

planning addendum

Rylands Building, Manchester
CD9 Properties

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 Client: CD9 Properties
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1.0 introduction

This planning addendum provides an overview of the impacts of proposed planning alterations for the Rylands Building in Manchester, including compressing floor zones.

The addendum discusses design changes generally as well as providing an overview of the Slim-Floor option utilising pre-cast Hollowcore planks or deep composite slabs by employing the use of ASB and UC sections with plates welded to the bottom flanges. The intended purpose of proposed flooring system options is to reduce the structural zone for the roof extension at the Rylands Building in Manchester. The floor zones are reviewed in section 4.0.

This study is preliminary only to establish the feasibility of reducing the floor-floor heights on the rooftop extension and should be considered along with assessments by the rest of the design team.

2.0 design assumptions

Throughout RIBA Stage 2 up to planning, considered assumptions have been employed for the design of the rooftop extension at the Rylands Building. These assumptions impact the viability of implementing a compressed floor zone, and are therefore listed below:

- All unitised glazing for the roof extension is top-hung, with a local absolute deflection limit of 10 mm applied to façade-supporting beams.
- All permanent and imposed loading for the rooftop office, including terraced areas and photovoltaic panels to the monopitch roof, is as per the loading diagrams in appendix a.
- Plant extents at eleventh is as per the current JBA planning addendum drawings and weights are the same as issued by Max Fordham at RIBA Stage 2.
- The extents of roof which is not a plant deck is to be of lightweight construction, as outlines in the loading diagrams in appendix a.

3.0 design changes

The headline revisions for Rylands Building in Manchester are listed below:

- Core massing.
- M&E plant locations.
- Compressed floor to floor.
- Cladding amendments.

The headlines are discussed in more detail in the following sections.

3.1 core massing

To reduce core massing, core one has been 'pushed' away from High Street and Bridgewater Place. The reduced massing is evident from the updated CGIs.

As a result of the reduced massing, the proposed steel CHS columns to the left of core one as positioned off grid. To prevent the columns punching through the existing roof slab at level 7, a deeper transfer slab may be introduced locally to the lobby area.

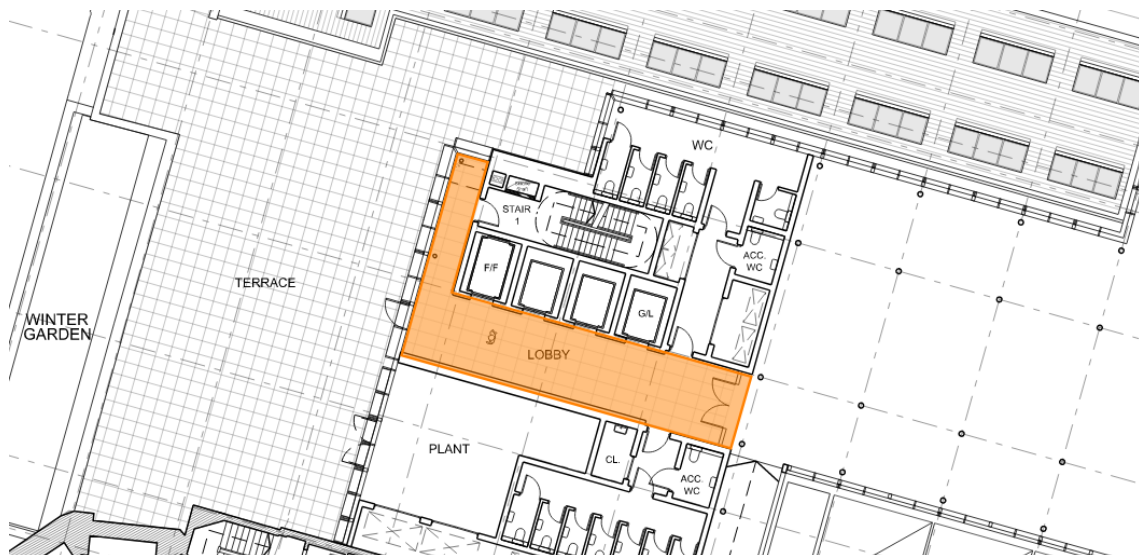


Figure 1: Transfer Slab

As core one is being formed as a new core, the deeper transfer slab – shaded in orange in Figure 1 – may be formed as part of the new core and should not affect the overall building height.

3.2 m&e plant locations

Due to the replanning of the core areas from level 7 through 10, there have also been modifications to the locations of proposed plant. Namely, plant originally located at level 7 has been relocated to the new uppermost roof plant demise.

To accommodate the increased plant at roof level, the demise has increased as shown in cyan in Figure 2.



Figure 2: Roof Plant

No additional information has been identified for the weight of the plant at roof level, it is assumed to not exceed the imposed loading as defined by class E213 in Eurocode 1.

It is worth noting that an allowance has been made for the weight of photovoltaic panels have been added to the monopitch roof. The increased loading from the panels has been captured by Woolgar Hunter in the planning addendum.

3.3 compressed floor to floor

The compressed floor to floor zones are covered in section 4.0.

3.4 cladding

On the planning addendum CGIs for the Rylands Building, the cladding around the core has been altered from stone to glazing as a continuation of the unitised system used elsewhere. There is also a portion of overcladding, which is understood to likely be metal. It is assumed that the loading and deflection criteria for the cladding around the core is no more onerous than elsewhere on the rooftop extension.

4.0 floor zones

4.1 level 7

Woolgar Hunter's structural planning report detailed three potential scenarios for the office floor zone at level 7. The three scenarios for the existing roof structure are:

- Scenario 1: The existing concrete slab and existing structural beams are found to be adequate, the existing structure may be reused.
- Scenario 2: The existing concrete slab is found to be inadequate, but the existing structural beams are able to be reused. In this instance, an over-roofing solution was proposed to be employed which would bear onto the existing concrete at existing beam locations.
- Scenario 3: The existing structural beams are found to be inadequate. In this instance, strengthening would be required and the 500 mm floor zone at level 7 would have to be reviewed.

The previously proposed floor zone is depicted in Figure 3.

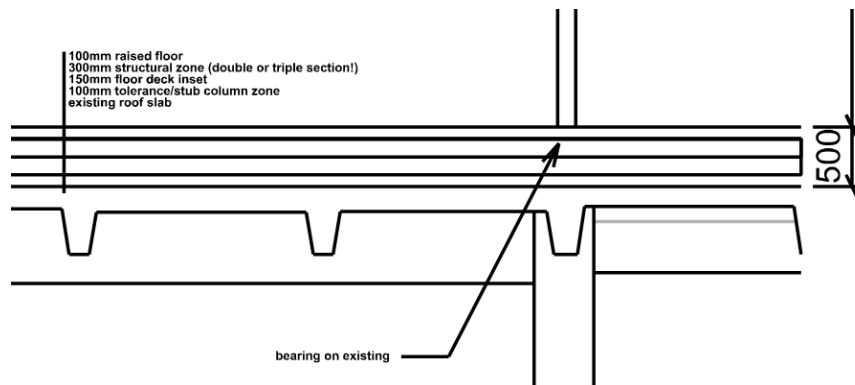


Figure 3: Original Planning Level 7 Zone (JBA Stage 2 Floor Zone Study)

The current proposed floor zone at level 7, is approximately 450 mm – including structural zone – which is shown in Figure 4.

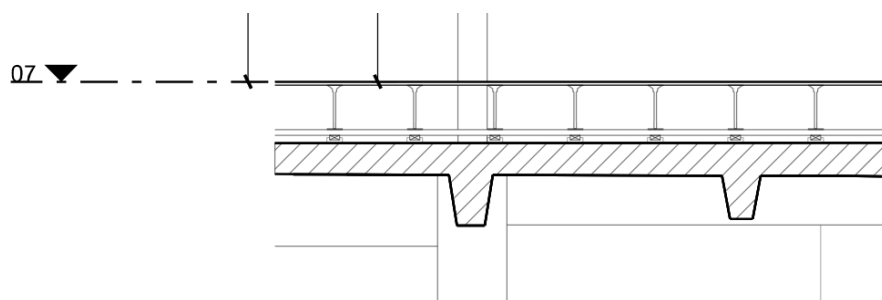


Figure 4: Planning Addendum Level 7 Zone (JBA Planning Addendum Drawings)

The three potential scenarios described above are still applicable until intrusive investigations have been undertaken at level 7. As such, the raised access floor at level 7 would have to be compressed to make a structural zone available. In the instance that the raised access floor was reduced to 100 mm – as previously shown – the over-roofing solution would be achieved

within the remaining structural zone. The electrical service distribution would have to be developed to be suitable for a 100 mm raised access floor.

4.2 level 8 to 11 (typical)

4.2.1 original planning zones

At level 8 to 11, the previous floor zone followed the following typical arrangement shown in Figure 5. The majority of the floor plates comprised a 415 mm structural UB zone, with a composite deck above, and services passing beneath the UBs. Where longer span beams were required – or deflections of the unitised system were critical – a 610 UB was utilised with cells for service distribution.

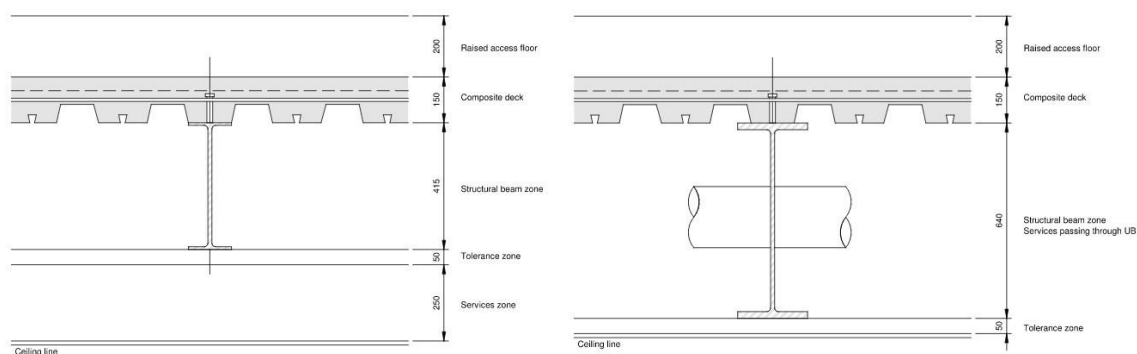


Figure 5: Original Planning Level 8-11 Zone (WH Stage 2 Drawings)

Both scenarios shown in Figure 5 conformed to the previous total floor zone of 1,100 mm. By compressing the overall height of the roof extension, the floor zones require the use of a Slim-Floor system. The current floor zone, which would employ a Slim-Floor system, with the initial conceptual zoning, is shown below in Figure 6.

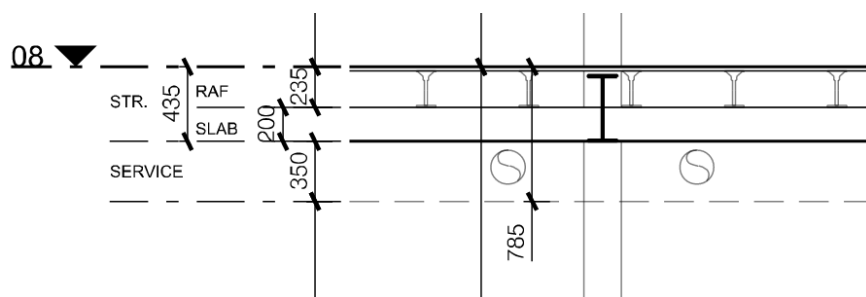


Figure 6: Planning Addendum Level 8-11 Zone (JBA Planning Addendum Drawings)

While the compressed structural zone at level 11 is the same as level 8-10, the imposed loading – due to plant – is larger than a typical office floor. The extents of the plant at upper roof level has been increased following feedback from the planners by some plant being relocated from level 7 to level 11, as already depicted in Figure 2.

Applying a Slim-Floor system to the rooftop extension at the Rylands Building has a series of design implications, which are described in the following sections.

4.3 slim-floor options

4.3.1 option one – hollowcore

An initial feasibility study has been undertaken based on a pre-cast Slim-Floor system using pre-cast planks spanning between steel beams. The manufacturer referenced for the Slim-Floor option is Bison, with their product denoted Hollowcore. Alternative deck options are noted in section 4.3.2 and 4.3.3 below.

An increased span is possible with Hollowcore compared to the current composite deck being used. The increased span allows for the removal of a number of intermediate beams. It should be noted that while composite action is utilised with the original proposed decking, it is not applicable to the Hollowcore described in this planning addendum, thus making the steelwork design less efficient.

Whilst intermediate beams may be removed to accommodate the longer span, the Slim-Floor system makes use of Asymmetric Beams (ASBs) or UCs with plates shop welded to the underside of the bottom flange – shown in Figure 7 – to provide a bearing for the slab system. This is likely to impact the cost, as noted in the discussion below.

The Hollowcore product shown below is the 200 mm plank, which is suitable for the 2 hour fire period for the proposed roof extension. The exposed steelwork (bottom flange plus upper portion of the web and top flange) of the Slim-Floor beams would require fire protection to protect the steelwork and prevent the beam acting as a thermal fin through the compartment floors in the event of a fire. Alternatively, the top section of the steel beam would require to be encased in concrete. Further input is required from the fire engineer to advise on this detail, which may affect the overall structural zone. As the ASBs require 2 hour fire resistance, suspension reinforcement may be required be bent over the steel section and embedded within the cores at a minimum distance of 600 mm from the ends of the units (SCI P342). While the planks are delivered to site dry, the wet ends and tying of the reinforcement will add time and cost to the programme, this is subject to design development and assessment by the fire engineer.

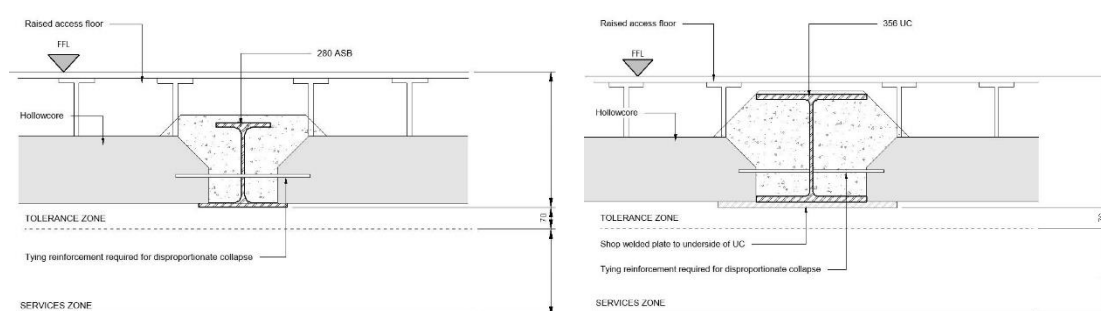


Figure 7: ASB and UC with Plate

It is noted that the current proposed Hollowcore slab will not have a screed topping. As such, an assessment will need to be undertaken by the acoustician with regards performance.

4.3.2 option two – composite

A deep composite deck (metal tray with concrete poured in situ) would be similar to the current composite deck proposals but with deeper troughs to enable a longer span. A deeper deck would be preferred to span between the primary steels and integrated within the deeper structural zones which could be equal to the ASB depth. This would have advantages in reducing the crane hook time and lifting issues associated with the pre-cast option. The visual

impact of the deep troughs in the soffit would need to be considered. A composite option would result in a deeper slab requirement, generally 320 mm for a 280 ASB and 356 SFB, with the raised access floor sitting above – versus the raised access floor sitting over the 200 mm pre-cast.

The manufacturer referenced for the Slim-Floor composite deck option is Tata, with the product denoted as ComFlor. Figure 8 and Figure 9 depict the two scenarios for the anticipated floor zones with a 280 ASB and 356 SFB.

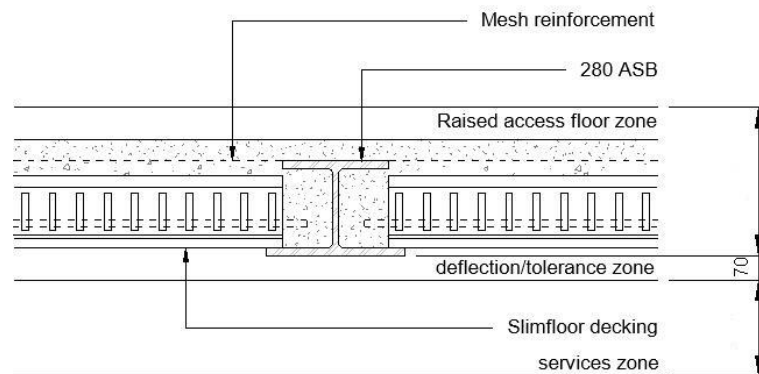


Figure 8: Slim-Floor 280 ASB

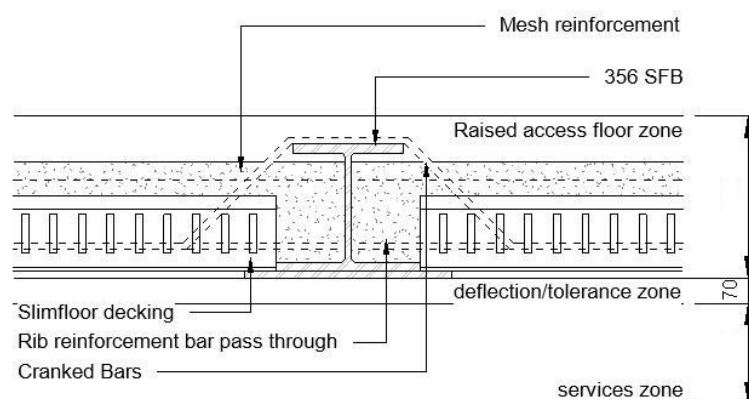


Figure 9: Slim-Floor 356 SFB

While the maximum structural zone for the two options will be the same (pinch points over the top of the ASB/ UC locations for services distributed though raised access floor), the structural zone for the rest of the floor plate will be greater than the Hollowcore as the required deck thickness is 320 mm for a composite decking to achieve a 2 hour fire period.

Cellform ASBs have not been considered at this stage, given the cost and coordination required, but may provide an opportunity to run some services within the structural zone to avoid the M&E zone being dictates by the cross-over requirements but this may present further additional costs and complexity with regards to the fire modelling.

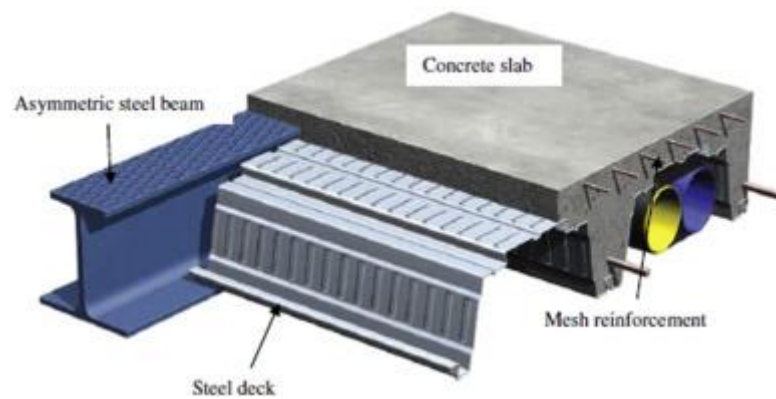


Figure 10: Deep Composite Deck

Additionally, the uplift in weight of the composite deck, compared to the Hollowcore solution, would require heavier steel beam sections compared to the Hollowcore solution, which will subsequently impact the extents of existing column enhancement and foundation interventions.

The details shown above are indicative and the degree of cover to the top flange and concrete encasement is to be advised by the fire engineer.

4.3.3 option three – alternative floor constructions

A third alternative would be to consider a joisted floor system either in steel or timber. This could be a relatively lightweight solution, overcoming some of the issues noted above. It is expected that a fire rated soffit would be required in order to achieve the 2 hour resistance, which will add to the costs of this option and potentially greater acoustic treatment.

A mass timber (e.g. CLT) floor slab panel could also be considered supported on the bottom flange of the steel beams. Further discussion with the cost consultant would be required in the first instance to determine whether this is a viable option.

The implementation of CLT would require considerable design development from a vibration, fire, and cladding perspective but may offer a lightweight solution with reduced embodied carbon compared to the concrete options 1 and 2 although there are challenges noted with material availability, considerable cost uplifts, and design that sits outside of current design code limitations.

4.4 discussion

Table 1 provides a summary overview of the primary points for consideration for the current composite deck versus the proposed options. Further detail on these items is given in the section below.

Option	Required Structural Zone	Fire	Disproportionate Collapse	Steelwork Rate	Buildability	Enhancement to Existing Columns/ Foundations
Original Composite	830 mm (see previous scheme). ^{NOTE 1}	Intumescent to all beams.	Floor plate tied together using current composite deck.	100%	As per previous reports.	As per previous reports.
Option One Pre-cast Slim-Floor	480 mm (see Figure 11). ^{NOTE 1}	Intumescent to all beams and fire boarding. ^{NOTE 2}	ASBs/ UCs drilled to pass bars through to achieve tying.	150%	Significant additional crane time to lift individual planks.	Increased enhancement extents compared to original composite.
Option Two – Composite Deck Slim-Floor	480 mm (see Figure 12). ^{NOTE 1}	Intumescent to all beams and fire boarding. ^{NOTE 2}	ASBs/ UCs drilled to pass bars through to achieve tying.	175%	Some additional crane time.	Increased enhancement extents compared to original composite and option one.
Note 1: This structural zone is based on the steel only (including deflection and tolerances) and does not account for fire protection (painted, sprayed or concrete) above or below the steelwork. Note 2: Subject to fire engineer's detailed modelling.						

Table 1: Option Comparison



Woolgar Hunter understand that the 350 mm services zone is comprised of a 250mm services zone and a combined 100 mm tolerance and deflection zone. For structural deflections and tolerances 70 mm of the 100 mm is required. As such, the total available structural zone from the co-ordinated floor section – including the 70 mm structural deflections and tolerances is 505 mm, current proposals show an anticipated structural zone requirement of 480 mm this leaves a small margin for design development as the team enter RIBA Stage 3. Figure 11 and Figure 12 show the dimensions of the structural elements used for the Hollowcore option and deep composite option.

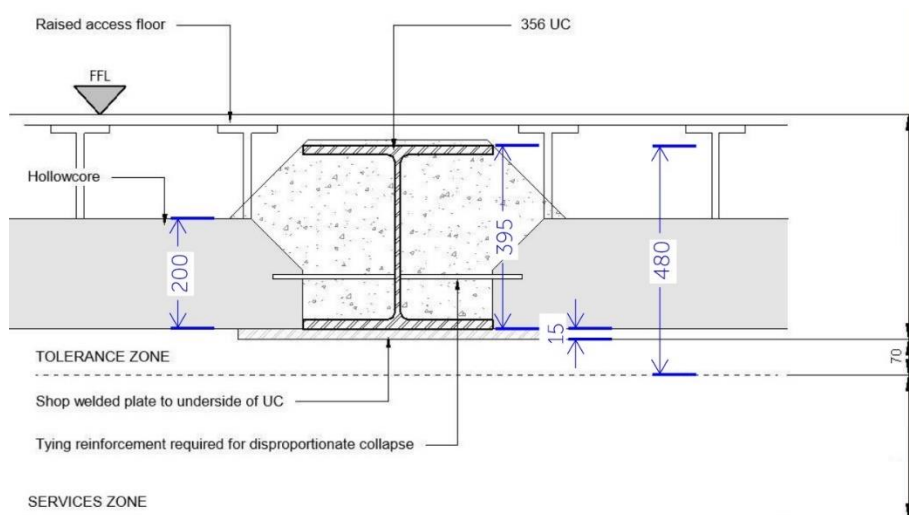


Figure 11: Hollowcore Structural Zone

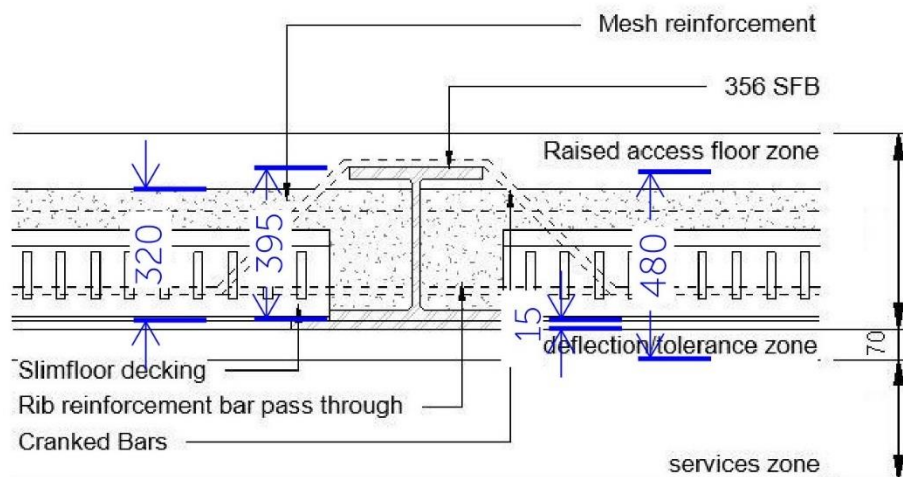


Figure 12: Deep Composite Structural Zone

Refer to architect's and M&E engineer's details for raised access floor zones and services zones.

4.4.1 steel tonnage

The pre-cast floor system gives a shallower structural zone versus the current composite deck system. However, to maintain similar strength and stiffness properties in a shallower profile and

with loss of composite action, the steel sections in Figure 7 will be significantly heavier per linear metre compared to the proposals originally submitted for planning.

As such, a comparison must be made between the current floor plates and the proposed floor plates with ASBs/ UCs with intermediate beams removed. Analysis of the floor plates indicates a ~50% uplift in the tonnage for steel per square metre (originally allowed 75 kg/m² in the original planning application design). This, as well as the non-standard sections, would be expected to significantly impact the steelwork costs.

The Hollowcore slab is also slightly heavier than the 150 mm composite metal deck. The overall increase in floor self-weight (steelwork plus slab) is approximately 0.7 kN/m². Due to the uplift in weight of the floor, this may affect the number of existing columns below requiring strengthening as well as the enhancement of the foundations. The extent of additional enhancement will require to be investigated further if this option is to be progressed.

While the Hollowcore may be suitable for the regular office grid arrangement, there are considerations to be made at glazing interfaces – especially regarding deflection. As the deflection must be strictly limited for the unitised glazing system, pushing the structure into the same depth as the typical floor ASB is unlikely to be economical. To avoid a downstand, it may be preferred to maintain the same UB section as currently proposed but aligning with the ASB soffit level. This will require further development to ensure restraint is provided to the top flange of the UB to prevent instability. Where doorways are required to open out onto the terrace areas, heavier UCs with thick plates will have to be utilised to prevent the UB upstand clashing with the opening.

4.4.2 vibration sensitivity

Footfall analysis was undertaken during Stage 2 for the floor plates of the office to determine its sensitivity to excitation due to footfall. Modifying the floor plate construction will change the sensitivity of the floor plates to footfall, which means this analysis should be undertaken again. Any additional mass required to control vibration response will have a follow on impact on column and foundation enhancement to the existing structure below. This analysis has not been undertaken at this stage and therefore allowance should be made for vibration reducing measures – either through increased mass (affecting vertical structure) or active damping devices on the floorplate.

4.4.3 buildability

As noted, the linear weights of the ASBs/ UCs with plates creates a significant uplift in the weight of single beams to be lifted for the roof extension. The pre-cast decks are also heavier than craning composite deck packs up the roof, with more square metres of decking being placed per lift for the composite decking.

Due to the height and reach required to lift elements to the roof extension, the maximum weight of single structural elements may be limited by the selected contractor. Contractor involvement will be required to determine a suitable lifting location as well as to note the weight limitations of any proposed steelwork and/ or pre-cast planks. As each pre-cast deck element needs to be lifted individually the crane hook time will be significantly increased for the Slim-Floor pre-cast Hollowcore option versus the current composite deck option. This is likely to affect the programme for the structure of the extension. However, the steelwork piece count for the Slim-Floor options is reduced versus the current composite option, so this additional hook time may be partially offset.

Additional considerations for the floor plates include the routing of electrical services, which will be impeded by the ASBs/ UCs, within the raised access floor. Moreover, the ASBs/ UCs will

need to be drilled to pass bars through to develop tying action for disproportionate collapse, as well as casting wet ends. Again, this will impact the programme time for the option.

A structural tolerance and deflection zone of 70 mm should be allowed for within the floor zones to enable the beams to deflect and be constructed without fouling the services zone.

4.5 conclusion

4.5.1 level 07

The zone shown on the JBA planning addendum section (Figure 4) is acceptable on the basis that the existing roof structure has sufficient capacity to carry the new loading. If the existing structure requires strengthening this would be done above slab and the raised access floor zone would reduce to 100 mm including finishes. The remainder of the zone allowance would be required for the over-roofing solution.

4.5.2 level 08-11

Both the precast and composite deck options noted above fit within the overall 505 mm structural zone (435 mm plus 70 mm), which includes structural deflection and tolerances, subject to confirmation from the fire engineer. Based on the matrix shown in Table 1 above, the pre-cast Hollowcore option is proposed as the preferred solution.

There will be significant cost premiums associated with adopting a compressed structural zone flooring solution, such as a 50% increase in steelwork tonnage, slower construction periods, increased fabrication/ man hours for producing the structural sections, complex fire detailing and an increased number of existing columns requiring enhancement. These penalties are likely to negatively impact the overall cost estimate and increase the overall project costs.

4.6 final comments

The use of Hollowcore is a structurally viable option to compress the overall height of the building, while maintaining the four storeys of roof extension. However, it must be noted this is only a high-level overview into the option and extensive design development will be required to fully assess its feasibility as a flooring solution and fully co-ordinate with the other disciplines. Additionally, there is a financial cost premium associated with the change in flooring solution, such as fabrication/ man hours for producing the structural sections, as well as an increased number of existing columns requiring enhancement throughout the existing building. These penalties are likely to negatively impact the budget.

5.0 next steps

This planning addendum has described an overview into Slim-Floor options for the proposed roof extension at the Rylands Building to validate the structural zone allowed in the overall build ups. Following on from the addendum, the next steps to develop the design are detailed below:

- Fire protection strategy and impact on structure and raised floor zone to be confirmed.
- High level review of impact of these changes on other disciplines and costing.
- Determine impact of flooring solution on number of existing columns requiring enhancement.
- Determine impact of flooring solution on the extents of foundation enhancement and new foundations.
- Develop full floor plate of reduced zone flooring solution, as this planning addendum only addresses typical bays and select threshold/ glazing details.
- Undertake initial footfall analysis for the proposed option to determine its sensitivity to excitation from footfall.
- Understand impact of crane hook time relating to composite flooring solution compared to pre-cast flooring solution (contractor/ PM input required).
- Determine whether upstand UBs will be viable and compatible with glazing system in order to reduce overall steel weights.
- Determine impact of electrical services distribution through raised access floor.
- Determine requirements of fire protection after fire engineer's detailed modelling.

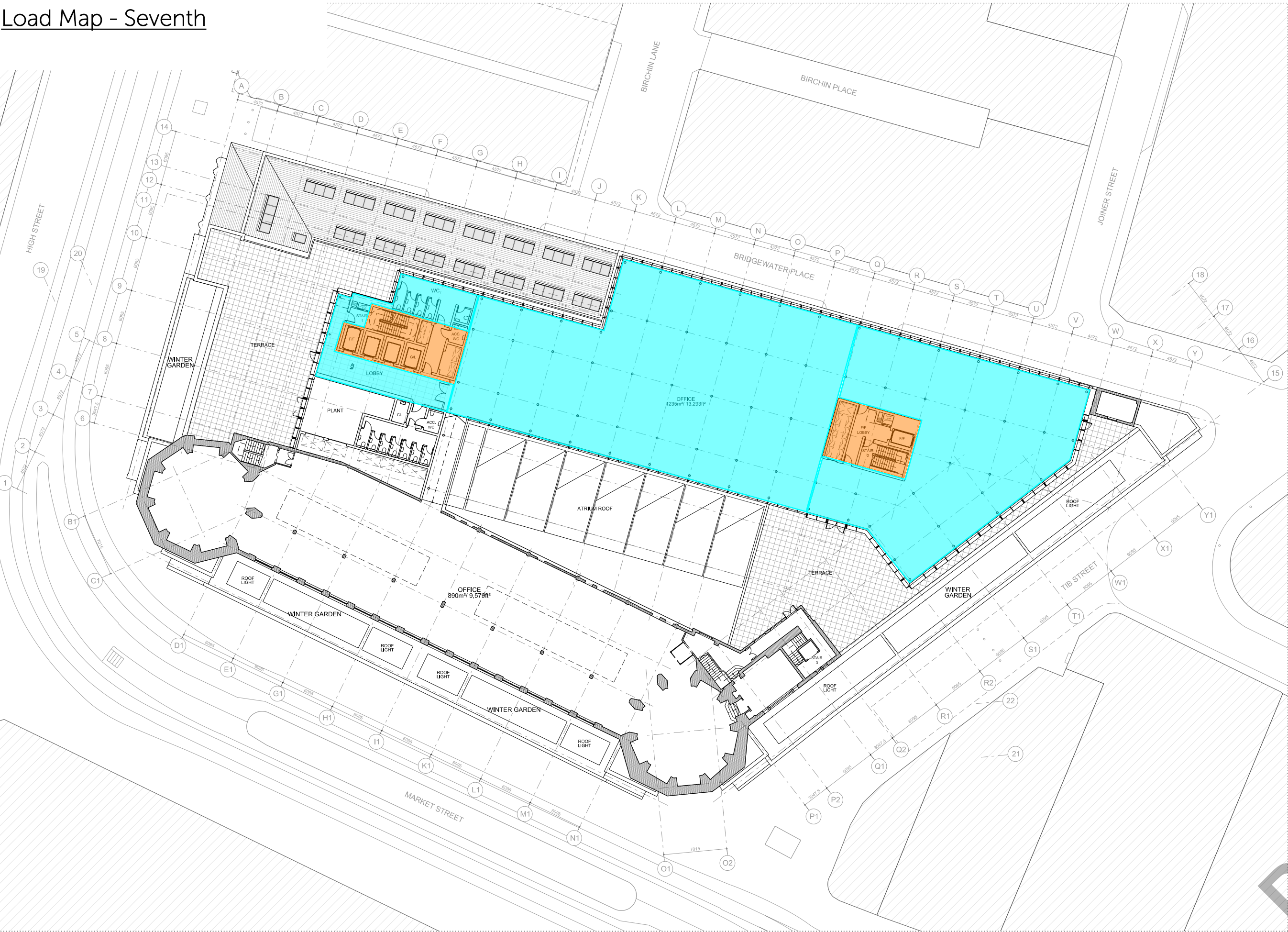
6.0 risks/ impact

The planning addendum has covered a variety of design and construction implications related to altering the flooring system from current composite deck to one of the proposed options. The headline risks and impacts are listed below.

- Confirmation of overall zone including fire protection remains a risk pending input from the fire consultant.
- Confirmation that the movement and tolerance zone as indicated by Woolgar Hunter previously can be accommodated within the MEP zone is required. If not, this will impact the overall floor zone by up to 70 mm.
- Confirmation that the above slab MEP distribution is able to fit between top of steel (or top of fire protection if required) and underside of raised floor is required. If not, the raised floor zone will require to increase, or openings will be required through the Slim-Floor beams which introduces additional cost and complexity.
- Heavier extension frame due to the ASBs/ UCs, which will impact the extents of the existing column enhancement as well as foundation interventions – both enhancement of existing and proposed. Risk of the increased level of strengthening not being feasible within budget.
- Limited time has been available for this validation review. Detailed assessment of full floorplate including vibration response assessment may result in areas which require heavier/ bespoke steelwork or deeper beams.
- Slower craneage for lifting individual pre-cast planks compared to composite deck pans which can be lifted in bulk.
- Longer programme to build the extension, which is related to the slower craneage.
- Complex connections of the ASBs/ UCs.
- Programme and cost impacts of drilling of ASBs/ UCs and tying of Hollowcore or composite deck to achieve disproportionate collapse requirements to be assessed by cost consultant.
- Drilling of ASBs/ UCs and tying of Hollowcore or composite deck to achieve disproportionate collapse requirements.
- Complex fire and acoustic detailing requires modelling from the specialist.

appendix a
floor loading

Load Map - Seventh



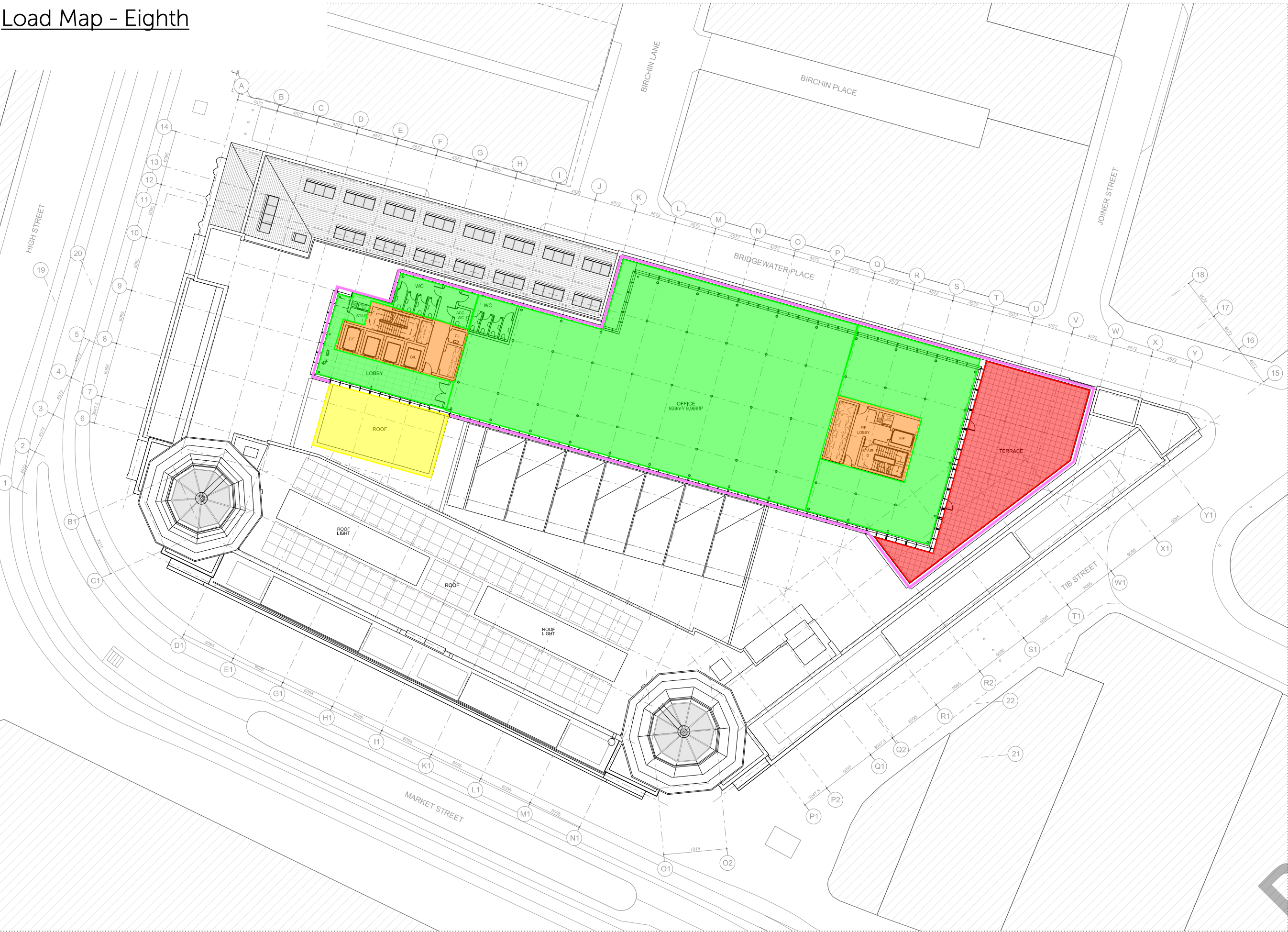
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Live Load = 2.50 + 1.00 kN/m²
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Live Load = 4.00 kN/m²
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Live Load = 4.00 kN/m²
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ISSUE FOR PLANNING DOCUMENT						

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Load Map - Eighth



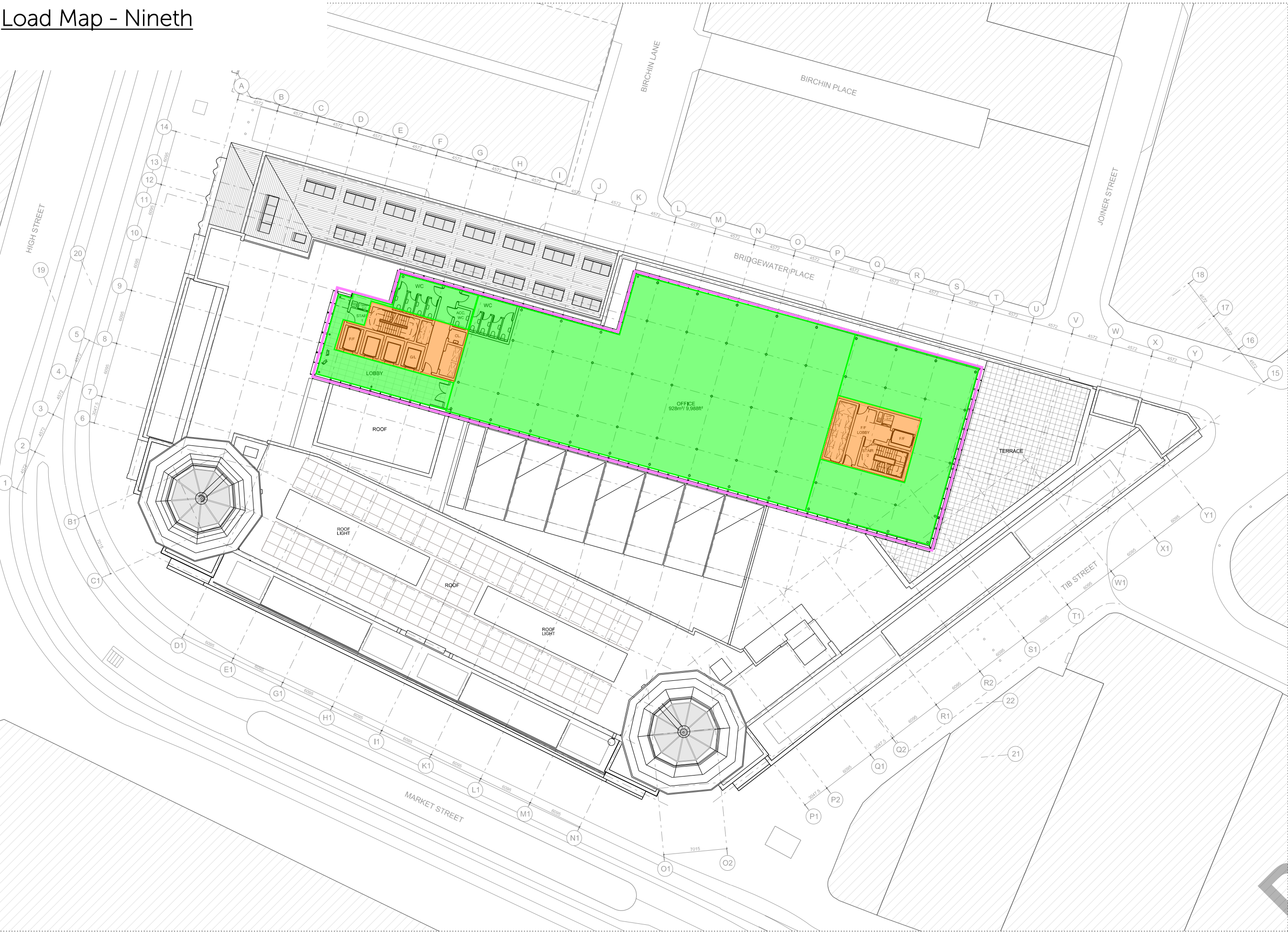
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Load Map - Ninth



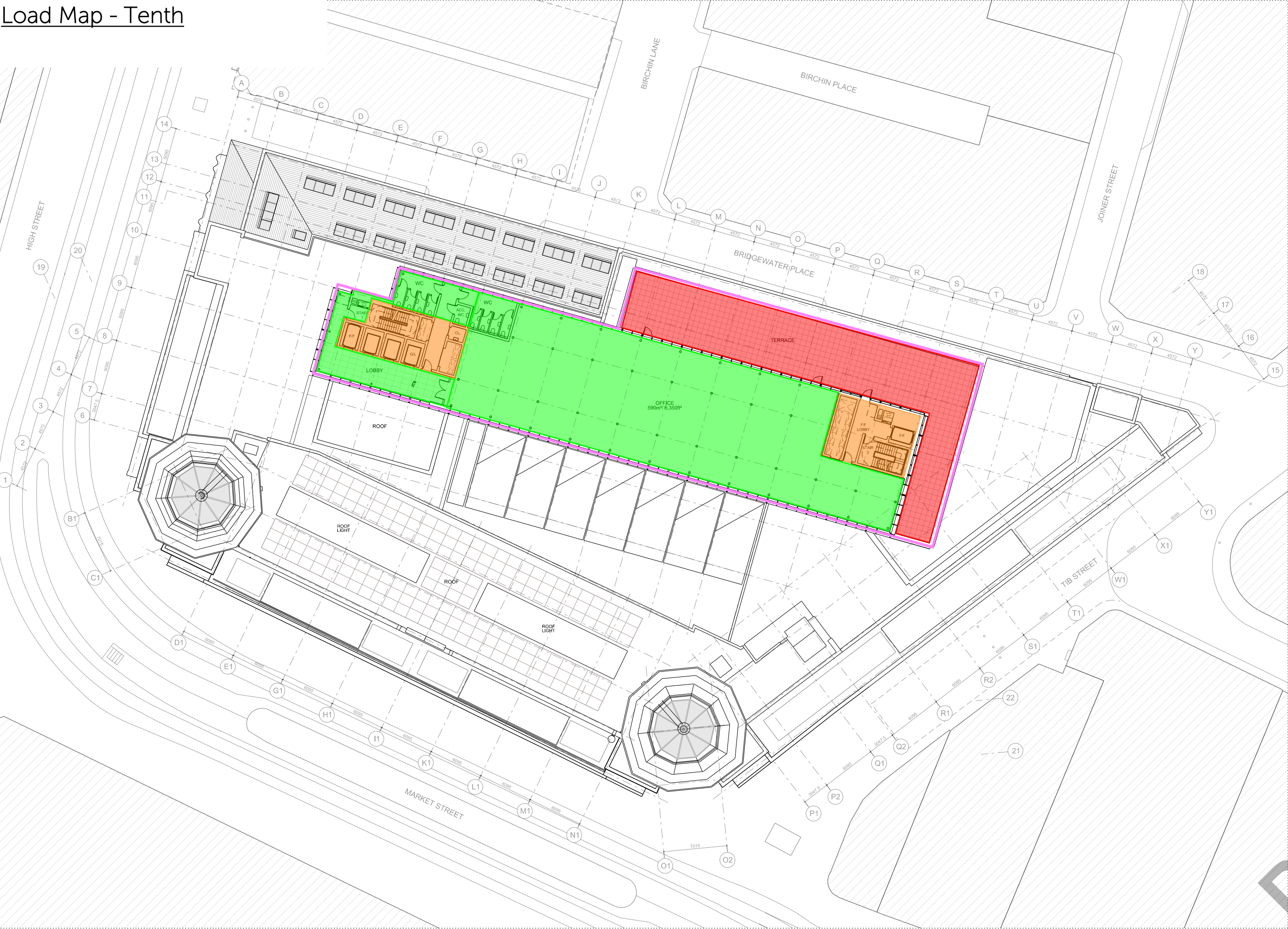
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Load Map - Tenth



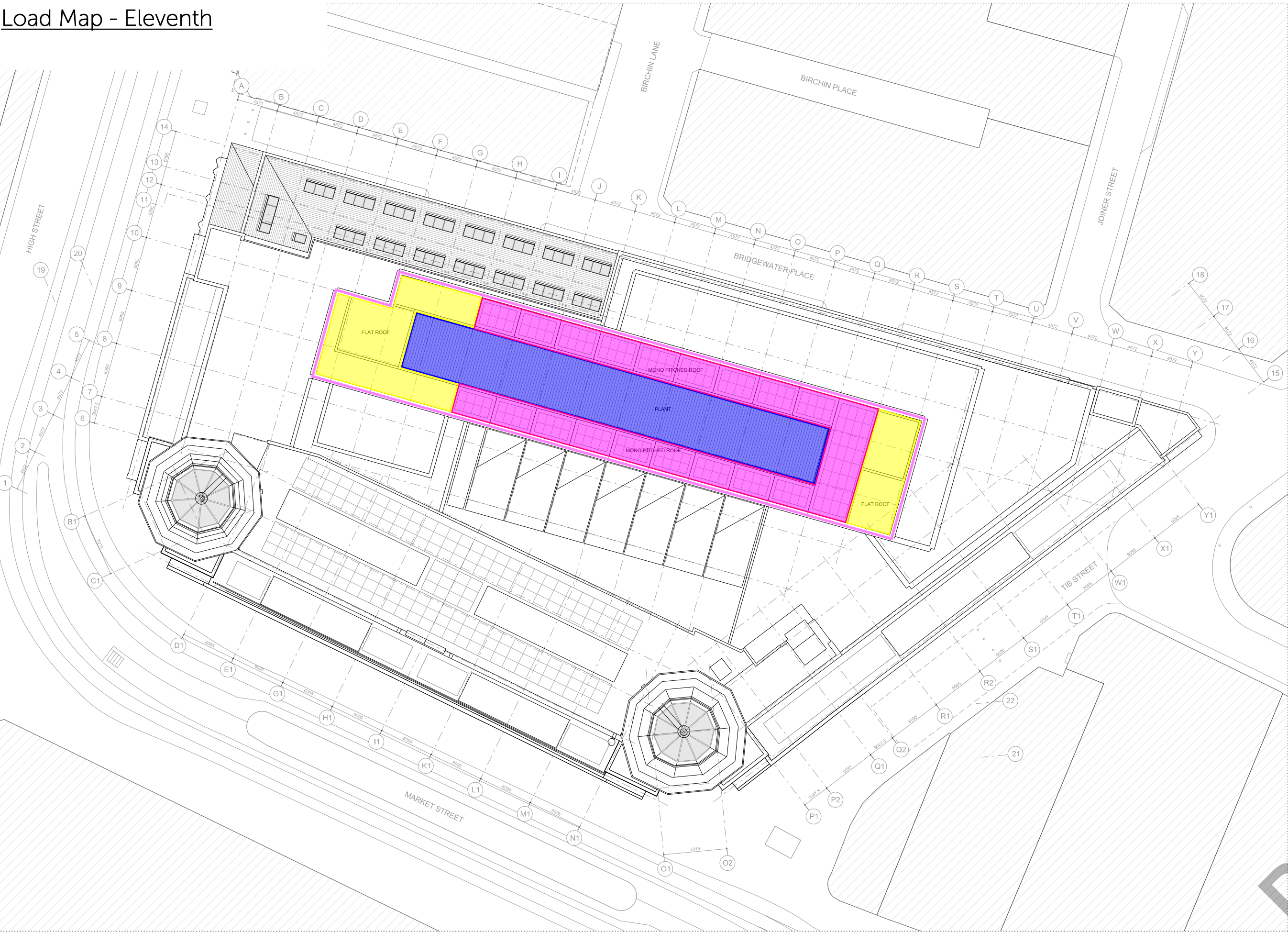
- Key**
- Slim Floor self-weight = 3 kN/m²
Dead load = 0.90 kN/m²
Live Load = 2.50 + 1.00 kN/m²
 - Slim Floor self-weight = 3 kN/m²
Dead load = 2.40 kN/m²
Live Load = 4.00 kN/m²
 - Reinforced concrete core construction
Live Load = 4.00 kN/m²
 - Dead load = 1.25 kN/m²
Live Load = 0.75 kN/m²
 - Slim Floor self-weight = 3 kN/m²
Dead load = 0.70 kN/m²
Live Load = 0.75 kN/m²
 - Slim Floor self-weight = 3 kN/m²
Dead load = 2.40 kN/m²
Live Load = 5.75 kN/m²
 - Dead load = 2.50 kN/m²
Live Load = 1.5 kN/m²
 - Dead load = 0.55 kN/m²
Live load = 2.50 + 1.00 kN/m²
 - Dead load = 1.25 kN/m²

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PROJECT RYLANDS BUILDING, MANCHESTER						
CLIENT CD9 PROPERTIES (MANCHESTER) LTD						
TITLE PROPOSED PLAN TENTH FLOOR						
SCALE 1:200@A1 1:400@A3				DATE AUG 2020		
JOB No 1526		DWG No AL[05]223		REV *		
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Load Map - Eleventh



- Key**
- Slim Floor self-weight = 3 kN/m²
Dead load = 0.90 kN/m²
Live Load = 2.50 + 1.00 kN/m²
 - Slim Floor self-weight = 3 kN/m²
Dead load = 2.40 kN/m²
Live Load = 4.00 kN/m²
 - Reinforced concrete core construction
Live Load = 4.00 kN/m²
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Dead load = 0.70 kN/m²
Live Load = 0.75 kN/m²
 - Slim Floor self-weight = 3 kN/m²
Dead load = 2.40 kN/m²
Live Load = 5.75 kN/m²
 - Dead load = 2.50 kN/m²
Live Load = 1.5 kN/m²
 - Dead load = 0.55 kN/m²
Live load = 2.50 + 1.00 kN/m²
 - Dead load = 1.25 kN/m²

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PROJECT RYLANDS BUILDING, MANCHESTER						
CLIENT CD9 PROPERTIES (MANCHESTER) LTD						
TITLE PROPOSED PLAN ROOF						
SCALE 1:200@A1 1:400@A3				DATE AUG 2020		
JOB No 1526		DWG No. AL[05]224			REV *	
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