Sustainable Low Cost Housing
Construction method

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Housing issues

- Sustainability issues
- Cost of construction
Housing Demand

- Population growth
- Increased wealth
- Thinning of household size
  - single parent families
  - lone person households
  - reduction in joint families
Household Energy Use in Australia

- 18 GJ per person in 1980
- 20 GJ per person in 1999

This is operational energy. How about embodied energy?
Embodied Energy

- Embodied energy includes manufacture and transportation of building materials, construction on site

- Embodied energy is 10%-20% over a 50-yr life cycle of a home

- Examples:
  - 1 tonne of cement production releases about 1 tonne of CO₂
  - Manufacture of 1 brick releases 1.5 kg of CO₂
Sustainable Low Cost Housing: Why?

• Safe

• Affordable

• Environmentally Sustainable
  (low embodied energy and minimum operational energy)
Housing Sustainability Issues

• Insulation
• Orientation and solar access
• Thermal mass
• Double (or triple) glazed windows
• Active systems
  – Solar PV panels
  – Solar hot water
• Water conservation
• Waste reduction and recycling
Construction Methods

• Heavy weight construction
  improves thermal comfort & reduces operational energy
  usually has higher embodied energy
  not cost effective for remote areas
  often quarried or processed with high impact

Light weight construction
  can have lower embodied energy
  preferred on remote sites
  usually requires more heating and cooling
Affordable housing

In developing countries many live in

- Tin Shacks
- Huts
- Homeless under bridges, trees etc.
Brick walled housing

- Mud brick & normal brick walled houses collapse in case of Earthquakes endangering the lives of people living inside.

- Mud brick walled houses are not aesthetic to look at and also require regular maintenance.
Human requirement

• Food
• Shelter

• Shelter provided should be
  Safe
  low cost
  hygienic
  comfortable
  built with low embodied energy materials
  need only low operational energy
Concrete Jacketed Rammed Earth Wall Construction

- Composite wall with concrete surfaces and a rammed earth core
- Low embodied energy
- High thermal mass
- Improved thermal performance
- Meets finish requirements of CSIRO guidelines
- Does not need skilled labour
- Highly suitable for remote areas
- Uses mostly local material
- Minimum building waste generated
- Importantly low cost of construction
Typical cross-section

Compacted Soil

Steel Tie (optional)

Concrete, 4.5cm

Variable ~ 35cm

Section through a wall
Construction Method

a) Formwork – 4 sides only

b) Insert two trays of dry cement mortar

Tray of dry cement mortar tipped into formwork and located in place – one each side

Section through formwork

Cement mortar

Loose earth

Trays extracted after filling centre with earth

c) Fill with soil and extract trays

Cement mortar

Compacted earth

d) Compacted earth and mortar mix – ready for placement of next level
Concrete jacketed rammed earth building under construction
Completed Concrete jacketed rammed earth building
Some examples of Concrete jacketed rammed earth buildings built in Australia
Conclusions

- Concrete jacketed rammed earth wall houses are affordable low cost dwellings for millions of people who are either not having a dwelling or living in a substandard dwelling.
- The approach promises to utilise less embodied energy than many current popular construction techniques.
- The design offers a high thermal mass & significant reduction in heating and cooling costs.
- The construction process requires relatively unskilled personnel and simple equipment.
- High quality durable finishes are produced.
- Potential reductions in cost and time of construction.
- The process will produce relatively little building waste.
- The walls are inherently non-combustible and will not produce toxic gases in a fire.
- The finished wall does not pose a threat to air quality by out-gassing.
- Minimum transport costs promise significant advantage in rural areas.
- Houses constructed using this method are aesthetically pleasant.
- Relatively more safer compared to mud brick walls or normal brick wall dwellings in case of earthquakes.
- These dwellings will improve the quality of life.
- These houses will provide self respect to people who otherwise have to live in tin shacks or huts or under trees or bridges.