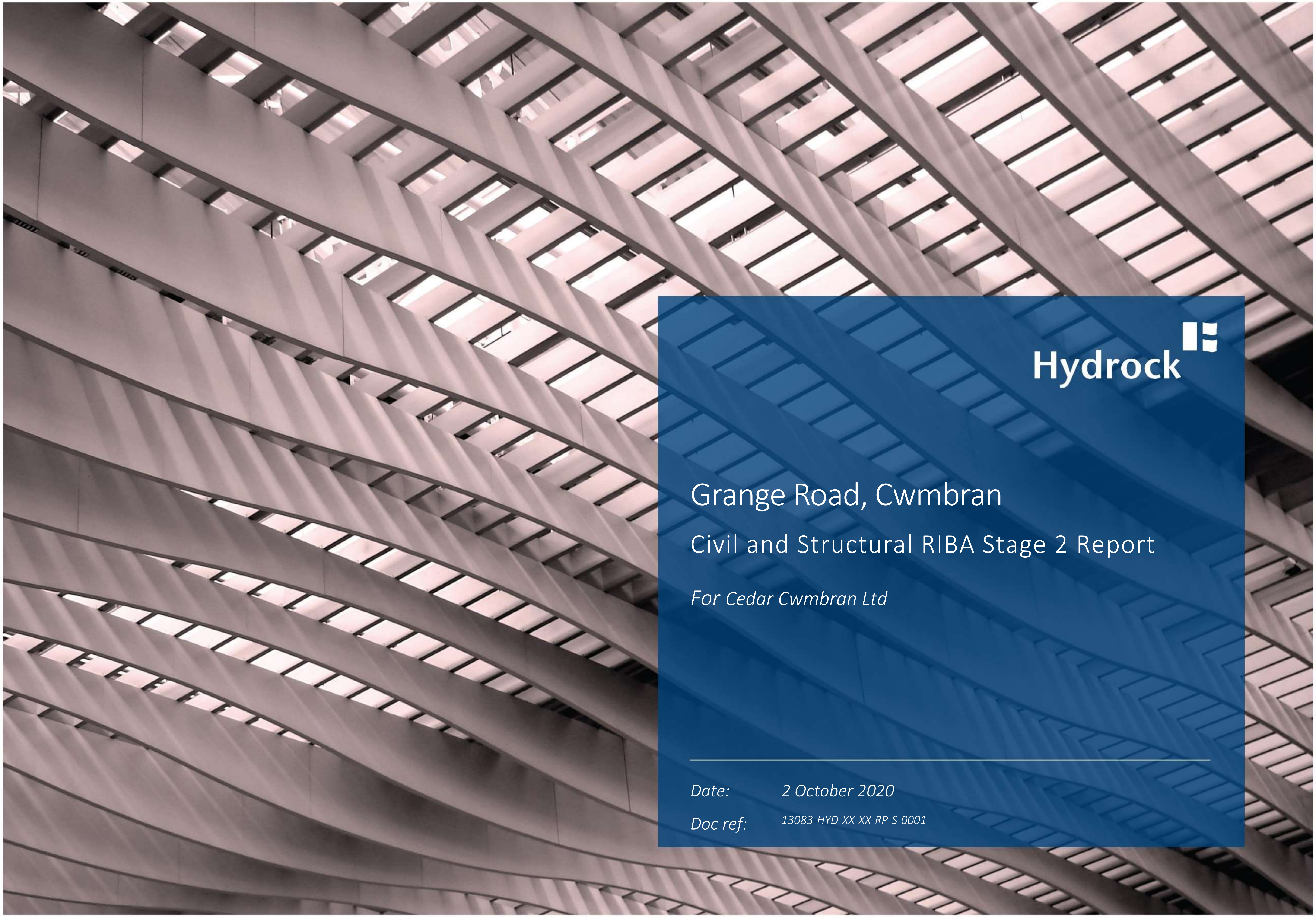

Hydrock

Grange Road, Cwmbran

Civil and Structural RIBA Stage 2 Report

For Cedar Cwmbran Ltd

Date: *2 October 2020*

Doc ref: *13083-HYD-XX-XX-RP-S-0001*

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1. DISCLAIMER

Hydrock Consultants has been appointed by Arctech Partnership LLP to provide structural engineering advisory services in relation to the design and construction of the proposed new combined factory and office unit for Cedar Cwmbran Ltd.

This report describes the structural strategy and scope of works for the proposed factory/office unit, in line with RIBA Stage 2 levels of detail. It should provide an insight into the proposed direction of the construction of the facility and allow the client to review, question and discuss, facilitating progression to RIBA Stage 3.

Note that this design is preliminary, and should be used as information and proof of concept only. The structural design will be subject to development through the next RIBA stage, with the potential for significant alterations to the design and detail.

2. INTRODUCTION

2.1 General

This report outlines the structural concept design for the proposed new combined factory and office unit for Cedar Cwmbran Ltd in Cwmbran, South Wales.

The purpose of this report is to provide a commentary on the engineering progress to date, design assumptions, engineering concepts, site constraints, as well as providing a basis for future design.

2.2 Basis of report

This report has been based on the following information:

- AutoCAD Draft Plan/Elevations/Sections provided by Arctech Partnership LLP: 8514-XX-XX-DR-A-(121-123)
- Sketch based layout provided by Arctech Partnership LLP: 8487-XX-XX-DR-A-036
- Phase 2 Ground Investigation Report by Hydrock: 13083-GRC-HYD-XX-XX-RP-G-0001

2.3 Site Information

The proposed unit is located on a reasonably flat and disused plot of land to the east of Cwmbran town centre, adjacent to Grange Road and Llanfrechfa Way, and approximately 500 meters to the east of the A4051. The site location is as follows:

- Postcode: NP44 8HT
- Grid Reference: ST 29811 94844
- X (Easting): 329811
- Y (Northing): 194844
- Site elevation: 50m

Figure 1: Proposed Site (Image obtained from Google Maps)

3. STRUCTURAL ENGINEERING

3.1 Existing structures

The proposed site is located in a mixed industrial and residential area of Cwmbran, and is bounded by Grange Road to the west and (beyond this) residential housing, by Crane Process Flow Technologies to the north, by Llanfrechfa Way and (beyond this) an industrial estate to the south, and open fields to the west. It is also noted that the Afon Lwyd river flows from north to south to the east of the site, passing within 150m at its closest point. Cwmbran Brook flows from north west to south east to the south of the site, passing within 50m at its closest point.

The proposed site used to form part of the Crane Flow Process site (to the north), utilised as a scrap yard, waste storage compound and works car park, amongst other usages.

3.2 Proposed structures

The proposed structure includes a number of different spaces (including production, storage and tool areas) in an open warehouse, with a two-story mezzanine serving as office space at the north east of the building. The building is assumed to have a 60-year design. Key structural features are as follows:

- Predominantly one storey open area, with a minimum of 10m head room (as per RPSGroup 'Crane Cost Plan 5' document, 2019).
- Regular grid triple-bay portal frame.
- Stairway access to three-storey office mezzanine at north east of building.
- Constant ground floor level throughout the interior, with stepped/ramped access from the exterior.
- 50 kN/m² live load capacity for ground bearing slab (design by others). Value will be considered when determining foundation capacities

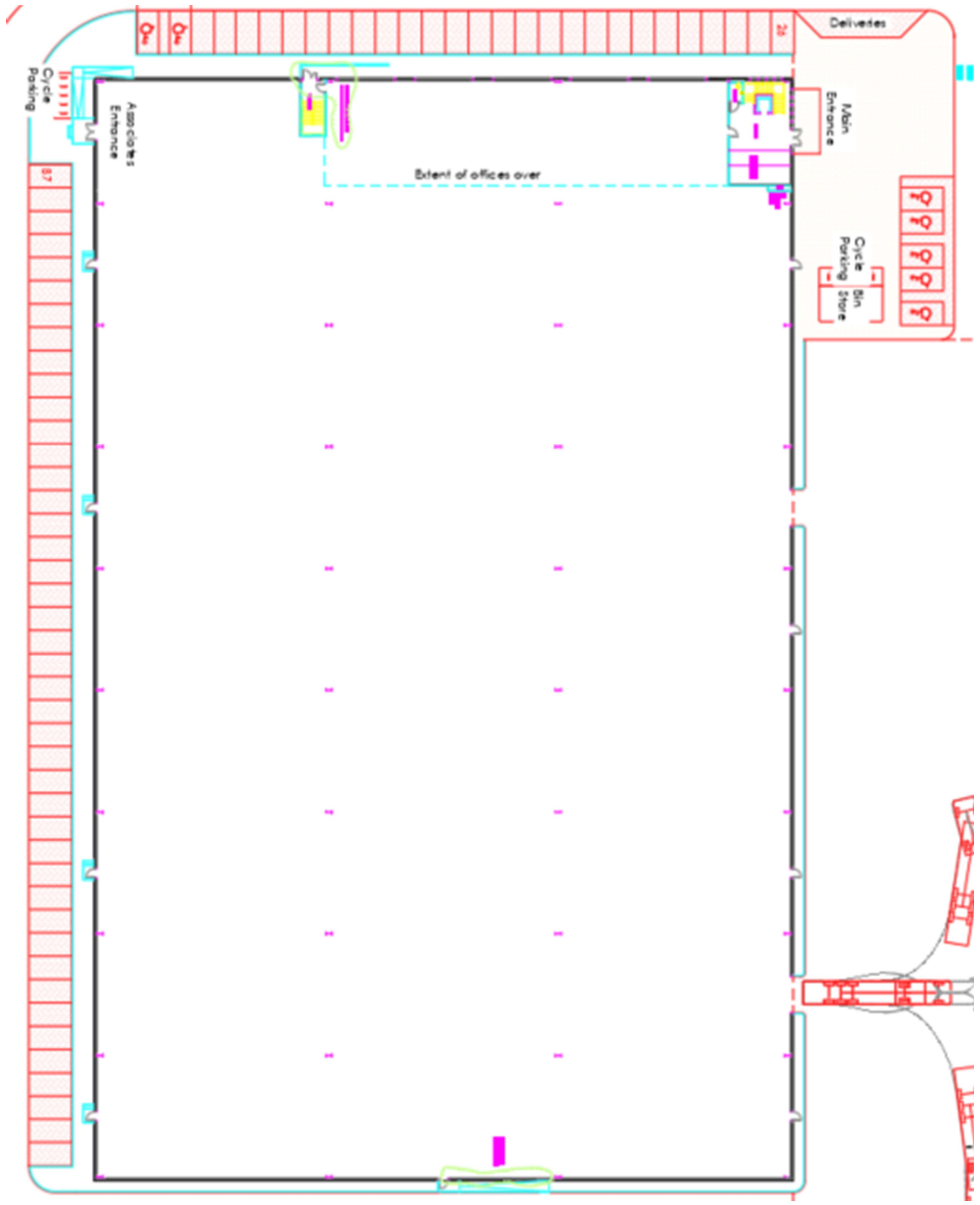

Figure 2: Site Plan (Arctech Partnership LLP: 8514-XX-XX-DR-A-120)

3.3 Superstructure Concept

3.3.1 Options

Two options have been proposed for the factory/office unit frame. These options, pros and cons, are discussed below (note the adjectives - long, medium, easy are used relatively speaking):

Table 1 - Superstructure options

Option	Details	Pros	Cons
A- 13.585m Portal Frame Bay Spacing	Braced steel portal frames at 13.585m bay centres, comprising columns, beams, vertical and horizontal bracing, with infill wall construction and lightweight roof	- Off-site manufacture - Tried and tested - Readily available manufacturers - Renders medium foundation loads - Easy creation of large unbroken spaces - Easy future development - Fewer structural members to assemble than Option 2 - Allowance for larger clear openings into structure than Option 2	- Long time to become weather tight - Low sustainability benefits - Greater steel tonnage per meter square due to the requirement for heavier steel members - Greater difficulty assembling steel members due to increased weight - Heavier crane lifts - Additional splice details for secondary transfer members. (spanning 13m +)- Heavier foundation loads
B - 6.793m Portal Frame Bay Spacing	Braced steel portal frame at 6.793m bay centres, comprising columns, beams, vertical and horizontal bracing, with infill wall construction and lightweight roof	- Off-site manufacture - Tried and tested - Readily available manufacturers - Renders medium foundation loads - Easy creation of larger unbroken spaces - Easily future development. - Reduced steel tonnage per meter square due to the use of lighter steel members. -Easier to assemble steel members due to reduced weight - Bay spacing allows use of regular cold-rolled steel for cladding fixing -Lighter foundation loads	- Long time to become weather tight - Low sustainability benefits - Greater number of structural members to assemble than Option 1 - Clear openings into structure are reduced - Greater number of foundations

Given the above assessment, Option B would appear to be the most appropriate superstructure option for the proposed unit.

For the purpose of this report, both Options A and B have been reviewed in order to determine member size. For increased economy, plan and vertical bracing is specified in combination with the portalised frames to achieve global structural stability.

3.3.2 Hot Rolled Steel Frame for Portal Frames at 13.585m Centres

NOTE: DESIGN SHOWN IS CONCEPTUAL AND SUBJECT TO CHANGE THROUGH RIBA DESIGN STAGES & RECEIPT OF MORE COMPREHENSIVE ARCHITECTURAL PLANS

The hot-rolled steel frame superstructure will comprise the following key components:

- Columns: rising from foundation level to eaves/roof, transferring vertical and horizontal loads from the roof and walls to the foundations.
- Beams: at column mid-span and roof level, transferring vertical and horizontal loads from the roof and walls to columns and bracing.
- Portal Frame: Portal frame action facilitating long spans and providing stability in the short direction of the building.
- Vertical Bracing: between portal frame columns in selected positions rising from Ground Floor level to roof, transferring horizontal loads from the frame to foundation level.
- Plan Bracing: within the roof structure in selected positions, transferring horizontal loads to the vertical bracing, providing stability in the long direction of the building.
- Secondary Steelwork: to support intermediate rafters and cold-rolled members for cladding fixings.

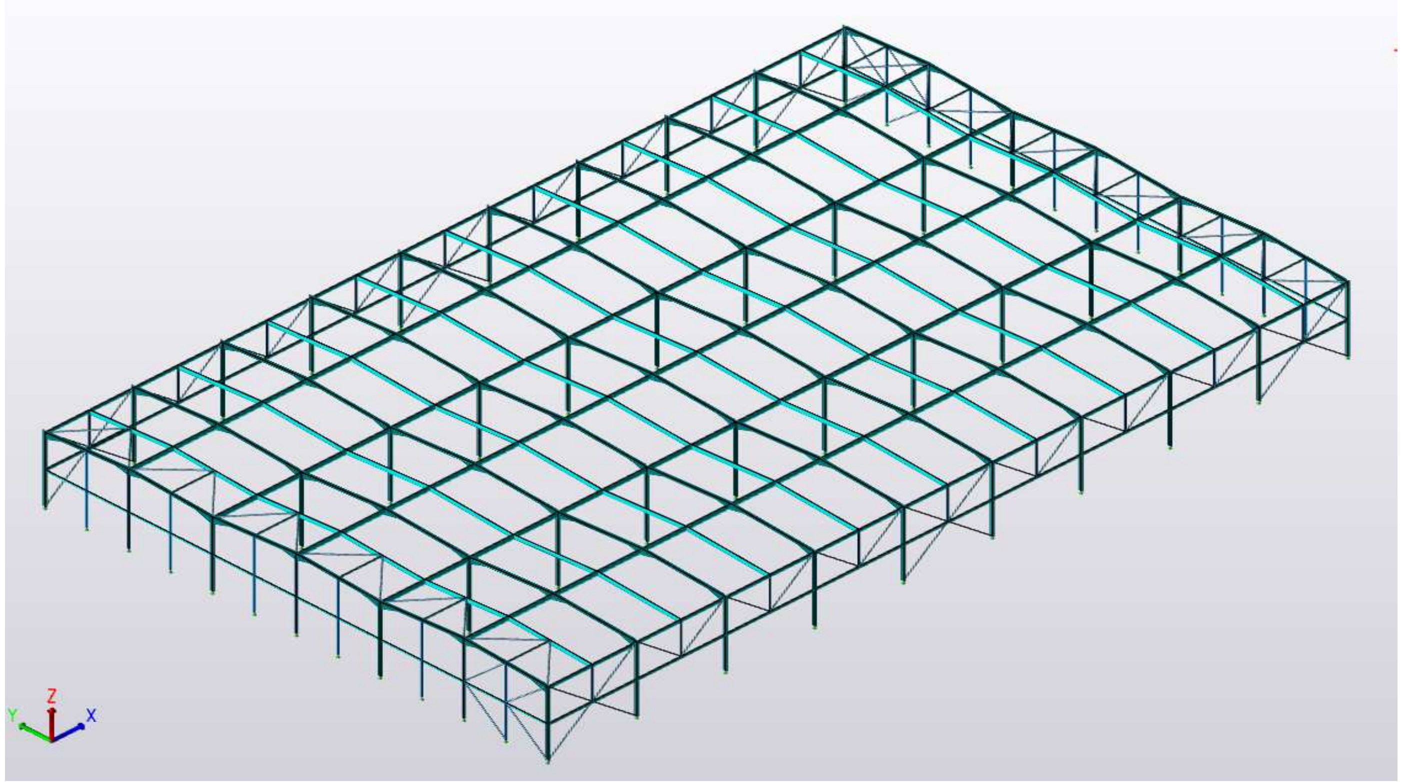

Figure 3: Apex view of Conceptual Tekla Model (Portal frames at 13.585m Centres)

3.3.2.1 Typical Section Sizes

Section Name	Typical Section Size
Portal Column	UB 533 x 210 x 122
Portal Rafter	UB 533 x 210 x 101
Ridge Beam	UB 610 x 305 x 109
Valley Beam	UB 686 x 254 x 125
Eaves Beam	UB 457 x 191 x 74
Roof Secondary Rafters	UB 610 x 229 x 101
Wall Posts	UC 203 x 203 x 60
Roof Bracing	CHS 193.7 x 10
Vertical 'X' Bracing	15 x 150 Flats
Gable End 'V' Bracing	CHS 193.7 x 10
Vertical 'V' Bracing	CHS 168.3 x 10
Perimeter Beams (at column midspan)	RHS 300 x 250 x 10

3.3.2.2 Typical Section

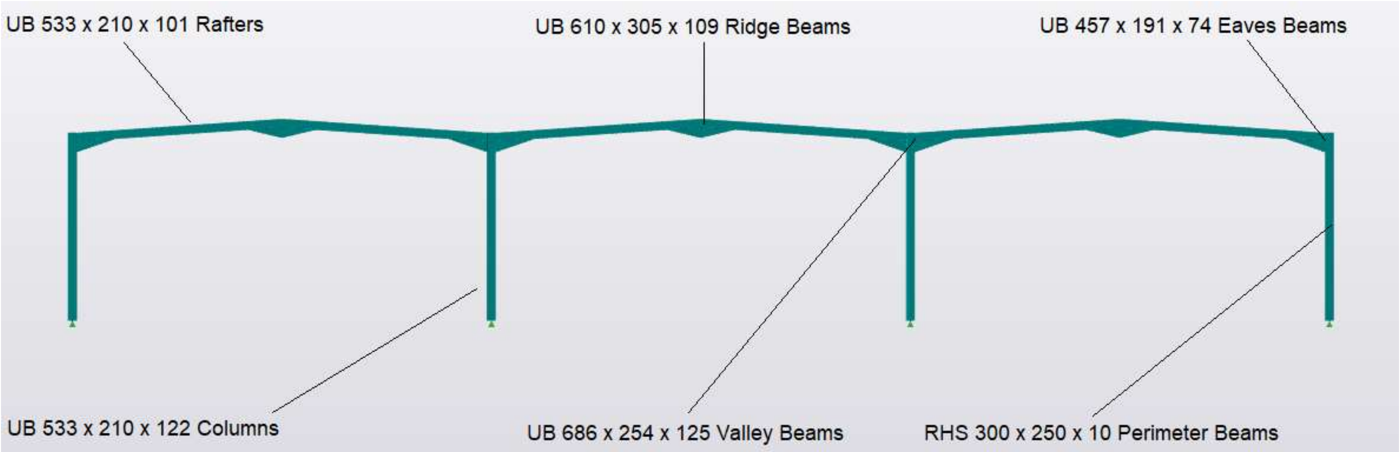

Figure 4: Typical Section Through Unit (Portal Frames at 13.585m Centres)

3.3.2.3 Bracing Plan

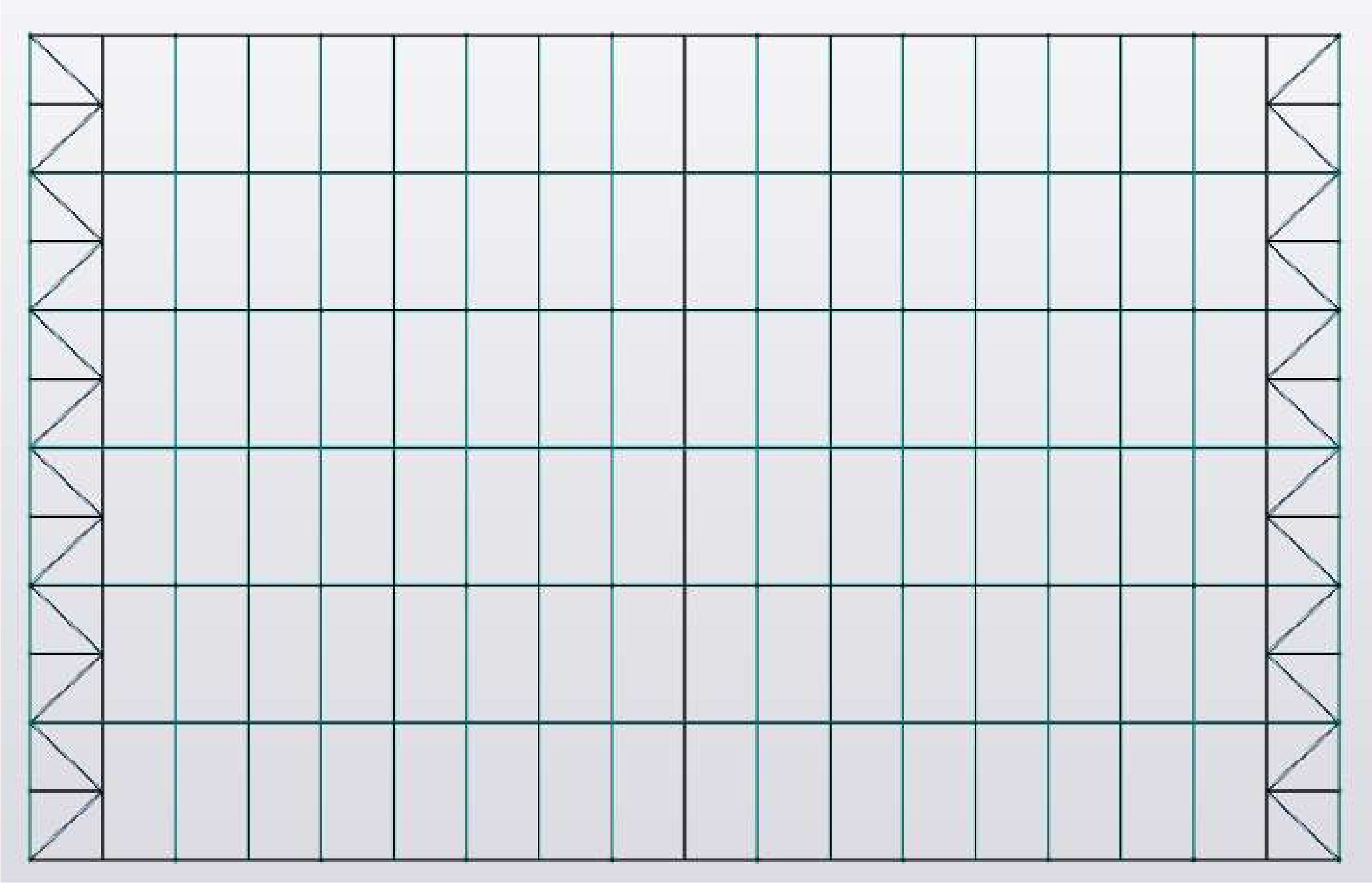

Figure 5: Typical Plan View of Roof Bracing (Portal Frames at 13.585m Centres)

3.3.2.4 Conceptual Model Loading

To produce the preliminary superstructure model, the following values have been used. These will need to be developed into later design stages.

Zone	Permanent Actions		Imposed Actions	
Roof	Roof System	0.60 kN/m^2	Roof Imposed	0.6 kN/m^2
	PV	0.15 kN/m^2	Snow	0.3 kN/m^2
	Services	0.25 kN/m^2	Snow (Drift)	1.2 kN/m^2
			Wind (max)	0.8 kN/m^2
External Walls	Built up Metal Framing System (TBC)	0.75kN/m^2	Wind (max)	0.8 kN/m^2

Location data for snow/wind loads	
Site altitude above sea level	50m
Zone number	3
Basic wind speed velocity	22.7m/s
Terrain category	Country

3.3.2.5 Superstructure Tonnages

Superstructure Tonnage	Mass (T)
Total	400
Total (+20% allowance for connections and secondaries)	480

Zone	Area (m^2)
Ground Floor	9385
Total	9385

Using approximate floor areas from preliminary plans, the superstructure tonnage rate is 45kg/m^2. When including the additional 20% for connections and secondaries, this rate increases to approximately 51kg/m^2.

3.3.3 Hot Rolled Steel Frame for 6.793m Bay Centres

NOTE: DESIGN SHOWN IS CONCEPTUAL AND SUBJECT TO CHANGE THROUGH RIBA DESIGN STAGES & RECEIPT OF MORE COMPREHENSIVE ARCHITECTURAL PLANS

The hot-rolled steel frame superstructure will comprise the same following key components as the Portal Frame at 13.585m bay centres (page 2).

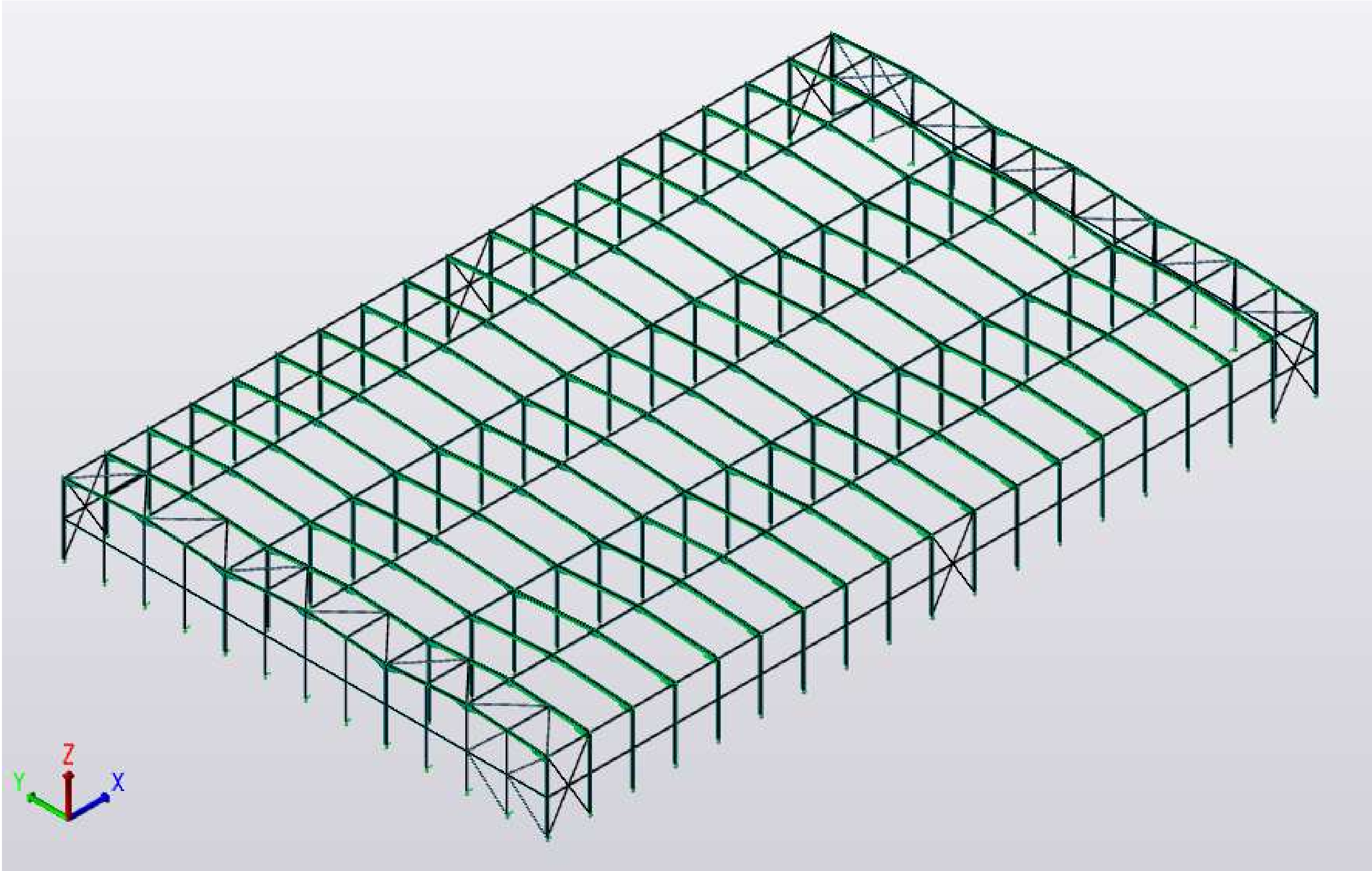

Figure 6: Apex View of Conceptual Tekla Model (Portal Frames at 6.793m Centres)

3.3.3.1 Typical Section Sizes

Section Name	Typical Section Size
Portal Column	UB 533 x 210 x 92
Portal Rafter	UB 457 x 191 x 89
Ridge Beam	UB 254 x 146 x 31
Valley Beam	UB 254 x 146 x 31
Eaves Beam	RHS 200 x 100 x 10
Roof Bracing	CHS 193.7 x 10
Vertical 'X' Bracing	15 x 150 Flats
Gable End 'V' Bracing	CHS 193.7 x 10
Perimeter Beams (at column midspan)	RHS 200 x 100 x 10

3.3.3.2 Typical Section

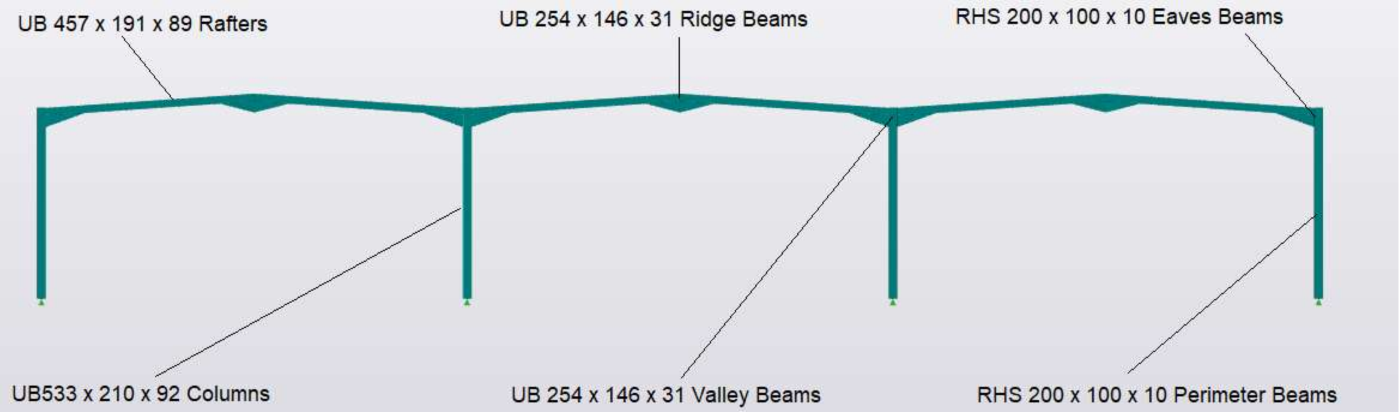

Figure 7: Typical Section Through Unit (Portal Frames at 6.793m Centres)

3.3.3.3 Bracing Plan

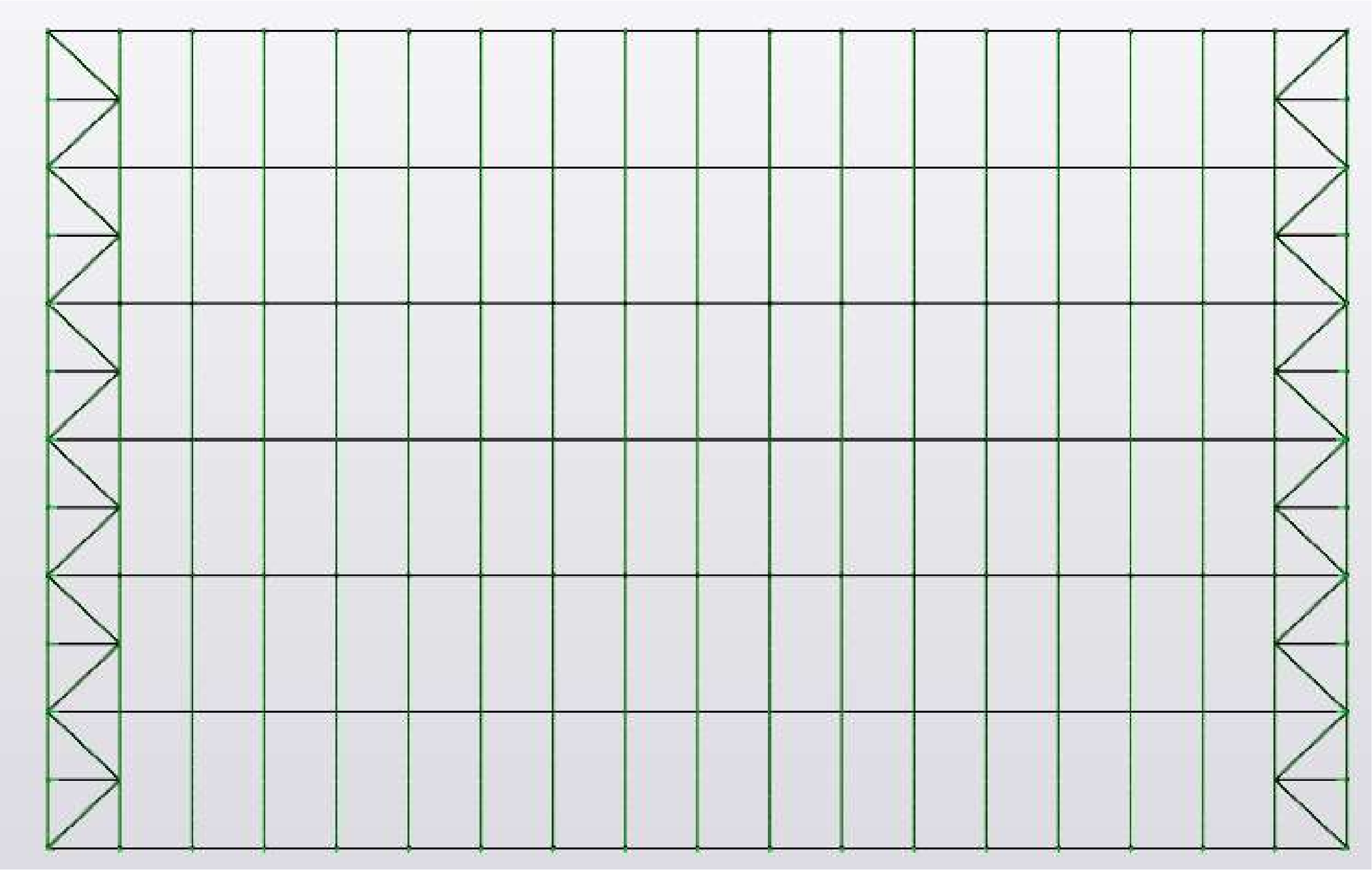

Figure 8: Typical Plan View of Roof Bracing (Portal Frames at 6.793m Centres)

3.3.3.4 Superstructure Tonnages

Superstructure Tonnage	Mass (T)
Total	315
Total (+20% allowance for connections and secondaries)	380

Zone	Area (m2)
Ground Floor	9385
Total	9385

Using approximate floor areas from preliminary plans, the superstructure tonnage rate is 35kg/m². When including the additional 20% for connections and secondaries, this rate increases to approximately 42kg/m²

3.3.4 Roof Support Structure

Given the selection of a hot-rolled steel frame, the roof structure is likely to comprise a cold formed roof support system. Two cold-formed options are readily available for the roof support structure:

Table 2 - Roof Support Structure Options

Option	Details	Pros	Cons
A - Purlins and thin deck	Cold-formed steel Z or C section purlins spanning between rafters, supporting a thin roof deck. Typical arrangement - Maximum spans - 7000mm 202Z18 purlins at 1000crs	- Standard construction - Easily allows for secondary support of plant, ceilings - Readily available - Simple installation - Smaller roof penetrations can be trimmed as part of system - Long spanning	- Relatively thick build-up - Can lead to awkward detailing for fire compartments over beams - Less attractive if left exposed
B - Deep roof deck	Deep roof deck spanning between roof beams. Typical arrangement Maximum spans - 7000mm (160mm trapezoidal deck)	- Can be utilised as diaphragm, potentially removing requirement for plan bracing - Relatively thin build-up - Easier detailing for fire compartments over beams - More attractive if left exposed	- Larger components and difficult installation - All penetrations require trimming - Less common - More difficult to install secondary support for plan and ceilings - Constrained span capabilities - increased costs

Both options above could be explored further in RIBA Stage 3, however, it would be expected that Option A - purlins - would be taken forward into the next stage.

3.3.5 Wall Support Structure

The following table gives potential options for the external walls, whilst the final build-up is to be confirmed by the Architect.

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Table 3: Wall support structure options

Option	Details	Pros	Cons
A - Cladding Rails /Side Rails with composite panels (applicable to 6.793m span between portal frame columns)	Cold formed Z or C section side rails spanning between primary hot rolled columns (left to right) 202mm thick C section at 1.5m centres	- Wind resisted in short direction between columns - Offsite manufacture - Quick and standard installation - Medium spanning solution	- Secondary steel may be required to trim out windows/ glazed panels/ doors. - Increased thickness of wall build up. - Relies on cladding for thermal mass.
B - SFS with composite panels/masonry	Cold-formed steel C-section studs. Typical arrangement - Plasterboard lining / 210mm SFS + insulation / cementitious board Spanning up down. Outer leaf can be either a self-supporting masonry panel, or a composite cladding system.	- Offsite manufacture - Standard construction - Openings easily formed - Quick installation	- Requires addition hot rolled steel to form secondary steelwork around openings.
C - Hot rolled steel rails (applicable to 13.585m span between portal frame columns)	Hot rolled RHS or UB steel members spanning between primary hot rolled columns (left to right)	- Wind resisted in short direction between columns -Offsite manufacture -Quick and standard installation -Long spanning solution	- Increased thickness of wall build up - Relies on cladding for thermal mass

Given the above assessment, Option A would appear to be the most appropriate solution for portal frames at the reduced 6.793m centres, due to the transfer of wind loads directly to columns, as well as being the most standard installation.

For portalised frames at larger 13.585m centres, Option C would appear the most appropriate solution, due to the requirement of larger steel members as a result of the significantly larger span between columns.

3.4 Substructure Concept

3.4.1 Ground Conditions

A Ground Investigation and Report has been carried out and produced for the site at Cwmbran by Hydrock. The report considers the existing ground conditions and provides Geotechnical information with regards to plausible substructure solutions.

The site was previously used by Crane Process Flow Technologies to the north, however all industrial buildings previously existing at the site have been demolished.

Ground and ground water conditions encountered by the investigation are as per the following report extract:

Table 4 - Ground conditions encountered by investigation (Extract from Hydrock Phase 2 Ground Investigation Report)

Strata	Range of Depths (mbgl)
Made Ground - Gravel, sand, silt and clay with varying quantities of brick, glass, concrete, slag, ash, sandstone, limestone and metal fragments.	0.00 - 2.70
Cohesive Alluvium - Firm, locally soft, reddish brown sandy slightly gravelly SILT.	1.50 - 2.50
Granular Alluvium - Dense locally very dense sandy GRAVEL with some cobbles and occasional lenses of sand.	5.00 - 6.40
The Raglan Mudstone Formation - Stiff reddish-brown clay.	≥ 7.00

According to the Ground Investigation report, borehole investigations encountered groundwater at relatively shallow depths within the made ground, and also within the Granular Alluvium, although the depths were not consistent across site. Excavations in general were stable, until reaching the Granular Alluvium at 2.3-2.6m bgl, where significant groundwater ingress led to pit instability.

Due groundwater being encountered at shallow depths, we would likely rule out any shallow foundation solution.

3.4.2 Suitable Bearing Strata and Foundation Options

Initial analysis into portal frame column axial force, and base of column horizontal shear loads (ULS) are shown below:

Portal Frame Type	Limit State	Maximum External Column Axial Load	Maximum Internal Column Axial Load	Maximum External Column Base Horizontal Shear Load	Maximum Internal Column Base Horizontal Shear Load
13.585m Bay Centres	ULS SLS (Dead) SLS (Live)	475kN 160kN 150kN	950kN 340kN 390kN	110kN	20kN
6.793m Bay Centres	ULS SLS (Dead) SLS (Live)	290kN 90kN 80kN	460kN 180kN 120kN	85kN	45kN

Anticipated floor loads are shown below:

Floor Construction - Concrete Slab	
	Unit Load
Dead	
250mm thick concrete slab	6.0kN/m^2
75mm screed + additional finishes	3.0kN/m^2
Total	9.0kN/m^2
Live	
Variable Partitions	1.0kN/m^2
General Industrial	50 kN/m^2

Initial conclusions within the Ground Investigation report suggest a raft founded within the Cohesive Alluvium, or piles taken into the underlying Granular Alluvium or Raglan Mudstone Formation. Indeed, the report concludes that:

'If a raft is to be utilised, all Made Ground under the foundation will need to be removed and recompacted with engineered fill to an appropriate specification.'

'If piles are to be utilised, a replacement piling method such as CFA would be most appropriate as this will limit the creation of contaminant pathways.'

Below, is a table highlighting the pros and cons of viable foundation and floor options:

Foundation	Details	Pros	Cons
Raft	Reinforced concrete slab, constructed on a compacted hardcore base and engineered fill (as determined by the geotechnical specialists) covering the footprint of the building, with areas of greater thickness at the perimeter of the building.	- Can be provided where shallow foundations are necessary but soil conditions are poor. -Resists differential settlement. - Require reduced earth excavation. -Distribute loads over large area. - Fast and inexpensive to construct since they do not require deep excavations compared to strip or pad foundations.	- Prone to edge erosion. - Less effective where structural loads are focussed in concentrated areas. - Complex reinforcement detailing at column bases and edges.
Cast In-Situ Concrete Piles (CFA)	Reinforced concrete piles and pile cap supporting portal frame columns at a regular grid interval, transferring loads to layers of soil or rock that have sufficient bearing capacity and suitable settlement characteristics.	- Piles possessing any size or length may be used for the construction at site. - Can be used for high structural loads in poor ground conditions, bypassing poor ground and transferring loads to underlying stiff soil/bedrock. -Length can be varied to suit varying ground conditions. -Durability is independent of ground water level. -Material required for manufacture is easily obtainable. -Concrete piles can be monolithically bonded into pile cap.	- Quality control is difficult, and requires careful supervision. - Specialist equipment and storage space required.

Due to the variance in depth and instability of the made ground throughout site, which is also of poor quality, raft foundations are at first glance a viable option. However due to the high structural loads focussed at portal frame column bases, as well as relatively shallow ground water level, it is suggested that piled foundations are a more viable option.

Floor type	Details	Pros	Cons
Cast In-Situ Reinforced Concrete Suspended Slab (approximately 250-300mm thick)	Reinforced concrete slab - either with straight bars or mesh, suspended above the ground.	- Surface of slab can be used as a finished surface with no additional requirements. - Monolithic architectural character. - Time proven - Flexibility in construction, varying shapes and lengths can be developed - No heavy lifting involved (no cranes) - Increased resistance to accidental actions & wind forces - Two-way structural systems -Increased access for services beneath slab - Reduced probability of moisture damage	- Skilled labour required - Weather dependant - Construction jointing - On-site concrete testing and potential variance in quality. - More susceptible to bending/cracking under high imposed loads. - Increased foundation loads
Ground Bearing Slab (approximately 250mm thick)	Reinforced concrete slab - either with straight bars or mesh, bearing directly onto ground.	- Reduced foundation loads - Surface of slab can be used as a finished surface with no additional requirements. Monolithic architectural character. - Time proven - Flexibility in construction, varying shapes and lengths can be developed - No heavy lifting involved (no cranes) - Increased resistance to accidental actions & wind forces - Two-way structural systems	- Reduced access for services beneath slab (slab removal usually required to repair utilities) - Increased probability of moisture damage - Skilled labour required - weather dependant - Construction jointing - On site concrete testing and potential variance in quality - Ground Improvement and removal of a significant volume of ground

Due to the early indication of underlying granular alluvium across the site and high risk of groundwater inflows associated with ground improvement across the footprint of the development, it is understood that a cast in-situ suspended 'flat' slab is more suitable. A suitable pile grid will need to be determined at RIBA stage 3; governed by required reinforcement rates, concrete thicknesses and pile capacities. If a suspended flat slab solution is adopted it will be necessary to include a cap or thickening above each pile to resist the high shear loads anticipated from the required loading conditions. Additional ground investigation within the footprint of the proposed structure may be required to enable detailed geotechnical design when the building loadings are finalised.

3.4.1 Codes and standards

The structural analysis and design of the building will be carried out using traditional hand calculations and the use of Tekla Structural Designer computer software.

The design will be conducted using the following codes and standards:

BS EN 1990	Basis of Structural Design
BS EN 1991-1-1	General Actions – Densities, Self-Weight, Imposed Loads for Buildings
BS EN 1991-1-3	General Actions – Snow Loads

BS EN 1991-1-4	General Actions – Wind Actions
BS EN 1991-1-7	General Actions – Accidental Actions
BS EN 1992-1	Design of Concrete Structures
BS EN 1993-1	Design of Steel Structures
BS EN 1996-1	Design of Masonry Structures (if applicable)

3.4.2 Design Actions

Actions will need to be confirmed during stage 3 design, but would typically include:

Table 5 - Design elements to be considered in Stage 3

Category	Items to be Considered
Permanent	- Hot-rolled steel frame - Roof and wall structure - Roof and wall finishes (internally and externally) - Glazing elements - Soffits to roof overhangs - PV arrays, wind catchers, smoke vents and other roof items - Folding internal partitions, fire curtains and roller shutters - Internal and external wall build ups - Building services - Mezzanine build-up (namely floor construction) and interaction with main frame
Imposed	- Roof access for normal maintenance - Roof access for PV arrays (if applicable)
Accidental	- Notional horizontal forces
Wind	- Wind actions in four principal orthogonal directions on main building - Wind actions on parapets and canopies
Snow	- Snow actions generally - Snow drifting due to multi-bay portal frames creating 'valleys'

3.4.3 Deflections

The following basic deflection limits are suggested for the design of the hot-rolled steel frame in RIBA Stage 3:

Table 6 - Suggested basic deflection limits

Direction	Type	Members	Suggested Limit - Relative	Suggested Limit - Absolute	Comments
Vertical	Permanent Actions	Beams, bracing	Span / 500		
	Imposed Actions	Beams, bracing	Span / 360 for simply supported Span / 180 for cantilevers Span / 200 for portal frames	68mm - Imposed load on Portal frame	
Horizontal	Wind Actions	Frame sway	Height / 300		Composite panels (Height / 500 for brittle cladding)

3.4.4 Disproportionate Collapse

Under Building Regulations Approved Document A, the proposed Factory/Office is Class 2A.

2a Lower Risk Group	5 storey single occupancy houses Hotels not exceeding 4 storeys Flats, apartments and other residential buildings not exceeding 4 storeys Offices not exceeding 4 storeys Industrial buildings not exceeding 3 storeys Retailing premises not exceeding 3 storeys of less than 2000m² floor area in each storey Single-storey educational buildings All buildings not exceeding 2 storeys to which members of the public are admitted and which contain floor areas not exceeding 2000m² at each storey

Figure 9: Extract from Table 11 of Building Regulations Approved Document A

This class of building will require effective horizontal ties between columns internally and to the perimeter, with said ties and their connections being able to resist a minimum axial force of 75kN.

3.4.5 Global stability

The global stability of the proposed superstructure will be achieved via the following systems:

- Vertical and horizontal support from foundations.
- Portal frames will provide stability in the short direction.
- Horizontal brazing in the roof structure will provide stability in the long direction, transferring horizontal forces at eaves level into the vertical bracing bays.
- Vertical bracing between portal frame columns will transfer horizontal forces to the foundations, providing stability in the long direction. Vertical bracing is to be arranged in bays, with at least two vertical bays in each orthogonal direction.

3.4.6 Building Movement

Building movement due to loading/ thermal expansion & imperfections will be assessed at later stage. Movement joints will be determined based on anticipated movements and fragility to deflection at different points in the building. (Glazing requirements, proposed finishes etc).

It is unlikely that any movement joints will be required to the structural frame. Guidance in SCI Publication P252 suggests an expansion joint is required in buildings that exceed 150m in length.

3.4.7 Thermal Considerations

The thermal performance of these elements should be assessed in RIBA Stage 3, with potential consideration of thermal breaks as required. Ideally, any thermal breaks should be placed within the thermal line of the building to limit the risk of condensation, and to maximise the efficiency of the envelope. Thermal breaking for superstructure and concrete works will be specified in accordance with Eurocodes:

- BS EN 1991-1-5 Thermal Actions
- BS EN 1993-1 Design of Steel Structures

3.4.8 Long-Term Corrosion Protection

The corrosion protection required to the main structural elements should be considered in RIBA Stage 3, if they exist in an external exposed environment in the permanent state. Typical corrosion protection arrangements for hot-rolled steel frame elements are:

- Painting
- Hot-dipped galvanising
- Cladding

Any treatments such as the above should be of a specification and installation suitable for the environment class and building design life or life to first maintenance criteria. Hot-rolled steel frame elements that exist below ground level, e.g. columns, should be suitably protected, normally through the use of a bituminous paint encasement in concrete. Hot-rolled steel frame elements that exist within cavities of walls, e.g. bracing, should be suitably protected through painting.

3.4.9 Temporary Corrosion Protection

Due consideration should be given at the subsequent design stages to the specification of the shop primer applied to hot-rolled steelwork relative to the length of time said steelwork will be left exposed to the elements on site.

Due consideration should be given at the subsequent design stages to the specification of the bolt finishes to hot-rolled steelwork relative to the length of time said bolts will be left exposed to the elements on site.

3.4.10 Fire Protection

It is likely that the main portal frame can be unprotected, with only the mezzanine levels and the portals over the mezzanine section requiring intumescent paint coating.

4. LATER DESIGN STAGES

4.1.1 Items for Consideration

- Full coordination with Architect and all other design disciplines
- Develop superstructure design in line with developed scheme. Agree option A or B portal frame.
- Agree design loadings
- Structural tonnages
- Structural specification
- Agree Architectural & Structural wall, floor & roof build-ups
- Ground Floor slab considerations
- Phase 2 Geotechnical Interpretive Report
- Foundation sizing

4.1.2 Information Required at Later Design Stages

- Proposed site levels
- Detail secondary steel arrangements