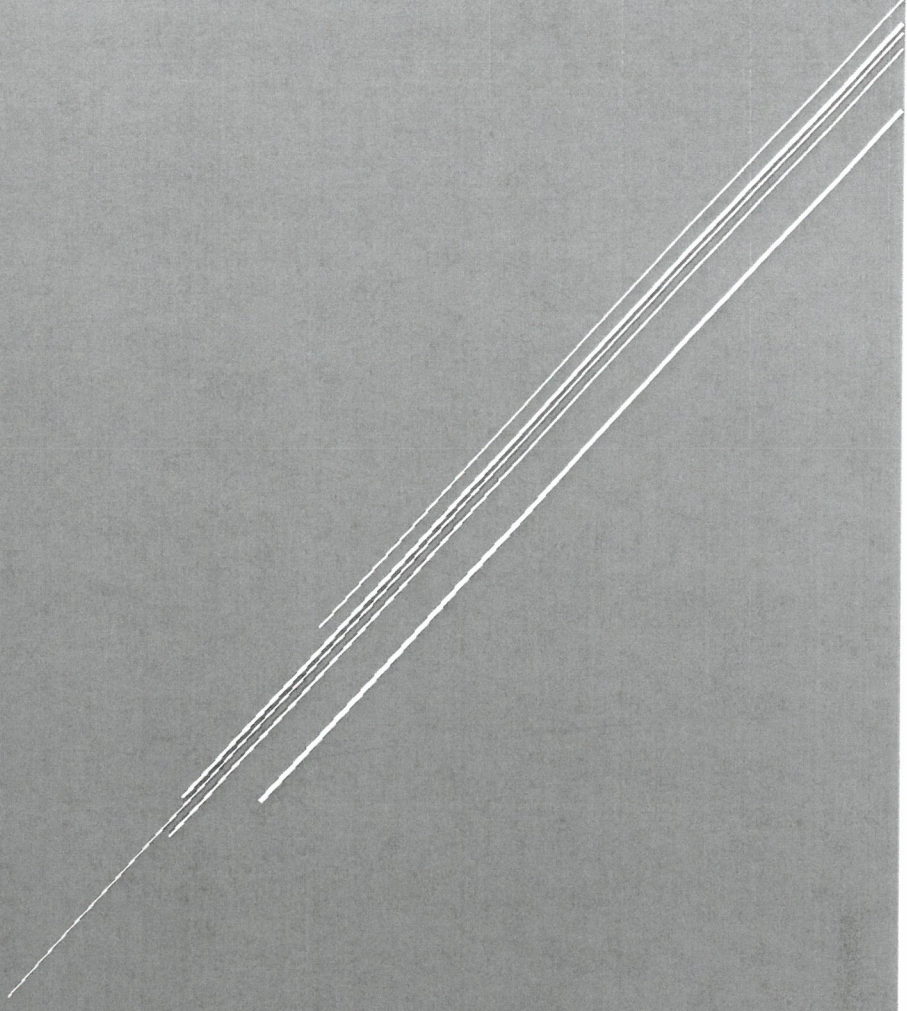




ELECTRICAL PROJECT

Morgan Williams

Contents

Introduction:	2
Lights:	3
Electrical Drawings:	7
Protective Devices:	8
Cable Calculations:	10
Load Balancing:	13
Distribution Boards 1 + 2:	14
Cable Support System:	15
References.....	16

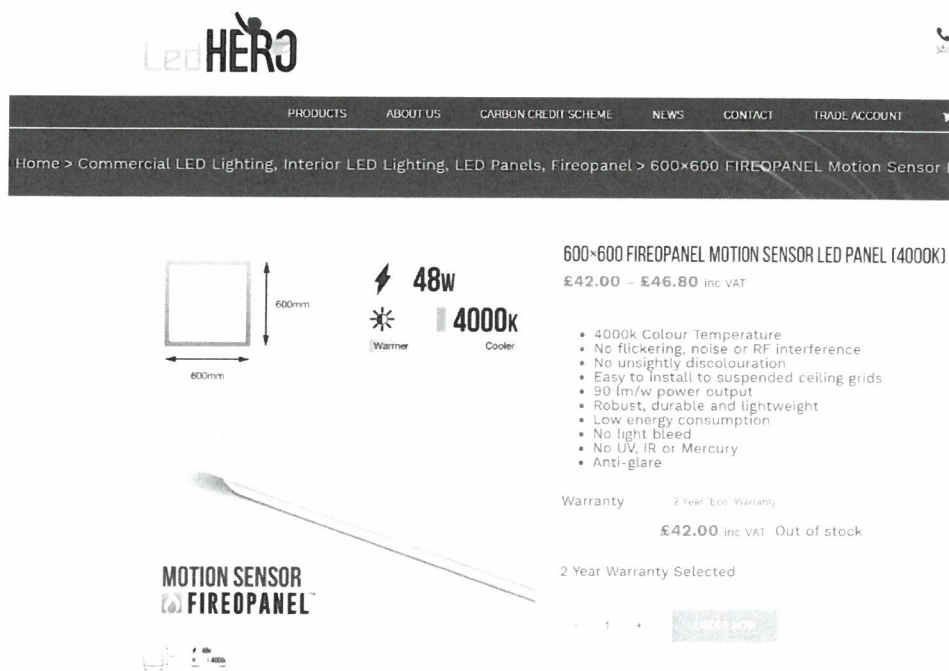
Introduction:

For this task, a sheltered accommodation is to be constructed. It will consist of 6 single bedrooms, 1 double bedroom, communal area/ kitchen and upstairs/ downstairs corridors. This project is for the design of the wiring systems, and electrical distribution within the sheltered accommodation. Within the accommodation, there are multiple types of circuits which includes 3 phase and single phase circuits.

Lights:

Corridor Lights:

For the corridor lights 600mm×600mm LED panel lights were selected due to the fact that there is unlimited budget, with lower power consumption than fluorescent lights, no start up current, no chemicals (e.g. mercury, phosphor) and they last longer making LED's more environmentally friendly and easier to maintain. Another reason for selecting these LED panels in particular is due to the fact that they have a built in motion sensor which not only reduces their energy consumption on normal lights which people may forget to turn off after use, it reduces the amount of wiring which needs to go into the circuit due to the fact that switches for these lights do not need to be installed reducing short term costs as well as long term and reducing copper use making the building more environmentally friendly. These lights also have a CE rating meaning that they have been built to European standards and are safe to use within the UK.



The screenshot shows the Led HERO website interface. At the top is the Led HERO logo and a navigation menu with links: PRODUCTS, ABOUT US, CARBON CREDIT SCHEME, NEWS, CONTACT, and TRADE ACCOUNT. Below the menu is a breadcrumb trail: Home > Commercial LED Lighting, Interior LED Lighting, LED Panels, Fireopanel > 600x600 FIREOPANEL Motion Sensor LED Panel (4000K). The main product area features a square LED panel with dimensions 600mm by 600mm. To the right of the panel, it specifies 48W power consumption and 4000K color temperature, with a 'Warmer' to 'Cooler' gradient bar. A list of features includes: 4000k Colour Temperature, No flickering, noise or RF interference, No unsightly discoloration, Easy to install to suspended ceiling grids, 90 lm/w power output, Robust, durable and lightweight, Low energy consumption, No light bleed, No UV, IR or Mercury, and Anti-glare. The price is listed as £42.00 - £46.80 inc VAT. A 'Warranty' section shows '2 Year Eco Warranty' selected, with the price £42.00 inc VAT and a note 'Out of stock'. At the bottom, there is a '2 Year Warranty Selected' option and a 'BUY NOW' button.

600x600 FIREOPANEL MOTION SENSOR LED PANEL (4000K)

£42.00 - £46.80 inc VAT

- 4000k Colour Temperature
- No flickering, noise or RF interference
- No unsightly discoloration
- Easy to install to suspended ceiling grids
- 90 lm/w power output
- Robust, durable and lightweight
- Low energy consumption
- No light bleed
- No UV, IR or Mercury
- Anti-glare

Warranty 2 Year Eco Warranty

£42.00 inc VAT Out of stock

2 Year Warranty Selected

BUY NOW

Additional information

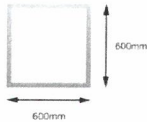
Dimensions	595 x 595 x 34 mm
Working Temperature	-20°C to +60°C
Working Humidity	10% – 70%
IP Rating	20
Executive Standard	CE
Luminosity	4320 Lumens
Lumens / Watt	90 lm/w
Input Current	0.7A
Output Current	360mA
Power Efficiency	>90%
Rated Voltage	220V
Output Voltage	100 – 150V
UGR	<18
Beam Angle	120°
Luminous Flux	3300 Lumens
Luminous Efficiency	>80lm/w
LED Chips	28 35
SDCM	<10%
CRI	>80
THD	<20%
PF	0.5
Input Supply	185-265v, 50-60Hz
Warranty	2 Year "Eco" Warranty, 5 Year "Premium" Warranty
Power	48W
Colour Temperature	4000K (Day Light)
Size	600x600mm

(ledhero, n.d.)

Communal Room Lights:

For the communal room, the same brand of LED panels were selected but without the microwave sensors. This is due to the fact that when people are in the communal room they may be sitting still which would result in the lights deactivating so a switched light would be more suitable for the communal lights. The ones which were selected also have the CE mark. These lights also come in packs of 8 and reduce overall cost for a bulk purchase and leave some additional spares in case any of the lights fail.

Home > Panels by the Box, LED Panels, Fireopanel > [Box of 8] 600x600 FIREOPANEL Standard LED Panel (4000K)



600mm
600mm
34mm

36w

4000k

Warmer Cooler

[BOX OF 8] 600x600 FIREOPANEL STANDARD LED PANEL (4000K)

£240.00 – £300.00 inc VAT

- 4000k Colour Temperature
- No flickering, noise or RF interference
- No unsightly discolouration
- Easy to install to suspended ceiling grids
- 120 lm/w power output
- Robust, durable and lightweight
- Low energy consumption
- No light bleed
- No UV, IR or Mercury
- Anti-glare

Add Backup Supply [Choose an option](#)

1 [Add to Basket](#)

STANDARD FIREOPANEL™

SKU: BOX-8UNITS-4K-FIREOPANEL
Categories: Fireopanel, LED Panels, Panels by the Box

Description

Product Data Sheet

Additional information

Dimensions	595 × 595 × 34 mm
Working Temperature	-20°C to +60°C
Working Humidity	10% – 70%
IP Rating	20
Executive Standard	CE
Luminosity	3600 Lumens
Lumens / Watt	100 lm/w
Input Current	0.7A
Output Current	360mA
Power Efficiency	>90%
Rated Voltage	220V
Output Voltage	100 – 150V
UGR	<18
Beam Angle	120°
Luminous Flux	3300 Lumens
Luminous Efficiency	>80lm/w
LED Chips	28 35
SDCM	<10%
CRI	>80
THD	<20%
PF	0.5
Input Supply	185-265v, 50-60Hz
Colour Temperature	4000K (Day Light)
Power	36W
Size	600x600mm
Add Backup Supply	No Backup Supply, 2x Emergency Plug & Play Driver

(ledhero, n.d.)

Emergency Lights:

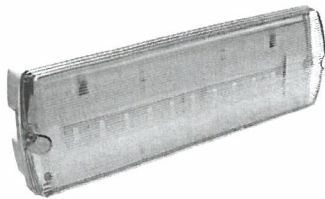
The requirements of emergency lighting is that the system should cover each exit door, escape routes, intersections in corridors, change in level between floors, windowless rooms and firefighting equipment.

The two main types of luminaries used for emergency lighting are self-contained and centrally supplied. A self-contained unit contains all the essential components including the charger, lamp, test equipment etc. Centrally supplied units are all fed from an emergency power system and are known as slave systems as they do not carry out operations independently. A centrally supplied unit may contain a battery and the luminaire but not much else will be found in this unit. Advantages of a self-contained unit over a centrally supplied are that it's easier to install, more flexible to install, no required room for battery and less maintenance but its disadvantages are that it more expensive, can be dimmer, more affected by differing temperatures and it doesn't have real time monitoring.

For emergency lights, maintained emergency lights were selected for this project. This is due to the fact that unlike non maintained lights, they are constantly on and do not need to be tested to see if they are work which should reduce the need for maintenance in the operation of these lights. The ones selected also have a low energy draw of just 2w per light. As per regulations for emergency lighting, a light has been placed at every junction of the accommodation in order to guide people to the exit of the accommodation.

LED IP65 Emergency Bulkhead Maintained 2W 78lm

Product code: 42591 Pack size: Each



£17.20

Exc. VAT: £14.33

★ ★ ★ ★ ★

Read reviews (11)



Catalogue page

Quantity

Add to trolley for...



COLLECTION

Check stock in your local branch



DELIVERY

20+ available for delivery:



Order before 9pm to receive your item the next working day.

Product Details

LED 3 hour maintained bulkhead 10 LED SMD strip. Can be converted to non-maintained operation. Includes self adhesive legend.

Technical Specification

Manufacture ID	LED10EM3CLR
Wattage	2
Lumens	78
Light Bulb Technology	LED
Type	
Type	Bulkhead Lighting
IP Rating	IP65

Delivery details

Click & Collect details

(ToolStation, n.d.)

The other option of having a non maintained emergency lighting may consume less electricity but it is less likely to be spotted if there is a fault with the circuit. There is also the added benefit of not having to install test facilities for the emergency lighting making it quicker, cheaper and easier to install.

Electrical Drawings:

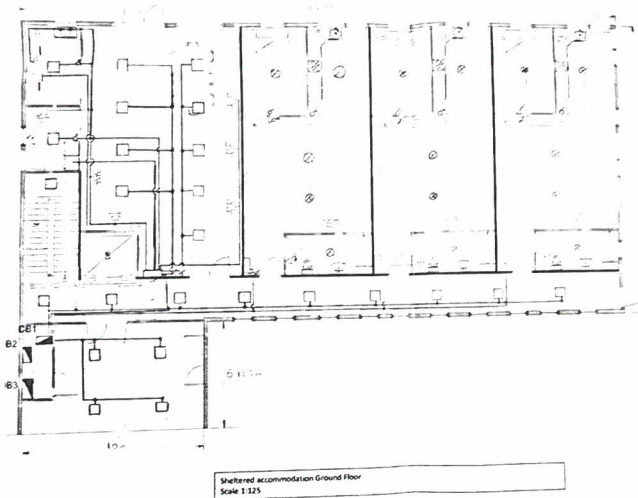
In order to determine the routes of which the cables would take as well as the locations of the fittings (e.g. light fittings, plug sockets etc.) there would have to be a few drawings created for the sheltered accommodation. From these drawings, the cable lengths may also be calculated as the drawing is a scale drawing. 1:125 scale (A3)

I can get the correct scale of the drawings by multiply the figure which I get from the ruler by 1.25.

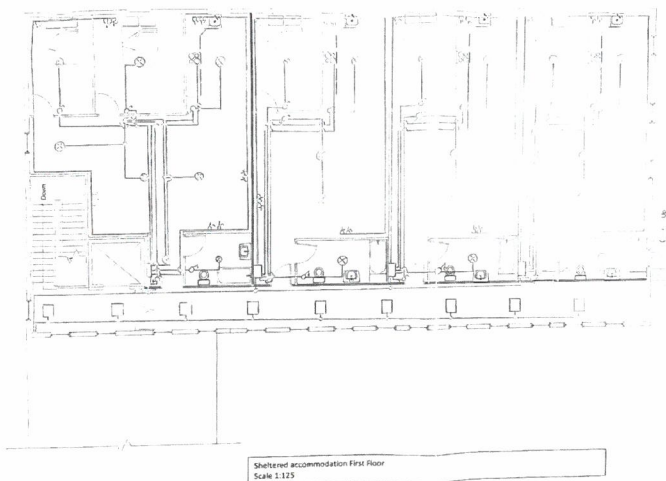
e.g. $6\text{cm} \times 1.25 = 7.5\text{m}(\text{scale})$

With the drawings, I also used an online lighting calculator to get an accurate idea of how many lights per room which I'd need for my selected light type. (Haponiuk, n.d.)

For the drawings, A main drawing plan will be made which shows all of the electrical wiring apart from the emergency lighting which will get its own wiring diagram.



Up Stairs



Down Stairs

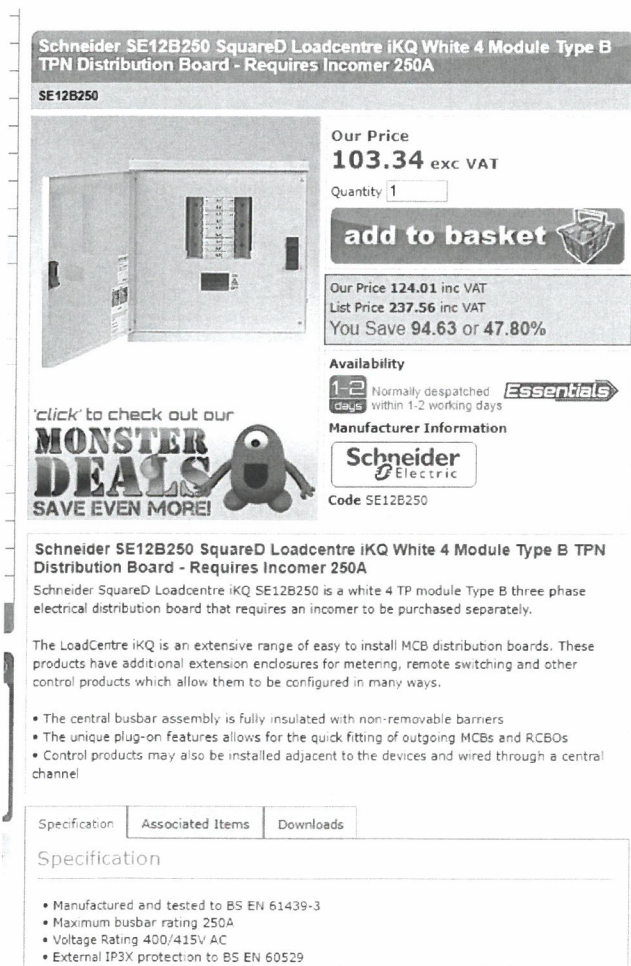
From these drawings which have been constructed, the cable calculations can now be carried out. These will determine things such as cable size and protection etc. These drawings were carried out

by hand since the drawings supplied were not in a format which could be easily edited on the PC but were scaled for a A3 paper print out.

Protective Devices:

For this project, there are multiple devices which need electrical protection. For the 3 phase circuits, and for the single phase circuit's trip devices were selected over fuses. This is due to the fact that most plug sockets themselves are fused if they are overloaded and will likely blow before they trip the circuit. As lights are unlikely to change over their load delivery, they do not really need to be fused and can be put straight into an rcd. In this project, each room has its own mcb to add in discrimination for the circuits so if one room is overloaded, it won't trip out the rest of the accommodation and will help isolate if there are any problems.

For the board DB3, a 3 phase distribution board was selected. This has the potential to carry up to 4 circuits which means that it has one more space than is required which gives more expandability for the future if the owners of the accommodation decide that another 3 phase appliance is to be installed.



Schneider SE12B250 SquareD Loadcentre iKQ White 4 Module Type B TPN Distribution Board - Requires Incomer 250A

SE12B250

Our Price 103.34 exc VAT

Quantity

add to basket

Our Price 124.01 inc VAT
List Price 237.56 inc VAT
You Save 94.63 or 47.80%

Availability
1-2 days Normally despatched within 1-2 working days **Essentials**

Manufacturer Information
Schneider Electric
Code SE12B250

'click' to check out our MONSTER DEALS SAVE EVEN MORE!

Schneider SE12B250 SquareD Loadcentre iKQ White 4 Module Type B TPN Distribution Board - Requires Incomer 250A

Schneider SquareD Loadcentre iKQ SE12B250 is a white 4 TP module Type B three phase electrical distribution board that requires an incomer to be purchased separately.

The LoadCentre iKQ is an extensive range of easy to install MCB distribution boards. These products have additional extension enclosures for metering, remote switching and other control products which allow them to be configured in many ways.

- The central busbar assembly is fully insulated with non-removable barriers
- The unique plug-on features allows for the quick fitting of outgoing MCBs and RCBOs
- Control products may also be installed adjacent to the devices and wired through a central channel

Specification | **Associated Items** | **Downloads**

Specification

- Manufactured and tested to BS EN 61439-3
- Maximum busbar rating 250A
- Voltage Rating 400/415V AC
- External IP3X protection to BS EN 60529

(<http://www.discount-electrical.co.uk>, n.d.)

This is the main incomer board which has been selected. For each of the circuits, the appropriate MCB can be selected and installed into the board.

An MCB is a protective device designed to trip when a certain amperage is reached and will do this within the first half cycle of the incoming current. For the trip device which will go into the

distribution board, a MCB will be selected as these can come in multiple sizes. An MCB will also trip in around 0.01 seconds and should protect the user and devices adequately.

Schneider SE10C116 SquareD Loadcentre iKQ 1 Module Single Pole Type C Miniature Circuit Breaker MCB 16A 10kA

SE10C116

Our Price **8.49** exc VAT

Quantity

add to basket

Our Price **10.19** inc VAT
List Price **18.86** inc VAT
You Save **7.23** or **45.99%**

Availability
1-2 days Normally despatched within 1-2 working days **Essentials**

Manufacturer Information
Schneider Electric
Code SE10C116

'click' to check out our **MONSTER DEALS** SAVE EVEN MORE!

Schneider SE10C116 SquareD Loadcentre iKQ 1 Module Single Pole Type C Miniature Circuit Breaker MCB 16A 10kA

Fuses:



A fuse is a safety device which is used to protect an electrical circuit and usually consists of a encased piece of wire built into a housing with two conductive poles and designed to melt at a certain amperage. Each of the sockets in the accommodation are fused sockets. This should reduce the chance of one socket shorting out the entire circuit if it is overloaded by the user. Once the fuse is blown it should be easy to change.

Cable Calculations:

In order to determine the correct cable sizes and protection, several calculations need to be carried out in the electrical project. During these calculations, several assumptions had to be made in the calculations such as the amount of power which an appliance consumes when plugged into a plug socket and the way the plug sockets are wired up. For these calculations, Microsoft excel was used due to the fact that it could make it quicker to carry out the calculations as well as it is likely to make less mistakes unless a mistake is made in the construction of the equations in Microsoft excel.

Design Current:

The first calculation to be made was to determine the design current of the circuit. This was done by taking the assumed power of the circuit and dividing it by the voltage of the circuit:

$$I_b(\text{Design Current}) = \frac{P}{V}$$

For 3 phase circuits:

$$I_b = \frac{I_n}{C_a \times C_g \times C_i \times C_f \times C_c}$$

Protective Device:

Next the protective device can now be selected since the design current has been worked out. I decided to fit each bedroom with a mini circuit breaker. These then went to the incomer boards (DB1, DB2, DB3).

Current Carrying Capacity:

The next part of the calculations was to work out the maximum current carrying capacity of the cable. The calculation used was:

$$I_z = \frac{I_n}{C_a \times C_g}$$

Selecting Cable Size:

After determining the current carrying capacity, the cable size can now be selected. The onsite guide page 196 can be used to select the correct size cable for the job as it contains information on what the max current load on each cable is.

1	-	18.10	
1	1	36.20	
1.5	-	12.10	
1.5	1	30.20	
1.5	1.5	24.20	
2.5	-	7.41	
2.5	1	25.51	
2.5	1.5	19.51	
2.5	2.5	14.82	
4	-	4.61	
4	1.5	16.71	
4	2.5	12.02	
4	4	9.22	
6	-	3.08	
6	2.5	10.49	
6	4	7.69	
6	6	6.16	
10	-	1.83	
10	4	6.44	
10	6	4.91	
10	10	3.66	
16	-	1.15	1.91
16	6	4.23	-
16	10	2.98	-
16	16	2.30	3.82
25	-	0.727	1.20
25	10	2.557	-
25	16	1.877	-
25	25	1.454	2.40
35	-	0.524	0.87
35	16	1.674	2.78
35	25	1.251	2.07
35	35	1.048	1.74
50	-	0.387	0.64
50	25	1.114	1.84
50	35	0.911	1.51
50	50	0.774	1.28

(Institute For Engineering And Technology, 2018)

Voltage Drop:

The next step of the cable calculations is to calculate the voltage drop. This is done by using the formula of:

$$((mV/A/m) \times Ib \times \text{length}) / 1,000$$

By using the table from the cable calculation, the value for mV/A/m can be found.

Determine Max Resistance Of Circuit:

Next in the calculations of the cables is the calculation of the max resistance within the circuit. The formula used for this is:

$$R1+R2 = \frac{(R1+R2) \times \text{multiplier} \times \text{length}}{1000}$$

Max Zs:

The maximum Zs can be used from the formula of:

$$Zs = Ze + (R1 + R2)$$

From using tables 41.3 in the 18th edition, the value can be checked and compared to that of the max ZS values of the protection device selected. (Institute For Engineering Technology, 2020)

Fault Current:

With the ZS value, the fault current and circuit disconnect time can now be determined. The fault current is determined through the formula of:

$I_f = \frac{U_{oc}}{Z_s}$ With U_{oc} standing for nominal voltage out and Z_s standing for earth fault loop impedance.

Disconnection Time:

With the fault current determined, the disconnection time of the safety device can now be found in the graph in the 18th edition BS7671 book.

Bedroom Cable Calculations															
Ground Floor Room 1:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time (Sec)
	Cooker:	4000	230	17.39130435	15.25	20	24	23.67984945	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	500	230	2.173913043	25.25	3	24	3.586800574	1	3.333	36.2	1.09686	0.27	168.268879	0.01
	Sockets:	n/a	230	16	34.875	16	24	19.12960306	2.5	10.044	19.51	0.8164935	0.27	211.6901758	0.01
Ground Floor Room 2:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Cooker:	4000	230	17.39130435	15.25	20	24	23.91200383	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	500	230	2.173913043	25.25	3	24	3.586800574	1	3.333	36.2	1.09686	0.27	168.268879	0.01
	Sockets:	n/a	230	16	34.875	16	24	19.12960306	2.5	10.044	19.51	0.8164935	0.27	211.6901758	0.01
Ground Floor Room 3:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Cooker:	4000	230	17.39130435	15.25	20	24	23.91200383	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	500	230	2.173913043	25.25	3	24	3.586800574	1	3.333	36.2	1.09686	0.27	168.268879	0.01
	Sockets:	n/a	230	16	34.875	16	24	19.12960306	2.5	10.044	19.51	0.8164935	0.27	211.6901758	0.01
First Floor Room 1 (Double Room):	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Cooker:	4000	230	17.39130435	13.25	20	24	23.91200383	2.5	4.147826087	19.51	0.310709	0.27	396.4083800	0.01
	Lighting:	800	230	3.47826087	48.875	6	24	7.173601148	1	12.903	36.2	2.12313	0.27	96.10944375	0.01
	Sockets Radial 1:	n/a	230	18	28.875	18	24	19.12960306	2.5	6.876	19.51	0.5589615	0.27	277.4558615	0.01
First Floor Room 2:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Cooker:	4000	230	17.39130435	15.25	20	24	23.91200383	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	500	230	2.173913043	25.25	3	24	3.586800574	1	3.333	36.2	1.09686	0.27	168.268879	0.01
	Sockets:	n/a	230	16	34.875	16	24	19.12960306	2.5	10.044	19.51	0.8164935	0.27	211.6901758	0.01
First Floor Room 3:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Cooker:	4000	230	17.39130435	15.25	20	24	23.91200383	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	500	230	2.173913043	25.25	3	24	3.586800574	1	3.333	36.2	1.09686	0.27	168.268879	0.01
	Sockets:	n/a	230	16	34.875	16	24	19.12960306	2.5	10.044	19.51	0.8164935	0.27	211.6901758	0.01
First Floor Room 4:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Cooker:	4000	230	17.39130435	15.25	20	24	23.91200383	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	500	230	2.173913043	25.25	3	24	3.586800574	1	3.333	36.2	1.09686	0.27	168.268879	0.01
	Sockets:	n/a	230	16	34.875	16	24	19.12960306	2.5	10.044	19.51	0.8164935	0.27	211.6901758	0.01
Corridors:															
Ground Floor Corridor:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Plugs:	n/a	230	16	25	20	28	24.3902439	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	1000	230	4.347826087	39.5	6	28	7.317073171	1.5	6.873	30.2	1.09686	0.27	168.268879	0.01
	Emergency Lights:	26	230	0.113043478	75.375	3	28	3.58536585	1	9.9495	36.2	0.5853	0.27	268.911493	0.01
First Floor Corridor:	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Plugs:	n/a	230	16	25	20	28	24.3902439	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Lighting:	900	230	3.913043478	33.5	6	28	7.317073171	1.5	5.829	30.2	1.09686	0.27	168.268879	0.01
	Emergency Lights:	14	230	0.008959565	35.625	3	28	3.58536585	1	4702.5	36.2	1.54755	0.27	211.6901758	0.01
Common Room															
	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Radial 1:	n/a	230	16	25	20	28	24.3902439	2.5	5.49	19.51	0.357033	0.27	366.8068507	0.01
	Radial 2:	n/a	230	16	14.25	20	28	24.3902439	2.5	5.829	30.2	1.09686	0.27	168.268879	0.01
	Lighting:	1100	230	4.782608696	39	6	28	7.317073171	1.5	4702.5	36.2	1.54755	0.27	211.6901758	0.01
3 Phase Circuits															
	Device:	Power (W)	Voltage (V)	Design Current (I)	Cable Length (m)	MCB size (Amps):	Temp (°C):	Current Carrying Capacity Of Cable	Cable Size (mm)	Voltage Drop (V)	R1+R2	Max Resistance Of Circuit (OHMS)	Zs (OHMS)	If (Fault Current)	Disconnection Time
	Lift:	6900	400	0.814180971	10.625	16	28	19.51219512	2.5	3.06	19.51	0.47729375	0.27	535.264747	0.01
	Dryer:	6400	400	8.937149595	22.75	16	30	19.51219512	2.5	6.552	19.51	0.7138525	0.27	406.5650985	0.01
	Cooker:	7000	400	9.788438275	30.375	16	30	19.51219512	2.5	8.748	19.51	0.8621625	0.27	353.164631	0.01

Load Balancing:

With three phase power, the load needs to be kept balanced during operation. This is due to the fact that in an unbalanced 3 phase circuit the neutral may end up carrying some of the current. By reducing load imbalance (Almost impossible to eliminate imbalance in real world) you can reduce the power consumption of a circuit as the neutral will no longer be drawing current. This should also reduce stress on the appliances used within the three phase circuits. (Barnett, 2009)

For this project, the board DB3 was selected to be the 3 Phase Board with an incomer of 400v. The other two boards are assumed to be 230v mains incomer boards.

The calculations were done in Microsoft excel which shows each of the live conductors and the current draw on that circuit shown below:

3 Phase Balancing (DB3):			
Phase:	L1	L2	L3
Lift:	13.4	13.4	13.4
Dryer:	8.9	8.9	8.9
Cooker:	9.74	9.74	9.74
Total Amps:	32.04	32.04	32.04
X Component ($=\cos\theta \times Lx$):	32.04	-16.02	-16.02
Y Component ($=\sin\theta \times Lx$):	0	27.747	-27.747
	Y axis:	X Axis:	Current:
Neutral:	0	0	0

For information on how to calculate if a load is balanced a video from YouTube was used to give basic information (Vree, 2015)

With this table now complete, it showed that the 3 phase circuits in the project were balanced and that there was no load on the neutral conductor.

Distribution Boards 1 + 2:

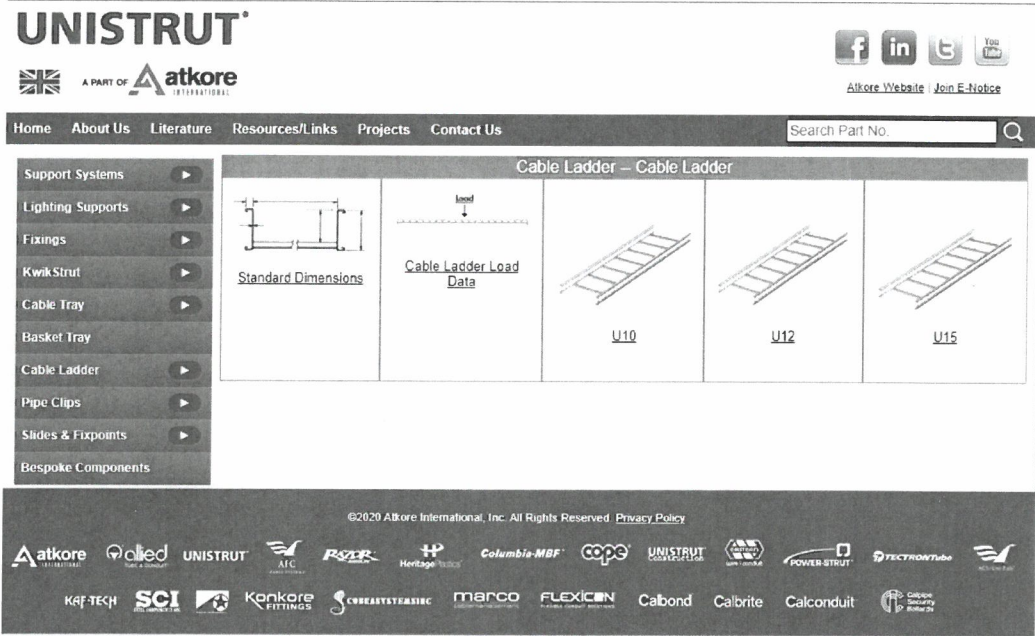
To show how the cables would be routed to each of the circuits, a table was constructed on excel to show what circuits supply what in the distribution boards 1+2.

Single Bedrooms:	Device:	MCB size (Amps):
	Cooker:	20
	Lighting:	3
	Sockets:	16
Double Bedroom:	Device:	MCB size (Amps):
	Cooker:	20
	Lighting:	6
	Sockets Radial 1:	16
	Sockets Radial 2:	16
Ground Floor Corridor:	Device:	MCB size (Amps):
	Plugs:	20
	Lighting:	6
	Emergency Lights:	3
First Floor Corridor:	Device:	MCB size (Amps):
	Plugs:	20
	Lighting:	6
	Emergency Lights:	3
Common Room:	Device:	MCB size (Amps):
	Radial 1:	20
	Radial 2:	20
	Lighting:	6
DB1:	Device:	MCB size (Amps):
	MCB To Rooms:	80
	Lighting:	6
	Sockets:	16
DB2	Device:	MCB size (Amps):
	MCB To Rooms:	80
	Lighting:	6
	Sockets:	16

Cable Support System:

The selected cable support system for this project is going to be a cable tray support system. This is due to the fact that since there is a suspended ceiling, it should be easier to install than electrical conduit, but another big benefit over electrical conduit is the fact that a cable tray system can carry multiple cables at once where as a conduit system limits expandability and makes it more difficult to install the cables for the electrical systems.

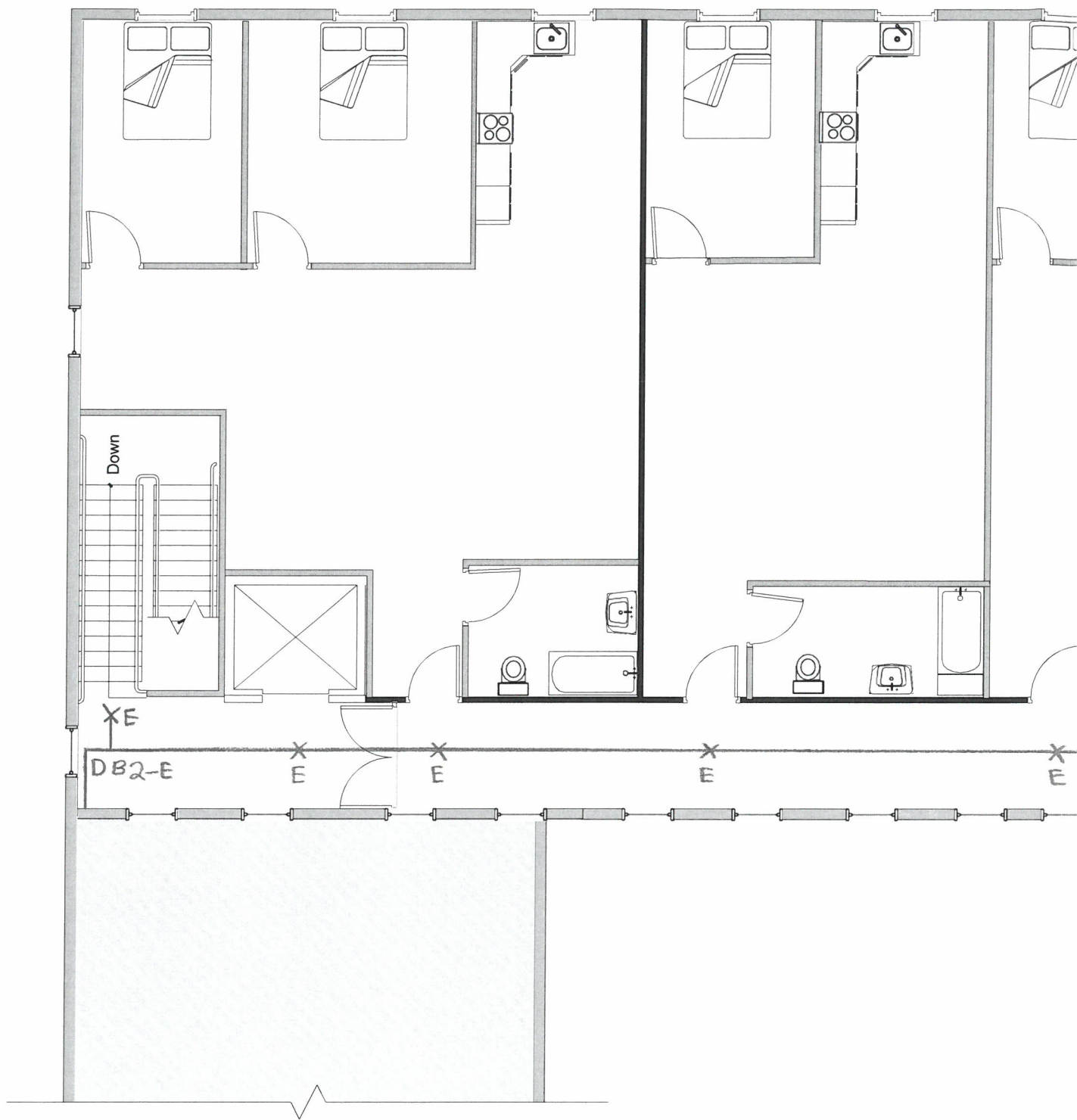
In an industrial system a conduit system may have an advantage due to the fact that the wires are more protected from bumps and accidents but since the wires are supported above the ceiling it is very unlikely that they will be bumped by anyone.



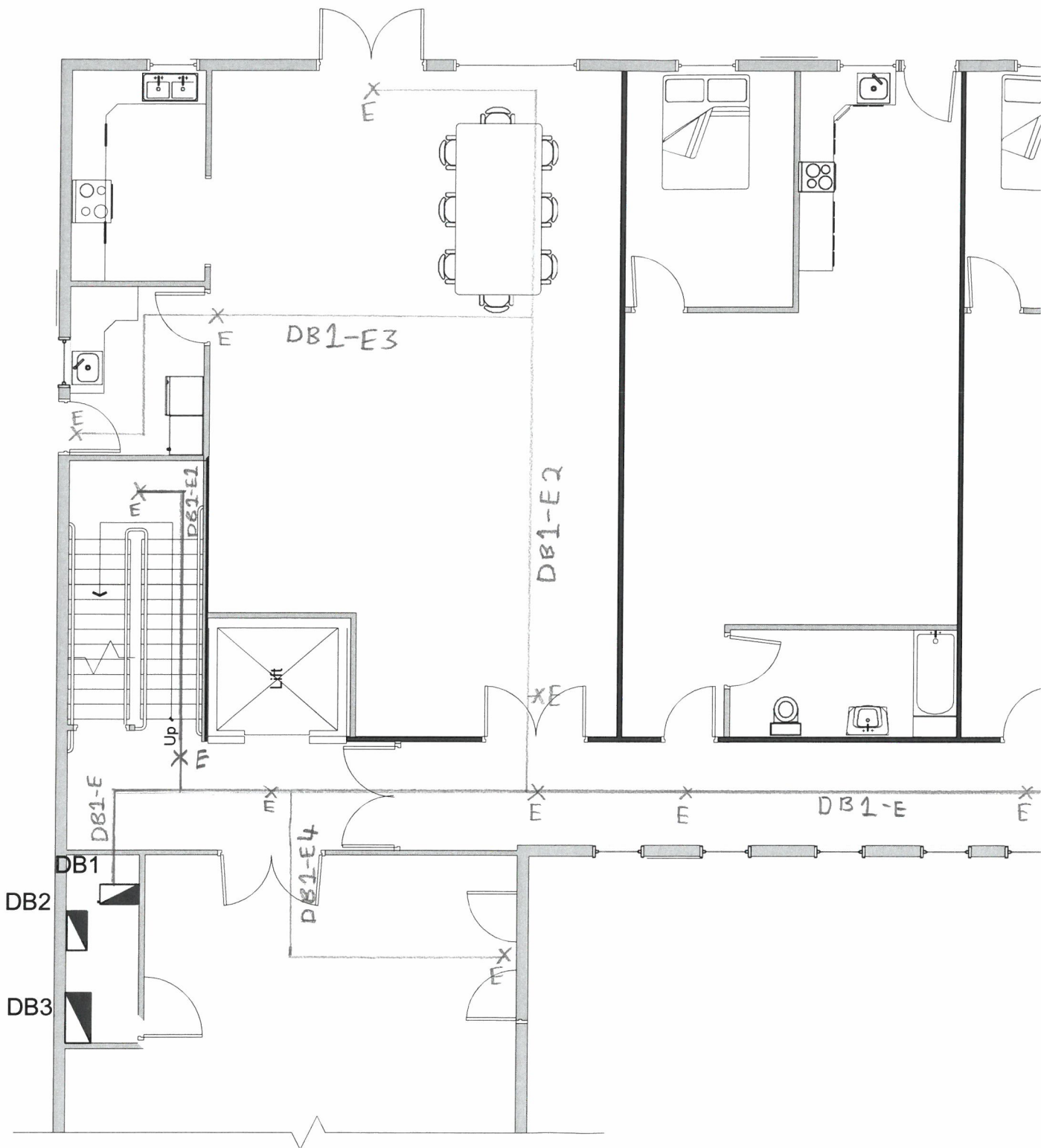
n.d.) (UNISTRUT,

References

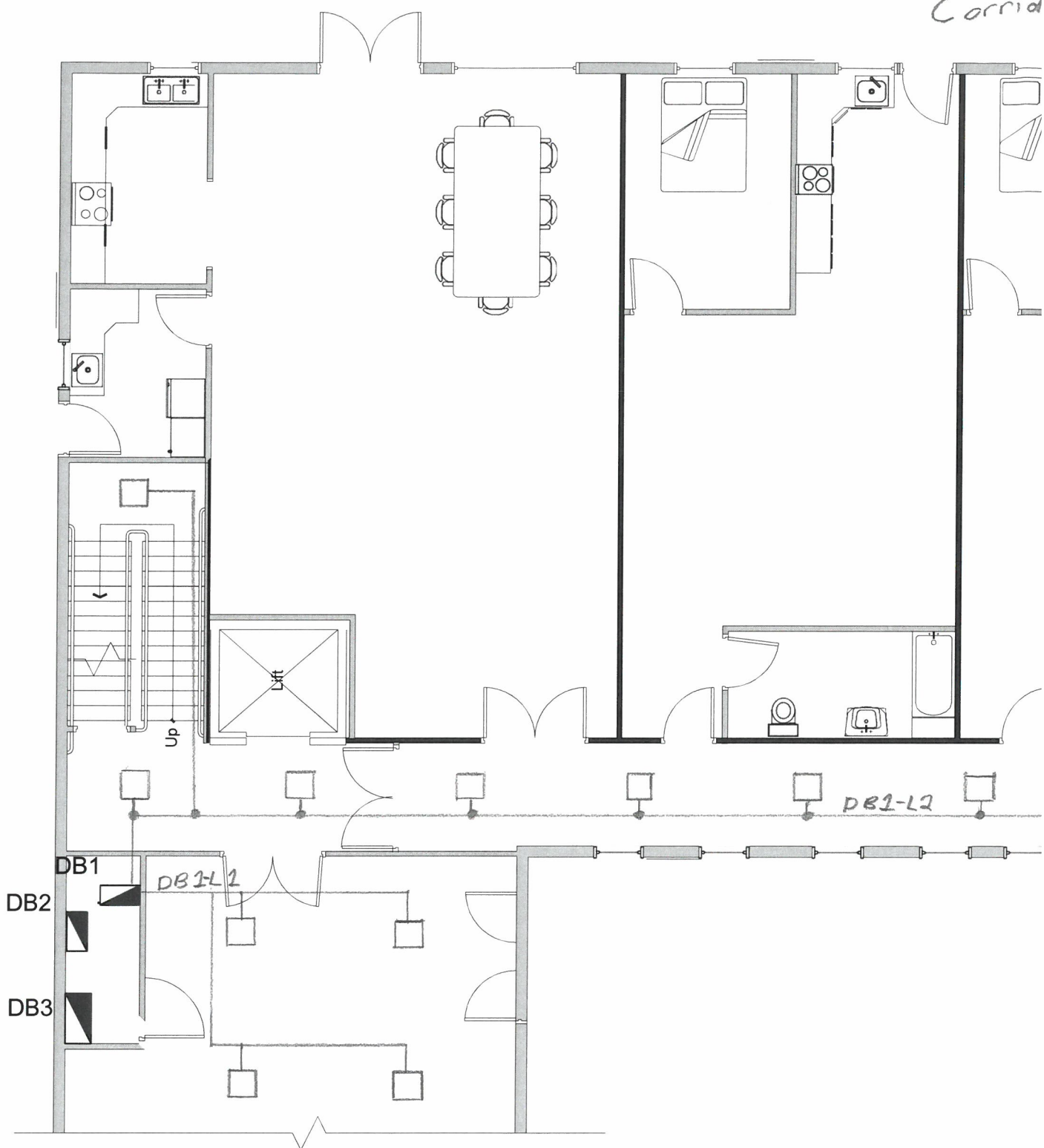
- Barnett, R. (2009, JAN 01). *Saving Energy Through Load Balancing and Scheduling*. Retrieved from EC&M: <https://www.ecmweb.com/power-quality-reliability/article/20892715/saving-energy-through-load-balancing-and-scheduling>
- Haponiuk, B. (n.d.). *Lighting Calculator*. Retrieved from Omni Calculator : <https://www.omnicalculator.com/everyday-life/lighting>
- <http://www.discount-electrical.co.uk>. (n.d.). *Schneider SE12B250 SquareD Loadcentre iKQ White 4 Module Type B TPN Distribution Board - Requires Incomer 250A*. Retrieved from http://www.discount-electrical.co.uk/product.php/396732655/Schneider-SE12B250-SquareD-Loadcentre-iKQ-White-4-Module-Type-B-TPN-Distribution-Board---Requires-Incomer-250A?gclid=CjwKCAiA0svwBRBhEiwAHqKjFqTepX-jInCF_g3o9_UBgKZPMns2EWj78-1TIlzQolpXMPsuD0p6bxo
- Institute For Engineering And Technology. (2018). *On Site Guide*. IET.
- Institute For Engineering Technology. (2020). *Requirements for Electrical Installations, IET Wiring Regulations, Eighteenth Edition*. IET.
- ledhero. (n.d.). *[Box of 8] 600×600 FIREOPANEL Standard LED Panel (4000K)* . Retrieved from ledhero: <https://www.ledhero.co.uk/products/led-panels/panels-by-the-box/600x600-fireopanel-standard-led-panel-4000k-box-of-8-panels/>
- ledhero. (n.d.). *600×600 FIREOPANEL Motion Sensor LED Panel (4000K)*. Retrieved from ledhero: <https://www.ledhero.co.uk/products/led-panels/600x600-fireopanel-motion-sensor-led-panel-4000k/>
- ToolStation. (n.d.). *LED IP65 Emergency Bulkhead*. Retrieved from <https://www.toolstation.com/led-ip65-emergency-bulkhead/p42591>
- UNISTRUT. (n.d.). Retrieved from <https://www.unistrut.co.uk/index.php?M1=Cable%20Ladder&M2=Cable%20Ladder>
- Vree, P. (2015, April 30). *3 Phase Neutral Current Calculation #1A (Balanced Loads)*. Retrieved from YouTube: <https://www.youtube.com/watch?v=DhQUGmg0fBk>



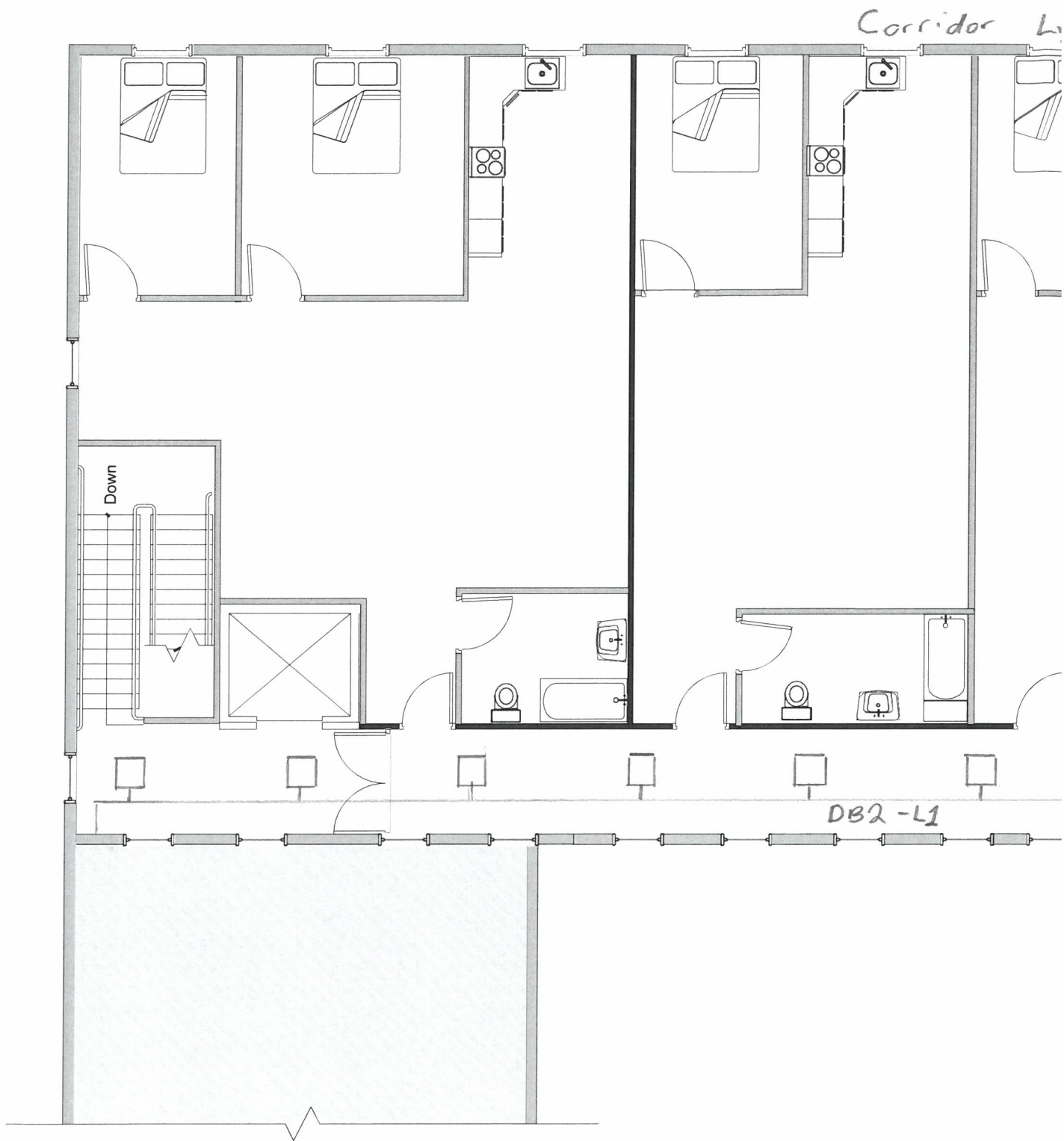
Sheltered accommodation First Floor
Scale 1:125



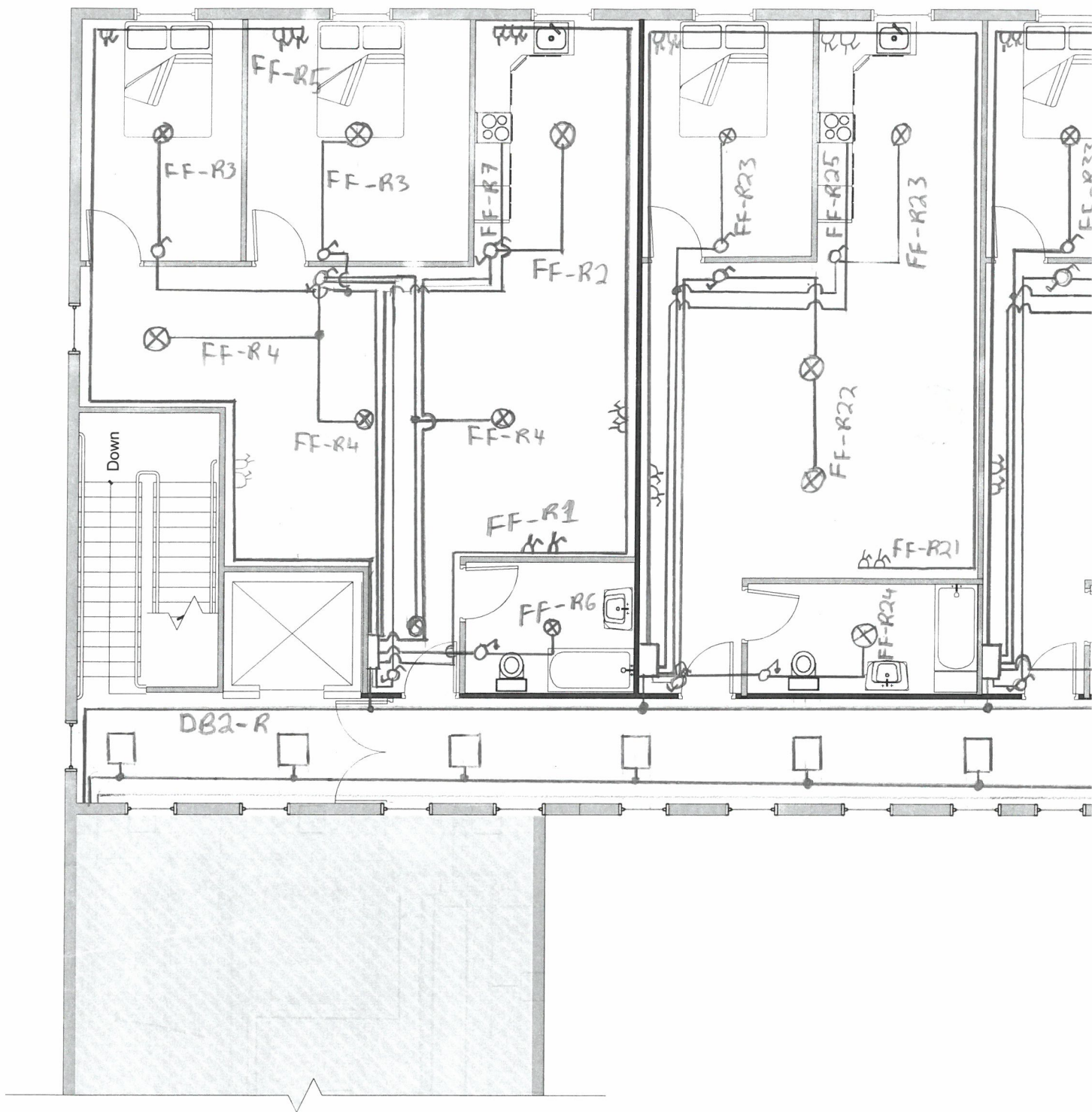
Sheltered accommodation Ground Floor
Scale 1:125



Sheltered accommodation Ground Floor
Scale 1:125



Sheltered accommodation First Floor
Scale 1:125



Sheltered accommodation First Floor
Scale 1:125