MaTr iD

Integrated Design
Good Practice Examples and Lessons Learned

Client: Executive Agency for Small and Medium-sized Enterprises (EASME)

Project: MaTrID: Market transformation towards nearly zero energy buildings through widespread use of integrated energy design

Homepage: www.integrateddesign.eu

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MaTr iD

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PREFACE

This Brochure is implemented within the frame of the European project MaTrID and presents good practice examples from participating countries. Also submissions from the *GreenBuilding Integrated Design Award 2014* have been taken into account. The good practice examples illustrate the main achievements of each project focusing on the Integrated Design process that has been followed from the early concept stages until the detailed design and construction phase, underlining the significance of lessons learned from the process.

MaTrID deals with the application of Integrated (Energy) Design (IED) during the building design process. According to EU regulations all new buildings shall be nearly Zero Energy Buildings (nZEB) by 2020. For this reason the Integrated (Energy) design approach supports the transformation of the real estate market towards nearly zero energy buildings.

1 About the project and Integrated Design

1.1 The MaTrID project

The Intelligent Energy Europe (IEE) project MaTrID aims at supporting the implementation of nearly Zero Energy Buildings (nZEB) by 2020. In this context the **building design phase is of particular importance**. Integrated Design (ID) in general is the most appropriate approach to reduce the complexity of the design process and to facilitate the interactions between the members of the design team. **ID** allows them to provide the **best solution for the whole building**. It is not limited to energy efficiency and goes beyond this issue. The greatest benefits are provided only if **applied in the earliest stages** of the project, when changes to the design are still easy to implement.

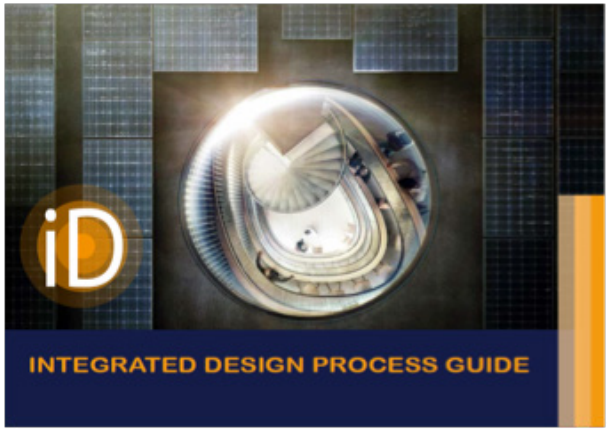
1.2. About this brochure

In this respect the benefit of EU collaboration is to cross-pollinate good practice among European countries. Therefore, MaTrID accompanied about 20 case studies among Europe between 2012 and 2014. The knowledge transfer within a design team and its actors as well as the knowledge transfer among Europe is the main benefit of the MaTrID project. This brochure can be seen as supplementary document to the ID tool-kit.

1.3 The ID tool-kit

In order to facilitate the practical implementation of Integrated Design, a user friendly **European ID tool-kit** has been developed. This tool-kit has been translated and adapted to the national level of partner countries.

The **ID Process Guide** is the core document of the ID tool-kit. It explains why ID is of particular importance and what it is in general, highlighting the ID process step by step. In doing so, special emphasis lies with **goal setting**. Moreover, it describes the interactions with certificates like BREEAM, LEED, DGNB, etc. The tool-kit includes further supplementary documents, like the **Client Brief**, **Tenants Brief** and **Scope of Services and Remuneration Models** as well as this Good Practice brochure.



Cover of the ID Process Guide. (Source: ID Process Guide. www.integrateddesign.eu)

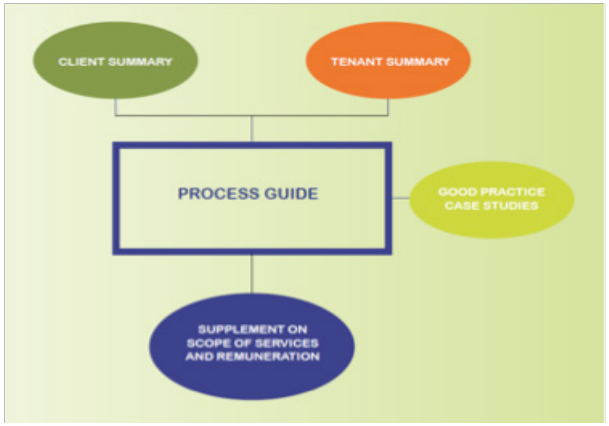


Diagram and connection of the ID Process Guide and its supplementary documents. (Source: ID Process Guide. www.integrateddesign.eu)

1.4 Integrated Design for nearly zero-energy buildings

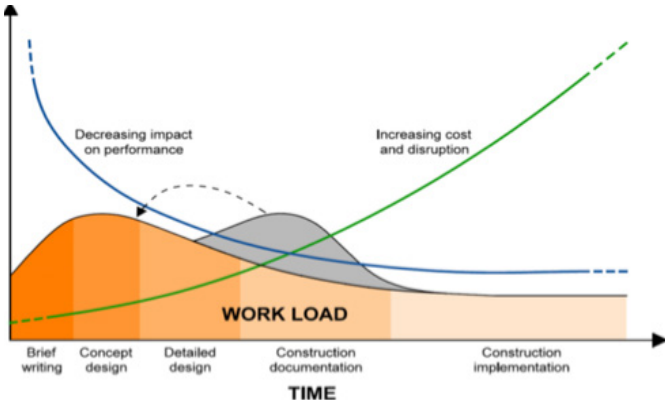
A major challenge for property owners, public authorities and developers is the **implementation of NZEBs in the near future**. The Energy Performance of Buildings directive (EPBD) applies to new constructions and buildings undergoing a major renovation and means that the properties will be built with an energy demand close to zero. This means that in less than one decade all new buildings will have to demonstrate very high energy performances and their reduced or very low energy needs will be significantly covered by renewable energy sources.

The **design of a NZEB requires an interdisciplinary approach**. Reducing the energy demand in buildings requires specifications for different designers and engineers, such as architects, building physics or façade designers. For this reason, the introduction of an interdisciplinary design team in the very early planning phase is fundamental for the successful design of NZEBs. In this context the building design phase is of particular importance.

Integrated Design is an approach that considers the design process as well as the physical solutions. The **overall goal** is to **optimize buildings** as whole system **throughout the lifecycle**. For the purpose of reaching high sustainability performance, the alternative building and technical solutions should be developed and discussed by an integrated, multidisciplinary team. ID emphasizes a decision process rooted in informed choices with regard to the project goals, and on systematic evaluation of design proposals. This approach for building design is paralleling the principles of environmental management referred in the international ISO 14001 standards. Here, identifying and prioritizing goals and developing an evaluation plan with milestones for follow-up, are central issues. Following figure indicates the importance of the Integrated Design process at the early phases. Therefore, a shift of work load and enhancement to the early phases very likely will pay off in the lifecycle of the building.

Experience from building projects applying ID shows that the investment costs may be about 5% higher, but the **annual running costs will be reduced** by as much as 40-90 %. The process of ID emphasizes that the performance of buildings should be assessed in a lifecycle perspective, both regarding costs and environmental performance.

More about the project, Integrated Design and its tool-kit can be found at www.integrateddesign.eu.



Early design phases offer opportunity for large impact on performance to the lowest costs and disruption. (Source: ID Process Guide. www.integrateddesign.eu).

2 Case studies and lessons learned

2.1 Office Buildings

2.1.1 University of Innsbruck, Faculty Building of Engineering Science – Austria

Owner: Bundesimmobiliengesellschaft mbH (BIG)
Location: Innsbruck/Austria
Type of the building: Office building for the Faculty of Engineering Science
Gross floor space: 14,000 m²
Investment costs: 12 million €
Year of completion: 2014

Achievements: This pilot project is a demonstration of feasibility of renovation of an office building in high thermal and energy quality and consideration of further sustainable criteria. Life cycle costs assessment of innovative measures and measures concerning energy efficiency were carried out through the design process. For this reason it was necessary to implement an Integrated Design process in order to fulfill these requirements.

Source: ID Process Guide (www.integrateddesign.eu)

About the ID process: The building owner has a team of project managers who carry out renovation projects in a certain, strictly defined procedure. Mainly the functional interest of the building user and the investment costs are important. In this renovation process additional sustainability criteria were the basis for the design. Life Cycle Cost Assessments were carried out in parallel to the design phase. The commitment and willingness of the building owner and the kick-off-workshop is very important for a good Integrated Design process.

Lessons learned from ID process: The Integrated Design process is often combined with required technical resources such as design software including the building information model (BIM). This project has shown that this holistic approach, taking into account comprehensive sustainability criteria and several experts, is not a matter of tools, it's a matter of team spirit and communication. Good communication between all participants was the basis for good project results.

More information about the project: Dirk Jäger, Bundesimmobiliengesellschaft m.b.H., dirk.jaeger@big.at, www.big.at

More information about the life cycle cost approach: Gerhard Hofer, e7 Energie Markt Analyse GmbH, gerhard.hofer@e-sieben.at,

2.1.2 Powerhouse Kjørbo – Norway

© Snøhetta architects

Owner: Entra Eiendom
Location: Kjørboveien 20, Sandvika, Norway
Type of the building: Office building
Gross floor space: 5,180 m²
Investment costs: 14 million €
Year of completion: 2014
Achievements: Powerhouse Kjørbo is the first rehabilitated energy positive office building in the world. A "Powerhouse" is defined as a building that during its lifecycle produces more renewable energy than it consumes for the production of building materials, construction, operation and demolition of the building. The building has obtained energy label A, has energy properties better than the Norwegian passive house standard NS 3701 and is classified BREEAM Outstanding in the design phase.

About the ID process:
Powerhouse is a collaborative project on the commercial development of energy-positive buildings. The multidisciplinary team comprised:

- Representatives for the owner
- ID facilitator
- Head of design – management
- Architect
- Structural engineer
- Energy consultant
  - PV
  - Energy consultant
  - Contractor (Norsk Hydro with know ledge on PV)
- HVAC consultant
- SINTEF with special competences
- Acoustic consultant
- Fire consultant
- Electricity consultant
- Contractor (Skanska)

All stakeholders were involved in the project from the early stages and formed a partnership. Sapa and Asplan Viak were not a part of the project before the feasibility study, but joined in the design phase. Asplan Viak provided multi-disciplinary consulting in the project and also represents the user (tenant).

The design process was a combination of discussion in a large group, with all members present, and discussions in smaller subtask groups. The larger group included up to approximately 20 persons, and the smaller subtask group's 3-6 persons. The themes of the subtask were:

- Thermal energy supply system
- Photovoltaics
- Ventilations strategy
- Embodied energy
- Daylight studies
- Buildings envelope – opaque walls

The workshops were whole day meetings. During the workshop, the working method altered between discussions in the large group and discussions in the smaller subtask groups.
The themes for the subtasks were specific technical, whereas and the theme of the group. Tthe themes in of the large group discussions whereas to coordinate and compromise functional needs and demands from the subtasks. Additionally, the ID-facilitator discussed all proposals, and ensured that they would not violate the project objectives

Lessons learned from ID process: The energy target was the main project goal. All project stakeholders worked towards this goal, thus in some occasion's the energy solutions were prioritized before architectural solutions and economy.
Summing up the lessons learned;

1. Work in a multi-disciplinary team is a complex activity. Communication is something as perceived as an easy task, but it's a much more difficult pursuit in practice. Challenges related to multi-disciplinary communication can be solved through good planning and setting aside enough time for meetings/workshops and clarification process.

2. Quality and degree of precision in the initial concept stage (feasibility study) is invaluable. Good quality of feasibility study can contribute to a more cost-efficient process at the later stages.

3. All design team members should take part of most discussions because they have to know how hard the process is to find the best solution. If they haven't participated, they tend to be less flexible in finding holistic solutions. It's important to be a part of the process in order to be motivated to change attitude. And it might end up being most cost efficient.

4. The initial phase should be longer – and the stage model has to be challenged. It's important to give time to the process; the client developer has to accept/ acknowledge this. But from a developer perspective it is crucial: Milestones represent designs that are well documented in order to secure confidence in decisions made (reducing economical risk)

More information about the project: Asplan Viak AS, Arne Førland-Larsen, Arne.forlandlarsen@asplanviak.no, http://www.powerhouse.no

2.1.3 National Tax Authority – Norway

© LPO architects

Owner: Entra Eiendom AS
Location: Helsfyr, Oslo, Norway
Type of the building: Office building
Gross floor space: 35,120 m^2
Investment costs: 64 million €
Year of completion: 2013

Achievements: The building was constructed in 1982 with cellular offices, old fashion HVAC systems and limited daylight utilisation. The renovated building has about 6000 new m^2 to give the building a more compact form and create more open spaces. The renovated building fulfill the passive house requirements, energy label A and BREEAM-NOR Very Good.

About the ID process: Norwegian Tax Administration is a collaborative project on the commercial development of low energy-buildings. The project is carried out by a number of key actors:

- Entra Eiendom - real estate owner / developer
- Optimo Prosjekt AS / Insenti AS (OP) as project manager
- Hambra, as ID facilitator
- Energetica Design, as consultant energy
- Sweco as HVAC consultant
- AF Gruppen AS as contractor for structural works and coordination
- Caverion, as contractor on HVAC

The multidisciplinary team comprised:

- Representatives for the owner
- ID facilitator / BREEAM AP /material Specialist (ID facilitator were divided between AP and Energy consultant)
- Head of design – management
- Architect
- Structural engineer
  ID facilitator Energy consultant (ID facilitator were divided between AP and Energy consultant)
- HVAC consultant
- Acoustic consultant
- Fire consultant
- Electricity consultant

ID facilitator and energy consultant attendant all project meeting and did comment on all design decisions in order to ensure the energy and environmental goals for the project.Early stage discussions gave increased environmental ambition. Energy label B was raised to energy label A/ Passive house level, BREEAM level very good and fulfilling Future built demands.

Lessons learned from ID process:

- The project had clear energy goals, committed by the building owner and the users.
- An ID/IED facilitator in design process was focusing energy and environmental issues.
- An environmental quality control plan was developed and used in the design process.
- The project got national funding for passive house measures.

However, the goal of reaching BREEAM-NOR Excellent came too late. It was too time consuming for the design team and therefore the project only reached BREEAM-NOR Very Good. So the main lesson learnt: Project goals have to be introduced as early as possible.

More information about the project:
Arne.forlandlarsen@asplanviak.no
http://task47.iea-shc.org/data/sites/1/publications/Norwegian_Tax_Directorate.pdf
www.futurebuilt.no

2.2 Mixed type

2.2.1 Smart Campus – Austria

© LPO architects

Owner: Wiener Netze GmbH
Location: Mariannengasse 4-6, 1090 Vienna, Austria
Type of the building: Headquarters, administration, operating area
Gross floor space: 93,000 m² (19,000 m² administration, 38,000 m² operating area (workshops, test bays, depots, central warehouse, corresponding offices and administration areas), 36,000 m² other areas for e.g. exhibitions, conferences, etc.
Year of completion: To be completed 2016
More details: www.smart-campus.at

Achievements: The building shall exhibit high environmental, economic and sociocultural quality standards. To meet these standards already the planning process was awarded the certificate ÖGNI/ DGNB Gold and the building will also comply with the requirements.

About the ID process: Together with the users of the new building the ID facilitator analysed the organisation processes of the existing facilities which are to be merged into the new location to create synergies. On this basis of the target processes the requirements were specified. Upon these a comprehensive space and function allocation plan with the required organisational structure and processes was elaborated. Additionally, targets for sustainability criteria were defined with the help of experts. These criteria are to be complied with during the design and construction phase.

Lessons learned from ID process: New approaches, processes; technologies need to be incorporated into the design process as early as possible, otherwise the decision will have to be explained over and over. At a later point in the planning process new ideas might not be implemented since from a certain point on changes imply much more work and costs. The calculation of life cycle costs helps to decide on investments which seem to be more expensive on the first glance but are sustainable and pay off by lower operating costs.

More information about the project: Wiener Netze GmbH, Erdbergstraße 236, A-1110 Vienna. smart-campus@wienernetze.at, www.wienernetze.at/eportal/ep/channelView.do/pageTypeId/40374/channelId/-45501

More information about the life cycle cost approach: e7 Energie Markt Analyse GmbH, Gerhard Hofer, gerhard.hofer@e-sieben.at, www.e-sieben.at

3.2.2 Lindholmshamnen - Älvstranden & Lindholmshamnen - Skanska – Sweden

© Berg C.F. Moller Architects

Owner: Älvstranden Utveckling AB, Skanska Nya Hem
Location: Gothenburg
Type of the building: Residential and Commercial
Gross floor space: 8,000 m² + 8,000 m²
Investment costs: 24 million € + 24 million €
Year of completion: 2015

Achievements: The site where the project is planned to be built is owned by the municipality. The municipal company Älvstranden has developed a model for how the planning and design of the site should be. The project Lindholmshamnen consist of four developing companies Älvstranden Utveckling AB, Skanska, PEAB and HSB. The Energy goals are set in the consortium contract and the common solutions e.g. the choice of district heating, locally common heat storage or property-specific solutions. The requirement for the entire area is to reach the score Miljöbyggnad Silver. Miljöbyggnad is a Swedish environmental certification for achieving sustainable buildings.

About the ID process: The ID Facilitator has worked with the Design Team to ensure that all issues are discussed from an energy perspective, so that the choice of solution is based on facts and not just opinions. During the planning phases the project had a parallel assignment where four companies were invited to present their ideas on sustainable and energy efficient construction. The ID Facilitator role was to evaluate their proposals and come up with a proposal

for further work. ID Facilitator has also worked with evaluate what kind of energy supply the site should have. Comprising contact with the district heating company Göteborg Energi and also detail planning for solar panels (PV).

Lessons learned from ID process: The market for zero and low energy buildings is growing. Public developers and major construction companies are showing the way. However the energy issue is not the number one priority in a construction project, but one of several important issues that must be dealt with. Many conditions for the possibility of building NZEB or even + NZEB given already in the process of zoning planning by local authorities. Therefore, it is important to planners in local authority to become aware that they can create the prerequisite for an area can be built with NZEB or even + NZEB in a cost effectively way.

More information about the project:
Ronnie Hollsten, Hifab AB, Ronnie.Hollsten@hifab.se, www.hifab.se

2.2.3 Childcare Centre, Cologno Monzese – Italy

© Comune di Cologno Monzese

Owner: Municipality of Cologno Monzese
Location: Cologno Monzese – Italy
Type of the building: Kindergarten
Gross floor space: 580 m^2
Year of completion: 2010
Investment costs: ~ 500,000 €

Achievements:

- The building achieves the A+ class according to the energy certification protocol defined by the regional law DGR VIII 5018:2007
- Thanks to this intervention, the Municipality of Cologno Monzese has been rewarded with the European GreenBuilding Partnership,
- This building won the *2010 European Green- Building Award* in the category Best New Projects,
- This intervention has been mentioned among the best projects of the *competition Premio all'innovazione amica dell'Ambiente 2009*,
- North facing skylights effectively and pleasantly illuminate indoor environments,
- A ground water heat pump is used to efficiently generate heat,
- A mechanical ventilation system coupled with a high efficiency heat recovery unit provides a good indoor air quality by saving a great amount of energy for heating,
- Electricity produced by a PV array with an area of 110 m^2 covers most of the electricity demand of the whole building.

About the ID process: A strict collaboration among all designers throughout the whole design process and construction development allowed to achieve an ambitious energy target and realize a high-performance public facility that provides a comfortable environment for children and teachers, by using little energy and having a reduced impact on the environment.

More information about the project: Comune di Cologno Monzese, arch. Lorenzo Iachelini, urp@comune.colognomonzese.mi.it

2.2.4 APIVITA Commercial & Industrial S.A. – Greece

© Apivita SA

Owner : APIVITA Commercial & Industrial S.A.
Location: Markopoulo, Attica, Greece
Type of the building: Commercial & Industrial
Gross floor space: 6,830m^2
Investment costs: 14 million €
Year of completion: 2015

© Apivita SA

Achievements: The new APIVITA building is in tune with the company's philosophy and values, symbolizing sustainability, innovation and a unique way of connecting the workplace with the natural environment. It is located in the Industrial Park of Markopoulo, Attica, Greece, in an area that was once an olive grove. In terms of architectural design, the building simulates a beehive, which brings together all the company's activities such as offices, training, museum, laboratories, cosmetics production, personnel dining hall, spa and events.

- Simplicity, aesthetics and functionality
- Natural lighting and ventilation
- Respect to natural resources and local biodiversity
- Reduction of ecological footprint
- Thermal and visual comfort
- Recyclable, natural and ecological building materials
- System of geothermic exploitation
- Photovoltaics
- Green roofs
- Biological waste cleaning and disposal of the water for watering/Rainwater tank
- Large plantations in the surrounding space

About the ID process: The design process of the building adopted from the very early stages the company's philosophy of sustainability, simplicity and functionality. All stakeholders were involved in the project from the early stages and formed a partnership. The project team worked together adopting a holistic approach towards all major aspects: energy, environmental, comfort, economic.

More information about the project:
National and Kapodistrian University of Athens (U.o.A) Theoni Karlessi, karlessith@phys.uoa.gr, http://www.apivita.com/new/the-new-apivita-factory

2.2.5 aspern IQ - Austria

©Wirtschaftsagentur Wien/ David Bohmann

Owner: Vienna Business Agency
Location: Vienna
Type of the building: technology centre (office, labs and research facilities, production area)
Gross floor space: 10,620m²
Investment costs: ~15 million €
Year of completion: 2012

Achievements: The aspern IQ attaches special importance to sustainability. Thanks to the combination of various individual measures, the building produces more energy than it uses:

- energetic optimization of building shell
- minimum energy demand due to demand-driven
- control of home automation
- 1.300 m² photovoltaic system with 130 kWp
- cold temperature of well water and re-cooling as energy-sources for cooling
- more than 90 % heat recovery of warmth and humidity

With the flagship project aspern IQ, the Vienna Business Agency sets standards which offer the highest usability comfort to tenants:

- ecologically compatible construction material
- high availability of daylight due to large window areas
- high attainable humidity (45 %)
- demand-driven control of ventilation depending on the number of people in the room
- comfortable radiation temperature control by concrete core activation

The combination of all these measures allows for a comfortable room and working atmosphere as well as low running costs of the passive house, certified according to klima:aktiv-guidelines.
aspern IQ is the winner of Green Building ID Award 2014.
About the ID process: From the first design idea onwards, the ideas of all team members flew into an holistic building concept. This ensured the timely consideration of all design aspects from the project start, through scheme design, approval submissions and working information up to site supervision. The result is an optimised building in terms of the targets with high degrees of operational and user comfort. By means of a simultaneous start by all design disciplines, all have the same knowledge and contribute innovation and creativity. The simultaneous working on the design ensures optimal results and efficient processes. Integrated design is design from a single source: An overall responsible project manager as contact who understands all design disciplines, their responsibilities, interfaces and interaction and an experienced team from all design disciplines, which works free of interfaces and professionally towards defined and coordinated project targets.

Lessons learned from ID process: The complex requirements of sustainable targets in building projects can nowadays only be satisfied inter-disciplinary. The strategy of additive design is obsolete. The integrated design philosophy is the logical representation of causal connection: sustainable building development pre-supposes consideration of life-cycle; this pre-supposes an integrate design approach supplemented by the advantages of the integrated design tool BIM.

More information about the project:
Wirtschaftsagentur Wien, Werner Weiss,
WWeiss@wirtschaftsagentur.at,
www.wirtschaftsagentur.at

2.2.6 Kobra – Slovenia

© Protim Ržišnik Perc

Owner: Kobra Team d.o.o.
Location: Šentjernej, Slovenia
Type of the building: Business building
Gross floor space: 1,300m^2
Investment costs: 2 million €
Year of completion: 2011

Achievements: After 29 years of Kobra Team's activity on the market the inspiration was to undertake a construction of a contemporary business building. With the help of the architects, the company's own interest and knowledge of the up-to-date technology as well as a good team of contactors, a contemporary plus energy business building was constructed, which is exploiting almost all natural energy sources. The basic principle was to use as many renewable energy sources as possible. Of those the solutions on the building use mainly the advantages of geothermal and solar energy. All renewable energy sources are hydraulically interlinked through a reversible heat pump, which in addition to heating the building and its sanitary water also enables passive and active cooling of the building. EU Commendation on Green Building ID Awards 2014.

About the ID process: The planning process followed the principles of integrated design. Designers from all fields of expertise exercise day-to-day harmonization and cooperate closely with the investor, end users as well as technical solution providers and contractors. Already in the phase of concept design which is in the process of integrated design more comprehensive and time consuming, all functional details, technical solutions, key construction principles and material are determined as well as the specific and detailed investment frame set. The investment frame was set based also on the comparable assessment of life cycle costs for the building and built-in devices (LCA and LCCA principles).

Lessons learned from ID process: Integrated design relies on the interdisciplinary and collaborative efforts of all parties involved not only at the concept and design stages, but also at the construction and facility use stage. Successful interdisciplinary cooperation hinges on effective project organization and management of all processes. Especially critical is the timely consultation with the appropriate expert and the active involvement of the end users.

More information about the project:
Kobra Team d.o.o., Branko Kovačič, brane@kobra.si
Gradbeni inštitut ZRMK, d.o.o. Marjana Šijanec Zavrl, marjana.sijanec@gi-zrmk.si

2.3 Hotels

2.3.1 Hotel in Milos – Greece

© ALD Architects

Owner: MILOS COVE SA
Location: Milos island, Greece
Type of the building: five star hotel
Gross floor space: 3,800 m^2
Investment costs: 4.5 million €
Year of completion: to be completed 2016

Achievements: The construction of a hotel in a coastal area with an archeological interest which should also have a high energy and environmental performance preserving at the same time the local biodiversity was a major challenge for the design process. The owner in cooperation with the architect, the engineers and the consultants adopted the ID principles from the early stages of the process.

About the ID process: The multidisciplinary team was consisted from the very early phases of the project and this helped to developing good cooperation between the members. Identifying, stating and overcoming problems is a major challenge in the ID processes. The basic steps that are followed are these:

- 1. Kick off meeting with multidisciplinary design team, discussion of needs and demands.
- 2. Assessment of the current situation by performing reports. Definition of project goals.
- 3. Workshops and meeting between architect, engineers and consultant to propose improvement solutions.
- 4. Meetings with developer to present and discuss the concepts.

Lessons learned from ID process: The agreement of the owner and the design team for proceeding with ID from the early design phase is crucial. The new approaches have to be introduced, defined and incorporated as soon as possible and this demands willingness and good cooperation between the team members. At first the team was skeptical about the procedure, but the positive results and the facilitation of problem solving convinced them about the procedure and the investment.

More information about the project:
National and Kapodistrian University of Athens (U.o.A) Theoni Karlessi, karlessith@phys.uoa.gr

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2.3.2 Hotel Golden Tulip Zakopane – Poland

© Hotel Golden Tulip Zakopane / Qualia Development sp. z o.o., Biprowłók sp. z o.o.

Owner: Qualia Development
Location: Zakopane/Poland
Type of the building: hotel
Gross floor space in: 8,811 m²
Year of completion: 2015

Achievements: The designed new hotel building will replace an existing old hotel. The design was optimized in order to decrease energy consumption and total operational cost. The most innovative features that occurred during this building design process were: feasibility study on building construction and HVAC systems, analysis on life cycle cost and energy efficiency of different external envelopes, heating, cooling and lighting system and energy sources. The ID process was applied in order to achieve those goals.

About the ID process: In the first place when an investor decided to design Golden Tulip Zakopane Hotel the meeting with ID facilitator has been organized. During the meeting investor described his goals in regards to the building and ID facilitator showed the benefits of using ID process. It was decided to use integrated design in the project. The same design team has been working during the whole process starting from design concept up to building documentation. The design team consists of architects, HVAC engineers, investor, energy consultant and ID facilitator. The close cooperation (every two weeks meetings and close cooperation using email and telephone consultation) within design team allowed to increase the effectiveness of the design phase.

Lessons learned from ID process: The most important in using Integrated Design procedure is awareness of the developer/client. In the first step it was useful to present to the client the opportunities and advantages of applying ID process. In such way the cooperation between client, design team and facilitator is much easier and much more analysis on the concept stage can be done. Very important is also good communication within the design team.

More information about the project:
Narodowa Agencja Poszanowania Energii (NAPE),
Jerzy Kwiatkowski, jkwiatkowski@nape.pl,
www.qualia.pl

2.4 School buildings

2.4.1 Delasalle Kindergarten – Greece

© Fotini Xyrafi

Owner: St. Paul Monastery of the Brothers of the Christian Schools – La Salle
Location: Alimos, Athens, Greece
Type of the building: school building
Gross floor space: 676.78 m^2
Investment costs: 550,000 €
Year of completion: 2014

Achievements: The construction of a sustainable bioclimatic building with respect to the surrounding area and the inhabitants was implemented with the use of renewables as PV panels, solar thermal and geothermal heat pumps resulting in high energy and environmental performance.

About the ID process: Integrated design and construction management are based on a constant cooperation of all team members involved in concept, design, implementation and end use. Efficient project organization and coordination of interdisciplinary processes are the two conditions for a successful integrated development. Well coordinated processes enable the development and implementation within planned time and budget. An experienced team of architects and engineers develops innovative and goal oriented solutions in an open, transparent and permanent dialogue with the clients. Active dialogue assures clarity, creates trust and ensures a strong chain of responsibility, in order to achieve the long-term goals and implement a sustainable building.

Lessons learned from ID process: All project stakeholders worked towards the sustainability goals in a holistic way and took part in most discussions because they had to know how hard the process is to find the best solution. During the design phase work team didn't change. The awareness (with the building owner) of the importance of clear goal setting in the beginning of the design stage, and the understanding of the consequences of the goals was a crucial point for actually succeeding in fulfilling the goals in the built project.

More information about the project:
National and Kapodistrian University of Athens (U.o.A) Theoni Karlessi, karlessith@phys.uoa.gr, www.saintpaul-delasalle.gr

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2.4.2 Romsdal VGS High School – Norway

© HUS architects

Owner: Møre og Romsdal Fylkes kommune
Location: Molde, Norway
Type of the building: School Building
Gross floor space : 12,000 m²
Investment costs: 50 million €
Year of completion: 2016

Achievements: The new school on the NW coastline of Norway is designed in massive wood as a passive house and with a "low tech" ventilation system. The owner have experienced that HVAC systems have become more and more complex, with great challenges for daily operations and costly maintenance. Overall goal for design of ventilations is to use Low Tech solutions, which in brief are systems designed with focus on simple solutions, and on the combination of natural and mechanical ventilation. The building owner and the project group have defined Low Tech ventilation. Low Tech ventilation is define as:

1. Low Tech ventilation should fulfill the indoor requirement.

2. Low Tech ventilation design should by based on LCC, optimizing energy cost, maintenance cost and investment cost.

3. Low Tech is and combination of mechanical and natural ventilation, using optimal strategy for different functions and areas in the building.

4. Low Tech ventilation enhance control solution and strategies with low complexity

5. Low Tech ventilation has 20% lower investments and running cost.

About the ID process:
The design team has been the same throughout the entire design. Supplement skills increased the number of participants along the process. The supplementations followed demands in the project, and skills needed in the process. The starting multidisciplinary group consisted of:

- Representatives for the owner
  - Management
  - Facility manager
  - Technical systems
- ID facilitator
- Head of design – management
- Architect
- Structural engineer
- Energy consultant
- HVAC consultant

During the multidisciplinary design, the group was supplemented:

- Acoustic consultant
- Fire consultant
- Electricity consultant

The design process was a combination of discussion in a large group, with all members present, and discussions in smaller subtask groups. The larger group included up to 12 persons, and the smaller subtask group's 2-4 persons. The themes of the subtask were:

- Thermal energy supply system
- Ventilations strategy
- Façade design and buildings envelope – opaque walls
- Structures, and design of prefabricated timber
- Fire strategy

ID facilitator was responsible for achieving the project goals and objectives. The overall goals / themes for the project is:

- Low tech technical system
- Passive level energy consumption – 70 kWh/m^2 total
- Use of massive timber constructions in and prefabricated system.

ID facilitator was leading the large group discussions, and every time design proposals might compromise the project goals, the ID facilitator called for alternative solutions. This process ensured that the overall design of the building was in corresponded with the project goals and objectives.

Lessons learned from ID process: Work in a multi-disciplinary team is a complex activity. Communication is something as perceived an easy task, but it's a much more difficult pursuit in practice. Challenges related to multi-disciplinary communication can be solved through good planning and setting aside enough time for meetings/workshops and clarification process.
Sketches describing solutions may reduce challenges related to multi-disciplinary communication. Quality and degree of precision in the initial concept stage (feasibility study) is invaluable. Good quality of feasibility study can contribute to a more cost-efficient process at the later stages. The concept design for Romsdal is more detailed, and many problem (normally solved I detail design) have already found solutions.
All design team members should take part of most discussions because they have to know how hard the process is to find the best solution. If they haven't been a part, they tend to be less flexible in finding holistic solutions. It's important to be a part of the process to be motivated to change attitude. And it might end up being most cost efficient.

More information about the project:
Asplan Viak AS, Arne Førland-Larsen,
PerF.Jorgensen@asplanviak.no

2.4.3 Torstvedt School – Norway

© NORDIC office of architecture

Owner: Larvik Municipality - LKE
Location: Torstvedt, Larvik, Norway
Type of the building: School Building
Gross floor space: School and sport facility 10,000 m², Kindergarden 1,200 m²
Investment costs: Unknown
Year of completion: 2016

Achievements: The building has obtained energy label A, with minimum 25 % reduced energy need according to the Norwegian low energy standard NS 3701. Heat pump based on energy wells, and mixed mode ventilation. These goals were achieved with cost neutral investments. Breeam NOR scheme has been used as a check list in the client brief and in the evaluation of the design competition.

About the ID process: The project was carried out by a number of key actors:

Developing Client Requirement and Briefwriting

- LKE- Larvik Municipality – Building owner
- Faveo Project management
- Norconsult – Demands for good teaching environment in the client requirement and brief writing.
- Asplan Viak - consulting firm – Environmental early stage design for the Architect competition – project development (Client requirements, Design basis – Brief writing – evaluation of proposal and follow up in design stages).

In the concept phase – the winning team in the Architect competition.

- Hent – construction company
- NORDIC office of architecture
- Bjørbekk og Lindheim landskapsarkitekter
- Sweco – Consultant engineers

The multidisciplinary design team indirectly increased the effectiveness of the design phase, with clear objectives for the project. The objectives where developed in at multidisciplinary team with all stakeholders involved. The goals where discussed in workshops, and finally presented for the board of Larvik Municipality building department.

Lessons learned from ID process: Working detailed with the client requirement and letting the building owner being a part of the process is very useful in the further process. This work is the fundament of the work in the following phases. The awareness (with the building owner) of the importance of setting precise goals in the beginning of the design stage, and the understanding of the consequences of the goals is is an important starting point for actually succeeding in fulfilling the goals in the built project.

More information about the project:
Asplan Viak AS, Arne Førland-Larsen
Arne.forlandlarsen@asplanviak.no,
www.lke.no/torstvedt-skole.html

2.4.4 Pontprennau Primary School – Wales

© Cardiff Council

Owner: Cardiff Council
Location: Pontprennau, Cardiff, Wales
Type of the building: School
Gross floor space: 2,250 m^2
Investment costs: 8.16 million €
Year of completion: 2016

Achievements: This project is using an existing building, renovating it from its existing purpose, and incorporating it into a new-build, adjoining school. The project benefits from the life cycle costing of the re-use of an existing building alongside the addition of a low-energy school. The project depends upon the on-going input of the surrounding citizens who will benefit the most from the school.

About the ID process: The design team consulted multiple companies and design boards throughout the design process. Mechanical and Electrical engineers were brought in early on the project, multiple renewable energy supply systems were investigated for their applicability, and the design team approached the Design Commission for Wales twice for advice and opinions on their three designs. The ID facilitator ensured all reports were pertinent, conducted workshops for the project, and will assist the contractors with ensuring the design aspirations are delivered throughout the construction phase.
Lessons learned from ID process:

The client in this instance was wholly separated from the tenant and the energy management department within the council, a situation which complicated and limited the design outcome. In light of this, we have learned an opportunity exists within local councils to break down barriers between the different project silos which define the 'business as usual' design process.

More information about the project:
Building Research Establishment Ltd (BRE), Andy Sutton SuttonA@bre.co.uk, www.bre.co.uk/matrid

2.5 Culture and leisure

2.5.1 Bassourakos Cultural Center – Greece

© Theros Architecture

Owner: Municipality of Evrotas
Location: Skala Lakonias, Greece
Type of the building: Cultural Center, mixed type (offices, exhibition, conference, restaurant)
Gross floor space: 1,680 m^2

Investment costs: 5.5 million €
Year of completion: to be completed 2016

Achievements: The renovation of the historic building was designed with respect to its historic characteristics, energy performance, surrounding environment and operational requirements. The combination of innovative interventions including, geothermal heat pump, green roof, PV panels, cool-photocatalytic materials, control of indoor air quality innovative features, was implemented in order to achieve the NZEB targets. EU Commendation in *Green Building ID Awards 2014*.

About the ID process: ID process was the most effective way of dealing promptly with the usual but also with the unexpected issues that came up during the procedure of implementation of the building project from the design to the construction phase. The constitution of the multidisciplinary team from the very early phases of the project helped to develop good cooperation between the members. Identifying, stating and overcoming problems is a major challenge in the ID processes. The basic steps that are followed are these:

1. Kick off meeting with multidisciplinary design team, discussion of needs and de mands.

2. Assessment of the current situation by performing reports. Definition of project goals.

3. Workshops and meeting between architect, engineers and consultant to propose impro vement solutions.

4. Detailed energy calculations to evaluate the measures that were proposed. Reporting.

5. Meetings with developer to present and discuss the concepts.

The role of the ID facilitator from the early stages of the design activities helped to determine the goals of the bioclimatic interventions while at the same time proposed the appropriate interventions, narrowing the band of the initial/conventional choices of the architect and the engineer

Lessons learned from ID process: This was a success result of the non-linear, circular iterative problem solving process that was adopted in accordance with the ID principles. The clarification of the milestones at each design phase is very important in order to achieve the agreed goals. The coordination by the ID facilitator is crucial at this level. Good communication between the team members helps the effective and prompt problem solving and has to be ensured during the whole process.

More information about the project:
National and Kapodistrian University of Athens (U.o.A) Theoni Karlessi, karlessith@phys.uoa.gr, http://www.eurota.gr/en

2.5.2 Parochallen – Sweden

© Picture from the construction work. Ronnie Hollsten, Hifab AB

Owner: Municipally of Götene
Location: Hällekis, Municipally of Götene
Type of the building: Education sports activities
Gross floor space: 740 m²
Investment costs: 1.3 million €
Year of completion: 2014

Achievements: The higher building cost compared to an average building cost shall be compared to the benefit of low maintenance and operation cost which will balance the difference, in profit of the owner and the tenants will not notice any higher cost.
The higher cost has been estimated to 8.6%. The specific energy use are 28 kWh/m², with is consider as a passive house.

About the ID process: The ID Facilitator has worked with the Design Team to ensure that all issues are discussed from an energy perspective, so that the choice of solution is based on facts and not just opinions.
During the concept design phase one of the most important players was Paroc which wanted to use the sporthall in Hällekis as a demonstration building.
The contribution from Paroc was really helpful and forced the other players to really do their best to achieving a really high energy efficiency result.

Lessons learned from ID process: The market for zero and low energy buildings is growing. Public developers and major construction companies are showing the way. In this case an isolation company wanted to support the local community and in the same time be able to build a demonstration project for showing their Isolation products. In this project the energy issue together with the cost issue were the most important tasks.
The developer was a small municipality which didn't had much experience of new construction which means that they were a bit insecure and needed to trust on that the design team would do a great work.
The project went well but in some cases it had been great if the contracts between the developer and all members of the design team had been clearer.

More information about the project:
Hifab AB, Ronnie Hollsten Ronnie.Hollsten@hifab.se

The project was sponsored by a local isolation company, Paroc. It was also supported by the Swedish low energy program LÅGAN.LÅGAN is a collaborative project between the Swedish Construction Federation, the Swedish Energy Agency, Region Västra Götaland, Formas and others. For further information, please visit www.laganbygg.se.

2.5.3 Creative Works – Wales

© Stride Treglown Architects

Owner: Blaenau Gwent County Borough Council
Location: Ebbw Vale, Wales
Type of the building: Arts Centre
Gross floor space : 3,600m^2
Investment costs: 4 million €
Year of completion: 2017

Achievements: The Creative Works is the latest addition to the expanding The Works regeneration site in Ebbw Vale. Reclaiming land following the demolition of a vast steel manufacturing plant, The Works is now home to a new hospital, a post-16 vocational and educational college, an 11-16 school, an energy centre for the site, a new leisure centre, and to the local archives for the region. The Creative Works looks to enhance the site with a cultural arts centre. The arts centre is set to consolidate two local, aging theatres under one roof, and will provide theatre, cinema, and gallery space alongside hospitality cafés and bars. The Creative Works is an arts centre joining an existing district heating network, alongside two schools, a leisure centre and an office building and archive. Its form and orientation within the valley and its operational schedule are more critical than similar arts centre projects, meaning early-stage energy modelling has an increased relevance in this instance.

About the ID process: The architect and client were keen to embrace Integrated Design, and looked to BRE for both guidance and energy modeling. During the early, conception design stages, the design team analysed several different designs in terms of orientation, form, meeting the brief, and energy consumption. A low energy building design has fallen out of this process, and has been further studied in terms of solar gains. The client is now awaiting further funding in order to progress the project to the detailed design stage.

Lessons learned from ID process: In this instance, the client was very receptive to adopting the ID approach. The project architect equally was very engaging with the process, and was open to learning from the early-stage energy comparison analysis. Being able to put energy consumption numbers to the various proposed designs was useful to everyone in the process. . All parties agree a larger design team would have benefitted the conceptual design stage. However, with funding uncertain for the entire building project, this was not pursued.

More information about the project: Building Research Establishment Ltd (BRE), Andy Sutton SuttonA@bre.co.uk, www.bre.co.uk/matrid

2.5.4 Splott Community Centre – Wales

© Stride Treglown Architects

Owner: Cardiff Council
Location: Cardiff, Wales
Type of the building: Leisure Centre/ Library/ Community Centre
Gross floor space: 3,000 m²
Investment costs: 6.9 million €
Year of completion: 2016

Achievements: This project has changed multipled times over the course of the conceptual design stage. The budget has decreased by 1/3, and the project itself is the focus of intense community scrutiny. However, the ID process has allowed for a better understanding between the designers and the contractors, a better relationship with the public in terms of consultation, and a lower energy building than the current design process would have produced.

About the ID process: This project has undergone various design changes since its inception. Negotiations with the design team and the client have resulted in multiple design options, all of which were interrogated through the ID process. The design team analysed two-storey and single-storey options with energy modeling, and weighed up the results alongside site analysis and budget options. The current proposal for a double-storey building has been considered the best option considering the site constraints, material costs, and public access. As the project enters the detailed design stage, extensive integrated studies and workshops with the contractor will ensure the lowest possible energy building for the site and the design proposal.

Lessons learned from ID process: This project is contractor-led as a Design & Build project. The contractor is a market leader in terms of low-energy buildings, and is keen to repeat the same for this project. However, previous non-ID projects for the contractor have been considered according to a rigid framework of material specifications, alongside basic Part-L requirement heating specifications. The application of ID on this project has been of particular interest in terms of exposing the contractor to a different method of design analysis and cooperation. Closer cooperation on similar projects in the future is anticipated.

More information about the project:
Building Research Establishment Ltd (BRE), Andy Sutton SuttonA@bre.co.uk, www.bre.co.uk/matrid

2.5.5 Stavros Niarchos Foundation Cultural Center – Greece

© Yiorgis Yerolymbos

Owner: Stavros Niarchos Foundation Cultural Center SA
Location: Athens, Greece
Type of building: Cultural center
Gross floor space: 215,000m^2 (plot)
Investment cost: 566 million € (grant amount; not contract amount)
Year of completion: 2016

Achievements: In 2006, The Stavros Niarchos Foundation announced its plans to fund the development of The Stavros Niarchos Foundation Cultural Center (SNFCC), a project that includes the construction and complete outfitting of new facilities for the National Library of Greece, and the Greek National Opera as well as the creation of the 170,000 m^2 Stavros Niarchos Park. In 2008, following a closed international design competition, the Foundation's Board of directors unanimously selected the Renzo Piano Building Workshop.
Sustainability is one of the SNFCC's fundamental values. The creation of an environmentally friendly and sustainable infrastructure for the buildings and the Park is an important goal in the design and construction of the Stavros Niarchos Foundation Cultural Center. Through environmentally innovative designs and practices, the project aims to earn at least Gold and ideally Platinum LEED certification, the first such designation in Greece and the first for a project of this scale in Europe.
A beacon of sustainability is borne out in every aspect of the design- from the Stavros Niarchos Park, which also functions as a green roof for the National Library and Greek National Opera, to the canal which provides anti-flooding protection for the site, to the photovoltaic canopy which produces energy for the needs of the two buildings and contributes to the goal of zero emissions.
The photovoltaic solar energy canopy, a 100m x 100m floating wing-like structure, which soars 14m above the Park's summit and extends outward from its perimeter, will provide energy for the buildings. An innovative structure, both from engineering and a construction point of view, the canopy will be supported by 40 metal pillars and expresses the Foundation's and Renzo Piano's commitment to environmental designs and practices.

About the ID process: Before the commencement of any procurement or construction activity all technical documents produced by the Contractor (Construction Drawings, Method Statements, Material submittals etc.) are subject to the review and approval of SNFCC specialists. Such a procedure coupled with the everyday general and contractual correspondence necessitates the exchange of enormous amounts of documents within and between the three main participating entities i.e. the (a) Project Designers, (b) Employer and its Representatives and (c) Contractor and its Consultants/ Subcontractors. The overall project design is driven by the highest environmental goals and international standards which are summarized in the following principles:

- Strict Compliance with the Environmental Impact Study and Environmental Terms approved by Greek Authorities
- Achievement of Platinum LEED certification
- Compliance with the highest international environmental standards

The same principles, which have already been applied in the design, are followed in every day construction activities.

The key participants in this special task are the SNFCC consultants and auditors, which include LEED specialists and third party environmental inspectors and the Contractor's LEED certified supervisors. Monitoring results are documented by a thorough and systematic record keeping. The status of the environmental conditions on site is constantly audited and evaluated thru periodical and ad hoc meetings and recorded in monthly reports.

More information about the project:
National and Kapodistrian University of Athens (U.o.A) Theoni Karlessi, karlessith@phys.uoa.gr
http://www.snfcc.org/default.aspx

2.6 Residential

2.6.1 Casa eco passiva Sicilia - Progetto Botticelli – Italy

© Marco Pietrobon

Owner: Ing. Carmelo Sapienza
Location: Mascalucia (CT), Italy
Type of the building: Residential
Gross floor space: 148 m^2
Year of completion: 2013

Achievements: The energy concept of this pilot-house has been developed for at least three year. Started in 2009, the main achievement of the project was to design and realize a net-zero energy house in a Mediterranean climate, also meeting the requirements of the Passivhaus voluntary certification scheme.

"Progetto Botticelli" has been certified according to both the Passivhaus and CasaClima Gold certification scheme. The house is an all-electric building and meets specified requirements in terms of energy performances, air-tightness and thermal comfort. Moreover, home automation improves energy efficiency and indoor environmental conditions, maximizing living comfort. Furthermore, building-integrated solar thermal collectors and photovoltaic system generate, over the year, more electric energy than that the house requires for satisfying all energy uses.

About the ID process: To succeed in the aforementioned achievements, all the pillars of integrated design have been implemented. Specifically, a multi-disciplinary design team was constituted from the early conceptual phase. Although the small size of the intervention, the disciplines and skills included in the team have been: architecture, civil engineering, electric and mechanical engineering, building physics, energy certification, geology, project development and management.
A few months were dedicated to the discussion and clarification of the client brief and selection of the design objectives and techniques to support and advanced design. The software PHPP, used to verify the fitness in the requirements of the Passivhaus voluntary certification scheme, was used to run the continuous quality control.

The owner of the building was a member of the design team, and also assumed the responsibility and the role of the ID facilitator.

Lessons learned from ID process: It is of fundamental importance to set clear and agreed milestones and responsibles at least for each design phase. The agreement on using the same calculation procedure and software (PHPP) from the conceptual design phase throughout the whole design process was of great help. It slightly limited optimization possibilities, but allowed to have an assessment tool for supporting the selection when the choice about a given design variable was not simple.
Mathematical optimization techniques coupled to dynamic energy simulation have been used to support the design of the building. Those techniques demonstrated to be useful to reduce considerably the design time, in the face of a still long computation time and a little user-friendliness.

More information about the project: Eng. Carmelo Sapienza, www.sapienzaepartners.it/progetto-botticelli/, www.casaecopassivasicilia.it/index.asp

2.6.2 Eco Silver House – Slovenia

© Marko Kramar

Owner: Akropola, d.o.o.
Location: Ljubljana, Slovenia
Type of the building: Multi-apartment building
Gross floor space: 12,000 m^2
Investment costs: 18 million €
Year of completion: 2014

Achievements: Multi-apartment new building in 11 floors. 128 apartments and business center in the ground floor.

About the ID process: Low energy indicators set by the design team cannot be achieved if the construction is not planned carefully down to the final element. In this project the airtightness set to 0.6 h-1 was the most difficult criteria to achieve and most important since it is linked to national subsides. Workers on construction site that can positively or negatively affect the end result of a given energy indicator do not know their impact on energy indicators. Majority of workers were not capable to perform the tasks set by designers.
Several mattings were held with the topic on airtight layer. ZRMK, contractor, designers and various suppliers of layer materials discussed all possible solutions, mostly about joints between different materials. How to construct them? How will different materials bund (physically and chemically)? What about the longevity of the materials? Different solutions ware analysed against these and other questions and at the end the 3D plan of airtight layer was elaborated with all the details.
The suppliers and designers held meetings for the construction workers and demonstrated the use of materials and how all the details in the design plans have to be actually carried out.

Lessons learned from ID process: Special care has to be taken during the construction phase of the project. Key indicators set in the design process that influence on the building energy performance (e.g. airtightness level) have to be defined and monitored during construction phase. All involved stakeholders have to be informed and have to take care of their

job related to observed indicator.

More information about the project available here: Gradbeni inštitut ZRMK, d.o.o. Marjana Šijanec Zavrl, marjana.sijanec@gi-zrmk.si http://www.akro-pola.si/eco-silver-house

2.6.3 Petrzalské Dvory – Slovakia

© iEPD (Institute for Energy Passive Houses)

Owner: Fredriksson s.r.o, Bratislava, Slovakia
Location: Bratislava, Slovakia
Type of the building: residential
Gross floor space: 24,190 m^2
Investment costs: 16 million €
Year of completion: 2017

Achievements: The most innovative features of the project are mainly the high energy efficient central ventilation system, energy efficient summer pre-cooling system, ultra-low energy standard with passive house components, water retention management and e-mobility & bicycle friendly design. In the current I. phase of the project (45 flats), the developer target is "ultra-low energy standard" in the energy class A (according to the current Slovak legislation). Legal requirements for new buildings in Slovakia are currently settled on energy class B.

About the ID process: The cooperation within the design team of Petržalské dvory project, has been intensive as well as interesting. The typical example can be seen between architect and structural engineer, in the process of thermal bridges elimination. It resulted to the implementation of thermally split balconies and minimization of linear thermal bridges. Further creative cooperation between architect and cost specialist, led to minimization of extra costs for splitting elements by smart facade geometry design.
Further, the interaction between architect, developer and risk manager needed to be mentioned. The complete redesign of the project phasing can be seen as the result of this cooperation. Useful was also the interaction between architect and HVAC engineer in case of ventilation system design.

Lessons learned from ID process:

- ID is an ideal approach to achieve very high cost efficiency (minimizing the extra-costs related with higher energy efficiency)
- creative co-operation between members of the design team (architect and other specialists) could lead not only to innovative technical solutions, but

also to innovative architectural elements
- important focus on the communication and co-operation skills
- importance of the early involvement of real-state & bank expert for early set-up of the project phasing and optimal design process (each project phase need to be self-sufficient with access, car-parking possibilities, infrastructure and energy connections, etc.)

More information about the project:
Slovak Innovation and Energy agency (SIEA), Eduard Jambor, eduard.jambor@siea.gov.sk www.petrzalskedvory.sk

2.6.4 Zelene Atrium – Slovakia

© iEPD (Institute for Energy Passive Houses)

Owner: smf marko
Location: Trnava Slovakia
Type of the building: residential
Gross floor space: 4,547m^2
Year of completion: 2015

Achievements:
Green Atrium consists of the refurbished and brand new part. New building consists of several basic functional parts: apartments, commercial space, administrative space, basement parking and common areas for the house residents. The project revitalizes a neglected area of the former printing company. It is rated with environmental scheme LEED, and optimized with software PHPP. In terms of sustainability, this project is literally a pilot project in Slovakia

About the ID process: Formation of the project team has begun during a design process. With the aim to achieve a passive house standard, planned buildings were calculated and optimized with Passive House Planning Package – PHPP. LEED processor has been involved after PHPP calculating phase with the main aim to monitor the environmental targets. Some design parameters of the project could no longer be affected in this planning phase. Multidisciplinary team is a prerequisite for good results, not only in case of architectural projects. The requirement to form such team is applicable in general, because of the need for a holistic approach to create the environmentally friendly architecture.

Lessons learned from ID process:

- Integrated design is a crucial approach for achievement of the best environmental friendly design, which was widely accepted in the composition of the design team.
- It is worthy to focus on the early design stages as long as it is necessary.
- BIM tool could be helpful and should be used in all projects especially in case of non-residential buildings.
- PHPP is a reliable and important tool for achie-

ving the highest energy efficient standards of buildings and should be recommended for all projects.

- PHPP is a great tool for monitoring of the energy standards and final quality of the building.
- Environmental schemes such as BREEAM, LEED, etc. are representing very useful tools for monitoring of environmental goals.
- Late composition of the team leads to compromises, which can negatively influence the results, especially in case of energy efficiency goals

More information about the project:
Slovak Innovation and Energy agency (SIEA), Eduard Jambor, eduard.jambor@siea.gov.sk http://www.zeleneatrium.sk

3.6.5 Single family house - Point 141 – Poland

© Single Family House – POINT141 / Danwood S.A.

Owner: Danwood S.A.
Location: Poland
Type of the building: residential
Gross floor space: 136.5 m²
Investment costs: 96,400 €
Year of completion: 2015

Achievements: The single family house is designed in prefabricated technology and fulfil requirements of Low Energy Building program of The National Fund of Environmental Protection and Water Management (NFEP&WM). The goal of the developer was to design prefabricated low energy building that can be localized in every place in Poland. The design must consider construction of external and internal envelopes, building systems and heat source. The advanced analysis has been carried out in order to achieve established goals.

About the ID process: The developer intend to design low energy single family house, thus at the beginning of the project he contact with energy consultant company. At the first meeting the decision on using ID process was established. From a very beginning ID facilitator was involved in the design team. The close cooperation between developer, architects, engineers and energy consultants was set. Most of the consultation was done by regular calls and e-mailing. Thanks to close cooperation in multidisciplinary team most of problems were solved on the concept design stage. ID facilitator was responsible for supervision on energy effectiveness of the proposed solution for the building. The use of ID process allow to achieve low energy building design at the end of the project.

Lessons learned from ID process: Some developers are aware that the market for zero and low energy buildings is growing. They noticed that in order to achieve very good energy standard more than only standard analysis must

be done. It was showed in that pilot project that ID process can be applied not only for individual designs but also for prefabricated buildings.

More information about the project:
Narodowa Agencja Poszanowania Energii, Jerzy Kwiatkowski jkwiatkowski@nape.pl, http://www.danwood.pl/

2.6.6 Apartment building in Vaives street 4 – Latvia

© Ekodoma Ltd.

Owner: flat owners
Location: Cesis city, Latvia
Type of the building: Residential apartment building
Gross floor space: 2437.6 m²
Investment costs: 260,489 €
Year of completion: 2014

Achievements: Majority of the renovation works were carried out in the summer. It was ensured, that the building façade interactions with surrounding environment was as low as possible.
During the building renovation, it was essential to allow building inhabitants to freely access and use the building
Before renovation building represented typical soviet period buildings. Such buildings represent the biggest share of all building stock not only in Latvia but also in other east European countries. The aim of the renovation is not only to ensure comfortable indoor climate and decrease energy consumption, modernize other engineering systems but also significantly improve building aesthetics value. Energy service contract (EPC) has been used to cover building renovation costs and implement the project. Beside energy efficiency measures during the project design phase it is planned to refurbish and repainted, the balconies, cold water supply system and all staircases.

About the ID process: The work of the team has been lead by ESCO company project manager who is specialized in building renovation projects. The team consisted from different engineers, energy auditors, engineering consultants to develop building renovation alternatives (Ekodoma). During the design phase work team didn't change. Already after the tendering process when constructions works have begun the construction company joined the team. The manager from ESCO was organizing and managing whole design process.

Lessons learned from ID process: One of the main challenges during renovation was to ensure that building can operate during renovation process. The refurbishment scenario chosen: to avoid internal works as possible to allow operating during renovation works. It's planned that new ventilation system ducts will be placed along the façade in the insulation layer. The work of the team has been lead by an ESCO company project manager who is specialized in building renovation projects. The team consisted from different engineers, energy auditors, engineering consultants to develop building renovation alternatives (Ekodoma). During the design phase work team didn't change. Already after the tendering process when constructions works have begun the construction company joined the team. The manager from ESCO company was organizing and managing whole design process.

More information about the project:
Agris@ekodoma.lv
http://renesco.lv

2.6.7 Apartment building in Mastu street 8k1

© Ekodoma Ltd.

Owner: flat owners
Location: Riga city, Latvia
Type of the building: Residential apartment building
Gross floor space: 1,846.9 m²
Investment costs: 265,700 €
Year of completion: 2014

Achievements: The first building in Riga that is refurbished by an ESCO according to EPC scheme. The building employs first mechanical ventilation system in multifamily building refurbishment projects in Latvia. Mechanical ventilation system is used to improve

air quality and achieve higher energy savings. Energy service contract (EPC) is used to cover building renovation costs and ensure full implementation of the project. Available structural funds have also been attracted to support the project implementation. EPC contract is based on the principle, that during the whole validity period of the project apartment owner (based on the previously determined baseline costs which have been set and agreed upon by both involved parties) pays to the ESCO for the same amount of consumed energy which would be monitored if no energy efficiency measures were implemented. So the aim is to set the payments for the building residents in a fixed level (in some cases even lowering the payment burden) and in the same time renovate the building and increase indoor climate conditions.

About the ID process: Organization of the team work was led by involved ESCO's project manager who is specialized in building renovation project management. The team consisted from different engineers with wide background of expertise in building construction and internal utilities, as well as energy auditors and engineering consultants, which developed different alternatives for building renovation (Ekodoma). The design team maintained constant and didn't change over all the period of project implementation. In the ESCO model, the main design criteria include prerequisites for high standard achievements regarding sustainability and longevity of the project. This is due to the fact, that EPC usually is long term contract, during which service provider is interested in achieving highest possible standards. The design team is being focused on long term goal achievements and the criteria of sustainability by the project manager, thus ensuring that all aspects of the building retrofit project are considered in the first project planning stage. Right after tendering process, representative from the company providing the construction works of the building also joined the design team. The manager from ESCO was organizing and managing whole design process.

Lessons learned from ID process: Before building renovation, during project initial phase, different renovation options are analyzed starting from some basic measures to comprehensive building renovation with integration of mechanical ventilation and RES systems to achieve very low energy building standards. The main goal was to ensure that the planed energy efficiency measures have been met and at the same time no sacrifices regarding the indoor climate conditions and inhabitant life style have been made during the retrofit process. Organization of the team work was led by involved ESCO's project manager who is specialized in building renovation project management. The design team is being focused on long term goal achievements and the criteria of sustainability by the project manager, thus ensuring that all aspects of the building retrofit project are considered in the first project planning stage. Right after tendering process, representative from the company providing the construction works of the building also joined the design team. The manager from ESCO was organizing and managing whole design process.

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3 Lessons learned and final remarks

What can we learn about the pilot projects in order to improve the ID process and coming up with more projects using the ID approach in future? The outcome of the pilot projects has been analyzed by using the SWOT method. A SWOT analysis is used to evaluate the strengths, weaknesses, opportunities and threats.

Strengths	Weaknesses	Opportunities	Threats
ID is an iterative process which secures that all energy related issues will be handled before the process leaves for the next step The outcome of the planning process will be more thorough and consist of fewer contradictions and inconsistencies. This in turn will result in fewer last minute changes and fewer building faults.	Relatively unknown in the construction industry Difficult to change traditional way of planning and constructing Demands good communication Demands an ID facilitator, which is a new role in the planning process The project manager needs to share responsibility and mandate to the ID facilitator Increased planning costs	EU directive about NZEB will increase the market for NZEB buildings and ID is an effective method for reaching NZEB energy demands The ID process gathers expertise from different work fields resulting in synergies Fewer last minute changes and fewer building faults will show that in total the ID process is cost effective Future improvements of the method is relatively simple, e.g it would be easy to add a process for increased accessibility for disabled people	Lack of knowledge and information about ID and the benefits using it among stakeholders Difficulties in finding the right way of using ID for each single project Clients willingness of paying more for the planning process For best results it is important to use ID from the very beginning of the project, preferably even before there is a drawing. This can be a threat, as many projects demand a drawing to achieve funding

To succeed with an ID process and construct buildings with nearly-zero energy requirements, it is crucial that the process is involved as early as possible, preferably already in the initial planning phase.

The client's understanding of advantages from using the ID process in conjunction with planning is of highest importance as that will result in enough mandate for the design team to fully succeed. For a cost effective energy optimized design, it is important that an ID facilitator becomes involved as early as possible in the planning process.

There is a need for more knowledge among and information to public planning officers and potential clients.

All design team members must understand the benefits of ID and how the process works. The awareness about how each member is expected to contribute in the various planning phases is also of highest importance. A major challenge is to keep the iterative solution methodology throughout the planning phase and not fall back into the traditional way of working, although the former initially takes somewhat more time.

The design team needs to consist of people who can think creatively and have an ability to work across traditional professional areas.

Once the ID process is in place, the results will depend on how well the design team can communicate and work together during the planning phase. Different technical solutions and frequent meetings, in real life or over telephone, will be required.

More lessons learned can be found in detail in the specific report at www.integrateddesign.eu/downloads/index.php.

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