Module 9

Waste as a Resource in Circular Economy

Circular Economy in the Construction Industry

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740
Within this module the trainee will gain an understanding of what the opportunities associated with material reuse are and how this can be applied to their industry. They will also recognise some of the barriers that exist within a national context. They will also become familiar with some material digital marketspaces as well as becoming familiar with the concept of buildings as material banks. This will all then be related to Multi-functional Green Roofs Facades and Interior Elements.
Objectives/Learning Outcomes

• 5 – Design with products and materials that can be easily reused or recycled after use
• 16 – Enable second hand sale of multifunctional roof/façade products through marketplaces or services
• 19 – Transform waste products and materials from multifunctional roofs, façades or interior elements for reuse, or as a last resort into lower value products in the same industry
• 20 – Use waste products and materials from construction demolition projects that have been processed and recycled
• 21 – Collect products and materials for reuse or recycling in roofs, façades or interior elements from outside construction
Objectives/Learning Outcomes

• 22 – Transform waste products and materials from multifunctional roofs, façades or interior elements for reuse outside construction, or as a last resort into lower value products outside construction

• 23 – Use waste products and materials from outside construction that have been processed and recycled

• 48 – Employ a regional construction digital marketplace for construction resources

• 58 - Reduce waste as much as possible during production

• 73 – Organise logistics and storage of secondary materials, whilst aiming to reduce waste
Objectives/Learning Outcomes

• 78 – Assess quality of materials to be reused from multifunctional green roofs, façades, and interior elements (audit of waste)

• 79 – Trade secondary materials and products on digital marketplaces
Content

• Waste as a Resource
  • Implementing material reuse

• Digital marketspace

• Material Banks

• Application for Multi-functional Green Roofs Facades and Interior Elements
Waste as a Resource
Waste as a Resource

The EU Data Centre on Waste compiles waste data at European level.

- According to data for 2010 for 29 European countries (i.e. EU-28 and Norway), around 60% of the waste generated consisted of mineral waste and soil, largely from construction and demolition activities and mining.

- For metal, paper and cardboard, wood, chemical and medical waste and animal and vegetal wastes, each waste type ranged from 2% to 4% of the total.

Waste as a Resource

Around 10% of the total waste generated in Europe consists of what is known as ‘municipal waste’

- Waste generated mainly by households, and to a lesser extent by small businesses, and by public buildings such as schools and hospitals.

In 2012, 481 kg of municipal solid waste was generated per person in the 33 member countries of the European Environment Agency (EEA). There is a slight downward trend from 2007 onwards, which can be explained partly by the economic crisis affecting Europe since 2008.

Europe's waste streams

In total, about 2500 million tonnes of waste was generated in the EU-28 and Norway in 2010. Here is an overview of where the waste came from and what it was composed of:

### Waste streams by source
- **Construction**: 34%
- **Mining and quarrying**: 27%
- **Manufacturing**: 11%
- **Households**: 9%
- **Energy supply**: 3%
- **Other sources**: 16%

### Waste streams by type of waste
- Mineral waste: 43.5%
- Soils: 16.4%
- Household and similar waste: 7.4%
- Construction waste: 5.0%
- Animal and vegetal waste: 4.4%
- Metal waste: 3.9%
- Chemical and medical waste: 2.5%
- Wood waste: 2.5%
- Paper and cardboard waste: 2.3%
- Other waste: 12.2%

Irish Context

The construction industry accounts for approximately

- 50% of materials used on the planet,
- 48% of all waste generated in Ireland

Very little of this waste is currently reused, or even recycled. Where recycling does take place, it is often in the form of downcycling, creating aggregates and backfill at best.

Irish Context

The objective of the pilot (Construction Materials Exchange (CMEx) project) is to demonstrate a

- feasible
- transparent
- fair
- user-friendly

system for the reuse of construction materials that would otherwise enter the waste stream.

Material Resources: The Cycle of Materials

Source: BERGE, B., (2009) the ecology of building materials 2nd ed
Circular Economy & Waste

- The construction sector consumes 42 billion tonnes of resources annually, making it the most material-intensive sector.
- The construction sector also produces about one-third of all global waste, most of which is not recycled or reused, but ends up in landfills.

Source: https://www.circle-economy.com/resources/building-a-circular-construction-sector-is-hard-but-it-is-happening
Circular Economy & Waste

Construction and Demolition (C&D) waste is waste from any building works, demolition and development (including transport infrastructure).

- The remainder includes concrete, brick, tiles, metal, glass, wood, plastic and metal.
- Excavated soil and stone is the largest element of construction and demolition waste at approximately 85%.
- The quantity of C&D waste generated and collected in Ireland increased to 8.8 million tonnes in 2019.

Circular Economy & Waste

- Most of the C&D waste collected in Ireland in 2019 was backfilled (82%), while 10 per cent went for disposal and only 7% per cent was recycled. This reflects the large proportion of soil and stones in C&D waste.

- Recycling was the main treatment operation for metals (100%) and waste bituminous mixtures (64%).

- It is notable that only 39% of segregated wood, glass and plastic waste was recycled in 2019 while 54% went for energy recovery (incineration).

Circular Economy & Waste

Figure 2. Composition of C&D waste material collected in Ireland, 2019


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Circular Economy & Waste - Example

Plasterboard Recycling Service (PRS)
https://www.gyproc.ie/services/plasterboard-recycling-service

https://www.gyproc.ie/services/plasterboard-recycling-service

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Circular Economy & Waste - Example

Expanded polystyrene (EPS)

EPS is used for packaging and insulation

Offcuts and waste are shredded, then heated and compressed into a solid mass, reduced to 10% of its original size, for resale and re-use.

It is exported to manufacture insulation to Spain, Portugal and Germany.

12% of EPS currently recycled globally

Waste Matters (Ireland) Ltd

https://www.youtube.com/watch?v=zDfdya7iUVY&ab_channel=WasteMatters

Recycling system at (LOETB) National Construction Training Centre at Mount Lucas, Ireland
Enablers for Reuse

- Increased community awareness and education on recycled products.
- Develop supportive regulations, policies and specifications.
- Facilitate sustainable programs.
- Promote product certification.
- Advocate targeted technologies and innovative practice.

Source: https://www.researchgate.net/figure/Emergent-model-on-barriers-and-enablers-for-using-recycled-C-D-waste-products_fig4_346258505

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Barriers for Reuse

- Increased costs of energy and transport.
- Lack of knowledge on recycled products.
- Limited technologies for waste recovery.
- Low quality and possible contamination.
- Lack of market availability of the products.
- Limitations caused by specifications, standards and permits.
- Limited acceptability and negative perception.

Source: https://www.researchgate.net/figure/Emergent-model-on-barriers-and-enablers-for-using-recycled-C-D-waste-products_fig4_346258505
Lendager Group - Resource Rows Project
Oerestad, Copenhagen

The Resource Rows is using upcycled bricks and waste wood, a recycled concrete beam used as a bridge and old windows and waste wood as rooftop community gardens huts with an atmosphere of allotment gardens.

A significant and innovative concept is to reuse brick facades from abandoned structures in the new building, saving as much as 29% CO2 by upcycling only 10% of all building materials.

Source: https://lendager.com/project/resource-rows/
Limerick 2020 - OPERA SQUARE
Limerick, Ireland

It’s one of the country’s biggest projects involving the recycling and reuse of construction rubble in which over 1,000 tonnes of

- stone
- brick
- cobblestone
- old doorways
- gates

have been salvaged.

Limerick 2020 - OPERA SQUARE
Limerick, Ireland

Sixteen old buildings, many of them Georgian, and of important historical significance, are being retained for use as living accommodation, but huge volumes of material which would otherwise go to landfill, are also being harvested for reuse in other building projects throughout the Opera Sita and greater Limerick.

Further information and image source - https://limerick2030.ie/opera-site/

Digital Marketspace
What is a Digital Marketspace

In simple terms, digital marketplaces connect multiple sellers with multiple buyers via an online platform. They exist across a wide range of operating models, including price comparison sites, affiliates, online auction platforms, lead generators, cashback sites, sales platforms and classifieds. Some marketplaces adopt multiple models to serve multiple needs.

Source: https://www.pwc.co.uk/industries/technology-media-and-telecommunications/insights/digital-marketplaces.html
Types of a Digital Marketspace

1. Business-to-consumer (B2C) marketplaces
2. Business-to-business (B2B) marketplaces
3. Peer-to-peer (P2P) or consumer-to-consumer (C2C) marketplaces
4. Consumer-to-manufacturer (C2M) or consumer-to-business (C2B) marketplaces
5. Service-to-consumer (S2C) marketplaces

Benefits of a Digital Marketspace

Easy to use. Online platforms are usually user friendly and human focused.

Access to a ready customer base. Supports connections with target audience and can remove barriers that may exist outside of these platforms.

Fulfillment, payment, and logistics. Payment and supply is easy and straightforward. It can also support buying local removing waiting times.

Innovation. Allows for new products, concepts or material used to be shared easily in one place with other professionals.

Marketing, analytics, and personalization. Easy to tailor your search or direct you towards a target audience from one place.

Global reach. Can allow for connections and sales to happen internationally where necessary, however, it is often better and more sustainable to purchase locally.

Source: https://www.the-future-of-commerce.com/2021/05/12/digital-marketplaces/
Examples of Digital Marketspaces in Construction

Digital marketplaces have a place in the construction industry going forward. They not only allow for easy access to expert reusable and more sustainable materials they also help to guide consumers to local business and suppliers.

The benefits of employing digital market spaces are similar to the benefits that can be seen in the second hand clothing market already, such as reduced material loss and longer lifetimes of products. This can lead us to a more sustainable future and circular future for the construction industry.

Ireland CMEx Project

The CMEx project is a pilot scheme to demonstrate a

• feasible
• transparent
• fair
• user-friendly system

for the reuse of construction materials that would otherwise enter the waste stream.

The project will identify and track resources through the supply chain;

- identify the potential value of matching materials
- apply these insights to steer organisational processes towards supporting a circular economy.

It will identify materials from the waste stream with the potential for diversion to reuse and develop mechanisms to enable reuse through an online platform that generates materials passports, facilitates material matches, and utilises blockchain technology to document transactions.

Excess Materials Exchange (EME) is a young and innovative technology company. They find new high-value reuse options for materials or (waste) products for companies. Far too many valuable resources and materials are wasted or ill-designed in the current paradigm, for which the planet must pay a heavy price. Isn’t that a waste?

EME aims to accelerate the global transition to a circular economy – and play a part in creating a more viable planet. By showing the financial and ecological value of materials. By challenging companies to design and produce their goods in a more efficient and circular manner.

Source: https://excessmaterialsexchange.com/en_us/
The digital platform unlocks the maximum potential of your company's materials, products and waste streams by matching them to their highest value uses. The best part about that? It's better for your profits as well as the planet. In our experience, material flows increase by 110% on average in financial value, and the ecological footprint reduces by 60% on average. Four tools are instrumental to our method of working:

1. Resources Passport
2. Tracking and Tracing
3. Valuation
4. Matchmaking

Source: https://excessmaterialsexchange.com/en_us/
Material Banks

A material bank is essentially a stockpile or store of materials for future use.

In construction this can take the form of a building, this change in the way we think about a building can help us to view a building as something that can continue its life after the initial use is complete.

This can pair with Material Passports or Design for Disassembly for added value.

Source: https://www.youtube.com/watch?v=3EKddd_dAn0
Follow link to watch video
In the Project BAMB – Buildings As Material Banks 15 partners from 7 European countries were working together with one mission –

- Enabling a systemic shift in the building sector by creating circular solutions.

Today, building materials end up as waste when no longer needed, with effects like

- destroying ecosystems
- increasing environmental costs
- creating risks of resource scarcity

Source: https://excessmaterialsexchange.com/en_us/
To create a sustainable future, the building sector needs to move towards a circular economy.

Whether an industry goes circular or not depends on the value of the materials within it – worthless materials are waste, while valuable materials are recycled. Increased value equals less waste, and that is what BAMB is creating – ways to increase the values of building materials.

Source: https://excessmaterialsexchange.com/en_us/
BAMB will enable a systemic shift where dynamically and flexibly designed buildings can be incorporated into a circular economy. Through design and circular value chains, materials in buildings sustain their value – in a sector producing less waste and using less virgin resources. Instead of being to-be waste, buildings will function as banks of valuable materials – slowing down the usage of resources to a rate that meets the capacity of the planet.

Source: https://excessmaterialsexchange.com/en_us/
Application for Multi-functional Green Roofs Facades and Interior Elements
Caixa Foundation - Madrid, Spain - Herzog & De Meuron

Situated in the heart of Madrid’s cultural district, the Caixa Forum Museum vertical garden was designed and created by Patrick Blanc using his Le Mur Végétal system. The adjacent square is accessible to the public who can walk up, touch, and explore over 15,000 plantings on the hydroponic living wall.

Nearly 300 different species were chosen by Patrick Blanc who had to keep in mind Madrid’s very demanding seasons – very hot in the summer and cold in the winter.

Question One

Taking into account all parts of the building here, what are some examples of reuse of waste that could have been utilised in the construction of this building?

Consider how the plants are attached, the materials used and the demolition of the building that may have stood here previously.

Question One
If this project was to be demolished, what opportunities would present themselves with the waste materials?


Source: https://architizer.com/projects/caixaforum/
QUIZ/ASSIGNMENT/ACTIVITY
EXTRA READING/STUDY
For Further Case Studies and Training Material Please Follow the Link Below

https://docs.google.com/spreadsheets/d/1DTte4Ph8pQ4lKzYGFl2_S-d1Z_Rmd9i/edit?usp=sharing&ouid=112148808974461842163&rtpof=true&sd=true
EXTRA READING/STUDY

BAMB - Building as Material Banks
https://www.bamb2020.eu/topics/reversible-building-design/

Urban Mining: The Future of Material Sourcing
https://www.malbaproject.com/post/urban-mining-the-future-of-material-sourcing
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