

Challenges in Industrialized Renovation of Apartment Buildings

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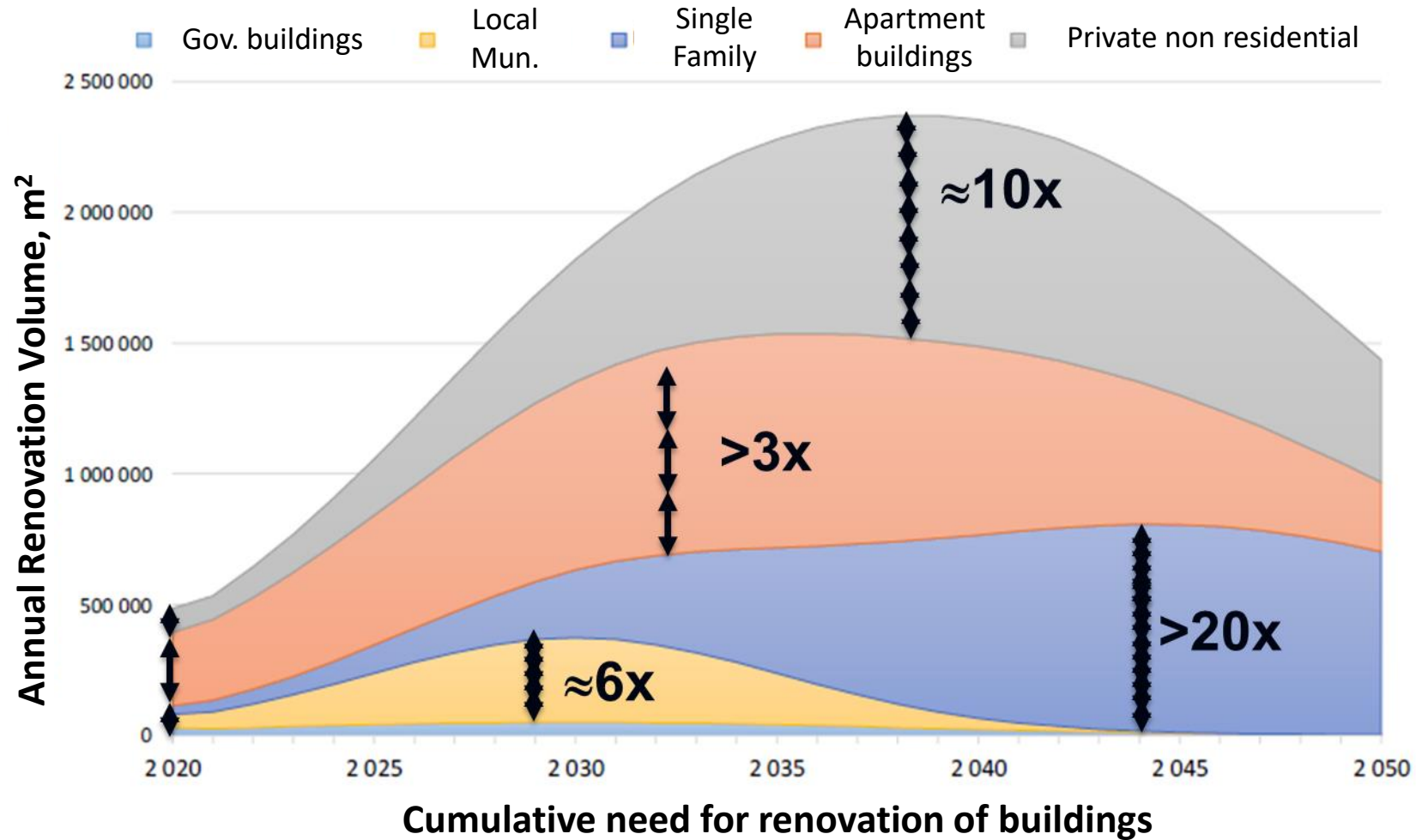
AGENDA

- Introduction
- Research Aim and Methods
- Case Description
- Results
- Discussion
- Conclusions

Introduction

- **The new European Green Deal framework:**
 - Renovation of existing building stock by 2050
 - Industrialization and digitalization of sustainable renovation
- **Estonian Renovation Roadmap:**
 - Improved quality of built environment
 - Reduction of thermal energy needs up to 70%, electricity consumption up to 20%, and CO2 emissions up to 90%
 - 141 000 (27 000 public, 100 000 single-family, and 14 000 residential) buildings with a total area of 5.4 million m2 need to be renovated

Introduction: The Challenge



Traditional mineral-based construction methods not fit for purpose:

- Industrialization
- Digitalization

Research Aim and Methods

Research Aim:

- To identify and understand existing practices, main barriers, and opportunities to develop the industrialized sustainable renovation of existing Soviet-time apartment buildings in Estonia

Research Method:

- A case study was carried out on the Akadeemia 5A student apartment building
 - Five semi-structured interviews
 - Secondary data sources: project documentation and presentations
- Two additional interviews with two building manufacturers to study their perspectives on the industrialized renovation of buildings

Case Description

Objectives: A nearly zero energy building (105 kWh/(m² a) and research of industrialized renovation

Building: Five-story building (Soviet building type 121); 80 apartments; built in 1986

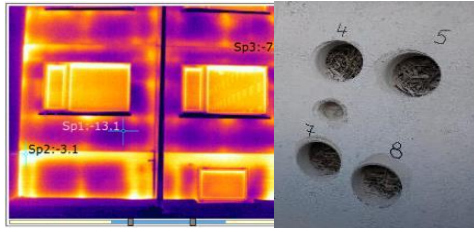
Conditions: External walls could not be removed as these formed an important part of the existing structural scheme

Energy Consumption: Measured primary energy use 300 kWh/(m² a)

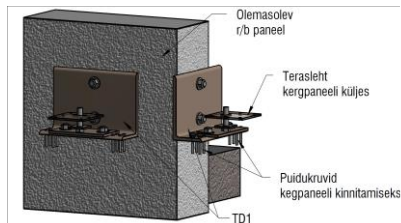
Cost: Total 822 €/m² (121 €/m² general construction works, 251 €/m² finishing works, 334 €/m² on energy efficiency works and 116 €/m² on nearly zero energy building works)



Results: Practices



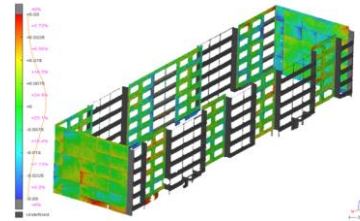
Building Research



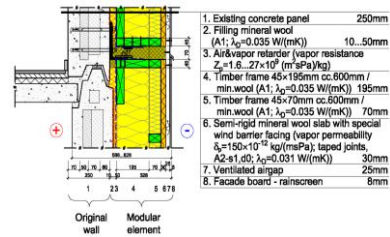
New connection



Windows and ducts in factory



Laser Scanning



Design for MA



Installation on site



Installation video

Results: Barriers

Planning:

- No easy access to existing building project documents
- Scanned data was missing information and was not compatible
- Selected procurement model

Design:

- Lack of moisture engineering, and engineering for fabrication competencies

Manufacturing:

- Heavy elements to handle (bending)
- Soft materials challenged manufacturing

Transportation

- Lack of space for storage
- Storage on site caused water and moisture damage

Installation:

- Inaccurate installation of connections
- Handwork to fit elements on site
- Poor planning of installation process

Results: Opportunities

Planning:

- Library of project documents for different building types
- Scan to BIM workflows to automate inventory modelling

Design and manufacturing

- New connections
- Better technical solutions to reduce work on site
- Design automation (configurator)
- Integration of design, manufacturing and installation
- Design for manufacturing

Transportation

- New lifting equipment
- Just in time delivery to reduce water and moisture damage

Installation:

- Involving surveyors or using rapid reality capture to aid installation
- Prototyping of installation in factory and on the site
- Plan for installation flow
- Digital tools for production planning, coordination and control

Results: Summary

	Practices	Barriers	Opportunities
Planning	Studying archived project documents; laser scanning	Time-consuming to find; poor practices of scanning	Digitalizing original project documents; implement Scan to BIM
Design	Prefabricated wall and roof elements; 3D connections	Lack of knowledge and understanding of industrialization	Standardization of products; integration of value chain; automation and digitalization
Manufacturing	Sequencing; windows and ducts installed in the factory	Heavy elements; inappropriate materials for manufacturing	Special lifting equipment; proper choice of materials
Logistics and Transportation	Sequencing; different equipment	Lack of space around the building; weather	Proper lifting equipment; just in time delivery; material kitting
Installation	Procurement of trade partners based on lower bid price	Installation of connections; poor installation management	Involvement of surveyors in the installation process; prototype installation; implement flow

Discussion

Barriers to Industrialized Renovation

- Procurement methods
- Traditional management approaches
- Industrialization and standardization capabilities
- Norms and standards
- Lack of competencies

Core Elements of Industrialized Renovation

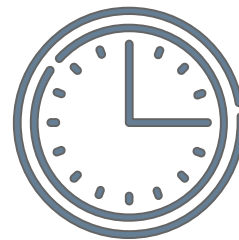
- Product industrialization and standardization
- Process industrialization and standardization
 - Integration of supply chain
 - Collaborative procurement methods
 - Tolerance management
 - Collaborative planning and control
 - Prototyping for rapid learning
 - Digitalization
 - Continues improvement

CONCLUSIONS

Large scale renovation brings forth challenges and opportunities for a systemic change in the construction industry



New capabilities for delivering industrialized renovation of sustainable buildings are needed



Improving the sustainable renovation of existing buildings requires a comprehensive and systemic approach



THANK YOU!

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