factors are applied to allow for the adverse effect of elevated temperatures on the mechanical properties of concrete and steel. Values of these reduction factors have been derived from fire tests conducted at Victoria University of Technology, Australia and extensive finite element analysis of the composite slabs.

Reduced shear bond capacity is also considered for elevated temperatures. Our software is able to detail LYSAGHT® structural steel decking profiles composite slabs when the soffit is exposed to fire, provided that 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 composite slab has been initially designed and detailed for room temperature conditions in accordance to this manual.
3. The fire design load is essentially uniformly distributed and static in nature.
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. The fire periods are 30, 60, 90, 120, 180 or 240 minutes.
6. Refer to figure 5.3 and 5.4 for the placement of fire reinforcement for additional fire resistance in LYSAGHT® BONDEK® II steel decking profile and LYSAGHT® POWERDEK® steel decking profile respectively.

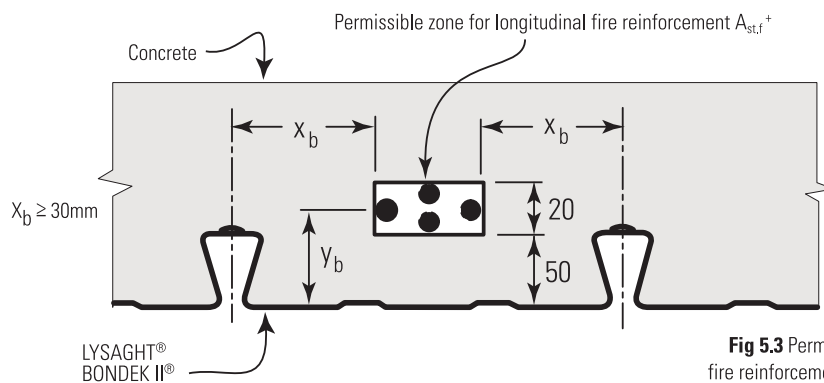


Fig 5.3 Permissible zone for location of longitudinal fire reinforcement on LYSAGHT® BONDEK® II profile

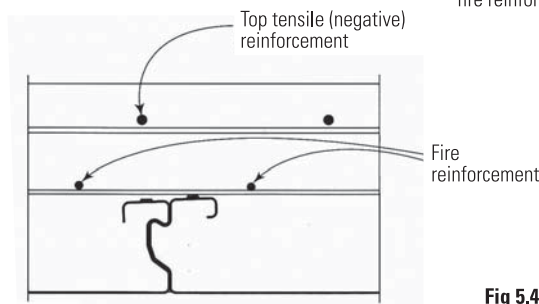


Fig 5.4 Location of fire reinforcement as mesh laid on LYSAGHT® POWERDEK® ribs

SAFETY

LYSAGHT® structural steel decking profiles are 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 as well as 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 LYSAGHT® structural steel decking profile enhance safety by reducing the likelihood of workers slipping.

It is a common sense, by nature, 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 LYSAGHT® structural steel decking profiles, wear clean dry gloves. Do not slide sheets over rough surfaces or over each other. Always carry tools, do not drag them.

Occupational health and safety laws enforce safe working conditions in most locations. Local laws may require you to have fall protection which includes safety mesh, personal harnesses and perimeter guardrails where they are appropriate. BlueScope Lysaght Singapore has a strict adherence to safety guidelines which is implemented on and off-site. BlueScope Lysaght Singapore Occupational Health and Safety Management System is accredited OHSAS 18001:2007 by Lloyd's Register Quality Assurance. In addition, the company is also conferred a "bizSAFE" status by Singapore's Workplace Safety and Health Advisory Committee (WSHAC) for delivering excellence in WSH Management System (Workplace Safety & Health).

LYSAGHT® structural steel decking systems are capable of withstanding temporary construction loads including the mass of workmen, equipment

and materials as specified in this manual. However, it is a good construction practice to ensure protection from concentrated loads, such as barrows, by use of some means such as planks and/or boards.

INSTALLATION

LYSAGHT® structural steel decking profiles are delivered in strapped bundles. If they are not required for immediate use, do stack sheets or bundles neatly and clear of the ground, on a slight slope to allow drainage of water. If they are left in the open, protect the decking sheets with waterproof covers.

PROPPING

It is a common practice to specify unpropped LYSAGHT® steel decking formwork, however, depending on the span of a the slab, temporary propping may be needed between the slab supports to prevent excessive deflections or collapse of the formwork.

LYSAGHT® steel decking formwork is normally placed directly on prepared propping. Props must stay in place during the laying of the formwork, the placement of the concrete, and until the concrete has reached the strength of 20 MPa. Propping generally consists of substantial timber or steel bearers supported by vertical props. The bearers must be continuous across the full width of the formwork.

Where the underside of the formwork is featured as a finished ceiling, wide form-ply strips attached to the bearers will minimise marking. The width of the form-ply strips depends upon the slab depth, metal thickness and spans. Form-ply strips of 300 mm width have been used successfully.

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

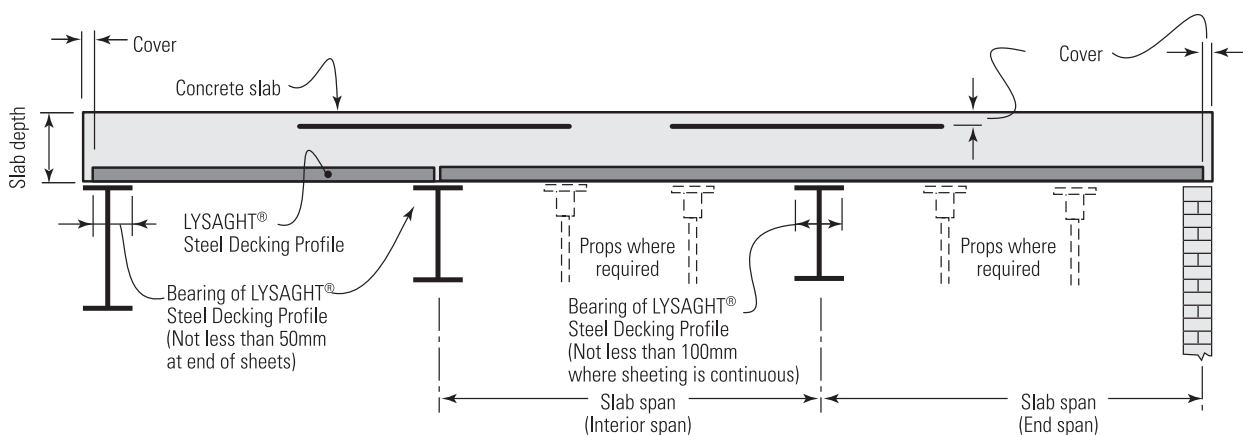


Fig 6.1 Typical layout of LYSAGHT® steel decking sheets during propping

LAYING

LYSAGHT® structural steel decking profiles must be laid with the sheeting ribs aligned in the direction of the designed spans. Other details include the following:

1. The slab supports must be prepared for bearing and slip joints as required.
2. Lay the steel decking sheets continuously over each slab span without any intermediate splicing or jointing.
3. Lay the steel decking 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.
4. Support the steel decking sheets across their full width at the slab support lines and at the propping support lines.
5. For the supports to carry the wet concrete and construction loads, the minimum bearing is 50mm for ends of steel sheets, and 100mm for intermediate supports over which the sheeting is continuous.
6. In exposed applications, treat the end and edges of the steel decking sheets with a suitable edge treatment to prevent entry of moisture.



Fig 6.2 Installation of LYSAGHT® structural steel decking systems

INTERLOCKING THE SHEETS

LYSAGHT® BONDEK® II Steel Decking Profile

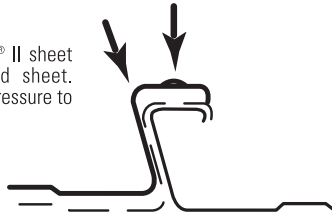
Overlapping ribs of LYSAGHT® BONDEK® II decking profile sheeting are interlocked. Either one of two methods shown can be used in most situations, though variations may also work.

In the first method, lay adjacent sheets loosely in place. Place the female lap rib overlapping the male lap rib of the previous steel decking

sheet and apply foot pressure, or a light kick, to the female lap rib (Figure 7.1). In the second method, offer a new steel decking sheet at an angle to the one previously laid, and then simply lower it down, through an arc (see Figure 7.1). If the steel sheets do not 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 on "Fastening Side-lap joints".

Method 1

Position LYSAGHT® BONDEK® II sheet parallel with previously-laid sheet. Interlock sheets by applying pressure to either position.



Method 2

Position LYSAGHT® BONDEK® II sheet at an angle. Interlock sheets by lowering sheet in through an arc.



Fig 7.1 Two methods of interlocking adjacent LYSAGHT® BONDEK® II sheets

LYSAGHT® POWERDEK® II Steel Decking Profile

- Place two sheets and press down 2nd sheet until LYSAGHT® POWERDEK® laps against next sheet to form a rib
- Place LYSAGHT® rib clip across both halves of rib and press down. Only one clip per rib at midspan is necessary for 1.0 BMT, 1.2 BMT and 1.5 BMT LYSAGHT® POWERDEK® 100; three clips for 1.5 BMT LYSAGHT® POWERDEK® 120 at quarter points required.

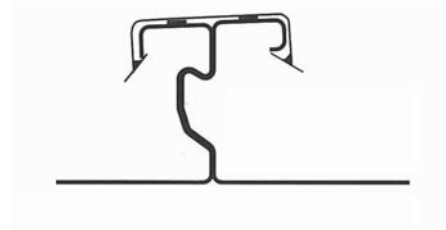


Fig 7.2 Fixing LYSAGHT® POWERDEK® steel decking sheets

The minimum bearing length of LYSAGHT® structural steel decking profile sheets at supports shall be 50mm when resting on steel or concrete, and 70mm when resting on masonry surface, such as brick or block.

SECURING THE PLATFORM

Once laid, LYSAGHT® structural steel decking systems provide a stable working platform. The steel decking sheet shall be fixed to supporting structure at end supports with screws or nails or equivalent. Where additional security is needed, one can use either weights or screws or nails into the propping bearers.

INSTALLING LYSAGHT® STRUCTURAL® STEEL DECKING PROFILE SHEETS ON STEEL FRAMES

GENERAL FASTENING

LYSAGHT® structural steel decking systems may be installed directly on erected structural steelwork.

The sheeting shall be fixed to the structural steel using spot welds,

or fasteners such as drive nails or self-drilling screws. 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. However, at least one fastener per pan shall be provided at end supports.

One example of fixing system is as follow :

- At the end of steel sheets: use a fixing at every rib (Figure 8.1).
- At each intermediate slab support over which the sheeting is continuous: use a fixing at the ribs on both edges (Figure 8.2).
- Fix LYSAGHT® structural steel decking profiles 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 4mm thickness or greater.
- For structural steel up to 12mm thickness, use 12-24 x 38mm self-

drilling hexagon head screws or equivalent.

- For structural steel over 12mm thickness, pre-drill and use 12-24 x 16mm hexagon head screws or equivalent.
- Spot welds should be 12mm minimum diameter. Surfaces to be welded must be free of loose material and foreign matter. Where the steel decking 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.

COMPOSITE BEAMS

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 in previous section is necessary to secure the sheeting prior to the stud welding.

Some relevant welding requirements are:

- 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 steel decking profile;

- Welding must be done in dry conditions by a certified welder;
- For pre-painted LYSAGHT® steel decking profile sheets, special welding procedures may be necessary
- For sheets transverse to beams, stud welding must be between pan flutes to ensure there is no gap between mating surfaces.



Fig 8.1 Fixing at end of sheets.



Fig 8.2 Fixing at intermediate slab supports over which the sheeting is continuous.

Fig 8.1 and 8.2 Positions for fixing LYSAGHT® steel decking profile

INSTALLING LYSAGHT® STRUCTURAL® STEEL DECKING PROFILE SHEETS 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, LYSAGHT® structural steel decking profile slabs are not usually installed directly on brick supports, although this is not always the case in earthquake construction.

SLIP JOINTS

Generally, a slip joint is provided between steel decking sheet and masonry supports (Figure 8.3).

Slip joint material must allow movement to occur, usually by allowing flow under pressure or temperature, however it must not run or solidify. Generally, the materials are a non-rotting, synthetic carrier impregnated with a neutral synthetic or petroleum-based material.

- At least one fastener per pan (screws, nails, or equivalent) shall be provided at end support.
- 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 must have adequate compressive strength to avoid it being compressed into irregularities of the mating surfaces and thus becoming a rigid joint.

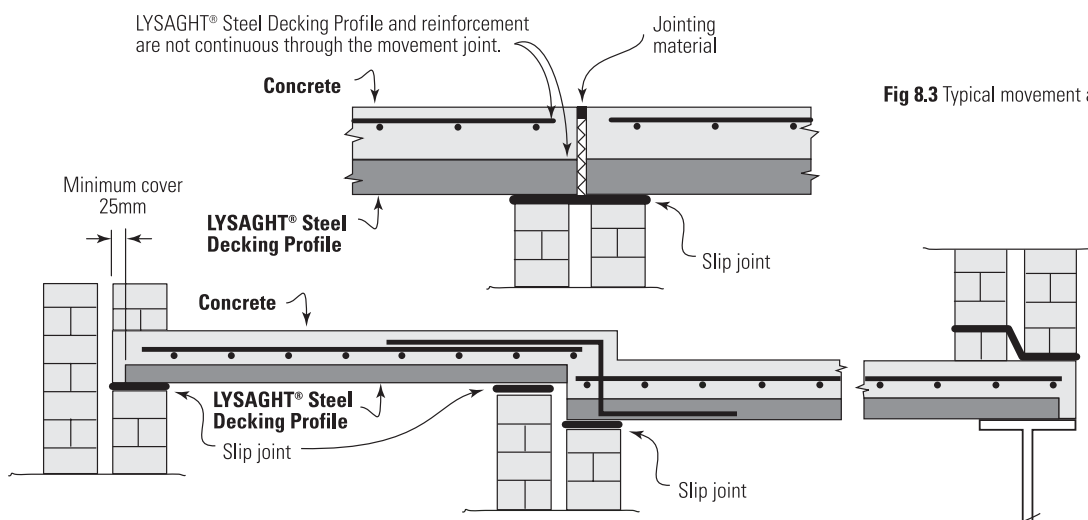


Fig 8.3 Typical movement and slip joints

CONSTRUCTION AND MOVEMENT JOINTS

Joints used between LYSAGHT® structural steel decking profile 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 steel decking slab. Movement joints need a slip joint under the steel decking sheeting. (Figure 8.3).

The steel decking sheet and any slab reinforcement are not continuous through a joint. Design engineers generally detail the location and spacing of joints because joints affect the design of a slab.

FASTENING SIDE LAP JOINTS

If LYSAGHT® structural steel decking sheets have been distorted in transport, storage or erection, sidelap 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 8.4).

CUTTING AND FITTING EDGE FORM

EDGE FORM is a simple C-shaped section that simplifies the installation of most LYSAGHT® structural steel decking slabs. It is easily fastened to the steel decking sheet profile, neatly retaining the concrete and providing a smooth top edge for quick and accurate screeding. It is made to suit any slab thickness.

EDGE FORM is easily spliced and bent to form internal and external corners of any angle and must 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 Figure 8.5. Fasten EDGE FORM to the underside of unsupported LYSAGHT® structural steel decking panels every 200mm. The top flange of EDGE FORM must be tied to the ribs at every 600mm with tie back strap 25mm x 1.0mm (Figure 8.6). Use 10-16 x 16mm self-drilling screws.

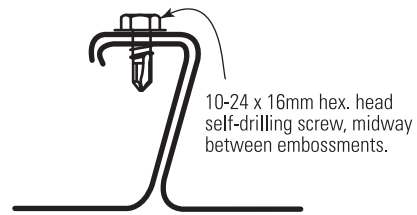
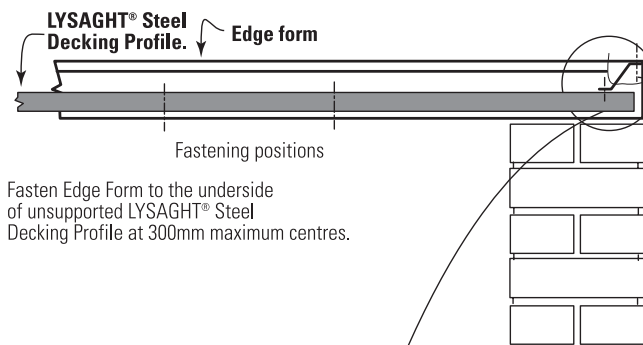


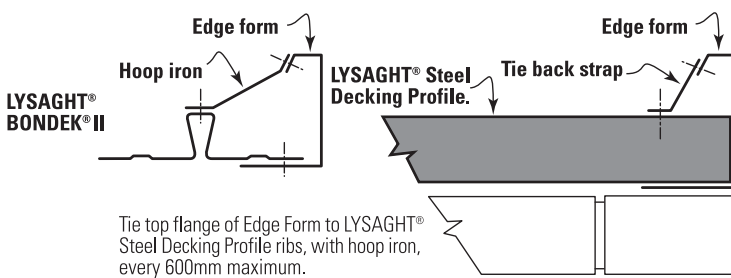
Fig 8.4 Fixing at a side-lap

Fastening bottom flange of Edge Form



Fasten Edge Form to the underside of unsupported LYSAGHT® Steel Decking Profile at 300mm maximum centres.

Fastening top flange of Edge Form



Tie top flange of Edge Form to LYSAGHT® Steel Decking Profile ribs, with hoop iron, every 600mm maximum.

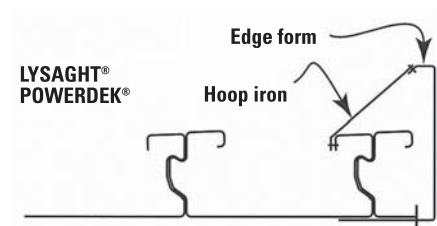


Fig 8.5 Typical fastening of EDGE FORM to LYSAGHT® BONDEK® II and LYSAGHT® POWERDEK® steel decking profile

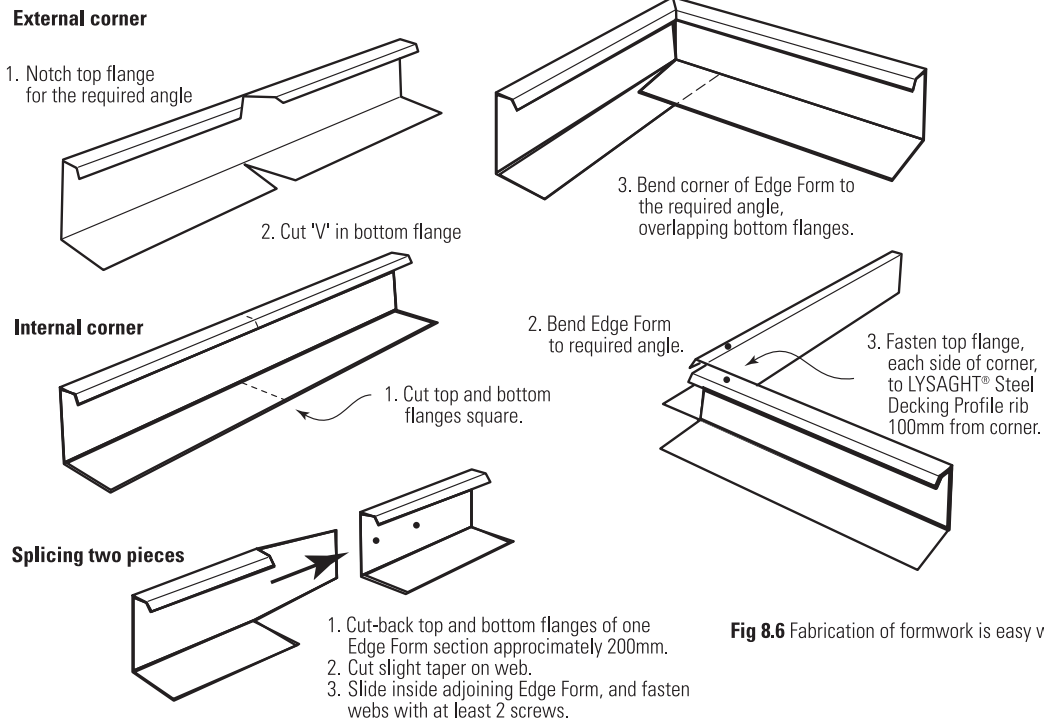


Fig 8.6 Fabrication of formwork is easy with EDGE FORM

SEALING

Seepage of water or fine concrete slurry can be minimised by following common construction practices. Generally, gaps are sealed with waterproof tape or by sandwiching contraction joint material between the abutting ends of LYSAGHT® steel decking sheet. If there is a sizeable gap, the waterproof tape has to be supported.

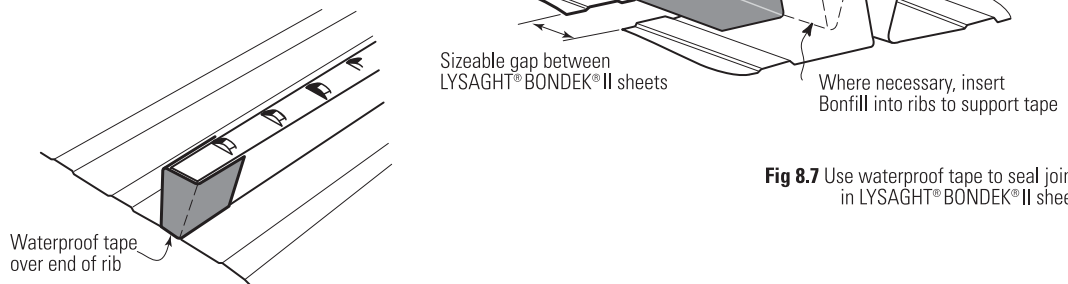


Fig 8.7 Use waterproof tape to seal joints in LYSAGHT® BONDEK® II sheets

ITEMS EMBEDDED IN SLABS

Included are pipes and conduits, sleeves, inserts, holding-down bolts, chairs and other supports, plastic strips for plasterboard attachment, contraction joint material and many others. Location of

items within the slab, see Figure 8.8. Minimise the quantity and size of holes through the steel sheeting by hanging services from the underside of steel decking sheet using accessories such as BON-NUT.

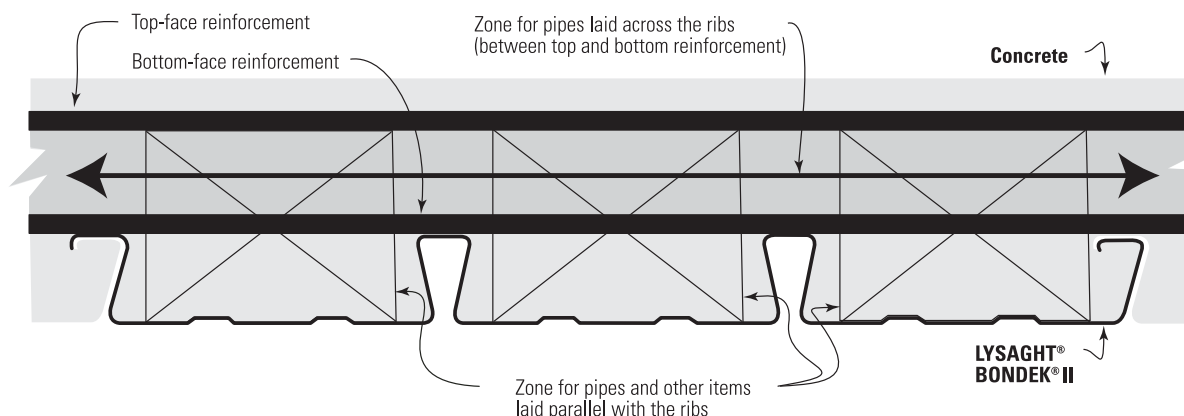


Fig 8.8 Zones for location of items embedded in slabs

HOLES

LYSAGHT® structural steel decking profiles act as longitudinal tensile reinforcement similarly to conventional bar or fabric reinforcement does in concrete slabs. Consequently, holes in the steel decking sheets, to accommodate pipes and ducts, reduce the effective area of the steel sheeting and can adversely affect the performance of a slab.

Some guidelines for holes are (Figure 8.8 & 8.9):

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

Location of Holes in LYSAGHT® BONDEK® II Steel Decking Profile

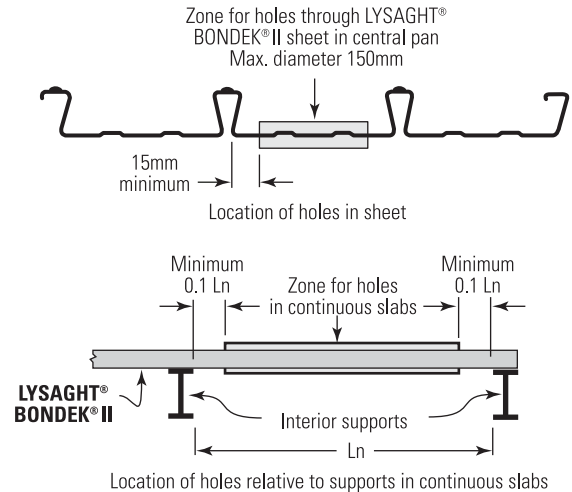


Fig 8.9 Zones for location of holes through LYSAGHT® BONDEK® II steel decking profile

Location of Holes in LYSAGHT® POWERDEK® Steel Decking Profile

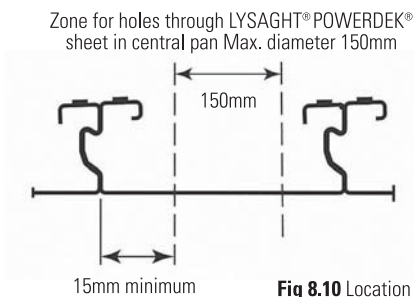
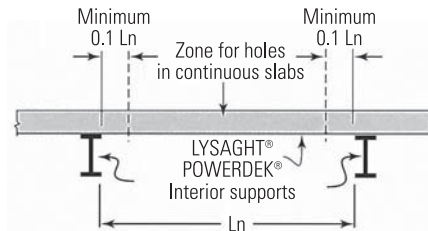


Fig 8.10 Location of holes relative to supports in continuous slabs of LYSAGHT® POWERDEK® steel decking profile



INSPECTION

We recommend regular qualified inspection during the installation, to ensure that the steel sheeting is installed in accordance with this manual and good building practice.

CUTTING

It is easy to cut LYSAGHT® steel decking 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 it over and finish by cutting the tops of the ribs.

REINFORCEMENT

LYSAGHT® steel decking profile acts as longitudinal tensile reinforcement. The condition of sheeting should be inspected before concrete is poured over. 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 8.11 and 8.12 shows a typical cross-section of a LYSAGHT® BONDEK® II profile and LYSAGHT® POWERDEK® profile composite slab and associated terms. Reinforcement must be properly positioned, lapped where necessary, to ensure continuity and tied to prevent displacement during construction. Fixing of reinforcement shall be in accordance with BS-8110: Part 1.

To ensure the specified minimum concrete cover, the uppermost layer of reinforcement must be positioned and tied to prevent displacement during construction. Where fabric is used in thin slabs, or where fabric is used to act as both longitudinal and transverse reinforcement, pay particular attention to 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 steel decking sheets, particularly where the soffit will be exposed. Transverse reinforcement may be used for spacing or supporting longitudinal reinforcement.

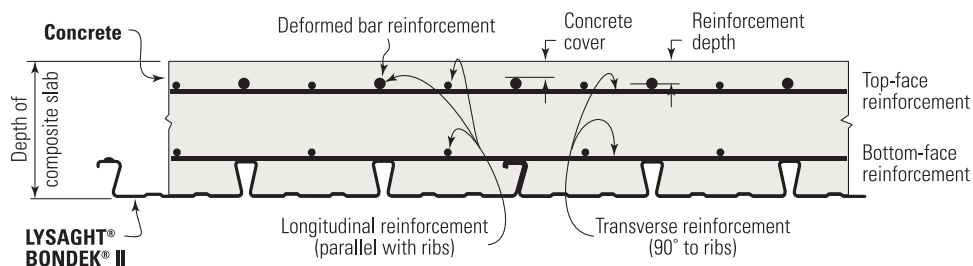


Fig 8.11 Typical cross-section of LYSAGHT® BONDEK® II profile composite slab showing common terms

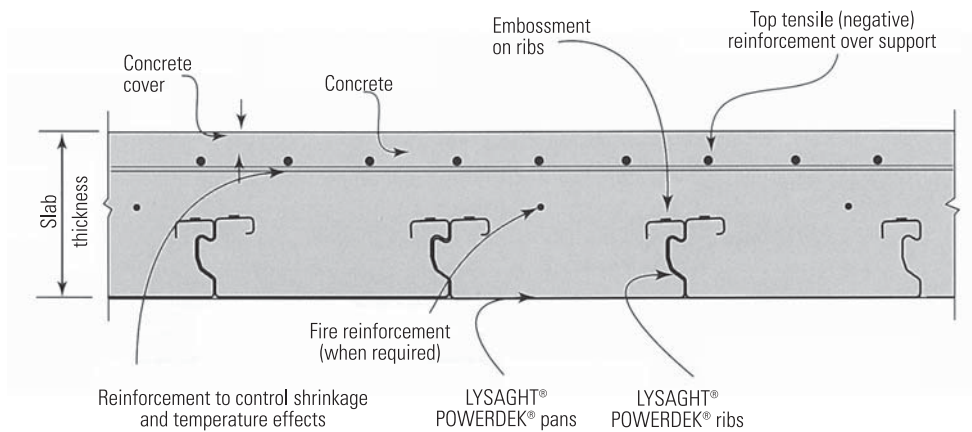


Fig 8.12 Typical cross-section of LYSAGHT® POWERDEK® profile composite slab reinforcement

TRANSVERSE REINFORCEMENT

Transverse reinforcement is placed at right-angles to the ribs of LYSAGHT® steel decking profile sheet. 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. To control flexural cracking in the top face of the slab, transverse reinforcement in the top-face may be required over walls or beams which run in the same direction as the LYSAGHT® steel decking profile sheets. For ease of construction, reinforcement for control of cracking due to shrinkage and temperature is usually fabric reinforcement.

LONGITUDINAL REINFORCEMENT

Longitudinal reinforcement is positioned to carry design loads in the same direction as the ribs of LYSAGHT® steel decking profile. 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. However, 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 bottom-face longitudinal reinforcement in elevated temperatures requires special design. (Figure 2.1)

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 from the top and bottom layers of reinforcement.

CONCRETE SPECIFICATIONS

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 BS8110: Part 1: 1997, Section 6.

CONCRETE ADDITIVES

Admixtures or concrete materials containing calcium chloride or other chloride salts must not be used. Chemical admixtures including plasticisers may be used if they comply with BS8110.

CONCRETE PREPARATION

Before concrete is placed, remove any accumulated debris, grease or any other substance to ensure a clean bond with the LYSAGHT® steel decking profile sheet. Remove any accumulated rainwater.

CONCRETE CONSTRUCTION JOINTS

It is an 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 must 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® steel decking profile sheet are normally located where shear forces are a minimum (such as the mid-third of a slab span) and ideally over a line of propping. Locate longitudinal construction joints in the pan (Figure 8.13 and Figure 8.14).

For 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 must 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.

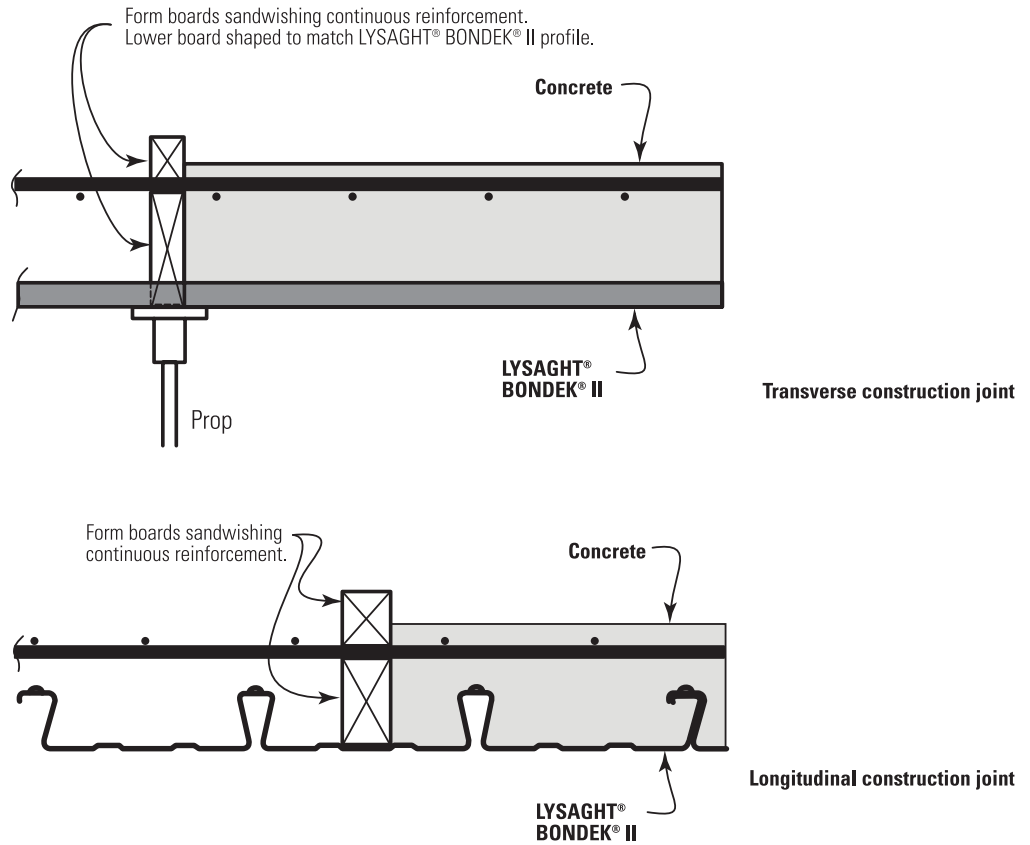


Fig 8.13 Typical construction joints for LYSAGHT® BONDEK® II steel decking profile

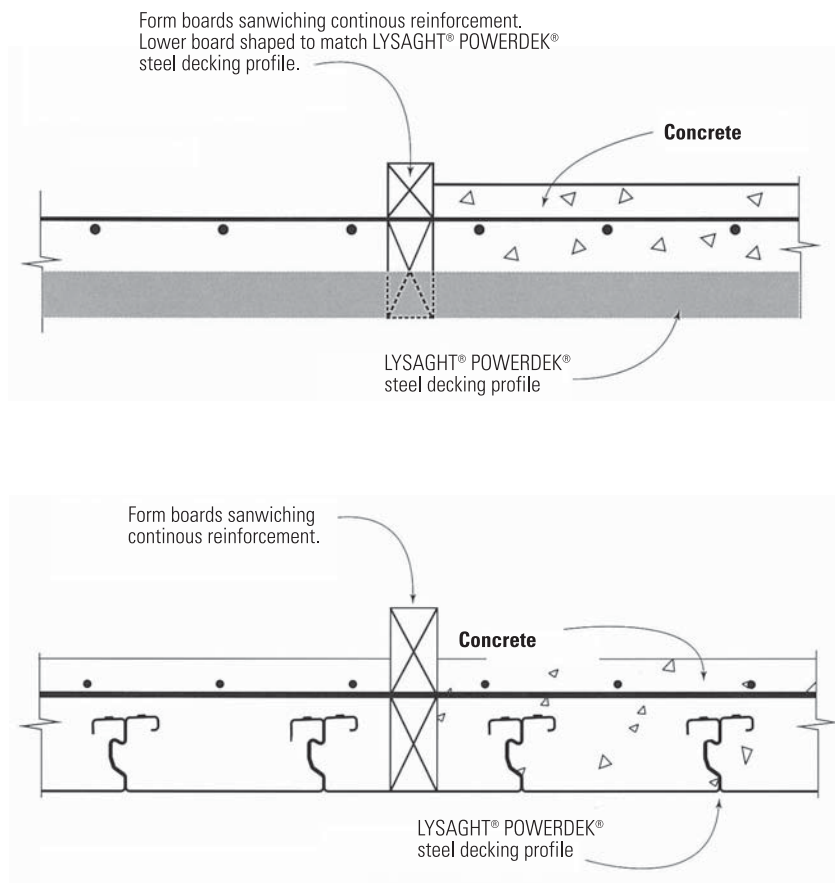


Fig 8.14 Typical construction joints for LYSAGHT® POWERDEK® steel decking profile

PLACING

The requirements for the handling and placing of the concrete are covered in BS8110: Part 1: 1997, Section 6.2.

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 a 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 EDGE FORMS and exposed soffits, should be cleaned of concrete spills while still wet, to reduce subsequent work.

CURING

After placement, the concrete is cured by conventional methods, for example, by keeping the slab moist for at least seven days or by covering the surface with sand, building paper or polythene sheeting immediately after it has been moistened with a fine spray of water. Follow good building practice. Be particularly careful when curing in very hot or very cold weather. Until the concrete has cured, it is a good practice to avoid concentrated loads such as barrows and passageways with heavy traffic.

WHEN TO REMOVE PROPS

Various factors affect the earliest time when the props may be removed and a slab initially loaded. Methods of calculating times and other guides are given in AS 3610-1995, Clause 5.4.3

SOFFIT AND EDGE FORM FINISHES

For many applications, LYSAGHT® steel decking profiles give 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, etc. Similarly, EDGE FORM will give a suitable edging. Additional finishes take minimal extra effort. Where the LYSAGHT® BONDEK® II steel decking 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 section on Fastening Side-lap joints). Exposed surfaces of LYSAGHT® steel decking profiles soffit and EDGE FORM may need cleaning and/or preparation for any following finishes.

PLASTERING

Finishes such as vermiculite plaster can be applied directly to the underside of LYSAGHT® steel decking profiles 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 / painted to suit interior design requirements.

CHANGE OF FLOOR LOADINGS

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 LYSAGHT® steel decking 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 LYSAGHT® steel decking sheet provide a positive key to keep the fire spray in position. Such work is beyond the scope of this guide book.

SUSPENDED CEILING

Ceilings are easily suspended from LYSAGHT® steel decking slabs using Ceiling Suspension Nuts and BON-NUT suspension nuts. 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 LYSAGHT® steel decking sheet before concreting (Figure 8.16).

SUSPENDED SERVICES

Services such as fire sprinkler systems, piping and ducting are easily suspended from LYSAGHT® steel decking profile slabs using BON-NUT suspension nuts. Ceiling Suspension Nuts are suitable for services other than fire sprinkler systems - threaded rods being used to support the services.

Fixing Plasterboard

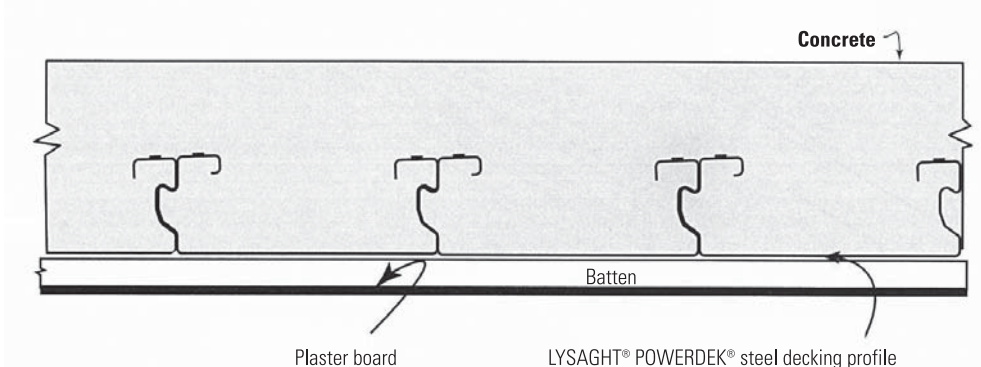
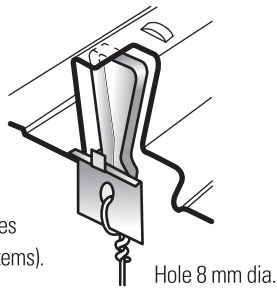


Fig 8.15 Fixing plaster board to LYSAGHT® POWERDEK® steel decking profile

ACCESSORIES

BONWEDGE

Lightweight bracket for rods to suspend ceilings or services (other than fire sprinkler systems).



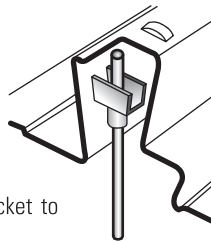
Configuration	Loading	Safe load (kN)
Single Bonwedge	Eccentric	1.0
Double Bonwedge	Eccentric	1.3
Double Bonwedge	Central	1.7

CEILING SUSPENSION NUT

Pressed metal threaded bracket to suspend ceilings or services.

Thread: M6

Max. load: 270 kg

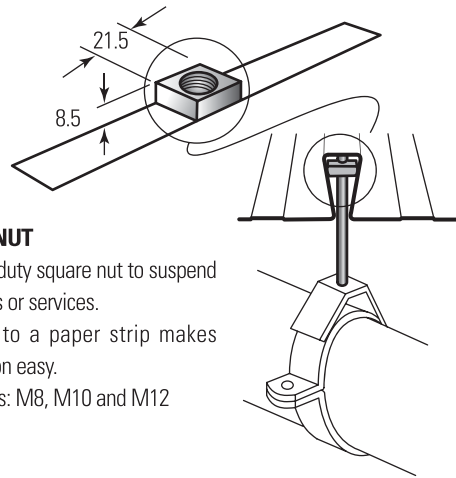


BON-NUT

Heavy duty square nut to suspend ceilings or services.

Glued to a paper strip makes insertion easy.

Threads: M8, M10 and M12

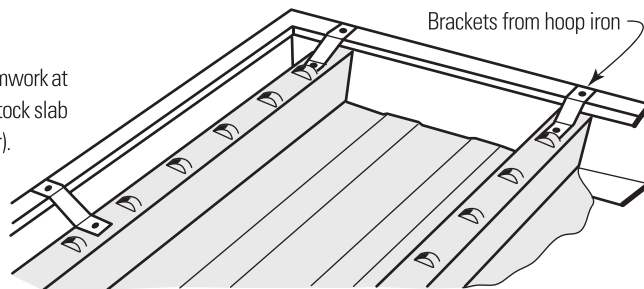


BONDEK® II BMT	Safe load (kN)
0.75	4.4
1.00	6.7

EDGEFORM

A galvanised section that creates a permanent formwork at the slab edges-cut, mitred and screwed on site. Stock slab depths: 100, 125, 150 mm (others to special order).

Stock length: 6100 mm

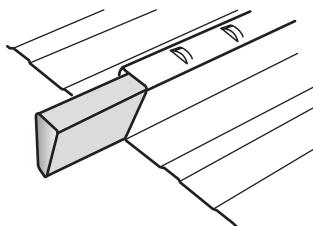


BONFILL

Polystyrene foam stops concrete and air entering ends of ribs.

Stock length: 1200 mm

Required: 300 mm per sheet of BONDEK® II



BONSTRIP

Plastic trim to cover gaps formed by ribs.

Used when underside of BONDEK® II forms an exposed ceiling.

Stock length: 3000 mm

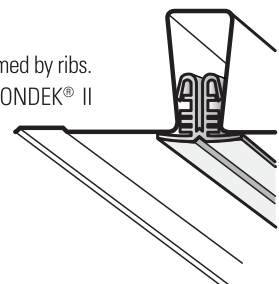


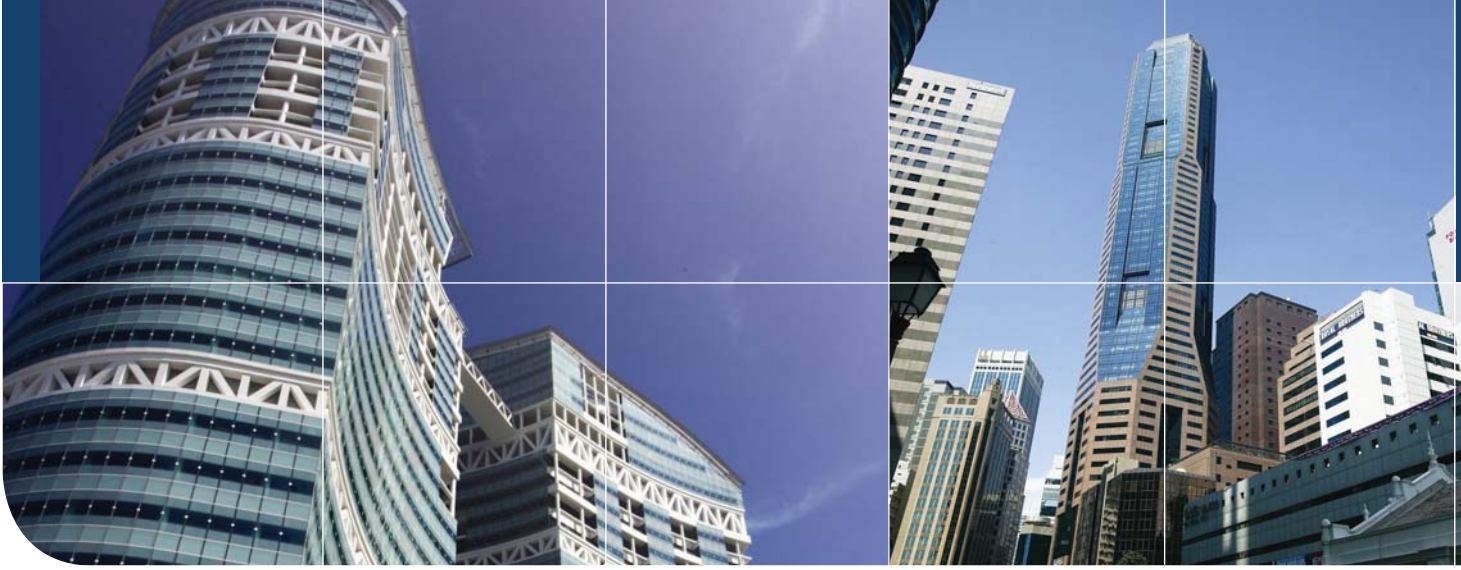
Figure 4.15

*Note: Not all accessories are available.



LYSAGHT®

THERE IS NO EQUIVALENT



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