Circular economy in the built environment: A Balfour Beatty perspective

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Constructing excellence
Future proof against what?

Simply put:

Managing planet Earth with its growing human urban population, resource constraints and changing climate.
Implication: Unsustainable growth
What are the key resources/materials we need?
How much resources/materials do we need?
For what?
What happens if we cannot access them?
What happens if they become too expensive or run out completely?

New business models – a circular European economy?
A secondary materials market?
Circular Economy examples within Balfour Beatty
Product Life Extension: XiSPAN Polymer

- National Rail own and maintain more than 25,000 masonry arch bridges
  - Many are beyond expected design life
  - Aging increases maintenance costs
  - Now facing higher vehicle loads and speeds than designed to withstand

- Balfour Beatty Rail, in collaboration with industry experts, designed XiSPAN Polymer in order to:
  - Maintain or increase capacity of the arch
  - Reducing or eliminating causes of deterioration
XiSPAN significantly improved the structural integrity of the pilot bridge, increasing its lifespan.

- Additional Benefits:
  - Less disruptive to rail and road traffic and more cost effective than traditional approaches
  - Uses less natural resources
  - Does not affect the visual appearance of the structure (important as many bridges are listed)
  - Has the potential to transform masonry arch bridge strengthening in the rail sector
Stone ballast under railway sleepers tends to shift over time, causing track alignment issues.

Tamping is traditional method to rectify track alignment faults:
- Tamping cannot position additional material under sleepers
  - Track alignment typically returns to previous, misaligned position
- Tamping is one of the largest contributors to ballast degradation.
Product Life Extension: Railway Stoneblowers

- The use of stoneblowing machines allows for insertion of additional material without disturbing the compacted ballast bed
  - Does not cause damage to the existing ballast and avoids the shortening of its useful life
  - Stoneblowing provides far greater track improvement durability
    - Avoiding the need to tamp sections of track by stoneblowing instead could provide up to a 40% increase in ballast life
Material Reuse: M25 DBFO

- Lean design - maximizes use of existing assets and drives out waste
  - During lane widening operations:
    - Produced in excess of 1,000,000 tonnes of Recycled High Quality Aggregates
    - 250,000 tonnes of Glass Sand used for drainage and backfill saving virgin aggregates
    - More than 3,000,000 tonnes of excavated fill to landscape bunds saving disposal to landfill
Material Reuse: M25 Junctions 5 to 7

- Delivering the first ‘Smart Motorway’ in the UK
  - Standard solutions developed for fast, safe and consistent installation
  - 12 mile stretch of M25 near Croydon
    - £1M savings from use of environmental bunds, recycled aggregates and volumetric trucks
    - 302 tonnes CO$_2$ emissions savings from using recycled aggregate over virgin sourced aggregates
Material Reuse: Gandhi Chaplin Memorial Garden

- Part of the Olympic Stadium Transformation project
- At least 50% of all deconstruction materials were to be reused by the London Legacy Development Corporation
  - 200 m² of bridge decking
  - 150 tonnes of materials
  - More than 10,000 plants from Olympic sites collected for this and other community projects
Circular Design: King Sheet Piling (KSP)

- KSP saves up to 40% of the steel used in a conventional sheet pile wall, whilst guaranteeing dramatic productivity, environmental, safety and sustainability benefits
  - Sheet piles are 100% re-cycled steel and can be re-used or re-cycled
  - Embedded carbon reduced through less steel, easier driving and reduced transport
  - Installation energy substantially reduced
Circular Design: King Sheet Piling (KSP)

- M25 widening project:
  - Savings over £10M
  - ~40,000 tonnes of CO\textsubscript{2} emissions saved through the substantial reduction of steel/use of recycled steel

- A421 improvements project:
  - Saved £2.7M in material costs
  - Embedded carbon was reduced by 905 tonnes of CO\textsubscript{2} emissions
  - Avoided a projected 3 month programme over-run
Reduced waste in construction

- 98% of demolition materials recycled
  - Selective deconstruction and site waste segregation – material reuse in new construction
  - Other materials recycled off-site or reused in school/community projects

- Currently 98% of construction materials recycled or reused
  - School/community based projects
Increased recycled content in construction materials
- Nearly 25% recycled content in materials brought on-site
  - Carpeting, plasterboard, insulation
- Approximately 60% for steel and concrete products

Product Life Extension
- A listed façade on Regent Street must be retained
  - Necessary to extend façade lifespan to match new build lifecycle
Community Wood Recycling (CWR) is a network of wood recycling social enterprises providing an efficient and cost effective collection service for all types of waste wood:

- Save resources by reusing and recycling waste timber
- Create jobs and volunteering opportunities for unemployed people

CWR are correctly licensed and supply Waste Transfer Notes:

- Also provide environmental reports and certificates of recycling
Construction of the new Moffat substation required over 1,500 cables of varying lengths to be installed

- The majority of the equipment arrived on timber cable drums
- Prevented timber cable drums becoming waste by carefully storing them on site and later returned these to Anixter for reuse
  - Over 1,500 cable drums have been returned to the manufacturer
  - Avoided approximately 28 Ro-Ro waste skips – saving £6,440
The Circular Economy is happening in infrastructure projects

Contractors have material scientists and expertise

CE materials / interventions need to be commercial viable

Challenge is pricing of CE materials – e.g. need to stimulate a secondary materials market – more collaboration required: not thinking about material banks and future use

Design is critical and so are the practicalities of construction and de-construction.