EHITUSTEADUSKOND
TEEDEINSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2014

1. Instituudi struktuur

Teedeinstituut, Department of Road Engineering
Instituudi direktor Andrus Aavik

- Geodeesia õppetool, Chair of Geodesy, Artu Ellmann
- Sillaehituse õppetool, Chair of Bridge Engineering, Siim Idnurm
- Teetehnika õppetool, Chair of Road Engineering, Andrus Aavik
- Teede ja liikluse teadus- ja katselaboratoorium, Laboratory of Roads and Traffic, Kristjan Lill

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

2.1 struktuuriüksuse koosseisu kuuluvate uurimisgruppide

2.1.1 teadustöö kirjeldus:

Road construction technologies and materials

1. The Estonian design guide of flexible pavements 2001-52 is based on administrative guide BCH 46-83 of the USSR Ministry of Transport Construction. Both guides are using GOST 25100-82 as the basis for the classification of soils. Estonia's accession to the EU pledged to harmonize its legislation with the latter, but the Estonian road design is still the areas using Russian Standard Order-based systems. The aim of the research project was to adjust the EVS-EN ISO 14688-1 and 2 soils classification with the Estonian design guide of flexible pavements 2001-52.
2. Research of deformation, wearing and other expluatational properties of pavement structures of Tallinn city streets and roads and development of standard pavement structures aims to:
   • Expand the use of local building materials in road construction;
   • Get information about the various pavement materials and their working properties under traffic load; specification of requirements for road construction materials;
   • Develop standard pavement structures for asphalt concrete pavements based on the traffic load and geological and hydrological conditions of the Tallinn and based on that extend the service life of asphalt pavements and optimization of road maintenance costs;
   • Develop alternative solutions to asphalt pavements in junction areas.
3. Improvement of manhole structures of engineering utility networks placed at Tallinn streets and roads and development of standard solutions and placement instructions aims to:
   • Provide an overview and analysis of Tallinn manhole design used in various engineering utility networks;
   • Provide an overview and analysis of the experiences of other countries and the solutions used;
   • Develop improved manhole standard solutions catalogue and technological maps;
   • Guide the construction of improved manhole structures and digital archiving at 2014 construction sites;

• Monitor and laser scanning of constructed manholes.

4. Research and consultations related to the construction of cement concrete pavements at Tallinn public transport stops aims to:
   • Develop alternative cement concrete pavement type solutions to public transportation stops instead of asphalt concrete pavement types;
   • Get information and analyze behavior of various cement concrete pavement structures and materials under heavy traffic load;
   • Develop recommendations for concrete pavement (including composite pavement) standard solutions for use in public transportation stops.
5. New ways of quality determination of bituminous binders taking into account specific conditions of bitumen use site and pavement service life aims to:
   - Perform chemical analysis of bituminous binders before and after laboratory aging (using EN and PG-system techniques), and to examine the relationships between the physical / functional properties and chemical composition in an effort to determine how the chemical composition influences the behavior of bitumen.
   - Determine bitumen main factions, functional groups, such as asphaltenes, resins, and saturated and aromatic oils (saturates, aromatics, resins, asphaltenes = SARA) content.
   - Chemical composition determination using gas chromatography, nuclear magnetic resonance spectroscopy and infrared spectrometer (Fourier Transform Infrared method) methods.
   - Propose a solution, how to fit bitumens, sold in our region, according to the PG-grade into our climate zone by changing their chemical or physical properties. It also sought solutions for surface dressing bitumens improvement for the production of bitumen emulsions.

Transport planning and transport impacts

The main research topics in the field of transport planning and transport impacts have been related to analysis of transport growth and its impact. An important traditional research area is traffic safety, where TUT has strong position at research and training areas (road safety auditing and inspection, road network impact analysis, safety analysis, etc).

Validation of marine geoid models by ALS technology

The main aim of this continuously ongoing research is to validate accuracy of gravimetric geoid models (GRAV-GEIOID2011 in particular) over marine areas. In this respect the nadir-range airborne laser scanning data seem to be very promising. However, issues related to ALS data acquisition methodology, elimination of possible systematic errors, data processing, analysis and accuracy estimations need a very throughout investigations.

Implementation of the airborne LIDAR and terrestrial laser scanner technology

The Geodesy chair is involved in the research on applicability airborne LIDAR data-series for monitoring coastal processes, detecting of ground surface in areas of complicated relief, etc.
The terrestrial laser scanning (TLS) technology is primarily investigated for enhancing acquirement spatial data of man-made and natural targets. Of particular interest are monitoring of 3D deformations of different construction types. Methods of incorporating the TLS-data into Building information modeling (BIM) are studied as well.
Both the airborne LIDAR and TLS technologies are applied for geoinformatic development of biodiversity, soil and Earth data systems.

Gravity field and geoid modeling in the Nordic-Baltic region

The Geodesy Chair is acting as a computing centre in a Nordic Geodetic Commission co-operation project for developing a new regional high-resolution geoid model for the Nordic and Baltic countries and over the entire Baltic Sea.

2.1.2 aruandeaastal saadud tähtsamad teadustulemused:

Road construction technologies and materials

Main results in 2014:

1. Soil classification of Estonian elastic pavement design guide 2001-52 is adjusted to the soil classification of EVS-EN ISO 14688-1 and 2.
2. Standard pavement structures for asphalt concrete pavements based on the traffic load and geological and hydrological conditions of the Tallinn are developed. Alternative solutions to asphalt pavements in junction areas are developed.
3. An overview and analysis of Tallinn and of other countries manhole design used in various engineering utility networks are provided; improved manhole standard solutions catalogue and technological maps are developed.
4. Alternative cement concrete pavement type solutions to public transportation stops instead of asphalt concrete pavement types and recommendations for concrete pavement (including composite pavement) standard solutions for use in public transportation stops are developed.
5. New ways of quality determination of bituminous binders taking into account specific conditions of bitumen use site and pavement service life five bitumens have been selected from different origins with identical penetration index 70/100 and viscosities, plus two bitumens from different suppliers with identical penetration index 160/220 and viscosity. The selected bitumens were subjected to the following investigation plan:
   - Evaluation of the main problems related to the quality determination of bituminous binders based on the literature review.
   - An Estonian temperature map of the roads has been developed, which is the basis for the determination of PG-grade.
   - Positioning of bitumens, sold in Estonia, in comparison with the world. For that bitumens have been tested as follows: a) the physical properties of bitumens determined in "traditional" way, ie a full analysis according to the EVS 901-2; b) bitumens PG-grade determined in two different laboratories (USA, Canada).

Transport planning and transport impacts

As in previous years we have been active on regular analysis of transport development trends focusing on traffic flows and loads change estimation.

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal:

1.1.

Mill, T.; Ellmann, A.; Aavik, A.; Horemuz, M.; Sillamäe, S. (2014). Determining ranges and spatial distribution of road frost heave by terrestrial laser scanning. The Baltic Journal of Road and Bridge Engineering, 9(3), 227 - 236.

Julge, K.; Ellmann, A.; Gruno, A. (2014). Performance analysis of freeware filtering algorithms for determining ground surface from airborne laser scanning data. Journal of Applied Remote Sensing, 8(1), 083573-1 - 083573-15.

Talvik, S. (2014). Precise levelling data processing near terraced landforms. Geodesy and Cartography, 40(2), 51 - 57.

3.1.

Julge, K.; Ellmann, A. (2014). Combining Airborne and Terrestrial Laser Scanning technologies for measuring complex structures. Cygas, D. (Toim.). Selected papers of the 9th International Conference on Environmental Engineering, Vilnius, Lithuania, 22-23, May, 2014. (1 - 7). Vilnius: Vilnius Gediminas Technical University Press "Technika"

Grünthal, E.; Gruno, A.; Ellmann, A. (2014). Monitoring of coastal processes by using airborne laser scanning data. Cygas, D. (Toim.). Selected papers of 9th International Conference "Environmental Engineering", 22–23 May 2014, Vilnius, LITHUANIA (1 - 7). Vilnius, CD: Vilnius Gediminas Technical University Press "Technika"

Julge, Kalev; Gruno, Anti; Ellmann, Artu; Liibusk, Aive; Oja, Tõnis (2014). Exploring sea surface heights by using Airborne Laser Scanning. In: IEEE/OES Baltic 2014 International Symposium: 2014 IEEE/OES Baltic International Symposium "Measuring and Modeling of Multi-Scale Interactions in the Marine Environment": Tallinn, Estonia, May 26-29, 2014. IEEE, 2014, (IEEE Conference Proceedings), 1 – 8.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustustest.

2.4 Loetelu struktuuriüksuse töötajatest, kes on välisakadeemiate või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed:

Andrus Aavik: World Road Association (PIARC), tehniline komitee Road Pavements, liige; Transportation Research Board of the National Academies (USA) representative for Tallinn University of Technology.

Artu Ellmann: International Association of Geodesy, Eesti korrespondentliige.

2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad:

- Siseriiklikud lepingud;
- Välisriiklikud lepingud;
- Konsultatsioonilepingud.

2.6 Soovi korral lisada aruandeaastal saadud T&A-ga seotud tunnustusi (va punktis 2.3 toodud tunnustused), ülevaate teaduskorralduslikust tegevusest, teadlasmobiilsusest ning anda hinnang oma teadustulemustele.

2.7 Instituudi teadus- ja arendustegevuse teemade ja projektide nimetused *(Eesti Teadusinfosüsteemi, edaspidi ETIS, andmetel)*

2.8 Struktuuriüksuse töötajate poolt avaldatud eelretsenseeritavad teaduspublikatsioonid *(ETIS klassifikaatori alusel 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1 ja 5.1).*

2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu *(NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu)*

2.10 Struktuuriüksuses järeldoktorina T&A-s osalenud isikute loetelu *(ETIS-e kaudu esitatud taotluste alusel)*

2.11 Struktuuriüksuses loodud tööstusomandi loetelu