Maximizing Materials Efficiency In the Building Sector

Egil Hogna, Norsk Hydro World Materials Forum 28th June 2018

Sustainability is the challenge of modern construction

- The growth of the world's larger cities requires sustainable urbanization
- The building sector can drive the shift towards a more circular economy
- Maximizing materials efficiency in design and construction requires changes also for the materials companies





The building industry status quo

Situation and challenges

- 90% of the world's infrastructure projects are either late or over-budget
- Construction has the lowest productivity gains of any industry
- Lack of investment in new technology and machinery
- Many small players and little consolidation
- Few tools that might improve productivity are used
- Few standards and customized nature of projects





Photo by Ricardo Gomez Angel on Unsplash

How to maximize materials efficiency?









Weak and stagnating productivity

Building industry has difficulties to change its habits and modernize its processes





Many ways to increase productivity

The Suppliers

- Develop more prefabricated solutions
- Develop modular solutions
- Develop and offer 3D printing for low volume units

The Building sector

- Use prefabricated / industrialized solutions
- Use 3D printing both for prototyping and low volume products
- Speed up the use of BIM
- Use materials that cater to both industrial production and "haute couture"

Collaboration

- Collaboration among building players: data transparency and digital tools enable solutions
- Consolidation?
- Standards
- Automation



KPI ideas for productivity

- General KPI
 - % professionals using digital, e.g., BIM tools
 - Modules: % building value based on modular/prefabricated solutions
 - Labor productivity (construction value per FTE)
- Specific KPI
 - Business specific IT solutions use: % of clients of a manufacturer which are equipped with specific software





Durability is already high for certain materials

- The lifespan of a residential building is around 70 to 100 years in Europe
- The time has come for :
 - Building to last or to reuse
 - Optimizing what we already have
 - Building "flexible" for adapting to changes in users needs





Ensure durability by making the right design choices

- Select durable materials that require little maintenance
- Choose long lasting and ideally flexible solutions
- Materials that allow for healthy solutions (take benefit of natural light, without VOC, fireproofing)
- Providing multifunctional and modular solutions
- Use sensors and embedded intelligence to increase efficiency in use





KPI ideas for durability

- Lifecycle cost per element/material
- Selection of materials should also include the KPI of maintenance and lifetime cost
- Holistic KPIs
 - Home satisfaction for consumers
 - Insulation measures





Why aluminium?

Hydro's strategic direction aims to realize full potential of aluminium's strong qualities and versatility



Aluminium

- Lightness and strength
- Durability and formability
- Corrosion resistance
- Conductivity
- Recyclability
- × Energy-intensity



Steel

- Strength and durability
- Recyclability
- Price
- X Weight
- × Corrosion
- × Energy-intensity



Copper

- Conductivity
- Corrosion resistance
- Recyclability
- × Price
- 🗙 Weight
- X Energy-intensity



- Composites
- Strength
- × Price
- × Recyclability
- X Climate footprint
- × Energy-intensity



- PVC
- Lightness and formability
- Corrosion resistance
- Price
- X Climate footprint
- 🗙 Recyclability
- 🗙 Durability



For illustrative purposes only

Circularity awareness

- The global economy is only 9.1% circular leaving a massive 'Circularity Gap'
- To curb global GHG emissions so that global temperature increase remains below 2 degrees, the World Green Building Council is calling for the dual goals of:
 - All new buildings must operate at net zero carbon from 2030
 - 100% of buildings must operate at net zero carbon by 2050





Ensure circularity by design and material choice

- Select materials that exhibit a good life cycle assessment
- Contribute to the zero carbon building target
- Participate in a closed loop getting closer and closer
- Use carbon neutral solutions and/or with high recycled content
- Rely on profitable waste management business (collection and recycling systems for metal have been operational for many years)
- Design for disassembly





Carbon footprint of aluminium varies with power source

CO2 emissions and main energy source in aluminium production by country Tonne CO2 / tonne aluminium





Source: CRU

LOW CARBON PRODUCTS

Infinite solutions









KPI ideas for circularity

- Overall indicator
 - % construction waste in total waste
- Material-oriented KPIs
 - Material recycling rate (e.g. 95% of aluminium from buildings is recycled)
 - Recycled content in key solutions
 - Price ratio scrap vs. primary material

Source: Eurostat



% Construction in total waste (EU)



As a conclusion

Use Less

- Increase quality level
- Improve production modes / conditions
- Foster cooperation between building industry participants

Use Longer

- Prefer long lasting products
- Build modular and easy to maintain
- Leverage smart/ connected solutions

Use Smarter

- Choose recyclable products
- Increase recycled content
- Design to disassemble
- Low CO₂ lifecycle emissions



Summarizing our session

- Digital tools and data management are critical to set benchmarks and track progress of using materials smarter, less and longer
- Using recycled material is one of the greatest opportunities to minimize overall materials intensity
- Innovation in materials and design continues to make in-roads enabling a reduction in materials intensity, but can go faster
- Collaborate to modify building codes to promote materials intensity reduction and use of recycled material

