

Economic



To build economically is important for most projects and it is no different here. But this is definitely not a low budget scheme. It is a priority to make use of local contractors and materials although there is a leeway to utilize outside expertise. One must not forget that this is a building for the glory of God and will require excellent craftsmanship necessarily costing money.

Prioritization

Facility		
Foyer	4	Essential 5
Auditorium	3	High Req 4
Bookstore	5	Medium Req 3
Kitchen	3	Low Req 2
Hall	5	No Req 1
Chapel	5	
Memorial W.	5	
Coffee Shop	4	

Local Contractors

Target Description:

As far as the design allows, local contractors part of the congregation, must be employed.

How is this Achieved?

Details and building techniques must be primarily within the scope of local business. The only exceptions would be specialized elements in the Auditorium which can't be bought in Tswane.

Local Materials

Target Description:

Most of the materials specified must be locally available.

How is this Achieved?

The use of unusual materials should be limited. However, this should not limit the overall design and character making of a religious building. Using local materials will limit the traveling distances for the distributors of construction materials and thus save money and energy.

Local Components

Target Description:

Where components are specified in the design, it should primarily be available on the local market.

How is this Achieved?

Use components locally available. This will be of great benefit when maintenance and repairs are needed. The specialists will be close and money and time will be saved.

How is this Achieved?

The structure of the Auditorium will determine its appearance and degree of multiple uses. Preferably the roof structure must allow for an open roof span to limit areas where sight lines to the stage are obscured. The congregation is not yet large enough to fill the whole space for ten thousand people. Therefore the designer suggests that the structure for a gallery is designed and only added when the extra seats are needed. This will prevent the feeling of wasted space while the congregation is still growing.

Suggestions for a roof structure of this size will be a domed structure with aluminum trusses, a concrete or steel structure. The advantage of the aluminum is its lightness compared to the steel. The depth of aluminum trusses would be far less than that of similar steel trusses. The disadvantage of steel or aluminum is their coldness. It would be preferred to use warmer materials like timber on the inside. Timber can always be added as nonstructural elements to cover the structure whether it is steel, concrete or aluminum.

The floor and walling structure would primarily be of concrete for its load bearing capacity and texture.



This Structure consists of large concrete gutter trusses spanning the longest distances. This will result in an excessively large structure and is not favorable.



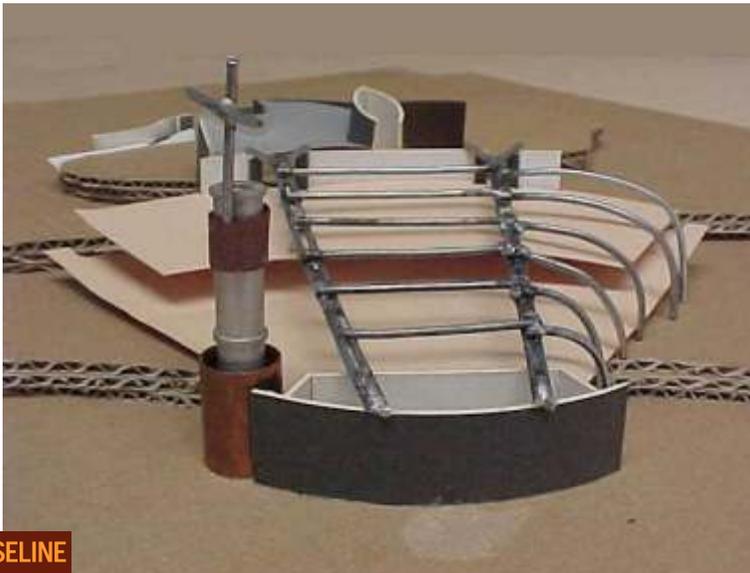
Structure Economic

Target Description:

The structure of the auditorium must accommodate future expansion in the form of an added or extended gallery. Although the structure should be economic, it must also provide for multiple usages.



The second structure comprises of two large steel space frames and smaller curved space frames in between. This structure will also be large but will create more opportunities than the concrete beam structure. The space frame will allow for interesting openings in the roof for light penetration. The actual frame can be covered with timber for a warmer finish. The two main beams will then also be used as rainwater collectors..



Prioritization

	Essential	High Req	Medium Req	Low Req	No Req
Facility					
Foyer	5				
Auditorium		4			
Bookstore			4		
Kitchen				4	
Hall					4
Chapel					5
Memorial W.					3
Coffee Shop					4

FIGURES 343-347: Photographs of structural models. (Steyn, 2003d)

Economic

Roof Structure of the Chapel

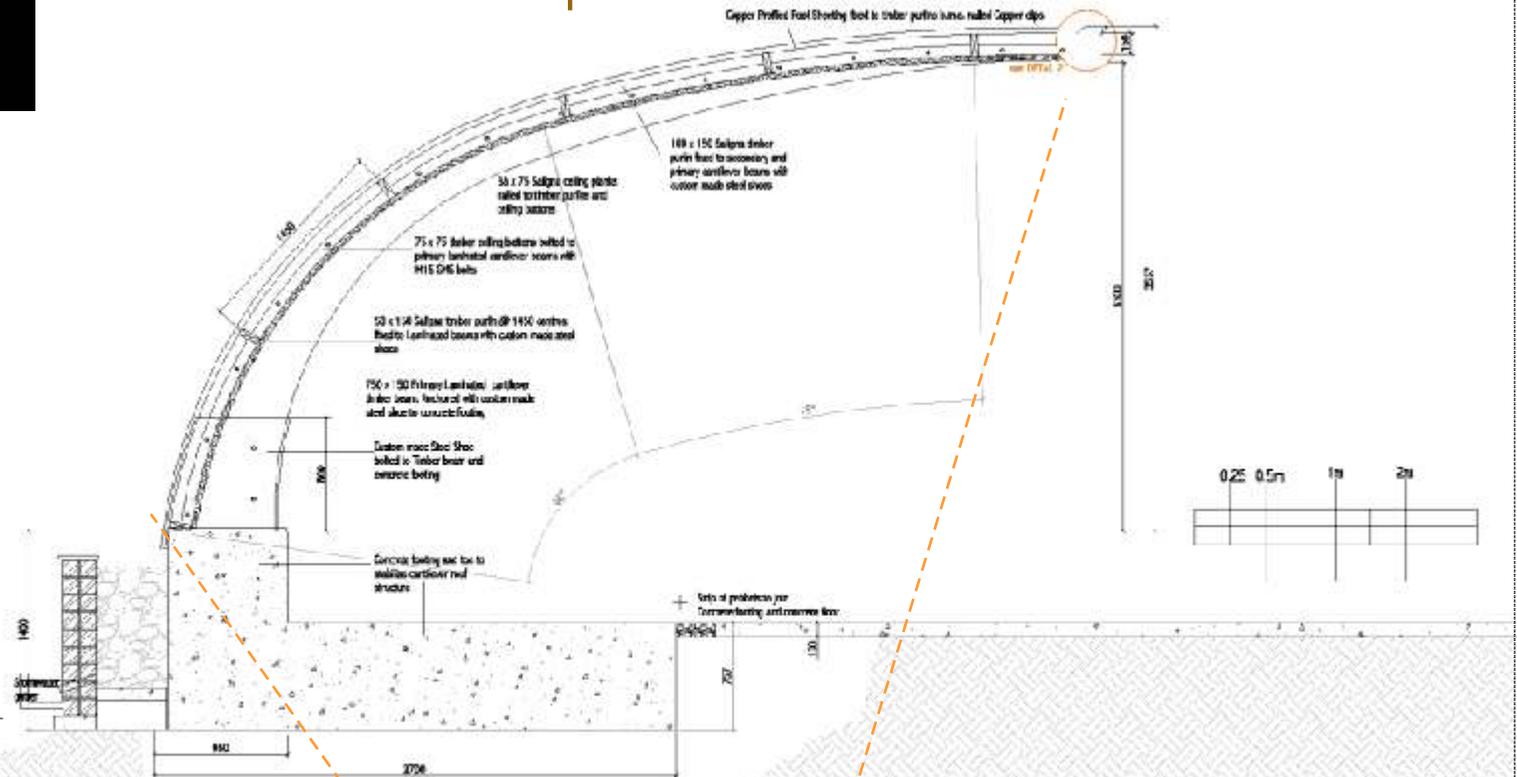


Figure 348: Detail section through the Chapel roof showing the cantilever timber structure. See A0 drawing page 6 no 6.2

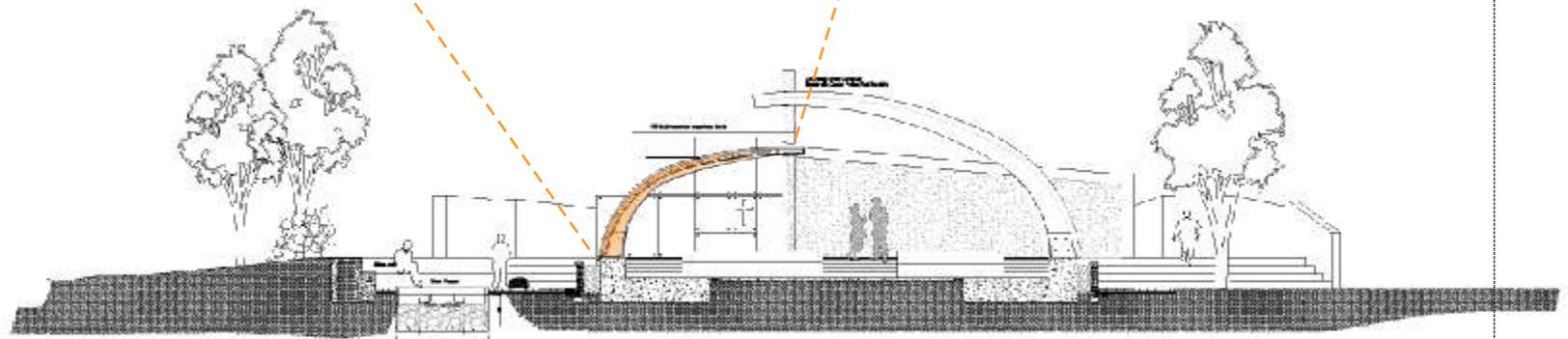
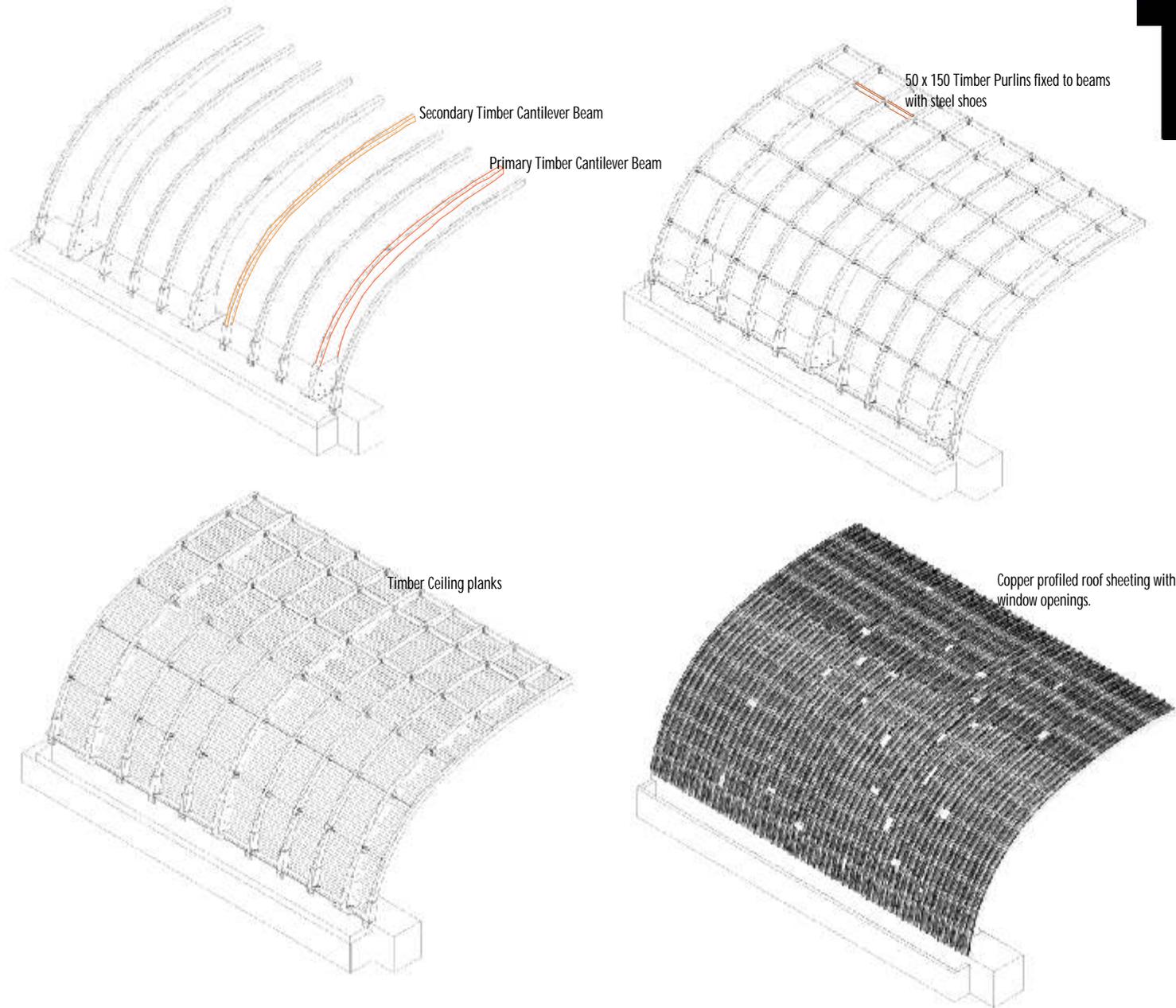


Figure 349: Section through the Chapel. See A0 drawing page 5 no 5.2

Economic



The roof structure consists predominantly of timber members.

1. The primary and secondary laminated cantilever beams are bolted to the concrete base with custom made steel shoes.
2. Timber purlins are bolted in between the cantilever beams with steel shoe hangers.
3. Steel tension rods are spanned in between the members
4. Timber ceiling planks are nailed to the structure from the inside
5. The copper profiled sheeting is clipped onto the outside.
6. The copper box windows are positioned and welded to the copper roof (see A0 drawing page 6)

FIGURES 350-353: Showing the roof structure of the Chapel.

Environmental



Environmental Control

Target Description:

Where necessary, environmental control for ventilation and solar control must be provided. Consider security issues.

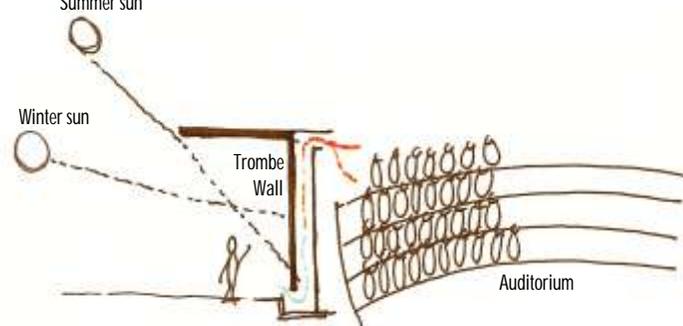


FIGURE 354: Section through the Northern side of the Auditorium, a Trombe Wall.

How is this Achieved?

Determine the effects of the sun's path. The angle of the sun will influence the character of a place by casting hard or soft shadows and has the underlying potential to create the desired effects. This will be very useful in the place making of the Foyer space, Chapel, Memorial wall and Biblical garden.

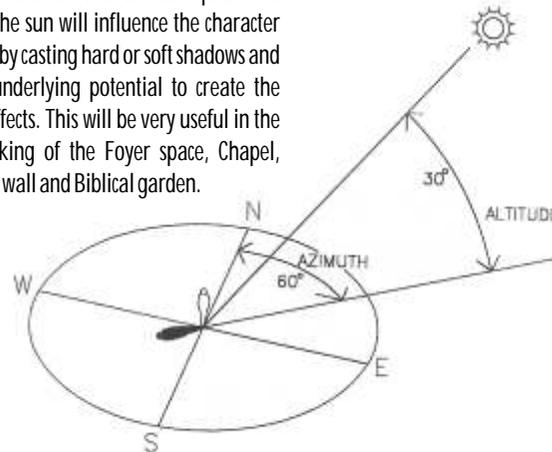


FIGURE 355: Diagram showing the difference between altitude and azimuth.

How is this Achieved?

Some windows must be operable for allowing natural ventilation. Security provision should not subtract from the design articulation. Areas with direct sunlight must be provided with solar control devices where the direct sun is unfavorable

To respond to environmental control with passive design is the most sustainable way. A Trombe Wall on the northern side of the Auditorium will heat air in winter with direct sunlight falling on the dark wall. The altitude of the sun in summer will keep the sun from shining directly onto the wall.

Sun Angles

Target Description:

The position of the sun and its effect on the buildings and landscape must be considered when identifying the areas in need of solar control devices.

JOHANNESBURG & PRETORIA Latitude (nearest) 26° South
Both cities taken as longitude 25.5°E (Add 4.5° or 18 minutes to solar time)

Solar times	06.00	08.00	10.00	12.00	14.00	16.00	18.00
Clock times	06.18	08.18	10.18	12.18	14.18	16.18	18.18
Azimuth 21/12	112E	101E	91E	0	91W	101W	112W
Altitude 21/12	10	35	63	88	63	35	10
Azimuth 21/3 & 9	90E	76E	53E	0	53W	76W	90W
Altitude 21/3 & 9	0	26	51	65	51	26	0
Azimuth 21/6	-	55E	34E	0	34W	55W	-
Altitude 21/6	-	14	32	40	32	14	-

FIGURE 356: Sun Angles for Pretoria and Johannesburg.

FIGURE 355: Diagram showing the difference between altitude and azimuth. (Napier, 2000: 4.5.1)

FIGURE 356: Sun Angles for Pretoria and Johannesburg. (Napier, 2000: 4.10)

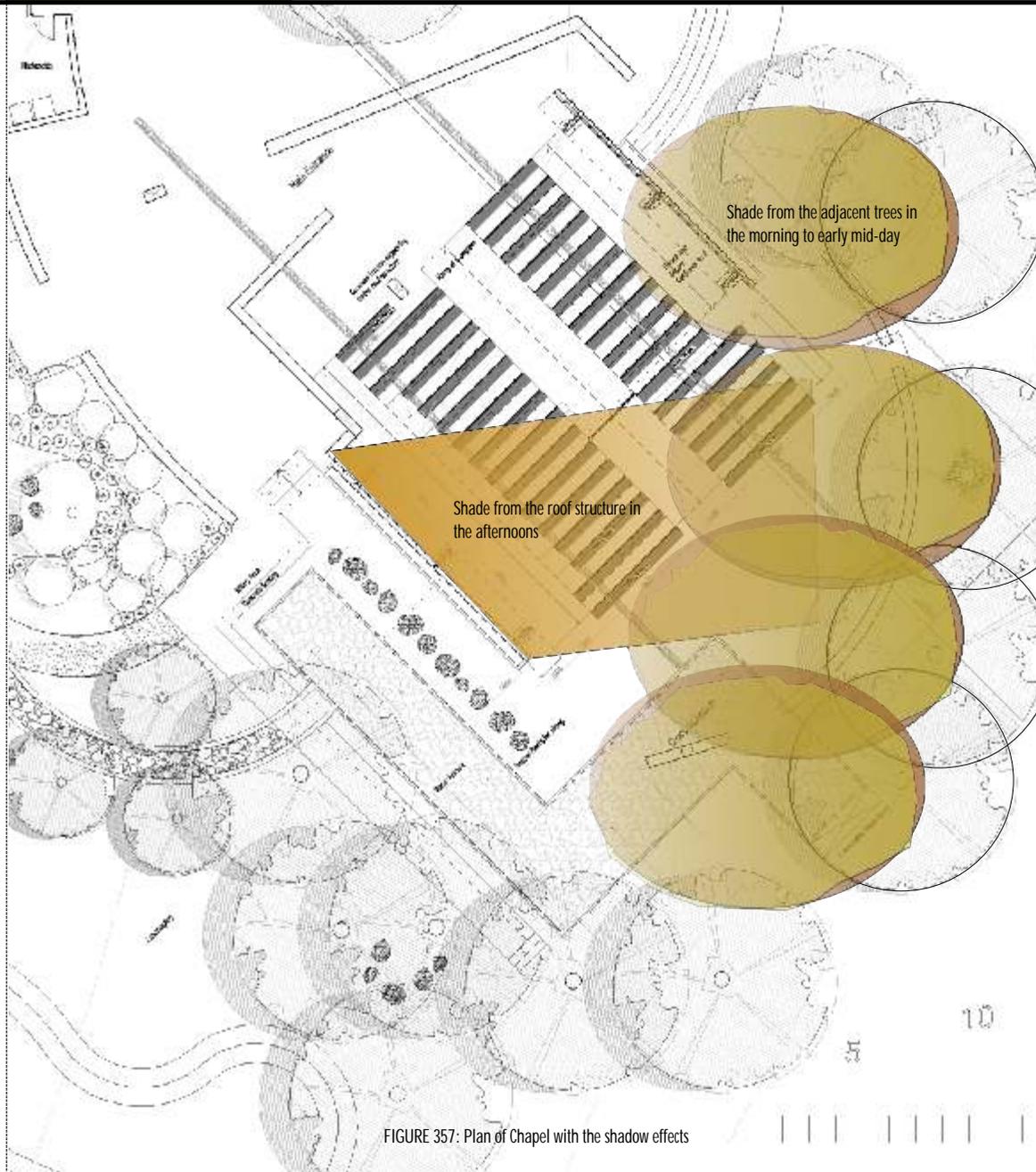


FIGURE 357: Plan of Chapel with the shadow effects

The front part of the Chapel is open to the sky and will thus have a problem with direct sunlight. Sun angles have been used to solve the problem. The trees surrounding the north eastern side will aid in providing shade during the morning. This is ideal for a morning wedding.

Weddings in the afternoon usually start after 15h00. The cantilever roof of the Chapel will then provide enough shade for the activities.

As the trees grow and enlarge their foliage diameter, the branches would grow over the walls of the front part of the Chapel and provide shade throughout the day. Thus a light structure of branches and leaves becomes the chapel's roof.

The trees providing shade contribute to the user's experience of natural elements. The sound of rustling leaves when the wind blows will be heard when sitting in the Chapel. Many Christians say that they experience God more intensely when surrounded by natural elements. When sitting inside the Chapel, one's experience of God's presence is intense and refreshing.

Environmental

Use of Energy

Target Description:

Limit the use of energy by maximizing the use of passive building design concerning cooling, heating and lighting. Where these systems are not adequate, use energy efficient devices.

How is this Achieved?

The auditorium and conference room are the only spaces depending fully on electrical lighting and partly on mechanical ventilation. The remaining spaces must make use of available day lighting and the sun as heating source. Irregular openings for natural light penetrating the Auditorium will create a religious atmosphere and aid with visibility during a power failure. Louvers for lighting control is essential for performance situations where a dark auditorium is required. These louvers can be manipulated either with a mechanical system or manually.

The kitchen will also require a large quantity of energy in the form of electricity; therefore energy efficient devices should be put to use. Gas cooking is much more sustainable than electrical cooking appliances.

Solar panels are very expensive and deliver small quantities of electricity in relation to the initial cost, but do not contribute as much pollution to the environment as grid electricity from coal. Although this is an option for an alternative energy source, it is not worth the money spent on installation and making it theft proof.

Another method to minimize the use of energy is to make use of gas heaters for hand washbasins, rather than using an electrical geyser. Previously heating the water by means of a water heater in the sun, and then distributing it to the gas heaters will advance the saving of energy.

A tremendous amount of energy will be saved if passive cooling and heating is used for the Auditorium and Foyer. (As previously discussed under Thermal Comfort.) The most energy will be used in the operation of the fans.

The ablution block and kitchenette outside the Chapel lends itself perfectly to install energy efficient devices. The ablution block and kitchen can use solar water heaters installed on the flat concrete roof, with gas heaters inside. The kitchenette can make use of a gas stove.

Prioritization

Facility		
Foyer	4	Essential 5
Auditorium	4	High Req 4
Bookstore	4	Medium Req 3
Kitchen	5	Low Req 2
Hall	4	No Req 1
Chapel	4	
Memorial W.	-	
Coffee shop	4	

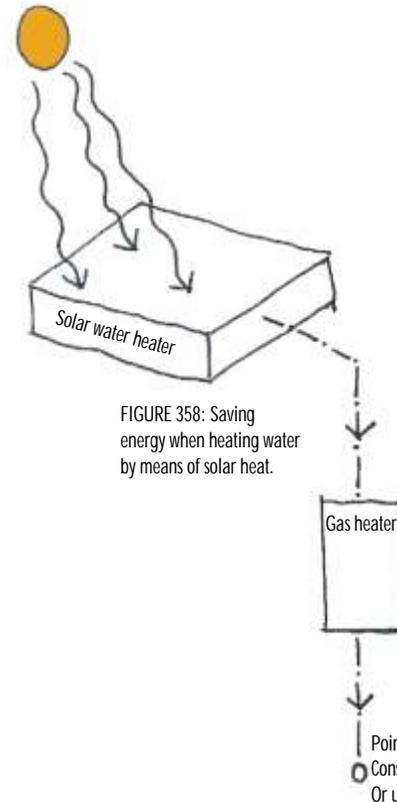


FIGURE 358: Saving energy when heating water by means of solar heat.

How is this Achieved?

Watering the landscape as well as kitchen related activities will use the greatest amount of water. A wonderful community project can be implemented with the use of greywater. Each family must bring 5 liters of greywater each time the family attends a service. This water can be used to water the landscape. This will also enlighten the community members to use biodegradable agents for cleaning purposes. Say 2 000 families attend a service, 10 000 liters of water is recycled. Water can also be saved by installing water efficient plumbing devices, utilizing rainwater and re-using some of the water. The water efficient devices will regulate the quantities of water. Greywater from the building can be reused to flush water closets. This will decrease the amount of municipal water used and therefore also the costs. South Africa is a water poor country and a Church with 30 000 members is a very good place to make people aware and to start saving natural water resources.

How is this Achieved?

The roofs of the buildings must be designed to collect all rainwater into storage tanks. According to the month of maximum rainfall, November, the storage tank must at least accommodate 300 (three hundred) cubic meters of water. The collected water can then be run through a filter and used for flushing water closets and watering the landscape, it will also be suitable for drinking. Predominantly drinking water will come from the municipal connection. Storm water must also be collected and used for irrigation and can be a source for the external water features.

Device	Conventional	Efficient
Water Closets	10 liters	Below 6 liters
Taps	0.25 - 0.3 l/s	0.03 - 0.17 l/s
Showers	0.4 - 0.7 l/s	0.2 l/s
Dishwashers	45 - 68 l/wash	26.5 l/wash

TABLE 13: Comparison between conventional and water efficient devices

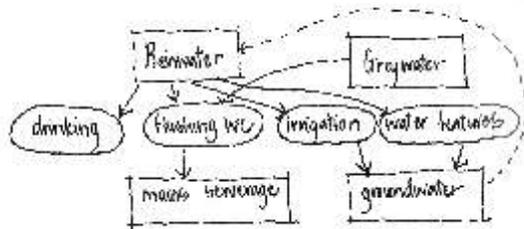


FIGURE 360: The Rainwater and Greywater systems.

Use of Water

Target Description:

Water consumption must be kept to a reasonable minimum.



FIGURE 359: Water efficient devices. A sildi valve and a flow regulator.

Rainwater

Target Description:

Rainwater must be collected and stored in containers to be used for irrigation and domestic purposes.

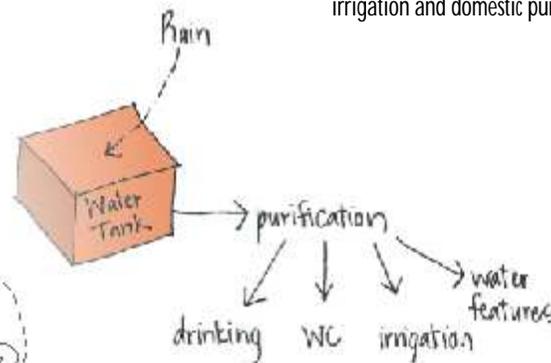


FIGURE 361: The Rainwater systems.

Amount of rainwater
 Summer max 375 mm
 Winter max 250 mm
625 mm / annum
 November max 138 mm
 Roof area ± 2000 m²
 0,138 x 2000 = 276 m³ water
 ≈ 300 m³

Environmental

Prioritization

	Facility	
Essential 5	Foyer	4
High Req 4	Auditorium	4
Medium Req 3	Bookstore	2
Low Req 2	Kitchen	5
	Hall	4
	Chapel	4
No Req 1	Memorial W.	-
	Coffee Shop	4

FIGURE 359: Water efficient devices. A sildi valve and flow regulator.

TABLE 13: Comparison between conventional and water efficient devices. (Gibberd, 2002)

Environmental

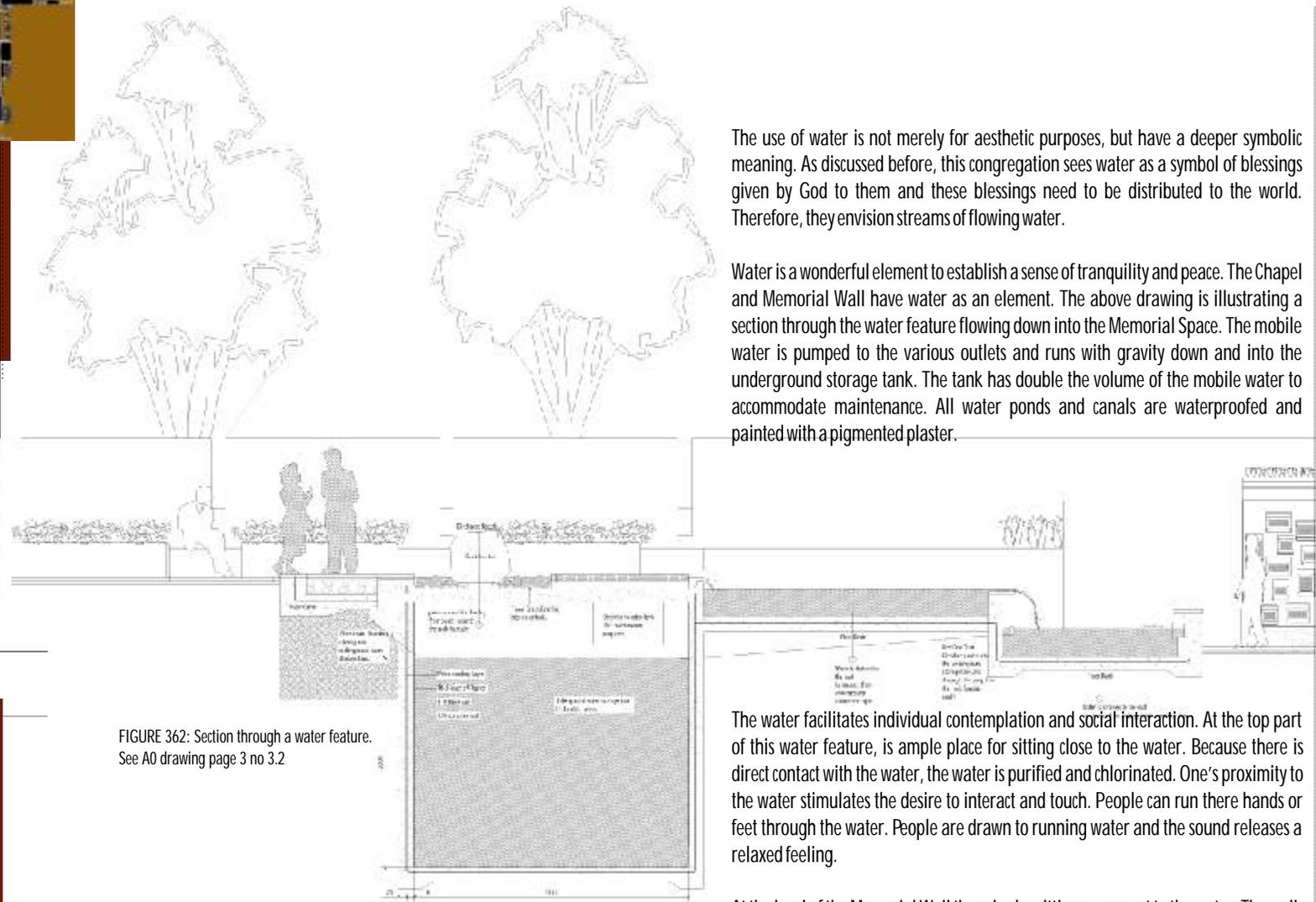


FIGURE 362: Section through a water feature.
See A0 drawing page 3 no 3.2

The use of water is not merely for aesthetic purposes, but have a deeper symbolic meaning. As discussed before, this congregation sees water as a symbol of blessings given by God to them and these blessings need to be distributed to the world. Therefore, they envision streams of flowing water.

Water is a wonderful element to establish a sense of tranquility and peace. The Chapel and Memorial Wall have water as an element. The above drawing is illustrating a section through the water feature flowing down into the Memorial Space. The mobile water is pumped to the various outlets and runs with gravity down and into the underground storage tank. The tank has double the volume of the mobile water to accommodate maintenance. All water ponds and canals are waterproofed and painted with a pigmented plaster.

The water facilitates individual contemplation and social interaction. At the top part of this water feature, is ample place for sitting close to the water. Because there is direct contact with the water, the water is purified and chlorinated. One's proximity to the water stimulates the desire to interact and touch. People can run their hands or feet through the water. People are drawn to running water and the sound releases a relaxed feeling.

At the level of the Memorial Wall there is also sitting room next to the water. The walls with the many niches will be reflected cloaking a tranquil scene especially in the evenings. The sound of running water will also bring a sense of relief to the visitors of the Memorial Wall. The water will remind them of God's many blessings and that He has not forgotten them in their experience of loss. Running one's hand through cold water is therapeutic.

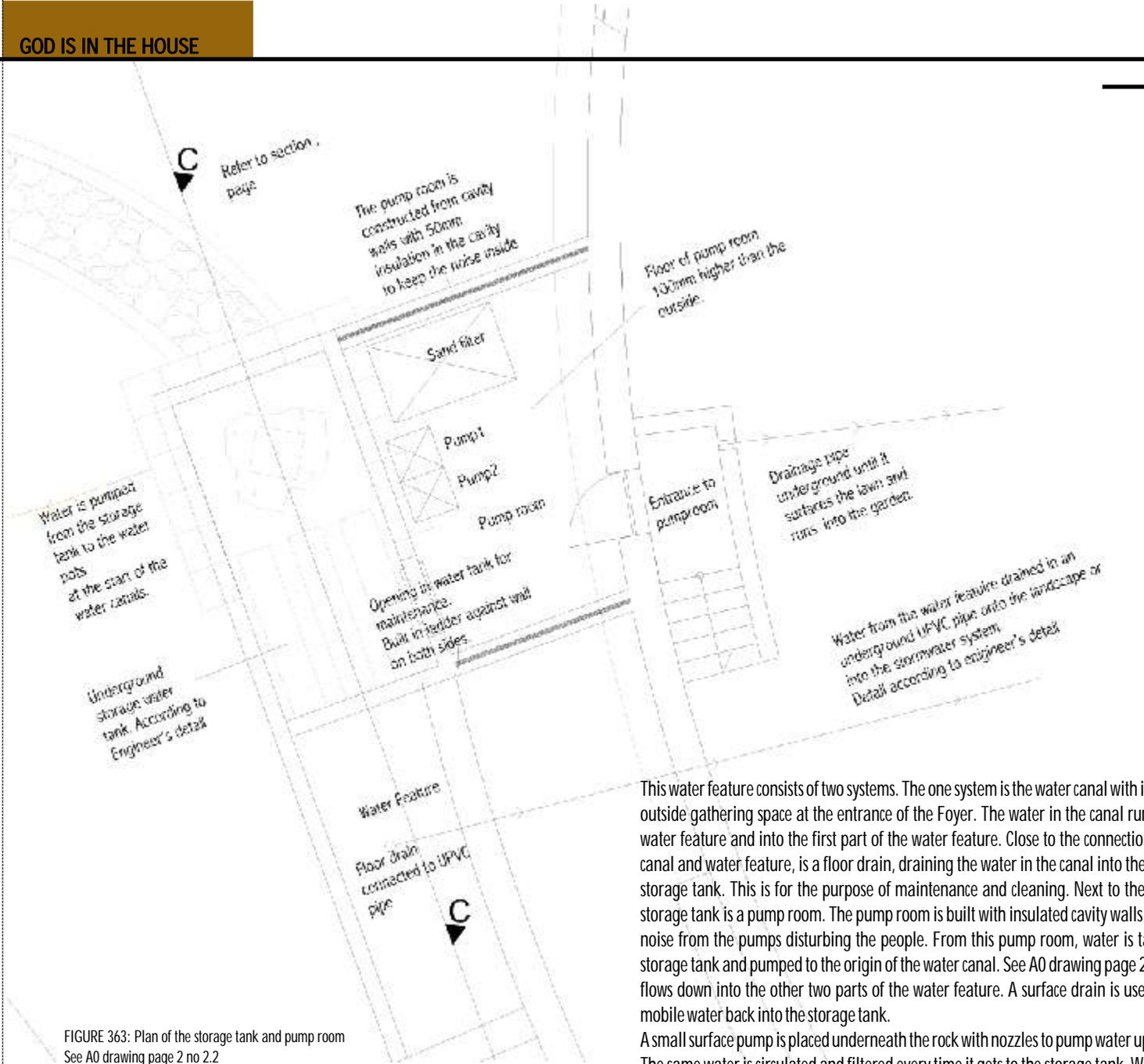


FIGURE 363: Plan of the storage tank and pump room
See A0 drawing page 2 no 2.2

This water feature consists of two systems. The one system is the water canal with its origin at the outside gathering space at the entrance of the Foyer. The water in the canal runs down to the water feature and into the first part of the water feature. Close to the connection between the canal and water feature, is a floor drain, draining the water in the canal into the underground storage tank. This is for the purpose of maintenance and cleaning. Next to the underground storage tank is a pump room. The pump room is built with insulated cavity walls to prevent the noise from the pumps disturbing the people. From this pump room, water is taken from the storage tank and pumped to the origin of the water canal. See A0 drawing page 2 no 2.1. Water flows down into the other two parts of the water feature. A surface drain is used to drain the mobile water back into the storage tank.

A small surface pump is placed underneath the rock with nozzles to pump water up into the rock. The same water is circulated and filtered every time it gets to the storage tank. Water is lost due to evaporation. A tap is installed to fill the storage tank to the required level.

Environmental

Organic Waste

Target Description:

Organic waste generated primarily by the Kitchen and Coffee Shop must be collected and turned into compost to be used for improvement of the soil. All congregation members must contribute to the recycling of organic waste.

How is this Achieved?

A compost heap must be built in a suitable position and then all organic material from the buildings, landscape, and congregation members can be dumped onto this heap. The positioning must not interfere with other activities or the comfort of occupants. If the compost is tended to on a regular basis, a rich fertilizer is created, very favorable for plants.

The congregation members must be educated in the advantage of recycling organic waste. There must be a system implemented where the members can bring their load of organic waste, in the form of kitchen produced waste and garden produced waste, and deliver it to the Church site for making compost. If most of the people contribute on a regular basis, lovely rich soil fertilizer will be produced. This is very necessary for the landscaping of the Church site since the soil is of poor quality. Needless to say, the amount of compost produced will exceed the needs of the Church site and the church members can in return for their effort, come and collect compost for their personal uses.

Prioritization

Facility		
Foyer	-	Essential 5
Auditorium	-	High Req 4
Bookstore	4	Medium Req 3
Kitchen	5	Low Req 2
Hall	-	No Req 1
Chapel	-	
Memorial W.	-	
Coffee Shop	5	

Inorganic Waste

Target Description:

All inorganic waste in the form of glass, plastic and paper must be collected in separate containers and taken for recycling. Here it is also important to inform the members on their duty as good citizens of South Africa, to recycle their inorganic waste.

How is this Achieved?

Areas of waste generation like the Kitchen, Coffee Shop, Bookstore, Foyer and Hall should have 4 different containers for assortment at the point of waste generation. These small containers can then be emptied into larger containers on site. The best position for these large containers would be at the delivery point of the kitchen. Members of the congregation must be encouraged to bring their waste (organic and inorganic) and add it to the containers. This waste is then sold to the recyclers, creating an extra income for the Church. A tremendous amount of waste can be collected from a congregation of 30 000 members. It will be a huge contribution to the conservation of natural resources.

How is this Achieved?

Cut and fill must be kept to a minimum by identifying the most suitable positions for the various buildings. The already sloping parts can be used for the Auditorium, needing to be at a slope. The more level areas will be more suitable for parking.

The Geological composition of the landscape will influence the type of foundations to be used. The Site is underlain by shale with local siltstone of the Daspoort Stage, Pretoria series of the Transvaal system. (ARQ Specialist Engineers. 2000:3) This is taken from the Geotechnical report done for the Woodlands Lifestyle Estate development. Thus there might be slight variations in soil profiles on the Church site. For the purpose of this project the information concerning the soil composition in this report will be used.

Due to the abundant presence of gravels and the intact structure of the soil profiles, no apparently visible collapsible soils were identified. The Church site does not border directly onto the Moreletaspruit, diminishing the occurrence of alluvial clay deposits. Potential expansiveness is minimal. (ARQ Specialist Engineers. 2000:4)

The weathered residual soil and very soft rock shale might prove relatively difficult to compact. (ARQ Specialist Engineers. 2000:6)

Foundation proposal:

Structures should be founded on reinforced strip footings, with reinforcement built into masonry. Adequate site drainage should be ensured and plumbing precautions implemented to prevent the accidental saturation of the subsoil. (ARQ Specialist Engineers. 2000:11)

The soil composition will also determine the kind of vegetation that will grow in the soil. The soil type requires a lot of fertilizer to be added for proper landscaping. The fertilizer will be in the form of the compost made from the collected organic material.

Landscape Inputs

Target Description:

The form and composition of the geological formations of the landscape should minimally be altered by cut and fill. Adding fertilizer will increase the soil potential.

Environmental

Environmental Planting

Target Description:

Landscaping must add to the religious atmosphere and consist of indigenous and biblical plants. Parking must have extensive planting to soften the visual impact.

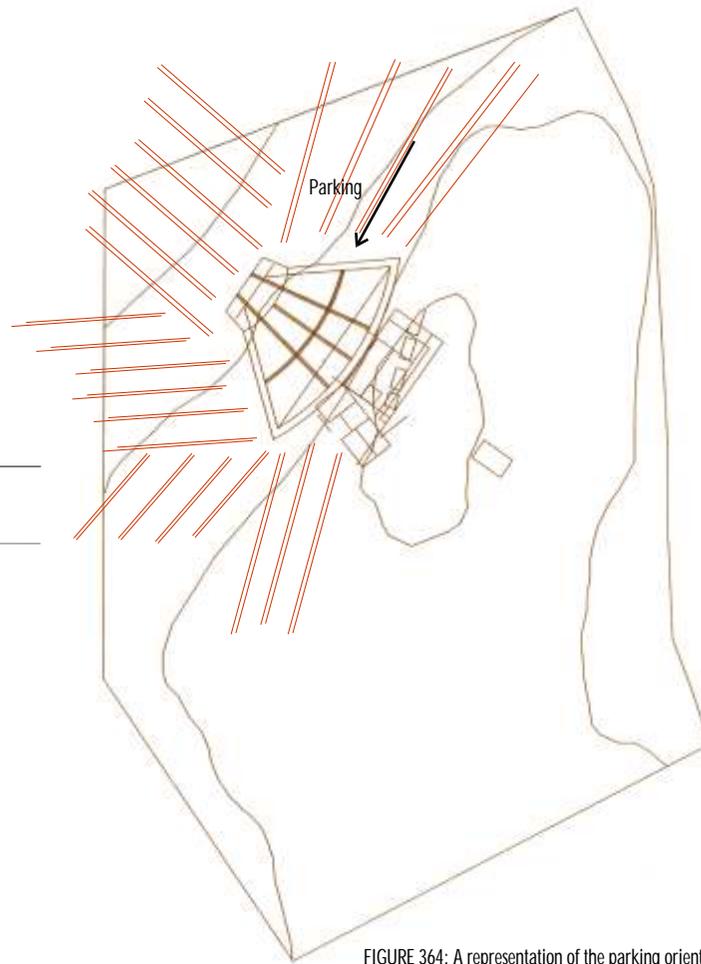


FIGURE 364: A representation of the parking orientation. Only part of the parking is shown.

How is this Achieved?

The arrangement and layout of the chosen plants must create spaces for prayer, meditation and social interaction. It must also create a visual barrier at the edges of the parking areas. Such a large area of landscaping will require an irrigation system. Indigenous plants require less maintenance and watering than exotic vegetation. However, a route with biblical plants will greatly add to the religious education of the congregation and it will contribute to the desired atmosphere.

For a Church building seating 10 000 (ten thousand) people, a monstrous amount of parking bays is required. In this case the number is calculated by working with a ratio of 2 people per vehicle, thus 5 000 (five thousand) parking bays. The parking bays including the circulation pathways will cover an area of 13 000 square meters. In other words 13 hectares. The site is only 18 hectares, leaving 5 hectares for all the buildings and exterior spaces. Because the client wants to continue with future additions to the site, one must consider to decrease the area used for parking. The only solution for this would be to go underground or into the air. It is also true that the building would not be filled with ten thousand people from the start. But this is its capacity and one must design for the optimum capacity. It is advisable to construct a smaller number hard parking, for example two thousand, and create soft parking for the rest. As the congregation grows, the number for hard parking can be increased.

Because the greatest part of the site will be covered with parking, one has to think of it as a landscaping element. It was discussed earlier that the approach to the building is very important in creating a religious atmosphere. The layout of the parking must facilitate this intention. A solution to establish this is shown in FIGURE 364. Here the parking is orientated such that the direction of movement looks onto the building. Trees are planted on either side of the walkways. A system can be implemented where each family in the congregation adopts a tree and tends it. This will encourage community participation and social interaction. The people can for example bring more greywater from their home and water their tree. This action will also lend itself to the education of the youngsters, building a sustainable community.

The landscape has many trees, grass to sit on and various plants with Biblical meaning.

The progression of spaces created by the landscape features must facilitate either individual contemplation or group interaction. The meandering pedestrian walkways and the water canals, create many 'islands' in the garden. These 'islands' are either public or semi-private, and some private. It is important to create different areas for people with different needs. People must use the garden in what ever way pleases them. Individuals can sit on a rock or on the grass in the private areas, or even groups can come together and interact in a quiet spot. The ideal is to create diversity in the design and layout of elements.

A future development for this project is a proposed Therapy Center. If the Therapy Center is positioned next to this garden, the garden can be used as medium in counseling and thus becomes a healing garden.

From the congregation came the suggestion of a picnic site somewhere in this project. This garden would also offer a wonderful picnic. It might seem strange to have people engage in outdoor family activities right next to a memorial Wall. But it is precisely what needs to be done. In the Christian faith, death is merely the entrance to eternal life, and therefore as much a part of life as birth. Young children must be taught that death is not something to fear.

These semi-private areas in the garden are used by individuals to spend time with the Lord in prayer and reading the Word, and by groups to converse on the Word or simply to socialize. It becomes a protective space where no pretenses are necessary. The Lord looks straight into one's heart. One can hide nothing from Him.

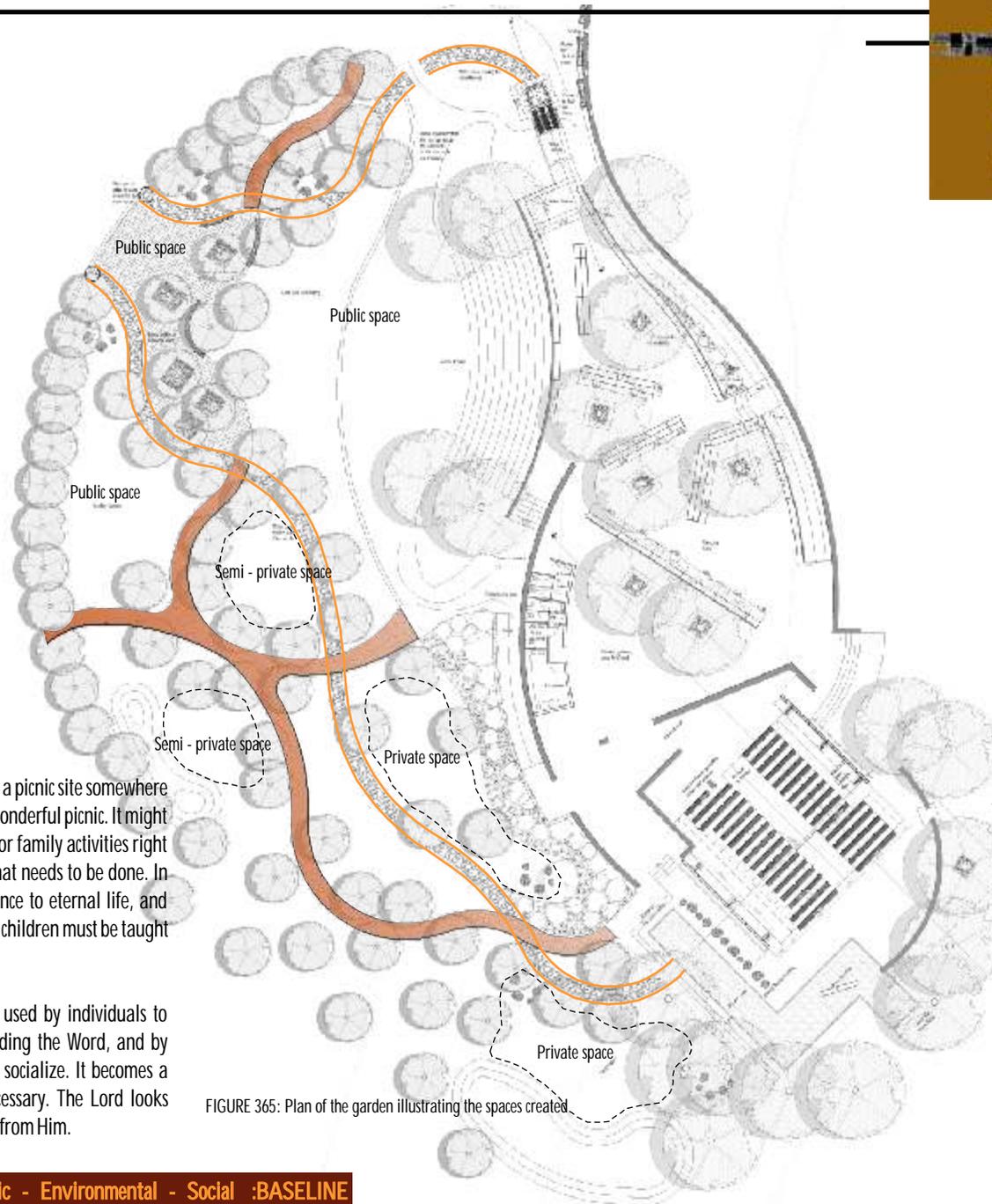


FIGURE 365: Plan of the garden illustrating the spaces created

The calm of the garden will wash onto the users. Gardens with water are frequently mentioned in the Bible. Adam and Eve live in the Garden of Eden before they sin. This garden also has a river. Genesis 10:2,15 A river watering the garden flowed from Eden. The Lord God took the man and put him in the garden to work it and take care of it.' It is God's plan from the beginning for man to be in the garden, peacefully living from it and lovingly tending to it.

In Numbers 24: 6-7 Balaam speaks of the blessings that will come to the Israelites as they settle in their new land. 'Like valleys they spread out, like gardens beside a river, like aloes planted by the Lord, like cedars beside the waters.

Water will flow from their buckets; their seed will have abundant water.' (NIV, 1998:226) Jesus himself often goes to a garden alone to spend time in prayer with his Father. A garden is a symbol of rejuvenation because of the time spent with the Lord. Isaiah 58:11 'The Lord God will guide you always; He will satisfy your needs in a sun-scorched land and will strengthen your frame. You will be like a well-watered garden, like a spring whose waters never fail.' (NIV, 1998:1102)

Environmental Materials

How is this Achieved?

The various materials must be compared in terms of the above-mentioned aspects.

Prioritization

Facility		
Foyer	4	Essential 5
Auditorium	3	High Req 4
Bookstore	3	
Kitchen	3	Medium Req 3
Hall	4	
Chapel	4	Low Req 2
Memorial W.	5	
Coffee shop	4	No Req 1

Target Description:

The selection of materials should be based on the embodied energy and water consumption during production and construction, the local availability of it and the potential symbolic meaning in it.

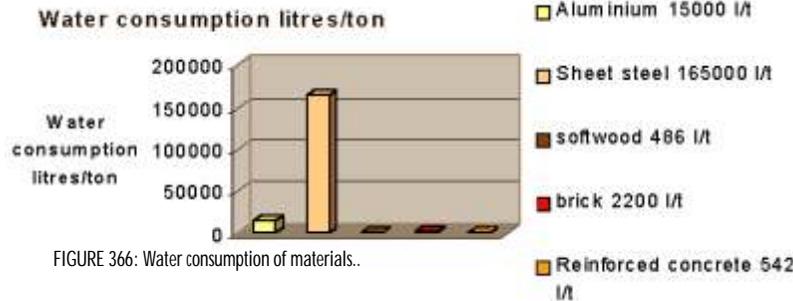


FIGURE 366: Water consumption of materials.

Water consumption litres/ton

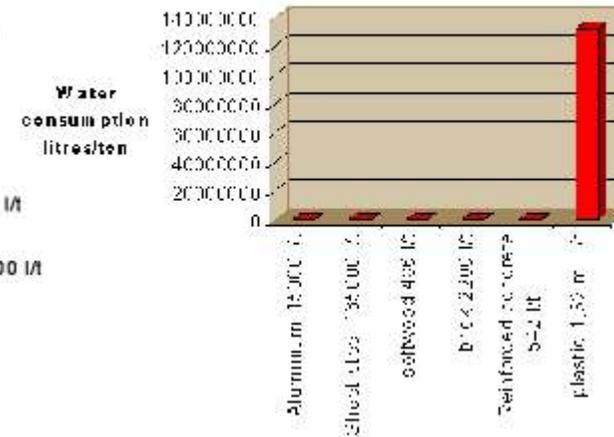


FIGURE 367: Water consumption of materials.

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FIGURES 366-369: (Gibberd, 2002)

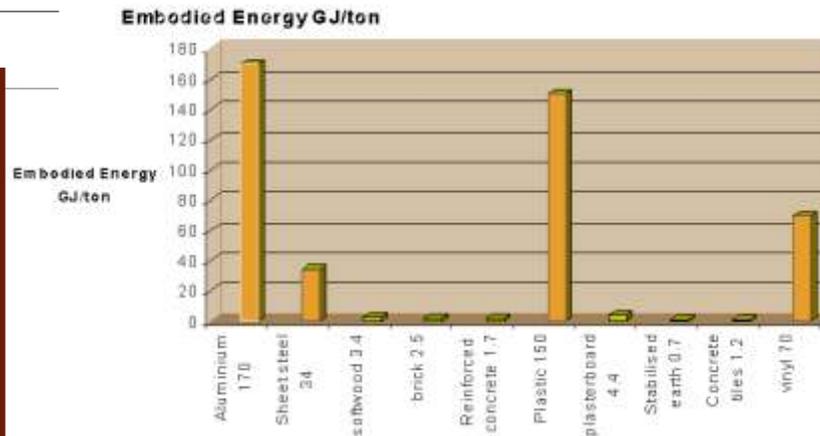


FIGURE 368: Embodied energy of materials.

Lowest Water consumption and accompanying embodied energy

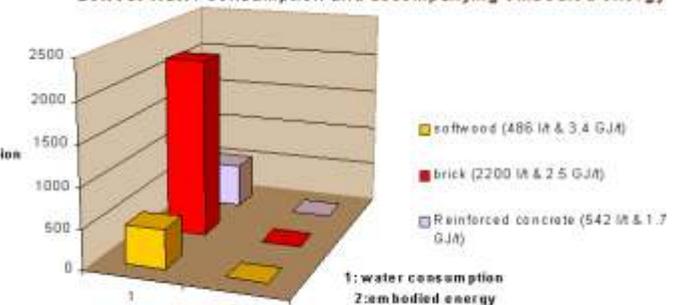


FIGURE 369: Embodied energy and Water consumption of materials.

From the graphs it is evident that concrete, timber and bricks are the best choice of materials concerning embodied energy and water consumption. For this design, the designer believes that raw materials and textures will enhance the ambience of a religious architectural character.

The user must be aware of the different materials used in the building. The materials as such will speak symbolism. In the briefing document research on the symbolic meaning of materials showed that timber, bronze and silver were very prominent materials to be used. Timber symbolizes Jesus as the Son of God in His true humanity. Timber is also a reminder of the immortality of one's soul. Brass shows the voluntary suffering of Jesus. He suffered, was tested and withstood the judgement. Silver points to purity and correctness. Materials can also act as a catalyst for the 4 symbolic colours: red, blue, purple and white.

Materials are one of the greatest contributors to the architectural impact of a space. The users should want to put out their hands and feel the texture. Concrete is a wonderful material with which to vary textures and colours. It is a medium of art. It lends itself to engravings and interesting patterns. Many people experience concrete to be cold and sterile. But the designer should use it that it create a warm and welcoming atmosphere. By adding pigment to the concrete a huge difference in appearance can be obtained.

This type of building, a Church, lends itself to the unexpected use of materials. This wonderful opportunity should not be missed.



FIGURE 370: An interesting wall finish, done by Pieter Mathews.

Materials continue

From the new book of Pieter Mathews, *Architecture*, one can get a very good idea of the different finishes for walls and floors. There are many different material finishes, each having its own character.

To understand the texture of a material, light is required. The texture and resulting impression of it will vary according to the amount and quality of light. A coarse texture will reflect less light and create a warmer and more relaxed space. (Mathews, 2003)



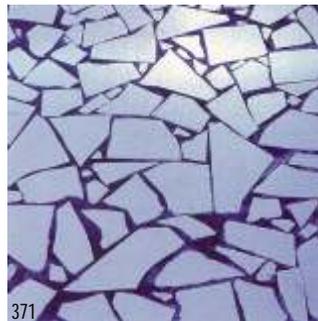
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FIGURE 371: Irregular ceramic tiles. (Mathews, 2003:19)

FIGURE 372: Cement slush finish. (Mathews, 2003:62)

FIGURE 373: Bagged soldier finish. (Mathews, 2003:69)

FIGURE 374: Concrete brut and titanium dioxide plaster. (Mathews, 2003:58)

FIGURE 375: Copper cladding. (Mathews, 2003:95)

FIGURE 376: Plaster carving (Mathews, 2003:99)

FIGURE 377: Tile floor. (Mathews, 2003:29)

FIGURE 378: Plaster imprint. (Mathews, 2003:72)

FIGURE 379: Timber and concrete floor. (Mathews, 2003:50)

FIGURE 380: Daubing finish. (Mathews, 2003:38)