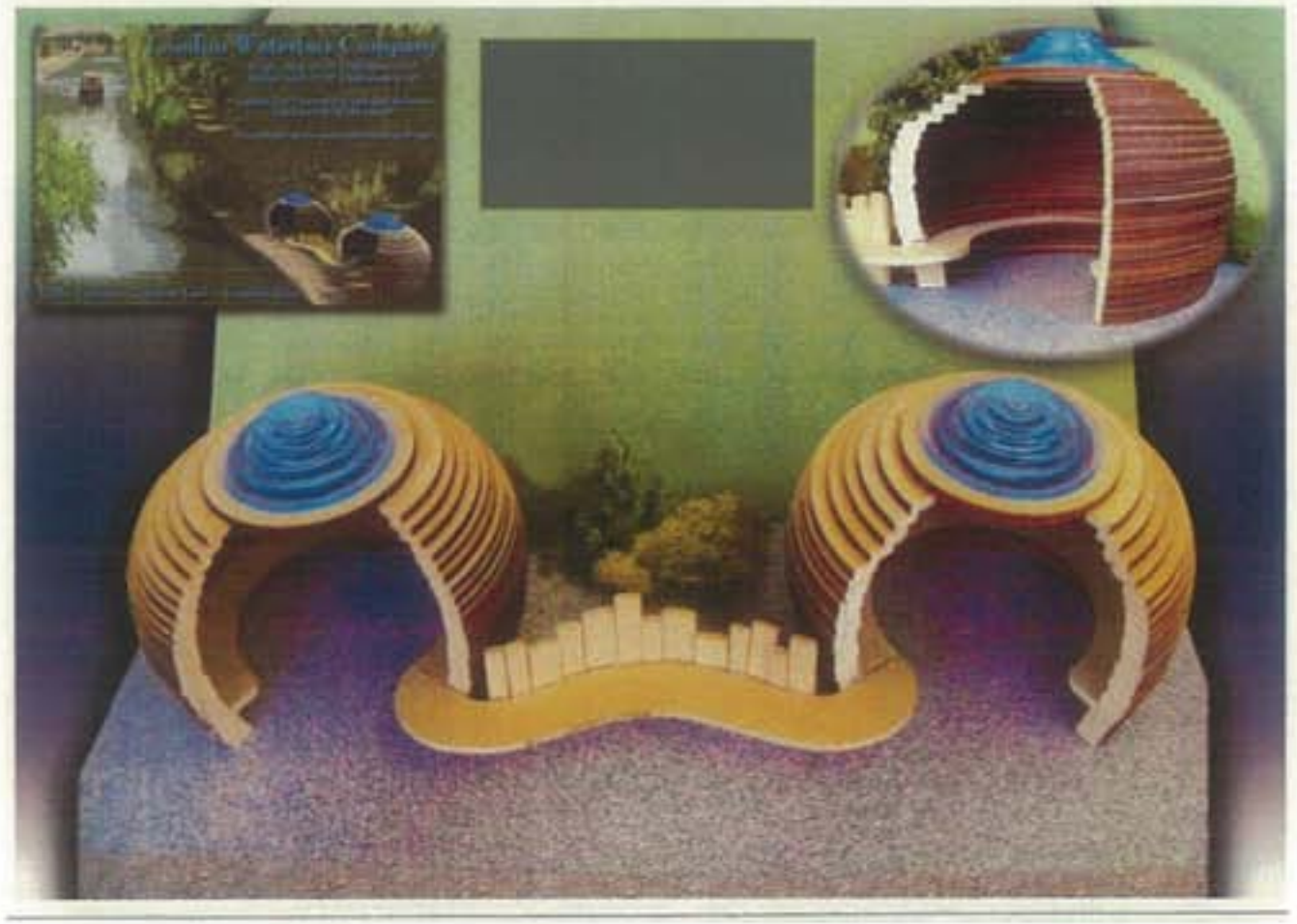
EDEXCEL

GCE Design and Technology:
Product Design (A2)
(Graphics Products)

EXEMPLAR MATERIAL 1

Title: Waterbus Shelter.

UNIT: 6GR04



Contents

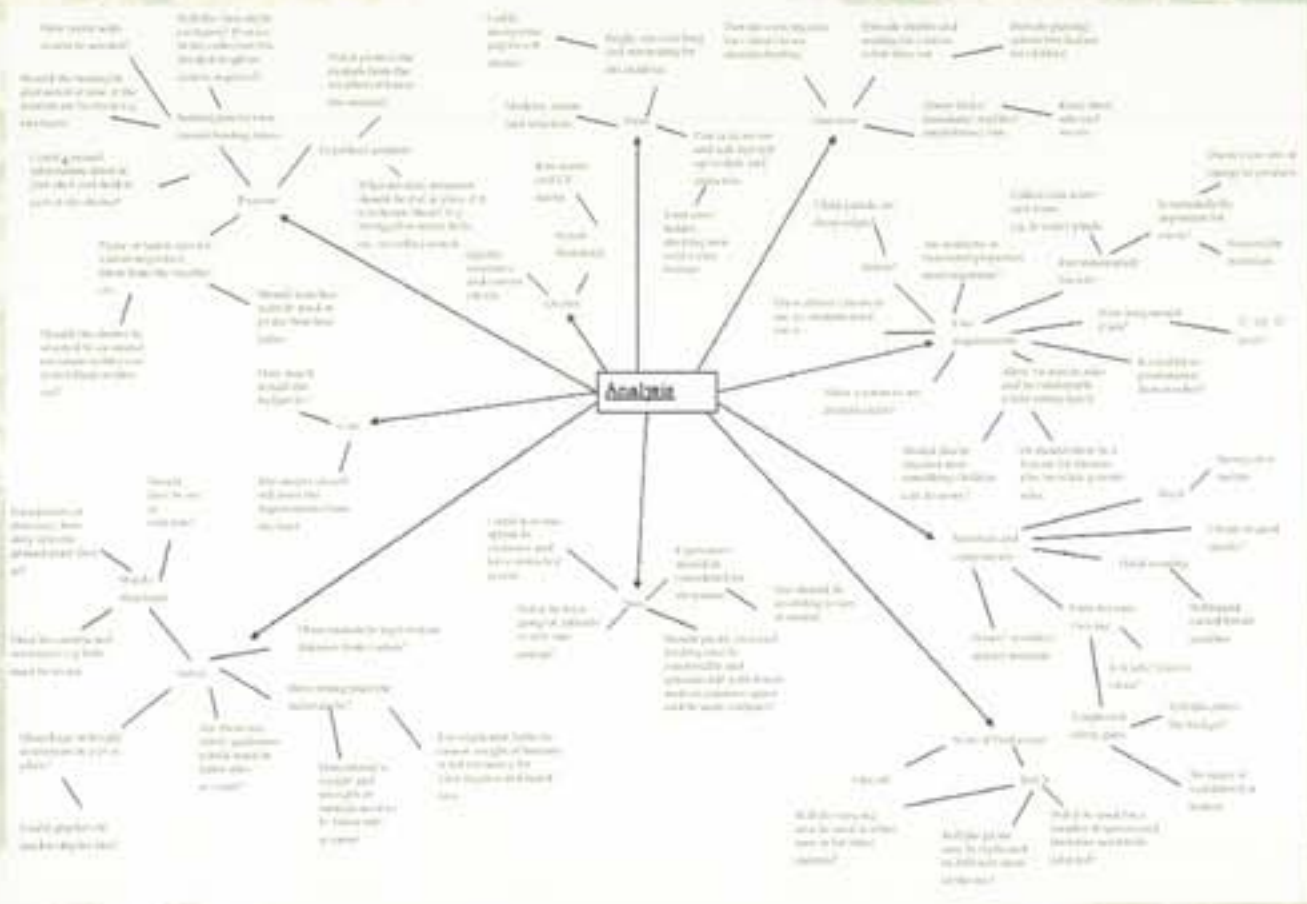
Research and Analysis

I was keen to design a shelter for a well known London attraction, and decided that London Zoo would be appropriate and provide me with the flexibility explore lots of creative ideas. After deciding this I made contact with the education department there and set up a meeting with Ruth Desforges, an Education Officer at the zoo.

Before our meeting I began to think about possible ideas that I could suggest to Ruth. I came up with 3 rough design briefs:

- To provide a safe, secure and practical shelter for animals, with open space to view the animals, a feeding area and attractive design.
- To provide a stylish picnic area for visitors with seating, shelter from the weather and space for comfort and watching animals.
- To act as a viewing area for visitors to watch e.g. lions being fed, with an attractive, simplistic design.

I also came up with a brainstorm of ideas for each of these briefs where I tried to explore lots of the factors that would need to be taken into account when designing the shelter.



Following my visit to the zoo, Ruth Desforges highlighted the need for a shelter for the waterbus service. The waterbus provides transport from London Zoo to Little Venice and Camden Lock, along Regents Canal. She thought that my previous ideas for the brief were all relevant yet there was a real need for the waterbus shelter and this would provide improved facilities within the zoo. My discussion with Ruth provided me with lots of important information which I will need to consider when designing the shelter.

It became clear, that although an inventive design is important to the zoo, it must fit in with the area and not detract from the animals and nature. As London Zoo is run and supported by The Zoological Society of London, an animal conservation charity, they survive from donations, so there is a budget which must be stuck to. For example, the gorilla enclosure cost £5.3 million and this money was raised through events and generous donations. Many of the buildings in the zoo are listed, so cannot be changed or knocked down. Although these buildings were once architecturally very impressive, they now appear dated and the zoo lacks any consistent theme. Therefore, another issue which must be taken into account is its flexibility, the zoo wants the shelter to last as long as possible but for it to date as little as possible, by either being able to change elements of it, paint it, add or remove parts easily. To ensure that the shelter dates as little as possible the theme should be very natural and not too abstract. The zoo is beginning to introduce a rough theme to the buildings, using organic, natural shapes and natural materials to fit in with the environment and focus the attention on the animals. I suggested the idea of a shelter that gives back to the environment to Ruth, and she seemed pleased with this idea, saying that the komodo dragon enclosure has a "green roof" and that the zoo is keen to be as kind to the environment as possible.

We visited the existing shelter together to discuss some possibilities, and realized that it is currently almost impossible to disabled visitors to get to and from the shelter as it is down a set of steps, so a wheelchair ramp could be installed. The service is also very poorly advertised and few visitors even see the board situated behind some bushes, let alone the shelter which is hidden in the woodland walk. The shelter is currently very small and has no seating; there is also plenty of room around it on the pathway for a larger seating area.

Current shelter

Therefore my design brief is to design a shelter and entrance located on the edge of London Zoo for the waterbus service. The design must fit with the following criteria:

- be within the budget of £8,000.
- have a natural design and be made of environmentally friendly materials.
- give back to the environment in some way.
- last for as long as possible, but be flexible enough to change if it becomes dated.
- provide sufficient seating for those waiting for the waterbus.

A Promotional Item must also be designed for the waterbus service. It should:

- advertise the service to visitors.
- provide information on the service with timetables and maps.

Analysis

Purpose
- To provide cover from the weather and temperature.
- To provide a seated and sheltered area for those waiting for the waterbus service.
- To advertise the service and make visitors to the zoo more aware that it exists.
  - With posters
  - With notice boards
- With a attractive, visible entrance

Size
- Wide enough for people sitting, standing and pushchairs etc.
- Wheelchair access
- Take advantage of wide and long path
- How many seats will be needed?
- How many people use the service and how many seats are there on the waterbus?

Performance Requirements
- Entrance must attract visitors to use the service
- Shelter needs to cover maximum amount of users
- Would it be safe and easy to clean?
- Too modern?
- Toughened safety glass could be used as an alternative as it doesn't cause injury if broken
- Glass could provide cover but also allow the woodland to be seen.

Materials and Components
- Hard wearing and long lasting
- Water/ weather/ impact resistant
  - Seals
- Natural materials as much as possible
- Can be painted, cut etc. easily to update the shelter

User Requirements
- Give back to environment
  - Provide space for animals homes, e.g. birds nest space on top
  - Collect rain water?
- Long lasting but flexible
  - Won't rust etc.
  - Seals for wood
- Good quality materials
- Safe for wildlife, for example, birds, squirrels etc.
  - No sharp edges
  - Glass may not be seen
- Shelter must be made within budget that will be set
  - By not over spending on materials
  - Practical design

Scale of Production
- One off
  - Copy writing
- Batch
  - Will it be used at Little Venice and Camden Lock?
    - Will it need to be adapted to suit the two other destinations?
    - Should the theme be very subtle so it will fit in with the other settings?

Cost
- Must be constructed to brief but within strict budget

Quality
- Quality assurance and control checks
- Good quality and long lasting but flexible enough to change
- British standards

Safety
- Zoo safety guidelines
- How strong must materials be?
  - Use ergonomics when considering seats to cater for heavier people
    - Must cater for heaviest customers
    - Or have a warning sign
- Good, deep foundations
  - Concrete to set foundations?
- Using experienced professionals
- Must be constructed accurately and securely

Function
- Natural shapes, colours and materials
  - Fit in with its surrounding
- Be adaptable
  - Easy to add/ remove parts
    - Minimum welding
    - Construction with bolts instead
- Advertise and give information about the waterbus service.
  - Noticeable entrance/ walkway
  - Leaflets at top of steps
  - Map on advertising board and timetable
- Give back to the environment
  - Improve visual aesthetics
  - Collect and reuse water

Form
- Natural and realistic style doesn't date easily
  - Not to everyone's taste
  - Not impressionist style
  - Could date easily
- Style that will not date
- Organic and natural shapes
  - The golden ratio
- In keeping with "Woodland Walk" area that surrounds the shelter.
  - Look like tree or branches?
  - Natural materials
    - Oak
    - Bamboo
    - Stone
    - Grass roof

Research into Existing Shelters

This lakeside shelter has been designed and produced by Altham Oak and Carpentry Ltd, after reading the information provided on their website and doing my own research I have developed an understanding for the materials, processes and construction methods that may have been used when creating this shelter.

Analysis of Research

Purpose

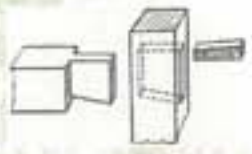
This shelter provides a small, covered seating area for up to 6 people, overlooking the lake at The Old Zoo, Brockhall Village.

Roof

The roof provides shelter from above and behind for privacy and weather protection. The front is covered in cleft/split oak shingles which last far longer than sawn cedar, which is a similar alternative as the fibres run continuously along the shingle. Shingles are often produced by quartering out the log, then removing the sapwood and heartwood radially. Skilled roofers would have been required to fix these as a different technique must be used to sawn shingles. They will probably have been fixed with stainless steel annular ring- shank nails at around 50mm x 260mm. The back of the shelter is covered with plants which join the roof to the ground, making the shelter appear part of the landscape and nature.

Joining Techniques

Joints used will include pegged mortise and tenon. As the shelter is made of wood, it will shrink as it dries out, the joints will then loosen as time passes, making the structure very unstable. This must be taken into account when designing it. The problem could be solved in two ways, with either a dovetailed and wedged tenon or drawbore pinning.



Dovetailed and wedged tenon

Drawbore pinning

Carving and Finishing

The carvings on the faces of the wooden beams are similar to Celtic Knot work. As oak is a hardwood, it would have been harder to work with and carve into than softwoods like pine. However it is far more resistant to damage than pine and so is better suited for outdoor furniture. Hardwood carving generally requires a chisel and a mallet and would have to have been done across or with the grain but not against it. These tools would create the basic carvings, detail would be added with either a fluter for deep cuts or a v tool for finer lines.

To get a smooth finish, a rasp may have been used for the larger areas and a riffler for the smaller, fiddlier parts.

Abrasive paper can then be used to smooth the finish even more.
These carvings give the shelter a style but also draw attention to the curved wood at the top, focusing on the natural elements.

Aesthetic Properties and Materials

This shelter has been designed to embrace the natural curves and shapes of wood. Its style fits in with its surroundings and does not look out of place. The twisted oak design at the front appears to be natural but adds interest to the shelter about how it was created.

This shelter has been made using English Green Oak beams, a sustainable resource, some of which have been grafted where the beams cross. Although oak is more expensive than other woods it is strong, durable and sturdy which makes it an ideal material for outdoor furniture. Oak becomes oxidised and over time turns silver which adds to its rusticity and natural elements.

To maintain the structures durability, heartwood (dead wood) may have been used for surfaces which would come into contact with the weather as it should not react or decay.

Structure

The rafters that support the roof are curved in two planes which provide maximum support for the roof.
The two benches on either side of the shelter are supported by the roofs support beams. Each chair has seat depressions and the backs are shaped to fit most bodies using ergonomic data, making them more comfortable than flat oak. The benches are positioned so that the opposite bench and the lake can be seen simultaneously.
The wooden legs may be protected from the damp ground with stainless steel feet

Product Specification

Purpose

- The waterbus entrance must advertise the service, using e.g. graphics, posters etc.
- The entrance needs to be more obvious than the current board hidden by trees resulting in more trade
- The shelter must provide a safe area with enough seating for the maximum boat load of 25 passengers
- There must be access to the shelter, space under the shelter and facilities onto the waterbus for wheelchairs and pushchairs
- The shelter must provide protection from the weather

Form

- The shelter and entrance should be themed but have a natural style to avoid them dated.
- The design of the promotional leaflet should be in keeping with the design of the shelter, with at least 2 colours the same
- The style should embrace and be inspired by natural elements

Function

- The entrance down to the shelter must advertise the service and provide information about it
- The shelter must cover the users while they wait for the waterbus, therefore it must have a roof of some kind
- It must give back to the environment in some way, for example, a rainwater collection system or if wood is used, seedlings should be replanted after logging

User Requirements

- The style of the shelter and entrance must not date so they can last as long as possible, at least 10 years without looking outdated
- The shelter must be adaptable so if changes need to be made, a whole new shelter is not required
- The design must be similar to the newest buildings and areas in the zoo
- It must not detract from the woodland walk

Performance Requirements

- The shelter must last at least 10 years
- The entrance must attract more customers to the service, at least 10%
- There must be access for wheelchairs and push chairs in the shelter
- Those waiting must be safe and protected from the weather

Materials and Components

- The materials should be sourced from local companies using sustainable methods of manufacturing, they should be Forest Stewardship Council certified manufacturers
- They must be of the best quality to increase the longevity of the shelter but still remain within the budget
- The majority of the components of the shelter should be natural and relatively unprocessed
- They need to be weather, water and impact resistant and should pass quality control and quality assurance checks for this
- They must be strong and hardwearing to ensure safety of the users and to maximise the life of the shelter

Size

- The seats should be designed considering ergonomic data to fit most peoples bodies
- There should be enough space for 2 wheelchairs , 4 pushchairs and the maximum capacity of 25 within the shelter
- The design should make the most of the large space along the canals edge, making it longer and wider

Safety

- The structure must have excellent foundations to keep it secure
- The materials must be able to withstand a persons weight and if it cannot this must be made obvious through signage
- The shelter should be child friendly with as few sharp edges at low heights as possible to reduce risk of injury
- The shelter and entrance must not contain any materials that conduct electricity in case they are struck by lightning

Quality

- The materials must be of good quality to be durable and long lasting
- The construction must be of very high quality to ensure the shelter is safe and secure
- The chair backs and seats should have depressions in them to make them comfortable

Scale of Production

- The shelter and entrance are one off designs, so do not need to be adjusted for other settings, people etc.

Cost

- The project must be within a budget of £8,000 as this is the charity's largest possible budget for it

Survey Results

After visiting the zoo for a second time to hand out my questionnaires, I have gathered a lot of valuable and relevant information.

The target audience for my market research was the zoo visitors and the staff at the zoo. The visitors are important to ask as they would be the users of the service and could give a good idea as to what sort of design, materials etc. would attract them, make them notice the service and want to use it. The staff at the zoo and on the boat are around the area so often that they would have very valuable ideas and knowledge of complaints or suggestions that has been made by the visitors about the waterbus shelter.

Why do they use the service?

It was clear that the zoo visitors use the waterbus service as a cheaper and more pleasant mode of transport around London than taxi. Advertising the prices would increase the service, as it is not displayed on the current board. Most of the visitors felt that they and others would be fair more likely to use the service if this was shown clearly.

Advertisement

None of the visitors I asked thought that the poster was a good promotional item for the service. They felt that the fact that it is hidden by the trees of the woodland walk and that there is no obvious entrance or walk way were the two main reasons why they wouldn't use the service or notice that it was there.

Materials, Components and Processes

Both the staff and the visitors felt that natural building materials would not only look attractive, but also be most appropriate for its purpose and positioning in the zoo. Therefore, this will definitely be one of the main factors to consider and should definitely be included in the specification.

When asked about the construction of the shelter, the staff suggested using traditional methods to keep it as natural as possible, for example the dovetailed and wedged tendon which may have been used for the construction of the lakeside shelter, compared to more modern materials and techniques like nails which may rust. They want the shelter to have as little impact on the environment, through the materials and construction.

The staff mentioned eco friendly paint, Natural Building Technologies supply Exterior Timber Paints which provide a good coverage, are durable and less harmful to the environment than most other paints. By reducing TiO2 (which cause habitat destruction and pollution) by over 25%, the paint has 30% less embodied energy and CO2 emissions than similar products. IT produces less transport CO2 emissions as it is manufactured in the UK.

The environmental costs of processing the materials of the shelter should definitely be considered when deciding where they will be sourced from. To help the local economy any natural materials should be grown and harvested locally. This will also reduce the distance for the materials to be transported and therefore reduce the greenhouse gas emissions. If wood is used it should be certified by the Forest Stewardship Council or Sustainable Forestry Initiative to ensure that it is processed and manufactured with environmental and social effects taken into account.

Main Features of Existing Shelter

When asked what they remembered of the service and its advertisement, very little was recalled about the entrance and shelter but far more about the journey. Most of the visitors who had used the service on previous visits felt that they would reuse it if that was one of the things they associated with the zoo.

So a more memorable and noticeable entrance, advertisement and shelter should make the service a bigger feature to the zoo and increase its use.

Natural Building Materials

Rammed earth

Wood

Straw

Bamboo

Rock

Sustainability Issues

Seeing as the zoo's aim is to conserve the animals and their habitats', it is no surprise that the staff felt strongly about the sustainability of the shelter and the materials it is made from.

The questionnaires showed that the majority of the visitors would be happy to see or be told that the materials are sustainable and come from reliable, good quality suppliers. A wooden waterbus shelter would be ideal to fit this specification point and it could be supplied from sustainably managed woodlands.

The best way to produce a sustainable shelter would be to use unprocessed, renewable and recycled materials. Another possibility could be to collect rain water and re- use it somewhere in the zoo. All of the visitors and staff that I spoke to were very keen on this idea and felt that this would be an excellent way to promote the shelter and zoo.

This rainwater catchment system works by collecting rainwater in a gutter, it passes through a filter and into a storage tank which can be above or below the ground.

This house collects and funnels water through the roof.

Sustainable methods to manufacture wood products should be used to minimize the effect on the environment. Forestry regulations say that seedlings should be replanted after logging.
There should also be a 35 year fallow period after logging to maintain soil fertility and allow it to recover.
Directional tree felling can prevent too much damage on the surrounding forest.

Style

Although a large amount of visitors preferred the idea of a stylishly designed shelter, because it would add extra interest and be a focal point, possibly making the service more noticeable, most of the visitors and all of the staff that I spoke to were clear that a natural design would be far more practical than, for example an abstract design. They felt that a natural design would date less than a stylized design, which would need changing or updating more drastically and would draw attention away from the surrounding woodland walk.

The staff's main issue was that the shelter would last as long as possible without looking dated and they felt that natural shapes and curves should be a key focus of the design.

Size and facilities

I found out that the waterbus can hold 25 passengers. The zoo staff told me that the passengers are often groups on school trips so the shelter should accommodate for this. The waterbus also accommodates for disabled passengers but they can not access the boat from the waters edge and can not get from the main path in the zoo, down the steep bank to the shelter and waterbus.

I noticed that many of the visitors came to the zoo with babies in pushchairs. When I asked these visitors they felt that push chair space would make it far more appealing to them and make the experience more enjoyable.

Therefore, it would definitely be worthwhile providing facilities for wheelchair access, sufficient space for pushchairs and enough seats for the average school trip, or waterbus's maximum capacity.

DESIGN ONE

Possible joining techniques for glass and wood

rubber washer

weather, water and impact resistant

Plasticised glass is safer than normal glass

Glass roof allows nature to be seen from both sides, so it doesn't break up the scenery

Will reflect water and woodland in certain light

Won't conduct electricity

long-lasting

the angle of the glass allows rain to roll down, the glass to then be collected at the bottom.

oak support beams

uses more space than current shelter

lots of space for wheelchairs and pushchairs

natural material

curved shape of support beams balances out the modern element of glass to make it more natural

Jigsaw used to cut out the pattern in the oak and the basic shape

The cut pattern in the wood adds detail, fits the theme and allows people see through the material

Can be varnished or sealed to protect wood from weather and water

durable

inexpensive to buy

solid wood means it will withstand the weight of a human

natural material

bolted to floor to stop it from rolling

Solid tree trunks will have been carved into to create seats for those waiting for the waterbus.

The seats will be shaped with ergonomics in mind so they are comfortable. They will be sanded and varnished to make them smooth and last longer.

To ensure that both designs are safe the foundations will need to be

Concrete will need to fill deep into the ground where the weight will be to support it. The bank may need to be reinforced to avoid subsidence.

Client Feedback

Positive:
- curves - watery
- tiers give good view of woodland
- glass doesn't break up woodland
- outdoor seats

Negatives:
- too large
- outdoor seating wrong way

Client Feedback

Positive:
- natural design cut into wood support beams
- glass allows people to view woodland as do cuts in wood

Negative:
- too large for surroundings
- not much protection from weather

Both designs may detract from the woodland area

DESIGN TWO

The shape of this bench is inspired by Gaudi's benches at Parc Guell, Barcelona.

carved tree trunk

curved natural shape

sanded after carved then oiled

covered to protect from weather

curved roof covers the edge of the canal to shelter as they board the boat

outdoor staircase saves seating space

two levels give more seating space and a different view of the woodland

covered for shade and protection from weather

same seats as inside

outdoor seating for Summer

Plasticised glass is safer than normal glass

bent steel frame

glass allows plenty of light to enter the space. It will help heat it in the winter and not break up nature

cast reconstituted stone

glass sidepanels

con folding glass doors allow fresh air in hot weather

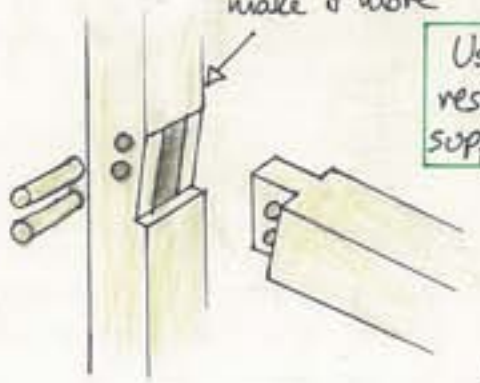
pin

plan view of door mechanism

hinge

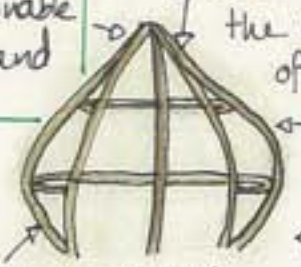
Design Three

Mortice + tenon joint will secure each wooden beam together. Pegs will make it more



Use sustainable resources and suppliers

Oak beams will make the organic shape of the shelter



natural

Oak last much longer than softwoods

Cob will be applied to the oak frame to cover the walls. The wood will be left uncovered so the can be joined.

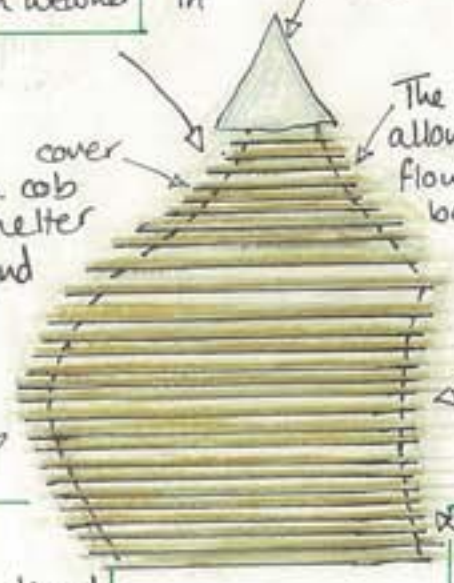
This shelter is constructed from oak, cob and curved plasticied glass

sustainable materials

It provides a safe, covered area to protect from weather

Glass lantern roof allows plenty of light in

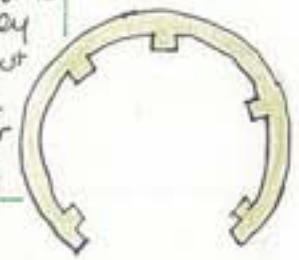
wood will be oiled to



Wooden cover most of the cob giving the shelter a modern and simplistic finish.

The wood will allow the rain to flow down and be collected then reused.

If the need to be replaced they can be taken out easily, so the whole shelter doesn't need changing



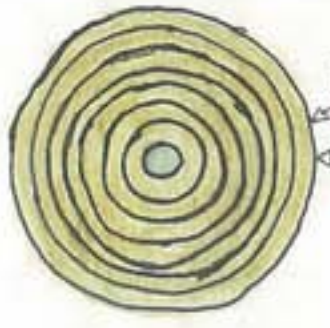
The design is similar to the new areas of the zoo, incorporating wood and curves.

This design may detract from the woodland

The shape of this design is inspired by a bulb of garlic.

Different sized oak are placed the same distance apart, attached to the main structure by mortice and tenon joints fitting into the oak beams supporting the structure.

Simple, natural style, so won't date



Plan view

The shape doesn't maximise the space.

space for push-chairs + wheel chairs

seating to hold 25

benches should be moulded using ergonomics.

oak bench

wide opening

Client Feedback

Positive:
- natural design would fit in with surroundings
- no particular style so wouldn't date
- good use of sustainable materials

Negatives:
- not very sturdy
- very little protection from elements

Design Four

There is space for wheelchairs and pushchairs

The natural style won't detract from the woodland

The bench backs are painted to look like the top of the shelter.

Natural elements

sustainable materials

Solid oak beams make the bench seats and back. The are cut to the desired shape using a

Uses more space than the current shelter

Attractive to customers

The cob will provide protection from the weather

Won't conduct electricity

The roof will have a layer of cob underneath the frame to make it water tight.

Thick cane makes the basic structure of the shelter.

It can be cut easily to get the range of lengths needed, and can be bent to make the curved shape.

This can then be used as a frame for vines and flowers to grow around.

Shouldn't date

long-lasting

Cane joiners will attach them together, creating the structure.

May not be very strong and impact resistant

The shelter doesn't give back to the environment

But allows plants to grow up and around it

Benches should be designed + shaped with ergonomics in mind

similar to newer parts of the zoo

Client Feedback

Positive:
- use of sustainable materials
- wouldn't detract from surroundings
- interesting shape

Negatives:
- too enclosed
- not efficient use of space
- too dark

Design Five

Lights could be used under the glass to make it a visible land mark in the dark.

brackets attach the two walls

If there were structural faults the whole shelter may need to be replaced.

Grooves allow for ventilation, drainage and stress relief

Double door allows wheelchairs + push-chairs in.

old style oak door

vertical board

round brass door handles

secret nailing gives it a clean finish

Wouldn't conduct electricity

shiplap cladding has a longer life than other designs

horizontal battens

A wooden cladded wall would be cheaper than stone

oak is a good thermal insulator

Enclosed shelter protects from the weather

Sustainable materials

oak cladding walls

This design may detract from the woodland walk.

The glass could be engraved to show the name of the stop

Water can flow down the slanted walls and be collected

enough seating for maximum load

glass panels in steel frame

ergonomics could be considered to ensure the height is sufficient

thermowood is produced using vapour and steam rather than chemicals which would be better for the environment.

glass front allows people to see in and out for when the waterbus arrives.

safe and sturdy structure

Mostly all natural materials

Plenty of space for wheelchairs and pushchairs

Uses more space than current shelter

Client Feedback

Positive:
- great use of natural materials
- original design
- would attract visitors to that part of the zoo
- good mix of old and new styles.

Negatives:
- this may be too big for the area
- the angle of the walls does not give much space inside

Design Six

The wooden side and roof could be secured in 2 ways

12cm coach screw

brackets set into materials

or using a knock down

ergonomics must be considered

cushioned seating covered in cream fabric possibly leather re-inforced with steel

oak frame

sikaflex

concrete

stone

Each roof section will be attached together in this way with sikaflex to secure them

Durable materials are long-lasting

pre-cast concrete in 3 sections

Glass back will sit in a rebate in the other materials

cedar

mild steel attached to stainless steel frame

Stainless steel benches

Plenty of seating

could date

Mostly natural materials

Water can flow down either side and be collected

The curved edges gives a natural appearance

laminated cedar sheets will make 3 panels

may detract from woodland

Plenty of space for wheelchairs and pushchairs

PLAN VIEW

Curve gives natural elements

bent stainless steel

ergonomics should be considered when designing the shape

sheet

rivet

2 mild steel sheets will be riveted onto a steel frame

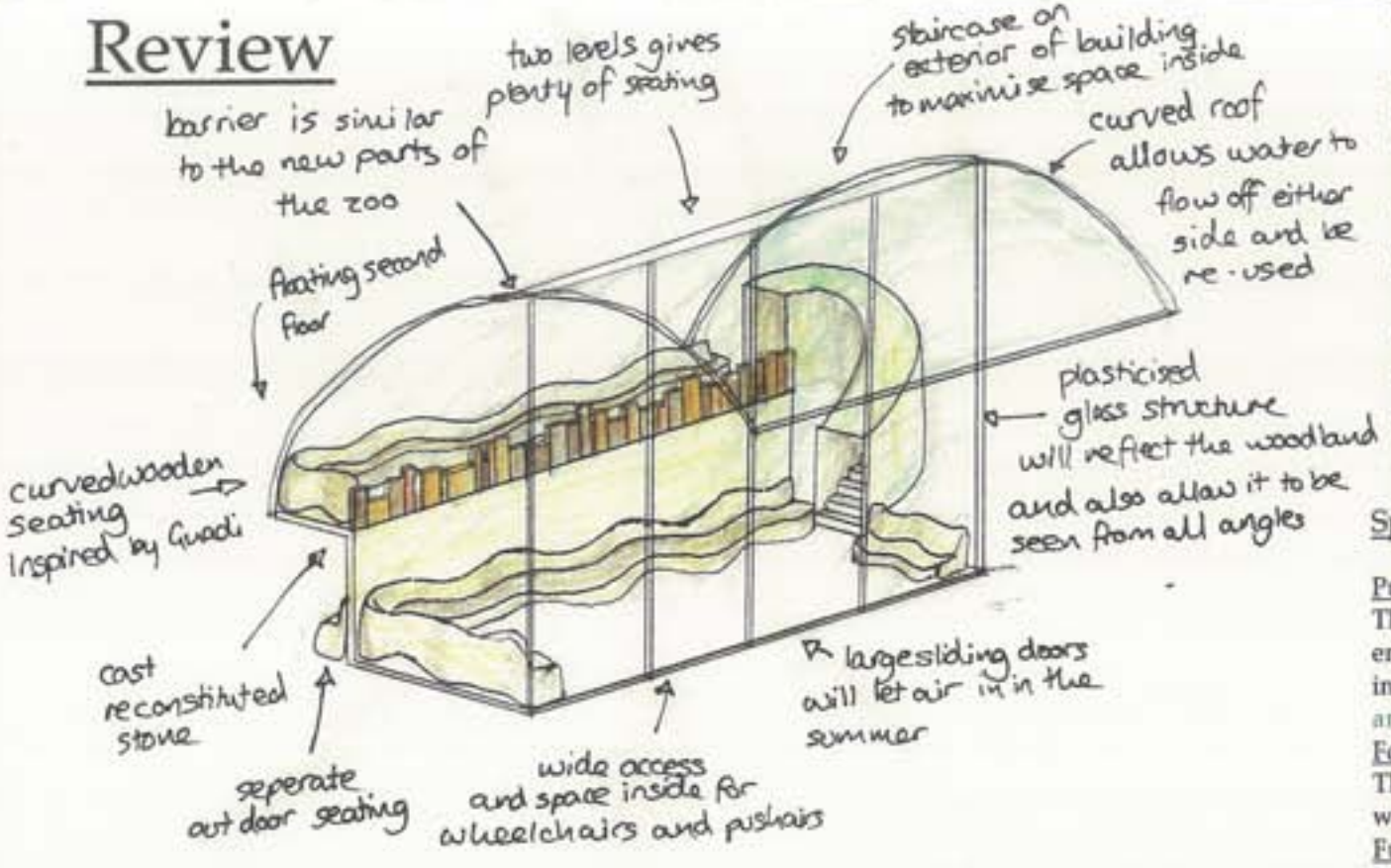
Riveting allows materials to be fastened from the outside.

Client Feedback

Positive:
- the curved aluminium wall is great and really works well with the water
- glass back and open front allow visitors to see in and out

Negative:
- the mixture of materials could be too busy and over the top
- modern style could date easily
- open front wouldn't give protection from weather

Review



3rd Party Feedback

John

"The outdoor seating is a very nice idea and perfect for the hot weather, however it is a shame that it is facing away from the canal, visitors may miss the boat if they can't see it arriving."

"I think that the mix of glass and wood cleverly combines modern and natural materials, allowing the shelter to fit in with the woodland but also be eye catching."

Eve

"This design may be too modern for the natural surrounding area."

"The glass could be a hazard for young children, the elderly and wildlife. Birds may fly into it and injury themselves."

"The external staircase seems unnecessary, why not have it inside the shelter. Then people could be seen as they go up the stairs incase of accidents, rather than being hidden."

"I think the curved roof is a really good feature and the water collection system is brilliant."

Emily

"I really like the glass used in this shelter, it will allow people to see out from all angles and people to see in."

"It's a very unusual and artistic design which I think would attract people to use the service."

"The large glass doors may be difficult to open and could be dangerous for young children."

"I think the Gaudi influence in this design is subtle but well done, could you include something educational about him into the shelter?"

Client Feedback

Ruth Desforges- Education Officer, ZSL London Zoo

"I really like the curves in this design, I feel that this reflects the watery theme of the canal. The two levels work really well by maximising the space; it also gives a good view of the woodland area. However, as it is currently, I think that the design may be a little too tall for the area."

"The glass is good as it allows visitors to feel immersed in their surroundings and enjoy the woodland walk. However, I would be concerned that the glass could create a greenhouse effect, making it very hot inside in the summer and too cold in the winter. How could you ensure that the shelter would not do this?"

"I really like the idea that you have come up with, of having seating outside which I am certain would be used a lot in the summer months. However, this may be better facing the canal, in the same direction as the other seats, so that the visitors can see the waterbus arranging."

"The scale of this design and the fact that it would require concrete foundations doesn't stand in this design's favour."

Specification

Purpose
This design has two levels of seating inside as well as one outside so there would be plenty of space for the maximum boat load. It is enclosed, strong and has few sharp edges, so would be safe for young children. The wide glass doors at the front of the shelter and area inside will allow space for wheelchairs or pushchairs to enter the shelter and wait there. However there are no facilities for wheelchairs and pushchairs to get to the second level of seating.

Form
The carved wooden bench is inspired by natural elements and has a curved shape, it is primarily glass which will reflect the surrounding woodland area, preventing it from breaking up the scenery. However it doesn't have a natural style and is very modern, so could date.

Function
The shelter will cover the users while they wait for the waterbus and can completely enclose them in the winter but provide ventilation in the hotter weather. The curved roof will allow rain to flow both ways off it, either back into the canal or into a water collection system towards the back of the shelter, creating a waterfall feature in front of the outdoor seating. It also provides shelter for people when they are boarding the waterbus.

User Requirements
The fence on the second level and benches are of a similar style to the newest parts of the zoo so would fit in, but the main structure is quite different and its shape and style may detract from the woodland walk. If structural elements need replacing, an entirely new shelter would need to be rebuilt, however if, for example, the glass breaks it could be replaced without effecting the rest of the shelter.

Performance Requirements
The shelter should last at least 10 years, if not longer as glass is very durable, however if it breaks, individual pieces may need to be replaced. It is a safe area that is completely covered to protect from the weather.

Materials and Components
Glass is not a very sustainable materials, however it can be supplied by sustainable manufacturers, to make it as environmentally friendly as possible. Oak and stone are sustainable materials which will give the shelter an organic and natural feel . These materials and their production may cause it to be over budget however. Plasticised glass is stronger and safer than normal glass so the shelter will be weather, water and impact resistant, lasting a long time.

Size
The shelter is quite large scale, so definitely makes the most of the space in terms of width, depth and height. The benches will be carved to the shape on the natural curve of the human back and the seats will have depressions to make them comfortable.

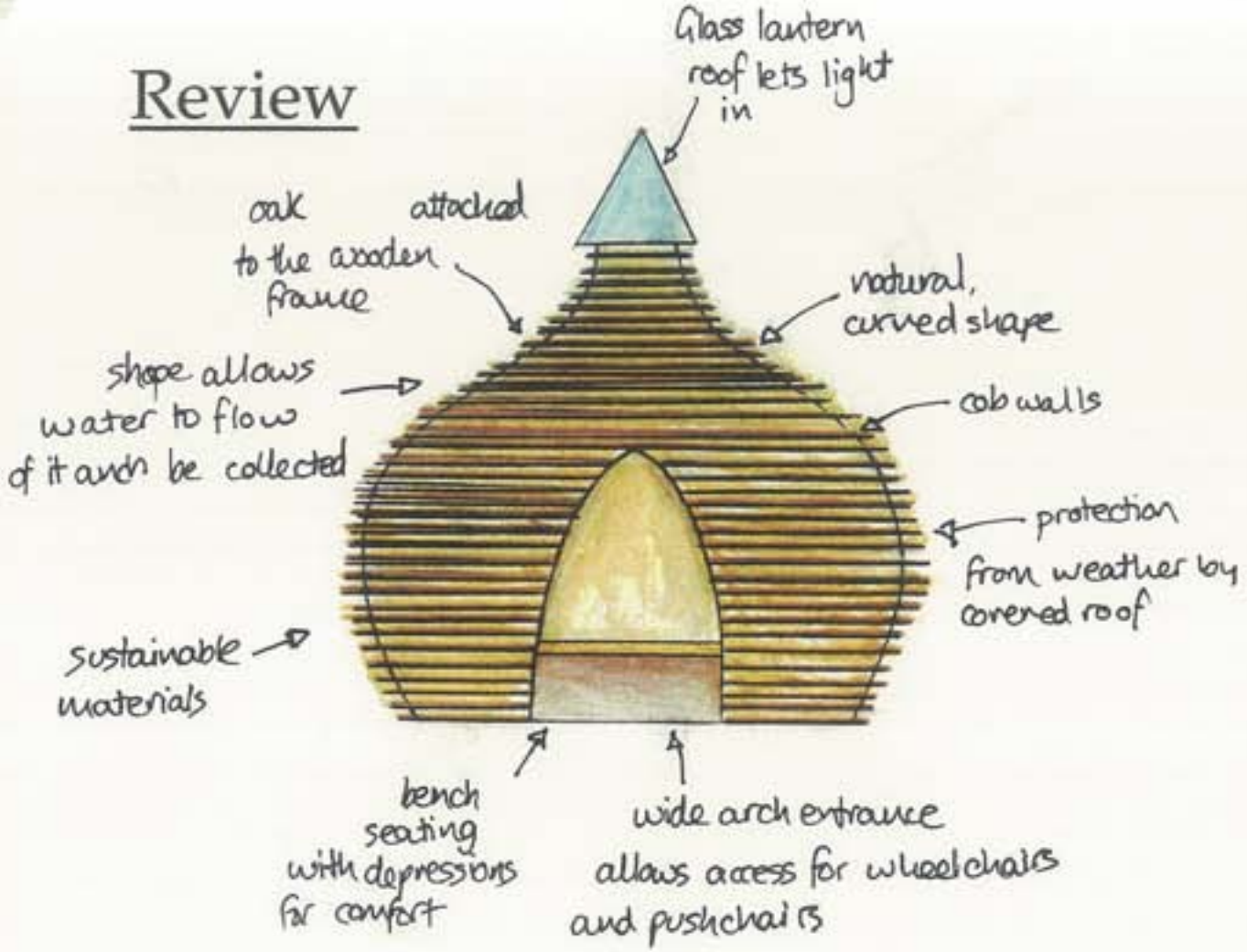
Safety
The stone back and floor of the second level of seating is strong to withstand the weight of a human, it will also be reinforced with a bracket to increase this. The wooden staircase will be thick and strong enough to withstand human weight. The foundations will be done according to the weight of the structure to ensure that it is very secure. The curved shape of the structure and the other elements means that there are few sharp edges which could be safety hazards. However the glass may not be seen by young children or the elderly that could act as a hazard. The shelter would not conduct electricity; however the metal frame may cause a problem

Quality
The plasticised glass will be longer lasting than ordinary glass, the oak seating will have depressions for comfort and will be oiled, as well as the stairs and fence, to waterproof them etc so that they are as durable and long lasting as possible. The construction of the shelter will be of very good quality to ensure its safety.

Scale of Production
The shelter and entrance are one off designs so do not need to be adjusted for other settings etc

Cost
The project may cost more than the £8,000 budget.

Review



3rd Party Feedback

Eve

"This design looks as though it may be very dark inside, especially early in the morning and late in the afternoon. Maybe the glass lantern could be wider or sit further down the shelter."

John

"I really like the natural shape of this shelter, and while it is eye catching it would not be too distracting and draw attention away from the woodland area."

"The natural materials of the shelter would also help it to blend in to the surroundings."

"A very contemporary design could date easily but the wood of this will age naturally and become more intriguing as it ages."

Emily

"The organic shape of this shelter is definitely the focal point of the design."

"This shelter doesn't look particularly big, and may be very dark, could you open up the front to let more light it?"

Client Feedback

Ruth Desforges- Education Officer, ZSL London Zoo

"I like how you have thought to use sustainable materials in this design and think that it wouldn't detract too much from the surrounding area. As you have said, it may not maximise the space sufficiently and could feel quite enclosed and claustrophobic for the visitors waiting inside."

"The shape of the structure is really interesting and natural but could it be opened up more or enlarged to make use of the space? However, this change doesn't need to be huge, only slight."

"I really like that the lantern on the top of the shelter lets in natural light. Could you incorporate more glass into the design? This could let in more light and allow visitors to look out from inside the shelter and take in the woodland habitat; the glass could be in between the wooden slats to use both ideas. "

"This design could also have a more watery theme."

Specification

Purpose
The shelter provides a safe, covered area for those waiting for the waterbus. It also provides space for wheelchairs and pushchairs under the shelter, the wide entrance will allow enough room for them to enter. The shape of this design means that it may not hold 25 people easily.

Form
The shelter has a natural theme and style, which should prevent it from dating; it also embraces natural elements as it was inspired by a bulb of garlic.

Function
Passengers waiting for the waterbus will be covered by the shelter's glass roof; but the open doorway may make the shelter cold and could allow water in. The sloping walls of this design means that rain water can flow down and be collected at the bottom.

User Requirements
The natural style of the shelter should prevent it from becoming dated, so should last longer than a shelter with a prominent style. The wooden slats could be replaced easily; however, faults in the basic frame may mean the whole shelter would need to be replaced. The newest parts of the zoo incorporate lots of wood and glass, so this design would fit in with it well, as well as not detracted from the woodland walk.

Performance Requirements
If the oak is oiled, to seal and protect it, then the shelter should last at least 10 years, it will also provide protection from the weather.

Materials and Components
The shelter is primarily made out of oak, which is natural and sustainable, it will be relatively unprocessed. however, the glass lantern roof would require a lot of energy for its production so is less sustainable. The glass could be bought from a sustainable supplier. The oak will be oiled and so will be weather and water resistant, the structure will be very strong so will be impact resistant and hardwearing.

Size
The bench will be carved with seat depressions using ergonomic data, to make it as comfortable as possible. The floor space and entrance gives enough space for wheelchairs, pushchairs and 25 waiting passengers. This design is larger than the current shelter however it's round shape means that it doesn't maximize the space around the canal.

Safety
The shelters foundations will be made according to the weight of the structure, to ensure that it is safe. The seats will be securely attached to the shelter and will be able to withstand human weight. There are very few sharp edges inside the shelter however the oak slats on the exterior of the shelter could be hazardous to children. The shelter will not conduct electricity, so will be safe.

Quality
The oak will come from sustainable, local and reputable suppliers, to ensure it is environmentally friendly and durable. The seating will have depressions to ensure that they are comfortable and fit to the average human body. The construction of the shelter will be very good quality.

Scale of Production
The shelter is a one off design so will not need to be adjusted to fit another setting etc.

Cost
The materials and simple design of this shelter will make it within budget.

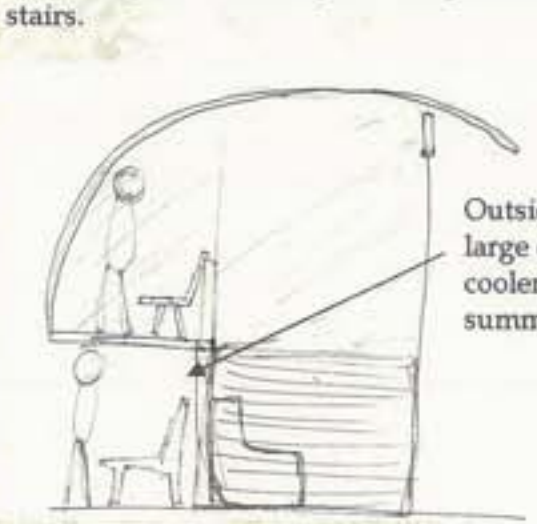
Development

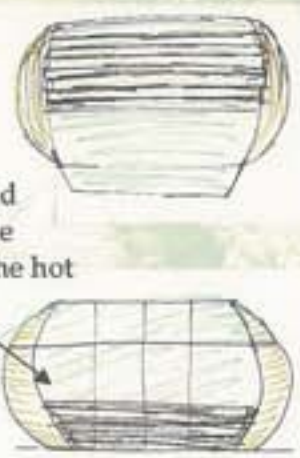
Original Thoughts

Before receiving the client feedback I needed to develop the designs properly, I decided to use the specification and the 3rd party feedback to begin the process.

There had been positive and negative feedback on both of the designs that I reviewed. I felt that both designs had some very strong features. The glass shelter would provide plenty of seating and a great view of the woodland surrounding it. Whereas, the oak bulb shaped shelter has a very natural appearance due to its shape and materials. Taking these features into account I came up with a shelter which combined both of these designs. It has the glass front and roof of Design Two, with the same sloping roof to allow water to flow into the canal or behind to create a waterfall feature, but the curved wooden edges of Design three. This gives the shelter a more organic shape and incorporates the natural materials, which were a requirement set by London Zoo, as well as providing more seating and glass.

I felt that although the stairs on the exterior of the shelter added another dimension to the design, they would be unnecessary and expensive to produce and fit securely and safely. I also thought that the shelter was too large for the setting, so to develop the design further I decided to down scale it, graduated seating eliminates the need for stairs.



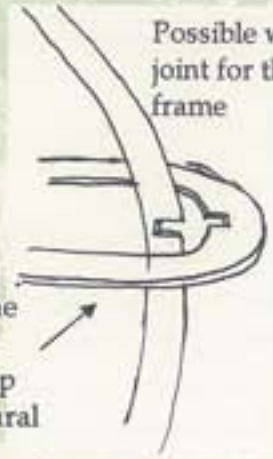


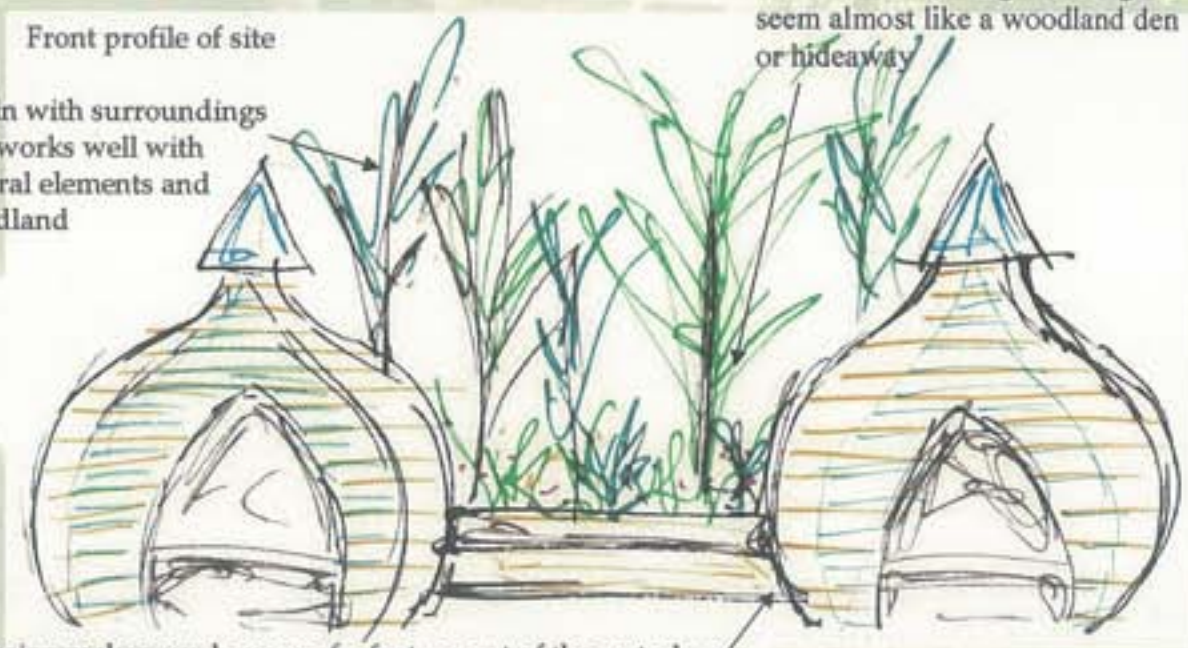
Changes Made After Receiving Client Feedback

Once I had received the client feedback, I explored many other ways of improving the design I had come up with. One of the main points that Ruth made was that the glass shelter seemed far too large. She also thought that it's fairly modern design may date quickly, leading to the need for a completely new shelter, and also detract from the surrounding woodland. She was keen on the natural and sustainable materials used in most of the designs so I decided that although glass allows the woodland to be seen, it would be best not to use too much in the design. This led me to refer back to Design Three as a design to develop. Taking into account all of Ruth's feedback on the designs and the specification, I tried to create a shelter which would meet all requirements.

Design Three was quite small and may not have held the maximum boat load, so to create more space, I felt that having two shelters side by side would increase the space and make more of a feature of the area and waterbus service. Ruth felt that the outdoor seating of Design Two was a really good feature but would be better facing the canal. So, I adapted the design, so that a bench could fit in between two shelters. The glass was still something that the client liked, allowing visitors to see the woodland surrounding them whilst also being covered. So I felt that having curved glass panels at the front of the shelter would allow for this, but also give extra light, opening it up and making the space less claustrophobic. The curves of this design also promote nature and although they aren't the same as the glass shelter, which Ruth felt reflected the watery theme well; it still gives a similar feeling. The water collection system will also be used to make the shelter more useful and environmentally friendly.

Sketches final design





Variations of Design Three

I decided to choose one of my original ideas for the final design, so to ensure that it was the best it could be, I have explored different ideas and variations by experimenting with the shapes, colours, materials and styles.

Design Two had outdoor seating which the client really liked. So to incorporate it into Design Three I thought that there could be seating in a hexagonal shape around the edge of the structure. This could be attached to the framework of the shelter or stand separately from the shelter, supported by a number of legs underneath.

Although this idea would provide external seating, the client and I feel that it ruins the smoothness and curves of the design. If external seating is going to be included in the design, it should have a less harsh, angular style.

A positive point which my client made about Design Two was the fact that the glass allows a lot of visibility of the surrounding woodland walk for those inside and out of the shelter. It also prevents the environment from being broken up and blocked off as much.

This gave me the idea of having glass panels or tiles, slightly overlapping, making up the walls of the shelter.

This design could be very striking, but it would be Ruth at London Zoo suggested that it may be very impractical for this particular setting. The glass would get dirty very easily and would need to be cleaned regularly to maintain its appearance. It may also be too modern for the natural sight and detract too much from the woodland.

I experimented with the idea of changing the shape of the design, to make it pentagonal. It gives the design a stronger, bolder style, making it more eye catching. This design has more of a structural element, which could make it far easier to manufacture and potentially less expensive.

Although this variation may be simpler and easier to build its bold style could make it stick out in the natural woodland walk, which the client does not want. The rounded shape make the design feel like a cocoon that sits in amongst the nature, rather than looking man made. This variation is also more stylized, so would cause the structure to date far more than the original.

Another possibility would be to keep the curved shape of the shelter, but remove the wooden slats sitting on top of each other. Instead the shelter would have a smooth curved finish, made up of a number of panels of wood.

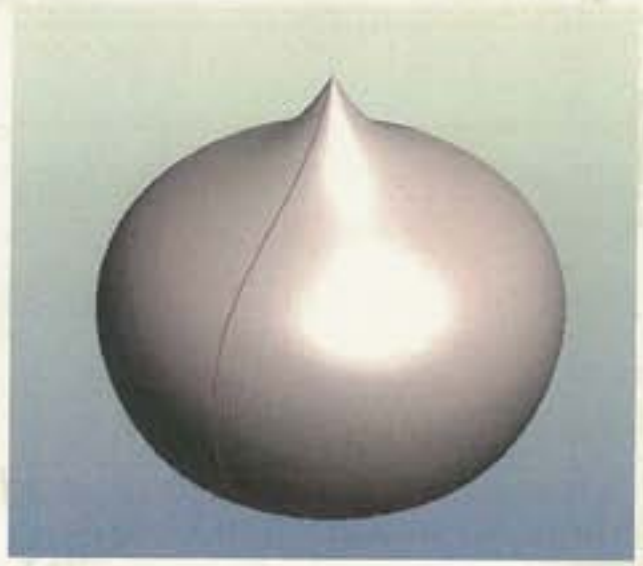
After discussing this variation with the client, we have decided this is not the most appropriate design as it has vital flaws. Firstly a single slat could be replaced easily and cheaply if there was a fault whereas a whole panel would need to be replaced in the alternative, which would be very expensive. Producing the curved shape of the panels would be a more expensive alternative, it would also have less of a clean finish, as bolts would be needed to join the panels together which could be visible, ruining the appearance. Whereas the original designs joinery would all be hidden within the structure.

After considering these different variations with my clients input at London Zoo, we still feel that the original design ticks the majority of the boxes and would be the most appropriate.

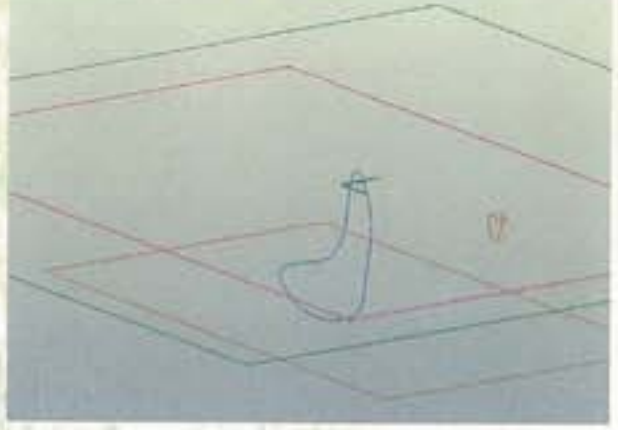
So, the final shelter will consist of wooden slats, making up most of the shelter and structure. The rest will be plasticised glass slats, which will make up a section at the front of the shelter, with space for a doorway cut into them. This will allow the visitors to see outside, watching the boats and wildlife and admiring the woodland. It will still have its original curved shape, glass lantern roof, to let in plenty of natural light and simple bench seating inside.

There will be two shelters side by side, which will provide sufficient seating for the maximum boat load, with a bench in between so visitors can sit outside in the warmer weather.

Computer Aided Design

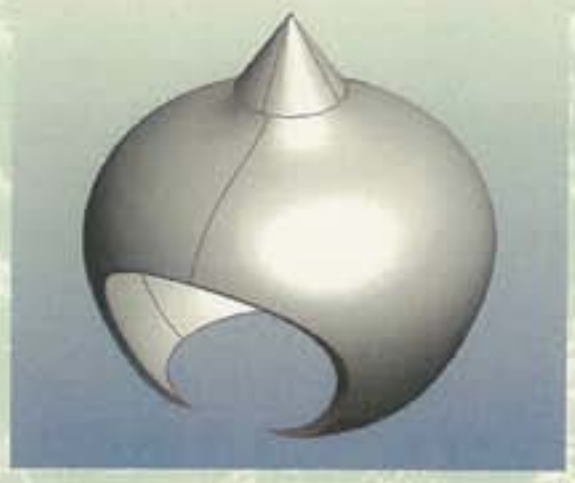


1. To create the basic frame for this design I drew the curve of the outside edge on a vertical work plane, attached to a vertical line. I then used the revolve tool to create a solid shape.



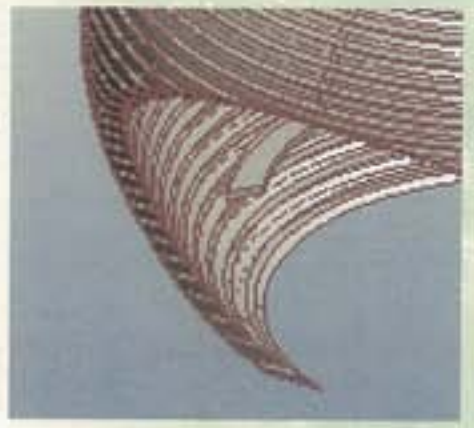
2. Next, I added the cone shaped roof on the top of the solid shape. To give the shelter a flat base I selected a horizontal work plane and then made a new work plane, dragging it down to the correct position. I then drew a rectangle on this work plane, subtracting the material below it to remove the rounded base.

I then had to make the solid shape hollow and then create a doorway at the front. I removed the inside in the same way as the first step. I drew a curve, slightly smaller than the original on a vertical work plane against a straight vertical line and then revolved the line around 360°. But instead of selecting add material I selected subtract material. Once I had been left with a hollow shape, I created a new vertical work plane and then drew the shape of the doorway, subtracting material back into the shelter.



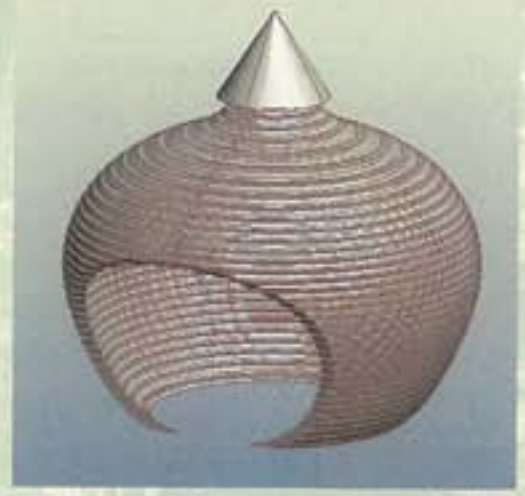
3. After this I removed the material across the design to make the spaces in between the wooden slats.

To do this I moved a horizontal work plane to the top of the shelter, just below the glass lantern. I then subtracted material below the work plane. After this I made another new work plane and subtracted the material again. To make the gaps evenly spaced I created each work plane the same distance apart and removed the same amount of material below each work plane.



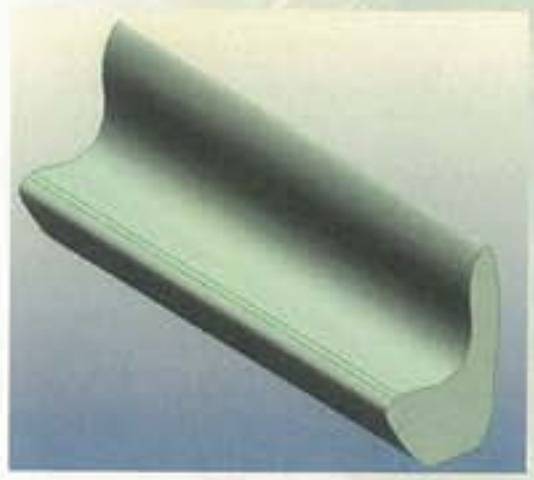
5. For the internal bench, I chose one of the existing work planes, which I used to create the gaps, and drew the shape from a plan view. I then extruded this down below the work plane.
I then drew some rectangular blocks below the bench to support it.

4. To make the front section of the design glass and the rest wood later when adding materials, I had to separate the two parts. I did this by making two thin horizontal cuts either side of the doorway and subtracting the material back into the design.



6. To make the bench, I selected a vertical work plane and then drew an organic looking shape which would be the end elevation of the bench. I then extruded this to make the bench the correct width.

To create the space for the plants to grow in the top of the bench I drew the shape on the same work plane as I had for the bench, and then subtracted the material along the back.

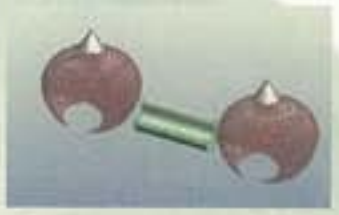


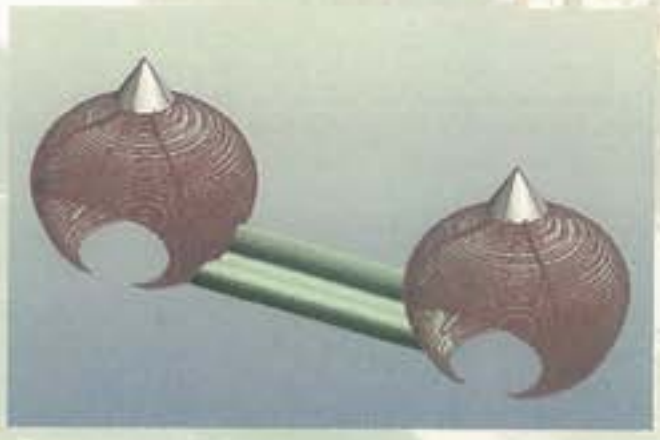
7. I added the bench into the drawing of the shelter and lined them up next to each other. I realised that the straight edges of the bench would either leave a large gap at either end or cut into the shelter.

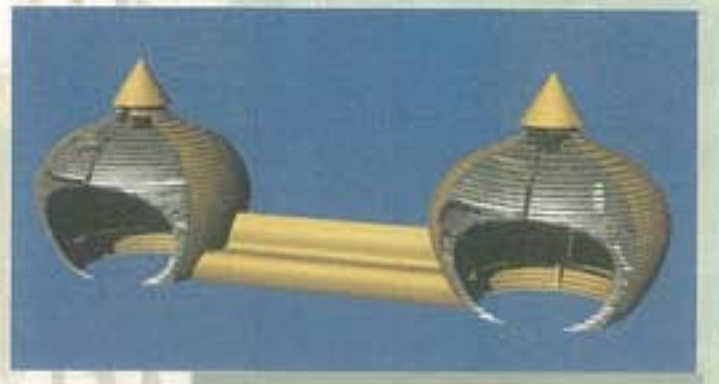
8. So I went back the bench design and decided to curve the ends to the same shape as the curve of the shelter.

To do this I drew two curves next to edge of the shelter, one from the plan view and the other from the front elevation. I then copied these lines onto the bench design and subtracted the material on the horizontal and vertical work planes.

Once this had been done I moved it back onto the shelter design and lined the bench up in between each shelter.



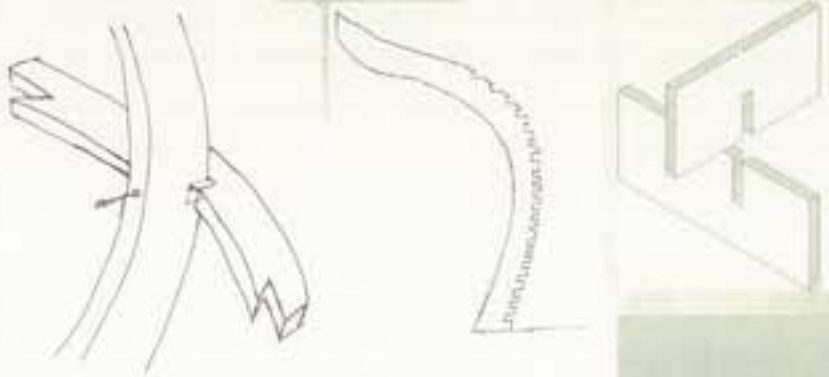




Materials and Manufacturing Processes

Framework of Shelter

The framework for each shelter will consist of two wooden panels in the shape of the front view of the shelter. Theses panels will cross each other at the top of the shelter, in the centre and will joined by a cross halving joint. On the outside edges of each panel, there will also be cross halving joint which will match with the cross halving on the wooden slats, so that they can slot into place.



Each frame will be secured to the ground with bolts in the interior of the shelter.

Internal Seating

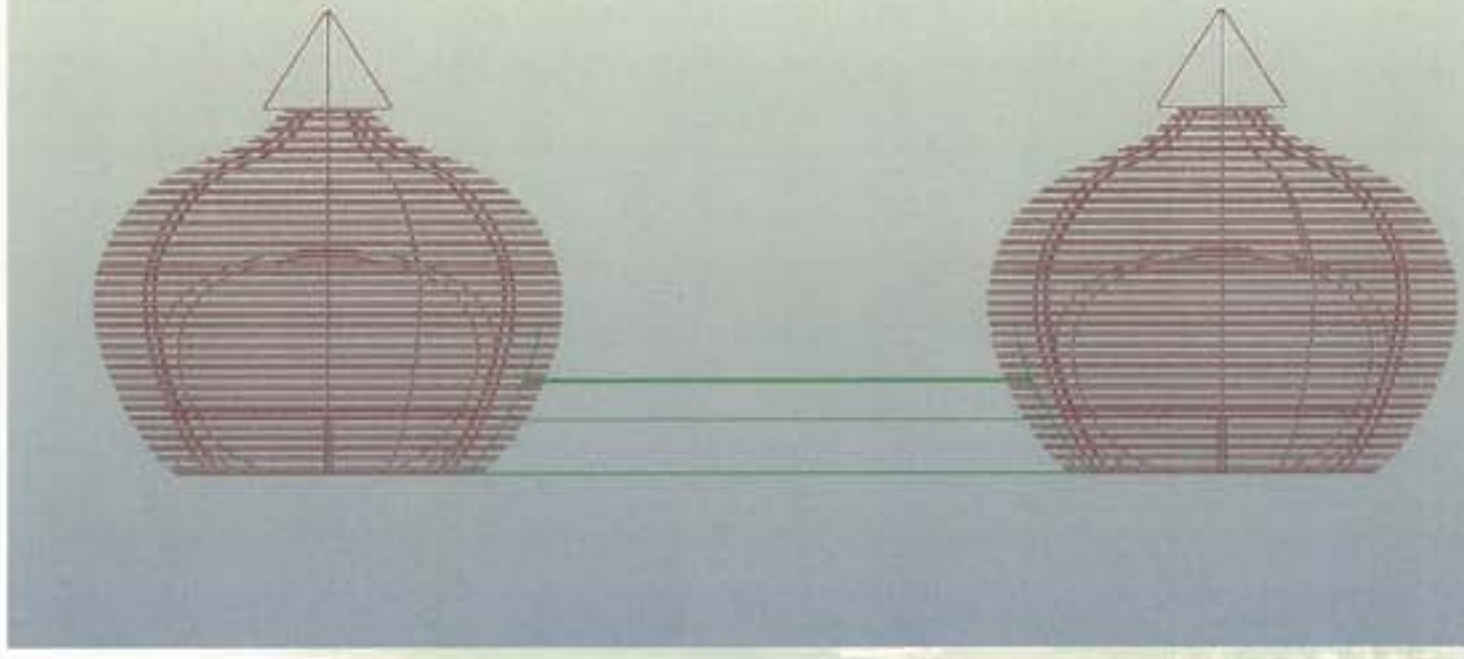
The internal benches will be solid oak like the slats. The oak will be sanded to get a smooth finish and even thickness along the bench. It will then be cut using an industrial laser cutter. The benches will have seat depressions to make it more comfortable and fit better with the body. These will be created using a sander after the shape of the bench is cut. The oak will then oiled to protect it from the elements.

These benches will be supported by three evenly spaced rectangular wooden blocks which will be bolted to the floor and the underneath of the seating using L brackets and bolts.

Attachment

The oak slats will be attached and secured to the basic frame of the shelter by traditional wood joints; however this will not be completely secure. So each wood joint will be reinforced by screwing into the slats, through the joint, from the inside of the shelter.

This will all be carried out onsite.



External Seating

The external bench will join the two shelters together. It has a natural curved shape which will be molded to fit comfortably on the body. The bench will be made of oak, its basic shape will be achieved by using a chainsaw and the smooth, rounded surface with then be created using a hand held electric sander. The oak will then be oiled and sanded, the same as the slats, to smooth it and protect it.

The top of the back has a dip for plants to be grown in, this will be created with a jigsaw and then will need to be lined and protected.

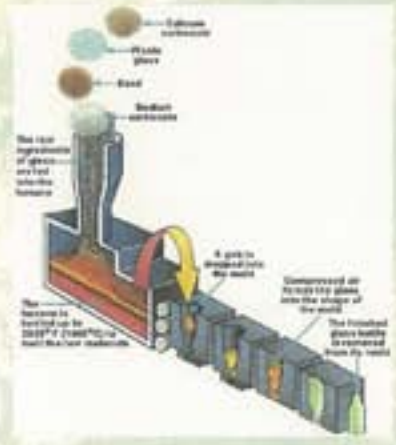
Slats

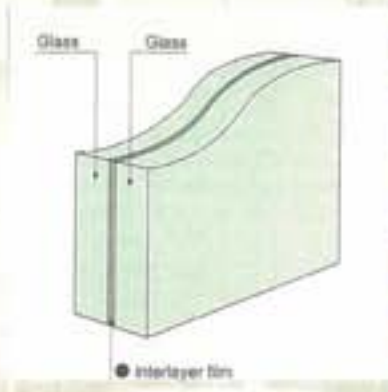
The wooden slats which will surround the back of the shelters will be solid oak, oiled to seal and protect it from the weather and water. The oak slats will be cut using an industrial sized laser cutter and then sanded to smooth the edges and remove any jagged edges.

The plasticized glass slats, at the front of the shelters will be cut in the same way and to the same size and scale. Plasticized glass is much safer than normal glass as it doesn't shatter and is much harder to break.

Glass Lantern Roof

On the top of each shelter is a plasticized glass cone shaped lantern which will let plenty of light in, removing the needed for electrical lighting. The lanterns will be blow molded to form the desired cone shape, through the process shown here.



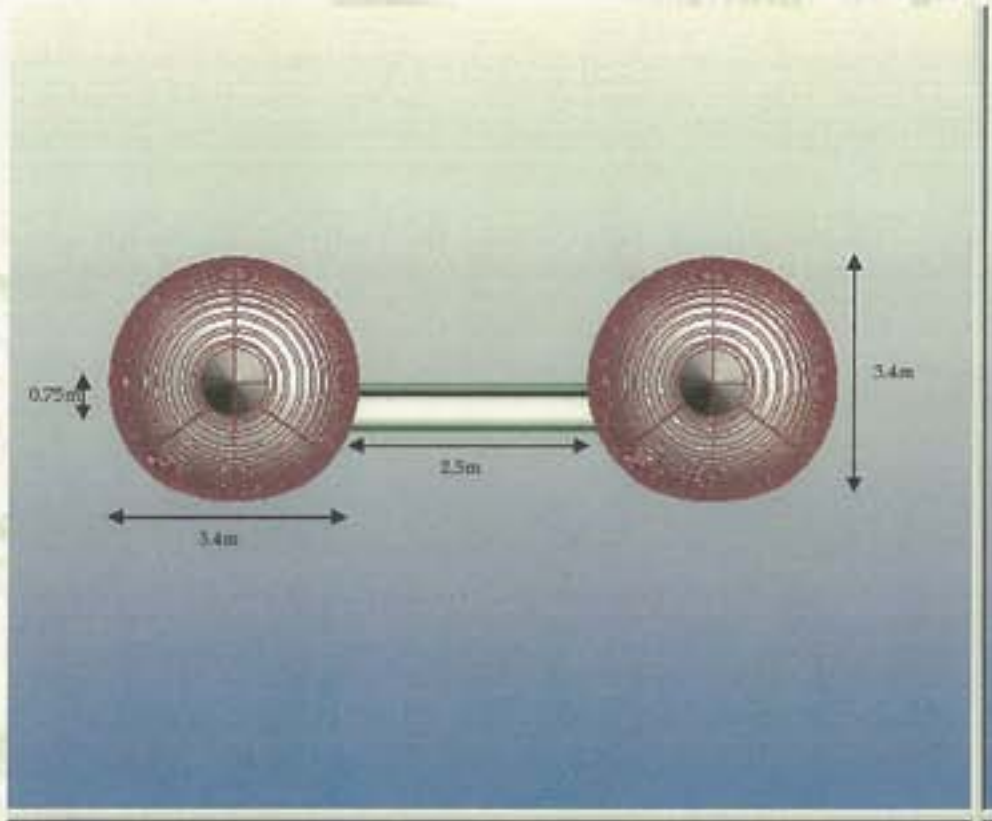


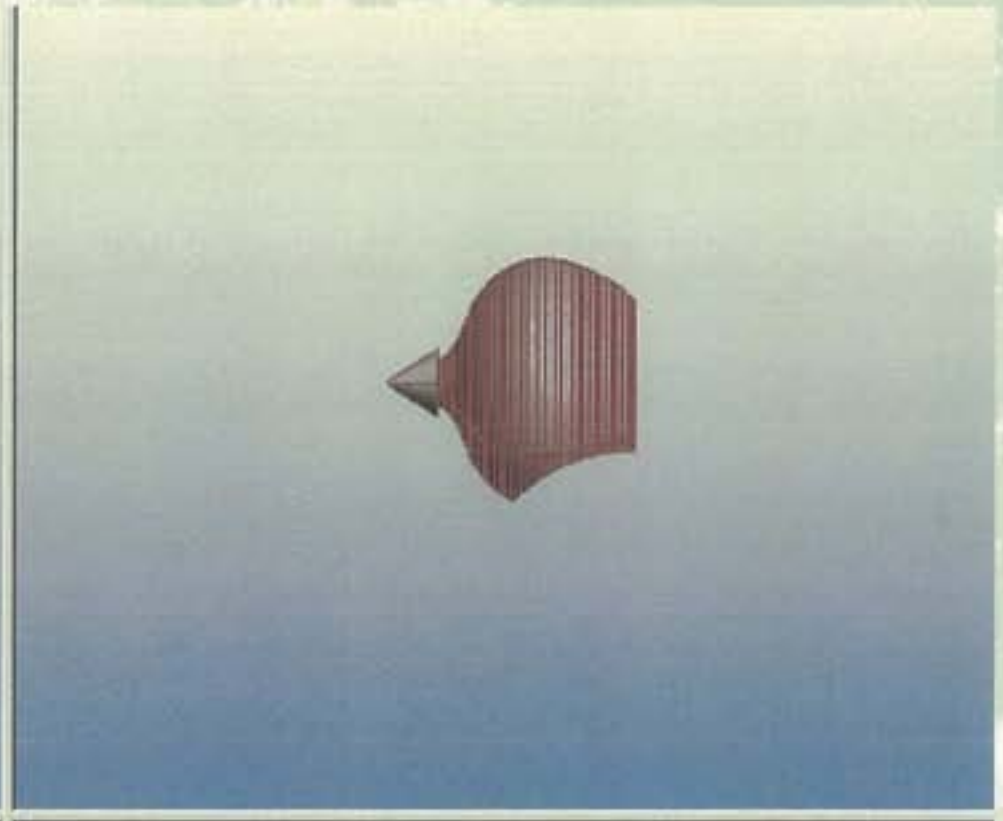
Plasticised glass is a lot safer than normal glass which shatters eaily. It is far more suitable in this setting as there are so many children in the zoo.

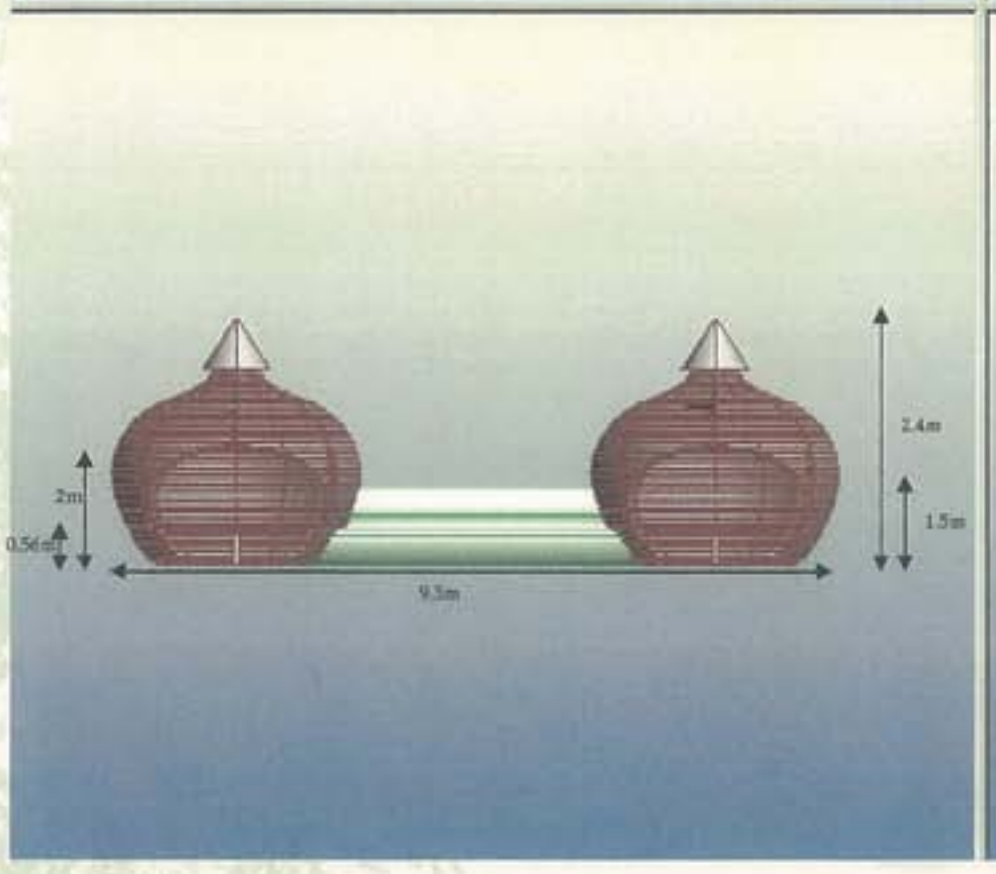
The lanterns will then be supported on top of each shelter with a steel frame, which will be bolted to the top wooden slat and to the glass.

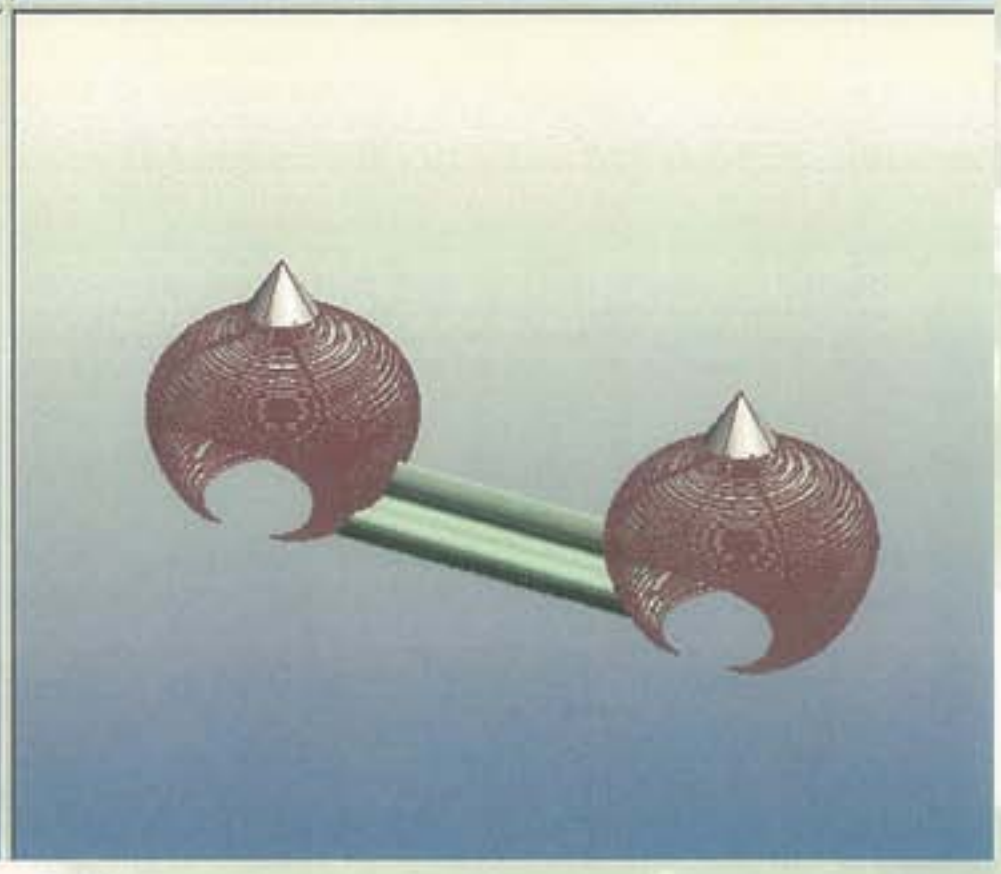
Ergonomics

To ensure that the shelter is a sensible size to fit the maximum boat load of 25, I must consider ergonomics and anthropometric data. The scale for the whole model will be 1:25.

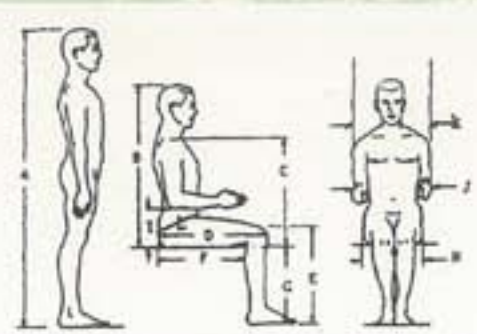








All the measurements in anthropometric data are larger for men than for women so I have used the male information. As the design involves 2 shelters I have allowed for them to hold a maximum of 15 people each.



The outside bench should allow for 8 adults to be sat down. Using the shoulder breadth of the average male, I worked out a suitable circumference for each shelter and the length of the bench.

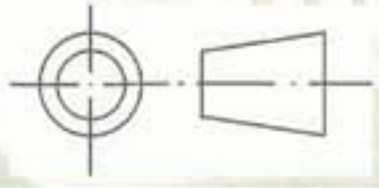
The average height of a male had to be considered when calculating the overall height of the shelter and the doorway. The distance from the back to the bend in the knee was needed to find out the depth of the benches, both inside and outside of the shelter and the length of the bottom of the foot to the back of a bent knee was needed to decide a suitable height for the seats of the bench.

Materials for the Model

The wooden slats of the model will be made of 2mm Medium Density Fiberboard. I will use the front view of this ProDeskTop image in 2D Design Tools, taking the radius of each slat and drawing a circle with the same radius, to create a set of rings in proportion to each other. These rings will then be contoured by the same amount and cut out on the laser cutter. The glass slats will be clear acrylic, drawn and made in the same way as the wooden slats. The wooden slats will be attached together with wood adhesive.

The external bench will be made of Styrofoam which I will shape using craft tools. I will then sand it using glass paper to get a smooth finish and paint it to create the appearance of wood. The internal benches will be made of 2mm MDF, drawn on 2D Design Tools and cut on the laser cutter. These will the supported by rectangular 2mm MDF blocks.

The glass lantern top will be clear acrylic. To get the correct shape and size I will create a net of the cone with paper, and then cut out the acrylic to that size and shape on the laser cutter. This shape will then be heated in the oven and bent into shape. Each roof will be attached to the models with multi-purpose adhesive.



Change of Design

After showing Ruth at London Zoo the ProDeskTop drawing of the final design she was very pleased and felt that it would fit in really well with the surroundings.

However, she thought that the external bench between the two shelters was not as suitable. She suggested that the bench was slightly more of a design feature and less simple, but still feels that the bench should be oak.

After discussing various designs with Ruth, we have adapted one to create a bench that will fit well with the current design and the rest of the zoo.

The different heights of the oak back panels were inspired by the newest development in the zoo and give a fun, hap hazard element to the design. The curved shape of the seat carries on the theme from the shelters making the two elements work well together.

Materials and Manufacturing of Shelter

The bench will consist of a number of solid oak parts, which will be attached together using traditional wood joints and bolts. The back of the bench consists of a number of solid oak planks, all at different lengths. The bench seat is curved, attaching to the internal benches of both shelters; this will be cut using a jigsaw to create a neat shape and accurate curves.

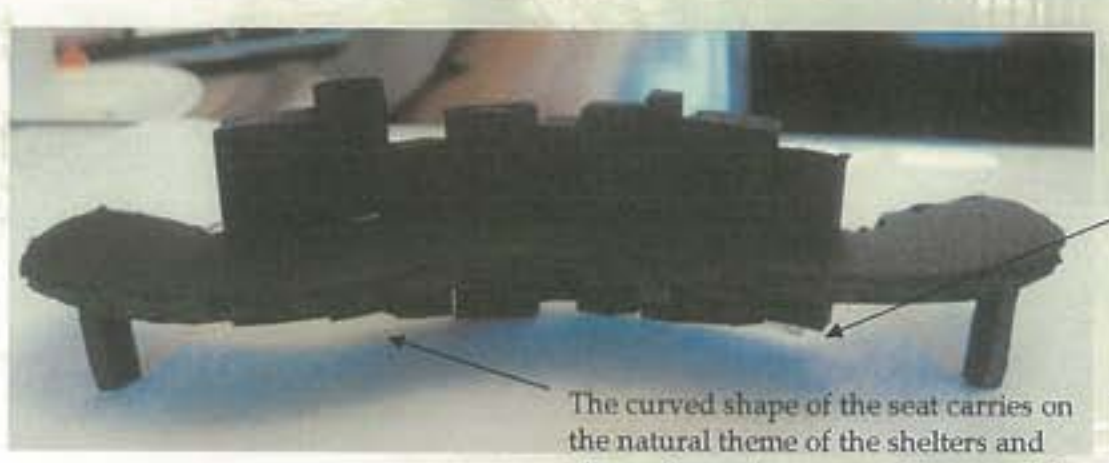
The back panels will slot into place, fixing to the seat of the bench by a mortise and tendon joint. The seat will be supported by 3 legs at the front of the bench and the back panels behind. All of the oak components will be sanded to smooth any jagged or sharp edges and will then be oiled or varnished using the same product as the shelter in order to protect it from sun and water damage. The oak used for the shelters and bench will be sourced by local suppliers, who are reputable and are Forest Stewardship Council certified, to ensure they are following the necessary rule for logging and production of wood.

Final Bench Design

I used foam board to make a rough model of the new bench design.

It allowed me to determine the overall size for the model and the dimensions for the individual components of the bench and their positioning in relation to each other. It also meant that I could work out an accurate angle for the join between this bench and the two internal benches.

I tried a few different sizes and variations for the back panels before deciding on the best version.



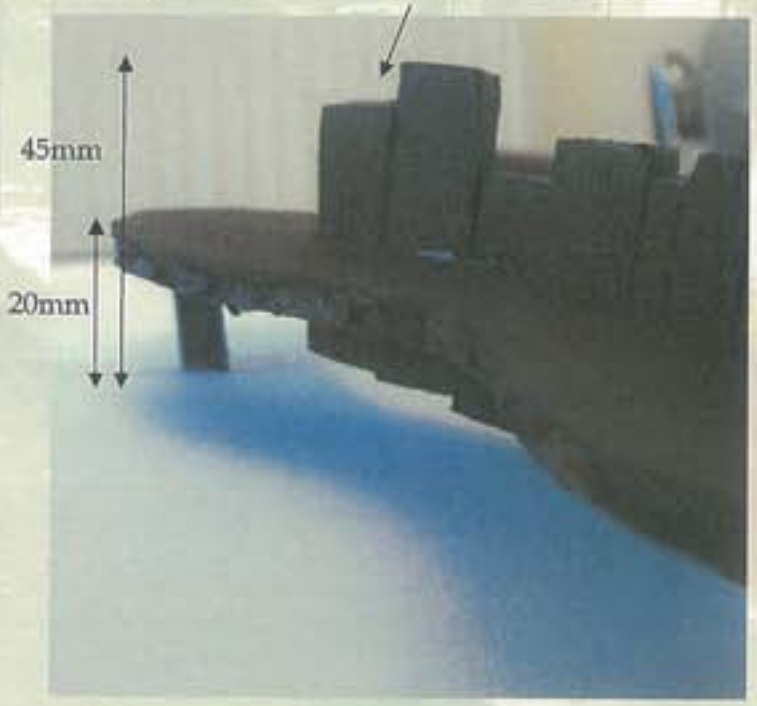
The curved shape of the seat carries on the natural theme of the shelters and allows the eye to move well around the design. It also creates a feeling of water and fluidity about the design

Tongue and groove wood joints could be used here to attach the internal and external seats of the bench together securely

The joint will be made stronger by smaller oak posts, reinforcing the back and front of the seat

The back panels provide support for the bench and make it sturdier than having 4 legs

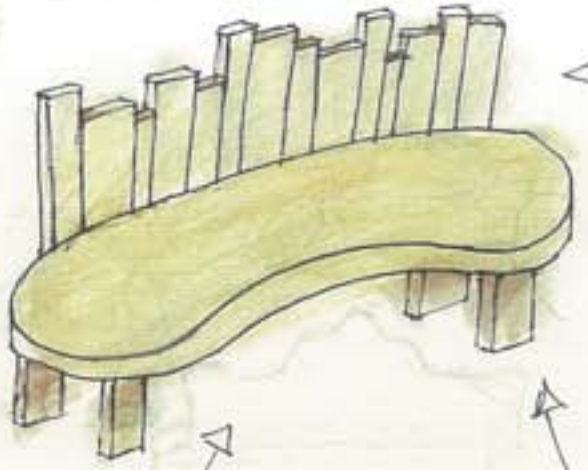
Different heights and thicknesses of back of bench give the design a playful appearance and style



Materials and Manufacturing of Model

The model of the bench will be made of 2mm MDF. Three strips will be cut on the band saw, to create a straight edge, of different thicknesses. These can then be cut to different heights to create the uneven appearance of the back. The shape for the seat of the bench will be transferred onto 2mm MDF and then cut out on the fret saw. All the components for the bench will be sanded with glass paper to smooth edges and remove splinters. It will then be temporarily assembled to check that each part is the correct size and shape, so the necessary changes can be made if they need to be. Once this has been done, it will be glued together with superglue and then attached to the bench of the shelter. To make the design smoother, the outer edges of the bench will be curved to match the joint of the internal and external seat. This will be created using glass paper.

Bench Design Ideas

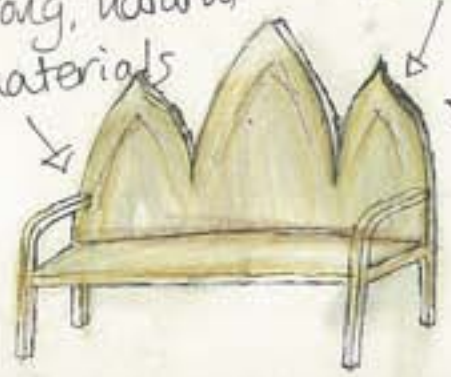


Staggered back gives the design a young, playful edge

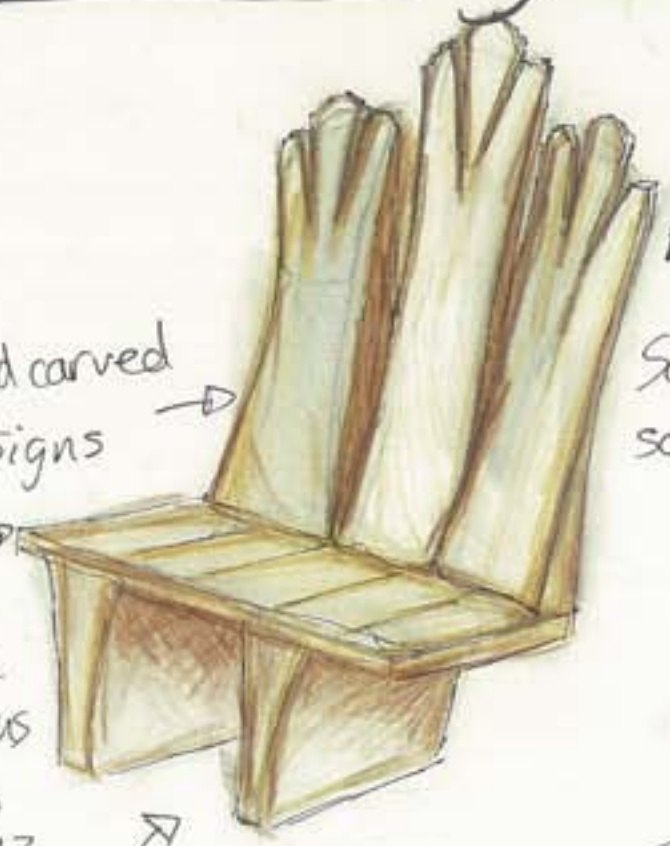
Inspired by newest parts of the zoo

Strong, natural materials

High, arched back



Hand carved designs



Would these designs be too small?

Three seater bench

Solid, locally sourced oak

Fits in with existing parts of London Zoo

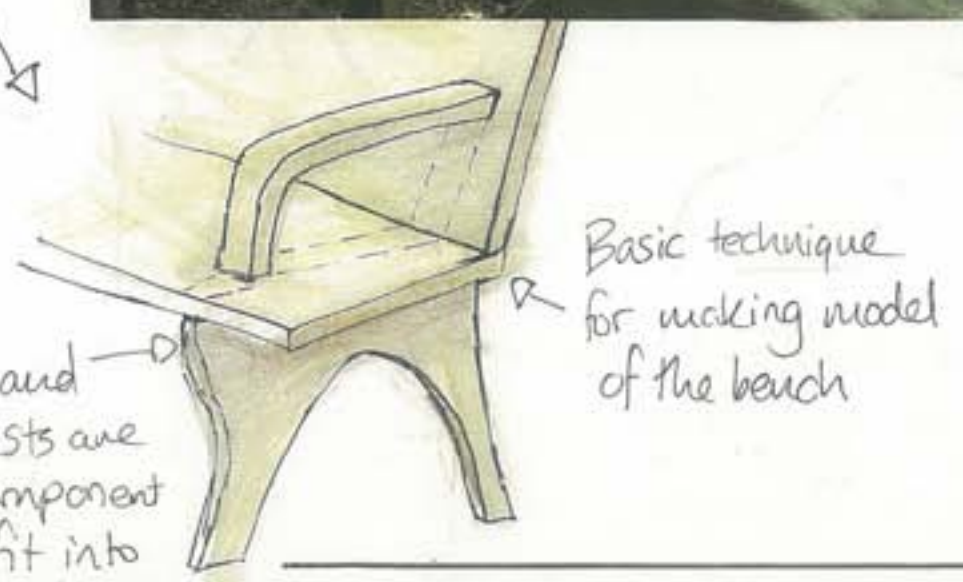
A number of these seats could be placed on the edge of the canal

Throne-style design would be fun for children to play around

Unprocessed and natural style

Strong structure makes it secure for children to play around

All oak would be sealed with oil or varnish to prolong its life and protect it from water and sun



Basic technique for making model of the bench

Legs and arm rests are one component which fit into back and seat

Intricate + traditional design

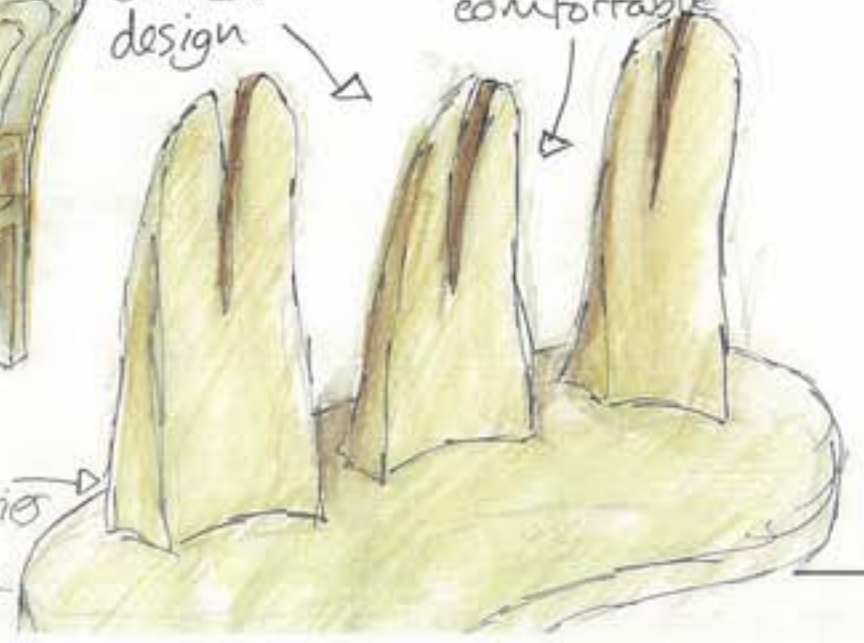
hand carved design in back

Slatted oak seat

Mortice + tendon joints would be used to join these

Natural, hand-carved design

Seat backs are curved to make them more comfortable



Curved seat carries on the design of the Shelters

After changing the design of the bench, I have done a watercolour drawing to show the final design of the shelter to the client.

Production Plan

Model Surroundings

- Mark calculated size onto 6mm MDF
- Cut to size on band saw
- Use glass paper to smooth edges
- Are the edges smooth? — No → Use glass paper to smooth edges
- Draw 3 side elevation of grass bank and canal edge onto 4mm MDF
- Cut on band saw
- Are they the same? — No → Cut on band saw
- Glue side elevation boards to base board with photo mount
- Are they secure? — No → Glue side elevation boards to base board with photo mount
- Print grass texture onto A3 card
- Cut card to size
- Does it fit correctly? — No → Print grass texture onto A3 card

Slats for model

- Use orthographic drawing to measure radius of each slat
- Draw circle around radius, then contour 10mm
- Cut out on 3mm MDF on laser cutter
- Assemble each slat on top of each other
- Are they the correct size? — No → Assemble each slat on top of each other
- Cut another set for second model
- Cut two sets of the top 6 slats in blue tinted acrylic

Interior bench

- Change contour lines of 27th ring on 2D design tools to make it wider
- Cut out on laser cutter
- Is it in proportion with rest of the shelter? — No → Change contour lines of 27th ring on 2D design tools to make it wider
- Sand edges with glass paper
- Are they smooth? — No → Sand edges with glass paper

Outdoor bench

- Draw bench seat on 3mm MDF
- Cut out on fret saw
- Is it the correct size? — No → Cut out on fret saw
- Smooth edges with glass paper
- Draw pieces for back of bench on 3mm MDF
- Cut out on band saw
- Smooth edges with glass paper
- Are they smooth? — No → Smooth edges with glass paper
- Sand edges to correct angle to fit with edge of bench inside shelter
- Do they fit? — No → Sand edges to correct angle to fit with edge of bench inside shelter
- Glue seat of inside and outside benches together
- Glue back of bench to exterior seat

Assembly of model

- Glue both sets of MDF slats in place with wood adhesive
- Allow to dry
- Are they in the correct place? — No → Glue both sets of MDF slats in place with wood adhesive
- Mark out doorway on shelters
- Cut out doorway on band saw
- Glue top 6 acrylic slats together with solvent?
- Glue both sets of acrylic onto MDF shelters
- Secure shelters to base for model

Attach to surfaces with photo mount

- Do they fit? — No → Attach to surfaces with photo mount
- Cut to fit
- Print ground, water and canal edge onto card
- Glue in place
- Do they fit? — No → Glue in place
- Sand edges to smooth and fit
- Cut out on fret saw
- Draw ground panel on 4mm MDF
- Glue onto side elevations

Gantt Chart , Risk Assessment and Health & Safety

	Task	Time Allowed for Task			
		Week 1	Week 2	Week 3	Week 4
1.	Draw and cut all components for model surroundings in 6mm MDF	¾ hour			
2.	Construct model surroundings	¾ hour			
3.	Allow to dry	1 hour			
4.	Print images onto card for surface textures and glue to surroundings	2 ½ hours			
5.	Cut MDF slats on laser cutter		3 ½ hours		
6.	Create interior bench and cut on laser cutter		½ hour		
7.	Model exterior bench in card and draw onto MDF		1 hour		
8.	Cut out parts for external bench and sand edges			1 ½ hours	
9.	Glue MDF slats together with wood adhesive			½ hour	
10.	Allow to dry			1 hour	
11.	Glue acrylic slats together			½ hour	
12.	Attach acrylic and MDF slats together			½ hour	
13.	Allow to dry			1 hour	
14.	Construct bench and allow to dry				3 hours
15.	Position model in setting and glue securely				½ hour
16.	Allow to dry				1 hour
17.	Add model plants				½ hour

As well as the general guidelines, more specific rules should be followed to ensure that the machinery is used safely.

According to the Health and Safety Executive, risk assessments should be carried out by schools and companies to identify the possible hazards and use suitable control measures to prevent accidents or injuries.

It is also important to be aware of the different signs and warning symbols in and around the workshop and understand what they mean. In particular, prohibition and mandatory signs for example:

Risk Assessment of Fret Saw

Hazard	Risk	People at Risk	Control Measure
Fret Saw	Dust/splinters	User Others in area	• Eye protection and overalls should be worn by user at all times • Sufficient dust extraction should be in place • An area should be clearly marked out around the machine to restrict other students from being too near to it
	Contact with blade	User	• Blade should be in place and used at all times • Students should be taught how to use the saw safely • A line should be marked on the saw to prevent hands being too close to the blade
	Changing of blade	User	• Only teachers should change the blade • They should know how to operate the saw safely and correctly • Use manufacturer's instructions or have them displayed near the saw
	Noise	User Others in area	• A program of noise monitoring should be in place and the recommendations should be applied • The survey must be carried out by a competent person
	Saw falling over	User Others in area	• The saw should be fixed securely to whatever it is placed on • This should be checked regularly and the necessary action taken
	Slipping/tripping	User	• A safe system of working should be implemented • The workshop should be kept clean and tidy to reduce the risk

Health & Safety

Before using the equipment and machinery in the workshop for the making of my model, there are a number of general rules of health and safety which should be taken into account.

Personal Protective Equipment (PPE) should be worn at all times when using tools, machinery and equipment in the workshop. This can include:

- Overalls
- Eye protection
- Face shield/mask
- Gloves
- Protective footwear
- Headphones

Other rules should be followed whilst working in the workshop:

- Long hair should be tied back to prevent it from catching in machinery
- Loose clothing and jewelry should be covered by an apron or removed
- Where possible, all safety guards should be closed around the blade, screw etc.
- Materials should be clamped and secured to prevent them from flying off
- Machinery should never be left running unattended or when not in use
- All emergency stop buttons or pedals should be marked clearly

Making and Construction of Model

1. Firstly, I cut out all of the slats for the model on 3mm MDF using the laser cutter. For the benches inside each shelter I changed the contour line on 2D Design Tools of the 27th ring to make it wide enough for visitors to sit on. Then I cut two out on the laser cutter in 3mm MDF.
Once these had been cut I temporarily assembled it to check that the slats were the correct size and fit together well.

2. To create the doorway for the shelters, I organised the rings on top of each other and used masking tape to hold them together, and then cut into the slats with a hand saw. Once they were cut I experimented with different variations of positioning of the slats.

Staggered edges for children to climb up or sit on, give it a more natural style

Lower slats pulled out for as extra seating

Straight edges give a smoother appearance

I decided to stick with the simple straight edges, primarily because I felt that the other two options would be safety hazards. After this, I chose to glue the uncut slats of the second shelter with wood adhesive into position on top of each other and then use the band saw to create a much smoother edge for the doorway. I then glued the previously cut slats together and used the band saw to trim the jagged edges.

4. Following this decision, I glued the acrylic rings together using a paint brush and liquid solvent cement and secured them on top of the MDF structure with uhu glue, a strong transparent adhesive.

5. For the surroundings of the model, I started with a base board of 6mm MDF cut out on the band saw. I then modelled the side elevation of the bank behind the shelters using cardboard to get the right angle of the slope.

Once I had found an appropriate size, I cut three out on 3mm MDF on the band saw, as well as a back board to support them. I sanded each part and then glued the side panels equally spaced apart to the base board, to create the basic shape of the surroundings.

I measured and cut 2 MDF panels to sit between the side panels and support the shelters and 2 for the edge of the bank. Once these were all glued securely, I printed the surface textures onto card, cut them to size with a craft knife and attached them to the MDF with photo mount.

6. For the external bench, I drew the plan view of the curved seat on paper and lined it up with the two shelters to create the correct angle for attaching to the internal benches. Once I had achieved the correct shape and angles, I transferred the shape to 3mm MDF and cut it on out the fret saw.
I modelled the back of the bench in card, and then cut out the different sized pieces on 3mm MDF on the fret saw. After sanding the edges of the seat and back with glass paper, I secured them with uhu.

3. I had planned to have a clear acrylic cone shaped roof on top of the MDF slats to let natural light into the shelter. I began to make this by heating a triangular shape of clear acrylic in the microwave and bending it into shape, but this was not effective. I also used acetate to create a cone shape, but this was very flimsy and did not look very effective. So, I modelled triangular and square based pyramids in cardboard to see how the shape would look with the shelter, however I felt that the sharp lines were too strong with the curves of the shelter.

So, I decided to adapt the design, making the top 6 slats of each shelter out of clear acrylic, cut in the same way as the MDF, on the laser cutter. Once they had been cut I felt that they were not very visible, so instead I cut them out on blue tinted clear acrylic which suited the rest of the design far better.

7. I then chose the correct positioning for the model and glued it into place with wood adhesive. I used model trees and shrubbery to create more of a feel of a woodland setting around the shelters.

Photographs of Model

Specification for Promotional Leaflet

Materials

- Should be produced on sustainably made materials, paper or card and sourced from local, sustainable suppliers
- Paper or card used must be recyclable, to be environmentally friendly
- The paper or card must be durable enough to last for 1 year if kept by zoo visitors as a reminder of the service

Shape and Size

- The leaflets size must be suitable to fit in the advertisement stand by the steps down to the shelter
- The leaflets must be of an appropriate size to fit in a visitors bag for storage, so no bigger than A5
- The design must be printed to an appropriate size, so that it can be read easily by the average visitor
- It must be large enough to fit the required amount of information needed clearly
- The shape and size should be simple, to minimise production and construction costs
- Leaflet must be big enough for visitors to notice it on the advertisement stand

Aesthetic

- The design must be eye catching and bold to attract the visitors attention
- The design must reflect the zoo and waterbus service
- Font design must be easy to read and simple
- Font size must be big enough to read clearly but not too large as to waster space and increase the leaflet size
- Headings must be clear, and should be seen at least 1 meter away
- Leaflet should include at least 1 image of the waterbus service and shelter but no more than 7
- Leaflet must include a timetable for the waterbus
- It must include prices for travel, information on the new shelter and other information about the service

Cost

- The total cost for the design and production of enough leaflets for one year must be no more than £1000

Text

- All text must be clear and readable
- All titles and subtitles should stand out from the rest of the text
- A maximum of 2 different fonts should be used on the leaflet to ensure that it flows well

Environmental Issues

- The paper or card must be 100% recyclable
- The materials should be biodegradable
- The production time and wastage should be kept to a minimum to ensure that energy is not wasted

Safety

- The leaflets must not have sharp or pointy edges to avoid injuring the visitors
- They must be user friendly
- They should meet International Standards Organisation safety standards

Manufacturing

- Should be mass produced very easily
- Quality control and insurance checks must be met and maintained
- The design must be simple enough to ensure that production time is kept to a minimum to keep costs as low as possible

Making of Promotional Flyer

1. To advertise the waterbus service at London Zoo, I decided to design a flyer to be displayed in the cafes and notice boards around the Zoo, as well as the entrance.
I began by taking a photograph of the model I have made, at the correct angle so that it could be superimposed onto the photograph I took of the site during my initial visit.

I then cropped the photograph to minimize the amount of cutting I would need to do in Photoshop.

2. The first step in Adobe Photoshop was to cut away the unwanted details on the photograph of the model. I did this by using the polygonal lasso tool to draw around the edge of the shelters and bench. I then deleted the surroundings, to leave me with an image of the model.

3. Next, I removed the current shelter from the photograph by using the clone stamp tool to create the pathway and more branches of the trees in the woodland area.

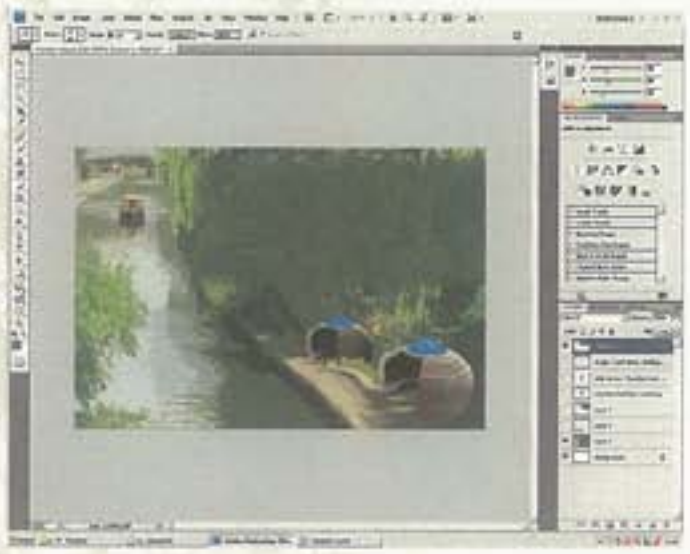
4. Once this had been done, I copied the image of the model onto a new layer, on top of the photograph of its setting. I used the transformation tools, varying the scale, skwewness, perspective and angles until the model sat well in the surroundings.

5. I then used the artistic filters to create a better image, more suitable for a promotional item. I chose the cutout watercolor filter because it made the bright blue top of the shelters pop out of the image, highlighting the new shelter.

6. To complement and enhance this bright blue of the shelter, I used the eyedropper tool to get the same shade in the text. I included the company name, in larger font than the rest to advertise it, as well as the fares and where the boats stop.

7. It was difficult to read the text when it was on top of the different shades of green, so I picked out one of the colours on the eyedropper tool and created a rectangle behind it to make it clearer.

8. I used the opacity tool to fade out some of the colour to show the pattern of the trees through the colour.



9. The sharp, straight lines of the box did not fit well with the curves of the image, so using the eraser tool with a blurred edge; I removed the clean lines to create a far more subtle background colour.

10. I played around with the positioning of the text, but because the two main features of the image, the shelter and the boat are in opposite corners there were few variations.

I chose this to be the final version because I felt it was the most balanced and look the most suitable and eye catching.


London Waterbus Company
Single- Adult £6.50, Child/senior £5.20
Return- Adult £9.30, Child/senior £7.40
London Zoo- One way trip with Zoo admission
Adult £19.00, Child £16.00
Boats depart on the hour from 10am until 4pm
Little Venice - Camden Lock - London Zoo

Evaluation of Model and Promotional Item against Specification

Project Specification

Purpose

- The flyer will advertise the service well and could be printed off in a larger format or edited to act as a poster for the entrance
- The entrance has not been changed, so may not help to increase trade; however the board could be moved into a more noticeable place and the flyer could be used as a poster to make visitors more aware of the service. The new shelter could help to increase trade, as it is more eye catching and noticeable than the existing shelter
- The two shelters would definitely provide enough seating for 25, along with extra external seating, provided by the bench
- The circular shape of the shelters and wide doorways allow plenty of room for wheelchairs and pushchairs inside the shelter. Ramps are kept on all of the waterbuses to ensure that pushchairs and wheelchairs can enter the boats easily and safely
- The shelters are completely covered, so would provide plenty of shelter from the weather. Except for the open doorway, very strong wind or rain could be blown into the shelter

Form

- The shelters definitely have a bold appearance, but it incorporates natural shapes, curves and materials which would prevent it from dating too much
- The flyer is very in keeping with the design of the shelter, primarily greens and blues, it has a natural style, the watercolour effect reflects the water of the canal well and the natural style of the zoo. The text background and text colour have both been picked from the photo of the shelter and setting at London Zoo
- The curved elements of the design definitely embrace nature and with the shape of the shelter being inspired by a bulb of garlic it has a natural style

Function

- The flyers will be available for visitors to take from the advertising board at the top of the entrance to the shelter; if this is moved to a more obvious position then the service will be advertised far better. It also provides the key information about service to inform visitors
- The shelter is covered over the top, providing complete shelter for those waiting underneath it
- The shape and design of the shelter allow water to flow down it easily and be stored in a water catchment system to be reused elsewhere in the zoo. Being primarily made out of wood, it will have a very small affect on the environment. The wood will be sourced from reputable suppliers who replant seedlings after using the forested area

User Requirements

- The natural style of the design should prevent the shelter from dating and should definitely look up to date for at least 10 years
- The external bench is very simply constructed so problems with this could be changed very easily. The simple design of the shelters should also minimise the problems which could go wrong
- The materials used to make the shelter are very in keeping with the new parts of the zoo, incorporating lots of wood. The shapes also have a natural appearance which suits the rest of the zoo well. The back of the external bench was also inspired by a fence in part of the zoo
- The bold design would definitely catch the visitors' eye and stand out against the woodland walk, however the natural materials and shapes help it to still be in keeping with the woodland

Performance Requirements

- The wooden slats will be varnished or oiled to protect them from sun and water damage which will occur in its situation, so it should definitely be able to withstand the elements for at least 10 years
- The promotional flyer, which can also be used as a poster should help to advertise the service and hopefully increase the number of customers
- The wide doorway into the shelters and space inside them will allow plenty of room for wheelchairs and pushchairs
- The shelter will be contrasted by qualified and experienced builders so will be safe and will undergo safety tests, it is also completely covered overhead so will provide protection from the weather

Materials and Components

- All suppliers will be local, reputable companies who are FSC certified and use sustainable methods of manufacturing, as well as replanting seedlings after logging
- The materials will all be of a very high quality and will be treated to protect them from the weather to increase the longevity as much as possible
- Almost all of the shelter and bench is made out of solid oak which will be unprocessed. However, the glass rood will need energy to produce it, as will any metal fixings and joints
- Quality control and assurance tests will be done once the shelter has been completed, any components which do not pass these tests will need to be improved and all materials will be weather, water and impact resistant up to a certain extent. The wooden slats may need to be re- oiled at a later stage to maintain the level of protection
- If the oak is oiled, then it will be much stronger than in its original state and this will maximise its life. All other materials will be very hardwearing

Size

- All dimensions for heights of seat bases and backs have been calculated taking ergonomic data into account, and the benches will have seat depressions to make them more comfortable
- Having two quite large shelters provides ample space for this amount of people
- The overall space that the shelters take up has been increased rather a lot, making much better use of the canals edge

Safety

- The foundations will be calculated to support the canals bank and the weight of the shelter, and will be very secure
- The shelters will be very strong and have sufficient reinforcements in the weaker areas, for example, at joins in the oak bench, in order to make it safe and secure for the waterbus customers
- The smooth and curved edges of the shelter and bench will cause very little harm to children, they will also be sanded and oiled to reduce the risk of splinters or jagged edges
- The shelter is primarily made up of wood and glass, so will not conduct electricity

Quality

- All materials will be of the best quality to make it a strong, well built shelter, however the costs will have to be kept within the budget
- All builders and constructors will be highly qualified with lots of experience to ensure it is of a very high quality
- All seats will have depressions in them to make them more comfortable

Cost

- The cost of the project should be within budget

Promotional Flyer Specification

Materials

- The card used for the flyer will be recycled and be supplied by a local, sustainable company
- The flyers only consist of card and ink, which is 100% recyclable
- Card of about 160 gsm will be used instead of paper to make it more durable and longer lasting

Shape and Size

- The flyers will be A5 and so will fit well in the stand at the entrance of to the shelter
- The flyer will be A5 so it will definitely fit easily in a visitors bag
- The printed size of the flyer is a suitable size, all the font can be read easily, is clear and stands out
- All the information needed on the flyer fits well, it is not cramped with too much information but still provide plenty of details about the service
- The flyer is A5 and rectangular so it is will be within budget to make

Aesthetic

- The watercolour effect on the image and natural, earthy colours reflect the zoo and waterbus service well
- The bright blue of the top of the shelter really stands out and makes the flyer noticeable, the text, in the same colour as the glass roof stands out too
- The text is in a simple font so it can be read easily
- The text is of an appropriate size, it is large enough to be read easily but it is not too large, fitting in well with the image and not wasting space
- The flyers heading is large enough to be read at least 1 meter away
- The background of the leaflet is the canal, with a boat and the new shelter, so it advertises the service well and shows it in its natural light and setting
- The flyer does not provide a timetable as times are simple, being on the hour from 10am until 4pm, however this is stated clearly
- The flyer gives information on all ticket prices, however the client wanted a more simplistic design, so not information is given about the new shelter and there is not in depth information on the service

Cost

- The flyers design and production for one year will be within budget, due the simplicity of the image, shape and size of the flyer

Text

- The text stands out well in front of the faded green, making it clear to read
- The company name stands out from the rest of the text as it is in a larger font size
- Only one font is used on the flyer to keep it more simplistic

Environmental Issues

- The card that the flyer will be printed on is 100% recyclable
- Card is biodegradable so the use of it will be environmentally friendly
- The size of the flyer is a standard size and the design can be printed easily, both of these factors will reduce the wastage of materials and production time to save energy

Safety

- The cards edges will be slightly pointed as it is rectangular however it should not be sharp and so it will be not be a safety hazard
- The flyers simple shape, size and layout make it very easy to use and read, providing the visitors with plenty of clear information
- The flyers will be tested to ensure they meet ISO standards and will be altered if they do not

Manufacturing

- The flyers' production will be very straightforward and so can be mass produced
- All quality control and assurance checks will be carried out during and after the production of the flyer and any that are not met will be altered until they do
- The standard card size and simple design will allow the flyer to be produced quickly and efficiently to reduce costs

Feedback and Evaluation

I revisited London Zoo once I had completed the making of the model and promotional item to find out what the client and Zoo visitors thought of the designs. I took along copies of the flyer and photographs of the model and explained the designs to them so that they could fully understand how the shelter would work. I then asked each person a list of questions to gain valuable, unbiased feedback.

Client Feedback

During my meeting with Ruth Desforges at London Zoo, we discussed the design and model of the shelter and the promotional flyer, she provided me with some valuable feedback which I will now consider and use to evaluate the two designs and then modify.

"The new shelter functions far better than the current one, with seating, and far more shelter from the weather during the summer and winter. This should meant that the visitors would be far more likely to sit and wait for the waterbus, therefore bringing the service more customers. "
"The appealing and striking design of the structure will stand out in amongst the woodland, making it more visible to the zoo visitors who are unaware of the service. This is perfect for its location as it is hidden in amongst the trees. I also feel that you have managed to get the balance between a great design and a design that fits in with the surroundings. It is bold and attention grabbing, but the natural materials prevent it from detracting from the woodland walk."
"If the service was advertised around the zoo, for example, in cafes and at information points, more people would be aware of the service and would be more inclined to look for the shelter and then use the waterbus. Therefore I think that it would be useful to enlarge the flyer to act as a poster and supply flyers at various points around the zoo. If this were to happen, it would be a good idea to provide a diagram or map showing the situation of the service in relation to other parts of the zoo."
"This design is very much in keeping with the newest parts of the zoo, so no changes would need to be made to the overall design. It also reflects and fits in with ethos of zoo, being made primarily of natural materials and incorporating natural shapes."
"One aspect of the design that I am particularly impressed with is the use of natural materials. It was definitely a good idea to remove the glass from the front of the design and open up the doorway instead, it provides light inside, but also reduces the cost of the materials and the amount of energy used to make it. The small element of glass that you have incorporated into the design, the glass roof, works really well. The blue tinted glass helps to tie the design in with the water and really links the two together, making the shelter appear as though it belongs there."
"The flyer would work brilliantly to promote the service; it fits in well with the design and style of the shelter, the zoo and the waterbus company. The watercolour effect of the image and the distinctive but natural shapes promote the service and shelter as being peaceful and relaxing."
"There are no parts of the design which I think need to be changed, however, there are a few possible improvements which could be made. To keep the sight clean, it would be a good idea to provide some waste bins and to encourage and educate children about the environment, it would be useful to provide some recycling bins or information. The other improvement could be to provide some sort of entertainment for the children while they wait for the waterbus. There could be some information inside or next to the shelters about the wildlife in the woodland walk, in particular the birds."

3rd Party Feedback

Emily

"This new design makes the service so much more noticeable, I would definitely be more likely to find out information about the waterbus and use it after seeing this shelter compared to the current one."
"The bench really brings the design together; I love the curves in the design."
"I think that the flyer could provide a bit more information about the service, or a more detailed brochure could be designed, with background information about the service, information on the new shelter and its natural materials and more details about the service. "

Eve

"I think this design could possibly draw attention away from the nature it is surrounded by, however, the fact that it is mostly oak helps it to fit in well."

John

"I really like the fact that the majority of this shelter is made out of natural materials."
"The design fits perfectly in the woodland surroundings and looks as if it belongs there.
"One possible development could be to provide something for children to do in or around the shelters"

User Group Feedback

All of the visitors felt that the shelter helped to promote the waterbus service much more than the current shelter. They all said that the design was a lot more noticeable and eye catching than the current shelter, which would make them more likely to use the service.
As with every design, the new shelter was not too everybody's taste, however no one felt that the shelter would stand out too much, to detract from the natural, woodland surroundings, and they all felt that it suited the style of the zoo. Those who did not like the theme or style of the design would have liked to have seen something either more traditional or more delicate. They felt that the design looked a bit too heavy and bulky; they suggested a light wood or different material.

All of the visitors were very positive about the flyer, saying that the simple design and layout allowed you to focus on the image of the shelter, canal and boat behind the text. They suggested some improvements for the flyer. The main point was to lighten the colours if the background image to give the flyer a brighter appearance. They were all keen on the watercolour effect of the image, which they thought reflected the nature of the waterbus service very well and the style and design of the shelter. They felt that the flyer was very suitable and promoted the service very well however they did not think that it was particularly attention grabbing, but that lightening the colours could help to improve this.

Evaluation

Having considered all of the feedback that I have gathered from the client, the user group and a 3rd party, as well as comparing the model and flyer against their specification lists, I am now able to evaluate the final products and decide whether the final product is suitable.

The natural style of this design as well as the use of strong, natural materials, enable the shelter to sit in amongst the woodland and look as if it belongs there rather than looking man made and unnatural, and be able to withstand a lot of wear and tear. Because of this, it will last a fairly long time without appearing dated or breaking, and so is very suitable for the zoo, surviving on charitable donations and fundraising, they will not have the money to replace it every 5 years. The new shelter will also function far better than the current shelter, with seating and lots of protection from the weather.

The construction of the model was overall very successful. Although, there were a few changes that had to be made to the design, resulting in alterations of the way in which the model was made. For example, the glass slats at the front of the design were removed as the client wanted to reduce costs and the impact that the production of the shelter would have on the environment. Another issue that I came across, was that the plywood I originally used bent, causing gaps in between the slats. This also prevented the slats from being glued together, as the bend in the wood was stronger than the glue. I then had to use MDF, which gave the model less of a natural colour and surface but a smoother, sleeker finish.

The design of the flyer has been very successful, there were no problems during the process of making it and the feedback was positive. The design suits the service and shelter and is eye catching and attractive. If the design had been less simplistic or the promotional item had been a leaflet, then more information could have been added, which some users were interested in seeing.

Overall, the feedback was very positive, and almost all of the specification points for the model were met. Therefore, it seems that the final design of the shelter has been successful and has turned out very well.

Modifications

Following on from the evaluation and feedback, I have been able to draw some conclusions about the design of the shelter and flyer. I can now look at what improvements could be made, in order to meet the parts of the specification which have not been successful.

Entrance down to canal

One of the specification points was to improve the entrance to the steps leading down to the shelter and canals edge, in order to make the service more noticeable and increase the number of customers. Unfortunately the budget did not stretch to cover this.

Simple, solid oak archway with London Waterbus Company carved into the top

With a larger budget, an archway could be designed and built to frame the opening in the trees which leads to the canal. This could be as a wooden archway, in a similar style and design to the shelter, or it could have a less obvious design, looking like a natural gap in the trees, but drawing the focus down to the canal and shelter.

Archway created by plants growing up arched trellis

If an archway couldn't be funded, then the board showing the poster for the waterbus service could be moved to a more obvious position, to make people more aware of the service.

Entertainment for children

After our discussions, Ruth and I both agreed that it would be a nice idea to provide some sort of entertainment for the children while they wait for the waterbus or something to attract them down to the shelter other than for the waterbus service.

This entertainment could be in many different forms, but we felt as the shelter is situated in the woodland walk it would be appropriate to relate it to nature. The woodland is home to lots of different types of wildlife, so there could be posters inside the shelters, or stands outside the shelters showing the different animals and giving some information about them. The trees are home to many different species of birds, so binocular posts could be fitted by the shelters to allow the children and their parents to try and spot the different birds. It could also give information on how to protect the animals' habitats.

A leaflet could also be designed and provided in the shelters for visitors to take, providing information about the wildlife they might see during their trip on the waterbus. This could include games, pictures and information to keep them entertained, but also learning about the wildlife.

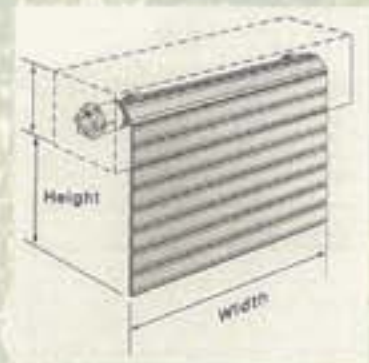
Protection from bad weather

Removing the glass slats at the front of each shelter meant that the light would be reduced and the shelters would seem too claustrophobic. To avoid this, the doorways were widened to open up each shelter and allow more natural light to shine inside them.

Unfortunately, this now means that very heavy rain and strong wind could enter the shelters far more than in the original design. Therefore, something could be designed to cover the entrance to each shelter.

The shelters are curved in two planes which would make it very difficult and expensive to design a sliding door to cover the entrance. However, a rolling shutter could be installed inside each shelter, just about the top of the doorway. This would provide protection from the weather and could allow the shelters to be locked at night, reducing the risk of them being vandalised. The shutters could be transparent to allow visitors to see in and out of the shelters.

However, this modification could ruin the design of the shelters and completely remove the natural style that they have.



Bins

Ruth felt that the new design for the shelter would attract more customers to use the waterbus service. So in turn, there would be more waste produced and potentially more litter. Therefore, she suggested that it would be suitable to include some waste bins and recycling bins into the design.

A bin could be placed by the edge of the canal where the boat stops to encourage people to dispose of any litter they have as they board the boat. There could also be bins inside each shelter, these could be set into the bench at either end of the design, or stand separately.

Signs could be put on the bins and around the site providing children with information about recycling. It would be a good idea if the bins had labels to separate different types of recyclable and non recyclable waste.

Flyer

The flyers design was really successful and received a lot of positive feedback. Its only downfall was the small amount of information that it provided for the visitors, however, this was due to the simplistic and minimal style that the client had asked for.

If another promotional item was designed, it could provide more information on the waterbus company, possibly names of the boats and how they run. It could also include information about the shelter and what things are available to do at the other stops along the canal.

Life Cycle Assessment

To assess the impact that the final design has on the environment, I have carried out a Life Cycle Assessment, considering the sustainability during the different stages of the shelters life.

Raw Materials

As the shelter will be made primarily out of solid oak, it will have a very small amount of environmental impact. Although this process does not require extracting materials and using large amounts of energy to produce the final material, it will involve deforestation, and although this is not to a high level, it still adds to the damage of forest areas.

However, most of the wooden shelter could be constructed using reclaimed oak. This would reduce the amount of degradation of forests, conserving resources and energy. This could only be done if the reclaimed oak was of a very high quality, as the safety of the shelter is still an important factor to consider, and if there was suitable wood available. If this was not an option, then new oak would need to be sourced, this could then be reclaimed once the shelter reaches the end of its life.

The design involves using very few materials, which will reduce the damage caused when sourcing the materials and manufacturing the shelter. It would be very difficult to reduce the amount of materials used in this design as it only requires oak, glass and stainless steel fixings.

The raw materials used to produce glass are not difficult to source. Unfortunately, the high temperature needed to heat the glass uses huge amounts of energy and the burning of fossil fuels creates enormous amounts of CO2. However, under many circumstances glass can be recycled. To reduce the impact that the production of glass creates on the environment, recycled glass will be used for the roof.

The fixings to keep the shelter secure and hold it together are stainless steel. The extraction of iron ore is mainly done through mining; this has a huge effect on the environment. A few of the effects include; the production of explosive fumes from drilling and blasting, increased noise, change in the composition of the top of the soil and polluted water damages agriculture and vegetation growth.

End-of-life

All of the materials used in the shelter could be reused for other projects or uses. The wooden slats could be reclaimed or recycled to ensure that it is not wasted. The glass could also be recycled easily as it will be in its original state at the end of its life.

The zoo will ensure that the shelter lasts as long as possible, as they do not have the funds to build a new shelter every 5 years, therefore it should last for a fairly long time.

The natural and environmentally friendly ethos of the zoo makes it far more likely that the materials of the shelter will be reused rather than being put on a landfill site. The design of the shelter will also help to reduce the amount of materials that will be wasted as the shelter can be dismantled easily, the materials will be undamaged and in their original state.

Manufacture

The manufacture of the oak slats could be done in two possible ways. They could be made up of a number of different parts joined together by halving joints. This would require more machining and labour costs but would result in much less wasted wood. Alternatively, the slats could consist of one or two parts which would require far less manufacturing and labour, but which would create far more waste as the curve of the slats would leave lots of wasted oak around it. The first option would be far more suitable, reducing the amount of waste significantly.

The manufacturing of the glass rings for the roof will be fairly simple. Recycled glass sheets will be cut on an industrial laser cutter. However, the circular shape of the rings could produce quite a lot of wasted glass around the edges. This could be minimised by placing the rings in suitable places on the computer before cutting. The smaller rings could be placed inside the larger rings, where the centre would be wasted. They could also be positioned as close together as possible. Laser cutting glass will use some energy, but this will not be a considerable amount.

After extracting the iron ore for the steel fixings, it requires various forms of processing; this uses vast amounts of energy and results in carbon dioxide emissions, contributing to global warming. Due to these factors, the use of stainless steel fixings will be kept to a minimum. The majority of joints and fixings will be traditional wood joints, however, the use of steel fixings rather than glue will allow the shelter to be dismantled and the wood to be reused at the end of its life.

Distribution

All of the materials used will be sourced from local suppliers, this will reduce the transportation mileage significantly, minimising the shelters environmental impact. The production and manufacturing of the components of the shelter will also be carried out near to London Zoo and the suppliers in order to, once again, reduce the amount of CO2 produced.

Use

The shelter has been designed to last at least 10 years, but due to its location, the materials and its purpose, it should last at least 30 years. This is a far better length of life, as it means that extracting the raw materials, manufacturing them and distributing the parts will not have to happen as frequently, reducing the environmental impact the shelter creates.

The design for the construction of the shelter allows it to be dismantled very easily. It is made up of a basic wooden frame that supports the oak slats and roof. The slats fit into the frame through traditional wood joints which will be reinforced by steel fixings, this allows any slat to be removed and replaced without affecting the rest of the shelter. The glass roof could also be replaced easily, as well as the bench. If one of the back panels needed replacing, this could be done be removing the fixings at the back and fitting a new panel.

The oak will be sealed to protect it from the weather and water; this will increase the durability of the product and ensure that it lasts as long as possible. The sustainable nature of the shelter could be used to promote the service and educate the zoo visitors about recycling and reusing materials.