EHITUSTEADUSKOND
EHITUSTOOTLUSE INSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2014

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 2014:

- fulfilling the R&D contracts and completing projects; presenting the results for the organisations related to the field
- 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 and HORIZON 2020 contracts:
  - GEEE – GreenEuroHub
  - INTERCEDE – Innovative Network for Training Early-stage Research Capability to Expand Disaster Expertise
  - DEGREE - Remote Dwelling's Health Quality Assurance, Energy and Greenhouse Gas Emissions Savings Analytics
  - BEGUN - Creation of e-learning system on built environment development by using big data and geo-information analytics

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

- **SuReEsDe – Sustainable Real Estate Development.** The project focuses on integrating sustainable real estate development and construction market skills and HEIs in EU and increasing cooperation between higher education and real estate and construction/building companies is one of the aim of this project. Expected outputs: a new international multidisciplinary approach to studying real estate development process in the field of sustainable development would be made. Students, as well as teachers and practitioners involved in the project will learn numerous aspects that must be considered in making economic, business, provisional, technological, technical, organizational, managerial and legal/regulatory decisions. They will learn how to apply theoretical models with a creative consideration of the external factors in the developmental area as well as the needs of the market and of society.
- **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

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.
- **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:

- **IUT-15 - 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.

One new international project was **started** in 2014:

- **GEEE - GreenEuroHub.** The GEEE project intends to increase awareness in energy efficiency and „green“ competencies for greater energy efficiency in retrofitting of existing build and new construction. The project will produce a mapping of national policies and vocational education trades as it directly relates to green skills and energy efficiency; create e-learning modules targeting contractors, but also suitable for vocational and higher education university learners.

Building Lifecycle uurimisgrupi 5 olulisemat publikatsiooni 2014

1.1

Nuuter, T.; Lill, I.; Tupenaite, L. (2014). Comparison of housing market sustainability in European countries based on multiple criteria assessment. Land Use Policy, 42, 642 – 651

Pikas, E.; Kurnitski, J.; **Liias, R**.; Thalfeldt, M. (2014). Quantification of economic benefits of renovation of apartment buildings as a basis for cost optimal 2030 energy efficiency strategies. Energy and Buildings, 86, 151 - 160.

1.2

Witt, E.; Lill, I. (2014). The Effect of Language Proficiency on Course Results. Journal of e-Learning and Higher Education, 2014, 1 - 12.

3.1

Sulakatko, I.; Lill, I.; Soekov, E.; Arhipova, R.; **Liisma, E.** (2014). Towards Nearly Zero-energy Buildings through Analyzing Reasons for Degradation of Facades. In: Procedia Economics and Finance: 4th International Conference on Building Resilience, Incorporating the 3rd Annual Conference of the ANDROID Disaster Resilience Network, 8th – 11th September 2014, Salford Quays, United Kingdom. (Toim.) D. Amaratunga; R. Haigh. Elsevier, 2014, 592 - 600.

Sulakatko, Virgo; Lill, Irene; Soekov, Erki; Arhipova, Riina; **Witt, Emlyn**; **Liisma, Eneli** (2014). Towards Nearly Zero-energy Buildings through Analyzing Reasons for Degradation of Facades. D. Amaratunga; R. Haigh (Toim.). Procedia Economics and Finance (592 - 600).Elsevier

2) Building Materials Research Group (ehitusmaterjalide 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 2014:

- 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 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 and OY VKG;
- Estonian Concrete producers' quality evaluation.

Three new national research projects were **completed** successfully:

- **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.
- **Successfully performed our (EP) part of Project Basics of new utilization process for oil shale combustion solid wastes** , 01-01-2011 31.12 2014, National R&D program „Energy“. RP "Energiatehnoloogia T&A toetamine" Archimedes SA

One new national research projects were **started** in 2014:

- **CBF and deSOx ashes as main constituents of the Portland oli shale cement type CEM II**. The aim of this research is creation of the industrial compositions of Portland oil shale cement CEM II based on burnt oil shale from different types of the asH collecting systems. Characteristic properties and durability of these mortars and concretes are tested.

Ehitusmaterjalide uurimisgrupi olulisemad publikatsioonid 2014.aastal:

1.1

Raado, L.; Hain, T.; Liisma, E.; Kuusik, R. (2014). Composition and Properties of Oil Shale Ash Concrete . Oil Shale, 31(2), 147 - 160.

Irha, N.; Uibu, M.; Jefimova, J.; **Raado, L.-M.; Hain, T**.; Kuusik, R. (2014). Leaching behaviour of estonian oil shale ash-based construction mortars. Oil Shale, 31(4), 394 - 411 .

Raado, L.; Kuusik, R.; **Hain, T**.; Uibu, M.; Somelar, P. (2014). Oil shale ash based stone formation – hydration, hardening dynamics and phase transformations. Oil Shale, 31(1), 91 - 101

1.2

Liisma, E.; Raado, L.-M. (2015). Damaging effect of the frost resistant concrete with poor quality of coarse limestone aggregate. Journal of Civil Engineering and Architecture, 106 - 113. [ilmumas]

3.1

Liisma, E.; Raado, L-M.; Lumi, S.; **Lill, I.; Sulakatko, V**. (2014). The Effect of Moisture Content of Insulation Boards on the Adhesion Strength of ETICS. Shitkova, M.; Vladareanu, L.; Guarnaccia, C. (Toim.). Recent Advances in Civil Engineering and Mechanics (103 - 108).WSEAS

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:

- 25.-26.september AECEF juhatuse seminar
- 20. – 21. november 2014 rahvusvahelise seminari "GEEE".

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); Land Use Policy (Elsevier)
- 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)

Rahvusvaheliste konverentside korraldamine:

- Prof. Irene Lill: 4th International Conference on Building Resilience, MediaCityUk, UK, 8-11 September 2014 – member of organizing committee, member of international scientific committee
- Ass. Prof Emlyn Witt: : 4th International Conference on Building Resilience, MediaCityUk, UK, 8-11 September 2014 – member of international scientific committee