Reuse of building components

Presentation of RFCS project

PROGRESS
PROVISIONS FOR GREATER REUSE OF STEEL STRUCTURES

Petr Hradil

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- VTT is one of the leading research and technology organisations in Europe.
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VTT Research Area: Lifecycle solutions

- Raw material processing
- Powder manufacturing
- Additive manufacturing
- Full-scale testing of components and structures

Manufacturing

- Multiscale modeling
- Materials design
- Components and structures
- Optimization
- Service life design
- RAMS design

Materials & design

Every step matters

Operation & maintenance

- Monitoring
- Ageing management
- Performance evaluation
- O&M services
- Asset management
- Resilience, Safety & Security
- Risk management

Ageing & lifetime extension

- Durability of materials
- Recovery, redesign & remanufacturing
- Utilization of secondary raw materials & side streams
- Circular business concepts

Retrofit, remanufacture re-use & recycle

Every step matters
Infrastructure Health Team

**Building materials**
- Material development
- Sustainable, resource-efficient use of materials
- Eco-efficient alternatives, utilization of by-products
- Material re-use and recycling technologies
- Design, performance verification and assessment
- Materials for nuclear waste management

**Geotechnics**
- Geological site characterization; geophysical, geotechnical, and hydrogeochemical analyses
- Surface- and groundwater modelling and monitoring
- Smart urban & smart water infrastructure Design of Engineered geo-barriers for nuclear waste disposal

**Structures**
- Safety assessment of infra-structure
- Exceptional loads and extreme environments
- Infrastructure service life design
- Durability modelling and maintenance optimization
- Novel construction products
- Safety of nuclear power plants containments

**Monitoring & NDE**
- Multi-scale monitoring and modelling
- Wireless sensors and network systems
- Performance monitoring in harsh environments
- Monitoring of geological waste disposal systems
- Non-destructive testing and evaluation for quality control and performance assessment
Vision for the future reusable buildings

High end-of-life value
Building owners will be actively engaged in offering reusable components for sale before the deconstruction.

Reusable BIM
BIM objects for the new building design will be equally sourced from the product manufacturers and second-hand material dealers.

Reversible and scalable design
Buildings will be designed for deconstruction and reuse. The evolution of future buildings (e.g. in thermal insulation, story height) will be anticipated in the design.
Demolition or deconstruction?
Focus on single-storey steel buildings
Broad applicability (industrial, commercial, sports, exhibition, warehouses), suitable for reuse and viable for circular-economy business models. The results will be easily extendable to other materials and building typologies.

Existing and future buildings
Reuse of existing building stock is challenging and only marginally profitable.
Documented case studies
Bus terminal at Schiphol Airport

1942 London

1958 Rotterdam

2015 Schiphol
Documented business models

Reuse of the whole primary structure (CZ)

Reuse of the reconditioned steel sections (UK)

Photo credits: Arnošt Balcar
Assessment of reusability

Technical reusability (similar principle to BRE or DGNB Design for Deconstruction)

Component: \( r = \sum \rho_i w_i \)

Building: \( R = \frac{\sum m_i r_i}{\sum m_i} \)

- Performance assessment result (%)
- Weighting factor for each performance category (%)
- Component mass (t)

Economic prospect (complementary score)

Component: \( e = P(c_1 \cap c_2 \cap \cdots) n \)

Building: \( E = \frac{\sum m_i e_i}{\sum m_i} \)

- Criteria (e.g. span, height, floor area)
- Number of new buildings in the selected area and time span

Comparison of different scenarios

Overall reusability index R

- Complete relocation
- Frames separately
- Only sections
Environmental benefits of reuse

Module A

- Reused steel input
- Avoided primary production and manufacturing
- Recycling
- Transport
- Manufacturing
- Use
- End of life
- Already accounted reuse
- Module D

Module B+C

- Reusable steel output
- Already accounted recycling
- Recovery rate
- Recovered material on input (e.g., scrap for recycling)

Module D = \sum (RR_i - S_i)(X_{r,i} - X_{p,i})Y_i

Recovery rate

Unit impact of the recovery

Unit impact of the primary production
Drone photogrammetry
Testing protocol

Non-destructive testing
- XRF spectrometer
- Hyperspectral camera
- Hardness testing

Minimum-invasive testing
- strength and ductility
- impact toughness
- weldability

Standard coupon tests
On-line trading platform
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