Conscious

engineering design

structural design calculations

For proposed alterations and refurbishment at:

Public Conveniences / Café,

Esplanade,

Seaford

BN25 1JH

Client: Seaford Town Council

Project Number: 1257

Rev:

Date: 21/07/2023

Conscious engineering design
Sky View,
5 Findon Avenue
Saltdean BN2 8RF
tel: 07896 250418
email: info@conscious-edesign.co.uk

PROJECT BRIEF AND DESIGN PHILOSOPHY

Design Brief:

Proposals to refurbish the existing public conveniences on the seafront near the Martello tower in Seaford, include various structural alterations. These calculations have been provided to substantiate the above structural requirements.

All works are to Building Inspector approval.

DESIGN CODES, STANDARDS AND REFERENCES

Basis of Design & Loading	BS EN 1990:2002	Basis of structural design
	BS EN 1991-1-1:2002	Actions on structures. General actions. Densities, self-weight, imposed loads for buildings.
Design of Structural Concrete Elements	BS EN 1992-1-1:2004	Design of concrete structures. General rules & rules for buildings
Design of Structural Steel Elements	BS EN 1993-1-1:2005	Design of steel structures. General rules & rules for buildings
Design of Structural Timber Elements	BS EN 1995-1-1:2004	Design of timber structures. General common rules and rules for buildings.
Design of Structural Masonry Elements	BS EN 1996-1-1:2005	Design of masonry structures. General rules for reinforced and unreinforced masonry structures
Geotechnical Design	BS EN 1997-1:2004	Geotechnical Design. General Rules

Design Notes

These calculations have been prepared with the aid of the following computer design programmes:

I. TEKLA TEDDS for Word 2022.
II. AutoDesk AutoCAD LT 2023

Results

- The calculations check that the member passes all of the applied checks and provides either a full set of calculations, or a summary table with the relevant pass/fail listed according to each check.
- The calculations are produced in summary form but can be expanded upon if required.

GENERAL STRUCTURAL NOTES

TO BE READ IN CONJUNCTION WITH NOTES ON DRAWINGS AND SPECIFICATIONS

1. Do not scale drawings and sketches.
2. Setting out to be checked on site by the Contractor & taken from the actual works wherever possible.
3. Any discrepancies must be reported to the Engineer prior to commencement of any structural works.
4. The contractor should check all parts of the existing structure being depended upon for structural support in the proposed design. Any weaknesses, sub-standard construction, poor material condition or inherent defects discovered during construction must be reported to the Engineer prior to continuation of the works.
5. The spans included within this document relate to design values, not actual values.
6. The Contractor shall confirm all dimensions on site prior to order of any structural members / materials.
7. It is assumed that the existing building is in good structural order. It must be noted that the contractor is completely responsible for the stability of the building structure whilst the works are in progress. The Contractor must ensure that all temporary design, shoring and propping are adequately provided and maintained throughout the course of the construction works.
8. The Contractor is responsible for notifying the Building Inspector when works which require approval are ready for inspection.
9. Provide adequate chocking/packing between new beams & existing structure where necessary.
10. All new structural steel elements are to be grade S275 unless noted otherwise (U.N.O.). All steelwork to be thoroughtly wire brushed to remove all loose mill scales and rust and is to be painted with two coats of High Build Zinc Phosphate primer. After erection, all damaged areas of paintwork are to be touched up. All welds are to be minimum 6mm fillet type and all bolts are to be zinc-plated grade 8.8, U.N.O.
11. The steelwork fabricator, if engaged, is responsible for the verification of all site dimensions prior to fabrication of steelwork.
12. All new structural hardwood elements are to be min grade D30 U.N.O., suitably treated against decay and insect attack. Ideally, new oak should be sourced from naturally seasoned stock where possible.
13. The client should be aware of the high probability of shrinkage cracking developing in exposed internal hardwood timbers as a result of a reduction in moisture content from a warmer, dryer atmosphere.
14. All assumed existing load bearing members, walls and foundations are to be checked on site and verified with the Building Control Officer prior to commencemnt of construction.
15. All existing wall thickness's and construction are to be checked on site by contractor prior to commencemnt of the works and any deviation from the assumptions made in the calculation/details should be reported to the Structural Engineer immediately.
16. The works must be carried out to the Building Control approval and to good standards of workmanship and in accordance with the relevant British Standards, Codes of Practice, Building Regulation requirements and the latest NHBC standards.
17. Works carried out on site based on these calculations and details without the necessary Building Regulations approval are entirely at the Client's/Contractor's risk.
18. Where works do not require a full plans application, the contractor should apply for a building notice. (We advise the client to consult their LABC for further information on qualifying conditions in this case).
19. The Architect/other parties are responsible for water proofing to all building elements to new and existing, all finishes, insulation, ventilation requirements, etc., and other parts of the Building Regulations.
20. The client is reminded of his obligations under The Construction (Design and Management) Regulations 2015 particularly the need to appoint a Prinicpal Designer for the construction works.
21. Any alteration to the design and specification must be approved by Conscious Engineering Design Ltd prior to construction. This design package and drawings attached only pertains to structural and civil engineering aspects of Building regulation's submission and approval.
22. Conscious Engineering Design Ltd excludes responsibility for losses associated with this design, should the following points of action not be followed:

a. Before ordering steelwork or other components, the design must be reviewed by the contractor in relation to the practicality, method and arrangement of the installation.
b. At any point during the work, should the contractor face issues with the design by Conscious Engineering Design Ltd or the contract administrator must be informed immediately so that a solution to any query or design error can be found.
c. Should any element of the design require alteration, Conscious Engineering Design Ltd must be informed immediately and before implementation so that any alteration can be checked and approved.
d. Changes to the design and/or specifications to suit site conditions or construction preferences requiring additional time by the engineer, must be approved by the client/contract administrator prior to commencement of such changes. Additional costs are to be approved in advance.

Failure to follow these points or to mitigate against unnecessary costs may invalidate insurances or warranties. Professional fees are charged at the discretion of Conscious Engineering Design Ltd, accept where correcting any error or otherwise unforeseen alteration.

DESIGNER'S RISK ASSESSMENT

HAZARD	RISK	PRECAUTIONS OR ACTIONS	REMAINING RISK
Demolition: Plant will be in use during the demolition and superstructure construction phases.	Med.	Site personnel to be fully aware of the areas where the machinery is operating	low
Temp.works: Construction Scaffold stability	high	Contractor to ensure stability using sufficient bracing to resist all loads. Regular inspections required to ensure adequacy of all fittings.	low
Danger from plant operation to the public	Low	Plant to avoid lifting over adjacent unmonitored airspace. Area under to be segregated from the public.	low
Plant stability	low	Provide level platform for plant to ensure safe operation.	low
S/Structure: Erectors and site personnel falling from height.	high	Provide stable working platform with guardrails and safety harness for operatives connecting steelwork.	low
Falling material from temporary scaffolds	high	Hard hats to be worn by all people on or visiting site. Adequate footwear should be worn by all permanent site personnel.	low
Potential of combined floor to floor - floor construction.	high	No work to be carried out on lower floor construction whilst upper floor is in progress.	low
Masonry: The use of chemical fixings	High	Fixings to be used in accordance with manufacturer's instructions in well ventilated spaces.	low
Construction	Med.	Extreme care to be taken when handling blocks (if required). Light blocks to be used where possible.	Med
Construction: Use of ladders	Med.	Ladders to be tied laterally at the top.	low
Placing Concrete: Potential chemical danger from wet concrete.	Med	Wear suitable protective footwear, clothing and gloves	low
Asbestos must be removed prior to commencement of works.			

Sky View, 5 Findon Avenue, Saltdean BN1 8RF
T: 07896 250418
E: info@conscious-edesign.co.uk

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Sky View, 5 Findon Avenue, Saltdean BN1 8RF
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E: info@conscious-edesign.co.uk

DESIGN CALCULATIONS

LOADING

PITCHED ROOF LOADING

Roof Pitch; $\theta_1 = 45°$;(Assumed)

Dead Loads

Tiling (Clay); $DL_{PR1} = 0.64$ kN/m^2
Battens; $DL_{PR2} = 0.04$ kN/m^2
Felt; $DL_{PR3} = 0.05$ kN/m^2
Sarking Boards; $DL_{PR4} = 0.1$ kN/m^2
Rafters; $DL_{PR5} = 0.2$ kN/m^2
Insulation; $DL_{PR6} = 0.05$ kN/m^2
Allowance for services; $DL_{PR7} = 0.2$ kN/m^2
Total; $DL_{PR} = (DL_{PR1} + DL_{PR2} + DL_{PR3} + DL_{PR4} + DL_{PR5} + DL_{PR6} + DL_{PR7}) = \mathbf{1.28}$ kN/m^2

Imposed Load

Imposed Load; $IL_{PR} = 0.6$ kN/m^2

MASONRY WALLS

Dead Load

102.5mm thick brickwork; $DL_{M.103} = (102.5 / 25) \times 0.591$ kN/m^2 = **2.42** kN/m^2
215mm thick brickwork; $DL_{M.215} = (215 / 25) \times 0.591$ kN/m^2 = **5.08** kN/m^2
100mm thick blockwork; $DL_{M.Blk} = (100 / 25) \times 0.547$ kN/m^2 = **2.19** kN/m^2
Plaster (13mm Both Sides); $DL_{PL} = 2 \times 0.12$ kN/m^2 = **0.24** kN/m^2
Plaster (13mm One Side); $DL_{PL.1} = 0.12$ kN/m^2
Render (15mm coat); $DL_{Rdr1} = 0.13$ kN/m^2
Internal Masonry Partition; $DL_{MP.103} = DL_{M.103} + DL_{PL}$ = **2.66** kN/m^2
Insulation; $DL_{W.Ins} = 0.1$ kN/m^2

Cavity Wall; $DL_{W.Cav} = DL_{M.103} + DL_{M.Blk} + DL_{PL.1} + DL_{W.Ins} + DL_{Rdr1}$= **4.96** kN/m^2
Brickwork Unit Weight; $DL_{BRK} = 21.5$ kN/m^3

FLAT ROOF LOADING

Dead Load

Weatherproof Membrane; $DL_{FR1} = 0.01$ kN/m^2
Plywood 18mm OSB3; $DL_{FR2} = 0.11$ kN/m^2
Joists & Firrings; $DL_{FR3} = 0.2$ kN/m^2
Insulation 120mm; $DL_{FR4} = 0.12$ kN/m^2
Plasterboard; $DL_{FR5} = 0.12$ kN/m^2
Total; $DL_{FR} = (DL_{FR1} + DL_{FR2} + DL_{FR3} + DL_{FR4} + DL_{FR5}) = \mathbf{0.56}$ kN/m^2

Imposed Load

Imposed; $IL_{FR} = 0.6$ kN/m^2

Sky View, 5 Findon Avenue, Saltdean BN1 8RF
T: 07896 250418
E: info@conscious-edesign.co.uk

LINTELS 1, 4, 5, 7, 8 AND 9 - LOADING

From Main Pitched roof;

Span of rafter in plan; $L_1 = 1.6m$

Roof Dead Load; $DL_{L1.1} = DL_{PR} \times L_1 / \cos(\theta_1) =$ **2.90** kN/m

Roof Imposed Load; $IL_{L1.1} = IL_{PR} \times L_1 =$ **0.96** kN/m

From Masonry – Case 1 - three courses of cavity construction above lintel;

Dead Load; $DL_{L1.2} = DL_{W.Cav} \times 0.225m =$ **1.12** kN/m

From Masonry – Case 2 - three courses of solid brick masonry above lintel;

Dead Load; $DL_{L1.3} = (DL_{M.215} + DL_{PL.1} + DL_{Rdr1}) \times 0.225m =$ **1.20** kN/m

From Greatest Span Flat Roof

Dead Load; $DL_{L1.4} = DL_{FR} \times (1.4m / 2) =$ **0.39** kN/m

Imposed Load; $IL_{L1.2} = IL_{FR} \times (1.4m / 2) =$ **0.42** kN/m

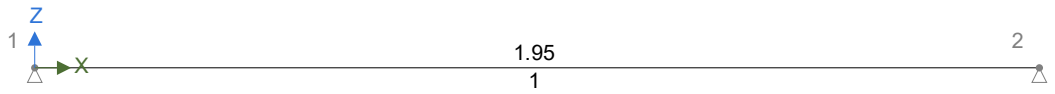
LINTEL 4 & 5 ANALYSIS

ANALYSIS

Tedds calculation version 1.0.37

Geometry

Geometry (m) - Concrete (EC2 normal) - R 100x215



Loading

Self weight included

Load combination factors

Load combination	Self Weight	Permanent	Imposed
1.35G + 1.5Q + 1.5RQ (Strength)	1.35	1.35	1.50
1.0G + 1.0Q + 1.0RQ (Service)	1.00	1.00	1.00
1.0G + 1.0ψ_2Q (Quasi)	1.00	1.00	0.30

Member Loads

Member	Load case	Load Type	Orientation	Description
LINTEL 4	Permanent	UDL	GlobalZ	4.49 kN/m
LINTEL 4	Imposed	UDL	GlobalZ	1.38 kN/m

Results

Total deflection

Self Weight - Total deflection

Permanent - Total deflection

Imposed - Total deflection

Reactions

Load case: Self Weight

Node	Force		Moment
	Fx (kN)	Fz (kN)	My (kNm)
1	0	0.5	0
2	0	0.5	0

Load case: Permanent

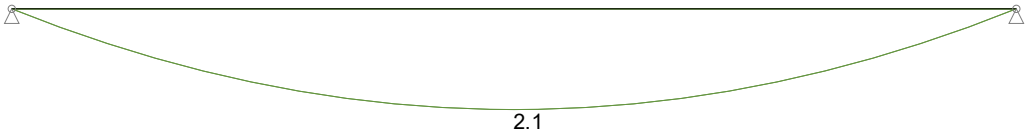
Node	Force		Moment
	Fx (kN)	Fz (kN)	My (kNm)
1	0	4.4	0
2	0	4.4	0

Load case: Imposed

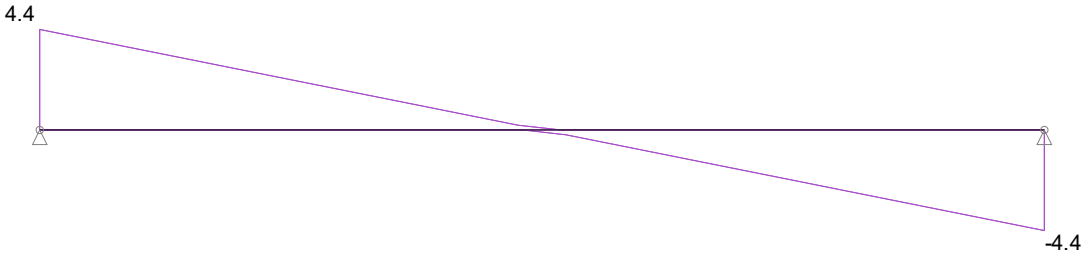
Node	Force		Moment
	Fx (kN)	Fz (kN)	My (kNm)
1	0	1.3	0
2	0	1.3	0

Forces

All load cases - Moment envelope (kNm)



All load cases - Shear envelope (kN)



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T: 07896 250418
E: info@conscious-edesign.co.uk

Element results

Envelope - All load cases

Element	Position (m)	Shear force (kN)		Moment (kNm)	
1	0	4.4 (max abs)	0.5	0 (min)	
	0.975	0		2.1 (max)	0.3
	1.95	-0.5	-4.4	0 (min)	

;

;

LINTELS 2, 3 AND 6 - LOADING

From Masonry (assume cavity construction above lintel);
Dead Load; $DL_{L2.1} = DL_{W.Cav} \times 1.2m =$ **5.95** kN/m

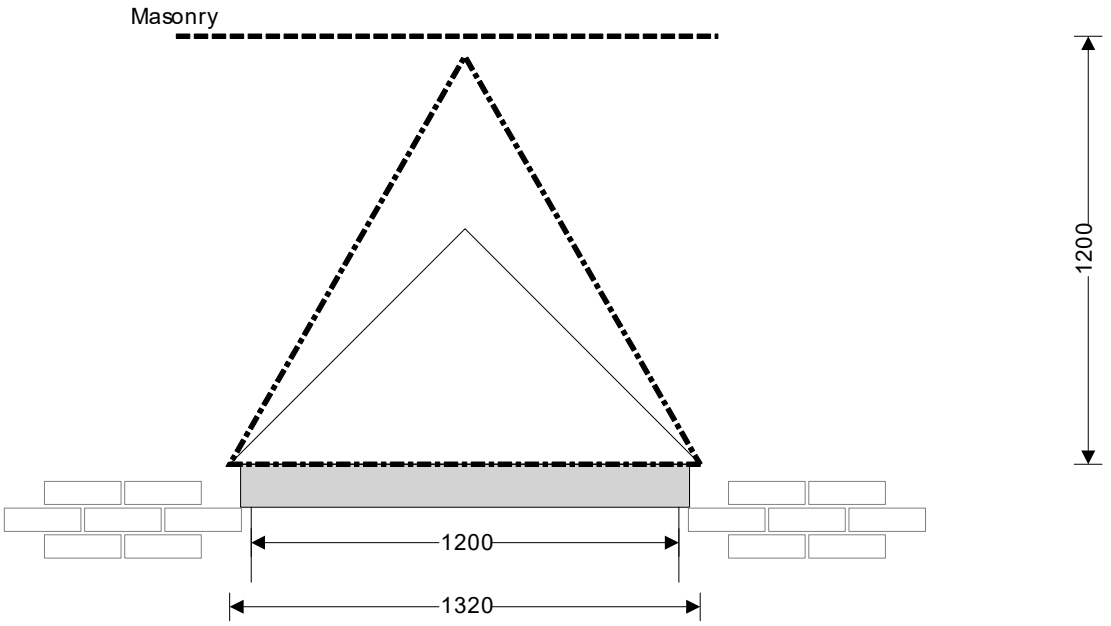
From Masonry (assume 3 courses of solid brick masonry above lintel);
Dead Load; $DL_{L2.2} = (DL_{M.215} + DL_{PL.1} + DL_{Rdr1}) \times 1.2m =$ **6.40** kN/m

LINTEL 6 - ANALYSIS

LINTEL ANALYSIS

In accordance with BS5977-1:1981 incorporating Amendment No. 1

Tedds calculation version 1.1.00



Basic lintel dimensions;

Lintel clear span;	L_{c1} = **1200** mm
Lintel load application length;	$L = L_{c1} \times 1.1$ = **1320** mm
Load zone height;	$h_{LZ} = \tan(45) \times L / 2$ = **660** mm
Interaction zone height;	$h_{IZ} = \tan(60) \times L / 2$ = **1143** mm

Load factors

Dead load factor;	LF_d = **1.40**
Imposed load factor;	LF_l = **1.60**

Masonry

Masonry height;	h_m = **1200** mm
Leaf 1;	
Masonry density;	γ_{mi} = **20.00** kN/m^3
Masonry thickness;	t_{wi} = **215** mm
Load at midspan;	$w_{mi} = h_{LZ} \times t_{wi} \times \gamma_{mi}$ = **2.838** kN/m

Sky View, 5 Findon Avenue, Saltdean BN1 8RF
T: 07896 250418
E: info@conscious-edesign.co.uk

Lintel self weight

Self weight of lintel; w_{lsw} = **0.000** kN/m

Masonry load zone

Height of load zone; $h_{LZ} = L / 2$ = **660** mm

Total masonry area; $A_{LZ} = h_{LZ} \times L / 2$ = **0.436** m^2

Total masonry load; $W_{LZ} = A_{LZ} \times t_{wi} \times \gamma_{mi}$ = **1.873** kN

Equivalent UDL; $w_{Equiv\_LZ} = W_{LZ} \times 1.33 / L$ = **1.887** kN/m

Load application summary;

Load Description	UDL total length (mm)	Start of UDL on lintel (mm)	End of UDL on lintel (mm)	Equiv. dead load on lintel (kN/m)	Equiv. imposed load on lintel (kN/m)
Masonry from load triangle	1320	0	1320	1.887	0.000

Analysis results at ULS

Maximum moment; M_{max} = **0.577** kNm

Maximum shear; V_{max} = **1.311** kN

Maximum reaction at support A; R_{A_max} = **1.311** kN

Maximum reaction at support B; R_{B_max} = **1.311** kN

Support reactions at SLS

Dead loads

Reaction at support A; R_{A_DL} = **0.937** kN

Reaction at support B; R_{B_DL} = **0.937** kN

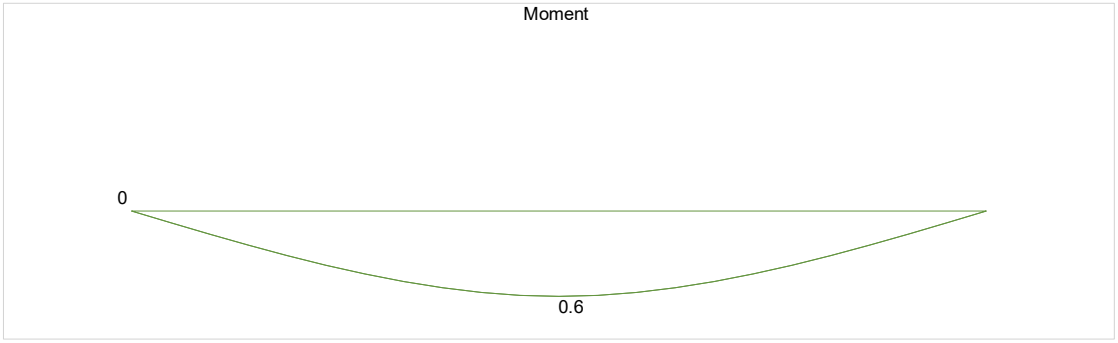
Imposed loads

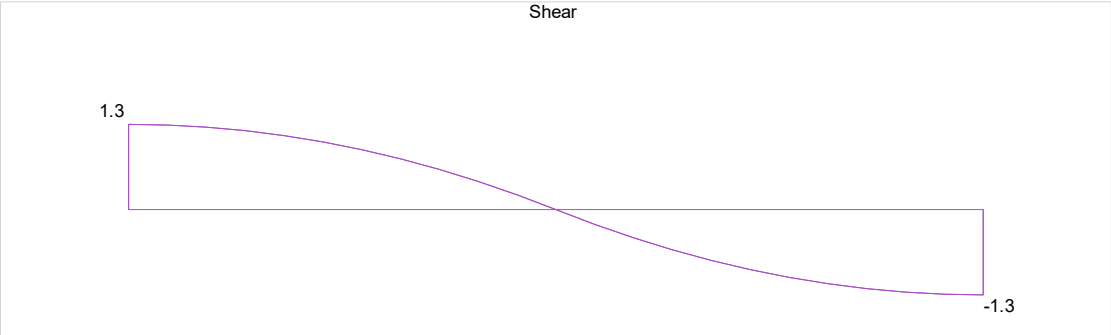
Reaction at support A; R_{A_IL} = **0.000** kN

Reaction at support B; R_{B_IL} = **0.000** kN

Equivalent UDL at SLS

Total equivalent UDL; w_e = **1.887** kN/m





CONCLUSION:

The existing masonry walls are likely to be constructed in the form of cavity masonry, however, there is a possability that the perimeter walls are in solid masonry. Therefore, a single specification for a suitable lintel section cannot be provided to cover every case, so two different options are proposed as follows:

Sky View, 5 Findon Avenue, Saltdean BN1 8RF
T: 07896 250418
E: info@conscious-edesign.co.uk

catnic
A Tata Steel Enterprise

Cavity Wall Lintel - CG90/100

Open back lintel

Benefits

Easy-to-use open back profile
Allows masonry to be built up continuously on both outer and inner leaf

Materials used in Lintels
The **CG**, **CH** and **CX** ranges are formed from galvanised steel, then powder coated

Duplex corrosion protection
Ensures optimum durability and longevity

Built-in DPC
Saves time in construction and means cavity is easy to clean without risk of damage to DPC

Integral Plaster key
With staggered slots applied to the inner flange and ribbed underside of insulation (perforated steel baseplate on **CH** and **CX** range)

Continuous insulation
Maximising thermal efficiency, minimising cold bridging

Features:

- Triangulated masonry load
- Supporting uniformly distributed masonry load
- Supporting uniformly distributed timber floor and roof loads
- Suitable for fair faced inner leaf masonry

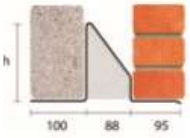
Note: Whilst the above information is intended to offer general guidance regarding typical applications, it should not be considered as comprehensive. Requirements not fully covered by the above should be referred to our technical services department for individual consideration.

90-105mm Cavity
100-115mm Inner Leaf

All ratios are shown inner to outer

Standard Duty

Standard lengths are available in 150mm increments up to 3000mm, 300mm at lengths from 3000mm to 3600mm.



CG90/100						
Standard lengths (mm)	750-1500	1650-1800	1950-2100	2250-2400	2550-2700	2850-3600
SWL 1:1/3:1 (kN)	15	18	20	22	26	26
Weight (kg/m)	6.1	7.6	8.3	8.9	10.2	13.0
Nominal height 'h' (mm)	140	140	160	180	220	220

The SWL (safe working load) is based on the total UDL (uniform distributed load) over maximum span using 150mm end bearings.

Catnic
Pontypandy Industrial Estate
Caerphilly
CF83 3GL
T: 029 2033 7900
F: 029 2086 7796

01/2015

www.catnic.com

Sky View, 5 Findon Avenue, Saltdean BN1 8RF
T: 07896 250418
E: info@conscious-edesign.co.uk

Hi-Spec & Fair Faced Ranges

All units are prestressed to ensure optimum performance and come with 30 minutes fire rating as standard. With a range of 18 different sections sizes and with lengths available up to 4800mm on certain sections sizes.

Hi-Spec Finish
An ex-steel mould finish and made from wet cast concrete. May see small air holes on the surface, aggregate and concrete fines to bottom arrises. For use normally in plastered/ situations. **Not for use in exposed painted situations.**

Fair Faced Finish
Type C Fair Faced Finish. All corners, arrises and faces on the lintel are perfect. For use in exposed/painted situations.

Order/Specification Code
Use the Hi-Spec reference on our load Tables (e.g. S5). For Fair Faced Lintels preceed the lintel reference with the word 'Faced', ie Faced S5.

Hi-Spec Range		P100	S4	R6	R9	R12
Load Table Units suitable for 100mm wide walls						
Fire Resistance Available (mins)		30	30	30	30	30
Suitable for Foundation Use		yes	yes	yes	yes	yes
Maximum Stock Length Available		2400mm	3000mm	3600mm	3600mm Longer lengths available on request - up to 4800mm	3600mm
Available Range Finish			Faced	Faced	Faced	Faced
		UNFACTORED LOADS IN kN/m				
Length	Clear Span	100x65	100x100	100x140	100x215	100x290
900mm	700mm	12.97	18.00	48.90	78.18	100.05
1100mm	900mm	7.96	14.20	39.00	62.44	79.90
1200mm	1000mm	6.47	12.80	34.23	56.72	72.57
1500mm	1200mm	4.50	11.25	24.38	48.57	60.85
1800mm	1500mm	2.86	7.25	15.96	36.27	49.65
2100mm	1800mm	1.95	5.02	11.21	25.78	41.91
2400mm	2100mm	1.21	3.66	8.27	19.21	31.70
2700mm	2400mm	n/a	2.77	6.32	14.83	24.53
3000mm	2700mm	n/a	2.15	4.97	11.76	19.49
3300mm	3000mm	n/a	n/a	3.99	9.53	15.83
3600mm	3200mm	n/a	n/a	3.48	8.36	13.49
Lintel Weight kg/m		16	23	34	53	70

Sky View, 5 Findon Avenue, Saltdean BN1 8RF
T: 07896 250418
E: info@conscious-edesign.co.uk

SUMMARY

Revision	MEMBER	OPTION	DESCRIPTION
	All Lintels	1 – For masonry cavity wall construction	Min Catnic CG90/100, or similar approved. Min 150mm bearing on both supports.
		2 – For solid masonry wall construction	Min R6 100 x 140 by Naylor or similar approved. (May need to be doubled up to cater for full width of wall). Min 150mm bearing on both supports.

END OF CALCULATION