NEED4B – NEW ENERGY EFFICIENT DEMONSTRATION FOR BUILDINGS

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Editorial

Welcome to the first newsletter of the "NEED4B - New Energy Efficient Demonstration for Buildings" Project.
The European Councils' energy related targets known as 20-20-20 by 2020 instigated focus on the building and construction sectors, as they are the highest energy consumers in EU. Clearly, to be able to reach these targets it is crucial to renovate the existing building stock and implement innovative technologies contributing to nearly zero-energy consumption in new buildings.
In this context, NEED4B serves Europe 2020 "A European strategy for smart, sustainable and inclusive growth" and in particular delivering smart, sustainable and inclusive growth in the field of energy efficient buildings. The aim of 7th Framework collaborative project NEED4B is to develop an open and easily replicable methodology for designing, constructing and operating new low-energy buildings, aiming to a large market uptake.
The project incorporates a very effective demonstration programme, visualizing the construction of app. 28,500 m^2, spread among 5 demo-sites introducing Integrated Project Delivery (IPD) methodology. The confirmed demo-sites are located in Quaregnon (BE), Zaragoza (ES), Borås & Varberg (SE) and Istanbul (TR), and all buildings share the common target of achieving primary energy consumption lower than 60 kWh/m^2 per year which in return contribute to less than 65% energy use and more than 90% CO_2 emissions reductions compared to current common practices in Europe.
Close cooperation among all demo-sites is established so that project partners seize an opportunity to exchange risks, difficulties, failures and best practices aiming to optimize and refine the IPD methodology and develop a replication and exploitation strategy that can have a European wide impact.
Experience and know-how gained through the demo-sites and the developed IPD methodology have the objective to increase the replicability through the development of business strategies for ensuring the market uptake, therefore increasing the overall impact.
With this first newsletter, NEED4B project partners invite all to observe and participate the progress of this 6-year challenging and intriguing project.

Enjoy reading.

Demo Sites

Quaregnon, BELGIUM (5.000 m²) – VSM Quaregnon Phase 1

Building type: Single family houses, apartments, detached and terraced houses
Building use: Several type of residential buildings
Targeted building energy consumption: under 50 kWh/m^{2}year
Owner : Private Property
Project Team : Site developer : VUE SUR MONS – Architect : FD2 – Engineers : UMONS

Main characteristics
The project consists of a group of apartments and individual houses aiming to develop new passive houses. 16 houses will be built for the first phase and 40 apartments and individual houses are foreseen for the second one. This project is supported by "Mons, European Capital of Culture 2015".

Structure and envelope
The buildings´ geometry is rectangular and compact. The buildings are well oriented to maximize the energy savings and maximize the photovoltaic generation. All the houses will get the passive label. For the façade, big ceramic bricks glued have been considered for the structure due to its cost-effectiveness and ease of implementation. This solution also provides good results for the thermal inertia of the buildings. For the roof, 2 different solutions will be used depending of the roof part. Sunscreens for south facing windows to avoid overheating in the summer have been considered. Finally, concerning the openings, triple glazing PVC windows will be used.

Building thermal load
Some first energy simulations have been carried out with PHPP to ensure certification with the passive house standard. They revealed that the opening surface for the northern façade had to be reduced in order to optimize the energy consumption. Additional energy simulations were developed with TRNSYS aiming to obtain the heating and cooling demand of each alternative under study during the preliminary design. In total, 20 cases were developed to study different optimization of the building envelope.

Systems and technologies
Heat pumps have been considered for heating and DHW. Fan coils with heat recovery will be used for the ventilation system. Regarding the water and waste management strategies, rain water collectors and storage have been considered. Photovoltaic electric generation is the main renewable energy system to be installed. For the Lighting system, LED technology will be used in order to reduce the electric consumption.

Indoor environment quality strategies
A HRV system will be placed in all the houses to avoid the concentration of pollutants. The indoor air temperature, radiant temperature and air velocity, ventilations rates and humidity will be controlled. The DialuxEvo software has been used to select the appropriate amount of luminaries.

Zaragoza, SPAIN (2.712 m²) – CIRCE II Building

Building type: single building
Building use: tertiary, offices and laboratories
Targeted building energy consumption: under 42 kWh/m^{2}year
Owner: University of Zaragoza
Project Team: ACCIONA (research, consultancy), CIRCE (research, building user), IDOM (architects), UNIVERSITY OF ZARAGOZA (project supervision owner).

Main characteristics
The technologies applied in CIRCE II building have been selected considering not only energy efficiency and cost-effectiveness, but also their replication potential in other office buildings in Europe with similar climatic conditions. The design process has been supported by the development of a BIM model and several energy simulations.

Structure and envelope
The orientation of the building has been carefully studied and the influence of the weather conditions of Zaragoza, especially wind resource, has been simulated in order to choose the most favourable configuration. The constructive solutions selected have been based on cost, energy consumption and CO_2 emissions during their life cycle following the LCA/LCC analysis criteria. A high thermal insulation envelope has been considered with U-values lower than 0,2W/m²K, including high performance glazing. Sunscreens have been carefully studied in the gaps based on a study conducted with a sunlight simulation program. Double skin-ventilated facades have been considered for west, east and south orientations and the future garden roof is expected to provide a high thermal inertia and insulation capacity.

Building thermal load
It was continually evaluated during the design process. The simulation software Design Builder was used to calculate thermal load and energy use.

Systems and technologies
Based on the premise that office buildings cannot be buildings with zero consumption by only improving the outer shell, the spirit from the beginning was to apply low exergy technologies, which enable to use the external environment for the benefit of the building. Therefore, the building integrates a Thermally Activated Building System [Tabs], which is an HVAC system based on hydraulic tubes embedded in the concrete slab connected to Ground-to-Water Thermal Exchange system. It allows a high thermal inertia in the internal skin of the envelope. A Geothermal energy system based on a closed loop is expected. The high-performance free cooling ventilation system will be supported by Canadian wells and a Trombe wall. The building also integrates renewable energy sources; photovoltaic panels and a small wind turbine will be installed in order to reduce the energy demand.

Indoor environment quality strategies
The ventilation system will be controlled by CO_2 probes. Regarding visual quality, there are external blades in the openings to prevent glare and the lighting is adjustable point-by-point.

Demo Sites

Istanbul, TURKEY (17.756 m²) – SCOLA Building

Building type: Single building
Building use: University buiding : classrooms and offices
Targeted building energy consumption: under 52 kWh/m^{2}year
Owner : Özyeğin University
Project Team : RMJM/Concept Design, B Design/Architectural, Emir Engineering/Structural, Civa Engineering/Mechanical, Latek Engineering/Electrical, Proses Engineering/ Infrastructural, Citylight/Lighting Consultant, Makpa/Kitchen Eq. Consultant, MEA/Acoustic Consultant UYY/Landscape, Fiba/Project Management

Main characteristics
The School of Languages (SCOLA) building is the part of the Campus of the Özyeğin University in Çekmeköy district. The design process has followed the spirit of the Campus master plan, which is also being designed and constructed aiming to become LEED certificated.

Structure and envelope
A reinforcement concrete system is being applied, as it is an easy and cost effective method in the Turkish construction market. Double skin façade materials have been selected which are aluminium perforated panels painted in to selective colors of nature at the site. Insulated aluminium frames and double glazing have been selected

Building thermal load
Simulations were performed by using the Carrier Hourly Analysis Program. Additional simulations using Designbuilder and Energyplus are being carried out by the university students for their masters studies.

Systems and technologies
The active technologies have been selected taking advantage of on site conditions to reduce the energy consumption: (1) Earth Tubes (Ground-to-Air Thermal Exchange) System for Ventilation – (2) Natural ventilation (supply) and mechanical exhaust system - (3) Central 4pipes fan-coil system are being installed to maintain thermal comfort level in a variable climatic environment - (4) Air Handling Units with heat recovery will be used in the areas where it is not possible to provide natural ventilation. 2 way control valves, thermostats and CO2 sensors will be used to control and regulate heating or cooling surfaces and to improve the indoor air quality.
A mechanical automation system and energy meters will be installed in order to achieve energy savings by following systems in real-time, getting alarms and reports so that the building performance can be maximized.
The *Lighting System* will be totally automated which enables almost 35% energy saving for lighting system. Concerning ICT, energy analyzer in the central electricity box as well as sub-energy analyzers over each floor (and rooms) will be monitored from the same software.
Regarding the integration of *renewable energy resources*, a 120 kWp PV system will be installed on the rooftop, considering c-Si modules and string inverters. The electricity production covers the overall lighting consumption of SELI.
Among the *Water Management strategies*, Rain Water Collection, Foul and drainage separation, and 117 basins and photocell battery fittings have been considered. All tabs have 2 lt/min/jet/spray water flow perlators.

Indoor environment quality strategies
All spaces are being simulated by Dialux software in 3D to get the best result for luminance distribution. Temperature and humidity control is considered in all spaces. The acoustic factor is being considered in the selection of the materials.

Borås and Varberg, SWEDEN (276 m²) – NEED4B House 35 (Borås)

Building type: Industrialised single family house.
Building use: Research and residential
Targeted building energy consumption: under 59,5 kWh/m^{2}year
Owner: SP and Derome/ Private Property
Project Team: SP: Engineers, Researcher. DEROME: Architects, Engineers, Consultants

Main characteristics
Two pre-fabricated low energy wooden framed villas compose the Swedish demo site. One building will be assembled in a new attractive residential area near Varberg and used as a display house for a time. The second building will be used as a full-scale test lab at SP headquarters.

Structure and envelope
The goal with the architectonic and structural design to find a design which is both attractive on the market, have low energy demand and provide a good indoor environment quality. The design process was made between SP and Derome. The initial requirements for the design have been a) Well insulated with low thermal bridges 2) Moisture safe and possibility to construct airtight 3) Easy to construct in Deromes factory. 4) Architectonic attractive and functional floor plan. 5) Relatively low price.

Building thermal load
The thermal load of the house was continually evaluated during the design process, in order to ensure that the project goals were met and that the final design was cost-optimal. The simulation software TMF Energi, specifically developed for the wooden-house industry in Sweden, was used to calculate thermal load and energy use with different HVAC options.

Systems and technologies In order to meet the heating demands with a low final energy use, several HVAC technologies were investigated during the design process. Four combinations of those technologies were simulated and tested in terms of energy use and Life Cycle Costs. Additionally, different sizes of the solar PV arrays were tested. LCC calculations showed that the heat pump with ground loop option had the lowest life cycle costs. All in all, the energy calculations, LCC calculations and local conditions at the sites resulted in selecting a ground source heat pump with a ground loop coupled with a moderate solar PV panel size, as the final design. For the ICT system, three different options are being investigated at the moment and will continue beyond NEED4B project end as the NEED4B House 35 will work as a test lab. For water and waste management, there will be regular collection and sorting of garbage and reuse. The domestic water flow is mixed with air to reduce flow.

Indoor environment quality strategies

Need4B House 35 will meet the indoor environment requirements to fulfill the gold level on “Miljöbyggnad” Swedish certification system.

In the spotlight

SCOLA Building

Located in Istanbul, Turkey, this very low energy building is integrating several novel strategies to improve the overall energy efficiency.
The ground source heat pump system at NEED4B Turkish demonstrator will save up to 4125 kg/year CO_2

The Turkish demonstrator, settled in the Özyegin University Campus, will host the School of Foreign Language (SCOLA), and in its design processes, technologies, and construction steps, several innovative applications are being applied.

All these applications are the milestones for near future of integrated project delivery concept, building construction and energy issues on buildings. Together with the design of each individual system, their effects on each other have been also considered since the beginning of the idea of SCOLA. The ultimate goal of this project is to show the difference between smart building and the intelligence-embedded building.

The most exciting technology going to be applied on SCOLA building is the earth tubes also known as a ground source heat pump system. In order to condition the air inside the building, the system basically benefits from the ground heat, which has an almost constant temperature value along the whole year. Depending on the season and the need, the system works as a cooling unit or heating unit.

The earth tube system will be a horizontally installed system on the eastern side of the building with 30m-long heat transfer pipes. The total installation area will be 1200 m² with 2 m depth. The earth tube system will be used for reducing the cooling and heating need of the basement floor in SCOLA building.

The heat gain of the system will be 24 kW/h for summer and 60 kW/h for winter which means 4125 kg/year CO2 saving with almost 4000 hours in operation. The ROI for the whole system has been estimated as around 12 years.

Integration of such a ground source heat pump will be the first in a university campus, representing an excellent case-study for Turkey. In addition, SCOLA building will be an open energy museum with different technology applications and their presentations.

NEED4B Partners collaborating in the SCOLA Building Project

Özyegin University - **www.ozyegin.edu.tr/energy**
The Center for Energy, Environment and Economy (CEEE) at Özyegin University studies issues related to energy, the environment and the economy in a coherent way.
CEEE at Ozyegin University coordinates all the activities in Turkey in response to the NEED4B Project. The Turkish Demonstration Site is one of the future buildings of the Ozyegin University Campus, and will host the School of English Language Institute (SELI).

Bg Mimarlik Musavirlik Ltd. STi - **www.b-design.com.tr/en**
Architecture firm experienced in the fields of master planning and project development, all fields of the project and design process and also restoration and renovation.
B-Design is the local architectural firm and design coordinator of the SCOLA building project. The design coordination is leading the electro-mechanical systems, building materials and cladding, and also the infrastructure issues. Moreover the design coordination of the whole building is related both interior and exterior. B-Design has been working cost effective and sustainable solutions in terms of material, FF&E etc.

FIBA Group.
www.fibaholding.com.tr
Dealing with Project and Construction Management in Ozyegin University.
FIBA Holding Construction Group coordinates project development with all groups of designers, preparation and implementation of tenders, preparation of contracts, cost control and analysis, contractor coordination, execution control, and project management.

Interview

Who is Prof. M. Pınar Mengüç and why are you involved in the project?

Prof. M. Pinar Mengüç is the Head of Mechanical Engineering and the Director of Center for Energy, Environment and Economy at Özyeğin University. He was in the US for more than twenty eight years before joining OzU in 2009; most recently he was a professor of mechanical engineering at the University of Kentucky. He spent his two sabbatical years at Harvard University, Boston and at University Federico II in Naples, Italy. He has been mainly involved in radiation transfer research; he is the co-author of two books in the field. He has written more than 105 research articles and presented more than 150 conference papers. He was invited to give more than 90 lectures around the world, and founder of a start-up company on characterization of nano- and micro-size particles with light scattering. He has guided more than 60 MS, PhD and post-doctoral students during his career.

One of the current research foci of the Center (CEEE), directed by Professor Menguc, is the energy efficient and sustainable buildings. Given that the buildings are responsible for about 40% of all the energy consumed, any improvement of the energy efficiency in buildings would result significant savings in the national economy. In NEED4B project, it is shown that there is significant potential to improve energy density in buildings with the merging of advanced engineering principles and the fundamentals of architecture. The understanding of this interactive design and development practices is by no means trivial, and present its own challenges in different countries and for different types of buildings.

What do you think the positive outputs of the project will be specifically in İstanbul and Turkey?

The NEED4B project in Istanbul involves the design of an education building within the Özyeğin University Campus. The concept is in line with European Union 20-20-20 by 2020 objectives. In the project we have shown that the sustainable design practices carried by engineers and architects can result significant improvement in energy use in buildings and make the structures much more environmentally friendly. The specific building that is worked in this project is named SCOLA, one of the most recent education-oriented buildings in the Campus. During the design and construction phases, we have encouraged the interactions between the engineers and architects with the researchers, who have carried out several computer simulations, suggested the use advanced materials wherever possible, and explored every possible detail for a more comfortable living environment that would serve more than 1000 students each year. This research team was based in the Center for Energy, Environment and Economy under the direction of Prof. M. Pinar Menguc. Detailed discussions were carried out by the team all along the design and construction of the building, and have required significant involvement of Dr. Pinar Ozuyar and Architect Yasemin Somuncu.

The process learned during the NEED4B project has shown us where such interactions are not straight-forward and needs to be carefully crafted. Effective engineering applications used included new types of insulation and paints, careful selection of window glasses and frames, solar shades as well as air cooling/heating units based on ground heat sources. All these innovations were in addition to solar energy practices and the passive architecture applications including the solar panels. The design practices carried out ahead of time included the computer simulations using Energy Plus and the Design Builder as well as the Computational Fluid Dynamics CFD calculations that allowed them to calculate the flow for the human comfort in the building. The practices are very unique in Turkey and they have been stimulating these ideas extensively in several conferences and they will continue doing so that will attract more engineers and architects to the Center for further discussion of these practices in different buildings.

How do you evaluate the progress of the project so far? How are the reactions of the stakeholders?

The project has been considered quite successful. Although the building has not yet been completed, all the stake holders are very pleased with the progress. It proved that it was not that easy to maximize separate stake-holders' expectations; yet, the overall level of satisfaction with the final building is very high. We hope that once the building becomes fully functional, this satisfaction level will be even higher.

The technical details were worked out as a group effort during the project. The CEEE team has been involved in the implementation of the building information methodologies (BIM) and the computer simulations were carried out extensively for heating, ventilation and lighting simulations. Solar heating of the building was minimized for the summer months to minimize the cooling load in the classrooms and the offices. This was accomplished by the proper choice of window glasses and the strategic placement of shading elements. Further reduction in cooling, as well as the heating loads, was achieved by the use of ground-based air heating/cooling heat exchanges (earth tubes). These are all sustainable energy practices, and worked out in tandem with the designing architects, CEEE researchers and the implementation engineers.

Of course, the building owner is an important stakeholder, and needs to be informed about the progress and to be convinced for the changes and the additional expenses. Extensive understanding of these principles by both the designers from architecture and engineering has been important. And then it requires extensive convincing of the stakeholders who will put their money into these cutting edge researches. It is worth to mention that the energy savings in this new building are predicted to be well beyond expected values, which has pleased the stakeholders extensively. We hope that the idea of putting these concepts in a workable framework for repeatability will be our biggest challenge for the next few years. That will also allow us to make the outcome of the project more extensive in different ways.

Interesting Links

Useful Links

- **European Commission**. E2B Public Partner Partnership: ec.europa.eu/research/industrial_technologies/energy-efficient-buildings_en.html
- **E2BA** – Energy Efficient Buildings Association: www.e2b-ei.eu/default.php
- **Eracobuild** – Strategic Networking of RDI Programmes in Construction and Operation of Buildings www.eracobuild.eu
- **BUILD UP** – European portal for energy efficiency in buildings: www.buildup.eu

Interesting Upcoming Events

SUSTAINABLE CITY 2014

9th Conference on Urban Regeneration and Sustainability – 23rd to 25th September 2014, Siena

The International Conference on Urban Regeneration and Sustainability addresses all aspects of the urban environment aiming to provide solutions leading towards sustainability. The Conference addresses the multi-disciplinary aspects of urban planning; a result of the increasing size of the cities; the amount of resources and services required and the complexity of modern society.

Web: http://www.wessex.ac.uk/14-conferences/sustainable-city-2014.html

Brochure: http://www.wessex.ac.uk/images/stories/pdf_cfps/2014/sustainablecity2014cfp.pdf

GREEN CITY ENERGY

- **Green City Energy Bari – 2nd & 3rd December 2013, University of Bari**

  The Second Edition of Green City Energy will be back in December in Bari to continue the discussion table started last year and take a look over the new policies and strategies at European level as well as the projects initiated at regional level. Green City Energy Bari is a platform for meetings between public administrations, companies, universities, research institutions and professionals for discussing issues concerning the development of the smart city. The Second Edition will be hosted again at the prestigious University of Bari on December 2nd & 3rd 2013.

  Web: http://greencityenergy.it/bari/

- **Green City Energy Genoa – Genoa March 2014 (dates to be defined)**

  "The International forum Green City Energy Genoa, on smart energy and sustainable development of the city and the port" will be held in Genoa on March 2014, at the Convention Center Area Porto Antico of Genoa as the third and final stage of the circuit. The event will present a unique structure that brings together international profile conferences, thematic workshops and an exhibition show dedicated to the industrial environment, energy and sustainable development.

  Web: http://greencityenergy.it/genova/

8th CONFERENCE on SUSTAINABLE DEVELOPMENT of ENERGY, WATER and ENVIRONMENT SYSTEMS

September 22nd to-27th 2013, Dubrovnik

Conference dedicated to the improvement and dissemination of knowledge on methods, policies and technologies for increasing the sustainability of development by de-coupling growth from natural resources and replacing them with knowledge based economy, taking into account its economic, environmental and social pillars, as well as methods for assessing and measuring sustainability of development, regarding energy, transport, water, environment and food production systems and their many combinations

Web: http://www.dubrovnik2013.sdewes.org/index.php