Implementing Circular Economy In Building Construction-From Theory To Practice

Presented by (Anil) Dashwanyl Jhuboo, MSc., Dip. Man., RPEM, MIEM,
Director of Civil Engineering Section
Ministry of National Infrastructure & Community Development
Board Member of Council of Registered Professional Engineers of Mtius
Board Member of Land Drainage Authority
Council Member of Construction Industry Development Board
A brief history of construction evolution

Thatched mud house of the first Indian immigrants

- Not durable and of a temporary nature
- Insignificant impact on soil properties such as absorption, etc.
- Use of natural organic material
- Environmentally friendly
- The question of recycling did not arise
A brief history of construction evolution

Case Creole
- More durable in time
- Has an impact on soil properties such as absorption, etc..
- Use of natural organic material
- Not so much environmental friendly
A brief history of construction evolution

Concrete Buildings
- Still more durable in time
- Such construction proliferated after cyclone Carol 1960
- Has a profound impact on soil properties such as absorption, etc..
- Use of natural non-organic materials, depleting the environment of its resources
- Large construction costs
- Really so much environmental friendly
The Previous Practice in Construction-Basic Linear Economy Model

Basic Linear Economy Model consisted of

1. Extract-large amounts of raw materials inputs and non-renewable resources
2. Use and
3. Landfill-generates large amount of non-degradable wastes

It is innovative practice to foster sustainability in a systematic way and moved away from a basic linear economy model to a circular economy (CE)

The 3R’s Principle
Reduce-action of minimising inputs and outputs of raw materials and wastes
Re-use – the operation of using a product again for the same purpose when it reaches its end of life and
Recycle-the process of recovering waste to manufacture a new product
Innovative Practice in Construction

Moving from the 3R’s principle to a 9R’s framework

1st strategy aims at better product manufacturing

Refuse-Depreciate a product with negative impacts and proposing a different one with identical or even better functions and fewer impacts
Rethink-Intensify the product use and use of products with multiple functions
Reduce- Decrease the use of raw materials and energy consumption while enhancing efficiency
Innovative Practice in Construction

Moving from the 3R’s principle to a 9R’s framework

2\textsuperscript{nd} strategy is to encourage product life span

- **Reuse**- reuse a discarded product that keeps the same functions by another user
- **Repair**- Fix a damaged product to give back its initial performance
- **Refurbish**- Renovate an outdated product to make it as a new one
- **Remanufacture**- Make a product using parts from a damaged product that has a different functions
- **Repurpose**- Make a product using parts from a damaged product that had different functions
Innovative Practice in Construction

Moving from the 3R’s principle to a 9R’s framework (Cont)

3rd strategy - last and least favoured

Recycle - Include, into the manufacturing process of a product, materials that reached their end-of-life use to make materials with either
1. Same qualities
2. Higher qualities - Upcycle
3. Lower qualities - Downcycle

 Recover - The process of retrieving heat, electricity or fuel from non-recyclable materials by incineration.
Closing the Material Loop in Construction
Nearly Zero-Energy Buildings-NZEB

A building’s life cycle consumes substantial amount of energy:
1. From material extraction
2. Processing of materials into products
3. Building construction
4. Operation of buildings
5. Demolition/reconstruction phases

The challenge to practitioners in the construction industry is to produce buildings with high energy efficiency or the NZEB
Circular Buildings

Circular buildings can:

1. Achieve energy neutrality-carbon footprint through judicious use of innovative materials
2. Produce an excess of energy through design and on-site renewable energy production
3. Reduce overall energy consumption allocated to building operations-New biodegradable materials to provide necessary services and thermal comfort to users
4. Reduce building water footprint-Similar to energy water is most consumed during construction and operation.
Circular Building Principles

- Designing out waste
  - Planning materials reuse and recovery
  - Off-site construction
  - Optimization of material use
  - Embracing a lean design

- Design for adaptability
  - Increased independency between systems
  - Upgradable components and systems
  - Detailed information regarding building’s composition
  - Compatible service-life of components and systems
  - Modularity of building elements
  - Structure, façade, and envelope can endorse multiple uses

- Selecting materials
  - Materials with low embodied energy and carbon
  - Transparent materials content
  - Preference is given to reusable and recyclable materials
  - Materials that can embrace disassembly and adaptability
  - Technical or biological materials that can be put back in the industry or nature
  - Non-toxic and non-hazardous materials

- Design for Disassembly
  - Safe and accessible disassembly
  - Guidelines for deconstruction
  - Disassembly process is done through standardized tools
  - Connectors and fixings allow multiple uses
  - Minimize chemical connections
A framework for implementation throughout a building’s life stages

**Product stage**
- Use locally sourced materials
- Prefer materials with recycled or recovered content
- Look to salvage construction products or components (reuse)
- Search for low embodied carbon and embodied energy materials
- Analyse the materials safety datasheet and give preference to safe materials for human and ecosystems
- Use materials with high recycling and reuse potential
- Prefer materials and components with the ability to embrace flexibility, adaptability, and deconstruction
- Give priority to durable and high-quality materials
- Create a list of all used materials and respective manufacturing company

**Construction process stage**
- Prefer prefabricated construction
- Give priority to modular construction
- Prefer mechanical to chemical connections (dry construction)
- Use water and energy efficient building equipment
- Provide CE training to construction team
- Increase the collaboration between building stakeholders
- Provide integrated project information, using a BIM framework
- Update the project with the as-built information to facilitate future maintenance, renovation, adaptation and disassembly

**Use stage**
- Implement a BIM integrated Facility Management (FM) procedure with preventive maintenance and repair service instructions
- Integrate water and energy management in FM
- Implement ecological purchasing and responsible sourcing policies for operational goods
- Use clean and renewable energy harvested on-site
- Promote water circularity by implementing a rainwater harvesting and/or greywater recycling system
- Provide a comfortable and healthy indoor environment
- Implement operational waste management policies

**End of life stage**
- Provide proper training to the construction team to cope with the building deconstruction
- Identify building elements and products that can be forwarded to building/architectural salvage companies
- Separate materials by typology and send them to waste management facilities for proper recycling, incineration or landfill
- Use water and energy efficient building equipment
- Ensure a safe deconstruction for workers and surroundings

**Tracking materials, energy, and water flows**
CE Target Groups in the Construction Sector

The circular economy target groups include economic operators in the value chain, policy makers, legal and technical actors:

1. Building users, facility managers and owners
2. Design teams (architecture and engineering of buildings)
3. Contractors and builders
4. Manufacturers of construction materials and products
5. Deconstruction and demolition teams
6. Investors, developers and insurance providers
7. Government/Regulators/Local authorities.
### Objective by Target Group

<table>
<thead>
<tr>
<th>Target group</th>
<th>Specific objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building users, facility managers and owners</td>
<td></td>
</tr>
<tr>
<td>Design teams</td>
<td></td>
</tr>
<tr>
<td>Contractors and builders</td>
<td></td>
</tr>
<tr>
<td>Manufacturers (of construction products)</td>
<td></td>
</tr>
<tr>
<td>Deconstruction and demolition teams</td>
<td></td>
</tr>
<tr>
<td>Investors, developers and insurance providers</td>
<td></td>
</tr>
<tr>
<td>Government/regulators/local authorities</td>
<td></td>
</tr>
</tbody>
</table>
The Challenge for Mauritius

1. Timid attempts at implementing CE
2. Technical actors have barely even environmental friendly in their concept design of infrastructure.
3. Resources are depleting fast, e.g. rocks. Sand is already banned since long.
4. There is need to develop new construction materials.
5. Research, Design and Innovation are required.
6. Paradigm shift in design philosophy and methodology.
7. Etc..
thank you
Implementing Circular Economy In Building Construction
-From Theory To Practice

Questions and Answers

[Short Questions are expected.]