Garnethill Pt 2

Reinventing Park Lighting

Design Journal

Initial Research
Concept Development
Concept Selection
Development
Presentation
Feedback
Re-Assessment
Final Design Changes
Engineering Drawing

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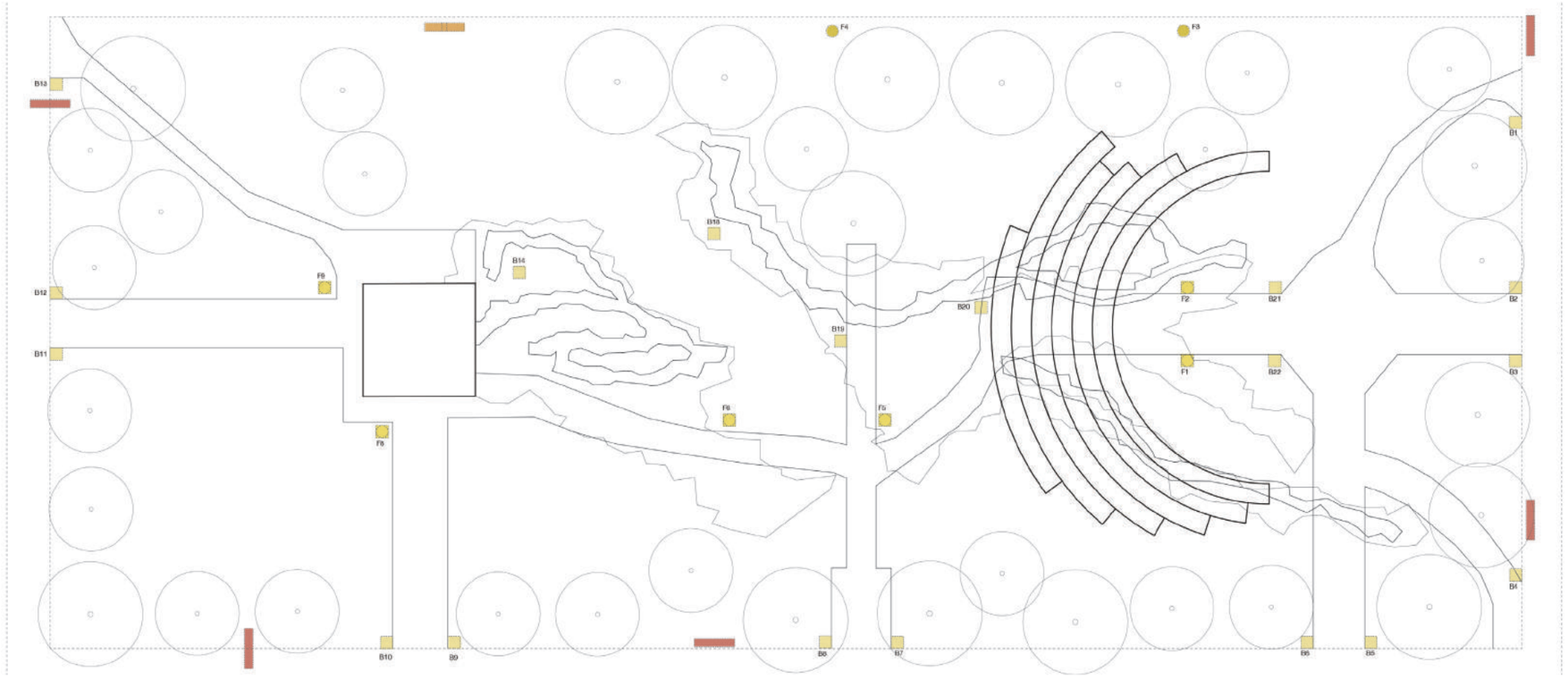
Garnethill Park Lighting Overview



ht Type Key

- Flood Light
- Street Light
- Magnus Light
- Council Light
- Ball Light

Notes on the Condition of Magus Lights

B1- Stump, Stolen Light
B2- Stickers, water, moss, base intact, graffiti
B3- Stickers, water, moss, base intact, graffiti
B4- Stump, Stolen Light
B5- Moss, water, leaves
B6- 2 sides missing, moss growing, stickers on side
B7- stickers, moss, water collected, leaves
B8- 2 sides missing, moss growing, stickers on side
B9- moss growing, stickers on side
B10- graffiti, one glass side, gone - metal replaced
B11- Some rubbish, leaves, good condition
B12- Leaves and moss, 1 side missing
B13- Stump, based ruined, Light stolen
B14- Not on base on rocks, water, stickers
B18- Side missing, with metal, graffiti, no water or cigs
B19- 4 sides gone, all metal, no cigs
B20- water collected, leaves, stickers, base ok
B21- Cigs, base bad condition
B22- stickers, moss, 1 side missing, base ok

Taking from the initial research from the Architectural survey, this diagram provides an overview of the currentl lighting situation. It does however, forget to mention the three black pillar lights used to light up the Kraska mural.

The park is actually fairly well lit, especially the lower half around the amphitheater and just above.

The pyramid is a particular dark spot, but the play area, around the slide is very well lit.

The very outer fringes are lit by light seeping in from the road, due to the absence of the box lights.

The Light

I assume the metal is of the stainless steel variety, seeing as it is left bare, and seems structurally quite strong.

In the grune brucke project, a considered gap between plastic and metal on light can be seen, a hint at the vast difference between these lights and the poorly made lights present in Garnethill Park.

The top of the lights, recessed as it is seems to make a compelling cigarette bin. As well as this, leaves collect and water pools.

It appears that the white, flat panels attract graffiti.

In some cases, where perhaps panels have been kicked in, the plastic parts have been replaced with some corrosion resistant metal pieces. These mustn't be very good at transmitting light, but must be at least more durable. This particular example (B19) has only one face of plastic paneling remaining.

The current light was implemented in the redevelopment 25 years ago. Technical specifications are at the moment not apparent, and as a class, we haven't seen it being turned on. From what I can identify through observation, the box is constructed from sheet metal, with white plasic inserts.

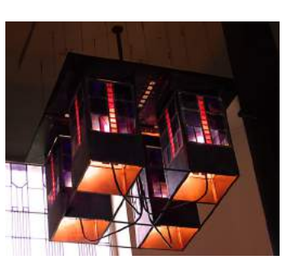
The box is mounted on a sheet of non-stainless metal, which is mounted upon, in general, recovered red-sandstone from the tenement that previously stood on the site.

These lights have been reported to have been subject to vandalism and graffiti, and are currently turned off. Some, where I assume they have been vandalized, have been completely removed, sometimes replaced with tall lampposts, sometimes left as a covered square of sandstone.

These lights are common amongst some Dieter Magnus park designs, most prominently in Magnus" "Grune Brucke" in Meinz. From what I can gather from online resources, those lights appear to have been constructed differently, looking more like a plastic box within a painted steel tubing fabrication. This confirms reports from community members that the lights were in fact not built to specification.

Charles Rennie Mackintosh

Due to the site's proximity with the Glasgow School of art, and the fact that the lights are often mistaken to have been designed in the Mackintosh style, it is perhaps appropriate to explore the themes of Mackhintosh's work, and perhaps draw inspiration from them.



The Grid

A grid of square, strong forms is a consistent motif of Mackintosh's work. It predicts the rational, orthogonal nature of the subsequent modernist movement, and shows Mackintosh's Japanese influence.

The Rose

The rose, and organic, nature inspired forms in general, are another consistent theme in Mackintosh's work. Mackintosh's combination of the purist grid and highly personal organic detailing is something he has in common with the Vienna Secessionists.

Lighting

By studying Mackintosh's personal approach to lighting, we can see why there has been confusion over the intent of the original Garnethill lighting. These lights draw heavily on themes of nature and on square geometric forms. Mackintosh also regularly introduces refined coloring into his lights, warm shades of pink and orange are common.

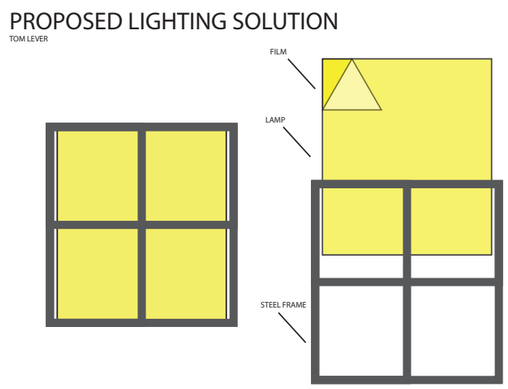
Graffiti and Anti-Social Behaviour

Anti Social Behavior (ASB), or such perceptions, have been a core discussion point throughout the project. With this in mind i carried out some research on how lighting could prevent, and defend itself against vandalism and ASB

Sacrificial Coating

Transparent sacrificial films can be applied to surfaces, both plastic and glass, which protect the material to an extent from scratching and gouging, and can be removed and re-applied in the event of maltreatment.

I approached two companies with a quick concept sketch, and asked for their views.



A reply from David Owen, to whom I was forwarded by Hanita Coatings, agreed that PolyZone Anti-Graffiti film for Plastic Glazing, might offer a potential solution, and mentioned that it came in roll lengths of 60” wide by 100 feet. This is rather large for the application, but could potentially be cut to size.

A reply from Max Bromley of Peerless Coatings Ltd, said that their Peeraguard Exterior Clear was not for self-application, but could be supplied in pre-covered and cut sheets. He arranged to send a sample with their frosted coating on a clear polycarbonate sheet.

http://www.hanitacoatings.com/films/products/safety-zone/clear-protection/anti-graffiti

http://www.peerless-coatings.co.uk/coatings-for-plastic/peeraguard-exterior-clear/

Permanent Coating

Paints can be added to surfaces which claim to make graffiti easy to clean off. GRAFFGO is one such solution. to quote the manufacturers -

“Graffgo is a unique anti-graffiti coating that protects all surfaces, including brick, concrete, render, stone, wood, plastic and more against all types of graffiti and poster glues.”

“Once coated with Graffgo, nothing can stick to the surface.”

“Graffgo is completely resistant to ALL paints, permanent markers and acids.”

“Simply power wash with water or use a brush with water and a little washing up liquid. Graffiti disappears and posters just slide off, providing permanent protection against graffiti attack – without the ghosting residue left behind by other, inferior anti-graffiti products.”

“Guaranteed from 5 to 10 years depending on application”

Contacting to find out more,Arthur Kemp, a glasgow based property maintenance contractor, who is a Graffgo contact, confirmed that the coating can be applied by spray or brush.

http://www.graffgo.com
Arthur Kemp http://www.ajc-rpm.co.uk/

To me it seems that both could be appropriate to various design challenges, I can use this information to aid in my idea generation. Sacrificial coatings seem to require more maintenence, but do provide some basic protection anyway, and could be replaced, say, every year. Permanent coatings seem to offer better direct resistance, but will lead to challenges later on in the life of the product, with re-spraying, or worse, replacement, required in later life.

Lighting and ASB

Evidence regarding the impact of the street lighting on crime and anti- social behaviour - a paper by the Cambridge Research Group - can tell me the following:

“The best conclusion that can be drawn from the research literature is that the general benefit of street lighting in reducing crime is unproven but in very specific circumstances, where there is an existing crime hot-spot and current lighting is poor then improvements may prove beneficial.”

“There is a strong association in minds of the public between the presence of lighting and a feeling of safety. However, recent survey evidence2 suggests that despite this the introduction of part-night lighting won’t change actual behaviour as other factors such as an area’s reputation, personal feelings of vulnerability and time-specific circumstances (such as pub closing times) have a stronger influence.”

This tells me that absolute lighting levels are not so much of a priority as i may have initially thought. I think the most important things these lights can do is reassure the community, and provide a specific mood.

I intend to create this light as a ‘guiding light’, which will make the park attractive and moody at dusk and through the night, without causing undue and unneccesary light pollution.

Lighting Technology

Halogen

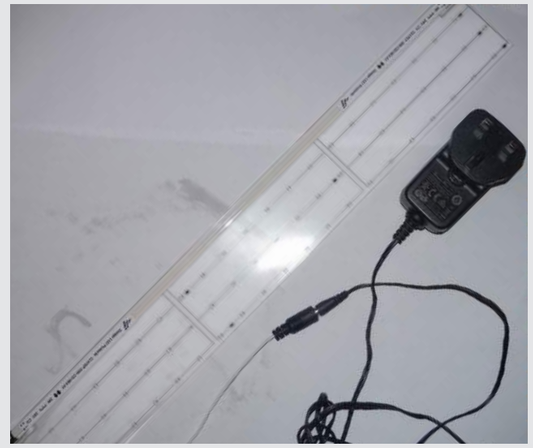
Halogen lighing has been traditionally used in car lighting for many years. Tizio (1972) was an example of this light source being used in a design context. It is now replacing Incandecent as the light used in traditional bulbs, and is about twice as efficient as Incandecent, although it

LED

Led technology has been around for a long while, but has increasingly in the near past been used more as a serious light source. It is very efficient, and also very versatile, as it only relies on arrays of small led's. It is available as individual diodes, as sheets, or as replacement conventional bulbs, such as this street light.

Florescent

Fluorescent is known popularly as the standard energy saving lamp, in it's compact (CFL) form. It is also popular publicly and commercially, as it's large long tubes have a long life and are efficient.



Case Study - Design LED products

A talk with a representative of design LED products, a company based in Livingston, gave me some more in-depth insight into a unique product they offer- flexible sheets of LED lighting.

Ness outdoor is their most suitable for outdoor use, but directional light is not this products strong point. It would be more suitable for a 'guiding' light.

THe product emits light from both faces, but a refelector (any shiny bit of metal) will amplyify light in one direction.

The products use a propreitory wire connector, but can interface with mains electricity through a plug or a more hard-wired solution.

Acrylic was suggested as the most suitable diffusing plastic material.

A sample was sent which allowed me to have a deeper look at the product. It was interestning, durable and extremely flexible, and may offer a graffiti resistant solution.

Technology	CRI	Efficacy (lumen/W)	Lifetime (hrs)	Color Temperature (K)
Compact Fluorescent	80-90	60-70	6,000-10,000	2700-6500
Incandescent	100	12-18	750-1,500	2400-2900
Linear Fluorescent	70 - 90	80-100+	20,000	2700-6500
Halogen	100	16-29	2,000-4,000	2850-3200
White LED	65-90	20-50	Up to 100,000	2700-6500

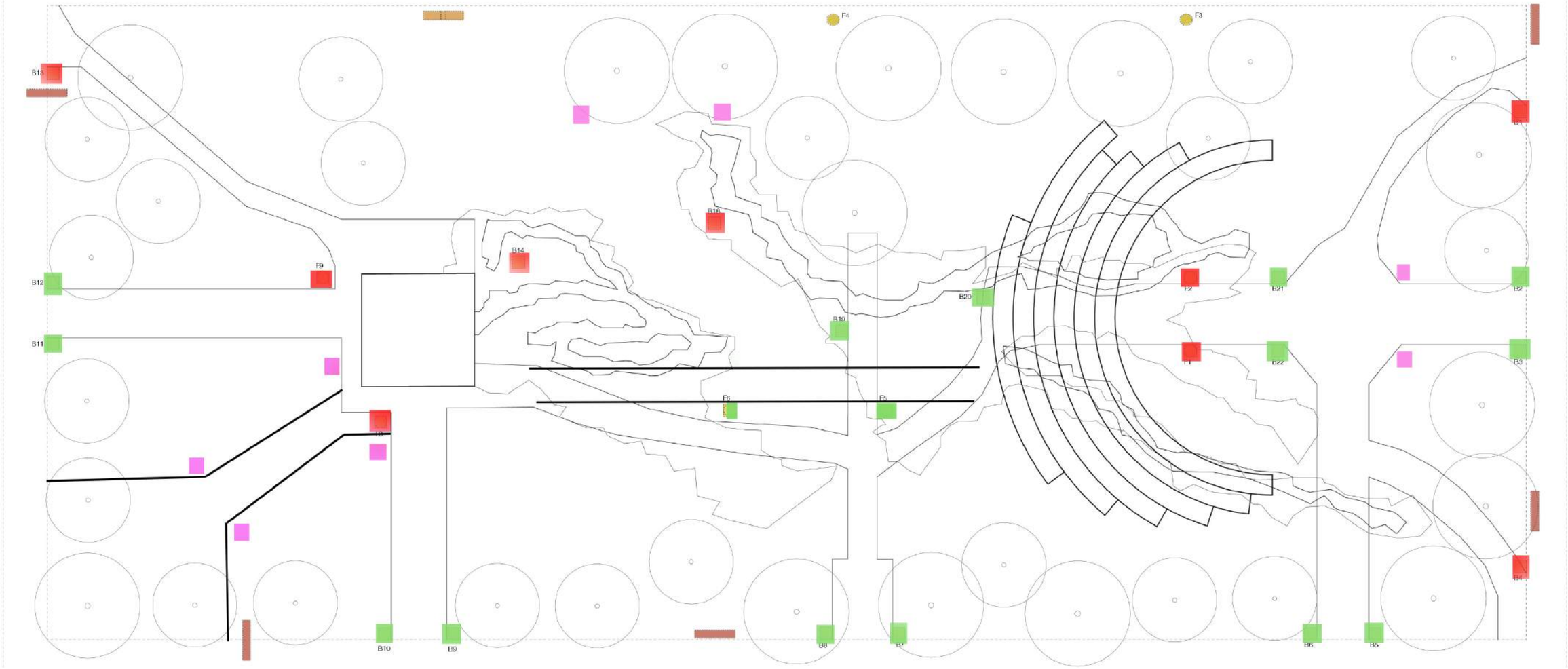
A table showing relative efficiencies and colors

Approximate brightness in lumens (Lm)

	180 Lm	360 Lm	600 Lm	1100 Lm	1400 Lm
Old bulb	25w	40w	60w	100w	150w
Halogen	18w	28w	42w	70w	105w
Energy saver (CFL)	5w	9w	15w	20w	
LED	4w	6w	10w		

An easy to read table showing different brightness ratings and wattages per bulb.

Proposed Park Lighting Scheme



Here is the outline of the plan that was fixed by our team on part one of the project. It involves 25 lights in the final plan, with some removed and some restored.

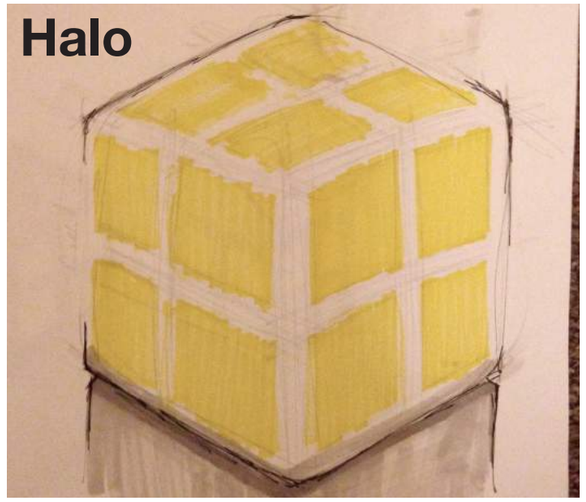
The total budget for lights is £10,000, which at 25 lights gives me £500 per light

8 brand new lights
17 restorations
9 casualties- can be used for salvage.

All lights with completely missing tops remain removed - no full restorations
Lamp post lights on bases all removed.
Back wall & park lit mainly by existing tall lights
entrances and core paths are the focus for introduction of updated lights in new scheme.

Idea Selection

Halo

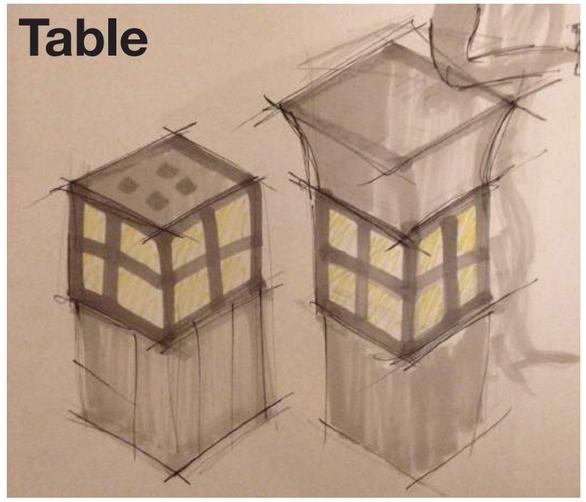


Top is replaceable, wipe clean surface
Plastic will be susceptible to denting and puncture
Retains square lighting, with modernist touch.
Can retail original frame, rotational moulding is not the best for very small scale production.

MMMM
DD
CCC
EEE

12

Table

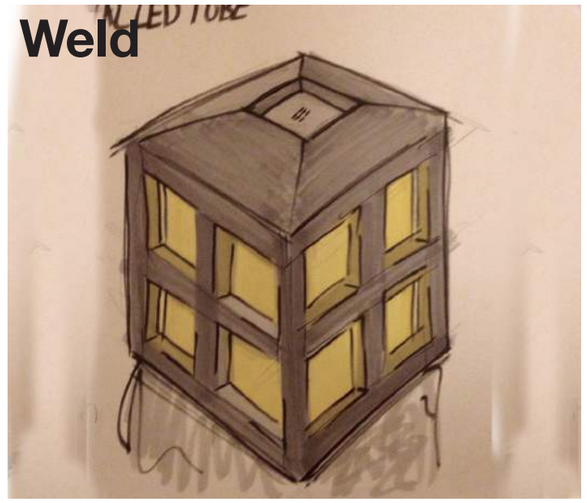


If original face is retained, no huge maintenece benefit
Structural improvements are good, but not neccesaritly uniqe to this specific implementation.
Does not improve on character.
Adds structural cost, but not hugely, no new components

MM
DDD
C
EEEE

10

Weld

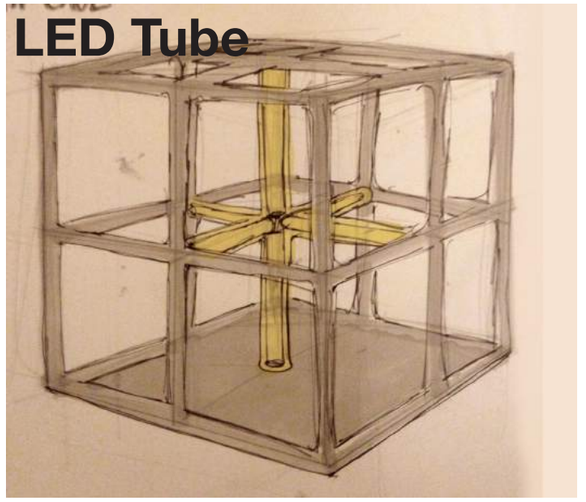


Systematic maintenance benefit, ash tray requires attention.
New frame would be durable, but only if additional foundation work is done.
Complete re-make would be costly especially when there is perhaps no perceived visual update.

MMM
DDDD
CC
EE

11

LED Tube



Would attract perhaps more waste catchment.
No benefit structurally over current design, internal tubes could possibly be pulled out.
Interesting play on the theme, brings something new.
Would be cheap if no significant frame updates required.

M
DD
CCCC
E

8

There are several core maintenance issues, mainly the water feature, litter and lighting.
The light must be easier to maintain than the current one.

The park has a reputation for anti social behaviour, it is dark and uninviting at night
The light must provide adequate light, as a “guiding light” (see prior ASB research)

Parents Association Women liked the look and feel of the Mackintosh/Magnus box lights, but were concerned that even a more durable redesign would remain “at kicking height”.
The lights must retain the low height of the current lights, but must be durable.

What should be designed out of the park? - “Vandal proof lighting. I have always thought it would be good to have a competition for art school students to design new lighting. Although I do love the ones that are there.”
It would be preferable to retain the character of the lighting, although not essential.

Our masterplan allocated £10,000 for the lighting scheme, at circa 20 lights in the park currenly, that means the price should be around £400 per light.
Cost is therefore a consideration, the cheaper they are, the more we can make, or the more money can go on other components.

Maintenence
Durability
Character
Economy

M
D
C
E

Each of the selection criteria is linked directly to a user insight, which were collected in the early stage from a wide selection of community members.

It seems like ‘Halo’ has won this rather passive ‘objective’ selection process. However, this is backed up by the fact that the design is genuinely new, responds physically to a problem, and creates a new aesthetic opportunity whilst retaining most of the structure of the old lights, and displaying a subtle visual nod to the old style.

Further Investigation

I Managed to get in touch with Les from LES who arranged to meet me and show me the lights in more detail.

The lantern is a Coughtrie BD model, sat loose on top of the base. It is made from die cast aluminium and features a matt black textured case. There are a range of power options, from 9W to 2x13W, and the lantern is IP65 resistant, which means it is completely sealed from dust, and sealed from low pressure water jets. It uses a florescent low-energy light source

However, I only looked at one light, and i had no reassurances from Les that they would be the same lanterns throughout. In any case, these lights will be easy to re-order if necessary.

http://www.coughtrie.com/lighting-products/product-listing-a-z/bh-bd-147/
http://www.tw-wireless.com/data/document/whitePaper/EE20100313-01_Water-Dust%20IP%20Resistant_FWS.pdf

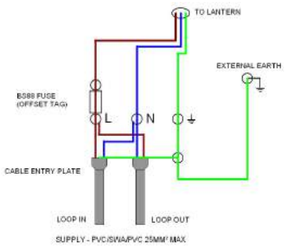
Most of the unsteadiness of the box is caused by missing bolts in the bottom sheet. Often this is because the metal has rusted though, but can be put down to lack of maintenence in other cases. Frames 100% locked down are impressively steady.

Accessing the control box, the lights couldn't be turned on directly. There is no confirmation on why this is, but Les didn't seem to think there would be any serious hurdles in getting the lights on if the park was restored. He dindn't personally know how though. This means my ability to test the power of these lights is limited for this project, but I don't think there would be any hurdles in say, attempting to re-use most of the infrastructure that exists.

There are some instances of wonky bases but these should be easily re-cememntable.

I'm pretty sure that these bars are actually welded , not folded sheet metal like I originally assumed. They have polished the weld lines off impressively on the front faces of the frame if this is the case.

In any case, the frame is very heavy and rigid, this is clearly not at fault structurally.



The light is wired in to the three common power wires - earth, live and neutral. The red device is a TOFCO F114 Fuse unit, which puts the electricity supply through a fuse and connects it to a lantern. These are ubiquitous devices which can be easily re-sourced in necessary.

http://www.tofco.co.uk

The most important finding is that these lights could be simply fixed if the council wanted them to be.

Process - Rotational Moulding

Process Selection

An in depth look at **Thomson** gives me a lot of initial information that will help guide my main process and material selection.

Rob Thompson, Manufacturing Processes for Design Professionals

Polyethylene is the most common plastic material for rotational moulding.
PA,PP,PVC,EVA possible
Resin tools are least expensive and suitable up to 100 parts (we intend to produce 30 ish)
products up to 10m3
plastic will shrink, possibly causing warpage in large flat areas. (possible redesign necessary)

Alternatives
blow molding (only suitable for large quantities)
sheet plastic fabrication (would not allow for clean edges)

Suitable Materials for this application

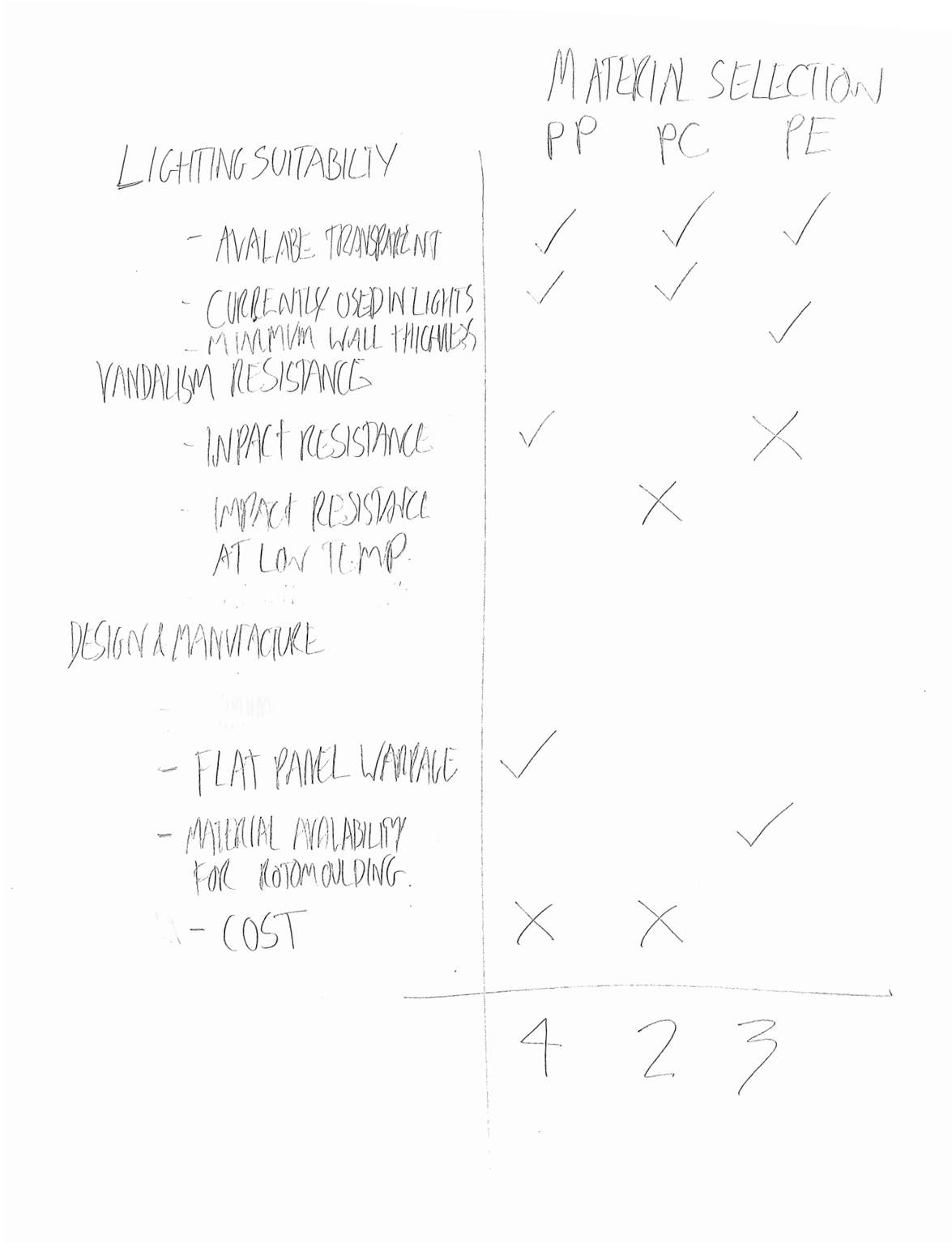
Polyethylene - available as transparent, wide range of densities.
Polypropylene -used in food and lighting application

Material Selection

In order to clarify my material selection process, I consulted a wide range of texts, which would give me a definitive view on what material might be best from a technical point of view. The below guide gave me a clear picture of what materials i should consider - PE, PC & PP

RESIN	ADVANTAGES	DISADVANTAGES
Polyethylene	Low cost Easy to mold	Lower impact strength than other resins
Polypropylene	Excellent ESCR High heat distortion temperature Autoclavable	Low impact strength at cold temperatures Higher cost than polyethylene
Microthene RL resins	Chemical bonding between resin and other material including metal	Higher cost than polyethylene
Polycarbonate	Clarity Toughness	Absorbs moisture Harder to mold than polyethylene

A guide to rotational Molding - LyondellBasell



MATRIX Polymers Catalogue.

Materials for Rotational Moulding

Polypropolene - PP 50 TR
Translucent - Lighing typical application.

“In rotomoulding however, polypropylene has always suffered from extremely poor impact performance especially at lower temperatures.”

Polycarbonate - ReClear PC 15
Transparent, Stiff, UL94 V0 at 3 mm - used for lighting

“Its low viscosity makes it an ideal grade for applications where asthetic appeal is more important than impact strength.”

A Designer’s guide to rotational molding

Recommended Wall Thickness for Commonly Molded Materials

PP 1.5 - 6.4 ideal, 0.75 - 10.16 possible
PC 2.0 - 10.16 ideal, 1.5 - 12.7 possible
PE 1.5 - 12.70 ideal, 0.5 - 50.8 possible

Product Form (all materials)

A dome as small as 0.015 cm/cm is enough to discourage warpage, but the larger the doming or crowning, the less warpage there will be. Highly polished flat surfaces reflect light and exaggerate the appearance of a warped surface. Textured surfaces help disguise minor warpage.

Flat-Panel Warpage Standards for Commonly Molded Materials (in ±cm/cm and in./in.)

ideal, commercial, prescision

PP 0.050, 0.020, 0.010
PC 0.010. 0.005, 0.003
PE 0.05, 0.02, 0.01

From this process I think it is better to select PC, on the basis that it reduces flat panel warpage, has good impact resistance properties, and it has a reputation for already being used in lighting applications, a testament to it’s good light transmitting properties. It has also been previously defined as good aesthetically.

Testing Projection

In order to test if there will be anything approaching the proper light projection pattern that i have proposed, I constructed a full size model from cardboard, and tested it inside by projecting the interior light through paper sheets.

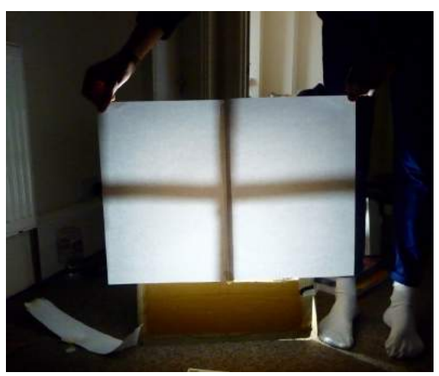
Paper does not have the same diffusion propoerites as thick plastic, but it serves as a quick proof of concept. It also allowed me to appreciate the visual effect of the light.

I tried the paper at various distances in order to see how the light spread over distance. The shadow started to become unclear at about 10cm.

0cm

2cm

4cm



10cm

Design For Manufacture

I have taken up some reading, specifically again, **A Designer's guide to rotational molding,** which has informed me of some critical design restraints, based on the materials. I took account of all three materials, just in case there were any restraints that made me re-consider my material source. In addition to the statistics on the process and material selection page, there is also:

Recommended Radius Size for Commonly Molded Materials

outside minimum, better; inside minimum, better (mm)

PP 6.35, 12.70; 6.35, 19.05
PC 6.35, 19.05; 3.20, 12.70
PE 1.52, 6.35; 3.20, 12.70

Recommended Draft Angles in Degrees per Side

inside minimum, better; outside minimum, better (degrees)

PP 1.5, 3.0; 1.0, 1.5;
PC 2.0, 4.0; 1.5, 2.0
PE 1.0, 2.0; 0.0, 1.0

Holes can be molded in, but rotational molding is not ideal for producing parts with holes through the wall. In spite of this limitation, techniques have been developed for molding holes through, into and onto rotationally molded parts

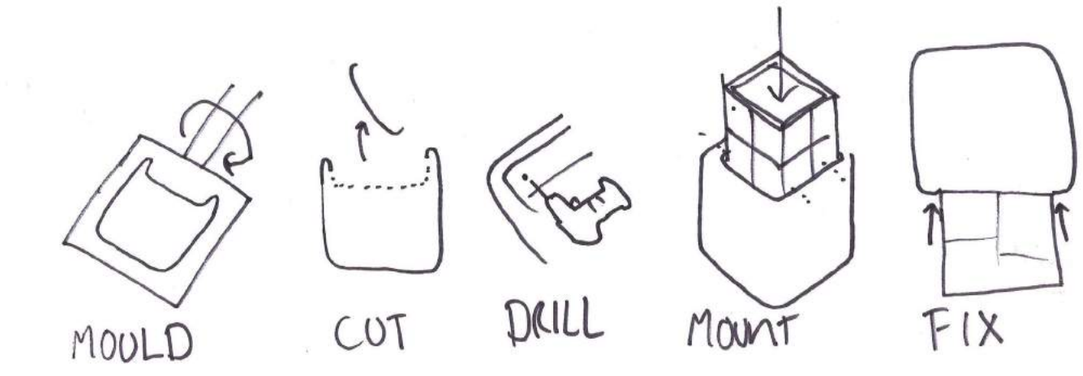
http://blog.theplasticpeople.co.uk/2012/06/01/how-are-polycarbonate-acrylic-different/

Acrylic will crack if it is drilled near an edge or with a drill bit not designed for plastic. Polycarbonate typically does not crack when being drilled even if drilled close to the edge with a standard drill bit.

Domed Faces
Faces are domed by 8mm on the interior, based on the idea that flat faces should dome by 0.015cm/cm to avoid flat panel warpage.

Matte Finish
A Matte finish is easier to achieve with the production process, and means that any warpage that does occur is less visible

Draft Angles
The interior draft angle at the bottom, where it 'folds up' is 4 degrees, in line with the 'better' inside minimum draft angle for Polycarbonate. The dome creates a 2.3 degree angle, which meets the 'better' outside draft angle recommendation.



'Fold up'
As rotational moulding cannot easily account for holes, the shell is moulded as a complete whole, and at this bottom 'fold', a large bottom face is cut away manually, or with CNC, to allow the shell to fit over the box frame. The material can then be direcly recycled, reducing costs.

Mounting
The box will be removed in order to screw the box to the frame, as hands will not be able to reach the interior bolt unless the bottom side is open. (the existing sides will be removed here also). The shell&box assembly will then be mounted to the plate as shown.

Garnethill Box Light

Here's the New Box Light for Garnethill Park. It retains the popular height and soft tone of the existing lights, while providing protection and ease of maintenance. It subtly alludes to the park's heritage and the former lights, but provides a clean, timeless and modern look.

Rotational moulding allows us to create a new light enclosure which will be optically clean, but also durable. The matte surface is also graffiti resistant, thanks to a Graffgo coating, meaning those ugly scribbles will wash right off.

Assembly

Shell
Roatationallty moulded, then hole cut into underside to allow electronics and light fitting. Coated in Graffgo solution to allow easy removal of Graffiti.

Rubber Feet
Store bought rubber feet separate box from frame, attached though drilled holes in top of frame.

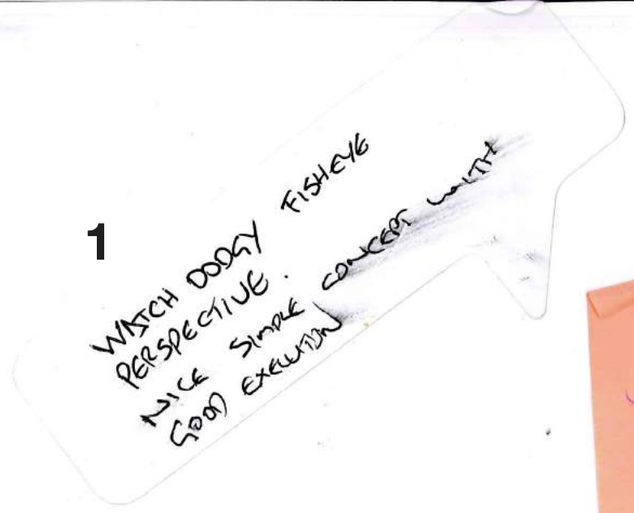
Existing Frame
Existing frame is welded and stainless, and suprisingly solid. This element is retained to save costs, provide rigidity, and to provide the signature light patten.

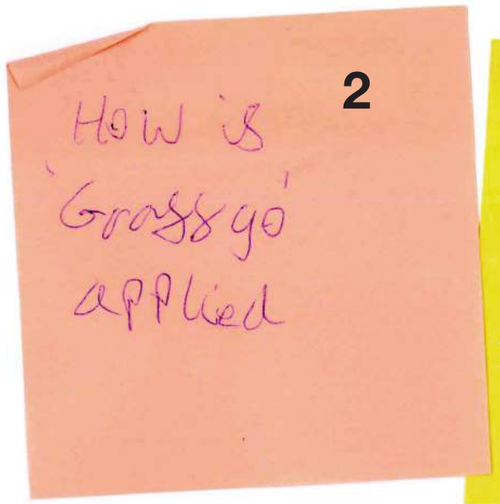
Existing Lamp
The existing lamps are still present, and are merely standard wall lighting units. They could be easily replaced with an LED solution if the budget allows.

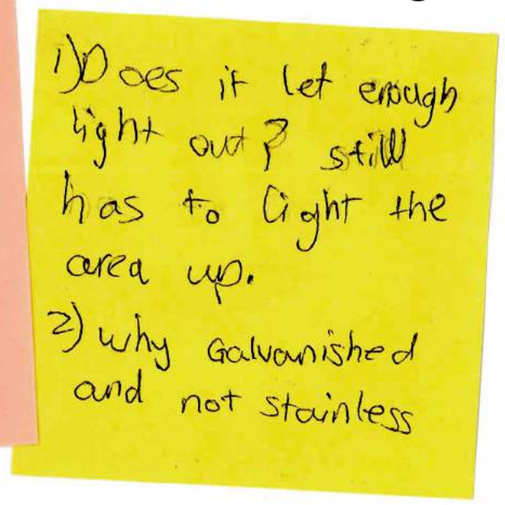
New Galvanised Plate
Current plate is rusty and in bad condition. To be replaced with something with a little more potential longevity.

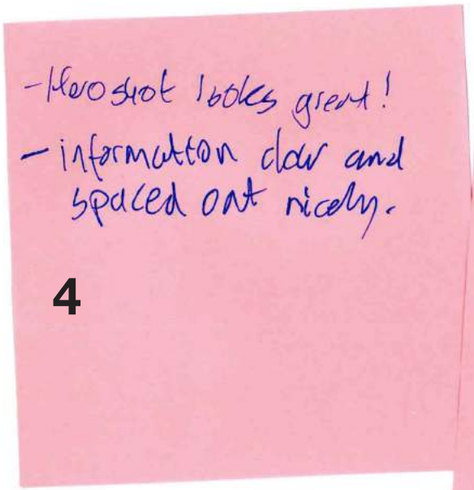
Cement & Brick Base
Existing base fits into general park atmosphere. In the grand plan, the proposed lighting scheme moves some of these around. Some will need fixing.

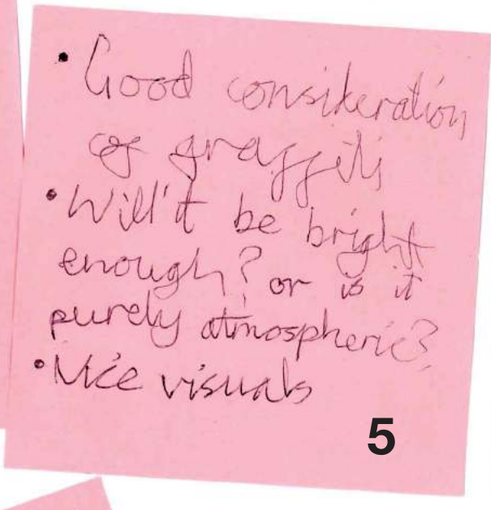
Feedback

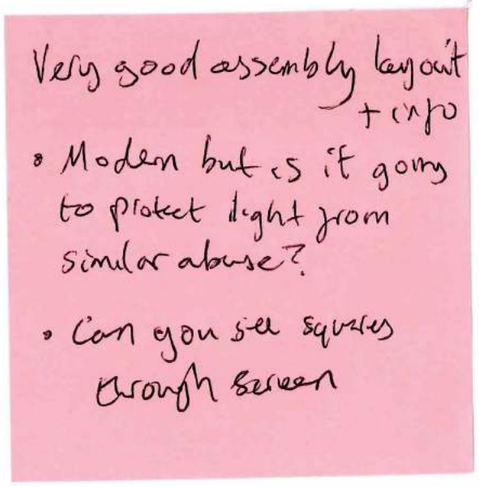


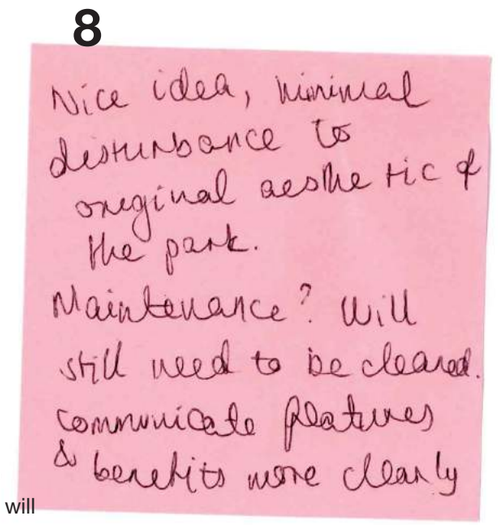


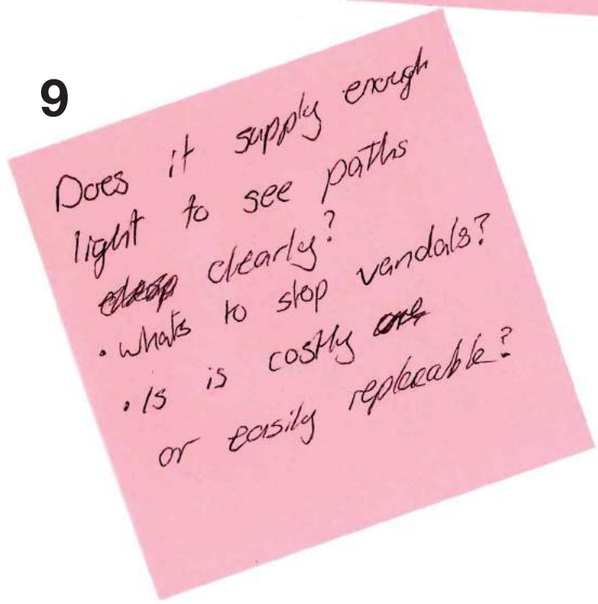


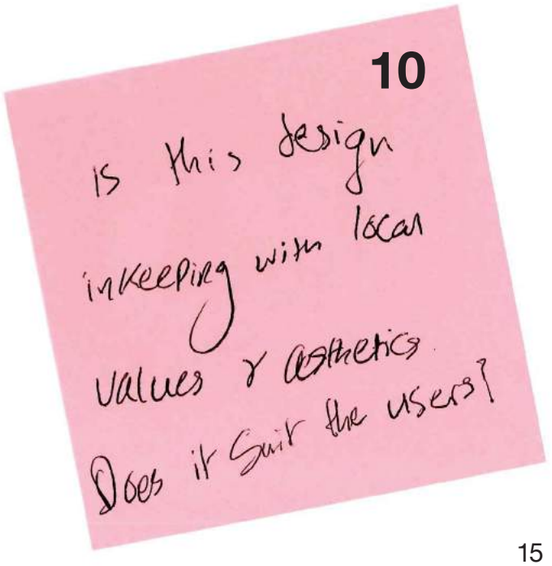












1 Watch Dodgy fisheye perspective
The diagram was either unclear or simply not to everyones' tastes.

2 How is Graffgo applied?
I should have made this clearer in my presentation, or perhaps I myself need to go further into depth

3 Does it let enough light through?
My initial design has based the thickness of the plastic et cetera on what already exists. My work until now has not verified the quality of this original lighting. I could do some development focusing on the minimum standards of the existing lantern, but I need to be clear on what I can gain.
3 Why Galvanised not stainless?
My initial material selection focused on the plastic housing. I could do some further research into the other materials.

6 Is it going to protect the light from similar abuse?
Graffgo should protect the light from paint & stickers. I will have to think about how I can test the impact resistance without moulding the full peice.

7 Does it fit into the style of the park?
This is a very good question, which perhaps asks for a philosophical inquiry into aesthetics. I was going for "less is unobtrusive" but noting short of a direct replica can guarantee full aesthetic compliance with the original vision.

A survey of the residents would tell me what *they* prefer, but there is every chance they will chose the original on fear alone. Needs more research to be sure;

8 Maintenance?
I think my design does respond to the core maintenance issues, but I will go on to asses it's suitability.

9 Does it let enough light though?
9 Is it costly? at this time I am still waiting for a quote.

10 Does it suit the users?

Re- Assessment

Materials

After finally getting hold of someone from matrix polymers, there has been a shift in my understanding of the materials. From Gary Nolan, I have gained the understanding that, as I already know, PE is the most common and easiest to use. And PP has been used successfully. However, the PC that they offer for rotational moulding, ReClearPC15, is problematic at best for a rotational moulding application.

PolyPropolene

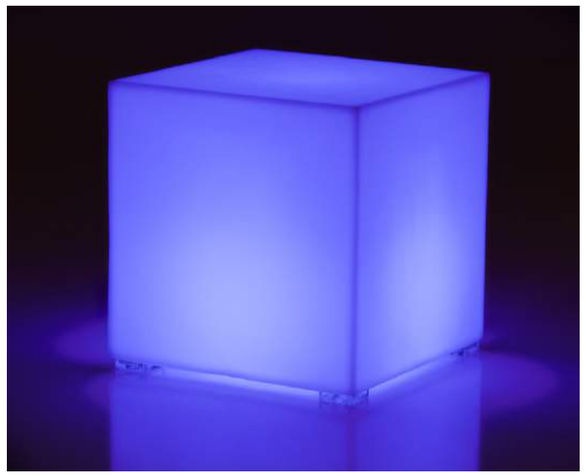
“We are trying to sell PP50TR this at the moment, as a clearer lighting solution, but our moulders are telling us that it is difficult to mould, and we are not having much sucess. We are having more success with PP45, which is available in white/transparent”

Polycarbonate

“We are currently trying to promote this, but what you won’t find on the catalogue is that we are having problems. It is extremely difficult to mould.

Hearing this, it would be wise of me to change my material choice.

Polypropolene and Polyethylene are now the two faviourites, so I will refer back to my original material selection, and chose Polyethylene based on its apparently superior impact resistance properties.



This now seems as if it should have been the obvious choice from day one, it should be cheaper, and there are many many examples of paralell products on the market, such as this square, flat, table light, ‘KUBIK’ by Studio Vondom.

Cost

Polyethylene Rotomoulded Shell

I have not been able to get an official quote for the production of the rotationally moulded shell, it seems I sent off the cad file and forgot about it. In the absence of a quote however, I attempted to cost the procut myself.

My main source was

http://www.andrew.cmu.edu/user/shc17/DesignI/UofM_IPD_Costing_Worksheet.pdf

Which gave me a method (in inches!!) to determine the cost.

Another source,

http://contractmoulding.francisward.com/How-much-do-moulds-for-rotomoulding-cost.html

puts the price of a steel mould at £4000-6000

and

£1/kg http://www-mdp.eng.cam.ac.uk/web/library/enginfo/cueddatabooks/materials.pdf

Puts the cost of LDPE at around £1/kg.

My method can be seen to the right.

The price comes in a bit steep at £178, a bit larger than I expected, but this is, I assume, a very rough estimate. This is for a steel mould, but resin moulds are cheaper and more suitable for low batch sizes. Rob Thompson, **Manufacturing Processes for Design Professionals,** can be quoted as saying that rotational moulding is typically 4 times the cost of materials, which would place the shell at about £40.

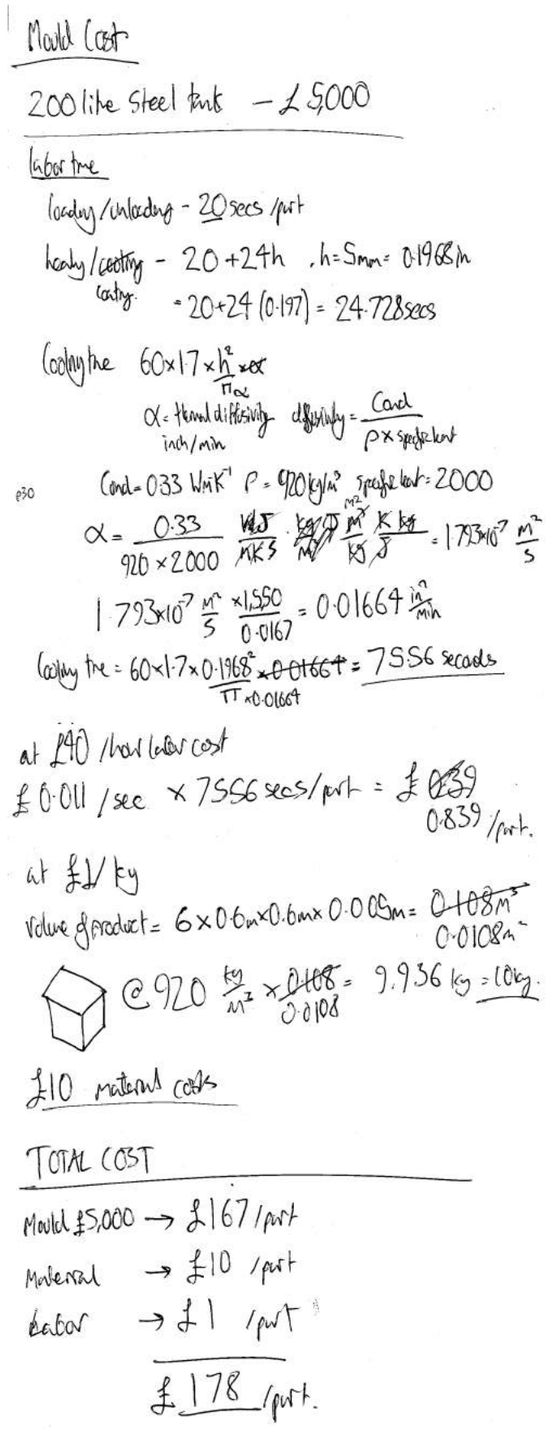
Stainless VS Galvanised

I was asked why I chose galvanised steel plate, and the honest answer is that I decided on a whim. Now, using https://www.metals4u.co.uk, I can price a 0.5x0.5m sheet :

0.9mm 304 Dull Polished Stainless Steel Sheet - £38.35

1mm Thick Galvanised Steel Sheet - £19.85

Although Galvanised is less than half the price, neither will break the bank with a budget of £500 per light, and so i will chose stainless based on it’s longer life and stonger strength.



Total Cost Calculation

Polyethylene Shell	£180
+Machining holes & base (30 min)	£20
Stainless Steel Sheet	£40
Screwfix andgle brackets (8)	£0.30
Screws ect	£3
Rubber Feet (5)	£3
Installation (1 hour each)	£40
Replacement lights and power source (if neccesary) approx £30, therefore if 30% need replacing, £10 on average	£10
Total Per Unit	**£296.3**

This price, however unreliable, is agreeable. I plan to install 25 lights, which puts the cost at **£7,407** in total. This is well in line with the £10,000 budget the team set for the lighting.

The price point here was helped along by the fact that it uses as much of the existing lights as possible. I have assumed that the missing lights are still being kept by LES in storage, as 8 new lights come in, and 8 go. I intend to re-use the stone bases.

Costs unaccounted for in the £7,400 price are:

A - The cost of any pointing or cement work required to bring the lights up to standard.

B- The fabrication costs of a new light frame. (although this will not have to be to a good aesthetic standard, as it will be forever under cover)

With more time i would love to have made these calculations, but hopefully the allowance in the budget covers this.

Re-Assessment

Materials

Scientific data on the light transmission of (now polyethylene) rotationally moulded parts has proven har to find, but there are quite a few parallel products that prove the ability of rotationally moulded polyelthylene to be a ‘guiding light’.

These Home Infatuation ‘Moonlight Globes’ “..are made of nearly unbreakable polyethylene that is waterproof, UV resistant and withstands both extreme summer heat and snow and below zero temperatures...” and seem to let out a generous amount of light.

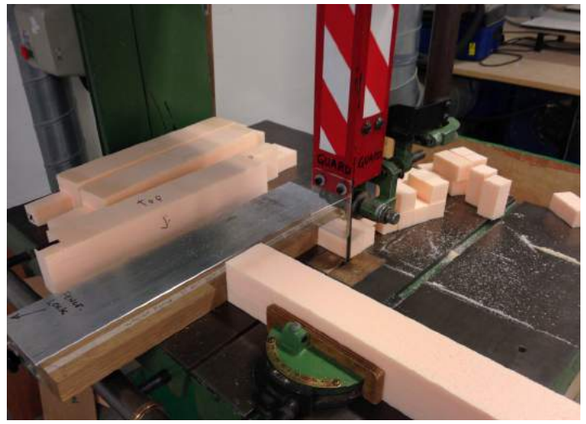
These seats are powered by a mere 7W bulb, which even if LED, based on my initial research is equivalent to the (minimum) 9W bulb found in the park

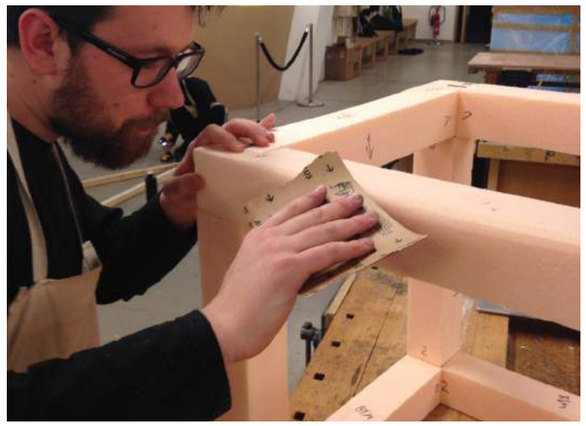
Prototyping

In otrer to test the look and feel of the product, and to get an idea of the light cast from the light, I made a prototype. The prototype was made from a foam structure and plastic panels, beacuse I could quickly get a smooth-cornered result by painting and sanding the foam.

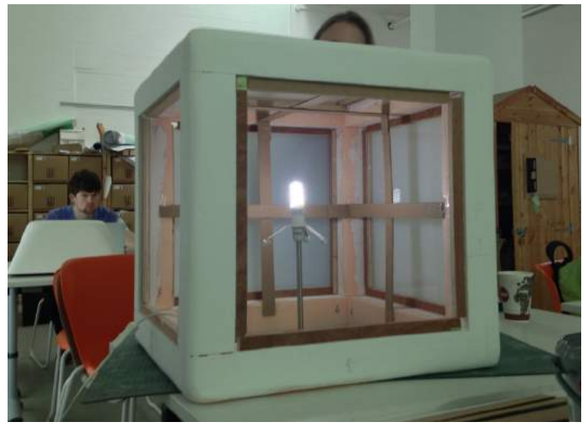
Production

I planned and produced foam members that attach with a complex joint, these were then sanded, and painted with emulsion paint. I would prefer a smoother finish, but foam tends to melt when spray painted.





The frame was supplimented by glued wooden ‘window frames’ which would hold on the sheets of plastic. I taped cardboard crosses to simulate the boxes. All of the geometry checks our, the cardboard crosses are a 45 cm square, which is equivalent to the inside faces of the steel box. the edges of the model are 60 cm out, which corresponds to the 598mm wide CAD model.



Light source

Inside i placed a 9W CFL. The light in the box at the moment is at least a 9W CFL, but could be up to 2x13W CFLs. There is no way of telling.

Plastic Sheet

I used an Opal Acrylic sheet, 030 grade, which means 70% light permissivity. It is 3mm thick. This is likey to be a likely to be a little more transparent than the final result, but unfotunately I couldn’t find any solid data on the translucency of rotationally moulded LDPE.

Testing

The light performs impressively, both visually and in terms of light projection. The light copes well and definitely fulfils it’s purpose as a ‘guiding light’

Having said this, i would have loved to do some more iterative testing on the prototype, but buying further plastic sheeting was beyond my means. The uncertainty of the power of bulbs in the park, and the uncertainty of the material properties mean that I couldn’t do much more.

This minimun-power, maximun translucently test though has convincingly proved the validity of the visual effect i was going for, and in an ideal world, would serve as a benchmark for further iterative testing.

Re-Assessment

Strength

As I do not have the resources to provide a full moulded peice at this stage, I have turned to Solidworks Simulation, a program I have little formal training on. I learned a bt about how the software works, and thought i'd do a few tests on the product.

I found the yeid strenght of LDPE to be 15 Mpa Minimum

http://www.matbase.com/material-categories/natural-and-synthetic-polymers/commodity-polymers/material-properties-of-low-density-polyethylene-ldpe.html#properties

And set the material property on the CAD file to Low/Med density LDPE.

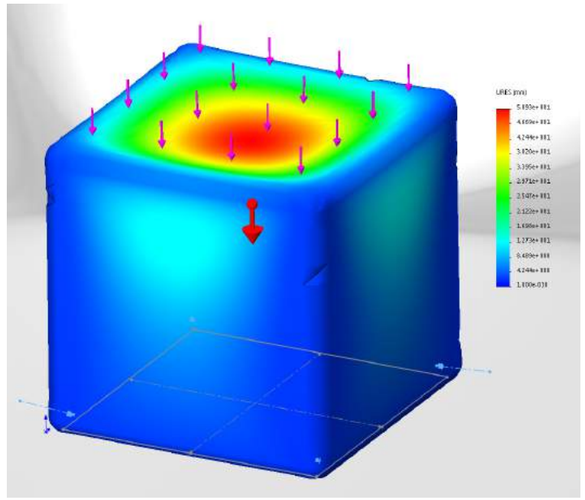
I tested a 1000N load on the top face of the box to simulate a (hefty) human sat on the top.

Fidings

I found that the biggest issue was the deflection, which was around 5cm in some cases. Changing the wall thickness reduced the internal stress, but did not do much for the overall deflection.

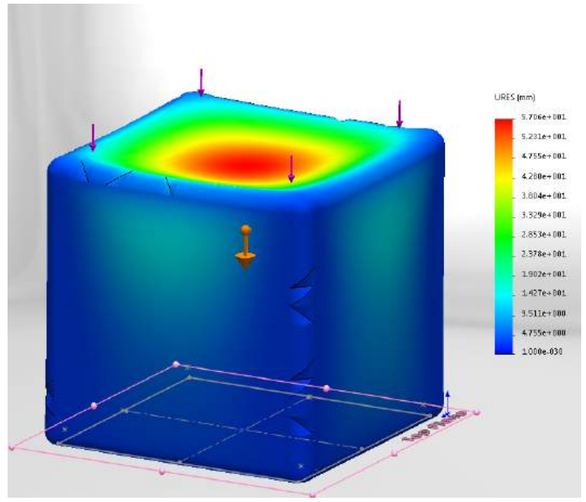
Simulating 4 support points, as was in the design, increased the internal stresses in the design, but only marginally, What it did do was decrease the deflections by a more significant margin

The stresses in this design then are way below yield, but due to the elastic nature of the material, It was under deflection. I will change my design to include a fith supporting foot in the top center of the box. This, I hope will prevent the deflection, which may cause the design to 'pop' into a different shape.



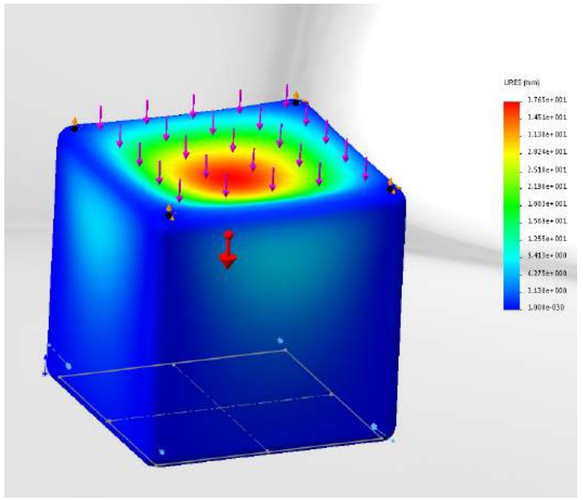
4mm wall thickness

57mm max displacement
2.5 Mpa max sress



5mm wall thickness

50mm max displacement
2.0 Mpa max sress



7mm wall thickness
Includes 4 support points (rubber feet)

42.5 mm max displacement
2.7 Mpa max stress

Re-Assessment

Does it fit into the style of the park?

Does it suit the users?

In order to test these ideas, I have taken the opportunity to visit the park on a sunny day, in the presence of many of the parks certified users. I was lucky to find a sunny day, seeing as so many of the people I had talked to before have raved about the park's summer feeling.

To them I showed my concept, and an image of the current lights (although there were plenty around for further reference) and asked for their opinitions and got them to cast a vote.

I talked to people from many cultures and all ages. In my experience of this, there was no determinable split between the demographics, that is to say, it isn't young vs old, new vs old.

I was worried that the investigation would be proof of "If I'd have asked people what they wanted, they'd have said they want a faster horse" however, the overall vote was in favor of the new design.

Although this was only a limited survey, this was a fairly wide real survey with people who were actually using the park, not a small study of invested local residents. What is has proven is that there is a positive attitude to the right kind of change, and not merely an attitude of preservation amongst park users.

Keep the lights and fix them

17

Re-do the lights with new durable plastic shell?

28

out of 47 people polled

Quotes

"Maybe you should make them out of a stronger material"

"Change is good"

"Could you use wooden frames? that would be more natural"

"The low lights are good for ambience, but the high lights are good for safety:

"I thought they were bins"

"Will your design let out more light? that would be more safe"

"Anythings better than these old ones"

"I like it, it reminds me of the new reid building, like a cross between that and the old mackintosh"

"Could you make them [the old ones] darker?, maybe paint them black"

"they are always broken"

"You should forget the lights, do up the park, that's what needs doing ... [after explanation] ... yeah well I do think the new ones are better"

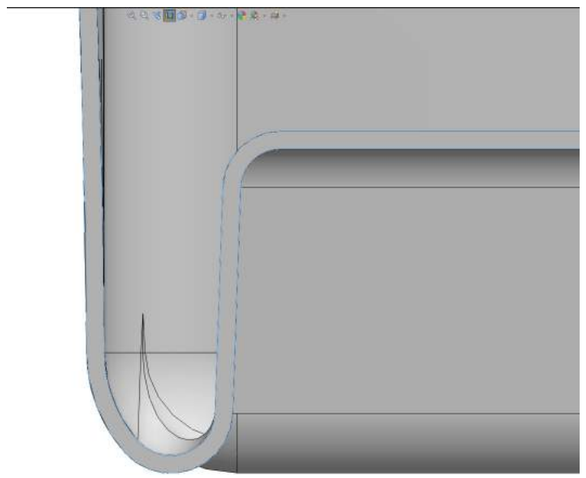
"They could be more of a table"

Final Design Changes

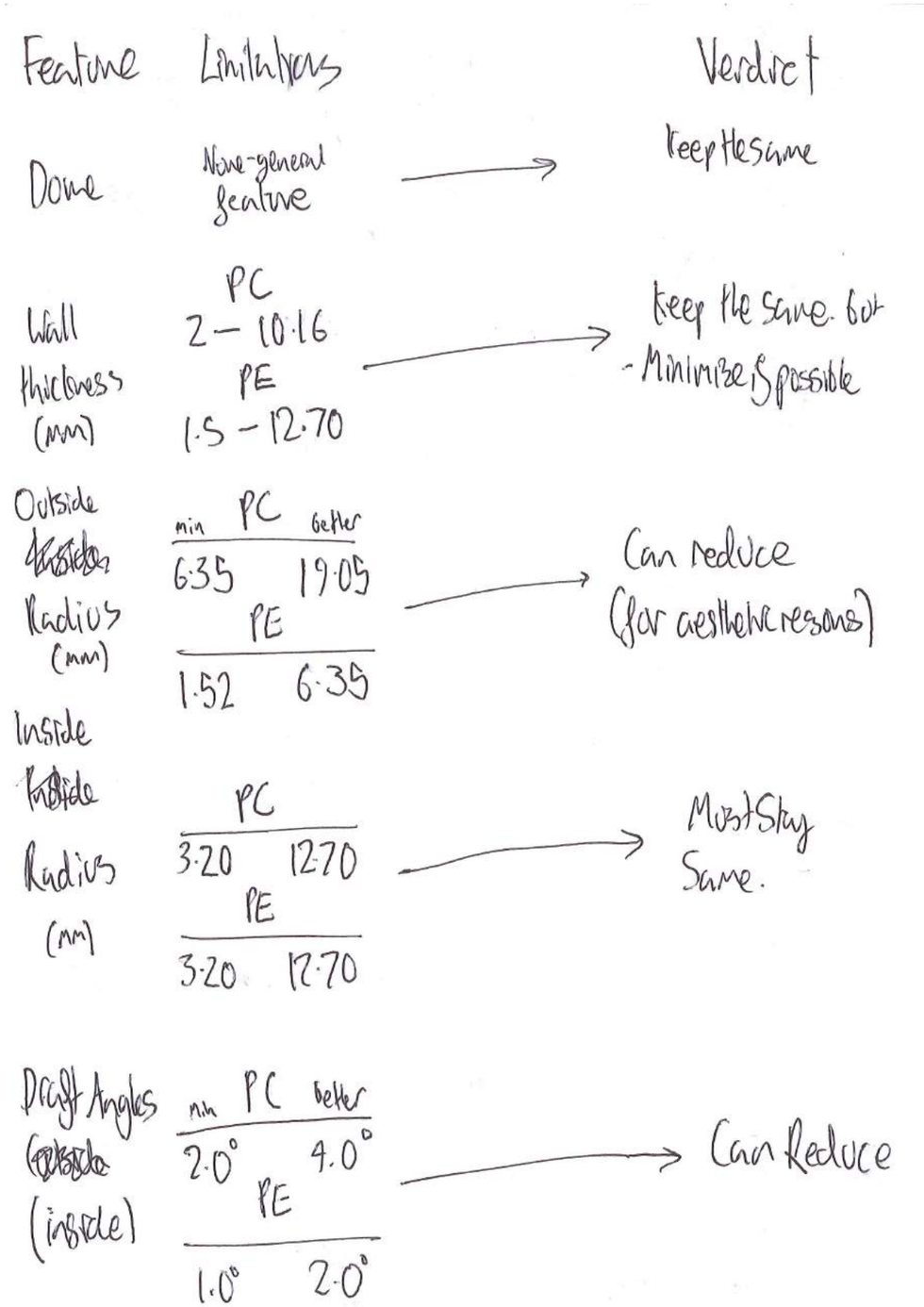
Due to the change in material, it is essential to check if any design changes are necessary.

I used the charts i had used prior in the process to see if i could make any changes, and in general I found that PE was a more allowable material, giving me more space to design and less constraints. Having said this, I am happy with the look and feel of the product, as it was not designed just to meet constraints and do not think any radical design changes are necessary. One thing I have changed is the draft angle on the interior of the box, this was a part likely to interfere with the sides of the box frame during installation, so I am happy to be allowed to reduce it. I reduced it from 4 to 2 degrees, as per the 'better' standard.

The strength tests did not give me a worrying amount of stress, so I am not worried about wall thickness. I think 4mm will be flexible enough to resist impacts, and have tested it's strength. It should let enough light through, as per my tests.



The new improved corner detail.



My hand method for assessing design limitations