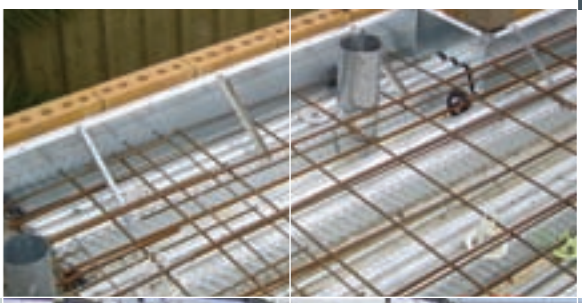
LYSAGHT W-DEK®

Design Software User's Guide



- Getting exceptional results from LYSAGHT W-DEK for composite concrete slabs
- Acts as permanent formwork with minimal propping and no stripping of formwork
- Works as composite slab saving on concrete and reinforcement costs
- Formwork tables are optimised for steel frame construction

AUSTRALIAN MADE®

LYSAGHT

Background

LYSAGHT W-DEK is a new innovative profiled steel decking which brings greater economy and design freedom to building with composite concrete slabs. Our design engineers scoured the globe to find the best "W"- profiles in the world. After careful examination, our engineers incorporated the best aspects of each profile into new LYSAGHT W-DEK. The profile has been specifically developed for Australian high tensile steels - which makes LYSAGHT W-DEK one of the best performing 'W' profiles in the world.

LYSAGHT W-DEK is a profiled zinc-coated high tensile steel decking for use in the construction of composite floor slabs. It has exceptional composite performance – no additional reinforcement is required in most applications.

It can be used as formwork during construction and as a reinforcement system in composite slabs.

Our increased understanding of composite slabs, together with testing in our NATA-accredited laboratory and leading Australian universities, has paid off with an optimised product, which provides significant cost savings for projects.

LYSAGHT W-DEK has exceptional spanning characteristics and spans up to 4.1 metres, reducing the need for supporting structures.

The built-in properties of high tensile steel are maximised in the design and fabrication of the deck profiles which result in products with high strength-to-weight ratio. LYSAGHT W-DEK is currently the most economical structural steel decking in Australia for typical applications because it provides widest cover per weight of steel.

The profiled ribs are 78mm in height, resulting in LYSAGHT W-DEK having excellent concrete displacement characteristics and minimal propping requirements. This speeds up installation and makes the costs of delivery, erection and structural framing significantly lower than for other systems.

Scope

This manual provides information on the design of formwork, propping, composite slabs and design for fire and some information for composite beams.

This manual is developed to the latest versions of the relevant Australian Standards and Eurocodes.

Conditions of use

This publication contains technical information on the following grades of LYSAGHT W-DEK:

- LYSAGHT W-DEK 0.75 mm thickness
- LYSAGHT W-DEK 1.00 mm thickness

Additionally, LYSAGHT W-DEK software allows you to get quicker and more economical solutions with a range of options. Call Steel Direct on 1800 641 417 to obtain additional copies of the Design Manual and Software.

Where we recommend use of third party materials, ensure you check the manufacturer's requirements. Diagrams are used to explain the requirements of a particular product. 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.

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..

Preface

LYSAGHT W-DEK design software is a user-friendly Excel-based software for the design of composite concrete slabs with LYSAGHT W-DEK structural decking.
It is suitable for steel frame construction.

LYSAGHT W-DEK design software is developed to Australian Standards (AS) whenever possible, Eurocodes have been used when certain design procedures are not available in Australian Standards.

It is a tool developed with latest information to assist a competent engineer with the most competent solution.

The software should be used to design composite slabs in conjunction with the LYSAGHT W-DEK Design & Construction Manual.

Disclaimer, warranties and limitation of liability

This publication is intended to be an aid for professional engineers and is not a substitute for professional judgement.

Terms and conditions of sale are available at local BlueScope Lysaght sales offices.

Except to the extent to which liability may not lawfully be excluded or limited, BlueScope Steel Limited will not be under or incur any liability to you for any direct or indirect loss or damage (including, without limitation, consequential loss or damage such as loss of profit or anticipated profit, loss of use, damage to goodwill and loss due to delay) however caused (including, without limitation, breach of contract, negligence and/or breach of statute), which you may suffer or incur in connection with this publication.

The LYSAGHT range of products is exclusively made by BlueScope Steel Limited trading as BlueScope Lysaght.

Produced at BlueScope Lysaght R&D Department.

www.bluescopesteel.com

Contents

1. Introduction

This User's Manual is designed to provide you with basic familiarity about LYSAGHT W-DEK design software to enable you to quickly understand and start using this powerful tool. The software is able to perform major tasks normally performed at a structural consultant's office. Use LYSAGHT W-DEK Design and Construction Manual with its set of tables. When input parameters are different from those listed for tables or the user wants to check several different options, the software will help with that.

The software offers following additional design options as compared to tables:

- Two major design options: Design and Design/ Check. The first option will perform design with the minimum possible slab thickness; the second one will check the chosen slab thickness and design the rest of the parameters.
- Selection of exposure classifications (A1, A2, B1 and B2)
- 25, 32 and 40 MPa concrete grades
- Superimposed dead load other than 1 kPa
- Other than office types of imposed loads
- Composite slab deflection limits L/250 for total loads and L/500 for incremental deflection
- Equal spans
- For negative, positive fire and shrinkage reinforcement,
  use D500N, D500L or 400Y
- User specified bar diameter
- Specified number of continuous spans (two-span, three-span etc.).
- Degree of control for shrinkage and temperature effects
- All fire rating periods: 30, 60, 90, 120, 180 and 240 min.
- Variable loads due to weight of stacked materials during construction stage.
- Design with relaxed crack control requirements for flexure
- Support width
- User specified concrete cover

The software is developed as a powerful tool to minimise time and efforts necessary by a consulting engineer to complete the job. However, it is essential for the user to have:

- Good knowledge of structural engineering
- Familiarity with design of composite concrete slabs
- Sound knowledge of local regulations and load requirements

For more information and technical support, contact Steel Direct on 1800 641 417.

This warning symbol means the user shall take care before proceeding further.

This symbol means that there is more information on this topic in other chapters.

This symbol means that the user shall refer to the relevant Australian Standard or Eurocode for more information.

This symbol means that this is important information. The user shall ensure they understand before proceeding.

2. Getting Started

2.1. Computer Requirements

To run LYSAGHT W-DEK design software your computer must have Microsoft Excel 2000 or a later version, on Windows platform.

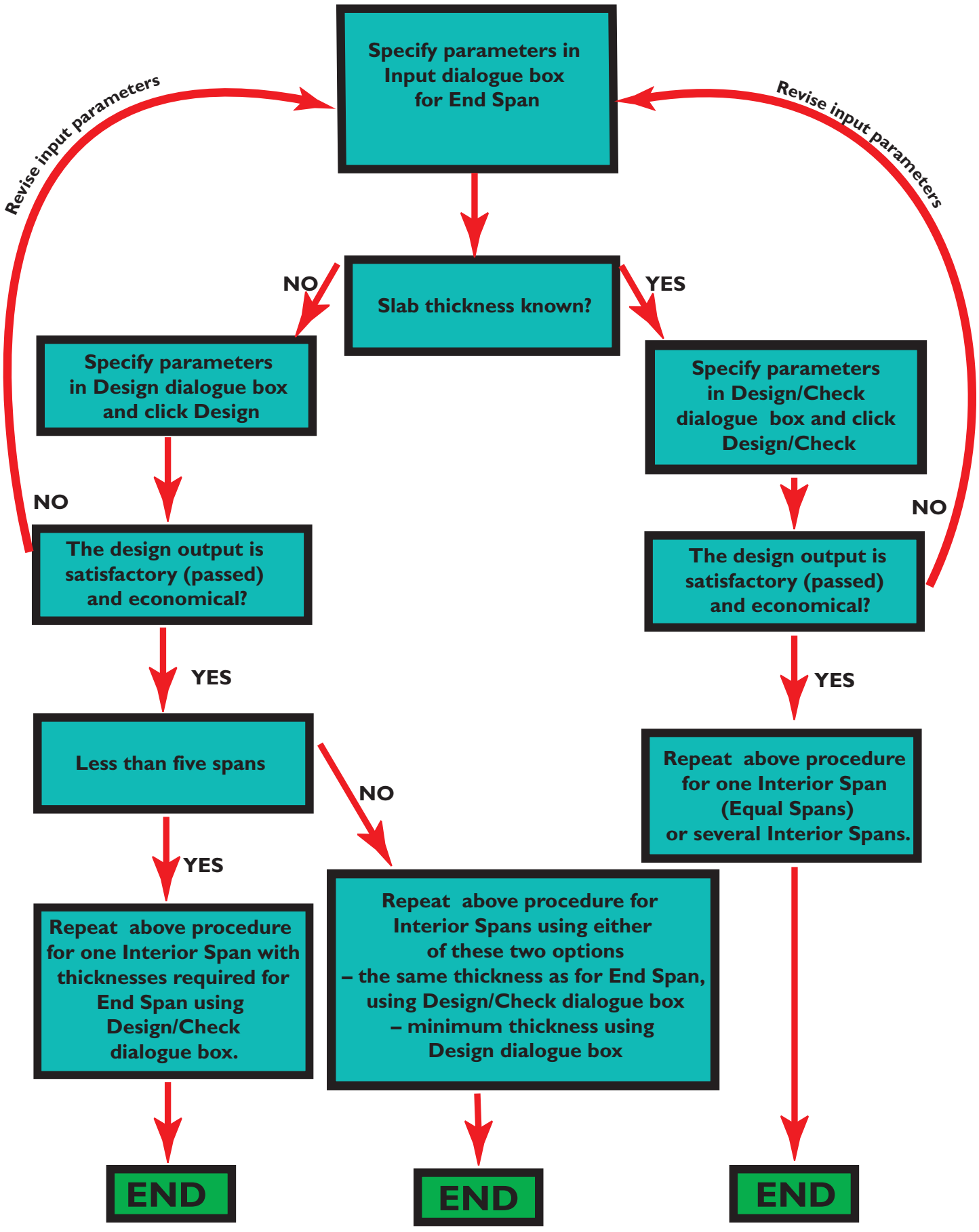
2.2 Installing LYSAGHT W-DEK Design Software

The LYSAGHT W-DEK design software CD is fixed on the inside back cover of this Guide.
It contains LYSAGHT W-DEK design software Excel file, User's Guide and Design and Construction Manual in .pdf format.

On your hard disc, create a directory (folder) called LYSAGHT W-DEK design software, and place the files from CD into the folder. Run the software, in the usual way, by double-clicking on the icons.

Ensure you enable Macros before proceeding with LYSAGHT W-DEK design software. The security settings for Excel shall be set to medium level when applicable.

3. Software Flowchart for the Design of Continuous Spans



4. LYSAGHT W-DEK Software Menu

LYSAGHT W-DEK design software **Menu** options are built into Excel **Menu** on the top of the screen.

Excel **Menu** may look different from what is shown below.

There are three additional **Menu** options:

- **Analyse (LYSAGHT W)**
- **Print (LYSAGHT W)**
- **Report (LYSAGHT W)**

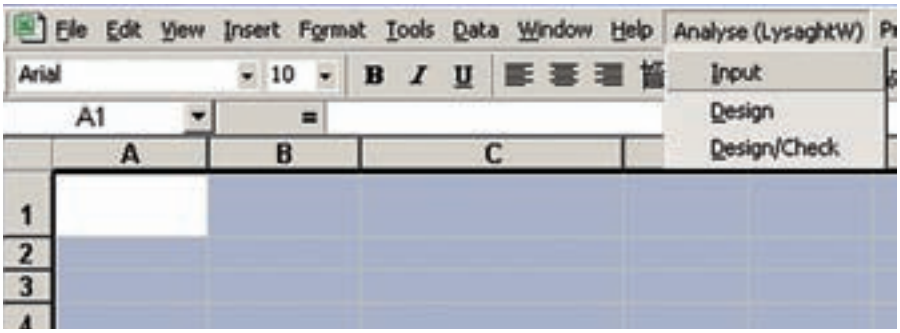


Figure 1
Analyse Menu

Analyse (LYSAGHT W) Menu has three submenu options:

- **Input**
- **Design**
- **Design/Check**

These options will be described in details in further chapters.

When the software is opened, the **Input** dialogue box will appear on the screen automatically (see cover page). For the second and consecutive runs, the user shall access the **Input** dialogue box through **Menu.**

Print (LYSAGHT W) Menu allows the user to print **Output/Input** information or **Report**.

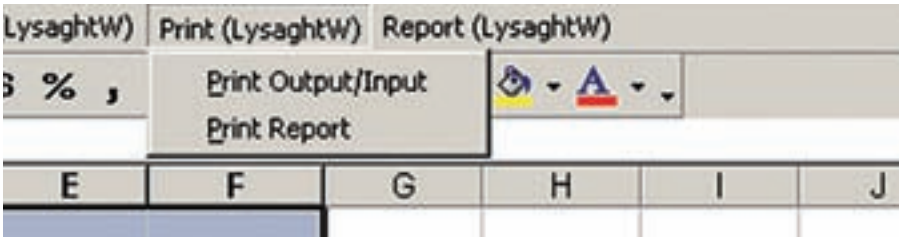


Figure 2
Print (**LYSAGHT W**) Menu

Report (LYSAGHT W) Menu will generate detailed design report which is described in more details in Chapter 10.

Figure 3
Report (**LYSAGHT W**) Menu

It shall be noted that **LYSAGHT W Menu** options are available only when LYSAGHT W-DEK design software Excel file is activated.

5. Input Dialogue Box

5.1 General

Input dialogue box is designed for quick and easy data entry. The user shall normally just choose one of available options. If required input information is missed or incorrect, the warning message would appear on the screen.

5.2 Conditions of Exposure

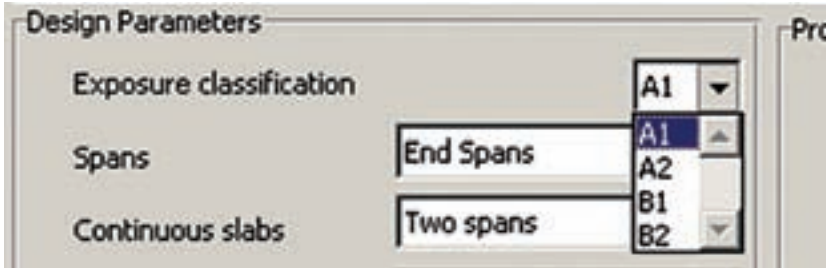


Figure 4
Exposure classification

The **Exposure Classification** shall be specified as required by AS3600-2001 Clause 4.3

5.3 Spans

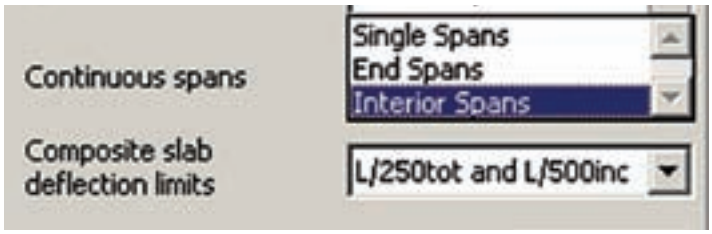


Figure 5
Spans

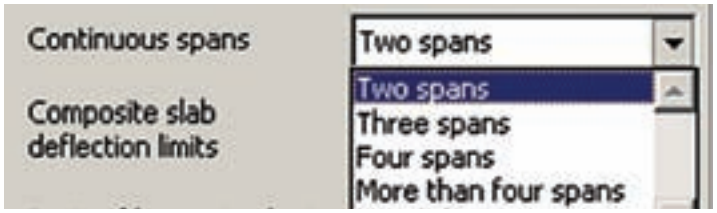


Figure 6
Continuous Spans

The user may specify **Single Spans** or **Continuous Spans** depending on the project.

Increased slab thickness may be required in many instances when continuous slabs are designed as a series of simply supported spans.

If the span is a Continuous one, the user may run the software several times: for **End Spans** and **Interior Spans** separately. If the continuous span is a **Two spans** then there is no option for **Interior Spans**, both spans are end ones. It shall be noted that **Continuous Spans** refer here to composite concrete slabs only, LYSAGHT W-DEK formwork spans are specified in Design and Design/Check dialogue boxes.

End Spans and **Interior Spans** may be designed with a different thickness to get the most economical design. However, The first Interior Span from the end support shall always have the same thickness as the End Span.

When the slab has less than five spans the user shall run **End Spans** first using **Design Menu** option to get the minimum possible slab thickness.
Then **Interior Spans** shall be designed with the slab thickness obtained for **End Spans** using **Design/Check Menu** option.

When the slab has five or more spans, the thickness of Interior Spans other than first **Interior Span** may be specified independently from **End Spans**.

See flowchart on page 6.

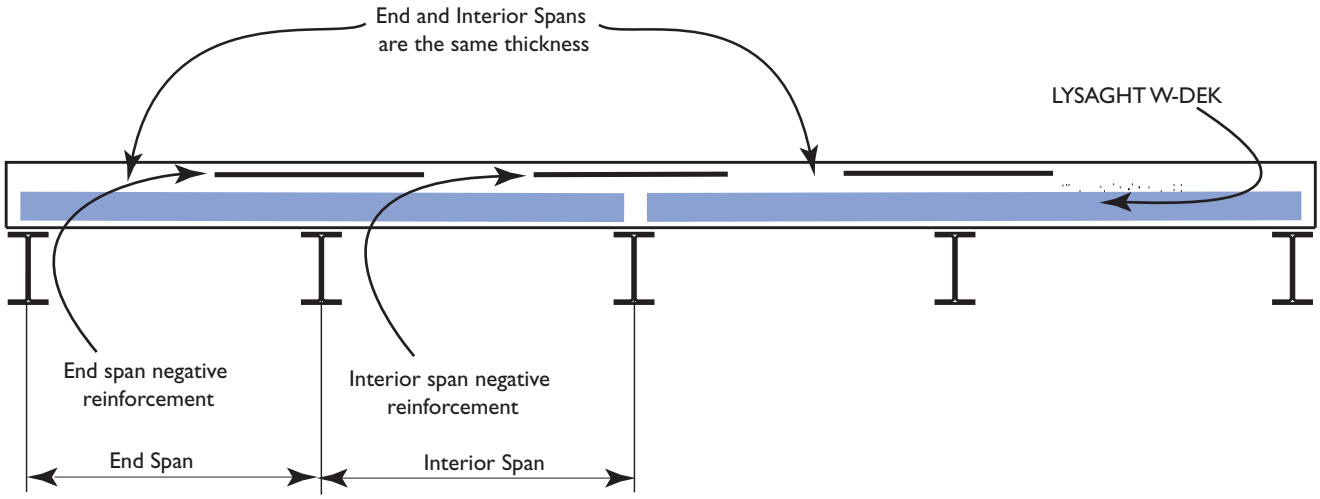


Figure 7
Spans

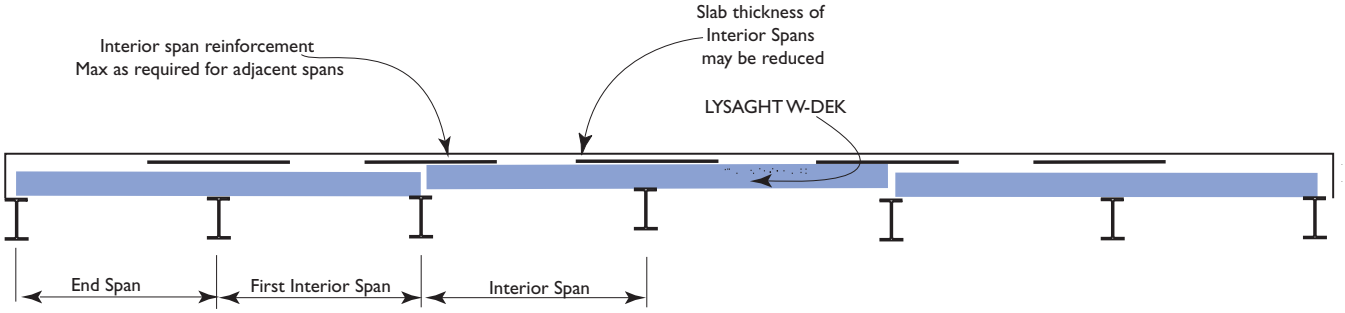


Figure 8
Spans

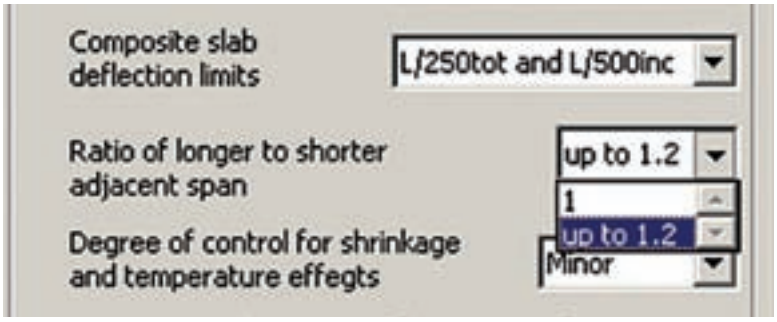


Figure 9
Ratio of Spans

The user may specify all spans as equal spans and with maximum **Ratio of longer to shorter adjacent span** of 1.2.

The software options for irregular lay outs with higher ratios of adjacent spans is not currently available, contact BlueScope Lysaght R&D for more information.

5.4 Composite Slab Deflection Limits

Figure 10
Composite slab deflection limits

The software is developed for Span/250 **Composite slab deflection limits** due to total load and two options for deflections limits due to imposed loads:

- Span/500 is recommended by AS3600-2001 TABLE 2.4.2 for concrete slabs which support brittle partitions like masonry walls, glass doors.
- No limits for slabs not supporting brittle partitions

5.5 Crack Control for Flexure

Figure 11
Crack control for flexure

Not required option may be used for areas of slabs fully enclosed within a building except for a brief period of weather exposure during construction and where it is assessed that wider cracks can be tolerated - according to AS3600-2001 Clause 9.4.1. This option will design reinforcement as required for relaxed crack control. Items 9 (i) and (iii) of Clause 9.4.1

5.6 Degree of Control of Shrinkage and Temperature Effects

Figure 12
Shrinkage control

Refer to AS3600-2001 Clause 9.4.3 for shrinkage control requirements.

Figure 13
Environment for shrinkage strains

It shall be noted that arid (interior) environment will result in higher shrinkage strains, which in turn may result in deeper slabs.

5.7 Properties of Materials

Figure 14
Concrete grades

The minimum Concrete grade possible depends on Exposure Classification.
B2 classification will require minimum concrete grade of 40MPa.

Figure 15
Negative, positive and fire reinforcement grade

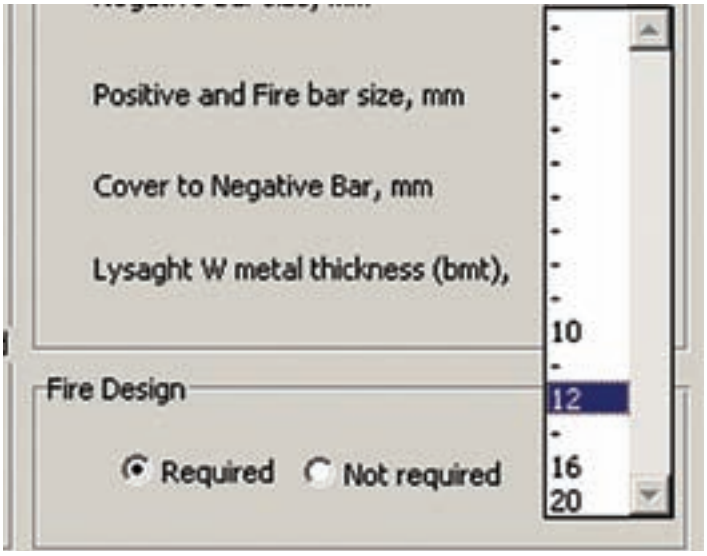


Figure 16
Negative bar sizes
Positive and fire bar sizes

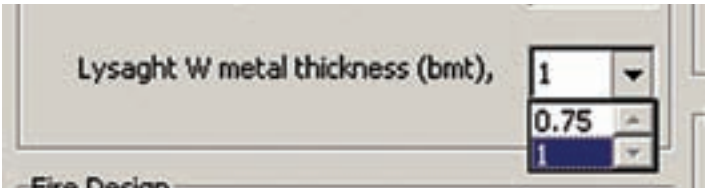


Figure 17
LYSAGHT W-DEK BMT (base material thickness)

The software may design composite slabs using : 0.75 BMT or 1.0 BMT sheets. The user may try 0.75 BMT for the first run. If the design is not economical (props are necessary), next run with increased BMT may be necessary. Contact Steel Direct to design slabs with 1.2 BMT LYSAGHT W-DEK.

5.8 Cover to Negative Bar

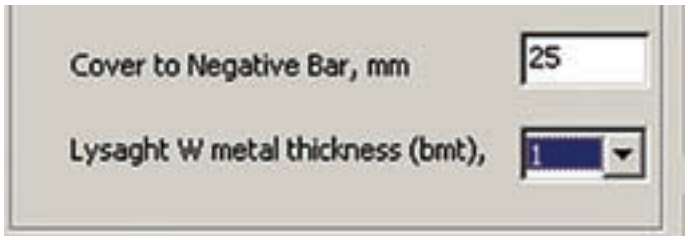


Figure 18
Cover to negative bar

Users shall specify appropriate covers to ensure that the concrete can be satisfactorily placed and compacted around reinforcement in accordance with the requirements of AS3600-2001, Clause 19.1.3 and 4.10.

5.9 Fire Design

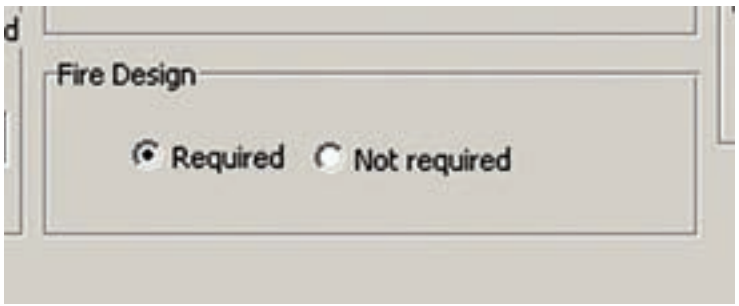


Figure 19
Fire Design

At this stage the user shall specify if the **Design for fire** is required or not.

The requirements for Fire Reinforcement and its location within the composite concrete slab is given in Chapter 8.

5.10 Shrinkage Reinforcement

This reinforcement is necessary to control cracking due to shrinkage and temperature effects in transverse direction. Shrinkage reinforcement can be specified as mesh or bars.

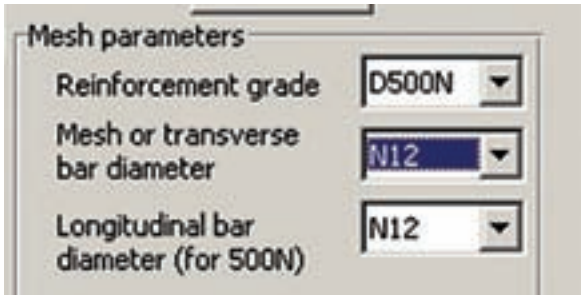


Figure 20
Shrinkage reinforcement

Users can specify the diameter of reinforcement and spacing
for longitudinal bars if the reinforcement grade is D500N.

The detailed definition of Shrinkage reinforcement and its location within the composite concrete slab is given in AS3600-2001 Clause 9.4.3.

If rectangular mesh (RL) is specified it shall be oriented such as more steel is spanning in transverse (perpendicular to sheeting) direction.

5.11 Loading Parameters

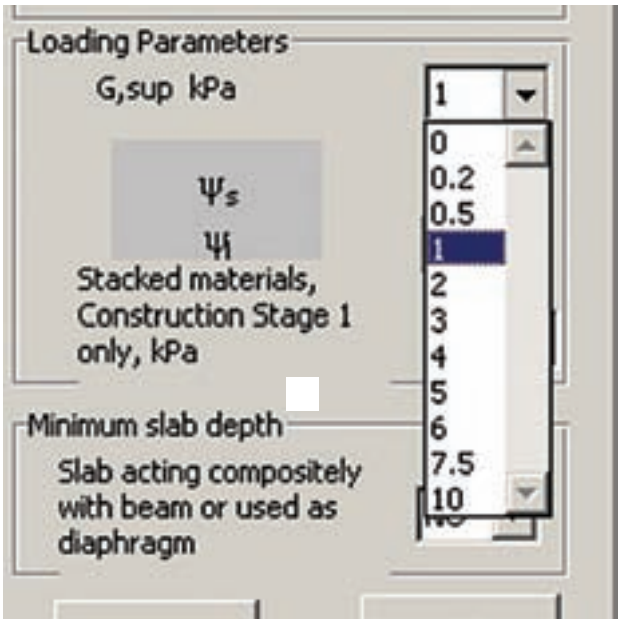


Figure 21
Superimposed dead load

Superimposed dead load (G) is a load of permanent nature in addition to self weight of composite concrete slabs.

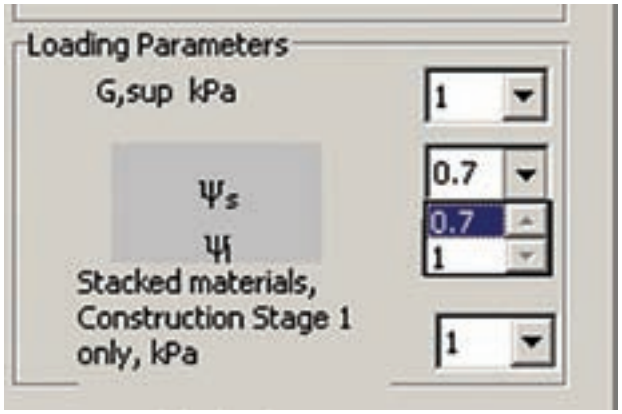


Figure 22
ψ_s load factor

ψ_s and ψ_l are factors for **Live** (Imposed) **Loads**. **Live Load** itself shall be entered in **Design** or **Design/Check** dialogue boxes which are described in next Chapters.

Refer to AS1170.0 : 2002 for more information.

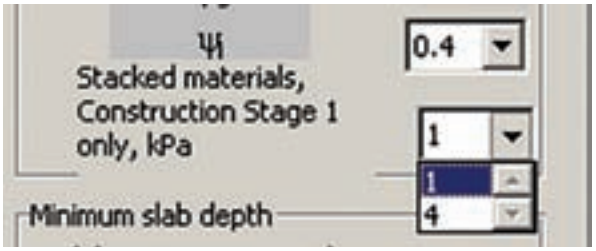


Figure 23
Stacked materials

This is the weight of Storage loads as specified in AS3610-1995, Clause 3.2.5. during construction stage before concrete is placed.
The value of the Storage Load is 4kPa. A 1kPa option is available.
If load is less than 4kPa is specified, it shall be clearly shown on formwork documentation and controlled on construction site.

6. Design Dialogue Box

6.1 General

When the user entered all necessary parameters in the **Input** dialogue box, the next step would be to click **Design** or **Design/Check** button at the bottom of the **Input** dialogue box. This will open one or another dialogue box. The **Design** option is used when the user wants to design the slab to the very minimum slab thickness. **Design/Check** option shall be used when the possible slab thickness is known. (User controlled - See flowchart on page 6.)

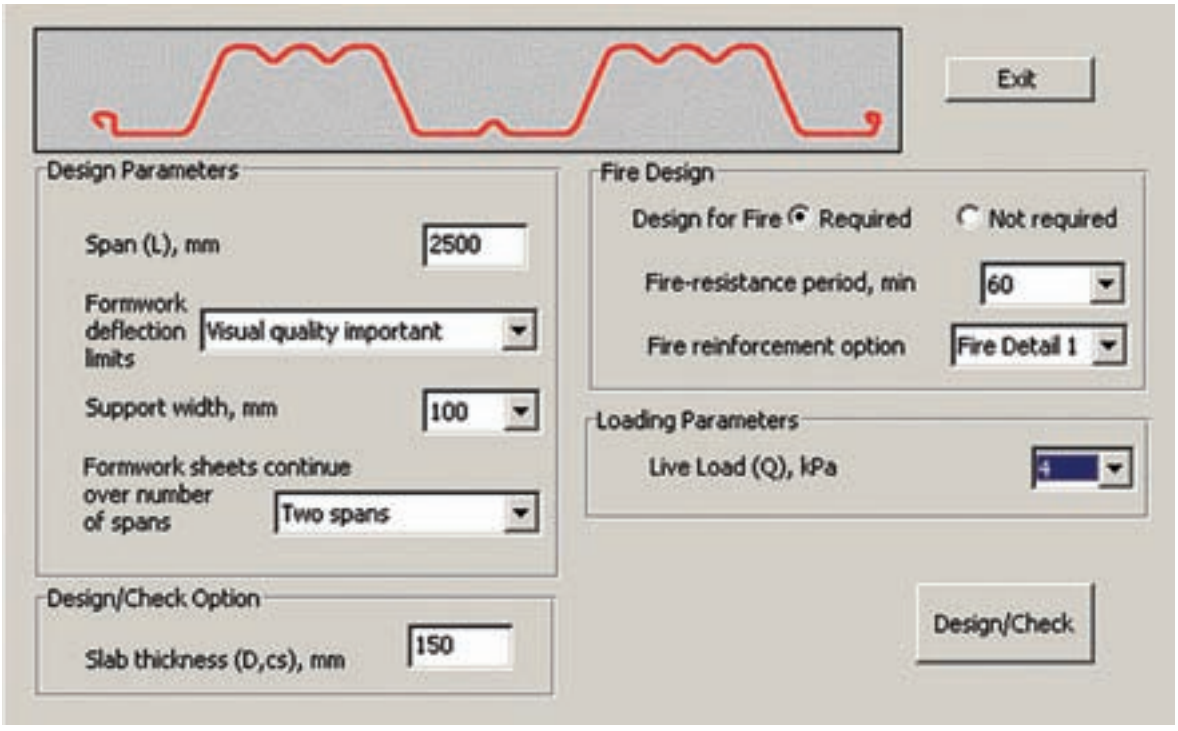


Figure 24
Design dialogue box

6.2 Slab Span

Figure 25
Slab span

The user shall type in the span length. It shall be centre to centre span, see Chapter 8 of this Guide for more details. The range of possible spans is from 1.8 to 6m.

6.3 Formwork Deflection Limits

Figure 26
Formwork deflection limits

Formwork deflection limits shall be specified as required by
AS3610:1995 and AS2327.1. Span/240 (visual quality important) deflection limit is recommended for slabs in which good general alignment is required. It is suitable for a Class 3 or 4 surface finish.

L/130 (visual quality not important) deflection limit is suitable for Class 5 surface finish.

6.4 Support Width

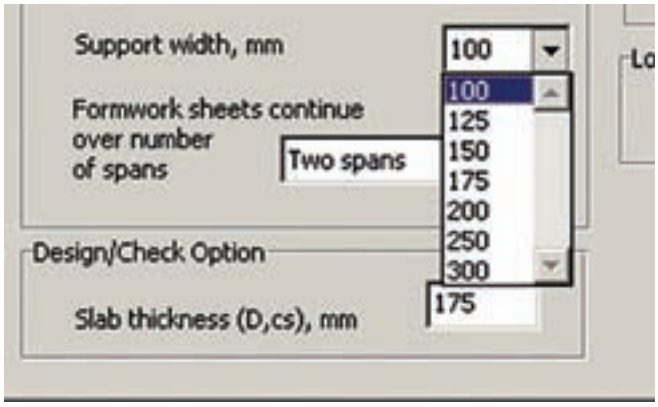


Figure 27
Support width

This is a width of a supporting structure – steel beams. It is important to enter correct value – it may result in smaller BMT of the LYSAGHT W-DEK formwork.

6.5 Live Load

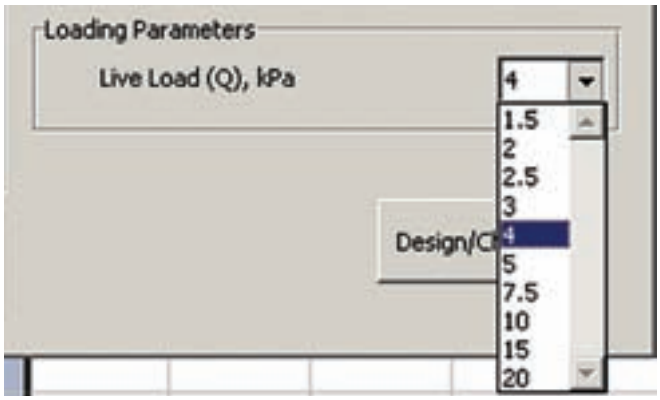


Figure 28
Live load

Live Load (Q) shall be specified as required by AS1170.1 - 2002.

6.6 Fire Design

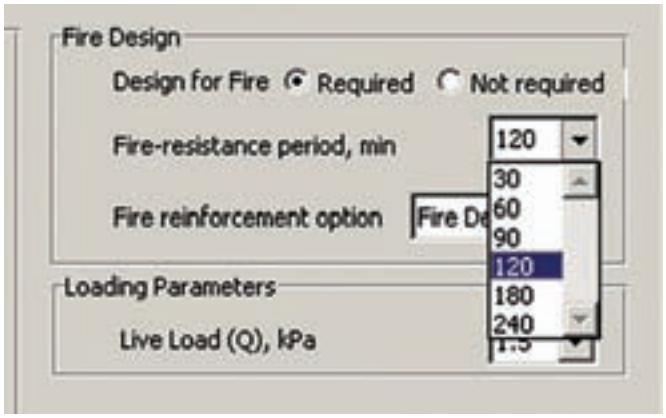


Figure 29
Fire design

The user may specify **Fire-resistance periods** of **30, 60, 90, 120, 180** and **240** minutes as defined by AS3600-2001 Section 5.0

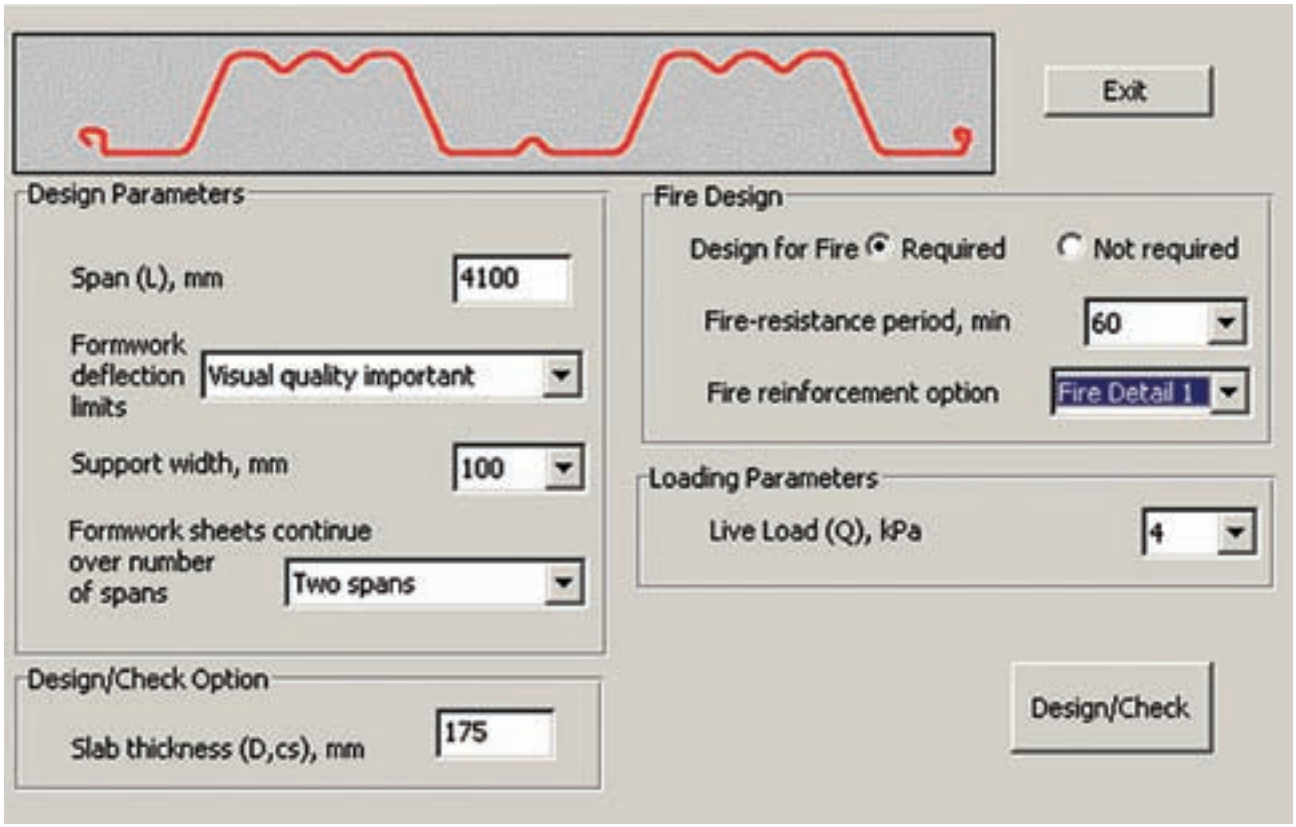
Figure 30
Fire reinforcement option.

7. Design/Check Dialogue Box

7.1 General

When the user entered all necessary parameters in the Input dialogue box, the next step would be to click **Design** or **Design/Check** button at the bottom of the Input dialogue box. This will open one or another dialogue box. The **Design** option is used when the user wants to design the slab to the very minimum slab thickness. **Design/Check** option shall be used when the slab thickness is known (user controlled). It may be in a case when the architect specified the slab thickness for other than structural reasons or **Interior spans** shall be designed to the slab thickness as required for **End spans** – see Chapter 5.3 of this Guide and the flowchart.

Figure 31
Design & Design/Check Options



This Dialogue box has the same options as **Design** dialogue box with an addition of **Slab thickness** option.

Figure 32
Design/Check dialogue box

7.2 Slab Thickness

Figure 33
Slab thickness

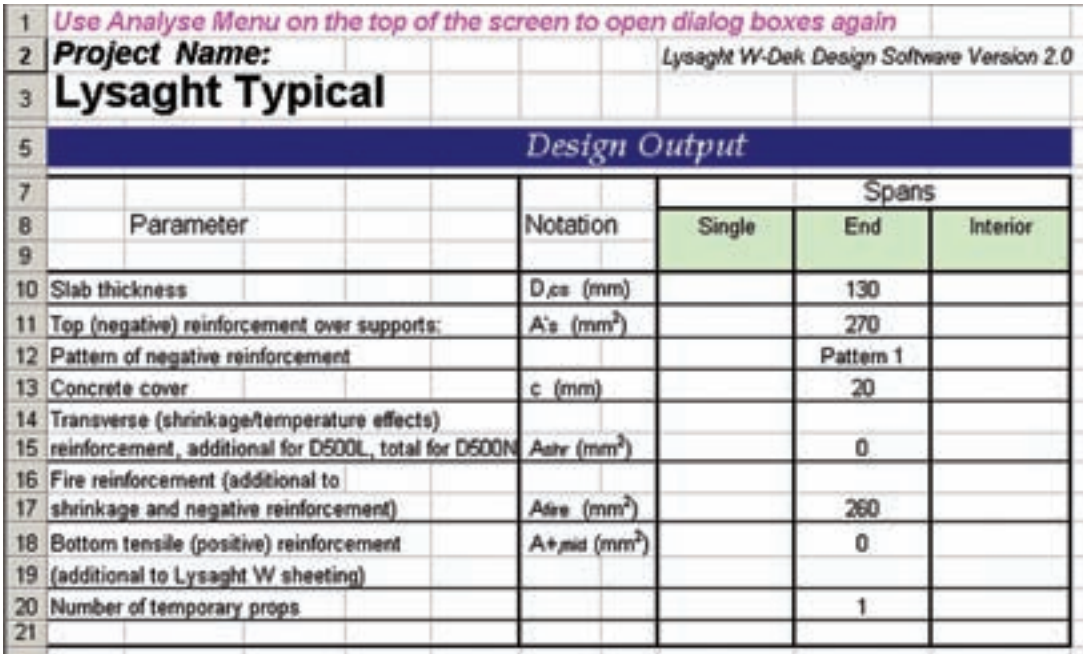
The slab thickness may vary from 130 to 250 mm. The user shall type in the necessary slab thicknesses. Slabs thicknesses of more than 250 mm are considered as not practical. LYSAGHT's Steel Direct shall be contacted to design slabs with more than 250 mm thickness. (Contact details are on back cover.)

8. Results Window

8.1 General

The **Results window** will appear on the screen automatically when the user clicks the **Design** or **Design/ Check** buttons on the relevant Dialogue box. Alternatively, the window may be opened by clicking on the **Results** worksheet at the bottom of the Excel window.

The window shows the design summary **(Design Output)** and the list of entered parameters in **Input, Design** or **Design/Check** dialogue boxes **(Input parameters)**.



Use Analyse Menu on the top of the screen to open dialog boxes again

Project Name: *Lysaght W-Dek Design Software Version 2.0*

Lysaght Typical

Design Output

Parameter	Notation	Spans		
		Single	End	Interior
Slab thickness	D,cs (mm)		130	
Top (negative) reinforcement over supports:	A's (mm²)		270	
Pattern of negative reinforcement			Pattern 1	
Concrete cover	c (mm)		20	
Transverse (shrinkage/temperature effects) reinforcement, additional for D500L, total for D500N	Ashr (mm²)		0	
Fire reinforcement (additional to shrinkage and negative reinforcement)	Afire (mm²)		260	
Bottom tensile (positive) reinforcement (additional to Lysaght W sheeting)	A+,mid (mm²)		0	
Number of temporary props			1	

Input parameters

Type of Buildings	**Steel Frame**	Negative Reinforcement Diameter	**12mm**
Span Configuration Continuous Spans	**End Spans** **Three spans**	Negative Reinforcement Grade	**D500N**
Exposure Classification Ll/Ls	**A1** **up to 1.2**	D,cs	**175**
Deflection Limits of Composite Slabs	**Total <L/250** **NO**	Lysaght W-dek sheeting	**0.75 mm**
L,eff, mm Formwork Deflection Limits	**3100** **Visual quality not important**	Q live load G superimposed dead load Q weight of stacked materials construction stage 1	**5 kPa** **1kPa** **4kPa**
Formwork sheets continue over number of spans	**Three or more spans**	ψ_s ψ_l	**0.7** **0.4**
Crack control for shrinkage and temperature effects	**Moderate**	Fire Design	**Required**
Crack control for flexure f'c	**Required** **32MPa**	Fire Resistance Periods	**120 min**
Shrinkage Reinforcement Grade	**D500N**	Fire Reinforcement Options	**Fire Detail 1**
Mesh or transverse bar diameter, mm	**N12**	Positive and Fire Reinforcement bar diameter, mm	**12mm**
Mesh longitudinal bar diameter, mm	**N12**	Environment for shrinkage	**Arid (interior)**
Mesh longitudinal bar spacing, mm	**100**	Cover to top reinforcement, mm Support width, mm	**20** **300**

Figure 34
Results window

The reinforcement types in the Design Output table is explained in the following Figures:

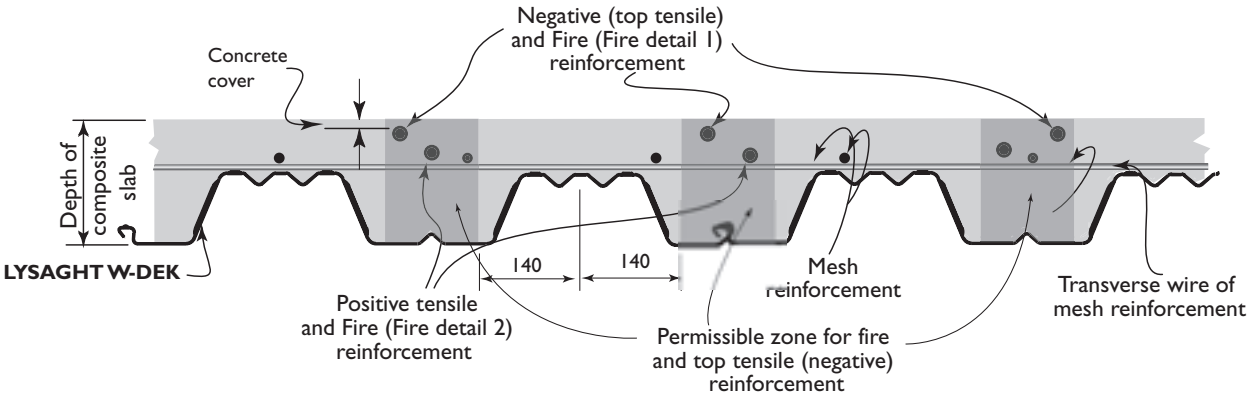


Figure 35
Slab cross section

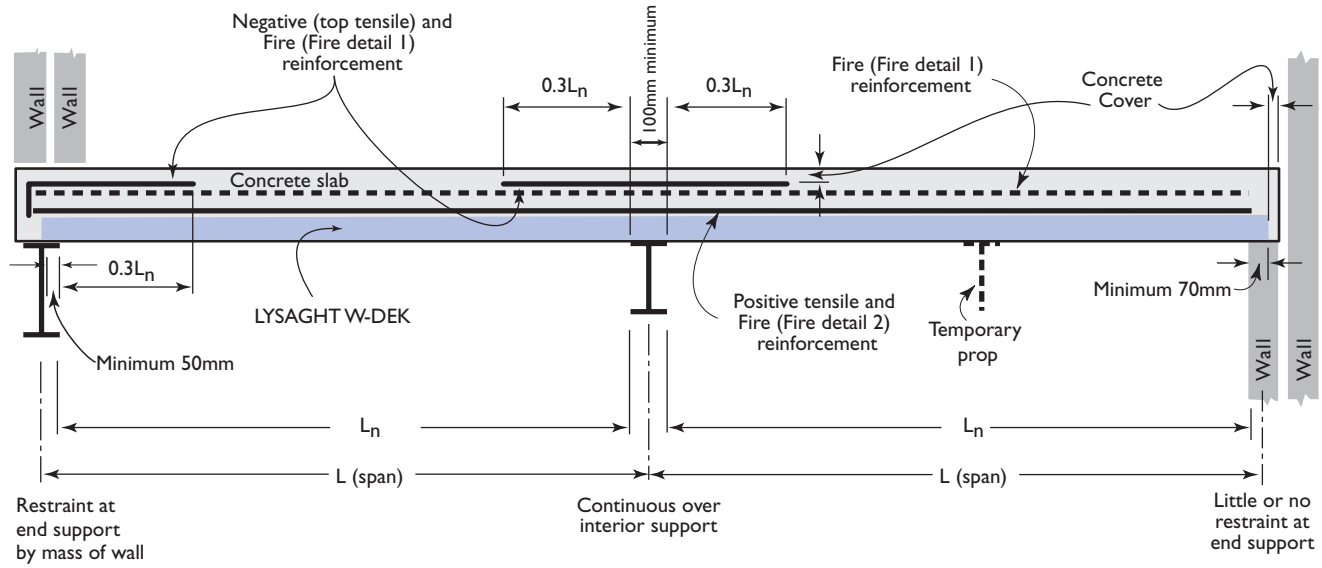


Figure 36
LYSAGHT W-DEK Pattern 1 for conventional (standard) reinforcement

1. Negative (top tensile) reinforcement shall be placed within a permissible zone for fire rated slabs. Negative reinforcement may be placed outside permissible zone if design for fire is not required. If it is necessary to place negative reinforcement outside the permissible zone for fire rated slabs, the design is possible through consultation with Customer Support which is accessed via Steel Direct 1800 641 417.
2. Positive tensile reinforcement is given as extra area to fire reinforcement (Detail 2) and may be placed outside the permissible zone. Alternatively, fire bars (Detail 2) may be specified with increased diameter to satisfy requirements for positive tensile reinforcement.
3. At least one bar per rib is recommended for all types of reinforcement except mesh.

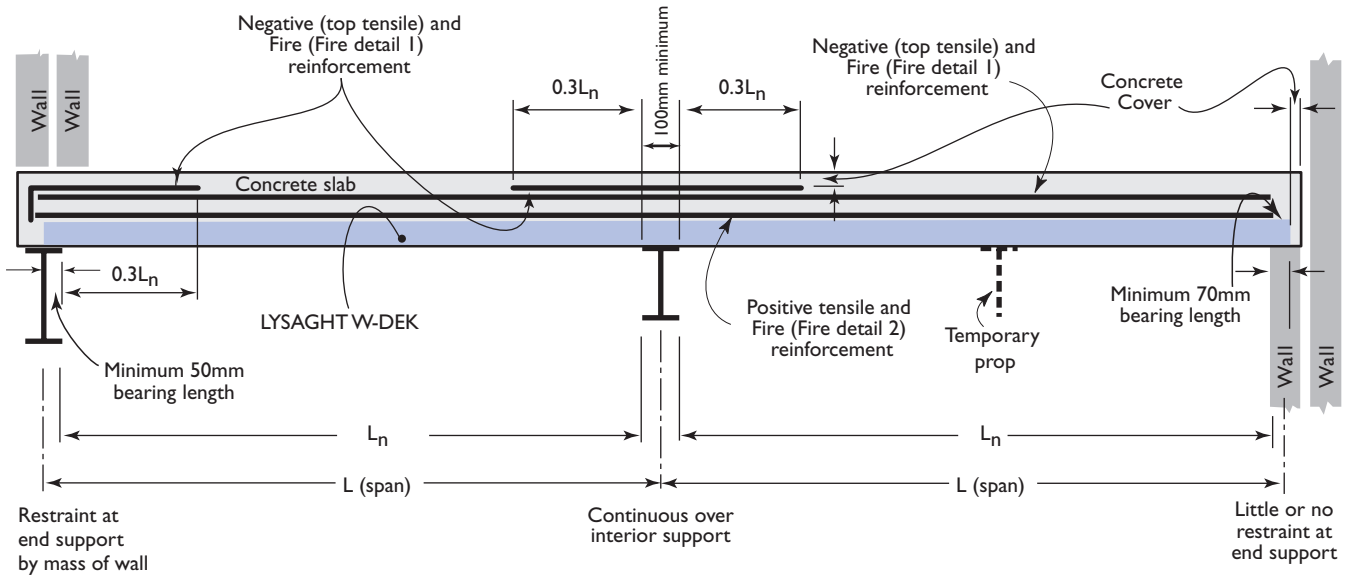


Figure 37
Pattern 2 of top tensile (negative) reinforcement

Pattern 2 for negative reinforcement shall be used when Live Load exceeds twice the dead load.

Every third bar of negative reinforcement at support shall continue all over the span (for Pattern 2 only)

Fire shall be designed for one option only - (Fire detail 1 or Fire detail 2.)

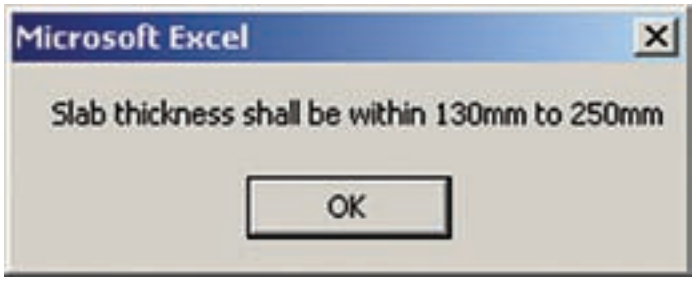
9. Warning Messages

Slab can not be designed to specified thickness

This message means that the minimum possible slab thickness shall be more than specified by the user using Design/Check option. The user may:

- Increase slab thickness specified using Design/Check option
- Reduce minimum required slab thickness by:
- Increasing concrete grade
- Decreasing Tensile and Compression reinforcement bar size
- Increasing slab deflection limit to L/250

All input parameters shall be checked if adequate.



Slab thickness shall be within 130mm to 250mm

This means that slab thickness entered is not correct.
250 mm is considered as the maximum practical slab thickness.
Contact Steel Direct if you still want to design deeper slabs.

This means that the slab span entered is outside allowed limits.

Tensile & compression reinforcement bar size have not been entered

Self explanatory.

Fire reinforcement bar size has not been entered

Self explanatory.

Specify correct number of spans for continuous slabs

That message may appear when the user designs first continuous span as an end double span and then tries to design interior span (as double span). The interior span shall be specified for continuous slabs with three or more spans.

1 kPa stacked materials Load shall be clearly specified on formwork documentation. Continue?

The user may chose Yes and continue with the design. However, 1 kPa load shall be clearly specified on design documentation and controlled on a construction site.

The transverse bar size has not been entered.

Self explanatory.

LYSAGHT W-DEK

Job Name: Lysaght Typical

INPUT PARAMETERS:

Type of building			Steel frames
Span configuration			End Spans
Continuous spans			Three spans
Ratio of shorter to longer spans			up to 1.2
Slab thickness	Dc	mm	165
Density of concrete:	r g	kg/m3	2400
Concrete grade			32MPa
Concrete slab span, centre to centre	L	mm	3100
Exposure classification	(AS 3600-2001, Table 4.3)		A1
Reinforcement (negative, positive, fire) grade	(AS 36000-2001, Table 6.2.1)		D500N
Reinforcing (positive, fire) bar diameter		mm	12
Reinforcing negative bar diameter		mm	12
Deflection limits of composite slabs	(AS 3600-2001, Table 2.4.2)		Total <L/250
Degree of control for shrinkage and temperature effects			Moderate
Shrinkage mesh grade	(AS 3600-2001, Table 6.2.1)		D500N
Mesh or transverse bar diameter			N12
Mesh longitudinal bar diameter (if D500N)		mm	N12
Mesh longitudinal bar spacing (if D500N)		mm	300
Concrete cover	(AS 3600-2001, Table 4.10.3.2)	mm	20
Slab acting compositely with steel beams or used as diaphragm			NO
Environment for shrinkage strains			Arid (interior)
Formwork sheets continue over number of spans			Three or more spans
Formwork deflection limit	(AS 2327.1-2003, Clause C2)		Visual quality not important
Lysaght W base metal thickness	t	mm	0.75
Permanent support width		mm	100
Superimposed dead load	Gsup	kPa	1
Live Load	Q	kPa	4
Load factor	y_s		0.7
Load factor	y_l		0.4
Construction loads due to to weight of stacked materials	M (AS 3610-1995, Clause 4.4)	kPa	1
Fire resistance level	FRL (Building Codes of Australia)	min	120 min
Load factor for imposed loads during fire			Fire Detail 1

Formwork design

Number of temporary props			0

PROPERTIES OF LYSAGHT W:

Moment capacity in positive bending	$f M^{+}_{u}$	kNm/m	6.61
Moment capacity in negative bending (used in partial plastic analysis)	$f M^{-}_{u}$	kNm/m	3.2
Shear (web crippling) capacity	$f V_{u}$	kN/m	23.0
Effective Second Moment of Area (for serviceability calcs.)	Ieff,ser (AS/NZS 4600:1996, Section 6)	mm4/m	775000.0
Yield stress	f_y (AS/NZS 4600:1996, Table 1.5)	MPa	550.0
Young's modulus of elasticity	(AS/NZS 4600:1996, Table 1.4)		200000

DESIGN LOADS:

Self weight of sheeting	G_{sh}	kPa	0.09
Self weight of concrete and reinforcement	G_c	kPa	3.47
Concentrated Live Load	Q_c	kPa	3.0
Concentrated Live Load UDL equivalent	$Q_{c,equiv}$	kPa	2.31
Load from stacked materials	M	kPa	1.0
Live Load	Q_{uv} (AS 3610-1995, Clause 4.4)	kPa	1.0
Concentrated point load	Q_p	kN	2.0
Self weight of reinforcement	Q_r (AS 2327.1-2003, Clause F2)	kPa	0.1

LOAD COMBINATIONS:

Strength:

Stage 1(before placing concrete):

$F_{dla} = 1.25*G_{sh} + 1.5*Q_{uv} + 1.5Q_M$		kPa	3.1
$F_{dlb} = 1.25*G_{sh} + 1.5*Q_r + Q_p$			

Stage 2(after placing concrete):

$F_{dlla} = 1.25*G_{sh} + 1.25G_c + 1.5*Q_{uv}$		kPa	5.9
$F_{dllb} = 1.25*G_{sh} + 1.25G_c + Q_c$			6.8

Serviceability:

$F_{def} = G_{sh} + G_c$		kPa	3.6
	(AS 3610-1995, Table 4.5.1)		

DESIGN FOR STRENGTH:

Maximum positive bending moment	M*	kNm/m	6.53
	$M^* < f M^{+}_{u}$		**OK**
Maximum shear force	F^*_v	kN/m	10.4
	$F^*_v < f V_u$		**OK**
Combined bending and shear	Not applicable for partial plastic analysis		

DESIGN FOR SERVICEABILITY:

Deflections	Dtot	mm	14.6
Deflection limits	Dtot,max	mm	23.8
	Dtot<MIN(Dtot,max)		**OK**

Composite slab design

MATERIAL PROPERTIES AND SLAB GEOMETRY:

Yield stress of mesh reinforcement	f_y	MPa	500
Lysaght W sheeting yield stress	$f_{y,sh}$	MPa	550
Yield stress of reinforcing bars	$f_{y,bar}$	MPa	500
Longitudinal shear capacity	$\tau_{u,Rd}$	MPa	115
	(prEN 1994-1-1, Clause B.3.6)		
Ratio of compressed stress block	γ		0.822
Long term shrinkage and creep factor	k_{sc}		2
	(AS 3600-2001, Clause 8.5.3.3)		
Modulus of elasticity of concrete	Ec	MPa	28600
	(AS 3600-2001, Clause 6.1.2)		
Shrinkage induced tensile stress	f_{cs}	MPa	0.4113
	(AS 3600-2001, Clause 8.5.3.1)		
Depth of Lysaght W	h_r	mm	78
Distance from centroidal axis of Lysaght W to extreme fibre in tension	$y_{sh,eff}$	mm	32
Distance from plastic neutral axis of Lysaght W to extreme fibre in tension	e_p	mm	78
	(prEN 1994-1-1, Clause 9.7.2)		
Effective cross-sectional area of Lysaght W	A_{pe}	mm^2	711
	(prEN 1994-1-1, Clause 9.7.2)		

LOADING:

Concrete slab self weight	G	kPa	3.40
	(concrete, reinforcement and sheeting)		
Superimposed Dead Load	G_{sup}	kPa	1
Live Load	Q	kPa	4

LOAD COMBINATIONS:

Strength:		kPa	11.51
	1) Fu=1.5*G (the rest of spans)	kPa	5.51
	(AS 1170.1-1989)		
	(AS 3600-2001, Clause 7.6.4)		
		kPa	11.95
	2) Fu=1.5*G (the rest of spans)	kPa	5.95
	(EN 1990, Section 6)		
Deflections:			
	Total propped $F_{s,tp} = (1+k_{sc})G + (\psi_s + k_l)Q\psi$	kPa	N/A
	Total unpropped $F_{s,tup} = (1+k_{sc})G_{sup} + (_{cs}\psi_l)Q + k$	kPa	9.00
	Incremental propped $F = k_{s,ipsc}G + (\psi_s\psi_l)Q + k_{cs}$	kPa	N/A
	Incremental unpropped $F = k_{s,iupsc}G_{sups} + k_{cs}\psi + (\psi_l)Q$	kPa	8.00
	(AS 3600-2001, Clause 8.5)		

11. Software Disc

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