University of Wales Trinity Saint David

Swansea SA1 Campus - Phase I

RIBA Stage 3 Civil & Structural Engineering

2016/9443

UWTSD-ARP-00-XX-RP-S-001

Issue1 | 3 March 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

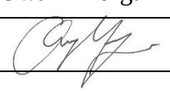
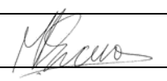
Job number 246523-00

Ove Arup & Partners Ltd
4 Pierhead Street
Capital Waterside
Cardiff CF10 4QP
United Kingdom
www.arup.com

ARUP

Document Verification

ARUP

Job title		Swansea SA1 Campus - Phase I			**Job number** 246523-00
Document title		RIBA Stage 3 Civil & Structural Engineering			**File reference** 2016/9443
Document ref		UWTSD-ARP-00-XX-RP-S-001			
Revision	**Date**	**Filename**	DRAFT Stage 3 C&S Report.docx		
Draft 1	24 Feb 2016	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Owain Morgan/John Smith/Jamie Lancaster	Matthew Evans/John Smith	Matthew Evans
		Signature			
Draft1 Issue	29 Feb 2016	**Filename**	UWTSD-ARP-00-XX-RP-S-001.docx		
		Description	Draft 1 Issue for RIBA Stage 3		
			Prepared by	Checked by	Approved by
		Name	Owain Morgan/John Smith/Jamie Lancaster	Matthew Evans/John Smith	Matthew Evans
		Signature			
Issue1	3 Mar 2016	**Filename**	UWTSD-ARP-00-XX-RP-S-001 (ISSUE1).docx		
		Description	Final Issue for RIBA Stage 3		
			Prepared by	Checked by	Approved by
		Name	Owain Morgan	Matthew Evans	Matthew Evans
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	X

Contents

		Page
1	**Introduction**	**1**
1.1	Objective	1
1.2	The Project	1
1.3	The Buildings	1
1.4	Design Development and Value Engineering	2
2	**The Site**	**3**
2.1	Site History	3
2.2	Ground and Groundwater Conditions	3
2.3	Foundations	4
2.4	Key Constraints & Risks	4
3	**Sustainability**	**5**
4	**Civil Engineering**	**5**
4.1	Flood Risk	5
4.2	Drainage	5
4.3	External Works	6
5	**Structural Engineering – Basis of Design**	**7**
5.1	Structural Design Philosophy	7
5.2	Design Codes and Guidance	7
5.3	Design Loadings – Vertical Loads	8
5.4	Design Loading – Lateral Loads	9
5.5	Robustness	9
5.6	Movements and Tolerances	9
5.7	Building Design Life and Durability	10
5.8	Materials	10
6	**Structural Engineering Proposal – FACE Building**	**12**
6.1	Foundations	12
6.2	Substructure	12
6.3	Stability System	13
6.4	Superstructure	13
6.5	Roof Level	14
7	**Structural Engineering Proposal – TECH Building**	**16**
7.1	Foundations	16
7.2	Substructure	16
7.3	Stability System	17
7.4	Superstructure	17
8	**Structural Engineering Proposal - LIBRARY**	**19**
8.1	Foundations	19
8.2	Substructure	19
8.3	Stability System	19
8.4	Superstructure	19
8.5	Roof Structure	20
9	**Specification**	**21**
9.1	Geotechnical Engineering	21
9.2	Civil Engineering	21
9.3	Structural Engineering	21
10	**Structural Items by Others**	**21**
11	**Construction Sequence Commentary**	**22**
11.1	FACE Building	22
11.2	TECH Building	22
11.3	Library	22
12	**CDM Issues**	**22**
12.1	Critical Issues during Construction	22
12.2	Future Demolition	22
13	**Outstanding Design Issues and Costing Notes**	**23**
13.1	Outstanding Design Issues	23
13.2	Costing Notes	24

Appendices

Appendix A

Architectural Drawings

Appendix B

Civil Drawings

Appendix C

Technical Note:
Structural Philosophy

Appendix D

Design Loading Allowance

Appendix E

Structural Drawings

Appendix F

Specifications

Appendix G

Hazard Risk Register

1 Introduction

1.1 Objective

This report presents the Civil and Structural proposals which have been developed at the end of RIBA Stage 3 for the Phase 1 of a new campus at SA1 Swansea Waterfront development for the University of Wales Trinity Saint David (UWTSD). The report also includes the technical design criteria which have informed these proposals. It is a development of the RIBA Stage 2 design options and takes account of feedback from the client and the design team.

1.2 The Project

SA1 Swansea Waterfront is the marketing name given to the brownfield development area located in western part of Swansea Docks. The area is located directly to the southeast of Swansea city centre. It is bordered by Fabian Way to the north and covers the Prince of Wales Dock area.

The Phase 1 of the campus development includes a new building for the Faculty of Architecture Computing and Engineering (FACE), the new library facility and the associated external works and landscaping to the Phase 1 area.

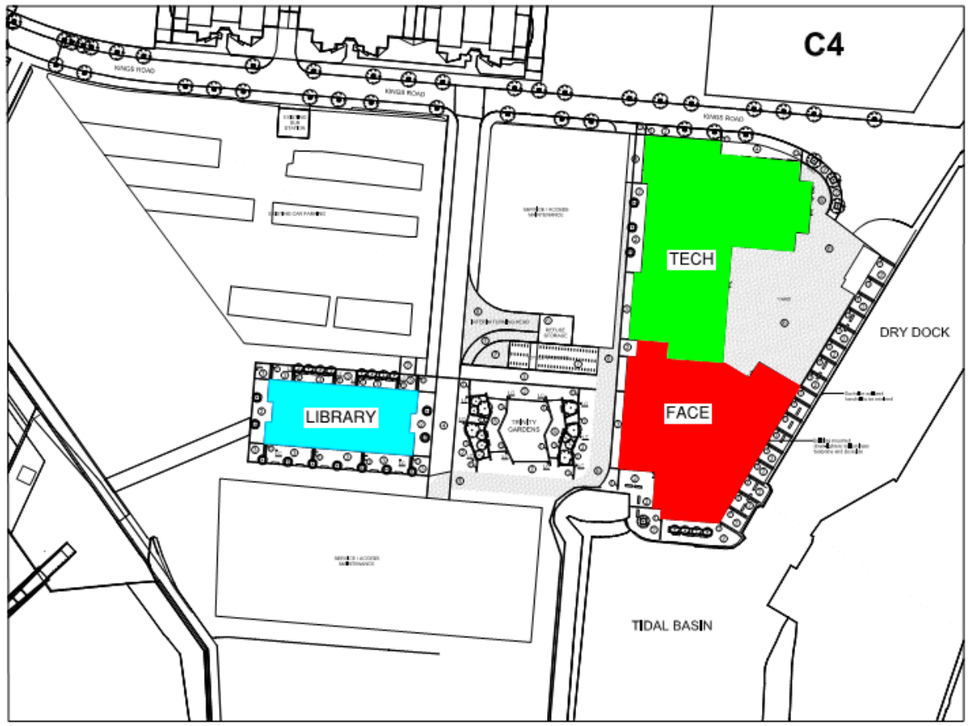


Fig 1 – Key plan showing the three buildings discussed in this report

1.3 The Buildings

1.3.1 Faculty of Architecture, Computing and Engineering (FACE)

The FACE building will include all the technical spaces required by the Faculty including workshops, laboratories and architectural studios. It will also include all the general learning spaces required to support the Faculty's academic programme including seminar and classrooms, learning studios and informal learning spaces and work space for the academic and administrative staff in the Faculty.

The FACE project is not however a standalone facility and strong connectivity between both the technical spaces and the flexible learning and work spaces with the subsequent phases of development will be essential.

The architectural development of the form of the FACE building creates a natural split between the two distinct areas of learning. There is a more traditional area for seminar, studio and class based learning and a technical area that includes laboratories and engineering technical workshops.

A structural movement joint is incorporated between the single storey technical space and the adjacent 4 storey traditional learning spaces to aid the acoustic (including vibration borne noise) separation.

Clear drivers in this Faculty are acoustic separation while maintaining appropriate staff/ student linkage between the distinct areas. In addition to the acoustic drivers, there is a desire to achieve a low energy building with natural ventilation and exposed thermal mass.

For the purpose of this report the FACE building will be spilt and referenced as two buildings, **FACE** and **TECH**.

FACE Building

The traditional learning area is a 4 storey building with a central atrium space. The building has been designed to respond to the surrounding streets and dockside, and so create a strong sense of place, as the first phase of the SA1 Waterfront Innovation Quarter. The large teaching spaces are located on the ground floor with various size learning studios, laboratories and work areas on the upper floors. The top level provides a large flexible space to accommodate the faculty facilities such as offices and meeting spaces.

The roof is a flat roof for PV solar panels. A number of "pop-ups" are provided to allow light into the top floor and provide natural ventilation into the spaces. The atrium roof consists of 3 glass boxes which provide natural light to the central atrium space. There is also a central plant area on the roof for the ventilation air handling units. The main stair core extends up to roof level to provide the main access to the roof.

TECH Building

The TECH building has largely a single-storey ‘engineered industrial’ character with metal cladding above a base of brickwork. The elevations comprise large glazed openings/doors which are protected by sliding security shutters.

The north-west corner has an increased height to provide some emphasis onto the main spine route King’s Road and provides space for the building plant room. The flat roof of TECH has angled ‘pop-ups’ which accommodate skylights, ventilation units and solar panels.

A number of the workshop spaces require significant areas free from columns and require extended headroom’s of a minimum 4.5m to accommodate equipment and create the right environment. This area accommodates large equipment’s such as CNC and Dyno Cell testing machines.

1.3.2 Library

The Library will provide physical and digital resources and services to actively support learning, teaching and research for the university and the wider community.

The concept of the Library is as a ‘converted/modernised engineering shed’. It has the ‘skeletal vestiges’ of a brick framework, which is lined out with a skin of glass and metal cladding panels.

The ground floor of the building is ‘cut out’ in all bays in order to create the maximum sense of openness and transparency. The entrances at either end are revolving doors for maximum wind protection. The main entrance area at the west end is a double-height space.

The metal roof has solar panels covering the south side with louvre panels serving the ventilation plant room. The deep overhangs of the roof help to protect glazing both from inclement weather and solar gain.

1.4 Design Development and Value Engineering

The RIBA Stage 3 structural design discussed in this report and included on the drawings is based on the Architectural layouts P2 issue (12/2/16)

Towards the end of the RIBA Stage 3 design process further coordination and updated layouts were developed by the Architect. These have not been fully captured in this report and will need to be developed further in the next stage of design.

The P2 Architectural layouts are included in Appendix A for reference.

The design development period for RIBA Stage 3 has involved several iterations of the buildings layouts. The P2 layouts that are used in this report incorporates the outcome of feedback from different parties such as the Design Commission for Wales and a value engineering process.

The key value engineering decisions which have influenced the structural solutions included in this report are noted below.

1.4.1 FACE Building

- Internal columns on the ground floor space of the east side of the building are positioned to minimise the long span secondary beams, while the ground floor space on the west side for the 90 person learning area is maintained as a column free area.
- The main roof level of the building to be flat. The structural solution to be similar to the levels below to maintain the exposed concrete soffit in the internal areas.
- Precast concrete planks to be maintained as opposed to introducing metal deck floor construction.
- Parapet level reduced.

1.4.2 TECH Building

- Additional columns introduced in wall lines to reduce beam spans and the structural depth.

1.4.3 Library

- Library size reduced to a 3 storey building to allow the whole building to be delivered as part of the phase 1 construction.

2 The Site

Integral Geotechnique (Wales) Limited (IGWL) were commissioned by UWTSD in early 2014 to complete a desk study and ground investigation for UWTSD to various areas of the wider SA1 development area. This resulted in the following ground investigations reports being completed.

1. Swansea SA1 Plots: E6/7/8 and Leisure Quarter Desk Study Report 11292/CF/14 dated April 2014
2. Swansea SA1 Plots A11B, A15/A16, C4, E9/part F Site Investigation Report 11292/PB/14 dated May 2014
3. Swansea Waterfront Site Investigation, Factual Ground Investigation Report Plots A15 and A16 report No. X081174 undertaken by Quantum Geotechnical prepared for White Young Green Ltd under the instruction of Welsh Government dated May 2008 (Appendix A of 11292/BP/14 referred above).

These reports have been reviewed to give an understanding of works completed to date and to evaluate the need for any further ground investigations works required to inform the proposed Phase 1 design.

The desk study report (ref 1 above) covers the area of the Phase 1 development and provides extensive background information about the site history and its environmental setting. It considers the anticipated ground conditions and provides recommendations for further detailed intrusive investigations to facilitate the detailed technical appraisal and inform the engineering design.

The Site Investigation Report (ref 2 above) typically covers sites outside the leisure quarter and not related to the Phase 1 works although a number of trial pits (5No.) and boreholes (2No.) have been undertaken on plot C4 which lies immediately to the north of the proposed FACE building, *(Refer to Fig 2 below).*

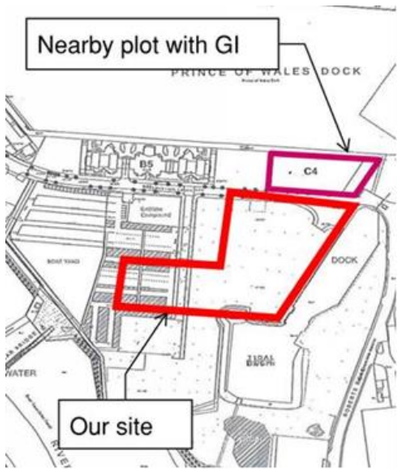


Fig 2 – Location of adjacent ground investigation works

This information has been used to inform initial foundation strategies, however due to the historical use of the site and its location, it is currently considered insufficient to develop the final foundation designs to the Phase 1 buildings.

A scope of works for more detailed plot specific intrusive investigations was developed during RIBA Stage 2 and issued under separate cover. A geotechnical and geo-environmental investigation based on the scope of works issued by Arup and Arcadis was tendered by the preferred contractor during the RIBA Stage 3 process. Due to the protracted nature of the tender process the output of the ground investigations have not been made available in sufficient time to incorporate in this RIBA Stage 3 report. Therefore it is incumbent on the RIBA Stage 4 designer to incorporate the findings of the investigation into the next stage of design.

For completeness, the following sections provide a brief overview/summary of the current information, for greater details the reader should refer to the reports noted above and the site specific investigation recently completed.

2.1 Site History

The site history is characterised by former dock lands and various industrial uses.

The area was undeveloped circa 1879 and is shown to be part of the Fabian Bay, a tidal area at the mouth of the River Tawe. By 1899 the Prince of Wales Dock had been constructed with a variety of industrial buildings and railway sidings.

Of most interest is a north-south trending lock connecting the Prince of Wales Dock to a Tidal Basin further south.

The former industrial uses are recorded as a Tin Plate Works, numerous railway sidings, goods sheds and later warehousing.

By 1919 a new dry dock was incorporated, and by the 1950's, the original Tidal Basin lock appears to have been filled.

The area was generally cleared of its industrial heritage by the early 1990's and it is understood that this did not include the formal removal of buried structures as part of any site clearance works.

2.2 Ground and Groundwater Conditions

Although no ground investigation has been undertaken for the specific plots associated with the FACE, TECH and Library buildings, the anticipated ground conditions, based on the site history and nearby ground investigation data, are anticipated to comprise of the following:

- Made ground to circa 3m depth
- Marine deposits to circa 8m depth comprising very soft to soft clay and loose sand
- Alluvial deposits to >8m comprising firm to stiff clay and medium dense to very dense sand and gravels

Coal Authority reports have been obtained for the area and indicate that all plots are not within the zone of likely physical influence on the surface from past or present underground coal workings. In addition, the Coal Authority reports indicate that there no known coal mine entries

within, or within 20 metres of the sites. The IGWL reports suggest that there is a negligible risk of the plots being affected by past underground mining activities.

Perched groundwater should be anticipated within the made ground deposits, and a groundwater body should be expected in both the superficial and the solid strata. It is probable, given the proximity to the coast line, that groundwater may be under a tidal influence.

The leisure water area is in an area of extreme flooding from rivers or seas without sea defences (Zone C2 TAN 15). Refer to Section 4.1 for further discussion on flooding.

2.3 Foundations

On the basis of the geotechnical review and in line with the recommendations of the IGWL investigations, it is anticipated that piled foundations will be required for multi-storey buildings.

It may be possible to found single storey lightweight buildings on a raft foundation subject to the findings of the plot specific investigations.

Given the above it is considered at this stage that ground floor slabs will be of suspended construction tied into the pile caps and associated ground beams. As noted above, it may be possible for lightly loaded areas to be ground bearing but this will be subject to the plot specific investigations.

CFA options are the preferred piled option, however, any obstructions such as historic slabs or foundations would need to be removed in advance of the piling works. Bored cased piles could be considered as an alternative as they may be able to penetrate through some buried obstructions.

The current pile design and layout has been developed based on outline calculations and typical geotechnical parameters derived based on the available ground investigation information outlined in the above sections.

2.4 Key Constraints & Risks

Based on the investigation information available to date, there are a number of key issues that present cost and programme risk, including:

- The reports suggest that the previous site clearance works undertaken some 10 to 20 years ago did not include the formal removal of buried structures.

  The presence of such obstructions can have a direct impact on foundation installation and substructure design. Trial pits were included in the ground investigation for Phase 1 to evaluate this risk and enable appropriate risk management to be established.

  Suitable allowances will need to be made in both programme and cost plans for piling works encountering obstructions.

- Contamination and ground gases are evident across the sites currently investigated and whilst unlikely to be a barrier to development, surplus excavated materials will need to be dealt with appropriately. Appropriate geo-environmental assessments and a remediation implementation and verification plan for the site will inform this risk.

- Based on the historical map data provided in the existing GI reports, the most notable buried obstruction is the original Prince of Wales Dock entry lock which appears to run from the old tidal basin directly north through the phase 1 site to the old dock. Figure 3 below is a best fit approximation and the exact position will need to be proved in the field to fully understand and manage the implications of this on the new development.

  The mapping shows this to have been filled by the 1950's, but there is no detailed information as to the lock itself or whether the walls were removed, which is considered unlikely.

It will be essential to establish if the lock walls remain and if there is a dock base. The precise location of the walls will need to be established to aid coordination of the foundations. This was included as part of the GI scope for the Phase 1 works to be undertaken.

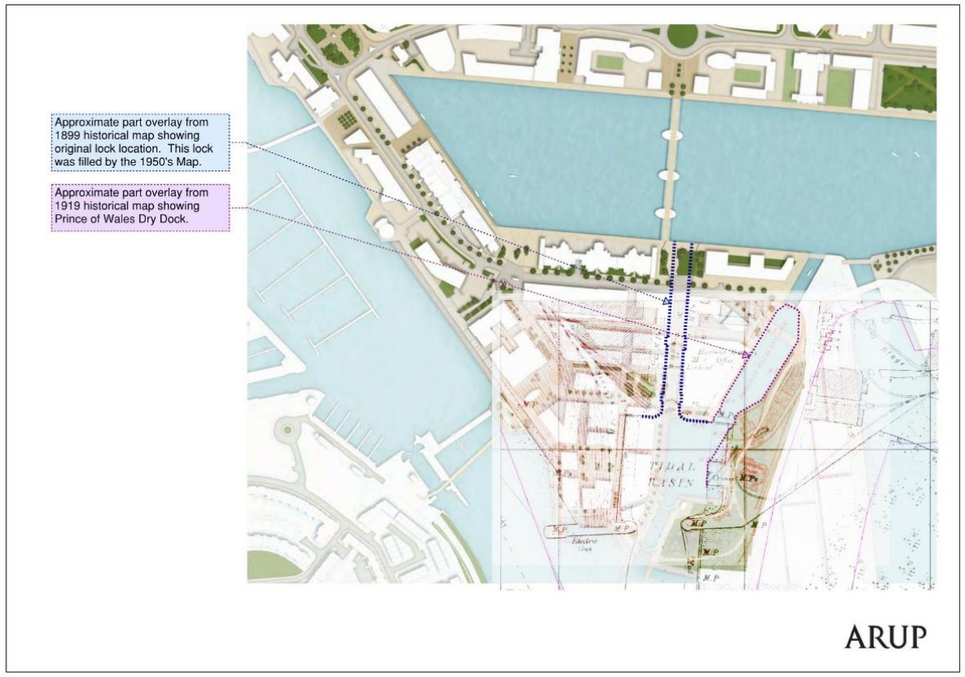


Fig 3 – Approximate Location of Old Lock Structure

3 Sustainability

The project is aiming to achieve a BREEAM excellent rating and will be designed to provide as sustainable a building as the budget will allow.

With respect to Structural and Civil design elements, the following sustainable concepts will be considered during the detailed design and used if appropriate:

- Use of Recycled Materials
  - Steel
  - Aggregates
  - Cement Replacement
- Thermal mass –exposed soffits
- Sustainable resourcing of material

- Sustainable Drainage Systems (SuDS) – Due to the presence of made ground, SuDS infiltration devises are not appropriate on this site. The drainage proposals follows the SA1 drainage strategy, which allows conventional drainage to discharge into the drainage network already formed within the highway corridors.

4 Civil Engineering

4.1 Flood Risk

4.1.1 Hydrology and Flood Risk

The site is located adjacent to the River Tawe estuary, TAN 15 Development Advice Maps show that much of the site is within Zone C2 although localised areas are within Zone A. The Natural Resources Wales (NRW) Flood Maps show that the majority of the site is within Flood Zone 1 and 2, however areas to the east and south are in Flood Zone 3.

The potential development of Swansea Bay Tidal Lagoon will have a neutral or marginal beneficial effect on the proposed SA1 development. The lagoon proposals will introduce an increased resilience to surge tides from the Sever Estuary flooding.

4.1.2 Flood Consequences for development

Following the production of an FCA in 2006, a minimum development level of 6.58mAOD was agreed with the Environment Agency (now NRW). Since this date, new extreme water levels have been published and an updated FCA advised that commercial development levels should be set at a minimum of 7.13mAOD with access roads leading into any undercroft parking should be formed at a minimum level of 7.94mAOD.

The proposed development will be sited at or above 7.13mAOD.

4.2 Drainage

This section is to be read in conjunction with the civil drawings which are included in Appendix B of this report.

4.2.1 Surface Water Drainage

The proposed surface water drainage layout is shown on Drawing CG1000 and comprises separate highway and plot drainage networks with outfalls into the adjacent docks. Plot and highway surface water drainage networks have previously been installed within Kings Road and also the connecting north-south spine road. Both surface water networks outfall into the existing docks to the north and south-west of the plots. The surface water drainage from the development will be connected into this water drainage network. The proposed network includes a surface water drainage run between the dock edge and the building, assuming there is sufficient space to install the pipe. If, following further investigation, it is found that space is at a premium, consideration may be given to directing flows to the north or directly into the dock via a new discharge point.

Due to the presence of made ground and potential risk from contamination, infiltration drainage SuDS systems are not suitable. Surface water flows will be discharged via the existing network into the docks and does not require attenuation.

Drawing CG1000 shows indicative connection points for downpipes and initial positions for gullies, these will need to be confirmed during subsequent design stages. The site is flat, and it may be advantageous to install linear drains and kerb drainage rather than road and yard gullies and produce the necessary falls.

The majority of drainage runs will be 150mm, however specific lengths will be 225mm and 300mm, see CG1000. These pipe sizes will need to be confirmed once all downpipe positions have been confirmed and a drainage model finalised. Pipe and manhole depths will vary between 0.8m and 2.5m depth.

4.2.2 Water Quality

Drawing CG1000 shows a petrol interceptor is required in the service yard area to ensure good water quality in the discharge of surface water. Drainage from roof areas will be kept separate and would not need to be treated though petrol interceptors.

4.2.3 Foul Water Drainage

A foul drainage network has previously been installed within the highway network around the development plots, which outfall into storage tanks and a pumping station to the west. The existing foul network has been adopted under a S104 agreement and discharges to drop shafts on the existing Dwr Cymru Welsh Water (DCWW) deep sewer which lies below Langdon Road to the west and connects to Swansea Waste Water Treatment Works (WWTW) to the east. The existing SA1 development has Water Industry Section 106 discharge consents in place, and together with the adoptable foul drainage network, it is intended to provide for fully serviced development plots.

A series of plot connection spurs are present on Kings Road in the north. The proposed foul drainage layout is shown on Drawing CG1000, this layout will need to be reviewed once

building details, finished levels and external works have been finalised. It is proposed that foul drainage from the eastern and northern area of the FACE building will be connected directly into the King's Road spurs in the north-east. Foul drainage from the western and southern areas of the FACE building will connect to a new drain running down the new north-south road, and will be connected across to the existing drain run running down the western road. Foul flows from the library building will also be connected to the western road foul drainage network. Gravity drainage will be feasible without the need for any additional pumping stations, providing floor levels of the building are set at or above 7.13mAOD.

The majority of drainage runs will be 150mm, with building spurs at 100mm. Pipe and manhole depths will vary between 0.8m and 2.5m depth.

4.2.4 Drainage Details

The drainage design should be carried out in accordance with Sewers for Adoption 7, the foul drainage design should be submitted to DCWW for adoption. Locations will need to be co-ordinated with building lines and other services details and should be installed in accordance with engineer's drawings and the Statutory Authority's requirements. Precise locations should be agreed with the engineer prior to commencing the work. In places, drainage runs are currently located close to or beneath tree lines, positions will need to be co-ordinated during the detailed design stage, some tree lines may need to be moved.

All kitchen waste water shall be discharged via grease traps and surface water drainage to vehicle parking areas or service yards shall have petrol interceptors, unless agreed otherwise.

4.3 External Works

The external works will consist of roads, service yards, turning areas, hardstandings, refuse storage, cycle storage, together with soft landscaping. The layout and finishes will need to be confirmed by the architect and/or landscape architect, an initial landscape plan produced by Stride Treglown includes areas of tarmac, natural stone and block paving, concrete paving slabs, trees and planting. Whilst the architect has proposed heavy duty tarmac to be included for the service yards and refuse turning area, Arup recommend that further details and assessment is carried out on HGV movement in these areas, and pending this assessment, concrete slabs should be included.

The indicative surfacing details are shown on Drawing CG1001 and CG1002. It should be noted that the exact type of paving units and kerbs/edging has not yet been specified, therefore the type and thickness of units will need to be confirmed. Furthermore, it is assumed that all paving areas will carry pedestrian loading only, should vehicular maintenance access be required, the construction thickness may need been amended. It is also assumed that a CBR of over 5% will be achieved at formation level, should the CBR value be lower, appropriate thicknesses of capping material will need to be included.

The proposed road layout has yet to be vehicle tracked in detail, the road should be at least 5.5m wide, however, the local widening is likely to be needed at the sharp bends proposed to accommodate any HGV vehicle movements. Further consideration should be given to determining routes for pedestrians and cyclists in the proposed layout and extending footway widths for any combined footway/cycleways to 3m.

The vertical elevation of the hardstandings has yet to be designed. The site is flat, therefore compliance with DDA guidelines should not be an issue. The current design assumes that the finished levels will vary to allow falls to drainage gullies. However, it may be beneficial to keep variations to a minimum, and include linear channel drains and kerb drainage.

5 Structural Engineering – Basis of Design

5.1 Structural Design Philosophy

The structural philosophy has been developed based on the proposals discussed in the RIBA Stage 2 Report. A design workshop was carried out which involved the whole design team and discussed the structural opportunities for each building.

Following the workshop a Technical Note was produced and issued to the design team which summarised the agreed structural philosophy for each building and forms the basis of the RIBA Stage 3 design.

The principles are noted below and the Technical Note is included in Appendix C of this report for reference. The structural solutions for each building will be discussed further in the next sections of this report.

5.1.1 FACE Building

The FACE building is to be a steel frame building with long span beams to minimize the internal columns within learning spaces. The structural slab is to be a 150mm thick overall consisting of a 75mm precast concrete biscuit with 75mm in-situ concrete topping. The slab is to be supported on long span universal beams at 3m centres acting compositely with the floor slab, with columns typically at max 6m along the perimeter.

There is a requirement for the ground floor 90 person learning space to be a column free area. The structure in this area is to clear span the learning space, with a maximum beam span of 15m. Elsewhere, it was generally accepted that columns could be provided in laboratories and learning spaces to provide a more efficient structural span with maximum beam spans of 12m.

The in-plane stability of the structure is to be provided by the diaphragm action of the concrete slabs with lateral stability provided by vertical steel bracing around the lift and stairs areas.

5.1.2 TECH Building

The TECH building is to be single story steel frame building. The roof is to be a metal deck in-situ concrete slab with long span cellular beams designed compositely. Initially, the intention was to clear span over the automotive testing area and only a single line of internal columns in the main tech area. Following a value engineering decision, further internal columns were introduced in partitions lines to reduce the spans and the structural depth.

The in-plane stability of the structure is to be provided by the diaphragm action of the concrete roof slab and lateral stability provided by vertical steel bracing.

5.1.3 Library

The library is to be a reinforced concrete frame building to the upper level with a steel frame above to support the roof. The floor structure is to be reinforced concrete flat slabs on a typical maximum grid of 6.3m x 7.5m.

The lateral stability is to be provided by the reinforced concrete walls around vertical circulation areas.

5.2 Design Codes and Guidance

The structural design will be carried out with reference to the following principal design codes and guidance documents

5.2.1 Codes of Practice and Design Standards

The structure will be designed in accordance to the current European Standards, including all relevant parts of the Eurocodes, their National Annexes and related Non-Contradictory Complimentary Information.

The principal codes being as follows:

- BS EN 1990:2002 and UK National Annex to Eurocode 0: Basis of Structural Design
- BS EN 1991:2002 and UK National Annex to Eurocode 1: Actions on Structures
    - Part 1-1: General Actions – Densities, Self-weight, Imposed Loads for Buildings
    - Part 1-3: General Actions – Snow Loads
    - Part 1-4: General Actions – Wind Loads
- BS EN 1992:2004 and UK National Annex to Eurocode 2: Design of Concrete Structures
- BS EN 1993:2005 and UK National Annex to Eurocode 3: Design of Steel Structures
- BS EN 1994:2004 and UK National Annex to Eurocode 4: Design of Composite Steel and Concrete Structures
- BS EN 1996:2005 and UK National Annex to Eurocode 6: Design of Masonry Structures
- BS EN 1997:2004 and UK National Annex to Eurocode 7: Geotechnical Design

In addition to the above the structural design will also satisfy The Building Regulations.

5.2.2 Material and Works Specifications

The design will be based on the following nationally recognised material and workmanship specifications, as amended by Arup, particular to this project.

- The National Structural Concrete Specification, 4th edition.
- The National Structural Steelwork Specification, 5th edition.

5.2.3 Health and Safety

Relevant current H&S Legislation and regulations including

- CDM Regulations (2015)
- HSE Approved Code of Practice

5.3 Design Loadings – Vertical Loads

The assumed locations of superimposed dead and imposed floor loads are shown in the loading plans which are provided in Appendix D.

5.3.1 Dead Loads (Permanent Actions)

Self-weight of the primary structures is calculated based on the design proposals. Weights of structural materials are based on relevant standards and include the following:

- Normal weight reinforced concrete: 2500 kg/m^3
- Lightweight reinforced concrete: 1900 kg/m^3
- Structural steelwork: 7850 kg/m^3

5.3.2 Superimposed Dead Loads (Permanent Actions)

The following superimposed dead load allowance and has been included for each building.

FACE Building

Location	Load Allowance
Ground Floor (insulation, service distribution, screed and finishes)	2.0kN/m^2
Suspended Floors (raised floor, ceiling and services)	1.0kN/m^2
Flat Roof build-up (hung services, insulation and waterproofing)	1.0kN/m^2
Lightweight Roof build-up (purlins, insulation and standing seam roof)	1.0kN/m^2

TECH Building

Location	Load Allowance
Ground Floor (partitions and lightweight finishes)	1.0kN/m^2
Flat Roof build-up (hung services, insulation and waterproofing)	1.0kN/m^2
Lightweight Roof build-up (purlins, insulation and standing seam roof)	1.0kN/m^2

Library

Location	Load Allowance
Ground Floor (insulation, service distribution, screed and finishes)	2.0kN/m^2
Suspended Floors (raised floor, ceiling and services)	1.0kN/m^2
Flat Roof build-up (hung services, insulation and waterproofing)	1.0kN/m^2
Lightweight Roof build-up (purlins/liner tray, insulation and standing seam roof including hung services and celling)	1.0kN/m^2

No allowance has currently been included for internal masonry partitions. Current Architectural layouts show lightweight stud partitions in all buildings.

Cladding

Location	Load Allowance
Masonry with fenestration (masonry outer skin and SFS internal skin)	2.5kN/m^2 on elevation
Curtain wall system	1.0kN/m^2 on elevation

5.3.3 Imposed Loads (Variable Actions)

The imposed load allowance for the buildings are based on values to BS EN 1991-1 and additional information provided by the UWTSD for the Technical areas. The design imposed loading for each building is listed below.

FACE Building

Location	Load Allowance	
	UDL	Point Load
General Learning	4.0kN/m^2	3.0kN
Common Area (cafes, lounges)	3.0kN/m^2	3.0kN
Circulation	4.0kN/m^2	4.0kN
Storage	5.0kN/m^2	4.5kN
WC Facilities	3.0kN/m^2	2.0kN
Learning Workshops (Computer workshops and labs)	5.0kN/m^2	4.5kN
Office Area	3.5kN/m^2	4.5kN
Plant Rooms	7.5kN/m^2	4.5kN
General Roof Area (inc PVs)	1.5kN/m^2	0.9kN
Lightweight Roof (Maintenance roof access only)	0.6kN/m^2	0.9kN
External Plant Enclosure	5.0kN/m^2	4.5kN

The above imposed load allowance includes 1kN/m^2 for partitions where appropriate.

TECH Building

Location	Load Allowance	
	UDL	Point Load
General Workshop Area	5.0kN/m^2	4.5kN
Automotive Area	5.0kN/m^2	10.0kN
Heavy Workshop Area	7.5kN/m^2	10.0kN
Plant Rooms	7.5kN/m^2	4.5kN
External Plant Areas (AHU and lightweight plant only)	3.5kN/m^2	4.5kN
General Roof Area (inc PVs)	1.5kN/m^2	0.9kN
Lightweight Roof (Maintenance roof access only)	0.6kN/m^2	0.9kN

The above values for the ground floor imposed loading is based on a design load assessment carried out for the TECH Building considering BS EN 1991-1 and the information provided for the existing UWTSD facilities and equipment at the Swansea Mount Pleasant Campus.

The load assessment for the ground floor areas is included in Appendix D.

Library

Location	Load Allowance	
	UDL	Point Load
General Learning	4.0kN/m^2	3.0kN
Storage	5.0kN/m^2	4.5kN
WC Facilities	3.0kN/m^2	2.0kN
Circulation	4.0kN/m^2	4.0kN
General Book Storage	5.0kN/m^2	7.0kN
Plant Rooms	7.5kN/m^2	4.5kN
Roof (Maintenance roof access only)	0.6kN/m^2	0.9kN
Roof (inc PVs)	1.5kN/m^2	0.9kN

The above imposed load allowance includes 1kN/m^2 for partitions where appropriate.

The General Book Storage loading allows for a typical library layout. This is based on BS EN 1991-1-1 loading category E12 (reading rooms with book storage) or category E13 (general storage height of up to 2m). It is assumed that the library is not a high density book storage facility and that there is adequate spacing between the storage units as visualised in Figure 4 of a typical library layout.



Fig 4 – Example of assumed library book storage loading allowance

5.3.4 Reduction of Imposed Loads

Imposed loads on columns (including allowances for partitions) may be reduced in accordance with BS EN 1991-1-1:2002, 6.3.1.2 (11).

5.3.5 Snow Loads

Snow load is to be considered on roof structures, this is outlined in BS EN1991-1-3: 2003.

5.4 Design Loading – Lateral Loads

5.4.1 Geometric imperfections

To make an allowance for geometric imperfections such as construction tolerances, vertical loads will be assumed to be at an eccentricity. This load is accounted for as an equivalent horizontal forces which are only to be considered in the ultimate limit state design.

For concrete structures, this is outlined in BS EN 1992-1-1:2004, 5.2.

For steel structures, this is outlined in BS EN 1993-1-1, 5.3.2 (7). The building will be checked if further second order analysis is required in accordance with clause 5.2.2 (6).

5.4.2 Wind loading

The wind loads have been assessed in accordance with BS EN 1991-1-4 and applied in accordance with NA to BS EN 1991-1-4 NA.2.23 to represent the torsional effect of the wind on the building.

The basic wind velocity, V_b used to establish the horizontal wind load on the structures and façades is 23.2 m/s. The maximum Peak Velocity Pressure, q_p for the buildings is 1.1 kN/m².

5.4.3 Vehicle Impact

No vehicle impact has been considered in the TECH building column design. It is assumed all vehicles will be maneuvered in a controlled manner in the vicinity of the building structure. Columns in the vicinity of vehicle routes should be protected against impact via sacrificial elements (e.g. bollards, etc.)

However, if necessary the columns will be designed for car impact forces in accordance with Table 4.1 of BS EN 1991-1-7.

5.5 Robustness

These structures are category 2b as defined by the Building Regulations Part A, section A3 and by BS EN 1991-1-7 2006. Therefore the detailed design of the frame will be adequate to resist disproportionate collapse. The structure will be designed with the provision of horizontal and vertical ties as outline in section 7.3.2.1. Typically these will be provided by the reinforcing steel or steel beams and their connections will be designed to carry the required tie forces.

Precast stair flights and/or steel stairs will be designed to be effectively tied to the supporting structures.

5.6 Movements and Tolerances

A fully detailed Movement and Tolerance report should be produced during the detail design phase to inform all parties of the movement limits within the structural frames of each building.

5.6.1 Horizontal Deflections

The overall deflection limit for sway stability for a braced frame is height/500 for the full building height.

The differential lateral movement due to applied horizontal loading at any particular slab level is limited to storey height/400.

5.6.2 Vertical Deflections

In order to ensure that slab edge deflections are within acceptable limits, to support perimeter cladding, the vertical deflection of the floors are to be limited to span/360 for imposed load.

5.6.3 Vibration of Floors

Response to pedestrian-induced vibration will be assessed following the guidance in “A Design Guide for Footfall Induced Vibration of Structures” (CCIP-016, 2006).

The steel beam designs are to be limited to a minimum frequency of 4Hz.

The RIBA Stage 4 designer must pay particular attention to the 15m long span beams and ensure vibrations are controlled through the final design to avoid unacceptable interference from the walkways on the classroom areas.

5.7 Building Design Life and Durability

5.7.1 Design Life

Structural elements are to be designed to a design life of 50 years.

Steel Structure

Where steelwork is within internal, temperature controlled environments, the life to first maintenance of any corrosion protection scheme can be expected to be up to 50 years.

Where steelwork is in semi-controlled or external environments, the life to first maintenance of any corrosion protection scheme can be expected to be approximately 15-20 years.

All external exposed steelwork to be galvanized.

Note that any decorative or fire protective coatings may need maintenance earlier than the timescales noted and these are specified by the Architect. In all instances it is of paramount importance that any decorative or fire protection top coats are compatible with the underlying corrosion protection system.

Concrete Structure

New concrete structures will be designed for the durability requirements of BS EN1991-1-1:2004. Concrete cover to reinforcement and minimum specified cement contents will be in accordance with the durability requirements of BS EN 1991-1-1:2004. Maximum permitted crack widths will be in accordance with the requirements of BS EN 1992-1-1 NA Table NA.4.

Within the building envelope, concrete elements will be classed as having mild exposure conditions.

5.7.2 Fire Resistance

The fire resistance period for the structural elements is 60 minutes.

For reinforced concrete elements, the fire resistance periods will be achieved by ensuring sufficient element sizes and cover to reinforcement, as specified by BS EN 1992-1-2 Section 5 and BS EN 1992-1-2 NA Table NA.1.

For steel elements, fire resistance will be provided by finishes to be specified by the architect.

5.8 Materials

5.8.1 Steel

Steel Properties

From clause 3.2.6 (1) of BS EN 1993-1-1:2005:

Young's Modulus:	210kN/mm²
Poisson's Ratio:	0.3
Coefficient of linear expansion:	12 x 10-6 per °C

Steel Grades

Hot Rolled Sections:	S355 unless noted otherwise
Plates:	S275 unless noted otherwise

Connections are to be designed by the steelwork fabricator for the forces specified on the structural drawings.

Grout

Grout around foundation bolts and under base plates is to be non-shrink and have a minimum characteristic strength of 40N/mm².

5.8.2 Concrete

Concrete Properties

From Clause 3.1.3 of BS EN 1992-1-1:2004:

Poisson's Ratio:	0.2
Young's Modulus:	28kN/mm² short term
	14kN/mm² long term
	38kN/mm² dynamic
Coefficient of linear expansion:	10 x 10-6 per °C

Reinforcement Properties

High Yield Bars	f_{yk} = 500N/mm²
Mesh (cold drawn)	f_{yk} = 500N/mm²
Young's Modulus	210kN/mm²

Concrete Grades

Location	Min Strength Class
Pile Concrete	TBC Piling Contractor
Substructure Concrete: Pile caps, Beams and Slabs	C32/40
Superstructure Slabs and Beams	C32/40
Columns	C32/40
Core Walls	C32/40

Concrete Cover to Reinforcement

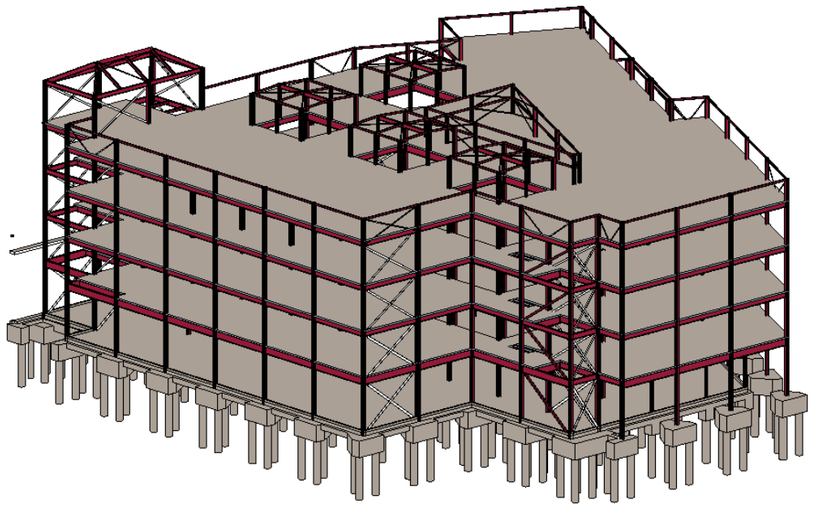
The concrete structures will be designed for a design life of 50 years. The concrete cover to reinforcement, maximum permitted crack widths and minimum specified cement contents will be in accordance with the durability requirements of BS8500-1:2006 and BS EN 1992-1-1:2004.

Concrete Finishes

Unless otherwise shown on the Architects drawings or finishing schedules, the following finishes are assumed for all concrete:

Description of surface	Formed	Unformed
Columns & walls with no finishes (or painted)	Special	N/A
Columns & walls with finishes applied	Ordinary	N/A
General in-situ slabs with finishes applied	N/A	Ordinary
Exposed soffits of floor slabs	Special	N/A
Plantroom slabs with no finishes	N/A	Plain
External Slabs	N/A	Special

6 Structural Engineering Proposal – FACE Building



This section is to be read in conjunction with the structural drawings which are included in Appendix E.

6.1 Foundations

The FACE building is to be supported on pile foundations typically with pile caps at column positions. Additional piles are provided to reduce the spans of the ground floor structure.

The foundation layout is based on a 600mm diameter CFA pile, 20m long with a compressive capacity of 1000kN. The pile capacity is based on the assumptions noted in Section 2. The foundation design is to be confirmed in the next stage of design following the full Site Investigation.

As noted in Section 2, there is potential for unforeseen obstructions to be found, particularly in the vicinity of the Prince of Wales Dock entry lock. The results of the Site Investigation should identify any potential issues with the current foundation layout and may require alternative foundation details to be developed in the next stage of design.

6.2 Substructure

6.2.1 Pile Caps

The columns sit on pile caps which spread the loads to the piled foundations. The pile caps range from single pile cap to 2, 3 and 4 pile caps. Combined 6 pile caps are provided to support the bracing at the stair cores. Typically all pile caps are 1400mm deep.

The internal column pile cap levels are set 175mm below the ground floor FFL level and will be tied into ground floor slab. For single and 2 pile caps, it is assumed that the slab will be cast monolithic with the pile caps before the superstructure is constructed to ensure the piles have adequate lateral restraint.

The perimeter column pile cap levels are set 450mm below the ground floor FFL to support the masonry cladding.

The pile caps at the movement joints are set 750mm below FFL with the ground beams supported above. The pile cap below the lift pit will is set 1050mm below FFL with setting out to be confirmed by the Architect once the details of the lift pits are confirmed in the next stage of design.

6.2.2 Ground Beams and Floor Slab

The ground floor slab SSL is 175mm below FFL to allow for a 100mm insulation and 75mm screed over the slab to Architects details. The slab SSL and top of the internal pile caps are set at the same level.

The ground floor slab is a 300mm thick flat slab spanning between pile caps with a perimeter upstand detail to provide an edge to the ground floor build up and support the SFS framing inner skin of the cladding.

The ground beams around the perimeter provide an edge detail which extends the structure below the frost line and supports the masonry outer skin of the cladding.

6.2.3 Lift Pits and Recesses

The lift pits are formed with reinforced concrete walls below the ground floor level spanning between the pile caps with a 300mm thick slab base to the pit. The lift pit base is currently assumed to be 1050mm below the FFL. Details and setting out of the lift pit is to be provided by the Architect in the next stage of design.

The lift pits are to be externally tanked with a waterproof membrane such as Fosroc Proofex. Details are to be developed in the next stage of design following confirmation of the ground water levels.

6.2.4 FACE TECH Movement Joint

A movement joint is provided in the ground floor slab between the FACE and TECH buildings with a double line of ground beams either side of the joint which are supported on the pile caps that are set down below. Where two columns are either side of the joint, the pile caps are shared.

The movement joint in the slab is provided to separate the two different floor build ups between both the FACE and TECH buildings. The joint also provides an isolation between the more dynamic workshop area and the more passive learning spaces.

Any vibration induced by the testing in the northern part of the TECH building will not transfer through the slab and ground beams at the movement joint. It is not expected that the adjoining pile caps which are set down below the beam level will transfer any vibration to cause an issue in the FACE building. This should be confirmed by the acoustic consultant during the next design stage.

The movement joint is to be 25mm filled with a compressible filler board with sealant to Architect's details. The underside of the joint is to be externally tanked with a waterproof membrane such as Fosroc Proofex. Details are to be developed in the next stage of design following confirmation of the ground water levels.

6.3 Stability System

The horizontal loads on the building are generated by wind loads and vertical elements being slightly off-vertical. These horizontal forces are resisted by the building stability system.

The floor slabs act as diaphragms (stiff plates) to transfer the forces into the vertical stability structure formed by the steel cross bracing. Braced bays are distributed around the vertical circulation spaces, perimeter and internal wall lines to provide sufficient lateral and torsional stiffness to the building. The bracing is to be steel flat plate which act in tension to resist the lateral forces. The braced bays acts as cantilevers, using push-pull in the piles to resist overturning at the base and shedding the horizontal load into the ground.

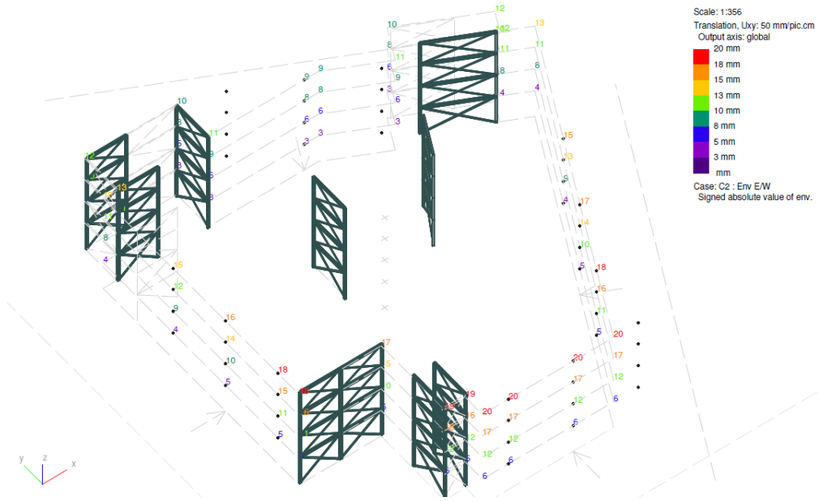


Figure 5: Stability structure analysis model: Showing the braced bays and building outline (left) with horizontal deflection output (right).

6.4 Superstructure

The primary superstructure is to be a steel brace frame with precast solid concrete slab with structural topping.

6.4.1 Columns

The columns are typically 254UC universal columns sections which carry the vertical loads from each floor down to the pile cap and through the piles into the ground.

The columns are arranged on plan to minimise the impact on the internal layout while maintaining and efficient and economical solution. Where possible, some of the columns stop at level 3 to free up the open space in the faculty area. The façade line on the east elevation is stepped back at level 3 to create an external terrace area. The columns between level 3 and the roof that are offset from the main column line are supported on transfer beams at level 3.

The columns on the west side of the building are positioned to create a clear span over the 90 person learning studio. This was a client requirement to ensure the full flexibility of the large ground floor space.

The columns on the east side of the building are positioned on either side of the corridor line above level 1 with offset column in the ground floor learning spaces. This is to minimise the long spans where possible and allow shallower depth beams to span over the corridor line to maximise the available space for the services distribution in the circulation space.

The columns which form the outline of the ground floor colonnade are assumed to be encapsulated by the façade. They are to be fully insulated within the masonry cladding piers to avoid cold bridging issues. The columns which form the inner line of the colonnade are wind posts only and have vertical slotted holes connection at the underside of the level 1 beams to ensure no vertical load transfer.

Where the building line steps in on the west side of the building to form a roof balcony, wind posts are provided and have vertical slotted holes connection at the underside of the roof level beams to ensure no vertical load transfer.

6.4.2 Bracing

Typically all braced bays have a vertical cross bracing arrangement with 200mm x 20mm steel flat plate sections which resist the lateral forces on the building and transfers the loads to the ground through tension. The bracing arrangement on the west elevation of the south core is arranged with a single diagonal brace at each level to avoid the windows. The bracing member is to be steel SHS box section which resists the lateral forces through tension and compression.

6.4.3 Floor Plate

The floor plate is a 75mm thick solid precast concrete plank with a 75mm structural concrete topping spanning a maximum of 3m. The slab is to act compositely with the steel beams. It is expected that the majority of the rooms will have an exposed soffit, therefore, the precast planks will provide an excellent quality concrete finish to the slab. The floor plate is to provide in-plane diaphragm action to transfer the lateral loads on the building to the vertical bracing.

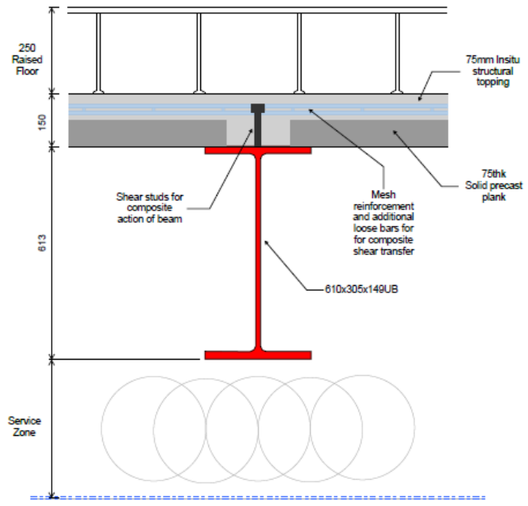


Figure 6: Section showing a typical structural section at floor level.

6.4.4 Beams

Typically the floor beams are arranged with secondary beams at 3m centres spanning onto 6m primary beams. The beams are design compositely with the slab in the permanent case and designed unrestrained full length to support the precast slabs in the construction case. An alternative temporary bracing system could be considered during construction, at the detailed design stage in conjunction with the fabricator/erector, to generate a shallow/lighter section if desired although it is felt that the complexity of the temporary bracing required may not deliver overall efficiencies.

Typically the long span secondary beams and primary beams are 610UB universal beams. The edge beam depth at level 2 and above is minimised to allow the NVHR ventilation units on the façade to fit below the beam and maximise the window height. Where the building line steps in on the east side at level 3, there are transfer beams to support the roof level structure.

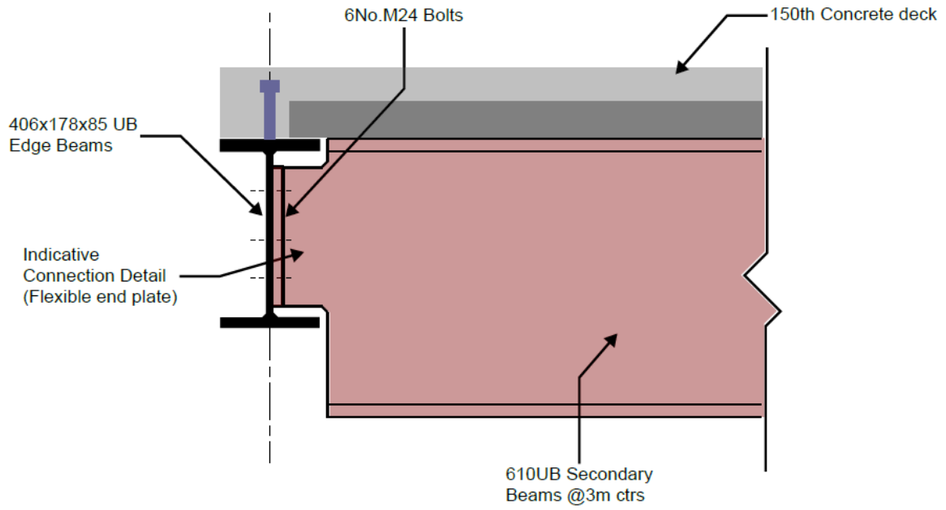


Figure 7: Typical section showing reduced edge beam support at the upper levels.

All beams which are greater than 10m are to be precambered.

Within the stair cores, beams are positioned at half landing height to support precast staircases.

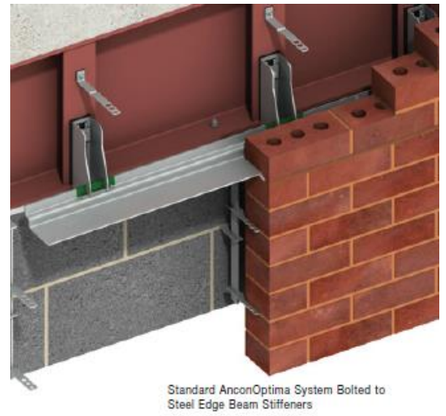
There risers are to be trimmed with steel beams. The size and location of the risers are to be confirmed by the Architect and Services Engineer in the next stage of design.

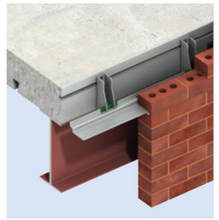
6.4.5 Stairs

The stairs are assumed to be precast concrete stairs design to the loading shown on the loading plans. The stairs should be anchored to the main structure for robustness.

6.4.6 Cladding Support

To accommodate the NVHR units, the edge beams depth were required to be minimised. To achieve this, the external masonry cladding shall be supported at each level from secondary framing/proprietary shelf angles off the primary structure. The shelf angle systems can be fixed to the steelwork or integral to the concrete slab, indicative details are show below. Final details of the cladding support is to be developed with the Architect in the next stage of design.


Standard AnconOptima System Bolted to Steel Edge Beam Stiffeners


AnconOptima Support System Fixed to CombiDeck Edge Trim

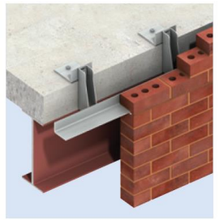

Ancon MDC/TC Top Cleat System

Figure 8. Indicative Ancon shelf angle details

6.5 Roof Level

6.5.1 Main Roof Structure

The main roof level is to be a flat roof with a similar beam arrangement and slab construction to the levels below. Where columns stop at level 3, the roof beam arrangement has been adjusted to increase the spans to allow flexibility of the level 3 area. The precast concrete slab construction provides consistent internal finishes to all internal spaces.

It is assumed that the insulation will be laid to falls to achieve the required slope for adequate drainage to the flat roof. Due to the complex shape and arrangement of the roof layout, it is not considered feasible to provide a slope in the steelwork in order to achieve the required falls across the roof.

There is a parapet upstand around the perimeter of the roof and at the edge of the openings for the roof pop ups. This will provide an edge detail for the roof waterproofing.

6.5.2 Stair Well, Atrium and Roof Light Pop-ups

The main stair well which is located adjacent the TECH building extends above the main roof level and provides access to the roof. The columns extend up to support the steel framed pitched roof.

There are four roof light pop-ups which extend above the main roof level. It is proposed that the structural framing will be a steel moment portal frame to minimise the need form vertical bracing and allow the clear vertical panels for the openable windows around its perimeter. It is assumed that the columns will have pinned base at roof level with lateral stability provided by the moment frame with in-plane bracing at the roof level.

6.5.3 Roof Plant Enclosure

The roof level plant enclosures is to be framed by cantilever posts around its perimeter with in-plane vertical cross bracing and intermediate beams. The cantilever posts are to be fixed to upstand concrete plinths. This detail will allow the roof waterproofing to be dressed up the concrete and minimise the complexity of detailing waterproofing around steel sections.

The plant room enclosure steelwork is to be galvanised.

6.5.4 Parapets

The perimeter columns extend above the main roof level to provide the parapet support. Intermediate posts are provided at secondary beam locations to provide additional restraint to the heads of the parapet. It is currently assumed that the parapet steelwork will be within the insulated building line to avoid issues with cold bridging at the roof level. Alternatively, proprietary wind posts fixed to the slabs could be provided, see indicative details below.

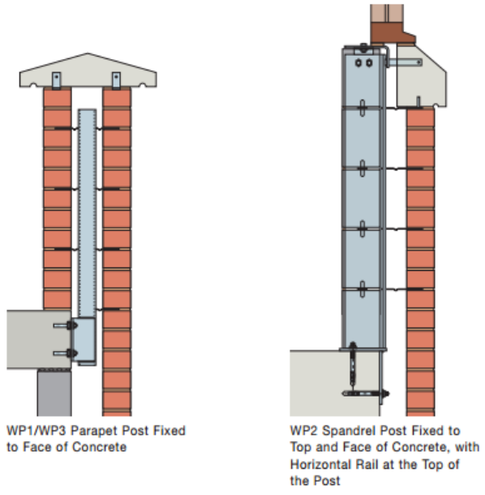
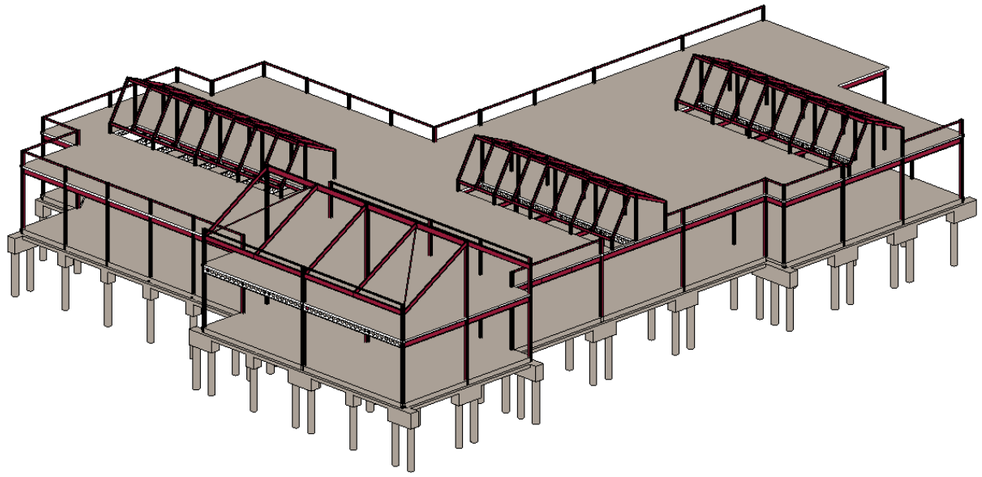


Figure 9. Indicative Ancon parapet post details

7 Structural Engineering Proposal – TECH Building



This section is to be read in conjunction with the structural drawings which are included in Appendix E.

7.1 Foundations

The TECH building is to be supported on pile foundations typically with pile caps at column positions. Additional piles are provided to reduce the spans of the ground floor structure.

The foundation layout is based on a 600mm diameter CFA pile, 20m long with a compressive capacity of 1000kN. The pile capacity is based on the assumptions noted in Section 2. The foundation design is to be confirmed in the next stage of design following the full Site Investigation.

7.2 Substructure

7.2.1 Pile Caps

The columns sit on pile caps which spread the loads to the piled foundations. The pile caps range from single pile cap to 2, 3 and 4 pile caps. Typically all pile caps are 1400mm deep.

The internal column pile cap levels are set 250mm below the ground floor SSL to allow the column base plates to be set down below the slab level and hidden. The perimeter column pile cap levels are set 450mm below the ground floor SSL to provide part of the support for the masonry cladding.

The pile caps at the movement joints are set 750mm below FFL with the ground beams supported above.

7.2.2 Ground Beams and Floor Slab

The ground floor structure is a 250mm thick 2-way spanning reinforced concrete slab. The slab spans between ground beams which are typically 600mm or 750mm deep by 450mm wide. The ground beam depth is to be integral with the slab depth to minimise the excavation required. Ground beams typically span between column pile caps. Where the spans between column pile caps are large, additional intermediate piles have been introduce to minimise the slab and ground beam spans.

The ground beams around the perimeter provide an edge detail which extends the structure below the frost line and supports the masonry cladding.

Ground beams are provided below the car lift to stiffen the ground floor structure. The details of the car lift is to be confirmed by the UWTSD in the next stage of design.

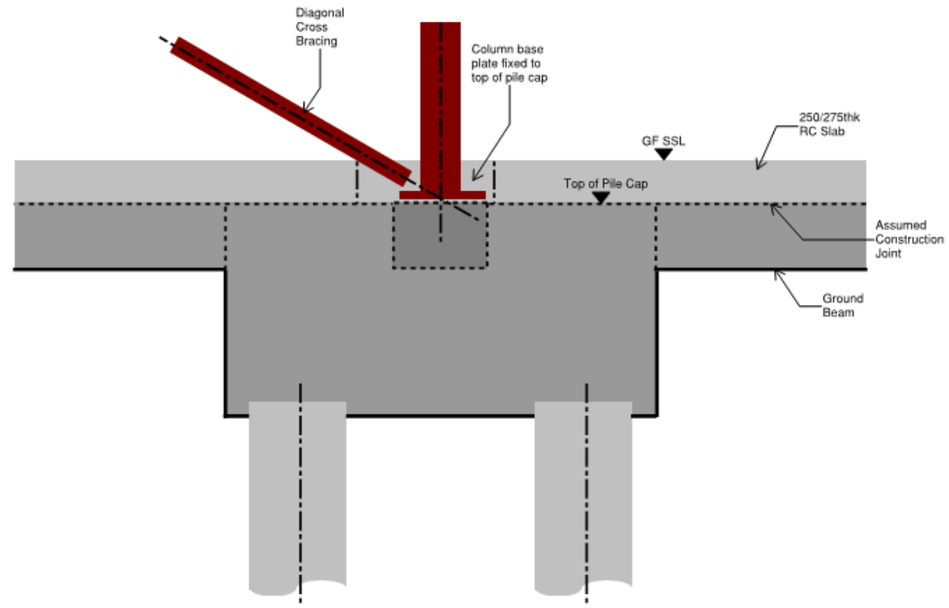


Figure 10: Indicative pile cap setting out.

7.2.3 Slab Recesses and Pits

There is a requirement for pits in the ground floor structure for the rolling roads. There will be a 2 and 4 wheel rolling road. The pits will be trimmed with ground beams and the slab recessed to house the rolling road. Anchor points will be cast into the ground beams for providing a safe anchor point for the cars when the rolling road is in use.

The exact details of the rolling road requirement is to be confirmed by the UWTSD in the next stage of design.

A 250mm deep x 300mm wide recess is to be provided in the slab for a direct fuel line into the DYNO testing room. The recess will be filled with inert material around the fuel line and covered with robust lockable cover plate that will allow maintenance access to the fuel line.

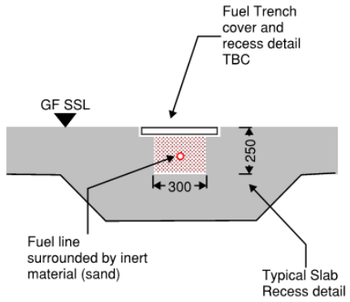


Figure 11: Indicative fuel line trench detail.

7.2.4 FACE TECH Movement Joint

A movement joint is provided in the ground floor slab between the FACE and TECH buildings with a double line of ground beams either side of the joint.

Where two columns are either side of the joint, the pile caps are shared. Further details of the movement joint are discussed in the section 6.2.4.

7.3 Stability System

The main roof slab acts as diaphragms (stiff plate) to transfer the forces into the vertical stability structure formed by the steel cross bracing. Braced bays are distributed within wall lines to provide sufficient lateral and torsional stiffness to the building. The bracing is to be steel flat plate which act in tension to resist the lateral forces. The braced bays acts as cantilevers, using push-pull in the piles to resist overturning at the base and shedding the horizontal load into the ground.

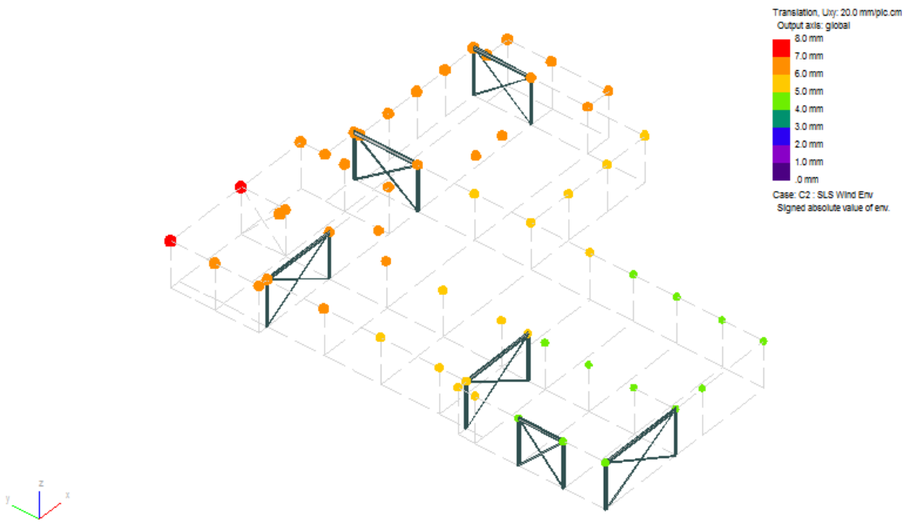


Figure 12: Stability structure analysis model: Showing the braced bays and building outline with horizontal deflection output.

7.4 Superstructure

7.4.1 Columns

The columns are arranged on plan to minimise the impact on the internal layout.

The columns are typically 203UC or 254UC universal columns section which carry the vertical loads from the roof down to the pile cap and piles.

7.4.2 Bracing

Typically all braced bays have a vertical cross bracing arrangement with 150mm x 15mm steel flat plate sections which resist the lateral forces on the building and transfers the loads to the ground through tension.

7.4.3 Roof Deck

The main roof level is a composite deck which provides diaphragm action to the roof level and minimises the requirement for plan bracing which simplifies the roof construction. The 150mm thick roof slab utilises a ComFlor 60 metal deck which can span up to 3.5m between secondary beams.

The final setting out of the openings for the roof light pop-ups are to be agreed with the Architect and MEP specialist, the roof diaphragm behaviour will need careful detailing around these openings to ensure diaphragm action is achieved.

Is assumed that the insulation will be laid to falls to achieve the required slope for adequate drainage for a flat roof.

7.4.4 Beams

Roof beams are typically arranged with cellular secondary beams at no more than 3.5m centres spanning onto universal beam primary and edge beams. The beams are designed to act compositely with the slab in both the permanent and restrained by the decking in the construction cases. The decision was taken to use cellular secondary beams to minimise the weight of steel required for the long spans. Three sections have been utilised to provide an optimal design for each combination of span/loading.

In the case of primary and edge beams it was decided to use universal beam sections as the spans are generally shorter and infills would be required if cellular beams were used here, leading to an increased construction time and cost. Typically 686UB sections have been used for the long span primary beams or in areas with plant loading. The 533UB series of sections have been used for short span and edge beams to minimise the number of different serials used throughout the building, whilst ensuring that there is not a significant difference in depth between primary and secondary members for simplifying the connection details.

It should be noted that there is no requirement from the university for any lifting beams in the workshop areas and that the beams have not been designed for any load fixing points.

All beams which are greater than 10m are to be precambered.

7.4.5 Roof Plant Room

The main plant room is located on the main roof level in the northern west corner. It is covered with a steel frame pitched roof. The steel columns extend through from the level below and braced. Roof bracing provides in-plane bracing for the roof.

7.4.6 Roof Pop-Ups

There are 3 roof pop-ups which extend above the main roof level. These provide provision for roof lights, PV mounting and internal plant space for air handing units and exhausts from the equipment in the rooms below.

The frame is to be a simple steel braced frame supported on the main roof level steelwork. Provisions of trimmer steelwork are provided for openings in the roof level for light and plant risers.

7.4.7 Parapet

The perimeter columns extend above the main roof level to provide the parapet support. Intermediate posts are provided at secondary beam locations to provide additional restraint to the heads of the parapet. Alternatively, proprietary wind posts can be provided as discussed in section 6.5.4.

7.4.8 Roller Shutter Doors

Typically at all roller shutter door locations there are columns and a beams above at roof level. The roller shutter doors will require secondary framing support connecting back to the main structural frame. Details to be developed in the next stage of design.

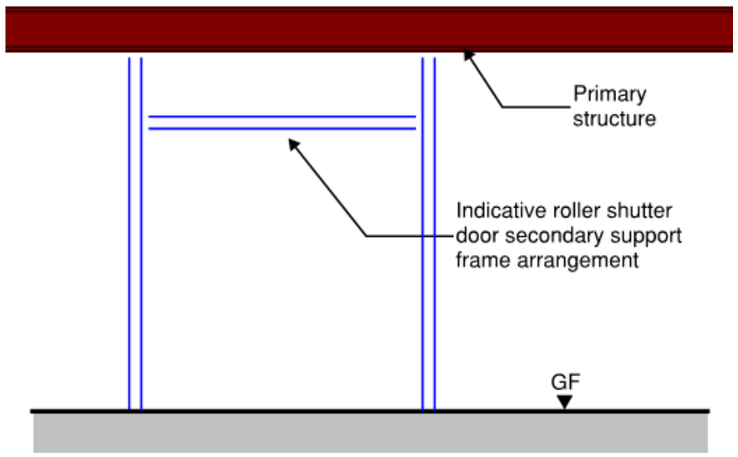
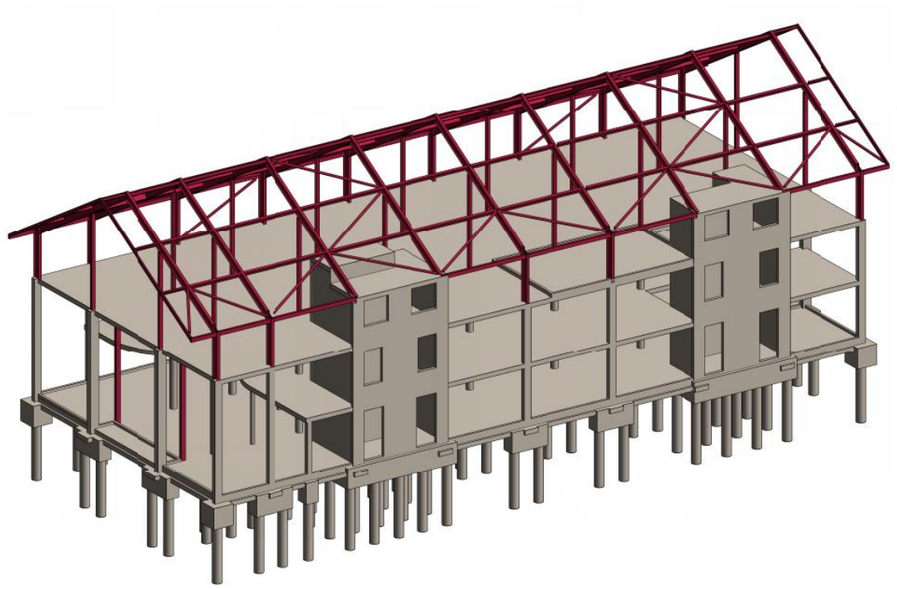


Figure 12: Indicative goal post arrangement to support the roller shutter doors.

7.4.9 Cladding Support

The majority of the cladding is to be lightweight panels over a brickwork plinth with the panels fixed to the main frame via SFS framing. At the North West corner, the masonry cladding extends full height the underside of the pitched roof over the roof level plant room. The masonry is to be supported from secondary framing/proprietary shelf angles off the primary structure. A perimeter cladding beams is to be provided at the window head level to support the masonry cladding above.

8 Structural Engineering Proposal - LIBRARY



This section is to be read in conjunction with the structural drawings which are included in Appendix E.

8.1 Foundations

The Library is to be supported on pile foundations typically with pile caps at column positions.

The foundation layout is based on a 600mm diameter CFA pile, 20m long with a compressive capacity of 1000kN. The pile capacity is based on the assumptions noted in Section 2. The foundation design is to be confirmed in the next stage of design following the full Site Investigation.

8.2 Substructure

8.2.1 Pile Caps

The columns sit on pile caps which spread the loads to the piled foundations. The pile caps range from single pile cap to 2 and 3 pile caps. The reinforced concrete stability cores are supported on large pile cap groups. Typically all pile caps are 1400mm deep.

The internal column pile cap levels are set 175mm below the ground floor FFL level and will be tied into ground floor slab. For single pile caps, it is assumed that the slab will be cast monolithic with the pile caps before the superstructure is constructed to ensure the piles have adequate lateral restraint.

The perimeter column pile cap levels are set 450mm below the ground floor FFL with additional concrete nibs cantilevering out to support the masonry brick piers at column locations.

8.2.2 Ground Beams and Floor Slab

The ground floor slab SSL is 175mm below FFL to allow for a 100mm insulation and 75mm screed over the slab to Architects details. The slab SSL and top of the internal pile caps are set at the same level.

The ground floor slab is a 300mm thick flat slab spanning between pile caps with a perimeter upstand to provide an edge to the ground floor build up and support the curtain walling. The ground beams around the perimeter provide an edge detail which extends the structure below the frost line.

8.2.3 Lift Pits and Recesses

The core pile cap is arranged to allow a recess in the base for the lift pit. The lift pit base is currently assumed to be 1050mm below the FFL. Details and setting out of the lift pit is to be provided by the Architect in the next stage of design.

The lift pit is to be externally tanked with a waterproof membrane such as Fosroc Proofex. Details are to be developed in the next stage of design following confirmation of the ground water levels.

8.3 Stability System

The main building stability system is provided by two reinforced concrete cores consisting of walls around the stair and lifts.

The main floor slabs act as diaphragms (stiff plates) to transfer the forces into the vertical stability structure. The cores are positioned on the south side of the building. They provide sufficient lateral stiffness to the building and the distance between both cores provides torsional stiffness to resist the eccentricity of the cores on plan in the east west direction. The cores acts as cantilevers, using push-pull in the piles to resist overturning at the base and shedding the horizontal load into the ground.

The steel roof structure stability is provided by a braced frame and discussed further in Section 8.5.

8.4 Superstructure

The building superstructure is a reinforced concrete frame to level 2 with the reinforced concrete cores extending to the underside of the roof.

A steel roof frame is provided above level 2 to form the roof structure.

8.4.1 Columns

The columns are arranged on a regular grid of typically 6.3m along the length of the building with a 6.3m edge spans and a 7.5m internal span across the width of the building.

The reinforced concrete columns are typically 450mm diameter internal and 500mm x 300mm rectangular columns on the perimeter. 250mm diameter and 300mm square columns are provided to support the level 1 slab which is set back at the main entrance area.

Steel CHS wind posts are provided between the ground floor and level 1 in the main entrance area to support the cladding where the gable end is recessed back from the main façade line.

The steel columns above level 2 are a combination of universal beams and box sections. The perimeter columns are universal column sections with RHS box sections are provided as wind posts at each gable end. The internal columns on the south side which are within the ancillary areas (WC, sever room and plant rooms) are UC sections with columns in open and flexible areas being CHS.

The columns in the plant room area are in an external environment and will be galvanised.

8.4.2 Walls

The reinforced concrete walls around the stair and lift core are to be 200mm thick with openings for doors and windows. The walls will be capped with a 250mm thick slab to tie the walls at the roof level.

The walls are to be exposed within the stair spaces with a good quality fair faced finish to the concrete. The nature and quality of the finish is to be agreed with the Architect before commencing works. It is recommended that an onsite reference trial panel is constructed to agree finish quality and jointing.

8.4.3 Floor Slabs

The main floor levels are to be 300mm thick flat slab. On the north and south elevation the slab edge is in line with the outer face of the column. On the east and west elevation the slab edge is inset to the gridline with a minimum of half the column width slab connection on one side.

The level 1 slab is set back from the main entrance area, additional columns are provided to support this slab edge.

The flat slab provides a flat soffit for the ease of service distribution through the library. It is expected that the library will have exposed soffits in most areas which allows the exploitation of the building's thermal mass in the design of heating, ventilation and cooling requirements, increasing energy efficiency.

The soffits are to be exposed with a good quality fair faced finish to the concrete. The nature and quality of the finish is to be agreed with the Architect before commencing works. It is recommended that an onsite reference trial panel is constructed to agree finish quality and jointing.

Currently there is only one riser void shown in the slab. The size and location of the risers are to be confirmed by the Architect and Services engineer in the next stage of design.

8.4.4 Stairs

The stairs can be in-situ or precast concrete stairs designed to the loading shown on the loading plans. The stairs should be anchored to the main structure for robustness.

8.5 Roof Structure

8.5.1 Roof Stability

The roof structure is to be a steel braced frame. The roof stability in the north south direction is provided by the roof bracing which is transferred into the reinforced concrete cores. Horizontal beams are provided at the head of the internal columns at the core locations to provide a direct load path into the core. In the east west direction the roof bracing spans between the core and braced bay which is on the north elevation between level 2 and the roof eaves.

8.5.2 Roof Steelwork

The roof structure is a steel frame with internal columns to support the roof rafters. The roof will be formed with standing seam roofing over insulation supported on a structural liner tray or purlins spanning between the main roof structure.

The structural liner tray is a RoofDek D60 (1.2) with a maximum span of 4.4m between the structural frame.

8.5.3 Cast-in Connections

The roof steelwork is to have cast-in connections for the steel column based plate connection to the reinforced concrete frame at level 2. Corbel details within the concrete structure may be required to transfer the loads from the steel to concrete frame.

The eaves beams connecting to the side of the reinforced concrete core walls will require vertical cast in plate connections. These are to be designed to transfer the shear force from the beams and the moment induced from the eccentricity of the fin plate connection to the concrete wall.

8.5.4 Roof Plant Room

The plant room at level 2 is within the building envelope but will be an external space. A concrete upstand will be provided around the space to form a barrier between the internal and external space at level 2 to aid waterproofing. The steelwork in the plant room will be in an external environment and will need to be galvanised and connections detailed to avoid cold bridging between the internal and external space.

It is assumed that the plant equipment will have adequate damping between their individual supports and the floor structure to minimise any vibration impact on the level 2 spaces. It is also assumed that there will be adequate acoustic performance for the boundary between the plant room and adjacent spaces.

9 Specification

9.1 Geotechnical Engineering

9.1.1 Outline Piling Specification

The specification for the piling works shall be the ICE Specification for Piling and Embedded Retaining Walls 2nd Edition, published by Thomas Telford Ltd in 2007, with the following additions:

- The design of the foundation scheme shall be undertaken by the Engineer. The design of the piles to carry the required loads shall be undertaken by the Contractor and shall be CFA or bored piles. The design shall be undertaken in accordance with BS EN 1997.
- Bending as a result of eccentric loading applied to the pile caps shall be considered in the pile design by the Piling Contractor.
- The concept pile design is shown on Drawings
    - UWTSD-ARP-AA-FN-DR-S-101.
    - UWTSD-ARP-BB-FN-DR-S-201.
    - UWTSD-ARP-CC-FN-DR-S-301.
- The design life shall be 50 years.
- Total settlements shall not exceed 15mm and differential settlements between adjacent columns shall not exceed 1:500.
- Integrity testing shall be undertaken on all piles
- Load tests shall be performed on at least 1% of the contract piles and every pile type / diameter.

9.2 Civil Engineering

The civil engineering works should be designed in detail in accordance with the following standards:

- The Building Regulations 2010: Approved Document Part H and M – Drainage & waste disposal and Access to end use of buildings
- BS EN 752:1998 Drain and sewer systems outside buildings (Parts 1-7)
- BS EN 12056:2000 Gravity drainage systems inside buildings (Parts 1-5)
- Sewers for Adoption: A design and construction guide for developers (7th Edition)
- BS8300:2001 Design of buildings and their approaches to meet the needs of disabled people – code of practice
- If highways are to be adopted, the components should be designed in accordance with Swansea City Council Standard Highway Details

The preliminary specification for Civil Engineering elements is presented in Appendix F and follows the NBS format. Surface finish details are shown on CG1002 and the specification, however, further input is required from the Landscape Architect regarding the products used for the various paving elements.

9.3 Structural Engineering

The following outline project specific structural specifications have been included in Appendix F.

- National Structural Concrete Specification 4th Edition
- National Structural Steelwork Specification 5th Edition

10 Structural Items by Others

The majority of structural and civil elements will be designed and detailed by the Structural Engineer, however where elements of work are designed by sub-contractors or suppliers, the Structural Engineer will be responsible for reviewing that the design complies with the performance requirements and co-ordinating these elements with the main structural works only. Elements that are expected to be in this category include:

- Precast concrete elements (e.g. stairs, precast planks etc)
- Steel staircases
- Proprietary retaining structures (e.g. gabions, Criblok)
- Proprietary cold-rolled steelwork (typical sizes have been be provided)

The Structural Engineer should assist in the co-ordination of the permanent works to accommodate these elements. In addition the Structural Engineer will review and comment on the design solution proposed by the designers and will carry out sufficient checks to satisfy themselves that the design intent has been met, works in this category include:

- Steelwork Connections
- Bases and supports for major services plant including lifts.
- Lifting Beams
- Architectural Metalwork (handrails, balustrades etc.)
- Internal Partitions
- External Cladding
- Final Proprietary Waterproofing Details

The Structural Engineer should review any contractor’s temporary works proposals with respect to their effect on the permanent works.

11 Construction Sequence Commentary

The following items are key design assumptions which are critical to the construction sequence for each building.

11.1 FACE Building

11.1.1 Substructure

Where single or 2 pile caps are provided, it is assumed that the ground floor slab is cast monolithic with the pile caps to provide lateral restraint before any vertical loads are exerted onto the piles.

11.1.2 Superstructure

The floor beams have been designed assuming that the beams are laterally unrestrained during construction to support the weight of the precast concrete planks and the wet concrete.

The FACE building level 3 transfer beams requires the level 3 slab to be cast in order to provide lateral restraint to the beam before any loading from above can be transferred.

11.2 TECH Building

11.2.1 Substructure

Currently there are no key design assumptions which impacts the construction sequence of the substructure.

11.2.2 Superstructure

An area on the roof adjacent to the roof plant room area has been designed to accommodate plant loading. This allows for the lifting of plant equipment onto the roof for moving into the enclosed plant room space. This is highlighted on the loading plans in Appendix D.

11.3 Library

11.3.1 Substructure

Where single or 2 pile caps are provided, it is assumed that the slab is cast monolithic with the pile caps to provide lateral restraint before any vertical loads are exerted onto the piles.

11.3.2 Roof Structure

The steel roof structure is supported on the reinforced concrete frame. The concrete frame will require to achieve sufficient strength prior to the fixing of the roof steelwork.

12 CDM Issues

A preliminary risk assessment has been carried out. It is a live document and should be constantly reviewed throughout the design process. For further reference should be made to the Civil and Structural Hazard Risk Register in Appendix G.

12.1 Critical Issues during Construction

12.1.1 Substructure

The FACE building and Library substructure utilises the ground floor slab to tie and provide lateral restraints to the pile caps. Where single or 2 pile caps are provided, it is essential that the slab is cast to provide lateral restraint to the piles before any vertical load is applied to the piles. Should the contractor wish to load these piles before the ground floor slab is constructed, additional ground beams or temporary props will need to be provided between adjacent pile caps to provide lateral restraint.

12.1.2 Superstructure

The FACE building level 3 transfer beams requires the level 3 slab to be cast in order to provide lateral restraint to the beam before any loading from above can be transferred.

The FACE and TECH buildings utilises the diaphragm action of the slabs to provide in-plane stability to the structure. The precast planks will not provide any restraint to the beams until the structural topping has been cast.

12.2 Future Demolition

In the first instance, it should be noted that demolition should only be considered if a detailed appraisal confirms that the building is not suitable for the future use of the site. Re-use of an existing building (or its structural frame at least) is the most efficient, sustainable and safest means of re-developing a site.

12.2.1 Superstructure

If demolition is considered necessary, the concrete superstructure lends itself to a controlled demolition process. The following issues should be carefully considered:

Columns

The removal of the floor slabs would have to be undertaken top-down, and in a sequential manner. This is essential as the slabs restrain the columns, and removing floor plates in a non-sequential manner or from bottom-up will increase the columns' effective lengths and reduce their capacity to support the axial load.

Transfer Structures

There are transfer beams at level 3 of the FACE building, consideration should be given to transfer load paths during any demolition.

12.2.2 Substructure

The substructure is of reinforced concrete construction. In isolation, the demolition would be straightforward.

13 Outstanding Design Issues and Costing Notes

13.1 Outstanding Design Issues

The following items records outstanding design issues from RIBA Stage 3 that are to be developed in the next stage of design. These identified areas of information that are either incomplete at this stage or require further investigation before full and final details can be prepared.

13.1.1 Civil Engineering Design

The following items will need to be developed during the next design stages:

- Finished levels of the roads, service yards, and other hardstandings in relation to the building, taking into account the entries into the building, road gradients, generate drainage falls whilst also ensuring DDA compliance.
- Horizontal and vertical alignment of the roads using conventional design packages such as Microstation InRoads, track vehicles for swept path using software such as WinTrack.
- Locations of gullies and downpipes, consider use of linear drainage channels and kerb drainage for surface water run-off, model the surface water drainage network in detail using conventional drainage packages such as WinDES MicroDrainage to confirm pipe sizes and generate invert levels and manhole schedules. Assess flows into Petrol Interceptor and determine size and specification of separator.
- Positions of waste traps, toilets etc, within the buildings and model the foul water drainage network in detail using conventional drainage packages such as WinDES MicroDrainage to confirm pipe sizes and generate invert levels and manhole schedules.
- Site investigation to assess condition and CBR of the formation material, together with the space available between the building and dock wall to confirm if storm drainage can be installed within this gap.
- Specification of the surfacing throughout the development and review construction thicknesses, taking into account loading imposed.
- Kerb and edging position, specification and details.
- Co-ordination and clash detection of drainage runs, utilities and landscaping.

13.1.2 Structural Engineering Design

The list below summarises the key structural engineering items to develop during the next stage of the design phase:

a) Progress general co-ordination of structure with Architecture and Services – super and substructure:
    - Finalise risers sizes and locations
    - ***Final*** co-ordination of concrete cores and steel bracing with Architectural layouts
    - ***Final*** co-ordination of sub and superstructure vertical structure (columns and walls)

b) Develop and finalise the foundation layouts based on the Site Investigation Report.

c) Further development and coordination of the structural design for the following items:
    - FACE Building
        - Roof pop-up details
        - Main stair well roof structure
        - Roof level parapet details including precast cornice support
        - Roof level plant screen structure
        - Roof diaphragm action
    - TECH Building
        - Roof pop-up details
        - Plant room roof structure
        - Roof level parapet details
    - Library Roof structure

d) Finalise setting out details and support requirements for the following items in the TECH building:
    - Roller shutter doors
    - Car lift
    - Rolling Road
    - Fuel Line
    - External bunded slab to support fuel and water storage tanks

e) Finalise and setting out of all the cladding support details
    - Ground beam setting out
    - Wind Posts
    - Cladding support beams

f) Finalise setting out details and support requirements for stairs and lifts

g) Finalise setting out details and locations of upstands

h) Finalise setting out of precast concrete planks arrangement

i) Finalise precamber requirement for all beams greater than 10m.

j) Review joints in the TECH building ground floor structure.

k) Development of all cast-in plate connections (base plates and vertical connections cast-in plates)

l) Carry out a footfall analysis to verify the vibration performance of the floor structures

m) Develop waterproofing details for lift pits based on the Site Investigation Report.

n) Advise on fence post and gate supports foundation detail

o) Advise on external garage structure

p) Further development and coordination of balustrades and signage support requirements

q) Finalise corrosion protection allocation

r) Finalise building movements and tolerances

13.2 Costing Notes

The following information has been prepared to inform the cost consultants and tendering contractors of the additional information not yet shown on the drawings that might have a cost implication.

These notes should be used to assess the risk to the cost plan and allow for appropriate contingencies to be applied.

13.2.1 Civil Engineering

The extent of the civil engineering elements are shown on the drawings and described in the specification, however the following should be taken into account and risk allowances included:

- The number of drainage gullies are likely to vary, and can only be determined at detailed design stage. Risk allowances should be included for additional gullies, drainage runs and/or linear drainage channels.
- The location of downpipes has not been confirmed. Additional drainage runs, saddles and/or manholes may be required to pick up all runs.
- The drainage networks have yet to be modelled, variations in pipe sizes, manhole locations and depths may be generated once the network is modelled. The size and type of the petrol interceptor will also need to be determined.
- The width and extent of road and footway/cycleways may increase from that shown.
- The surfacing details and loading in pedestrian areas have not been confirmed, additional construction thicknesses may be required.
- The type and extent of kerbing and edging around the roads and hardstandings.
- A CBR of >5% has been assumed, should the CBR be less than 5%, additional layers of capping material may be required.

13.2.2 Steelwork Allowances

The extent of new steelwork is broadly as described on the drawings and this report. In addition to this information the following allowances should be made:

- Allow for 1 No. shear studs at 200cts to all primary steel floor beams and 300cts to all secondary steel floor beams.* (FACE)
- Allow for 2 No. shear studs at 200cts to all primary steel floor beams and 300cts to all secondary steel floor beams.* (TECH)
- Allow for 1 stud at 300 cts for 203 deep UC's sections. (FACE)
- All steelwork to be fire protected to achieve the 60 minute fire ratings. It is anticipated that the steel beams will be protected with 'off site applied' intumescent paint. The steel columns can be protected by either intumescent paint or fireboard.
- All steelwork to be S355 with sub grades in accordance with BS EN 1993-1-10.
- Allow for all beams with spans greater than 10.0m to be precambered.
- Allow for column splices every two floors
- Additional trimmer steelwork will be required around openings in the structural slabs over and above the amount already shown on the drawings.
- Allow for all secondary steel to lift shafts. Details to be designed and coordinated by the lift supplier.
- Allowance for base plates and holding down bolts at all column locations
- Allowance for cast-in connections for the library roof structure

** Note*

Secondary Steel Floor Beam = Beam spanning perpendicular to span of the floor deck

Primary Steel Floor Beam = Beam spanning parallel to span of the floor deck

13.2.3 Concrete works – Sub and Super structure

The extent of new concrete works is basically as described in this report and on the drawings. In addition to this information the following should be allowed:-

- The following reinforcement allowances should be made. These are based on typical reinforcement rates.

Pile Caps	150kg/m^3
Ground Beams	250kg/m^3
Ground Floor Slab	150kg/m^3
Flat Slab	135kg/m^3
Columns	250kg/m^3
Core walls	100kg/m^3
Insitu suspended slabs on metal deck	8kg/m^2 on plan and 6kg/m to all edges
Upstands	100kg/m^3
Structural screeds	4kg/m^2

In addition to these figures allowance should be made for chairs to support the reinforcement.

- Allow for C32/40 concrete for all concrete strcutures U.N.O.
- Allow for all exposed concrete arises to rectangular elements to have 25mm x 25mm chamfers.
- Allow for 300mm high 150mm wide RC plinths to plant in plantrooms. (extent unknown at this stage)
- Allow for cast in fixings to all lift shafts and slab edges for lift steelwork and cladding.
- Allow for bent-out reinforcement in core walls for connection to in-situ slabs; for both the sub and superstructure.

13.2.4 General Allowances

Additional items:

Many items will be defined by or required in support of other packages of work, such as cladding and building services. Their precise requirements will not be known until after a steelwork contractor is appointed e.g.

- Connection and base plate details
- Cleats, lugs and brackets for attachments
- Notches and holes in beams, fabricated off-site
- Bolt holes in steelwork, drilled off-site (for example for cladding attachments)
- Off-site corrosion protection to steelwork
- Cast-in fixings for support of cladding
- Cast-in sleeves in walls, slabs and ground beams
- Additional services openings in slabs and walls
- Plant support bases

Site Activities:

Ideally all steelwork fabrication and corrosion protection will be done off-site, but inevitably some may have to be carried out on-site i.e.

- Notches in steel beams, cut and reinforced on-site
- Holes in steelwork, cut and reinforced on-site
- On-site corrosion protection to steelwork
- On-site fire protection to steelwork
- Holes cut in concrete slabs and walls (where information for forming the holes is not available in time)
- Bolt holes drilled in concrete (where information for casting in bolts or sockets is not available in time)

Secondary and tertiary steelwork items (all contractor-designed)

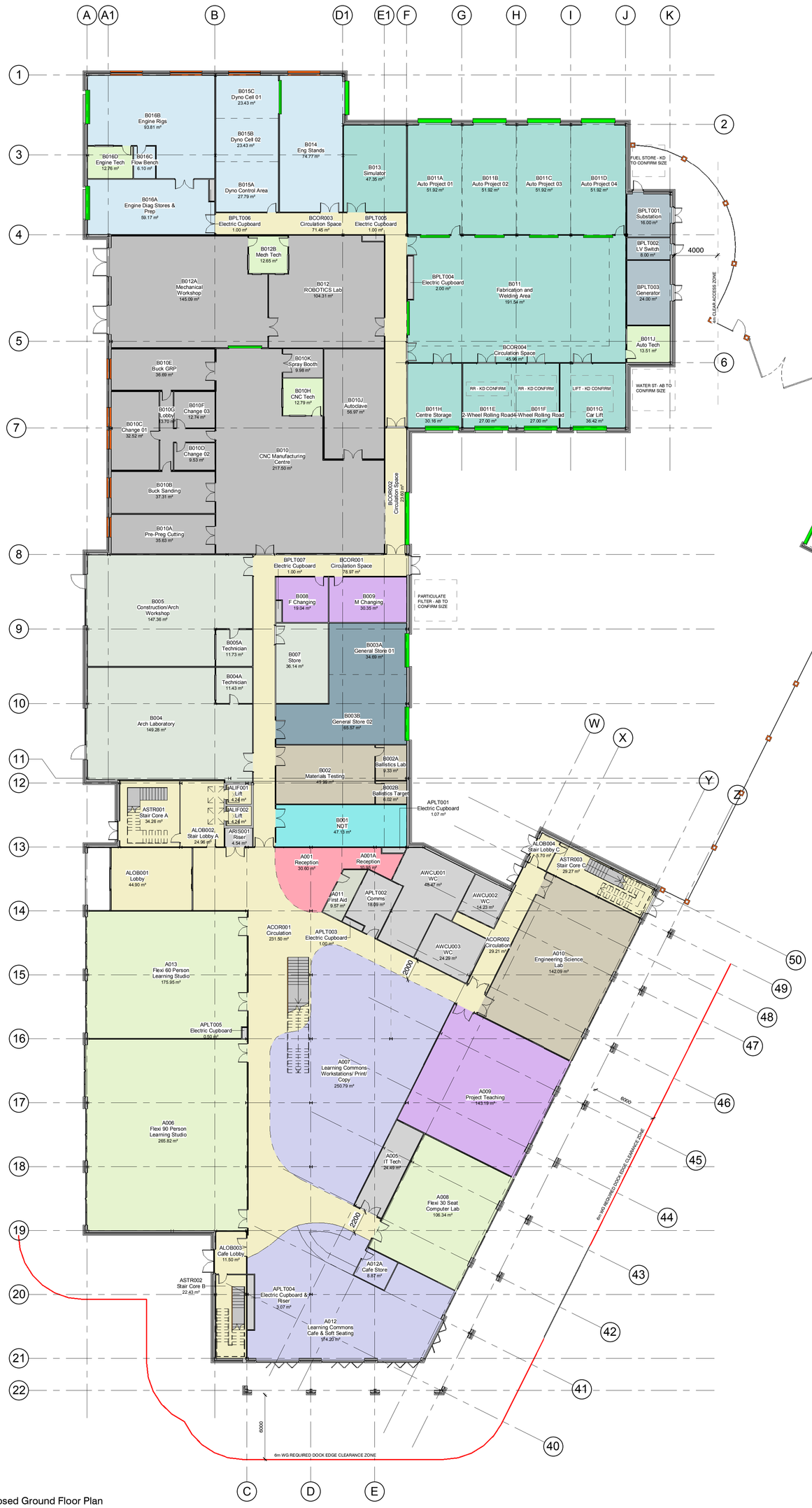
- Minor trimmers to steps and recesses in slabs
- Door trimmers
- Windposts, Lintels, Bedjoint reinforcement
- Cold rolled side and roof rails
- Posts supporting handrails
- Lifting beams – lifts and plant
- Plant screens and enclosures – general support steel
- Stainless steel ledger angles for masonry
- Supports for M, E & PH items
- Access gantries on/around plant
- Services support racks
- Chequer plate infills to service risers
- Cast-in Unistrut/Halfen channels
- Service trench cover plates
- Mansafe system eyes and attachments
- Handrailing
- Signage bracketry and supports
- Abseiling system eyes and attachments (if required)

Appendix A

Architectural Drawings

Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.

0mm 50mm 100mm



Proposed Ground Floor Plan
1 : 200

Colour Schedule

- Architecture
- Automotive Centre
- Building Support
- Central Store
- Circulation
- Core
- Engine Diagnostics
- Engineering Science
- Faculty
- Flexi
- Garage
- Learning Commons
- Manufacture Centre
- NDT
- Plant
- Project Teaching
- Tech Bases

STATUS	REV	DATE	DESCRIPTION
S1	P2	12/02/16	RIBA Stage 3 Control Estimate. Building model updated to include amended layout and client requirements. Further co-ordination with ESHA elevations completed.
S2	P1	03/02/16	General revision to align with VE/comments from KD
S0	P0.7	21/01/16	Work in progress issue
S0	P0.5	18/01/16	Work in progress issue
S0	P0.3	15/01/16	Work in Progress issue for ICT integration
S0	P0.2	12/01/16	Work in progress issue
S0	P0.1	04/01/16	Minor Revision CAT 8 Removed

CONSULTANT

Stride Treglown

REVISED BY Aled Jones
CHECKED BY Ian Standen

© Stride Treglown Limited 2015

stridetreglown.com

CLIENT NAME
University of Wales Trinity Saint David

ORIGINATOR NO
70266_01

PROJECT
UWTSD FACE and Tech
University of Wales Trinity Saint David
Swansea
SA1

DRAWING TITLE
Proposed Ground Floor Plan

SUITABILITY STATUS
S1 Co-ordination

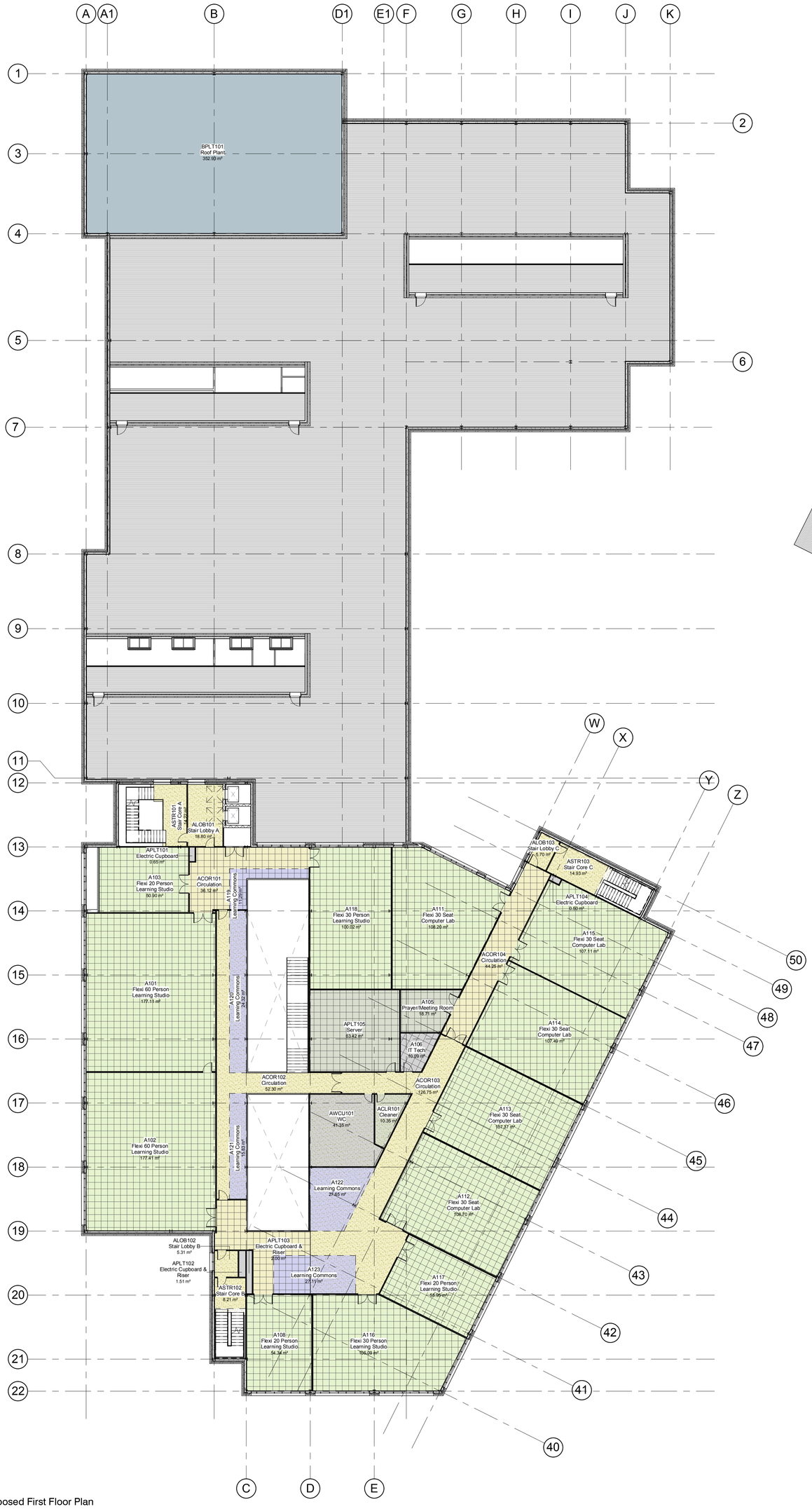
SCALE
1 : 200 @ A1

PROJECT | ORIGINATOR | ZONE | LEVEL | TYPE | ROLE | CLASS | NUMBER
UWTSD_01-STL-00-GF-DR-A-ZZ-02002

REVISION
P2

Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.

0mm 50mm 100mm



Proposed First Floor Plan
1 : 200

Colour Schedule

- Building Support
- Circulation
- Core
- Flexi
- Learning Commons
- Plant
- Void

STATUS	REV	DATE	DESCRIPTION
S1	P2	12/02/16	RIBA Stage 3 Control Estimate. Building model updated to include amended layout and client requirements. Further co-ordination with ESHA elevations completed.
S2	P1	03/02/16	General revision to align with VE/comments from KD
S0	P0.7	21/01/16	Work in progress issue
S0	P0.5	18/01/16	Work in progress issue
S0	P0.3	15/01/16	Work in Progress issue for ICT integration
S0	P0.2	12/01/16	Work in progress issue. Drawing number amended to conform with BS
S0	P0.1	04/01/16	Minor Revision CAT 8 Removed

CONSULTANT

Stride Treglown

REVISED BY: Aled Jones
CHECKED BY: Ian Standen

© Stride Treglown Limited 2015

stridetreglown.com

CLIENT NAME
University of Wales Trinity Saint David

ORIGINATOR NO
70266_01

PROJECT
UWTSD FACE and Tech
University of Wales Trinity Saint David
Swansea
SA1

DRAWING TITLE
Proposed First Floor Plan

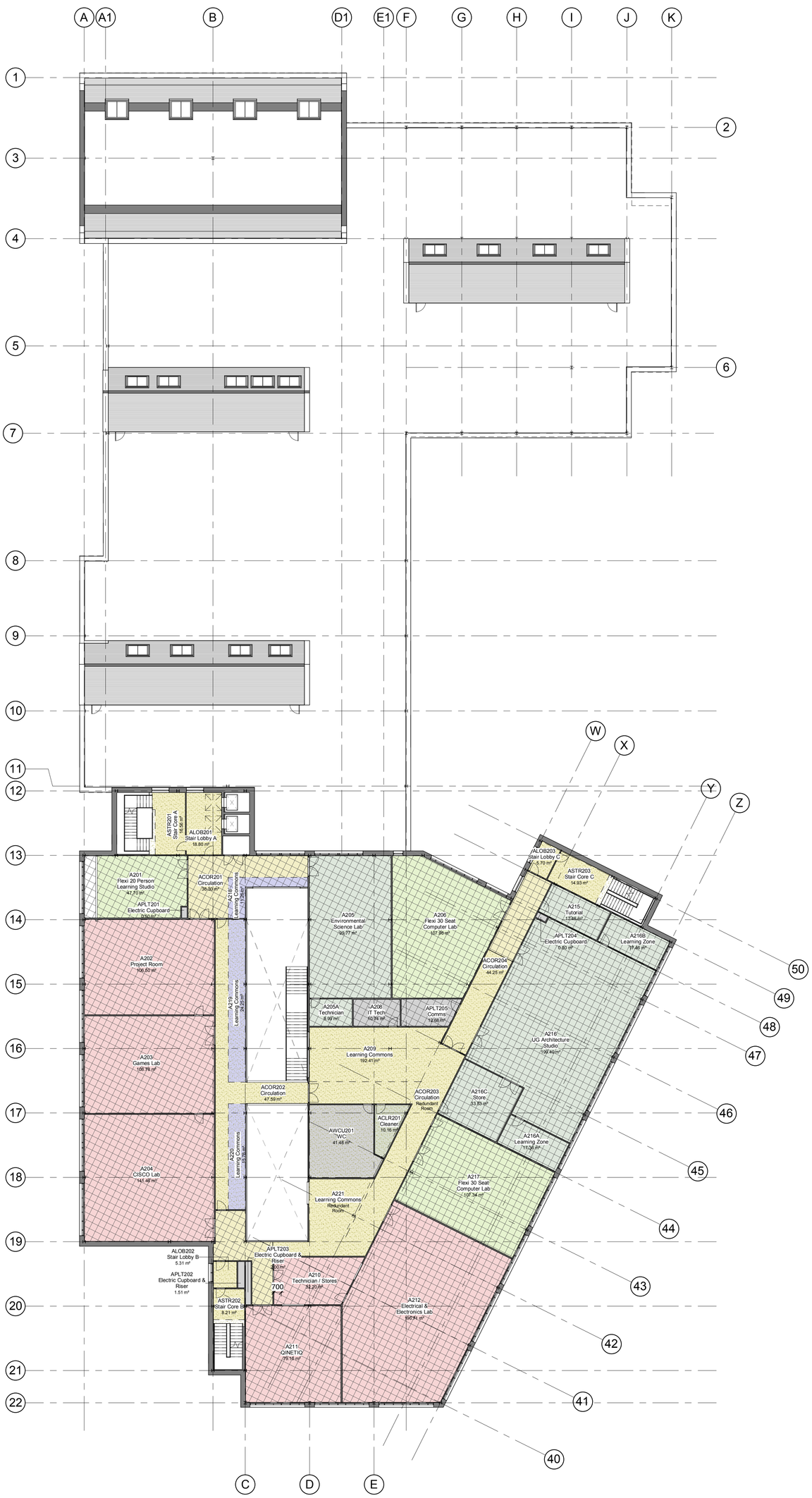
SUITABILITY STATUS
S1 Co-ordination

SCALE
1 : 200 @ A1

PROJECT | ORIGINATOR | ZONE | LEVEL | TYPE | ROLE | CLASS | NUMBER
UWTSD_01-STL-01-01-DR-A-ZZ-02003

REVISION
P2

Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.
0mm 50mm 100mm



Proposed Second Floor Plan
1 : 200

Colour Schedule

- Architecture
- Building Support
- Circulation
- Computing
- Core
- Flexi
- Learning Commons
- Void

S1	P2	12/02/16	RIBA Stage 3 Control Estimate. Building model updated to include amended layout and client requirements. Further co-ordination with ESHA elevations completed.
S2	P1	03/02/16	General revision to align with VE/comments from KD
S0	P0.7	21/01/16	Work in progress issue
S0	P0.5	18/01/16	Work in progress issue
S0	P0.3	15/01/16	Work in Progress issue for ICT integration
S0	P0.2	12/01/16	Work in progress issue. Drawing number amended to conform with BS
S0	P0.1	04/01/16	Minor Revision CAT 8 Removed

STATUS	REV	DATE	DESCRIPTION

CONSULTANT

Stride Treglown

REVISED BY: Aled Jones
CHECKED BY: Ian Standen

© Stride Treglown Limited 2015

stridetreglown.com

CLIENT NAME
University of Wales Trinity Saint David

ORIGINATOR NO
70266_01

PROJECT
UWTSD FACE and Tech
University of Wales Trinity Saint David
Swansea
SA1

DRAWING TITLE
Proposed Second Floor Plan

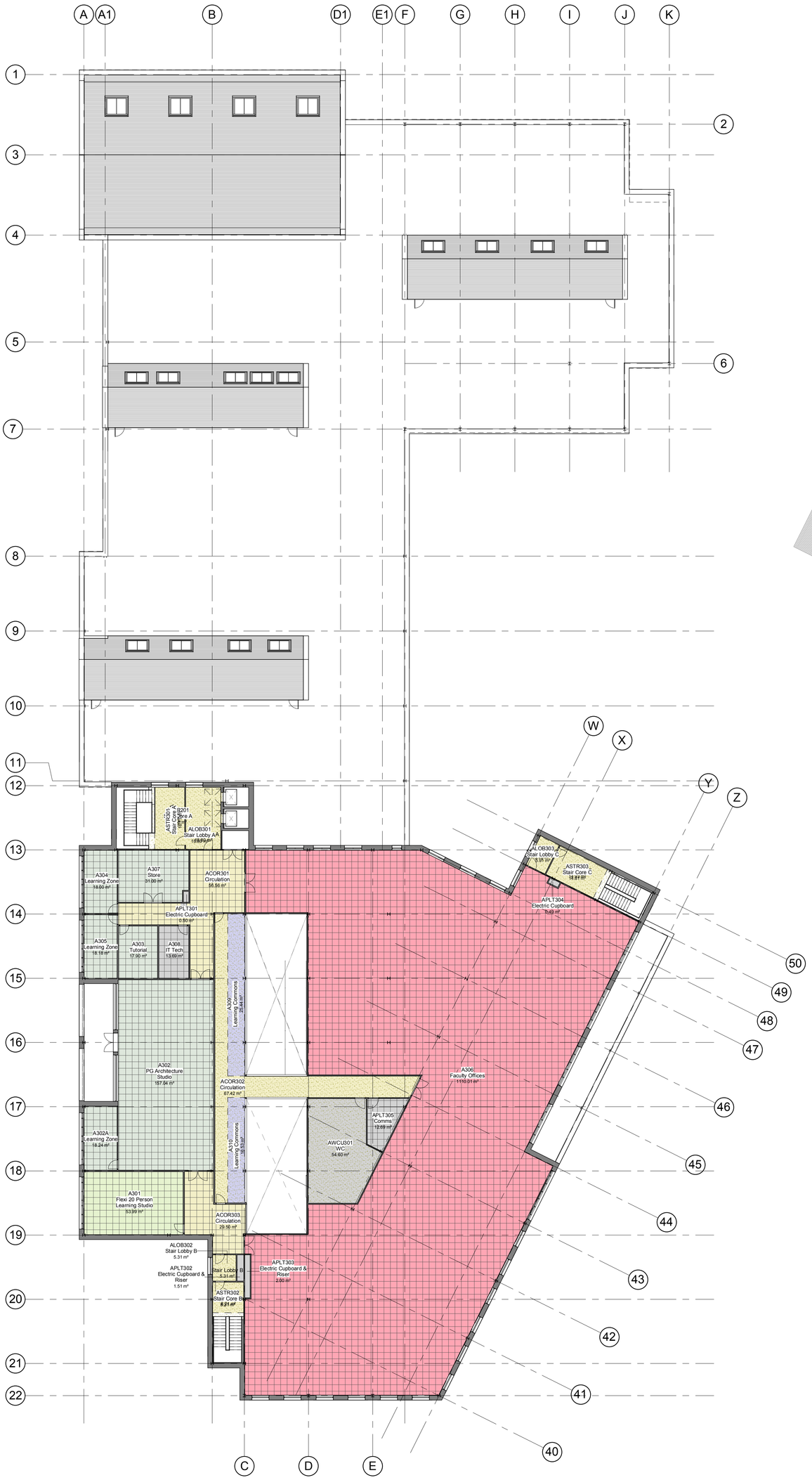
SUITABILITY STATUS
S1 Co-ordination

SCALE
1 : 200 @ A1

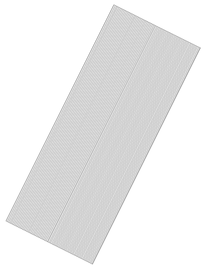
PROJECT | ORIGINATOR | ZONE | LEVEL | TYPE | ROLE | CLASS | NUMBER
UWTSD_01-STL-01-02-DR-A-ZZ-02004

REVISION
P2

Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.
0mm 50mm 100mm



Proposed Third Floor Plan
1 : 200



Colour Schedule

- Architecture
- Circulation
- Core
- Faculty
- Flexi
- Learning Commons
- Void

STATUS	REV	DATE	DESCRIPTION
S1	P2	12/02/16	RIBA Stage 3 Control Estimate. Building model updated to include amended layout and client requirements. Further co-ordination with ESHA elevations completed.
S2	P1	03/02/16	General revision to align with VE/comments from KD
S0	P0.7	21/01/16	Work in progress issue
S0	P0.5	18/01/16	Work in progress issue
S0	P0.3	15/01/16	Work in Progress issue for ICT integration
S0	P0.2	12/01/16	Work in progress issue. Drawing number amended to conform with BS
S0	P0.1	04/01/16	Minor Revision CAT 8 Removed

CONSULTANT

Stride Treglown

REVISED BY: Aled Jones
CHECKED BY: Ian Standen

© Stride Treglown Limited 2015

stridetreglown.com

CLIENT NAME
University of Wales Trinity Saint David

ORIGINATOR NO
70266_01

PROJECT
UWTSD FACE and Tech
University of Wales Trinity Saint David
Swansea
SA1

DRAWING TITLE
Proposed Third Floor Plan

SUITABILITY STATUS
S1 Co-ordination

SCALE
1 : 200 @ A1

PROJECT | ORIGINATOR | ZONE | LEVEL | TYPE | ROLE | CLASS | NUMBER
UWTSD_01-STL-01-03-DR-A-ZZ-02005

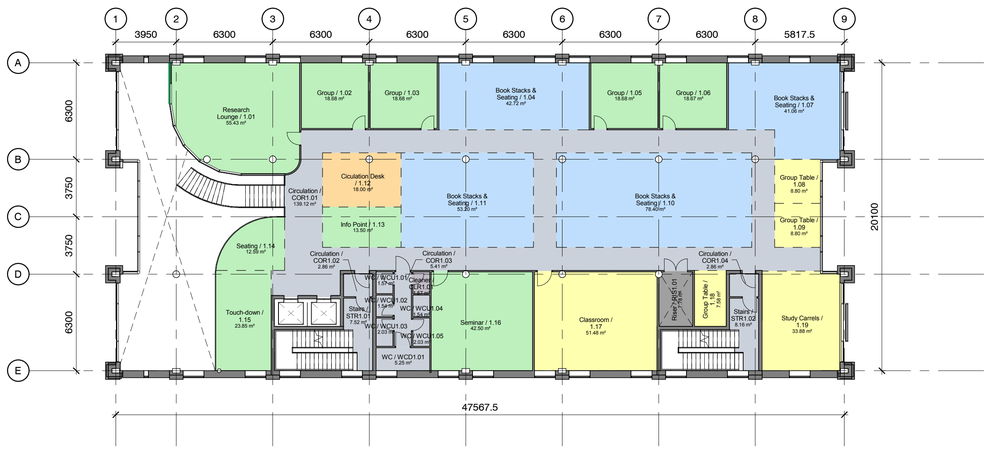
REVISION
P2

Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.

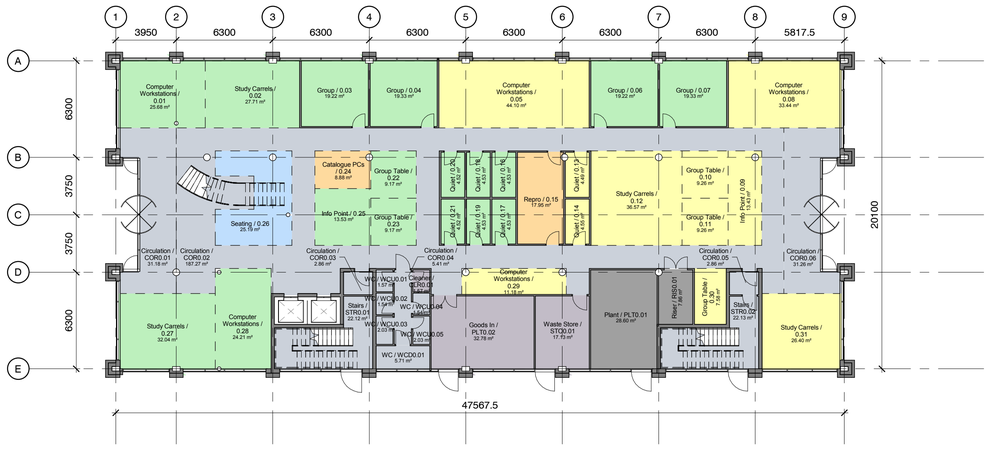
0mm 50mm 100mm



02 Second Floor Level
1 : 200



01 First Floor Level
1 : 200



00 Ground Floor Level
1 : 200

Book Stacks
Building Support
Circulation / Core
DRC
Learning Commons
Plant
Staff

GIA Area Schedule	
Level	**Area**
00 Ground Floor Level	931.60 m²
01 First Floor Level	816.39 m²
02 Second Floor Level	950.85 m²
Grand total	2698.83 m²

STATUS	REV	DATE	DESCRIPTION
S1	P2	12/02/16	RIBA Stage 3 control estimate. Building model updated to include amended plant space information. Further co-ordination with ESHA elevations completed.
S0	P1.4	09/02/16	Building reduced to 3 storeys. Phasing removed. Internal layout amended to client's requirements.
S0	P1.3	15/01/16	Work in Progress issue for ICT integration
S2	P1.0	05/01/16	WC areas amended following fire strategy meeting. Circulation area to first floor group rooms added.
S0	P0.8	16/12/15	Areas aligned to Stage 2 report and interior arrangement amended to suit.
S0	P0.7	14/12/15	Line between phases 1 and 2 amended. Grid line 10 and wall position amended to reduce area of phase 2. GIA schedule added to sheet. To confirm currently proposed areas match ER. Second floor group rooms redistributed.

CONSULTANT

Stride Treglown

REVISED BY Marié Nevin
CHECKED BY Gareth Brown

© Stride Treglown Limited 2015

stridetreglown.com

CLIENT NAME
University of Wales Trinity Saint David

ORIGINATOR NO
70266_02

PROJECT
UWTSD Library
University of Wales Trinity Saint David
Swansea
SA1

DRAWING TITLE
Proposed Floor Plans

SUITABILITY STATUS
S1 Co-ordination

SCALE
1 : 200 @ A1

PROJECT | ORIGINATOR | ZONE | LEVEL | TYPE | ROLE | CLASS | NUMBER
UWTSD_02-STL-00-ZZ-DR-A-ZZ-02001

REVISION
P2

Appendix B

Civil Drawings

A3

Connection to existing drainage

Connection to existing drainage

Connection to existing drainage

Connection to existing drainage

Connection to existing drainage

Face

Library

DRY DOCK

TIDAL BASIN

N

Notes

1. The details shown on this drawing are based on a preliminary design produced for RIBA Stage 3. The details shown will need to be reviewed and revised during subsequent design stages.

2. Drainage layout and gully locations indicative at this stage. Actual drainage layout and connection points to be determined once internal and external layout and structural details have been developed.

3. Rainwater downpipe and foul stack locations are indicative based on infomation recieved from Strides Treglown on 15-02-2016. Exact locations to be determined at subsequent design stages.

4. All pipes 150mm unless shown otherwise.

Legend

- Existing Highway Drainage
- Existing Storm Drainage
- Existing Foul Drainage
- Proposed Highway Drainage
- Proposed Storm Drainage
- Proposed Foul Drainage
- Drainage Channel
- Road / Yard Gullies
- Petrol Interceptor

Issue	Date	By	Chkd	Appd
P1	03/03/16	RV	JS	JS
RIBA Stage 3 - Final Issue				
P0	29/02/16	RL	JS	JS
Preliminary Issue				

ARUP

4 Pierhead St, Capital Waterside
Cardiff, CF10 4QP
T +44(0)29 20473727 F +44(0)29 20472277
www.arup.com

Client
University of Wales Trinity Saint David

Job Title
Swansea SA1 Campus Phase 1

Drawing Title
Existing and Proposed Drainage

Scale at A3 1:1000

Discipline Civil

Drawing Status
Preliminary - RIBA Stage 3

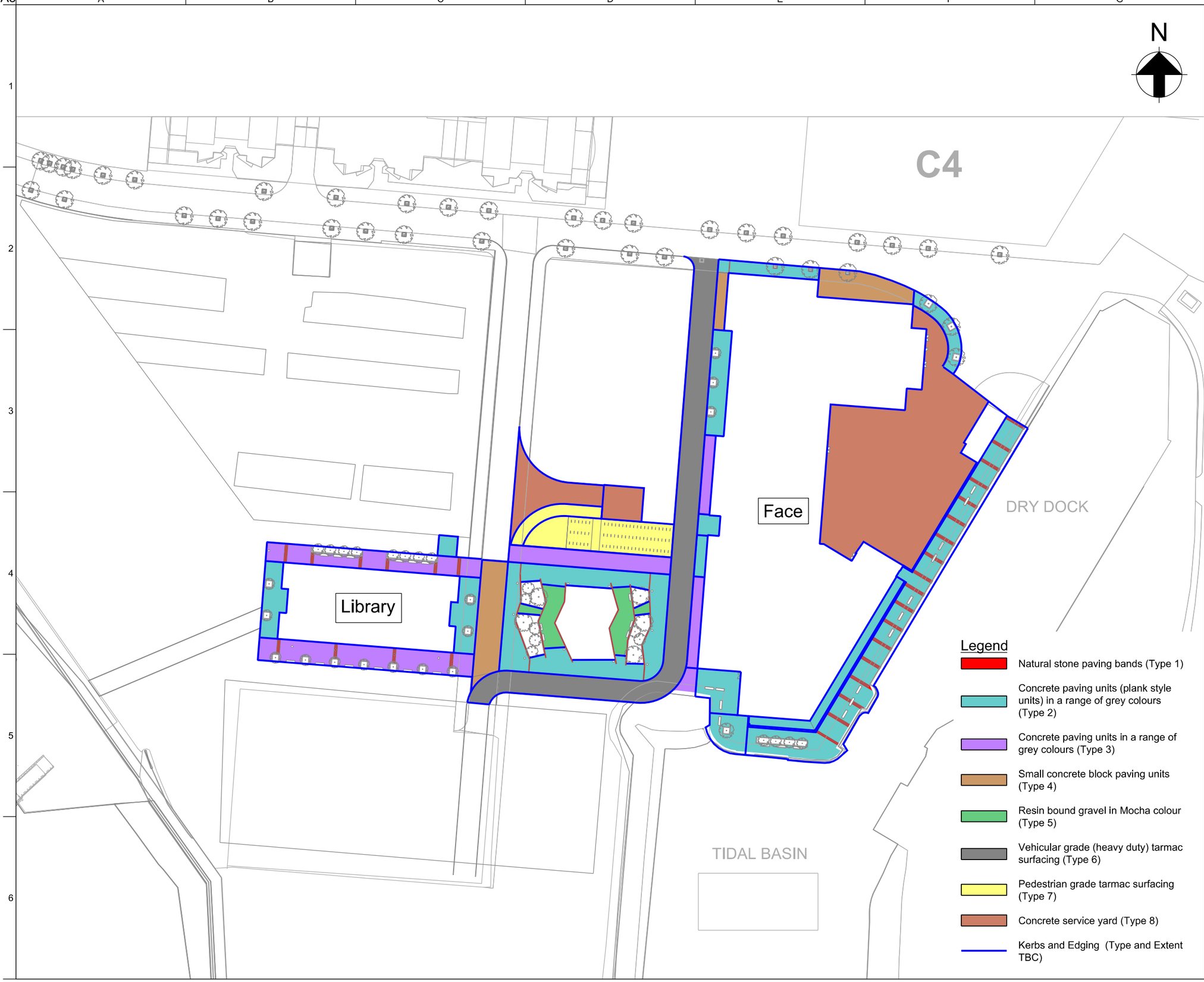
Job No	Drawing No	Issue
246523	**CG1000**	**P1**

J:\246000\246523-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\CG1000.dgn

Do not scale

© Arup

A3



Notes

1. The details shown on this drawing are based on a preliminary design produced for RIBA Stage 3. The details shown will need to be reviewed and revised during subsequent design stages.

2. For Surface Construction details refer to drawing CG1002.

Legend

- Natural stone paving bands (Type 1)
- Concrete paving units (plank style units) in a range of grey colours (Type 2)
- Concrete paving units in a range of grey colours (Type 3)
- Small concrete block paving units (Type 4)
- Resin bound gravel in Mocha colour (Type 5)
- Vehicular grade (heavy duty) tarmac surfacing (Type 6)
- Pedestrian grade tarmac surfacing (Type 7)
- Concrete service yard (Type 8)
- Kerbs and Edging (Type and Extent TBC)

Issue	Date	By	Chkd	Appd
P1	03/03/16	RV	JS	JS
RIBA Stage 3 - Final Issue				
P0	29/02/16	RL	JS	JS
Preliminary Issue				

ARUP

4 Pierhead St, Capital Waterside
Cardiff, CF10 4QP
T +44(0)29 20473727 F +44(0)29 20472277
www.arup.com

Client
University of Wales Trinity Saint David

Job Title
Swansea SA1 Campus Phase 1

Drawing Title
Proposed External Works

Scale at A3 1:1000

Discipline Civil

Drawing Status
Preliminary - RIBA Stage 3

Job No	Drawing No	Issue
246523	**CG1001**	**P1**

J:\246000\246523-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\CG1001.dgn

Do not scale

© Arup

Natural stone paving bands (Type 1)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE	Stone paving - as per Strides Treglown details	80
BEDDING	Sand CAT **II** conventional pavements to BS 7533-3:2005	30
SUB BASE	Type 1 sub base to clause 803 (SHW)	175

Concrete paving units (plank style units) in a range of grey colours (Type 2)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE	Pre cast concrete paving - as Strides Treglown details	80 (TBC)
BEDDING	Sand CAT **II** conventional pavements to BS 7533-3:2005	30
SUB BASE	Type 1 sub base to clause 803 (SHW)	175

Concrete paving units in a range of grey colours (Type 3)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE	Pre cast concrete paving - as per Strides Treglown details	80 (TBC)
BEDDING	Sand CAT **II** conventional pavements to BS 7533-3:2005	30
SUB BASE	Type 1 sub base to clause 803 (SHW)	175

Small concrete block paving units (Type 4)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE	Pre cast concrete - as per Strides Treglown details	65 (TBC)
BEDDING	Sand CAT **II** conventional pavements to BS 7533-3:2005	30
SUB BASE	Type 1 sub base to clause 803 (SHW)	175

Resin bound gravel in Mocha colour (Type 5)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE & BEDDING	Resin bound, Sureset aggregate of 10mm nominal size, Mocha colour, AC 10 dense bin 100/150 to BS EN 13108 - 1:2006	70
SUB BASE	Type 1 sub base to clause 803 (SHW)	150

Vehicular grade (heavy duty) tarmac surfacing (Type 6)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE	AC 10 close surf 100/150 to BS EN 13108 - 1:2006, minimun PSV 65	35
BINDER COURSE	AC 20 dense bin 100/150 to BS EN 13108 - 1:2006	50
BASE (ROADBASE)	AC 32 dense base 100/150 to BS EN 13108 - 1:2006	100
SUB BASE	Type 1 sub base to clause 803 (SHW)	225 (see note 2)

Pedestrian grade tarmac surfacing (Type 7)

LAYER	SPECIFICATION	THICKNESS (mm)
SURFACE COURSE	AC 6 Dense Surf 100/150 to BS EN 13108-1:2006	20
BEDDING	AC 20 Dense Surf 100/150 to BS EN 13108-1:2006	50
SUB BASE	Type 1 to sub base to clause 803 (SHW)	150

Concrete Service Yard (Type 8) - See Note 5

LAYER	SPECIFICATION	THICKNESS (mm)
SLAB	Air entrained PAV2 (Strength Class: C35) concrete with A393 mesh with 40mm cover to top of concrete	200
SUB BASE	Type 1 sub base to clause 803 (SHW)	250 (see note 2)

Notes

1. The details shown on this drawing are based on a preliminary design produced for RIBA Stage 3. The details shown will need to be reviewed and revised during subsequent design stages.

2. The construction thickness shown assume a CBR of 5%, CBR to be confirmed during the works. Where CBR <5% advise engineer.

3. Refer to drawing CG1001 for Surface Finish Extent.

4. All paving units and pedestrian surfacing designed for pedestrian use only.

5. Concrete service yard to include construction and movement joints at 6m centres.

Issue	Date	By	Chkd	Appd
P0	03/03/16	RL	JS	JS
Preliminary Issue				

ARUP

4 Pierhead St, Capital Waterside
Cardiff, CF10 4QP
T +44(0)29 20473727 F +44(0)29 20472277
www.arup.com

Client
University of Wales
Trinity Saint David

Job Title
Swansea SA1 Campus
Phase 1

Drawing Title
Surface Construction Details

Scale at A3 1:250

Discipline Civil

Drawing Status
Preliminary - RIBA Stage 3

Job No	Drawing No	Issue
246523	**CG1002**	**P0**

J:\246000\246523-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\CG1002.dgn

Do not scale

© Arup

Appendix C

Technical Note:

Structural Philosophy

File Note

ARUP

4 Pierhead Street
Capital Waterside
Cardiff CF10 4QP
United Kingdom
www.arup.com

t +44 29 2047 3727
f +44 29 2047 2277

Project title	UWTSD SA1 - Phase 1	Job number	246523-00
cc	Design Team	File reference	UWTSD TN1
Prepared by	Owain Morgan	Date	8 January 2016
Subject	Technical Note 1 - Structural Philosophy for FACE, TECH and Library Buildings		

A meeting was held at the Stride Treglown Office on the 8th December 2015.

Present:

Pierre Wassenaar (Stride Treglown)
Gareth Brown (Stride Treglown)
Mathew Evans (Arup)
Adrian Broad (TBandA)
Kevin Parry (Lee Wakemans)
Ian Standen (Stride Treglown)
Owain Morgan (Arup)
Neil Embleton (ESHA)
Steve Nichols (Kier)
John O'Toole (UWTSD PM)

The purpose of the meeting was to agree the structural philosophy for each buildings considering the architectural, structural and service distribution requirements for the building.

The following note describes the key decisions agreed between the project design team for the structural engineering philosophy of the 3 building areas of the phase 1 development. The Stage 3 structural design will progress on the principles and assumptions noted below.

FACE Building

Typical Floor Build-up
- 250mm raised floor
- 150mm thick slab consisting of a 75mm precast concrete biscuit with 75mm insitu concrete topping
- 610 deep universal beams designed compositely, un-propped in construction
- Service zone below structure

Grids and Structural Spacing
- Typical column grids at 6m along perimeter
- Clear span required over the 90 person learning area, max 15m beam spans @ 3m centres in this area
- Elsewhere, max 12m span @3m centres

File Note

246523-00 8 January 2016

Stability System
- In-plane stability provided by the diaphragm action of the concrete slabs
- Lateral stability provided by vertical steel bracing around the core and stairs areas.
- Note: RC cores may be required due to the extent of the openings on the elevations shown by ESHA.

TECH Building

Typical Roof Build-up
- Roof insulation and waterproofing to architect specification
- 150mm metal deck in-situ concrete slab
- Long span cellular beams designed compositely
- 1m service zone below structure
- 5m clear zone from the floor to the undersize of the service zone.

Grids and Structural Spacing
- Secondary beams at max 3m centres
- Clear span required over automotive testing area
- Single line of internal columns in the main tech area.

Stability System
- In-plane stability provided by the diaphragm action of the concrete slab
- Lateral stability provided by vertical steel bracing.

Library
- The library is to be a RC Concrete frame building to level 3.
- Steel frame roof structure above level 3.
- RC flat slabs.
- RC concrete cores around vertical circulation areas.

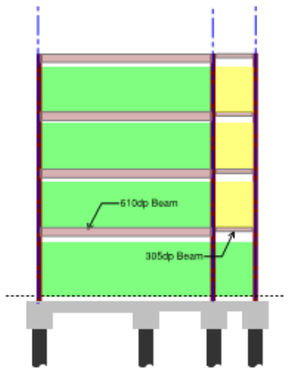
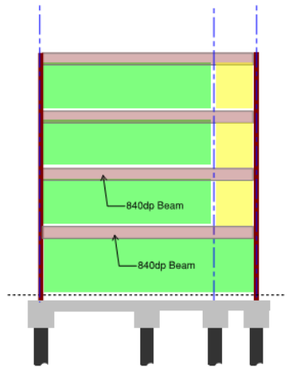
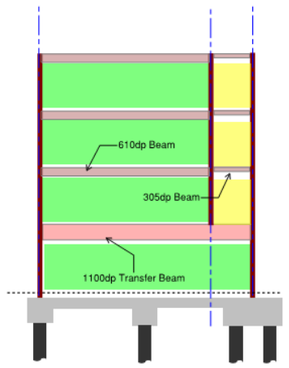
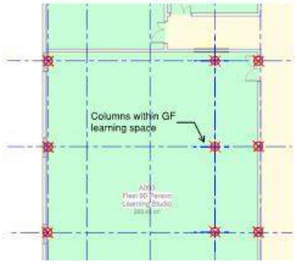
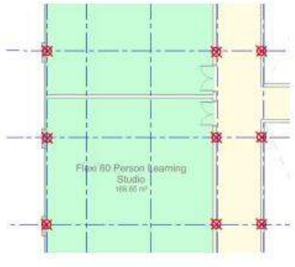
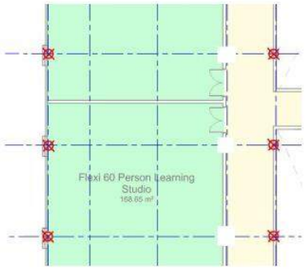
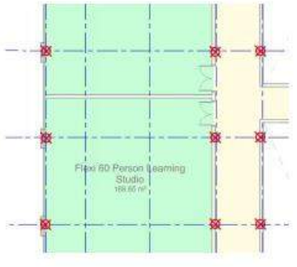
Grids and Structural Spacing
- Typical 6.3m x 7.5m max

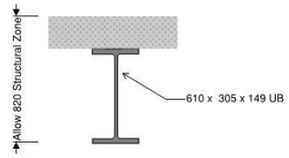
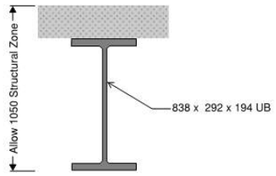
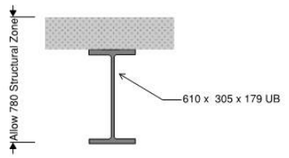
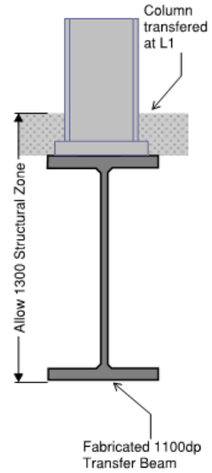
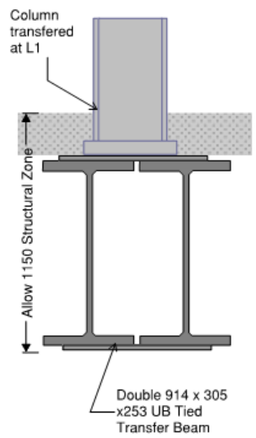
File Note Attachments
- Structural Comparison Matrix for the FACE and Library building produced for the meeting.
- Structural Concepts for the Library roof produced post the meeting.
- Structural layouts for the 3 buildings sketched based on the philosophy above.

UWTSD FACE Flexi: Floor Structure Scheme Comparison Matrix

Assumptions:

- The following matrix considers only the floor structure and build up for comparative purposes.
- Grid: 15m x 6m
- Temporary propping or intermediate restraints required for long span beam solution
- Loading Allowance: SDL=1kPa, LL=5kPa
- ***Simplified floor plate weight only for comparative purposes**

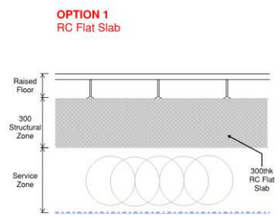
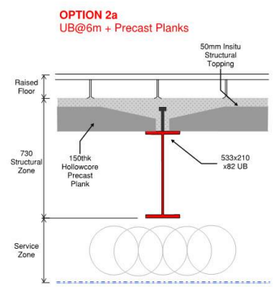
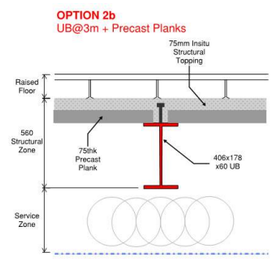
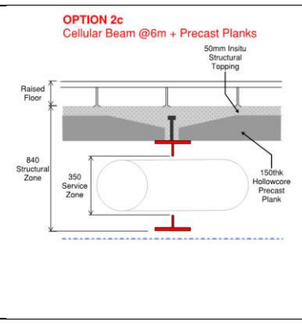
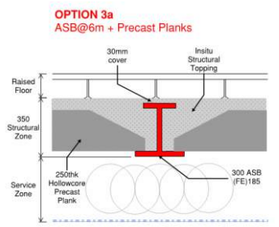
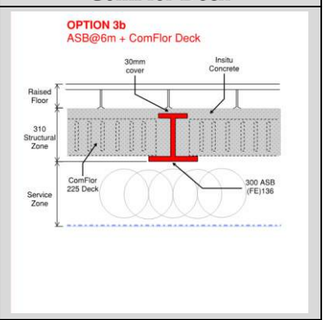
	Option 1	Option 2a	Option 2b	Option 3a	Option 3b
Description	**Max 12m span@6m**	**Max 15m span@6m**	**Max 15m span@3m**	**Transfer Beam at L1**	**Transfer Beam at L1**
Typical Section					
Ground Level Column Layout					
Upper Levels Column Layout					

Typical Section at L1					
Typical Beam Spacing	6m	6m	3m	6m	6m
Slab Thickness (Overall) (Precast + topping)	200mm	200mm	150mm	200mm	200mm
Structural Zones	820mm	1050mm	780mm	1300mm Upper Levels: 820mm	1150mm Upper Levels: 820mm
Beam Size L1	610x305x149 UB	838x292x194 UB	610x305x179 UB	Fabricated Plate Girder 1100dp x400w (40mm flanges 25mm web) 435kg/m	Double UB 2No.614x305x253UB
Beam Size Upper Levels	610x305x149 UB + 305dp short span beams	838x292x194 UB	610x305x179 UB	610x305x149 UB + 305dp short span beams	610x305x149 UB + 305dp short span beams
Steel Weight / m2 on Plan* (weight of beam divided by centers of beams)	25kg/m^2	33kg/m^2	60kg/m^2	L1: 73kg/m^2 Upper Levels: 25kg/m^2	L1: 85kg/m^2 Upper Levels: 25kg/m^2
Main Advantages	- Shallowest structural depth - Shallow structural zone in corridor area above level 1 to maximize service distribution in the circulation area	- No internal columns within GF learning space		- No internal columns within GF learning space - Minimal structural depth for L2 and above structure - Shallow structural zone in corridor area above level 1 to maximize service distribution in the circulation area	
Main Disadvantages	- Column within GF learning space	- Large structural depth within circulation spaces above L1. - Issues with service distribution - Heavier Solution - Possible vibration issues for long spans at all levels		- Increased structural depth or weight of L1 structure - Significant structural cost for transfer beam solution for complex fabrication - Significantly heavier solution (cost) - Possible vibration issues for long span transfer structure a L1	

UWTSD Library: Floor Structure Scheme Comparison Matrix

Assumptions:

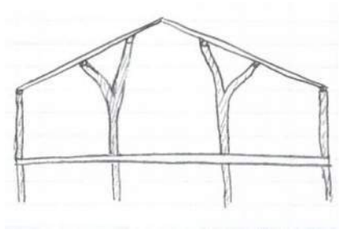
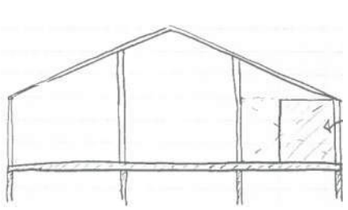
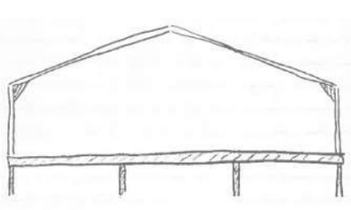
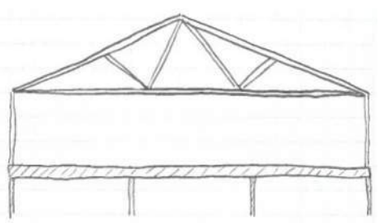
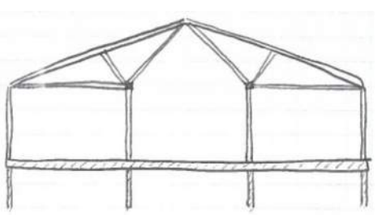
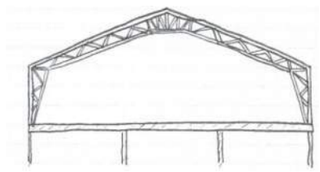
- The following matrix considers only the floor structure and build up for comparative purposes.
- Grid: 7.5m x6m
- Loading Allowance: SDL=1kPa, LL=5kPa based on Eurocode EC1 type E12
- ***Simplified floor plate weight only for comparative purposes**

	RC Frame	**Steel Frame**			**Steel Frame SlimDeck**	
	Option 1	**Option 2a**	**Option 2b**	**Option 2c**	**Option 3a**	**Option 3b**
Description	RC Flat Slab	UB@6m + Precast Planks	UB@3m + Precast Planks	Cellular Beam@6m + Precast Planks	ASB@6m + Precast Planks	ASB@6m + ComFlor Deck
Typical Section						
Typical Spacing	N/A	6m	3m	6m	6m	6m
Structural Zone	300mm	730mm	560mm	840mm *(or 660mm)*	350mm	310mm
Slab Thickness (Overall)	300mm	200mm	150mm	200mm	325mm	300mm
Beam Size	N/A	533x210x82 UB	406x178x60 UB	637x210/152x67 ACB *(or 460x210/210x122 CB)*	300ASB (FE) 185	300ASB (FE) 136
Steel Weight / m2 on Plan* (weight of beam divided by centers of beams)	N/A	14kg/m^2	20kg/m^2	12kg/m^2 *(or 21kg/m^2)*	31kg/m^2	23kg/m^2
Service Zone	Below Structure	Below Structure	Below Structure	Within Structure – Limited to 300mm duct size (350mm diameter openings)	Below Structure	Below Structure
Services Distribution	Highly Flexible	Flexible if below steel	Flexible if below steel	Limited to opening size	Highly Flexible	Highly Flexible
Services Holes	Moderately Flexible	Requires early coordination. Openings require additional trimming beams	Requires early coordination. May require additional reinforcement	Requires early coordination. Openings require additional trimming beams	Requires early coordination. Openings require additional trimming beams	Moderately Flexible
Buildability Temporary Propping	Yes	-	-	-	Yes	Yes
Fire Protection	Inherent protection	Additional protection required	Additional protection required	Additional protection required	Inherent (60mins)	Inherent (60mins)
Vibration Issues	-	-	-	-	Possible due to shallow depth	Possible due to shallow depth
Acoustics (TBC by MAC)	-	-	-	-	-	-
Additional Comments		Beam size driven by construction stage. Could be reduced in size, but requires temporary restraint or propping during construction	Beam size driven by construction stage. Could be reduced in size, but requires temporary restraint or propping during construction	Two sizes noted, minimum weight beam and minimum depth *(in italics).*	ASB was designed to be used with ComFlor 225 deck. Using precast planks increases the structural slab self-weight beyond what is required for the deck span, hence this is not an efficient design.	Client preferred not to have exposed steel decking. Assuming no hung ceilings will be provided, This option has been discarded

UWTSD Library: Roof Structure Scheme Comparison Matrix

Assumptions:

- The following matrix considers only the roof and column structure for comparative purposes.
- Grid: 7.5m x6.3m

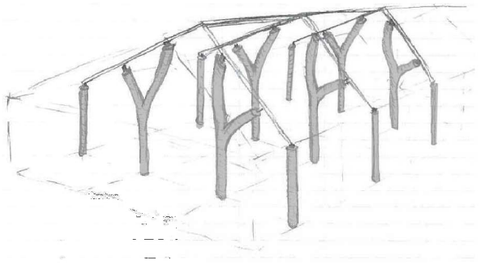
	RC Frame	Steel Frame			
	Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Description	Concrete Columns with Steel Roof	Simple Pinned Frame	Portal Frame	Roof Truss	Steel 'Tree' columns
Typical Section					
Column Arrangement	RC columns with internal Y shape columns and RC ring beam at eaves	Standard steel columns and roof beam	Will require UB's as steel columns	Standard steel columns, no internal columns	Steel columns to support diagrid roof
Roof Steelwork Arrangement	Simple steel beam roof arrangement to underside of roof	Simple steel beam roof arrangement	Steel portal frame above L03	Clear Span Roof Truss	Steel Diagrid Roof
Bracing Arrangement	Possible additional stability elements along the perimeter	In plan bracing braced back to the cores. Possible additional bracing in corners	Bracing in the opposite elevation to the cores. Possible additional bracing in corners	Plan bracing at tie level. Bracing in the opposite elevation to the cores. Possible additional bracing in corners	Possible additional bracing in corners
Steel to Concrete connection	At Roof Level	At L03 slab	At L03 slab	At L03 slab	At L03 slab
Complexity of Formwork/Connections	Complex formwork to achieve 'tree' column shape	Simple connections	More complex connections	More complex connections	Explicit connections at internal columns
Associated Cost	High	Low	Medium	Medium	High
Buildability, Temporary Propping	Complex columns and roof structure interface	Simple Common Solution	Common Solution	Common Solution	Requires temporary propping until all elements are linked together
Additional Comments and Variants	RC ring beam to connect all perimeter columns. Variants: • Concrete shell roof potential • Timber cut roof construction		Variants: • Roof as standard beams and columns • Welded connections – possibility to have interesting welds such as used in old railway stations • Roof as truss with profiled columns. Example:  More expensive solution		The design as discussed by ESHA – steel 'tree' columns

UWTSD Library: Roof Structure Schemes Sketches and Images

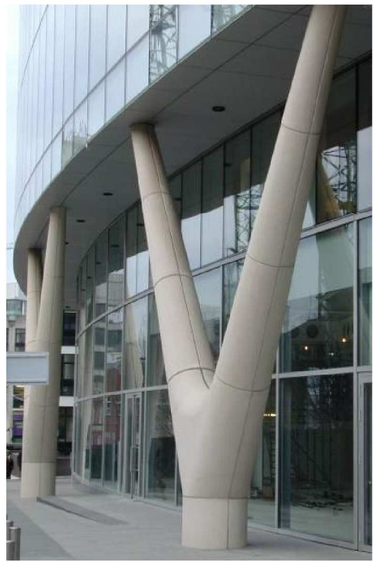
Assumptions:

- **The following sketches indicate the primary structure only**
- The images show potential available options for the development

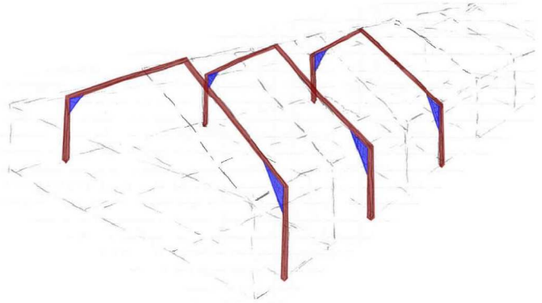
Option 1: Concrete Columns with Steel Roof

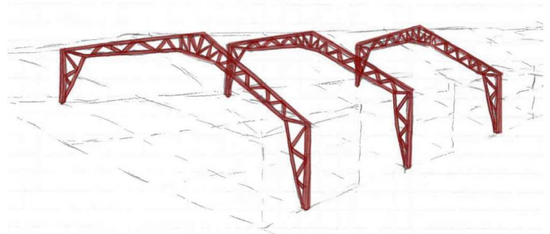






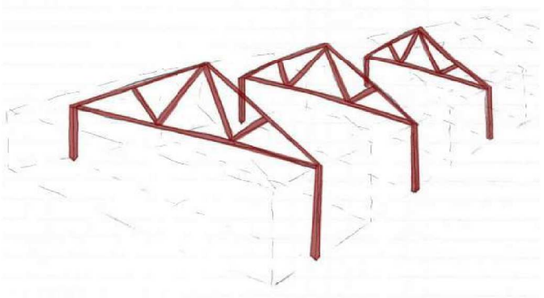
Option 3: Portal Frame







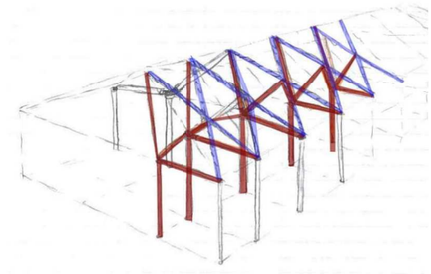
Option 4: Steel Truss

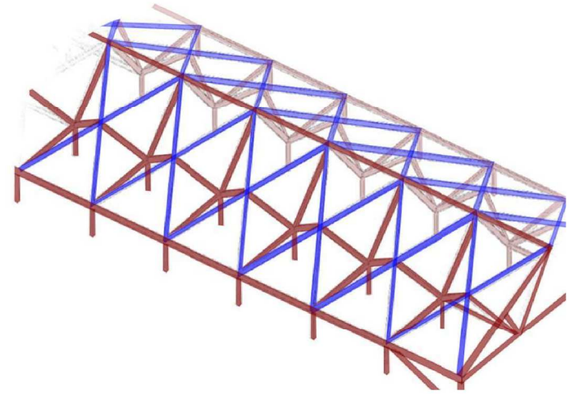






Option 5: Steel 'Tree' Columns



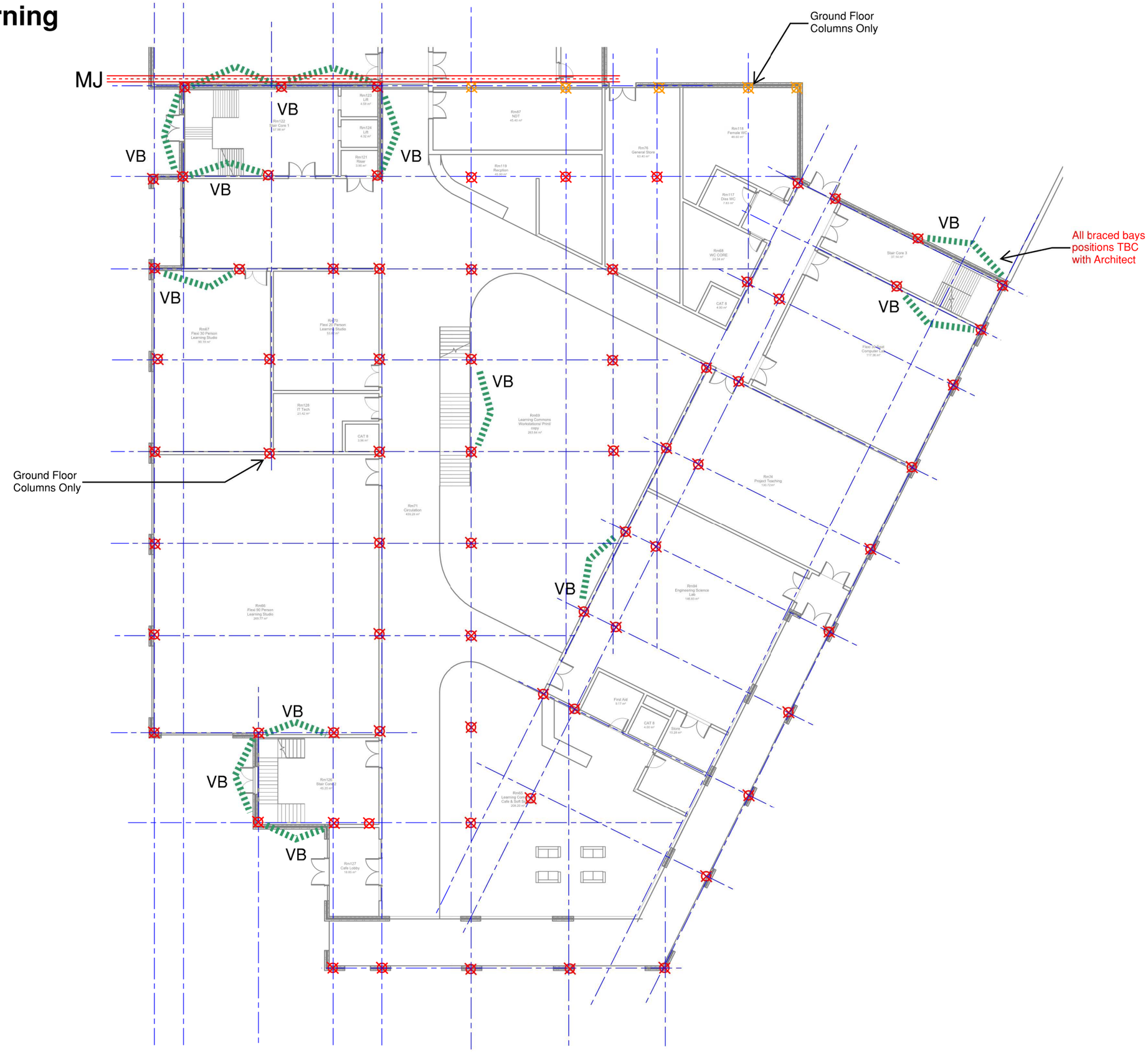


FACE SK151215-01 GF Column Layout v4

FACE-Learning

Scheme Layout v4

15/12/15



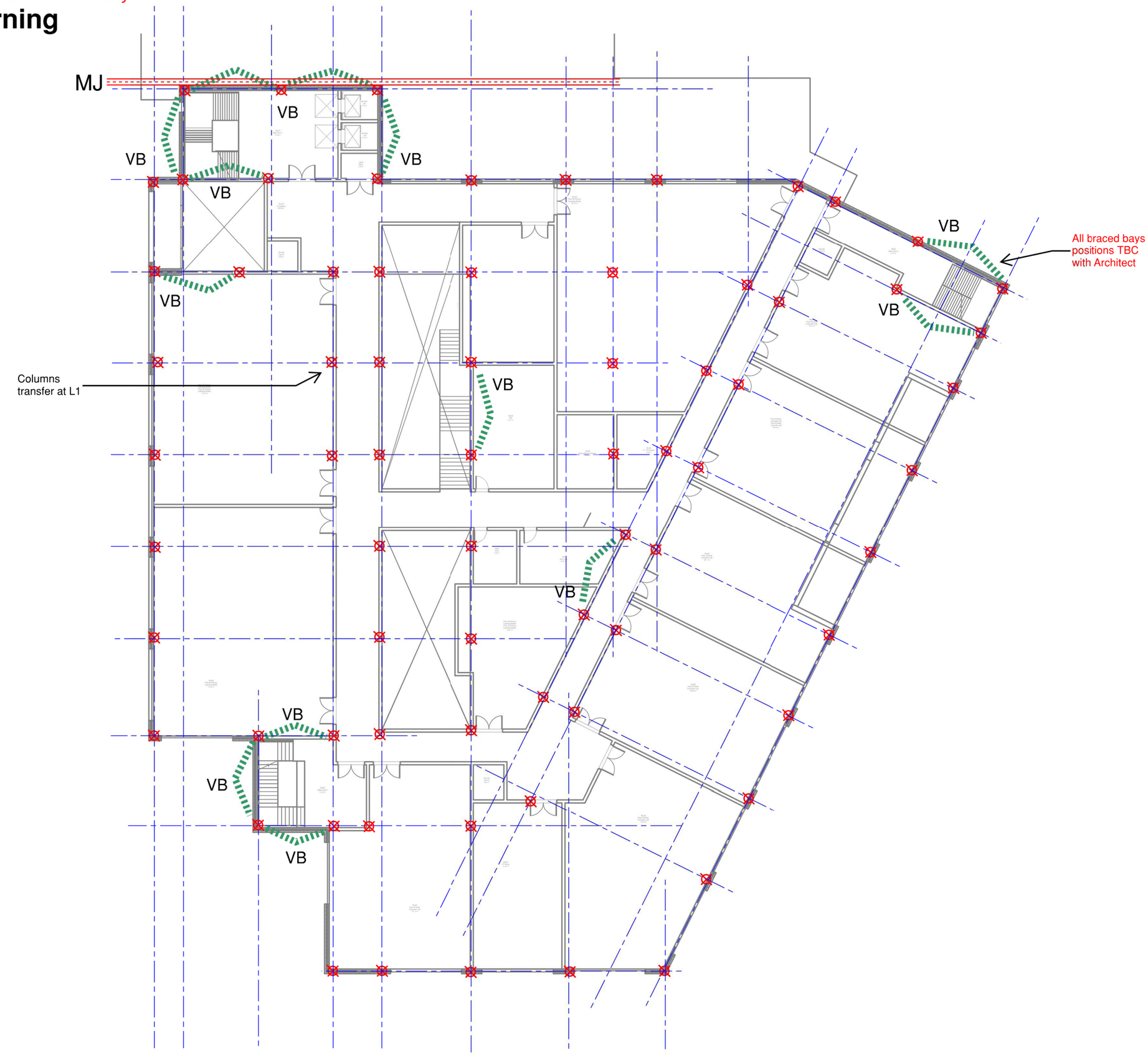
Level 0

FACE SK151215-02 L1 Column Layout v4

FACE-Learning

Scheme Layout v4

15/12/15



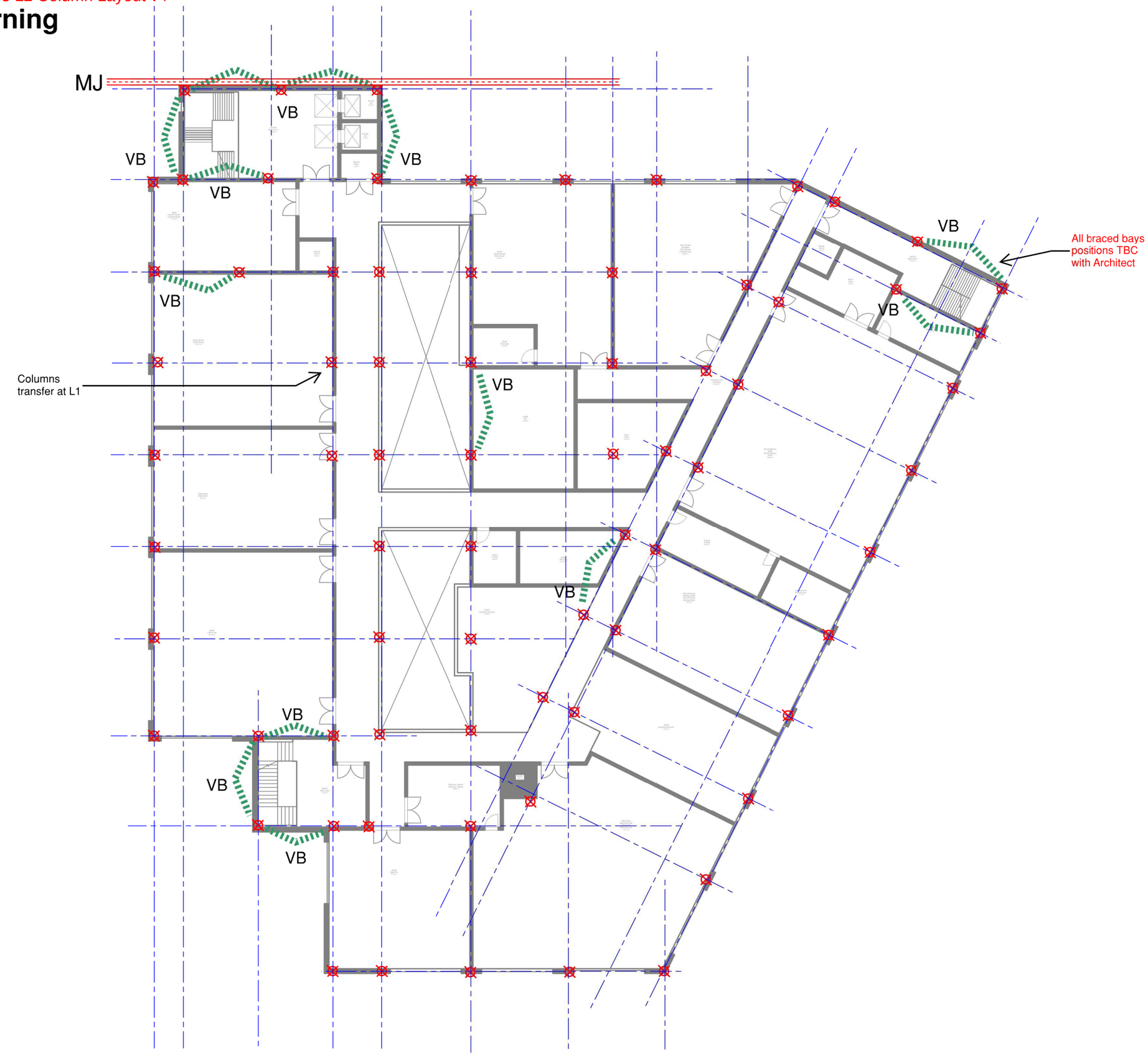
Level 1

FACE SK151215-03 L2 Column Layout v4

FACE-Learning

Scheme Layout v4

15/12/15



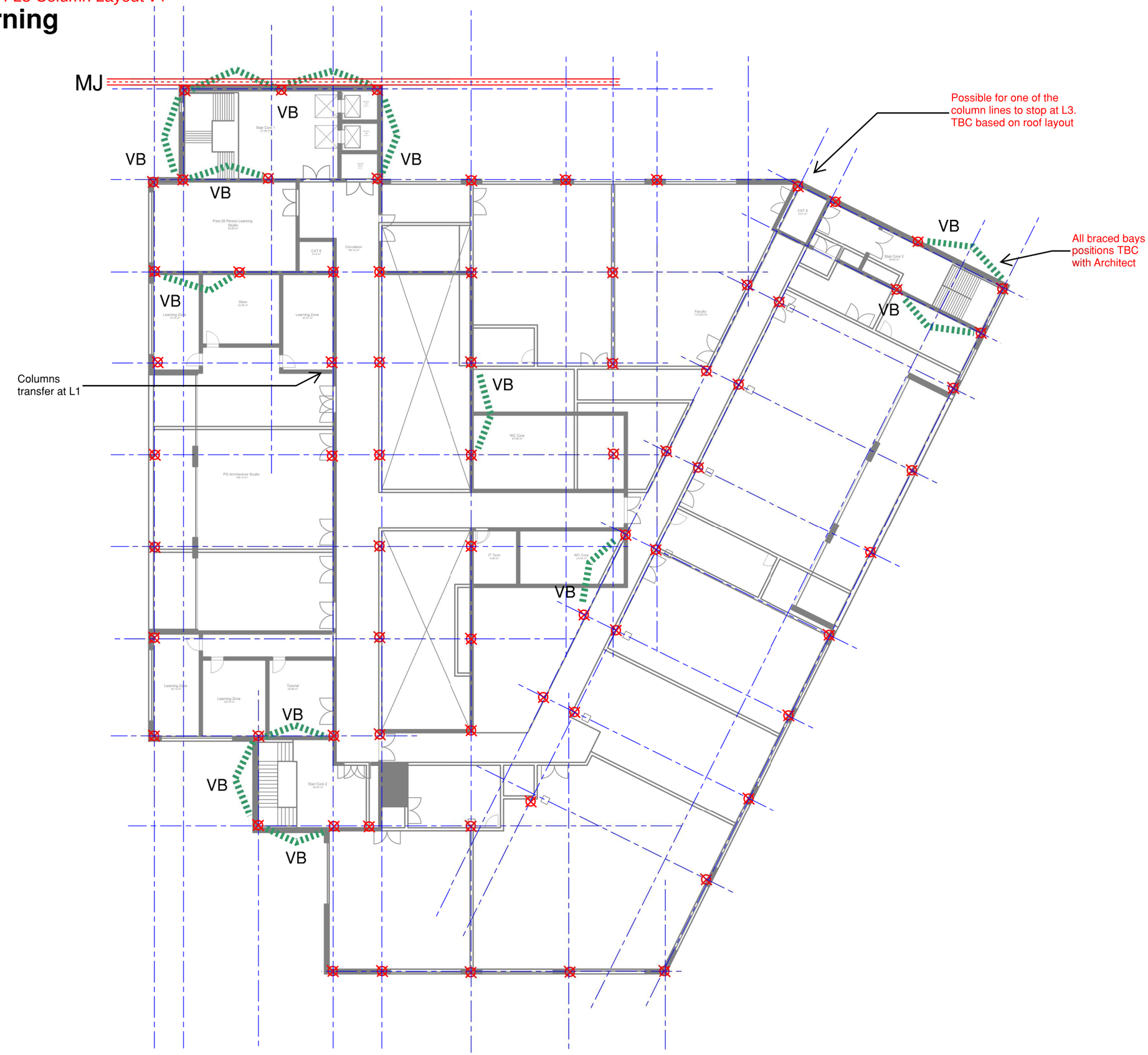
Level 2

FACE SK151215-04 L3 Column Layout v4

FACE-Learning

Scheme Layout v4

15/12/15



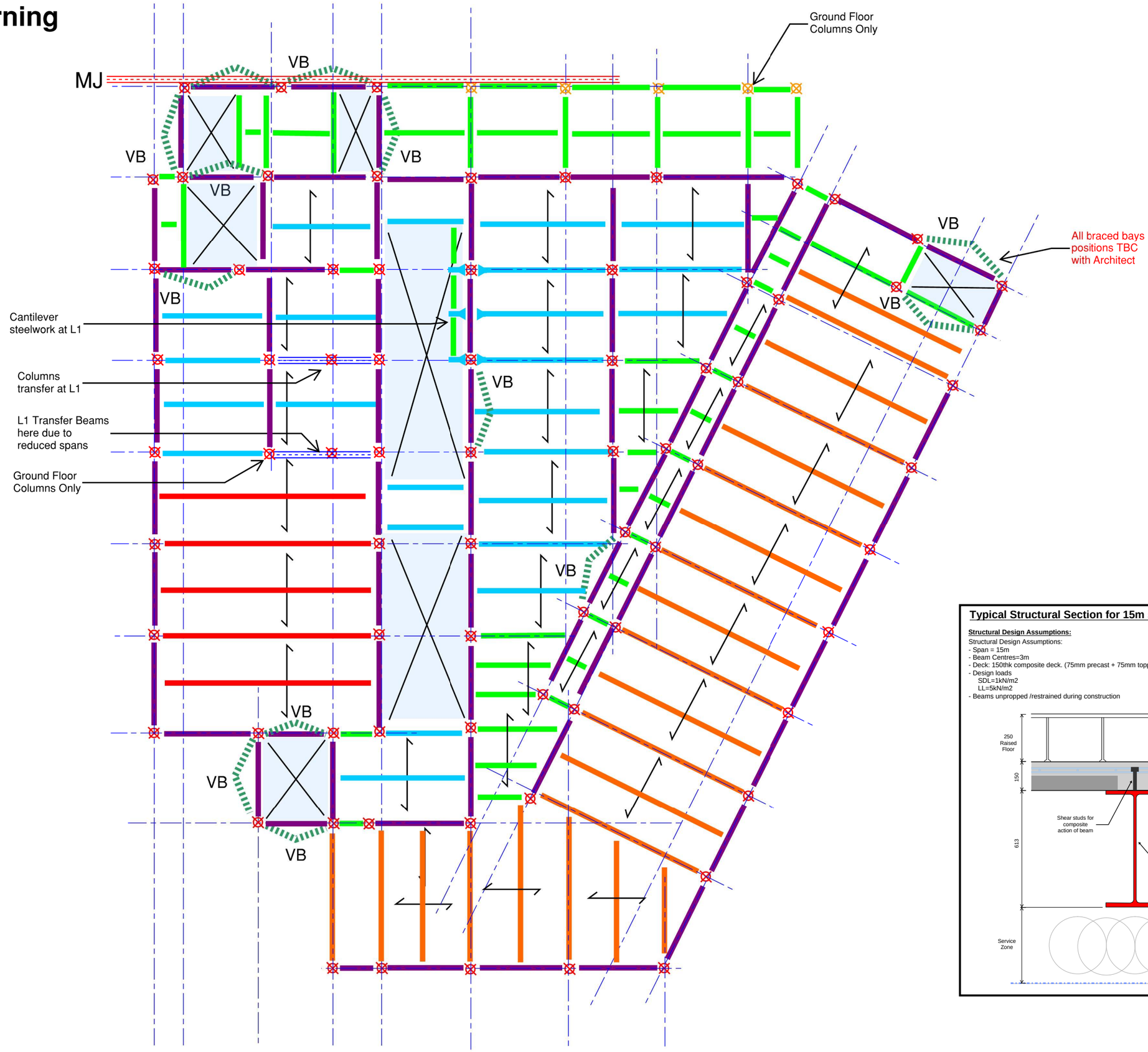
Level 3

FACE SK151215-05 L1 Beam Layout v4

FACE-Learning

Scheme Layout v4

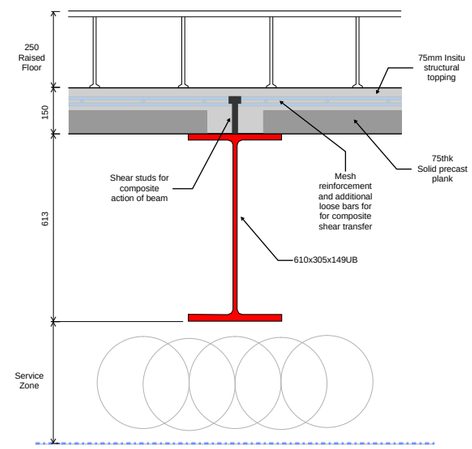
15/12/15



Typical Structural Section for 15m span beams @ 3m centres

Structural Design Assumptions:

Structural Design Assumptions:
- Span = 15m
- Beam Centres=3m
- Deck: 150thk composite deck. (75mm precast + 75mm topping)
- Design loads
  SDL=1kN/m2
  LL=5kN/m2
- Beams unpropped /restrained during construction

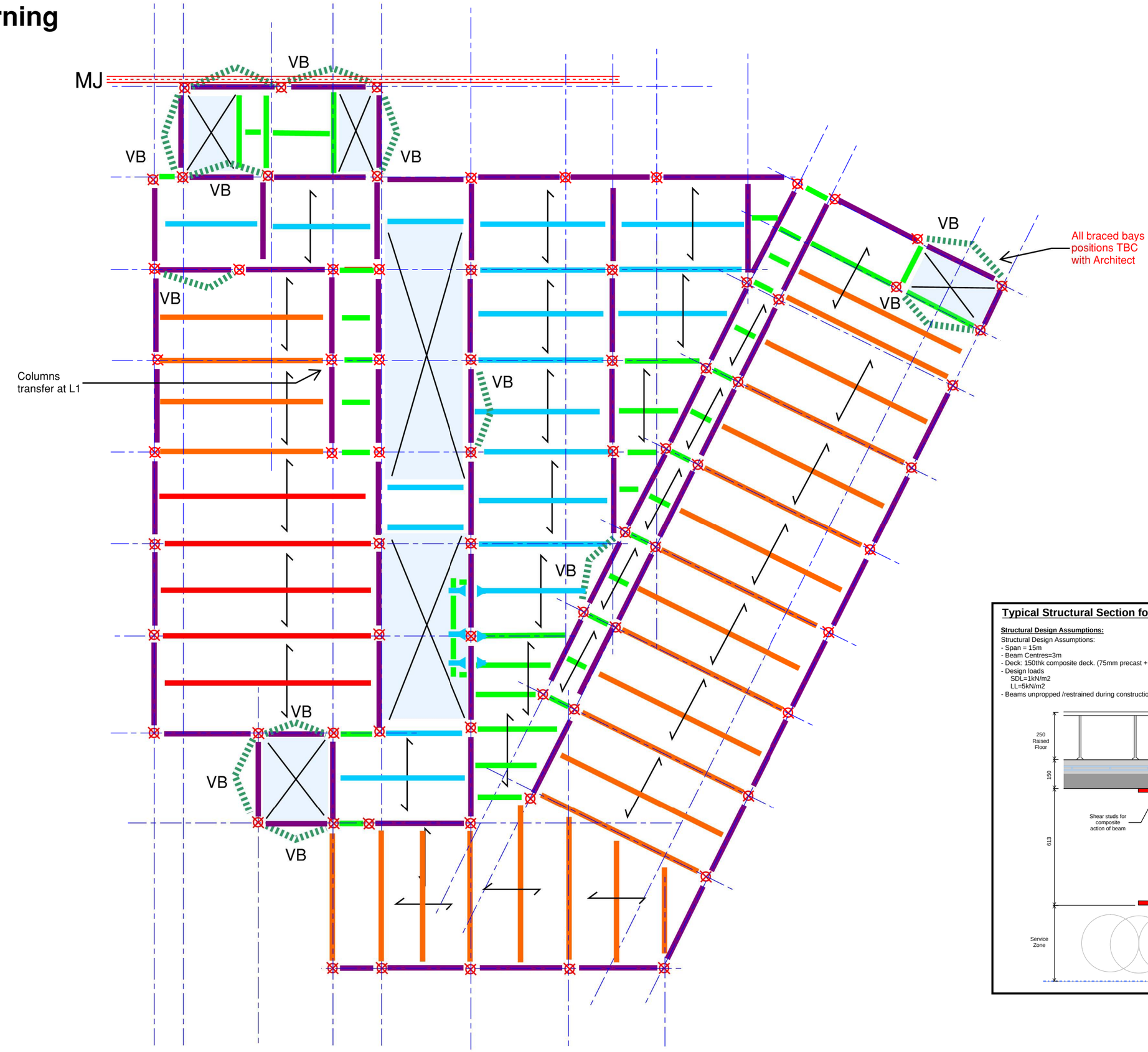


FACE SK151215-06 L2 and L3 Beam Layout v4

FACE-Learning

Scheme Layout v4

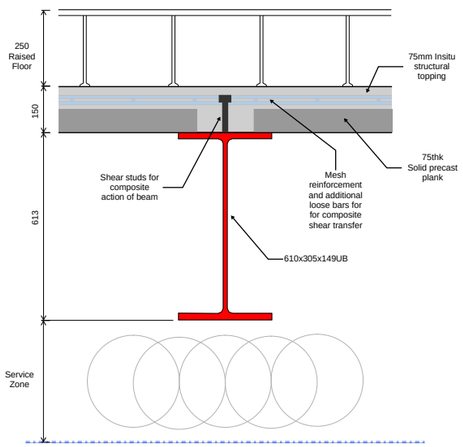
15/12/15



Typical Structural Section for 15m span beams @ 3m centres

Structural Design Assumptions:

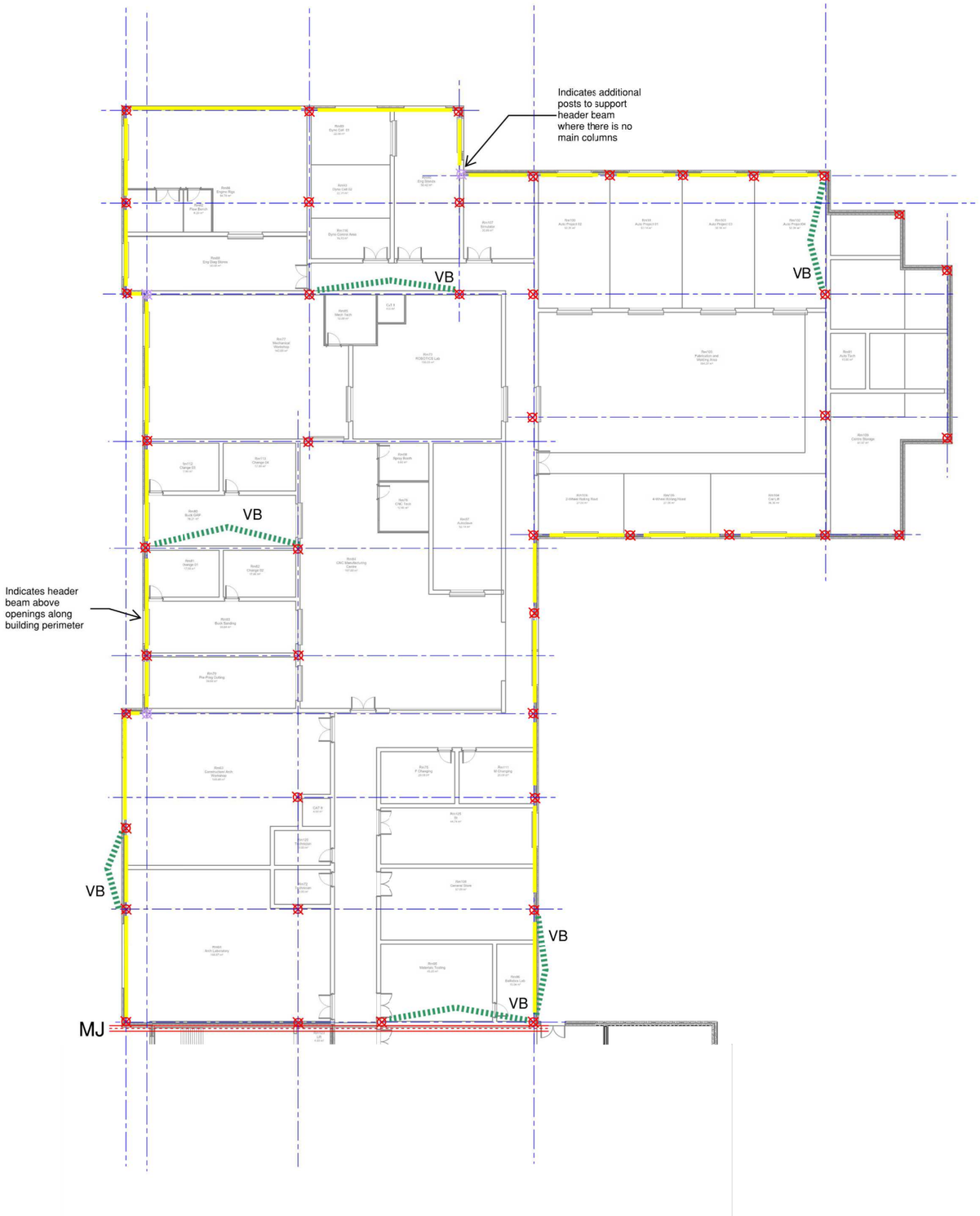
Structural Design Assumptions:
- Span = 15m
- Beam Centres=3m
- Deck: 150thk composite deck. (75mm precast + 75mm topping)
- Design loads
  SDL=1kN/m2
  LL=5kN/m2
- Beams unpropped /restrained during construction



TECH SK151211-01 Column Layout v3

TECH-Workshops

Scheme Layout v3
11/12/15 OM



TECH SK151211-02 Roof Beam Layout v3

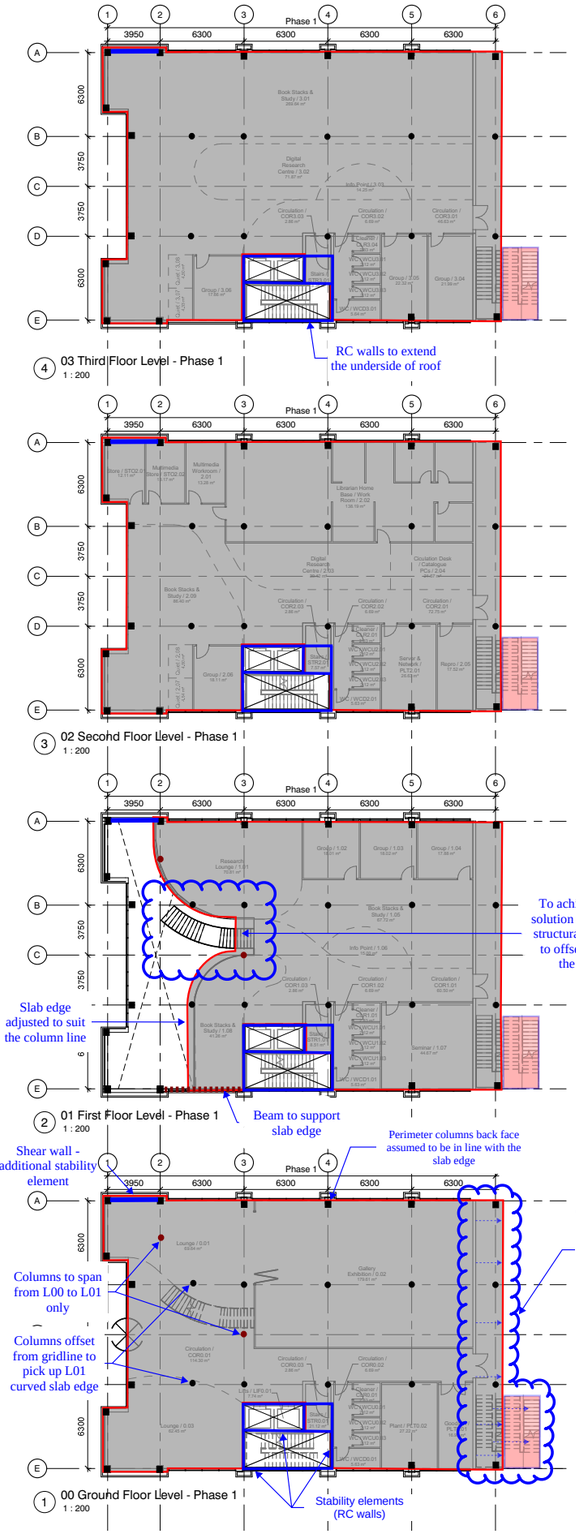
TECH-Workshops

Scheme Layout v3
11/12/15 OM



Library Scheme Structural Layouts

Phase 1



Comments:

- There are no risers in the building. Should an allowance be made for them?
- Openings in the stability elements (shear walls) to be coordinated.
- Perimeter columns back face assumed to be in line with the slab edge.
- Architectural scheme currently requires temporary props, this approach will need discussing further as it creates added complexity both during and after construction and will likely lead to an increase on costs overall.
Alternative proposal: Slab edge should be moved past the columns at gridline 6 with temporary stair moving outside of the gridline.
- RC slabs and columns assumed to stop at L03. Roof structure and support TBC based on "LIB SK151216 Library Roof Scheme Options" concepts.
- To achieve an efficient structural solution and create continuity in the structural floor plate, it is preferred to offset the slab edge outside of the column line as shown (L01 slab).
- Concrete cores to extend to the underside of the roof to provide the stability for the roof framing.

Library Building

Structural Layout

Phase 1

University of Wales Trinity Saint David
Swansea SA1 - Phase I

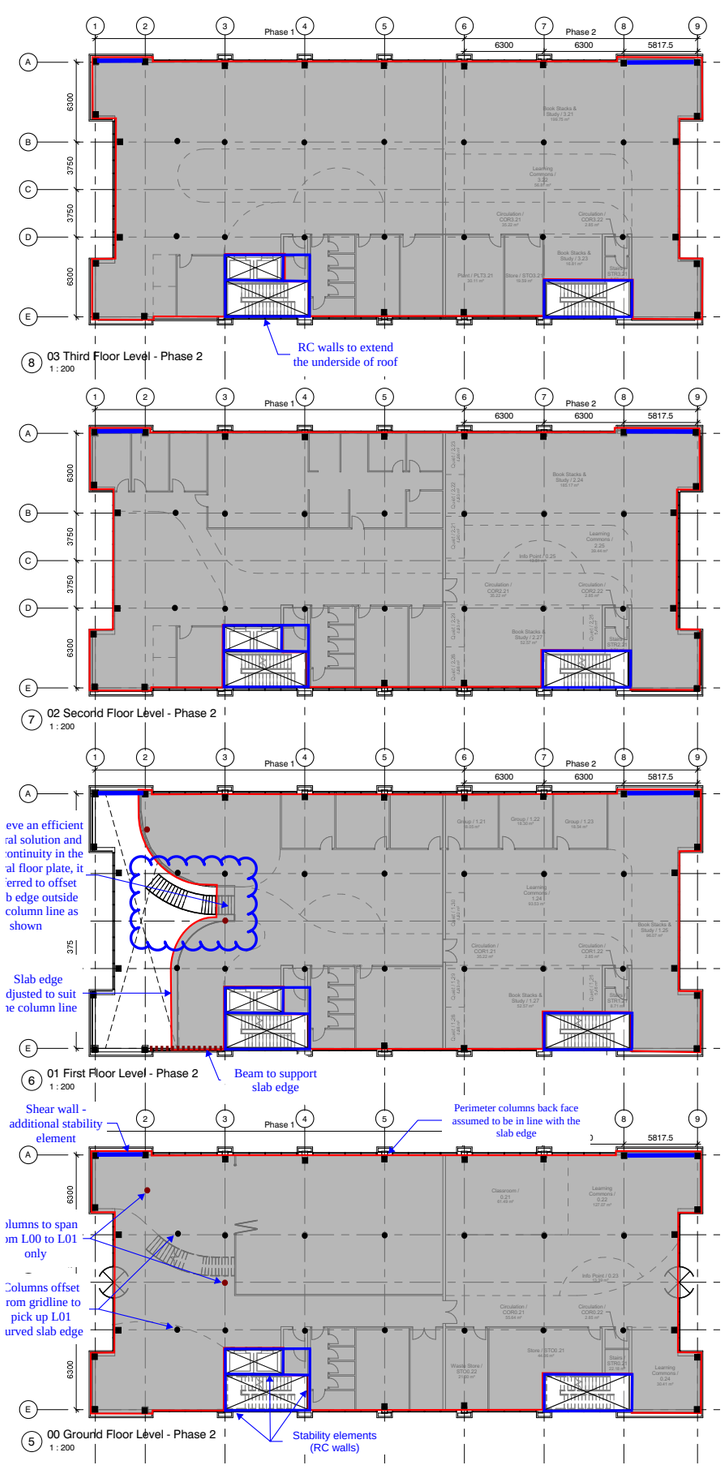
18 Dec 2015

LIB SK151218-01

ARUP

Library scheme Structural Layouts

Phase 2



Comments:

- There are no risers in the building. Should an allowance be made for them?
- Openings in the stability elements (shear walls) to be coordinated.
- Perimeter columns back face assumed to be in line with the slab edge.
- Architectural scheme currently requires temporary props, this approach will need discussing further as it creates added complexity both during and after construction and will likely lead to an increase on costs overall.
Alternative proposal: Slab edge should be moved past the columns at gridline 6 with temporary stair moving outside of the gridline.
- RC slabs and columns assumed to stop at L03. Roof structure and support TBC based on "LIB SK151216 Library Roof Scheme Options" concepts.
- To achieve an efficient structural solution and create continuity in the structural floor plate, it is preferred to offset the slab edge outside of the column line as shown (L01 slab).
- Concrete cores to extend to the underside of the roof to provide the stability for the roof framing.

Library Building

Structural Layout

Phase 2

University of Wales Trinity Saint David
Swansea SA1 - Phase I

18 Dec 2015

LIB SK151218-02

ARUP

Appendix D

Design Loading Allowance

D1 Loading Plans



Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	2.0	3.0	2.0
	Internal Plant	2.0	5.0	4.5
	Common Area	2.0	3.0	3.0
	Office	2.0	3.5	2.7
	Computer Lab	2.0	4.0	4.5
	Learning Workshop	2.0	5.0	4.5
	General Learning	2.0	4.0	3.0
	Circulation Area	2.0	4.0	4.0

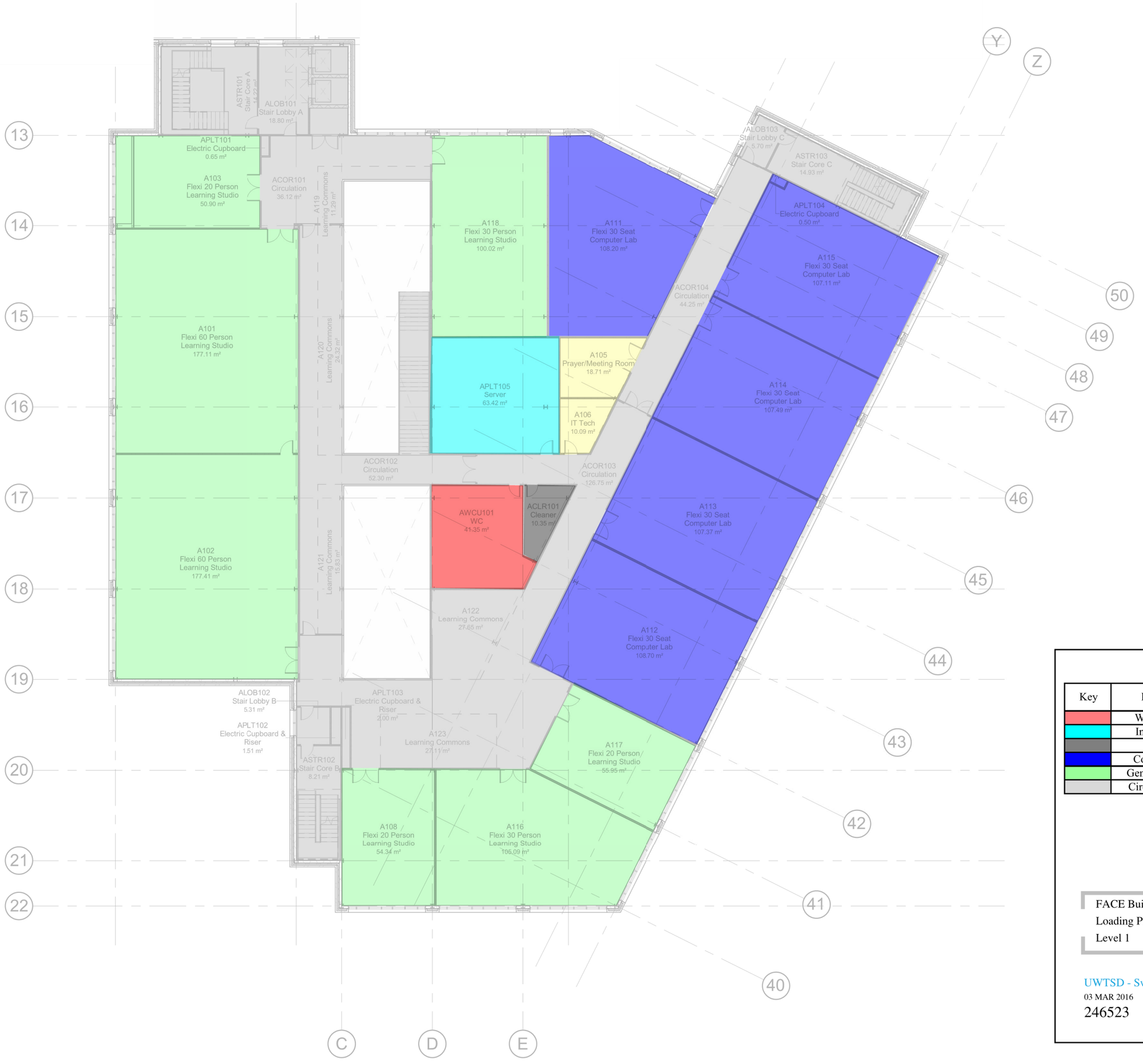
FACE Building
Loading Plan
Ground Level

UWTSD - Swansea SA1 Campus, Phase 1

03 MAR 2016

246523

ARUP

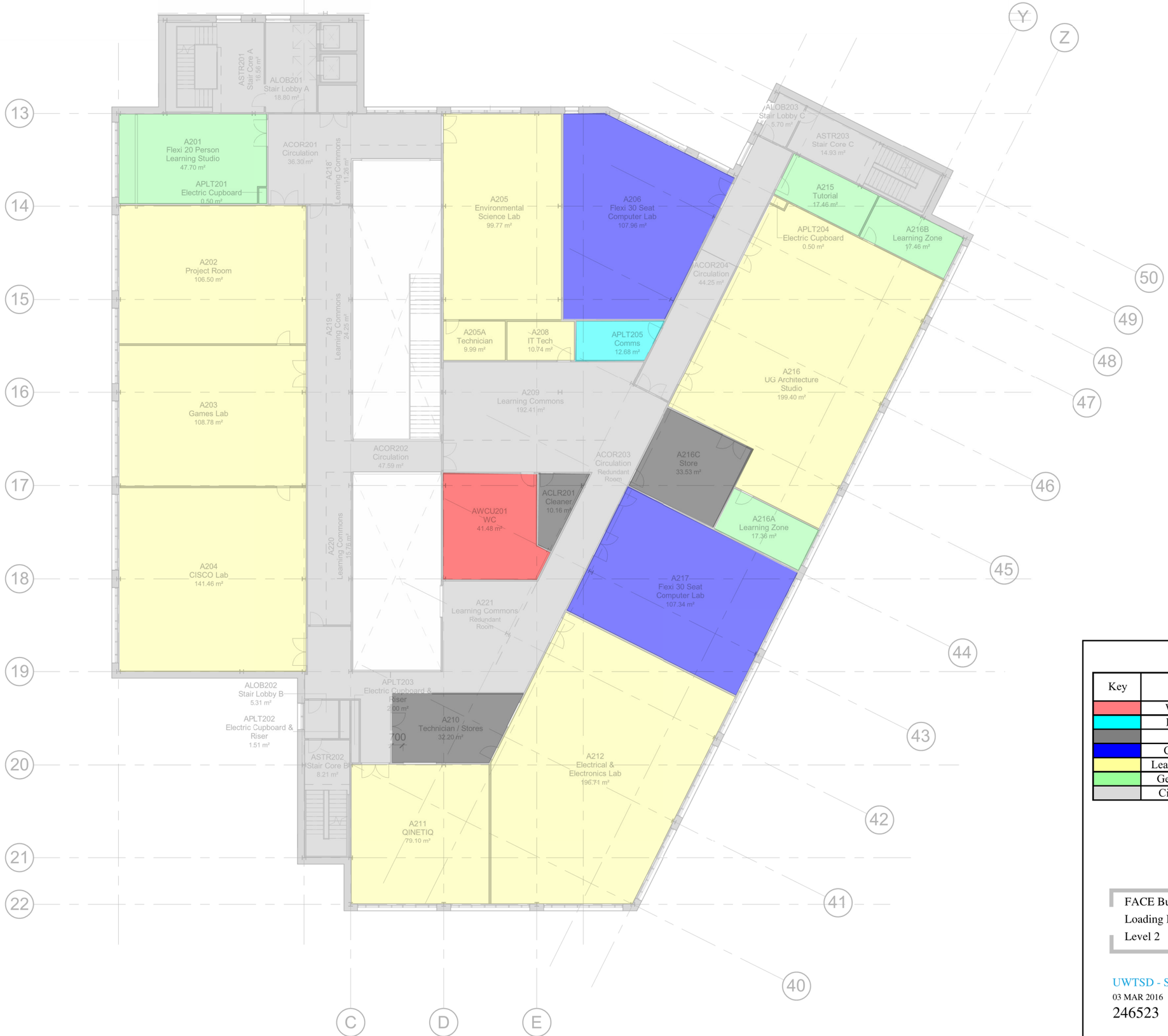


Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	1.0	3.0	2.0
	Internal Plant	1.0	5.0	4.5
	Storage	1.0	5.0	4.5
	Computer Lab	1.0	4.0	4.5
	General Learning	1.0	4.0	3.0
	Circulation Area	1.0	4.0	4.0

FACE Building
Loading Plan
Level 1

UWTSD - Swansea SA1 Campus, Phase 1
03 MAR 2016
246523

ARUP

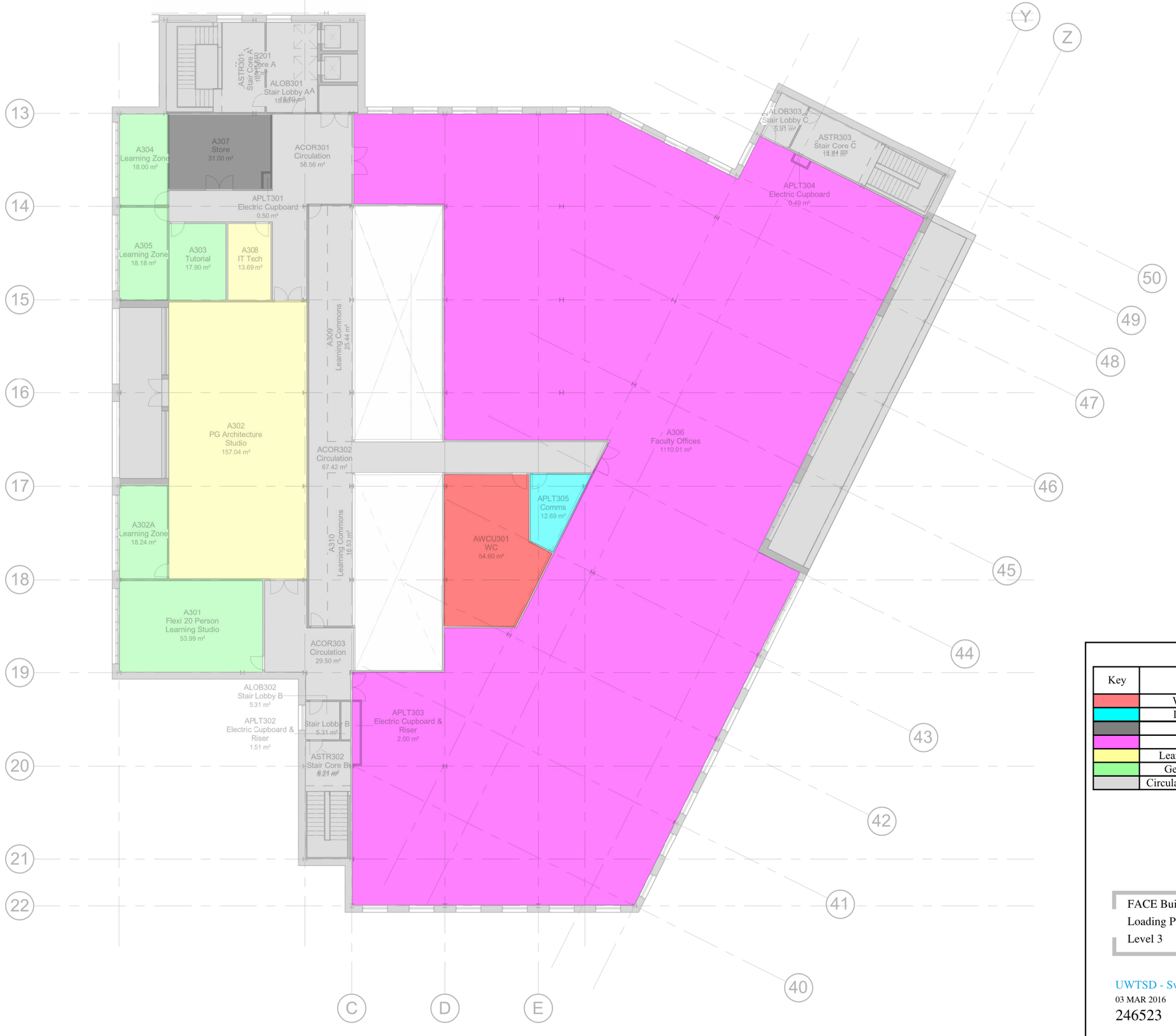


Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	1.0	3.0	2.0
	Internal Plant	1.0	5.0	4.5
	Storage	1.0	5.0	4.5
	Computer Lab	1.0	4.0	4.5
	Learning Workshop	1.0	5.0	4.5
	General Learning	1.0	4.0	3.0
	Circulation Area	1.0	4.0	4.0

FACE Building
Loading Plan
Level 2

UWTSD - Swansea SA1 Campus, Phase 1
03 MAR 2016
246523

ARUP

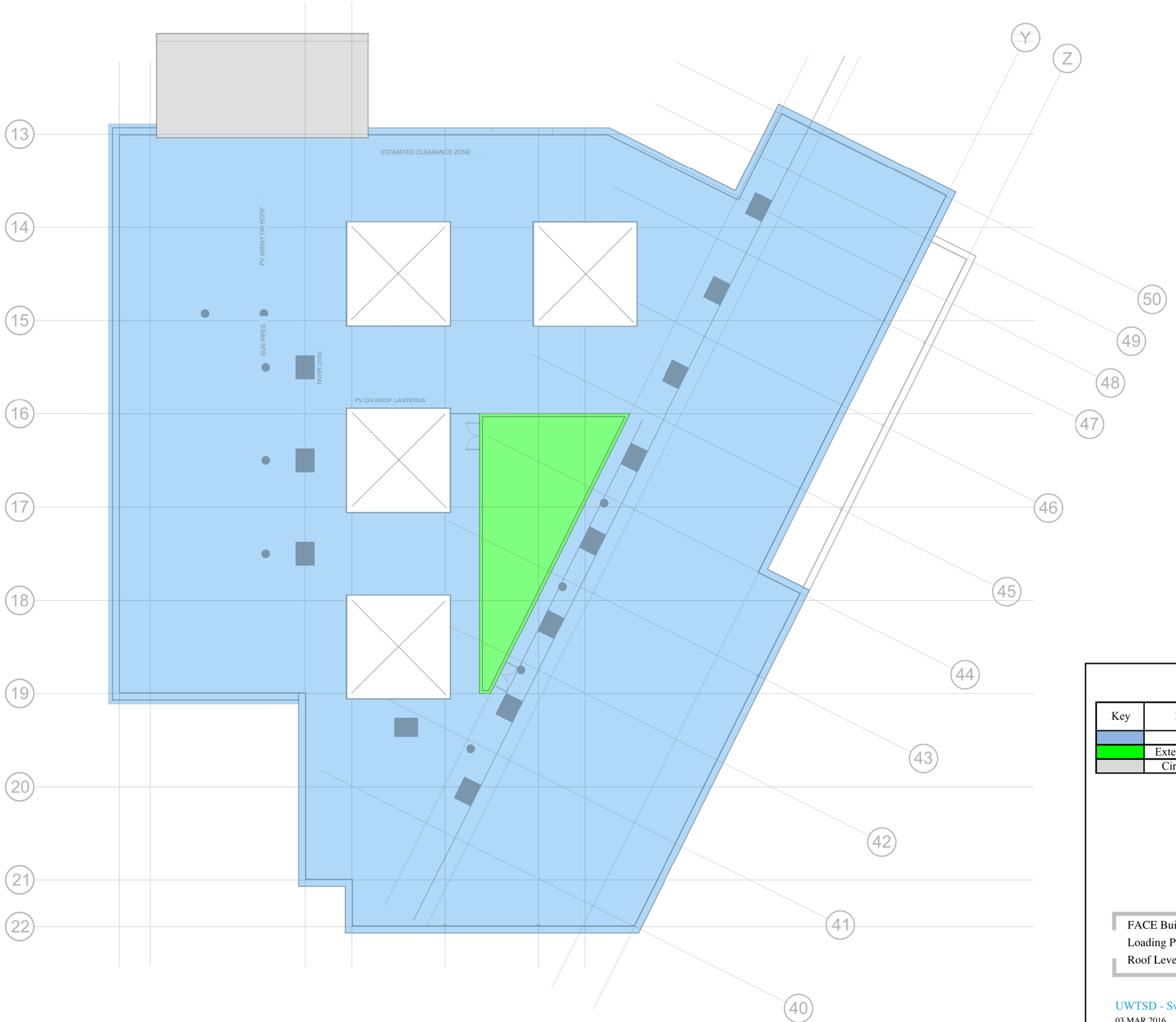


Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	1.0	3.0	2.0
	Internal Plant	1.0	5.0	4.5
	Storage	1.0	5.0	4.5
	Office	1.0	3.5	2.7
	Learning Workshop	1.0	5.0	4.5
	General Learning	1.0	4.0	3.0
	Circulation Area/Balcony	1.0	4.0	4.0

FACE Building
Loading Plan
Level 3

UWTSD - Swansea SA1 Campus, Phase 1
03 MAR 2016
246523

ARUP

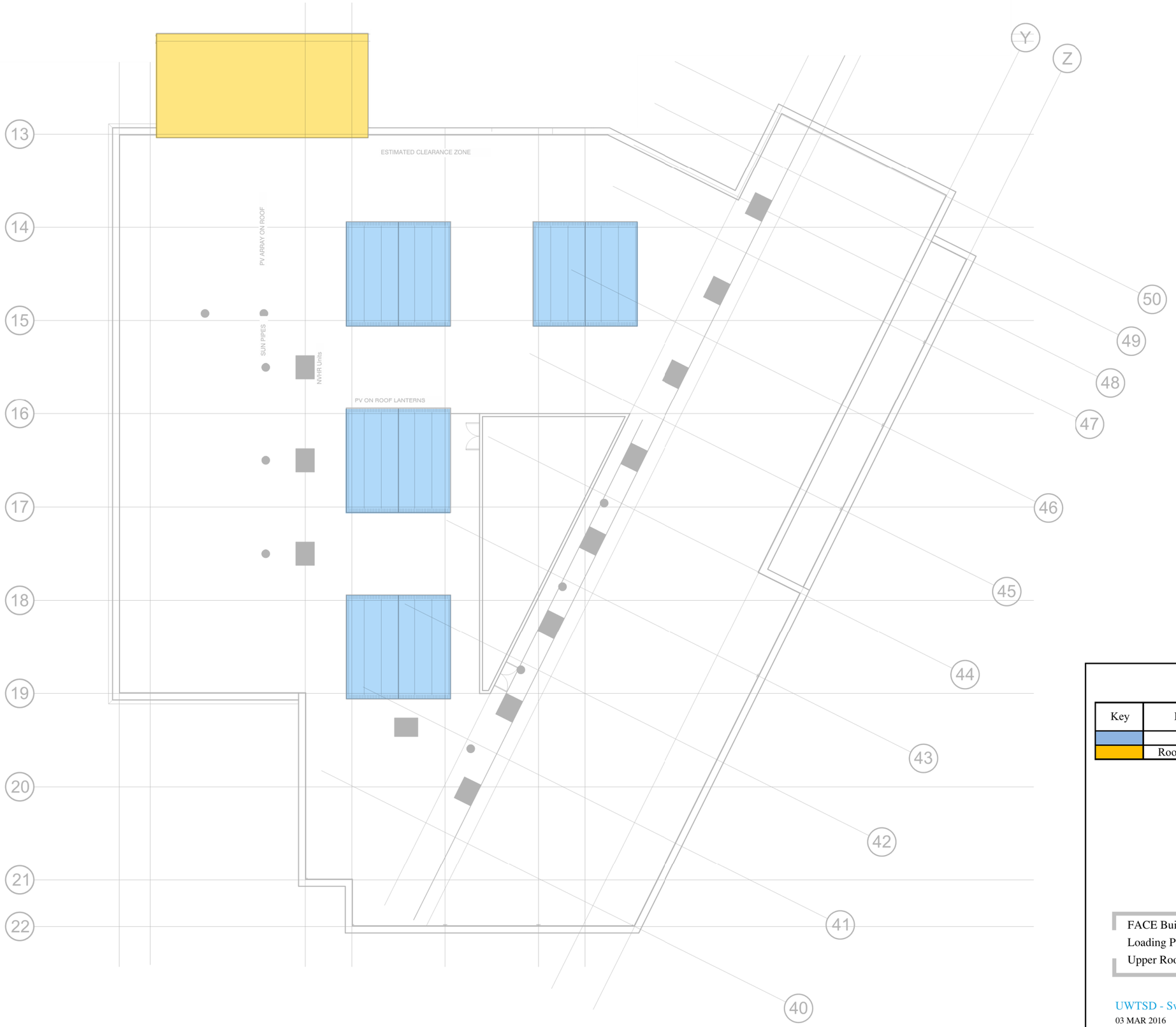


Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	PV Roof	1.0	1.5	0.9
	External Plant Area	1.0	5.0	4.5
	Circulation Area	1.0	4.0	4.0

FACE Building
Loading Plan
Roof Level

UWTSD - Swansea SA1 Campus, Phase 1
03 MAR 2016
246523

ARUP



Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	PV Roof	1.0	1.5	0.9
	Roof (No Access)	1.0	0.6	0.9

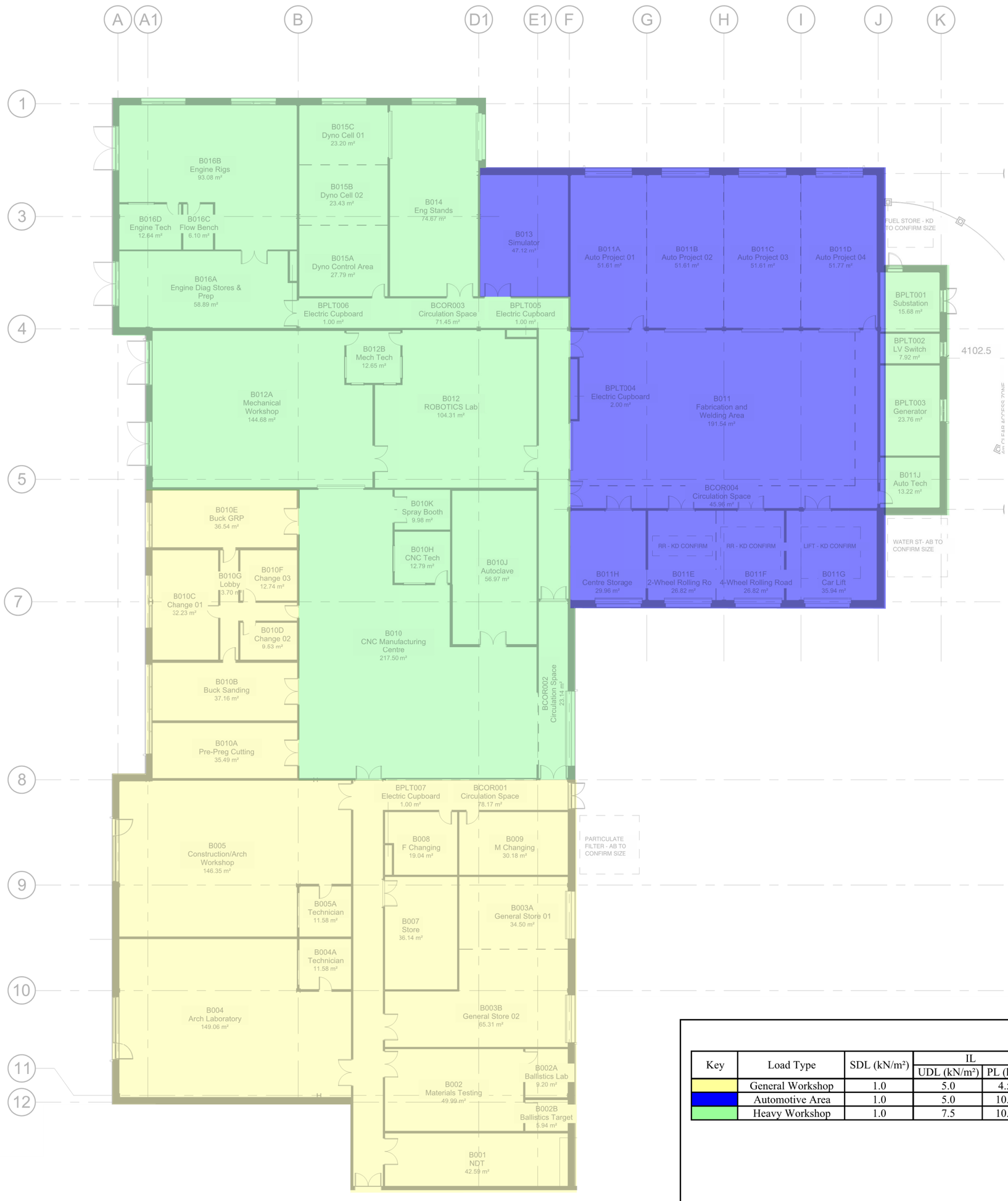
FACE Building
Loading Plan
Upper Roof Level

UWTSD - Swansea SA1 Campus, Phase 1

03 MAR 2016

246523

ARUP



Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	General Workshop	1.0	5.0	4.5
	Automotive Area	1.0	5.0	10.0
	Heavy Workshop	1.0	7.5	10.0

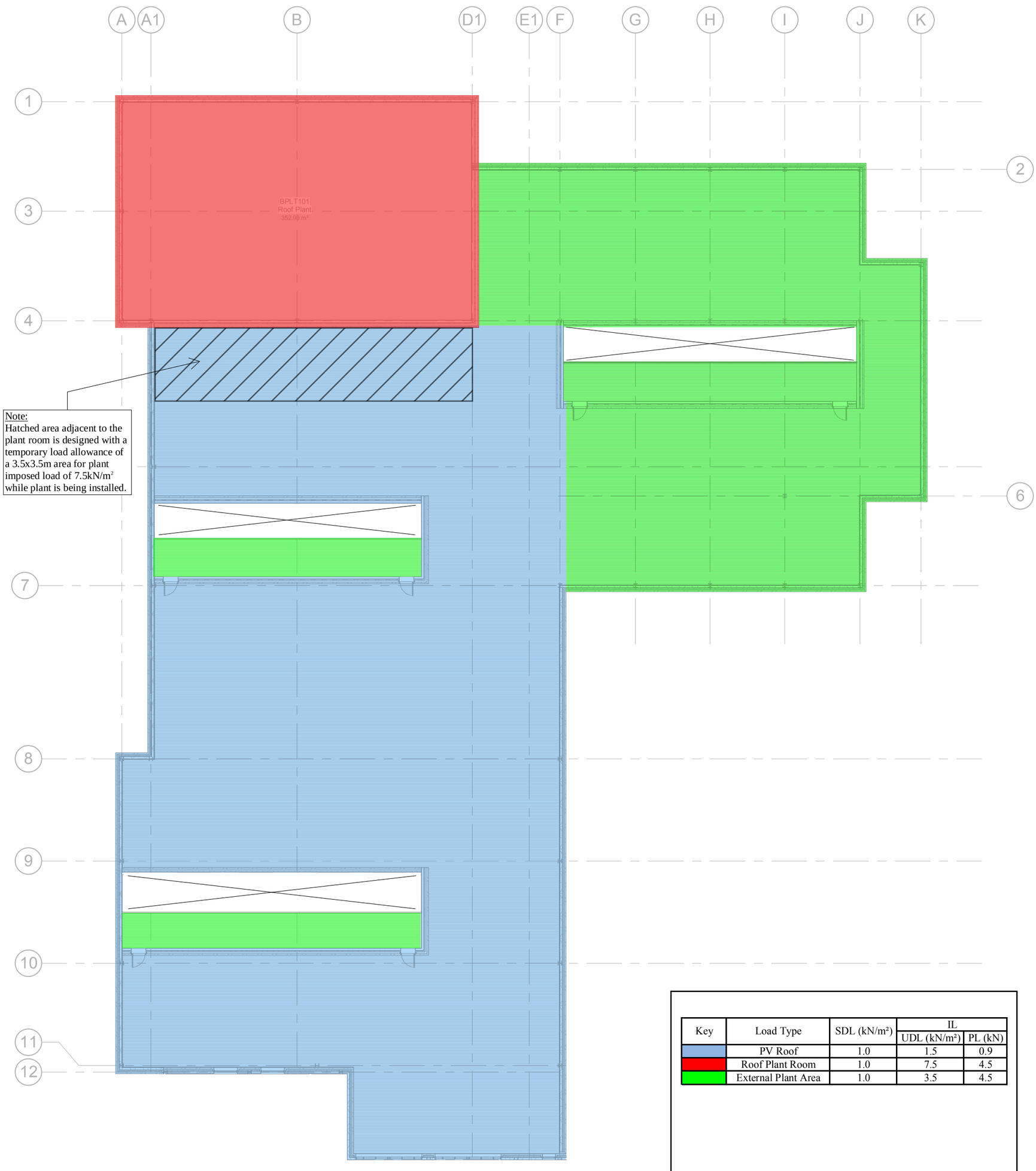
TECH Building
Loading Plan
Ground Level

UWTSD - Swansea SA1 Campus, Phase 1

03 MAR 2016

246523

ARUP

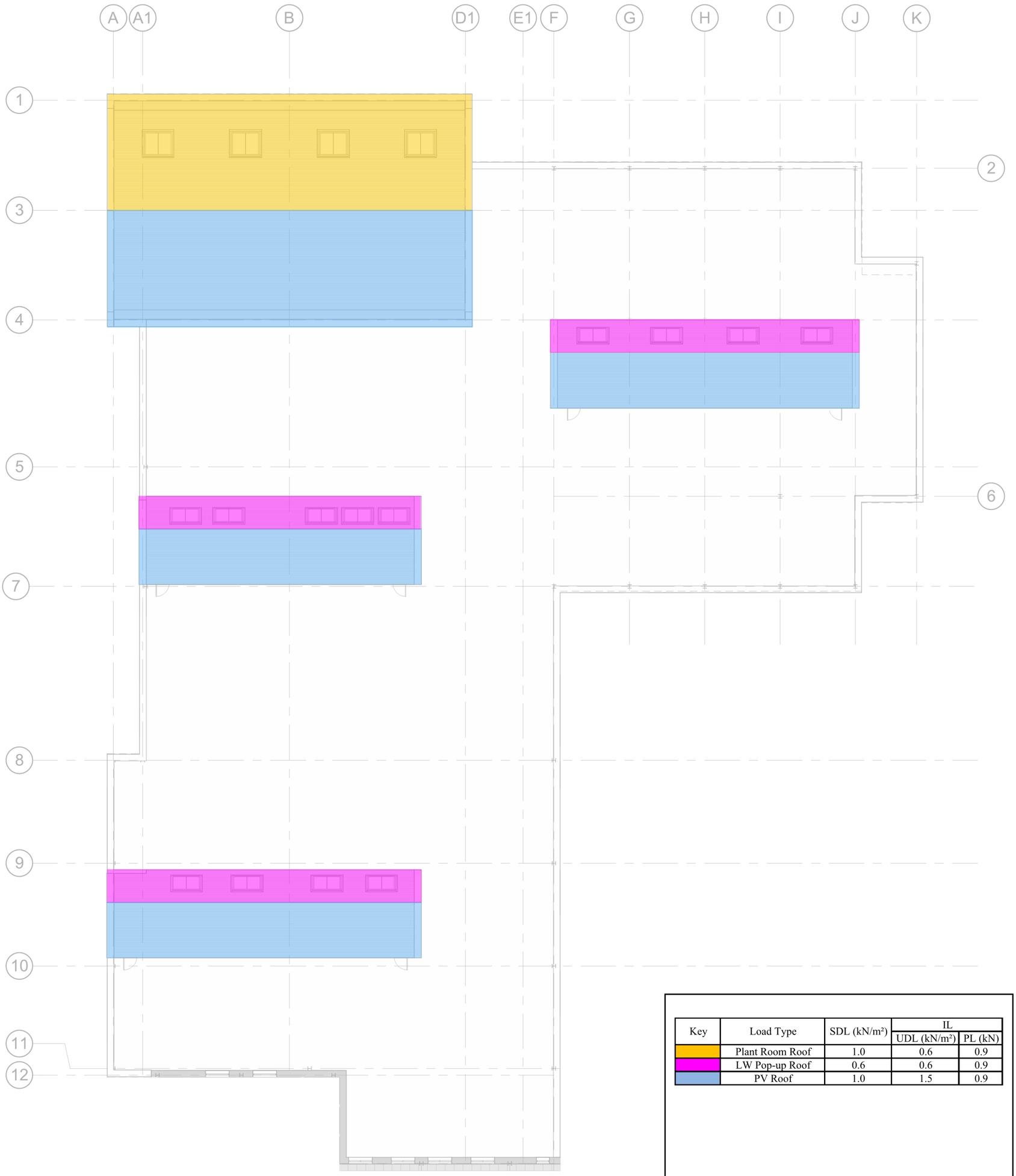


Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	PV Roof	1.0	1.5	0.9
	Roof Plant Room	1.0	7.5	4.5
	External Plant Area	1.0	3.5	4.5

TECH Building
Loading Plan
Roof Level

UWTSD - Swansea SA1 Campus, Phase 1
03 MAR 2016
246523

ARUP



Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	Plant Room Roof	1.0	0.6	0.9
	LW Pop-up Roof	0.6	0.6	0.9
	PV Roof	1.0	1.5	0.9

TECH Building
Loading Plan
Upper Roof Level

UWTSD - Swansea SA1 Campus, Phase 1
03 MAR 2016
246523

ARUP



00 Ground Floor Level

Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	2.0	3.0	2.0
	Storage	2.0	5.0	4.5
	Internal Plant	2.0	7.5	4.5
	General Learning	2.0	4.0	3.0
	Circulation Area	2.0	4.0	4.0

Library
Loading Plan
Ground Level

UWTSD - Swansea SA1 Campus, Phase 1

29 FEB 2016

246523

ARUP



01 First Floor Level

Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	1.0	3.0	2.0
	General Book Storage	1.0	5.0	7.0
	General Learning	1.0	4.0	3.0
	Circulation Area	1.0	4.0	4.0

Library
Loading Plan
Level 1

UWTSD - Swansea SA1 Campus, Phase 1

29 FEB 2016

246523

ARUP



02 Second Floor Level

Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	WC Facilities	1.0	3.0	2.0
	Storage	1.0	5.0	4.5
	Internal Plant	1.0	7.5	4.5
	General Book Storage	1.0	5.0	7.0
	General Learning	1.0	4.0	3.0
	Circulation Area	1.0	4.0	4.0

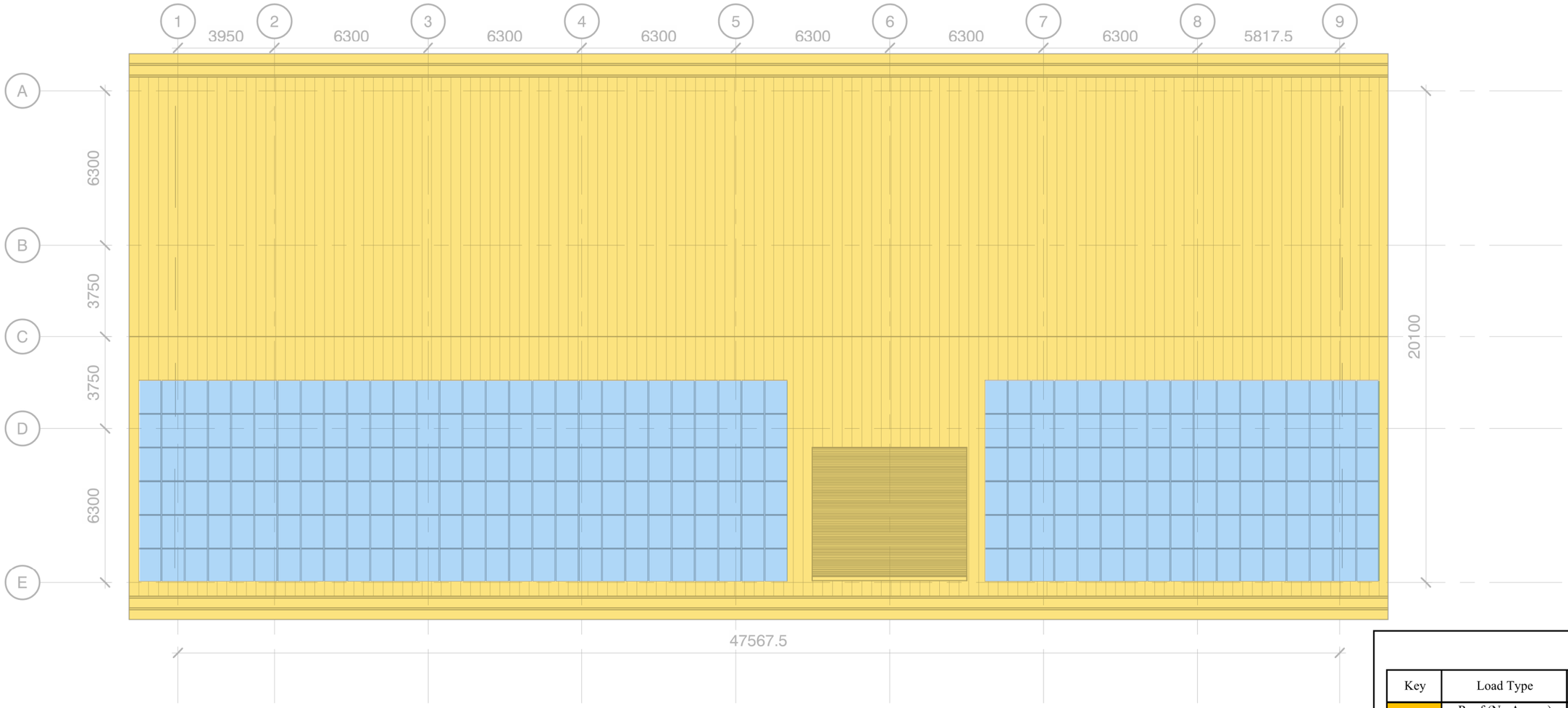
Library
Loading Plan
Level 2

UWTSD - Swansea SA1 Campus, Phase 1

29 FEB 2016

246523

ARUP



03 Roof Level

Key	Load Type	SDL (kN/m²)	IL	
			UDL (kN/m²)	PL (kN)
	Roof (No Access)	1.0	0.6	0.9
	PV Roof	1.0	1.5	0.9

Library
Loading Plan
Roof Level

UWTSD - Swansea SA1 Campus, Phase 1

29 FEB 2016

246523

ARUP

D2 TECH Building GF Load Assessment

ARUP	Job No.	Sheet No.	Rev.
	246523-00		
	Member/Location	Loading	
Job Title: UWTSD TECH Building	Drg. Ref.		
Calculation: Ground Floor Live Load Review	Made by: EM	Date: 21/01/2016	Chd.: OM

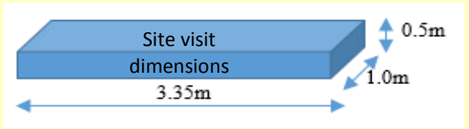
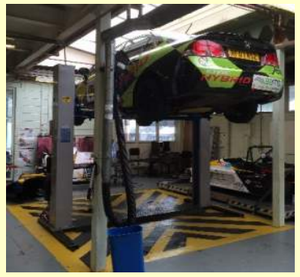
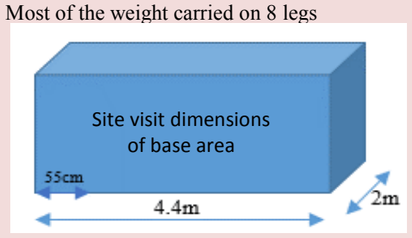
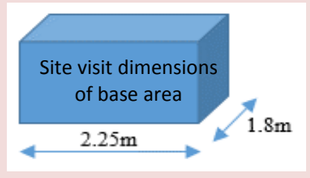
TECH Building Loading Information Review

The information provided in the document is based on:
- BS EN 1991-1-1: 2002 Eurocode 1: Actions on structures Inc. NA
- Site visit to the existing UWTSD Swansea Mount Pleasant Campus on 11/01/2016
- Existing University's Major Workshop Machinery List

EC1 References	**Area load**	**Point Load**
E208 Factories, workshops and similar buildings	5.00 kN/m²	4.50 kN
E213 Plant rooms, heavy industrial loading etc. including weight of machinery	7.50 kN/m²	4.50 kN
F Traffic areas	2.50 kN/m²	10.00 kN

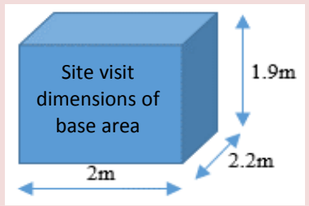
Room No	Room Title	Area	Comments	Dimensions	Assumptions	Images	Assessed load	EC1 Ref.	Design load		Notes
									Area load	Point Load	
B016A B016B	Engine Stands Engine Rigs	93.93 m² 60.54 m²	Has a potential to accumulate engine stands - Engine stand 550kg (16No.) - Engine stand 900kg (3No.) - Engine stand 227kg (13No.)	 (850x1000) (1050x840) (750x900)	Assuming accumulation of the goods as shown in the picture		 6.50 kN/m² 10.00 kN/m² 3.40 kN/m²				[A]
B014	Engine Diagnostics Stores & Prep	71.84 m²	Has a potential to accumulate engine stands - Engine stand 350kg (8No.) - Engine stand 454kg (8No.) - Engine stand 550kg (8No.)	 (850x1000) (1050x840) (750x900)	Assuming accumulation of the goods as shown in the picture (Diagnostics Lab as per room sheet) ↖ Confirmation of use required		 4.70 kN/m² 5.80 kN/m² 6.30 kN/m²				
B016C	Flow Bench	6.10 m²	Light equipment: wind tunnel, flow bench				5.00 kN/m²	E213	7.50 kN/m²	10.00 kN	[B]
B016C	Engin Tech	12.76 m²	Technician's office				3.00 kN/m²				
B015A	Dyno Control Area	24.84 m²	Operator's office			 	3.00 kN/m²				
B015B	Dyno Cell 02	23.38 m²	Will required roof mounted radiator, its own cooling system potentially located at the roof above and external fuel storage				5.00 kN/m²				
B015C	Dyno Cell 01	23.38 m²					5.00 kN/m²				
B013	Simulator	39.96 m²	Car simulator				5.00 kN/m²				
B011A	Autoproject 02	48.63 m²					5.00 kN/m²				
B011B	Autoproject 01	50.59 m²					5.00 kN/m²				
B011C	Autoproject 03	50.59 m²					5.00 kN/m²				
B011D	Autoproject 04	50.58 m²					5.00 kN/m²				
B011J	Auto Tech	11.25 m²	Technician's office				3.00 kN/m²	E208 / F	5.00 kN/m²	10.00 kN	[B]
B011	Fabrication and Welding Area	193.83 m²					5.00 kN/m²				

ARUP	Job No.	Sheet No.	Rev.
	246523-00		
Job Title: UWTSD TECH Building	Member/Location: Loading		
Calculation: Ground Floor Live Load Review	Drg. Ref.		
	Made by: EM	Date: 21/01/2016	Chd.: OM

Room No	Room Title	Area	Comments	Dimensions	Assumptions	Images	Assessed load	EC1 Ref.	Design load: Area load	Design load: Point Load	Notes
B011E	2-Wheel Rolling road	25.56 m²	Requires a pit to for the rolling road 				5.00 kN/m²				
B011F	4-Wheel Rolling road	26.54 m²	4-wheel rolling road will require longer pit with adjustable back rollers for different lengths of cars and is likely to be floor mounted UWTSD to confirm which option they consider				5.00 kN/m²	E208 / F	5.00 kN/m²	10.00 kN	[B]
B011G	Car lift	35.58 m²	Load is concentrated on two legs (2.8t) with spreader plates - punching shear issue				5.00 kN/m²				
B010E	Buck GRP	39.61 m²					5.00 kN/m²				
B010B	Buck Sanding	39.86 m²					5.00 kN/m²	E208	5.00 kN/m²	4.50 kN	
B010A	Pre-Preg Cutting	38.07 m²					5.00 kN/m²				
B010	CNC Manufacturing centre		CNC machine – 7tonnes with 12 feet support. Most of the weight carried on 8 legs 	(6000x4250)	Assumed that the load is spread over the dimensions given in the Major Workshop Machinery sheets		2.75 kN/m²	E213	7.50 kN/m²	10.00 kN	[B]
			Two smaller CNC machines – heavy duty ones (3.6t) 	(2550x2550)	Assumed that the load is spread over the dimensions given in the Major Workshop Machinery sheets		5.60 kN/m²				[C]

ARUP

Job No.	246523-00
Sheet No.	
Rev.	
Member/Location	Loading
Job Title	UWTSD TECH Building
Drg. Ref.	
Calculation	Ground Floor Live Load Review
Made by	EM
Date	21/01/2016
Chd.	OM

Room No	Room Title	Area	Comments	Dimensions	Assumptions	Images	Assessed load	EC1 Ref.	Design load		Notes
									Area load	Point Load	
B010H	CNC Tech	12.79 m²	Technician's office				3.00 kN/m²				
B010K	Spray Booth	10.03 m²					5.00 kN/m²				
B010J	Autoclave	52.09 m²	Heavy piece of kit (3.2t) Requires separate cooling system: external, roof mounted, directly above the autoclave 	(2350x3600)	Assumed that the load is spread over the dimensions given in the Major Workshop Machinery sheets		3.80 kN/m²				
B012B	Mechanical workshop	145.83 m²	Material Laboratory equipment - Excel Lathe D560x1500 (2.3t) x2 - Excel Lathe D420x1000 (1.57t)	(2850x1230) (2000x920)	Assumed that the load is spread over the dimensions given in the Major Workshop Machinery sheets		6.60 kN/m² 8.50 kN/m²	EC213	7.50 kN/m²	10.00 kN	[D] [E] [B]
B010H	Mech Tech	12.79 m²	Technician's office				3.00 kN/m²				
B012	Robotics Lab	100.05 m²	Typically - KUKA Robotic Arm is located	(2500x106)	Assumed that the load is spread over the dimensions given in the Major Workshop Machinery sheets		5.00 kN/m² 4.60 kN/m²				
B002	Material Testing	45.09 m²	Sensitive equipment testing				5.00 kN/m²	E208	5.00 kN/m²	4.50 kN	
B002A	Ballistics Lab	15.05 m²					5.00 kN/m²				
B004	Arch Laboratory	141.71 m²	Typical teaching lab/workshop				5.00 kN/m²	E209	5.00 kN/m²	4.50 kN	
B005	Construction/Arch Workshop	142.43 m²	Typical teaching lab/workshop				5.00 kN/m²				
B008	F Changing	22.44 m²	WC/Change facilities				3.00 kN/m²				
B009	M Changing	22.65 m²	WC/Change facilities				3.00 kN/m²				
B010C	Change 01	32.52 m²	WC/Change facilities				3.00 kN/m²	A3	5.00 kN/m²	4.50 kN	
B010D	Change 02	13.03 m²	WC/Change facilities				3.00 kN/m²				
B010F	Change 03	13.12 m²	WC/Change facilities				3.00 kN/m²				
Rm160	Plant	16.64 m²	Plant room areas				7.50 kN/m²				
Rm161	Plant	41.35 m²	Plant room areas				7.50 kN/m²	E213	7.50 kN/m²	4.50 kN	
Rm162	Plant	23.87 m²	Plant room areas				7.50 kN/m²				

ARUP

Job No.	Sheet No.	Rev.	
246523-00			
Member/Location	Loading		
Job Title	UWTSD TECH Building	Drg. Ref.	
Calculation	Ground Floor Live Load Review	Made by EM	Date 21/01/2016 Chd. OM

Room No	Room Title	Area	Comments	Dimensions	Assumptions	Images	Assessed load	EC1 Ref.	Design load		Notes
									Area load	Point Load	
B007	Architecture Store	50.85 m²	Storage loading TBC				5.00 kN/m²				
B003	General Store	51.50 m²					5.00 kN/m²	E14	5.00 kN/m²	4.50 kN	
B011H	Central Storage	62.71 m²					5.00 kN/m²				
BCOR01	Circulation Space	52.34 m²	Corridors				4.00 kN/m²				
BCOR02	Circulation Space	63.68 m²	Corridors				4.00 kN/m²				
BCOR03	Circulation Space	82.28 m²	Corridors				4.00 kN/m²	C35	5.00 kN/m²	4.50 kN/m²	
BCOR04	Circulation Space	83.28 m²	Corridors				4.00 kN/m²				

[A] 10kN/m² loading is applied at a small area and it is assumed that there will be minimal loading directly around the machinery. Therefore, on average 7.5kN/m² allowance will cover the applied loading
[B] Increased point load allowance included to allow for load in line with loading Category F. It is assumed that the heavy point loads are distributed over individual concrete plinths or spreader plates.
[C] Referenced weight obtained from: www.mwmachinery.com/cncvmc/4430.htm
[D] Referenced weight obtained from: www.excelmachinetools.co.uk/pdfcatalogue/E-Catalogue/E-Catalogue-2011-12_Page33.pdf
[E] Referenced weight obtained from: www.mscdirect.co.uk/EXE-01160H/SEARCH:CATEGORY/product.html

Appendix E

Structural Drawings

01 Project Description

The Swansea SA1 Campus - Phase 1 is a new development which includes a new building for Faculty of Architecture, Computing and Engineering (FACE), the new library facility and the associated external works and landscaping to the Phase 1 area. The site is in the northern part of Swansea Docks. The area is located directly to the southeast of of Swansea city centre. It is bordered by Fabian Way to the north and covers the Prince of Wales Dock area.

The project comprises of the three buildings and referenced on the key plans as follows:
- AA, The design and construction of the FACE Building - flexi learning space
- BB, The design and construction of the TECH Building - workshop areas
- CC, The design and construction of the Library

02 General Notes

1. This and all drawings must be read in conjunction with the specifications, the Architect's drawings, the Engineer's drawings, the Services Engineer's drawings and the Specialist Sub-contractor's drawings. The Main Contractor is to notify the Architect and Engineer of any discrepancies before proceeding.
2. All dimensions are in millimetres (mm) unless noted otherwise.
3. Do not scale from these drawings, use given dimensions only.
4. All levels are in metres & related to Ordnance Survey Datum
5. All setting out in accordance with the Topographical Survey to be confirmed by Main Contractor.
6. All levels are measured to the structure unless noted otherwise.
7. Where proprietary products are specified, the contractor may substitute alternative materials with equal performance, dimensions and specification provided he gains approval for such substitution.
8. No holes other than those shown on the drawings are to be formed in the works without review by the Structural Engineer.
9. Inserts and Fixings - General
   a) For details of all other cast-in elements such as ducts, conduits, pipes and lightning protection, refer to the relevant Service Engineers, Architects or specialist Sub-contractors drawings.
   b) For positioning of lift shaft channel fixings, refer to Service Engineers and Sub-contractors drawings.
   c) The metal, glass and other cladding systems, together with the associated fixings are not shown on these drawings. For details refer to the Architects and Sub-contractors drawings.
   d) For details of all cast-in elements such as plates, bolts, ducts, conduits, pipes refer to the relevant structural drawing.
10. See Architectural drawings for the following:
   a) Size and location of all door and window openings, except as noted.
   b) Size and location of all interior and exterior non load bearing partitions, except as noted.
   c) Size and location of all concrete kerbs, slopes, depressed areas, change in level, floor ducts, chamfers, grooves, inserts. etc, except as shown.
11. See Mechanical, Plumbing and Electrical drawings for the following:
   a) Pipe runs, sleeves, floor drains, hangers, trenches, wall and slab openings, etc, except as shown or noted.
   b) Electrical conduit runs, boxes, outlets in walls and slabs, except as shown or noted.
   c) Concrete inserts for Electrical, Mechanical or Plumbing fixtures.
   d) Location of plant room machine or equipment bases, lifting beams, anchor bolts for motor mounts, except as shown or noted.
   e) Lightning protection details.
12. Holes through slabs and walls with maximum dimensions of less than 300mm x 300mm or 300mm dia. are TYPICALLY NOT SHOWN on the Structural drawings.
    For details of such holes refer to the relevant Architect's and approved Builderswork Drawings.
    Holes of ANY size through beams, and columns are shown on the structural drawings.
13. Openings, pockets, etc. larger than 50mm shall not be placed in concrete slabs, decks, walls, unless specifically detailed on the Structural drawings. Notify the Engineer when drawings by others show openings, pockets, etc. larger than 50mm which are not shown on the Structural drawings, but which are located in Structural members. NO reinforcement should be cut without the agreement of the Structural Engineer.
14. All Mechanical systems suspended loads exceeding 200kg shall be reviewed by the engineer prior to installation unless specifically detailed on the drawings.
15. Construction material shall be spread out if placed on the roof or floor. Loads shall not exceed the design live load as specified on the Loading Key Plan drawings.
16. The Robustness class of the structure in accordance with Building Regulations is as follows :
    Class 2b.

03 Loads, Stability, Construction and Safety

1. Loads
   a) For Design Super-Imposed Dead Loads & Design Live Loads refer to the relevant specification.
   b) Wind Loads have been calculated in accordance with BS EN 1991-1-4 : 2005 `Eurocode 1 : Actions on Structures - General Actions - Wind Actions'
      Basic Wind Speed Vb= 23.2 metres per second.
   c) Pressure coefficients for the design of wind loaded members should be assessed in accordance with BS EN 1991-1-4 : 2005 (by specialist designer)
2. Stability
   Lateral and Torsional Stability of the Structural Frame is achieved by Diaphragm action of the slabs and roof decking transferring lateral loads to the vertical steel bracing or reinforces concrete cores.
   The forces are transferred into the foundations.
   The structural deck for the slabs is to act as a diaphragm and should be detailed to achieve this.
   The contractor is responsible for providing temporary stability to the structure until perminent stability is achieved.
3. Design
   The Structures have been designed for their final configuration.
4. Construction
   a) The Contractor shall be responsible for Design, Fabrication, Erection and Removal of all Temporary Works and shall provide all Temporary Bracing and Backpropping necessary to maintain stability during construction.
   b) Requirements for any Temporary Movement Joints will be shown on the Structural Drawings. These locations to be agreed with the Contractor.
5. Health and Safety
   a) For Health and Safety information refer to Pre-Construction Health and Safety File, Design and Construction Team Hazard Registers. Specific residual risks which are required to be managed are shown on the relevant drawings.

04 Foundations

1. Read in conjunction with the relevant Ground Investigation Reports, Civil Engineering Specifications, and the Structural Specifications.
2. The site is a brownfield site. An assessment of ground contamination based on investigation findings is contained within the Ground Investigation Report.
   The ground investigation carried out was a sampling process, and the Contractor should exercise due care when working in the ground in all areas of the site.
3. The foundation strategy is piled foundations.

04 Foundations (Continued)

4. Excavation to be backfilled with 6N/ 6P Type Engineered Fill or equal aproved in accordance with the Specification for Highway Works, refer to Civil Engineering Specification.
5. Services passing through the structure are to be isolated and protected in accordance with the Services Engineer's Specification.
6. Where necessary, service ductwork and penetrations are to be sealed against gas and water ingress in accordance with the Specialist Sub-contractor's requirements.
7. All construction joints to lift pits are to contain Hydrophilic strips or equal approved.
8. Foundations are to be centred under columns and walls UNO.

05 Reinforced Concrete

1. All concrete is to comply with the National Structural Concrete Specification for Building Construction 4th Edition, and as modified in the contract Concrete Specification, which take precedence over all notes specific to Reinforced Concrete and Reinforcing Steel on the Arup Structural drawings.
2. Openings shown on the Structural General Arrangement drawings are to be checked by the Contractor against relevant Services Builders work drawings prior to construction. Any discrepancies must be drawn to the attention of the relevant Design Team Member.
3. Clean all areas where concrete is to be placed and render free from standing water immediately prior to placing the concrete.
4. All holes in reinforced concrete are to be formed. No cutting or removal of placed concrete is permitted without prior agreement of the Structural Engineer.
5. The positions and details of all construction joints not shown on the drawings are to be agreed with the Structural Engineer before any work commences.
6. The Contractor is to agree with the Architect all visible concrete joints not shown on the drawings.
7. All formwork shall be removed after concreting. Details of any formwork to be left in place shall be submitted for approval.
8. The Contractor is responsible for providing all sleeves for plumbing and electrical openings in concrete before placing. Do not cut off any reinforcing bars which may conflict. Notify the Structural Engineer of conditions not shown on the drawings.
9. The Contractor is responsible for designing, detailing and providing all stools and spacers for adequately supporting the reinforcement cages.
10. All concrete in contact with the ground is to be placed on a minimum of 50mm thick layer of blinding concrete.
11. For details of lightning protection requirements to be incorporated into the concrete works, including earthing continuity through reinforcement, refer to the Services Engineer's drawings.
12. All formwork and propping under suspended concrete works must be removed before any masonry work is built above.
13. Cover to all reinforcement to be as shown on the Reinforcement Drawings.
14. Starter kickers to all walls to be a minimum of 75mm high unless noted otherwise.
15. All couplers shall be screwed couplers or weldable screwed couplers, and shall be capable of transferring the full design tension capacity of the connected reinforcement. The couplers shall be installed according to the product's specification.
16. Reinforcement should be detailed to pass through all joints.
17. The weights of reinforcement stated in the costing notes are based on certain assumptions about how the reinforcement will be detailed. The Contractor should verify these quantities by examining the reinforcement drawings and should amend these quantities submitted with the Contractor's Tender, except to the extent resulting from subsequent variations.
18. All concrete admixtures are to be approved by the Construction Manager, and are to be used in strict accordance with their manufacturer's requirements and recommendations.
19. Curing agents applied to finished surfaces of slabs and beams shall be compatible with applied finishes.
20. All square edges to walls, columns and beams to have 25mm x 25mm chamfers unless noted otherwise.

06 Precast Concrete

1. All precast concrete is to comply with the National Structural Concrete Specification for Building Construction 4th Edition, and as modified in the Concrete, which takes precedence over all notes specific to Precast Concrete on the Arup Structural drawings.
2. All precast concrete units are to be designed by Specialist for the loading shown on the Loading Key plan drawings along with any temporary loading or condition that exists during erection and construction. All calculations and drawings should be submitted to the Structural Engineer (Arup) for review.
3. Temporary loads applied during construction works are to be determined with the main contractor and then agreed with the Structural Engineer.
4. Concrete grade to be determined by the Precast Concrete Specialist in response to structural requirements.
5. All precast concrete elements are to be adequately anchored down to the supporting structure.
6. All fixings, bolts, cleats, angles etc to be stainless steel.
7. For details of Precast Concrete Flooring see Table in Section 09 Floor and Roof Decking below.

07 Masonry

1. No Blockwork partitions has been agreed for use, it is generally assumed that internal partitions are lightweight. If blockwork is to be adopted than it must be agreed in advance with the Structural Engineer.
2. See Architect's Drawings for layout of all masonry walls.
3. Blocks shall be medium dense aggregate blocks to BS EN 771-3, with minimum compressive strength of 7N/mm² unless noted otherwise on Construction Drawings.
4. Mortar mix shall be Group 3 unless noted otherwise.
5. Secondary steelwork to blockwork not shown. Allow for head restraint to 50% of wall lengths. Allow for bonded and de-bonded ties either side of wind posts and columns. All wind posts to be hot dip galvanised. All blockwork accessories to be stainless steel UNO

08 Precast Concrete Stairs

1. All stairs to be designed for the loading shown on the Loading Keyplan drawings.
2. All stairs to be anchored in accordance with the requirements of BS EN 1991-1-7 Annex A for a Consequence Class 2b structure.
3. For precast stair performance specification refer to the Specification.

09 Floor and Roof Decking

1. Read in conjunction with steelwork and concrete notes.
2. Shear stud requirement on steel beam supporting concrete slabs on metal decking is shown on the relevant construction Steelwork Layout drawings.
3. Where metal decking is to be through fixed with composite shear studs to the top of beams, the beam top flange is to be unpainted. Fire protection of the voids in trapezoidal decking is to be provided separately where steelwork is intumescantly painted.
4. The metal deck is to be in accordance with the specification to B.S. EN 10147 (yield stress 350N/mm²).acting with the slab, is to be designed by the steelwork contractor in accordance with the Arup performance requirements.
5. For details of Decking Types shown on drawings refer to the Table below:

Floor and Roof Decking			
Reference	O/A Depth (mm)	Decking Type	Notes
D-1	150	75mm thick Precast Concrete Solid Planks with 75mm Structural Concrete Topping	Slabs @ FACE Building (Levels 01 to 04 supported on steelwork)
D-2	150	Tata Steel ComFlor 60 (1.2)	Main Roof @ TECH Building supported on steelwork
D-3	150	Structural Liner Tray - Tata Steel RoofDek D60 (1.2)	Library roof supported by steelwork

10 Structural Steelwork

1. All steelwork to comply with the National Structural Steelwork Specification 5th Edition CE Marking Version for Building Construction, published by BCSA / SCI / TATA Steel, as modified in the Contract Specifications.
2. Member size notation is shown on the Construction Drawings.
3. Steelwork Fabricator designed work is to be submitted for review by Structural Engineer.
4. Minimum weld size to be 6mm Continuous Fillet Welds unless noted otherwise.
5. Site welding to be carried out only with prior written consent of the Structural Engineer.
6. Design of all temporary propping/restraint is the Steelwork contractor's responsibility.
7. Holding down bolts and setting-out templates are to be provided by the Steelwork Contractor. Setting-out and adjustment to be accepted by the Steelwork Contractor prior to commencing erection.
8. 25mm Dia. grout holes are to be provided in all baseplates with an area greater that 0.5m².
9. All HSFG Bolt assemblies to be in accordance with BS EN 14399. All HSFG bolts to be grade 8.8 unless noted otherwise. Tension Control Bolts (TCB) are permitted provided they are used in accordance with the manufacturer's recommendations for corrosion protection and installation.
10. All connections are to be designed using a minimum of 12mm thick steel plate and should have the minimum tie capacity of 75kN or a value equivalent to the ULS shear load at the connection, whichever is the greater. Tie forces are not to be considered as additive to any other loads.
11. Contractor is to provide and install all flashing and closure plates at end of all units, around columns and at all perimeter locations.
12. All closure plates shall be in accordance with BS EN 10346
13. Where no camber is shown, install beams with rolling bow upwards.
14. All Trade Contractor designed work is to be submitted for approval by the Construction Manager. All submissions and method statements are to be submitted for approval by the Construction Manager prior to commencement of fabrication works.
15. The Steelwork Contractor is to allow for co-ordination with other Trade Contractors whose work interfaces with the steel frame.
    This co-ordination may include, as directed by the Construction Manager, the design, fabrication and erection of steel elements, brackets, fixings, specified by other Trade Contractors. Work to be specified by other Trade Contractors is not shown on Arup drawings.
16. Refer to the Steelwork Specification for all notes relating to Temporary Works during erection. The Steelwork Contractor is responsible for all temporary works which include but are not limited to the items noted on the drawings, specification and scope of works.
17. For corrosion protection details refer to the Steelwork Specification as stated in Note 1 above.
18. Weld Symbology on drawings is to be in accordance with BS EN 22553 : 1995
19. Steel beams supported by concrete connect via cast-in steel plates cast with the concrete works. Cast-in plates shall have shear studs and bent reinforcing bars pre welded to the cast in face. Cast-in plates to be installed to concrete works to a positional tolerance of +/- 15mm. Cast-in plates to be surveyed after installation by the steelwork fabricator and steel seating brackets and bespoke fins plates to be site welded to embed plates.Depending upon the sequencing of the on and off site works, steel beams may need to be fabricated with green ends to allow modification on site to suit as surveyed cast-in locations.

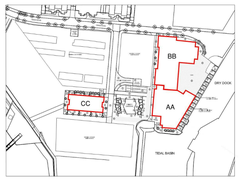
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
General Notes

Scale at A1 1 : 1

Role Structural

Suitability S2 - Issued for Information

Arup Job No 246523

Rev P2

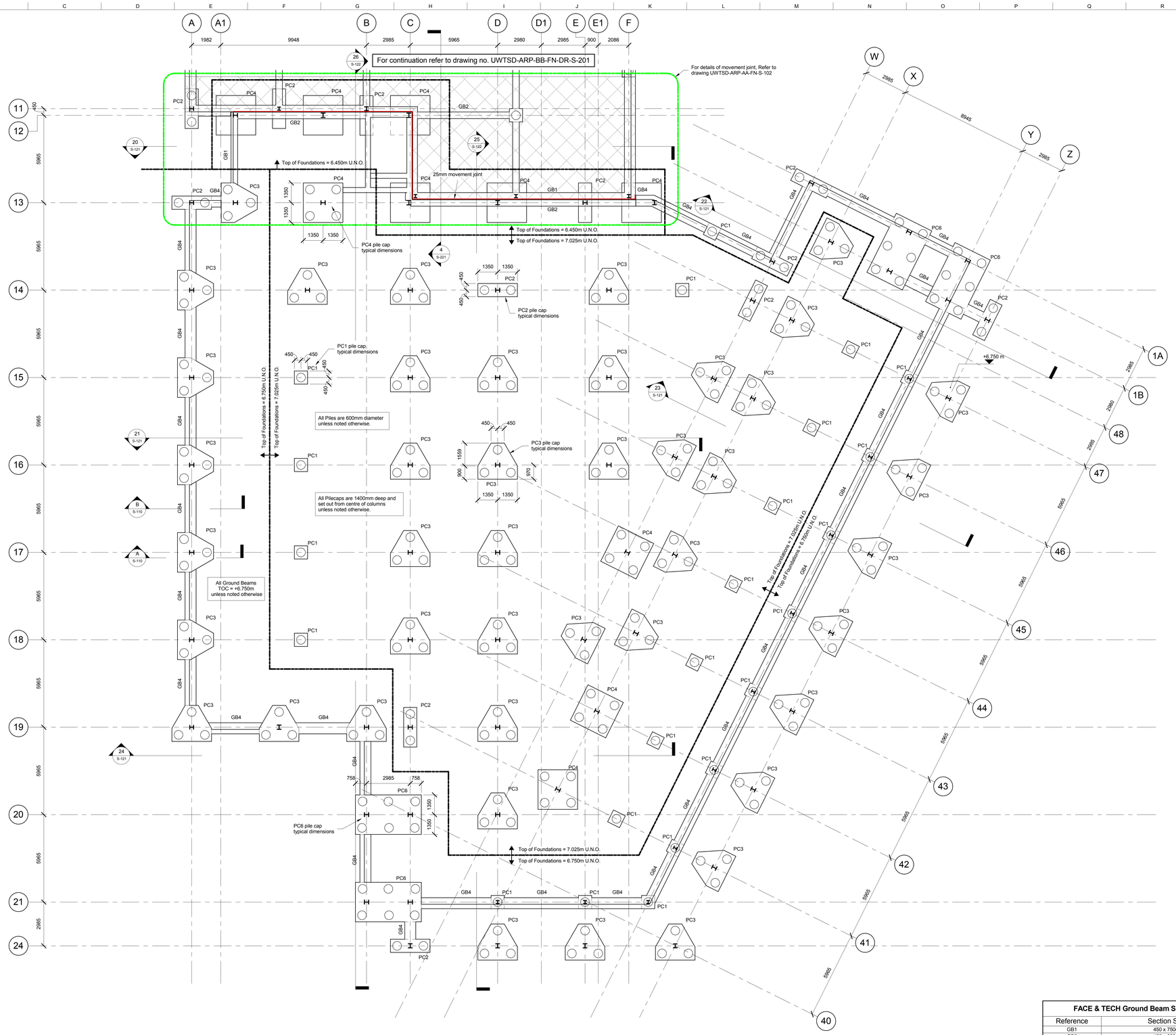
Name
UWTSD-ARP-00-XX-DR-S-000

03/03/2016 15:08:10

Do not scale

© Arup

E1 FACE Building



Level FN - G.A. Foundation Layout

1 : 100

Note:
The foundation and ground floor layout is indicative, based on the assumption noted in the Arup Stage 3 report. Final layouts to be developed and designed in the next stage of design following the results of the Site Investigation.

FACE & TECH Ground Beam Schedule

Reference	Section Size
GB1	450 x 750dp
GB2	450 x 600dp
GB3	750x750dp L Beam
GB4	750 x 450dp
GB5	350 x 1050dp
GB6	350 x 1175dp

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:32

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building) General Arrangement Foundation Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

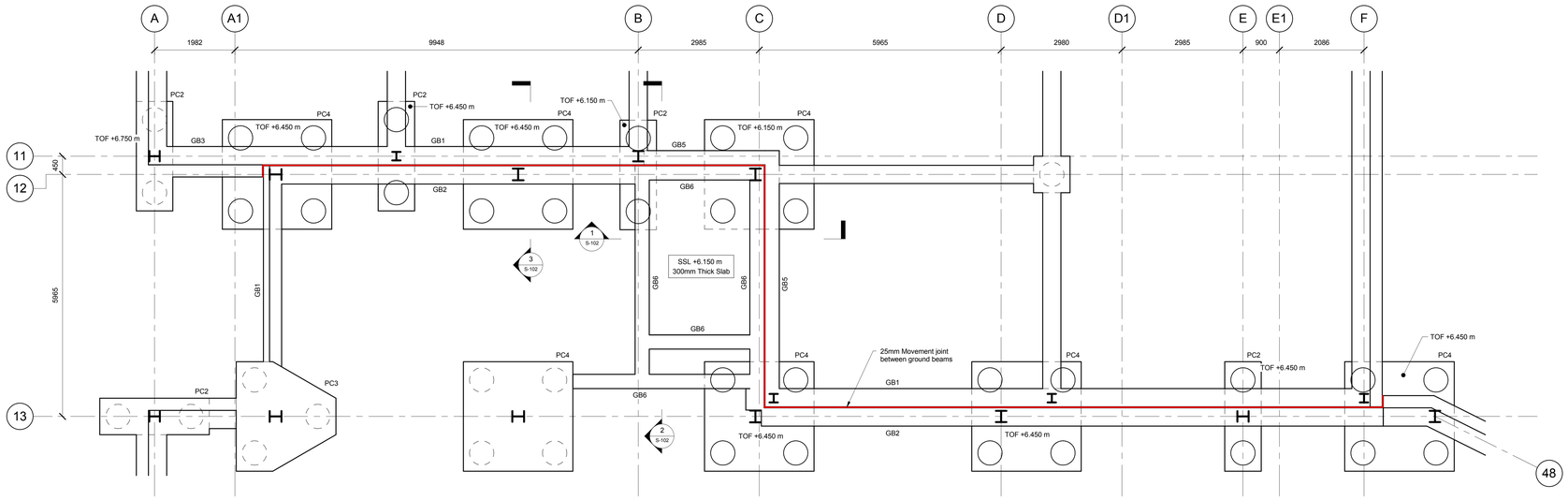
Arup Job No. 246523

Rev P2

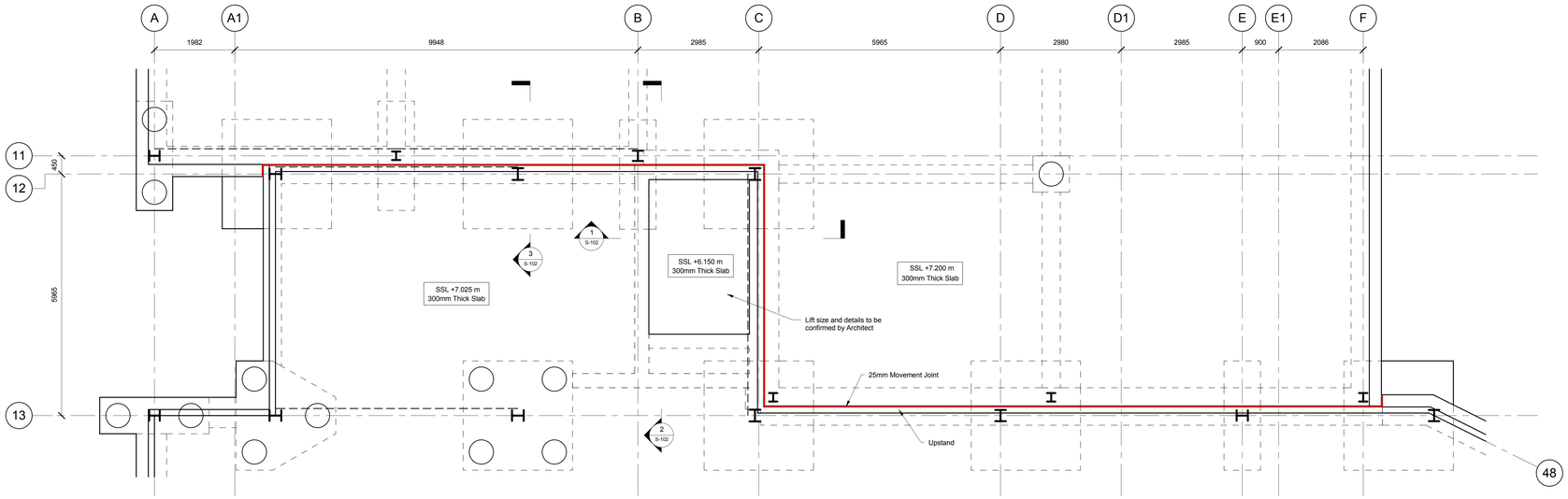
Name
UWTSD-ARP-AA-FN-DR-S-101

Do not scale

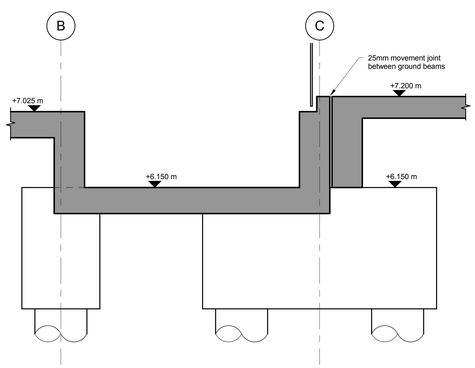
© Arup



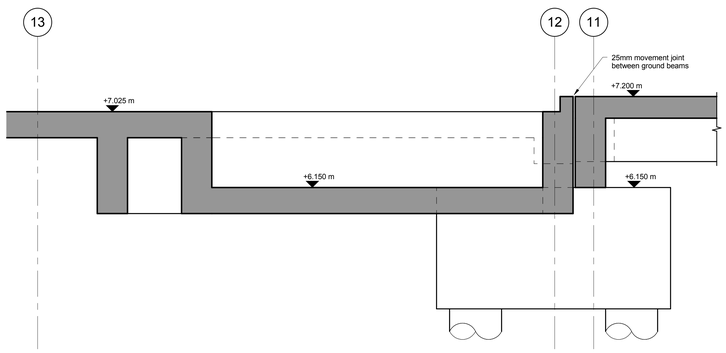
A Level FN - G.A. Foundation Layout
1 : 50



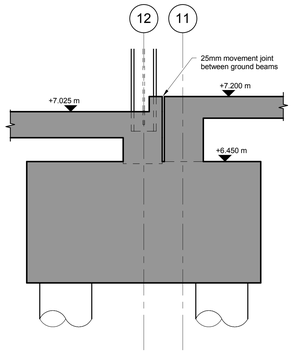
B Level 00 - G.A. Ground Floor Layout
1 : 50



1 Section 1
1 : 25



2 Section 2
1 : 25



3 Section 3
1 : 25

FACE & TECH Ground Beam Schedule

Reference	Section Size
GB1	450 x 750dp
GB2	450 x 600dp
GB3	750x750dp L Beam
GB4	750 x 450dp
GB5	350 x 1050dp
GB6	350 x 1175dp

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:39

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan

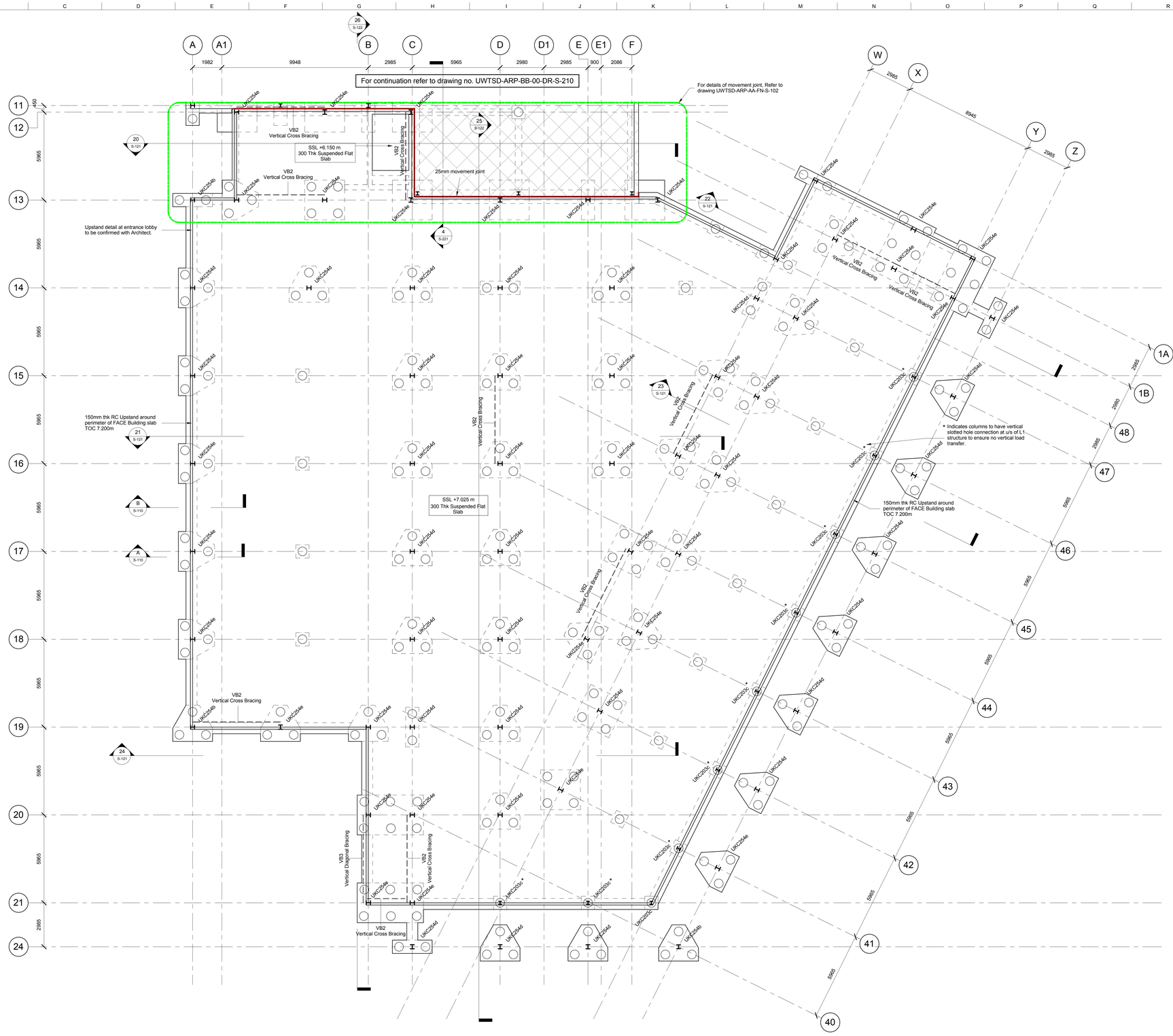


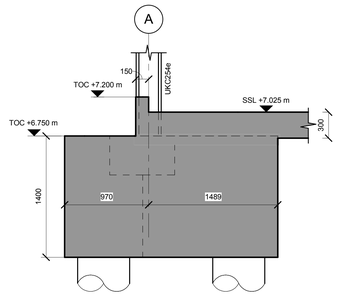
Drawing Title
Zone AA (FACE Building)
General Arrangement
Layout
Movement Joint

Scale at A0: As indicated
Role: Structural
Suitability: S2 - Issued for Information
Arup Job No: 246523
Rev: P2
Name: UWTSD-ARP-AA-FN-DR-S-102

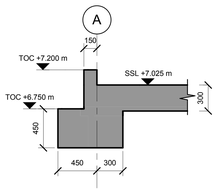
Do not scale

© Arup





A Detail A
1 : 25



B Detail B
1 : 25

Level 00 - G.A. Column Layout
1 : 100

Note:
The foundation and ground floor layout is indicative, based on the assumption noted in the Arup Stage 3 report. Final layouts to be developed and designed in the next stage of design following the results of the Site Investigation.

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



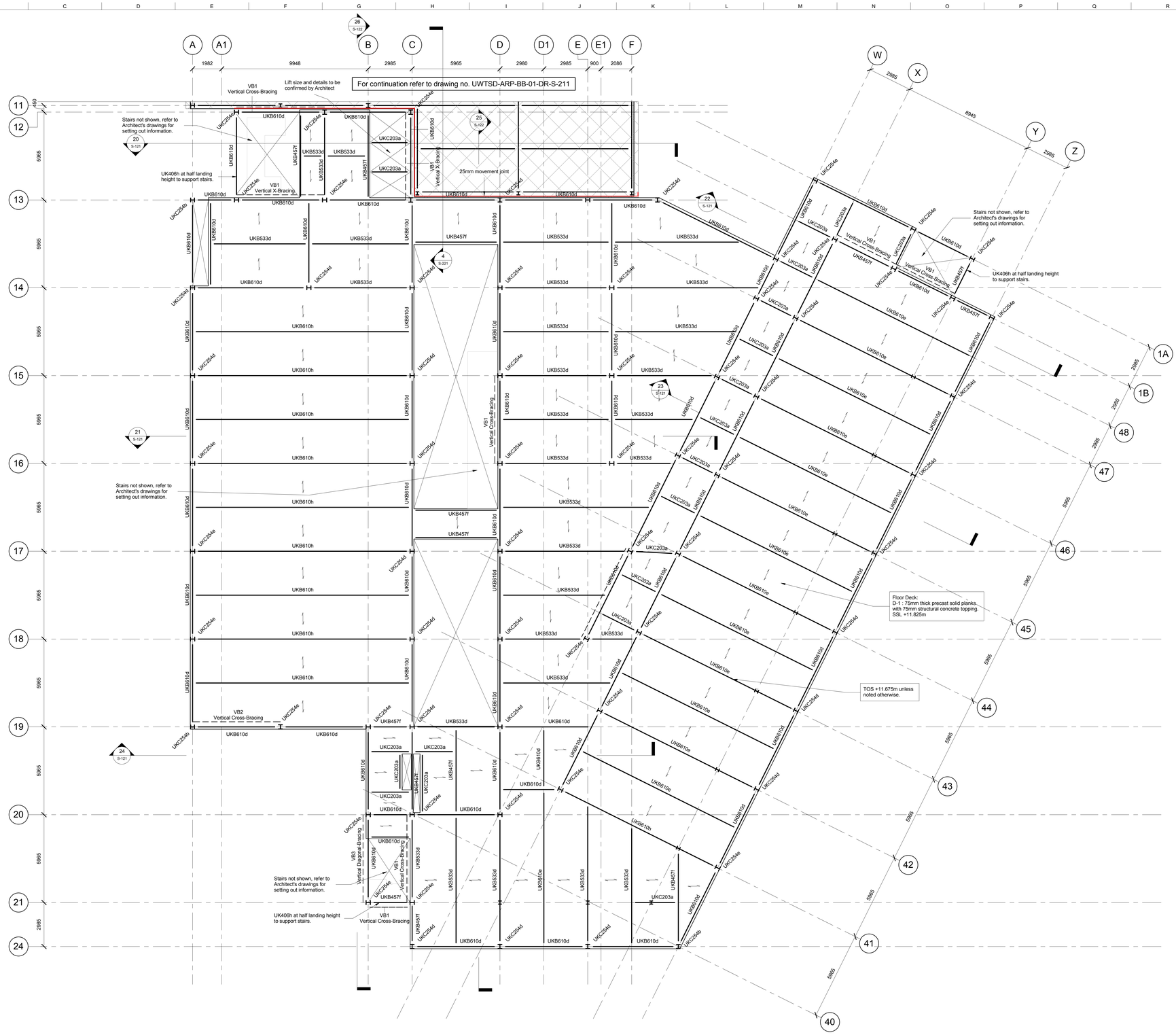
Drawing Title
Zone AA (FACE Building)
General Arrangement
Ground Floor Layout

Scale at A0: As indicated
Role: Structural
Suitability: S2 - Issued for Information
Arup Job No: 246523
Rev: P2
Name: UWTSD-ARP-AA-00-DR-S-110

03/03/2016 16:04:30

Do not scale

© Arup



Level 01 - G.A. Framing Plan

1 : 100

Notes:

All beams which are greater than 10m are to be precambered.

Riser positions to be confirmed with Service Engineer

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building)
General Arrangement
First Floor Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No. 246523

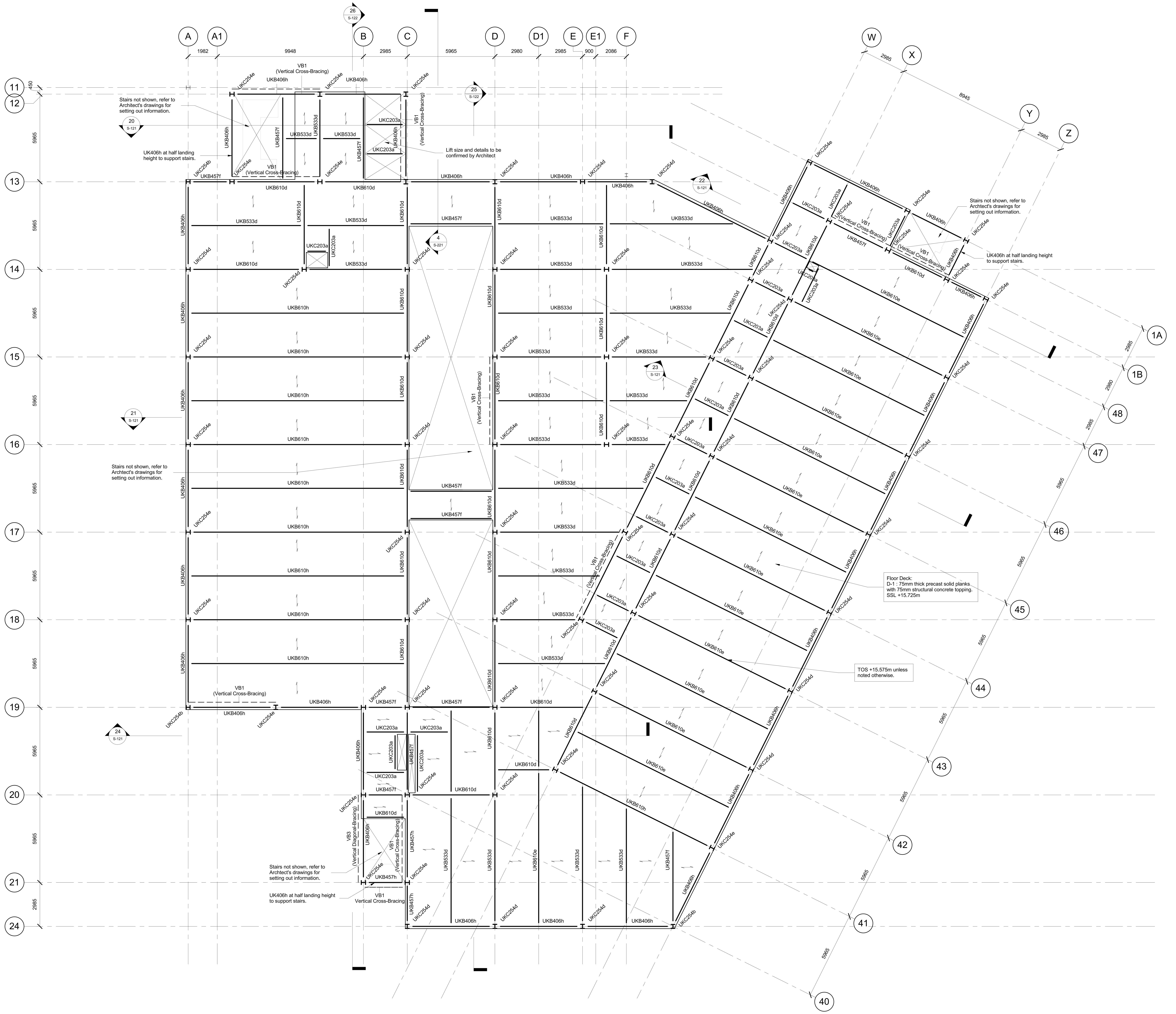
Rev P2

Name
UWTSD-ARP-AA-01-DR-S-111

03/03/2016 16:04:27

Do not scale

© Arup



Level 02 - G.A. Framing Plan

1 : 100

Do not scale

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:27

Notes:

All beams which are greater than 10m are to be precambered.

Riser positions to be confirmed with Service Engineer

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

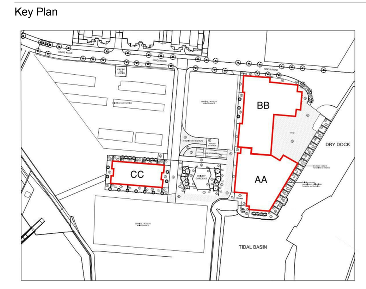
Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building)
General Arrangement
Second Floor Steelwork Layout

Scale at A0: 1 : 100

Role: Structural

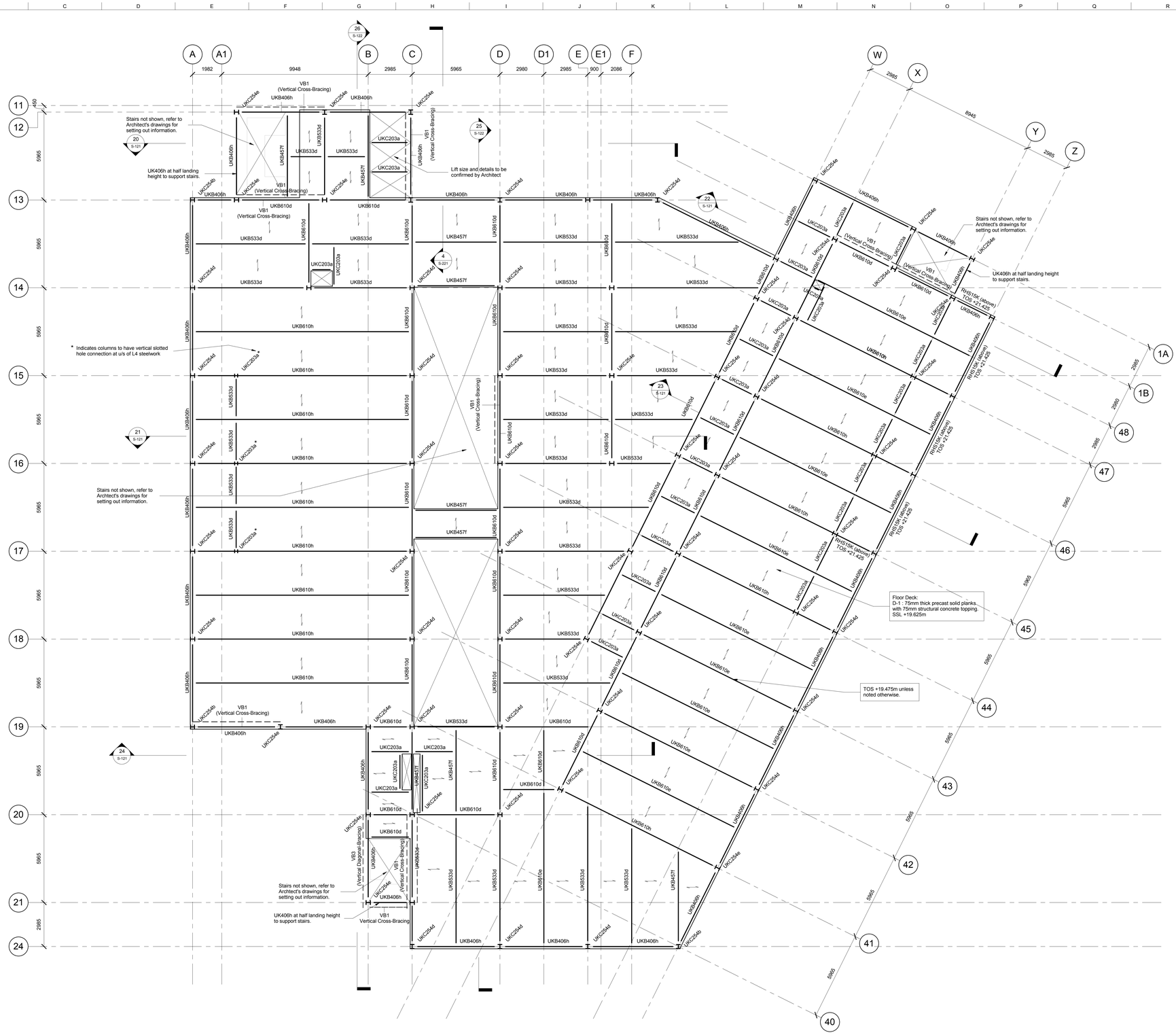
Suitability: S2 - Issued for Information

Arup Job No: **246523**

Rev: **P2**

Name: **UWTSD-ARP-AA-02-DR-S-112**

© Arup



Level 03 - G.A. Framing Plan

1 : 100

Notes:

All beams which are greater than 10m are to be precambered.

Riser positions to be confirmed with Service Engineer

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building) General Arrangement Third Floor Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No. 246523

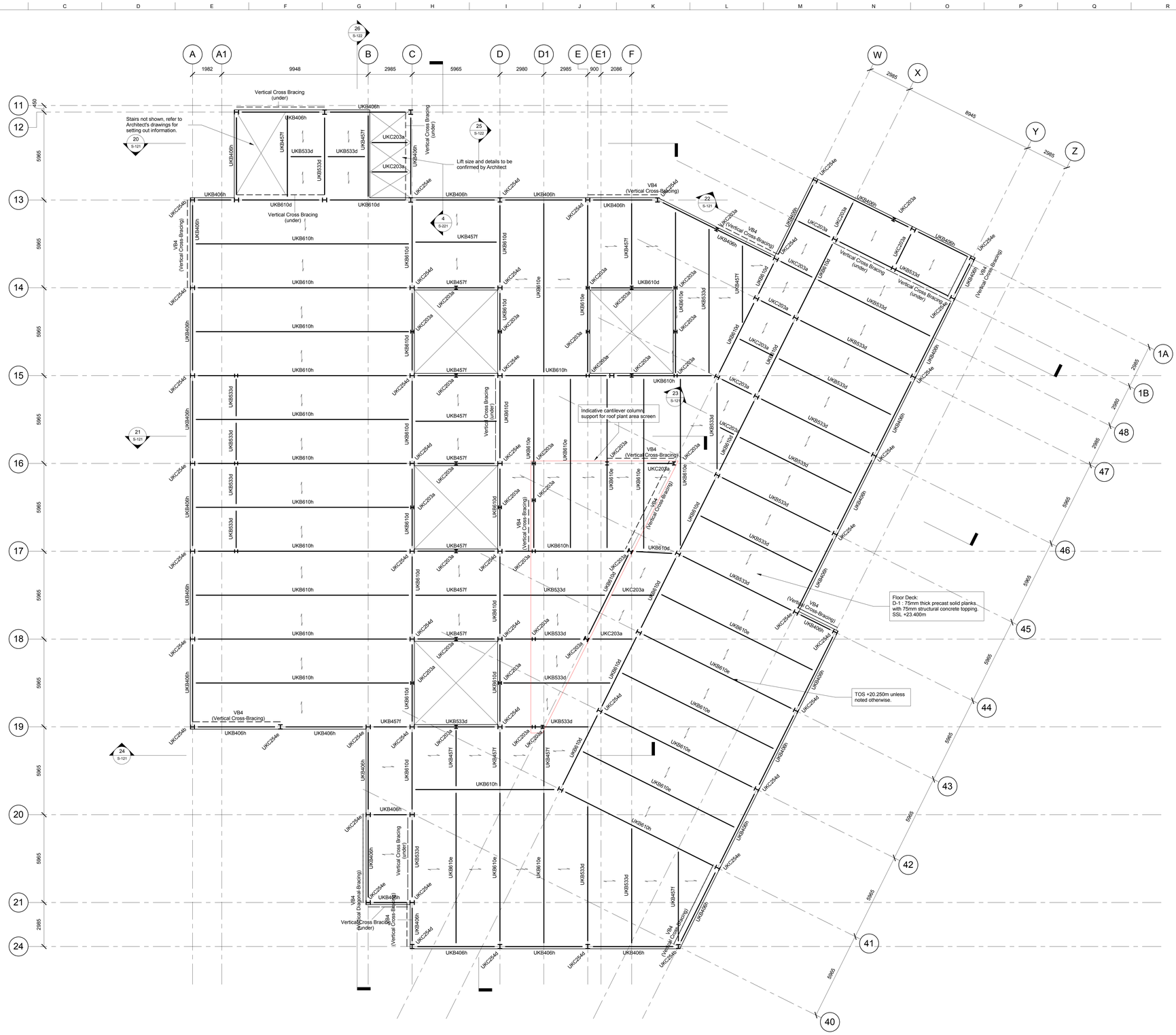
Rev P2

Name UWTSD-ARP-AA-03-DR-S-113

03/03/2016 16:04:28

Do not scale

© Arup



Level RF - G.A. Main Roof Layout

1 : 100

Notes:

Columns continue through to support parapet. Additional cantilever stub section at all secondary beam locations.

All beams which are greater than 10m are to be precambered.

Riser positions to be confirmed with Service Engineer

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building)
General Arrangement
Main Roof Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

Rev **P2**

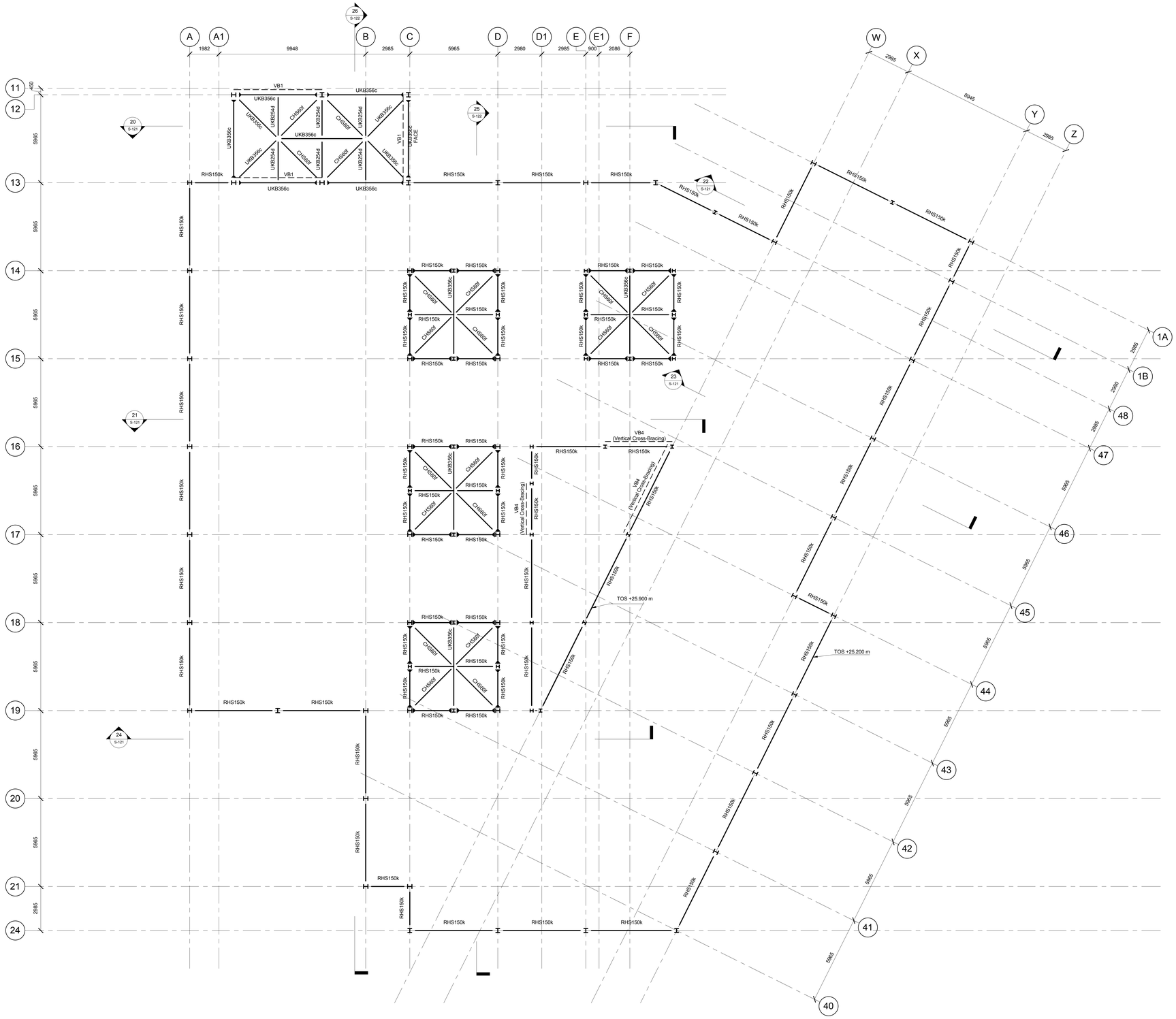
Name **UWTSD-ARP-AA-04-DR-S-114**

03/03/2016 16:04:29

A0

Do not scale

© Arup



Level RF - G.A. Upper Roof Layout

1 : 100

Note:
The upper roof level steelwork is indicative and is to be developed in the next stage of design.

Notes:

Columns continue through to support parapet. Additional cantilever stub section at all secondary beam locations.

All beams which are greater than 10m are to be precambered.

Riser positions to be confirmed with Service Engineer

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building)
General Arrangement
Upper Roof and Parapet Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

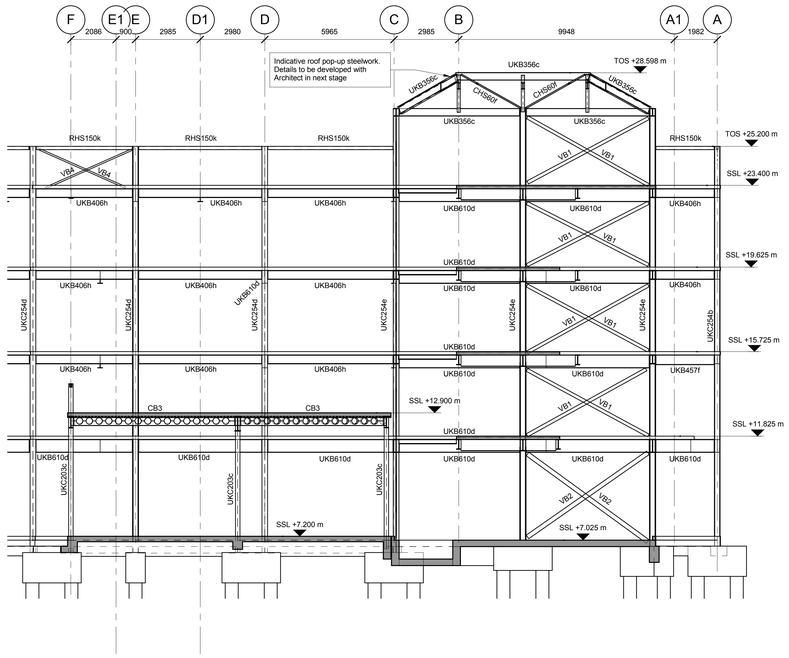
Rev **P2**

Name **UWTSD-ARP-AA-RF-DR-S-115**

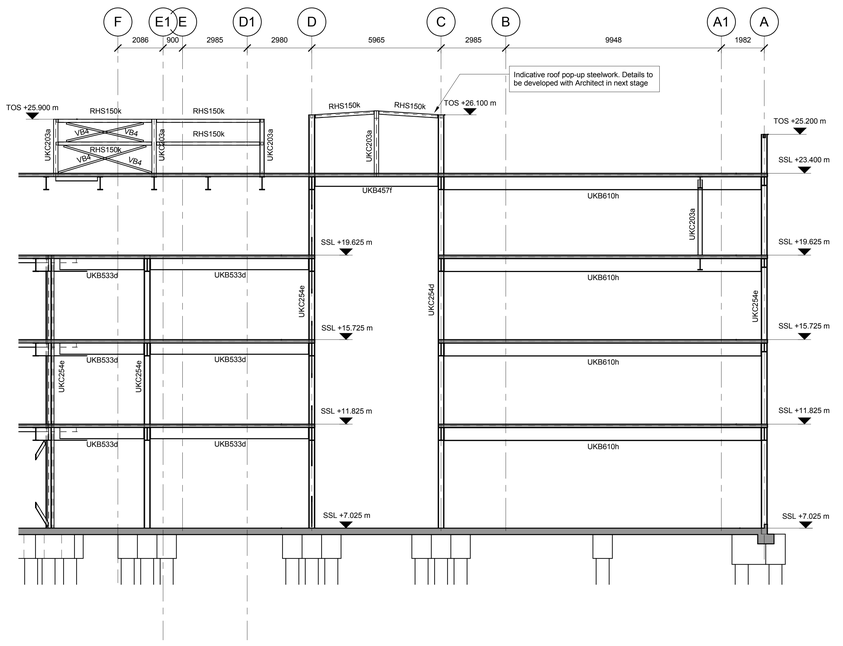
03/03/2016 16:04:35

Do not scale

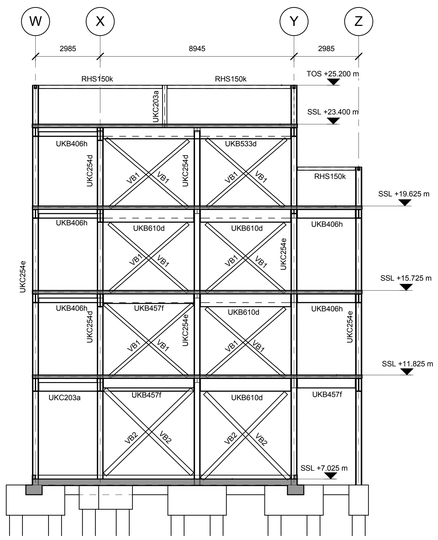
© Arup



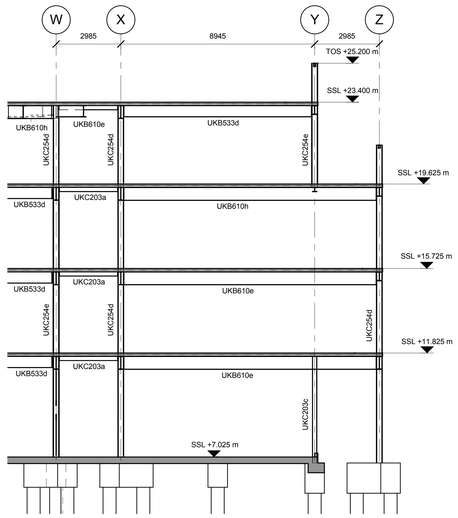
20 Section 20
1 : 100



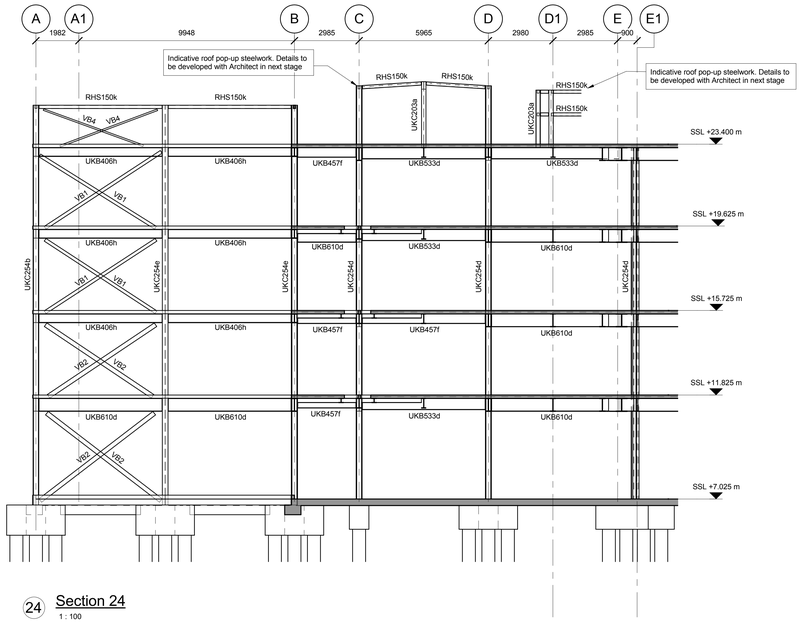
21 Section 21
1 : 100



22 Section 22
1 : 100



23 Section 23
1 : 100



24 Section 24
1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:37

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan

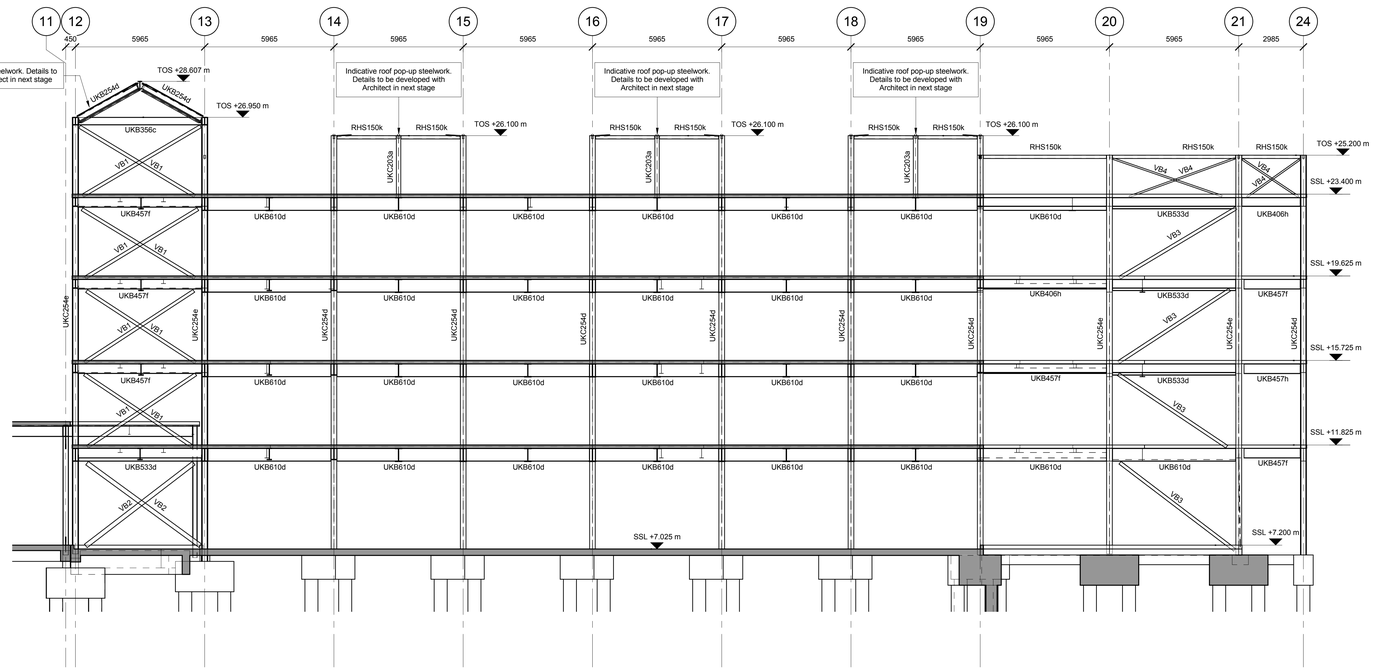


Drawing Title
Zone AA (FACE Building)
Sections and Elevations
Sheet 1

Scale at A0 1 : 100
Role Structural
Suitability S2 - Issued for Information
Arup Job No 246523
Rev P2
Name UWTSD-ARP-AA-ZZ-DR-S-121

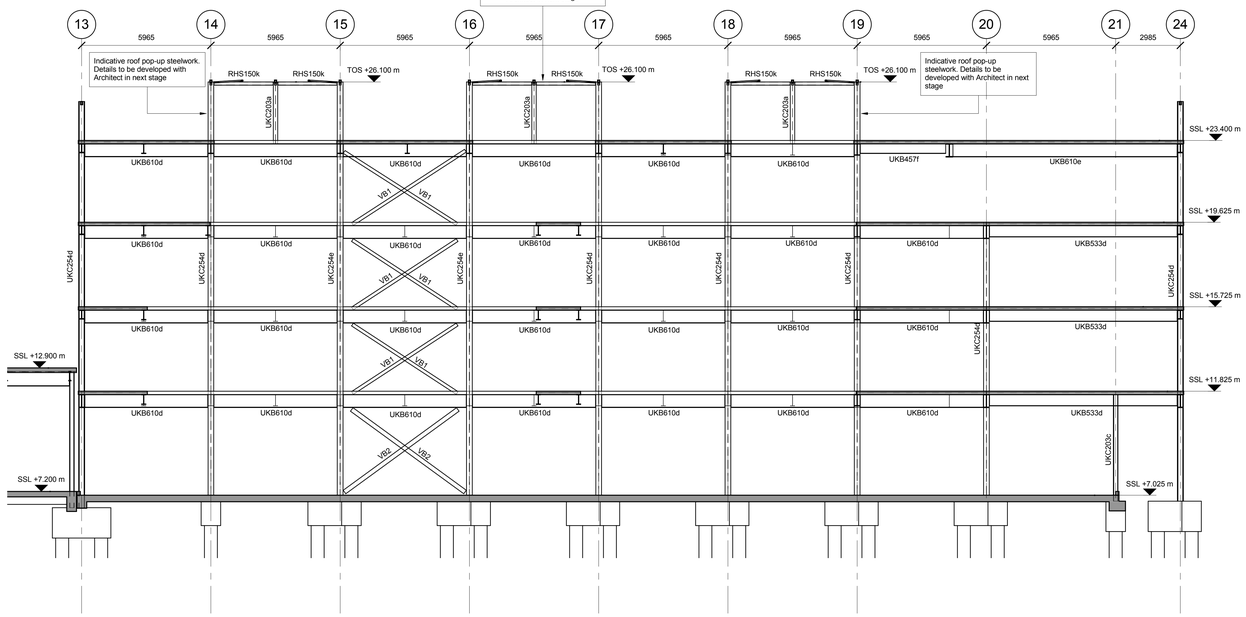
Do not scale

© Arup



26 Section 26

1 : 100



25 Section 25

1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:38

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	SC	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone AA (FACE Building)
Sections and Elevations
Sheet 2

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

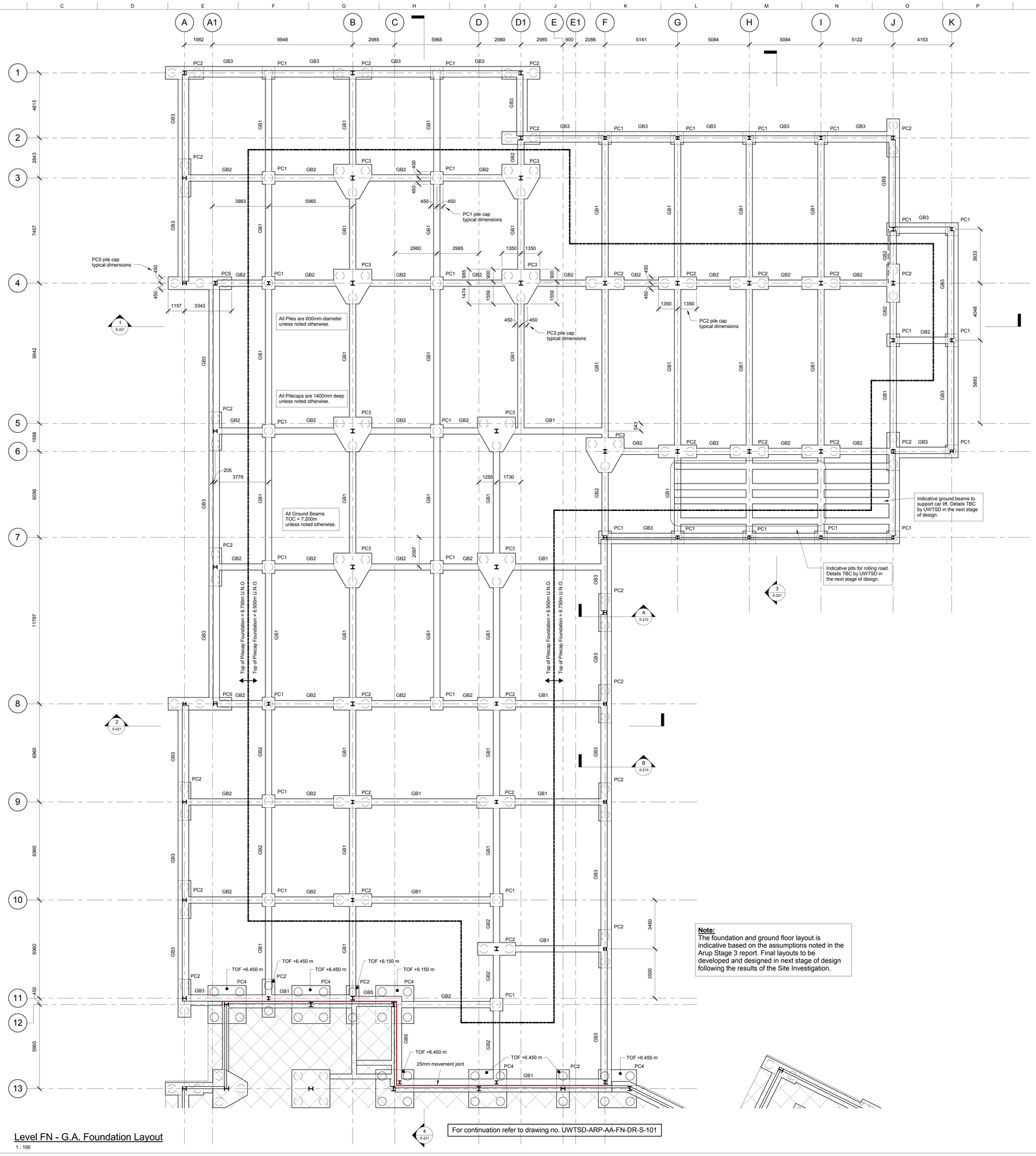
Arup Job No **246523** | Rev **P2**

Name **UWTSD-ARP-AA-ZZ-DR-S-122**

Do not scale

© Arup

E2 TECH Building



Note:
The foundation and ground floor layout is indicative based on the assumptions noted in the Arup Stage 3 report. Final layouts to be developed and designed in next stage of design following the results of the Site Investigation.

For continuation refer to drawing no. UWTSD-ARP-AA-FN-DR-S-101

Level FN - G.A. Foundation Layout

1 : 100

FACE & TECH Ground Beam Schedule	
Reference	Section Size
GB1	450 x 750dp
GB2	450 x 600dp
GB3	750x750dp L Beam
GB4	750 x 450dp
GB5	350 x 1050dp
GB6	350 x 1175dp

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:41

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan

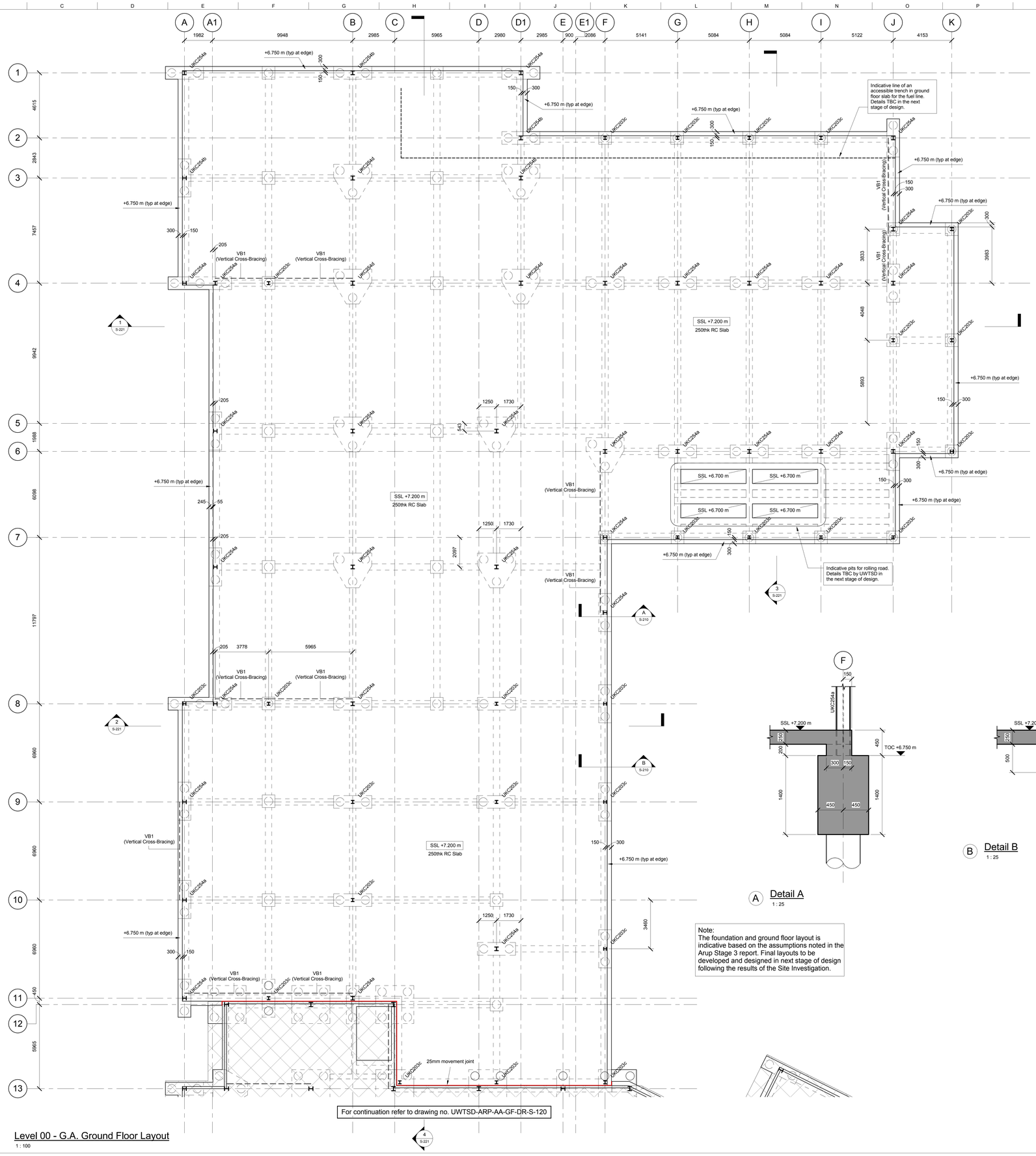


Drawing Title
Zone BB (TECH Building)
General Arrangement
Foundation Layout

Scale at A0 1 : 100
Role Structural
Suitability S2 - Issued for Information
Arup Job No 246523
Rev P2
Name UWTSD-ARP-BB-FN-DR-S-201

Do not scale

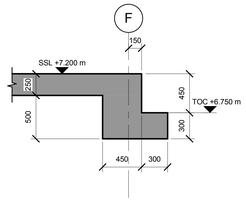
© Arup



Level 00 - G.A. Ground Floor Layout
1 : 100

For continuation refer to drawing no. UWTSD-ARP-AA-GF-DR-S-120

A Detail A
1 : 25



B Detail B
1 : 25

Note:
The foundation and ground floor layout is indicative based on the assumptions noted in the Arup Stage 3 report. Final layouts to be developed and designed in next stage of design following the results of the Site Investigation.

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

Structural Column Schedule - TECH Building

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.

03/03/2016 16:04:30

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone BB (TECH Building)
General Arrangement
Ground Floor Layout

Scale at A0 As indicated

Role Structural

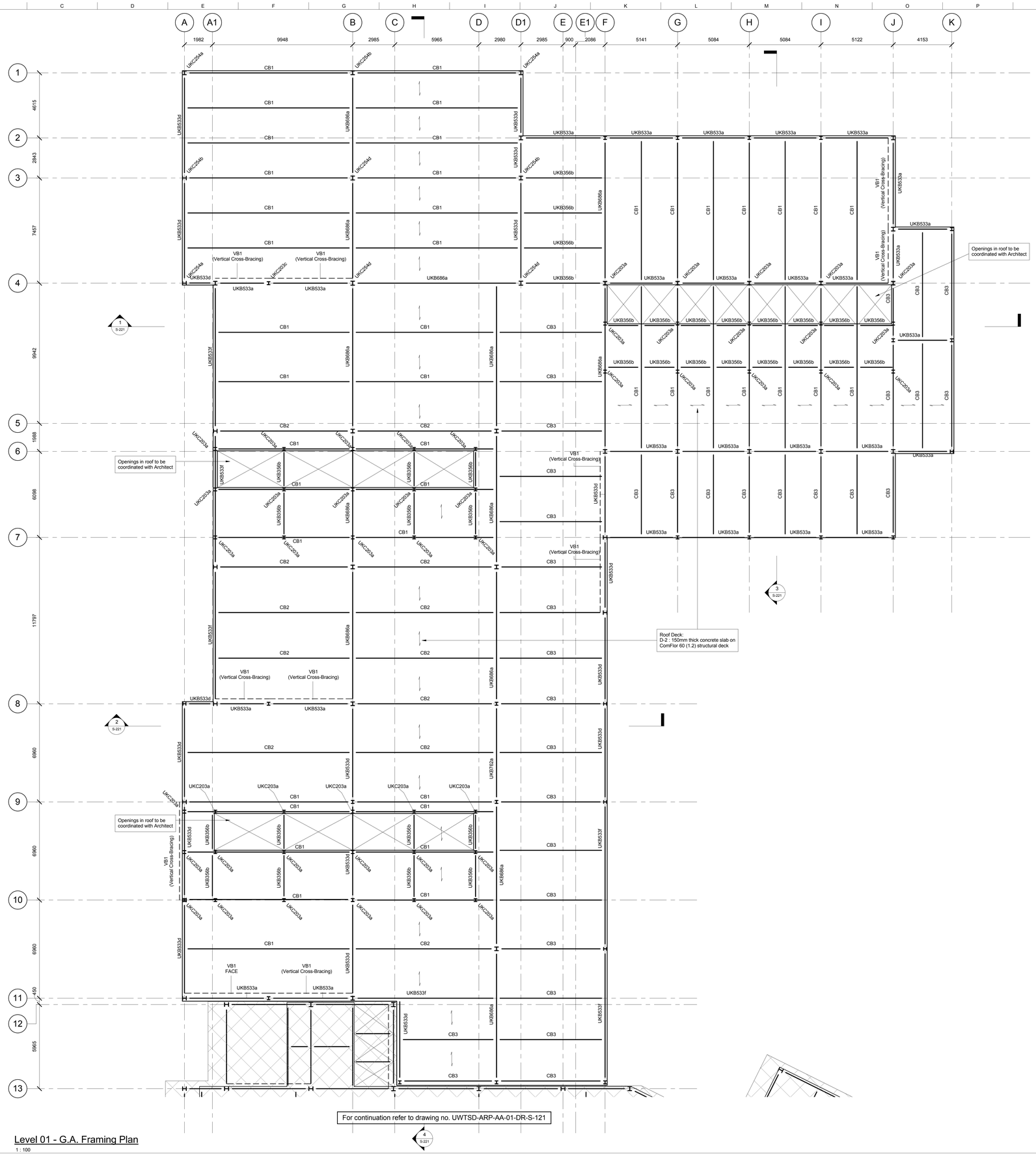
Suitability S2 - Issued for Information

Arup Job No 246523

Rev P2

Name UWTSD-ARP-BB-00-DR-S-210

Do not scale
© Arup



Level 01 - G.A. Framing Plan

1 : 100

Do not scale

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.

Notes:

Columns continue through to support parapet. Additional cantilever stub section at all secondary beam locations.

Intermediate header beam above window openings to support cladding above.

All beams which are greater than 10m to be precambered.

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Structural Cellular Beam Schedule - TECH Building

Reference	Section Size	Spacing	Hole Ø
CB1	596x152/152x69.5 ACB	525	350
CB2	535x171/171x45 CB	500	400
CB3	431x102/102x30.5 ACB	450	300

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone BB (TECH Building)
General Arrangement
Main Roof Level Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

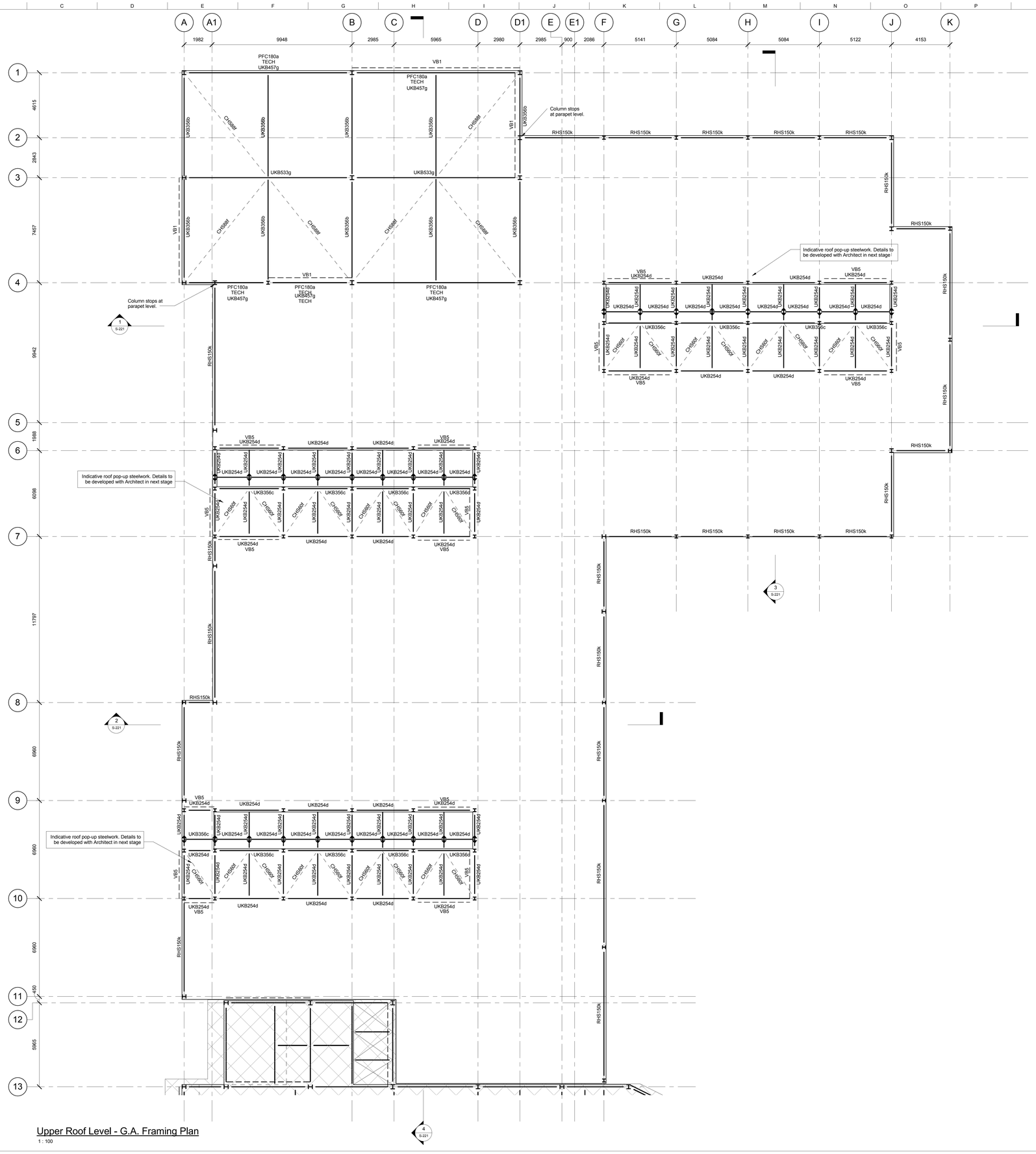
Arup Job No 246523

Rev P2

Name UWTSD-ARP-BB-01-DR-S-211

03/03/2016 16:04:40

© Arup



Upper Roof Level - G.A. Framing Plan

1 : 100

Notes:

Columns continue through to support parapet. Additional cantilever stub section at all secondary beam locations.

Plant room and pop up roof cladding support to be confirmed by Architect. Assume purlins spanning between steel frame.

Structural Vertical Bracing Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
VB1	15x150 Flat
VB2	20x200 Flat
VB3	SHS150x150x8
VB4	10x75
VB5	10x100

Structural Column Schedule - FACE and TECH

Reference	Section Size
UKC203a	UKC203x203x46
UKC203c	UKC203x203x60
UKC254a	UKC254x254x73
UKC254b	UKC254x254x89
UKC254d	UKC254x254x132
UKC254e	UKC254x254x167

Structural Beam Schedule - FACE and TECH

Reference	Section Size
CHS60f	CHS60.3x4
CHS88f	CHS88.9x4
PFC180a	PFC180x75x20
RHS150k	RHS150x100x12.5
UKB254d	UKB254x146x31
UKB356b	UKB356x127x39
UKB356c	UKB356x171x45
UKB406h	UKB406x178x85 +
UKB457f	UKB457x191x67
UKB457g	UKB457x191x74
UKB457h	UKB457x191x82
UKB533a	UKB533x165x66 +
UKB533d	UKB533x210x82
UKB533f	UKB533x210x101
UKB533g	UKB533x210x109
UKB610d	UKB610x229x101
UKB610e	UKB610x229x113
UKB610h	UKB610x305x149
UKB686a	UKB686x254x125
UKB762a	UKB762x267x134
UKC203a	UKC203x203x46

Structural Cellular Beam Schedule - TECH Building

Reference	Section Size	Spacing	Hole Ø
CB1	596x152/152x59.5 ACB	525	350
CB2	535x171/171x45 CB	500	400
CB3	431x102/102x30.5 ACB	450	300

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone BB (TECH Building)
General Arrangement
Upper Roof and Parapet Layout

Scale at A0 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

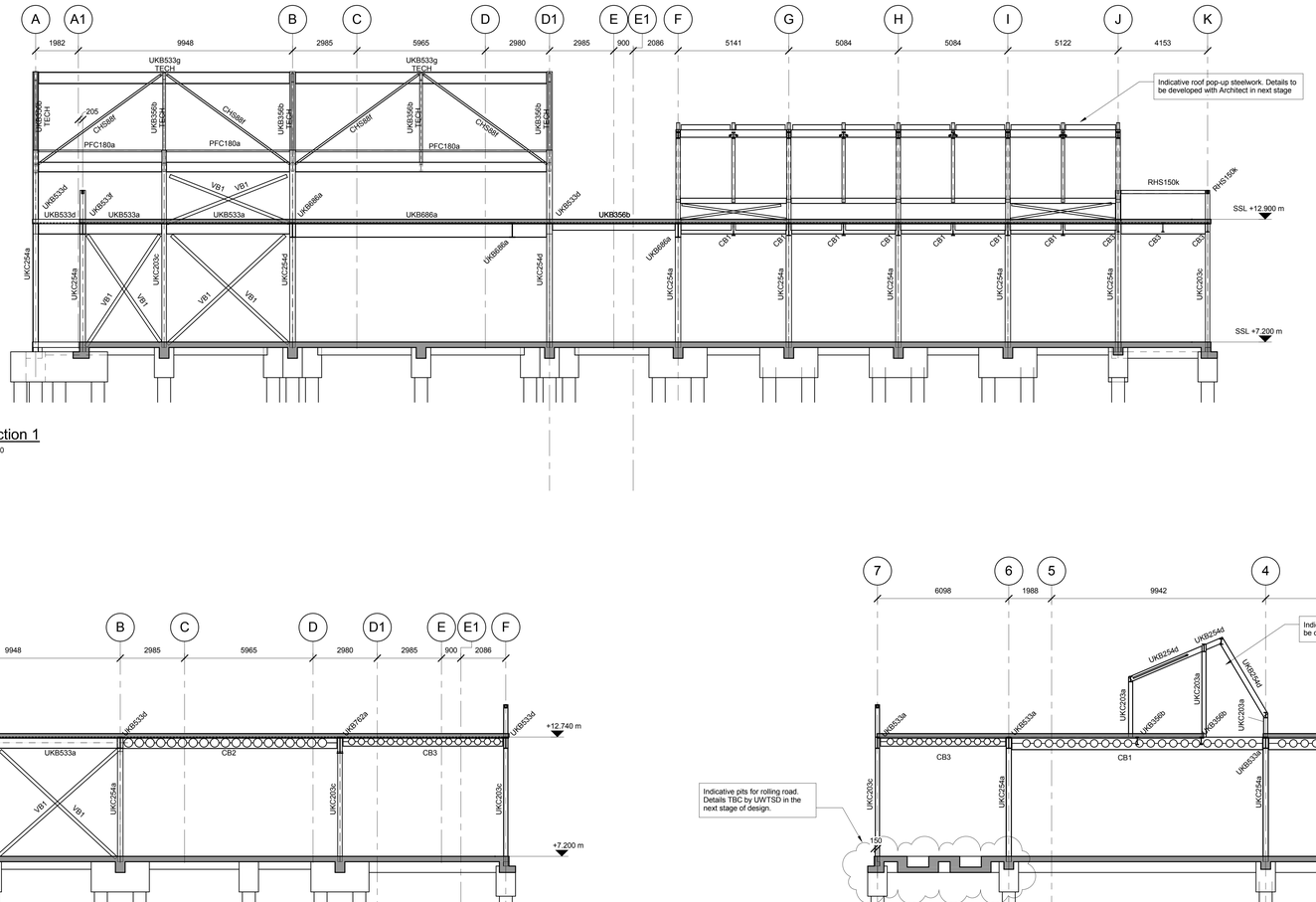
Rev **P2**

Name **UWTSD-ARP-BB-RF-DR-S-212**

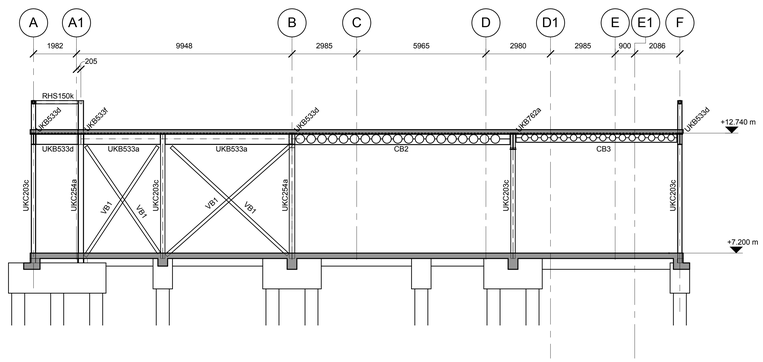
03/03/2016 16:04:34

Do not scale

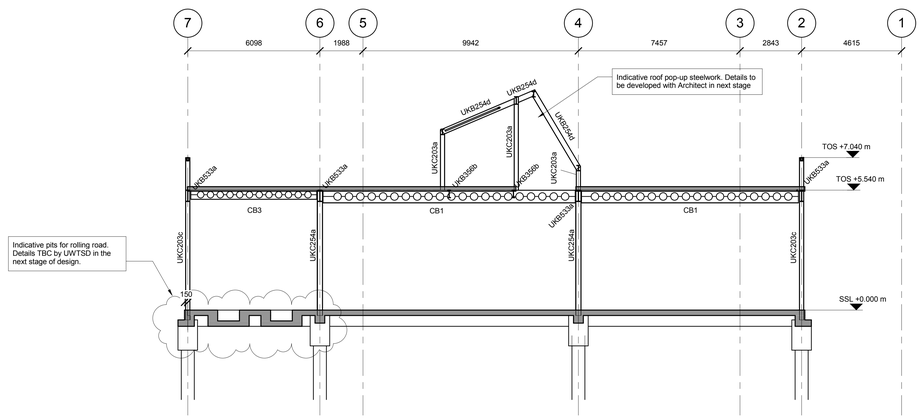
© Arup



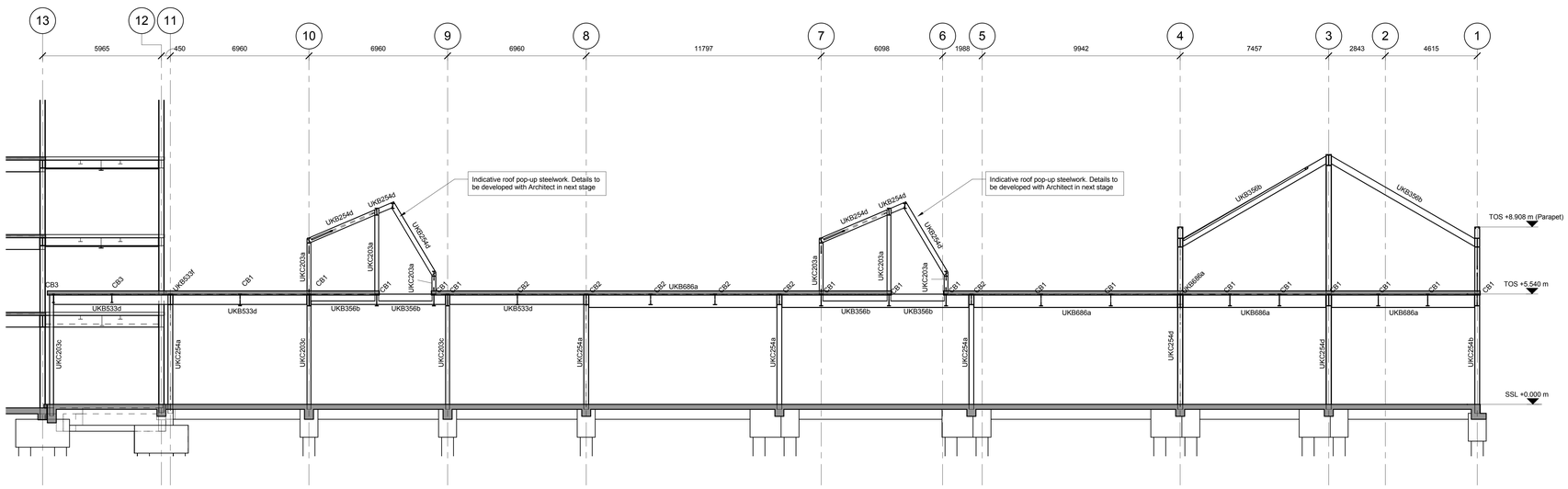
1 Section 1
1 : 100



2 Section 2
1 : 100



3 Section 3
1 : 100



4 Section 4
1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in meters above ordinance datum unless noted otherwise.
5. All slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.

Rev	Date	By	Chkd	Appd
P2	02/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan


Drawing Title
Zone BB (TECH Building)
Sections and Elevations
Sheet 1

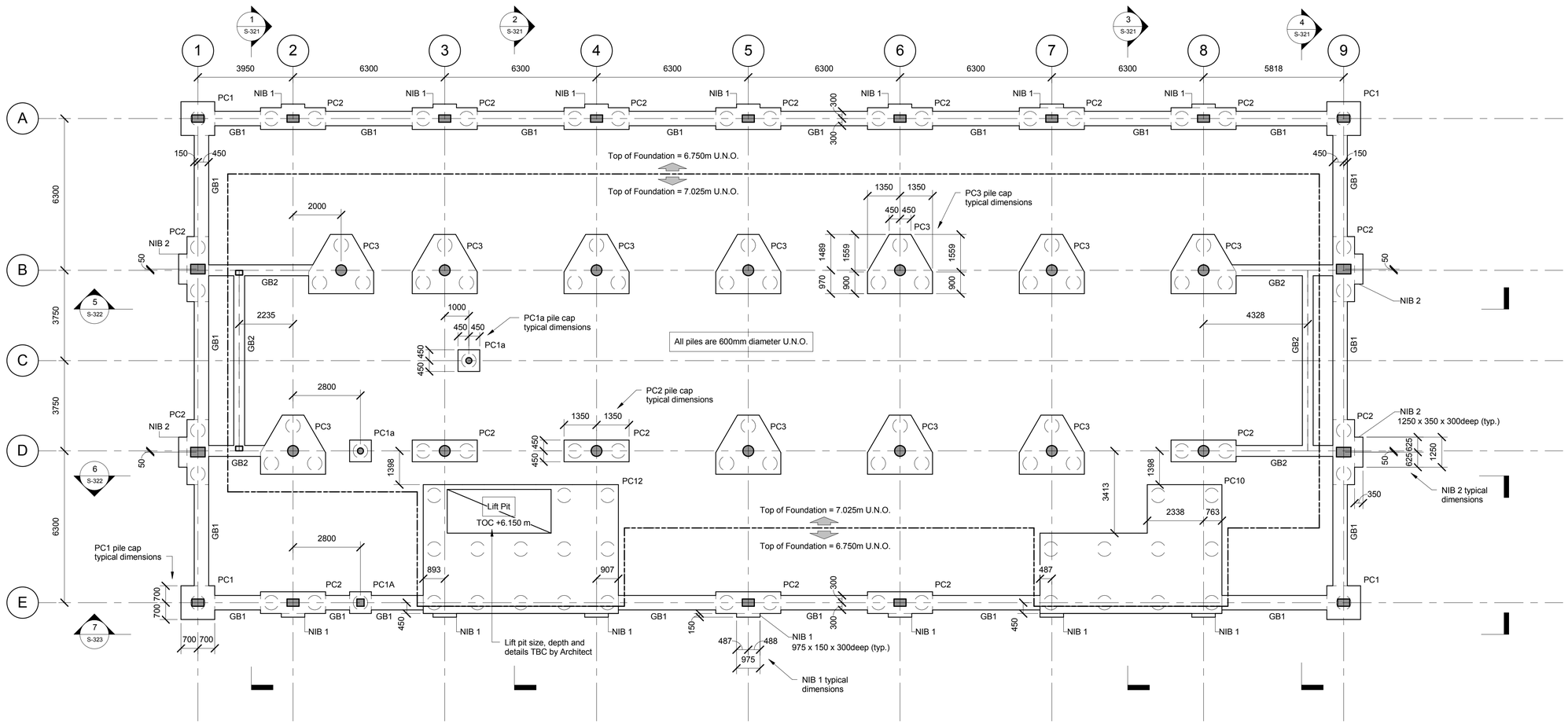
Scale at A0 1 : 100
Role Structural
Suitability S2 - Issued for Information
Arup Job No 246523
Rev P2
Name UWTSD-ARP-BB-ZZ-DR-S-221

03/03/2016 16:04:47

Do not scale

© Arup

E3 Library



Level FN - G.A. Plan

1 : 100

Beam References
GB1 - Ground Beam 600mm x 300mm deep
GB2 - Ground Beam 450mm x 300mm deep

Note
Pile caps depth - 1400mm U.N.O.

Note:
The foundation and ground floor layout is indicative based on the assumptions noted in the Arup Stage 3 report. Final layouts to be developed and designed in next stage of design following the results of the Site Investigation.

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

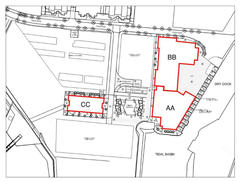
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
General Arrangement
Foundation Layout

Scale at A1 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

Rev **P2**

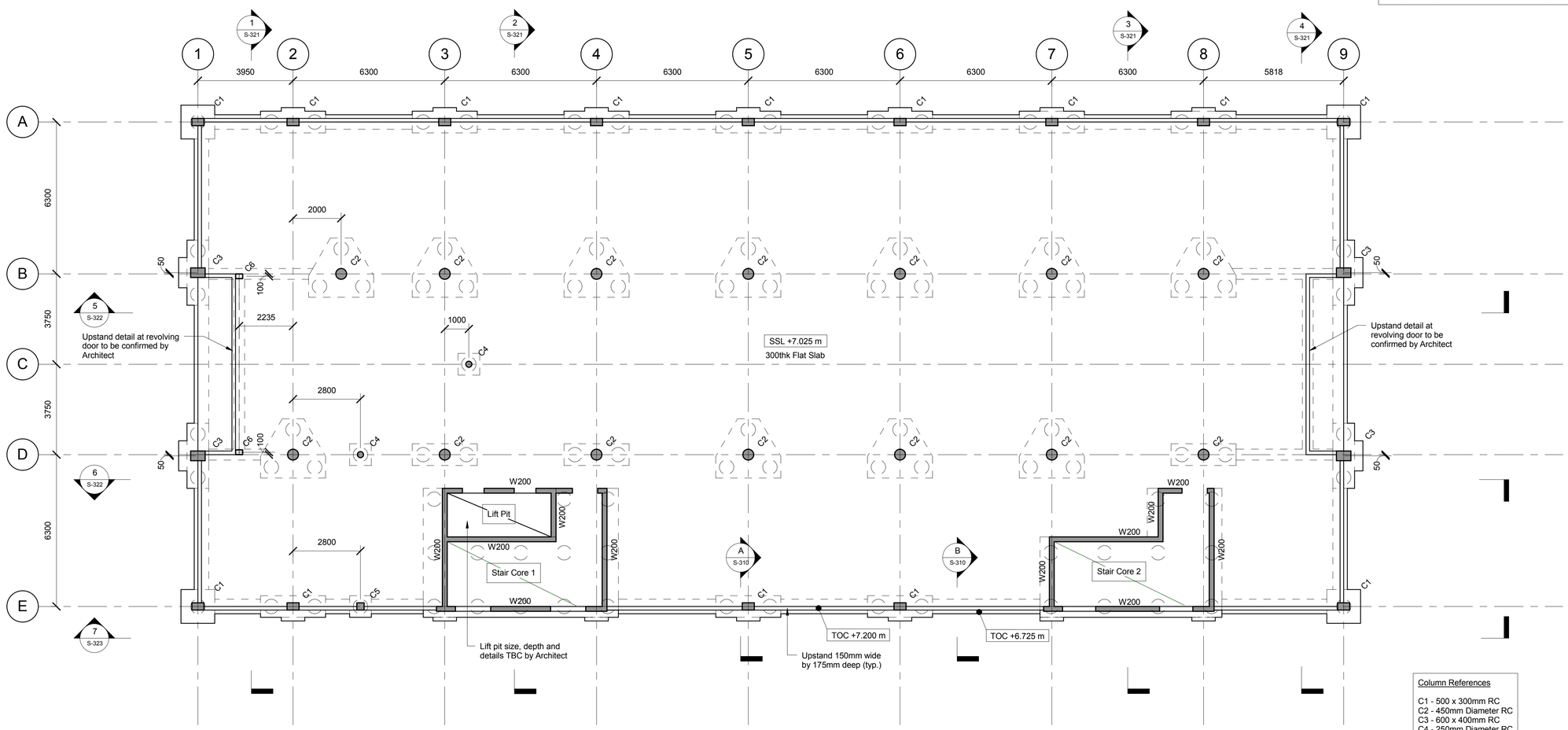
Name **UWTSD-ARP-CC-FN-DR-S-301**

03/03/2016 16:44:46

Do not scale

© Arup

Note:
The foundation and ground floor layout is indicative based on the assumptions noted in the Arup Stage 3 report. Final layouts to be developed and designed in next stage of design following the results of the Site Investigation.

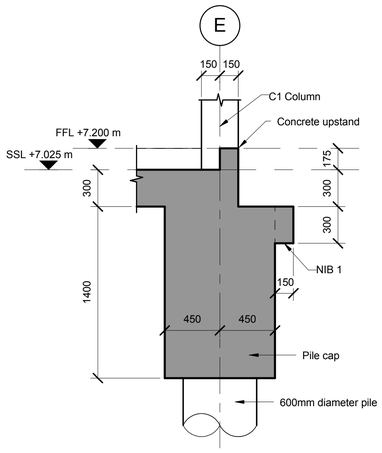


Column References

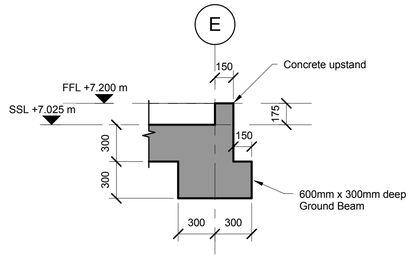
C1 - 500 x 300mm RC
C2 - 450mm Diameter RC
C3 - 600 x 400mm RC
C4 - 250mm Diameter RC
C5 - 300 x 300mm RC
C6 - 300*200*8 RHS

Note
- Core walls (W200) 200mm thick U.N.O.
- Where single or 2 pile caps are provided, it is assumed that the slab is cast monolithic with the pile caps to provide lateral restraint before any vertical loads are exerted onto the piles

Level 00 - G.A. Plan
1 : 100



A Detail A
1 : 25



B Detail B
1 : 25

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

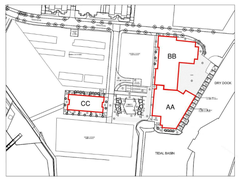
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



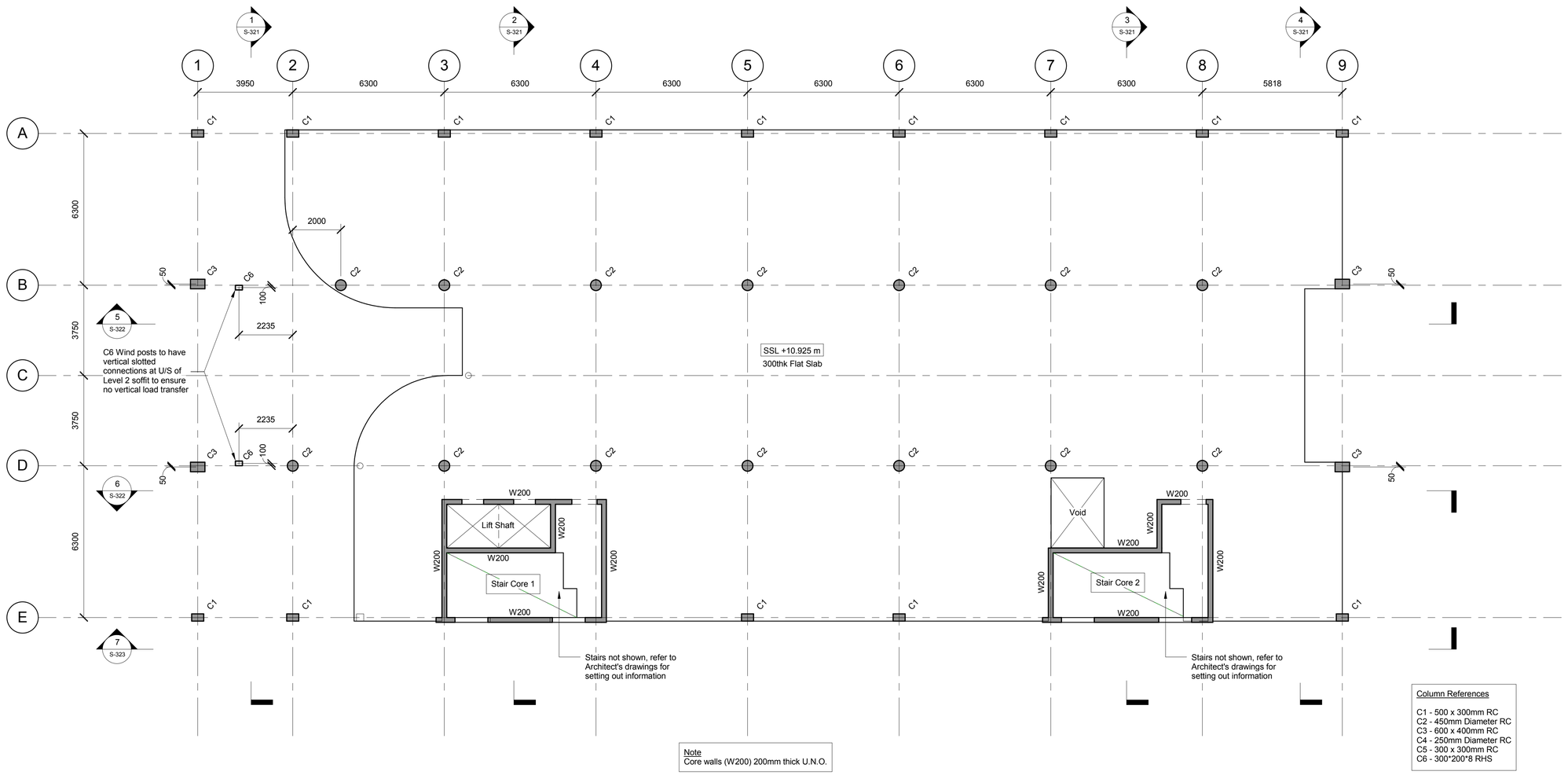
Drawing Title
Zone CC - LIBRARY
General Arrangement
Ground Floor Layout

Scale at A1: As indicated
Role: Structural
Suitability: S2 - Issued for Information
Arup Job No: 246523
Rev: P2
Name: UWTSD-ARP-CC-00-DR-S-310

03/03/2016 16:44:47

Do not scale

© Arup



Column References

C1 - 500 x 300mm RC
C2 - 450mm Diameter RC
C3 - 600 x 400mm RC
C4 - 250mm Diameter RC
C5 - 300 x 300mm RC
C6 - 300*200*8 RHS

Note
Core walls (W200) 200mm thick U.N.O.

Level 01 - G.A. Plan

1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

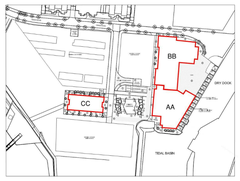
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
General Arrangement
First Floor Layout

Scale at A1 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

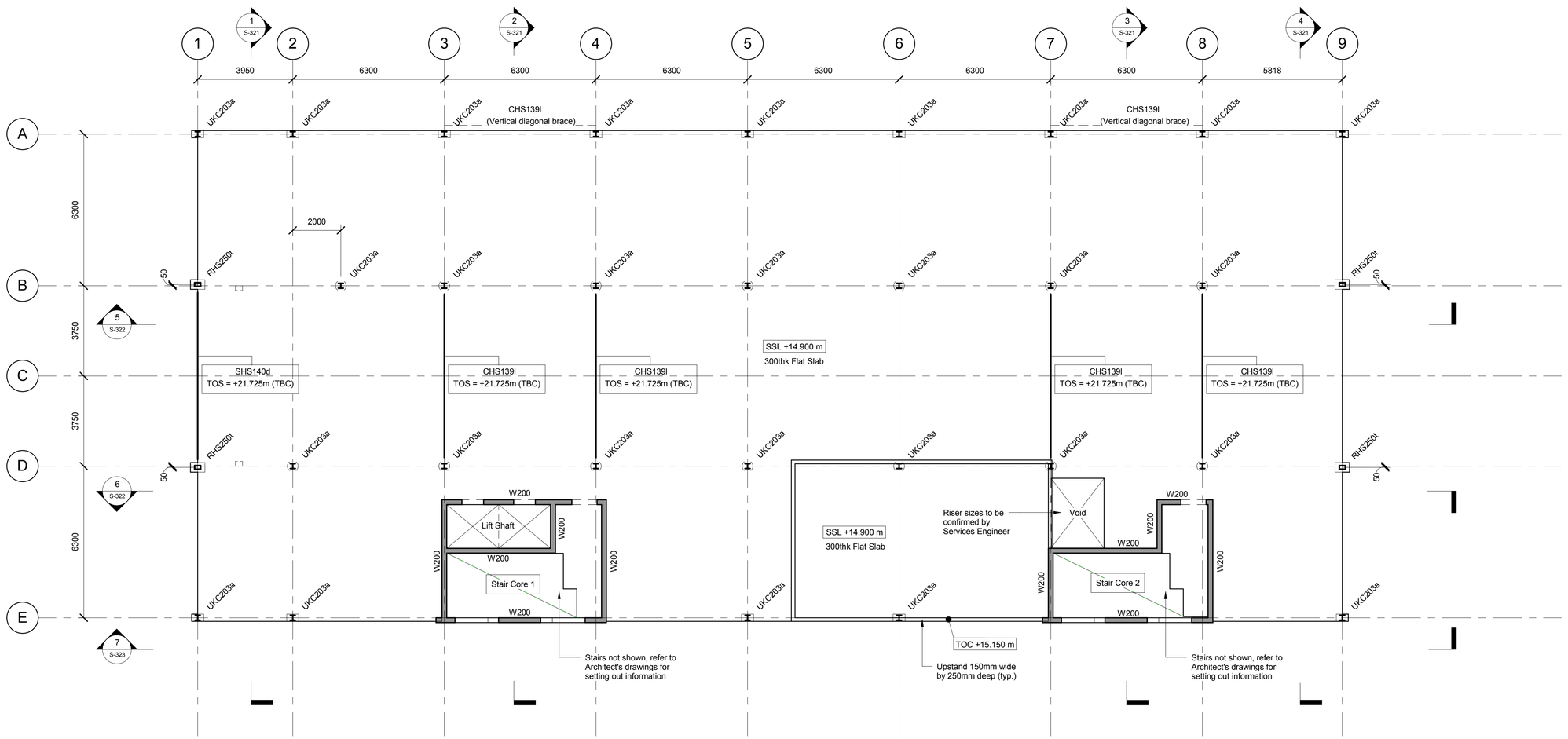
Rev **P2**

Name **UWTSD-ARP-CC-01-DR-S-311**

03/03/2016 16:44:48

Do not scale

© Arup



Note
Core walls (W200) 200mm thick U.N.O.

Level 02 - G.A. Plan

1 : 100

Structural Column Schedule		
Column Reference	**Count**	**Section Size**
RHS250t	4	RHS250x150x12.5
UKC203a	28	UKC203x203x46

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

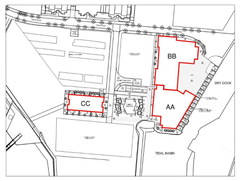
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
General Arrangement
Second Floor Layout

Scale at A1 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

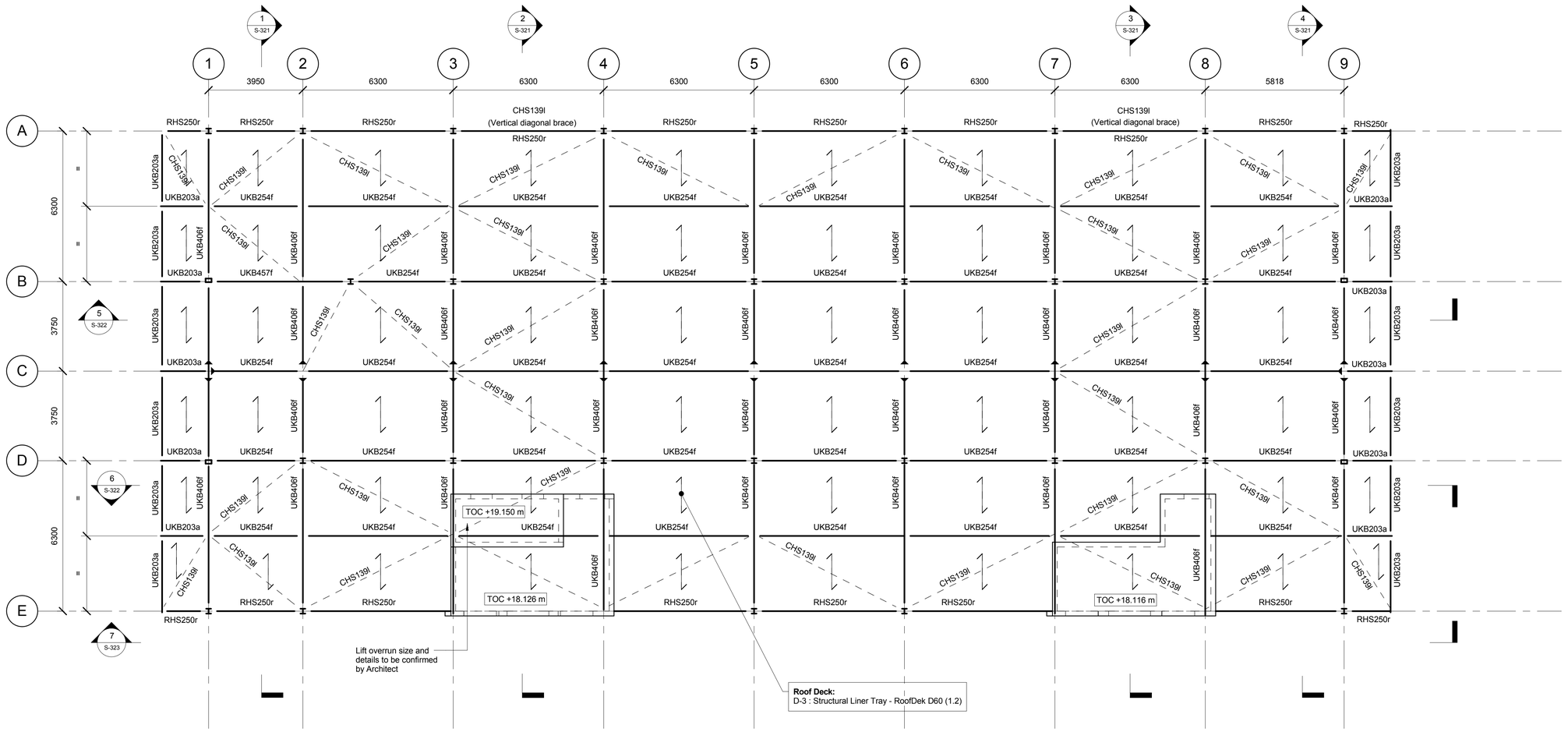
Rev **P2**

Name **UWTSD-ARP-CC-02-DR-S-312**

03/03/2016 16:44:48

Do not scale

© Arup

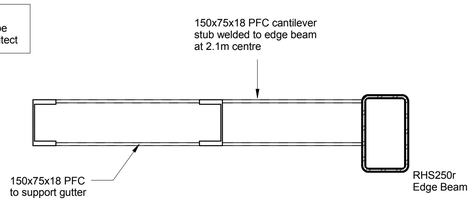


Level RF - G.A. Plan

1 : 100

Structural Framing Schedule	
Steelwork Reference	**Section Size**
CHS139l	CHS139.7x8
RHS250r	RHS250x150x10
SHS140d	SHS140x140x6.3
UKB203a	UKB203x102x23
UKB254f	UKB254x146x43
UKB406f	UKB406x178x67
UKB457f	UKB457x191x67

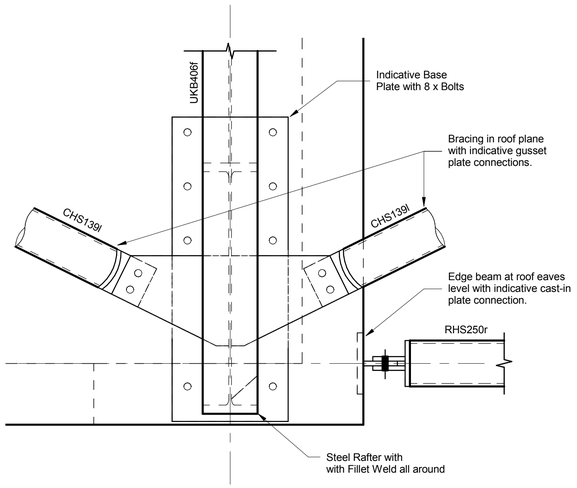
Note:
Roof edge detail to be developed with Architect



Indicative Edge Beam Detail

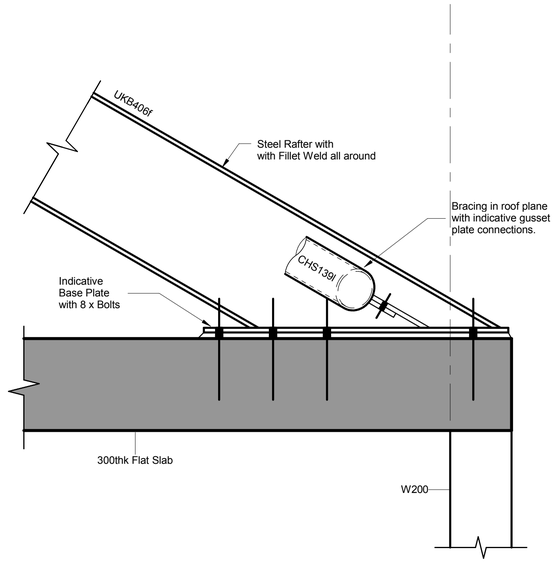
1 : 10

Note:
Roof frame initial scheme sizing shown to be devloped in next stage of design



Indicative Concrete-Rafter Connection Detail

1 : 10



Indicative Concrete-Rafter Connection Section

1 : 10

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

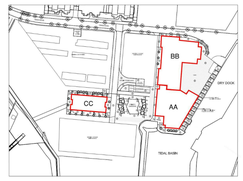
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales Trinity Saint David

Project Title
Swansea SA1 Campus Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
General Arrangement
Roof Level Layout

Scale at A1: As indicated

Role: Structural

Suitability: S2 - Issued for Information

Arup Job No: **246523**

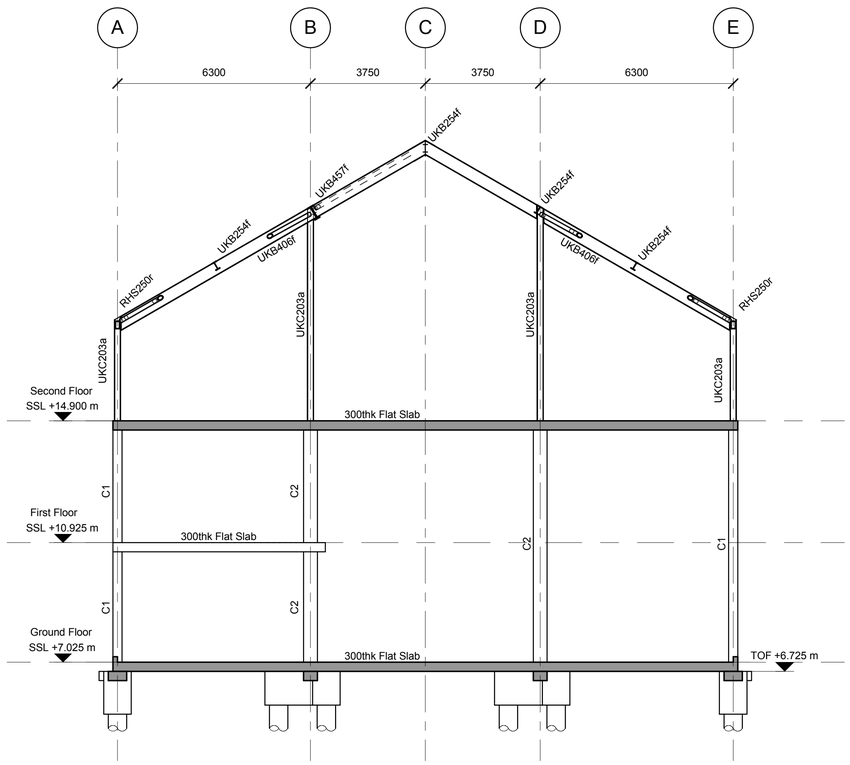
Rev: **P2**

Name: **UWTSD-ARP-CC-RF-DR-S-313**

03/03/2016 16:48:30

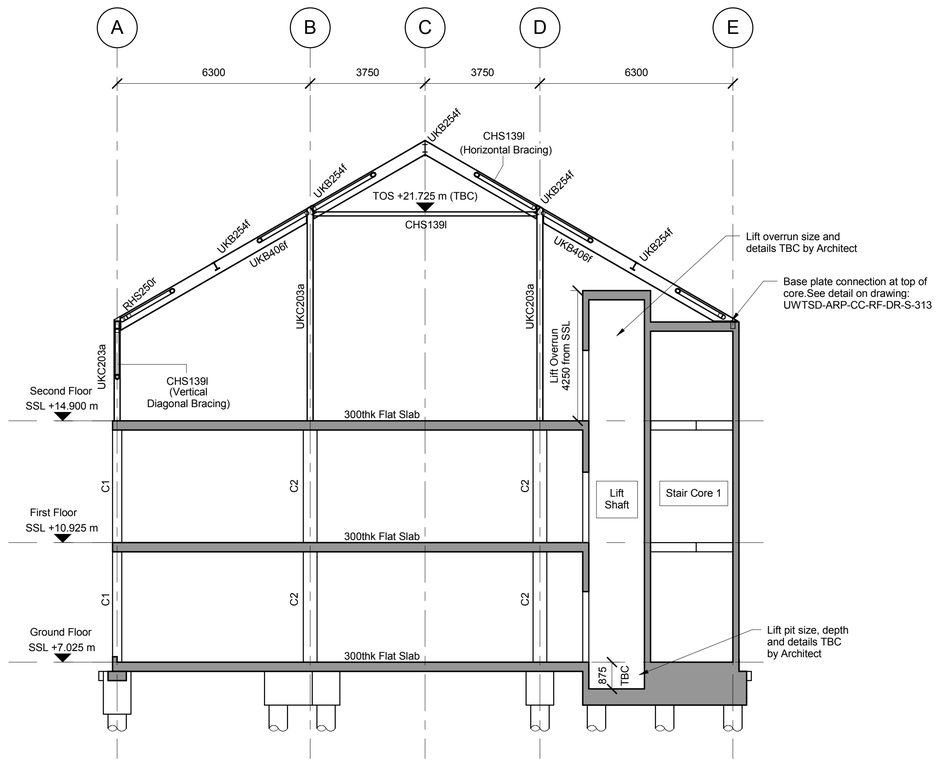
Do not scale

© Arup

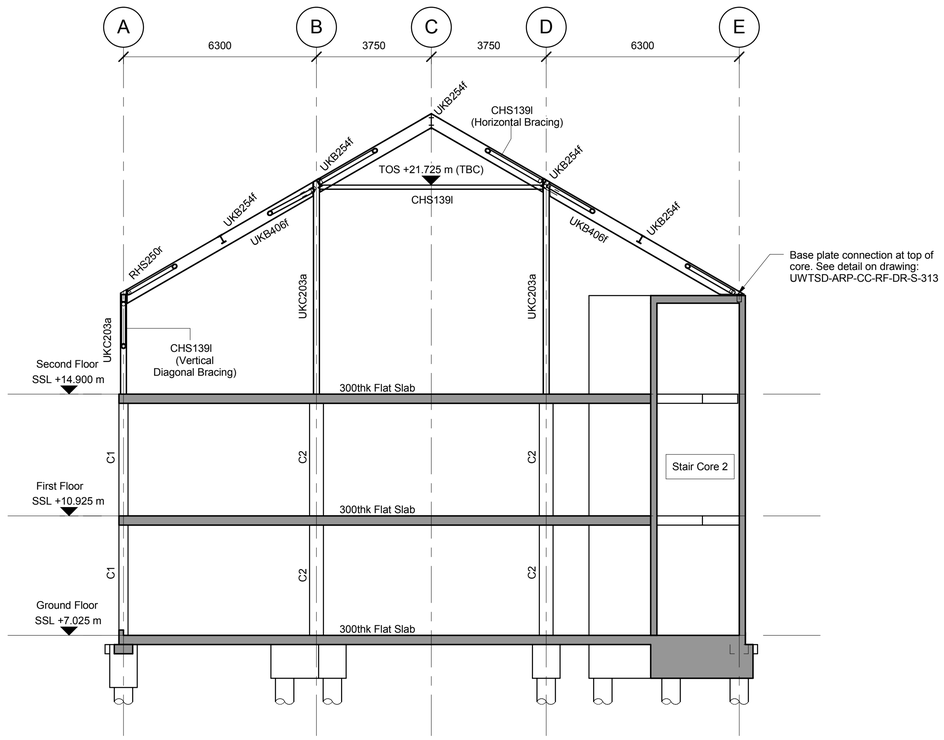


1 Section 1
1 : 100

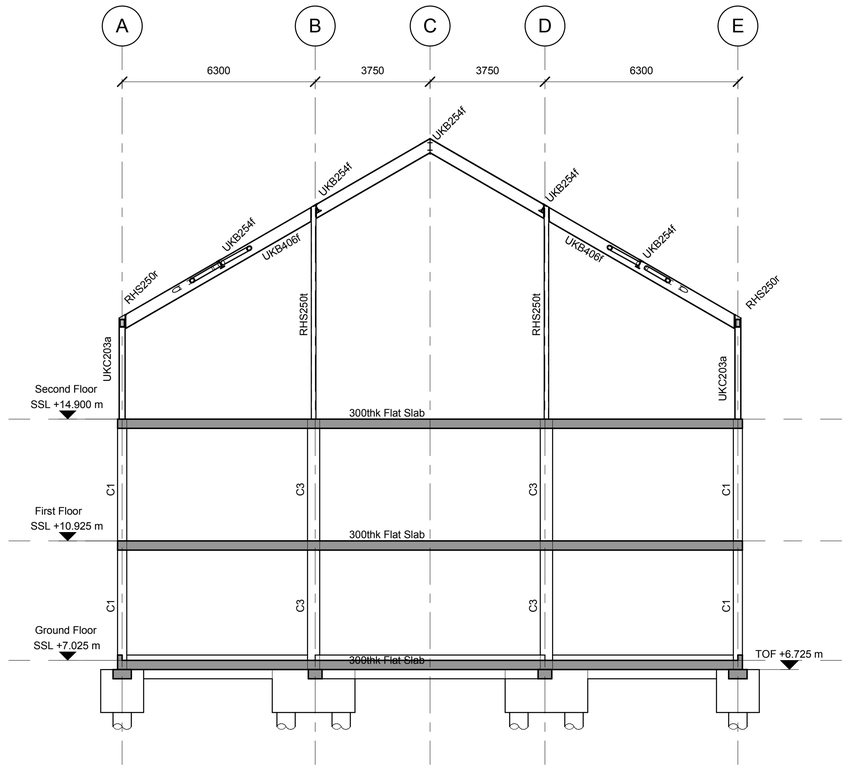
Note:
Roof steelwork setting out to be confirmed with Architect



2 Section 2
1 : 100



3 Section 3
1 : 100



4 Section 4
1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

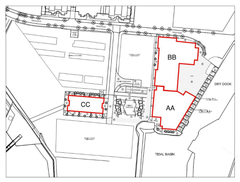
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
Sections & Elevations
Sheet 1

Scale at A1 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

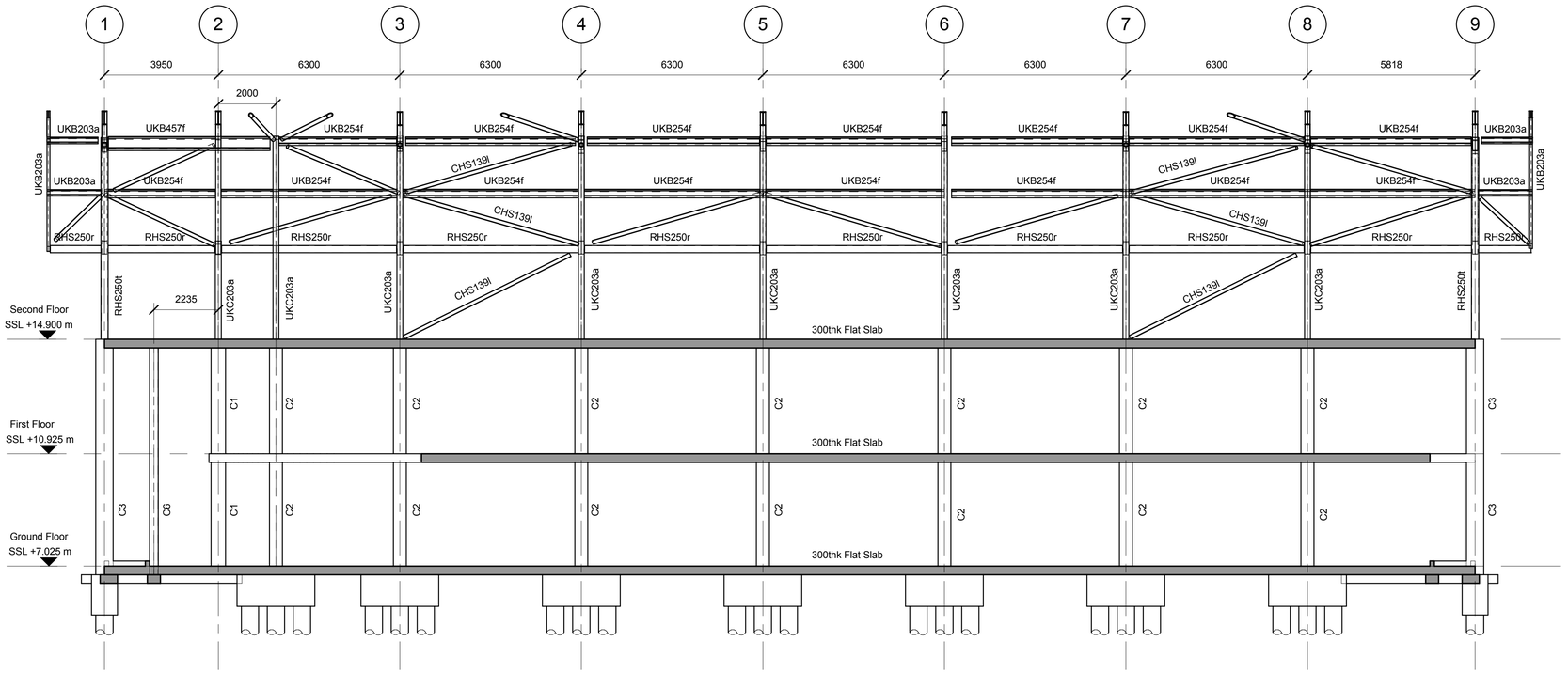
Rev **P2**

Name **UWTSD-ARP-CC-ZZ-DR-S-321**

03/03/2016 16:44:50

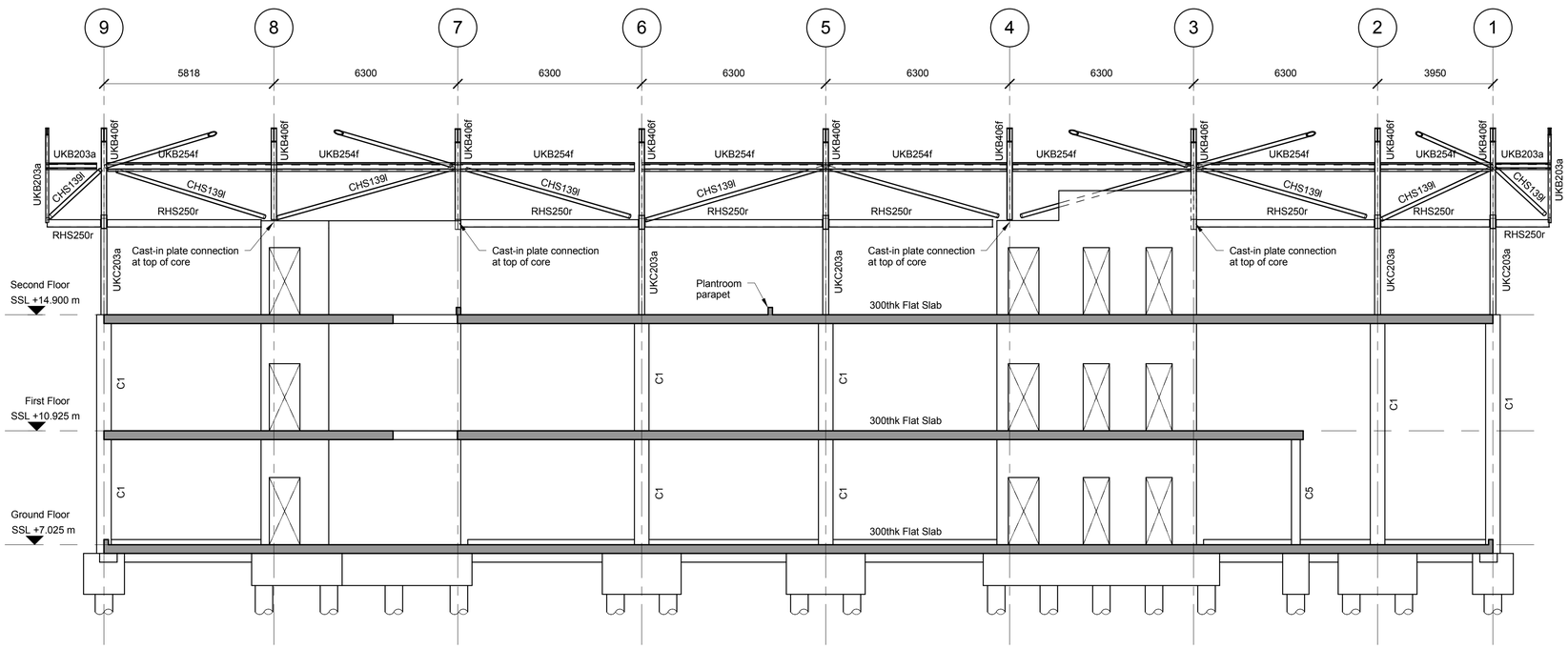
Do not scale

© Arup



5 Section 5

1 : 100



6 Section 6

1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

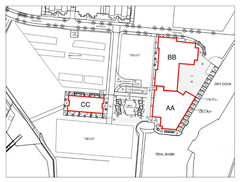
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
Sections & Elevations
Sheet 2

Scale at A1 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

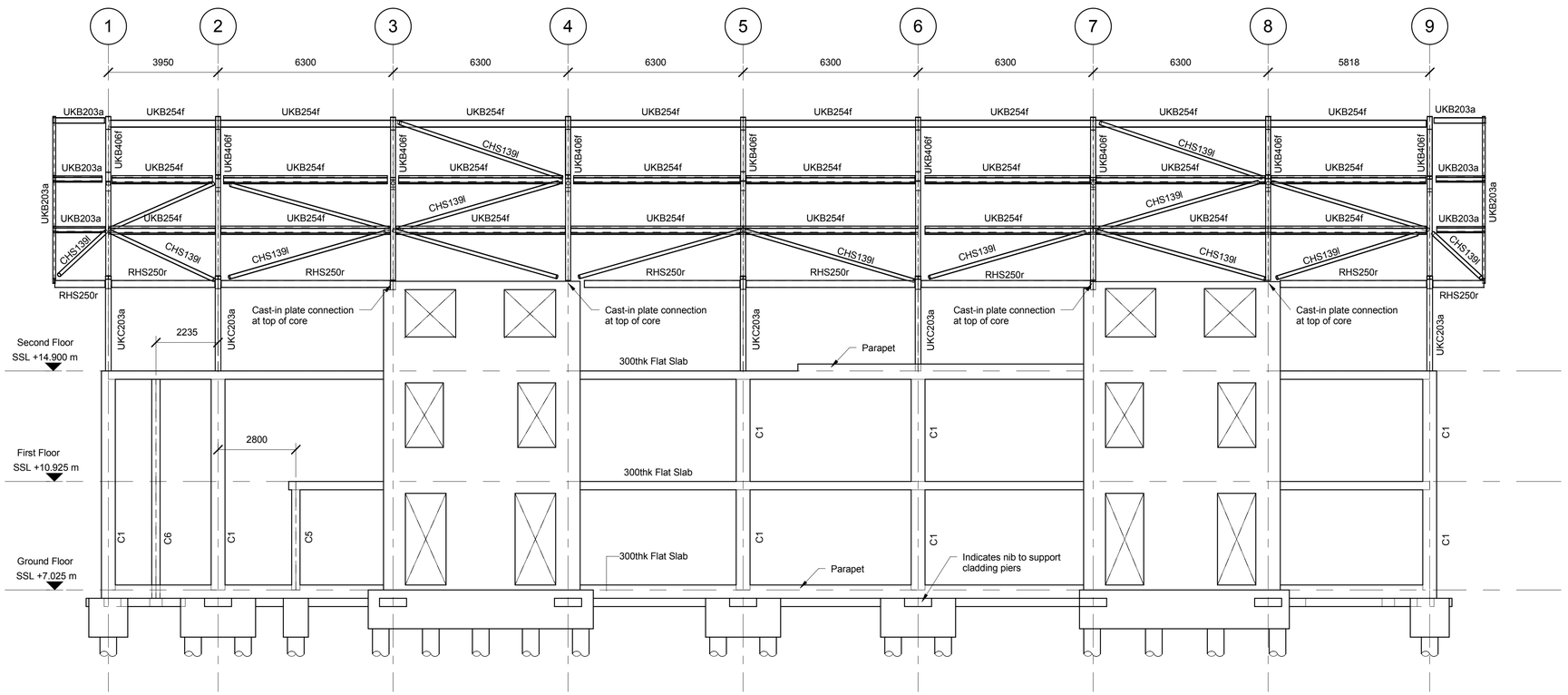
Rev **P2**

Name **UWTSD-ARP-CC-ZZ-DR-S-322**

03/03/2016 16:44:52

Do not scale

© Arup



7 Section 7
1 : 100

Notes

1. For General Notes refer to Drawing UWTSD-ARP-00-XX-DR-S-000.
2. This drawing is to be read in conjunction with all relevant Engineer's and Architect's Drawings, Specifications and Reports.
3. All dimensions are in mm unless noted otherwise.
4. All levels are in metres above ordinance datum unless noted otherwise.
5. All columns, walls, slabs, pile caps and beams to be concrete grade C32/40 UNO.
6. For precast staircase details refer to Specialist Manufacturer's Details.
7. Lift shafts, risers, doors and other significant openings sizes and setting-out to be confirmed and coordinated with Architect.
8. Lift pits and overrun setting-out to be confirmed and coordinated with Architect.

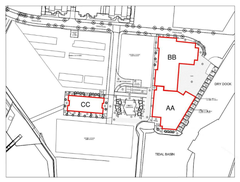
Rev	Date	By	Chkd	Appd
P2	03/03/16	JWJ	OM	ME
Stage 3 Final Issue				
P1	29/02/16	VS	OM	ME
Issued for Information				

ARUP

Client
University of Wales
Trinity Saint David

Project Title
Swansea SA1 Campus
Phase 1

Key Plan



Drawing Title
Zone CC - LIBRARY
Sections & Elevations
Sheet 3

Scale at A1 1 : 100

Role Structural

Suitability S2 - Issued for Information

Arup Job No **246523**

Rev **P2**

Name **UWTSD-ARP-CC-ZZ-DR-S-323**

03/03/2016 16:44:53

Do not scale

© Arup

Appendix F

Specifications

F1 Civil Engineering Specification

University of Wales – Trinity St David

Swansea SA1 Campus – Phase 1

Civil Engineering Specification (NBS)

P0 | 27 February 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 246523-00

Ove Arup & Partners Ltd
4 Pierhead Street
Capital Waterside
Cardiff CF10 4QP
United Kingdom
www.arup.com

ARUP

Contents

		Page
1	D20 EXCAVATING AND FILLING	1
2	Q10 KERBS/ EDGINGS/ CHANNELS/ PAVING ACCESSORIES	17
3	Q20 GRANULAR SUB-BASES TO ROADS/ PAVINGS	21
4	Q21 IN SITU CONCRETE ROADS/PAVINGS/BASES	25
5	Q22 ASPHALT ROADS/ PAVINGS	33
6	R12 BELOW GROUND DRAINAGE SYSTEMS	36

References

Tables

No table of figures entries found.

Figures

No table of figures entries found.

Drawings

No table of figures entries found.

Pictures

No table of figures entries found.

Photographs

No table of figures entries found.

Attachments

No table of figures entries found.

1 D20 EXCAVATING AND FILLING

To be read with Preliminaries/General Conditions

1.1 Generally / The Site

D20/145 VARIATIONS IN GROUND WATER LEVEL

- Give notice: If levels encountered are significantly different from levels in the site investigation report or previously measured and groundwater affects integrity of formations.

D20/150 EXISTING SERVICES/ FEATURES/ STRUCTURES

- Services: Full topographical survey and site investigation covering the drainage and services has been commissioned for this site. Please use the results of these surveys to accurately locate any services. Confirmation of exact location should still be obtained prior to excavation.
- Site features to be retained: there are some trees on the site which have been highlighted on drawings which are not to be interfered with.

1.2 Clearance/ Excavating

D20/162 TREE PROTECTION FENCE

- Erect fence in accordance with BS5837 before each phase of site clearance has begun. Refer to Arboriculturalist's drawing for an indicative fence layout. Gain approval for adequacy of fencing from CA prior to commencing clearance.

D20/165 TREE ROUTES WITHIN PROTECTION AREA

- Refer to Arboricultural Report for methods of treating roots within protection areas.

D20/168 SITE CLEARANCE

- Timing: Before topsoil stripping, if any.
- General: Do not compact topsoil. Refer to D20/112A for more information.
- Treatment: None.

D20/170 REMOVING TREES, SHRUBS, HEDGES

- Tree removal in accordance with Arboricultural Consultant's specification
- Identification: Clearly mark trees to be removed.
- Safety: Comply with HSE/ Arboriculture and Forestry Advisory Group Safety Guides.

Swansea SA1 Campus – Phase 1
Civil Engineering Specification (NBS)

- Felling: Cut down and grub up roots of shrubs and smaller trees. Fell larger trees as close to the ground as possible and remove tree stumps using an approved method suitable for the location.
- Work near retained trees: Take down trees carefully in small sections to avoid damage to adjacent trees that are to be retained, where tree canopies overlap and in confined spaces generally.
- Stumps: Obtain approval before removing stumps by winching and do not use other trees as supports or anchors.

D20/220 STRIPPING TOPSOIL

- General: Before beginning general excavation or filling, strip topsoil from areas where there will be regrading, buildings, pavings/ roads and other areas shown on drawings.
- Depth: Top 75mm to be discarded
  - Remove to an average depth of 300mm.
  - Give notice where the depth of topsoil is difficult to determine.
- Handling: Handle topsoil for reuse or sale in accordance with clause 225.
- Around trees: Do not remove topsoil from below the spread of trees to be retained
- Site storage: If space allows & if suitable to be reused on site.
- Contaminated Topsoil: Strip and separately stockpile and remove from site to a licensed landfill site including specific testing requirements for disposal.

D20/221 TREATING TOPSOIL

- Treatment: Apply a suitable translocated nonresidual herbicide.
- Timing: Not less than two weeks before excavating topsoil.

D20/225 HANDLING TOPSOIL

- Aggressive weeds:
- Species: Included in the Weeds Act, section 2 or the Wildlife and Countryside Act, Schedule 9, part II.
- Give notice: Obtain instructions before moving topsoil.
- Earthmoving equipment: Select and use to minimize disturbance, trafficking and compaction.
- Contamination: Do not mix topsoil with:
- Subsoil, stone, hardcore, rubbish or material from demolition work.
- Oil, fuel, cement or other substances harmful to plant growth.
- Other grades of topsoil.
- Multiple handling: Keep to a minimum. Use topsoil immediately after stripping.

- Wet conditions: Handle topsoil in the driest condition possible. Do not handle during or after heavy rainfall or when it is wetter than the plastic limit as defined by BS 3882, Annex N2.

D20/240 ADJACENT EXCAVATIONS

- Proximity: Where an excavation encroaches below a line drawn at an angle from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto must be completed before the higher excavation is made.
- Angle of line from horizontal: 45°.

D20/250 PERMISSIBLE DEVIATIONS FROM FORMATION LEVELS

- Beneath mass concrete foundations: ±25 mm.
- Beneath ground bearing slabs and r.c. foundations: ±15 mm.
- Embankments and cuttings: ±50 mm.
- Ground abutting external walls: ±50 mm, but such as to ensure that finished level is not less than 150 mm below dpc.

D20/255 ACCURACY – LINEAR DIMENSIONS

- Permissible deviations from linear dimensions generally: ±5MM.

D20/260 INSPECTING FORMATIONS

- Give notice: Make advance arrangements for inspection of formations for:
- Foundations & filling formations
- Service trenches
- Roads and pavings.
- Preparation: Just before inspection remove the last 150 mm of excavation. Trim to required profiles and levels, and remove loose material.
- Seal: Within 4 hours of inspection, seal formations with material specified on the contract drawings.

D20/270 FOUNDATIONS GENERALLY

- Give notice if:
  - A natural bearing formation of undisturbed subsoil is not obtained at the depth shown on the drawings.
  - The formation contains soft or hard spots or highly variable material.

D20/280 TRENCH FILL FOUNDATIONS

- Excavation: Form trench down to formation in one operation.
- Safety: Prepare formation from ground level.
- Inspection of formations: Give notice before commencing excavation.

- Period of notice: four working days.
- Shoring: Where inspection of formation is required, provide localised shoring to suit ground conditions.
- Concrete fill: Place concrete immediately after inspection and no more than four hours after exposing the formation.

D20/290 FOUNDATIONS IN MADE UP GROUND

- Depth: Excavate down to a natural formation of undisturbed subsoil.
- Discrepancy: Give notice if this is greater or less than depth given.

D20/310 UNSTABLE GROUND

- Generally: Ensure that the excavation remains stable at all times.
- Give notice: Without delay if any newly excavated faces are too unstable to allow earthwork support to be inserted.
- Take action: If instability is likely to affect adjacent structures or roadways, take appropriate emergency action.

D20/320 RECORDED FEATURES

- Recorded foundations, beds, drains, manholes, etc: Break out and seal drain ends.
- Contaminated earth: Remove and disinfect as required by local authority.

D20/330 UNRECORDED FEATURES

- Give notice: If unrecorded foundations, beds, voids, basements, filling, tanks, pipes, cables, drains, manholes, watercourses, ditches, etc. not shown on the drawings are encountered.

D20/350 EXISTING WATERCOURSES

- Diverted watercourses which are to be filled: Before filling, remove vegetable growths and soft deposits.

D20/360 EXCESS EXCAVATION

- Excavation taken wider than required:
  - Backfill: As clause 700.
  - Excavation taken deeper than required:
  - Backfill:
  - Concrete grade C35 under foundations
  - Hardcore as clause 710 underground bearing slab
  - Well graded granular material elsewhere.

D20/370 UNDERGROUND STRUCTURES IN LANDSCAPE AREAS

- Generally: Remove walls, roads, foundations, disused services, drains, manholes and the like to minimum depth.
- Minimum depth below finished levels:
  - Grass, ground cover and perennial planting: 600 mm.
  - Shrub planting: 750 mm.
  - Within 2 m of tree planting: 1000 mm.
- Walls and slabs remaining: In every 10 m² of wall or slab, make a drainage hole at least 600 mm diameter.

1.3 Disposal of Materials

D20/410 EXCAVATED TOPSOIL STORAGE

- Topsoil to be placed in landscaped bunds
- Storage: Stockpile in temporary storage heaps where space allows.

D20/415 EXCAVATED TOPSOIL REMOVAL

- General: Remove from site surplus topsoil.
- Contaminated Topsoil: and remove from site to a Licensed landfill site including specific testing requirements for disposal

D20/420 TOPSOIL STORAGE HEAPS

- Location: where space allows.
- Height (maximum): 1.5m.
- Protection:
  - Do not place any other material on top of storage heaps.
  - Do not allow construction plant to pass over storage heaps.
  - Prevent compaction and contamination.

D20/421 TOPSOIL STORAGE HEAP TREATMENT

- Treatment: As clause 221.

D20/441 SURPLUS SUBSOIL

- Excavated material: Stockpile in temporary storage heaps.
- Retained material: Place within landscaped areas and bunds on site.
  - Locations: Where suitable with respect to material properties and design levels.
  - Protected areas: Do not raise soil level within root spread of trees that are to be retained.
- Remaining material: Remove from site.

D20/450 WATER

- Generally: Keep all excavations free from water until:
  - Formations are covered.
  - Below ground construction are completed.
  - Basement structures and retaining walls are able to resist leakage, water pressure and flotation.
- Drainage: Form surfaces of excavations and fill to provide adequate falls.
- Removal of water: Provide temporary drains, sumps and pumping as necessary. Do not pollute watercourses with silt laden water.

D20/454 GROUND WATER LEVEL/ RUNNING WATER

- Give notice: If it is considered that the excavations are below the water table.
- Springs/ Running water: Give notice immediately if encountered.

D20/457 PUMPING

- General: Do not disturb excavated faces or stability of adjacent ground or structures.
- Pumped water: Discharge without flooding the site or adjoining property.
- Sumps: Construct clear of excavations. Fill on completion.
- Locations: To be agreed with Civil Engineer (if necessary).

D20/460 PERMANENT DRAINAGE SYSTEM

- Disposal of water from the excavations through system: To be agreed with Civil Engineer (if necessary).

1.4 Filling

D20/500 PROPOSED FILL MATERIALS

- Details: Submit full details of proposed fill materials to demonstrate compliance with specification, including:
  - Type and source of imported fill.
  - Proposals for processing and reuse of material excavated on site.
  - Test reports as required elsewhere.
  - Timing: At least 14 days before starting filling.
  - Additional requirements: Refer to D20/112A for more information

D20/510 HAZARDOUS, AGGRESSIVE OR UNSTABLE MATERIALS

- General: Do not use fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling, including material that is:
  - Frozen or containing ice.
  - Organic.
  - Contaminated or noxious.
  - Susceptible to spontaneous combustion.
  - Likely to erode or decay and cause voids.

- With excessive moisture content, slurry, mud or from marshes or bogs.
- Clay of liquid limit exceeding 80 and/or plasticity index exceeding 55.
- Unacceptable, class U2 as defined in the Highways Agency 'Specification for highway works', clause 601.

D20/520 FROST SUSCEPTIBILITY

- General: Except as allowed below, fill must be non frost-susceptible as defined in Highways Agency 'Specification for highway works', clause 801.17.
- Test reports: If the following fill materials are proposed, submit a laboratory report confirming they are non frost-susceptible:
  - Fine grained soil with a plasticity index less than 20%.
  - Coarse grained soil or crushed granite with more than 10% retained on a 0.063 mm sieve.
  - Crushed chalk.
  - Crushed limestone fill with average saturation moisture content in excess of 3%.
  - Burnt colliery shale.
- Frost-susceptible fill: May only be used within the external walls of buildings below spaces that will be heated. Protect from frost during construction.

D20/525 TESTING OF SUITABILITY OF FILL MATERIALS BEFORE START OF FILLING

- Laboratory: UKAS/NAMAS accredited laboratory.
- Submit report to: Civil Engineer.
  - Timing: 14 days before starting filling.
- Samples: Deliver to laboratory as required.
  - Additional requirements: Refer to D20/112A for more information.
  - Tests: CBR tests to BS EN 1377-4.
  - Frequency: At formation level at each location
- Tests: Natural Moisture Content, Compaction and In-situ Density tests.
- Frequency: As clause D20/900

D20/530 PLACING FILL

- Excavations and areas to be filled: Free from loose soil, rubbish and standing water.
- Freezing conditions: Do not place fill on frozen surfaces. Remove material affected by frost. Replace and recompact if not damaged after thawing.
- Adjacent structures, membranes and buried services:
  - Do not overload, destabilise or damage.
  - Submit proposals for temporary support necessary to ensure stability during filling.
  - Allow 14 days (minimum) before backfilling against in situ concrete structures.

- Layers: Place so that only one type of material occurs in each layer.
- Earthmoving equipment: Vary route to avoid rutting.

D20/535 COMPACTION

- General: Compact fill as soon as possible after placing.
- After compaction: Surface of each layer must be well closed, showing no movement under compaction plant, and without cracks, holes, ridges, loose material and the like.
- Defective areas: Remove and recompact to full thickness of layer using new material.

D20/540 BENCHING IN FILL

- Adjacent areas: If, during filling the difference in level between adjacent areas of filling exceeds 600 mm, cut into edge of higher filling to form benches 600 mm minimum width and height equivalent to depth of a layer of compacted filling.
- New filling: Spread and compact to ensure maximum continuity with previous filling.

D20/560 GEONETS

- Manufacturer: TBC.
  - Product reference: Non Woven Geosynthetic.
- Preparation of subgrade: C.
- Fixing: Proprietary.
  - Centres: Proprietary.
- Jointing: Proprietary.

D20/605 SUBSOIL FOR AREA SOFT LANDSCAPE

- Fill: Subsoil arising from excavations meeting the following specification:
- Quantity: Provide as necessary to make up any deficiency of subsoil existing on site and to complete the work. Source: Contractors choice Texture: (to BS 1377: Part 2):
  - Sand (0.05-2.00mm) max. 70% min. 20%
  - Silt (0.002-0.05) max, 60% min. 5%
  - Clay (less than 0.002mm) max. 30% min. 5%
- Reaction: (to BS 1377:Part 3) pH 5.0 - 8.0. Stone content (dry sieving): less than 50 by dry weight
- Maximum size of stone in any dimension: 75mm
- Electrical conductivity (salinity): less than 1500 microsiemens per cm when expressed on a 1:2.5 w/v soil: water extract
- Phytotoxic elements (ICRCL 59/83 Table 3, Group B):

- Total Copper (CU): less than 130mg/kg
- Total Nickel (Ni): less than 70mg/kg
- Total Zinc (Zn): less than 300mg/kg
- Water soluble Boron (b): less than 3mg/kg

- Zootoxic elements (ICRCL 59/83 Table 3, Group A):
  - Total Arsenic (As): less than 40mg/kg
  - Total Cadium (Cd): less than 15mg/kg
  - Total Chromium (Cr): less than 1000mg/kg
  - Total Lead (Pb): less than 2000mg/kg
  - Total Mercury (Hg): less than 20mg/kgScreened or blended topsoil will not Be acceptable
- Visual inspection: Free from visible weeds, roots of aggressive perennial weeds, turf and significant quantities of other foreign matter (brick, concrete, plaster, grass, metal, plastic, timber etc)
- Submit: Certificate of analysis.
- Excluding:
  - Materials other than inert sub-soil arising from the excavations or imported
  - Material from marshes or bogs
  - Peat, logs, stumps, slurry, mud and perishable material
  - Material susceptible to spontaneous combustion
  - Material in a frozen condition
  - Clay of liquid limit exceeding 80 and/or plasticity index exceeding 55
  - Material with excessive moisture content

D20/610 COMPACTED FILLING FOR LANDSCAPE AREAS

- Fill: Material capable of compaction by light earthmoving plant.
- Filling: Layers not more than 200 mm thick. Lightly compact each layer to produce a stable soil structure.

D20/615 LOOSE TIP FILLING FOR SOFT LANDSCAPE AREAS

- Filling: Do not firm, consolidate or compact when laying. Tip and grade to approximate levels in one operation with minimum of trafficking by plant.

D20/617 HIGHWAYS AGENCY TYPE 1 GRANULAR FILLING

- Fill: To Highways Agency ‘Specification for highway works’, clause 803:
  - Crushed rock (other than argillaceous rock).
  - Crushed concrete.
  - Recycled aggregates.
  - Crushed non-expansive slag to clause 801.2.
  - Well-burned non-plastic colliery shale.
- Filling: To Highways Agency ‘Specification for highway works’, clauses 801.3 and 802.

D20/618 HIGHWAYS AGENCY TYPE 2 GRANULAR FILLING

- Fill: To Highways Agency ‘Specification for highway works’, clause 804:
  - Crushed rock (other than argillaceous rock).
  - Crushed concrete.
  - Crushed non-expansive slag to clause 801.2.
  - Well-burned non-plastic colliery shale.
  - Natural gravel.
  - Natural sand.
- Filling: To Highways Agency ‘Specification for highway works’, clauses 801.3 and 802.

D20/620 SUBGRADE IMPROVEMENT LAYER (CAPPING)

- Fill: To Highways Agency ‘Specification for highway works’, Table 6/1, Class 6F1 or 6F2.
- Filling: Place and compact to Highways Agency ‘Specification for highway works’, Table 6/1, clause 612 and clause 613.3, 613.9 and 613.10.

D20/625 COMPACTED GENERAL FILLING/ EARTHWORKS

- Specification: Highways Agency ‘Specification for highway works’, Earthworks section, 600 series, Table 6/1 and Appendices 6/1, 6/2, 6/3, 6/6, 6/7, 6/8 and 6/9 (see clauses 900-960 in this section).
- Definition: References to the ‘Overseeing Organisation’ are deemed to be to the issuer of this specification.

D20/650 PROTECTION OF COMPACTED FILLING

- Temporary protective filling: Before allowing construction traffic, raise level of compacted cohesive soil filling at least 150 mm above formation level using properly compacted temporary filling.
- Removal: Remove temporary protective filling from site before permanent construction.

D20/700 BACKFILLING AROUND FOUNDATIONS

- Under oversite concrete and pavings: Hardcore.
- Under grassed or soil areas: Material excavated from the trench, laid and compacted in 300 mm maximum layers.

D20/710 HARDCORE FILLING

- Fill: Granular material, free from excessive dust, well graded, all pieces less than 75 mm in any direction, minimum 10% fines value of 50 kN when tested in a soaked condition to BS 812-111, and in any one layer only one of the following:
  - Crushed rock (other than argillaceous rock) or quarry waste with not more binding material than is required to help hold the stone together.
  - Crushed concrete, crushed brick or tile, free from plaster, timber and metal.
  - Crushed non-expansive slag.

- Gravel or hogging with not more clay content than is required to bind the material together, and with no large lumps of clay.
- Well-burned non-plastic colliery shale.
- Natural gravel.
- Natural sand.

- Filling: Spread and level in 150 mm maximum layers. Thoroughly compact each layer.

D20/730 BLINDING

- Surfaces to receive sheet overlays or concrete:
- Blind with:
  - Concrete where shown on drawings; or
  - Sand, fine gravel, or other approved fine material applied to fill interstices. Moisten as necessary before final rolling to provide a flat, closed, smooth surface.
  - and for blinding: To BS EN 12620, grade 0/4 or 0/2 (MP).
  - Permissible deviations on surface level: +0 -25 mm.

1.5 Highways Agency Earthworks Specification Appendices

D20/900 APPENDIX 6/1 – REQUIREMENTS FOR ACCEPTABILITY AND TESTING ETC OF EARTHWORKS MATERIALS

1. The fill material for use in the Contract shall be in accordance with Clause 602.1, 608.1 and Table 6/1.

2. Class 3 material (chalk) is not permitted in the works.

3. Acceptability limits for permitted materials for Table 6/1 are shown below. Material shall be acceptable if the appropriate test results lie within the upper and lower limits.

TABLE 6/1-1: MATERIAL ACCEPTABILITY LIMITS

Class	General Material Description	Material Properties		
		Property	Limits	
			Lower	Upper
1A, 1B, 1C, 2A, 2B, 2C, 2D	General Fill	Moisture content Dry Density	OMC – 2% 90%MDD	OMC + 2% -
		CBR	>5%	
4	Landscape Fill	See note (a) below.		
5B	Topsoil	Refer to Table 6/1 and Appendix 6/8		
6F4	Capping	Refer to Table 6/1		
6F5	Capping	Refer to Table 6/1		
6N	Fill to Structures	(v) effective angle of internal friction (∅') and effective cohesion (c')	∅' = 35° c' = 0kN/m²	-
		(vi) permeability	5 x 10^{-4} m/s	-
6P	Fill to Structures	(v) effective angle of internal friction (∅') and effective cohesion (c')	∅' = 35° c' = 0kN/m²	-
		(vi) permeability	5 x 10^{-4} m/s	-

Notes:

(a) Material which does not comply with requirements of class 1, 5 or 6 and is not designated as Class U1 or U2 shall be deemed to comply with the requirements for class 4.

(b) The optimum moisture content for Class 1 and 2 materials shall be determined from BS 1377, Part 4.

(c) Moisture content shall be determined on the material passing the 37.5 mm BS sieve.

(d) For determination of effective angle of internal friction use procedure detailed in Clause 636 of SHW.

(e) For permeability testing requirements see Clause 640 of SHW.

(f) The CBR of Class 1 and 2 materials placed within 0.6m of sub-formation level shall be 5% or greater.

(g) The CBR of any Class 6N, 6P, 6F4 or 6F5 material (except where designed to be loosely placed) shall be greater than 15 %

(h) At the final formation level, in situ CBR tests shall be carried out for external works, moisture content and in situ density tests may also be required. The No. of tests are specified in clause 525. The Contractor shall allow in his prices for CBR & in situ tests to be undertaken.

4(a) The Contractor shall be responsible for the classification and confirmation of acceptability of all earthwork materials. This will require trial pitting and testing at the point of excavation for site won materials. For imported materials, testing shall be carried out at the point of deposition. Testing shall be undertaken by a UKAS/NAMAS accredited laboratory, and results submitted to the Engineer at least 14 days prior to excavation / filling operations. The Contractor shall allow in his prices for soil tests to be undertaken. Testing for each material shall be per 1000m^3 of earthwork material.

(b) If for any reason in the Engineer's opinion, the material has altered it's classification or become unacceptable for whatever reason, he may require the Contractor to undertake additional classification and acceptability testing.

(c) The Contractor shall keep an updated schedule of testing, a copy of which will be submitted to the Supervisor on weekly basis. This schedule should record the following:-

- Sample or test number (a unique reference number).
- Sample or test location (co-ordinated reference point and reduced level).
- Description of the material tested.
- Date sampled.
- Description of tests to be carried out.
- Date sample dispatched for testing.
- Date test result received.
- Classification of soil in terms of Table 6/1

The schedules shall be submitted together with a plan at 1:500 scale showing the sample and the in-situ test locations.

5 The classification of acceptability of the earthworks materials shall be carried out by the Contractor at the point of excavation for materials excavated within the site, and at the point of deposition for material imported on to the site.

D20/910 APPENDIX 6/3 – REQUIREMENTS FOR EXCAVATION, DEPOSITION, COMPACTION (OTHER THAN DYNAMIC COMPACTION)

1. Isolated patches of soft fragmented or insecure material shall be excavated and filled by well ramming in a Class of fill with similar characteristics as the surrounding intact material.
2. No undercutting of slopes is permitted.
3. Over steepening of embankment side slopes for the purpose of Clause 608.5 shall not exceed a slope of 1 in 1.75 unless otherwise stated and shall remain only for the minimum period necessary consistent with the safety of the Permanent Works.
4. The requirements for benching and shaping to existing earthworks faces to receive fill in accordance with Clause 608.12 shall be adopted with the maximum vertical height of each bench not exceeding 600mm. The minimum width and height of excavated benches shall be equivalent to the depth of a layer of compacted filling.
5. Where an excavation is completed to the Design Level it shall be offered for inspection to the Engineer prior to backfilling, in accordance with the Contractor's Inspection and Test Plan.
6. Excavated site won materials are potentially suitable for re-use in the works, subject to meeting the requirements of Appendix 6/1, and provided that no significant contamination is identified in these materials (see 10). The site investigation information shows that a proportion of the excavated material conforms to the moisture content limits outlined for General Fill in Table 6/1-1. However the material is highly susceptible to moisture content changes caused by wet weather and trafficking and earthworks will need to undertaken appropriately to ensure that the material does not become unsuitable. A proportion of the material to be excavated is wet of optimum moisture content, the contractor may consider drying out and/or specialist stabilisation/treatment to ensure that all materials fall within the criteria set out in Table 6/1-1
7. The Engineer may instruct areas of soft material to be removed and replaced with Class 1/2 or 6 acceptable fill.
8. Any earthworks slopes which require top-soiling shall be prepared in accordance with the requirements of sub-clause 603-7(iii)
9. Compaction is to be undertaken in accordance with the general requirements of sub-clause 612.4 of the SHW where these do not contradict the requirements set out in the Highways and External Works Specification forming part of this contract.
10. Investigation of the chemical composition of any made ground in the existing car park areas has been carried out, contamination has not been encountered. The Contractor shall be responsible (during the works) for confirming that materials excavated fall within the general chemical

characteristics and concentrations identified from the previous testing. If the Contractor suspects that the materials found don't comply with these requirements then (as stated in the planning conditions) works shall cease and the relevant Authorities shall be informed. A strategy will be developed to deal with any identified contamination. The material shall be set aside for inspection and testing as necessary to allow confirmation of whether it requires off-site disposal. The assessment of materials shall be carried out to the satisfaction of the Engineer.

Earthworks General

1. The earthworks requirements are shown on the Contract Drawings.
2. Blasting is not permitted.
3. Prior to the commencement of backfilling, the ground surface at excavation level is to be proof rolled in accordance with Clause 616. Any soft areas are to be removed and replaced with compacted acceptable material.
4. The positions and dimensions of any old foundations, basements, obstructions or other structures remaining at excavation level shall be accurately surveyed and recorded prior to being covered. The Contractor shall agree the dimensions of all exposed foundations prior to removal and submit daily records of the same to the Engineer for his signature.
5. Care must be taken when compacting fill adjacent to existing structures. All methods used in these areas must be approved by the Engineer before work commences.

D20/920 APPENDIX 6/5 – GEOTEXTILES USED TO SERPARATE EARTHWORKS MATERIALS

D20/925 APPENDIX 6/6 – FILL TO STRUCTURES AND FILL ABOVE STRUCTURAL FOUNDATIONS

1.) Fill to structures and fill above structural foundations is detailed on the Drawings.

D20/930 APPENDIX 6/7 – SUB-FORMATION AND CAPPING AND PREPARATION AND SURFACE TREATMENT OF FORMATION

1.) The capping requirements are shown on the Drawings.

2.) The allowed surface tolerances of capping are given in Q20/310 and SHW sub-clause 616.1

3.) Capping material shall be Class 6F1 or 6F2 as defined in Q20/200 and SHW Clause 601.

4.) Capping shall be constructed in accordance with Clause 612 and sub-clauses 613.3, 613.9 and 613.10. In cuttings or on embankments, the following procedures should be used:-

(a.) In cuttings in accordance with sub-clause 613.11

(b.) On embankments - where required in accordance with sub-clause 613.12(i)

5.) In an area where hard material is exposed, the Contractor shall inform the Engineer prior to excavation to sub-formation level or as shown on the drawings.

6.) The site investigation data indicates that existing material at formation level has a CBR values of over 5%. For placed materials, CBRs of 5% and 15% are assumed for Class 1/2 and 6 materials respectively, providing they are compacted within the limits set out in Table 6/1-1. These values are subject to confirmation by testing

7.) At the final formation level, in situ CBR shall be carried out for external works, moisture content and in-situ density tests may also be instructed by the engineer. The No. of tests are specified in clause 525. The Contractor shall allow in his prices for CBR, moisture content and in situ density tests to be undertaken.

D20/935 APPENDIX 6/8 – TOPSOILING

1) Please refer to the Landscape Architects documents for details of the topsoil and subsoil specifications.

D20/940 APPENDIX 6/9 – EARTHWORK ENVIRONMENTAL BUNDS AND LANDSCAPE AREAS

Landscape Areas

1) Please refer to the Landscape Architects documents for details of the landscaped areas specifications.

2 Q10 KERBS/ EDGINGS/ CHANNELS/ PAVING ACCESSORIES

To be read with Preliminaries/ General conditions.

2.1 TYPES OF KERBS, EDGINGS AND CHANNELS

Q10/110 PROPRIETARY PRECAST CONCRETE KERBS, EDGINGS, CHANNELS

- Standard: To BS EN 1340.
- Manufacturer: TBC
- Product reference: TBC
- Designations: TBC
- Size (width x height x length): see Designations.
- Special shapes: see Designations.
- Finish: As cast.
- Colour: TBC.
- Bedding: Proprietary.
- Joints generally: Dry 2-3mm gap.
- Sealant movement joints: Not required

2.2 Roads/Paving Accessories/Marking

Q10/390 ROAD MARKING (LIGHT DUTY)

- Manufacturer: Contractors choice.
  - Product reference: Give notice.
- Colour: white and yellow.
- Surfaces to receive markings: Clean and dry, loose material removed.
- Application: Uniform, with no streaks or ragged edges.

Q10/395 ROAD MARKING (THERMOPLASTIC)

- Standard: Road Safety Markings Association standard specification document for road marking and road studs (StanSpec).
- Manufacturer: Contractors choice.
  - Product reference: Give notice.
- Colour: white and yellow.
- Retroreflectivity to BS EN 1436: Class R2.

Q10/400 RETROREFLECTING ROAD STUDS

- Standard: Road Safety Markings Association standard specification document for road marking and road studs (StanSpec).
- Manufacturer: Contractors choice.
  - Product reference: Give notice.
- Colour: White.

2.3 Laying

Q10/510 LAYING KERBS, EDGINGS AND CHANNELS

- Cutting: Neat, accurate and without spalling. Form neat junctions.
  - Long units (450 mm and over) minimum length after cutting: 300 mm.
  - Short units minimum length after cutting: The lower of one third of their original length or 50 mm.
- Bedding of units: Positioned true to line and levelled along top and front faces, in a mortar bed on accurately cast foundations or on a race of fresh concrete.
- Securing of units: After bedding has set, secured with a continuous haunching of concrete or on a race of fresh concrete with backing concrete cast monolithically.

Q10/520 ADVERSE WEATHER

- Conditions: Do not construct if the temperature is below 3°C on a falling thermometer or 1°C on a rising thermometer. Adequately protect foundations, bedding and haunching against frost and rapid drying by sun and wind.

Q10/530 CONCRETE FOR FOUNDATIONS, RACES AND HAUNCHING

- Standard: To BS 8500-2.
- Designated mix: Not less than GEN0 or Standard mix ST1.
- Workability: Very low.

Q10/530A CONCRETE FOR FOUNDATIONS, RACES AND HAUNCHING TO ACO CHANNEL UNITS

- Standard: To BS 8500-1, -2 and BS EN 206-1.
- Designated mix: Not less than Standard mix ST5.
- Workability: Very low.

Q10/540 CEMENT MORTAR BEDDING

- General: To section Z21.
- Mix (Portland cement:sand): 1:3.
  - Portland cement: Class CEM I 42.5 to BS EN 197-1.
  - Sand: to BS EN 12620, grade 0/4 or 0/2 (MP).
- Bed thickness: 12-40 mm.

Q10/545 PROPRIETARY BEDDING FOR UNITS LAID DIRECTLY ON ROAD WEARING COURSE

- Manufacturer: TBC
  - Product reference: TBC
- Bed thickness: Proprietary.

Q10/547 BEDDING/ BACKING OF UNITS ON FRESH CONCRETE RACES

- Standard: To BS 7533-6.

Q10/550 KERB DOWELS

- Dowels: Steel bar to BS 4482.
  - Size: 12 mm diameter, 150 mm long.
- Installation of dowels: Vertically into foundation while concrete is plastic.
  - Centres: To suit holes in kerbs.
  - Projection: 75 mm.
- Grouting of holes in kerbs: Filled with 1:3 cement:sand mortar finished flush.

Q10/560 HAUNCHING DOWELS

- Dowels: Steel bar to BS 4482.
  - Size: 12 mm diameter, 150 mm long.
- Installation of dowels: Vertically into foundation while concrete is plastic.
  - Centres: 450 mm.
  - Distance from back face of kerb: 50 mm.
  - Projection: 75 mm.
- Haunching: Rectangular cross section, cast against formwork, fully enclosing and protecting dowels.

Q10/570 CHANNELS

- Installation: To an even gradient, without ponding or backfall.
- Lowest points of channels: 6 mm above drainage outlets.

Q10/600 RADIUS KERBS/ CHANNELS

- Usage: Radii of 15 m or less.

Q10/610 ANGLE KERBS

- Usage: Internal and external 90° changes of direction.
- Cutting of mitres: Not permitted.

Swansea SA1 Campus – Phase 1
Civil Engineering Specification (NBS)

Q10/620 ACCURACY

- Deviations (maximum):
  - Level: ± 6 mm.
  - Horizontal and vertical alignment: 3 mm in 3 m.

Q10/630 NARROW MORTAR JOINTS

- Jointing: Ends of units buttered with bedding mortar as laying proceeds. Joints completely filled, tightly butted and surplus mortar removed immediately.
  - Joint width: 3 mm.

Q10/640 TOOLED MORTAR JOINTS

- Jointing: Ends of units buttered with bedding mortar as laying proceeds. Joints completely filled and tooled to a neat flush profile.
  - Joint width: 6 mm.

3 Q20 GRANULAR SUB-BASES TO ROADS/ PAVINGS

To be read with Preliminaries/ General conditions.

Q20/110 THICKNESSES OF SUB-BASE/ SUBGRADE IMPROVEMENT LAYERS

- Thicknesses: See Drawing No CG1002.

Q20/120 CHECKING CALIFORNIA BEARING RATIO (CBR) OF SUBGRADES

- Subgrade variation: If material appears to vary from that stated in the site investigation report, or if there are extensive soft spots, test subgrade CBR to BS 1377-4 or BS 1377-9. Submit results and obtain instructions before proceeding.

Q20/140 EXCAVATION OF SUBGRADES

- Final excavation to formation or subformation level: Carry out immediately before compaction of subgrade.
- Soft spots and voids: Give notice.
- Old drainage and service trenches: excavate to remove soft or degraded material, then backfill with specified granular sub base material and compact.
- Wet conditions: Do not excavate or compact when the subgrade may be damaged or destabilized.

Q20/145 PREPARATION AND COMPACTION OF SUBGRADES

- Timing: Immediately before placing sub-base.
- Soft or damaged areas: Excavate and replace with sub-base material, compacted in layers 300mm (maximum) thick.
- Compaction: Thoroughly, by roller or other suitable means, adequate to resist subsidence or deformation of the subgrade during construction and of the completed roads/ pavings when in use. Take particular care to compact fully at intrusions, perimeters and where local excavation and backfilling has taken place.

Q20/150 SUBGRADES FOR VEHICULAR AREAS

- Preparation and treatment: To Highways Agency ‘Specification for highway works’, clauses 616 and 617.

Q20/200 SUBGRADE IMPROVEMENT LAYER (CAPPING)

- Material: To Highways Agency ‘Specification for highway works’, table 6/1, Class 6F1, 6F2 or 6F3.

- Standard: Placed and compacted to Highways Agency ‘Specification for highway works’, table 6/1, clauses 612 and 613.3, 613.8, 613.9, 613.10 and 613.13.

Q20/210 HIGHWAYS AGENCY TYPE 1 GRANULAR MATERIAL

- Material: Type 1 unbound mixture to Highways Agency ‘Specification for highway works’, clause 801 and 803.
  - Recycled aggregate: Permitted.

Q20/211 GRANULAR MATERIAL

- Quality: Free from excessive dust, well graded, all pieces less than 75 mm in any direction, minimum 10% fines value of 50 kN when tested in a soaked condition to BS 812-111 and BS EN 1097-2, and in any one layer only one of the following:
  - Crushed rock (other than argillaceous rock) or quarry waste with not more binding material than is required to help hold the stone together.
  - Crushed concrete, crushed brick or tile, free from plaster, timber and metal.
  - Gravel or hoggin with not more clay content than is required to bind the material together, and with no large lumps of clay.
  - Natural gravel.
  - Natural sand.
- Filling: Spread and levelled in 150 mm maximum layers, each layer thoroughly compacted.

Q20/220 FROST SUSCEPTIBLE GRANULAR MATERIAL

- Definition (non frost susceptible material): To Highways Agency 'Specification for highway works' clause 801.8.
- Depth of frost susceptible material below final surface of paving (minimum):450mm.
- Testing: Test materials used if required and supply certificates.

Q20/225 PLACING OF MATERIAL WITH HIGH SULPHATE CONTENT

- Standard: To Highways Agency ‘Specification for highway works’, clauses 801.2 and 801.3.
  - Separation distance (minimum): 500mm.

Q20/230 PLACING GRANULAR MATERIAL GENERALLY

- Preparation: Loose soil, rubbish and standing water removed.
- Structures, membranes and buried services: Ensure stability and avoid damage.

Q20/240 LAYING GRANULAR SUB-BASES FOR VEHICULAR AREAS

- General: Spread and levelled in layers. As soon as possible thereafter compact each layer.
- Standard: To Highways Agency 'Specification for highway works' clause 802.
- At drainage fittings, inspection covers, perimeters and where local excavation and backfilling has taken place: Take particular care to compact fully.

Q20/241 LAYING GRANULAR SUB-BASES FOR VEHICULAR AREAS

- Proposals: Well in advance of starting work submit details of:
  - Maximum depth of each compacted layer.
  - Type of plant.
  - Minimum number of passes per layer.
- General: Spread and levelled in layers. As soon as possible thereafter compact each layer.
- At drainage fittings, inspection covers, perimeters and where local excavation and backfilling has taken place: Take particular care to compact fully.
- Sub-base surface after compaction and immediately before overlaying: Uniformly well closed and free from loose material, cracks, ruts or hollows.

Q20/250 LAYING GRANULAR SUB-BASES FOR VEHICULAR AND PEDESTRIAN AREAS

- General: Spread and levelled.
- Compaction:
  - Timing: As soon as possible after laying.
  - Method: By roller or other suitable means, adequate to resist subsidence or deformation of the sub-base during construction and of the completed paving when in use. Take particular care to compact fully at intrusions, perimeters and where local excavation and backfilling has taken place.

Q20/310 ACCURACY

- Permissible deviation from required levels, falls and cambers (maximum):
  - Subgrades:
  - Roads and parking areas: +20 -30 mm.
  - Footways and recreation areas: ± 20 mm.
  - Sub-bases:
  - Roads and parking areas: +/- 10mm.
  - Footways and recreation areas: +/- 10mm.

Q20/320 BLINDING

- Locations: Surfaces to receive sand bedded interlocking brick or block paving to sections Q24 and Q25.
- Material: Sand, fine gravel or PFA.
- Finish: Close, smooth, compacted surface.

Q20/330 COLD WEATHER WORKING

- Frozen materials: Do not use.
- Freezing conditions: Do not place fill on frozen surfaces. Remove material affected by frost. Replace and recompact if not damaged after thawing.

Q20/340 PROTECTION

- Sub-bases: As soon as practicable, cover with subsequent layers, specified elsewhere.
- Subgrades and sub-bases: Prevent degradation by construction traffic, construction operations and inclement weather.

4 Q21 IN SITU CONCRETE ROADS/PAVINGS/BASES

To be read with Preliminaries/General conditions.

4.1 TYPES OF PAVING

Q21/115A CONCRETE SLAB TO TRAFFICKED AREAS AND REFUSE STORAGE

- Granular sub-base: As section Q20 CLAUSE 210
- Thickness: Refer to Drg No CG1002.
- Separation membrane: None
- Mesh reinforcement: To BS 4483 type A393 free from oil, dirt, loose rust and scale.
- Concrete:
  - Cover: 40mm.
  - Designated mix: PAV 2 Air Entrained to BS 5328 (Strength C35).
  - Nominal maximum size of aggregate: 2 mm.
  - Exposure condition: Severe
  - Workability: 75 mm slump.
  - Minimum thickness(es) of slab(s): 200mm.
- Finish: Brush

4.2 GENERAL/PREPARATION

Q21/140 READY-MIXED CONCRETE

- Production plant: Currently certified by a body accredited by UKAS to BS EN 45011 for product conformity certification of ready-mixed concrete.
- Source of ready-mixed concrete: Obtain from one source if possible. Otherwise, submit proposals.
  - Name and address of depot: Submit before any concrete is delivered.
  - Delivery notes: Retain for inspection.
- Declarations of nonconformity from concrete producer: Notify immediately.

Q21/150 REINFORCEMENT CARBON STEEL.

- Standard: To BS 4449 or BS 4483.
  - Product form/ designation: Ribbed.
  - Strength grade: B500A.
- Cutting and bending: To BS 8666.

- Supplier: A firm currently approved by the UK Certification Authority for Reinforcing Steels (CARES).
- Nominal cover (minimum): 40mm.
- Cleanliness: Free from corrosive pitting, loose material and contaminants which may adversely affect reinforcement, concrete, or bond between the two.

Q21/155 IDENTITY TESTING OF FRESH CONCRETE

- Testing: To BS EN 206-1, annex B and BS 8500-1, annex B.
- Recording: Maintain complete correlated records including:
- Sampling, site tests, and identification numbers of specimens tested in the laboratory.
  - Location of the parts of the structure represented by each sample.
  - Location in the structure of the batch from which each sample is taken.
- Regular identity testing:
  - Tests: Test prescribed mixes for strength and workability in accordance with BS 5328: Part 4.
  - Sampling: Rate of sampling: as BS 5328:Part 4.
- Identity testing laboratory: Accredited by UKAS or other national equivalent.
- Identity tests results:
  - Submission of reports: Within one day of completion of each test.
  - Number of copies: 2.
  - Reports on site: A complete set, available for inspection.
  - Nonconformity: Obtain Instructions immediately.

Q21/240 SUB-BASE PREPARATION

- Surface: Sound, free of debris, mud and soft spots, and suitably close textured.
- Levels and falls: Within specified tolerances:
  - Vehicular areas: ±20 mm.
  - Pedestrian areas: ±12 mm.
  - Drainage outlets: +0 to -10 mm of required finished level.
- Kerbs and edgings: Complete, adequately bedded and haunched, and to required levels.

Q21/250 LAYING FABRIC REINFORCEMENT

- Flatness: Lay in flat sheets, straight and out of winding.
- Main reinforcement: Parallel to long axis of slab.
- Temporary support: Securely fix and support fabric during construction of slab.
- Lapping at joints (minimum):

  - Longitudinal bars: not less than 300mm.
  - Transverse bars: not less than 450mm
- Extent of fabric: Fully within slab.
  - Stopping short of slab edges by: 60 ±20 mm.
  - Stopping short of centre line of transverse joints by: 100 ±20 mm.
  - Stopping short of centre line of longitudinal joints: 350 ±50 mm.
- Alternative placing method: Fabric may be placed on top of first compacted layer of concrete, followed by top layer of concrete, placed within two hours of the first layer.

Q21/260 STEEL FORMWORK

- Side forms: Steel, drilled for dowel bars, free from warping and kinks.
- Fixing:
  - To required line, ±10 mm.
  - To required level, ±3 mm.
- Locking plates: Use where necessary to ensure rigidity and prevent movement during laying and compaction of concrete.
- Removal of forms: Six hours (minimum) after completing compaction. Treat exposed edges with waterproof compound.

4.3 LAYING CONCRETE

Q21/310 TRANSPORTING CONCRETE

- General: Avoid contamination, segregation, loss of ingredients, excessive evaporation and loss of workability. Protect from heavy rain.
- Entrained air: Anticipate effects of transport and placing methods in order to achieve specified air content.
- Placing: Use suitable walkways and barrow runs for traffic over reinforcement and freshly placed concrete.

Q21/320 LAYING CONCRETE GENERALLY

- Timing: Place as soon as practicable after mixing and while sufficiently plastic for full compaction. After discharge from the mixer do not add water or re-temper.
- Temperature of concrete at point of delivery:
  - In hot weather (maximum): 30°C.
  - In cold weather (minimum): 5°C.
- Cold weather:
  - Do not use frozen materials.
  - Do not place concrete against frozen or frost covered surfaces.

  - Do not place concrete when air temperature is below 3°C on a falling thermometer. Do not resume placing until rising air temperature has reached 3°C.
- Surfaces on which concrete is to be placed: Free from debris and standing water.
- Placing in final position: Place in one continuous operation up to construction joints.
- Do not place concrete simultaneously on both sides of movement joints.
- Spreading: Spread and strike off with surcharge sufficient to obtain required compacted thickness.
- Adjacent work: Form neat junctions and prevent damage. Keep clean all channels, kerbs, inspection covers, etc.

Q21/330 COMPACTING

- General: Fully compact concrete to full depth (until air bubbles cease to appear on the surface) especially around reinforcement, cast-in accessories, into corners and at joints.
- Poker vibrators: Do not use to make concrete flow into position. Do not allow to come into contact with fabric reinforcement.
- Wet formed joint grooves: Rectify any irregularities by means of a vibrating float.
- Finish: A dense, even textured surface free from laitance or excessive water.
- Excess concrete: Remove from top of groove formers.

Q21/340 MANHOLE COVER AND GULLY GRATING FRAMES

- General: Set frames in independent concrete slabs placed over, but slightly larger than, exterior of manhole shaft or gully pot and any concrete surround.
- Positioning of joints in main slab: Set out so that manhole/ gully slabs are adjacent to a main transverse joint, wherever possible.
- Joints: Separate the independent slabs from main slabs with 25 mm thick joint filler board. Set board 20 mm below top of slab to form a sealing groove.

Q21/350 LEVELS

- Lines and levels of finished surface: Smooth and even, with regular falls to prevent ponding.
- Finished surfaces: Within ±6 mm of required levels (+6 or -0 mm adjacent to gullies and manholes).

Q21/360 SURFACE REGULARITY

- General: Where appropriate in relation to the geometry of the surface, the variation in gap under a 3 m straightedge (with feet) placed anywhere on the surface to be not more than 5 mm.
- Sudden irregularities: Not permitted.

Q21/380 QUALITY CONTROL

- Standard: BS EN 13877-2.
- Tolerance on paving thickness: BS EN 13877-2, table 4.
- Control: See BS EN 13877-2, table 7 – Thickness of pavement, strength of concrete.
- Number of cores: As Table 7 – Category 2.
- Location: Submit proposals complying with recommendations of clause 5.

4.4 JOINTS

Q21/410 JOINTS GENERALLY

- Layout: All joints to be accurately located, straight and well aligned.
- Construction joints made at end of working day: Form as contraction joints.
- Modifications to joint design or location: Submit proposals.
- Temporary support: Prior to concreting, set formwork, dowel bars, tie bars, joint filler boards, sealing groove fillets and the like rigidly in position and support to prevent displacement. Maintain support until concrete has set.
- Keep clean:
  - Do not allow concrete to enter gaps or voids in formwork or to render movement joints ineffective.
  - Do not allow concrete to impregnate or penetrate materials used as compressible joint fillers.

Q21/420 TIE BARS

- Standard: To BS 4482.
  - Product form: Plain.
  - Strength grade: 250.
- Bar dimensions: 12 mm diameter x 900 mm long.
- Protection: Middle 400 mm to be thoroughly cleaned and coated with a corrosion resistant flexible polymeric coating.
- Cleanliness: Free from corrosive pitting, loose millscale, loose rust and contaminants which may adversely affect the tie bars, reinforcement, concrete, or bond between the two.
- Location: Place tie bars centred on and perpendicular to line of joint, within middle third of the slab depth.

- Centres: 600mm.
- Cover below top crack inducer/ joint groove (minimum): 20mm.

Q21/430 DOWEL BARS

- Material: Plain, round, mild steel to BS EN 13877-3 and free from oil, dirt, loose rust and scale.
- Bar dimensions: 20 mm dia x 550mm long(EJ), 16 mm x 800 mm long (CJ).
- Location: Place dowel bars in movement joints at mid depth of the slab ±20 mm, centred on joint and at 300 mm centres. Bars to be parallel to longitudinal axis and top surface of the slab.
- Misalignment tolerance per 300 mm length of dowel bar: ±3 mm.
- Debonding of bars: Flexible plastics sleeve covering, not less than 0.6 mm thick.
- Bars in expansion joints: Provide 100 mm long plastics caps for free bar movement. Before placing concrete, ensure there is a space between the end of the cap and the end of the dowel bar 10 mm greater than the thickness of the joint filler board.

Q21/440 LONGITUDINAL CONSTRUCTION JOINTS

- Definition: Longitudinal joints are those parallel to the main axis of the paving.
- Standard: To Concrete Society Technical Report 66.
- Formed groove:
  - Size (minimum width x depth): 15 x 13 mm.
  - Preparation: Repair damaged edges of initially cast slab prior to forming groove.
  - Method: Fix preformed fillet against top edge of the initially cast slab before placing the adjacent slab. Remove when concrete is fully cured.
- Completion: Round upper edges of slabs at joints to 5 mm radius. Do not overwork concrete.

Q21/450 CONTRACTION JOINTS WITH SAWN GROOVE

- Standard: To Concrete Society Technical Report 66.
- Temperature: Do not start sawing if temperature is falling.
- Sawn groove:
  - Timing: Cut as early as possible after the slab has been placed but without causing edges of groove to spall.
  - Width (minimum): 3 mm.
  - Depth: 3 mm per 10 mm depth of slab or 50 mm, whichever is the greater.
- Upper portion of joint: Enlarge by sawing a groove:

- Width (minimum): 13 mm.
- Depth: 25 mm.

Q21/460 CONTRACTION JOINTS WITH WET FORMED GROOVE

- Standard: To Concrete Society Technical Report 66.
- Bottom crack inducer: preservative treated softwood, triangular section, height 50 mm.
- Locate vertically below the top groove within a horizontal tolerance of ±10 mm.
- Fix to sub-base to retain in position when concrete is placed.
- Wet formed groove: Form when surface of concrete is plastic.
  - Groove depth: 30mm.
  - Temporary fillet: 20 mm wide. Remove when concrete is fully cured.
- Completion: Recompact displaced concrete without overworking. Round edges of groove to 5 mm radius.

Q21/470 EXPANSION JOINTS

- Joint filler board:
  - Type: Aerofil.
  - Standard: To Highway Agency 'Specification for Highway Works', clause 1015.
  - Thickness: 25 mm.
  - Depth: Joint filler board must extend from underside of sealing groove fillet to full depth of slab to provide complete separation of adjacent slabs.
  - Holes for dowel bars: Accurately bored or punched holes to form a sliding fit for dowel bars.
- Completion: Round upper edges of slabs at joints to 5 mm radius. Do not overwork concrete.

4.5 SURFACE FINISH

Q21/510 SAMPLE AREA

- Finish: Brushed.
- Size: 12 m².
- Location: Submit proposals.
- Timing: Complete sample area and obtain approval before proceeding with remainder of work.

Q21/530 BRUSHED FINISH

- Direction: At right angles to longitudinal direction of the slab.

Texture depth: Approximately 1 mm with finished surface having an overall even texture.

4.6 CURING/PROTECTION/FINISHING

Q21/610 CURING

- General: Immediately after completion of surface treatment prevent evaporation from surface and exposed edges of slabs for a minimum period of seven days.
- Early curing:
- Cover with waterproof sheeting held clear of surface. Seal against draughts at edges and junctions.
- Do not apply sprayed compounds or sheets in direct contact until surface is in a suitable state and will not be marked.
- Coverings for curing: Contractor's choice of:
  - Impervious sheet material.
  - Resin based aluminized curing compound containing a fugitive dye and with an efficiency index of 90% when tested to BS 7542.
  - Sprayed plastics film.

Q21/650 COLD JOINT SEALING

- Sealant:
  - Either: To BS 5212-1, type Paraseal.
  - Or: To BS EN 14188-2, class Not required.
  - Provide a manufacturer's certificate of compliance.
  - Application: Prepare joints and apply sealant in accordance with BS 5212-2.

Q21/660 PROTECTION

- Prevent damage to concrete:
  - From rain, indentation, physical damage, dirt, staining, rust marks and other disfiguration.
  - From thermal shock.
  - In cold weather, from freezing expansion of water trapped in pockets, etc.
  - By use as a building platform or for storing, mixing or preparing materials.

5 Q22 ASPHALT ROADS/ PAVINGS

To be read with Preliminaries/ General conditions.

5.1 Types of Paving

Q22/110 ASPHALT CONCRETE PAVING FOR BINDER COURSE AND BASE COURSE

- Standard: BS EN 13108 – 1:2006 .
- Granular sub-base: See Q20.
  - Compacted thickness: As per relevant construction thickness drawing.
- Base: As per relevant construction thickness drawing CG1002.
  - Paving grade: As per relevant construction thickness drawing.
  - Compacted thickness: As per BS 594987 Table 6A.
- Binder course: As per relevant construction thickness drawing.
  - Paving grade: As per relevant construction thickness drawing.
  - Compacted thickness: As per BS 594987 Table 6A.
- Reclaimed content:
  - Standard: To BS EN 13108-8.
  - Value (maximum): 50%.

Q22/140 ASPHALT CONCRETE PAVING FOR SURFACE COURSE

- Standard: BS EN 13108 – 1:2006.
- Surface course: As per relevant construction thickness drawing CG1002.
  - Paving grade: As per relevant construction thickness drawing.
  - Compacted thickness: As per BS 594987 Table 6A.
- Reclaimed content:
  - Standard: To BS EN 13108-8.
  - Value (maximum): 10%.
- Other requirements: Surface course aggregate to have a minimum PSV of 65.

5.2 Preparatory Work/Requirements

Q22/220 BITUMINOUS MATERIALS GENERALLY

- Suppliers names: Submit.
  - Timing (minimum): 2 weeks before starting work.
- Test certificates: At the time of delivery for each manufacturing batch submit certificate:
  - Confirming compliance with this specification and the relevant standard.
  - Stating full details of composition of mix.

Q22/240 ACCEPTANCE OF SURFACES

- Surface: Sound, clean and suitably close textured.
- Level tolerances: To BS 594987.
- Kerbs and edgings: Complete, adequately bedded and haunched and to the required levels.

Q22/250 ABUTMENTS

- Vertical edges of manholes, gullies, kerbs and other abutments: Clean and paint with a thin uniform coating of a material of the contractors choosing (subject to the engineers approval) .
- Finishing: Tamp surface around projections.
  - Level: Flush or not more than 3 mm above projections.

5.3 Laying

Q22/310 LAYING GENERALLY

- Preparation: Remove all loose material, rubbish and standing water.
- Adjacent work: Form neat junctions. Do not damage.
- Channels, kerbs, inspection covers etc: Keep clean.
- New paving:
  - Keep traffic free until it has cooled to prevailing atmospheric temperature.
  - Do not allow rollers to stand at any time.
  - Prevent damage.
  - Lines and levels: With regular falls to prevent ponding.
  - Overall texture: Smooth, even and free from dragging, tearing or segregation.
  - State on completion: Clean.

Q22/320 ADVERSE WEATHER

- Frozen materials: Do not use.
- Suspend laying:
  - During freezing conditions.
  - If the air temperature reaches 0°C, or in calm dry conditions -3°C, on a falling thermometer.
  - Hot rolled asphalt: During periods of continuous or heavy rain or if there is standing water on the base.

Q22/330 LEVELS

- Permissible deviation from the required levels, falls and cambers (maximum): In accordance with BS 594987, Table 7.

Q22/340 FLATNESS/ SURFACE REGULARITY

- Deviation of surface: Where appropriate in relation to the geometry of the surface, the variation in gap under a 3 m straightedge placed anywhere on the surface to be not more than:
  - Base: +/- 10mm.
  - Binder course: +/- 5mm .
  - Surface course: +/- 5mm .
  - Where a straightedge cannot be used the surface must be of a comparable standard of accuracy when judged by eye.

5.4 Completion

Q22/390 DOCUMENTATION

- Standard: BS EN 13108-1:2006 and BS EN 13018-4:2006.
  - Declaration of conformity: Submit.
- Number of copies: As per clients instruction.
- Submission: As per clients instruction.

6 R12 BELOW GROUND DRAINAGE SYSTEMS

To be read with Preliminaries/ General conditions.

6.1 General

R12/110 BELOW GROUND DRAINAGE SYSTEMS

- Surface water and rainwater drainage sources: External roads, footpaths and service yards. See clause 311-327
- Foul drainage sources: Sanitary appliances including Kitchen Grease Drain, Shower area connection, Sump Vent Pipe, Shower Tray Connection, Soil Vent Pipe, Stub Soil Pipe, Stub Waste Pipe, Waste Vent Pipe. See clause 311-317
- Pipes, bends and junctions: See Clauses 336-344.
  - Accessories: See Clauses 357-359. Access points, Rodding points.
- Manholes and inspection chambers: See Clauses 407 to 421.
- Disposal: Storm to storm outfall, foul to sewer outfall.

6.2 Products

R12/311 CONNECTORS

- Material and standard: Plastics to BS 4660 and Kitemark certified.
- Manufacturer: Contractor’s choice.

R12/313 ONE PIECE POT GULLIES FOR ACCESS ROAD

- Standards:
  - Concrete: To BS 5911-6 and Kitemark certified, or Agrément certified.
  - Polypropylene: To BS EN 1852-1.
- Material: Concrete or plastic.
- Manufacturer: CPM or Similar approved.
  - Product reference:
- Sizes: 750 x 450mm dia. internal.
- Outlet sizes: DN 150

R12/329 PIPES, BENDS AND JUNCTIONS – SUPPLY

- Pipes and fittings: From same manufacturer for each pipeline.

R12/336 PIPES, BENDS AND JUNCTIONS - CLAY (FLEXIBLE JOINTS) TO FOUL DRAINAGE

- Material and standard: Vitrified clay to BS EN 295-1, Kitemark certified.
- Manufacturer: Hepworth or similar approved
  - Product reference: Supersleve.
- Sizes: as per design.
- Crushing strength (minimum): 40kN/m.
- Jointing type: Polypropylene coupling.

R12/338 PIPES, BENDS AND JUNCTIONS - CLAY - RIGID JOINTS FOR FOUL SEWER

- Material and standard: Vitrified clay to BS 65.
- Type: Normal.
- Manufacturer: Hepworth or similar approved.
  - Product reference: Supersleve.
- Sizes: as per design.
- Strength class: 40kN/m.
- Jointing type: Spigot and socket with resin cement mortar joints.

R12/344 PIPES, BENDS AND JUNCTIONS - PLASTICS - STRUCTURED WALL TO SURFACE WATER

- Standard: To Agrément certified.
- Material: uPVC
- Manufacturer: Osma or similar approved.
  - Product reference: TwinWall
- Sizes: 100mm to 450mm
- Jointing type: Double spigot or spigot & socket

R12/357 CONNECTORS – SADDLE

- Standards:
  - Clay: To BS EN 295-1 and Kitemark certified, or Agrément certified.
  - Plastics: To BS 4660 and Kitemark certified, or Agrément certified.
- Manufacturer: Contractor's choice but integral with material of pipes

R12/359 FLEXIBLE COUPLINGS

- Standard: To BS EN 295-4 and Kitemark certified, or Agrément certified.
- Manufacturer: Contractor's choice.

R12/369 RESIN CEMENT MORTAR FOR JOINTING RIGID CLAY PIPELINES

- Manufacturer: Contractors choice.

R12/373 ROOT BARRIERS

- Manufacturer: Contractors choice.

R12/379 WARNING MARKER TAPES FOR FOUL AND SURFACE WATER PIPES

- Type: Heavy gauge polyethylene.
- Manufacturer: Contractors choice.
- Colour: As per manufacturer's guidelines.
- Widths: 150mm.
- Message: dependant on manufacturer.
- Wire detection aid: Required.

R12/401 INSPECTION CHAMBERS - PLASTICS FOR INTERNAL AND EXTERNAL USE.

- Standard: To BS 7158 or BS EN 13598-1, or Agrément certified.
- Diameter: As per design.
- Manufacturer: Hepworth or similar approved.
- Bases:
  - Product reference: TBC.
- Shaft units:
  - Product reference: TBC.
- Access covers and frames:
  - Product reference: TBC.
  - Loading grades to BS EN 124:1994.

R12/407 MANHOLES AND INSPECTION CHAMBERS - CONCRETE (IN ROADS AND CAR PARKS)

- To BS 5911-3 and BS EN 1917 and Kitemark certified; or
- To BS 5911-4 and BS EN 1917.
- Manufacturer: Contractor's Choice.
- Shape: Circular.
- Sizes: As per manhole schedule – 1200mm and 1500mm.
- Cement type and content: To BS5911-1 and BS EN 1916.
- Chamber sections:
  - Jointing type: Mortar.
- Cover slabs:
  - Loading grades to BS EN 124: as per manhole schedule.
  - Openings: To suit access covers.
- Steps: Required in chambers over 900mm deep.

R12/433 MANHOLE CHANNELS AND BRANCHES – CONVENTIONAL

- Material: As per standard draining detail.
- Manufacturer: As per standard draining detail.

R12/439 MANHOLE STEPS

- Standard: To BS EN 13101.
- Manufacturer: Contractor's choice
- Material: Plastic

R12/446 SEALING FOR CONCRETE MANHOLES – MORTAR

- Manufacturer: Contractor's Choice.

R12/471 ACCESS COVERS AND FRAMES TO MANHOLES IN ROADS & TRAFFICED AREAS

- Standard: To BS EN 124.
- Manufacturer: Saint Gobain or similar approved.
  - Product reference: Inter-Ax D400.
- Materials: Ductile iron.
- Sizes: 675mm x 675mm clear opening.
- Loading grades to BS EN 124: D400 in roads.

R12/473 ACCESS COVERS AND FRAMES - PRECAST CONCRETE SEATINGS

- Standards: To BS 5911-3 and BS EN 1917 and Kitemark certified.
- Manufacturer: Contractor's choice.
- Opening sizes: To suit access covers.

R12/483 CONCRETE (GENERAL)

- Standards: To BS 8500-1, -2 and BS EN 206-1.
- Concrete: GEN1 or ST2.

R12/485 CONCRETE (STRUCTURAL)

- Standards: To BS 8500-1, -2 and BS EN 206-1.
- Concrete: GEN3 or ST4.

R12/487 CONCRETE (MANHOLE BENCHINGS AND SURROUNDS)

- Standard:
  - England and Wales, Northern Ireland: To WRc 'Sewers for Adoption'.

- Concrete: In situ.

R12/489 CONCRETE (MANHOLE BENCHING TOPPING)

- Standard:
  - England and Wales, Northern Ireland: To WRc 'Sewers for Adoption'.
- Concrete: High strength.

R12/496 GRANULAR MATERIAL

- Standard: To BS EN 12620.
  - Size: Dependent on location - see Execution clauses in this section, and in section R17.

R12/497 GRANULAR MATERIAL – MANUFACTURED

- Standard: To BS EN 12620.
- Manufacturer: Contractors choice.
  - Product reference:.
- Source material:.
- Size: Dependent on location - see Execution clauses in this section, and in section R17.

R12/498 GRANULAR SUB-BASE MATERIAL

- Standard: To Highways Agency Volume 1, 'Specification for Highway Works', Type 1 Unbound mixtures for sub-base.

6.3 Execution

R12/611 EXISTING DRAINS

- Setting out: Before starting work, check invert levels and positions of existing drains, sewers, inspection chambers and manholes against drawings. Report discrepancies.
- Protection: Protect existing drains to be retained and maintain normal operation if in use.

R12/613 EXCAVATED MATERIAL

- Turf, topsoil, hardcore, etc: Set aside for use in reinstatement and landscaping. Refer to earthworks drawings and spec for further details.

R12/616 SELECTED FILL FOR BACKFILLING

- Selected fill: As-dug material, free from vegetable matter, rubbish, frozen soil and material retained on a 40 mm sieve.
  - Compaction: By hand in 100 mm layers.

R12/623 LOWER PART OF TRENCH – GENERAL

- Trench up to 300 mm above crown of pipe: Vertical sides, width as small as practicable.
  - Width (minimum): External diameter of pipe plus 300 mm.

R12/625 LOWER PART OF TRENCH - TRANSITION DEPTH

- Trench widths up to 300 mm above crown of pipe (maximum):
  - DN 100 pipelines more than 6.0 m deep: 600 mm.
  - DN 150 pipelines more than 5.4 m deep: 700 mm.
  - DN 225 pipelines more than 4.0 m deep: 800 mm.
  - DN 300 pipelines more than 2.9 m deep: 900 mm.

R12/631 TYPE OF SUBSOIL

- General: Where type of subsoil at level of crown of pipe differs from that stated for the type of bedding, surround or support, give notice.

R12/635 FORMATION FOR BEDDINGS

- Timing: Excavate to formation immediately before laying beddings or pipes.
- Mud, rock projections, boulders and hard spots: Remove. Replace with consolidated bedding material.
- Local soft spots: Harden by tamping in bedding material.
- Inspection of excavated formations: Give notice.

R12/641 PIPES AT DIFFERENT LEVELS IN COMMON TRENCH

- Subtrench: Permissible provided soil of step is stable and unlikely to break away.
  - Subtrench not permissible: Trench depth as required for lower pipe. Increase thickness of bedding to upper pipe as necessary.
- Lower pipe: Backfill with compacted granular material to at least half way up higher pipe.
- Clear horizontal distance between pipes (minimum):
  - Pipes up to DN 700: 350 mm.
  - Pipes exceeding DN 700: 500 mm.

R12/667 CLASS S SURROUND

- Type of subsoil: to be confirmed.
- Trench width up to 300 mm above crown of pipe (maximum):
  - DN 100 nominal pipe size: 600 mm.
  - DN 150 nominal pipe size: 700 mm.
  - DN 225 nominal pipe size: 800 mm.
  - DN 300 nominal pipe size: 900 mm.
- Granular material:
  - Pipe sizes DN 100 and DN 150: Size 4/10.

  - Pipe sizes DN 225 and DN 300: Size 4/10, 10/20 or 4/20.
  - Pipe sizes DN 375-500: Size 10/20 or 4/20.
  - Pipe sizes DN 600 and above: Size 10/20, 20/40, 4/20 or 4/40.
- Bedding:
  - Material: Granular, compacted over full width of trench.
  - Thickness (minimum): 50 mm for sleeve jointed pipes, 100 mm for socket jointed pipes. Where trench bottom is uneven, increase depth by 100 mm.
- Pipes: Dig slightly into bedding, rest uniformly on barrels and adjust to line and gradient.
- Initial testing before placing surround: Required.
- Surround:
  - Material: Granular.
  - Depth: To 50 mm above crown of pipe.
  - Compaction: By hand in 100 mm layers.
- Backfilling:
  - Material: Protective cushion of selected fill.
  - Depth: 150 mm (250 mm for adoptable sewers) above crown of pipe.
  - Compaction: By hand in 100 mm layers.

R12/678 CLASS Z SURROUND

- Type of subsoil: to be confirmed.
- Blinding:
  - Material: Concrete (general).
  - Thickness (minimum): 25 mm.
  - Width: Full width of trench.
  - Allow to set before proceeding.
- Pipes:
  - Temporary support: Folding wedges of compressible board. Prevent flotation.
  - Clearance under pipes (minimum): 100 mm.
  - Adjust pipes to line and gradient.
- Initial testing before placing surround: Required.
- Surround:
  - Material: Concrete (General).
  - Depth: To 150 mm above crown of pipe.
  - Width: Full width of trench.
- Vertical construction joints:
  - Location: At face of flexible pipe joints.
  - Material: 18 mm thick compressible board pre-cut to profile of pipe.
  - Socketed pipes: Fill gaps between spigots and sockets with resilient material to prevent entry of concrete.

R12/680 CONCRETE SURROUND FOR PIPE RUNS NEAR FOUNDATIONS

- Class Z surround: Provide in locations where bottom of trench is lower than bottom of foundation and as follows (horizontal clear distance between nearest edges of foundations and pipe trenches):
  - Trenches less than 1 m from foundations: Top of concrete surround not lower than bottom of foundation.
  - Trenches more than 1 m from foundations: Top of concrete surround not lower than D mm below bottom of foundation, where D mm is horizontal distance of trench from foundation, less 150 mm.

R12/683 LAYING PIPELINES

- Laying pipes: To true line and regular gradient on even bed for full length of barrel with sockets (if any) facing up the gradient.
- Ingress of debris: Seal exposed ends during construction.
- Timing: Minimize time between laying and testing.

R12/685 JOINTING PIPELINES

- Connections: Durable, effective and free from leakage.
- Junctions, including to differing pipework systems: With adaptors intended for the purpose.
- Cut ends of pipes: Clean and square. Remove burrs and swarf. Chamfer pipe ends before inserting into ring seal sockets.
- Jointing or mating surfaces: Clean and, where necessary, lubricate immediately before assembly.
- Allowance for movement: Provide and maintain appropriate clearance at ends of spigots as fixing and jointing proceeds.
- Jointing material: Do not allow to project into bore of pipes and fittings.

R12/687 CONCRETE SURROUND FOR CROSSOVERS

- Class Z surround: Provide where two pipelines (other than plastics pipes) cross with less than 300 mm separation.
  - Extent, on both pipes: 1 m centred on the crossing point, and beyond as necessary to come within 150 mm of nearest flexible joints.

R12/689 PIPELINES PASSING THROUGH STRUCTURES

- Pipelines that must be cast in or fixed to structures (including manholes, catchpits and inspection chambers): Provide 600 mm long rocker pipes adjacent to the external face of the structure (or both faces where appropriate, e.g. walls to footings), with flexible joints at both ends.
  - Distance to rocker pipe from structure (maximum):150 mm.
- Provision for movement for pipelines that need not be cast in or fixed to structures (e.g. walls to footings):
  - Rocker pipes as specified above; or
  - Openings in the structures to give 50 mm minimum clearance around the pipeline. Closely fit a rigid sheet to each side of opening to prevent ingress of fill or vermin.

R12/691 BENDS AT BASE OF SOIL STACKS

- Type: Nominal 90° Rest Bends.
  - Radius to centreline of pipe (minimum): 200mm.
- Height of invert of horizontal drain at base of stack below centreline of lowest branch pipe (maximum): 750mm.
- Bedding: Do not impair flexibility of pipe couplings.
  - Material: Concrete (general).

R12/693 DIRECT CONNECTION OF GROUND FLOOR WCS TO DRAINS

- Drop from crown of WC trap to invert of drain (maximum): 1.3m.
- Horizontal distance from the drop to a ventilated drain (maximum): 6 m.

R12/695 BACKDROP PIPES OUTSIDE MANHOLE WALLS

- Excavation beneath backdrop pipe: Backfill.
  - Material: Concrete (general)
- Pipe encasement:
  - Material: Concrete General.
  - Thickness (minimum): 150 mm.

R12/697 INSTALLING FLEXIBLE COUPLINGS

- Ends of pipes to be joined: Cut cleanly and square.
- Outer surfaces of pipes to be joined: Clean and smooth. Where necessary, e.g. on concrete or iron pipes, smooth out mould lines and/ or apply a cement grout over the sealing area.
- Clamping bands: Tighten carefully to make gastight and watertight seals.

R12/699 CONNECTIONS TO SEWERS

- General: Connect new pipework to existing adopted sewers to the requirements of the adopting authority (Dwr Cymru Welsh Water) or its agent.

R12/705 INITIAL TESTING OF PIPELINES

- Before testing:
  - Cement mortar jointing: Leave 24 h.
  - Solvent welded pipelines: Leave 1 h.
- Method: Block open ends of pipelines to be tested and pressurise. Air test short lengths to BS EN 1610.

R12/711 TRENCH SUPPORTS

- Removal of trench supports: Sufficient to permit compacted filling of all spaces.

R12/713 INSTALLING ROOT BARRIERS

- Root barrier installation: Full depth of excavation where adjacent to existing or proposed vegetation. Fit closely to trench wall nearest the tree.

R12/715 BACKFILLING TO PIPELINES

- Backfilling above top of surround or protective cushion: Material excavated from trench, compacted in layers 300 mm (maximum) thick.
- Heavy compactors: Do not use before there is 600 mm (total) of material over pipes.

R12/718 BACKFILLING OVER CONCRETE

- Minimum times from placing concrete:
  - Backfilling generally: 24 h.
  - Heavy compactors and traffic loads: 72 h.

R12/720 BACKFILLING UNDER ROADS AND PAVINGS

- Backfilling from top of surround or protective cushion up to formation level: Granular sub-base material, laid and compacted in 150 mm layers.

R12/728 LAYING WARNING MARKER TAPES

- Installation: During backfilling, lay continuously over pipelines.
- Depth: 300-400 mm.
  - Pipelines deeper than 2 m: Lay an additional tape 600 mm above the top of the pipeline.

R12/732 TEMPORARY BRIDGES

- Trench bridges: As necessary to prevent construction traffic damaging pipes after backfilling.

R12/736 INSTALLING RODDING POINTS

- Bedding and surround:
  - Material: Concrete (general).
  - Thickness (minimum): 100 mm.
- Permissible deviation in level of external covers and gratings: +0 to -6 mm.

R12/741 INSTALLING INSPECTION CHAMBERS - PLASTICS

- Bedding:
  - Material: as per manufacturers guidelines.
  - Thickness (minimum): as per manufacturers guidelines.

- Surround:
  - Material: as per manufacturers guidelines.
  - Thickness (minimum): as per manufacturers guidelines.
- Backfilling: as per manufacturers guidelines.
  - Compaction: By hand in 100 mm layers.
- Concrete collar:
  - Material: as per manufacturers guidelines.
  - Thickness (minimum): as per manufacturers guidelines.
  - Width (minimum): as per manufacturers guidelines.
- Seating: as per manufacturers guidelines.

R12/734 INSTALLING ACCESS POINTS AND GULLIES

- Bedding:
  - Material: As per manufacturers instructions.
  - Thickness (minimum): As per manufacturers instructions.
- Surround:
  - Material: As per manufacturers instructions.
  - Thickness (minimum): As per manufacturers instructions.
  - Height: As per manufacturers instructions.
- Backfilling:
  - Material: As per manufacturers instructions.
  - Compaction: By hand in 100 mm layers.
- Setting out relative to adjacent construction features: Square and tightly jointed.
- Permissible deviation in level of external covers and gratings: +0 to -6 mm.
- Raising pieces (clay and concrete units): Joint with 1:3 cement:sand mortar.
- Exposed openings: Fit purpose made temporary caps. Protect from traffic.

R12/743 INSTALLING CONCRETE MANHOLES

- Bases:
  - Material: In-situ Concrete to be GEN3 (designed to BRE Special Digest 1 Concrete in Aggressive Ground).
  - Thickness (minimum): 225 beneath invert of pipe as per standard detail.
- Surround:
  - Material: In-situ Concrete to be GEN3 (designed to BRE Special Digest 1 Concrete in Aggressive Ground).
  - Thickness (minimum): 150mm as per standard detail.
  - Height: Full height of Precast Concrete rings.
- Backfilling:
  - Material: Selected excavated material or imported granular fill where necessary.
  - Compaction: By hand in 100 mm layers.

R12/753 FIXING MANHOLE STEPS

- Fixing: Bed in joints.
- Positioning: 300 mm vertical centres staggered 300 mm horizontally, with lowest step 300 mm (maximum) above benching and top step 450 mm (maximum) below top of cover.

R12/755 JOINTING CONCRETE MANHOLE CHAMBER SECTIONS

- Jointing and sealing: Mortar.
- Inner joint surface: Trim surplus jointing material extruded into chamber and point neatly.

R12/757 LAYING CONVENTIONAL CHANNELS, BRANCHES AND BENCHING

- Main channel: Bed solid in 1:3 cement: sand mortar.
  - Branches: Connect to channel, preferably at half pipe level, so that discharge flows smoothly in direction of main flow.
  - Branches greater than nominal size 150 mm: Connect the branch soffit level with the main drain soffit.
  - Connecting angles more than 45° to direction of flow: Use three-quarter section channel bends.
- Benching:
  - Material: Concrete (structural).
  - Profile: Rise vertically from top of main channel to a level not lower than soffit of outlet pipe, then slope upwards at between 10% and 30% to walls.
  - Topping:
  - Material: Concrete (structural).
  - Application: Before benching concrete has set, and with dense smooth uniform finish.

R12/773a INSTALLING ACCESS COVERS AND FRAMES FOR MANHOLES

- Seating: Brickwork to F10/380.
- Bedding and haunching of frames: Continuously.
  - Material: 1:3 cement: sand mortar or proprietary bedding material..
  - Top of haunching: 30 mm below surrounding surfaces.
- Horizontal positioning of frames:
  - Centred over openings.
  - Square with joints in surrounding paving.
- Vertical positioning of frames:
  - Level; or
  - Marry in with levels of surrounding paving.
- Permissible deviation in level of external covers and frames: +0 to -6 mm.

R12/776 EXPOSED OPENINGS IN INSPECTION CHAMBERS, ACCESS POINTS, FITTINGS AND EQUIPMENT

- General: Fit purpose made temporary caps. Protect from site traffic.

6.4 Completion

R12/901 REMOVAL OF DEBRIS AND CLEANING

- Preparation: Lift covers to manholes, inspection chambers and access points. Remove mortar droppings, debris and loose wrappings.
  - Timing: Before cleaning, final testing, CCTV inspection if specified, and immediately before handover.
- Cleaning: Thoroughly flush pipelines with water to remove silt and check for blockages. Rod pipelines between access points if there is any indication that they may be obstructed.
- Washings and detritus: Do not discharge into sewers or watercourses.
- Covers: Securely replace after cleaning and testing.

R12/903 TEMPORARY MEASURES

- Water used to stabilize tanks and the like during installation: Drain.

R12/911 TESTING AND INSPECTION

- Dates for testing and inspection: Give notice.
  - Period of notice:14 days.

R12/921 FINAL TESTING OF PRIVATE GRAVITY DRAINS AND SEWERS UP TO DN 300

- Before testing:
  - Cement mortar jointing: Leave 24 h.
  - Solvent welded pipelines: Leave 1 h.
- Standard: To Building Regulations.
- Method: Air

R12/931 FINAL TESTING OF ADOPTABLE AND LARGE PRIVATE SEWERS

- Standard (sewers up to and including size DN 750):
  - England, Wales and Northern Ireland: To WRc ‘Sewers for adoption’.
  - Method: Air.

R12/941 WATER TESTING OF MANHOLES AND INSPECTION CHAMBERS

- Timing: Before backfilling.
- Standard:

- Exfiltration: To BS EN 1610.
- Method: Testing with water (method W).
- Infiltration: No identifiable flow of water penetrating the chamber.

R12/971 CCTV INSPECTION OF PIPELINES

- General: Carry out and record internal inspection using CCTV equipment.
  - Locations to be inspected: All constructed foul and storm water drains.
- Illumination: Of adequate intensity.
- Recording: Provide continuous position recording, still photographs and stopping of the camera at any point of note.
  - Copy of DVD recording: Submit.

R12/976 CCTV INSPECTION OF ADOPTABLE PIPELINES

- General: Permit the Adopting Authority or its agent to carry out and record internal CCTV inspection of pipelines and associated manholes after completion.
  - Locations to be inspected: point at which sewer enters existing sewer .
- Pipelines under highways: Complete construction, except for laying of wearing course, before inspection.

R12/978 LIFTING KEYS

- Lifting keys: Supply suitable keys for each type of access cover.
- Timing: At completion.

F2 Structural Engineering Specification

University of Wales Trinity Saint David

Swansea SA1 Campus – Phase I

Project Steelwork Specification

UWTSD-ARP-00-XX-RP-S-002

Issue | 29 February 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 246523-00

Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

ARUP

Contents

		Page
1	**INFORMATION REQUIRED BY STEELWORK CONTRACTOR**	**2**
1.1	Project Specification for Structural Steelwork	2
2	**MATERIALS**	**12**
3	**INFORMATION PROVIDED BY THE STEELWORK CONTRACTOR**	**12**
4	**WORKMANSHIP - GENERAL**	**12**
5	**WORKMANSHIP - WELDING**	**13**
5.1	General	13
5.2	Welder Qualification	13
5.3	No Change	14
5.4	No Change	14
5.5	No Change	14
5.6	Shear Stud Welding	14
6	**WORKMANSHIP - BOLTING**	**15**
7	**WORKMANSHIP - ACCURACY OF FABRICATION**	**15**
8	**WORKMANSHIP - ERECTION**	**15**
9	**WORKMANSHIP - ACCURACY OF ERECTED STEELWORK**	**16**
10	**PROTECTIVE TREATMENT**	**16**
11	**QUALITY ASSURANCE**	**16**

DEFINITIONS

The following definitions apply for the purposes of this Specification:

The Works	Structural Steelwork described in the contract drawings
Examiner/Examining Body	An **independent** person or organisation who has been accredited by UKAS (ISO 9001) as being competent to verify compliance of welder tests to BS EN 287 and welding tests to BS EN ISO 15614. Personnel who witness procedures shall be approved inspectors (PCN, EN 473) and approvals shall be by a qualified welding technologist (certified IWT or above).
FSBW	Full strength butt weld, a weld that is not full penetration but is designed to develop the full strength of the connection, it may have an un-fused land in the centre.
FPBW	Full penetration butt weld, a weld that is fully fused for the full thickness of the material
PPBW	Part penetration butt weld, similar to a FSBW but is not designed to develop the full strength of the connection and will have an un-fused land
FW	Fillet weld is normally between two plates at right angles. It can also apply to plates lapped (lap weld).

1 INFORMATION REQUIRED BY STEELWORK CONTRACTOR

1.1 Project Specification for Structural Steelwork

1.1.1 Reference to National Structural Steelwork Specification

The National Structural Steelwork Specification for Building Construction 5th Edition CE Marking Version, as modified by this project specification, applies to Phase I works of the SA1 Campus for The University of Wales Trinity St David. The specification shall be read in conjunction with all other contract documents.

Table 1.1 Proposed Works

(i) [A brief description of the structure].

The project is split into three structures:

FACE Building

The traditional learning area is a 4 storey building with a central atrium space. The building has been designed to respond to the surrounding streets and dockside, and so create a strong sense of place, as the first phase of the SA1 Waterfront Innovation Quarter. The large teaching spaces are located on the ground floor with various size learning studios, laboratories and work areas are located on the upper floors. The top level provides a large flexible space to accommodate the faculty facilities such as offices and meeting spaces.

The roof is a flat roof for PV solar panels. A number of “pop-ups” are provided to allow light into the top floor and provide natural ventilation into the spaces. The atrium roof consist of 3 glass boxes which provide natural light to the central atrium space. There is also a central plant area on the roof for the ventilation air handling units. The main stair core extends up to roof level to provide the main access to the roof.

TECH Building

The TECH building is a single-storey building of ‘engineered industrial’ character with metal cladding above a base of brickwork. The elevations comprise large glazed openings/doors which are protected by sliding security shutters.

The north-west corner has an increased height to provide some emphasis onto the main spine route, King’s Road, and provides space at roof level for the building plant room. The flat roof of TECH has angled ‘pop-ups’ which accommodate skylights, ventilation and solar panels.

A number of the workshops spaces require significant areas free from columns and require extended headroom’s of a minimum 4.5m to accommodate equipment and create the right environment. This area accommodates large equipment’s such as CNC and Dyno Cell testing machines.

Library

The Library will provide physical and digital resources and services to actively support learning, teaching and research for the university and the wider community.

The concept of the Library is as a ‘converted/modernised engineering shed’. It has the ‘skeletal vestiges’ of a brick framework, which is lined out with a skin of glass and metal cladding panels.

The ground floor of the building is ‘cut out’ in all bays in order to create the maximum sense of openness and transparency. The entrances at either end are revolving doors for maximum wind protection. The main entrance area at the west end is a double-height space.

The metal roof has solar panels covering the south side with louvre panels serving the ventilation plant room. The deep overhangs of the roof help to protect glazing both from inclement weather and solar gain.

(ii) [The intended purpose of the structure].

The Swansea SA1 Campus - Phase 1 is a new educational campus development which includes a new building for the Faculty of Architecture Computing and Engineering (FACE), the new library facility and the associated external works and landscaping to the Phase 1 area.

(iii) [Details of the Site within which the Works will be constructed].

The site is in western part of Swansea Docks. The area is located directly to the southeast of Swansea city centre. It is bordered by Fabian Way to the north and covers the Prince of Wales Dock area. For further details refer to the Stage 3 design reports and the ground investigation reports available.

(iv) [The building class in accordance with the Building Regulations].

This structure is defined as category 2b in accordance with the Building Regulations Part A, section A3 and by BS EN 1991-1-7 2006. Therefore, as per guidance in the building regulations, the detailed design of the frame shall be adequate to resist disproportionate collapse.Those parts of the structure (if any) that are external

Roof top plant rooms and parapet support steelwork shall be considered as external structural areas on all buildings unless the final architectural detailing demonstrates the structural elements to be enclosed behind the weathering line and adequately insulated.

All external steelwork is to be galvanised or treated with an E1 paint specification.

(vi) Those parts of the structure (if any) that may be manufactured to Execution Class 1.

No part of the structure may be manufactured to Execution Class 1.

Table 1.2A Design

(i) A statement describing the design concept.

It is envisaged that the final detailed design of all members including baseplate and holding down bolts shall be undertaken by a competent structural engineering consultancy employed by the Main Contractor. The consultant shall provide connection forces for all members to allow the design of the connection by the Steelwork Fabricator.

FACE Building

The FACE building is to be a braced steel frame building with long span floor beams to minimize the internal columns within learning spaces. Floor construction comprises 150mm thick overall solid composite concrete floors consisting of a 75mm precast concrete biscuit with 75mm in-situ concrete topping. The slab is to be supported on long span universal beams at 3m centres designed compositely, with columns typically at max 6m along the perimeter.

The in-plane stability of the structure is to be provided by the diaphragm action of the concrete slabs with lateral stability provided by vertical steel bracing around the lift and stairs areas.

TECH Building

The TECH building is to be single story steel frame building. The roof is to be formed from a composite metal deck in-situ concrete slab with long span cellular beams designed to act compositely with the roof slab.

The in-plane stability of the structure is to be provided by the diaphragm action of the concrete roof slab and lateral stability provided by vertical steel bracing arranged in two orthogonal directions around the building.

Library

The library is to be a reinforced concrete frame building to the upper level with a steel frame roof structure. The floor structure is to be reinforced concrete flat slabs on a typical maximum grid of 6.3m x 7.5m.

The lateral stability is to be provided by the reinforced concrete walls around vertical circulation areas.

The roof structure is a portal frame with in-plan bracing in the longitudinal direction.

(ii) Design Drawings showing all dimensions relevant to the steelwork or, if agreed, equivalent electronic data.

The engineering consultant shall provide appropriate Structural drawings and details along with a fully co-ordinated electronic model.

(iii) The design standards to be used for connection design.

The connections should be designed to Eurocode 3. For simple connections the methods in the BCSA/SCI green book or ECCS technical publication 126 should be used where practical. For moment connections the principle in the BCSA/SCI green books should be used where practical.

Where Full Strength Welds are not Full Penetration Welds account shall be taken of any eccentricity between the welds and the connected part in the design of the connection

(iv) Information necessary to design the connections including forces, moments and their combination required to be transmitted at each joint. If connection design is to be in accordance with BS 5950-1 or BS EN 1993-1-8, the forces and moments should be the factored values as defined by the code.

The factored forces, combinations and other requirements for the design of the connections shall be shown on the structural drawings.

Where required the final detailed design drawings will also indicate any design restraint assumptions that may affect the connection detailing. In the absence of such information the Steelwork Fabricator should assume that the members have been designed assuming NO notches or trimming that would affect buckling of the beams have been allowed for in the design.

(v) Particulars of any aesthetic, structural or clearance limits to be observed or environmental conditions which may affect detailing or protective treatment.

Consideration to be made on the exposed steelwork connections for any visible steelwork in the Library roof, agreement with the Architect is required on the form and style of any exposed connections.

(vi) Details and locations of any temporary works assumed by the Engineer in the design.

Refer to section 1.4.

(vii) A schedule of drawings, calculations and other information, in addition to items referred to in clauses 3.6.2 and 8.1.1, which the Steelwork Contractor must submit for acceptance.

Information on the Examiner/Examining Body that shows they comply with the requirements set out in the definition at the beginning of this project specification.

(viii) Any part of the steelwork where the manufacturing processes must be restricted including positions where holes cannot be punched. e.g. plastic hinge positions (see 4.6.1).

The library roof cross frame are designed as portal frames, no punched holes shall be allowed at plastic hinge positions.

(ix) Details of any dynamic or vibrating forces and if fatigue is to be considered. Appropriate amendments to this Specification should be included since these factors are outside the intended scope.

None.

(x) The designation of the steel to be used including the standard number, material grade, impact quality and any through-thickness requirements (see Tables 2.1 and 2.2).

All material to harmonised European Standards (e.g. BS10025) shall be CE marked. All plates, flats and rolled sections are to be of steel grade S355JR with steel grade S275JR for the connections to BS EN 10025. All external plates, flats and rolled sections are to be of steel grade S355J0 with steel grade S275J0 for the connections to BS EN 10025. Any tubular sections to be S355J2H to BS EN 10210.

The Steelwork contractor should select suitable material and welding procedures to avoid lamellar tearing where applicable.

(xi) Positions on the structure where additions and stiffeners are required to develop the strength of the member, and where notching may affect member stability, including stiffeners required around service holes and in tubular joints.

The steelwork contractor should note that beams have been designed assuming that the connection has no notch or other feature which may reduce its buckling moment capacity.

(xii) Any property class of bolt assemblies and their coatings which are specifically required.

- Grade 8.8 bolts should be used for structural connections.
- A minimum number of 2 bolts per connection must be used.
- No bolt smaller than M16 may be used.
- HD bolts to be Grade 4.6 unless stated otherwise on the contract drawings.
- Bolts in exposed areas or areas where access will not be available following construction to be spun galvanised

(xiii) Details of the fixings or bolts to the foundations or walls designed by the Engineer, or a statement indicating that the Steelwork Contractor has to design these items and prepare a Foundation Plan Drawing (see 3.3).

The Structural Engineer shall design all the connections into the foundations and into all concrete structures. For all other fixing details reference should be made to the structural drawings.

(xiv) Any prescriptive requirements on thickness and type of bedding material (grout) to be used under column base plates.

Conbextra GP by Fosroc or equal approved. Thickness as defined on the structural drawings

(xv) Requirement for any particular type of fabrication detail and/or restriction on types of connection to be used.

In some instances, the drawings may show the form of the connections. The contractor shall verify the connection for the forces given on the drawings and decide on appropriate sizes for plates, bolts and welds etc. If the contractor wishes to propose a connection of a different form he must submit sketches for approval by the Engineer. This submission is in addition to those defined in section 3.6

(xvi) Details of cutouts, holes or fittings required for use by others, or a statement clarifying the scope of coordination with others that the Steelwork Contractor has to undertake in this respect.

Refer to structural drawings

(xvii) Camber and presets which have to be provided in fabrication so that continuous frames and other steelwork can be erected to the required geometry.

Any requirements for cambers or presets will be shown on structural drawings.

Table 1.3 Workmanship

(i) Areas on steelwork where hard stamping or other permanent forms of identification may not be used (see 4.1.3(ii)).

None.

(ii) Any special welding procedures (such as for non-standard joint types, or for restricted access situations) which have to be approved prior to the work commencing.

None.

(iii) Any special requirements regarding fabrication or erection attachments (see 3.4.2 and 5.4.5).

Attachments to visible steelwork or those which extend beyond the structural zone must be removed unless agreed with the architect in advance.

(iv) Any production test plates which are required (see 5.4.7).

None.

(v) Any project-specific supplementary NDT (see 5.5.7)

None.

(vi) Short plate girders to be considered to be restrained for the purposes of clause 7.4.8.

None.

(vii) Welded box section elements to be treated as struts or columns for the purposes of clause 7.5.4.

None.

Table 1.4 Erection

(i) A Site plan showing position of datum level and setting-out lines.

See information provided by the construction manager

(ii) Width and level of the prepared working area, for access of Site traffic, access equipment and cranes, and areas available for storage (see 8.2).

See information provided by the construction manager

(iii) Availability of site services and any prearranged procedures for cooperation with other contractors (see 8.3.1(i)).

See information provided by the construction manager

(iv) Any limitation on dimensions or weights of components to be delivered to the Site or ground capacity limits for heavy loads.

See information provided by the construction manager

(v) Any design features which would affect the construction sequence, or which may create an unusual hazard during construction.

Refer to section (vii)

(vi) Details of any underground services, overhead cables or site obstructions.

See information provided by the construction manager

(vii) An outline of the method of erection envisaged by the Engineer, giving the sequence for erecting the structure taking into account any phasing of the Works, including positions on the structure where temporary bracing, metal decking or other restraints are needed to provide stability to individual members of the structure until walls, floors or other non-steel structures are in position (in accordance with 8.4.1).

The steelwork has been designed assuming that the frames will be erected using a traditional approach. The column base plates should be assessed if they are expected to stand as cantilevers in the temporary condition. Temporary bracing using guy wires etc. may be required.

(viii) A description of any temporary works and any special requirements for temporary bracing required by the Engineer to comply with (vii) above; the stage when it is no longer necessary, or whether it is to be left in position after completion of the steelwork.

No special temporary bracing is required by the Engineer. Temporary bracing to maintain stability during erection remains the responsibility of the Steelwork Contractor / Erector. If temporary bracing is provided to aid construction of the structural decking, it should only be removed once the decking has been fully fixed

(ix) A list of the responsibilities at the interface between the steelwork and other trades.

Refer to information provided elsewhere in the project specification and to information to be supplied by the main contractor.

(x) A Safe Site Handover Certificate and other information necessary so that the Steelwork Contractor can comply with Section 8 (see 8.3.1).

Refer to information provided elsewhere in the project specification or the main contractor.

Table 1.5 Protective Treatment

(i) The grade of preparation in accordance with 10.2 or any requirement for surface preparation outside the provisions of 10.2.

The grade of surface preparation will be given as in the specification tables below (cl. 1.5.1.4).

(ii) Thickness and composition of any sprayed metal coatings (see 10.3).

Refer to specification tables below (cl. 1.5.1.4)

(iii) Any requirements for galvanizing including post-galvanizing inspection (see 10.4).

All externally exposed steelwork shall be galvanised. Galvanising to be in accordance with BS EN ISO 1461:2009.

(iv) Any requirements for paint treatment (see 10.5).

All internal steelwork should be treated in the following manner: -

SPECIFICATION I-2

Surface Preparation Abrasive blast cleaning to Sa 2 1/2 of ISO 8501-1			
Coat	**Material**	**Thickness / microns**	**Application**
Primer	Epoxy Zinc Phosphate	75	Shop
Barrier	None		
Finish	Compatible finish as specified by Architect		

Generally all external steelwork is to be galvanised (refer to section (iii)), where galvanised finishes are not required all external accessible steelwork (including steelwork exposed to a cavity), should be treated in the following manner:-

SPECIFICATION E-1

Surface Preparation Blast cleaning to Sa 2 1/2 of ISO 8501-1			
Coat	**Material**	**Thickness / microns**	**Application**
Primer	Epoxy Zinc Phosphate	75	Shop
Intermediate	Epoxy MIO	125	Shop
Finish	Polyurethane	75	Site

Notes on the above tables:

- All materials shall be supplied from a single manufacturer.
- The thickness as quoted are nominal dry film thickness. Nominal dry film thickness is as defined in ISO 12844-5 and shall be measured in accordance with ISO 19840.
- All materials are to comply with the Volatile Organic Content (VOC) limits in the current edition of the European Directive 2004/42/EC or the appropriate local regulations

Please refer to Architect's specification for details of decorative paint finish.

(v) Responsibility for touch-up of damaged areas and cleaning of surface treatments on Site, and the specification for this work.

The Steelwork Contractor shall repair any damage to the coating to the same standard as the original specification. The Steelwork Contractor is to submit a detailed method statement addressing the procedures to be adopted for repair.

(vi) Any requirement for fire protective coating and/or the limiting fire temperature to be observed.

Refer to the architectural specification for fire protection requirements.

The limiting temperatures of the steelwork are to be calculated using the information in the UK National Annex to BS EN 1993-1,2.

- For beams the utilization ratio can be calculated assuming it is the ratio of the loads in the fire condition to those in the ambient condition. The loads for the areas of floor will be given in drawings. Beams that do not support concrete slabs shall be marked on the drawings.
- For columns and braces the limiting temperature is to be calculated assuming a utilization ration of 0.7 and a slenderness calculated using an effective length factor of 1.0.

Table 1.6 Inspections and Tests

(i) Inspections or tests to be carried out or witnessed by the Employer, Engineer or Inspection Authority.

Information on the requirements for welding procedure trials is given in section 5. The Engineer and Independent Inspection Authority shall be given the opportunity to witness these trials and any associated material tests.

(ii) The period of advance notice required for these additional requirements.

Unless otherwise agreed the period of advance notice shall be one week.

Table 1.7 Programme

(iii) The date(s) of issue of the Design Drawings or data for construction and other information necessary for the progress of the Works.

Reference should be made to the contract documentation

(iv) The period to be provided in the Steelwork Contractor's programme for acceptance of submitted information.

10 working days should be allowed for review of submitted information. This period is from time of receipt of the information by the Engineer to dispatch of comments. This time period also applies to resubmitted information. Should the Steelwork Contactor commence fabrication before receipt of the Engineers comments this is at their own risk.

(v) The date(s) by which the Site is expected to be ready with foundations prepared, free from obstruction, and accessible; with working surfaces, access roads and storage areas prepared and services available.

See information provided by Construction Manager

(vi) The proposed starting and completion dates for erection of steelwork and the dates when other contractors' activities are expected to interface with the steelwork erection programme.

See information provided by Construction Manager

2 MATERIALS

As NSSS apart from:

Note that cold finished hollow section to BS EN 10219 will not be permitted unless the Engineer is specifically notified in advance and approves their use in writing.

2.2.2MTesting

The first paragraph is to be modified as shown below. The modifications are in italics. The second paragraph is replaced by that below.

All steel products for use in The Works shall have been specifically tested in accordance with the appropriate product standard in Table 2.1. The steel product manufacturer shall declare the results using an inspection certificate type 3.1 to BS EN 10204. *Mechanical test results in place of a type 3.1 certificate from the manufacturer are not acceptable for production steel or for steel used in welding procedures.*

The steelwork contractor shall obtain the manufacturer's test certificate for the finished product and make it available to the Engineer or Inspection Authority. Steel that is supplied as ingot or slab and subsequently rolled will require additional testing, to be confirmed by the Engineer.

3 INFORMATION PROVIDED BY THE STEELWORK CONTRACTOR

As NSSS apart from:

3.4.3A Welding

Where any full strength weld consists of a partial penetration butt weld and superimposed fillet the component specification shall clearly show the dimensions of the nominated un-fused land within the weld to enable sizing by ultrasonic inspection.

4 WORKMANSHIP - GENERAL

As NSSS apart from:

4.1.1A Traceability of steel

Add: The marking of the steel members is to ensure traceability and facilitate reuse of the steel members.

Add: The Steelwork Contractor shall produce copies of the inspection certificates for inclusion in the Health and Safety and Maintenance Files; these should be submitted to the CA.

4.1.3M Marking steelwork

The second paragraph is to be modified as shown below. The modifications are in italics.

Completed components shall be marked with a durable and distinguishing erection mark, *section size, and steel grade* in such a way as not to damage the material. *Marking shall contain sufficient information to assist checking and re-design post construction during refurbishment and at end of life. Marking should enable the element characteristics to be identified in the construction information provided to the CA for the Health and Safety and Maintenance files.* Hard stamping may be used for steel grades up to and including S355, except where otherwise specified in the Project Specification. *Marking shall be in a discreet but accessible location for exposed elements to the Architect's approval*

5 WORKMANSHIP - WELDING

The following clauses replace relevant parts in section 5, National Structural Steelwork Specification, 5th Edition, CE Marking Version. The requirements take precedence over the NSSS 5th Edition, CE Marking Version and EN 1090.

5.1 General

Welding shall be a metal arc process in accordance with BS EN 1011-1 and BS EN 1011-2 as appropriate, together with clauses contained in this section.

The Steelwork Contractor's system for the management of welding shall meet the standard quality requirements as described in BS EN 3834-3.

Note: *As a minimum, this requires that welding coordination is undertaken by persons with technical knowledge as that described in BS EN ISO 3834-5 (Certified International Welding Engineer, IWE).*

All welding documentation (welder qualifications, welding procedure qualification records, welding procedure specifications and associated work instructions) shall be reviewed for applicability by the person responsible for welding coordination.

Joints shall be prepared in accordance with BS EN ISO 9692, parts 1 and 2. Consideration should be taken when preparing hollow sections to Annex E, BS EN 1090-2. Precautions shall be taken to ensure cleanliness of the connection prior to welding.

5.2 Welder Qualification

5.2.1 Approval

Welders shall be tested to meet the requirements of EN 287. Attention shall be paid to section 9, period of validity.

5.2.2 Certification

Welder approvals shall have been witnessed and approved by an Examiner/Examining Body who shall be an independent body accredited by UKAS (ISO 9001).

5.2.3 Validity

As required in EN 287, welders shall be tested within 2 years of the previous test (ultrasonic, radiographic) and the report kept with the welder's approval sheet. The welder shall be subject to re-test **every 4 years**.

5.2.4 Limitations

Welders shall work within the stipulated limitations as given in EN 287 at all times. Welds completed by welders found to be working outside stated limitations may be required to be removed.

5.3 No Change

5.4 No Change

5.5 No Change

5.6 Shear Stud Welding

(i) Method

Shear studs shall be welded in accordance with BS EN ISO 14555 and the manufacturer's recommendations for materials, procedures and equipment. Adequate return earth connections shall be made local to the area being stud welded.

If the studs are to be welded by other than drawn arc and this has not been indicated on the Engineers drawings, the Engineer shall be notified. Unless agreed otherwise, the size of fillet weld shall be chosen such that the full tension capacity of the stud can be developed.

The local area around where the stud is to be welded shall be clean with no surface corrosion and free of moisture before commencement of welding.

Where the decking profile includes a central rib that does not allow the studs to be placed in the centre of the trough, unless otherwise noted, they are to be placed on the side of the rib closest to the end of the beam.

Note: *See the BCSA Code of Practice for Metal Decking and Stud Welding for further guidance.*

(ii) Trial Welding

When specified by the Engineer and before production welding of studs commences, procedure trials shall be carried out. The trials shall be made on

samples of materials representative of those to be used in the work (carbon equivalent, grade and thickness).

At the start of each shift when stud welding is in progress each welder shall perform the fixing of at least two trial studs. If either of these trial studs fails a bend test in accordance with the following clause, then further trials shall be conducted until satisfactory performance is established.

(iii) Tests and Inspection

All studs are to be visually inspected and ring tested. Studs shall be replaced if they show less than a full 360° collar of weld or if they do not give a clear ring when struck with a metal club hammer.

After satisfactory visual inspection and ring testing, bend tests shall be made at locations agreed with the Engineer. A minimum of 5% of the studs, but not less than two studs per beam shall be tested by bending the head of the stud towards the nearer end of the beam.

The bend test shall be by means of a steel tube placed over a stud and bending the head until it is displaced laterally a distance of one quarter of the height of the stud (at least 15°). The stud weld shall not show any signs of cracking or lack of fusion.

Studs subjected to the bend test shall not be straightened.

(iv) Defective Studs

Studs with defective welding shall be replaced with a new stud in an adjacent location. The replacement stud shall be re-tested as in 5.6. Inspection shall increase to 5 adjacent studs, if further failures are found the cause shall be determined before resuming welding. The defective stud need not be removed.

If it is necessary to remove the defective stud it shall be detached and, where the flange is subject to tension, the surface ground and checked for cracks using the methods described in 5.5.5.

6 WORKMANSHIP - BOLTING

As NSSS.

7 WORKMANSHIP - ACCURACY OF FABRICATION

Notwithstanding the permitted deviations given below the steelwork shall be fabricated such that it can be erected to the tolerance given in section 9 as amended by this project specification.

8 WORKMANSHIP - ERECTION

As NSSS.

8.9M Certificate of completion

The final paragraph is to be modified to read:

A record of the dimensional checks at acceptance is to be made and submitted to the Employer before acceptance.

9 WORKMANSHIP - ACCURACY OF ERECTED STEELWORK

As NSSS except the following:

9.4A Deviations

The following is to be added to this clause:

Where it is necessary to combine permitted deviations to establish the acceptability of the position of the steelwork the deviations shall be combined using the root sum square method.

9.6.19(A)

Members other than columns shall not deviate from their specified position relative to the adjacent columns by more than 5mm.

10 PROTECTIVE TREATMENT

As NSSS.

11 QUALITY ASSURANCE

11.2.1A System requirements

Add:

The Steelwork Contractor shall be a Silver or Gold member of the BCSA Sustainability Charter.

The Steelwork Contractor shall provide evidence that information regarding the company's carbon footprint is supplied to BCSA for inclusion in the steel construction industry sustainability Key Performance Indicators. A carbon footprint tool is available from BCSA for this purpose.

The purchasing strategy and inventory management system will demonstrate that, where comparable alternatives exist, procurement of construction products is based on:

- the principles of responsible sourcing as defined in *BES6001* or *BS8902*
- favouring suppliers who can demonstrate environmental performance of products through a recognised system of environment labelling, or supplier operation of an EMS certified to BSENISO14001

11.1.2A System acceptance

Add:

The system shall be subject to open audit and approval by the CA with respect to its ability to achieve the maximum possible credits to BREEAM assessment methods.

Documentation will be required to provide evidence for these credits.

11.2.4A Welding coordination

Unless otherwise agreed with the Engineer, as a minimum, the RWC shall be a Certified International Welding Engineer.

ANNEX E

The table is to be amended as follows:

The primer thickness for specifications I-2 and I-3 is to be 75microns.

The specification in the last line of the table is to be labelled I-5 rather than E-2.

The notes are to be amended as follows:

Note (2) M Minimum dry film thickness in microns.

University of Wales Trinity Saint David

Swansea SA1 Campus Phase 1

Project Concrete Specification

UWTSD-APR-00-XX-RP-S-003

Issue | 26 February 2016

Job number 246523-00

Ove Arup & Partners Ltd
4 Pierhead Street
Capital Waterside
Cardiff CF10 4QP
United Kingdom
www.arup.com

ARUP

Contents

		Page
General		**1**
SECTION P1	**Information to be supplied TO the Constructor**	**2**
P1.1	General information	2
P1.2	Design	5
P1.3	Drawings and calculations	7
P1.4	Execution management	9
P1.5	Materials	12
P1.6	Project requirements	14
P1.7	Water-resisting construction	16
P1.8	Concrete	17
P1.9	Surface finishes	25
P1.10	Precast concrete	25
P1.11	Prestressed concrete construction	25
P1.12	Deflection allowances	26
P1.13	Further information	26
SECTION P2	**Information to be supplied BY the Constructor**	**28**
P2.1	General information	28
P2.2	Design	28
P2.3	Drawings and calculations	29
P2.4	Execution management	29
P2.5	Materials	29
P2.6	Project requirements	29
P2.7	Water-resisting construction	29
P2.8	Concrete and concreting	30
P2.9	Further information	30

Appendices

Appendix A

Precast Concrete Stair Specification

General

i) The specification for the structure shall be the National Structural Concrete Specification for Building Construction (NSCS) 4th edition.

ii) The NSCS Project Specification is provided by the Employer and identifies the appropriate information specific to the structure over and above that stated in NSCS Standard Specification. Clauses in the Standard Specification may be modified by information given in the Project Specification.

SECTION P1 Information to be supplied TO the Constructor

P1.1 General information

P1.1.1 Project contacts

Project name	Swansea SA1 Campus, Phase 1
Project ref	246523
Address	

Employer

Name	University of Wales Trinity Saint David		
Address	Swansea Campus, Mount Pleasant, Swansea, SA1 6ED		
Contact name	Ray Selby		
Telephone	01792 481000	E-mail	r.selby@uwtsd.ac.uk

Principal Contractor

Name	Kier Construction		
Address	Conway House, Conway House Business Park, Cardiff CF3 0EY		
Contact name	Stephen Nicholls		
Telephone	02920361616	E-mail	Stephe.nicholls2@kier.co.uk

Employers Engineer to RIBA Stage 3

Name	Ove Arup & Partners Ltd.		
Address	4 Pierhead Street, Capital Waterside, Cardiff, CF10 4QP		
Contact name	Matthew Evans		
Telephone	029 2047 3727	E-mail	Matthew.Evans@arup.com

Employers Engineer after RIBA Stage 3

Name	TBC		
Address			
Contact name			
Telephone		E-mail	

MEP Engineer

Name	Troup Bywaters + Anders
Address	3 Park Place, Cardiff, CF10 3DP
Contact name	Chris Lynn

Telephone	02920003760	E-mail	c.lynn@tbanda.com

Contract Administrator (CA)

Name	TBC		
Address			
Contact name			
Telephone		E-mail	

Other named parties to the Contract:

Name	TBC

P1.1.2 Description of the project works

Nature of building and intended use, number of floors, column grids, stair and core, stability system, foundations, basements, location of water-resisting construction, special finishes, relevant project sustainability targets and procedures, etc.

The project is split into three structures:

FACE Building

The traditional learning area is a 4 storey building with a central atrium space. The building has been designed to respond to the surrounding streets and dockside, and so create a strong sense of place, as the first phase of the SA1 Waterfront Innovation Quarter. The large teaching spaces are located on the ground floor with various size learning studios, laboratories and work areas are located on the upper floors. The top level provides a large flexible space to accommodate the faculty facilities such as offices and meeting spaces.

The roof is a flat roof for PV solar panels. A number of “pop-ups” are provided to allow light into the top floor and provide natural ventilation into the spaces. The atrium roof consist of 3 glass boxes which provide natural light to the central atrium space. There is also a central plant area on the roof for the ventilation air handling units. The main stair core extends up to roof level to provide the main access to the roof.

The FACE building is to be a braced steel frame building with long span floor beams to minimize the internal columns within learning spaces. Floor construction comprises 150mm thick overall solid composite concrete floors consisting of a 75mm precast concrete biscuit with 75mm in-situ concrete topping. The slab is to be supported on long span universal beams at 3m centres designed compositely, with columns typically at max 6m along the perimeter.

The in-plane stability of the structure is to be provided by the diaphragm action of the concrete slabs with lateral stability provided by vertical steel bracing around the lift and stairs areas.

TECH Building

The TECH building is a single-storey building of ‘engineered industrial’ character with metal cladding above a base of brickwork. The elevations comprise large glazed openings/doors which are protected by sliding security shutters.

The north-west corner has an increased height to provide some emphasis onto the main spine route, King’s Road, and provides space at roof level for the building plant room. The flat roof of TECH has angled ‘pop-ups’ which accommodate skylights, ventilation and solar panels.

A number of the workshops spaces require significant areas free from columns and require extended headroom’s of a minimum 4.5m to accommodate equipment and create the right environment. This area accommodates large equipment’s such as CNC and Dyno Cell testing machines.

The TECH building is to be single story steel frame building. The roof is to be formed from a composite metal deck in-situ concrete slab with long span cellular beams designed to act compositely with the roof slab.

The in-plane stability of the structure is to be provided by the diaphragm action of the concrete roof slab and lateral stability provided by vertical steel bracing arranged in two orthogonal directions around the building.

Library

The Library will provide physical and digital resources and services to actively support learning, teaching and research for the university and the wider community.

The concept of the Library is as a ‘converted/modernised engineering shed’. It has the ‘skeletal vestiges’ of a brick framework, which is lined out with a skin of glass and metal cladding panels.

The ground floor of the building is ‘cut out’ in all bays in order to create the maximum sense of openness and transparency. The entrances at either end are revolving doors for maximum wind protection. The main entrance area at the west end is a double-height space.

The metal roof has solar panels covering the south side with louvre panels serving the ventilation plant room. The deep overhangs of the roof help to protect glazing both from inclement weather and solar gain.

The library is to be a reinforced concrete frame building to the upper level with a steel frame roof structure. The floor structure is to be reinforced concrete flat slabs on a typical maximum grid of 6.3m x 7.5m.

The lateral stability is to be provided by the reinforced concrete walls around vertical circulation areas.

The roof structure is a portal frame with in-plan bracing in the longitudinal direction.

P1.1.3 Construction planning requirements:

Note: the information here is largely reproduced from the Contract Documents to assist the Constructor in the preparation of Section P2. The Constructor should notify the CA if any discrepancy is identified between the Contract Documents and the Specification.

Where details of the site conditions are provided, such as underground services, overhead cables, adjacent buildings and site obstructions, they are given to assist the Constructor in their tender stage planning. The Constructor should always confirm the accuracy of this information when on site, before starting work.

General

For information see Contract documents.

Positions of the Reference Line (as defined in BS EN 13670) datum level and setting-out lines, width and level of access, level of the prepared working area for site traffic, cranes and pumps, and areas available for storage and site accommodation are shown on drawing numbers:

For information see Contract documents.

Details of Underground services, overhead cables, adjacent buildings, site obstructions or other constraints on the Constructor.

For information see Contract documents.

Availability of site services and any pre-arranged procedures for sole or shared use:

For information see Contract documents.

Factors affecting construction sequence, including working restrictions on time or special nuisance (including noise); or other aspects that may create an unusual hazard:

For information see Contract documents.

Special requirements for temporary propping:

For information see Contract documents.

Restrictions on dimensions and/or weights of units to be delivered to site:

For information see Contract documents.

Interface Requirements/restrictions between the Works and following trades:

For information see Contract documents.

Special requirements for headroom:

For information see Contract documents.

A programme showing clearly any phased requirements and the earliest and the latest release dates of work to following trades or to the Employer is shown on drawing numbers:

For information see Contract documents.

Access will be made available to the Constructor on:

For information see Contract documents.

Environmental Factors relating to achievement of Considerate Constructors or Site Waste Management requirements:

For information see Contract documents.

P1.2 Design

P1.2.1 General

The design has been carried out in accordance with BS EN 1990, BS EN 1991 and BS EN 1992.Any design by the Constructor is to be carried out in accordance with these codes and the design data given in this specification.

None

P1.2.2 Loading

For all full breakdown of structural loading for each floor level, refer to the loading plans contained in the contract documentation.

P1.2.3 Other design data

Design data	Location	Location	Location	Location	Location
	All				
Fire rating (hours)	1				
Exposure Class	TBC based on SI				
Design life (years)	50				
Maintenance/ replacement assumptions					

P1.2.4 Special requirements for composite structures

The contractor must include a method statement to ensure a visually acceptable finish for any exposed soffit.

P1.3 Drawings and calculations

Project values should be entered in the grey panels

Notes

1. Types of construction:
RC: Reinforced concrete
PCE: Precast concrete elements
PCP: Precast concrete products in accordance with product standards
PSC: Prestressed concrete

2. Format
P: Paper
E: Electronic
B: Both

		Preparation		Tender issue		Acceptance issue				Construction issue			
Type Note 1		**Prepared by**	**Format** Note 2	**Number of copies**		**Number of copies**		**Period before construction (weeks)**		**Number of copies**		**Period before construction (weeks)**	
			Project	Default	Project	Default	Project	Default	Project	Default	Project	Default	Project
General arrangement drawings	RC	CA		2						5		11	
	PCP	CA		2						5		11	
	PCE	CA		2						5		11	
	PSC	CA		2						5		11	
Design Information drawings	RC	CA								5		11	
	PCP	CA								5		11	
	PCE	CA								5		11	
	PSC	CA								5		11	
Construction sequence info	All	CA		2						5		11	
Design calculations	RC	Constructor				3		8		5		5	
	PCP	Manufacturer				3		8		5		5	
	PCE	Constructor				3		8		5		5	
	PSC	Constructor				3		8		5		5	

		Preparation		Tender issue		Acceptance issue				Construction issue			
Type Note 1		**Prepared by**	**Format** Note 2	**Number of copies**		**Number of copies**		**Period before construction (weeks)**		**Number of copies**		**Period before construction (weeks)**	
			Project	Default	Project	Default	Project	Default	Project	Default	Project	Default	Project
Specialist drawings	RC					3		8		5		5	
	PCP	Constructor				3		8		5		5	
Enter details as required	PCE	Constructor				3		8		5		5	
	PSC	Constructor				3		8		5		5	
Reinforcement drawings and schedules	RC					3		7		5		5	
Pre-cast concrete elements	PCP	Manufacturer											
	PCE	Constructor				3		7		5		3	
	PSC	Constructor				3		7		5		3	
Builders' work information	All	CA				3		6					
Coordinated builders work drawings	All					3		4		5		2	
Temporary works and erection drawings and/or calculations and method statements	All	Constructor				3		4		5		2	
As-built drawings	All									3		Months after completion	

P1.4 Execution management

P1.4.1 Execution Class

The following parts of the structure are to be constructed in accordance with execution Class 3:

None

P1.4.2 Execution documentation

The following documentation is required: Project values should be entered in the grey panels.

Information	**When required** Number of working days before construction with updates as requested unless noted		**Format/Notes** P = Paper E = Electronic B = Both	
	Default	**Project**	**Default**	**Project**
Contractor's Quality Assurance Certification	At tender		Paper	
SpeCC registration or equivalent	As requested		Paper	
Detailed construction programme	20		Paper	
Falsework and formwork: design	20		Calculations & drawings	
Falsework and formwork: pre-concreting cleanliness	As requested		Paper	
Reinforcement: source and supplier	20		Paper	
Reinforcement: Certification	20		Paper	
Reinforcement: pre-concreting location	As requested		Paper	
Spacers	As requested		Paper	
Couplers: source and supplier	20		Paper	
Couplers: Certification	20		Paper	
Continuity strips: source and supplier	20		Paper	
Continuity strips: Certification	20		Paper	
Post tensioning work:				
Certification	20		Paper	
Specific quality plan	20		Paper	
Other information	As Cl P1.11.3		Paper	
Concrete: readymix plant details	20		Paper	
Concrete: readymix producers' certification	20		Paper	

Information	**When required** Number of working days before construction with updates as requested unless noted		**Format/Notes** P = Paper E = Electronic B = Both	
	Default	**Project**	**Default**	**Project**
Concrete: delivery ticket	As requested		Paper	
Concreting: method statement and pour sequence for each section of the work	5		Paper	
Precast concrete	As Table P1.10		Paper	
As built geometry: setting out and dimensions	10 working days after the construction is complete at each level		Paper	
As built geometry: reinforcement cover	As requested		Cover meter survey	
Environmental certification and responsible sourcing documentation where required: relating to reinforcement, aggregate, cementitious materials, formwork and concrete supply including: ISO 14001 Certification for Concrete Supply Responsible Sourcing certification for Concrete Supply Responsible Sourcing certification for Cement Manufacture Responsible Sourcing certification for Aggregate Extraction Responsible Sourcing certification for Reinforcement Responsible Sourcing certification for Timber OR Written confirmation of legality of Timber	20		Paper	

P1.4.3 Approvals timing

The timings given in NSCS Standard Specification apply to all approvals except as noted below. Project values should be entered in the grey panels.

Standard Specification clause ref.	Item	Requirements Before or after as appropriate. Working days unless stated	
		Default	Project
4.1.2.1	Material test results	10	
4.2.1	Quality plan	5	
4.3.3	Notice to CA for concrete pour inspection	1	
4.3.3	Before prestressing work starts	1	
4.3.3	Before covering up or backfilling	5	
4.3.3	For water-resisting construction to allow joint inspections	5	
4.3.4	Response by CA to request for modifications	5	
4.3.7	Copies of test results	3 No.	
4.3.8	Proposal and response time for work rectification	5 & 5	
6.2.1	Notice to CA for site changes to reinforcement	1	
7.1.1.4	Extension calculations for post-tensioning tendons	10	
7.3.1.1	Notice to CA for site changes to post-tensioning tendons	1	
7.4.1	Grouting records	5	
8.1.2.1	Concrete non-conformity	24 hours	
8.2.1.3	Method of fixing kickerless shutters	5	
8.2.1.4	Premature cessation of a pour	2 hours	
9.1.2	Precast connection details	15	
9.1.3	Precast erection specification and work programme	5	
9.5.3	Proposals for cutting standard precast products	5	
Other			

P1.4.4 Inspection

Items not defined in table 1 of BS EN 13670 shall be inspected as follows:

N/A

Additional third party inspection, carried out by N/A is required of the following parts of the structure:

N/A

P1.4.5 Documents

The following **special documentation** is required:

Certification of aggregate sourcing and content is required for BREEAM reasons.

Requirements for **responsible sourcing** documentation:

Concrete Supply shall be certified against BRE BES 6001 Framework Standard for the Responsible Sourcing of Construction Products or other scheme to BS8902. Certification level to be a minimum of Good.

P1.4.6 As built geometry

The **overall concrete** dimension shall be checked:

List of requirements	Frequency
N/A	

The **cover to reinforcement** shall be checked:

List of requirements	Frequency
N/A	

P1.4.7 Curing class

List where curing classes other than 2 shall be used:

Class	Location
3	All locations U.N.O

P1.4.8 Protection

The following special protection is required:

To visual concrete, following striking of concrete.
No marking of concrete visible in the completed building is permitted.

P1.5 Materials

P1.5.1 Reinforcement

Stainless steel reinforcement shall be used in the following locations:

None

Epoxy coated steel reinforcement shall be used in the following locations:

None

Anchorages and couplers shall be:

As noted on relevant drawings.

Fibres shall be used as follows:

Type of fibres	Location & dosage
N/A	

Requirements for **responsible sourcing** of reinforcement:

The fabricator, and mill supplying the reinforcement, shall be certified through either the Eco-Reinforcement scheme operated by BRE Global, or the 'Sustainable Reinforcing Steel Scheme' operated by CARES, or other third party accredited scheme that follows the principles of BS8902.

P1.5.2 Timber

Requirement for **responsible sourcing** of timber or timber products:

100% of timber to be certified sustainably sourced by CPET recognized schemes.

P1.5.3 Other materials

Materials not permitted:

Best practice guidelines as set out in 'Good practice in selection of construction materials' (Sheehan, 1997) should be followed.

Materials requiring special consideration:

General

All products / materials to be used in areas where the concrete surface will be visible to the public must be specially considered to ensure consistency of finish and colour. Main contractor should ensure no markings are made on visible concrete surfaces.

Aggregates

Aggregates, both coarse and fine, are to be sourced from a single quarry for the duration of the scheme. Back up plants, where used, must carry a supply of the same aggregates to ensure colour consistency. Maximise recycled or replacement aggregates.

Protection

Insulating materials shall have a global warming potential (GWP) < 5

Insulating forms

All insulation materials should have a Global Warming Potential of less than 5

Form release agents

Form release agents shall be high performance chemically active type, vegetable based and ultimately biodegradable at 28 days > 60 %, according to the norm NF EN ISO 9408 OCDE 301 F.

Volatile Organic Compounds (VOC) of the agent shall be zero where conditions allow but in any case < 20 %. Careful attention shall be paid to manufacturer's instructions particularly the rate of application to ensure an even, low porosity finish and economy of use."

Items supplied by the Employer:

None

Requirement for **responsible sourcing** of materials:

N.A.

List of materials to be supplied under **Constructor-specified supply**:

None

P1.6 Project requirements

Enter variations from NSCS Standard Specification

Standard Spec. Clause ref	Change N: New D: Deleted M: Modified	Description
3.4.6	M	Temporary works and erection drawings; Add: "and all special stability requirements" after "propping".
5.2	M	Delete 'Permanent Formwork may be used subject to the agreement of the CA' and replace with 'Permanent Formwork may be used subject to the agreement of the CA where it is part of a structural system; where it can contribute to the overall performance of the building by providing an architectural finish or exposed thermal mass; or where it is inaccessible after construction of the element.'
6.1.1.1	M	Delete "Grade 500 unless otherwise specified in the NSCS" replace with "Grade 500B or C unless otherwise agreed by the CA"
7.1.1.1	M	Add: Evidence of certification shall be provided at tender stage.
7.1.1.6	N	Access to the works shall be granted to CARES for the purpose of quality auditing and maintenance of certification by arrangement with the post-tensioning contractor and/or the CA. This should be arranged with the timing agreed in advance with the CA.
5.4.1	M	Designate the existing clause "Ground Support" as "i)" Delete: "or faces of excavations" and add "or as shown on the drawings" after "CA".

Standard Spec. Clause ref	Change N: New D: Deleted M: Modified	Description
		Add “2) Work below Ground Vertical faces of strip footings, bases and slabs may be cast against faces of excavation, provided: - Prior approval is obtained. - The faces are sufficiently accurate and stable. - Supports to faces are withdrawn progressively as concrete is placed. - Adequate measures are taken to prevent contamination of concrete. Faces of walls must be cast against formwork.”
6.2.1	M	Delete: “prior written” before “agreement”.
6.2.3.3	N	Semi-structural/structural welding Only firms that have achieved certification to CARES Appendix 10 – Quality and operations assessment schedule for the manufacture of pre-assembled welded fabrications using welded semi-structural and/or structural joints, shall be permitted to bid for or undertake contracts to supply pre-assembled welded fabrications.
8.5.1	M	Delete “In ground bearing slabs isolated crack widths up to 2.0mm between panel joints” Add “In reinforced ground bearing slabs isolated crack widths up to 0.5mm between panel joints” Delete “In concrete slabs cast on metal deck formwork as part of a composite structure isolated crack widths up to 1.0mm” Add “In concrete slabs cast on metal deck formwork as part of a composite structure isolated crack widths up to 0.5mm”
9.1.1	N	The precast concrete supplier shall: be a signatory to the British Precast Sustainability Charter; provide evidence that they have, or are working towards ISO 14001 certification and be participating in the British Precast ‘Concrete Targets’ health and safety improvement scheme.

P1.7 Water-resisting construction

P1.7.1 Detail

Water resisting construction is not envisaged but should the detailed design deem it necessary the designer shall provide clear details of any special measures to be considered in construction using the following format.

Location	Detail	Waterstops	Separation membranes	Joint fillers
	Manufacturer			
	Material			
Slabs: horizontal construction joints	Type			
Slabs: horizontal movement joints	Type			
Walls :horizontal slab/wall junctions	Type			
Walls: vertical construction joints	Type			
Walls: vertical movement joints	Type			

P1.7.2 Crack widths

These should be limited to	TBC by the detailed designer if required.

P1.8 Concrete

P1.8.1 Designated concrete

To be In accordance with BS 8500–2 and BS EN 206–1

Project values should be entered in the grey panels.

	Requirements	Defaults	Location	Location	Location
1.	Concrete designation (Ref. BS 8500–2: 2006, Table 5)		To be completed by the detailed designer during RIBA Stage 4	To be completed by the detailed designer during RIBA Stage 4	To be completed by the detailed designer during RIBA Stage 4
2.	Maximum aggregate size (mm) Enter 10, 14, 20 or 40	20			
3.	Slump class S1, S2, S3, S4 or other value	S3			
4.	Special restrictions on cement types (enter reference if required)	None			
5.	Special requirements for aggregates (enter reference if required)	None			
6.	Use of RCA permitted? Maximum mass fraction of total coarse aggregate enter a higher mass fraction of total coarse aggregate, where permitted (Ref. BS 8500–1: 2006, Cl. 4.2.3c)	Yes 20%			
7.	Requirements for accelerated or retarded set	None			
8.	Special colour requirements None or see P1.9	None			
9.	Type and dosage of fibres	See P1.5.1			
10.	Chloride class Cl 1,0 for GEN series, Cl 0,20 for SRPC, Cl 0,40 for all other concretes or enter special requirements	As BS 8500-1			
11	Minimum air content	None			

	Requirements	Defaults	Location	Location	Location
12	Method of placing concrete				
13	Requirement for finishing concrete	See P1.9			
14.	Identity testing for consistence or other properties required in accordance with BS EN 206: 2000 Annex B and BS 8500–1: 2006 Annex B (If yes then details to be added into P1.13)	No			

Notes

1. All sections of the Specification must be completed before it is passed to the Producer. The person sending the final specification to the producer must send copies of the document to all other parties (CA, Engineer, Employer, as appropriate) who have contributed to the Specification.
2. Where 'None' is entered in the table this is a default value to ensure that the Specification is complete. All those involved in completing the specification need to check if 'None' is appropriate.
3. Guidance on specification of designated concrete can be found in BS 8500–1: 2006, Section 4.2.

P1.8.1 Designed concrete

To be In accordance with BS 8500–2 and BS EN 206–1

Project values should be entered in the grey panels.

	Requirements	Defaults	Location
1.	Concrete reference		To be completed by the detailed designer during RIBA Stage 4
2.	Strength class		
3.	Maximum water-cement ratio		
4.	Minimum cement content kg/m^3		
5.	DC-Class where appropriate		
6.	Permitted cement types - See BS 8500-1:2006, Cl. 4.3.2, Note 4		*Req. 6.1 or 6.2 or 6.3 or 6.5*
7.	Maximum aggregate size (mm) - Enter 10, 14, 20 or 40	20	
8.	Chloride class (a value must be entered unless Cl 0,40 is acceptable)	Cl 0,40	
9.	Target density/density class (for lightweight and heavyweight concrete)	N/A	
10	Consistence class S1, S2, S3, S4		
11	Method of placing concrete		
12	Requirement for finishing concrete	See P1.9	
13	Type and dosage of fibres	See P1.5.1	
14.	Use of RA conforming to BS 8500-2:2006, Cl. 4.3, permitted? If YES: enter requirements for: Maximum acid-soluble sulphate, method for determination of the chloride content classification with respect to ASR, method for determination of alkali content., any limitations on use in concrete, e.g. exposure classes, maximum mass fractions etc (Enter details in P1.13) Note 5		Req. 14.1 or 14.2
15	Special requirements for aggregates Guidance: Write ‘Req. 15.1’ or 15.2 as per notes, otherwise ‘None’		
16	Minimum air content, or other requirements to resist freeze-thaw attack	None	
17	Special requirements for temperature of fresh concrete	None	
18	Special requirements for strength development	None	
19	Special requirements for heat development during hydration	None	

	Requirements	Defaults	Location
20	Special requirements for retarded stiffening	None	
21	Special requirements for resistance to water penetration	None	
22	Special requirements for resistance to abrasion	None	
23	Requirements for tensile splitting strength	None	
24	Additional technical requirements See BS 8500–1: 2006, Cl. 4.3.3 sections n & m	None	
25.	Identity Strength testing required? (If Yes then details to be added into P1.13)	None	
26.	Identity Consistence testing required? (If Yes then details to be added into P1.13)	None	
27.	Other properties Identity testing required? (If Yes then details to be added into P1.13)	None	

Notes

1. All sections of the specification must be completed before it is passed to the producer. The person sending the final specification to the producer must send copies of the document to all other parties (CA, Engineer, Employer as appropriate) who have contributed to the specification.
2. Where 'None' is entered in the table this is a default value to ensure that the specification is complete. All those involved in completing the specification need to check if 'None' is appropriate.
3. Guidance on specification of designed concrete can be found in BS 8500─1: 2006, Section 4.3.

Notes related to 6 Permitted cement types

4. The following are not general requirements and only apply if called up in the table of requirements under '6. Permitted cement types':

   Req. 6.1 General

   EITHER:

   Fly ash to BS EN 450-1 in the proportion 30 - 35% by mass of cement (cement type IIB-V)

   OR

   GGBS to BS EN 15167-1 in the proportion 50-55% GGBS by mass of cement (cement type IIIA)

   Req. 6.2.

   EITHER:

   Fly ash to BS EN 450-1 in the proportion 35% by mass of cement (cement type IIB-V)

   OR

   GGBS to BS EN 15167-1 in the proportion 55-60% GGBS by mass of cement (cement type IIIA)

   Req. 6.3 Foundations

   EITHER:

   Fly ash to BS EN 450-1 in the proportion 40% by mass of cement (cement type IVB-V)

   OR

   GGBS to BS EN 15167-1 in the proportion 70-75% GGBS by mass of cement (cement type IIIB)

   Req. 6.5 Precast applications

   EITHER

   Fly ash to BS EN 450-1 in the proportion > 14% by mass of cement (cement type IIA-V or IIB-V)

   OR

   GGBS to BS EN 15167-1 in the proportion >29% GGBS by mass of cement (cement type IIB-S or IIIA)

Notes related to 14 Recycled Aggregates

5. The following are not general requirements and only apply if called up in the table of requirements under '14. Use of RA'.

   Req. 14.1

   RA not permitted. RCA permitted to 20% mass fraction within the limitations of BS 8500-2: 2006.

   Req. 14.2

   RA and RCA not permitted.

P1.8.3 Prescribed concrete

To be in accordance with BS 8500 -2 and BS EN 206–1.

Project values should be entered in the grey panels.

	Requirements	Defaults	Location	Location
1.	Concrete reference		To be completed by the detailed designer during RIBA Stage 4	
2.	Cement type, class and content			
3.	Water/cement ratio			
4.	Consistence Class S1, S2, S3, S4			
5.	Type, category and maximum size of aggregate			
6.	Special requirements for density (for lightweight and heavyweight concrete)	None		
7.	Concrete chloride class or maximum chloride content of aggregate			
8.	Required admixtures - quantity and source of material			
9.	Additional requirements for source of materials	None		
10.	Requirements for proportion of fine aggregate			
11	Special requirements for temperature of fresh concrete	None		
12	Additional technical requirements	None		
13	Use of RCA permitted?	Yes		
	Maximum mass fraction of total coarse aggregate Enter a higher mass fraction of total coarse aggregate, where permitted (Ref. BS 8500–1: 2006, Cl. 4.2.3c)	20%		

Notes

1. All sections of the Specification must be completed before it is passed to the Producer. The person sending the final specification to the Producer must send copies of the document to all other parties (CA, Engineer, Employer) as appropriate who have contributed to the specification.
2. Where 'None' is entered in the table this is a default value to ensure that the Specification is complete. All those involved in completing the Specification need to check if 'None' is appropriate.
3. Guidance on specification of Prescribed concrete can be found in BS 8500─1: 2006, Section 4.4

P1.8.4 Standardised prescribed concrete

To be in accordance with BS 8500 -2 and BS EN 206–1.

Project values should be entered in the grey panels.

	Requirements	Defaults	Location	Location	Location
1.	Concrete reference		To be completed by the detailed designer during RIBA Stage 4		
2.	Designation				
3.	State if concrete is reinforced	Unreinforced			
4.	Maximum aggregate size (mm) Enter 10, 14, 20 or 40	20			
5.	Consistence Class S1, S2, S3, S4				
6.	Restrictions on cement types	None			
7.	Restrictions on aggregate types	None			
8.	Any other special requirements	None			

Notes

1. All sections of the Specification must be completed before it is passed to the Producer. The person sending the final Specification to the Producer must send copies of the document to all other parties (CA, Engineer, Employer as appropriate) who have contributed to the Specification.
2. Where 'None' is entered in the table this is a default to ensure that the Specification is complete. All those involved in completing the Specification need to check if 'None' is appropriate.
3. Guidance on specification of standardised prescribed concrete can be found in BS 8500─1: 2006, Section 4.5.
4. Standardised prescribed concrete produced using sulfate-resisting Portland cement is not intended to produce sulfate-resisting concrete.

P1.8.5 Proprietary concrete

To be in accordance with BS 8500 -2 and BS EN 206–1.

	Requirements	Defaults	Location	Location
1.	Concrete reference		To be completed by the detailed designer during RIBA stage 4	
2.	Strength class			
3.	Exposure class			
4.	State if concrete is reinforced	Reinforced		
5.	Requirement for finishing concrete	See P.1.9		
6.	Any other special requirements, including restrictions on constituents.			
7.	Use of RCA permitted?	Yes		
	Maximum mass fraction of total coarse aggregate. Enter a higher mass fraction of total coarse aggregate, where permitted (Ref. BS 8500–1: 2006, Cl. 4.2.3c)	20%		
8.	Producer to provide confirmation, in accordance with BS 8500–1: 2006, Section 5.2j that concrete complies with the above performance requirements	Yes		
9	Identity strength testing required. (If Yes then details to be added into P1.13 in accordance with BS EN 206 Annex B)			
10	Identity consistence testing required. (If Yes then details to be added into P1.13 in accordance with BS 8500–1 Annex B)			
11	Identity other properties testing required. (If Yes then details to be added into P1.13 in accordance with BS 8500–1 Annex B)			

Notes

1. All sections of the Specification must be completed before it is passed to the Producer. The person sending the final Specification to the Producer must send copies of the document to all other parties (CA, Engineer, Employer as appropriate) who have contributed to the Specification.
2. Guidance on Specification of proprietary concrete can be found in BS 8500─1: 2006, Section 4.6.

P1.9 Surface finishes

Description of surface	Formed	Unformed
Columns & walls with no finishes (or painted)	Special	N/A
Columns & walls with finishes applied	Ordinary	N/A
General insitu slabs with finishes applied	N/A	Ordinary
Exposed soffits of floor slabs	Special	N/A
Plantroom slabs with no finishes	N/A	Plain
External Slabs	N/A	Special

P1.9.1 Reference Panels

The Ordinary and Plain Formed Reference Panels for this project are at:

Use of a Reference Panel as defined by the architect. Requirement for a trial panel which is both cast separately and stored on site to be agreed with the architect in advance of any works. No part of the finished structure shall be used as a trial sample panel unless agreed I writing y the Architect and Client.

P1.9.2 Special finishes

Special Finishes to exposed concrete elements to be agreed in advance with the Architect and Client body.

P1.10 Precast concrete

For requirements for the precast concrete staircases, refer to Appendix A.

P1.11 Prestressed concrete construction

The requirements for the prestressed construction are:

None

P1.11.1 Quality audit

A quality audit carried out by CARES, or equivalent is required. -

P1.11 2 The stressing sequence required:

Location	Requirement
N/A	

P1.11.3 Other prestressing information required

Transfer strength required for stressing, N/mm^2	
Load/extension graphs shall be plotted for at least four points on in-situ trial tendons– list locations	
Definition of a tendon group	
Specific requirements for anchorages	
Specific requirements for tendon coating materials	
Specific requirements for duct materials	
Method of anchorage sealing	
Full scale grouting trials to be carried out	
Documentary evidence of compliance of anchorage	
Vent labeling is required	
Actual position of tendons to be marked on slab soffit to indicate location in both plan and elevation within the slab.	
Special requirements for crack widths	
Other	

P1.12 Deflection allowances

P1.12.1 To be used in calculating formwork pre-camber

Location	Design deflection
N/A	

P1.12.2 Design pre-camber required for precast concrete elements

Location	Design deflection
N/A	

P1.13 Further information

Further information to expand data given in Cl P1.1 to P1.12

Clause ref.	Additional Information
8.1.2.3 Identity Testing	Identity testing for compressive strength shall be performed in accordance with Annex B of EN 206-1: 2000. Sampling shall be at the rate of one sample per 18m3. Conformity shall be judged on the basis of any group of four consecutive results using the criteria in table B.1 of EN 206-1:2000. Each sample should

	consist of 3 no. cubes: 2 for testing at 28 days and 1 spare. Any additional cubes for early strength are at the discretion of the constructor. The constructor shall keep accurate records of all testing and advise the CA of any nonconformity.

SECTION P2 Information to be supplied BY the Constructor

Required at tender stage unless noted, with updated information issued for construction

P2.1 General information

Project contacts

Project name			
Project ref.			
Address:			
Telephone		E-mail	

Constructor

Name				
Address				
Contact Name				
Telephone		E-mail		
SpeCC Registration Required		SpeCC Registration Number		

Designer

Name			
Telephone		E-mail	

Temporary works coordinator

Name			
Telephone		E-mail	

Other specialist contractors to be used by Constructor:

Name			
Telephone		E-mail	

P2.2 Design

Details of any Constructor-designed structure as defined in Table P1.3

P2.3 Drawings and calculations

Details of any proposed variation of values in Cl. P1.4 and other specification changes:

P2.4 Execution management

P2.4.1 Construction planning

An information requirement schedule, based on the construction programme and this Specification is to be issued to the CA within two weeks of Constructor being appointed.

P2.4.2 Other execution management proposals by Constructor:

Details of any other proposals for execution management from the Contractor

P2.5 Materials

Details of any alternative materials, or material sources, proposed by Constructor:

P2.6 Project requirements

Details of any proposals for alternative specification or workmanship from the Constructor:

P2.7 Water-resisting construction

When the Constructor is responsible for the detailed design of water-resisting construction the following materials will be used:

Location	Detail	Waterstops	Separation membranes	Joint fillers
	Manufacturer			
	Material			
Slabs: horizontal construction joints	Type			
Slabs: horizontal movement joints	Type			
Walls :horizontal slab/wall junctions	Type			
Walls: vertical construction joints	Type			
Walls: vertical movement joints	Type			

P2.8 Concrete and concreting

Any proposed concrete specification variations, in addition to the Constructor's input to the tables in section P1.8

P2.9 Further information

Further information to expand data given in sections P2.1 to P2.8

Clause ref.	Additional Information

Appendix A

Precast Concrete Stair Specification

1 Precast Stair Performance Specification

The precast stair flights are to be contractor designed and detailed. The following performance specification is provided as a requirement for its design and is to be read in conjunction with all Architect's and Engineer's drawings and specifications.

1. Unless noted otherwise, unfactored design loads are as follows:

Imposed Loads	4.0kN/m²
Services	0.15kN/m²
Finishes	Loads TBC in conjunction with Architect
SW stairs	9.0kN/m² (Manufacturer to confirm having designed stairs and advise if this load is exceeded)

   Handrail loads to be as Table NA.8, NA to BS EN 1991-1-1:2002.

   Temporary loading during construction to be agreed with the Contractor.

2. Tolerance

   Permissible deviations of the dimension for the precast concrete will be those given in Clause 4.3.1.1 of BS EN 14843:2007.

3. Concrete Quality

Stair	C28/35 minimum
Top	Ordinary
Landings	Suitable to receive finishes (TBC by Architect)
Half Landings	Suitable to receive finishes (TBC by Architect)
Soffit	Special Finish (TBC by Architect)

4. The proprietary stairs are to be designed and detailed by the manufacturer for the imposed loads in note 1 above to achieve stair flights with the deflection characteristics specified in BS EN 1992-1-1:2004.

5. The precast stairs are to be designed and detailed to comply with the requirements of BS EN 1992-1-1:2004 and BS8500 when subject to exposure classes given below:

   XC1

   If a more severe exposure condition is judged by the precast manufacturer to be more appropriate they should allow for this in their design and inform the Contractor and Structural Engineer in writing.

6. Stair flights should be designed to give a minimum of 60mins fire resistance.

7. Details of the flights and landings and associated supports should be detailed by the manufacturer. Connections to the main structure (to walls slabs or beams) are to be designed by the specialist and may be cast-in or post-drilled to suit the specialist. Specialist is to check with the Structural Engineer that these details are acceptable and that loads, etc. have been accommodated in the main structure design.

University of Wales Trinity Saint David
Swansea SA1 Campus Phase 1
Project Concrete Specification

8. The arrangement of the precast units is assumed to be such that the flights span onto transversely spanning precast landing units.

   Any request to change from this arrangement must be made to the Contractor and the Structural Engineer prior to proceeding with an alternative design.

9. Stair flights are to be effectively tied to the main structure to avoid disproportionate collapse. This is expected to be achieved by casting in 'flying' rebar into a structural concrete topping or 'slot' in the primary frame. Details are to be developed and agreed between the Specialist and the Structural Engineer.

Appendix G

Hazard Risk Register

Hazard Risk Register

ARUP

Register reference

Project	University of Wales Trinity Saint David	Job number	246523-00
Package /Topic	Civil and Structures	Design stage	Stage 3

Remember: Avoid – Reduce – Control and Communicate relevant information to others

Date (+initials)	Area/Location of Risk Exposure	Description of Hazard and Risk Exposure	Mitigation of Risk (Potential or Achieved)	A	R	C	Further Action	By	Status Active / Closed
Feb 16 EM	Site Wide - Substructures	Obstructions in the ground as a result of remaining old structures such as the dock wall.	A pre-commencement survey should be carried out to determine the extent of existing structures.		✓	✓		PC	
Feb 16 EM	Site Wide – Substructure	Damage to existing services during piling and excavation.	Existing services to be identified and recorded. Excavations to be hand dug where necessary following relevant advice from utilities. Diversions may be required.		✓		Existing services to be identified and co-ordinated with the new works. Possible damage to buried and existing services are to be assessed and protection / diversions provided as necessary.	PC	
Feb 16 EM	Site Wide - Substructures	Possible presence of asbestos and contamination in made ground.	Complete site geo-environmental and asbestos survey.			✓	Ground Investigation report to be completed and Ge-environmental assessment to be undertaken by specialist.	PC	
Feb 16 EM	FACE building and Library – Substructure	Pile caps loaded before ground floor slab is cast to provide lateral restraint	Note to be added onto the structural drawing to communicate the assumption.			✓	PC/Sub to develop suitable method of working and provide temporary bracing if required.	PC	
Feb 16 EM	Site Wide – Ground levels	Risk of vehicles hitting structure.	Provide suitable protection where possible. If not, structure to be designed to resist impact.	✓	✓		Stage 4 designer to review in detail with client and design team.	PC	
Feb 16 EM	TECH Building	Risk of vehicles hitting structure.	Provide suitable protection where possible. If not, structure to be designed to resist impact.	✓	✓	✓	Bollards to be provided at column positions in the automotive area and in service yard to protect building perimeter.	PC+ Architect	
Feb 16 EM	Site Wide	Storage of materials; overloading of permanent works.	Loading to be maintained within design loads.	✓				PC	

Hazard Risk Register

Register reference

Project	University of Wales Trinity Saint David	Job number	246523-00
Package /Topic	Civil and Structures	Design stage	Stage 3

Remember: Avoid – Reduce – Control and Communicate relevant information to others

Date (+initials)	Area/Location of Risk Exposure	Description of Hazard and Risk Exposure	Mitigation of Risk (Potential or Achieved)	A	R	C	Further Action	By	Status Active / Closed
Feb 16 EM	Site Wide – Facades	Attaching/erecting cladding to frame at height.	Consider fixing methodology to minimise risk		✓		Review with Architect and supplier to design safe system	All	
Feb 16 EM	Site Wide – Structural Steel Frame	Lateral stability - Unstable structure/ Collapse.	Permanent bracing is to be installed as frame is erected or temporary bracing is required.		✓	✓	PC/Sub to develop suitable method of working and provide temporary bracing if required.	PC	
Feb 16 EM	Site Wide – Structural Steel Frame	Lateral stability – In-plane stability of the structural deck. Unstable structure/ Collapse.	Slab to be installed as frame is erected or temporary bracing is required.		✓	✓	PC/Sub to develop suitable method of working and provide temporary bracing if required.	PC	
Feb 16 EM	Site Wide – Structural Steel Frame	Fire and corrosion protection to steelwork.	Protected systems to be specified.	✓	✓			PC	
Feb 16 EM	Site Wide	Working at height.	Ensure use of nets pre-fixed barriers and safe access methods.		✓			PC	
Feb 16 EM	Site Wide	Working adjacent to the docks.	Methods of working to be considerate of adjacent dock walls to minimise damage and prevent collapse.			✓	Dock wall condition survey and monitoring by PC throughout works.	PC	
Feb 16 EM	Site Wide	Working adjacent to deep watercourse - Potential for contamination from adjacent works,	PC to enable appropriate site measures to minimise risk.			✓		PC	
Feb 16 EM	Site Wide	Working adjacent to deep watercourse -drowning etc.	Appropriate guarding, life buoys and safety boats if necessary.			✓		PC	
Feb 16 JS	Site Wide	Working in below ground excavations during groundworks phase. Ground could become unstable during works potentially during heavy rainfall causing movement or collapse for both embankments and trenches.	Ensure all groundworks are properly installed and supported and that particular care is taken during periods of heavy rainfall.		✓	✓	Inspections and monitor by PC during works	PC	

Hazard Risk Register

Register reference

Project	University of Wales Trinity Saint David	Job number	246523-00
Package /Topic	Civil and Structures	Design stage	Stage 3

Remember: Avoid – Reduce – Control and Communicate relevant information to others

Date (+initials)	Area/Location of Risk Exposure	Description of Hazard and Risk Exposure	Mitigation of Risk (Potential or Achieved)	A	R	C	Further Action	By	Status Active / Closed
Feb 16 JS	Site Wide	Working at or below water table. Some works may be necessary within the water table. During periods of rainfall water could rise rapidly causing drowning.	Care should be taken that adequate emergency exit is installed prior to entering excavations below the water table and that ground water levels are constantly monitored, especially during heavy rainfall.		✓	✓	Inspections and monitor by PC during works	PC	
Feb 16 JS	Site Wide	Installation of surface water drainage. Due to its nature surface water drainage may be quickly flooded during rainfall causing flooding to the site or drowning.	Water levels should be monitored, especially during rainfall and a mitigation plan be in place during the installation of the system.		✓	✓	Monitor by PC during works	PC	