Front-loading the Design Process for Environmental Benefit

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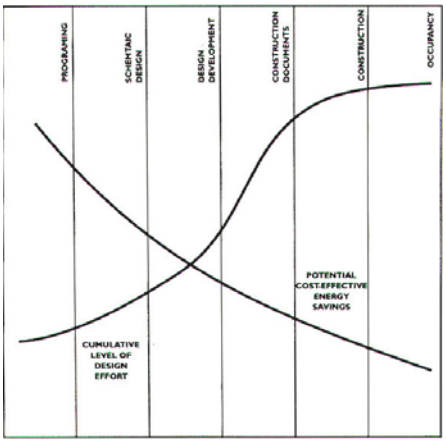
The Centre for Sustainable Design
Faculty of Engineering, Physical Science and Architecture

The Healthy House

Mermaid Beach, QLD, 1999
Richard Hyde and
Upendra Rajapashka

Outline

- The importance of early design decisions
- Design as Problem Solving
- Importance of Problem setting
- Front – Loading the Design Process
- The Environmental Brief
- Roles of the Environmental Brief
- Conclusions



Design As Problem Solving

Popper "All life is problem solving"

– Conjecture/Refutation

Hillier Musgrove and O'Sullivan

– Conjecture/Analysis

Conjecture/Analysis

$P_1 \rightarrow TS \rightarrow EE \rightarrow P_2$

P_1= original problem
TS = Tentative Solution (conjecture)
EE = Error Elimination (Analysis)
P_2 = Solution (next problem)

Problem Setting

PS → P_1 → TS → EE → P_2

PS = Pre-structuring (setting the problem)

- Key task is problem setting
- Designer (Design Team) as problem setter as well as problem solver.

The Environmental Brief

- Brief explicitly informs pre-structuring
- Environmental aims laid out in the brief inform design problems
- Problems provide criteria by which to assess Conjectures made.
- Only way to have environmentally responsible solutions is to have environmentally responsible problems

The Process of the case study projects

- 5 Case studies
  - 4 residential
  - 1 commercial fitout (EPA Cairns office – William McCormick Place)
- All clients with 'Environmental' aims
- Varying degrees of sustainability
- Action/Research process
  - Iterative improvement of the front-loading process

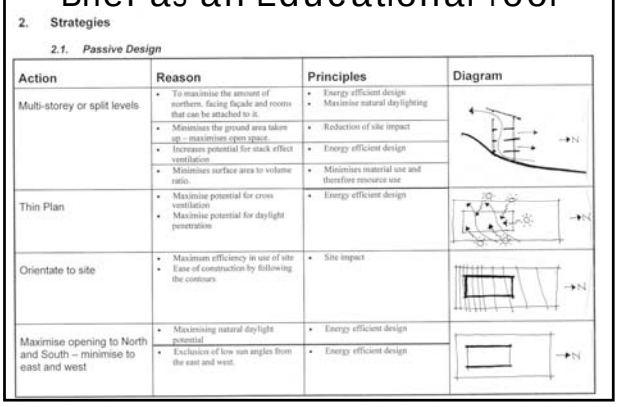
Briefing Document

- Defining level of 'sustainability'
- Defining environmental goals
- Defining functional requirements
- Defining Environmental Strategies
  - Passive
  - Resource
  - Material
  - Construction

Roles of the Environmental Brief

- Brief as an Educational Tool
- The Discussion of Issues
- Brief as a Bridge between Generic and Specific
- Facilitating Priority Setting
- Facilitating Goal Setting
- Brief as a Starting Point for Design Assessment
- Brief as a Record

Brief as an Educational Tool



2. **Strategies**

2.1. Passive Design

Action	Reason	Principles	Diagram
Multi-storey or split levels	• To maximise the amount of northern, facing façade and rooms that can be attached to it. • Minimises the ground area taken up – maximises open space. • Increases potential for stack effect ventilation. • Minimises surface area to volume ratio.	• Energy efficient design • Maximise natural daylighting • Reduction of site impact • Energy efficient design • Minimises material use and therefore resource use	
Thin Plan	• Maximise potential for cross ventilation • Maximise potential for daylight penetration	• Energy efficient design	
Orientate to site	• Maximum efficiency in use of site • Ease of construction by following the contours	• Site impact	
Maximise opening to North and South – minimise to east and west	• Maximising natural daylight potential • Exclusion of low sun angles from the east and west.	• Energy efficient design • Energy efficient design	

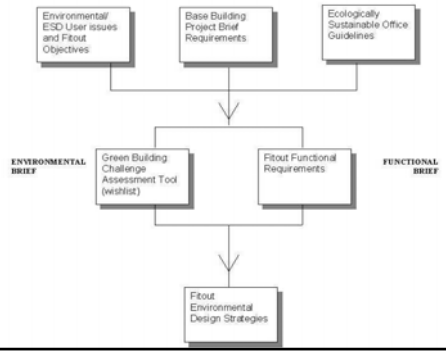
The Discussion of Issues

- ***3.11 Floor Coverings***

Types

- All floor surfaces must be non-slip in both wet and dry conditions.
- In all office and public areas, floors shall be carpeted using recyclable modular carpet tiles. Carpet must be antistatic type.
- The use of ceramic tiles or vinyl sheet or tiles is not encouraged in office areas.
- Wet areas must have smooth, impervious floor finishes which are easily cleaned.
- High traffic public areas are to be covered in a resilient, hard wearing, easy to clean surface (eg quarry tiles, rubber tiles, special carpet).

A Bridge Between Generic and Specific



Facilitating Priority Setting

- Clients control resources
- Resources limit potential environmental strategies (as per any other type of strategy)
- Presenting Whole of Life (WOL) environmental cost-benefit analysis

Facilitating Priority Setting

Strategy	Capital Cost	Life Cycle Cost benefit	Environmental Benefit
Photovoltaics	$14,000	$420 per year	1,400 kg/CO2/year
Rainwater collection	$4,500	approx $0	350kL of water per year
Solar Hot water	$1,800	$280 per year	700 kgC02/year
Total per year	$20,300	$700 per year	2.1 tonnes CO2 + 350kL water
Total life cycle	$20,300	$35,000	105 tonnes CO2 + 17500kL water.

Facilitating Goal Setting

Materials

Specific Goals

- **Minimise Land use**
- **Minimise use of greenfield sites**
- **Maximise use of already disturbed land**
- **Minimise finite, virgin natural resource use**
- **Maximise use of recycled materials**
- **Maximise use of renewable materials**
- **Reuse materials**
- **Reuse Building**

A Starting Point for Design Assessment

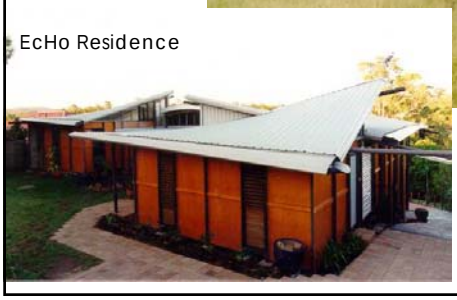
- **E2.3 Minimum use of scarce natural resources**
- Target Benchmark – A comprehensive process has been used to determine and avoid all significant fitout materials which are scarce and/or which incur significant adverse acquisition and production environmental impacts. In particular, the design team has gone to considerable lengths to eliminate the use of tropical hardwoods from non-sustainable sources and use more benign alternatives. **[score 5] Critical**
- **E2.4 Use of salvaged materials, components and systems**
- Target Benchmark – 10% of the total cost of the construction materials and components used in the fitout originate from salvaged sources **[score 2]**
- **E2.5 Use of materials with a high post-consumer recycled content**
- Target Benchmark – 50% of new construction materials and components used in the fitout have high post-consumer recycled content. **[score 5]**

Brief as a Record

- Reference for design decisions within the individual project
- Reference for future projects
  - Feed Forward of design strategies
  - Informing problem setting of future projects

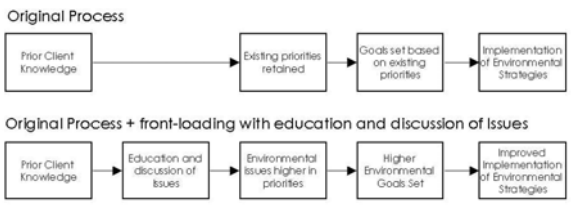
Logan Waste Administration Building

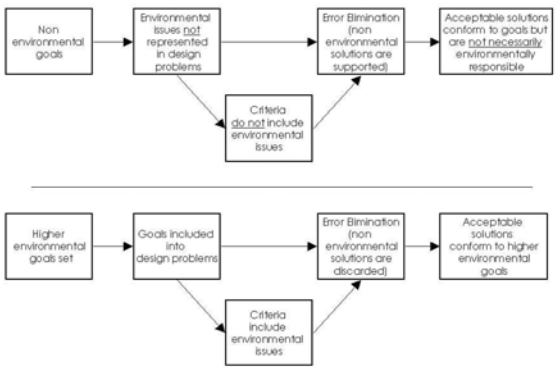
EcHo Residence



Conclusions

- Difficult to find a positive relationship between front-loading and improved environmental outcomes over the series of case studies
- Relationship between goals set and environmental outcomes
- High goals = high outcome
- Low goals = low outcome





Forth coming book

‘The Environmental Brief’

Richard Hyde
Steve Watson
Wendy Cheshire
Mark Thomson

Published by E&FN Spon, Due early 2005 ????