A Critical Canonical Survey of Timber Buildings

incorporating the

Duality Database Timber Module 1.2

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Joseph William Gottstein Memorial Trust Fund

The Joseph William Gottstein Memorial trust Fund was established in 1971 as a national educational Trust for the benefit of Australia's forest products industries. The purpose of the fund is to create opportunities for selected persons to acquire knowledge which will promote the interests of Australian industries which use forest products for the production of sawn timber, plywood, composite wood, pulp and paper and similar derived products."

Bill Gottstein was an outstanding forest products research scientist working with the Division of Forest Products of the Commonwealth Scientific Industrial Research Organization (CSIRO) when tragically he was killed in 1971 photographing a tree felling operation in New Guinea. He was held in such high esteem by the industry that he had assisted for many years that substantial financial support to establish an Educational Trust Fund to perpetuate his name was promptly forthcoming.

The Trust's major forms of activity are,

1. Fellowships - each year applicants are invited from eligible candidates to submit a study program in an area considered to be of benefit to the Australian forestry and forest industries. Study tours undertaken by Fellows have usually been to overseas countries but several have been within Australia. Fellows are obliged to submit reports on completion of their program. These are then distributed to industry if appropriate.

2. Seminars - the information gained by Fellows is often best disseminated by seminars as well as through the written reports.

3. Wood Science Courses - at approximately two yearly intervals the Trust organises a week long intensive course in wood science for executives and consultants in the Australian forest industries.

4. Study Tours - industry group study tours are arranged periodically and have been well supported.

Further information may be obtained by writing to,

The Secretary,
J.W. Gottstein Memorial Trust Fund,
Private Bag 10, Rosebank M.D.C.,
Clayton, Victoria, 3169 Australia

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Preface

The aim of the Gottstein work was to carry out a survey of timber buildings, which could act as canons or exemplars of interdisciplinary work in the fields of architecture and engineering. The author attended the World Timber Conference in Lausanne in 1998 to identify the candidates' buildings. From this set of candidates' buildings, selected examples of additional buildings have been identified. Ten have been used, which represent a broad spectrum of approaches to timber designs provided in a case study formal. Running in parallel with this was a process of software development to catalogue these buildings and to make them accessible on the web.

A software called File Maker Pro, which is a relational database, was developed to provide a framework for containing the case studies. There have been particular barriers to the development of the data base not with standing the limited capability of the software in the early years of development. Recent versions have addressed the problems. This software now has a web portal facility, which enables the database to be accessed using Internet Explore and Netscape Navigator software. Internet Explorer provides the optimum performance since the Jarva facility can read the protocols in the database software. Access to the database is through the Department of Architecture web site:

1. www.architect.uq.edu.au
2. research
3. environmental design and technology area
4. sustainable design future
5. projects at the cutting edge.

A short cut is to use the following link.

http://www.architect.uq.edu.au/web2001/research/ed/sdf/projects/duality.html

This software application has three years to develop and now represents a trend in web design, which is using a database system for ease of information input. The software provides two views: a Table view, which gives an overview of the projects and a Form view, which gives details of the project.

The facility has a search capability. A method of categorizing the key words has been established using the of both architecture and engineering and how these are integrated to avoid a sense of duality, that is the architecture and engineering were not separate concerns in the design but synthesized to make a satisfactory whole. An additional set of environmental material has been added. The search engine therefore is based on a range of discipline specific criteria. The frameworks for the key words have been developed from the existing approaches to architecture and engineering and environmental fields. These have been reworked and simplified for use in the database.

To this end, the project draws together three areas of work. The identification and selection of timber buildings as exemplars of work in the field, the software development as an education tool and the development of framework to assist with understanding the integration of architecture, engineering and environmental issues in the design of these buildings. The intellectual material contained in the document forms the text and images contained in the database, the web portal provides an additional method of publishing the work. In addition the document provides the intellectual basis of the project which is not fully published in the database. The intention is the web provides the basic publication of the exemplars and the report provides more in depth material.

The project could not have been realized with out the support of the Gottstein Trust. The Trust has been an enabler of this innovative project and has shown considerable patience and encouragement with what has turned out to be a more complex, time consuming and ambitious project than first anticipated.

Acknowledgements

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Part 1: Background

A Critical Canonical Survey

Aims

1. To make a canonical survey of selected recent nationally and internationally respected timber buildings and structure that demonstrate a cogent synthesis of architecture and engineering concepts using timber materials.

2. Analyse the selected buildings and structures to identify the architectural and engineering concepts used.

3. Critically examine the selected buildings and structures with the view of bringing new insight and objectivity to bear on the architectural and engineering practice used.

Buildings surveyed

The following buildings have been surveyed to date and from this series 1 has been selected to represent the spectrum of issues and included in this report.

Series 1
'Air Ark' Tent house
Buckingham Palace Ticket Office
Clare house
Collaborative Design Lab
Dalgety Wool Stores
Jim Thompson's house
La Maison de l'Arbre
Mapleton house
The Green Room
The Healthy Home

Series 2
Couran Cove Apartments
Couran Cove Cabins
Couran Cove Chapel
Landsborough Museum
Paulk house
Radiant house

St Andrews Church
Thompson/ Foy house
Thorncrown Chapel
Tjibau Centre

Series 3
Floating market: Restaurant
Janson house
Kingfisher Bay Resort: Apartments
Kingfisher Bay Resort: Centre Complex
Kingfisher Bay Resort: Villas
St Andrews Church
Sunshine Coast University Library: Vernanda
Thompson house
Thorncrown Chapel
West Stow Centre

Series 4
A' Frame house
Floating Markets
Gerry Murtagh's house
Jimmy Lim's House
Knoble house
Kuala Lumpur Airport
Rex Addison's house
Watson Brown house
Watson Brown Beach house
West Stow Centre

Duality database

Introduction

Over the last six years the Departments of Architecture and Engineering, the University of Queensland, have developed an Inter Disciplinary (ID) Fourth Year design course to foster integrated working methods and innovative building design. This course has a focus on environmental issues and includes an emphasis on the use of timber materials. The course is supported by industry partners, which include the Plywood Association of Australia and the Timber Research and Development Advisory Council of Queensland. One outcome from the course is the development of a **Duality Database**. It is named the Duality Database after the work of Sandaker and Eggen in their book the “Structural Basis of Architecture.” They suggested that the structural basis of architecture lies in the resolution of the two dualistic sets of parameters, the technical and the aesthetic. The database therefore seeks to explore the tectonic armatures used in exemplary buildings, through images, simulation of structural behaviour and video.

In particular, it critically assesses the sets of concepts used in the engineering and architecture. By articulating these concepts it has been found that the database assists with cross-discipline communication and extends creativity amongst architects and inventiveness in engineers. More over it exemplified a method of working in practice, which seeks to unite the two professions and extends their design skills. The database is presently structured as an archive of case studies with an emphasis on the synthesis between architecture and engineering. It contains case studies of a range of buildings and student projects developed during the combined architecture and engineering ID Course. These have a particular material focus and include further case studies of the canons of timber design. These are exemplary buildings and structures where timber is used in a creative and innovative manner in resolving the duality problem. These are analyses using the critical framework established in the Database.

The development of the Timber Module of the Database in this way will provide information to a wider audience and have greater relevance in the professions. More important it will foster innovative timber design and design practice. Research was carried out using a survey methodology to examine exemplars, which could act as the major canons of design in the database.

Development and testing of the database concept

The analysis of this information has taken place with selected buildings integrated in the database. This has been carried out through a Fourth Year Elective Program in the Department of Architecture, the University of Queensland. The reasons for this were firstly to test the database concept. The main assumption is that if students can use it through an education program then feedback can be gained and improvements made to the teaching tool. In addition the way students could become interested in this kind of database would also be examined. Thus, the elective basis of the program, which is essentially ‘interest led’ is an ideal vehicle for this kind of examination.

To this end the elective program was aimed at simply documenting the case study buildings. Yet it was found that the buildings reflected a range of issues that needed investigation to fully understand the concepts involved. The students therefore became less content with just documentation and more interested in examining these related issues. Thus the database whilst it retained its original structure it, evolved as a flexible system providing issues and information that are generated out of the building case study. For example, the case study on the Green Room by Bud Brannigan, although a simple elegant timber structure raises a number of issues concerned with sustainability and recycling of buildings. The technical detailing that facilitates the kind of demountability needed for recycling is discussed. The inclusion of this kind of information and direction provided an area of potential further investigation and greater depth to the information about the building.

Improvements to the Database

Improvements to the data base structure for the Timber Module are:

- Expanded Home page to clarify the **Duality Concept.**
- Addition of a new field on the **Environment** to cover the Sustainability issues concerning timber in the case study buildings.
- Use of **Multi Frame** to give better animation to the structural action found in the selected case studies.
- **Zoom features** to expand and contract images to observe details of projects.
- Additional information field in **References**, this connects to another database containing further data sheets on related issues.

These features have come from trialing the database as a teaching tool in a Fourth Year elective program in the Department of Architecture. The Database is available as a Filemaker Pro 5 document or on the Internet. The Internet version does not support the Multi frame animation. Images have been scanned at 100 dpi so that enlargement is possible for investigation

Data Sheets

The Filemaker Pro 5 version supports the following:

- **Welcome**, included is support from Joseph William Gottstein Foundation, FWRDC and the Forest and Wood Products Research and Development Corporation.
- Enhanced **Home page**, ‘Duality Concept ‘ button access.

- **Duality Concept** explanation.
- **Duality Concept** explanation continued, return button.
- **Search:** key word search base on architectural, engineering and environmental frameworks.
- **Help.**
- **Browse** selection alphabetically.
- **Project Profile, Project information:** click on the image and the image enlarges.
- **Project Profile, Architecture**: text is larger than box it can be scrolled to read more.
- **Project Profile, Architecture**: click on image and it enlarges, note unzoom.
- **Project Profile, Engineering:** click structural behaviour image and it deforms under load.
- **Project Profile, Engineering:** for Clare House, click on structural behaviour image to enlarge image.
- **Project Profile, Duality**: click on images and they can be enlarged.
- **Project Profile, Environment:** click on images and they can be enlarged.
- **Project Profile, References** click on Extra Info and access additional information.
- **Extra Info**. Text block extends beyond page, selected images to right.
- **Extra Info**. Text block extends beyond page, selected images to right, continued. Access back to main fields by Home or by other buttons.

The Duality Concept

A pathway for inter-disciplinary design

It is argued that present design education processes in architecture and civil engineering do little to bring the two disciplines together; rather, they tend to perpetuate polarity between the professions. Architects receive a basic education in structural design and are focused largely on conceptual design whilst engineers are taught mainly analysis techniques to validate design decisions. This differing foci of the disciplines was identified by Peter Rise as contrasting modus operandi: architects are seen as being creative in profession work whilst engineers more inventive. A way out of this dilemma is to begin to demonstrate the relevance and value of a more coordinated approach to design.

The barriers to this approach lie in the different philosophical and value structures of the two groups, the different conceptual bases to their design approaches and intergroup communication. At the root of these barriers is the fundamental problem of the different ways that architects and engineers understand buildings. This can create a sense of duality between the groups, where each has a difference perception of the nature of design.

The duality concept is one of seeking to identify the different issues in each discipline and how these are synthesised in a range of built examples. A further foundation idea therefore behind the database comes from the work of Sandaker and Eggan who developed the problem of the differing roles played by building structures. They point to the functional role of structure, largely concerning the application of the principles of statics. But they also point to the principles of aesthetics, the visual expression of the structural form.

Yet, we have found many other dualities in the investigation the building cases given here. These lie not only in architecture and engineering but also in the environmental consequences of the building design. Hence the database contains an additional field in this area.

Furthermore, it was found that these case studies exhibited a range of interesting concepts to resolve the dualities. Hence the search engine is focused on identifying concepts. For example, Buckminster Fuller developed the famous ‘tensegrity’ concept- the expression of both tensile and compressive elements, as a driving idea for both architects and engineers. It is found in different forms in many of the buildings in the data base.

In researching these buildings in the database a range of additional issues has been found which are contained in the reference section. This is connected to a separate database and gives more in-depth information such as plans and sections.

The duality idea is therefore that structural elements can be defined as having the quality of structural dualism if its form is derived simultaneously from both architectural and engineering intentions and consideration for environmental implications

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Sandaker, P and Eggan, R, *The Structural Basis of Architecture,* 1995.

Key words and concepts

The development of the key words for the database comes from three linked frameworks drawn from the theory of architecture, the statics of engineering and the principles of 'Green' building. It is often forgotten that the basis of these three frameworks is the materials, which in turn form the fundamental basis of design.

The focus of this survey is timber. It is an archetype material for expression, structure and construction of building. With the invention and development of new materials and the large scale of modern buildings, timber is in danger of being side lined. However, timber formed a large part of our building stock in pre-industrial times. It therefore seems important that an understanding of the reinterpretation of timber in the world of modern environmental design is undertaken.

Furthermore, this inherent characteristic of timber and the link to the past, therefore makes it very relevant to the current Regionalism theme in architecture. The essence of this approach is to think of buildings in terms of the historical context, the place and regional specificity. Some see this as a new style of architecture others as a critical discourse about new directions in design. The concepts and key words generated from this discourse are used in describing the architecture of the case studies.

Regionalism taxonomy

The regionalism taxonomy developed by Robert Powell in his thesis "Regionalism as Cultural Identity' is a way of describing buildings that represent a new direction in architecture that moved away from Modernism. It was argued that designers, clients, governments and countries that follow this approach achieve a greater sense of identity and authenticity in their architecture. This may or may not be true, interpretation of architecture is complex, but what is useful is that the simple act of describing and interpreting is the basis of discourse and this inturn forms the building blocks of theory. Therefore the taxonomy assists with defining the scope of the buildings that form the case studies since examples could be selected which represent the categories defined.

The nature of the regionalist response is defined by how the phenomena of the building is interpreted and perceived. Evelyn Adam, in her essay on the Mapleton house, defined six principles which can be developed from an analysis of the writings of regionalism and a review of this building. She draws on the work of Frampton and Kelbaugh. Doug Kelbaugh, in his paper ‘Towards an Architecture of Place: Design Principles for Critical Regionalism,’ delivered in the Pomona meeting on critical regionalism outlines the first five points that encompass the various ‘principles’ of critical regionalism.

1. A sense of place
2. A sense of nature
3. A sense of history
4. A sense of craft
5. A sense of limits (spatial limits)
6. A sense of modernism

The last principle is added which draws on the context of buildings in terms of modern architecture. It argues that modern regionalism is a mixture of traditional values in architecture and modern principles of form and structure.

Powel argues that specific characteristics of a built project can be identified from the way architects use these principles in the design. Hence the taxonomy is constructed around two major polemics: the characteristics of modernism versus those of traditional architecture.

The main characteristics that are examined are:

Figure 1: Basic structural actions

Actions	**1-dimension**	**2-dimension**	**3-dimension**
compression	Column Strut Wall	Buttress Flying buttress Arch Barrel vault	Ribbed vault Fan vault Dome Thin shells Grid shells
tension	Tie Cable Hanger	Catenary Suspension bridge	Shear-free (bubbles, cable nets) Shear-resistant (fabrics, membranes)
truss	n/a	Statically determinate (pin jointed , Warren truss, etc) Statically indeterminate (redundant members, rigid joints, etc)	Space truss Lattice truss
bending	Beams One way slab Portal frames Vierendeel	Grillage Two-way slabs (Flat, ribbed, coffered, etc.)	Frames Kubik ‘truss’
shear	Plate action Shear wall	Plate action Shear wall	Folded plates Torsion

- Form: traditional form versus modern form
- Program: existing traditional use versus new use
- Materials and construction: New materials versus old traditional material and construction
- Concepts: Derivation versus transformation

The selection of buildings also informs the approach to regionalism taken by designers, the critical aspect of the work reflects on the taxonomy.

Qualitative engineering framework

The engineering key words and concepts are drawn from structural actions and systems. The focus on actions and systems is a way of shifting the thrust of engineering from design analysis to design synthesis and to a common language between architects and engineers as a basis for discussion. Dualities occur when the means of communication are different since without communication the method of exploration cannot be shared. Therefore, a method of both exploration and language is necessary; hence actions speak louder than words. The framework follows a qualitative approach consistent with the teaching of architects but also follows the logic and discipline of the engineer. Again it is borrowed and customized from the work of Bill Addis in his book "The Art of the Structural Engineer.'

The structural actions translate into one-, two- and three-dimensional spatial qualities, which are overlaid by a range of structural forms and systems. Structural actions both simple (Figure 1) and complex (Figure 2) have form and material consequences, which concern all designers. At one level the use of structure may be a matter of simply 'suppressing it' or

Figure 2: Complex structural actions.

complex actions	*systems*
combinations	post and lintel, column and beam, tied arch, jack arch
composite materials	grp, grc, fibreglass, plywood, chipboard, etc.
composite action	reinforced concrete; steel beam, metal decking with shear studs; concrete-encased steel column with shear studs
stiffening	self weight (for arch or catenary) trussing (for beam, arch or strut) truss action (for arch or catenary) beam action (for arch or catenary) folded plate action (for flat plate or thin shell)
stabilising	geometry (bricks and voussoirs in walls, masonry arches, domes, etc.) tie downs (for masts, etc.) pre-stressing (self weight in gravity structures, tension and compression in strut and tie structures, tension in membranes)
bracing	triangulation cross bracing or K-bracing (for frames) portal action, rigid joints, vierendeel action (for frames) shear action (shear walls and plate action in floors)

Architecture

A taxonomy of regionalism that forms the basis of a creative architecture in the context of place, climate and time

- Historically Derivative Regionalism (Veranacularism)
  - Conservative Vernacularism (Typological Design)
  - Neo Vernacularism (Interpretive)
  - Conservation
    - Perservation
    - Restorat

Engineering

Principles of structural action that are constants for inventive engineering

	1-dimension
Compression	Column Strut Wall
Tension	Tie Cable Hanger
Truss	n/a
Bending	Beams One-way slab Portal frames Vierendeel
Shear	Plate action Shear wall

Environment

Principles of 'Green' design applicable to all disciplines in design

Respect for site

Respect for users

Holism

Duality

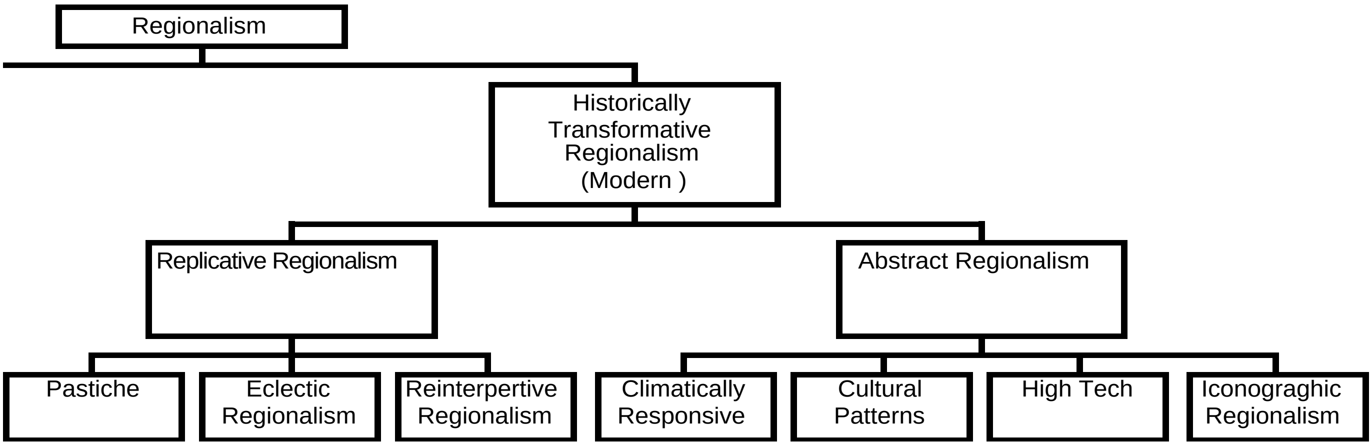
Duality is not about the power of two but the integration of issues in design

Technical synthesis

Materiality

KISS

buildings can be



2-dimension	*3-dimension*
Buttress Flying buttress Arch Barrel vault	Ribbed, fan vault Dome Thin, grid shells
Catenary Suspension bridge	Shear-free (bubbles, cable nets) Shear-resistant (fabrics, membranes)
Statically determinate,(pin jointed, Warren truss, etc) Statically indeterminate, (redundant members, rigid joints, etc)	Space truss Lattice truss
Grillage Two-way slabs (flat, ribbed, coffered, etc.)	Frames Kubik ‘truss’
Plate action Shear wall	Folded plates Torsion

Conserving energy

Working with climate

Minimising new resourses

Tensegrity

Proportion

ed according to the KEYWORD TAXONOMIES 'expressing it' yet the approach can go further and provide a deeper meaning to the building design as seen in the case studies.

Environmental issues and Green Architecture

The rising social concern for the sustainability of buildings and their impact on the environment is increasingly becoming an issue for clients, users and building designers. Sustainablility is seen an overarching imperative in the design of timber buildings which have increasingly been translated into a form of design practice called 'Green Building' design. A set of principles has now been developed through the work of Robert and Brenda Vale. These principles are as follows:

- Conserving energy
- Working with climate
- Minimizing new resources
- Respect for users
- Respect for site
- Holism

The first five principles are more inward looking concerned with the building per se, whilst the sixth has a more outward focus. The principle of holism is defined as a broader modus operandus, which seeks to relate the building to its wider context and environment.

Application

The application of this framwork was used to form the discussion about the case studies. In this way a common thread between a wide and disparate collection of buildings can be achieved.

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Part 2: Case Studies

Air Ark house demonstration building located in the Botanical Gardens, Brisbane. The prototype was developed and raffled as part of a publicity event.

'Air ark' Tent house

Author: Richard Hyde.

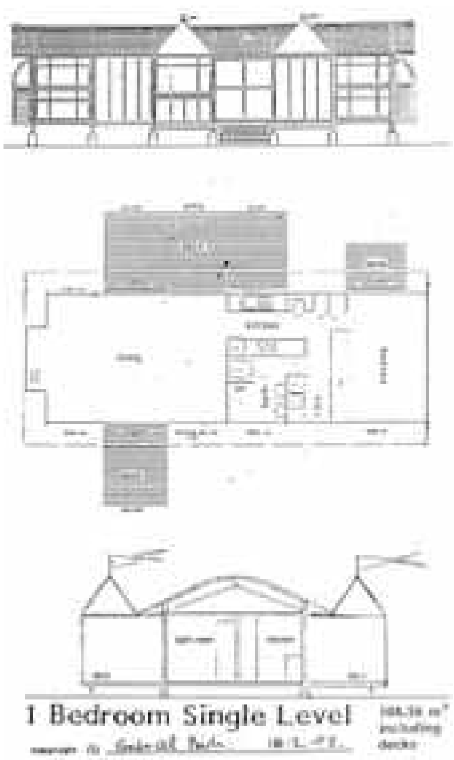
Type: Residential.
Location: North Stradbroke Island, Queensland.
Architects: Gabriel Poole.
Engineers:
Date: 1992.

Architecture

Gabriel Poole has designed a number of houses that have followed a system, which is designed for a broader project home market. This market is primarily for those people that select their home from an existing prototype design that meets their needs in terms of life style, site and cost. To this end, the Air Ark house was designed as a set of ideas relating to living in a tropical climate. It is designed to enhance the experience of living in the climate through its lightweight construction. This is achieved through a composite building system which uses steel, timber and various types of fabric to form the sense of enclosure. The innovative features are:

- Braced frame which provides design flexibility
- Prefabrication to give a kit of parts
- A lightweight and adjustable skin which can adapt to a given climate and site

Air Ark house: plan and section



The building system is related to the original house at Eumundi, which was constructed primarily of steel. The Air ark uses timber penalised floors for improving buildability and fold up 'window walls 'that resemble garage doors to provide ventilation.

The climatic responsive design is aimed at remote isolated sites where nature can provide privacy and prospect. The question raised by this architecture is how appropriately does this system meets peoples needs? The various built examples of the system have seen many of the innovative features replaced. The primary structure of timber and steel remains but the fabric roof is often replaced by steel and the fold-up walls replaced with traditional windows. This shows the flexibility of the system to meet different conditions whilst retaining the essence of the original idea. Primarily it suits people who wish to live a particular lifestyle and enjoy the subtropical and tropical climate.

Engineering

The structural system uses a braced frame made of 100x100mm galvanised square hollow section. The structural bay produced is 4.8m x 3.6m. The use of a timber and steel composite has many advantages. The steel braced frame provides an easily transported framework for the building, which can be filled in with various elements for structural or climatic purposes. The lightweight structure has a large degree of transparency but one of the key issues is providing appropriate wind bracing. An analysis of the available bracing systems reveals that in the transverse plane bracing is provided by a 'P' shape, which forms a triangulation between column and truss to give stability. In the longitudinal direction plywood bracing panels are alternated with window openings. Cross bracing in the roof and a plywood diaphragm floor resists torsional loads. These structural systems are articulated and expressed which avoids the need for extensive finishing systems.

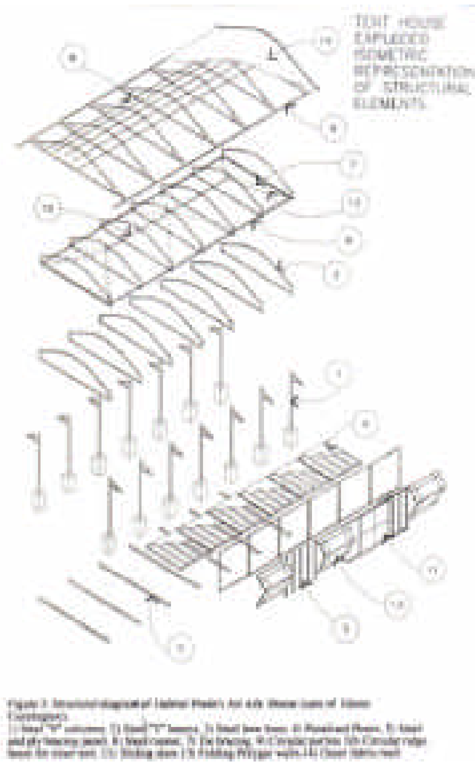
Above: a rhythm of structural plywood bracing and folding walls

Of additional structural interest are the cantilevered bays at each end of the building. These bays are used for spatial effect proving a fire feature in the living room and a bed niche in the bedroom. The floor system is cantilevered to transfer main structural loads. Steel ribs are curved to take the cladding and provide additional support to the cantilevers.

Environment

Both the Tent House and the Air Ark represent low-energy development which incorporates solar collection panels and water tank features. Mechanical cooling of the internal spaces is unnecessary, as natural ventilation and insulated double ceiling space ensure a high probability of comfort zone temperatures. The key issue is the provision of comfort in winter, particular for sub-tropical climates. If the building is orientated to the site to allow solar gain then passive heating can be provided. If not then supplementary heating may be required. The reason being is that the structure and fabric are lightweight and have very little thermal capacity. Their capacity to store heat or insulate the building is minimal, therefore there is a high reliance on external microclimate control.

Below: axonometric of structural elements showing hybrid system



A significant feature of this building is the way it markets environmental features making a link between building form, life style and climate. The use of the veranda house concept to allow walls to retract and open the house to the exterior making capital form its location. The lighting effects from the fabric roof means the building filters both sunlight and moonlight giving the occupants an experience of the external environment unmatched in other mass produced building systems.

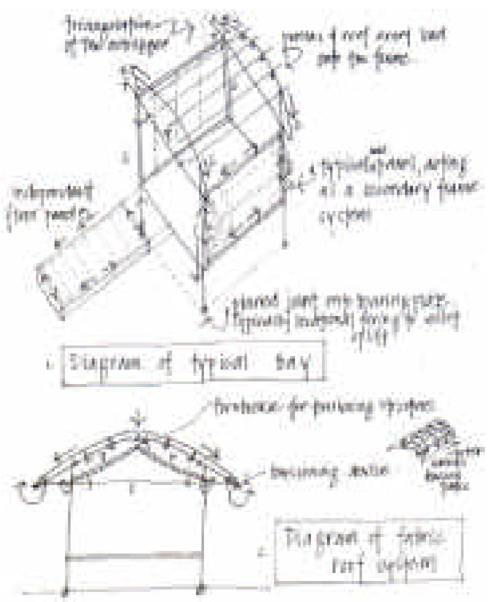
Duality

The structure is an armature that facilitates a connection from inside to outside. The use of the steel frame provides a minimal structural system. The expression of the building is one of a contrast in different materials: the steel skeleton, the timber bracing walls, the fabric roof. This gives a highly ephemeral building, which defies the norms of housing and creates its own aesthetic. It draws on a number of Modernist precedents, which have a minimalist approach to structure. Yet the detailing of this building and its fit with its environment make it a model of a regionalist design. It clearly cannot be taken out of its rural and microclimate context

Above: a fabric roof is stretched over the bow string roof truss.

Below: structural plywood and stud bracing walls sit between steel columns.

Below: a typical bay of structure showing the 'P' columns that brace the frame.



without compromising its climatic and functional purposes.

A key element of synthesis comes from the detailing of the steel and the integral timber systems. The single skin timber bracing panels alternate with the retractable walls to give both structural logic and an aesthetic rhythm to the faces. The panels connect in a seamless manner, which belie the sophistication of gaskets on which this type of technical resolution relies. Similar detailing is found with the fabric roof. This is stretched over the portals and tension through a lacing system at the gable verges and a jacking system at the eaves.

Key words

Architecture: functionality, climate responsive, prefabrication, life style, minimalist

Engineering: bow truss, braced frame, one dimensional, portal action, plywood and steel

Environment: passive low energy principles, demountable and recyclable, respect for site, minimal enclosure

Duality: technical synthesis, building craft, elemental articulation and mechanisms

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Right: deformed steel arches form bays to the main building

Left: the final location of the Air Ark house on South Stradbroke Island. The winner of the building moved the house and converted it into a two storey home by assembling the building on a traditonal bearing structure which formed the ground floor.

Below: panalised timber floor system prefabricated and assembled on site by offering floor to the steel frame a bay at a time.

Buckingham Palace ticket office located in the Serpentine, London. The building has a demountable parasol roof which shelters the ticket cabin and visitors.

Buckingham Palace Ticket Office

Author: Richard Hyde.

Type: Commercial.
Location: London, UK.
Architects: Michael Hopkins Architects.
Engineers: Ove Arup and Partners.
Date: 1996.

Architecture

The ticket office is a temporary structure used to accommodate the seasonal increase in visitors to Buckingham Palace. It is located adjacent to the entrance to the palace and to the Serpentine. The plan of the office is curved to reflect the geometry of the park.

The building comprises two elements; a shade structure made of translucent fabric and a cabin. The shade structure provides shade and shelter to visitors collecting tickets and to the sales cabin.

The shade structure is supported by timber poles and cables whilst the cabin is varnished, laminated timber. The structure apart from serving its traditional function also forms a visual marker for the building by contrasting the light colour of the fabric with the vegetation of in the park. The organic form is sympathetic to the surrounding landscape.

The building uses a distinctive iconography derived from the timber ships that once visited the port of London giving a historical theme. The use off site and the climate as generating ideas in the form and method of construction clearly reflect the dominance of place in the design thinking

Below: section through the building showing the clear expression of tension and compression elements.

Structure

The building is designed to be demountable and transportable for seasonal use. The structure of the cabin and the shade structure are independent but have connecting elements.

The cabin is made of a shell system similar to that of a boat. An outer skin of glue laminated members is supported by a series of timber ribs. These elements are made in parcels and connected together to form the exterior of the cabin.

The shade structure is supported by a system of poles. One of the main structural poles is fixed in the longitudinal direction to two vertical poles to give the main compression element. Further compression elements radiate from the main pole to take compression from the fabric roof.

Two primary vertical masts are used to displace the fabric vertically. A cable truss is forced between the mast to support the fabric. High stresses occur at the point of connection of the truss and the fabric, which is dispersed by 'coat hanger' rigging spars. This system provides upward tension to the fabric, which is in turn tensioned downward and horizontally by horizontal spars. The resulting action gives the hyper form and surface stability

Bracing is achieved using a cable bracing system. Cables are anchored to concrete block which act as gravity tension anchors. Additional bracing is provided by the rigidity in the connectors at the knuckle joint between masts.

Above: pin joints are used extensively for the tension structure which appears to be braced by the cabin below. Tensegrity principles are used in the design of the structure with anexpresssion of compressiver and tensile forces in the desoign of the members.

Environment

The temporary nature of the building allows seasonal relocation of the building and also future reuse. This flexibility reduces site impacts and longer-term environmental impacts. The tension anchors can be largely sacrificial elements if necessary.

The use of the two structures has advantages for climatic and thermal performance uses. The double roof structure, which separates the functions of enclosure from shelter, has some obvious advantages. It forms a parasol which separates environmental protection from enclosure.

The shade structure avoids heat gain to the ceiling by the nature of ventilation. In addition, the sheltering effect allows ventilation to the ceiling to be achieved in the roof and in the side windows. This protects stack ventilation.

In addition, the structure is raised above the ground to allow ventilation to the structure under the cabins. This form of lightweight structure allows for the extremes of the warm, wet summers which are characteristics of the English temperate climate.

Below : The geomentry of the canopy and cabin is radius to address the curviture of the landscape on the site. This subtle arrangement emphasises the the building's relationship to the site and the place.

Duality

The lightweight articulated structural form provides a visual marker for the seasonal functioning of the building. The form is consistent with its structural and constructional logic using the marine technical vocabulary of boat hull, mast and ringing to form a shelter and enclosure.

The integrated nature of the connection details results in systems, which allows the two elements of shade structure and cabins to function separately. The 'tensegrity' ideas of expressing tension and compressive elements are found in the shade structure. The craft of detailing is found in the design of the connectors to the cabin panels and to the shade structure. These connectors carry out many functions in construction, structural rigidity as well as providing joints for assembly, disassembly and levelling.

Finally, the fabric structure provides a diffusion of light that protects both the timber cabins and the visitor from the effects of the weather. The horizontal poles support the structure but also direct the cables away from the circulation

Above: the character of the joints expresses purpose following a high tech approach in the sence that the construction industry has borrowed from others. Many of the parts come from the nautical industry: the stainless steel riggin wire, the bottle screws for tensioning the cable stay structure and pin fixings.

routes to and from the cabin, thus defining the space, the entry and cabin form.

The architectural vocabulary of this building is clearly different from the neighbouring buildings and appears, like a chameleon, to uses its materials function and structural form to integrate with its environment.

Key words

Architecture: functionality, iconic regionalism, prefabrication.

Engineering: tension, catenary, three dimensional, cable, hanger, sheer free, sheer resistance, laminated.

Environment: passive low energy principles, demountable and recyclable, respect for site, minimal enclosure, low embodied energy, parasol roof.

Duality: tensegrity, building craft, elemental articulation, tectonic.

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Von Buren, C., et al, L'image de la nouvelle construction en bois, Lignum, Zurich, 1997, p. 141

Below: the cabin structure is made of laminated timber connected to a series of ribbed frames very simiplar to a rowing eight. The system allows the building to be formed into series of prefabricated panels - roof, wall, floor and corner sections.

Above: the parasol roof is designed based on a cable truss system. This combines the fabric structure of the canopy and and the cable support structure for the masts. Additional struts are supported by the truss providing the saddle back shape needed to stabalise the roof. This approach also allows the canopy to span further. The solution is similar to the structural solutions found in tall sailing ships which used struts or booms to maximise sail area. The iconography generated by the high tech approach and nautical structural vocababulary are clealry evident giving the building a sense of history.

The Clare house is located at Buderum, South East, Queensland, the building respects the site and responds to climate.

Clare house

Author: Richard Hyde.

Type: Residential.
Location: Buderum, Queensland.
Architects: Clare Design.
Engineers:
Date: 1992

Architecture

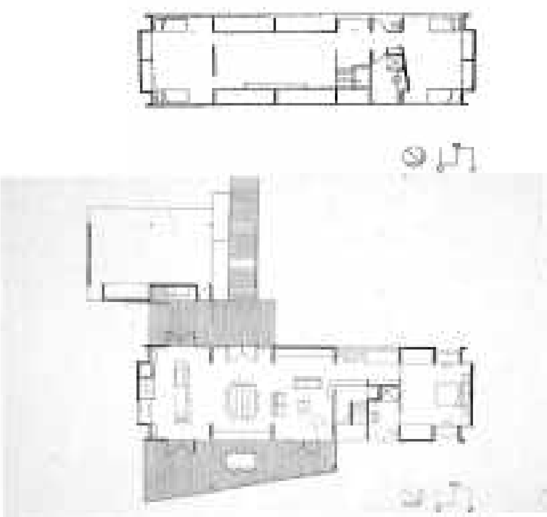
The architecture of the Clare House has been recognised for its 'poetic and superbly functional forms, yet expressed in a beguilingly simple form.'

The architects designed the house as their own home. 'We had a very tight budget... we simply wanted to do a prototype that really delivered for the money.'

These aims led to a system of building, which modified the traditional lightweight timber construction of platform frame construction with shear walls. The sheer walls are articulated to form fin walls, which subdivide the plan into a series of bays. These bays contain the main living spaces and master bedroom on the ground plane. The first floor is the children's bedrooms and family areas. The system is sufficient to accommodate in addition the constraints of a sloping topography and creek over which the house is placed.

Further aims were to integrate the building with the site for views and for thermal comfort. The main building material is timber, steel and fibre cement for cladding. These are composed and articulated so the materials contrast and complement each other.

Plans: the building is orientated to optimise ventilation and solar heating



Engineering

The architects explain the main determinants of the structural engineering in spatial terms, 'our structures are generally dictated by our spaces and not the other way around.' In addition the structural systems also facilitate the interaction with the site.

A pole frame system is used to support the main platform of the house above the creek bed. The first floor consists of a timber diaphragm floor supported on a set of double beams between the poles. Bracing at this level is achieved in two ways: poles are buried in the ground to give rigidity to the ground, knee braces are used between the poles and the floor beams.

The stability of the main body of the house is achieved by the use of additional walls. Fin walls give stiffness in the transverse direction and bracing ply attached to the timber frame provide bracing in a conventional manner in the longitudinal direction. The outcome is a panel and beam system comprising glue lam beams at the first floor and roof. Furthermore, horizontal bracing is achieved through the plywood ceiling and timber floor.

Above: plywood fin walls provide connection to glue laminated beams providing bracing.

Environment

The building is elevated and is gentle to the site with little benching used. The orientation of the building is such that the long face of the building faces north-east and south west. This facilitates cross-ventilation and cooling breezes from the north-east in summer. The thin plan form and voids in the first floor further enhances the ventilation effects. The site to windward is clear which gives the building uninterrupted access to the sea breeze.

There is a provision of extensive verandahs and external space. The northerly verandah is placed on the east corner which assists with diffusing light into the building and providing shading in summer thereby reducing heat gain. Overhead eaves at the roof-line are extended and supported to fully shade the windows.

A minimum number of openings are placed in the east and west walls, which are insulated to reduce solar gain from low angle sun. The light colours and reflective cladding add to the thermal defense provided by the skin.

The curved roof is a simple and cost effective form. Plywood roof panels provide the ceiling and stain finished. Electrical installation for ceiling fans was provided but not needed due to the close proximity to the ocean and the climatic response of the building

Above: the detailing of timber finishes expresses the materials and artilculates the spaces and elements.

Duality

The building, although simple in plan form, is complex in section. This results from the integration of structural, spatial and environmental design considerations. The pole frame system reduces the site impact and means that little benching is required. The fine walls are orientated in line with the prevailing wind, thus facilitating the ventilation effects.

In addition, the braced frame gives considerable flexibility with planning the name; space can flow between bays of structure as in the kitchen, living dining or be enclosed as with the bedrooms.

The use of beams creates opportunities at the roof for curving the members. This acts to simplify the construction by avoiding ridges and utilising an integrated timber ceiling of plywood which serves both a structural and aesthetic function.

The inter-connection of the stiff fin wall bracing frames and diagram floors allows considerable opacity in the north and south walls to achieve a connection to the external environment designed by the architect.

Below: highly durable cladding materials and shading systems provide a language that responds to the climate.

Above: easterly elevation minimses glazing to avoid heat gain. The organisation of the elements is created using Mondrian concepts.

Key words

Architecture: regional, climate responsive, minimalist, site specific

Engineering: fin walls, post and beam, one dimensional, portal action, plywood

Environment: passive low energy principles, holism, respect for site

Duality: technical synthesis, building craft, elemental composition

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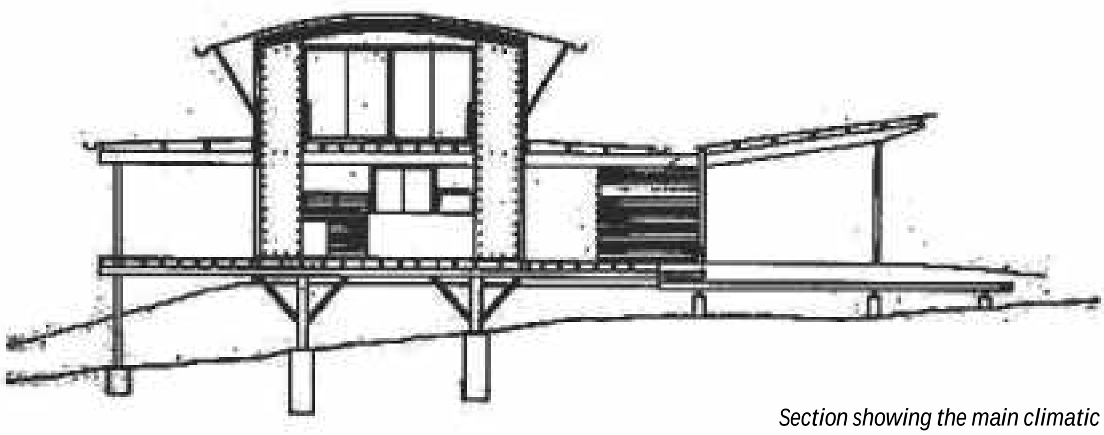
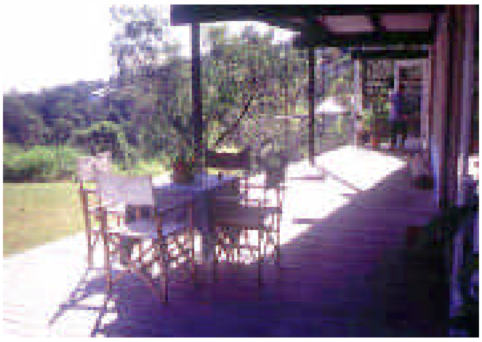
Below: pole frame structure is combined with knee bracing to give stability .



Section showing the main climatic responsive features: fin walls and an open section facilitate air movement



Above: veranda space creates an extrnal room.

Below: vernada roof diffuses light into the bedrooms reducing heat gain.

Below: first floor family space is connected to the ground floor with voids facilitating air movement.

Collaborative Design Laboratory

Author: Richard Hyde.

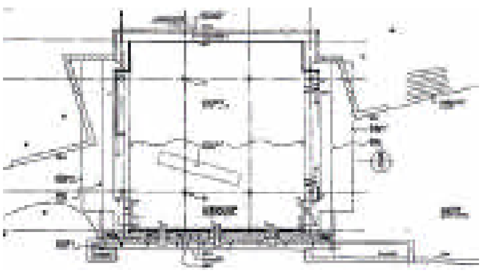
The location of the Laboratory is on the University of Queensland Campus in an area of natural beauty. The design borrows masonary landscape elelements and utilises innovative timber technology .

Type: Academic.
Location: Brisbane, Australia.
Architects: Donovan Hill Architects.
Engineers:
Date: 1998

Architecture

The architecture of Collaborative Design Laboratory is as much about the process of building as it is about the final form. The intentions for the building came from the development of a new Faculty structure in which the Department of Architecture joined other Physical Sciences and Engineering disciplines. A need for a new teaching facility, which could draw together Architecture and Civil Engineering, was proposed and funded. In addition, industry groups who support these Departments also agreed to support the project, through donation of materials. Input from the student and from the design consultation process within the University also shaped the design decision making. Thus, prior to the architect receiving the brief, a range of siting, functional and material issues had been examined in a briefing document. The availability of materials and construction systems from sponsors also helped shape the form of the structure.

Below: ground floor plan.



The site of the building is adjacent to one of the main landscape features of the University campus a large naturally formed lake. This provided a number of siting problems since the proposed building would interrupt site lines from the adjacent buildings to the lake. Master planning constraints also suggested there may be a larger building to be built over and adjacent to the proposed building. Furthermore the function of the Laboratory was also viewed as not sympathetic to the Lake environs. It is intended to use the Laboratory for the construction of large models, which is a noisy and messy practice. The consequence of these decisions was to base the design on landscape principles rather than building principles. Hence it became in part an extension of the landscape rather than simply the generation of a building form.

The resulting building plan in at the ground level is a simple multi-function space produced by a tartan grid of columns. Access is provided by a bank of timber sliding doors to the north and south. These can be drawn back to fully link the interior space to external courtyards, thus increasing the effective area of the building,

The facades to the east and west are blocking elements, the former reducing noise and view from the lake into the building, the later, forms a retaining wall where the building is integrated into the site. The materiality of the building draws from the landscape elements on the site and fuses the building with it's environment

The nature of the Lab draws from many sources: the sponsors of the materials, elements of the site, light weight construction while also providing a challenge for the architect to synthesise the eclectic range of elements to a whole.

Above: single skin plywood finishes provide a lightweight enclosure behind the retining wall.

Engineering

The primary structure of the building is a concrete slab, columns and bore piers. The bored piers and slab provide a reaction point for the cantilever columns. These are approximately 450 mm in diameter and take both the racking loads and dead loads from the roof.

The roof structure is lightweight construction. A double beam system is used comprising 600mm laminated veneer lumber (LVL) beams 'flitched' with a 10mm steel plate between the two beams. These are used to form the primary spanning elements spanning across the space. Secondary, LVL beams span between these primary beams to support the roof joists. These joists cantilever from the LVL structure and are propped by the lightweight, timber stud wall elements. The joists cantilever beyond the wall elements to form eaves.

The roof deck comprises a 12.5mm plantation pine plywood deck nailed to the joists. This receives a membrane and roof tiles. This is a boned system, which is designed to accommodate the movement in the timber substrate and also to maintain the adhesion to the concrete roof tiles.

Above: the structural systems is based on a concept of cantilever upon cantilever.

The earth retaining elements of the structure react from the slab and are constructed of a core filled block wall. A spoon drain and an airspace are created between the light weight wall and the block retaining wall to facilitate maintenance. This also removes the need for expensive vapour barriers to the retaining wall.

Secondary structural elements are formed to provide sun shading and hand rails. These are cantilevered from the primary structure. Additional pole supports are strutted from the skylights and horizontal solar shading system. A grid mesh of stainless steel wires is tensioned over the struts to provide the support for planting to eventually shade the roof.

Below: columns provide cantilevered bracing for the main structure, transfering windloads to the foundations.

Environment

The environmental issues concerning the intervention of the building on the site were extensive. The building footprint and site line necessitated excavation into the existing rock and clay subsoil. This site impact of the building is minimised through keeping reduced levels to a minimum so the floor level of the new building remained the same as the adjacent existing building.

Another major concern was drainage. The location of the building close to an existing building and the earth integration of the structure led to problems of defining the watercourses in periods of high rainfall. The use of perimeter channel drains and the use of porous surface materials around the apron of the building alleviated this problem.

Above: the site over looks a sceinic part of the campus which gave a need for an integrated building and landscape concept

Drainage from the roof area achieved by draining the roof to the front of the building where water is collected and distributed to gutters that cantilever from the structure. Water is collected and reused in the planting areas.

Solar heat load to the roof was also perceived as a problem. Devises were used to minimise heat gain through the roof. Firstly a light reflective tile was used for the roof and secondly both foil and bulk insulation was provided below the ply wood deck.

Natural light is provided by the use of perimeter lighting and skylights. The main skylight is located to the back of the building adjacent to the retaining wall. The perimeter lighting does not effectively provide light at this point and therefore it is supplemented by the use of additional skylights. These additional skylights are provided above the north and south sliding doors. Raked translucent sheeting is used to diffuse the light and increase the illuminance from the perimeter glazing system.

Above: roof lighting gives additional natural light saving on energy consumption.

Below: roof shading system which forms an organic parasol to the roof deck.

Finally, ventilation is provided through the use of sliding doors, which can be peeled back to provide large openings in two walls. Trickle ventilation is also achieved through smaller openings in the perimeter glazing. Glare to the east is reduced with a diffusing panel.

Duality

The architectural and engineering concepts are fused together through the use of the cantilever. The architects suggest that the building be based upon the principle of adding cantilevers to cantilevers to give the basis of the impression of the elements suspended in space.

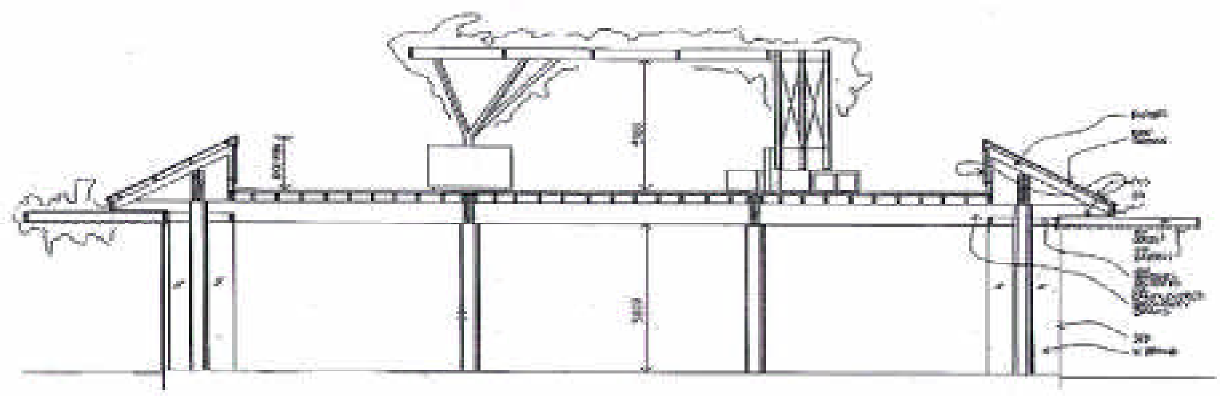
The primary structure is designed as a cantilevered column system to avoid bracing systems inside the building and give a clear and flexible space. The roof systems cantilever from the primary structure and are independent of the main structural walls that retain the earth and form the landscape wall to the lake.

This is achieved in a number of places, particularly with the shading devises to the south and north. To create the cantilever the primary structure is raised up to allow outrigger beams to be strutted from the primary structure. The framing and battening is then hung from the outrigger structure.

Additional cantilevers are used for the handrails. A double column of hardwood rails is connected to the bluestone wall and cantilevers to form the support to the steel and wire rail system.

The essence of the integration of the structure and design is also seen with the legibility of the construction materials. These are articulated through careful detailing. The cantilever columns use sacrificial fibre cement formwork, which gives a high level of finish to the concrete. The sliding doors and glazing are designed with vertical timber mullions and structural glazing to reduce the visual weight of the perimeter glazing system.

Finally, the ceiling system is made of plywood panels are coordinated with the regular two-way grid of the primary and secondary roof structure. The shadow line detailing and articulation of the metal connection system of the roof further enhance the sense of the craft of the building.



Above: north south section showing the roof lighting and shading.

Key words

Architecture: tectonic, regional eclectic, expressive, landscape integrated.

Engineering: compression, cantilevered elements, column bracing frame, one and 2 dimensional action, plywood diaphragm, shear action, composite materials;

Environment: passive low energy principles, daylight control, roof lights, and respect for the site, minimal enclosure.

Duality: technical synthesis, building craft, elemental articulation, tectonic form.

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courtyards, thus increasing the effective area of the building,

Above: Red Cedar horizontal sliding doors use structural glazing to brace the door panels. The detailing of the LVL timber structure relies on flitch plates to make the connections and stiffen the beams. Note the hanging beam to maintain the headroom and cantilevered shading systems.

Below: parasol shading system is cantilevered from the roof lighting area.
A stainless steel grid mesh provides supports for the organic cover.

Located on the Deakin University Campus in Geelong, this building demonstrates the way timber buildings can be recycled through applying new uses.

Dalgety Wool Store

Author: James Jago and Richard Hyde.

Type: Academic.
Location: Deakin University, Geelong, and Victoria.
Architects: McGlashin and Everist Arhcitects.
Engineers:
Date: 1891.

Architecture

The Dalgety Wool Store project provided an opportunity to redevelop an existing building to a new mixed-use program entirely removed from the original use of the purpose built structure. This approach has made provision for the demonstration of innovative processes. It has allowed an investigation into economic and financial viability of reuse scenarios such as this. A conscious contribution to the protection of heritage places, and character of the city has been made.

Mixed-use spaces in and around the building were encouraged. It is possible for the activities within these spaces to spill out into the streets. It is argued that the internal uses of the building can be viewed from the street forcing the interaction between activities within and beyond the site.

The atriums and courtyards are integral components of the design aimed at introducing as much natural light as possible into the plan depth. The access points into the building are inviting and easily accessible from the street. This is important in ensuring that the public perception of the building's character is not compromised. New additions to the building complement the existing structure and do not merely replicate it. Thus there was an emphasis on generating innovation that respects the existing identity of the site.

Another important design element was to ensure the building had enough flexibility for future changes in use which would not pose a problem nor demand another design or refit. This design by McGlashin and Everist is what is termed "Lose-fit" design.

The final design has 'activated and preserved an amenity asset, maximised the use of existing infrastructure, provided an opportunity to reintroduce activity and diversity into the central city area and enhance the prospect of demonstrating sustainable

Below: an external courtyard is created between old and new parts of the building.

development practices (Savery, 1994: 23). This forms a patten of preservation by introducing a change of program and by exploiting the spatial potential of the previous potential.

Engineering

The refit was developed from the existing grid of timber columns and beams. Slight modifications to some of the structure have been made to areas where it was thought necessary in relation to the new use or new exposure.

The structural system involves the use of an exterior masonry wall, which acts as the main bracing element of the building. A post and beam system is used to form the large open spaces. Corbels are used to reduce shear loads at the column points. Joints are made using a scarf at the middle point of the beams.

Some structural elements previously internal for example are now external and exposed to weathering conditions. The structural framework was filled with lightweight panels to create workplaces and removed in others to create courtyards, atriums and the internal streets.

Below: a new atrium space created to bring natural light into the building.

The street façades were redefined with new doors and windows in proportion to the existing fenestration. These windows were double-glazed to increase thermal properties and create a more appropriate thermal comfort zone for the employees in winter months.

In accordance with the architectural program, new insertions are identified with bright colours and industrial finishes to complement the existing building and enhance the character and amenity of the area.

The reorganisation of the timber column grid allowed the form of the building to relax and made it possible to insert internal and external courtyards, cloisters and arcades. This was also necessary to allow spaces of appropriate span to accommodate lecture theatres and the great hall. Theatre consultants were commissioned to advise on the acoustic design of the great hall.

The central courtyard combined with the three level cloisters surrounding it, allow high levels of natural light into most internal spaces. This has implications on energy load with respect to running costs and occupant wellbeing. The latter increases work productivity.

New insertions in the façade frame significant views of the water and the pier, enhancing the buildings link with the precinct and its

Environment

The main aim was to minimise the ecological impact in developing a new campus for Deakin University. By reusing the existing wool store a total demolition has been avoided and thus a significant reduction in building material going to land fill has been achieved. Also by utilising an existing building the need to clear any new land or excavate existing land has also been avoided.
Energy is required for any refurbishment, maintenance or demolition of a building site. This scheme has helped address this issue by eliminating the demolition component of the equation and thus conserving energy.

Below: view from the first floor atrium.

Reusing the Dalgety wool store also means there will be less demand for new construction materials which add to the

Above: the existing timber structure is expressed to form an external walkway around the courtyard.

embodied energy of the building and associated environmental pollution created as a result of their production process.

Ecologically sustainable design issues also addresses both the social equity and cultural identity issues. This scheme has addressed both of these by acknowledging the historical significance of the wool store precinct to the nature and identity of Geelong. This was also facilitated by the enhancement of the existing brickwork during the refit.

The scheme maximises natural lighting therefore reduces lighting loads and energy consumption.

An increase in the quality of space was achieved, enhancing working environment, and possible benefits of employee well being and productivity.

One feature of retort is to apply passive design features in the building. Whilst the use of natural light is a benefit the added heat loads in summer can cause problems. Heat exhaust fans have been attached to the roof but the open section of the building means large amounts of heat stratify at the roof. However this appears to provide only limited means for escape for the excessive hot air. There is therefore a thermal comfort issue on this upper level, which has been solved with the installation of an air conditioning system. Post Occupancy Analysis already conducted confirms thermal comfort issues on the upper floor. This may result in occupant discomfort, a decline in work productivity and increased absentees.

Duality

The building expresses the materials and construction techniques historically by providing icons of the era in which they were constructed. The structural alterations and the architectural components complement each other so that new and old complement each other. The effect is to preserve the existing building structure, which adds a further layer to the story the building tells the occupants. The manner in which the existing timber columns are retained to create cloisters around the courtyard on all levels providing a feature of the refit.

Below: atrium spaces are created in the existing volume and new staircases introduced to improve circulation between levels.

The reinventing of the building through the integration of a new academic program is not spatially dissimilar to the original function. Large open spaces are required for the studio spaces of the Department of Architecture program now inhabiting part of the building.

Furthermore, the design problem is different to the traditional design approach where the program defines the form of the building. In this case the form and space of the building is defined and the design synthesis involves reworking the existing form and volume. Hence the internal space exploit to give a great hall, and a central atrium, which have been executed in terms of both engineering and architecture.

The existing south facing glazing in the saw-tooth roof provides ample natural lighting to the upper floors. New insertions such as the internal staircase descending the full height of the building into the cafeteria have been carefully designed to slot in unnoticeably with the material and form of the existing structure.

The internal courtyard is a highly effective display area that provides direct access to the street for installation and removal. “This is a totally competent scheme which functions well, with superb space and light quality throughout (Jackson, 1997: 61).

Above: day lighting is provided through a saw tooth clerestorey roof system. This is orientated south to avoid solar heat gains. A system of steel tension wire assists with supporting the timber beams below the clerestory.

Key words

Architecture: expression of materialist, regional preservation, minimalist.

Engineering post and beam, one-dimensional, column and beam, masonry bracing wall, shear action.

Environment: passive low energy principles, minimising new resources, respect for users, holism,

Duality: technical synthesis, human craft, elemental articulation, and spatial exploration

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Below: the courtyard used for external exhibitions.

The 'Green Room' is located at Queensland College of Arts in Brisbane. It is a minimalist building which gains its name from the adoption of environmental sustainable principles and the identity this creates for the users with with in the campus.

The Green Room

Author: Alex Sheu and Richard Hyde.

Type: Academic.
Location: Queensland College of Arts, Brisbane, Queensland.
Architects: Bub Brannigan.
Engineers:
Date:

Architecture

The name 'Green Room' signifies the unique position this building has within the heart of Queensland College of Arts. Designed as a student facility, and despite its small size, the final building achieved sufficient character within the campus that students named it 'Green room.'

The name 'Green Room' has two meanings attach to it. It is both a room that incorporates green principles and a room that provided a long waited amenity space in a campus environment.

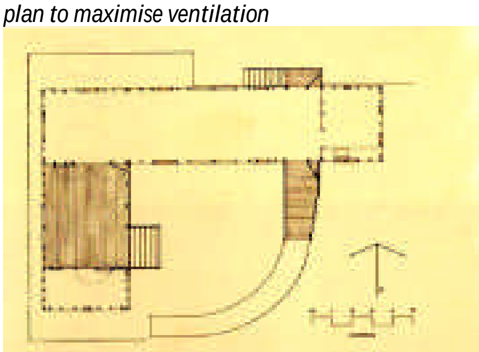
'It is a challenge from a number of point of views. One is the budget is very low and it posed immediate problem... And the other issue was in fact if it need to be moved..."(Brannigan, 1999.)

The budget range was between $50,000-$60,000. The architectural idea to meet this budget was to make a minimalist building.

Below: external courtyard created by the 'L' shaped plan

The maximum width requirement for transport building result in the plan configuration of three 4.2 by 8.4 meter segments. The idea was the three segments could be rearranged on the next site. The building consists of a 4.2 by 13.2 meter common room, attached with a 4.2 by 3.6 meter open kitchen. The two spaces take up two modules enclosed by single skin wall. The third module attached perpendicular to the main building on one side, contains a semi-open verandah and office.

Below: environmental principles generate a thin plan to maximise ventilation



The three modules formed an L shape plan, which together with the natural slope of the site create a courtyard space.

The building reinterprets the regional tradition of lightweight single skin construction found in the traditional Queenslander using modern construction systems. It creates a new building type, which comes from the impermanence of form of construction and creates a potential new market for the design profession in the area of low cost building.

Engineering

The construction is standardised for cost effectiveness.

The floor is supported on timber columns, which are connected to pad foundations. Floor joists and bearers are connected to the columns forming a platform frame. The single skin stud wall bears on the floor. The wall comprises a series of double studs at intervals supports the roof beams, which in turn supports the purlins and roof sheet above it. The structural layout of building was coordinated with the size of a standard plywood sheet. This forms the basic module of the design. Plywood panels were used for all surfaces, floor, ceiling and wall.

The bearer and columns are connected by a single 250mm long bolt which allows for easy disassembly.

The main direction of the engineering of the building is to enable the building to be relocated rather than dismantled. The advantage of this is that the embodied energy from the construction of the building is not wasted, buildings can be simply moved to a new site intact. Thus the buildings can be taken away leaving the timber column supports and the foundations.

The building form of the single skin wall differs from traditional construction with the timber framing exposed inside. Timber was used for all components. The use of one material enables the building be completed with a single trade, the carpenter which again reduces cost.

Environment

Naming the building 'The Green Room', notes the client's desire for the building to embody green principles in its design and construction. Plantation timber, a renewable resource of low embodied energy, was used to construct a large part of the building.

Passive climate responsive strategies were employed to help maintain the thermal comfort. The key components of this approach are the use of shading to windows and walls, thin plan, optimum orientation and natural ventilation.

The long and narrow plan of the building has more perimeter zones and maximum northern exposure. Nature ventilation was encouraged wherever possible. When a ceiling fan was needed, a solar powered system was employed. As a re-locatable building, the structure also showed little site disturbance and potential for recycling.

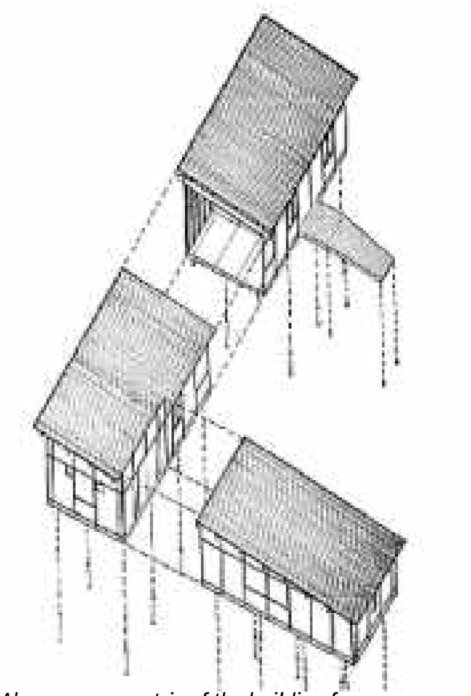
The potential for recycling was further explored in another of Brannigan's projects; the Pimpama River Estate Visitor Centre. As a visitors centre for the sale real estate, the client required the building to be dismantled and stored away before being set up again on the next site.

Duality

The architecture is about making a space that shapes the landscape it occupies. A series of interesting spaces, both external and internal, was created with the insertion of the building envelope.

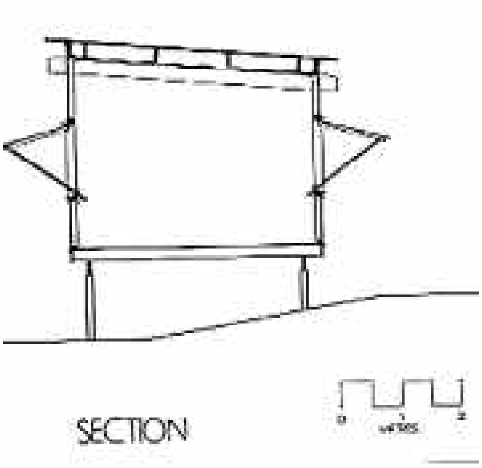
The use of single skin construction with ply wood panels wrapped

Above: a courtyard is created by the building form and the site toporaphy.



Above: axonometric of the building form.

Below: steel roof supported by rafters cantilever to provide overhanging eaves for shading to the single skin construction. Cover strips provide a durable method of covering the joints to the plywood. Note also small vision panels to provide light and view.



Above: typical section; column and pad foundations minimise site impact.

around the whole external face reinforced the building's scale and identity as a room. The external ply wood sheets form a diaphragm, which acts as perimeter bracing. The roof and floor are further examples of the timber horizontal diaphragms.

The simple detailing and staining of fabric add to the minimal quality of the building.

The use of column and pad footing creates a high setting of the building giving a minimum impact on the topography and also the landscape.

There is a clear synthesis of structure and form for the building. Both the architecture and structure were used minimally to create a building of such minimal quality. 'This building is a combination of a lot of determinants or factors. At the end they all just comes together to allow the building to work...' (Brannigan, 1999.)

Key words

Architecture: reinterpreted regionalism, prefabrication, minimalist, and impermanency.

Engineering bearing wall, one-dimensional, column, strut and wall, timber panel bracing, shear action.

Environment: passive low energy principles, relocatable, respect for site, minimal enclosure, minimising new resources, respect for users, holism.

Duality: technical synthesis, human craft, modular construction, and dimensional coordination elemental articulation, kiss (keep it stupid and simple.)

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Below: interior space showing the expressed wall, floor and roof diaphragms which brace the structure.

Above: interior stain finishes to the plywood are low cost and durable.

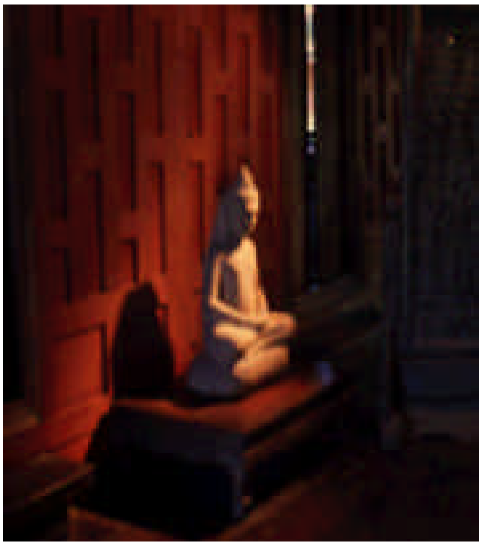
Below: details of the windows and wall framework. The expressed stud system with single skin construction requires dimensional coordination to be successful and quality control of the timber elements. Top hung windows open to provide ventilation and shading to opennings.

Jim Thompson's House

Author: Richard Hyde.

Type: Museum.
Location: Bangkok. Thailand.
Architect: Jim Thompson.
Engineers: unknown.
Date: unknown.

The building is located on a klong (canal) in Bangkok. The 'H' plan creates two coutryards , one is a pubic courtyard and a second is private adjacent to the Klong.



Above: the use of niches creatres spaces inside for the display of artifacts.

Architecture

Somerset Maugham on his visit to the Orient in the 1920's commented on the character of the urban environment. 'They are all alike, with straight streets, their arcades, their tramways, their dust, their blinding sun... their dense traffic, their ceaseless din...'

By contrast Maugham formed a romantic attachment to the traditional architecture, he found the buildings to be 'incredible.' In the traditional architecture the banality of the modern city is alien. 'They are unlike anything in the world, so that you are taken back... It makes you laugh with delight to think something so fantastic could exist on this sombre earth.'

The Jim Thompson house draws on this inherent contrast between old and new, modern and traditional to form an urban museum out of the components from six separate old houses some dating back to the 1800's. To classify the resulting architecture within the taxonomy is difficult, One could argue it is a form of conservation since it involved the activities of restoration and preservation. Yet the way the vocabulary of the traditional buildings has been reinterpreted in terms of the museum program is inventive and transforms the buildings to the modern context. This creates a reinterpretation of the traditional architecture for the modern context.

Below: the north facade opens to a terrace and to the klong.

The plan form follows the classic tropical model H plan with two wings comprising bedrooms and dining rooms with a gallery drawing room connecting these two wings. The drawing room opens to the terrace. The main living areas are elevated to the first floor to overcome flooding.

The domestic scale of the building lends itself to an intimacy with the works of art, which now inhabit the building. Rather than coming across members of the Thomson family one find groups of artefacts strategically located in wall niches or as freestanding elements, creating a museum with the museum building.

Engineering

The basic form of the structure is deceptively simple. Timber poles 200-300mm in diameter are embedded into the ground. The poles are inclined slightly inwards to enhance stability. Timber platforms are suspended between the poles using a conventional beam and joist system. At the roof a form of bracketed truss system is used to create the steeply pitched roof. Terracotta tiles are used as cladding. Jack roofs are strutted from the frame to provide additional shading.

Bracing is achieved through frame action between the poles and the ground. Floors provide strong horizontal diaphragms. In the vertical plane the cladding system is dressed on the outside of the poles which provide shear walls. Windows are simple cut-out sections in these panels.

The panel system forms into a truss form, straight elements are interlocked with receded panels to form a stable structure. Thus small pieces can be united to form a larger structural whole through simple interlocking timber joints.

The system allows the building fabric to expand and contract with the heat and moisture of the tropics without apparent defects in the form of the building.

Environment

Two key environmental strategies form the basis of the building. First the building parti comprises a cluster of small thin pavilions, which maximises cross ventilation. Second between the enclosed spaces are decks which act as external rooms for a many of social functions. Jack roofs cover these spaces in many areas providing shade to occupants and to the skin of the building.

The cladding system uses a lightweight single skin construction, which responds to temperature quickly. This is an advantage in the tropical climate renowned for its small diurnal temperature range, still wind conditions and high humidity. Any slight down ward variation of temperature and movement of air is relished. Hence the slight variations in temperature are mimicked quickly by the building as heat is not stored in the fabric. Window proportions also facilitate the breeze and heat exchange, being tall and thin, cool air can access at the bottom, hot air escapes at the top, enhancing the thermal siphon effects. Ceilings and attics are used in some spaces but the high ceilings enhance this air movement.

The materials used the building and the way it touches the ground also demonstrates the environmental sensitivity of the builders. High durability timbers such as Chengal wood are used for the poles with Teak for cladding and decking. In addition the elevation of the building provides shaded spaces under the building.

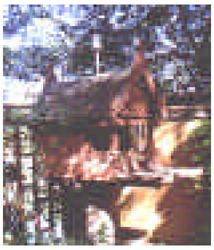
Duality

The technical synthesis in the building comes from the tradition of timber calving and craftsmanship. Many elements are seen as opportunities for expression of cultural and religious symbols such as sills, bargeboards and finals. The different types of timber, darker timber poles contrast lighter cladding timber. Red ochre stain is used to the exterior.

The subtle and finely crafted approach is seen in the design of the poles. The large and bulky elements are tapered at the top inclined for perceptual effects to reduce the scale to a domestic scale of architecture.

Above: Jack roofs are used to provide shading and protection to the timber single skin construction. These are braced to the floor elements. Traditional ornamentation gives a symbolic and cultural purpose to elements of the building.

Below: details of the windows and wall framework. The full height bifold door system can open the living area maximising ventilation required for thermal comfort in the hot humid tropics



The tradtitional spirit house.

The highly prefabricated system is the seeds of is doing and undoing. A village can erect a house in one day. It is reputed that this communal act of building coincides with the marriage ceremony. This deeply significant act reinforces the cultural link between house and family which is rarely approached in modern design. Further more In this case the prefabrication system allowed for dismantling and reuse of old houses to create the museum. This model is advocated by the environmental sustainable design yet rarely put into practice.

The multiple synergies found in this building are hard to find in more modern buildings and come from a refinement of the building typology over an extended of time. Yet interestingly these buildings can be reinvented in the modern context thorough conservation and transformation to form a contrast to current urban form.

Above: single skin panels are prefabricated and set in plane with the pole frame strucuture.

Below: the pole frame inclined inwards for perceptual and structural purposes provides tall spaces with high ceilings.

Key words

Architecture: cultural icons and metaphors, regional restoration, prefabrication, minimalist.

Engineering: pole frame, one dimensional, column, strut and wall, timber panel bracing, shear action.

Environment: passive low energy principles, demountable and recyclable, respect for site, minimal enclosure, minimising new resources, respect for users, holism.

Duality: technical synthesis, human craft, elemental articulation, and perceptual effects.

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Above: the undercroft below the building provides cool spaces.

Below: exernal cladding is reused inside the building and reversed to give scale and texture. The moduar system allows for bays to be cut into the panels in a visually acceptable manner.

The house is located in a rainforest on the coastal ranges of the Sunshine Coast in Queensalnd. The timber minimalist building uses the landscape to filter the climate.

Mapleton house

Author: Richard Hyde and Evelyn Adam.

Type: Residential.
Location: Mapleton, S.E.Queensland.
Architects: Richard Leplastrier.
Engineers:
Date:

Above: the northerly orientated deck forms the main external room.

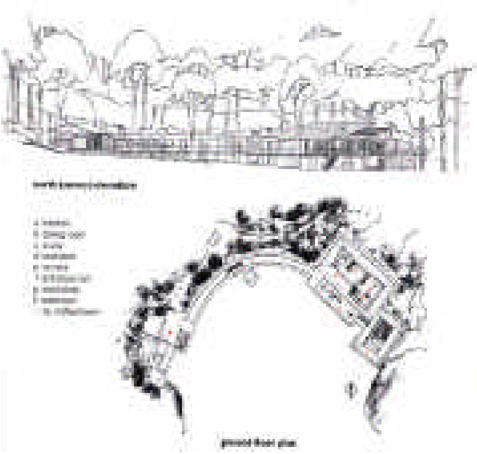
Architecture

The Mapleton house is located in a rainforest setting in the hinterland of the Sunshine Coast in south east Queensland. A clearing was created for the building adjacent to an existing workshop. The new building and the existing building are linked by a covered walkway. The buildings and walkway form the southerly edge to the clearing.

The buildings form a set of linked pavilions: the main pavilion contains the social family functions of living, kitchen/ dining and bedroom, whilst the adjacent pavilion forms the bathroom and guest bedroom.

The habitable spaces are located on the first floor. The ground floor is used for carparking and houses a range of sustainable technologies; photovoltaics, batteries and a Clivus Multrum toilet.

Below: plan showing the site response.



The elevated position gives a prospect for the north east facing decks, which connects the internal spaces to the clearing. The large moveable to the doors northeast allow the interior to act a veranda and hence tend to blur the relation between inside and out. The verandah follows the pattern of the Queensland house, wrapped around the building. The connection of the building to the site and climate enhances its sense of place. The use of recycled materials for elements such as the window glass and the rosewood interior panelling evoke a sense of history. The form of the building therefore contains the strands of regionalism through an iconographic quality. The northern deck, the verandah and the recycled materials evoke images of the traditional architecture but using modern methods of construction and engineering.

Engineering

The building engineering serves the functionality of the building. A form of post and beam structural system is used with predominant pin connections to facilitate deconstruction. The main columns are approximately 15O mm-square hardwood posts, which are embedded into the ground to give stability and stiffness. High durability species are used.

A system of double bearers is used into two directions to form the floor system. Hardwood joists support hardwood flooring. This gives a horizontal floor diaphragm.

The building cladding is minimal and appears to carry little of the wind loads. The under structure of knee braces in two directions seems to fulfil this function whilst also supporting the floor and columns.

The columns therefore are effectively cantilevered at the first floor. The braces redistribute wind loads to the floors and roof beams. In addition the sheltered location of the building with in the building in the forest setting reduces wind loads on the building thus enabling the building to be as visually as light as possible.

The essence of the engineering is in the detailing of the structural joints. The rafters to the veranda illustrate this; a semi circular pipe section is used to collect the loads from the radiating elements and transfer them pack to the column. The building craft that comes from the use of non-typical engineering jointing solutions gives a level of innovation in the building which seems to bridge enhance the architectural quality of the building.

Environment

The house follows the principles of an autonomous house, as it does not require the use of municipal services for water or power. To this end the building envelope is tuned to receive, collect and redistribute natural resources.

The central feature of the building is that it provides heating and cooling for the users rather than the building. This may seem to be a semantic definition but it is an important distinction because the building envelope provides a minimal form of enclosure. Hence the design provides a set of spaces which have differing thermal qualities at differing times of the day and year.

This approach can be demanding of the users since there is a need to move around the house and to selecting spaces that are appropriate. The key strategy that works well in section is ventilation. The northerly rooms are orientated to collect the breeze, which is siphoned to high level clerestory and through lower windows. The position and size of windows and doors allow the breeze to be regulated. More important for thermal comfort in summer the building increases the velocity of air inside the building and moves the air across areas where people are located. This is achieved by the Venturi effect where the input apertures are larger than the output.

An important environmental feature is the timber construction, some of which is recycled. This gives the building a lower embodied energy. The post and beam construction has been prefabricated and can be deconstructed through the use of simple bolted fixings.

Duality

The essence of the craft of building from the engineering and architectural perspective is an understanding of the potential and weakness of the materials used. A number of key strategies are found which demonstrate this approach. First, using the form

Above: the wrap-around verandah is feature adopted from the Queenslander house to protect the lightweight skin and allow the building to be opened in all weather conditions.

Above: interior finishes include recycled glass and Rosewood timber panelling.

Above: detailing of the roof includes a large gutter to collect rainwater for recycling and is developed as a design feature.

of the building to protect the vertical surfaces enhances the durability of the timber materials. Second, clear strategies are used to achieve technical synthesis. The resource generating ecologically sustainable design technologies are seamlessly integrated into the building or become icons in the building. The water collection system is formed from an oversized gutter, which helps shade the deck and drops water into a large collection tank at the end of the deck. Down pipes are avoided and the element becomes a water feature in the wet season.

Below: three dimensional interlocking joints for the upper frame triangulate the roof structure.

The bathroom uses a Japanese theme. The conventional floor of using water resistant surface of tiles or concrete is substituted for a timber duck boards which allow water to be collected below the floor and directed by gravity to the septic tank. This type of detailing gives the building a warmth and human scale more akin to a piece of furniture than a building. The craft in the design and engineering also reflects this; the use of intricate interlocking timber joints seems to make visual effortless work of complex structural actions.

The building clearly follows a Messian theme where God is in the details. This is perhaps the success of the building; the articulation of structural elements that follow the themes of the spaces and provide an overall minimalist character.

Key words

Architecture: regional iconographic, prefabrication, minimalist, first generation ESD.

Engineering post and beam, one and two-dimensional, column, strut and wall, recycled timber panel knee bracing.

Environment: passive low energy principles, demountable and recyclable, respect for site, minimal enclosure, minimising new resources, respect for users, holism.

Duality: technical synthesis, human craft, elemental articulation.

Below: two way bearer system is used to support the floor joists. Additional two way knee bracing is used as a subfloor bracing system.

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Above: craft used in the detailing of the skin.

Above: sliding screen doors supported in a floor track and from the mian roof beams. Note the detail of the threshold, the recessed track and the flooring that reduces water water penetration whilst keeping the floor levels flush.

Below: timber duck boards allow water to drain through to a sub-floor soaker.

The building is situated four blocks from the beach. It challenges the norms of traditional housing in urban areas through 'Green' design.

The Healthy Home

Author: Richard Hyde.

Type: Residential.
Location: Broadbeach, Gold Coast, SE Queensland.
Architects: Richard Hyde and Upendra Rajapashka.
Engineers:
Date: 1999.

Architecture

Sustainable development is an amorphism that is both perplexing and paradoxical in the design of a building. Some designers approach the design of sustainable buildings by making them autonomous through developing a level of self-sufficiency, others by developing a building, which reduces environmental impacts.

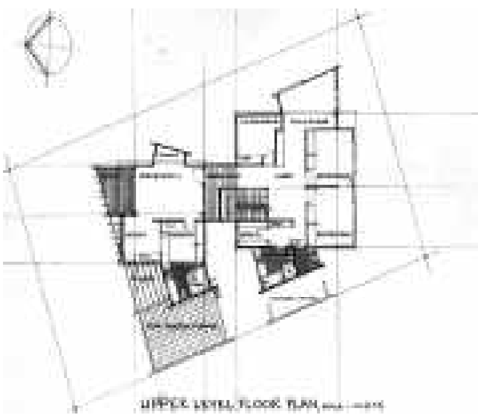
The Healthy Home offers no comprehensive definition of sustainable development rather it describes a number of 'green architectural' strategies that can be used to minimise environmental impacts that may make the building process a little more benign with respect of the global devastation that has characterised much of human growth.

Sustainability sits as a philosophical backcloth that guides the path of green design. The design implications are seen in the way the building responds to the climate and site. In addition the client's ambitions were for a healthy home.

The major feature of this house is that it is designed for an urban site. The block has a particularly poor aspect with its longest sides facing east and west (areas of heat gain from the low angled sun). The plan form departs from the normal building alignment on the block. It is split into two pavilions connected by a breeze. Also it is rotated so that the building is aligned north south to catch the sea breezes and improve solar access for winter heating. This helps create major microclimate zones on the site, a cooler easterly zone, which contains the external decks, and a hotter westerly zone, which is occupied by the carport.

The building respects both its site and micro climate in its plan and section forming a climatically responsive regional building which challenges the norms for sustainable buildings in urban areas.

Below: sketch plans.



Engineering

Timber has a major role in this building. New plantation timber is used in the structure, whilst recycled timber is used for secondary structural elements and for the floors. The latter is made of re-milled timber boards cut from large sections salvaged from old buildings. The material is excellent quality and seasoned so once installed does not shrink. The structural recycled timber comes in a variety of sizes and conditions and was dressed on site to make the necessary elements such as the carport and decks. Due to its weight and hardness it is best used for major bearers and columns. The new engineered products which are composite 'I' sections or solid sections are much lighter to handle and easier to cut than the old hard wood.

The structure: a skeletal frame system made of glue laminated timber. The reasons for using this system are three fold.

First, the system is made of a number of posts and beams, which are connected, with both pin and semi-rigid joints. Pin joints are used at connection of floor and column whilst the semi-rigid joints are used at the roof level. These rigid joints offer some resistance to raking and allowed a reduction in the bracing walls. The benefit is to create larger open internal spaces to improve the ventilation in the building.

Second, the use of the skeletal system meant that only pad footings were needed where the frame connected to the ground. The advantage of this approach is that it minimises the number of footings required which intern reduced the impact of the building on the site. From the timber skeleton a suspended timber floor was use thus avoiding the use of concrete slab on ground.

Finally the use of the skeletal system improved the buildability of the project. Frames were prefabricated and assembled on site then were erected in one day.

Environment

Three main environmental themes run through this building. The urban context in which this building is located comprises many buildings that are consuming more and more energy through the use of air conditioning. This form of climatic control is not necessary if buildings are designed to respond to the climate. This buildings addresses this challenge through its spatial organisation that provides thermal delight, environmental connectivity whilst meeting user needs and lifestyle choices. Also in the section, the breezeway provide cross ventilation and the open section allows hot air to siphon through the 'pop up' roof vents.

The second theme concerns the envelope control in the building. This is designed to keep out unwanted heat in summer and allow access to sunlight in winter. The key to making this lightweight building perform in these conditions is to use radiant barriers in the walls and roof and light coloured reflecting external surfaces.

The third theme involves the design of the interior. Traditional paint finishes such as orgon oil and lime wash are used for the wall surfaces to reduce the off gassing of materials. Pre-finished plantation timber windows are used with a body-tinted glass to assist with shading from ambient solar radiation.

A holistic, post-construction environmental assessment is currently being undertaken. This will assess the design in terms of its environmental performance, but more importantly the assessment will establish benchmark performance criteria that can be then be used in the design-phase assessment of future

Below: erection of the portal frame system, its main advantage are speed of construction, mimimum side damage and open section to provide improved ventilation.

Below: secondary framing underconstruction with the 'pop-up' roofs that provide stack ventilation.

Below: details the portal frame to pad footing connection. An epoxy dowel and plate system is used which makes a descrete fixed connection which hides the steel connectors. It also facilitates the protection of the timber from termite attach. Also, the suspended timber floor means no chemical barriers are needed to resist termites. The pad footing provide an inspection point and only a few ground contact points which reduces oppotunities for termite access.

Below: view through the house showing the timber louvres that control the ventilation to the stack system. Finishes reduce off-gassing and improve air quality in the building.

projects.

Duality

The contribution this building makes is to demonstrate that through technical synthesis free running lightweight timber buildings are feasible for urban areas. The innovative timber structural systems are linked to the climate in a similar way to the Queenslander providing thermal siphoning for cooling and a highly degree of envelope not found in conventional buildings.

In this way the Healthy House responds to the need for higher density and urban conditions with out the need for air conditioning. The resource generating capabilities through photovoltaic panels and water storage and recycling give a level of autonomy to the building for little extra capital cost. The life cycle benefits from these technologies further enhance its green credentials. The holistic response results form each part being designed with reference to the next so the effects of the whole exceed the sum of the parts.

The building forms a prototype second-generation environmental sustainable design (ESD), which responds to urban needs.

Key words

Architecture: climate responsive, second-generation ESD, prefabrication,

Engineering portal frame, two and one-dimensional, column and shear walls, timber panel bracing, frame action.

Environment: passive low energy principles, recycled materials, low impact finishes, respect for site, envelope control, minimising new resources, water recycling and energy conservation

Duality: technical synthesis, structural form and climatic response

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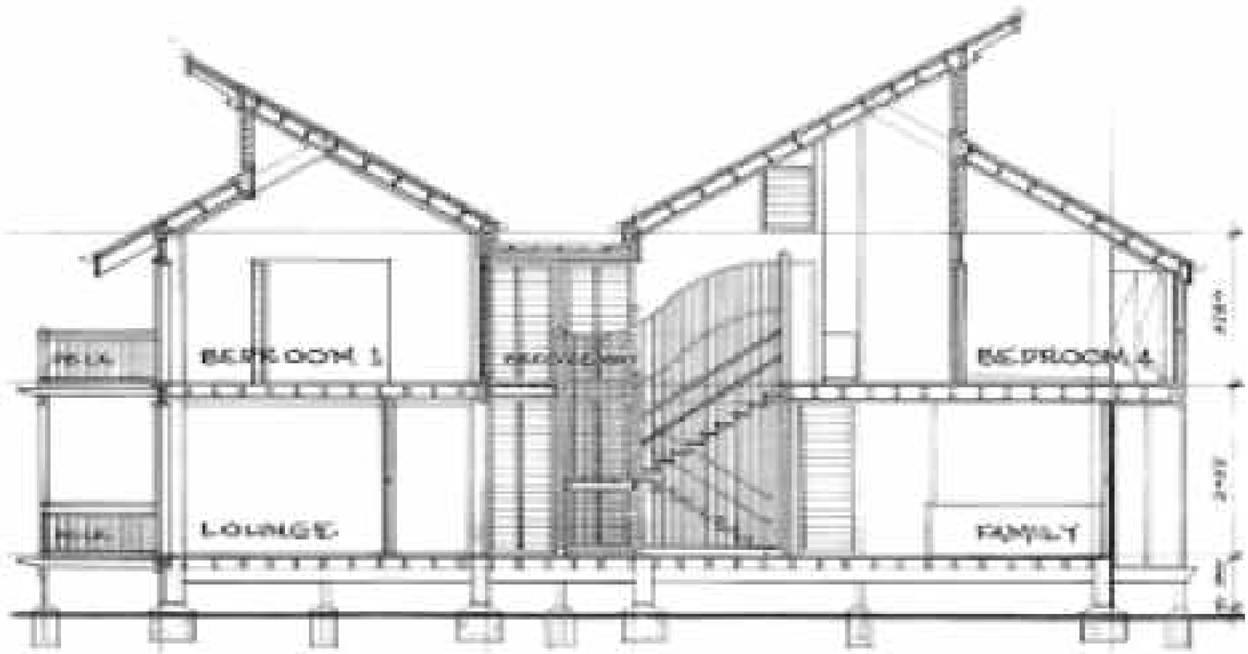


Above: typical section showing the vertical spatial connections to allow air movement.

Above: a combination of new engineered products such as 'I'beams and recycled timber used in the project to reduce the amount of new resources used.

Below: details of the recycled floor joists: recycled timber has less embodied energy than new timber but can require denailing and dressing on site. Remilled floor boards were used and have the advantage of preshrinkage.

Located in the Botanical Gardens in Montreal, this building address the contempory use of timber at many levels through its function, structure, cladding and iconograpgy.

La Maison de l'Arbre

Authors: Rhyse Williams and Richard Hyde.

Architect: Simon Peloquin.
Engineer: Alain Mousseau.
Landscape Architect: Carlos Martinez.
Construction: Gerpro Construction, Montreal.
Date: 1998.

Above: clerestory lighting provides drama through shadowing effects. The light is also reflects and diffuses into the display space providing natural lighting.

Below: the glue laminated timber structure penetrates cladding to provide an external shading system.

Architecture

The La Maison de l'arbre (The Tree House) is located in the Montreal Botanical Gardens and offers an invitation to discover the world of forests and trees. It main function is interpretation, that is to assist students and the general public to gain a greater appreciation for trees and forests and their care. The building has a clear organisation of public rooms distributed around a central spine, which connects inside and out. The spine has two functions, to bring top light into the display space and second provide a visual axis to exterior spaces. The axis is terminated in a balcony, which over looks the garden. The roof height of the spine is increase to form a gallery space, which acts as a large lantern. Functional planning also responds to the spine with servant and mainly back of house spaces to the northeast and public rooms to the south (equator facing).

Throughout the public rooms you are in constant contact with the outside. When you see a display about a particular tree, out of a window beside the display, you can see the trees in the gardens. Also you are in constant contact with the outside weather, the setting sun, the differing seasons, and the weather all orientating the viewer to the wonder of nature.

This building evokes the cultural response to nature as a collection of elements to be observed, experienced and understood. These cultural patterns are reworked into the regional response through a series of filters to change and reorientate our experience of natural elements. This experience is further enhanced through the materiality of the structure and cladding.

Engineering

The main structural system is a pin jointed post and beam system, which provides open spaces to the public room. Horizontal loads appear to be transferred through the gallery space to the elements to the east of the spine. The light and openness of the public room is stabilised by the solidity of the servant spaces.

There is a clear structural diagram that overlay the spatial and function diagram, which assists with generating the technical synthesis in the building.

Drama is created in the gallery space were an asymmetric series of knee braces stabilise the building. Columns are made as slender vertical timber elements, their effective length reduced by the knee braces. These braces are rotated and angled out of plane with the column to facilitate a connection to the column creating a two dimensional structural form. This structure creates the lantern, which consists of a contrast of solid and void elements. Longitudinal bracing at high level sits behind the voids of the windows thus giving a pattern of light and shade on the white eastern solid wall.

An important feature of the structure is the joint detailing. Most connections are made using steel plates and bolts. The plates are slot morticed into the columns and beams reducing the visual complexity at the connection. In addition where bolts are recessed into the elements and shadow lines are created between elements. This attention to detail is rewarded with a highly articulated structural system giving strong clean lines. Further, the use of the glue laminated timber enhances this with a consistency of material (little variation in colour and imperfections such as knots.)

Finally the prefabricated post and beam system is surrounded by an envelope of 50x100, 50x150, and 20x200 mm thick walls, consisting of a combination of glazing, stained pine siding and stained plywood. The exterior walls are double stud construction to reduce thermal gain/loss. The floor framing is parallel chord trusses overlayed with timber decking.

Environment

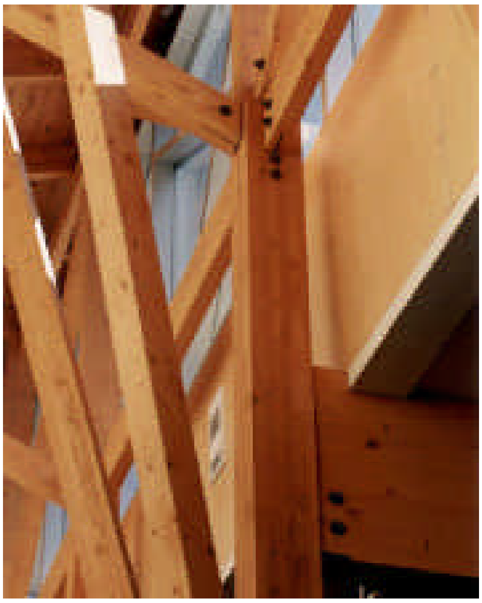
Montreal, Canada is positioned at Latitude 45 degrees, 28 minutes North and Longitude 73 degrees, 45 minutes East. Temperatures vary from –17 degrees C in winter to 24 degrees C in summer (comment from R. Hyde, it was 28 deg with 60% humidity at the time of the visit). The average temperature maximum, 8 degrees C and minimum –1 degree C. this may explain why the building is orientated to the North-South to capture the winter sun. Although the building is air conditioned in summer to maintain comfort to the interior, the orientation in winter would reduce the load on the air conditioning system in heating mode, as solar radiation would help warm the building.

The major benefit of the high glazing ratios is the natural lighting in the building, which reduces electric lighting. Hence the thermal loads for heating and cooling may be of set by the reduction in lighting loads

Another problem is that the climatic temperatures are changing around the world. Generally temperatures are rising, changing the ranges that designers work off for thermal comfort. This could create a problem for the building, as there seems to be no vents to release hot air from light tower during hot weather, although this could be a positive aspect in winter. Inclusion of high level windows or vents and possibly further ventilation strategies throughout the museum level would allow the building to be more flexible in the environmental options for users and thus possibly reduce the amount of energy used to air condition (hot or cold) the spaces.

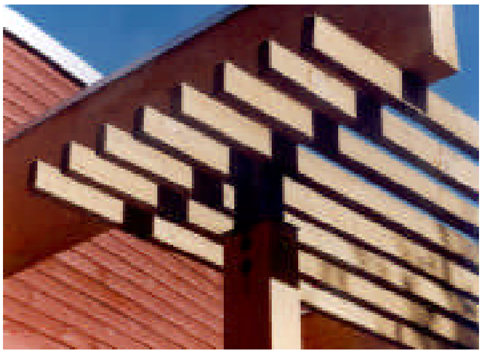
Duality

The design of the building is based on the architect's interpretation of the tree. This is demonstrated in the structure,



Above: structural details simple and effective and articulate the timber linear elements giving the structure a consistant, highly crafted appearance.

Above: the structure frames the view.
Below: details of the shading and external detailing of the gluelam.



Above: details of the slot mortice system used to hide the steel plate connection system.

with tree like columns ordering of the main circulation gallery. The structure attempts to simulate the alignment of trees and also to diffuse natural light to the display spaces simulating the light filtering qualities of the tree canopy.

The structural expression of the timber structure is carried into other spaces. In the public rooms the classic approach to museum buildings separates primary and secondary structural systems is used to allow a spatial and geometric contrast. The sticking example of this is the interpretive space, which is created from an orthogonal grid of beams and columns, which intersected by the curved line of enclosure. The external area of this structure forms a pergola space, which filters views to the outside and incoming westerly sun.

Aside from the experiential quality of the structural systems, the architect has interpreted the tree as a poetic form of abstraction: the trunk as the column and the braces as the branches. This organic metaphor creates a poetic form abstraction of a tree.

The use of sunlight creates a dramatic lighting effect of light and shade to the gallery space.

Key words

Architecture: regional interpretation, cultural patterns, prefabrication,

Engineering: post and beam grid, two and one-dimensional action, column and strut, knee bracing, pin joints

Environment: envelope control, natural light

Duality: technical synthesis, poetic abstraction, expressive structural form and drama

References

Below: exterior view of the gallery which provides a connection to the landscape.

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Above: interior of the wood display area showing the use of natural light for ambient lighting.

Above: details of the display areas.