Annex 4

Additional Details on Eight Good Practices from RESETnet

Barcelona:

Description:

Site

The project consists in the creation of a biomass district heating system in La Granja, a new residential area of 15,5 hectare located in the town of Molins de Rei (Catalunya). The project is based on a centralised installation of a biomass plant for water heating and its distribution to 695 dwellings through a horizontal network, with individual billing by dwelling.

The operation, management and maintenance of the service are carried out by Molins Energia, S.L, a company specially created for the project. The shareholders are the Municipality of Molins, ICAEN, Area Metropolitana de Barcelona and a private partner, Biomassa Aprofitament Energètic S.L. (constituted by CASSA and Hidrowatt).

The main environmental and energy objectives are:

- to use the biomass as renewable energy source in the domestic sector:
- reduction of CO_2 emissions about 2,000 tones/year and energy savings of 900 TOE/year
- to promote centralised domestic energy management centralised with individual control: new concept of energy service
- to evaluate the energy efficiency of a district heating system in the Mediterranean climate and possible district cooling.

Design Concept

The system is made up of three basic elements. A solid fuel boiler of 2.25 MW that uses wood waste to produce domestic hot water and heating, supported by three modular natural gas boilers of 817 kW each one. These natural gas boilers support the hot water service in case of necessity (for example, when stopping the biomass boiler to clean it, moments of high consumption).

The hot water distribution network of La Granja, which includes the piping, pumping, and heat storage systems.

Finally, there is a centralised management, control and monitoring system. The heat generation station is located in a industrial zone, recently built, 400 m far from the residential zone. The heating and hot water supply service is continuous, that is 24 hours a day (except in the summer). The facility operates 12-16 hours a day. The hot water storage tanks will provide supply the rest of the time. Continuity of service is guaranteed due to the installation of those tanks, consequently allowing the facility to be switched off at night. A backup system, designed to use natural gas, as the second fuel, ensures supply in case of a lack of biomass or a higher need of heat. Each dwelling has a heat timer similar to conventional systems, domestic operation is identical to that of an individual one. Energy is metered and consumption invoiced separately for each consumer through the meter installed in each dwelling and a remote reading system installed at the facility.

Construction Innovation

The general planning of the sector has been analysed in order to identify the energy quality of the design: sun, shadows, wind, urbanisation, orientation of the buildings, green, public space, mobility. The study has finished with proposals for the energy and environmental design of the sector and buildings.

The installations in the dwellings are connected to the vertical distribution network. A calorie meter is installed at the entrance of each home with a communication bus for readings at the control centre.

Two exchangers, one for heating (12 kW) and the other for domestic hot water (35.5 kW) are installed.
This actual district heating system will be extended to a second new residential area, which includes a hotel and a commercial zone.

Overall results:

Energy features

The use of renewable energies in the project allows the employment of local resources (wood waste), using waste to produce energy, and reducing emissions of CO2 and other pollutant gases. These benefits represent savings of 900 TOE/year and a 2.000 tonnes/year reduction in CO2 emissions.
The developers will also benefit from the positive image of housing from an energy and environmental point of view. Finally users will also benefit from having the advantages of a collective system with individual elements - control and billing. Moreover, the space traditionally occupied by conventional equipment (boiler and storage tank) will also be recovered in these dwellings.

Financial resources:

- dwellings 695
- saving (Euro/y) 170.000
- techno-investment (Euro) 812.500
- extra-cost (Euro/m2) 14,6
- maintenance (Euro/y) 77.550
- pay-back period (y) 8,8

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Glasgow:

Description:

Site

The Glasgow project involved the refurbishment of the Lighthouse Building, designed by Charles Rennie Mackintosh. The lighthouse building has been a landmark in Glasgow city centre since it's construction in 1895. The building is constructed with cast iron columns, steel beams, concrete floors and stands six storeys high, including the basement level.
The building has been classed as grade 1 listed and is of significant historic value to the local area which has had a significant impact on the design options.
The aim of the project was to design a centre for art and design with exhibition and gallery space that will engage the citizens of Glasgow. The building will accommodate educational space, art and architectural exhibitions and a demonstration of embedded renewable energy.
An objective of the design was to produce a multifunctional building which will appeal to the citizens of Glasgow and not just the designers. There was also a requirement to maintain the appearance of the existing building which has a valuable presence within the city which has been reflected in the design.

Design Concept

A key objective throughout the scheme was to produce an environmentally sensitive design that achieves the lowest practical energy demand through the utilisation of innovation in the context of an existing building.
As the centrepiece of Glasgow's response to it's selection as European City of Architecture and Design in 1999 the building has been used to demonstrate opportunities of urban renewable energy.
The "Viewing Gallery" an integral part of the building's refurbishment was designed to achieve low energy demand through effective passive solar design, and improved thermal performance standards achieved.
The design team then used energy simulation software to produce a renewable energy solution capable of meeting a significant portion of this reduced demand.
The key benefit to the adoption of this strategy is that power is generated when it is required and can be used directly as oppose to exporting to the grid.
In order to describe the scheme further this report will first consider the methods used to reduce the energy demand and then describe the renewable energy technologies which will meet a significant proportion of the resulting demand.

Construction Innovation

The design brief for the Viewing Gallery required the development of a low energy scheme that would not have a negative impact on the aesthetics of the existing building.
The technologies chosen to meet these criteria included the following components:

- Low emissivity argon filled double glazing to reduce winter heat loss and summer solar gain.
- Transparent insulation materials with integral shading provided to facades to reduce winter heat loss and solar heat gain.
- Improved insulation standards over and above building regulations were applied where it was practical to do so.

Overall results:

Energy features

For the building as a whole it was important to minimise the major energy demands as far as practically possible.
The following technologies were used to achieve this:

- Illuminance responsive lighting control designed to maximise use of natural daylighting & minimise use of artificial lighting.

- Displacement ventilation strategy where the extract air velocity is varied in accordance with the number of people in the space controlled by CO2 sensors located in the extract.
- Underfloor heating system installed to maximise operating efficiency of gas fired condensing boilers.

Within the "Viewing Gallery" the following renewable energy technologies were used to meet demand:

- Façade mounted PV (10m2) with integral heat recovery.
- roof mounted ducted wind turbines (DWT) with integral photovoltaic (PV) cells.

The Ducted Wind Turbines (DWT) produce electricity predominantly during the winter period where windy conditions occur frequently and the PV façade can contribute little. In the summer period when winds are lighter the PV façade is predominantly responsible for supplying the power. During the spring and autumn periods when winds are light and the solar contribution reduced both systems contribute. This combination of the way in which the systems are used gives rise to an embedded renewable energy approach that is ideal for the climate of Glasgow, This could only have been achieved by using the simulation software to direct the design from the outset.

Financial resources:

- saving (kWh/y) 3.432
- renewable energy 32%
- techno-investment (Euro) 1.028.101

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Lyon:

Description:

Site

RESTART project concerns energy efficiency and renewables programme for 200 dwellings in 7 independent projects in social housing sector. Synthesis of the RESTART building projects:

	1 - Villeurbanne Damidot	2 – Lyon-Fossé de Trion	3- Lyon Cours Vitton	4 - Lyon Avenue Berthelot	5 - Villeurbanne Leon Blum	6 – Lyon – Les balmes	7 - Lyon Delore	total
total m²	1266	3430	1744	2806	1292	1744	1876	14.158
Number of dwellings	17	47	25	40	19	22	27	197
Green houses	15	27	15	40	15		0	112
m² solar collector	20	60	40	75	0	148	54	397
Direct solar heating	19 kWh/m²	11,5 kWh/m²	16,5 kWh/m²	18 kWh/m²	22 kWh/m²	39 kWh/m²	11 kWh/m²	
Energy performance	126 kWh/m²	181 kWh/m²	176 kWh/m²	152 kWh/m²	164 kWh/m²	185 kWh/m²	117 kWh/m²	
Savings compared with standards	55%	35%	37%	40%	41%	43%	57%	
Share of Renewable energy sources In the energy consumption	19%	12%	14%	20%	12%	23%	19%	

Design concept

Approach:

- A mandatory guidebook of specification
- Information on technologies for architects and engineers
- An engineer at the disposal of the social housing organisation to help the design and to follow the construction according to RESTART specifications
- An intersectoral working group to discuss the obstacles and to evaluate the dissemination at urban scale

Common innovation features

- High insulation of walls
- Passive solar design and / or solar hot water or direct solar heating
- Electricity saving
- Water saving

Energy features

The photovoltaic installation is installed on the roof of the energy department of INSA (school of engineers). This program aims to demonstrate the interest and the feasibility of PV technology within an urban context.

Technical features:

- Peak power 8 kWp
- Approximately 60m² of PV roof panels
- Electricity used in winter for lighting of common rooms

- Feasibility study for the connection of the PV with a cooling installation in summer
- Communication towards students or potential users and developers:
- Installation of a demonstration panel to give regular information to the students - production , consumption , technologies…
- Development of practical courses for the students on PV technology and installation

Overall results:

- Share of RES in the energy consumption between 10 to 23 %
- Energy savings between 20 to 45%
- 80Fr/m² per year of running cost compare with 125 frs for traditional buildings
- Large and diversify demonstration examples at urban scale

Financial resources:

- dwellings 213
- saving (Euro/y) 910.000
- techno-investment (Euro) 1.001.662
- extra-cost (Euro/m2) 6,54

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Turin:

Description:

Site

The urban regeneration embraces a number of large industrial facilities, built in the first half of the century in the north-western periphery. This derelict area creates a large "urban vacuum" between two high density residential areas to the north and the south.
The Environment Park, a Science and Technology Park devoted to environmental issues, is becoming an asset for the City of Turin. It represents an opportunity for revitalising a district of 1.000.000 m2 and a valuable opportunity for environmental reversion.
The project was created under the concepts of building sustainability: it makes use of environmentally-friendly materials and renewable energy forms, minimizing pollution and fossil fuel consumption. The design guidelines of the project specifies low buildings blending into the greenery of the natural park.

Design Concept

Environment Park aims at performing functions of research, service, learning and training, addressed to local economy businesses and developing specific targeted activities in the field of environmental innovative technologies, at the European and International level.
Environment Park performs innovative measures with regard to:

- Microclimate control: local control and tuning of climatic parameters;
- Renewable energies: incorporate a demonstration of a mix of energy conscious solutions at the district level.
- Information: facilitate the transfer of technological knowledge between technological research and experimentation and "end users"

Construction Innovation

A large number of energy and environmentally conscious solutions are integrated in the Environment Park resort, such as:

- Space Heating: 98% biomass (wood chips); 2% electric driven heat pump
- Space Cooling: 90% absorption heat pump; 10% electric driven heat pump
- Solar Energy: 660 m2 of south faced interactive wall
- Lighting: 5-10% daylight ratio, 100% electronic ballasts
- Heat & Cooling Distribution: Radiant ceilings + Air
- Thermal Insulation: exceeding national standards
- River Water: direct cooling; condenser cooling; decorative water falls
- Rain Water: water-garden irrigation
- Solid Waste: separate collection system

Overall results:

Energy features

1. Use of green: the green roof
The peculiar aspect of this Technology is represented by the thermo-physical features. The presence of a layer of earth covered with grass on a usual roof made of concrete causes a system reaction to thermal stress that is different from other building with traditional roof. The thermal behaviour of these structures is quite peculiar: the green roof has a positive impact on energy conservation of the whole structure, by reducing the thermal loss in winter, as well as the thermal loads coming through the roof in summer.

2. Air-facades: the blue Technology
Air-facades represent an innovative element of “transparent covering” integrated with the heating and air-conditioning equipments. Such connection aims at realising a dynamic insulation of the front that guarantees occupants’ comfort

conditions, as well as the reduction of energy consumption both in winter and summer.

3. Extra insulation - Sandwich walls

Opaque walls with sandwich structure are optimised for the thermal insulation, reducing the U value of the building

4. Air conditioning by radiating beams

Air conditioning is provided by a mixed system water/primary air. This equipment is based on water of a system constituted by "radiating beams", like water plants. Beams are fed by warm or cool water, depending on the requirements, and provide to partially cover the thermal loads of rooms. The remaining sensitive thermal load and the totality of latent load are satisfied by treated air. This air is introduced in rooms through the same beams. With such equipment, the indoor cooling is largely obtained by a comfortable radiant system.

5. Efficient lighting

A dimming system and an automatic screening of glass surface (blue technology) are incorporated in the Environment Park building. The control of the natural indoor lighting conditions at the change of the external conditions (clear sky, covered sky) is one of the relevant indicators of the technology assessment.

6. Wood-chip boiler: a renewable heating source

The energy for heating is produced by a low emission wood chips furnace, using low cost electrostatic filters. The wood chips, stocked in a 200 m3 silo, are provided, free of charge, by the pruning of the Turin green areas, reducing the waste disposal cost for the Municipality. Testing and experimental data on this equipment are supplied by the BMS (building management system) of the Environment Park headquarters.

Financial resources:

- surface (m2) 32.000
- saving (Euro/y) 189.420
- techno-investment (Euro) 780.242
- extra-cost (Euro/m2) 24
- maintenance (Euro/y) 73.875
- pay-back period (y) 6,7

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Rotterdam:

Description:

Site

Nieuw Terbregge is a new urban area in Rotterdam. Its 860 dwellings demonstrate an integrated sustainable approach with a reduced energy demand and optimised energy infrastructure based on renewable energy sources.
Nieuw Terbregge is located in a second ring around the city centre, on an undeveloped site between the main highway-ring road of Rotterdam and the river Rotte. The development of the whole project of 860 houses is in hand of a commercial project developer, who works on the basis of performance requirements provided by and agreed with the City of Rotterdam.
Nieuw Terbregge is separated from a major highway by a hill containing well kept and controlled polluted sand. This hill is developed into a linear park, from which one can overlook the highway and the buildings.
On its north border Nieuw Terbregge faces dykes of the Rotterdam river Rotte.

Design Concept

Different energy strategies have been allocated to various parts of Nieuw Terbregge and served a design consideration from the first start of the project.
The main environmental aspects are reduction of energy use, application of renewable energy technologies, the use of environmentally sound materials, reduction of water consumption and nature development. The relatively polluted water of the nearby river Rotte, for example, will be filtered by halophytes before it enters the area.
Four architects were developing parts of Nieuw Terbregge while one was in charge of the urban development. The energy strategies became integral part of urban and architectural design.

Construction Innovation

Nieuw Terbregge is innovative for its energy technology application at large scale. Also the process is innovative. The public private partnership created the possibility to integrate urban and architectural design of various parts of Nieuw Terbregge.

Active and passive solar design integration

A part of Nieuw Terbregge demonstrates the application of solar energy in buildings. As the aim was to focus on replicable technologies passive solar and active solar thermal systems are applied. Two storey sunspaces on the entrance façade of some houses and 6 m2 solar collectors contribute to the energy demand of space heating and domestic hot water.

Heat delivery stations

Other parts of Nieuw Terbregge demonstrate the integration of heat delivery through small scale combined heat and power stations. Each heat delivery station provides heat to about 40 houses, thereby minimising the length of transportation pipes. Small scale combined heat and power (chp) units are placed 'in cascade', so that the heat load is optimised. Heat is temporarily stored in a central storage tank. Electricity enters the electricity grid, and is partly used on site.
One heat delivery station also contains a ground water heat pump system. Combination of heat/power installations and heat pumps are especially efficient while the heat/power installation produces electricity that can be used for the heat pump.

User manuals

In order to maximise the effects of the energy techniques a user manual was made for all inhabitants. This manual gives specific information for use of the installations and features of the dwelling and explains the backgrounds.

Overall results:

Energy features

Overall

High-insulating glass (U-value of 1.3 - 1.0 W/m2K) and appropriate insulation levels (U values below 0.3 W/ m2K) have been applied to minimise the heat demand.

Demonstration houses

- 40 chp demonstration house
- low E + chp / heat pump + solar collectors
- 64 solar demonstration houses
- low E + condensing gas boiler + 6.5 m2 solar collectors plus two storey sunspace
- 276 high performance houses
- collective chp or 2.7 m2 solar collectors

The heat delivery stations are developed, managed and maintained by the utility company. Several solutions of planning and design integration are demonstrated in Nieuw Terbregge, Rotterdam. The City of Rotterdam also required this project to meet the requirements of their Sustainable Building program. The choice of sustainable building materials has been a design input.

National benchmarks

Since 1996 the Dutch Building Code contains an Energy Performance Standard for new houses. In 1998 and 2000 the maximum coefficient admitted was lowered. The RESTART project developed in 1996 demonstrates energy performances below the 2000 level.

The measures taken reduce the emission of CO_2 by 25% to 55% compared to new houses in 1996. Further reduced levels are anticipated for the second part of Nieuw Terbregge which is currently under development.

City benchmarks

The project serves as an example for the 10,000 's of houses Rotterdam shall build in the near future. New project initiatives of the commercial developer already build on the RESTART Rotterdam project experiences.

Financial resources:

- dwellings	380 high performance
- saving (Euro/y)	138.273
- techno-investment (Euro)	1.189.426
- extra-cost (Euro/m2)	39,6
- pay-back period (y)	8,6

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Copenhagen:

Description:

Site

The site for intervention is called "Hestestalds-karreen" (The Horse-stable Block). The urban renewal Block is located in the inner part of district "Vesterbro", a workers residential area, close to the City area and built in the industrialisation period 1870-1900. In the general Urban Plan for The Municipality of Copenhagen, Inner Vesterbro has been pointed out as an urban renewal area.

In 1991 The City Council agreed to an Acting Plan for urban renewal matters concerning Inner Vesterbro. This means that, renovation activities has been planned within a period of 6-8 years and within an economical budget of 5-600 mill. dkr./year (70-80 mill. euros/year).

The Horse-stable Block consists of 19 properties. At the start of the renovation it had 450 inhabitants, 303 dwellings and 37 shops/workshops/industries.

Design Concept

The demonstration project "Visible resource Balance" has the main environmental aspects: reduction of energy use - first of all by inspiring residents to a changed behaviour, demonstration of renewable energy technologies, and reduction of water consumption. The project is closely connected to a "normal" renovation process for the urban renewal block, the 'Hestestald's block. The renovation programme for the block has been planned over a period of 18 months and the final decisions on the programme was taken by the City Council ultimo February 1996.

The Urban Renewal Company Copenhagen has been responsible for the over-all block planning, the courtyard project and a number of common projects in connection to that. The projects has been made in co-operation with the local Block Council and circulated among the owners and residents for consideration. The Urban Renewal Company has, in addition to the common projects, also been responsible for renovation projects on 4 properties taken over by the municipality. The "normal" urban renewal projects have a budget of 289 mill. dkr. (39,5 mill. euros). For supplementary ecological projects the local Block Council and The Urban Renewal Company has an extra budget of about 36 mill. dkr. (4,8 mill. euros) from the Ministry of Urban affairs and Housing and 0,4 mill. euros from EU. The design process started in June 1996 and, due to a number of difficulties, the projecting and final project approvals from the Municipality has been very much delayed. Construction work on all buildings and common projects, including the courtyard project, will be completed in Summer 2002.

Construction Innovation

The 'Hestestald's block project is first of all innovative for its design features concerning "energy-axis" as an architectural concept for visualisation of the resource flow in a residential block. The project is also innovative when it comes to organising different owners into a "Block Council" with the object of projecting, running and controlling the supply and consumption of heat, energy and water.

The overall aim of the demonstration projects is:

- to create balance in consumption of resources and production of waste
- to incite the residents to a changed behaviour in consumption of water, electricity and heat, by establishing visible "green" common constructions
- to save common resources and, at the same time, enrich the environment, by re-use and use of materials with care.

Willing to implement ecological ideas in the renewal plans to come, it is very important to show examples, not only as single projects on residential buildings but also in a larger scale based on co-operation among different owners. In the case of the "Hestestalds"-block, the ideas has grown up from the bottom, which increase the chances of success for the future running of the block. Examples in scale 1:1 may give inspiration to other Block Councils.

Overall results:

Energy features

The total block is supplied with district heating, electricity and water from the municipal utilities. As a part of the demonstration project the normal projected individual heat exchangers are replaced by one common heat exchanger, connected to the buildings by pipelines placed in service tunnels, "energy-axis", prepared as visible elements inside the renewed courtyard. The "energy-axis" also give room for pipes supplying toilets and laundries with rainwater, a prepared pipeline system for cleaned 'grey water' and cable trays for i.e. local IT-systems.

Basic energy features in connection to the 'normal' building renovation:

- use of low temperature district heating saving energy compared to the 'high temperature' district heating used in other parts of Copenhagen City
- use of high insulation glass (V-value of 1,5-1,3 W/m²K) when replacing the windows - otherwise providing with extra inner glass
- additional insulation on the attic floor and the basement floor
- individual metering of heat energy and water consumption

Demonstration projects provides in addition the following energy features:

- common heat exchanger, saving 5-10% of heat consumption due to a more professional running (11 properties / 18 buildings)
- CTP-based central monitoring and publishing of results on heat, energy and water consumption/production (14 properties / 20 buildings)
- common photovoltaic-installations providing electricity for common laundry, low energy lightning in courtyard and residents room, pumps, CTP etc. (206 m² / 16500 kwh)
- individual photovoltaic-installations for staircase lightning etc. (4 buildings / 120 m² / 16400 kwh)
- individual re-use of heat in ventilation air (6 buildings / 96 flats)

Financial resources:

- dwellings	303 and 37 shops
- saving (Euro/y)	109.905
- techno-investment (Euro)	1.025.068
- extra-cost (Euro/m2)	34
- maintenance (Euro/y)	6.700
- pay-back period (y)	9,9

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Porto:

Description:

Site

The building selected for RESTART, was renovated in order to be the main office of the CRUARB. The CRUARB is the technical body from the Porto Municipality for the coordination of the rehabilitation process in the "Historic Centre of Porto".
The CRUARB headquarters is a typical building of the historic centre, deeply inserted in the urban tissue, with a strong patrimonial value: 4 stories, low floor area, thick granite walls and just one important external façade (facing South). The main façade, facing south, it is almost 40 % windowed. Although, since the relation between the street length and the building height is 1 to 4, the façade is strongly shadowed by the front buildings.
The implantation area of the building is 270 m2 and the total built area is 1.080 m2. The ground floor (260 m2), at the street level, is being used as an exposition hall, so it does not have a permanent occupation. In between the first and the second floor there is a small (25 m2) room which is used as a reception to the main office area, which is located in the second, third and fourth floors, each one of 265 m2 of floor area. There is still a very small room, in the roof, which is used as a technical room for the main mechanical systems (HVAC and elevators).

Design Concept

Due to the strong patrimonial value of the building, the potential for intervention at the building envelope was very limited. Anyway, some very important measures were taken in order to reduce the needs of commercial energy needs for acclimatization and artificial lighting of the building. The HVAC system was also carefully designed, in order to achieve the best results in thermal comfort, air quality and energy consumption, within the restrictions proper of this type of building.
Day lighting:

- Central skylights opening;
- Careful selection of the skylights glass (light transmission/solar gains/light reflectance coefficient);
- Opening of apertures underneath the skylights in order to allow the natural light to reach the lower levels of the building;
- Special care concerning the spatial distribution of the working spaces at each floor.

Building envelope:

- Application of thermal insulation in the roof and partition walls and floors confining with non acclimatized zones;
- Selective covering of the massive granite walls from inside in order to optimise the comfort conditions and the thermal inertia of the building;
- High quality double glass wood frame vertical windows;
- High quality skylight glass (high light transmission - low solar gains - low reflectance).

Natural ventilation:

- Full use of the high potential for natural ventilation of the central hall of the buildings;
- Automatic partial opening of the skylights to increase the natural ventilation (free-cooling, night cooling);
- Enthalpy control of the skylights openings;
- If necessary special doors will cut the communication between the lowest and the highest levels of the building, keeping the infiltration rates under a reasonable value.

HVAC system:

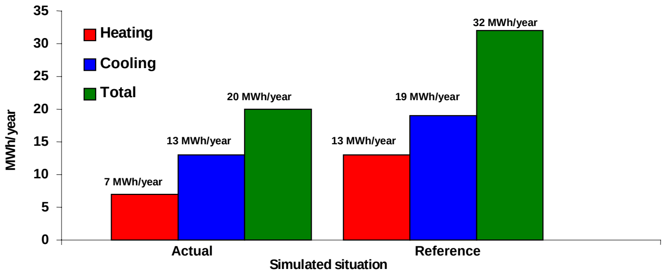
- Accurate load calculation;
- Central system to avoid addiction of security factors;
- Air quality;
- Maximum free-cooling rate;

- Temperature space control;
- Central management system.

Overall results:

Energy features

The main conclusion is that, despite the very limited potential for intervention at the design stage, due to the historic and patrimonial value of this building, there were still quite a lot of opportunities to explore in order to optimise the energy use for both lighting and climatization, the thermal behaviour and the indoor comfort conditions (see Design Concept).
The energy consumption of the building was simulated for the actual building and a theoretical reference building, with the same characteristics of CRUARB, without specific treatment from the energy point of view.
The results are presented in the following graph:



The key results can be summarised as follows:
- Energy savings concerning artificial lighting: 40%;
- Energy savings for heating and cooling: 40 %;
- Peak thermal load reductions: 20% for heating and 20% for cooling.

Additionally, higher comfort levels have been reached for:
- Inside air quality;
- Lighting conditions;
- Aesthetics (no individual air conditioning units);
- Noise (no individual air conditioning units).

The good results prove that, even under so severe and limited degrees of freedom, it was possible to improve the thermal performance and the overall comfort of the building.

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Dublin:

Description:

Site

494 low energy houses have been built - retro-fitted in the Republic of Ireland by South Dublin County Council (SDCC) and the multi-national, CRH Plc, on sites in Dublin, Dundalk, Limerick and Waterford, as part of the EC demonstration project, RESTART (Renewable Energies Strategies and Technology Applications for Regenerating Towns). The aim of this project has been to address the challenges of integrating energy efficient design principles in mass urban housing. The consortium shown above was formed to bring together a combination of industrial strengths, technical experience and municipal responsibilities to address a range of environmental issues in housing developments and encourage change in construction practices and standards, and to demonstrate sustainable local energy planning.

Design Concept

The aim of this project was to address the challenges of integrating energy-efficient design principles in mass urban housing. Significant energy savings, reductions in environmental impact and improvements in indoor comfort conditions were the project's principal objectives and these have been achieved through a broad range of passive and active renewable energy and energy conservation measures that have been incorporated in the design of the buildings and their sites, representing considerable performance improvements by comparison with homes built to the requirements of the Irish Building Regulations.

Design Innovation

The project aimed to optimise the following: microclimatic conditions of each site (wind/shelter, solar radiation); the bioclimatic design of the building envelope (form and materials); the use of renewable energies to minimise the use of conventional fuels in the buildings; to improve thermal comfort for the occupants; to minimise environmental impact through these energy saving measures; and in the selection of construction materials from sustainable sources (appropriate life-cycle characteristics, longevity, recycle-ability).
Site planning is important to more than the overall energy strategy and includes:

- the development of neighbourhood planning, design and building technology guidelines for energy efficient urban design
- bio-climatic building design approach aiming to integrate local climatic studies, the enhancement of local natural features, wind breaks, shelter belts and optimum orientation, with energy efficient estate layout and house design in a comprehensive neighbourhood approach towards energy efficiency.

Integrated design to resolve many varied and dissimilar issues was considered essential to the successful achievement of the project's objectives:

- Complete team involvement from early stages.
- Site layout and orientation.
- Building envelope and elemental performance.
- Thermal capacity.
- Construction detailing.
- Energy supply to include active solar system.
- Natural ventilation.
- Daylighting and efficient lighting.
- House design suited to conservative market needs.
- Bio-climatic retro-fitting of existing dwellings.

Excavated material from the house sites (topsoil etc) was retained on site to provide berming as part of the wind shelter belts. The significant cost savings (approximately €400 per dwelling) were applied to the cost of energy systems in

the buildings. New design standards for roads, paths, etc., in response to a microclimatic analysis and a re-evaluation of conventional site layout norms helped reduce costs for site development and energy systems in the houses.
The Dutch Environmental Preference Method was used to evaluate the life-cycle environmental impact and energy saving potential of construction materials and systems specified. Recycled materials and those that have better environmental performance and less impact were preferred. Materials containing harmful substances, CFCs, toxins or giving rise to volatile emissions were rejected.
The higher building construction costs, as indicated by comparison with 'standard house' costs (1993 Building Regulations) and those of houses constructed in Ireland under a previous THERMIE-funded project can be offset in both social and private developments by:

:: More economic site design considerations
:: Reduced road / street widths
:: Lower building maintenance costs
:: Health improvements: reduced health and in-care costs due to higher comfort standards and higher quality environments created.
:: Reduced fuel poverty to lower income groups.

The elemental cost breakdown of typical energy components identifies an extra over-cost of between €1000 and €3000 per dwelling as an achievable target off-set, which could come within the range of savings described above when comparing a more energy-efficient house with a current standard local authority dwelling; the re-use of excavated material for berms will alone pay for the extra insulation involved.

Overall results:

Energy features

- Passive and active solar energy use -depending on building type
- Microclimatic design in site layout and building orientation
- Use of thermal mass of external walls to moderate temperature swings
- Bio-climatic building design approach aiming to integrate local climatic studies, the enhancement of local natural features, wind breaks, shelter belts and optimum orientation. Energy efficient estate layouts and house design form part of a comprehensive neighbourhood approach towards energy efficiency. Integrated design to resolve many varied and dissimilar issues was considered essential to the successful achievement of the project's objectives:
- Optimised performance of building envelopes and elements in new build and retro-fit solutions.
- Retro-fitting of existing dwelling to performance levels exceeding current housing norms.
- Optimised construction detailing.
- Natural ventilation.
- Daylighting and efficient lighting.
- Energy efficient appliances and heating systems with optimised controls

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