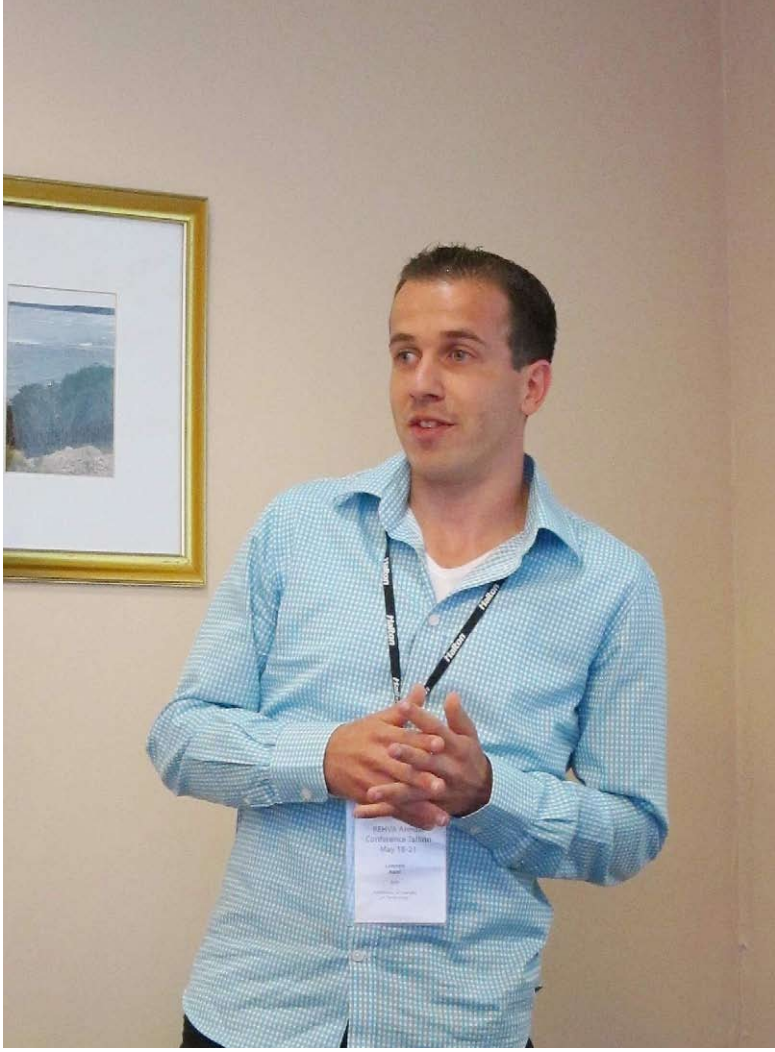
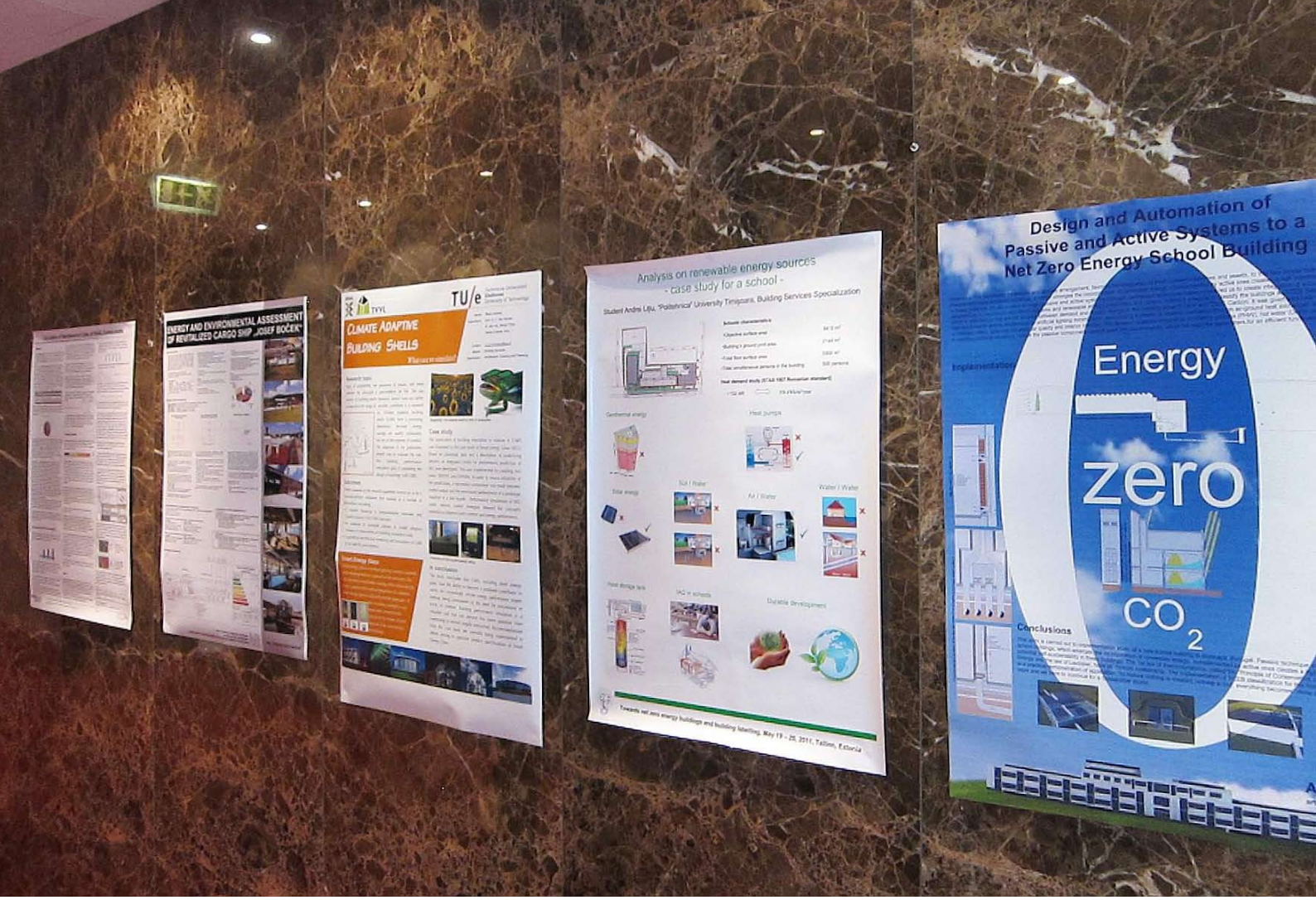
REHVA International Student competition

at Annual Conference, 19 May 2011, Tallinn, Estonia



The Winner: MSc. Roel Loonen from the Eindhoven University of Technology, Netherlands.

The call of REHVA's Education Committee under the chair of prof. Dr. ing. K.(Karel) Kabele to participate in the international student competition of REHVA brought six entries this year. It was a pity that the Serbian candidate had to withdraw due to financial reasons. Five 'young masters' remained, sent by their national HVAC societies. In the past, this competition was only held in combination with the Clima conferences and had therefore a sequence of once in three years. Last year during the Clima 2010 in Antalya however, REHVA decided to hold this competition every year. Tallinn was the first 'intermediate' contest of this kind, and brought 'only' 5 students to Tallinn. Maybe the quantity was somewhat disappointing, the quality of the posters was good, concluded Karel Kabele, successor of Prof. Dr.-ing. M.(Michael) Schmidt and chair of the jury, after the presentations. None of the candidates is a native speaker so there was an equal playing field for all of them concerning that aspect of the presentation (oral and poster). And the winner is…….. R.C.G.M. (Roel) Loonen MSc., Eindhoven University of Technology (TU/e), Unit Building Physics and Systems, Netherlands. His graduate teacher was prof. dr. ir J.L.M.(Jan) Hensen. Following is a summary of his work, and that of the other four colleagues (all rewarded with the second prize).



Poster summaries

1. Climate adaptive building shells,

R.C.G.M. Loonen; TU/e-Netherlands

Because building shells are at the interface between interior and ambient climate, they fulfill a number of vital functions that dictate most of the building's energy consumption. The building's environment is changing over time (short-term weather conditions, diurnal and seasonal cycles), and this also applies for occupants' behavior and comfort preferences. In spite of these changing conditions, conventional building envelopes are 'rigid systems' with fixed thermo physical and optical properties that cannot adapt to this variability. Climate adaptive building shells (CABS) on the other hand do have the ability to repeatedly and reversibly change their functions, features or behavior over time. By adapting their behavior in response to prevailing weather conditions, these façades can seize the opportunity to save energy for heating, cooling and/or lighting. At the same time, CABS are also expected to introduce positive contributions to indoor air quality and thermal and visual comfort levels.

The application of CABS in practice thus far remains limited. By exploiting advances in material sciences, and due to the widespread availability of sensors and actuators, there are however hardly any technological obstacles for making the building shell adaptive. The increase in complexity that is associated with dynamic instead of static façades is mainly responsible for the conservative attitude that is preventing the widespread adoption. Introduction of CABS changes the traditional way in which buildings are designed; CABS are intrinsically dynamic, and therefore it requires the design of a 'process' rather than an 'artifact'. Investigating the role that building performance simulation (BPS) can play in promoting the design of buildings with CABS was the main research objective of the study. The study started with a systematic review of CABS characteristics and an analysis of specific requirements for simulation of adaptive rather than fixed building envelopes. In a second stage it was studied how the capabilities of BPS can fulfill this demand. The applicability of BPS in relation to CABS was then demonstrated in the case study of smart energy glass (SEG).

All the competitors with the chair of the REHVA jury in front of their posters, from left to right: F. Schmahl; R. Loonen; prof. dr. K. Kabele (chair of the jury); A. Ribeiro; Z. Šestáková; A. Litiu.

Based on laboratory tests and a description of underlying physics, an integrated model for performance prediction of SEG was developed.

In conclusion, BPS is able to facilitate increased insights in the system's dynamics, ranging from short-term impacts to seasonal cycles, and also makes it possible to explore the integrated effects and trade-offs of various operational control strategies. The assertion that BPS can be a valuable instrument in designing buildings with CABS was confirmed in the case study of SEG. BPS not only displayed its traditional capabilities as a design aid, but also proved to be useful as active tool in product design and development.

2. Calculation of maintenance costs of HVAC components,

F. Schmahl; RWTH Aachen – Germany

Because of the growing importance of reliable life cycle costs calculations for construction and construction services companies, the analyses of the current state of research concerning life cycle costing is important. It appears that some elements of costs, e.g. energy costs, can already be anticipated quite accurately – at least the expected energy consumption. However, there is no focus on maintenance costs in recent research activities so that a forecast of maintenance costs is rather rough compared to other elements of costs – although maintenance costs out value other elements of costs (energy costs included) in most cases.

Within buildings maintenance costs it is easy to identify building services (HVAC systems) as cost drivers as the service life of HVAC components is rather short compared to the building structure. A deeper analysis shows that costs of continuously conducted maintenance activities (planned preventative maintenance such as inspections and minor repairs) can be predicted on a quite high level of accuracy. Uncertainty exists with regard to major repairs, i.e. refurbishment, replacement, renovation etc. The need for these activities occurs discontinuously, i.e. the corresponding costs arise at discrete points in time breaking through the continuous cost plot as peaks.

New emerging construction contracts, especially public-private partnerships (PPP) force construction and construction services companies for the first time to calculate these elements of costs bindingly for the long term. Workaday, companies calculate these costs applying annual and constant flat rates and deterministic service life estimates which is not correct with regard to the above described cyclical nature of maintenance costs and which can lead to errors in discounted cash flow calculations where the exact point in time of a payment is extremely important. On the other hand, there is no possibility of a direct and exact estimation of discontinuous maintenance costs (in terms of amount and point in time) as available data is too limited and inconsistent. Hence, the objective is to build up the architecture of a model that, using fuzzy logic, transforms expert knowledge concerning degradation factors of HVAC

systems which can be acquired in terms of linguistically expressed IF-THEN rules into transition probabilities for a Markov Chain application. Applying this model it is possible to establish a condition profile for each point in time within the life cycle of the HVAC system (or component) of interest. This enables the user to derive the necessary maintenance expenditures from this profile. This study concentrated on the architecture to create the condition profile. The derivation of the cost consequences and the acquisition of expert knowledge should be investigated in future research activities.

3. Energy and environmental assessment of the revitalized cargo ship "Josef Boček",

Z. Šestáková; Czech technical university Prague – Czech Republic

The goal of this study was to evaluate by an energy audit, the existing state and to find potential savings of energy on the floating multifunctional leisure-time facility of the freestyle park Modřany. Originally that facility was a double bladed river cargo ship, built in 1956 and was used for transport of loose material. The energy and environmental efficient measures were defined. The audit with its recommendations has to fulfill requirements of the law Energy Management Act 406/2000 Coll. with its revisions.

The mean technical units were analyzed in the study: The heat source and heating system; water heating (hot water supply) system; ventilation; cooling; lighting; electrical appliances; other systems (a.o. elevators, mechanical drainage, diesel power generator back up). It was analyzed that the heat loss of the ship is 64 044 kW, from which 69% is lost via heat transmittance through constructions and 31% is heat loss of ventilation. Infrared camera measuring has been applied with the result that the exterior construction does not have any massive thermal bridges.

Energy Performance Certificate based on the law Energy Management Act 406/2000 Coll. (EPBD implemented) has been issued. The ship has been classified as D - Unsatisfactory.

In this study proposals for improvement were made. The following were recognized: CHP (remark: cogeneration cannot be installed due to unsuitable fuel supply – electricity); Solar Energy (solar thermal panels and PV); Wind energy; Heat pumps (different options); Biomass energy. By analyzing (combination of) the different options, the study advised to install an air to water heat pump installation for space heating and water heating, and to pump river water for washing down toilets, cleaning and watering plants. This would bring the following savings: Energy saving 396.1 GJ/year; Cost savings on the purchase of energy 411 100 CZK/year (16 444 €/year); Capital costs 1 607 260 CZK (64 290 €). Resulting in a simple payback period of 3.9 years.

By installing a new heat source - heat pumps (air - water type, high temperature use) and pumping river water for washing down toilets, cleaning and watering plants the energy performance of the "building" can be decreased (i.e. improved) in terms of EPBD-ranking from class D to class B.

4. Analysis on renewable energy sources – case study for a school,

A. Liţiu; Politechnica University Timişoara - Romania

A comparable study as Mrs. Z. Šestáková did in her work (see under 3) for an old cargo ship, transferred to a leisure-time facility, Mr. Liţiu, did his study for a school and analyzed which renewable energy sources are best fitted, from both technically and economically points of view, for that school (from 1st to 8th grade) situated in the rural environment. To be more exact the location is Beregsău Mare village, approximately 18 km from Timişoara, Western Romania. The energy obtained from these sources will be needed in providing hot water for heating purposes and domestic use. The following options were taken into account: Geothermal energy; solar energy; heat pumps soil/water; water/water; air/water). After analyzing all the possible renewable energy sources, the ones that fit best the needs and circumstances are the solar hot water panels and the air / water heat pump. Together they would not only assure the necessary heat demand but also a higher energy performance. Using these energy sources the most viable heating system would be radiant surfaces heating, e.g. radiant floor heating. Another discussed topic in the study was indoor air quality. Poor indoor air quality has both short term negative effects (headaches, difficulty to concentrate, fatigue and lethargy) and long term effects (respiratory infections – e.g. asthma).

The study concludes: Promoting the renewable energy sources as a significant and non polluting energetic resource, is one of the main objectives of the world energetic politics, which in the context of durable development, have as purpose reducing energetic consumption, increasing the safety in energy supply, protecting the environment, assuring a better air quality and developing viable energetic technologies.

Prof. dr. F. Allard (president of REHVA), congratulates all the students with their work and presentations (left), Prof. dr. M. Schmidt (President elect of REHVA), fully agrees (most right).

The best renewable energy source is different from case to case. The circumstances of each situation must be analyzed so that the unfitted sources of renewable energy can be discarded from the start. After deducting the best source of renewable energy a thorough study begins to value the renewable energy source's complete potential.

5. Design and automation of passive and active systems to a net zero energy school building,

A. Ribeiro; Trás-os-Montes e Alto Douro University - Portugal

In this study a new school building model, developed to enable an energy-efficient and sustainable building was made. The bioclimatic framework and the organization of space, allied with the integration of passive techniques, in which emerges the incorporation of renewable energy, complemented by active ones, creates a high potential of self-sustainability in buildings. The building automation through passive and active systems, via centralized technique management, led us to create integration of actuators, with innovative perspectives, in the natural ventilation systems and renewable energy production in school building. With the proposed model, it is expected a radical change in the way to designing the building, making it possible to obtain a Net Zero Energy Building balance. This is reflected by the annual balance between demand and supply energy in the building equal to zero and "Zero" Carbon. It was given particular attention to natural light components and its relationship to artificial lighting minimization and cooling systems or heating ventilation through air-ground heat exchanger, air collector, cross effect or chimney effect, ensuring excellent air quality and indoor comfort conditions.

Remark:

During the plenary REHVA Annual Meeting 2011 it was discussed whether REHVA will continue to organise these student competitions every year or only during Clima conferences. The majority of the member countries opt for every year, being aware of the fact that this means to be themselves responsible for delivering a candidate (c.q. a team of candidates). In other words: The call for posters is open NOW for the student competition during the REHVA Annual Meeting in Timişoara, Romania from 17 – 20 April 2012. For conditions see: www.rehva.eu. REHVA cordially invites its member organizations, but also students and their professors directly (in the second case REHVA secretariat will inform their national organization) to respond.