Waterman Moylan
Engineering Consultants

Cross Guns Bridge

Planning Stage – Structural Report

January 2021

Waterman Moylan Consulting Engineers Limited
Block S, East Point Business Park, Alfie Byrne Road, Dublin D03 H3F4
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Waterman Moylan
Engineering Consultants

Cross Guns Bridge

Planning Stage – Structural Report

Client Name: Bindford Ltd.

Document Reference: 20-011r.006

Project Number: 20-011

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015 and BS EN ISO 14001: 2015)

Issue	Date	Prepared by	Checked by	Approved by
01	28.01.21	R. Nelson	R. Nelson	

Comments

Revised Ground Floor GAs

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Content

Appendices

1. Introduction

1.1 Scope

Waterman Moylan has been appointed by Bindford Ltd to provide Structural Consultancy Services for the proposed residential development at Phibsborough, Dublin 7 and to develop the scheme to Planning Stage.

The following provides a summary of the advice and encapsulates the information gathered thus far.

The main structural issues covered are as follows:-

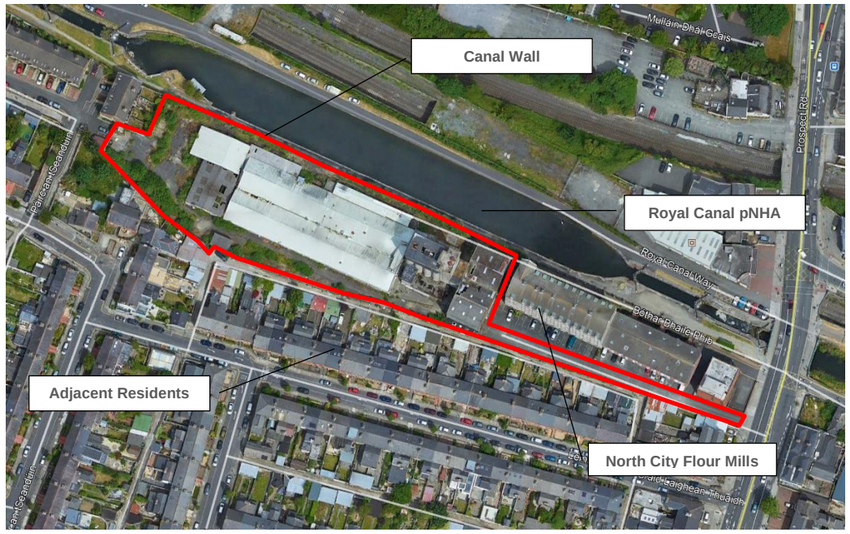
- Develop an understanding of site constraints.
- Form of the new structure.
- Advise structural dimensions
- Review of construction methodology in relation to the site constraints
- Optimise building envelope within site constraints.
- Liaised with the Environmental Consultants and Conservation Architect regarding the structural works

2. Site Constraints

The circa 0.73 hectare site lies adjacent to the Royal Canal approximately 600m North of Phibsborough Village. The site is currently vacant with existing derelict industrial buildings, warehouse and silos that are in a state to disrepair. The site will be razed to ground level as part of the demolition works.

The site is relatively constrained with:

- Royal Canal pNHA
- Canal Wall
- North City Flour Mill
- Adjacent Residential Properties
- Ground Conditions



2.1 Royal Canal & Royal Canal pNHA

The site is adjacent to the Royal Canal and the Royal Canal's proposed Natural Heritage Area (pNHA). Precautionary mitigation measures will need to be implemented during construction to ensure the Royal Canal pNHA is safeguarded against accidental pollution or impact from site activities. Mitigation measures are outlined in the Ecological Impact Assessment [Whitehill Environmental 2020].

2.2 Retained Canal Wall

The existing towpath wall shall be retained and sympathetically incorporated into the scheme.

The wall will likely require underpinning to prevent undermining the wall foundations during construction of the ground floor slab. A structural survey to the canal wall will be undertaken over the next stage to confirm the depth of underpinning required.

2.3 North City Flour Mills

The North City Flour Mills built in circa 1840 lies adjacent to the site and is currently in use as apartments. Dilapidation surveys will be required ahead of the works commencing, in addition to monitoring of noise and vibration during demolition and construction.

2.4 Adjacent residential Properties

The site is adjacent to several residential properties along Leinster Street North. Dilapidation surveys will need to be undertaken to these properties ahead of the works commencing, in addition to monitoring of noise and vibration during demolition and construction.

2.5 Irish Rail

The western intercity rail line runs adjacent to the Royal Canal on the opposite side of the canal to the site. The rail line is circa 40m from the site boundary and considered far enough away not to be affected by the construction activities or proposed development as per Iarnrod Eirean's Guidance of Third Party Works (2018). The Contractor may need to consult with Iarnrod Eirean regarding proposed tower cranes during construction.

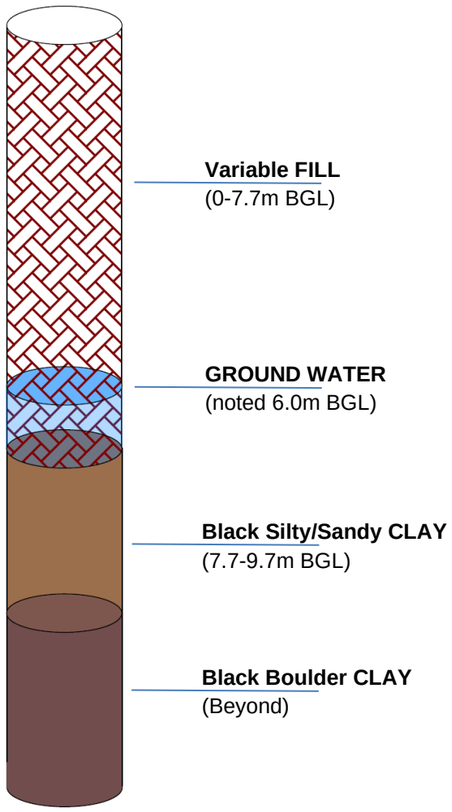
2.6 Traffic Management

Construction timings and methods, protection and potential temporary detours for both pedestrians and vehicles shall be studied prior to the commencement of construction activities. The Contractor shall agree and submit proposals to Dublin City Council for approval.

2.7 Ground Conditions

Geotechnical investigations have yet to be undertaken on the site.

Borehole records from the adjacent North City Flour Mills indicate that the subsurface geology is likely to be as follows:



2.8 Ground Water Table

Groundwater monitoring has not been undertaken on the site. Groundwater strikes were noted in the borehole logs for the adjacent North City Flour Mills at circa 6.0m(bgl).

With regards to the basement waterproofing and consideration in accordance with BS8102:2009 – code of practice for the protection of below ground structures against water from the ground, the water table can be classified as category “low” in accordance with clause 5.1.3.

3. Structural Concept

The structural scheme has been arrived upon following the review of a number of design iterations and assessment of floor spans and structural zones.

The scheme presented here aims to:

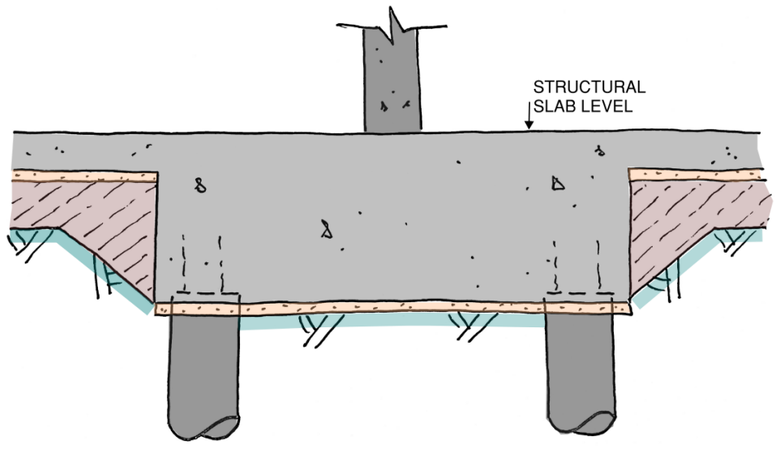
- Provide a flush soffit (as much as possible), achieving optimal floor sandwich whilst maximising clear floor-to-floor heights.
- Provide a clear path for service routes (as much as possible)
- Minimise the number column transfers between the hotel bedrooms, ground floor and basement layouts;
- Avoid ground floor transfer structures through the use of cross-walls acting as deep beams;
- Be capable of fast construction minimising on-site programme time;

3.1 Substructure

3.1.1 Foundations

The soil conditions and anticipated building loads would require piled foundations. The proposed piles are to be conventional continuous flight auger (CFA) or rotary bored piles of 750mm diameter, subject to a site investigation, and will be designed to resist the vertical and horizontal loads from the structure above.

Pile caps will be reinforced concrete cast in-situ elements designed to spread the building loads into the piles. The pile caps are typically 1800m deep for 750mm diameter piles.



Typical Foundation Pile Cap

3.1.2 Basement Structure

The perimeter of the new basement will be constructed using a secant piled wall with hard and soft piles 750mm in diameter. The thickness and spacing of the piles will be confirmed by the specialist piling contractor and based on the site investigation. Following the site investigation and monitoring of groundwater levels a contiguous piled wall may be considered where the groundwater levels are far enough below formation levels to obviate the need for a groundwater cut off. The perimeter basement walls will be lined in a 300mm reinforced concrete wall.

3.1.3 Basement Waterproofing

Requirement and details for basement waterproofing are shown by the Architect.

Table 2 **Grades of waterproofing protection**

Grade	Example of use of structure[A)]	Performance level
1	Car parking; plant rooms (excluding electrical equipment); workshops	Some seepage and damp areas tolerable, dependent on the intended use[B)] Local drainage might be necessary to deal with seepage
2	Plant rooms and workshops requiring a drier environment (than Grade 1); storage areas	No water penetration acceptable Damp areas tolerable; ventilation might be required
3	Ventilated residential and commercial areas, including offices, restaurants etc.; leisure centres	No water penetration acceptable Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use

A) The previous edition of this standard referred to Grade 4 environments. However, this grade has not been retained as its only difference from Grade 3 is the performance level related to ventilation, dehumidification or air conditioning (see BS 5454 for recommendations for the storage and exhibition of archival documents). The structural form for Grade 4 could be the same or similar to Grade 3.

B) Seepage and damp areas for some forms of construction can be quantified by reference to industry standards, such as the ICE's *Specification for piling and embedded retaining walls* [1].

Grades of Waterproofing Protection (extract from BS8102:2009)

In basement habitable areas, core lobbies, electrical rooms and lift-pits, the basement waterproofing performance will need to be BS 8102:2009 Grade 3. Current proposals to achieve this required environment will be developed over the next stage. At this stage and for any preliminary cost plans we would suggest that a “white tank” system by Rascor or Dryteck is considered.

3.2 Super-Structure

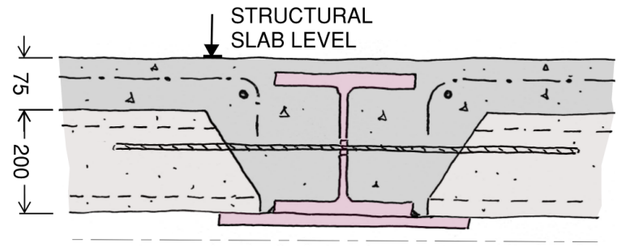
A material options study for the super-structure was undertaken and can be summarised as follows.

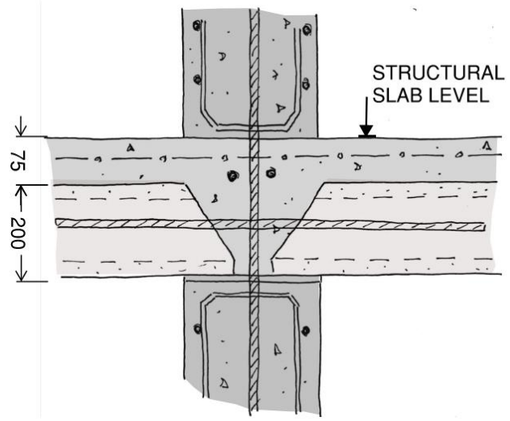
	Framing Layout	Speed-of-Construction	Fire Resistance	Acoustic Performance	Vibration Performance
Hybrid Precast Hollowcore & Crosswalls	Good	Good	Good	Good-Average	Good
In-situ Concrete Frame	Good	Poor	Good	Good	Good
Steel Frame & Precast Concrete	Good	Good	Average	Good-Average	Average
Masonry Walls & Precast Concrete	Poor	Poor	Good	Good-Average	Good
Timber CLT Slabs & Crosswalls	Good	Good	Poor	Average	Average

It is proposed to use a hybrid precast concrete hollow-core floor slabs with reinforced concrete cross-walls for the superstructure. The structural solution provides economy of design and speed of construction, whilst achieving the Architectural aspirations for minimum transfer structures at Ground Floor.

A hybrid precast concrete and in-situ cross-wall construction has a number of benefits over a conventional concrete frame approach:

- High strength to weight ratio
- Greater opportunity for off-site prefabrication
- Higher quality of finish due to off-site construction
- Less requirement for temporary works and back-propping slabs
- Less formwork and shuttering on site
- Faster construction time on site (early stage first-fix MEP)
- Longer achievable floor spans for shallow floor zone





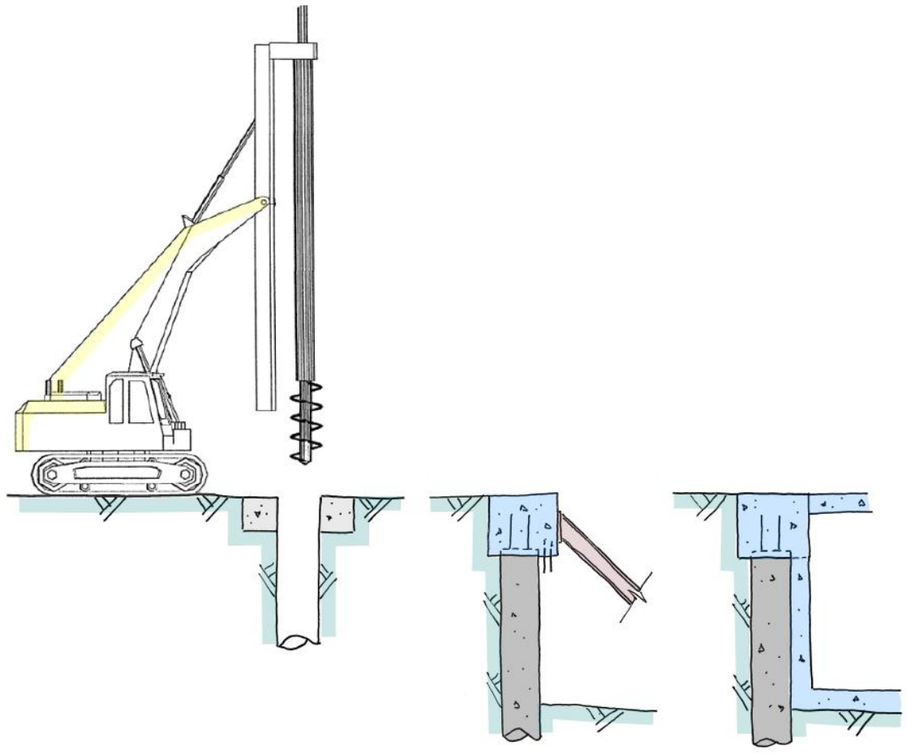
Typical Floor Structural Build-up

The use of steel UC sections set within the depth of the structural slab allows for a clear soffit and the uninterrupted distribution of services within the ceiling zone.

4. Construction Methodology

4.1 Basement & Foundations

The sequence of works for the construction of the basement will be as follows:



Typical Basement Construction Sequence

- Install Piling Mat & Temporary guide wall (if required)
- Install Secant Piles
- Construct RC Capping Beam
- Excavate basement & Install Temporary Works (if required)
- Construct Basement RC Slab
- Construct Basement RC Lining Walls

4.2 Measures to Protect Adjacent Structures (Canal Wall, Towpath & Canal)

The following measures have been considered in design over the Planning Stage to protect the adjacent structures:

(1) The extent of basement footprint and depth of basement has been kept to a minimum.

(2) The basement has been set-out and positioned away from the Northern site boundary. It is deemed that this is far enough away so that the zone of influence from the basement excavation will not affect the Canal Wall, Towpath or Canal.

(3) Driven piles shall not be used.

(4) CFA Piling is proposed that minimises noise and vibration during the works.

(5) The Secant piled wall will be design for minimum lateral movement as per the ICE Specification for Piling and Embedded Retaining Wall and best practice. The basement perimeter walls will be continuously monitored for movement during the works.

(6) The Secant Piled wall to the basement perimeter will provide a groundwater cut-off and prevent groundwater movement between the basement excavation and surrounding subterranean area. This will mitigate the risk of changes to the existing groundwater levels during construction (subject to the ground investigation and level of the existing groundwater).

(7) Additional measures will be adopted by the Contractor during construction as per health and safety requirements and best practice.

4.2.1 Response to the Inspector's Report on Recommended Option [ABP-307400-20]

In response to the Inspector's Report on Recommended Opinion No.7 – the above mitigation measures demonstrate that the proposed construction methodology will not have an impact on the Royal Canal.

5. Fire Protection of the Structure

It is currently understood that a 90-minute fire protection will be required generally for the structure, with 120 minutes required for certain core and escape routes, subject to the Fire Consultants Report. 240 minutes is required in electrical ESB substation rooms.

Fire protection to all concrete elements will be achieved as follows, as per IS EN 1992-2:

Core walls and Columns	-	RC concrete cover and minimum element dimensions
Horizontal members and hollowcore slabs	-	RC concrete cover and minimum element dimensions.
120 minute areas	-	RC concrete cover and minimum element dimensions.
240 minute areas	-	RC concrete cover and minimum element dimensions.

6. Proposed Loadings

6.1 Design Loadings and Service Movements

6.1.1 Vertical Loads

These comprise superimposed live loads [due to occupancy, plant, storage, etc.], superimposed dead loads [due to M&E services, etc.] and self-weight of structure plus cladding. Superimposed live loads and dead loads are listed below and the design takes into account structure and cladding self-weight.

6.1.2 Horizontal Loads

These comprise either wind loading on the building façade or "notional loads" as defined in British Standards. Notional loads occur due to lack of fit of the structure, etc. The combination of these two are used in the design in accordance with IS EN 1990.

6.1.3 Service Movements

Horizontal and vertical movements due to superimposed live loads and wind loads are limited to the following:

Horizontal building sway [wind load] = $\frac{height}{500}$

Vertical slab/beam deflections [superimposed live load]:

i] Floor beams = $\frac{span}{360}$

ii] Slab/Beam supporting cladding = $\frac{span}{500}$ or 10 mm whichever is less.

6.1.4 Loading Table

A Typical Bedroom Floor

200 Precast Slab	3.00 kN/m^2
75mm Screed	1.80 kN/m^2
Floor Finishes	0.35 kN/m^2
Ceiling & Services	0.25 kN/m^2
	5.40 kN/m^2
Imposed load (Class A1)	3.5 kN/m^2

[Including 2.0kN/m^2 partitions with tiled finish]

B Typical Ground Floor Commercial

350 normal weight slab	8.75 kN/m^2
Raised floor	0.35 kN/m^2
90mm Screed (2000kg/m^3)	1.80 kN/m^2
Floor insulation	0.05 kN/m^2
Ceiling &services	0.45 kN/m^2
	11.40 kN/m^2
imposed load	5 kN/m^2

D Roof Areas

200 Precast Slab	3.00 kN/m^2
75mm Screed	1.80 kN/m^2
Sedum	3.00 kN/m^2
Waterproofing	0.30 kN/m^2
Insulation	0.20 kN/m^2
	8.30 kN/m^2
imposed load (MEP)	7.5 kN/m^2
Imposed load (PVs)	3.0 kN/m^2
Access/Maintenance	0.6 kN/m^2

E Corridor / Lobby Areas

200 Precast Slab	3.00 kN/m^2
75mm Screed	1.80 kN/m^2
Floor Finishes	0.35 kN/m^2
Ceiling & Services	0.45 kN/m^2
	5.60 kN/m^2
Imposed load	5.0 kN/m^2

F Disproportionate Collapse

The structure is in excess of five storeys and therefore will be checked for disproportionate collapse in accordance with IS EN 1991-1-7:2006 Annex A and Building Regulations.

Accidental loading at 34 kN/m^2 will be applied to "key elements", i.e. columns and beams carrying columns, and criteria in regard to perimeter ties and tying forces.

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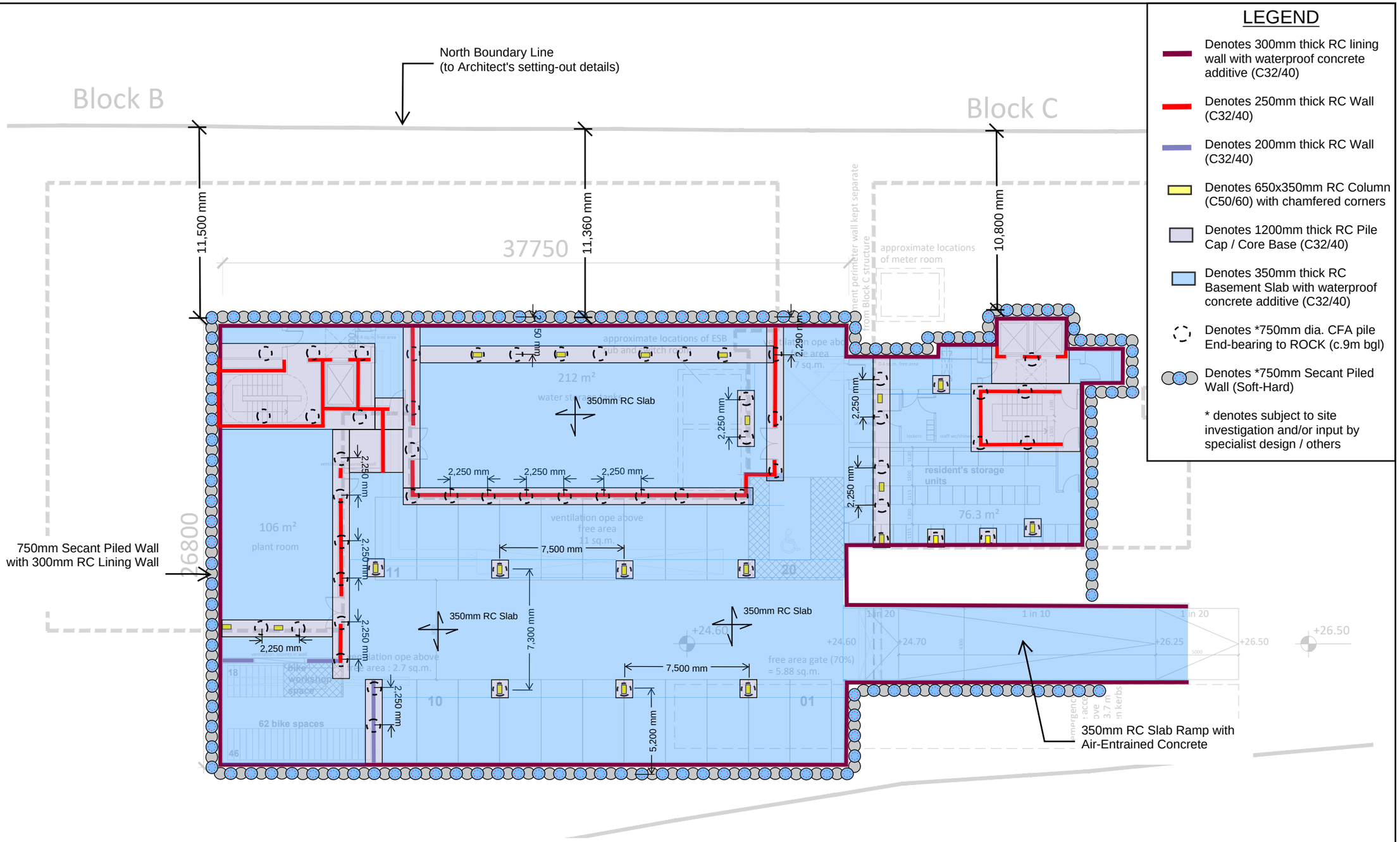
Engineering Consultants

APPENDIX

A. Waterman-Moylan Structure's Drawings



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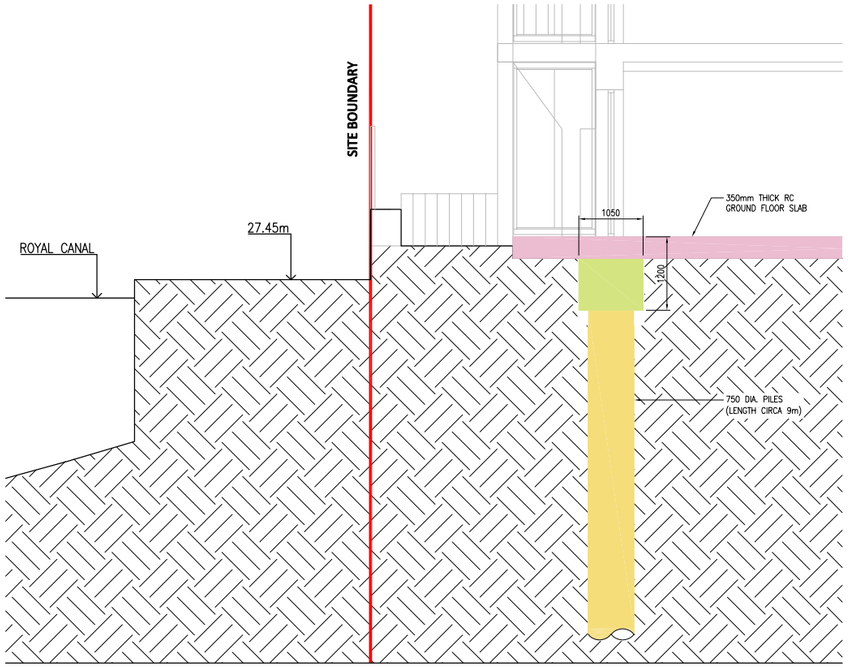
TITLE: BASEMENT LEVEL GA

PROJECT: Cross Guns Bridge

CLIENT: Bindford Ltd.

DRAWING STATUS	ISSUED FOR PLANNING				
DRAWN	RN	DESIGNED	RN	CHECKED	RO
PROJECT	20-011	DATE	20.01.2021	SCALE	NTS
DRAWING REFERENCE	20 - 011 - WMS - ZZ - ZZ - SK - S - 0010				



BLOCK A SECTION A–A
SCALE 1:50

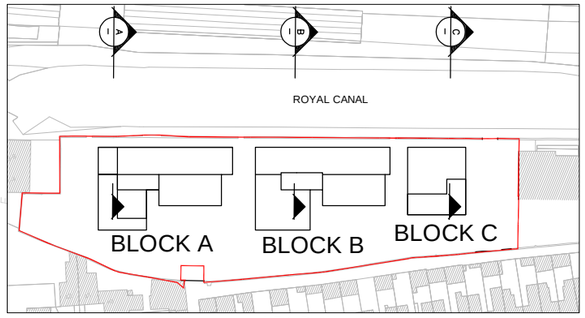
Block A:

A) Piles installed at regular centres
(expected to reach depths > 9m)
Depths TBC by piling contractor

B) Ground beams to be constructed in line above piles with starters placed to extend into load-bearing walls above

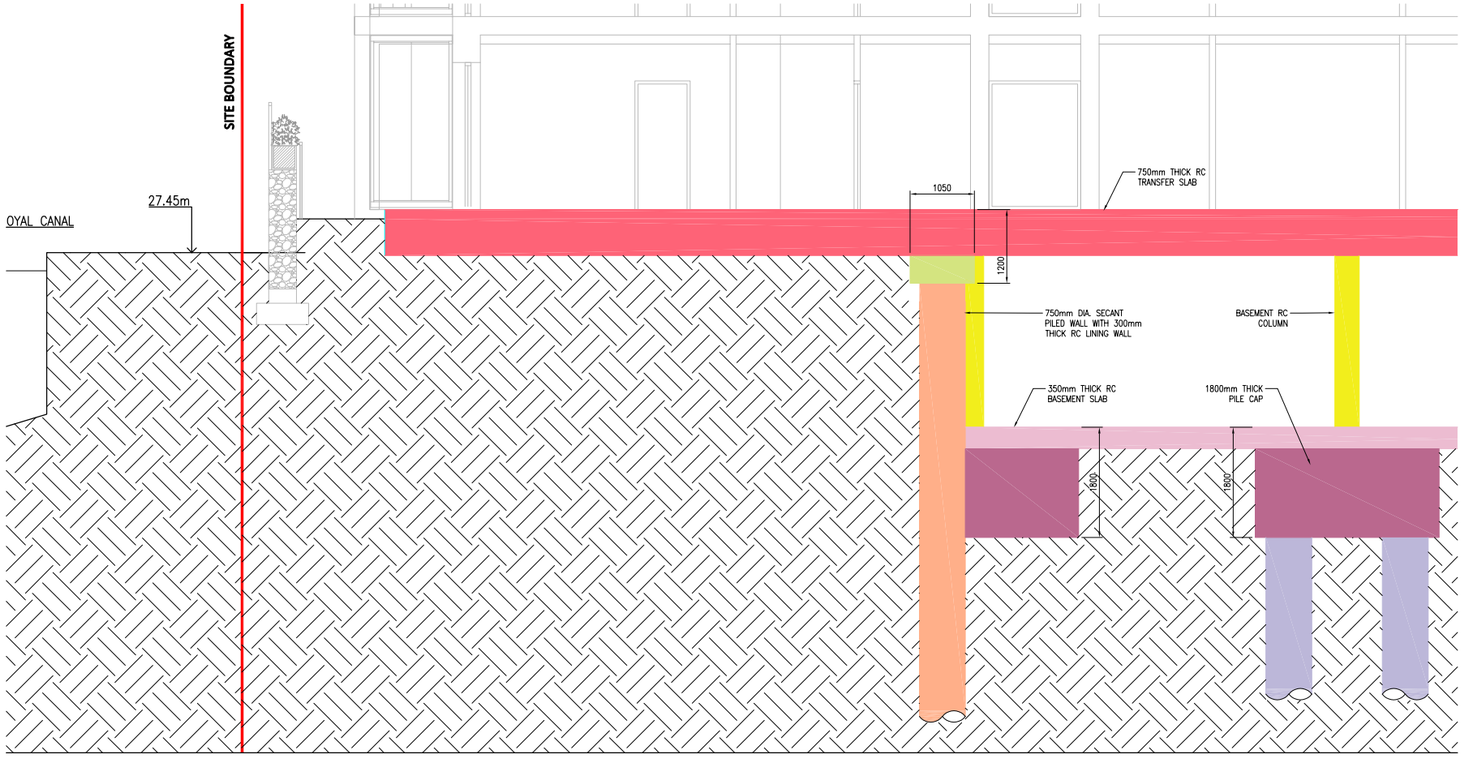
C) Ground Floor Slab to be constructed; slabs to be suspended between ground beams.

Note; All new vertical and lateral loads from Block A will be directed to lower depths via piles.
Canal and Tow Path will not be subjected to new loads.



KEY PLAN
SCALE 1:1000

GENERAL NOTES



BLOCK B SECTION B–B
SCALE 1:50

Block B:

A) Secant Piled Wall is installed around basement perimeter.
Wall is formed by constructing alternating primary and secondary overlapping piles forming a continuous impervious structure; (expected to reach depths > 12m)
Depths TBC by piling contractor.

B) Capping Beam installed.

C) Basement Excavation down to bulk formation.

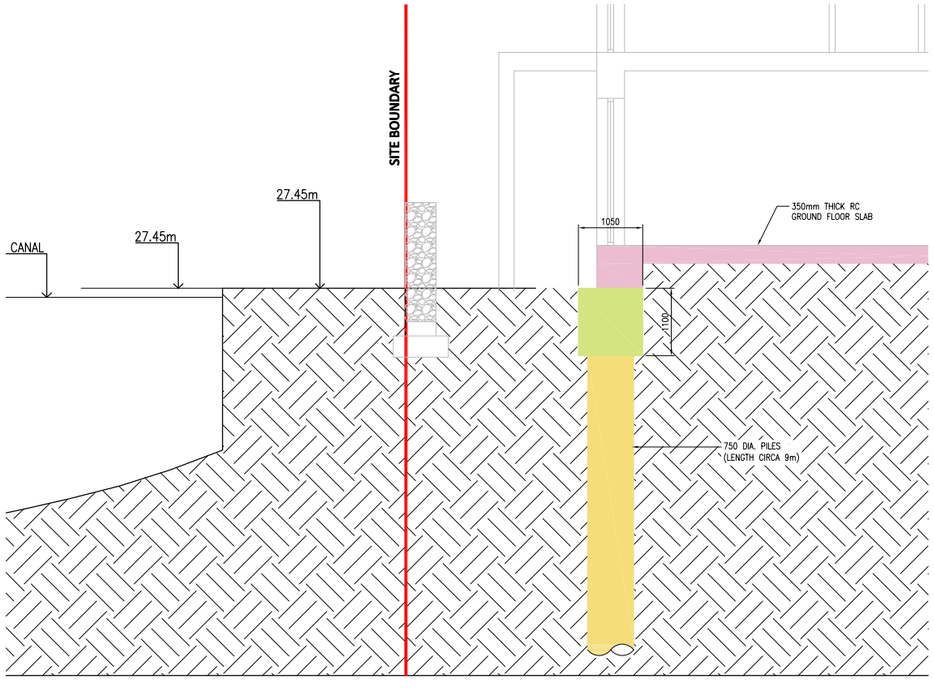
D) Internal Piles to be bored and installed with pile caps and edge ground beams formed.

E) Basement Slab is constructed; slab to be suspended spanning between ground beam and pile caps.

F) Columns and Load bearing walls constructed from basement to underside of Ground Floor.

G) Ground Floor Transfer Slab is constructed.

Note; All new vertical and lateral loads from Block B will be directed to lower depths via piles.
The Secant Pile Wall will be designed to resist any lateral and earth pressure from the Canal during excavation of the basement.
Canal and Tow Path will not be undermined or subjected to new loads.



BLOCK C SECTION C–C
SCALE 1:50

Block C and parts of Block B:

A) Piles installed at regular centres
(expected to reach depths > 9m)
Depths TBC by piling contractor

B) Ground beams to be constructed in line above piles with starters placed to extend into load-bearing walls above

C) Ground Floor Slab to be constructed; slabs to be suspended between ground beams.

Note; All new vertical and lateral loads from Block A will be directed to lower depths via piles
Canal and Tow Path will not be subjected to new loads.

Rev	Date	Description	By

Amendments

Project
CROSS GUNS BRIDGE

Title
TYPICAL CROSS SECTIONS

Client
BINFORD LTD.

Waterman Moylan
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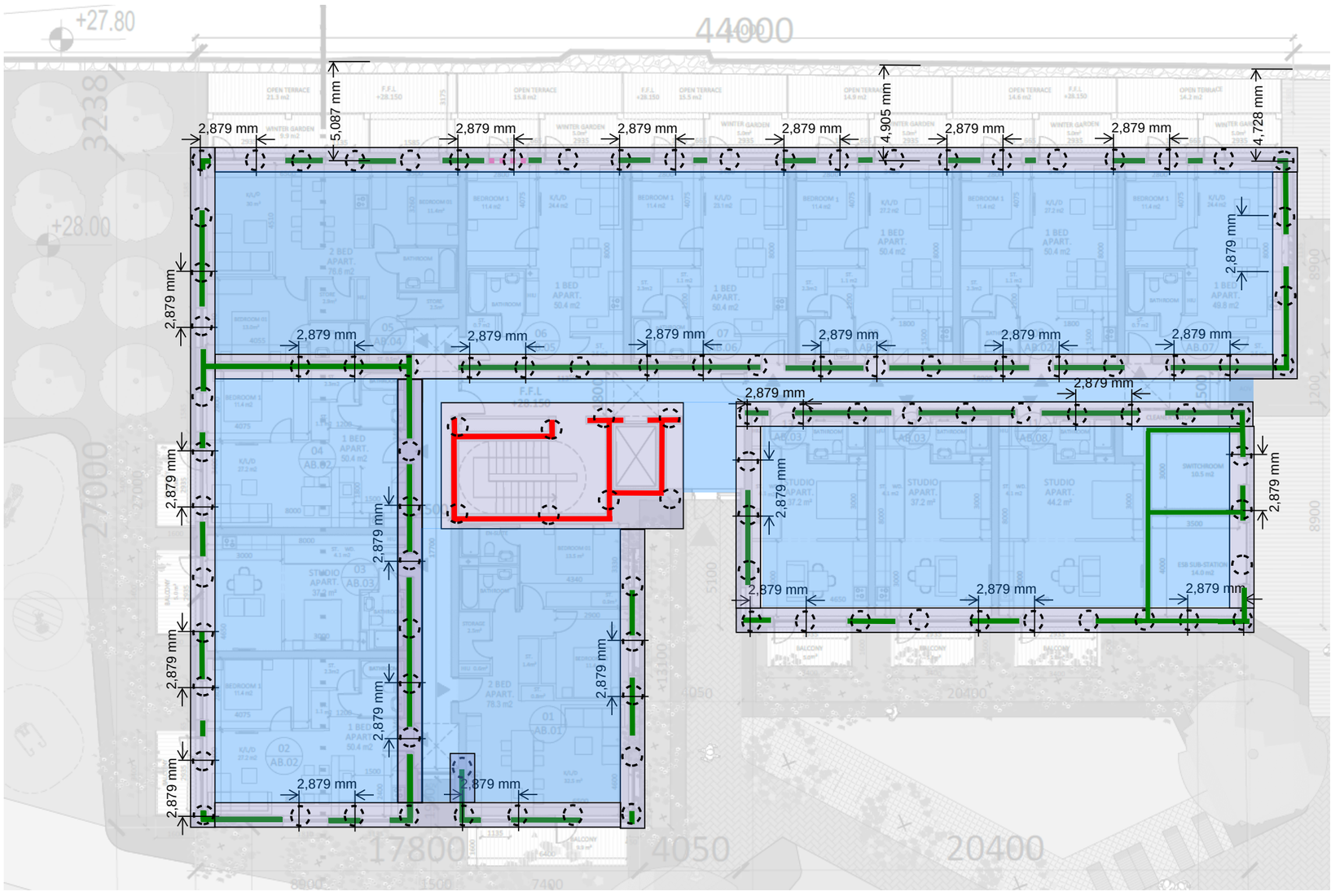
FOR PLANNING

Designed By	Checked By	Waterman Ref
FK	RO	20-011
Drawn By	Date	Scales @ A1
TB	SEP 20	1:100

Project - Originator - Volume - Level - Type - Role - Number | Revision

20-011-WMS- ZZ -ZZ-DR-S-21001



LEGEND

- Denotes 220mm thick RC Wall / Blade Column (C50/60)
- Denotes 250mm thick RC Wall (C32/40)
- Denotes 200mm thick RC Wall (C32/40)
- Denotes 500x500mm RC Column (C50/60)
- Denotes 1200mm thick RC Pile Cap / Core Base (C32/40)
- Denotes 350mm thick RC Suspended Slab (C32/40)
- Denotes *750mm dia. CFA pile End-bearing to ROCK (c.9m bgl)

* denotes subject to site investigation and/or input by specialist design / others

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TITLE: GROUND FLOOR GA BLOCK A

PROJECT: Cross Guns Bridge

CLIENT: Bindford Ltd.

DRAWING STATUS	ISSUED FOR PLANNING				
DRAWN	RN	DESIGNED	RN	CHECKED	RO
PROJECT	20-011	DATE	20.01.2021	SCALE	NTS
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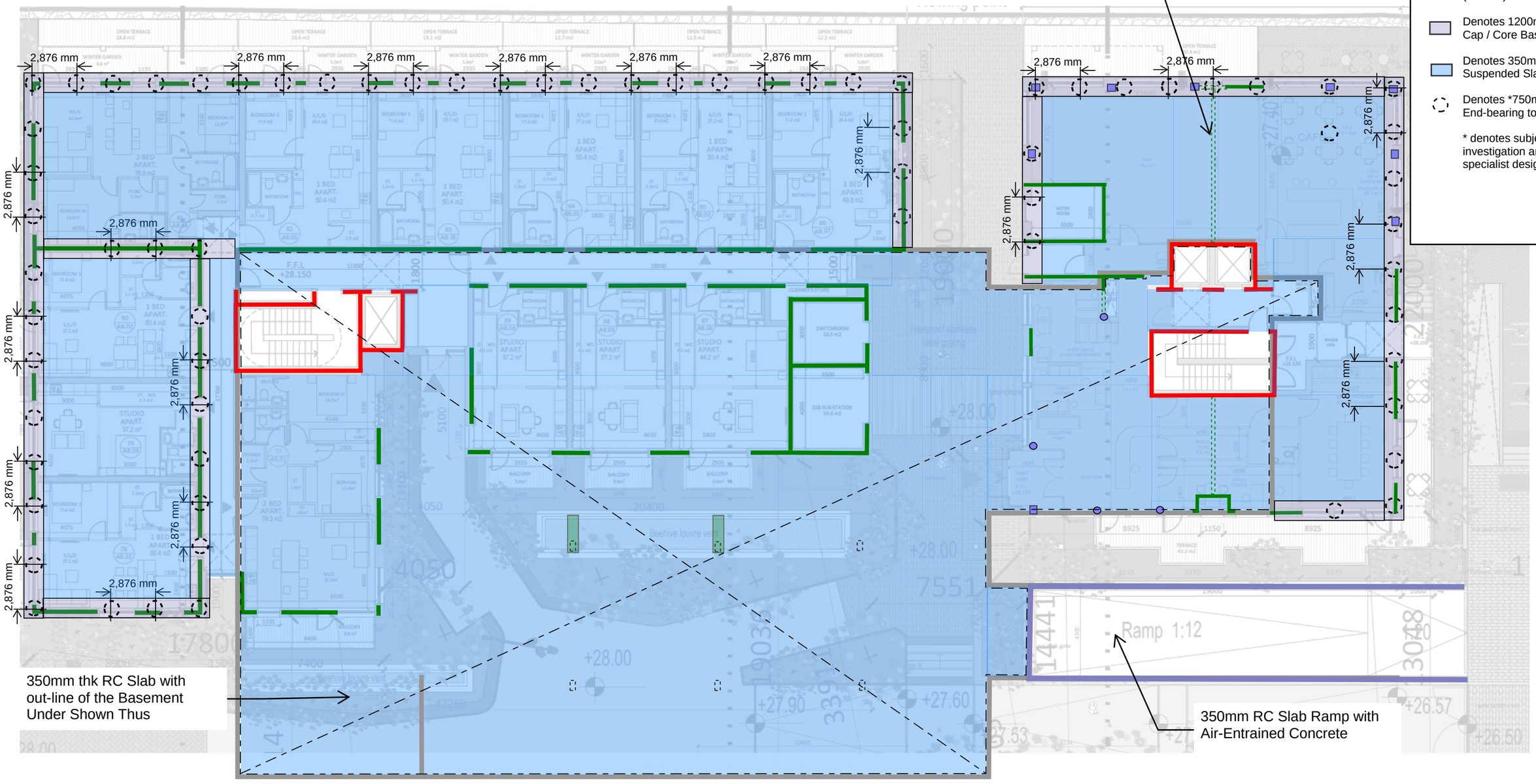

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TITLE

GROUND FLOOR GA BLOCKS B & C

PROJECT	Cross Guns Bridge	CLIENT	Bindford Ltd.

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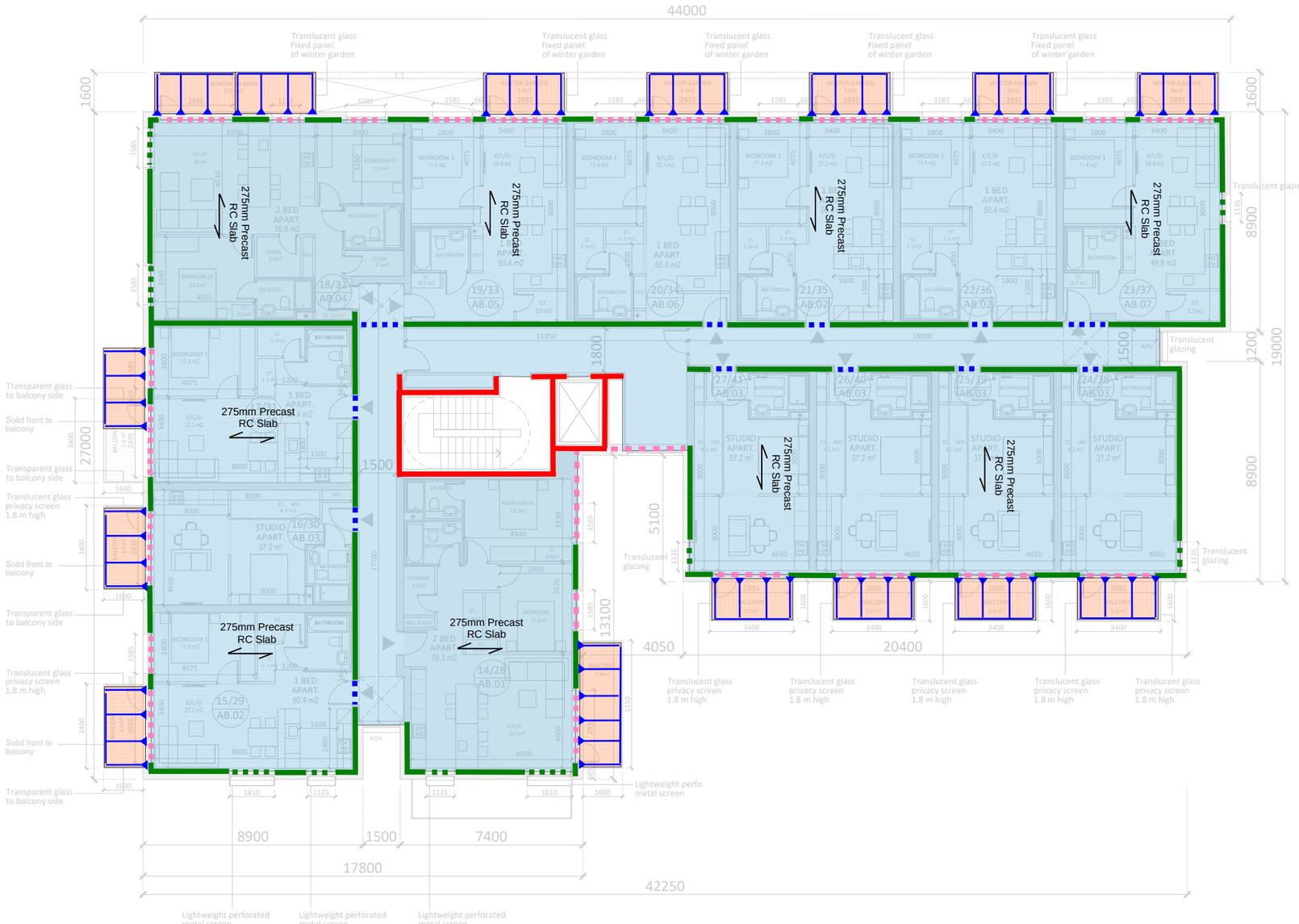
DRAWING REFERENCE	20 - 011 - WMS - ZZ - ZZ - SK - S - 0010				

LEGEND

- Denotes 220mm thick RC Wall / Blade Column (C50/60)
- Denotes 250mm thick RC Wall (C32/40)
- Denotes 200mm thick RC Wall (C32/40)
- Denotes 220x400mm deep RC Beam (C32/40)
- Denotes 220x400mm deep RC Beam with 125mm cont. nib/boot to support slab (C32/40)
- Denotes 203UC46 Steel Beam (Slimflor Beam) with 400x15mm thick plate to bottom flange
- Denotes 203UC46 Steel Beam with Schok Isokorb Thermal Break Moment Connection (shown thus ◀)
- Denotes Balcony Construction as per Architects details
- Denotes 275mm thick Precast Slab (*200mm thick Hollowcore with 75mm structural screed)

* denotes subject to input by specialist design by others



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TITLE: TYPICAL FLOOR GA BLOCK A

PROJECT: Cross Guns Bridge

CLIENT: Bindford Ltd.

DRAWING STATUS	ISSUED FOR PLANNING				
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DRAWING REFERENCE	20 - 011 - WMS - ZZ - ZZ - SK - S - 0013				

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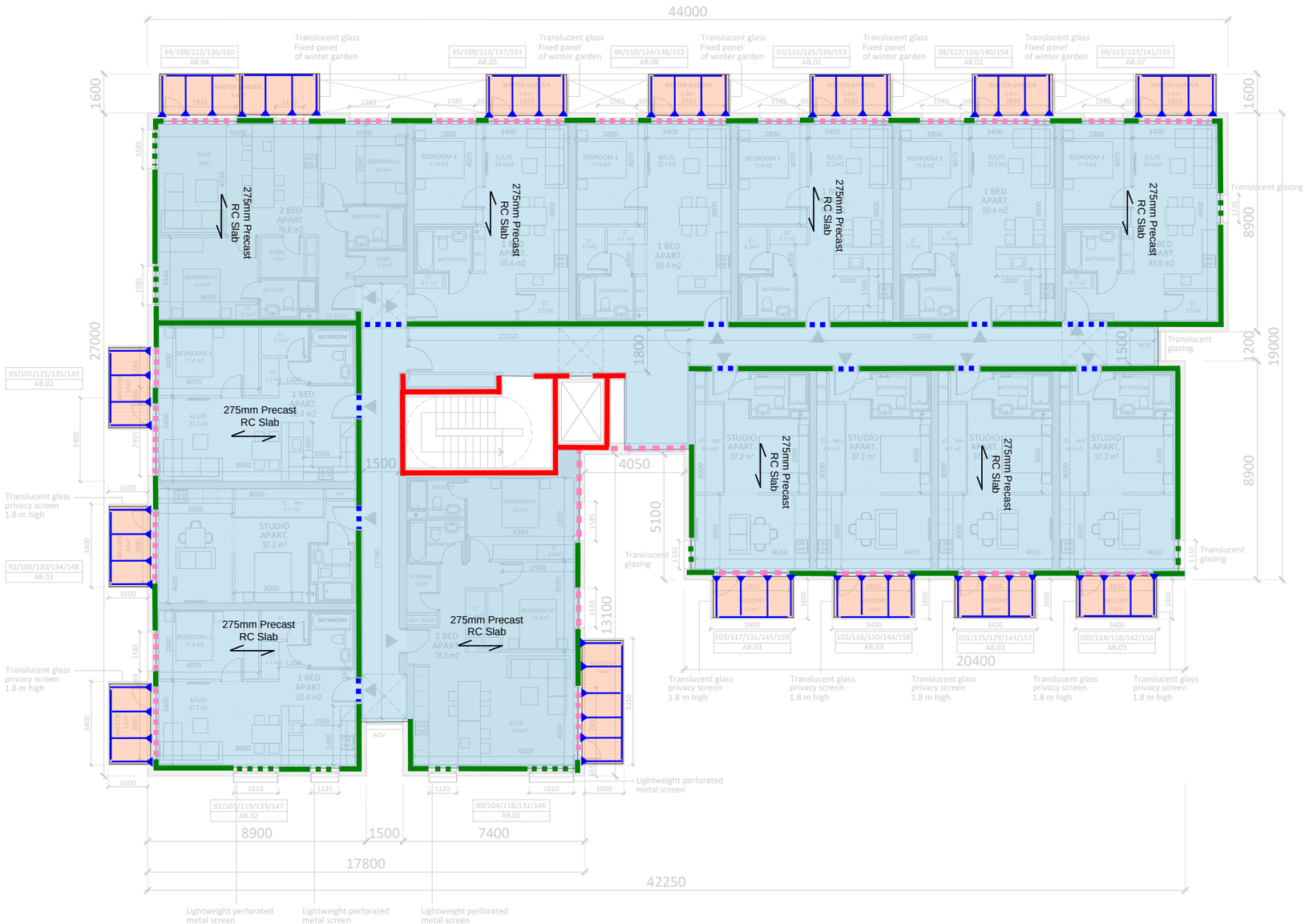
- Denotes 220x400mm deep RC Beam (C32/40)
- Denotes 220x400mm deep RC Beam with 125mm cont. nib/boot to support slab (C32/40)
- Denotes 203UC46 Steel Beam (Slimflor Beam) with 400x15mm thick plate to bottom flange
- Denotes 203UC46 Steel Beam with Schok Isokorb Thermal Break Moment Connection (shown thus ◀)
- Denotes Balcony Construction as per Architects details
- Denotes 275mm thick Precast Slab (*200mm thick Hollowcore with 75mm structural screed)

* denotes subject to input by specialist design by others



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TITLE: TYPICAL FLOOR GA BLOCK B

PROJECT: Cross Guns Bridge

CLIENT: Bindford Ltd.

DRAWING STATUS	ISSUED FOR PLANNING				
DRAWN	RN	DESIGNED	RN	CHECKED	RO
PROJECT	20-011	DATE	20.01.2021	SCALE	NTS
DRAWING REFERENCE	20 - 011 - WMS - ZZ - ZZ - SK - S - 0014				

LEGEND

- Denotes 220mm thick RC Wall / Blade Column (C50/60)
- Denotes 250mm thick RC Wall (C32/40)
- Denotes 200mm thick RC Wall (C32/40)
- Denotes 220x400mm deep RC Beam (C32/40)
- Denotes 220x400mm deep RC Beam with 125mm cont. nib/boot to support slab (C32/40)
- Denotes 203UC46 Steel Beam (Slimflor Beam) with 400x15mm thick plate to bottom flange
- Denotes 203UC46 Steel Beam with Schok Isokorb Thermal Break Moment Connection (shown thus ◀)
- Denotes Balcony Construction as per Architects details
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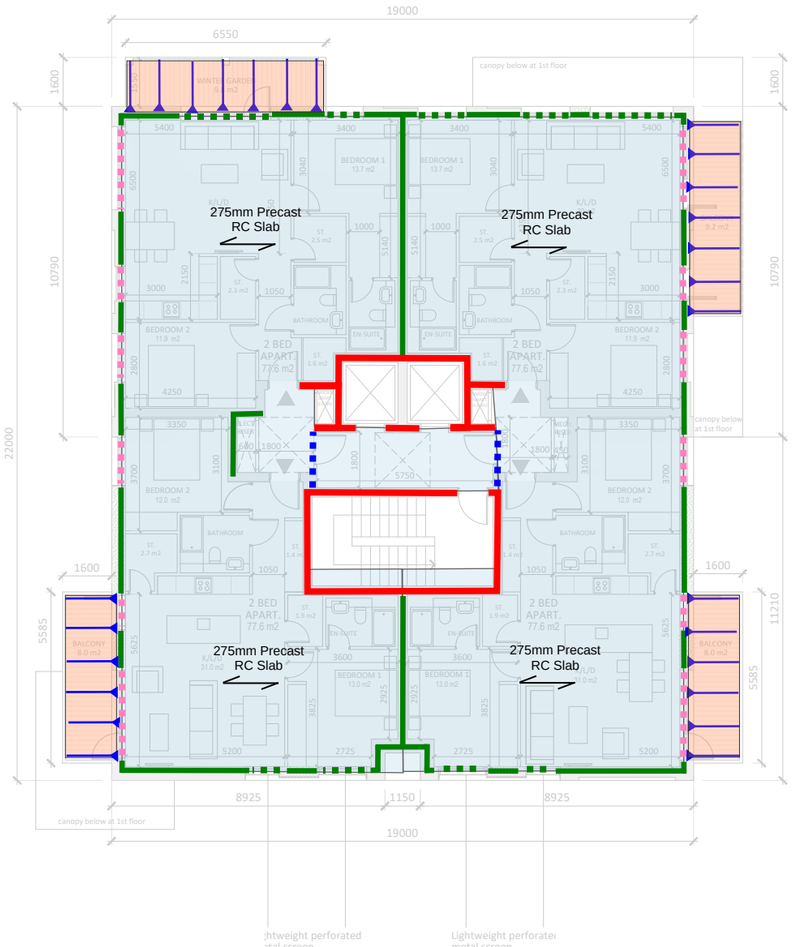

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TITLE: TYPICAL FLOOR GA BLOCK C

PROJECT: Cross Guns Bridge

CLIENT: Bindford Ltd.

DRAWING STATUS	ISSUED FOR PLANNING				
DRAWN	RN	DESIGNED	RN	CHECKED	RO
PROJECT	20-011	DATE	20.01.2021	SCALE	NTS
DRAWING REFERENCE	20 - 011 - WMS - ZZ - ZZ - SK - S - 0015				

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