LIVING RAINFOREST

Advanced Timber Construction

The structure of the dome is timber, the most environmentally friendly structural material possible. The structure is propped to reduce the span, and therefore size, of the roof members. There is no need to bridge the whole 60m width of the dome in a single span, and in fact there are considerable benefits in propping the structure from the central ‘tree’. The tendency to use aluminium (with 1000 times the embodied energy of timber) and steel (with 500 times the embodied energy of timber) for large span structures is avoided. The size of the timbers and strength of the connections can be kept to a minimum. An economic and elegant structure, using readily available timber from a sustainable source, will also provide the ideal platform for exploring the canopy of the rainforest. Modularity The structural form has also been designed to allow replication in future, larger projects. The square plan form allows infinite multiplication of the basic dome structure to form larger squares and rectangles.

Glazing

The rainforest plants and animals need light, so a transparent material is required to cover them. The lower embodied energy and reduced pollution involved in the production of glass, as opposed to plastic, is a factor in the choice of glass. However, more significant in the case for choosing glass is the ease of recycling it at the end of the life of the building. Moreover, the degree of technological evolution of glass allows the greatest control over the performance of this transparent skin. The significant potential heat loss can be limited through double glazing and low emissivity coatings. Photovoltaics can easily be incorporated within the skin. Special coatings can control solar gain, filter out any part of the solar radiation spectrum which is not required, and even avoid the need for cleaning. Because of the chosen structural system the extra weight of glass versus plastic is not such an issue, unlike geodesic and other large span structures.

Ventilation

Ventilation is to be natural rather than mechanical, via remotely operated ventilators in the roof skin. Fine adjustment of the vents will be provided by the central control system, to give the optimum level of ventilation. High humidity levels have to be maintained within the rainforest area and at the same time overheating or overcooling must be avoided. A fine balance is required and the ability to make subtle changes in the amount of ventilation. Sensors will measure temperature, humidity, wind speed and wind direction and provide this information to the central control system.

Rainwater Collection

With the large area of roof there is huge potential to collect rainwater. The supply of mains water to the site is restricted and the chemicals in it are not ideal for use on the plants. Collected rainwater will be filtered and treated before it is stored. Water will be filtered and treated again before it is used to water plants, used in the misting system to increase humidity, used in the aquatic exhibits, and used throughout the building. Water flowing from the roof and the level of water in the rainwater storage system will be visible to visitors from the entrance way of the building, within a large glass ‘rain gauge’.

Rammed Earth Walls

The walls separating the rainforest from the ‘buffer zone’ will be of rammed earth. This construction uses material either from the site or close by, which reduces transport. Little energy is used in its construction – unlike concrete, brick and blocks. The natural finish of the rammed earth walls is ideal as a backdrop to the rainforest. A membrane will be added to the ‘buffer zone’ side of the rammed earth walls to control the flow of humidity from the rainforest space. A further insulating layer will be added to control the flow of heat from the warmer rainforest to the cooler surrounding buildings.

External walls

The external walls of the building are of timber frame construction. Timber is a renewable resource, which absorbs CO_2 during growth, and requires relatively small amounts of energy to work it. Composite timber ‘I’ beams which form the framework of the walls are an efficient use of small sections of timber. At the same time they provide a large wall thickness, which in solid walls can be filled with environmentally friendly insulation material (such as sheep’s wool) to ensure a very highly insulated, breathing skin to the building. Solid sections of external wall will be clad with timber boarding. Glazed sections will have high performance energy conserving windows. These windows will open to provide natural ventilation and cooling.

Earth Sheltering

Some areas of the building are earth sheltered – earth is banked up against the walls. The visual effect of this measure is to root the building into the earth. There are also environmental benefits; the insulating effect of the earth reduces heat loss and protects these parts of the building from cold winds. Importantly, earth excavated for the construction of the building can be reused to create these banks, avoiding the need to transport it away from the site and even from contributing to landfill in some cases.

Photovoltaic Cells

A significant area of the roof (1000m2) will have photovoltaic cells laminated within the glass skin. Around 100kW of power will be produced at peak times, equivalent to around 80,000 kWh per year. The clean electricity produced by these cells, directly from the Sun's energy, will be used to power the building. Excess production will be exported to the grid, providing a source of renewable energy to others.

Passive Solar Design & Biomass

Obviously a significant input of energy is required to maintain the tropical rainforest area at around 25°C when the external ambient temperature is often much below this. To limit the effect on the environment of heating the rainforest, the design strategy is firstly to minimise as far as possible the energy required for heating the building, then to provide any heat input from the least polluting viable source. The main elements of this strategy are:

A 'buffer zone' of other accommodation has been formed around the rainforest, like a thermal blanket, to minimise the amount of heat lost to the outside. Heat passing through this 'buffer zone' from the rainforest will be controlled carefully and also provide heat to these spaces.

Solar energy entering the building through the glazed roof and windows will assist in heating the spaces. In spring and autumn in particular, the contribution of this 'solar gain' will reduce the need for heating. The high thermal mass of the rammed earth walls will store solar energy collected during the day and radiate it at night.

The amount of heat lost through the external envelope of the building will be minimised by the use of high performance insulating materials, for example highly insulated timber frame construction and earth sheltering to the perimeter walls. The large area of glazing will be engineered to provide exceptional insulating characteristics for these essential transparent areas.

Energy for heating the building will come from an efficient and clean burning biomass boiler, powered by wood chips from locally grown timber. Growing trees for fuel helps reabsorb the CO_2 produced during burning, making it an infinitely better choice than fossil fuel. The use of energy and the pollution associated with transporting fuel is also minimised by using a local source.