

## LIGHTWEIGHT STRUCTURES IN THE ENVIRONMENT

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### Introduction a European Perspective

Undoubtedly everyone at this conference is more than familiar with recent work in the area of environmental engineering that has been carried out in Europe. With stricter environmental regulations coming into force, architects and engineers have begun looking for radical alternative systems which reduce the long-term energy usage by buildings.

The use of conservatories as creators of warm air for adjacent spaces was one of the main developments away from traditional air conditioning type solutions. More recent examples now create a complete enclosure around the habitable areas. The external skin is the bio mediator for all the habitable building areas inside this outer zone.



**Fig 1. Training Centre in the Ruhr. Interior with classrooms and offices as separate buildings under an external skin**

Not all the structures of these envelopes are what I might term lightweight. In fact, I would be very hard pressed to describe the timber structure in the image as lightweight in any way shape or form.

But there is from my perspective there is absolutely no reason whatsoever why they should not be extremely lightweight, as indeed some are.

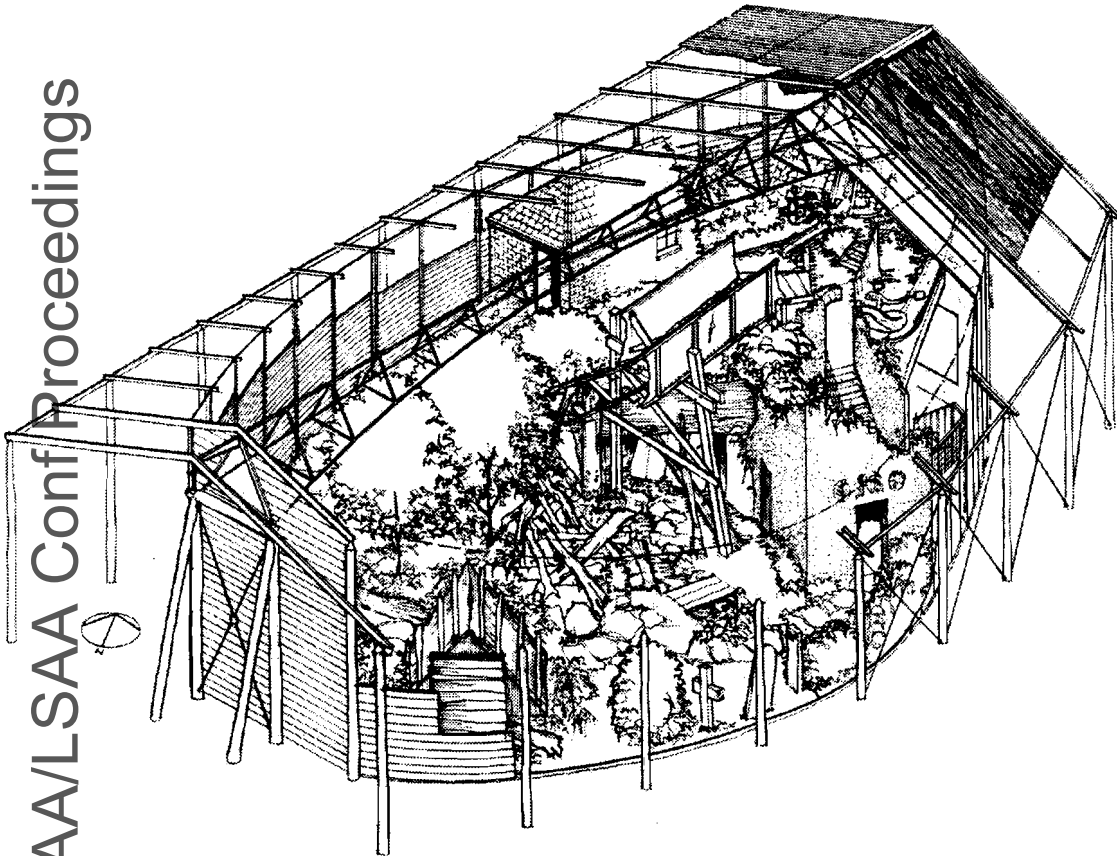
My own work represents an ongoing preoccupation with these environments as enclosures, and the opportunity they bring to integrate the natural world with the man made. Whenever the possibility potentially exists to try and design spaces where the outdoors can be brought indoors in the form of a conservatory, then I have pushed to try and make these environments real.

And it is three of these environments that I want to look at and illustrate.

### Visitor Centre, Strahan

In the midst of the southwest Tasmanian wilderness is the port town of Strahan, in which can be found the Strahan Visitor Centre. A purpose built building, half rough hewn timber, half glass and steel, the Centre houses a rainforest in which sits one of the most bizarre and engaging exhibitions ever seen in Australia. Amidst straggling Huon pines and manferns and a creek can be found, among many other things, an aboriginal cave with a partly excavated kitchen bench, and a brick and tile suburban living room circa 1970 western suburbs full of Greenie artefacts, and a flooded out timber and iron railway bridge.

Described as an ark with a novel inside, the building's physical structure and the interior were conceived from the outset as one, rather than a building with a void filled with a flexible exhibition space, and the building is itself an expression of the ongoing conflict between the natural and the industrial that is so characteristic of south west Tasmania. The almost violent polarities of the area are expressed in the building that seeks to explore some of the great conflicts that have shaped the area—physically, intellectually, aesthetically.



**Fig 2 Cutaway Isometric Projection of the Strahan Visitor Centre**

To begin at the beginning. Built in 1992 a cost of \$1 million in 11 months from commission to opening, the Strahan Visitor Centre was the subject of considerable controversy during its genesis. Commissioned by the Tasmanian government, the Centre went out to a nation wide competition for ideas for the interpretation of the southwest. Our winning submission was conceived by Kevin Perkins, one of Australia's leading furniture makers, and myself, and we were subsequently joined by writer and historian Richard Flanagan, and the three of us together created and oversaw the building of the Centre.

With the Centre we sought not to repeat old myths, but to provoke and challenge. We wanted the Centre to alienate and challenge visitors to rethink all that they would normally take for granted. All the major and minor fixtures were all designed to tell a story, so that even if visitors were unable to read one of the 45,000 words in the centre they would still understand what we were saying and we tried to ensure that the spirit of the interpretation was embedded in every aspect of the built fabric. The glue that moulded these different stories together was the local natural vegetation, which on Tasmania's west coast is temperate rainforest formed by mainly diverse species, Huon and Celery Top pine, leatherwood and sassafras. To enable a natural environment to be created we built a glass and steel conservatory. We then tried to layer text upon contra images upon art works upon plant life upon physical forms.

With the extremely tight design and construction time, the shell was rising while the interior was still evolving. The centre is an engineering tour de force by Jim Gandy; a dramatic prefabricated steel roof structure supporting

10mm structural glazing which literally soars over fractured the wilderness below. The principal support is a beautiful arched ridge truss, off which are hung prefabricated panels, braced by central triangular profile trusses which stiffen them into rigid planes, supporting either the glass or, at the rear, corrugated iron. To help create an air of impermanence, all the galvanised tubular steel roof structure is supported off green Celery Top pine logs, which we knew would shrink 25mm in their first year as supports.



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**Fig 3. Interior of the interpretative area.**

The building's overall concept, its interpretative text, its images, its very design, soon became the subject of massive controversy. It was said that it was impossible to put a temperate Tasmanian rainforest environment inside a building and the contents of the interpretation were seen to be extremely subversive.

The building's critical acclaim, including a series of architectural awards and international praise for its interpretation, enabled it to survive tenuously its first five years of its life against massed bureaucracy. The building became an ark, for the massed stories within. Rather than create a centre that gave authoritative answers that were in reality neither authoritative nor answers, we aimed to create a centre of questions, a starting point rather than an end point for future thought and discussion. In the process I had built my first conservatory as a true social incubator, a space redolent with many meanings.

#### **Forestry Headquarters, Hobart**

Hidden in a dark urban side street in Hobart is a secret world. The new headquarters for Forestry Tasmania recycled two dark drab (but heritage listed) 1930s brick buildings and extended these with a series of new structures to the rear of the old to create a new office development with a floor area of 6,000 sq m.

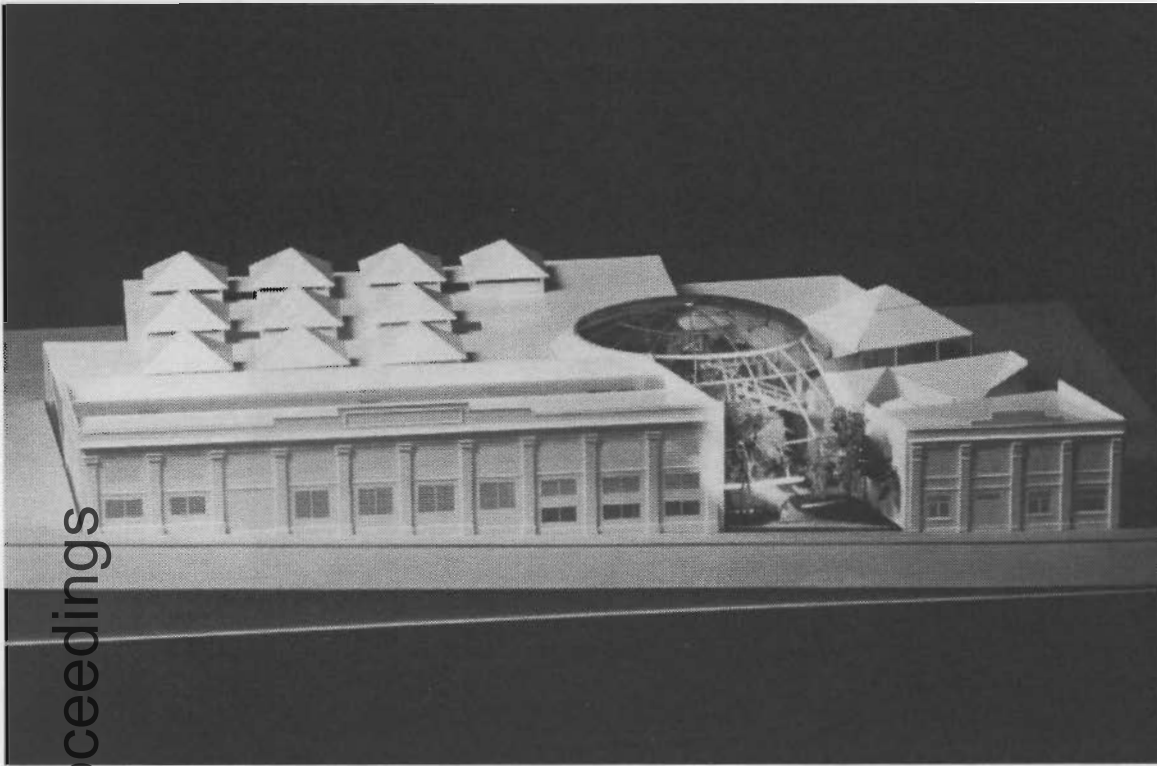


Fig 4. Model showing the overall development

The centrepiece of the building is a large timber framed, dome shaped conservatory, which covers a living forest landscape. Adding a dramatic new glazed volume comes as a complete surprise. Inserted in a 16 metre wide gap between the solemn brick walls of the existing structures, the narrow crack is roofed with a fragment of a dome that soars up into an opening at the rear crowned by a high shallow dome.



Fig 5. The central dome with the tail extension

The new structure is a portion of a 30 metre radius sphere, the circular top of which is a 22 metre diameter dome with a 'tail' that continues the curved surface a further 15 metres out and down to the front entrance.

The idea from the outset was to create a 'soul' for the new office by growing a natural forest under a conservatory roof, and in the process to use timber structurally in an innovative way. As it now is, the green tinted heat absorbing glass clad dome sails over all below it in a manner very much akin to a medieval illustration of a celestial heavenly orb floating above an earthly world of rivers and forests.

This space has become a verdant living oasis in the midst of the hard urban landscape outside. Temperate rainforest trees have been replanted to replicate their natural ecosystem. Not insignificantly, the dome has become an important semi public domain in its own right, with even wedding vows being exchanged under its timber spiders web.

In the dome, there is a unique quality present in no other office building in Tasmania. The smell as one enters the building says it all. It is the natural smell of a living forest.



**Fig 6. The interior with its forest soon after planting**

Our original submission included the intention to use the dome as a heat source for the surrounding offices. However, because of the fact that the building would be a leased property, whose real owner was an institutional investor, Civil and Civic, as project managers, declined to develop this option and opted for traditional packaged units. A great opportunity lost to fully exploit the thermal potential inherent in the space.

### Scottsdale Forestry Offices and Interpretative Centre

Third time lucky.

In Scottsdale, North East Tasmania, a current project is attempting to demonstrate how a real, sustainable ecological vision can be created. We wanted to create a building which could publicly demonstrate that the clean, green image is far more than merely a tourist advertising logo. Instead of merely repeating this jingoistic cliché, we wanted to demonstrate that this image can be translated into a structure that will demonstrate how the ecological necessities, which the future will demand that we take up, can be made into a very harmonious building right now.

Our building is again a conservatory which houses the interpretative display on the Ground Floor and the offices as upper level platforms within the space inside the large internal volume created by the outside shape.

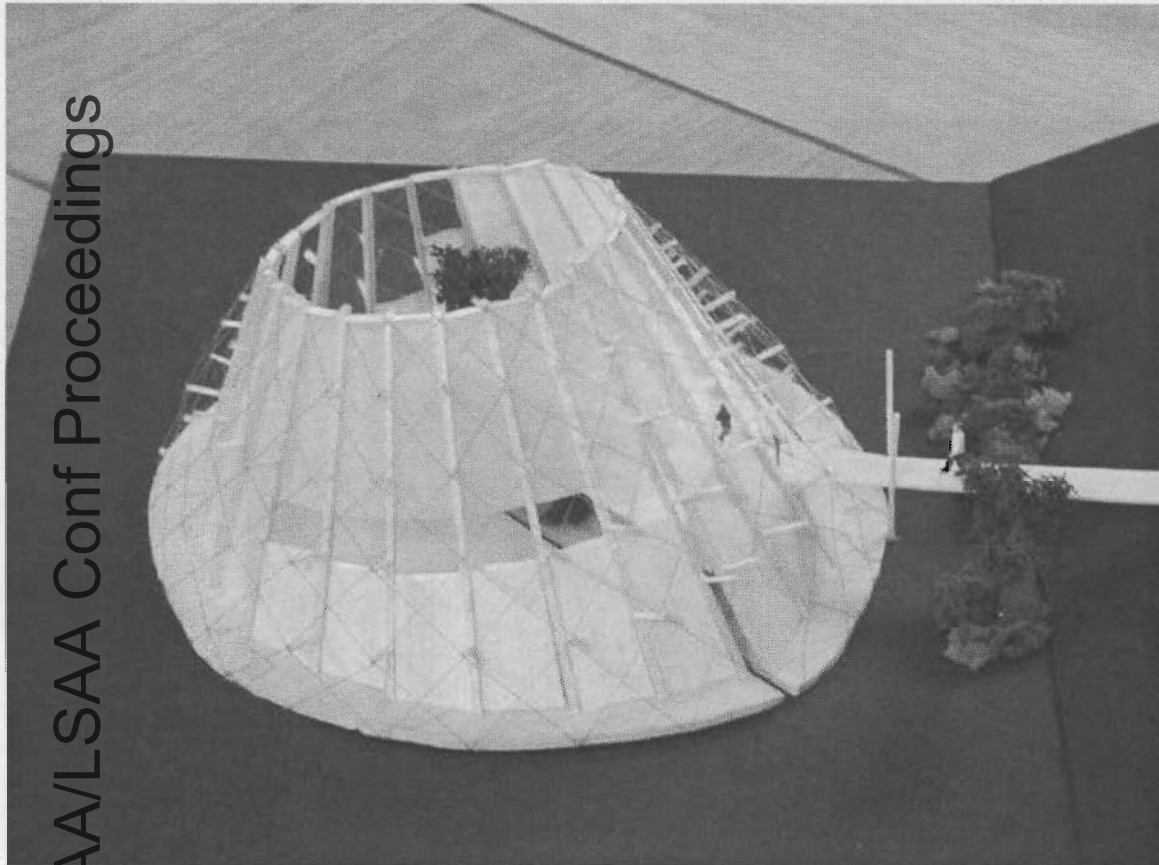


Fig 7 Sketch model of Offices and Interpretation Centre with roof membrane removed.

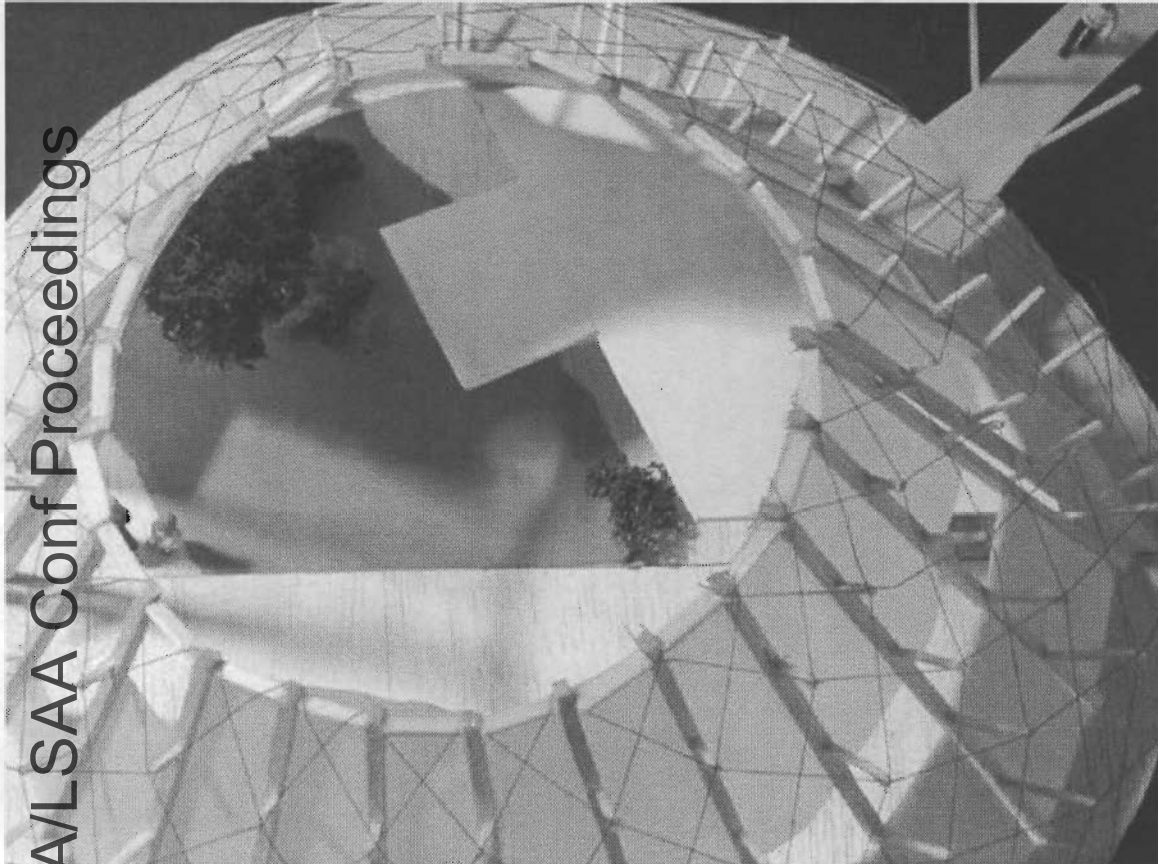
Externally, the form of the building has been determined by the wish to reduce the overall wall surface area to a minimum to reduce heat gain and loss, so it is a round shape as opposed to a square. By creating a high volume, the Stack Effect of air stratification will form natural zones of warmer and cooler air inside the building. We can manipulate these areas to our benefit to produce a building that we hope will be as energy efficient at various times of the year as is possible using current technology. And to do it using completely natural processes as much as possible, integrating plants and trees as important bio mediators inside this microclimate.

The external form also should indicate something of the specific nature of its function. The building will be a very forceful demonstration of sustainable resource timber linked in with new age cellular plastics and lightweight woven membranes. The exposed structure will be treated Radiata Pine laminated beams used as conical struts externally and as supports for upper floors internally. The walls will be formed from twin skin clear polycarbonate sheets, and clear glass where vision is required.

It is intended that the roof will be one of the latest white woven membranes such as Ferrari Précontraint, but the final choice will be determined after more exhaustive analysis. The structural support of the roof membrane is the device which will give the building its most dramatic effect. The external lacing which ties the outer edge of the membrane to the ground is stainless steel wires formed into a double spiral pattern that exactly emulates the Fibonacci spirals formed on Radiata Pine cones. The wires act to tie down the membrane like the method a drum skin (which is itself a structural membrane) is tied down to the body of the drum below.

This practice has begun working closely with Advanced Environmental Concepts (AEC) The space would be modelled in a 3D CAD package and the relative thermal performances of all the surfaces, walls floor and roof, would be added. The building would be populated with people and machines, computers being significant heat sources, and weather profiles for the local area would give a simulated performance of the building during different times of the year. The design will then be adjusted to maximise heat retention in winter and create adequate cooling in summer.

The basic premise behind the proposed thermal model is that the building is an environment that traps heated air (caused by the Greenhouse Effect) and that the hot air then naturally rises to the apex of the interior space. These air currents can be redirected down to create warmth in enclosed areas in winter or alternatively directly exhausted to the outside in summer.



**Fig 8. View from above with tensile membrane removed**

The office floors will be free standing inside the inner skin. The intention is to create an open flexible office environment wherever possible, with individual offices only if specifically required. The general approach to the layout will be to utilise what is termed *bürolandschaft* (office landscaping). Plants are integrated into balconies of semi open offices, and the lowest level is given over to social areas such as cafés and meeting rooms, and in our case, interpretative spaces.

Apart from the technical aspects, the quality of the spaces formed by this process is of very significant importance. The air that is being recirculated is oxygenated air enriched by the vegetation inside the outer skin of the building. The 'outdoor' environment in effect becomes the lungs for the rest of the building. There cannot be a healthier internal environment with natural processes creating warmth and plants enriching and purifying the air.

#### **In Conclusion**

These three projects illustrate an ongoing personal journey of experimentation, of never accepting the limitations of the status quo.

From a freestanding structure tailored to tell stories, to an internal space as a living heart and soul of a more traditional environment, to the latest where the conservatory has become a complete skin around the habitable environment within. In the process, the role of plants has been evolving from a situation where complete doubt and cynicism as to their survival has been replaced by their accepted role as an intrinsic part of a true biomorphic environment.

The continuity of a single client (Forestry Tasmania) is an important consideration in the genesis of all three projects. One could say cynically that these projects arise because political necessity is the mother of all invention; with the need for positive publicity for a group seen by some as rapers and pillagers of the bush. For me the opposite is true. The willingness of this client to back my innovative thoughts has made what otherwise might have remained as idle hopes, be transformed into convincing reality.

This has meant a partnership where the goals are similar: for me the demonstration of new ways to create environments that engage and delight, while at the same time pushing structural innovation to the very limits; and as well, showing how in the future a very fragile ecology can be better managed to the benefit of all.