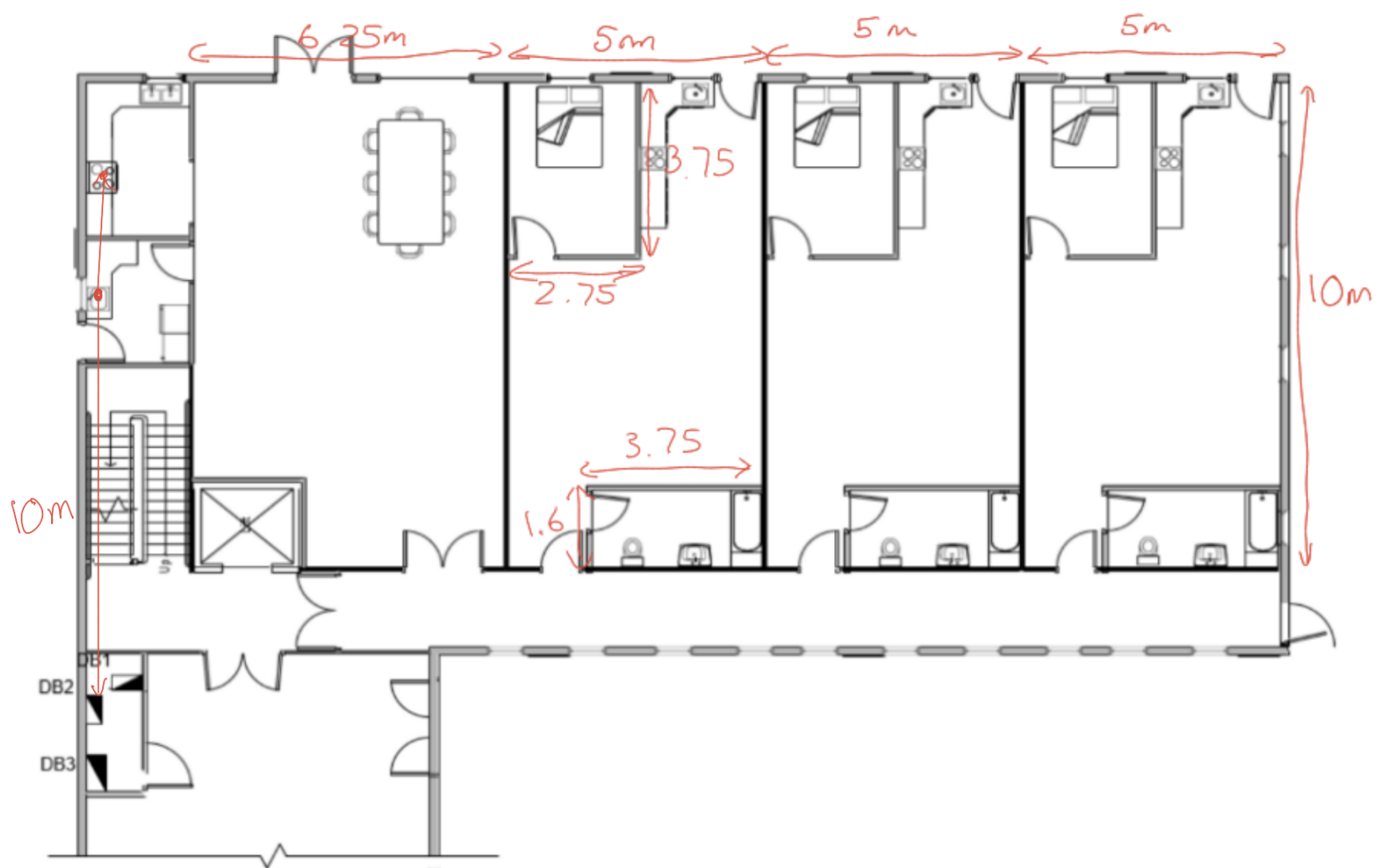
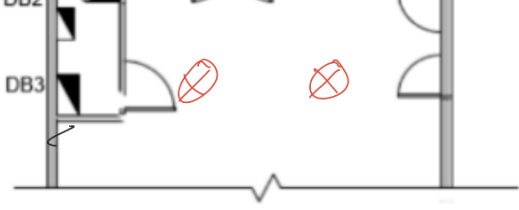


Joshua Cursio Electrical design Assignment



Appropriate lighting is required to be chosen in this assignment to fit with regulations. Based off personal experience and the size of the room it can assume the number of lights needed when designing.





When choosing lights there were a few options that were available to me.



HUBAA CEILING LIGHT

This light has a 1-year grantee, max wattage of 60W, power supply voltage of 220-240V, costs £14.99 and has a life span of 20,000 hours.

ENLITE SLIM-FIT FIXED LED DOWNLIGHT



This light has a 1-year grantee, a 6W power consumption, power supply voltage of 220-240V, costs £59.99, has a 520 Lumin rating and has a life span of 25,000 hours.



SYLVANIA STARTECO LED CEILING LIGHT

This light has a 3-year manufacturers grantee, 18W power consumption, power supply voltage of 220-240V, has a lifetime of 30000 hours and a Lumin level of 1550 lm.

When comparing all the lights I have decided to go with the SYLVANIA STARTECO LED CEILING LIGHT based on its many rewards. One example is the substantial increase in grantee time being 3 years. This helps if any faults occur in that period the light can be replaced at any point. Also, the lifetime of 30000 hours is a substantial amount for any household light.

Cable Calculations

Ring 1 - Bedroom Lights

Ring 2 - Kitchen dining Lights

Ring 3 - Hallway Lights

Ring 4 - Cooker

Ring 1

Current for circuit

$$I_b = \frac{P}{V} \quad (\text{single Phase})$$

$$\frac{8 \times 100}{230}$$

$$= 3.3A$$

Protective device

BSEN 60898 type B 6A. This is because the only available device below a 6A protective device is a 3 device. Choosing the 6A will not only cover the 3.3 amps calculated, but it will also allow room for any tolerance issues.

Current carrying capacity of cable

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

$$\frac{6A}{1.03 \times 0.82 \times 1 \times 1}$$

$$= 7.1A$$

Cable Size

Table 4D2A used

$$= 1.00 \text{ mm}^2 \text{ Cable}$$

Voltage Drop

$$V_d = \frac{mV/A/m \times I_b \times L}{1000}$$

$$\frac{44 \times 3.3 \times 16.245}{1000}$$

$$= 2.35 V$$

The max tolerance for the voltage drop is 3%. 2.35V is in this tolerance.

Max resistance

$$R1 + R2 = \frac{(r1 + r2) + \text{multiplier} \times \text{length}}{1000}$$

$$= \frac{36.2 \times 1.04 \times 16.245}{1000}$$

$$= 0.611 \Omega$$

$$Z_s = Z_e + (R1 + R2)$$

$$= Z_e + 0.611$$

$$= 0.27 + 0.611$$

$$= 0.881 \Omega$$

Ring 2

Design Current

$$I_n = 100 = 7.2 A$$

$$\frac{1 \times 100}{230} = 2.9A$$

Protective device

BSEN 60898 type B 6A. This is due to the only available device below a 6A protective device being a 3A device. Choosing the 6A will ensure the 3.3A calculated are covered as well as the tolerances needed.

Current carrying capacity

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

$$= \frac{6A}{1.03 \times 0.82 \times 1 \times 1}$$

$$= 7.1A$$

Cable Size

$$\text{Cable Size } 1.00\text{mm}^2$$

Voltage Drop

$$V_d = \frac{mV/A/m \times I_b \times L}{1000}$$

$$= \frac{44 \times 2.9 \times 21.25}{1000}$$

$$= 2.7V$$

When calculating the voltage drop there is a 3% tolerance allowed; because there is a voltage drop of 2.7V the circuit is in tolerance.

Max resistance

$$R1 + R2 = \frac{(r1 + r2) \times \text{multiplier} \times \text{length}}{1000}$$

$$= \frac{36.2 \times 1.04 \times 21.25}{1000}$$

$$= 0.8 \Omega$$

$$Zs = Ze + R1 + R2$$

$$= 0.27 + 0.8$$

$$= 1.07 \Omega$$

Ring 3 (Hallway Lighting)

Design Current

$$\frac{7 \times 100}{230} = 2.9A$$

Protective device

BSEN 60898 type B 6A. Choosing a 6A protective device is the safer option as the design current is close to the protective device rating of the one below (3A). Choosing the 6A will ensure the 2.9A calculated is covered including the tolerances needed.

Current carrying capacity

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

$$= \frac{6A}{1.03 \times 0.82 \times 1 \times 1}$$

$$= 7.1A$$

Cable Size

1.00mm² Cable Size.

Voltage Drop

$$V_d = \frac{Mv/A/m \times I_b \times L}{1000}$$

$$= \frac{44 \times 2.9A \times 26.25}{1000}$$

$$= 3.34V$$

When calculating the voltage drop there is a 3% tolerance allowed; because there is a voltage drop of 2.7V the circuit is in tolerance.

Max resistance

$$R1 + R2 = \frac{(r1 + r2) \times \text{multiplier} \times \text{length}}{1000}$$

$$= \frac{36.2 \times 1.04 \times 26.25}{1000}$$

$$1000$$

$$= 0.98 \Omega$$

$$Z_s = Z_e + (R_1 + R_2)$$

$$= 0.27 + 0.98$$

$$= 1.25 \Omega$$

Ring 4 - Cooker and Tumble dryer

Radial sent to the two due to the higher power usage.

Design Current

$$I_b = \frac{P}{V}$$

$$= \frac{7000 + 6400}{400}$$

$$= 33.5$$

Protective device

BS EN 60898 40A. I have chosen a 40A protective device due to when calculating the reading was 34.75A. When looking for the appropriate device, I found this as the most suitable. The device closest to this one was the 32A that would be below the amount of the reading.

Cable size

When finding the cable size, using method A for finding the correct sizing there is no 40A option available. From experience I have decided to use the cable from the reading of the 42A protective device; this makes sure the cable is suitable to fit the readings.

I have chosen the 10mm (2) cable.

Current capacity

$$\frac{I_n}{C_a \times C_i \times C_g \times C_f \times C_c}$$
$$= \frac{40}{1.03 \times 0.82}$$
$$= 47.3A$$

Cable Size

10mm² Cable size

Voltage Drop

$$V_d = \frac{mV/A/m \times I_b \times L}{1000}$$
$$= \frac{4.4 \times 33.5 \times 10}{1000}$$
$$= 1.47V$$

Max resistance

$$R_1 + R_2 = \frac{(r_1 + r_2) \times \text{multiplier} \times \text{length}}{1000}$$

$$= \frac{3.66 \times 1.04 \times 10}{1000}$$

$$= 0.03 \Omega$$

$$Z_s = Z_e + (R_1 + R_2)$$

$$= 0.27 + 0.03$$

$$= 0.3 \Omega$$

Fault Current

$$I_f = \frac{V_{OC}}{Z_s} = \frac{400}{0.3}$$

$$= 1333.3 \text{ A}$$

Minimum disconnection time is 0.1 seconds on a 40A. Although the fault current is 1333A, the protective device is there to make sure there are no problems.

Thermal constraints

$$S = \frac{\sqrt{I^2 \times t}}{K} = \frac{\sqrt{1333.3^2 \times 0.1}}{115}$$

$$= 421.6$$

115

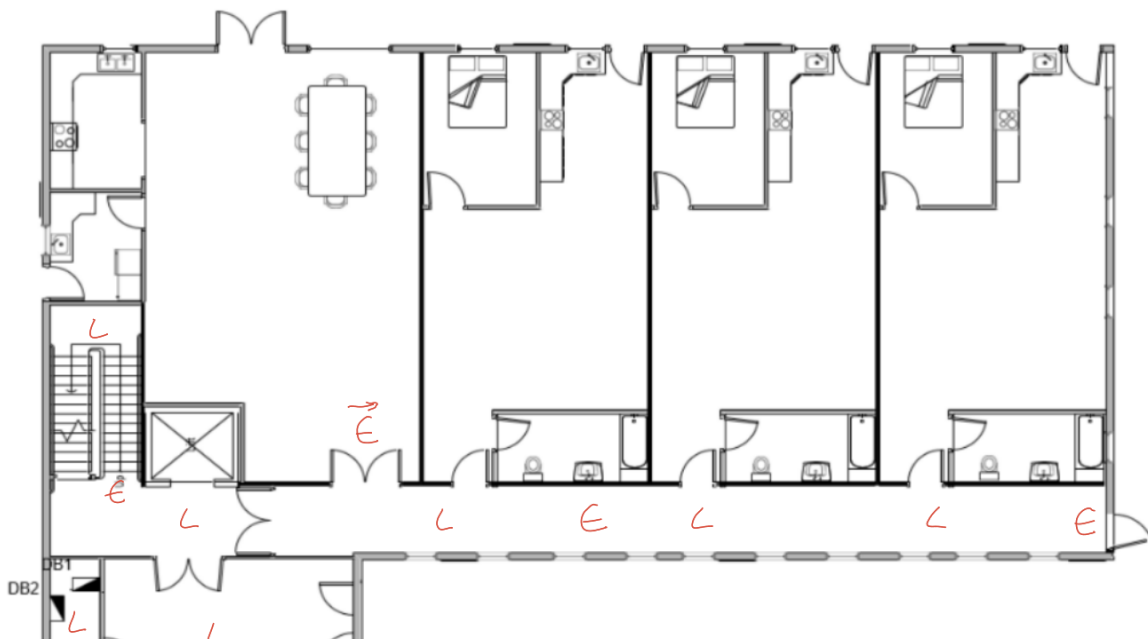
$$= 3.66 \text{ m}^2$$

Cable support system

When researching the appropriate wiring support systems there were lots of options to take in to account. One option was to have the cables chased in to the walls and piped conduit to support the cables strongly. However, due to the nature of the housing this level of protection isn't necessary. A similar and as effective method is to put the cables in a basket and trunkin throughout the property. The ceiling is easy to remove and get through. Any maintenance will be easy to sort as the trunkin will allow easy access to the cables. Installing trunkin allows for quick installment with no mess or risks involved. Baskets will be placed on top of the ceiling in order to guide them to the correct position and have no risk due to no immediate contact with the ceiling.

Emergency lighting design

When designing the emergency lighting diagram, I needed to consider the areas in which the lights are needed. Safelincs.co.uk said emergency lights are needed in 'all areas that are available to the public'. This means in this building the hallway and I'm going to add a smaller light in the communal living area above the exit to allow for maximum safety.





$E = \text{Exit Light}$

$L = \text{Normal Emergency Light}$

Emergency lighting is needed in certain places. One example of this is the stairs. 'An illuminated directional sign or series of signs must be provided to help people make their way to the emergency' (eaton.com) The stairs on the diagram shows there is a normal light in the middle to cover the stairs to reduce risks, and a directional light guiding the person towards the nearest exit. As the communal room is not necessarily open to public but is open to the residents living there, I decided to put in one directional light as a safety precaution. The hallway is then covered to ensure there are no darker spots, while having a directional light Aswell to guide the person. As there is no specific area for the fire extinguisher, I covered all areas in the hallway to ensure that and a potential health and safety kit is show clearly.

Lighting Clac

After designing and looking at aspects in which I could have improved on, I noticed that the amount of lights in each room were estiated. With it — being an esitimation I thought there may be some slight error that can be re looked at.

Bedrooms

$$N = \frac{E \times A}{F \times m_f \times v_f}$$

$$200 \times (10 \times 5)$$

$$1550 \times 0.95 \times 0.85$$

$$= \frac{10000}{1251.6}$$

$$= 8 \text{ lights needed}$$

Communal Kitchen area

$$N = \frac{E \times A}{F \times \eta_f \times \eta_f}$$

$$= \frac{200 \times (6.25 \times 10)}{1550 \times 0.95 \times 0.85}$$

$$= \frac{12500}{1251.6}$$

$$= 10 \text{ lights needed}$$

In the bedrooms there is a standard number of lights in every room that is 8. In the calculation, I found that 8 is a perfectly suitable amount to have in a bedroom producing enough lighting.

In the kitchen and dining area, the calculation has shown that it needs 10 lights to produce a median rating of lighting in the area. When designing I chose 6 lights in the area from experience. This was slightly out.

However, I also took into consideration that there are 2 connected rooms with a light in each that will, most of the time, also be producing light for the communal room. The lack of lighting in the initial room is compensated by the 2 adjoining rooms.

To improve next time, I would have done the lighting calculations in the

first place to get an accurate gauge on how many lights is needed.
Lighting levels gotten from [superbrightleds.com](https://www.superbrightleds.com)

In conclusion, all calculations I have done have come from the desired information needed for the assignment to be filled out to its most potential. When selecting the lights, I ensured I selected a range of different lighting styles and then chose the one most suitable for it. After I looked at a way of improving the lighting design by finding out the exact number of lights needed.

In future, I will make sure to do the lighting calcs beforehand to ensure the correct layout needed.

References

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