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Structural Calculations

Boorley Green – Juliette Balconies Fixing Calcs

AB19/291/11

Revision	Date	Changes
-	26 Nov 19	Preliminary issue



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Introduction

The following calculations relate to the design of the balcony fixing elements of this building type.



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Reference Drawings

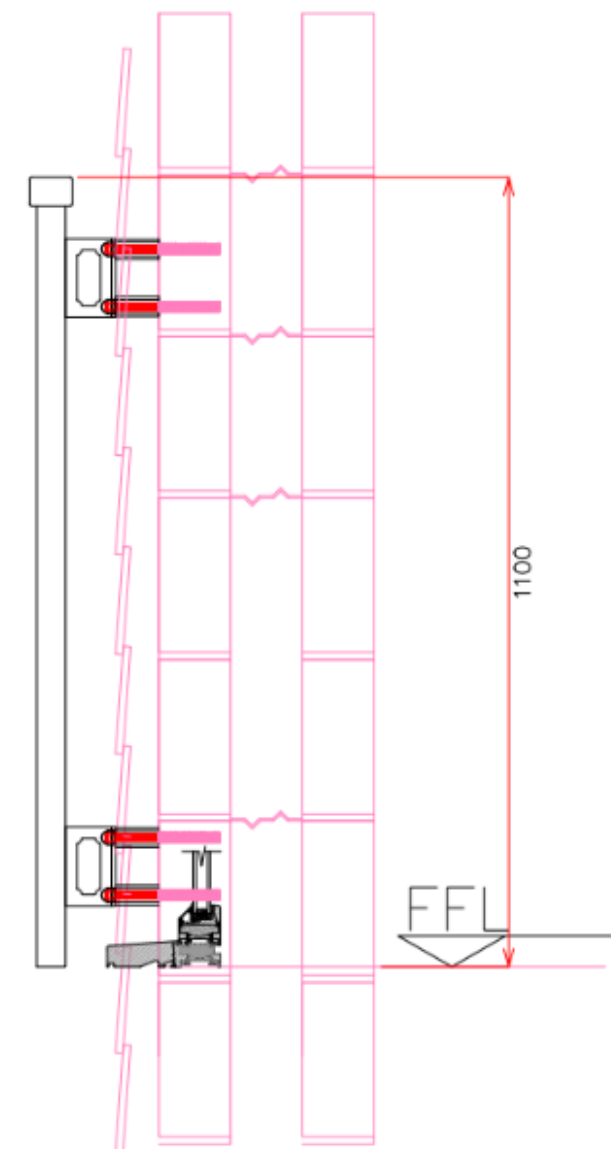
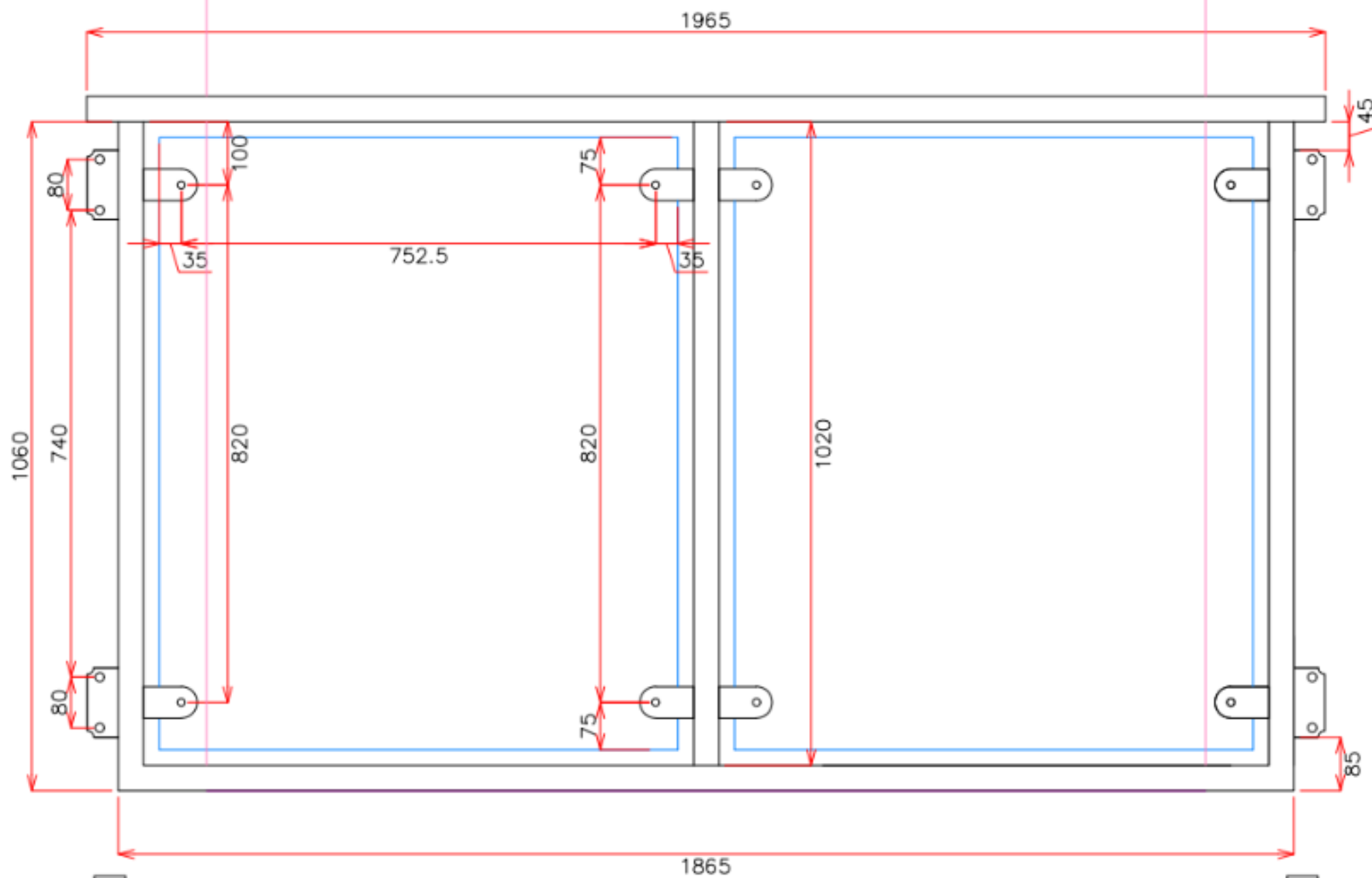


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R-KEM+® RAWL CARTRIDGE

FOR CONCRETE, BRICK, BLOCK AND STONE

RAWL®

FIXINGS

Specification Data

Performance Data at Standard Embedment Depth

SIZE	CONCRETE, $f_{ck,cube} = 30\text{N/mm}^2$ (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	11.5	9.9	5.1	7.9	3.6	5.7	80	100	100
M10	20.0	15.7	8.3	12.6	5.9	9.0	90	130	130
M12	28.7	22.9	11.5	18.3	8.2	13.1	110	150	150
M16	45.7	42.5	16.6	34.0	11.9	24.3	130	170	170
M20	62.0	66.8	20.9	53.4	15.0	38.2	150	190	210
M20 DEEP	69.7	66.8	23.2	53.4	16.6	38.2	180	190	230
M24	79.3	95.7	26.4	76.6	18.9	54.7	190	240	240
M24 DEEP	87.9	95.7	29.3	76.6	20.9	54.7	220	240	270

SIZE	RECOMMENDED LOAD (<i>kN</i>) (Unfactored) TENSION OR SHEAR (<i>F_{rec}</i>)			
	BRICKWORK 20.5N/mm ²	BLOCKWORK 7N/mm ²	BLOCKWORK 3.5N/mm ²	BLOCKWORK 2.8N/mm ²
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				

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



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Structural Calculations



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Loading

			<u>Dead</u>	<u>Live</u>
Pitched Tiled Roof 1 :				
Slates or Tiles	=	0.60 kN/m ²		
Battens	=	0.06 kN/m ²		
Felt	=	0.05 kN/m ²		
Rafters	=	<u>0.14 kN/m²</u>		
		0.85 kN/m ² / Cos 47.5 = 1.26 kN/m ²		
Ceiling joists	=	0.10 kN/m ²		
Insulation	=	0.05 kN/m ²		
Plasterboard and skim	=	0.15 kN/m ²		
Services	=	0.05 kN/m ²		
		TOTAL	1.61 kN/m²	
Roof & ceiling imposed load	=	1.00 kN/m ²		
		TOTAL		1.0 kN/m²
Pitched Tiled Roof 2 :				
Slates or Tiles	=	0.60 kN/m ²		
Battens	=	0.06 kN/m ²		
Felt	=	0.05 kN/m ²		
Rafters	=	<u>0.14 kN/m²</u>		
		0.85 kN/m ² / Cos 35 = 1.04 kN/m ²		
Ceiling joists	=	0.10 kN/m ²		
Insulation	=	0.05 kN/m ²		
Plasterboard and skim	=	0.15 kN/m ²		
Services	=	0.05 kN/m ²		
		TOTAL	1.39 kN/m²	
Roof & ceiling imposed load	=	1.00 kN/m ²		
		TOTAL		1.0 kN/m²
Precast Floor:				
Finishes	=	0.50 kN/m ²		
Screed	=	1.80 kN/m ²		
Precast Units	=	2.50 kN/m ²		
Services	=	0.10 kN/m ²		
		TOTAL	4.90 kN/m²	
Imposed loading	=	1.50 kN/m ²		
Partitions loading	=	1.00 kN/m ²		
		TOTAL		2.50 kN/m²
Timber Floor:				
Boards	=	0.15 kN/m ²		
Joists	=	0.15 kN/m ²		
Ceiling	=	0.10 kN/m ²		
		TOTAL	0.40 kN/m²	
Imposed loading	=	1.50 kN/m ²		
Partitions loading	=	0.30 kN/m ²		
		TOTAL		1.80 kN/m²
Insitu Concrete Floor:				
Finishes	=	0.05 kN/m ²		
Insulation	=	0.05 kN/m ²		
Insitu Slab (200mmn)	=	4.20 kN/m ²		
Other	=	0.00 kN/m ²		
Services	=	0.00 kN/m ²		
		TOTAL	4.90 kN/m²	
Imposed loading	=	1.50 kN/m ²		
Partitions loading	=	1.00 kN/m ²		
		TOTAL		2.00 kN/m²



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Internal Wall:

100mm blockwork	=	1.40 kN/m ²	
Plasterwork both sides	=	0.20 kN/m ² * 2 = 0.40 kN/m ²	
TOTAL			1.80 kN/m²

Internal Wall:

140mm blockwork	=	2.00 kN/m ²	
Plasterwork both sides	=	0.20 kN/m ² * 2 = 0.40 kN/m ²	
TOTAL			2.40 kN/m²

External Wall:

Brickwork outer leaf (102mm)	=	2.20 kN/m ²	
Blockwork inner leaf (100mm)	=	1.40 kN/m ²	
Plasterwork to one side	=	0.20 kN/m ²	
TOTAL			3.80 kN/m²

External Wall:

Brickwork outer leaf (102mm)	=	2.20 kN/m ²	
Blockwork inner leaf (100mm)	=	2.00 kN/m ²	
Plasterwork to one side	=	0.20 kN/m ²	
TOTAL			4.20 kN/m²

Party Wall:

Blockwork leaf 1 (100mm)	=	1.70 kN/m ²	
Blockwork leaf 2 (100mm)	=	1.70 kN/m ²	
Plasterwork both sides	=	0.20 kN/m ² * 2 = 0.40 kN/m ²	
TOTAL			3.80 kN/m²



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Juliette Balcony Fixing Calculations

Anchors (Joint not visible):

Service load on handrail = 0.74 kN/m

Tensile capacity of resin anchor = 1.1 kN

Reduction factor = 0.75

Stability:

$$\text{Total load} = 0.74 \times 2 = 1.48 \text{ kN}$$

Lever arm = 1.1 m

$$M_{ED} = 1.63 \text{ kNm}$$

$$M_{Rd} = (2 \times 0.75 \times 1.1 \times 0.9) + (2 \times 0.75 \times 1.1 \times 0.125) \\ = 1.69 \text{ kNm}$$

$$1.69 > 1.63 \therefore \text{OK}$$

Shear:

Weight of 10mm thick glass = 24.93 kg/m^2

$$24.93 \times 2.2 = 55 \text{ kg}$$

$$V_{Ed} = 55 \times 9.81 = 0.54 \text{ kN}$$

$$V_{Rd} = 0.75 \times 1.3 = 0.98 \text{ kN}$$

$$0.98 > 0.54 \therefore \text{OK}$$

Tension:

$$N_{Ed} = \frac{2 \times 1 \times 1}{8} = 0.25 \text{ kN/fixing}$$

Values are overestimates

$$N_{Rd} = 0.98 \text{ kN}$$

$$\therefore \text{OK}$$

Interaction OK by inspection



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Commentary:

The above calculations show that the fixings are okay for the loadings provided and that RAWL R-KEM+ M12 resin anchors are required in the positions indicated on page 4.



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T&Cs

General Construction Notes and Guidance on using these Calculations

1. Calculations are not to be used for the purpose of ordering materials and should only be used for Building Regulations submissions. All dimensions should be checked by the contractor on site.
2. All steelwork to be mechanically wire brushed and painted two coats of red oxide. Steelwork located in the cavity or below DPC to be suitably protected with 2 coats of bituminous paint.
3. All steelwork connections to use grade 8.8 bolts unless stated otherwise. These are to be spanner tightened using the appropriate podger spanner (min length 460mm) or suitable power tools in accordance with BS2583. If a torque wrench is used the torque applied should be around 90Nm for M16 bolts, 110Nm for M20 & 130Nm for M24.
4. All timber to be grade C24 (SC4), unless stated otherwise. Preservative treated to Architects details.
5. To be read in conjunction with Architects drawings, any inconsistencies between the drawings should be reported. If any site conditions or existing details are found that may affect the structural design, JMS Consulting Engineers are to be notified immediately.
6. For details of fire protection to steelwork, see Architects drawings.
7. The Contractor is to ensure that all existing construction is adequately supported, using needles and props as required. Where a new beam supports the existing construction, adequate pre-load is to be applied and suitable packs such as driven dry-slate introduced, then pointed up with mortar.
8. All blockwork to be 7.3 N/mm² in class III mortar below DPC in accordance with BS 5628 : Part 3 : 2005 or suitable 7.0 N/mm² foundation quality blocks in class II mortar in accordance with the manufacturer's instructions. All brickwork below DPC to be Engineering Bricks DPC in accordance with BS 5628 : Part 3 : 2005.
9. The project requires the introduction of heavy structural elements such as steel beams or concrete lintels. Although the Construction (Design and Management) Regulation 1994 would not normally apply to this type of construction, the designer still has an obligation to foresee risks and bring to the attention of the builder such risks. In consequence, the builder is to take into consideration the placement of all structural elements, ensuring that the method of lifting and placement is safely carried out. Responsibility for this element lies with the Contractor. As the existing walls need to be propped in order to introduce some of the lintels, this should also be considered in relationship to the risk assessment of the Contractor. Safe working procedures must be adopted. Responsibility for this element lies with the Contractor. Splice details for long-span beams can often be accommodated if required.
10. All construction products should be CE marked in accordance current legislation. This includes all fabricated structural steelwork in accordance with BS EN 1090-1 and BS EN 1090-2. The consequence class is CC2 unless noted otherwise. The service class is SC1 for all buildings, SC2 for all lifting beams, sculptures & fall arrest systems. Production category will be PC1 unless noted otherwise. All site welded items, S355 steelwork & CHS lattice girders will be PC2. As such the execution class for buildings will be EXC2.
11. CLIMATE CHANGE: The Building Research establishment have produced a document CBG 63 "Climate Change: impact on building design and construction". Part of their recommendations are that designers and builders should give consideration to:
 - a. Increased wind loading by providing additional laps and fixings to roof coverings
 - b. Consider foundation depth on shrinkable clays and to avoid future problems, increase the depth above standard requirements if there is a risk. This should be in accordance with the NHBC Standards, Chapter 4.2 Guidance on Building near Trees. If the calculations do not specifically design the depths of the foundations to take into account any local trees, then this should be checked and agreed with the Building Inspector on site.



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Party Wall etc. Act 1996

If part of the work is adjacent to the boundary, the adjacent neighbours right to support could be affected; the issues associated with Party Wall Act may need to be considered. This may include providing information to the adjoining owner, giving sufficient notice of works in compliance with the Act. If the following list applies to this project then the Party Wall Act will apply.

- Installing a new beam into the shared wall between properties
- Demolishing, building or under-pinning an existing shared wall
- Building a new wall at or on the boundary or junction of two properties
- Damp-proofing all the way through a party wall
- Digging foundations that are within 3m of a Party Wall, where the new foundations are deeper than the existing ones
- Where the new foundations are within 6m and lower than a 45° line from the bottom of the existing foundations