

C12. Final Design of RC Columns

Final design of the RC columns is not documented herein. The method is as indicated at the preliminary design stage section B7.

C13. Detailed Design of the Core

C13.1 Preliminary discussion and statement of limitations of this section

The analysis and design of a reinforced concrete core for a high rise building incorporating composite construction is essentially the same as that for a reinforced concrete building. Depending on the detailing it is possible that the steel frame may behave in a more ideally 'pin jointed' fashion than a reinforced concrete frame. This may make the steel framed composite building less 'forgiving' than a reinforced concrete building that will inevitably tend to have considerable 'rigidity' due to the nature of the 'monolithic' connections between concrete columns, beams and slabs. This partial rigidity in the RC building may in turn give rise to significant rigid frame 'portal' strength and stiffness against horizontal loading that could allow for a reduction in the strength and stiffness of the core. On the other hand the reduced overall mass of a composite building may lead to reductions in the size of the core depending on the balance between vertical and horizontal load effects.

Despite this, for design purposes many buildings, whether reinforced concrete or steel framed composite, are designed assuming no contribution to horizontal strength and stiffness from the frame and consequently the design of the core for RC or composite construction under this assumption will be identical.

This section does not present fully detailed calculations for either the analysis or design of the reinforced concrete core because the focus of this design file is on those aspects of design that are relatively unique to composite construction.

The analysis and design of the core of a high rise building relying on 'pure shear core action' represents the single most complicated and critical element of the structural design of a high rise building. This is particularly the case where the building height exceeds say 15 or 20 storeys or where horizontal loads are larger than normal due to high wind loading or seismic loading. Core design should always be undertaken using rational engineering principles but equally, senior engineers with experience of the realities and practicalities of high rise construction should inform the design.

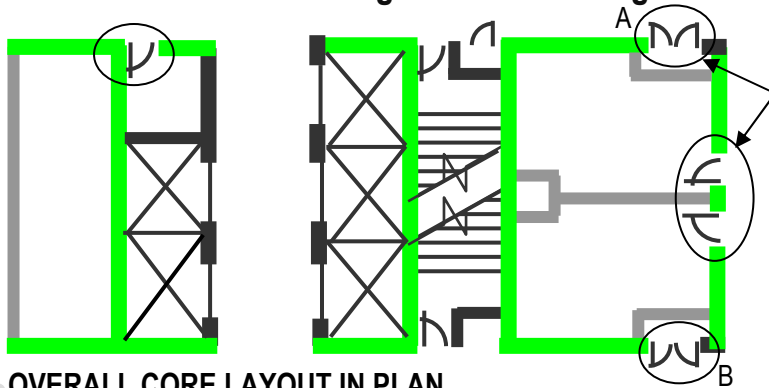
The following record of design calculations is not intended to represent a definitive method for the final analysis and design of a high rise core. It is intended to be representative of an approach that has been successfully applied to the design of reinforced concrete cores symmetrically placed in a symmetrical building (so as not to be required to carry significant torsion loading) and where the building is no more than 20 floors in height.

The emphasis is on modelling for analysis and the determination and interpretation of predicted stresses and stress resultants and comparison to code defined limits. No detailed design calculations are provided though some indication of the design method is provided.

There have been some deliberate simplifications and omissions in this section some, but not all, of which have been noted.

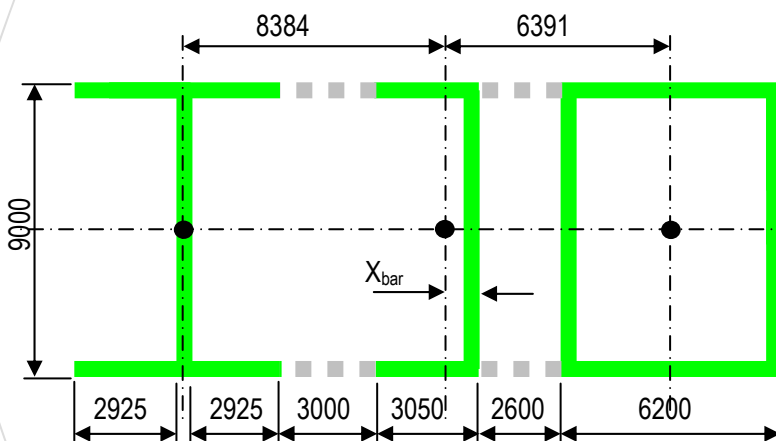


C13.2 Basic modelling of the core using beam elements



OVERALL CORE LAYOUT IN PLAN

Some doors are ignored in the model for simplicity. This is non conservative. Doors at A and B will considerably reduce the ability to shed load into the right hand wall as a flange to the box section. To incorporate doors at A and B requires the introduction of another vertical beam representing just the right hand wall.

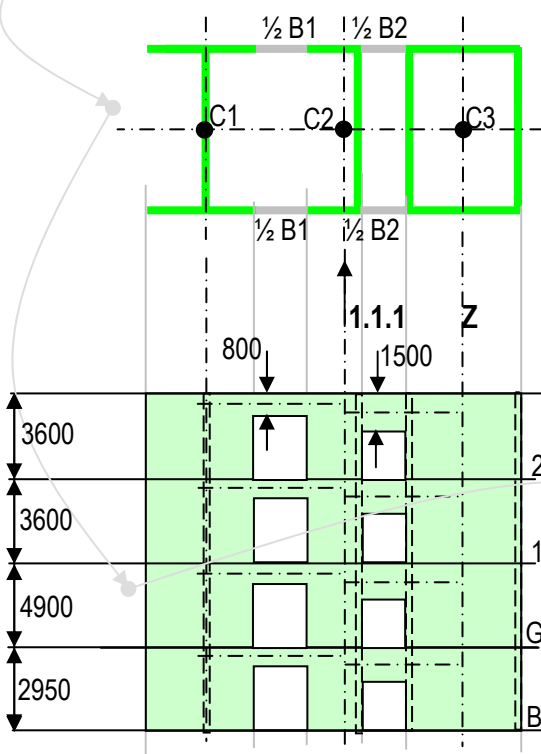


Distance to centroid of central channel

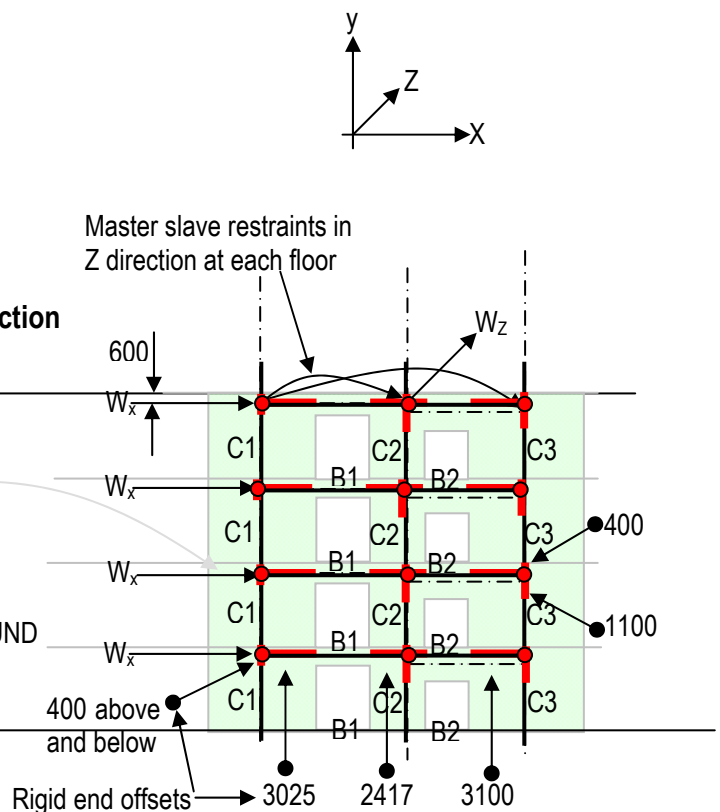
$$X_{bar} = \frac{2 \times 3050 \times 200 \times 1525 + 8600 \times 200 \times 100}{2 \times 3050 \times 200 + 8600 \times 200} = 691 \text{ mm}$$

Note all walls are assumed to be 200 thick. Note 'link beams' provided over openings. These provide important shear connection between the three parts of the core. They play a similar role to that of shear studs that link the steel and concrete parts of the composite beams.

PRIMARY STRUCTURAL WALLS EXTRACTED FROM CORE LAYOUT (with simplification)



REPRESENTATIVE PART ELEVATION



REPRESENTATIVE MODELLING



Composite Design Example for Multistorey Steel Framed Buildings

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Table of contents

Table of contents	iii
Preface	v
Section A: INPUT INFORMATION	1
A1. Client and Architectural Requirements	2
A2. Site Characteristics	4
A3. Statutory Requirements	5
A4. Serviceability	8
A5. Design Loads	9
A6. Materials and Systems	10
A7. Design Aids and Codes	11
Section B: CONCEPTUAL AND PRELIMINARY DESIGN	12
B1. Conceptual and Preliminary Design	13
B1.1 Consideration of alternative floor framing systems– Scheme A	14
B1.2 Consideration of alternative floor framing systems– Scheme B	15
B1.3 Framing system for horizontal loading – initial distribution of load	16
B1.4 Alternatives for overall distribution of horizontal load to ground	17
B2. Preliminary Slab Design	21
B3. From Alternatives to Adopted Systems	22
B3.1 Adopted floor framing arrangement	22
B3.2 Adopted framing arrangement for horizontal loading	23
B4. Indicative Construction Sequence and Stages	24
B4.1 The importance of construction stages in composite design	24
B4.1 Indicative construction sequence and construction stages	25
B4.2 Adopted construction sequence for design of erection columns	27
B4.3 Core construction alternatives	27
B4.4 Adopted construction method for the core	27
B5. Preliminary Sizing of Primary and Secondary Beams	28
B6. Plenum Requirements and Floor to Floor Height	30
B7. Preliminary Column Sizes and Core Wall Thickness	33
Section C: DETAILED DESIGN	35
C1. Detailed Design - Introduction	36
C2. Design Stages and Construction Loading	37
C3. Detailed Load Estimation After Completion of Construction	38
C3.1 Vertical loading	38
C3.2 Wind loading	39
C3.3 Seismic loading Not considered	40
C4. Erection Column Design	41
C4.1 Load distribution for erection column design	42
C4.2 Side Column C5 (typical of C5 to C10)	43
C4.3 End column C2 (typical of C2, C3, C12 and C13)	44
C4.4 Corner column C1 (typical of columns C1, C4, C11 and C14)	44
C5. Floor Beams – Construction Stage 1	45
C5.1 Secondary beams Group S1(11 050, 2800) (Beams B22 – B41, B43 – 48)	45
C5.2 Primary beams Group P1(9800, 5725) (Beams B1, B7 to B12, B18,	46
B19 – 21, B49 – 51 and B42)	46
C5.3 Primary beams Group P2(9250, 6600) (B2, B6, B13 and B17)	47
C6. Floor Beams – Construction Stage 3	48
C6.1 Secondary beams Group S1(11 050, 2800) (Beams B22 – 41, B43 – 48)	48
C6.2 Primary beams Group P1(9800, 5725) (Beams B1, B7 - B12, B18 – 21,	49
B49 – 51 and B42)	49
C6.3 Primary beams Group P2(9250, 6600) (Beams B2, B6, B13, B17)	49
C7 Floor Beam Design for Occupancy Loading	50
C7.1 Secondary beams Group S1(11 050, 2800) (Beams B19, B21, B22 - B41,	51
B43 – B49 and B51)	51



C7.2	Primary beams Group P1(9800,5725) (Beams B1, B7 to B12, B18)	58
C7.3	Primary beams group P2(9050, 6600) (Beams B2, B6, B13, B17)	63
C8.	Assessment of Dynamic Performance of Floor System	69
C8.1	Definition of the dynamic assessment process	69
C8.2	Application of the dynamic assessment process	73
C9	Final Slab Design	79
C9.1	Slab design for the office areas	79
C9.2	Slab design for the compactus areas	80
C10.	Longitudinal Shear Reinforcement Design	81
C10.1	Introduction	81
C10.2	Proprietary longitudinal shear reinforcement products	83
C10.3	Secondary beams group S1, B22 typical – longitudinal shear design	84
C10.4	Internal primary beams group P2, (B2 typical) longitudinal shear design	85
C10.5	Primary beams P1, (B1 typical) – longitudinal shear design	87
C10.6	Perimeter beams B19 to 21 and B49 to 51	88
C11.	Floor System Design Review and Final Decisions	89
C11.1	Floor design review	89
C11.2	Final floor framing plan and deck reinforcement	90
C12.	Final Design of RC Columns	91
C13.	Detailed Design of the Core	91
C13.1	Preliminary discussion and statement of limitations of this section	91
C13.2	Basic modelling of the core using beam elements	92
C13.3	The Space Gass Analysis Model	96
C13.4	Model verification and static deflections for W_s	97
C13.5	Dynamic analysis for natural frequency of building	98
C13.6	Interpretation and application of stress resultants from Space Gass	100
C13.7	Further investigation of the core using a Strand7 finite element model	102
C13.8	Review of core investigations	105
C14.	Steel Connection Design	106
C14.1	Can it be built?	106
C14.2	Representative connections	108
C14.3	Web side plate connection design for $V^* = 142$ kN	108
C14.4	Flexible end plate connection for $V^* = 279$ kN	112
C14.5	B2 to core web side plate connection for $V^* = 308$ kN	113
C14.6	Column splice for a load of $N^* = 1770$ kN	114
C14.7	Column base plate for a load of $N^* = 1770$ kN	115
C15.	Web Penetrations	116
C16.	Some Final Thoughts and Disclaimers	117
Appendix I	Theory and discussion – composite slabs	119
Appendix II	Theory and discussion - composite beams	133
Appendix III	Dynamic assessment of the floor system	149
Appendix IV	Theory and discussion steel connections	163
Appendix V	Corrosion and fire protection	175

