ENTRY NUMBER: 208

RIAI

BUILDING TRUST

RIAI RISING STAR AWARD 2022

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2000 Word Synopsis

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1. Introduction

This is a synopsis of the work I have completed throughout my third year in architectural technology. I have presented and elaborated on the following topics in my synopsis.

- Technical response to a design brief.
- Integration of sustainability.
- Use of analytical and collaboration tools.

2. Technical Response to a Design Brief

This year in the technical design studio we were given a Community Leisure and Sports Centre as our design brief. We were tasked with auditing the planning application drawings under a series of headings and to produce an esquisse to demonstrate building regulation compliance. This involved identifying a range of options for structural, environmental schemes and the external building fabric. Finishing with the construction of a digital Revit model and then producing tender drawings. My initial approach was to analyse the architects design through an architectural audit **(Fig. 2.1/ Fig. 2.2)**. This involved troubleshooting the given layout and design to identify areas that fail to meet the criteria which are outlined in the Technical Guidance Documents (TGD's).

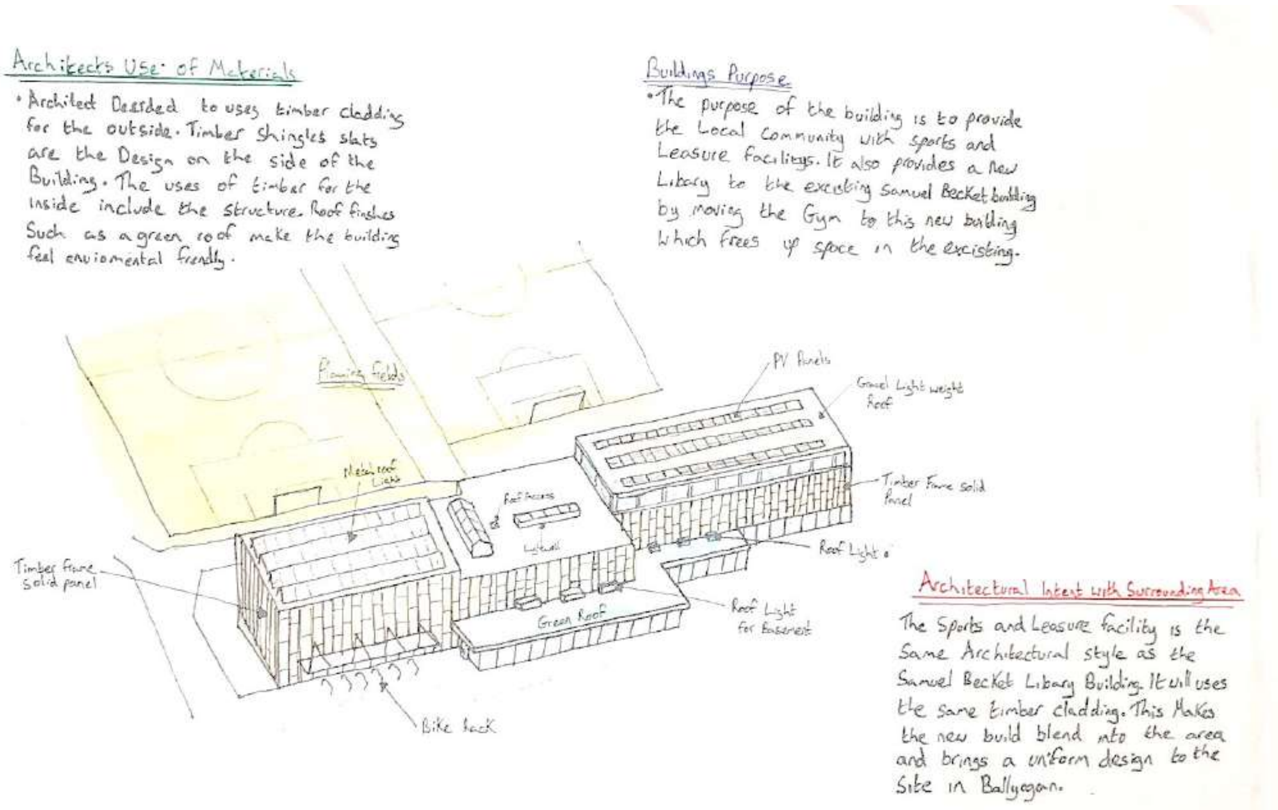
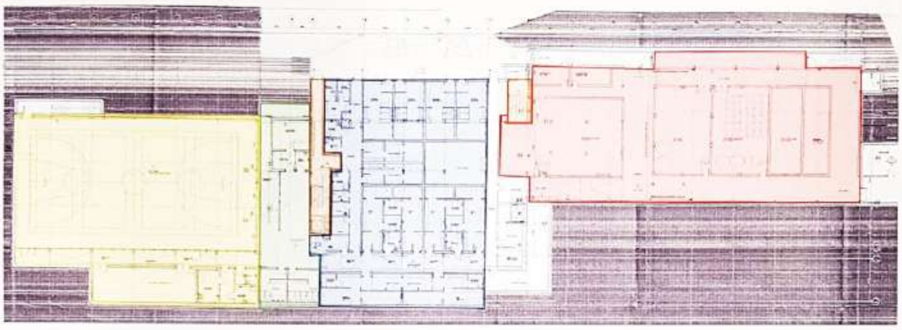


Fig. 2.1 : Architectural Intend 3D Model

Audit Schedule



Basement	Provided	Consideration
Sports Hall	A 833m2 Multipurpose Hall can host 3 badminton courts, Basketball court and other types of activity's. Storage room to the south side of the sports hall separated by a 2 meter corridor with curtain wall toughened glazing.	Occupancy load of 220 for the Sports hall. A 30min fire protected walls and door will need to be specified for storage room. Sports hall will act as a separate fire compartment, a 60min fire wall and door must be constructed on grid 7. Two means of escape should be provide for the capacity. TGD part B.
Dressing Rooms	Architect has provided plenty changing facility's for the sports hall and playing Fields. 4 Dressing rooms for the outdoor playing fields, 2 Referee changing rooms, 2 staff changing rooms, 4 changing rooms for indoor sports activity's and 1 male and female general changing room. DA WC's Located in the Changing room area.	Changing Facility's to comply with Metric Handbook. Sanatory fixture are calculated to the amount of people that would uses this building at one time, as shown in Metric Handbook. Disabled WC's to be as sized and laid out as stated in TGD part M. Door and Corridor widths to be sized in accordance to TGD Part M.
Plant Area	Space Provide for Ventilation, Pool, Mechanical Plant rooms. It also houses Chemical storage rooms and Pool balancing tank.	Plant and Storage rooms to be 60min fire protected as in TGD part B.
Hallway	Hallway provide connection to each floor and to key rooms such as toilets and dressing rooms.	Sanatory fixture are calculated to the amount of people that would uses this building at one time, as shown in Metric Handbook. Disabled WC's to be as shown in TGD part M. Corridors to be 30min ire protected as in TGD part B.
Vertical Access	Lift provide at reception desk to basement and first floor, stair core located at swimming pool side and beside lift at reception. Main stairs to basement at north side of main entrance hall with ramp.	Stairs and Lifts sizes comply with TGD part M and K. Stair and lift core comply with TGD part B for have 2 stair cores as a means of escape. The Stairs and lift core have 60min fire protection. Emergency lighting throughout the stair core and ventilations via AOV's at the top of both stair cores.

Fig. 2.2 : Architectural Audit Analysis

In the audit I identified key criteria that had to comply with TGD Part B – Fire Safety. This included elements such as occupancy loads, means of escape, corridor and door widths, performance for structural integrity, fire detection and fire-fighting. I started by sketching over the proposed plans with the use of tracing paper to include the crucial elements listed above. I started by calculating the occupancy loads of each room **(Fig. 2.4)**, this calculation was determined by the area of the room and the number of suitable exits through which people could escape. While doing this I also had to identify routes for means of escape. The width of doors and corridors had to be analysed to make sure they met fire safety requirements. Fire escape stair cores and corridors had to be a 60 minute fire rating which I indicated in red on my sketched plans **(Fig. 2.3)**. Storage rooms were also sealed with a 30 minute fire rating to prevent any fires from passing outward from those rooms. Doors leading into each of these fire protected areas had the suitable fire rated doors with smoke seal such as a FD30s or FD60s. I located on the plans the suitable location of fire detection and fire fighting services such as smoke detectors, fire exit signs, refuge area for stair cores, dry risers for fire fighters and AOV etc **(Fig. 2.3)**.

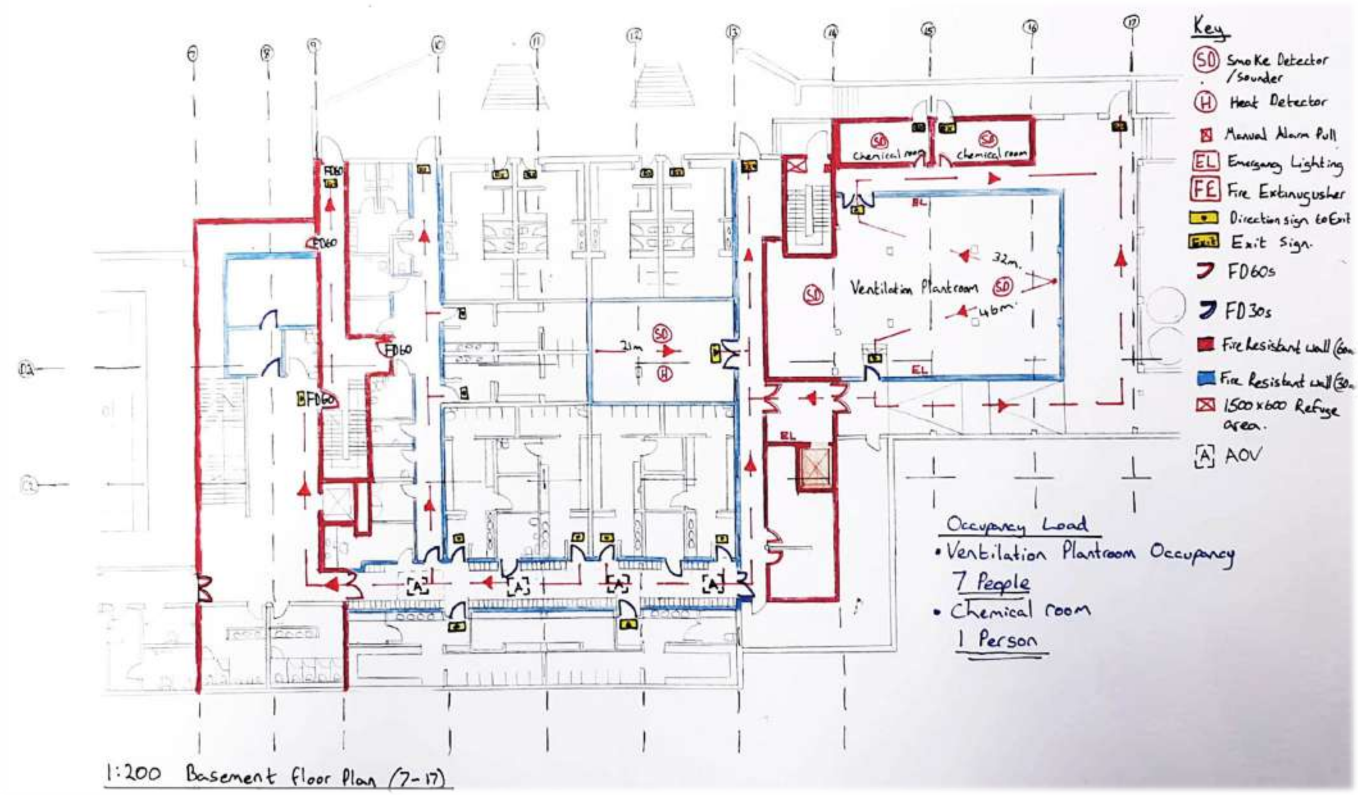
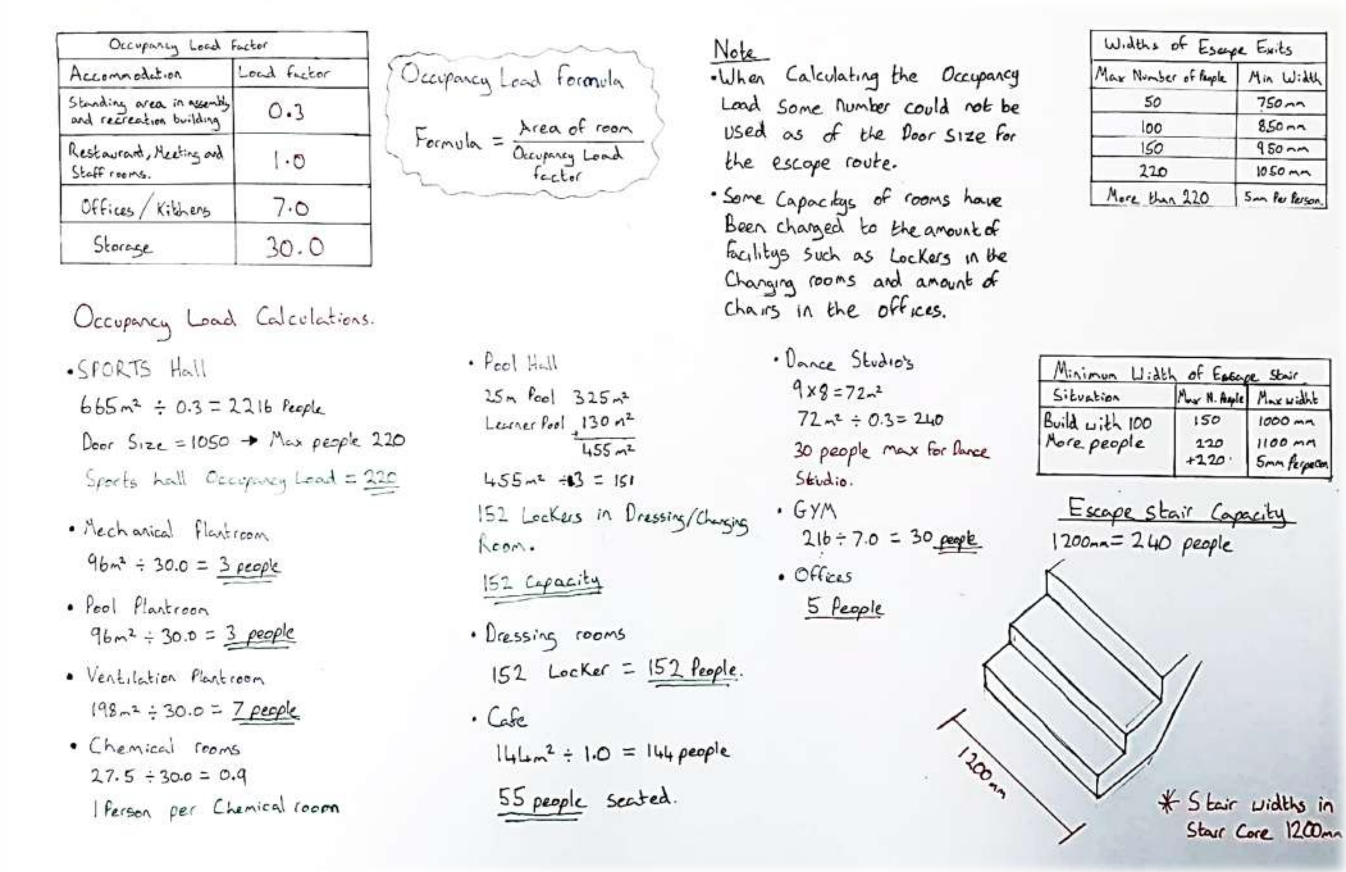


Fig. 2.3 : Fire Layout Schematic – TGD B



Occupancy Load Factor	
Accommodation	Load factor
Standing area in assembly and recreation building	0.3
Restaurant, Meeting and Staff rooms.	1.0
Offices / Kitchens	7.0
Storage	30.0

Occupancy Load Formula

Formula = Area of room / Occupancy Load factor

Note
• When Calculating the Occupancy Load some number could not be used as of the Door size for the escape route.
• Some Capacitys of rooms have been changed to the amount of facilitys such as Lockers in the Changing rooms and amount of Chairs in the offices.

Widths of Escape Exits	
Max Number of People	Min Width
50	750mm
100	850mm
150	950mm
220	1050mm
More than 220	5mm Per Person

Occupancy Load Calculations.

• SPORTS Hall
665m² ÷ 0.3 = 2216 People
Door Size = 1050 → Max people 220
Sports hall Occupancy Load = 220

• Mechanical Plantroom
96m² ÷ 30.0 = 3 people

• Pool Plantroom
96m² ÷ 30.0 = 3 people

• Ventilation Plantroom
198m² ÷ 30.0 = 7 people

• Chemical rooms
27.5 ÷ 30.0 = 0.9
1 Person per Chemical room

• Pool Hall
25m Pool 325m²
Learner Pool + 130m²
455m²
455m² ÷ 3 = 151
152 Lockers in Dressing/Changing Room.
152 Capacity

• Dressing rooms
152 Locker = 152 People.

• Cafe
144m² ÷ 1.0 = 144 people
55 people seated.

• Dance Studio's
9×8 = 72m²
72m² ÷ 0.3 = 240
30 people max for Dance Studio.

• GYM
216 ÷ 7.0 = 30 people

• Offices
5 People

Minimum Width of Escape Stair		
Situation	Max N. People	Max width
Build with 100 More people	150	1000mm
	220	1100mm
	+220	5mm Per person

Escape stair Capacity
1200mm = 240 people

1200mm

* Stair widths in Stair Core 1200mm

Fig. 2.4 : Occupancy Load Calculations – TGD B

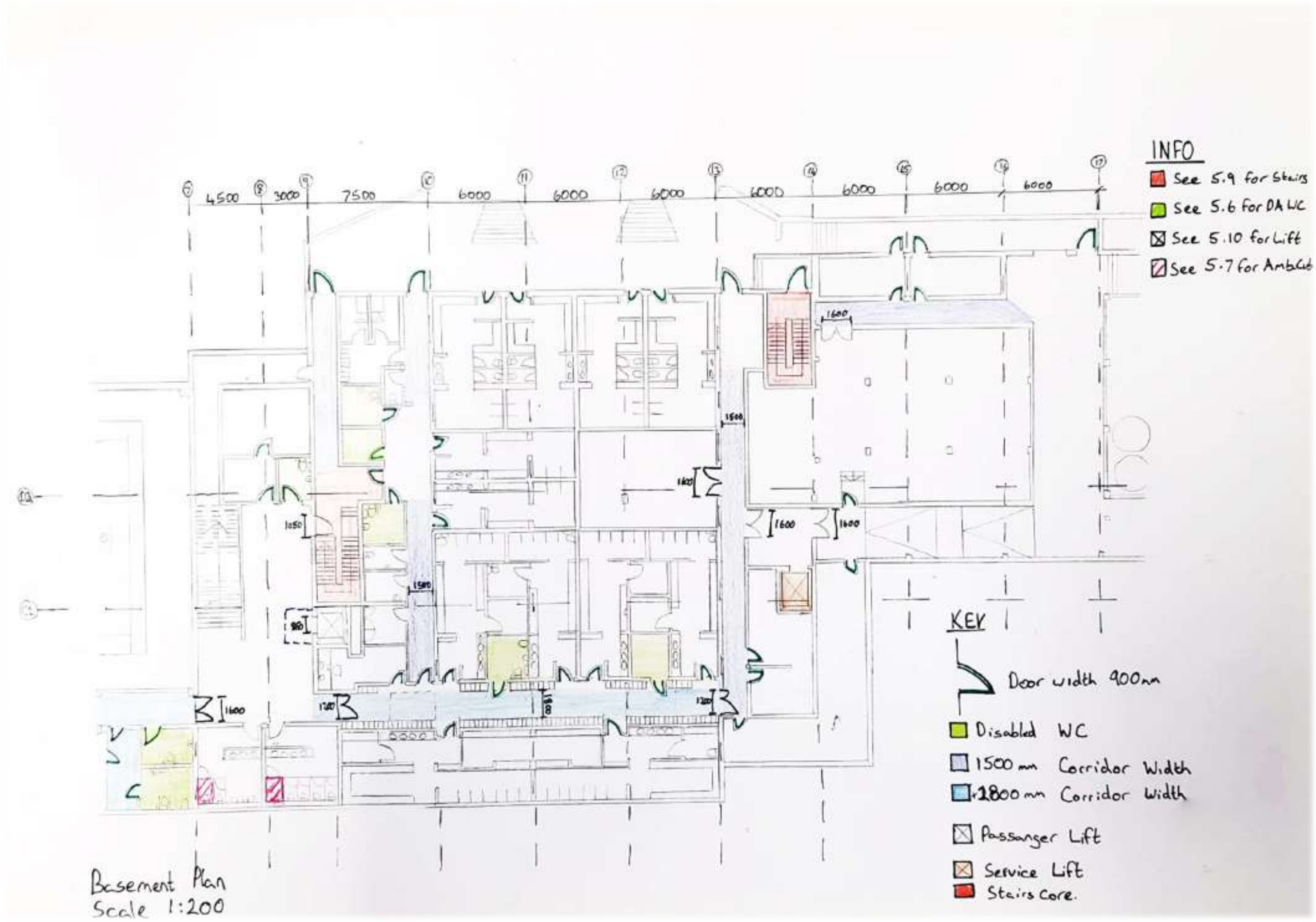


Fig. 2.5 : Accessibility Analysis – TGD M

The Community Leisure and Sports Centre is to be a public amenity, therefore I had to comply with TGD Part M – Access and Use. In this part I had to analyse corridors, staircases, ramp and door widths. I had to ensure the staircases and ramps, inside and accessing the building, comply with the regulations **(Fig. 2.5)**. In my esquisse I developed a suitable stairs that works in the building while also meeting the needs of an ambulant disabled person **(Fig. 2.6)**. Lifts in the leisure and sports centre provide quick access to all levels for all users of the facilities. I had to find a suitable size of lift that would meet the needs of a wheelchair user and another occupant of the lift **(Fig. 1.6)**. Outside the lift door I ensured that there was adequate space for the wheelchair to turn around once it exits the lift. Corridor and door widths had to meet the minimum widths for wheel chair users. I had to change some corridor and door widths to provide space for wheelchair users to pass each other.

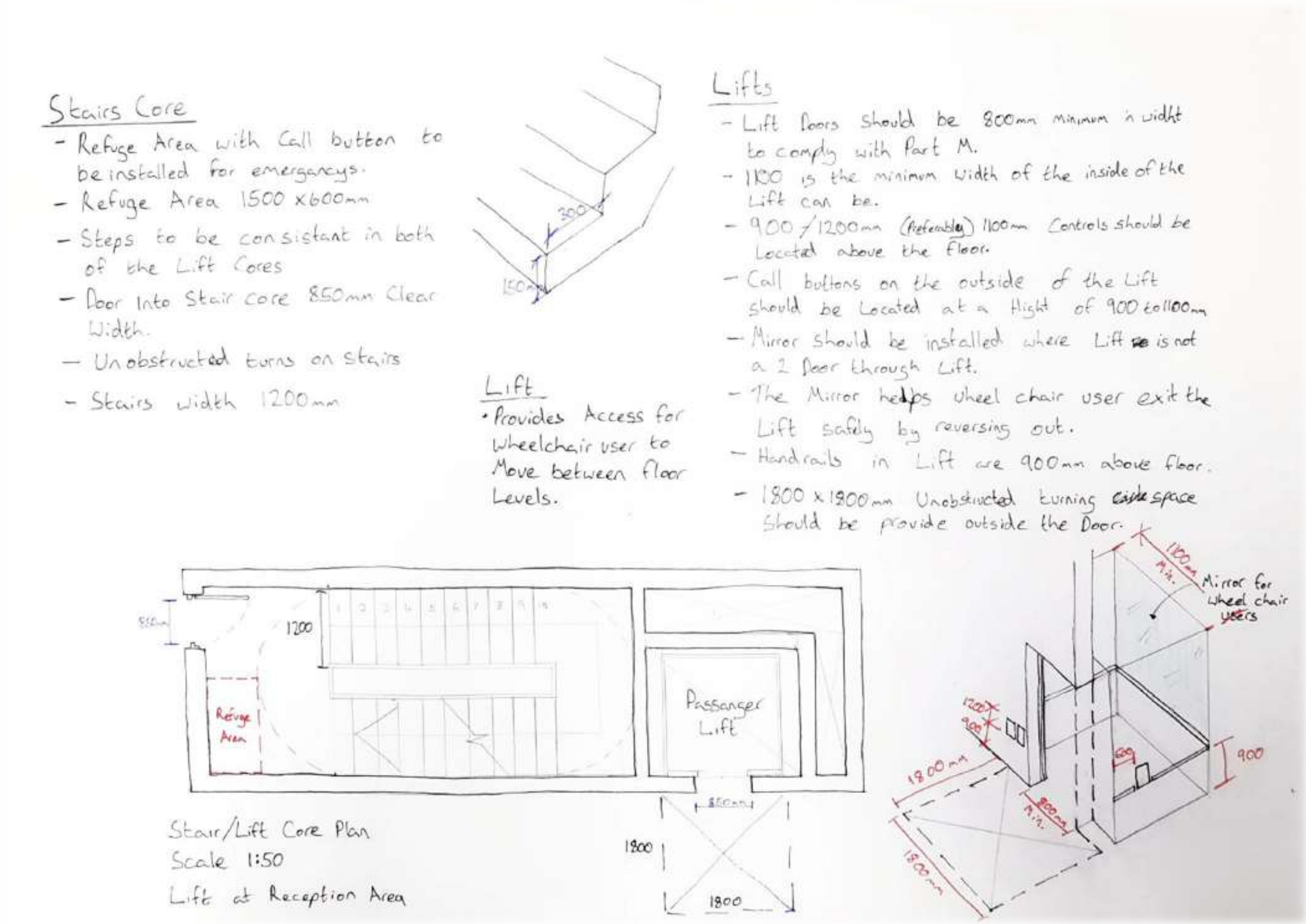


Fig. 2.6 : Stairs/Lift Core Layout – TGD M

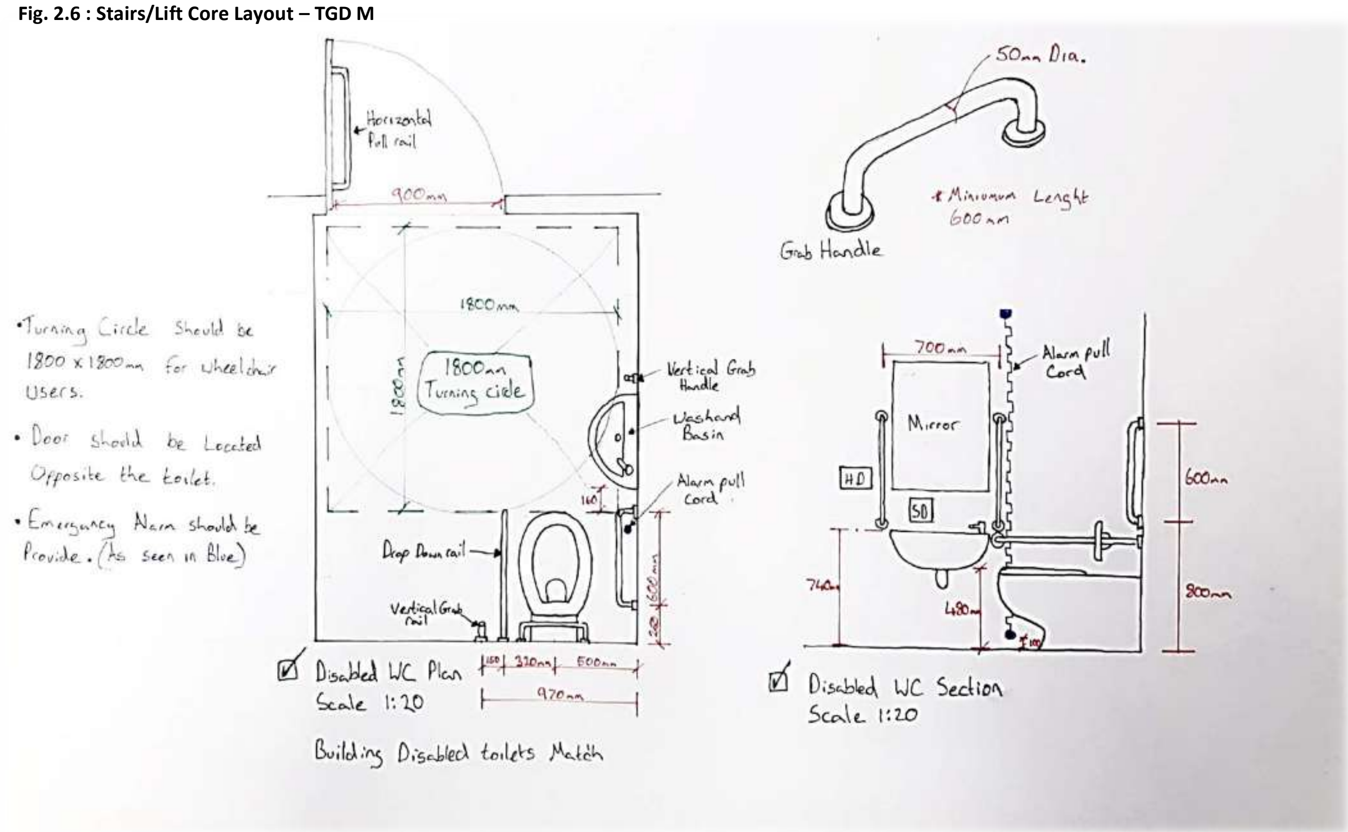


Fig. 2.7 : Accessible WC Layout – TGD M

I also checked that sanitary facilities were in compliance with the regulations. I made sure there was a correct number of cubicle toilets and that adequate space was given in cubicle toilets for ambulant disabled users. Wheelchair accessible toilet had to be designed as specified in the TGD part M. I did this by taking the room size for the proposed toilet area and began sketching the layout of the wheelchair accessible toilet in the area provided **(Fig. 2.7)**.

The design brief had specified engineered timber structure and timber cladding. I did various research on Glulam and CLT (Cross Laminated Timber) structural elements **(Fig. 2.9/Fig. 2.10)**. I had to find a suitable layout and structural design to meet the architects specification. I calculated to find a rough size to base the columns and beams around. I choose glulam for the columns and beams because of their structural strength and CLT for the floor and roof decks. For the external envelope I chose a SIP panels which had an external timber rain screen façade design attached to it in order to meet the architect's design brief.

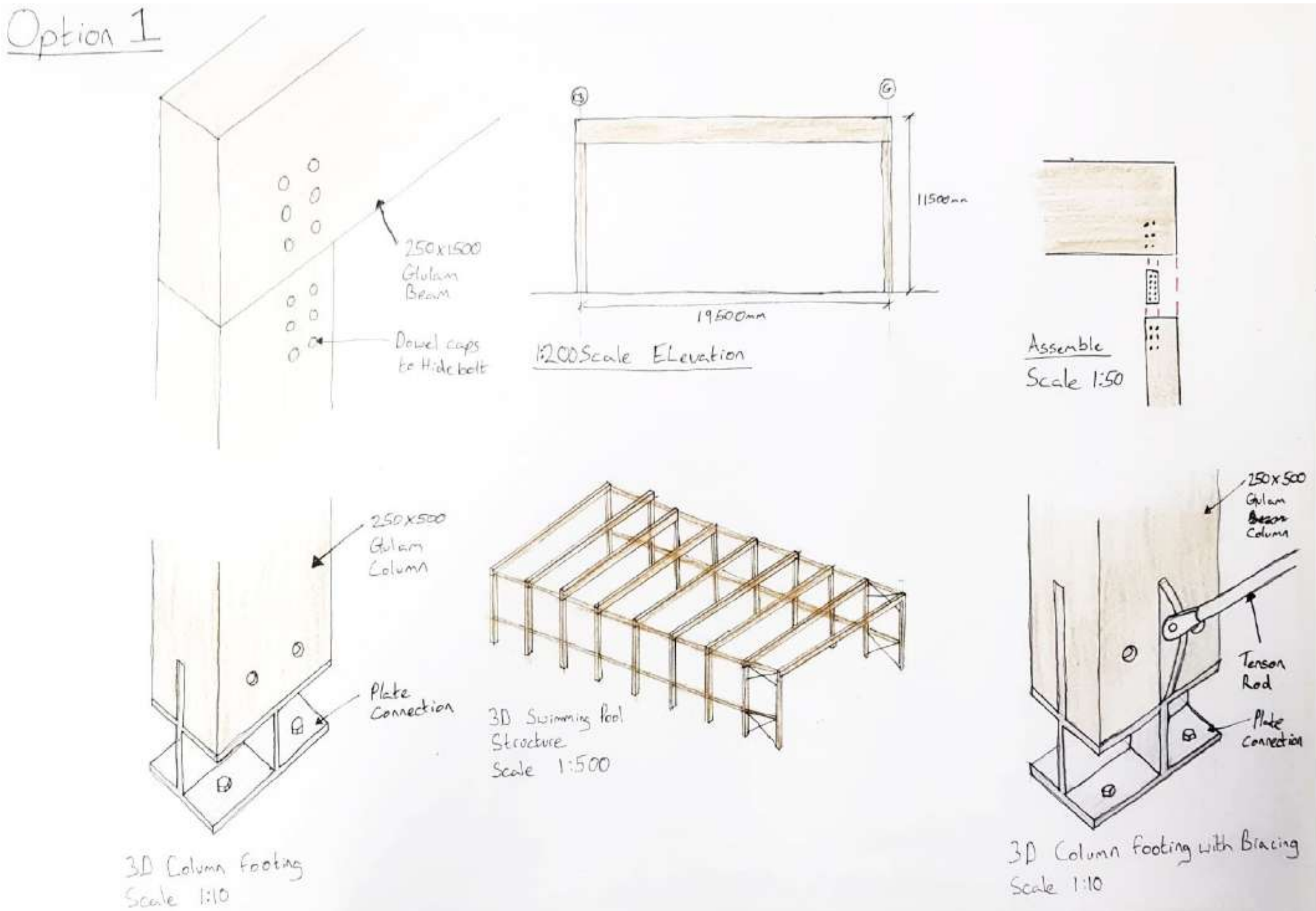


Fig. 2.8 : Glulam Structural Research

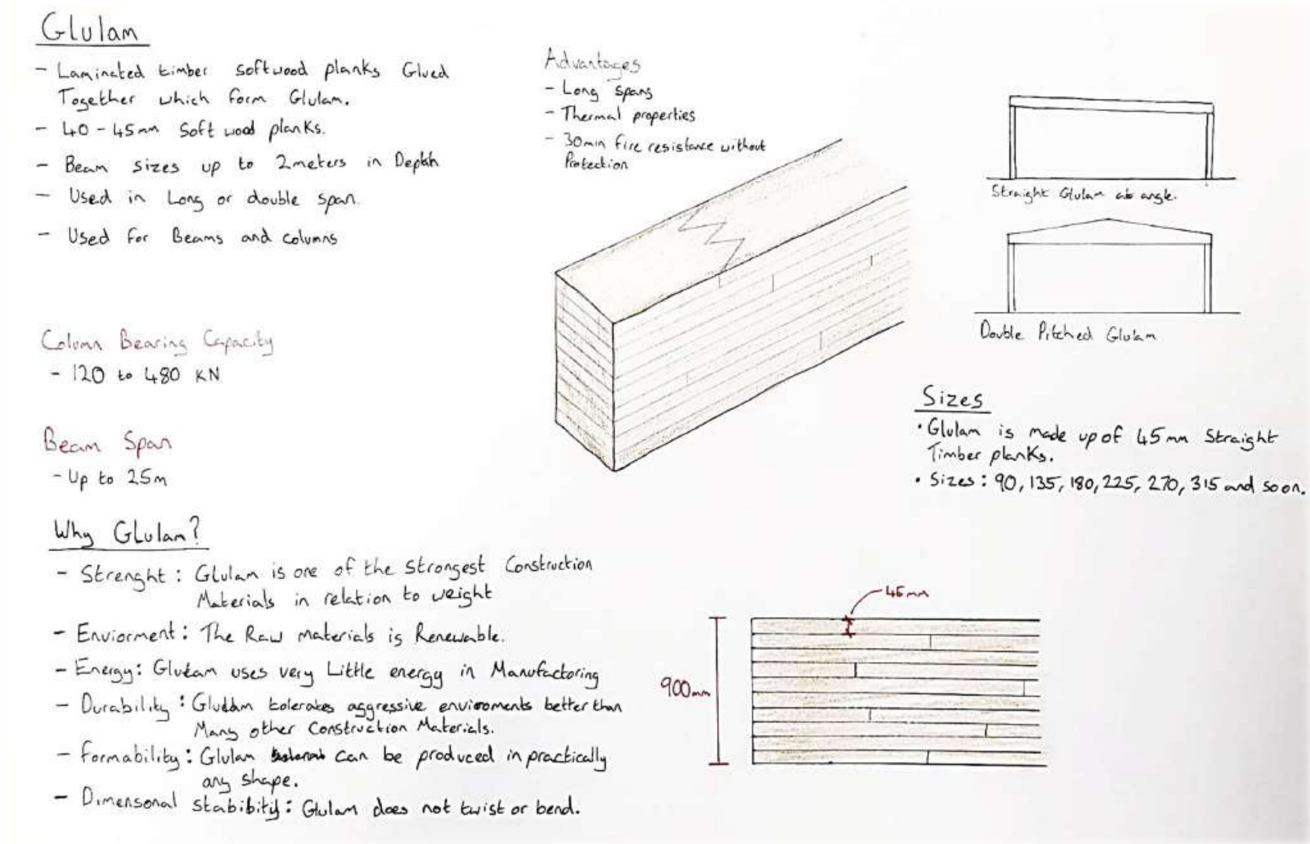


Fig. 2.9 : Glulam Research

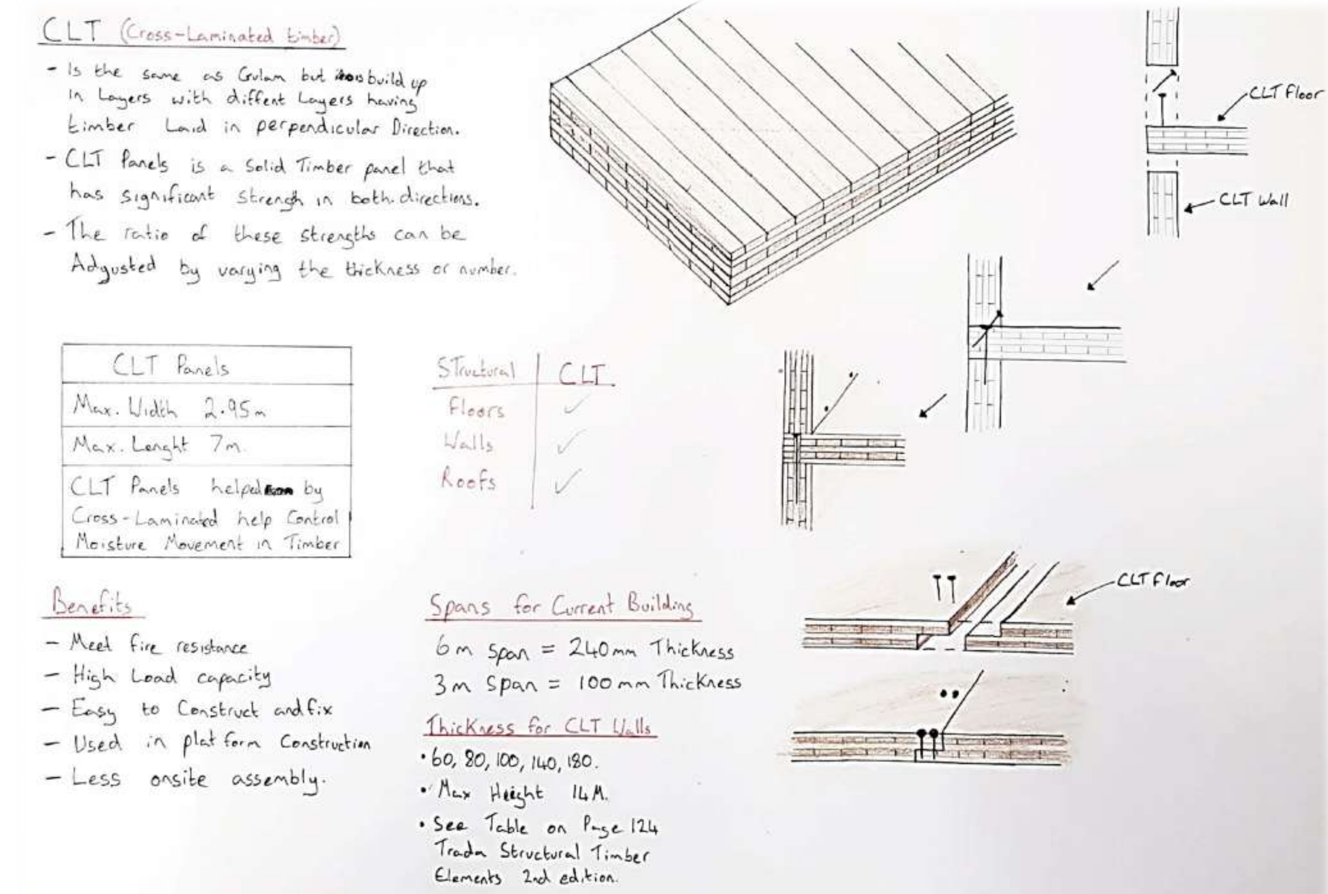


Fig. 2.10 : CLT Research

I examined certain areas of the building to develop solutions to solve problematic details while keeping in mind the impact it may have on the architectural design. I researched and created ideas that would allow me to achieve the design goal and ensure its buildability. I started with the examination of the junctions of interest by doing a research sketch based development of the junctions. The development of 3D sketches **(Fig. 2.11/Fig. 2.12)** also gave me a greater understanding of the details and it helped to see any clashes with other elements of the building. Once these details where solved and met the design intent I later on in the project translated these sketches into final 2D drawings with the uses of Revit.

I researched the impact of activities in relation to the transfer of acoustics from room to room. The rooms in the community leisure and sports centre would create different types of sounds such as Impact, reflective and airborne sounds. As this building facilitates leisure and sports, I had to find a way to prevent the transfer of sounds through the building by incorporating various products to improve the acoustic performance **(Fig. 2.13)**.

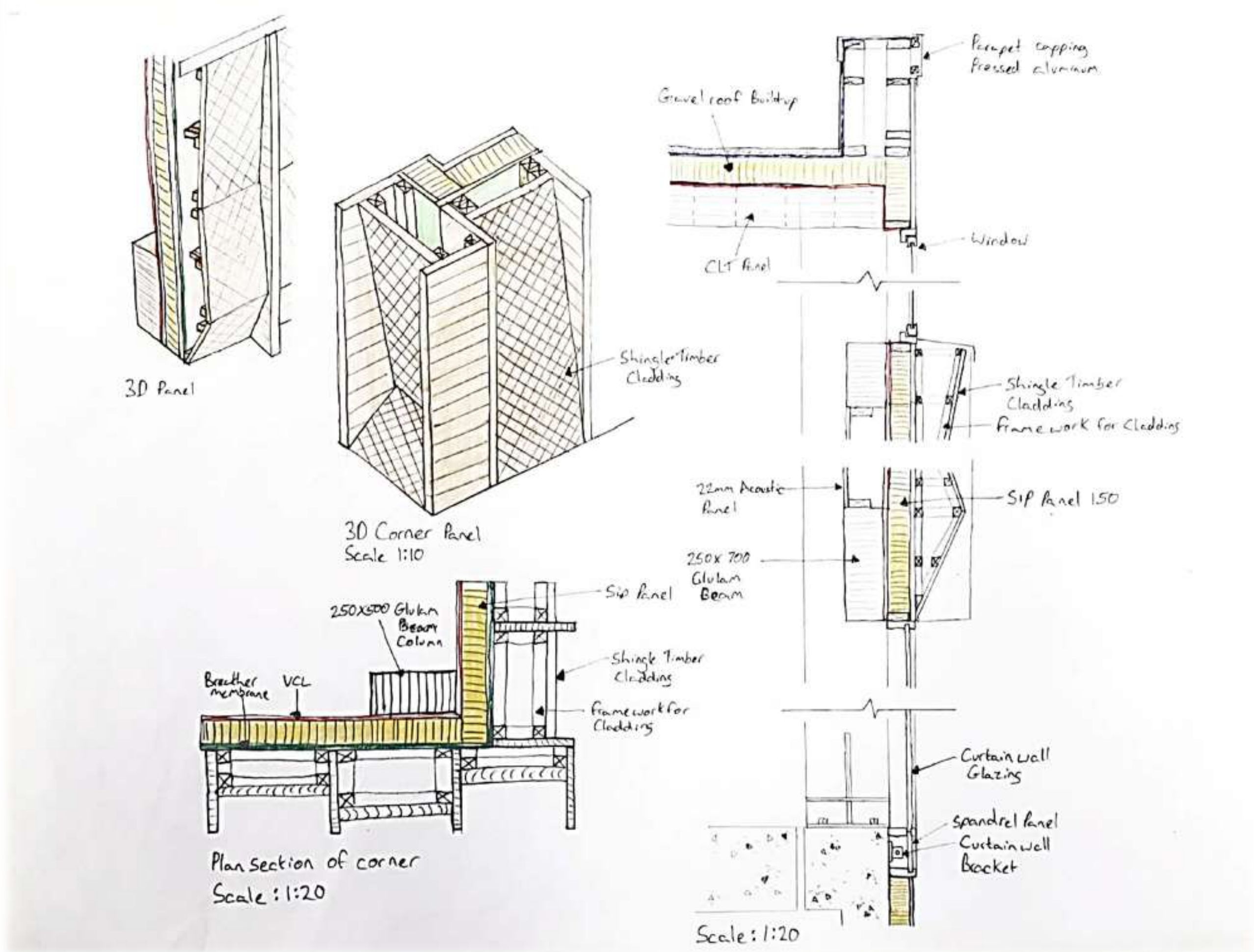


Fig. 2.11 : External Envelop Timber façade Sketch's

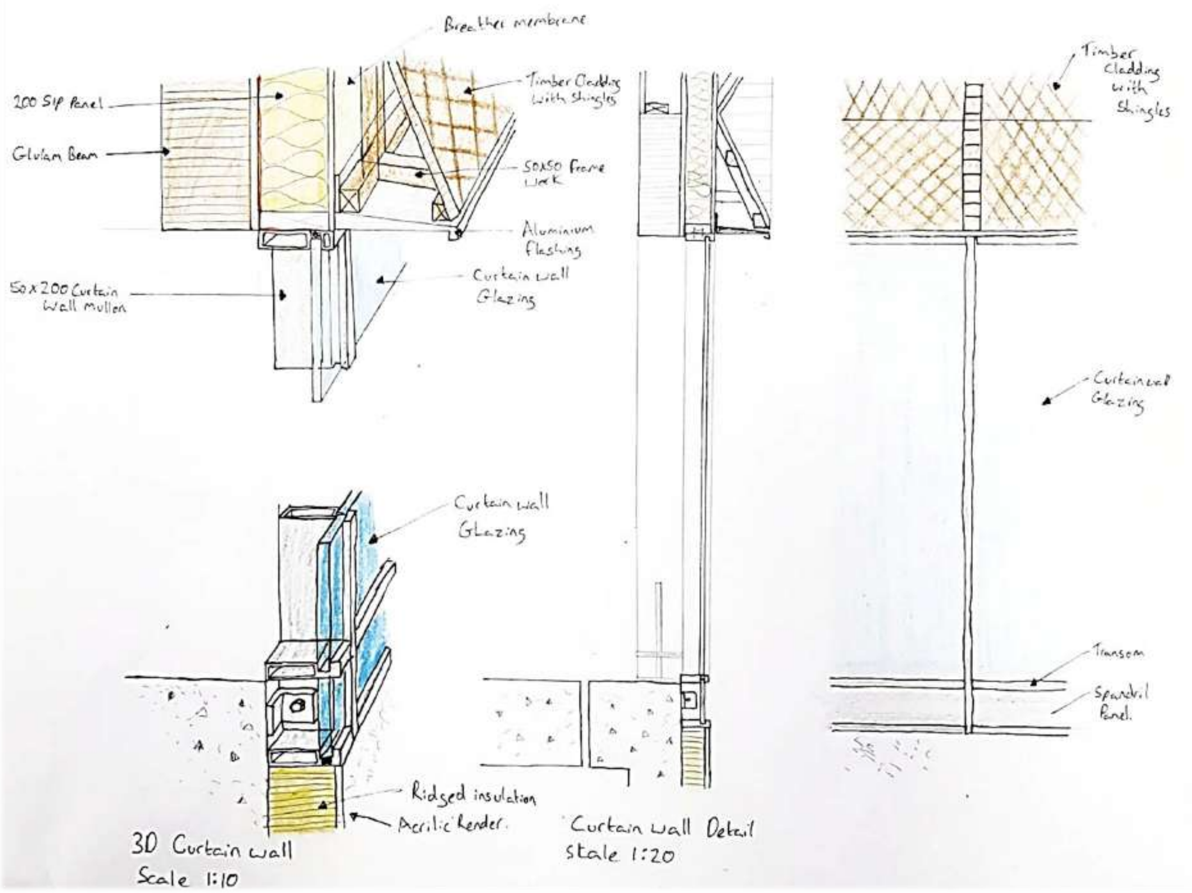


Fig. 2.12 : Curtain Wall Sketch's

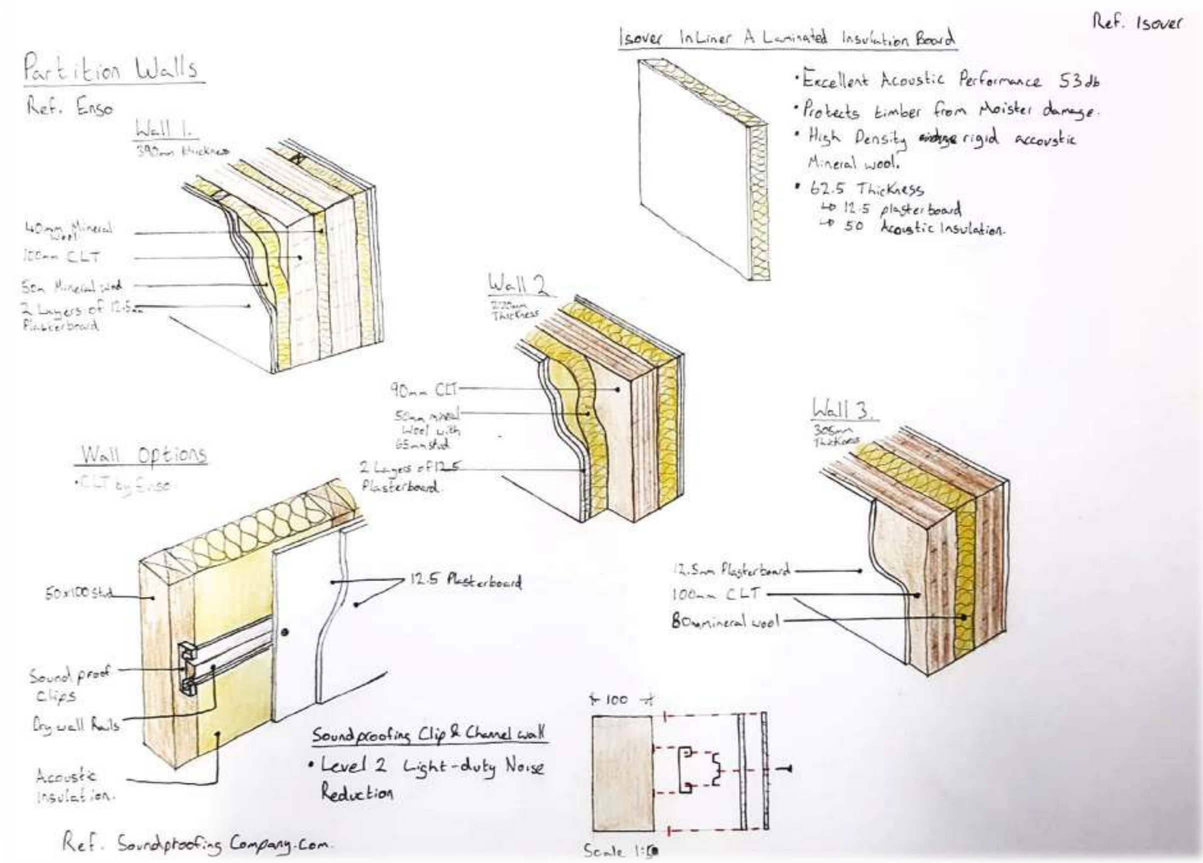


Fig. 2.13 : Acoustic Research

3. Integration of Sustainability

During the development of the Community Leisure and Sports Centre, sustainability was crucial to incorporate into the design development of the building. It was important that I investigated key factors that were suitable to the sustainability and environmental performance strategy which would make the building meet NZEB (Nearly Zero Energy Building) requirements. I started to develop an environmental design strategy during the design development stage, as this provided me with what is required to achieve a sustainable design. The design strategy helped me to identify areas of the building that affected the environment and which would also lead to an impact on the architectural design.

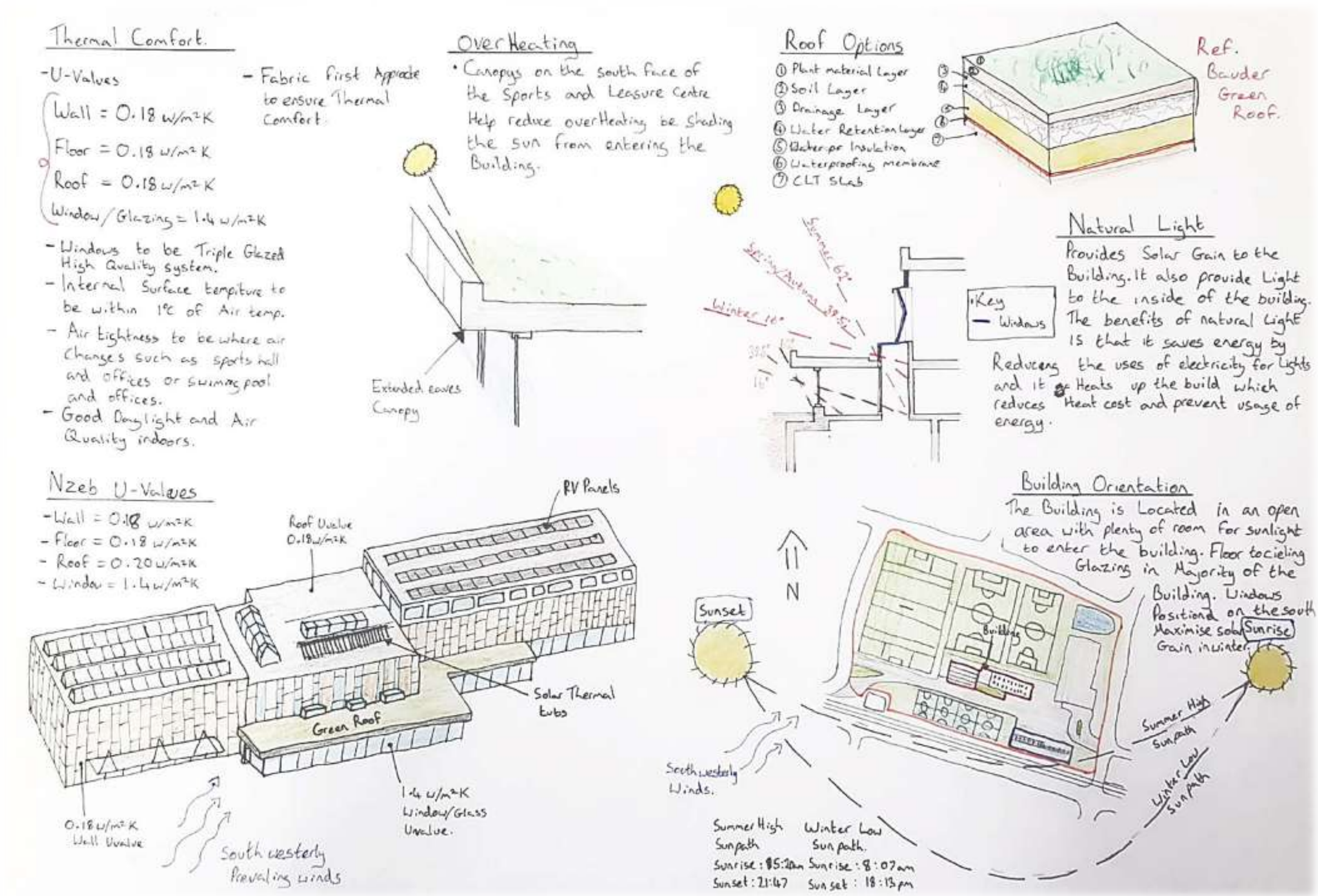


Fig. 3.1 : Site Analysis, Natural Light, Overheating & Thermal Comfort

In the environmental design strategy I carried out an analysis of ways to improve the overall building's sustainability and environmental performance **(Fig. 3.1)**. I looked at areas such as overheating and how to cool the building. I used a solar study of the building and its surrounding area which helped me prevent extreme overheating by incorporating systems such as brise soleil and overhangs in certain areas. The uses of natural and mechanical ventilation were researched, to create a natural and efficient flow of cool fresh air throughout the building via vents, windows and ventilation ducts **(Fig. 3.2)**.

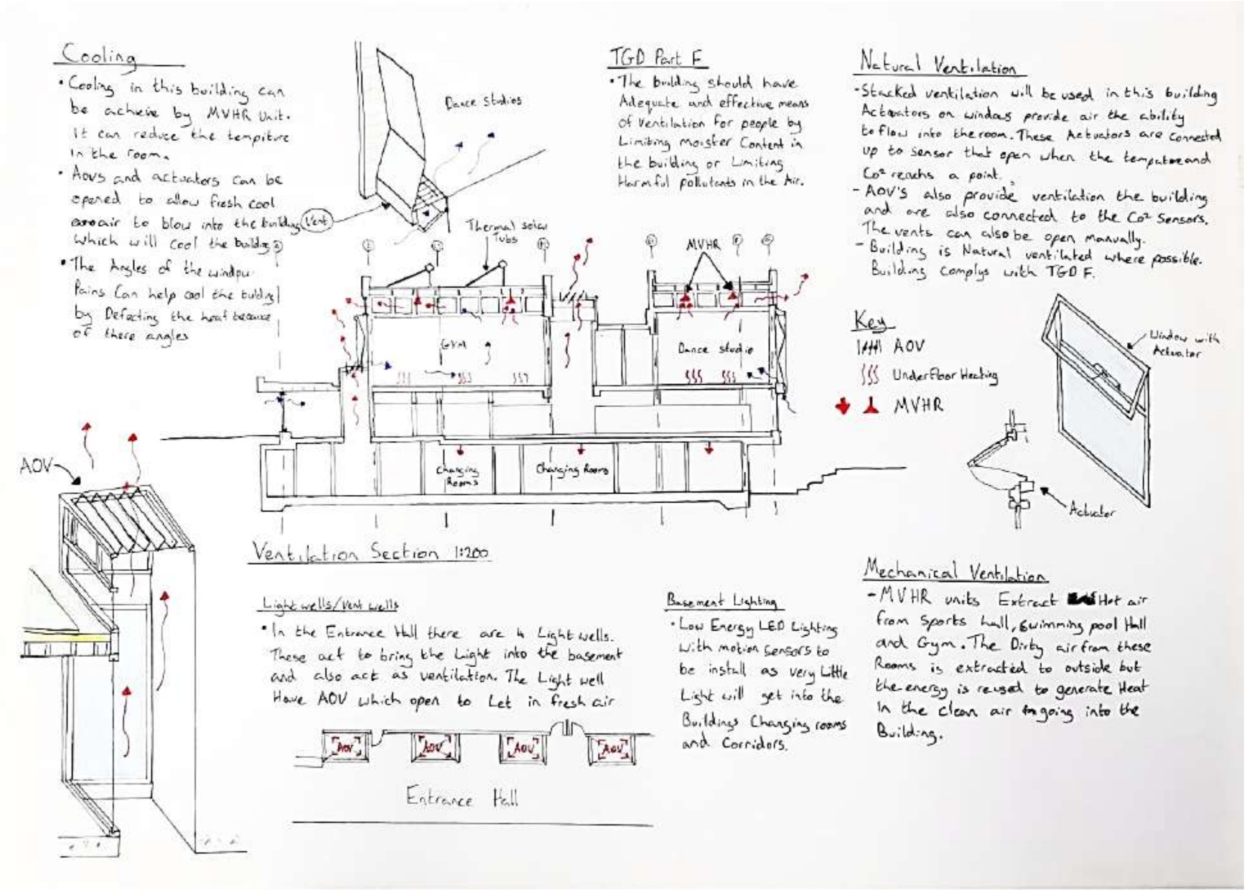


Fig. 3.2 : Cooling, Natural ventilation & Mechanical Ventilation

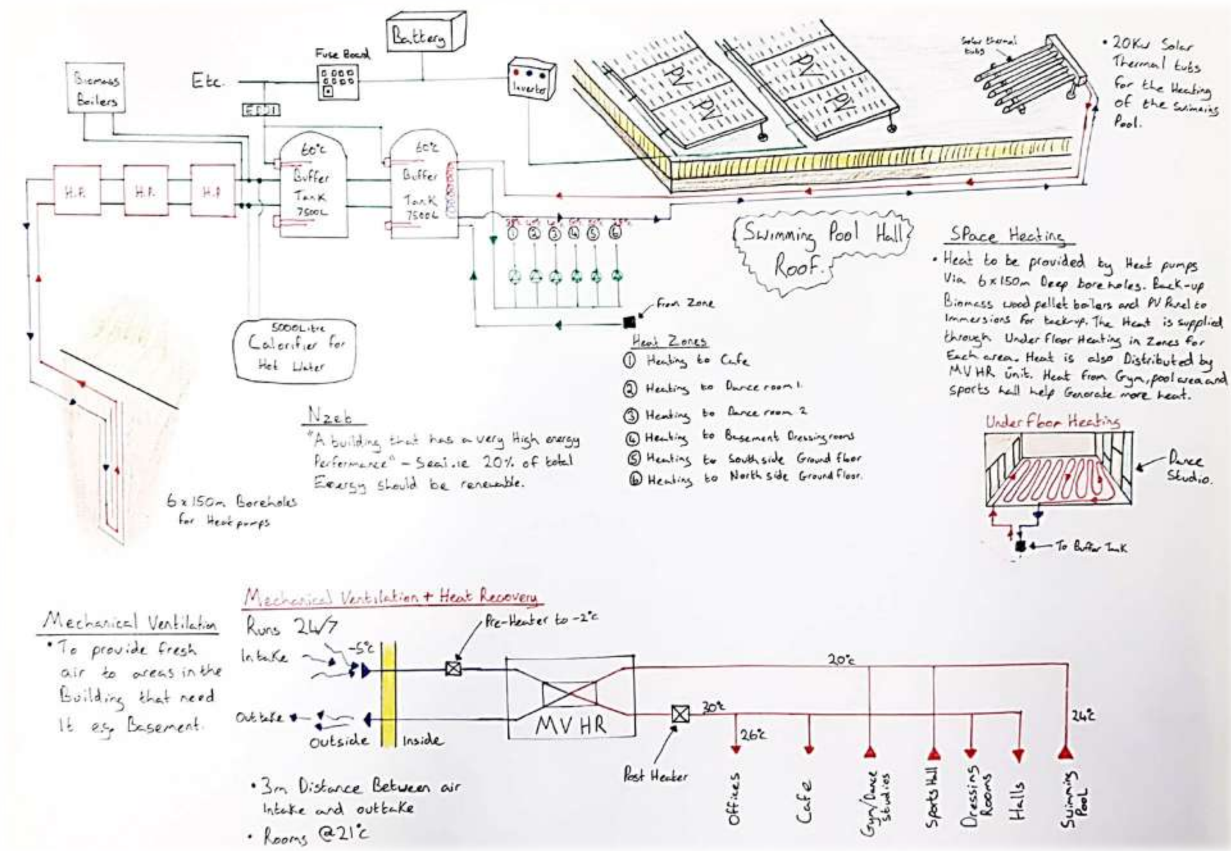


Fig. 3.3 : Space Heating Strategy/Mechanical Ventilation Schematics

I researched and calculated the outputs of energy from a variety of renewable energy systems which give 20% electrical power as required to meet NZEB. I chose heat pumps and MVHR (Mechanical Ventilation with Heat Recovery) to heat and cool the building **(Fig. 3.3)**. The uses of a MVHR benefitted the performance and air quality of the leisure and sports centre as it circulated fresh air and provides an even temperature around the building. The renewable energy I chose was based on the calculations of the energy outputs **(Fig. 3.4)**. I specified PV Panels and Wind Turbines with battery storage to supply the heating and ventilation systems while also supplying power to other units in the building.

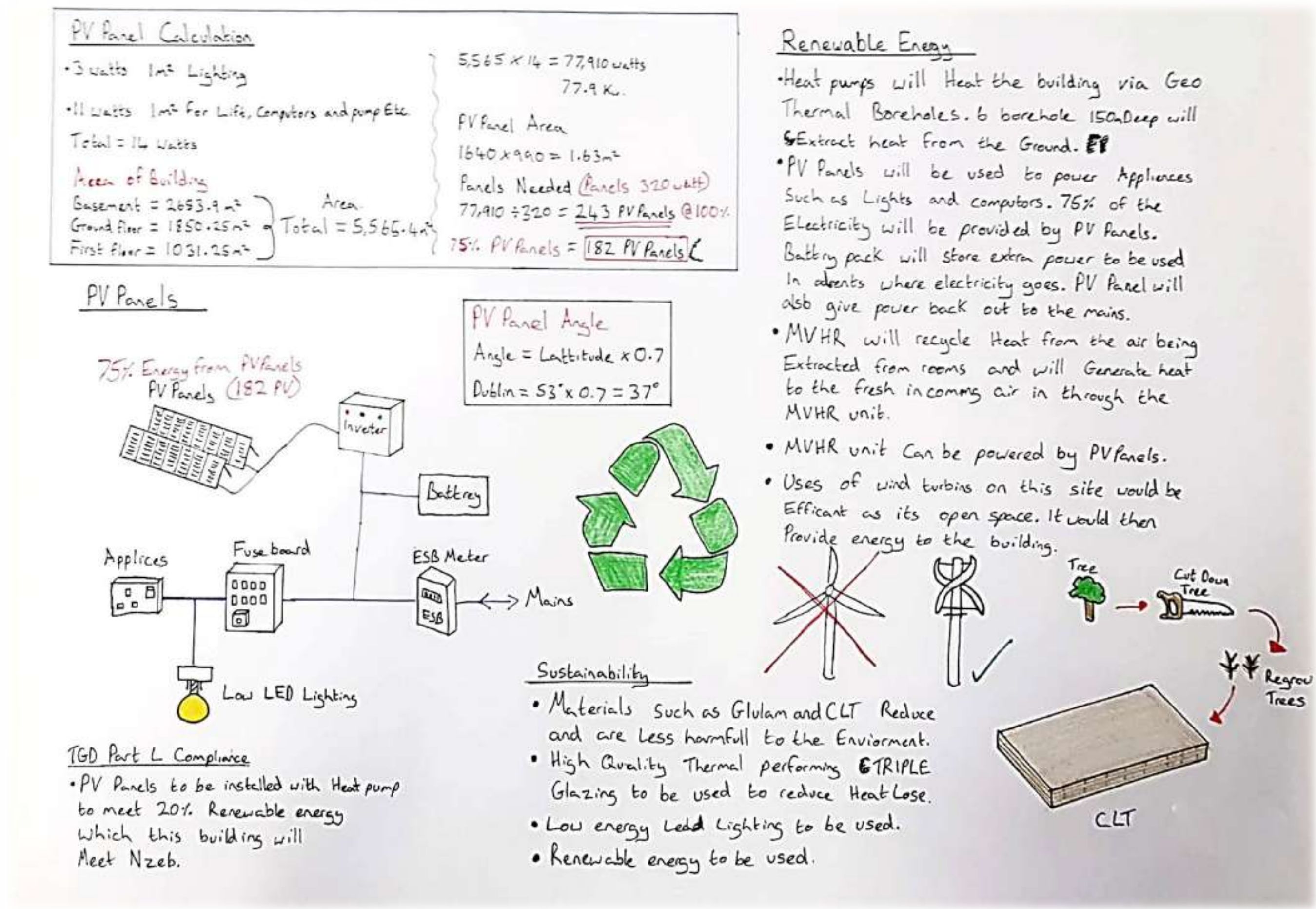


Fig. 3.4 : Renewable Energy & PV Panel Calculations

The use of environmentally friendly materials was a huge consideration. The architectural brief intended that the building structure and façade was to be made from timber elements. The use of timber was vital as it is a renewable material. I maximized the use of renewable materials such as Glulam and CLT structural elements where possible to reduce the embodied carbon from other materials such as concrete. I incorporated an extensive green roof which provides a natural and environmentally friendly texture to the building and its surrounding area.

I specified structural insulated panels (SIPs) for the external envelope because they are a high performance, environment friendly building envelope. This building system provide efficient thermal properties which improves the U-Value of the wall. The necessary U-Value required by NZEB would reduce heat loss and reduce the amount of energy used to heat the Community Leisure and Sports Centre, which will provided a high performing Nearly Zero Energy Building. U-Value calculations for the floors, walls and roofs were carried out to meet the current U -Value **(Fig. 3.6)**.

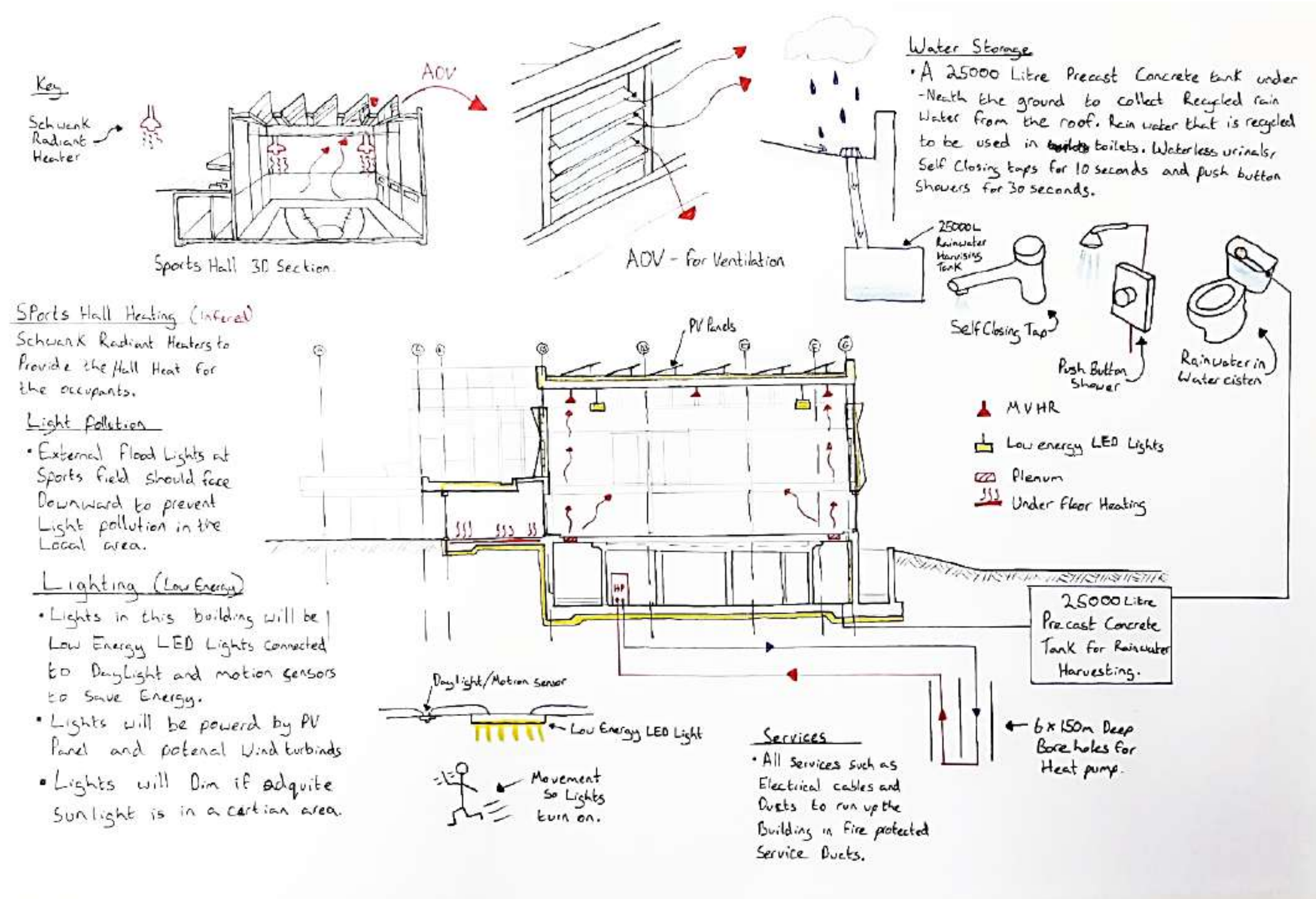


Fig. 3.5 : Water Usage/Lighting strategy

The Community Leisure and Sports Centre has a lot of toilet and shower facilities therefore I incorporated a rainwater harvesting tank which would supply toilets with recycled water. The use of eco flush systems would also reduce the use of water in the building **(Fig. 3.5)**. I created a site plan **(Fig. 3.6)** once we advanced into the creation of GA drawings of the build. On this site plan I included the location of various environmental strategy systems such as the renewable energy systems and rain water harvesting tanks etc as stated previously.

Fig. 3.6 : Site Plan/Heat Loss Calculations

Heat Loss Calculation

Swimming Pool

Heat Loss= Area x U-value x Temperature Diffence = Watts

	Surface Area	U-Value	Temperature Diffrence	Watts
Roof	2634.4m²	0.14	29	10695.6
Floor	2297.9m²	0.11	29	7330.3
Wall 1	818.5m²	0.14	29	3314.9
Wall 2	207m²	0.14	29	840.42
Wall 3	182m²	0.14	29	738.09
Wall 4	99m²	0.14	29	401.9
Wall 5	526.7m²	0.14	29	2138.4
Window/Door	856.2m²	1.4	29	34,761.7
			Total Fabric	60,222.1 Watts

Ventilation Factor= 0.33w/m³
Air Change rate= 4/hr
Volume x temperature Diffrence x Ventilation factor x Air change- kw
38199.2 x 29 x 0.33 x 4= 1,462,265.3kw

Heat Loss Calculation

Sports Hall

Heat Loss= Area x U-value x Temperature Diffence = Watts

	Surface Area	U-Value	Temperature Diffrence	Watts
Roof	700m²	0.14	21	2058
Floor	700m²	0.11	21	1617
Wall 1	418.7m²	0.14	21	1225.1
Wall 2	330m²	0.14	21	970.2
Wall 3	240m²	2.5	6	3600
Wall 4	240m²	0.14	21	705.6
Door	3.3m²	1.2	21	83.16
Glazing	90m²	1.4	21	2646
			Total Fabric	12905 Watts

Ventilation Factor= 0.33w/m³
Air Change rate= 4/hr
Volume x temperature Diffrence x Ventilation factor x Air change -kw
8000 x 21 x 0.33 x 4= 232,848kw

Foul Water CL/IL

MH Number	Cover Level (CL)	Invert Level (IL)
FW MH 1	89.000	88.600
FW MH 2	89.000	88.252
FW MH 3	92.000	88.659
FW MH 4	91.000	87.106
FW MH 5	89.500	87.090

Note: Manholes to be 1200mm dia.

Surface Water CL/IL

MH Number	Cover Level (CL)	Invert Level (IL)
SW MH 1	89.000	88.600
SW MH 2	89.000	88.458
SW MH 3	88.000	87.600
SW MH 4	88.000	86.071
SW MH 5	86.700	86.300
SW MH 6	86.700	86.217
SW MH 7	86.700	86.300
SW MH 8	86.700	85.629
SW MH 9	86.700	86.108
SW MH 10	88.000	86.400

Note: Manholes to be 1200mm dia.

KEY

- Site Notice
- Site Boundary
- Foul Water
- Surface water
- ESB Electricity Mains
- Irish Water Mains
- Telecom's
- Surface Water Intake from Attenuation Pond
- Surface Water Outlet into Attenuation Pond
- Foul Water Wavin AJ
- Surface Water Wavin AJ
- ESB Mini Sub Station
- EV Charger
- Fire Hydrant
- Telecom's Manhole
- External Lighting
- Roof Access Hatch
- AOV- Automatic Air Vent
- PV Panels
- SVP
- RWP
- Existing Buildings
- DA Parking
- Petrol Interceptor
- Road Gully
- Sluice Value
- Water Meter
- Safety Bollards

Energy Calculation

PV Panel Calculation
3 watts 1m² Lighting
11 watts 1m² for Lifts, Computers and Heat Pumps etc
Total= 14 watts

Area of Building:
Basement= 2683.9m²
Ground floor= 1850.25m²
First floor=1031.25m²

Total Area : 5565.4m²

5565.4m²x14 =77910 watts (77.9kw)

320 watt PV Panels

PV Panel Area
1640x990=1.63m²

PV Panels needed
77910÷320= 243 PV Panels @100% energy

75% PV Panels = 182 PV Panels

PV Panel Angle
Angle= Latitude x 0.7
Dublin=53ºx0.7=37º

4. Use of Analytical and Collaboration Tools

Throughout the past few years of studying to be an Architectural Technologist I have learned the role of Building Information Modelling (BIM) in particular Revit. This year I have learned vital analytical and collaboration tools in Revit which play an important role in the detailed development of buildings.

In the BIM module I have completed projects which included the learning of ISO 19650 standards as applied to a professional BIM project. This module developed my ability to produce procurement drawings in a clear and professional manner. This is achieved through data organization as well as understanding the appropriate industry quality and acceptable level of 2D and 3D information required for each stage of the assembly process to construct a building. The module explores the theory behind collaborative working through an applied cloud-based team project. In college we used these new ways of collaborative modelling in groups which prepared me to understand how collaborative modelling works so we can successfully manage and communicate with the design team members through Autodesk BIM 360 to create an advanced model.

Fig. 4.1 : BIM Model

My fellow peers and I were task by the BIM module lecturer to develop a 3D BIM360 Model. This model was used to produce a sets of digital drawings to express the design and construction of the building from general arrangement drawing to a series of technical design details. This can be shared with the 3D BIM model through Autodesk BIM360 app and website to the necessary design team or contractors on site.

In the BIM module I learned how to create various project and shared parameters. I would have created project parameters to express U-Values of walls in Revit. I learned how to add thermal properties to these wall build-ups such as resistance so the U-Value can be created. I expressed these calculation on sheets with a 3D model representing the walls in different colours to indicate which wall has the U-Value. I also learned how to create custom wall and door tags which would indicate the U-values and how to show fire rated walls and doors on 2D drawings **(Fig. 4.2)**.

Wall U Value Schedule

Type	Thermal Resistance (R)	U-Value Calc	Type Mark
392 MM WALL_A_100 MM BRICK,53MM AIR GAP,9MM OSB SHEETING,140MM STUD WALL, 40MM INSULATION, 35MM SERVICE CAVITY, 15MM SOUNDBOARD	6.1492 (m²·K)/W	0.031976	WT 01
392 MM WALL_A_100 MM BRICK,53MM AIR GAP,9MM OSB SHEETING,140MM STUD WALL, 40MM INSULATION, 35MM SERVICE CAVITY, 15MM SOUNDBOARD	6.1492 (m²·K)/W	0.031976	WT 01
392 MM WALL_A_100 MM BRICK,53MM AIR GAP,9MM OSB SHEETING,140MM STUD WALL, 40MM INSULATION, 35MM SERVICE CAVITY, 15MM SOUNDBOARD	6.1492 (m²·K)/W	0.031976	WT 01
392 MM WALL_A_100 MM BRICK,53MM AIR GAP,9MM OSB SHEETING,140MM STUD WALL, 40MM INSULATION, 35MM SERVICE CAVITY, 15MM SOUNDBOARD	6.1492 (m²·K)/W	0.031976	WT 01

Calculated U-Values with Type Mark

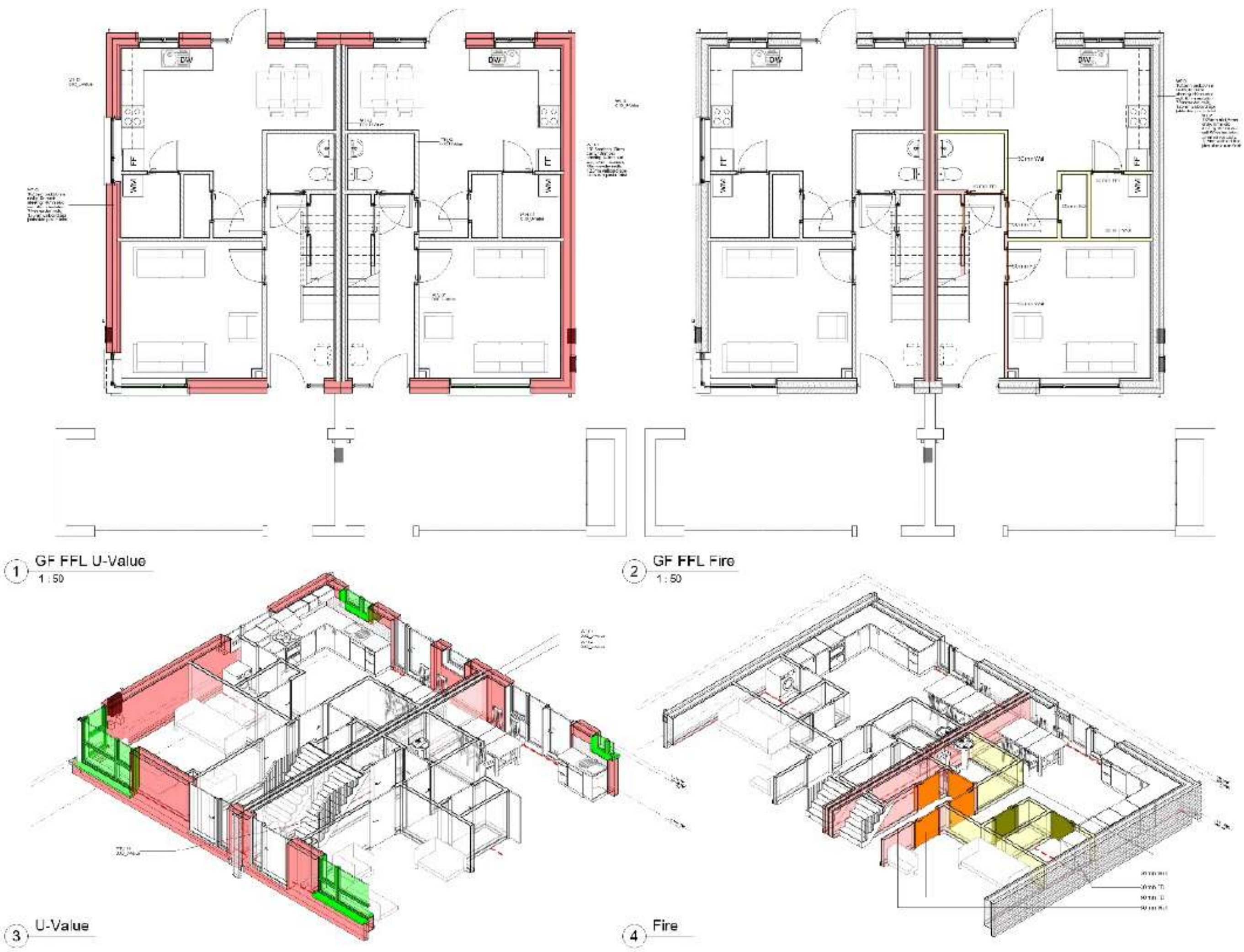


Fig. 4.2 : Project and Shared Parameters – U-Values & Fire Rating

Fig. 4.3 : Community Leisure and Sports Centre 3D BIM Model

In the technical design studio I incorporated what I experienced in the BIM module to bring a professional standard to my 3D BIM model, while also using ISO 19650 standards to organise my project file parameters and project browser with the correct naming conventions. Through the knowledge I learned from the BIM module and my own self thought desk research I was able to generate the Community Leisure and Sports Centre to a high professional standard **(Fig. 4.3)**. The use of Revit in the final stage of the project helped create a tender package which consisted of many analytical features such as shared parameters that aided and made it easier to quickly finalise the drawings where necessary with door, wall and stair tags. I develop plans, sections, elevations, details **(Fig. 4.5)**, 3D details **(Fig. 4.5)** and rendered view of the Community Leisure and Sports Centre **(Fig. 4.4)**.

Fig. 4.4 : Realistic Renders

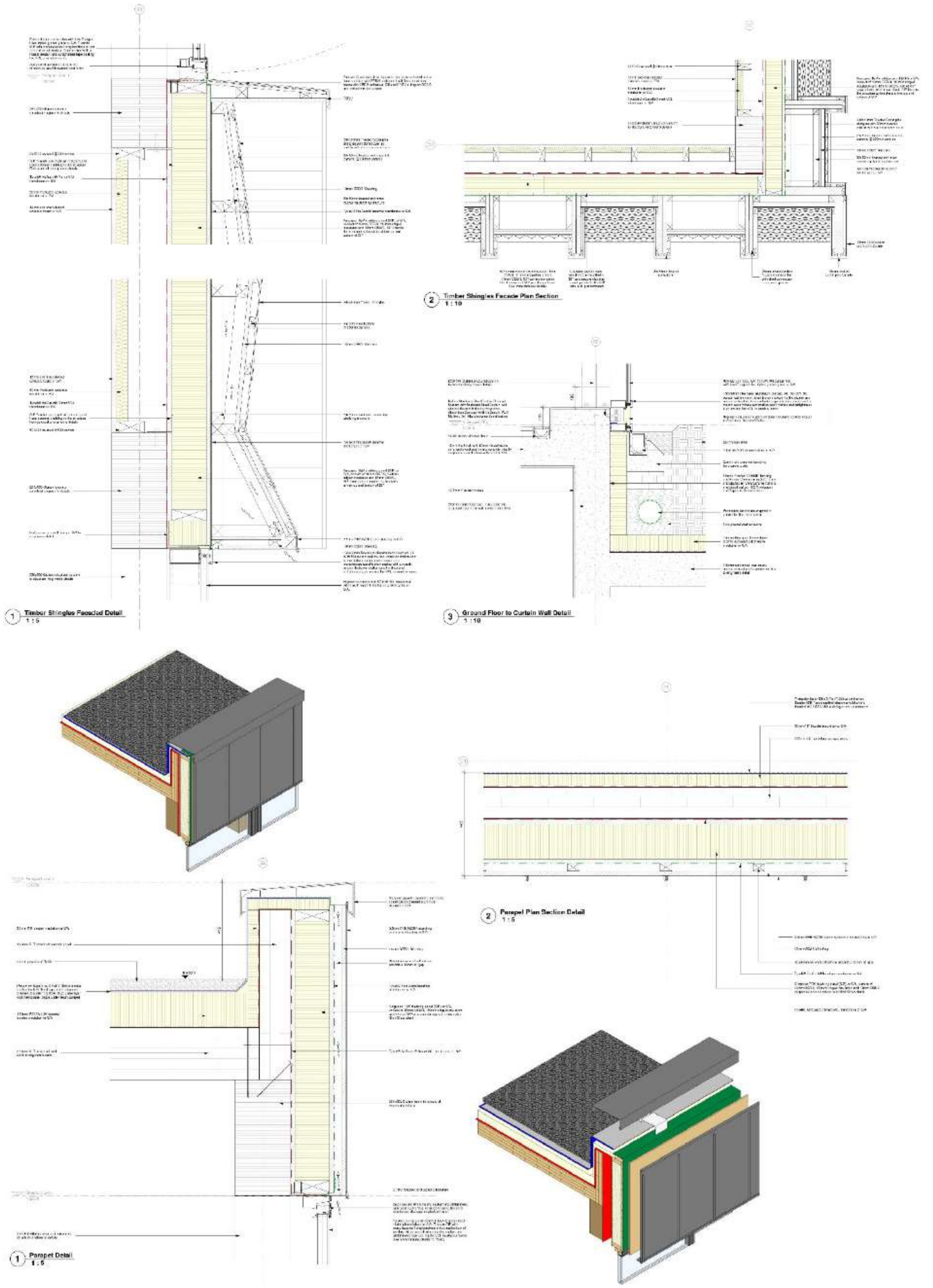


Fig. 4.5 : External Envelop & Parapet Details (2D/3D)

5. Conclusion

Overall, I feel I have gained an understanding of the professional standard of work need to be met as an Architectural Technologist. I have seen my knowledge develop and feel over the past year I've become ever more determined to constantly find new ways and ideas to constantly upskill and expand my technical knowledge even further. I am thankful for the guidance and skills being thought to me and grateful for the opportunity of this award to be able to demonstrate my skills and work throughout my 3rd year in Architectural Technology.