Subtask C
Concepts, Case Studies and Guidelines

Olaf Bruun Jørgensen (STL)
Esbensen Consulting Engineers A/S
obj@esbensen.dk, www.esbensen.dk
Subtask C: Concepts, Case Studies and Guidelines

Objectives:

• Develop concepts and principles for high quality architectural integration of solar systems.

• Develop building concepts that utilize active and passive solar energy, achieving high quality architecture, sustainable solutions, attractive indoor climate and high energy performance.

• Develop knowledge and strategies to promote and implement high quality architecture using solar energy.
Means:

• Collecting good examples of buildings using solar energy and sort into a set of typologies.
• Analyzing such example buildings and documenting architectural quality, technologies energy performance and indoor climate.
• Analyzing the performance of different concepts focusing on the effects of the solar systems.
• Participating in the development of demonstration projects.
• Presenting the results in international seminars.
Subtask C: Concepts, Case Studies and Guidelines

Results:

• Comprehensive collection of case studies of high quality architecture and energy efficient building designs including solar solutions for new build and renovation for various building types (housing, offices, schools, etc.)

• Communication Guidelines for architects to increase the use of cost effective solar energy solutions in building design
### Case Studies

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Year</th>
<th>SHE</th>
<th>Project Description</th>
<th>Company Name</th>
<th>Country</th>
<th>Architect</th>
<th>Contact Person</th>
<th>Email</th>
<th>Phone</th>
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<tbody>
<tr>
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<td>SHE</td>
<td>Description 1</td>
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<td>Architect C</td>
<td>Contact Person C</td>
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**Total Projects:** 181

**Architects:**
- 33 architects (T41)
## Case Studies – selected

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<thead>
<tr>
<th>PROJECT ID</th>
<th>PROJECT NAME</th>
<th>YEAR</th>
<th>STATUS</th>
<th>TECHNICAL INFORMATION</th>
<th>COUNTRY/DEPOT</th>
<th>TECHNOLOGY</th>
<th>POWER LEVEL</th>
<th>ENERGY</th>
<th>FUNCTION</th>
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<tr>
<td>1</td>
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<td>2</td>
<td>SolarWatt, Germany</td>
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<td>3</td>
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<td>4</td>
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<td>5</td>
<td>SunLiner, Germany</td>
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<td>10</td>
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60 projects
Building Types

- Residential: 18
- Office: 6
- School / University: 2
- Public Culture: 6
- Other: 18
Xelox Energy Lab is a manifesto-building for a company which produces solar parabolic troughs. The visual distinctive element is a large PV surface (35kWp) forming the diaphragm that screens a southern façade whose rhythm is defined by the repetition of a photovoltaic component sloping to find the sun. The energetic consumption of the building is very low (<6kWh/m²), also parabolic troughs and solar thermal have been used on the roof.

Xelox Energy Lab, Medolago (BG), Marco Acerbis, Eiante, Solar Manufacturer
New Building (under construction), Factory, 2007
SUNNY WOODS – A BUILDING LIVING UP TO ITS NAME
Sunny Woods was the first multi-family house to achieve an annual zero energy balance by reducing the energy demand to about 10% of a conventional building and including active and passive solar design strategies. The building won the Swiss and the European Solar Prize in 2002. 200 m² roof integrated thin film PV cells cover about 80-100% of the electricity demand. 6 m² vacuum collectors integrated into the balcony balustrades support the production of domestic hot water and space heating.

Residential Building, Zurich-Höngg, Kämpfen für Architektur, Naef Energietechnik, Fabrisolar
New Build, Visible, integrated into roof/facade, 2001
The recent construction of a Gymnasium in Markt Großostheim comes with integrated solar thermal collectors. The roof of the hall is used as a thermal power station for a local heating network. This network is primarily supplying the gym itself, and an outdoor pool.

The collectors are integrated into the south faced side of the facade. With a declination of 35° they are optimally aligned for insulation. The whole room is light-flooded and makes maximum use of daylight.
DWELLING HOUSES, AT

Hard in Vorarlberg faces a great demand for reasonably priced tenements - the goal of this project was consequently to optimize the building's structural shell and the floor plan in order to minimize rental and running costs. Prefabricated wood elements, a meticulously insulated roof to reduce the waste of energy and movable PVs on the south side which serve also as sun protection are the most remarkable features of this house.

This building is an example for high quality in residential architecture aiming at low-income families. It is also a nice example for integration of solar energy. The skeleton structure with wooden wall panel and a prefabricated sanitary block are unusual for this kind of buildings. The effect of the interior quality is controllable with the moving solar shades.

As part of the ongoing expansion of Pearson International Airport, the new Fire and Emergency Services Training Institute (FESTI) came with a mandate to pursue high sustainability practices. Taking full advantage of the site, the double-angled, south-west facing, 240m² solar wall heats the air that is then used to condition the interior spaces. By combining the use of the solar wall with the thermal mass of hollow core concrete slabs, heat captured from the sun's energy can be stored and released on demand, while eliminating much of the bulky mechanical equipment traditionally needed to condition interior spaces. As one of the primary expressive elements of the building, solar wall compliments and works with the architecture rather than competing against it.

On the angled south-west facade black, perforated corrugated metal makes up the solar wall. Additional non-perforated metal panels are used behind the solar wall on the tower to harmoniously bring together the various elements of the project. The bold colour and large surface of the solar wall highlights this facade as being significant to the project without compromising the architectural language of the project. The successful integration of the solar thermal energy system, and the layering of materials adds to the visual aesthetic and modern appearance of the facility.

Fire and Emergency Training Services Institute, Kleinfield Mychajlowycz Architects Inc, Ontario, Canada, New Build, Institution, 2008
The portrayal has developed from the problem to cope with sun shading for the new placed facade to the entrance hall facing directly to the south and against the open space by the yard. From the yard, the pattern of the solar cells in interact in a delicate way with the existing brick pattern. The facility combines an aesthetically attractive manner with the use of solar cell shading.
SOLAR UMBRELLA HOUSE, USA

The solar shelter, called solar umbrella, consists of a 4-kilowatt solar panel array. It wraps the house from the south side and continues up and over the roof. The solar array acts as a screen which protects the house from direct heat gain, while taking in the sun’s rays in order to provide 100% of the building’s electrical energy requirements. Since the Solar Umbrella House’s system is grid interted, all surplus energy is returned to the community. Its strength lies in the use of PV technology to create an element of architecture.
SOLAR XXI, passive office building

in this building, vertical bands of photovoltaic panels are integrated into the south facade, with an alternative rhythm with the glazing, resulting in an elevation based on the concept of modularity and repetition. The PV panels acquire a compositional quality determinant to the final outcome. The project seeks to reconcile the different systems - photovoltaic, solar collectors, ground passive cooling - by a balance of formal and spatial integration. The systems are assumed from the initial phase as compositional elements that potentially generate the final form and not as disjunctions added during the process, and thus act as an example of project methodology applicable in similar cases.
I-BOX, STORELVA, NO

This seven-unit passive row house in Tromsø, in the very north of Norway, is focused on low energy usage and the environment. The three story row sits on a site sloping down to a river. The main structure is solid timber elements, with exterior mineral wool insulation and hardwood siding. The top portion of the south facade is covered with solar collectors. The collectors recessed cladding, making them flush with the cladding below. The top of the collectors extend above the rooflines, acting as a baffle stack. The light cladding and large windows make the collectors stand out as a clear statement of the environmental intentions of the building.

In addition to the solar collectors, heat collectors are placed in the ground for pre-heating/cooling of the air intake. A buffer tank for the heat collection systems combined with a backup air-to-water heat pump, stores and delivers energy to the building heating system.
Copenhagen Towers are two buildings with hotel and offices. The façade of the hotel consists of 1,700 m² customized photovoltaic modules in 38 different sizes which match the rest of the façade as an integrated part of the design.

The building integrated solution that replaces the entire façade cladding.

The size of the plant is 200 kWp on the façade of the South Towers, east, west and south-facing façade. At the roof of South Wing is placed a 70 kWp plant at 500 m².

Copenhagen Towers, Ørestads Boulevard 106-116, København.
Architects: Dissing+Weitling (hotel) og Foster+Partners (offices), Gaia Solar, New Build, hotel and office, 2009
A very progressive façade installation was completed using a standard fixing system at the Allan Gilbert Building, University of Melbourne where 48.4kWp BP Solar poly-crystalline cells were laminated by Flabeg International into heat-strengthened glass panels. This is connected to six 5kW and four 6kW inverters to convert the DC panel power into usable balanced three phase AC grid power. The PV panels sit within a 2mm liquid interlayer, sandwiched between 6mm thick clear inner and low-iron outer glass. Building on project expertise developed both in Australia and overseas by design partners ARUP, BP Solar, and Solar Technologies, the facility demonstrates the application of building-integrated photovoltaic power generation within an urban habitat.
The northern façade of the Building and Construction Training Centre at the University of Ballarat’s SMB Campus is not only an eye-catching design, it also features high-tech construction materials. Covering 200 square metres, supplied by Schott Solar through Going Solar, the 85 x 100Wp panel glass is coated with thin films of transparent conductor amorphous silicon and connected to eight Fronius IG-15 inverters. Although thin film amorphous silicon is normally not transparent, this façade is made up of a semi-transparent version called ASI-THRU, where 10 per cent of the surface is free of silicon. This means people inside the building can see outside, but still enjoy privacy. The ASI-glass is double-glazed, providing excellent thermal properties and the ability to block solar radiation from entering the building. This has cut the air-conditioning plant size by 40% and significantly reduced air-conditioning running costs.
A small concrete cube housing toilet facilities by the tourist route Autodirektet in the west of Norway. Situated in a vast mountain landscape close to lakes and great views, it’s a popular starting point for hiking and fishing trips. The southern façade is glazed, with PV cells integrated in the lower part of the glass. The PCs provide privacy for the toilets as well as power supply for the vacuum-toilets and water pump.
Solar Energy and Architecture

OVERVIEW

It is clear that solar energy use can be an important part of the building design and the building's energy balance to a much higher extent than it is today. This Task should help achieving high quality architecture for buildings integrating solar energy systems, as well as improving the qualifications of the architects, their communications and interactions with engineers, manufactures and clients. The vision - and the opportunity - is to make architectural design a driving force for the use of solar energy.

The title of this Task indicates that focus is on both high architectural quality and high energy performance. Thus, it would be counterproductive to show the use of solar applications in buildings where the energy performance is poor or even worse than without solar applications.

This title also indicates a new way of approaching the use of active solar energy in buildings that sees architects composing their architecture with solar components conceived as building elements.

The illustrations above are from left to right: Lærkebjerg School by 2arkitektur, Denmark, Sunny Woods by Beat Kämmerl Architects, Switzerland.
Task 37 - Advanced Housing Renovation with Solar and Conservation

OVERVIEW

Buildings are responsible for up to 35 percent of the total energy consumption in many of the IEA participating countries. Housing accounts for the greatest part of the energy use in this sector. Renovating existing housing offers an enormous energy saving potential. The Task objective is to develop a solid knowledge base on how to renovate housings to a very high energy standard and to develop strategies which support market penetrations of such renovations. Task 37 will include both technical R&D and market implementation as equal priority areas.

The Task will begin by analyzing the building stock in order to identify building segments with the greatest multiplication and energy saving potential. Examples of building segments are year of construction, type of buildings, type of envelope and components. Within these segments important topics for discussions are: ownership and decision structures, inhabitants and their characteristics and actual groups of retrofit market players.

www.iea-shc.org/task37
Terraced houses, Albertslund, DK
Bjørnenes Kvarter 15C og 15D

PROJECT SUMMARY
Renovation and re-insulation of roof, facade and floor. Bay windows. New bathroom, kitchen and interior surfaces. Designed according to Danish low energy class 2 (63,3 kWh/m² yr/year for a 120 m² house).

SPECIAL FEATURES
Solar panels for domestic hot water and mechanical ventilation with heat recovery

ARCHITECT
NOVA5 architects, DK

ENERGY CONSULTANT
Niras Consulting Engineers, DK

OWNER
BoVest Building Association, DK

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation
BACKGROUND

The houses in the living area of Albertslund South were built in 1963-65 and consists among others of 550 terraced houses. Today the houses suffer from various constructional problems being very hard to solve. Therefore, the owner, BoVest housing association, decided to implement a comprehensive renovation.

Due to a fire in two of the houses (Bjøm mens Kvarter 15C og 15D) it was decided to make these exhibition house showing how the renovated and rebuilt houses would look like.

It is an aim that the houses are renovated so they comply with the standards for low energy class 2 (63,3 kWh/m² pr year for a house of 120m²). To meet this goal solar panels and mechanical ventilation with heat recovery has been installed.

SUMMARY OF THE RENOVATION

• New roof construction (prefabricated roof elements)
• Reinsulation of lightweight facades
• New windows and doors with triple energy glazing
• New kitchens and new bath rooms
• Ventilation with heat recovery
• Solar panels for hot water and also connected to the floor heating in order to use the waste heat.
• Mounting of prefabricated bay windows
CONSTRUCTION

**Floor construction**  \( U\)-value: 0.15 \( W/(m^2\cdot K) \)
- Interior to exterior
- White oiled parquet (on joists) 22 mm
- Joists 50 mm
- Vapour barrier
- In-situ casted ground deck floor heating 150 mm
- Rigid insulation 300 mm
- Capillary break layer 150 mm
- Total 672 mm

**Wall element**  \( U\)-value: 0.18 \( W/(m^2\cdot K) \)
- Interior to exterior
- 2 layer of plaster 24 mm
- Vapour barrier
- Lightweight element: 200 mm
- Insulation 200 mm
- Flat plaster layer 424 mm
- Total 672 mm

**Roof Element**  \( U\)-value: 0.12 \( W/(m^2\cdot K) \)
- Top down: Lightweight prefab. element
- Asphalt roofing
- Ventilation space min. 45 mm
- Insulated ridge construction 400 mm
- Vapour barrier
- Suspended ceiling 200 mm
- 2 layers of plaster on steel section 24 mm
- Total 669 mm

Large glazing areas results in good utilisation of daylight.
Summary of U-values W/(m²·K)

RENEWABLE ENERGY USE

The future houses are all expected to use solar energy.
Langkærparken, DK

16,000 identical apartments in DK

- BR08 ~ 70 kWh/m²
- LEK 2 ~ 58 kWh/m²
- LEK 1 ~ 35 kWh/m²
- ”LEK 0” ~ 18 kWh/m²
Energy elements

Diagram showing various energy elements such as:
- Solar collectors
- Roof thermal integration
- Altaner
- Solarmodulation

Diagram also includes:
- Installation updates
- Building thermal comfort
- Ventilation zones
- New super biomass doors and windows
- New facade cladding (skifer)
- Fire protection
- East facade entrance
- West facade entrance
- Ventilation at the basement with retrofitting
New facades

Facade, East

Facade, West
Langkærparken

House end, south

Budget: 7,1 mio AUS $

Call for tender: 5,5 mio AUS $
(2010.04.20)
When done the right way, solar and high quality architecture walk hand in hand and does pay!