Michael Evans & Associates Ltd

Consulting Structural & Civil Engineers

34 Station Road, Draycott, Derbyshire DE72 3QB
Tel : 01332 871 840 - Fax : 01332 871 841
www.mevans.co.uk

Structural Calculations

In respect of

Waiting Area Extension

Bramcote Crematorium

Client

Broxtowe Borough Council

Architect

Job No. 16-124

Mar 2016

Issue no	Date	Description
3	17-Mar-16	Suggested fixing detail of beam B2 (Sht No. 8) and Appendix 1 added
2	08-Mar-16	New beam added (Sht No. 7), updated Sht Nos. 2 & 3
1	01-Mar-16	First issue

Michael Evans & Associates Ltd
CONSULTING STRUCTURAL ENGINEERS
34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
Fax. 01332 871841

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Mar 2016	16-124	Waiting Area Extension 1

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Broxtowe Borough Council - Bramcote Crematorium	RC	RS	3	

Refer to Broxtowe Borough Council scheme drawing titled Beam-Engineering (19.02.16)

Dimensions are for design purposes only

Basic loads	Load type	Components: Name	Components: UDL kN/m²	Service Load kN/m²	Load factor	Ultimate load kN/m²	Note
Roof on slope	**Deadload**	Asphalt - 2 layers	0.42	0.65	1.40	0.91	
		Boarding, felt	0.13				
		Rafter	0.10				
Roof on plan	**Deadload**	Pitch= 0 º		0.65	1.40	0.91	
	Liveload	Snow		0.75	1.60	1.20	
	D+L			**1.40**		**2.11**	
Ceiling	**Deadload**	Ceil joists	0.10	0.30	1.40	0.42	
		Plasterboard	0.20				
	Liveload		0.25	0.25	1.60	0.40	
	D+L			**0.55**		**0.82**	
Blockwork	**Deadload**	Block **100** thk.	1.30	**1.50**	1.40	**2.10**	γ_m = **3.1**
		Plaster	0.20				$t_{eff(cavity)}$ = **133**
Brickwork	**Deadload**	Brick **100** thk.	2.00	**2.00**	1.40	**2.80**	

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34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
Fax. 01332 871841

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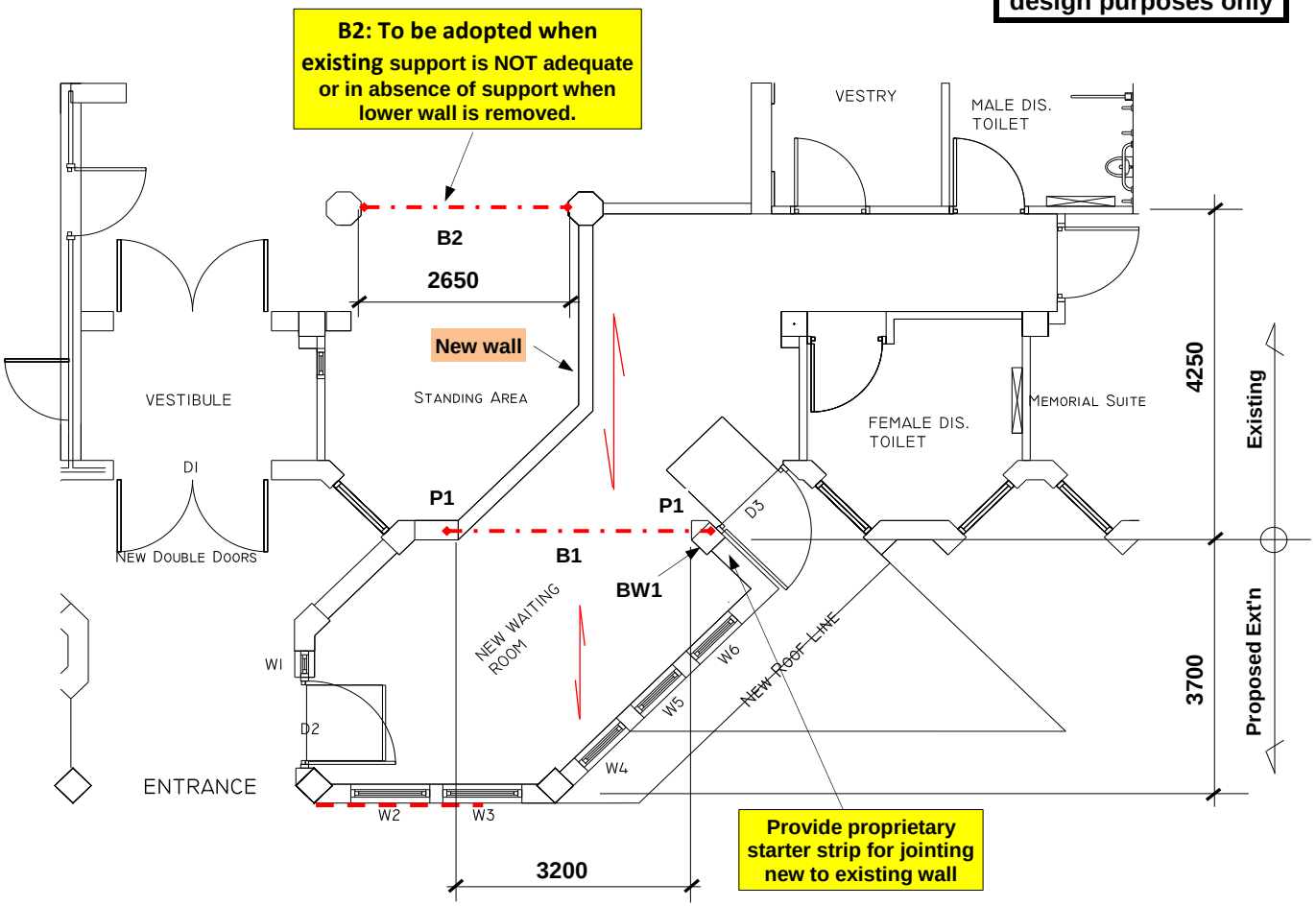
A. 08.03.16: Beam B2 added

.:. Schematic arrangement.

Dimensions are for design purposes only



GROUND FLOOR PLAN

Notes:

Span direction of roof rafters

Beam

Existing rafters: 63 x 195mm timber

Assumptions:

1) Existing cavity wall is 250mm thick
2) New rafters designed by others

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34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
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Mar 2016	16-124	Waiting Area Extension 3A

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A. 08.03.16: Beam B2 & B1 detail added

.:. Summary

> Beams & Padstones.

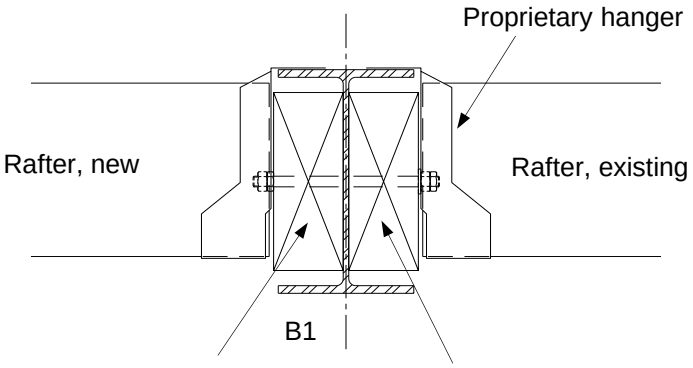
Dimensions are for design purposes only

Ref	Beam	Clear span [mm]	1 end [mm]	2 end [mm]	Total [mm]	
B1 Option 1	152 x 152 x 23UC (275), approx weight -80kg	3200	100	100	3400	(Option 1: Rafters over beam)
B1 Option 2	254 x 146 x 31UB (275), approx weight -105kg	3200	100	100	3400	(Option 2: Rafters within beam)
B1 Option 3	2/150 x 75 x 18PFC (275) bolted together @ 1.0m c/c, weight of each beam ~60kg	3200	150	150	3500	(Option 3: Double member, rafters over beam)
B2	152 x 152 x 23UC (275) with 225x6mm PLT, approx weight of beam & plate - 90kg	2700	-	-	2700	(225mm wide plate for 250mm cavity wall)

Ref	Padstones	
P1	250x100x65 Deep Concrete	(For Option 1: Rafters over beam)
P1	250x100x65 Deep Concrete	(For Option 2: Rafters within beam)
P1	Not required	(For Option 3: Double member, rafters over beam)

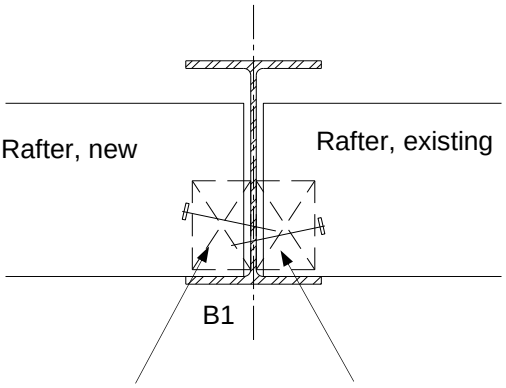
For options 1 & 2, Padstone is positioned across cavity wall. Provide appropriate padstone length.

> Suggested connection details (if adopting B1 Option 2)



75x200mm C16 timber to pack out web of beam and bolted using M12 Gr 8.8 bolts at 1200mm centres

OPTION 1



63x100mm C16 timber noggings between rafters shot-fired to web of beam by Hilti X-EDNI 72 or Equal

OPTION 2

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34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
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> Roof beam B1

Clear span = 3200 mm; Effective span say, L = 3300 mm

Loading: Roof 8.0 / 2 @ 1.95 = 7.8

Self weight 0.3

8.1 kN/m

+ Option 1: Rafters over beam

L= 3.300 m UDL = 8.1 kN/m L_e = 1.2 L = 3.960 m m_{LT} = 0.925

W = 26.6 kN M = 11.0 kNm R = 13.3 kN (SLS)

x 1.50 W = 39.9 kN M = 16.4 kNm R = 19.9 kN (ULS)

Check 1 152 x 152 x 23 UC *(code 36)* **grade 275 weight ~ 76 kg** 152 152 D/B= 1

Class= Semi-compact T= 6.8 p_y = 275 N/mm^2; Zx = 164 cm^3; Sx = 182 cm^3; Ix= 1250 cm^4

Shear check $P_v = 0.6 p_y A_v$ = 0.6 x 275 x 5.8 x 152.4 = 146 kN

Fv/xPv = 19.9 / 146 = 0.14 < 0.6 Low shear OK

Mc check Semi Mcx= py Zx= 45.1 1.2 py Zx = 54.1 1x Mcx = 1 45.1 = 45.1 kNm

MA / 1Mcx = 16.4 / 45.1 = 0.36 OK

Mb check

ry	*λ*	*u*	*x*	*v*	β_w	λ_{LT}	λ_0	η_{LT}	p_E	Φ_{LT}	p_b	*Le limit*
3.7	*107.0*	*0.8*	*20.70*	*0.81*	*0.9*	*69.0*	*34.3*	*0.24*	*425*	*401*	*191*	1.269

$M_A = M_{ULT}$ = 16.4 kNm Mb=pb Zx= 31.3 1 Mb = 31.3 kNm

MA/(1Mb/mLT) = 16.4 /(31.3 / 0.925)= 0.49 OK

Deflection Deflection limit to 14 mm and L/ 360 I_x = 1250

$$d_{D+L} = \frac{5 \times 26.6 \times 3300^3}{384 \times 205 \times 1250 \times 10000} = 4.9 \text{ mm} = L/680$$ **OK**

Adopt 152 x 152 x 23UC (275), approx weight -80kg

+ Option 2: Rafters within beam depth (min. rafter bearing length = 65mm)

Check 1 254 x 146 x 31 UB *(code 87)* **grade 275 weight ~ 103 kg** 254 146 D/B= 1.74

Class= Plastic T= 8.6 p_y = 275 N/mm^2; Zx = 351 cm^3; Sx = 393 cm^3; Ix= 4413 cm^4

Shear check $P_v = 0.6 p_y A_v$ = 0.6 x 275 x 6 x 251.4 = 249 kN

Fv/xPv = 19.9 / 249 = 0.08 < 0.6 Low shear OK

Mc check Plastic Mcx=py Sx 108.1 1.2 py Zx = 115.8 1x Mcx = 1 108.1 = 108.1 kNm

MA / 1Mcx = 16.4 / 108.1 = 0.15 OK

Mb check

ry	*λ*	*u*	*x*	*v*	β_w	λ_{LT}	λ_0	η_{LT}	p_E	Φ_{LT}	p_b	*Le limit*
3.4	*117.9*	*0.9*	*29.60*	*0.86*	*1.0*	*89.6*	*34.3*	*0.39*	*252*	*312*	*144*	1.153

$M_A = M_{ULT}$ = 16.4 kNm Mb =pb Sx= 56.7 1 Mb = 56.7 kNm

MA/(1Mb/mLT) = 16.4 /(56.7 / 0.925)= 0.27 OK

Deflection Deflection limit to 14 mm and L/ 360 I_x = 4413

$$d_{D+L} = \frac{5 \times 26.6 \times 3300^3}{384 \times 205 \times 4413 \times 10000} = 1.4 \text{ mm} = L/2401$$ **OK**

Adopt 254 x 146 x 31UB (275), approx weight -105kg

Michael Evans & Associates Ltd
CONSULTING STRUCTURAL ENGINEERS
34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
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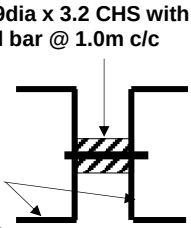
> Roof Beam B1 (Option 3: Double member)

Clear span = 3200 mm; Effective span say, L = 3300 mm



Loading:			Inner	Outer		
Roof, existing	4.3 / 2 @ 1.95 =		4.1			
Roof, extension	3.7 / 2 @ 1.95 =			3.6		
Self weight			0.2	0.2	Sum	Ratio
			4.3 +	3.8 kN/m =	8.2 kN/m	1.1

+ Inner leaf:

L= 3.300 m UDL = 4.3 kN/m L_e = 1.2 L = 3.960 m m_{LT} = 0.925

W = 14.3 kN_{serv} M = 5.9 kNm_{serv} R = 7.2 kN_{serv}

γ_f say = 1.50 W = 21.5 kN_{ult} M = 8.9 kNm_{ult} R = 10.8 kN_{ult}

Try 1 150 x 75 x 18 PFC *(code 14)* grade 275 weight ~ 59 kg 150 75 D/B= 2

Class= Plastic T= 10 p_y = 275 N/mm^2; Zx = 115 cm^3; Sx = 132 cm^3; Ix= 861 cm^4

Shear check $P_v = 0.6 p_y A_v$ = 0.6 x 275 x 5.5 x 150 = 136 kN

Fv/xPv = 10.8 / 136 = 0.08 < 0.6 Low shear **OK**

Mc check Plastic Mcx=py Sx= 36.3 1.2 py Zx = 38.0 1x Mcx = 1 36.3 = 36.3 kNm

MA / 1Mcx = 8.9 / 36.3 = 0.24 **OK**

Mb check

ry	λ	u	x	ν	β'_w	λ_{LT}	λ_0	η_{LT}	p_E	ϕ_{LT}	p_b	Le limit
2.4	165.0	0.9	13.10	0.58	1.0	90.2	34.3	0.39	249	311	143	0.823

$M_A = M_{ULT}$ = 8.9 kNm Mb =pb Sx= 18.9 1 Mb = 18.9 kNm

MA/(1Mb/mLT) = 8.9 /(18.9 / 0.925)= 0.43 **OK**

Deflection Deflection limit to 14 mm and L/ 360 I_x = 861

$$d_{D+L} = \frac{5 \times 14.3 \times 3300^3}{384 \times 205 \times 861 \times 10000} = 3.8 \text{ mm} = L/868$$ **OK**

+ Outer leaf:

L= 3.300 m UDL = 3.8 kN/m L_e = 1.2 L = 3.960 m m_{LT} = 0.925

W = 12.6 kN_{serv} M = 5.2 kNm_{serv} R = 6.3 kN_{serv}

γ_f say = 1.50 W = 18.8 kN_{ult} M = 7.8 kNm_{ult} R = 9.4 kN_{ult}

Try 1 150 x 75 x 18 PFC *(code 14)* grade 275 weight ~ 59 kg 150 75 D/B= 2

Class= Plastic T= 10 p_y = 275 N/mm^2; Zx = 115 cm^3; Sx = 132 cm^3; Ix= 861 cm^4

Shear check $P_v = 0.6 p_y A_v$ = 0.6 x 275 x 5.5 x 150 = 136 kN

Fv/xPv = 9.4 / 136 = 0.07 < 0.6 Low shear **OK**

Mc check Plastic Mcx=py Sx= 36.3 1.2 py Zx = 38.0 1x Mcx = 1 36.3 = 36.3 kNm

MA / 1Mcx = 7.8 / 36.3 = 0.21 **OK**

Mb check

ry	λ	u	x	ν	β'_w	λ_{LT}	λ_0	η_{LT}	p_E	ϕ_{LT}	p_b	Le limit
2.4	165.0	0.9	13.10	0.58	1.0	90.2	34.3	0.39	249	311	143	0.823

$M_A = M_{ULT}$ = 7.8 kNm Mb =pb Sx= 18.9 1 Mb = 18.9 kNm

MA/(1Mb/mLT) = 7.8 /(18.9 / 0.925)= 0.38 **OK**

Deflection Deflection limit to 14 mm and L/ 360 I_x = 861

$$d_{D+L} = \frac{5 \times 12.6 \times 3300^3}{384 \times 205 \times 861 \times 10000} = 3.3 \text{ mm} = L/991$$ **OK**

Adopt 2/150 x 75 x 18PFC (275) bolted together @ 1.0m c/c, approx weight of each beam -60kg

Michael Evans & Associates Ltd
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34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
Fax. 01332 871841

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> Padstones

Padstone table (MEA.T.01). All loads are at ultimate

Padstone Ref.	Loading area L1 (m)	L2 (m)	Load (kN_{ult}/m)	Reaction (kN_{ult})	Wall Strength Mortar	Basic (kN/m^2)	f_k (kN/m^2)	γ_m	Without Padstone L_o (mm)	W_o (mm)	C_o (kN_{ult})	With Padstone L_{ps} (mm)	W_{ps} (mm)	D_{ps} (mm)	Code	C_{ps} (kN_{ult})	Check
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
P1	Single Beam-UC			**19.9**	M4	3.6	**3.5**	3.1	100	152	**21**	250	100	65	C	**Yes**	OK
P1	Single Beam-UB			**19.9**	M4	3.6	**3.5**	3.1	100	146	**21**	250	100	65	C	**Yes**	OK
P1	Double Beam			**9.4**	M4	20	**5**	3.5	100	70	**13**					**No**	OK

(2)&(3)are spans of gross loading area; (5)=((2)*(3)*(4))/4;(12) C_o: Capacity without padstone C_o = 1.25*(8)*(10)*(11)/(1000*(9); (17) C_{ps}: Capacity of padstone C_{ps} = 1.25*(8)*(13)*(14)/(1000*(9), but if (12)>(5) then (17)="No" meaning do not need; (18)=OK when (17)≥(12).

> Consider blockwork strength.

Blockwork Strength table (MEA.T.07). All loads are at ultimate

Location of wall	Load on roof & floor: Roof m	Roof kN/m^2	Sub roof m	Sub roof kN/m^2	1st floor m	1st floor kN/m^2	Load on Wall H (m)	Load kN/m^2	Total load (kN/m)	Wall Strength Mortar	Basic kN/m^2	f_k kN/m^2	End	t_{eff}	β	C_w (kN/m)	Check
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	15	*15*	*16*	*17*
Ext'g wall-inn	4.25	2.94					2.4	2.10	**11**	M4	3.6	3.5	0.75	133	0.89	**100**	OK
Ext'g wall-out	3.70	2.94					2.4	2.10	**10**	M4	20	5	0.75	133	0.89	**144**	OK

(8) Heigth of wall in total; (14) = ((3)*(2) + (5)*(4) + (7)*(6))/2 + (8)*(9); (10) Total vertical load on masonry; (12) Basic capacity; (15) Reduction factor β - BS 5628.Table 7; (16) Capacity of wall C_w = 1000 * block thk. * f_k * β /(1000* γ_m);

- **Check pier between BW1-inn - B1**
  Pier length 360 mm Openings either side 3200 &
  Concentration factor = 1960 / 360 = 5.44 Area reduction factor = 0.75
  Equivalent load / m 11 x 5.44 / 0.75 = 81 kN_{ult}/m < 100 kN_{ult}/m OK

Adopt min 3.6N/mm² blockwork + M4 mortar

- **Check pier between BW1-out - B1**
  Pier length 250 mm Openings either side 3200 &
  Concentration factor = 1850 / 250 = 7.40 Area reduction factor = 0.74
  Equivalent load / m 10 x 7.40 / 0.74 = 104 kN_{ult}/m < 144 kN_{ult}/m OK

Adopt min 20N/mm² brickwork + M4 mortar

Michael Evans & Associates Ltd
CONSULTING STRUCTURAL ENGINEERS
34 Station Road, Draycott, Derbyshire, DE72 3QB.
Tel. 01332 871840
Fax. 01332 871841

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		7A

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> **Roof beam** B2 (Supporting cavity wall, glazing and lower roof)

Clear span = 2650 mm; Effective span say, L = 2700 mm

Loading:					
Roof, lower	4.3 / 2	@ 1.95	= 4.1		
Cavity wall	1.05	@ 3.50	= 3.7	(250mm thk assumed)	
Double glazing	0.8	@ 0.50	= 0.4	(height assumed)	
Self weight			0.4		
			8.6	kN/m	

\+ Consider steel beam

L= 2.700 m UDL = 8.6 kN/m L_e = 1.2 L = 3.240 m m_{LT} = 0.925

W = 23.3 kN M = 7.9 kNm R = 11.6 kN (SLS)

x 1.50 W = 34.9 kN M = 11.8 kNm R = 17.5 kN (ULS)

Check 1 152 x 152 x 23 UC *(code 36)* grade 275 weight ~ 62 kg 152 152 D/B= 1

Class= Semi-compact T= 6.8 p_y = 275 *N/mm²; Zx =* 164 *cm³; Sx =* 182 *cm³; Ix=* 1250 *cm⁴*

Shear check $P_v = 0.6 p_y A_v$ = 0.6 x 275 x 5.8 x 152.4 = 146 kN

Fv/xPv = 17.5 / 146 = 0.12 < 0.6 Low shear OK

Mc check Semi Mcx= py Zx= 45.1 1.2 py Zx = 54.1 1x Mcx = 1 45.1 = 45.1 kNm

MA / 1Mcx = 11.8 / 45.1 = 0.26 OK

Mb check

ry	*λ*	*u*	*x*	*v*	β_w	λ_{LT}	λ_0	η_{LT}	p_E	Φ_{LT}	p_b	*Le limit*
3.7	*87.6*	*0.8*	*20.70*	*0.85*	*0.9*	*59.5*	*34.3*	*0.18*	*571*	*474*	*214*	1.269

$M_A = M_{ULT}$ = 11.8 kNm Mb=pb Zx= 35.2 1 Mb = 35.2 kNm

MA/(1Mb/mLT) = 11.8 /(35.2 / 0.925)= 0.31 OK

Deflection Deflection limit to 14 mm and L/ 360 I_x = 1250

$$d_{D+L} = \frac{5 \times 23.3 \times 2700^3}{384 \times 205 \times 1250 \times 10000} = 2.3 \text{ mm} = L/1160$$ OK

Provide 6mm plate intermittently welded on top flange to support cavity wall. Plate width 25mm less than cavity wall thickness. For 250 wall thickness, use 6x225mm plate.

Adopt 152 x 152 x 23UC (275) with 225x6mm PLT, approx weight of beam & plate - 90kg

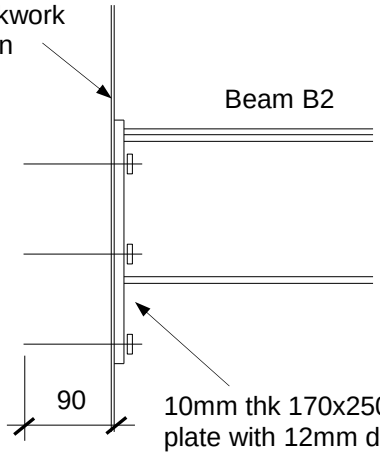
See next sheet for suggested fixing detail

Suggested Fixing Detail, Beam B2

Capacity of M10 anchor with R-KF2/KSF resin = 2.9 $kN_{service}$
(assumed 20N brickwork) Req'd = 4.0
say, use 6 Nos.

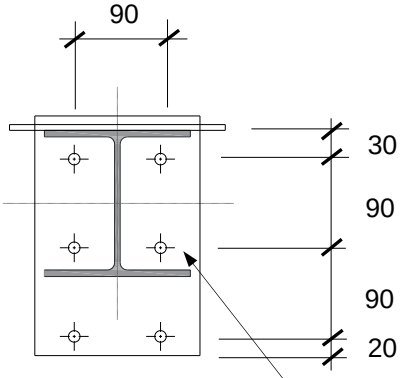
This fixing detail is PRELIMINARY subject to exposure of brick column detail. Steel should only be fabricated once actual dimension is obtained. The use of steel packs at one end is expected.

Existing column:
hollow brickwork construction



(min. embedment)

10mm thk 170x250mm end plate with 12mm dia. hole for M10 anchor. Beam 6fw all around to end plate.



6 Nos M10 stud anchors + mesh sleeves using Rawl-Plug R-KF2/KSF resin installed to manufacturer's recommendation. Min embedment 90mm. See Appendix 1.

APPENDIX 1

Extract from RAWL plug resin fixing brochure - R-KF2/KSF resin cartridge

R-KF2/KSF® RAWL CARTRIDGE

FOR CONCRETE, BRICK, BLOCK AND STONE

Product Information

60-200
R-KF2-380
(380ml)

60-150
R-KSF-150
(150ml)

DESCRIPTION

R-KF2 and R-KSF are general purpose resins, for solid and hollow structures with both products having a relatively short cure time.

SUITABLE FOR USE IN:

Concrete
Brickwork
Blockwork
Stone
Overhead Applications

FEATURES

1. Suitable for Solid and Hollow substrates.
2. 150ml R-KSF is ideal for small applications.
3. R-KSF fits a standard mastic gun.
4. R-KSF Odourless and Styrene free.

R-KF2

BASE MATERIAL TEMPERATURE (°C)	WORKING TIME	CURING TIME
30	4 mins	30 mins
25	7 mins	1 hour
15	15 mins	2 hours
5	30 mins	3 hours

R-KSF

BASE MATERIAL TEMPERATURE (°C)	WORKING TIME	CURING TIME
30	4 mins	30 mins
20	8 mins	50 mins
15	14 mins	2 hours
5	30 mins	4 hours

Cartridge & Stud Data

STUD THREAD SIZE (mm) (d)	STUD OVERALL LENGTH (mm) (l)	WASHER DIAMETER (mm) (D_W)	MAXIMUM FIXTURE THICKNESS (mm) (T_{fix})	HOLE DIAMETER IN CONCRETE (mm) (d_o)	HOLE DIAMETER IN FIXTURE (mm) (d_f)	STANDARD EMBEDMENT IN CONCRETE (mm) (h_o)	RECOMMENDED TORQUE (Nm) (T_{inst})		STUD PRODUCT CODES				APPROX No OF HOLES PER 380ML CARTRIDGE	
									ZINC PLATED		STAINLESS STEEL GRADE 316 A4			
							CONCRETE	BRICKWORK	PRODUCT CODE	NEW CODE	PRODUCT CODE	NEW CODE	380ml	150ml
M8	110	17	17	10	9	80	3	2	60-708	STUDS-08110	60-906	STUDS-08110-A4	84	33
M10	130	21	28	12	11	90	9	6	60-710	STUDS-10130	60-911	STUDS-10130-A4	61	24
M12	160	24	36	14	13	110	17	11	60-712	STUDS-12160	60-916	STUDS-12160-A4	42	16
M16	190	30	42	18	17	125	36	24	60-716	STUDS-16190	60-921	STUDS-16190-A4	28	11
M20	260	37	90	24	22	145	53	-	60-720	STUDS-20260	60-926	STUDS-20260-A4	7	3
M24	295	44	85	28	26	180	60	-	60-724	STUDS-24295	60-931	STUDS-24295-A4	6	2

Note: For perforated brickwork and hollow block work a mesh sleeve must be inserted into the hole prior to the resin being pumped. Studs over 16mm diameter are not recommended in brickwork.

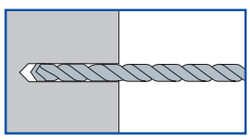
The specification of longer studs will allow greater fixture thicknesses than shown for the standard studs quoted. Minimum embedment should be observed.

We recommend that embedment above 500mm and 20mm in diameter a power operated resin gun should be used.

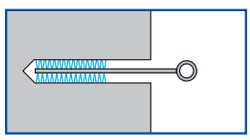
Please contact the Rawl Technical Advisory Service for further advice.

Installation

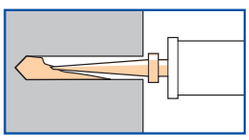
INSTALLATION
Solid substrates



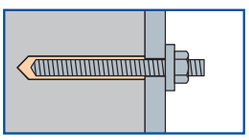
1. Drill hole to correct diameter and depth for stud size being used.



2. Clean the hole using brush and air three times.

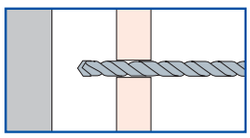


3. Insert cartridge into cartridge gun and attach nozzle. Dispense to waste until an even colour and then pump into hole.

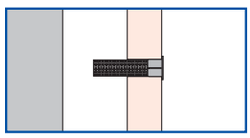


4. Insert stud or socket with a twisting action. Leave the anchor undisturbed until the resin has cured and then attach fixture.

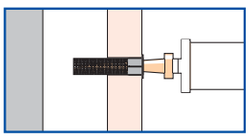
INSTALLATION
Hollow substrates & substrates with voids



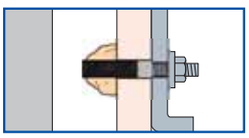
1. Drill hole to correct diameter and depth for mesh sleeve size being used.



2. Insert sleeve into hole.



3. Insert cartridge into cartridge gun and attach nozzle. Dispense to waste until even colour. Then insert nozzle and pump to fill sleeve.



4. Insert stud or socket with a twisting action. Leave the anchor undisturbed until the resin has set and then attach fixture.

Specification Data

Performance Data at Standard Embedment Depth

SIZE	CONCRETE, $f_{ck,cube}$ = 30N/mm² (C20/25)								
	CHARACTERISTIC RESISTANCE *(kN)*		DESIGN RESISTANCE (Factored) *(kN)*		RECOMMENDED LOAD (Unfactored) *(kN)*		CHARACTERISTIC EDGE DISTANCE (mm)		CHARACTERISTIC SPACING (mm)
	TENSION (N_{Rk})	SHEAR (V_{Rk})	TENSION (N_{Rd})	SHEAR (V_{Rd})	TENSION (N_{rec})	SHEAR (V_{rec})	TENSION ($C_{cr,N}$)	SHEAR ($C_{cr,V}$)	TENSION & SHEAR ($S_{cr,N}$) ($S_{cr,V}$)
M8	9.5	9.9	4.1	7.9	2.9	5.7	60	80	80
M10	16.4	15.7	6.5	12.6	4.7	9.0	70	90	90
M12	25.7	22.9	9.7	18.3	6.9	13.1	80	110	110
M16	42.5	42.5	14.7	34.0	10.5	24.3	90	130	130
M20	52.0	66.8	17.6	53.4	12.6	38.2	110	150	150
M24	61.9	95.7	20.0	76.6	14.3	54.7	130	170	170

For further explanations on calculations please see pages 10 and 11.

SIZE	RECOMMENDED LOAD *(kN)* (Unfactored) TENSION OR SHEAR (F_{rec})			
	BRICKWORK 20.5N/mm²	BLOCKWORK 7N/mm²	BLOCKWORK 3.5N/mm²	BLOCKWORK 2.8N/mm²
M8	1.4	0.6	0.5	0.4
M10	2.9	1.3	0.9	0.7
M12	4.0	2.0	1.1	0.9
M16	5.0	3.0	SIZES ABOVE M12 ARE NOT RECOMMENDED	
M20	SIZES ABOVE M16 ARE NOT RECOMMENDED			
M24				

When calculating loads in brickwork, apply the published edge distance and spacing for concrete and assume these figures to be the absolute minimums. Concrete reduction factors must NOT be applied.

Reduction Factors – Edge and Spacing Distances

The full characteristic edge and spacing distances shown in the table above are the minimum allowable for the quoted DESIGN RESISTANCE or RECOMMENDED LOAD, depending on your design method.

Where these dimensions are not achievable, the appropriate reduction factor/s from the tables below must be applied to the DESIGN RESISTANCE or RECOMMENDED LOAD. Choose the required bolt diameter across the top of the appropriate table and read down the left hand column until actual edge or spacing distance is found. Read off the reduction factor where the two lines intersect (interpolate as required). Multiply this factor by the DESIGN RESISTANCE or RECOMMENDED LOAD quoted in the table. On the occasion that multiple close edge and/or spacing distances occur, the appropriate reduction factors must be applied.

Edge Distance (Concrete Only)

EDGE (mm)	TENSILE : EDGE REDUCTION FACTORS						SHEAR : EDGE REDUCTION FACTORS					
	M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
40	0.80						0.50					
50	0.90	0.83					0.62	0.56				
60	1.0	0.91	0.85				0.75	0.66	0.54			
70		1.0	0.92				0.87	0.78	0.64			
80			1.0	0.93			1.0	0.89	0.72	0.62		
90				1.0	0.89	0.85		1.0	0.82	0.69	0.60	
100					0.95	0.89			0.91	0.77	0.66	0.60
110					1.0	0.95			1.0	0.84	0.73	0.66
130						1.0				1.0	0.86	0.73
150											1.0	0.86
170												1.0

Spacing (Concrete Only)

SPACING (mm)	TENSILE & SHEAR REDUCTION FACTORS					
	M8	M10	M12	M16	M20	M24
40	0.80					
50	0.85	0.82				
60	0.90	0.87	0.82			
70	0.95	0.91	0.85			
80	1.0	0.95	0.89	0.85		
90		1.0	0.93	0.88	0.84	
100			0.96	0.91	0.87	0.84
110			1.0	0.94	0.89	0.87
130				1.0	0.95	0.89
150					1.0	0.95
170						1.0

Performance Data for Reinforcement Bars

If you are bonding rebar into reinforced concrete, where the size, position etc. of the reinforcing is known, then design principles contained within Eurocode 2 can be adopted instead of the design recommendations contained within this manual.

REBAR DIA. (mm)	HOLE DIA.	DESIGN RESISTANCE (F_d) *(kN)*																							EMBEDMENT DEPTH TO FAIL REBAR (mm)
8	10	10.0	12.4	14.9	17.4	19.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	176
10	12		13.9	16.7	19.5	22.3	25.0	27.8	30.6	33.4	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	246
12	15			18.3	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.7	45.7	48.8	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	323
14	18	MINIMUM			23.0	26.3	29.6	32.9	36.2	39.5	42.8	46.1	49.4	52.7	56.0	59.2	62.5	65.8	66.9	66.9	66.9	66.9	66.9	66.9	407
16	20	REBAR DEPTH				28.1	31.7	35.2	38.7	42.2	45.7	49.3	52.8	56.3	59.8	63.3	66.9	70.4	73.9	77.4	80.9	84.4	87.4	497	
DEPTH (mm)		80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500		
20	25	39.3	44.3	49.2	54.1	59.0	68.8	78.7	88.5	98.3	108	118	128	137	137	137	137	137	137	137	137	137	137	137	694
25	32			53.0	58.3	63.6	74.2	84.8	95.4	106	117	127	138	148	170	191	212	214	214	214	214	214	214	214	1007
32	40	MINIMUM				69.3	80.9	92.4	104	116	127	139	150	162	185	208	321	277	323	350	350	350	350	350	1514
40	50	REBAR DEPTH						99.3	112	124	137	149	161	174	199	224	248	298	348	397	447	497	546	2200	
DEPTH (mm)		200	225	250	275	300	350	400	450	500	550	600	650	700	800	900	1000	1200	1400	1600	1800	2000	2200		

REBAR DIA. (mm)	HOLE DIA.	RECOMMENDED LOAD (F_{rec}) *(kN)*																							EMBEDMENT DEPTH TO FAIL REBAR (mm)
8	10	6.7	8.3	9.9	11.6	13.3	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	176
10	12		9.3	11.1	13.0	14.9	16.7	18.5	20.4	22.3	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	246
12	15			12.2	14.2	16.3	18.3	20.3	22.3	24.4	26.4	28.5	30.5	32.5	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	323
14	18	MINIMUM			15.3	17.5	19.7	21.9	24.1	26.3	28.5	30.7	32.9	35.1	37.3	39.5	41.7	43.9	44.6	44.6	44.6	44.6	44.6	44.6	407
16	20	REBAR DEPTH				18.7	21.1	23.5	25.8	28.1	30.5	32.9	35.2	37.5	39.9	42.2	44.6	46.9	49.3	51.6	53.9	56.3	58.3	497	
DEPTH (mm)		80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500		
20	25	26.2	29.5	32.8	36.1	39.3	45.9	52.5	59.0	65.5	72.1	78.7	85.3	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	694
25	32			35.3	38.9	42.4	49.5	56.5	63.6	70.7	78	85	92	99	113	127	141	142	142	142	142	142	142	142	1007
32	40	MINIMUM				46.2	53.9	61.6	69.3	77	85	92	100	108	123	139	154	185	216	233	233	233	233	233	1514
40	50	REBAR DEPTH						66.2	74.5	83	91	99	108	116	132	149	166	199	232	265	298	331	364	2200	
DEPTH (mm)		200	225	250	275	300	350	400	450	500	550	600	650	700	800	900	1000	1200	1400	1600	1800	2000	2200		

Concrete Strength Class:
C20/25
(25N/mm² 150mm Cylinder; 30N/mm² 150mm Cube).

Reinforcement Bar:
Minimum Yield Strength
f_{yk} **460N/mm².**

Note: Performance based on clean holes; blown and then brushed with a stiff nylon brush.

Product Information

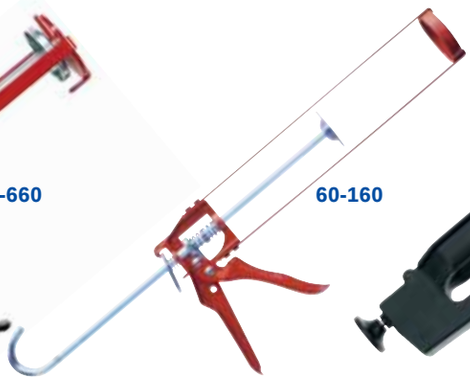
Brushes and Blow Pump

HOLE SIZE BRUSHES	PACK	QUANTITY	PRODUCT CODE	NEW CODE
M8 - 10 mm	POLYBAG	1	60-980	BRUSH-M08/10
M10 - 14 mm	POLYBAG	1	60-981	BRUSH-M10/14
M16 - 28 mm	POLYBAG	1	60-982	BRUSH-M16/10
BLOW PUMP	POLYBAG	1	60-687	BLOWPUMP

Dispenser Guns

for R-KEX

for R-KEA, R-KF2
suitable for 380 ml cartridge



for R-KSF
suitable for 175 ml and 300 ml cartridge

Heavy duty cartridge gun
for R-KEM+
suitable for 175 ml and 300 ml cartridge

CFS Gun

DESCRIPTION	SUITABLE FOR	PACK TYPE	QUANTITY	PRODUCT CODE	NEW CODE
400ml CARTRIDGE GUN	R-KEX	POLYBAG	1	60-645	R-GUN-400ml
380ml CARTRIDGE GUN	R-KF2 / R-KEA	POLYBAG	1	60-660	R-GUN-380ml
300ml SKELETON GUN	R-KSF / R-KEM	POLYBAG	1	60-160	R-GUN-300ml
300ml CARTRIDGE GUN	R-KEM+	POLYBAG	1	60-172	R-GUN-300ml-C
300ml CFS GUN	CFS	BOXED	1	-	CFS GUN

Driving Systems – R-CAS Studs

TO FIT SIZE	BOX QUANTITY	DRIVER SOCKET FOR 3 JAW CHUCK MACHINES		QUANTITY	SDS ADAPTOR	
		PRODUCT CODE	NEW CODE		PRODUCT CODE	NEW CODE
M8	5	60-709	DRIVER-M8	1	60-780	SDS-ADAPTOR
M10	5	60-711	DRIVER-M10	1	60-780	SDS-ADAPTOR
M12	5	60-713	DRIVER-M12	1	60-780	SDS-ADAPTOR
M16	5	60-717	DRIVER-M16	1	60-780	SDS-ADAPTOR
M20	1	60-731	DRIVER-M20	1	—	—
M24	1	60-732	DRIVER-M24	1	—	—
M30	1	60-735	DRIVER-M30	1	—	—

R-HAC Installation Adaptor for Rebar & Studding

DESCRIPTION	DRILLING MACHINE	PRODUCT CODE	NEW CODE
ADAPTOR	SDS Plus	60-780	SDS-ADAPTOR
SETTING HEAD	SDS Plus	60-782	SDS-SETTING

Mixer Nozzles

DESCRIPTION	BOX QUANTITY	PRODUCT CODE	NEW CODE
MIXER NOZZLE (R-KF2, R-KSF, R-KEA)	10	60-640	NOZ-10
MIXER NOZZLE (R-KF2, R-KSF, R-KEA)	100	60-642	NOZ-100
MIXER NOZZLE (R-KEX)	10	60-228	NOZ-RKEX-10
MIXER NOZZLE (CFS)	4	-	CFS-NOZ-4
MIXER NOZZLE (CFS)	12	-	CFS-NOZ-12

Product Information

Internally Threaded Sockets

SOCKET TYPE AND INTERNAL THREAD LENGTH (lg)	SOCKET OVERALL LENGTH (mm) (l)	HOLE DIAMETER IN CONCRETE (mm) (d_O)	HOLE DEPTH IN CONCRETE (mm) (h_O)	HOLE DIAMETER IN FIXTURE (mm) (d_f)	USE WITH CAPSULE Ref	TIGHTENING TORQUE (Nm)			SOCKETS PER BOX/ PACK	SOCKET PRODUCT CODES					
										ZINC PLATED		STAINLESS STEEL GRADE 303 A2		DRIVE SYSTEM	
						30 N/mm² CONCRETE	20.5 N/mm² BRICKWORK	7.0 N/mm² BLOCKWORK		RODUCT CODE	NEW CODE	PRODUCT CODE	NEW CODE	PRODUCT CODE	NEW CODE
M6x24	75	12	75	7	R-CAS-10	5	3	1.5	10	60-620	ITS-Z-06075	—	—	60-690	ITS-DRIVE-06
M6x24	75	14	75	7	R-CAS-10	5	3	1.5	10	—	—	60-985	ITS-SS-06075	60-690	ITS-DRIVE-06
M8x25	75	14	75	9	–	11	6	3	10	60-622	ITS-Z-08075	60-987	ITS-SS-08075	—	—
M8x25	90	14	90	9	R-CAS-12	11	6	3	10	60-623	ITS-Z-08090	60-988	ITS-SS-08090	60-692	ITS-DRIVE-08
M10x30	75	20	75	11	–	22	13	6	10	60-624	ITS-Z-10075	60-989	ITS-SS-10075	—	—
M10x30	100	20	100	11	R-CAS-16	22	13	3	10	60-626	ITS-Z-10100	60-992	ITS-SS-10100	60-694	ITS-DRIVE-10
M12x35	100	20	100	13	R-CAS-16	38	21	6	6	60-628	ITS-Z-12100	—	—	60-696	ITS-DRIVE-12
M12x35	100	22	100	13	R-CAS-16	38	21	6	6	—	—	60-993	ITS-SS-12100	60-696	ITS-DRIVE-12
M16x50	125	28	125	17	R-CAS-20	95	30	–	6	60-630	ITS-Z-16125	60-995	ITS-SS-16125	60-698	ITS-DRIVE-16

All sockets can be used with cartridge systems and in these circumstances a drive system is not required.

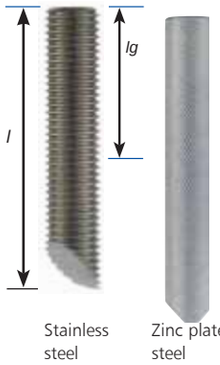
R-KEM + & RM50 Performance Data

SIZE	CONCRETE, $f_{ck,cube}$ = 30N/mm² (C20/25)															PRODUCT CODE
	CHARACTERISTIC RESISTANCE (kN)				DESIGN RESISTANCE (kN)				RECOMMENDED LOAD (kN)				CHARACTERISTIC EDGE DISTANCE (mm)		CHARACTERISTIC SPACING (mm)	
	TENSION (N_{RK})		SHEAR (V_{RK})		TENSION (N_{Rd})		SHEAR (V_{Rd})		TENSION (N_{rec})		SHEAR (V_{rec})		TENSION ($C_{cr,N}$)	SHEAR ($C_{cr,V}$)	TENSION or SHEAR ($S_{cr,N}$) ($S_{cr,V}$)	
	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*				
M6x75	9.8	*14.6*	5.7	*8.8*	4.5	*6.8*	3.2	*4.9*	3.2	*4.8*	1.8	*2.7*	100	130	130	60-620 60-985
M8x75	15.9	*19.2*	9.9	*15.4*	7.3	*8.9*	7.9	*12.3*	5.2	*6.4*	5.7	*8.8*	130	150	150	60-622 60-987
M8x90		*21.7*				*10.0*				*7.2*						60-623 60-988
M10x75	24.2	*27.5*	15.7	*24.1*	11.2	*12.8*	12.6	*19.3*	8.0	*9.1*	9.0	*13.8*	150	170	170	60-624 60-989
M10x100		*36.6*				*16.9*				*12.1*						60-626 60-992
M12x100	36.1	*36.6*	22.9	*35.2*	16.7	*16.9*	18.3	*28.2*	11.9	*12.1*	13.1	*20.1*	150	180	180	60-628 60-993
M16x125	54.0	*54.0*	42.5	*65.1*	25.0	*25.0*	34.0	*52.1*	17.8	*17.8*	24.3	*37.2*	170	220	220	60-630 60-995

R-CAS & R-KEX Performance Data

SIZE	CONCRETE, $f_{ck,cube}$ = 30N/mm² (C20/25)															PRODUCT CODE
	CHARACTERISTIC RESISTANCE (kN)				DESIGN RESISTANCE (kN)				RECOMMENDED LOAD (kN)				CHARACTERISTIC EDGE DISTANCE (mm)		CHARACTERISTIC SPACING (mm)	
	TENSION (N_{RK})		SHEAR (V_{RK})		TENSION (N_{Rd})		SHEAR (V_{Rd})		TENSION (N_{rec})		SHEAR (V_{rec})		TENSION ($C_{cr,N}$)	SHEAR ($C_{cr,V}$)	TENSION or SHEAR ($C_{cr,N}$) ($C_{cr,V}$)	
	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*	5.8 GRADE	*8.8 GRADE*				
M6x75	9.8	*14.6*	5.7	*8.8*	4.5	*6.8*	3.2	*4.9*	3.2	*4.8*	1.8	*2.7*	100	130	130	60-620 60-985
M8x75*	15.9	*21.7*	9.9	*15.4*	7.3	*10.0*	7.9	*12.3*	5.2	*7.2*	5.7	*8.8*	130	150	150	60-622 60-987
M8x90																60-623 60-988
M10x75*	24.2	*38.4*	15.7	*24.1*	11.2	*17.8*	12.6	*19.3*	8.0	*12.7*	9.0	*13.8*	150	170	170	60-624 60-989
M10x100																60-626 60-992
M12x100	36.1	*50.0*	22.9	*35.2*	16.7	*23.1*	18.3	*28.2*	11.9	*16.5*	13.1	*20.1*	170	180	180	60-628 60-993
M16x125	66.1	*89.5*	42.5	*65.1*	30.6	*41.1*	34.0	*52.1*	21.9	*29.6*	24.3	*37.2*	200	220	220	60-630 60-995

* Note: M8x75 and M10x75 Sockets are not suitable for R-CAS capsules



Stainless steel

Zinc plated steel

SOCKET DIAMETER (mm)	ZINC PLATED	STAINLESS STEEL
M6	11	11
M8	13	12
M10	17	16
M12	17	20
M16	25	25

THREADED RODS AND MESH SLEEVES

Plastic Sleeves

STUD SIZE (mm)	HOLE DIAMETER IN STRUCTURE (mm)	SLEEVE LENGTH (mm)	BOX QUANTITY	PRODUCT CODE	NEW CODE
M6/M8	16	13 x 80	10	60-607	PLS-13080-10
M6/M8	16	13 x 80	5	60-608	PLS-13080-5/5
M10	16	13 x 130	10	60-609	PLS-13130-10
M10	16	13 x 130	5	60-614	PLS-13130-5/5
M12/M16	20	18 x 85	10	60-615	PLS-18085-10
M12/M16	20	18 x 85	5	60-616	PLS-18085-5/5

Mesh Sleeves

STUD SIZE (mm)	HOLE DIAMETER IN STRUCTURE (mm)	SLEEVE LENGTH (mm)	BOX QUANTITY	PRODUCT CODE	NEW CODE
M6/M8	12	11 x 85	10	60-805	MS-11085
M10	16	15 x 95	10	60-807	MS-15095
M10	16	15 x 130	10	60-809	MS-15130
M10	16	15 x 200	10	60-111	MS-15200
M12	18	17 x 95	10	60-113	MS-17095
M12	18	17 x 200	10	60-115	MS-17200
M16	22	21 x 200	10	60-117	MS-21200

Mesh Sleeves x 1m

HOLE DIAMETER IN STRUCTURE (mm)	STUD SIZE	SLEEVE LENGTH (mm)	BOX/PACK QUANTITY	PRODUCT CODE
14	M8 - M10	12,5 x 1000	10	SP-CE-R10
16	M12	15,0 x 1000	5	SP-CE-R12
22	M16	20,5 x 1000	10	SP-CE-R16
28	M20	26,0 x 1000	5	SP-CE-R20

THREADED RODS

MATERIAL
steel DIN 975 - zinc plated.

Grade 4.8, Length 1m

THREAD	QUANTITY	PRODUCT CODE
M6	50	975-06-1000-ZN
M8	50	975-08-1000-ZN
M10	25	975-10-1000-ZN
M12	20	975-12-1000-ZN
M16	10	975-16-1000-ZN
M20	10	975-20-1000-ZN

Grade 8.8, Length 1m

THREAD	QUANTITY	PRODUCT CODE
M6	10	975-06-1000-88-ZN
M8	5	975-08-1000-88-ZN
M10	5	975-10-1000-88-ZN
M12	5	975-12-1000-88-ZN
M16	5	975-16-1000-88-ZN
M20	5	975-20-1000-88-ZN