EHITUSTEADUSKOND
EHITUSTOOTLUSE INSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2013

1. Instituudi struktuur

Ehitustootluse instituut, Department of Building Production
Instituudi direktor Irene Lill

- Ehitusmaterjalide õppetool, Chair of Building Materials, Lembi-Merike Raado
- Ehitustehnoloogia õppetool, Chair of Building Technology, Irene Lill
- Ehitusökonoomika ja -juhtimise õppetool, Chair of Construction Management and Economics, Roode Liias
- Ehitusmaterjalide teadus- ja katselaboratoorium, Laboratory of Building Materials, Margit Rosenberg

2. Instituudi teadus- ja arendustegevuse (edaspidi T&A) iseloomustus

2.1 Struktuuriüksusesse kuulub kaks uurimisgruppi

1) Building Lifecycle Research Group (ehitise eluea sidusuuringute grupp) Juhid: Irene Lill ja Roode Liias

The Building Lifecycle Research Group brings together researchers from the **Chair of Building Technology** (Irene Lill) and the **Chair of Construction Management and Economics** (Roode Liias).

The research reflects the building lifecycle as a whole, integrating the construction process and its outcomes with management strategies, technologies and materials used and also with economics and facilities management. Recent research studies have included:

- Multi-attribute decision making methods for the assessment of different management strategies;
- Comparing risk transfers under different procurement arrangements;
- Different aspects of construction economics and management in the major fields of civil engineering (building construction, road engineering, engineering services, etc.);
- Developing and providing BIM-related know-how;
- Process management strategies in construction;
- Surveys of the technical condition of housing;
- Regulation of construction activities and creation of normative materials and standards for the Estonian construction industry;
- Construction-related disaster resilience;
- Educational aspects of civil engineering, etc.

Members of the group are also active research partners within other faculty and industry projects where their expertise is needed, for instance in:

- Energy saving renovation methods for buildings and facilities,
- Creation of engineering solution and design methods for energy-saving and environmentally friendly structures;
- Surveying the technical condition of apartment buildings;
- Sustainable management of historic rural churches in the Baltic Sea Region.
- Advising the public and private sector in questions of construction management, building maintenance, etc.

The major results for 2013:

- fulfilling the R&D contracts and completing projects; presenting the results for the organisations related to the field
- translation of the whole of the 7-part standard EN 15221 into Estonian; introducing the main ideas of these documents to organisations working in the sector and preparing the concept for the new national standard EVS 807:2015
- carrying out regular teaching and training for road engineering organisations in Estonia as for FIDIC contracts and carrying out different dispute resolution cases
- preparations to get the new ERASMUS contracts:
  - SuReEsDe – Sustainable Real Estate Development
  - SuReMaSuPi – Sustainable refurbishment of residential buildings and the management after completion. Sustainable public information

The following international and national projects were **completed** successfully:

- Central Baltic Interreg IV A project **DigiEduET - Digital Processes for Education and Management of Construction**. The project contributed to research and competence development in civil engineering higher education and practice by improving teaching methodology and curriculum development through implementing contemporary digital methods. The project aimed to raise the level of building know-how in regard to the building standards followed in the programme area, harmonize prevailing technology and quality demands, as well as enhance the use of common building terminology.
- **LARGE - Learning Augmented Reality Global Environment**. The project was designed to create a new type of learning environment that supports educational institutions in delivering their curricula in the most attractive and effective way.
- **EPA: Development of Estonian spatial planning curricula sector co-operation for establishing joint courses, practice and training system.** The project with Tartu University aimed to develop a unified study-programme in spatial planning for Estonian universities. In parallel to this, the training courses were started keeping in mind the lack of spatial planning professionalism in the field in Estonia. Practitioners were also involved. The project followed the guidelines set up in the Estonian development plan for assuring the quality of education.
- **Elaboration of parametric product catalogues and creating the alternative environments for these catalogues. This** project was carried out for the Ministry of Economic Affairs and Communications. BIM (building information modelling) is a fast-developing, IT-based paradigm supporting the efficient design, construction, operation and maintenance of buildings. It targets the entire supply chain and is intended to enhance the performance and cooperation of all stakeholders through the sharing and seamless transfer of information. The outputs of this research included: analyses of the current situation and reasoning the need for product catalogues; providing alternatives to assure the managing and functioning of the environment for these catalogues; the preparation of three samples prepared for the three most popular products used by the market; and methodological guidelines for preparing the catalogues.

The team is **continuing** working on international projects:

- **CENEAST-Reformation of the Curricula on Built Environment in the Eastern Neighbouring Area.** The goal of the project is to upgrade the curricula for BSc, MSc, PhD building and civil engineering programmes with new modules, to create a virtual interuniversity networked educational system, and to support the skills development of staff and students' training in the partner countries.
- **ANDROID- Academic Network for Disaster Resilience to Optimise Educational Development.** ANDROID is an Erasmus academic network which aims to promote co-operation and innovation among European higher education institutions to increase society's resilience to disasters. The ANDROID disaster resilience network comprises 67 partner organisations from 31 countries. These include higher education institutions, national and local government departments, non-governmental organisations and independent research organisations

In cooperation with the other departments of the faculty:

- **Nearly zero energy buildings (nZEB) in Estonia: energy, durability and indoor climate performance analyses combined with cost optimality assessment for transformation**. Technical solutions for nZEB most urgently needed in Estonia are studied. These include new heating and ventilation solutions suitable for specific operation conditions in nZEB, verified with laboratory measurements. New external wall assembly solutions are studied with computational analyses and climate chamber tests. Office building solar shading and façade analyses will use energy simulations, field measurements and full scale measurements at the TUT technological facility. Energy simulations are combined with economic and cost optimisation analyses.

Two new international projects were **started** in 2013:

- **CADRE-Collaborative Action towards Disaster Resilience Education.** This project will improve the quality and relevance of higher education through active cooperation between higher education institutions and partners from outside academia, including construction professional bodies, local/national/international bodies and social partners. The team aims to establish a framework for industry, community and university integration to address societal concerns, and develop an innovative professional doctoral programme that integrates professional and academic knowledge in the construction industry to contribute towards societal resilience to disasters.
- **CASCADE- Collaborative Action towards Societal Challenges through Awareness, Development and Education.** CASCADE aims to provide the foundation for a future programme targeting South Asian Countries and which will promote bi-regional coordination of Science &Technology cooperation. During the project, the team will: compile a regional position paper that identifies global challenges and research priorities; map and develop an inventory of national and regional stakeholders corresponding to the global challenges; and raise awareness on research & innovation priorities for fostering cooperation and building mutual understanding on how to address common global societal challenges.

In cooperation with the other departments of the faculty:

- **Nearly-zero energy solutions and their implementation on the renovation of buildings.** Estonia's energy consumption indicators are often higher than those in other European countries. Buildings account for 40% of the final energy use and offer the largest single potential for energy savings. Nearly zero energy buildings (nZEB) offer a realistic solution for the reduction of energy use in the new and existing built environment. The project is strictly focused on solutions and examples of nearly zero energy buildings as well as sustainable and cost-effective energy-renovation of dwellings to low-energy levels. Better indoor climate, energy performance, environmental impact, cost effectiveness, and longer service life will be taken into account in solutions of nZEB and major renovations. The outcomes of the research project are significant at both the Estonian and EU scale. This proposal contributes to the EU objective of 20% primary energy savings in 2020 that is one of the five headline targets of the Europe 2020 Strategy for smart, sustainable and inclusive growth.

Building Lifecycle uurimisgrupi 5 olulisemat publikatsiooni 2013:

1.1

Witt, E.; Lill, I.; Malalgoda, C.; Siriwardena, M.; Thayaparan, M.; Amaratunga, D.; Kaklauskas, A. (2013). Towards a framework for closer university-industry collaboration in educating built environment professionals. International Journal of Strategic Property Management, 17, 114 - 132

Mill, T.; Alt, A.; **Liias, R.** (2013). Combined 3D building surveying techniques – terrestrial laser scanning (TLS) and total station surveying for BIM data management purposes. Journal of Civil Engineering and Management, 19, S23 - S32.

Pikas, E.; Sacks, R.; Hazzan, O. (2013). Building Information Modeling Education for Construction Engineering and Management: Procedures and Implementation Case Study. Journal of Construction Engineering and Management, 1 - 20.

Sacks, R.; **Pikas, E.** (2013). Building Information Modeling Education for Construction Engineering and Management: Industry Requirements, State-of-the-Art and Gap Analysis. Journal of Construction Engineering and Management, 1 - 23.

2.2

Sutt, J.; Lill, I.; Müürsepp, O. (2013). The Engineer's Manual of Construction Site Planning. Oxford, UK: Wiley-Blackwell

2) Building Materials Research Group (ehitismaterjalide uurimisgrupp) Lembi-Merike Raado

The Building Materials Research Group brings together researchers from the **Chair of Building Materials** (Lembi-Merike Raado) and the **Research and Testing Laboratory of Building Materials** (Margit Rosenberg). Main activities in this area are connected with the utilization of oil shale ash in the production of building materials and energy saving and the renovation of buildings. The Research and Testing Laboratory of Building Materials has certified testing personnel, standards, methods and equipment for the evaluation of conformity for various building products:

cement, mortar, grout and concrete products and also for natural and artefact stones and insulation products.
Researchers of the group are valued experts in the construction industry and conduct research connected with the properties of Portland cement concrete and the utilization of oil shale mining waste materials in concrete. Members of the group are research partners for other faculties where expertise in building materials is needed on a regular basis. For instance, with the Faculty of Chemical and Materials Technology in the research of new utilization processes for oil shale combustion solid wastes and regarding the structural properties of chemically bonded phosphate ceramics with the Faculty of Social Sciences.

Research involves the following studies:

- Main characteristics of binders or binder constituents based on oil shale ashes from electrostatic precipitator systems;
- Basics of new utilization processes for oil shale combustion solid wastes;
- Sustainable management of historic rural churches in the Baltic Sea Region;
- Low strength backfilling concrete based on the residues of oil shale processing;
- Frost resistance of various concretes and comparison of their test methods;
- Building properties of chemically treated timber;
- Durability characteristics (vapour and water migration) of facade systems, thermal insulation and external facade coverings.

The major results for 2013:

- Working with EN Standards regarding the status of national standards EVS in the field of glass building materials and concrete (with the Estonian Union of Building Materials Producers);
- Research on properties and durability of glass construction materials for the Estonian Ministry of Defence;
- Research on the possibilities for utilization of fluidized bed combustion oil shale ashes and ashes from gas purification systems as a Portland cement second constituent contracted by Kunda Nordic Cement and Eesti Energia;
- Estonian Concrete producers' quality evaluation.

Two new national research projects were started:

- **Main characteristics of binders or binder constituents based on oil shale ashes from electrostatic precipitator systems**. The renovation process of boilers and ash precipitator systems and means of environmental protection in the Eesti Energia Narva Power Plants have changed the mineralogical and chemical composition of ashes. The aim of this research work is to identify the changes in the properties of waste ashes and define areas for using them as binders or main constituents in Portland cements.
- **Low strength backfilling concrete based on the residues of oil shale processing**. Utilization of the oil shale ash produced in Petroter processing of the oil shale. Properties and durability of various backfilling concretes based on oil shale ash as a binder modified with other mineral bindings and mining residue as aggregate is studied. The aim of the study is to determine compositions of oil shale ash binders able to harden and durable in underground conditions.

Ehitusmaterjalide uurimisgrupi olulisemad publikatsioonid 2013.aastal:

1.1

Raado, L.; Hain, T.; Liisma, E.; Kuusik, R. (2013). Composition and Properties of Oil Shale Ash Concrete. Oil Shale, 2014, No2, vol. 32 xx - xx. [ilmumas]

3.1

Liisma, E.; Raado, L.-M. (2013). Internal and External Damages of Concrete with Poor Quality of Coarse Limestone Aggregate. In: Proceedings of CESB13 conference Central Europe Towards Sustainable Building, Prague 2013 : Prague: Grada Publishing for Faculty of Civil Engineering, Czech Technical University in Prague, 2013, 393 - 396.

2.2 Loetelu töötajate rahvusvahelistest tunnustustest – puuduvad

2.3 Loetelu töötajatest, kes on välisakadeemiate või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed.

- professor Roode Liias AECEFi juhatuse liige
- emeriitdots. Toomas Laur Eesti Betooniühingu auliige
- CIB (International Council for Research and Innovation in Building and Construction) erinevate töögruppide liikmed: Roode Liias, Irene Lill, Lembi-Merike Raado, Tiina Nuuter , Emlyn Witt.

2.4 T&A-ga seotud tunnustused ja ülevaade teaduskorralduslikust tegevusest, teadlasmobiilsusest ning anda hinnang oma teadustulemustele.

Rahvusvahelise seminari korraldamine

TTÜ ehitustootluse instituut korraldas 26. – 28. veebruar 2013 rahvusvahelise seminari "CENEAST".

Ülevaade teaduskorralduslikust tegevusest

Kaastöö retsensendina rahvusvahelistes teadusajakirjades:

- Prof. Lembi-Merike Raado: Journal of Civil Engineering and Management (Taylor and Francis), Baltic Journal of Road and Bridge Engineering, Oil Shale (Estonian Academy of Science); Journal of Materials and Structures, (Springer)
- Prof. Irene Lill: "Automation in construction" (Elsevier); "Journal of Civil Engineering and Management" (Taylor and Francis), "International Journal of Strategic Property Management" (Taylor and Francis), "International Journal of Disaster Prevention and Management " (Emerald), "Technological and Economic Development of Economy" (Taylor and Francis)Archives of Civil and Mechanical Engineering" (Wroclaw Univerity of Technology)
- Prof. Roode Liias: Journal of Civil Engineering and Management (Taylor&Francis), International Journal of Strategic Property Management (Taylor&Francis); Technological and Economic Development of Economy (Taylor&Francis); Construction Economics and Management; (Taylor&Francis), Journal of Facilities Management (Emerald).
- Ass. Prof. Emlyn Witt: " Journal of Civil Engineering and Management" (Taylor and Francis); and "The Journal for the Advancement of Performance Information and Value" (CIB W117 & Performance Based Studies Research Group)