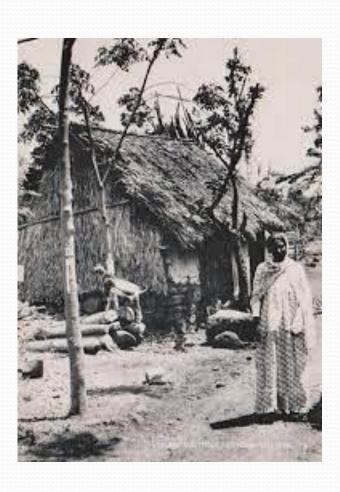
# Implementing Circular Economy In Building Construction-From Theory To Practice

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# 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
- Environmental friendly
- ■The question of recycling did not arise

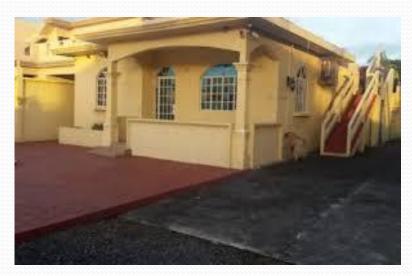
# A brief history of construction evolution



#### **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 Priciple

**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

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#### **Innovative Practice in Construction**

#### Moving from the 3R's principle to a 9R's framework

2<sup>nd</sup> 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)

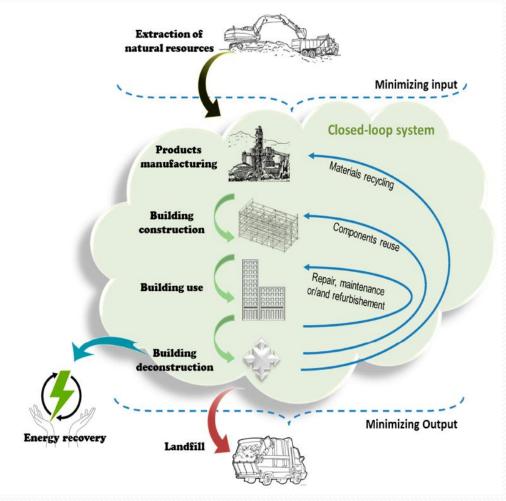
#### 3rd strategy-last and least favoured

**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 Priciples**

# 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

# Circular building Principles

# 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

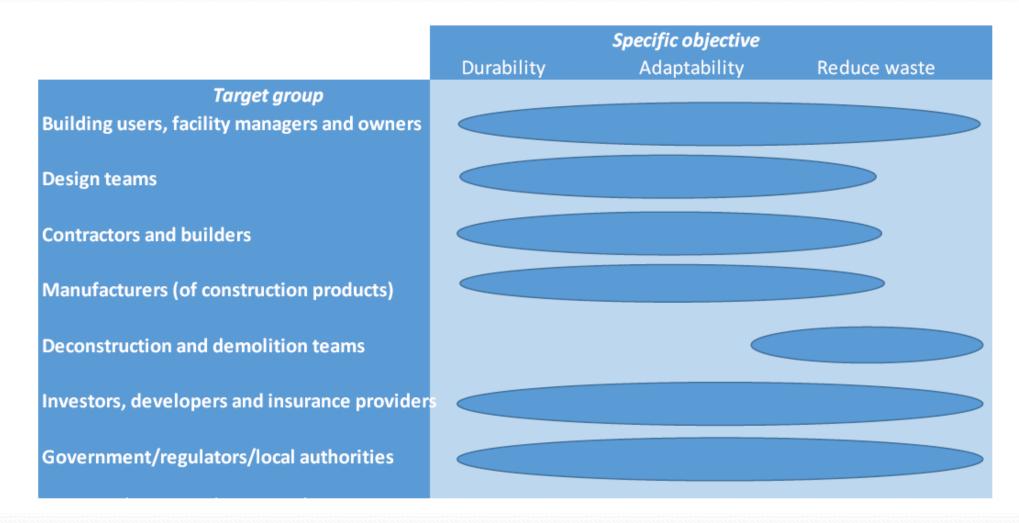
#### Tracking materials, energy, and water flows

### **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**



### The Challenge for Mauritius

#### The challenges 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..









# Implementing Circular Economy In Building Construction -From Theory To Practice



**Questions and Answers** 

[Short Questions are expected.]