642: CasaNova, a low energy quarter

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Abstract

The CasaNova-district in the southern part of Bolzano is currently under construction. It will provide public housing for approx. 3000 persons in 950 apartments. For CasaNova the municipality of Bolzano aimed from the beginning of the planning at the realization of a sustainable district regarding the energy performance. The urban concept includes the construction of eight so called “housing castles”, which consist of 3-4 buildings encircling a common green area.

In order to hold the space heat consumption of the apartments low, a limit of 30-50 kWh/m² depending on the volume of the building was defined. Space heating and the domestic hot water for the houses will be provided to an important part by renewable energy sources, and to the major part by a district heating. The heat for the latter will be produced by the waste incinerator of Bolzano and a further district heating plant using natural gas.

According to the project description the adopted measures will lead to a reduction of space heat consumptions of about 42% compared with a scenario following the requirements of the law 10/91, which was in force at planning stage. Considering all energy efficiency measures and renewable energy sources applied the primary energy consumption is reduced by 65% compared to typical constructions in Italy.

The reduction of car traffic is a declared goal of the planning documents for the realization of the area. This will be obtained through a package of measures such as the integration in the bicycle net of Bolzano and the creation of a train station for the “City Train” which connects Bolzano city centre and the town of Merano. A further comparatively innovative aim is the intensive rain water recycling at district level.

Keywords: Low Energy Communities and Neighbourhoods, Sustainable Urban Design

1. Introduction

The buildings sector accounts for 40% of the energy consumption in Europe. It offers the largest potential for energy efficiency. Research shows that more than one-fifth of the present energy consumption and about 30-45 Mt of CO_2/a in Europe could be saved by applying more ambitious standards to new buildings and renovations by 2010. This could represent a considerable contribution to meeting the Kyoto targets [1].

Heating still accounts for the largest part of energy consumption in residential buildings in Italy. In 1991, this consumption amounted to 17.3 Mtoe (68.9% of total residential consumption), while consumption in 2003 was of 19.1 Mtoe (68.2% of total residential consumption).

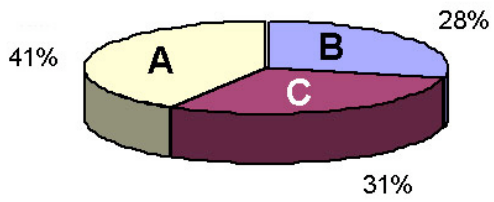

Fig 1: Energy consumption in Italy in 2005, subdivided into sectors : A – Construction sector, B – Industry, C – Transportation (Source ENERDATA)

The energy consumption for domestic hot water has increased in recent years to about 3 Mtoe in 2005 (approximately 10% of consumption in the residential buildings) [2].

In order to reduce this energy need, several actions are in progress in Europe in order to rise the energy efficiency. These actions were tackled on demand of environmental and economic policies, as well as in order to ensure energy supply. There is the attempt to reduce the dependence on the importation of fossil energy sources. The European Commission has adopted an Action Plan aimed at achieving a 20% reduction in energy consumption within the year 2020 [3]. The construction industry sector has a determinant role for achieving this target.

In recent years, the implementation of renewable energy sources (RES) and measures improving the rational use of energy (RUE) in South Tyrol (Italy) region has increased considerably. This rise has become possible thanks to the supporting actions of the Province. Today, 43% of the energy needs of the province of Bolzano are satisfied with renewable energy sources (not considering the energy consumption of transport). The target of the administration is to rise this percentage to 75% within the year 2015 [4].

2. Urban planning and the architectural project

The CasaNova project is an ambitious initiative aiming for a harmonic development of the city.
The urban plan stated the following targets [5]:

- to satisfy the need of social housing;
- to manage a residential initiative through a direct planning by the municipality on public land purchased by the city;
- to ensure quality and efficiency of the urban processes;
- to implement a model of excellence for settlement, giving high quality living conditions and at the same time a valorisation of the suburbia.

The project tries to solve the problem of the relationship between urban outlying expansions and the beautiful surrounding countryside. At the border of the city there is a sharp switch from constructions to rural landscape, denying any dialogue. The CasaNova quarter aims for a fusion between city and countryside:
"The district will gently and discreetly enter among the orchards, as if the landscape would tenaciously retain its imprint on the territory" [5, Frits van Dongen].

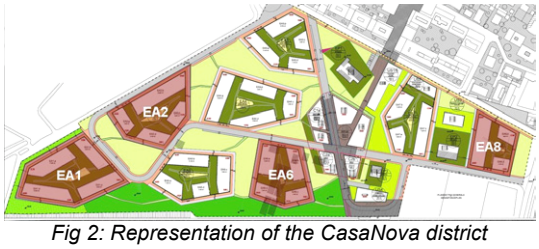

Fig 2: Representation of the CasaNova district

The obtained effect is to get buildings "embedded in the country", to offer a substantial portion of green countryside to the inhabitants as well as to the neighbouring districts.
The project should create optimal conditions for the formation of micro-communities capable of offering, in a human dimension of living, urban opportunities for closer social relations, as well as elements of differentiation, and the possibility of personalization.

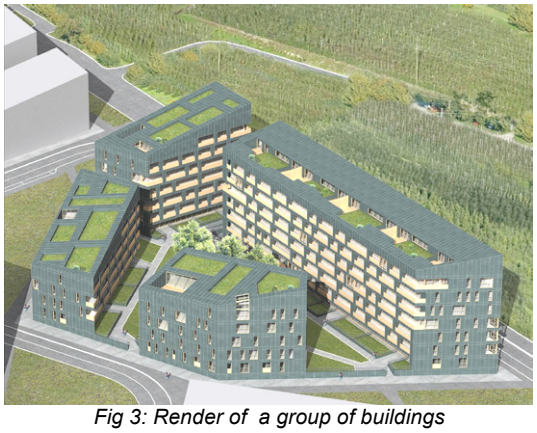

Fig 3: Render of a group of buildings
[Dott. Arch. G. Donato]

Driven by this idea, a proposal was made for a special aggregation of housing units: several residential groups, called "housing castles", formed by three or four buildings gathered around a courtyard. Each residential group will be different, every building will be different.

3. Energy sustainability

The high expectations placed in the new district substantially influenced the choices of regulations on how to provide space heating, domestic hot water and cooling in summer.
The CasaNova project aimed for a high level of comfort, allowing at the same time a significant reduction of energy consumption and emissions compared with traditional quarters. Therefore the project involves solutions that will lead to an energy optimisation based on a mix of available technologies for primary energy savings, on rational and efficient use of traditional energy sources and on the use of renewable energies.
The concept of the optimization of energy consumption followed a bottom up approach, beginning with the analysis of a single building, and then studying the installations of the whole quarter.

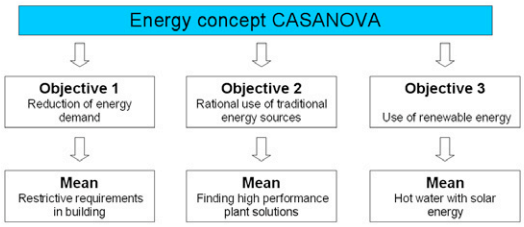

Fig 4: Energy conception of CasaNova

3.1 Objective 1: Reduction of energy demand

When the project was approved (in 2004), law 09/01/1991 n.10 defining the maximum space heat requirement (SHR) of buildings was in force. The specifications of the law led, on average, to consumptions of about 90 kWh/m^{2}a [6]. In order to reduce the consumption of thermal energy in the CasaNova district, SHR was limited to 30 to 50 kWh/m^{2}a, in function of the volume of the building: For buildings with a volume more than 20.000 m^3 the SHR is limited to 30 Wh/m^2, whereas buildings with a volume lower than 5000 m^3 may have a SHR of 50 kWh/m^{2}a. For the volumes in between the maximum SHR is defined by a linear function (Fig.5).

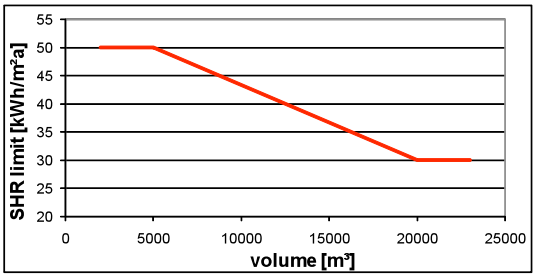

Fig 5: Space heat requirement(SHR) limit for buildings in function of the volume

To obtain these low values of consumption, any possible measures to reduce heat loses and measures to increase passive gains must be implemented. Therefore all buildings will feature a high insulation standard and some will be equipped with ventilation systems with heat recovery.
To optimize the passive gains, the height of the single buildings varies depending on their position, and in this way reduces the shadowing effects: the buildings in the south of the housing castles are lower than those in the north.
The implementation of the objective 1, without considering energy provision systems, will lead to annual energy savings of 42% compared with constructions that would have fulfilled the requirements of the above mentioned law 10/91 [6].

3.2 Objective 2: Rational use of traditional energy sources

Once the measures for the limitation of energy consumption for heating were defined, efforts were spent on the choice of the most efficient system for heat production and distribution. Evaluating different options from an energetic point of view led to the conclusion that centralized systems should be more efficient than autonomous ones due to a higher average seasonal coefficient of performance.
In consideration of the compactness of the district with consequent manageable heat losses in the net, it was opted for a district heating system that will lead to energy savings of about 30% compared with autonomous boilers and about 4% compared with a centralized heating system in every building [6]. The choice of a district heating plant implicates further advantages:

- A better control of emissions of pollutants due to continuous monitoring of fumes and the analysis of performance that will be conducted every six month;
- Better health conditions due to the fact that combustion processes for the production of heat will occur neither within the apartments nor in buildings;
- A better management and maintenance of the heating system, where the responsibility lies with the owner of the plant and not with the occupants of the apartments nor with the owner of the building;
- The possibility of connection to the nearby incinerator in order to use the waste heat. The connection represents a double advantage: During winter, it will reduce the primary energy consumption of the district heating plant. In summer, the heat of the waste incinerator fed into the grid will be sufficient to cover the heat demand for domestic hot water and for cold production in the district by means of sorption chillers. The sorption chillers will be installed to provide cooling to the tertiary sector and public institutions without any need for further primary energy. For residential areas, however, no cooling is foreseen.

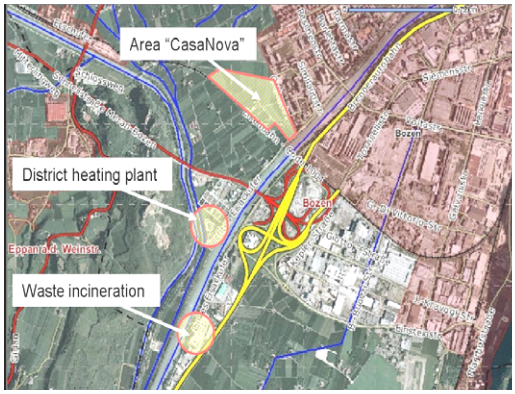

Fig 6: Map of the area of the district CasaNova in which is represented the district heating plant and the waste incinerator.

3.4 Objective 3: Use of renewable energy

Each building will cover a part of the energy consumption through renewable energy sources. Two RES are therefore taken into account: solar and geothermal energy. Solar energy will be exploited by means of solar thermal collectors for domestic hot water production and grid connected photovoltaic systems for electricity production. Some buildings will cover their heat demand by means of geothermally fed heat pumps and partly by direct air flow through a geothermal preheater.
Due to the manifold implemented solutions, the forecast of the RES energy production in the CasaNova quarter, is done on the base of the concept of the Institute for Social Dwelling (IPES) which will erect four of the eight buildings castles. With this assumption, about 35% of energy consumption for domestic hot water would be covered by solar thermal collectors. The photovoltaic systems, with an average capacity of some 250 W_p per apartment would result in an estimated electricity production of about 260.000 kWh/a.

3.5 Overall energy savings

The high the insulation standard of the buildings and the sophisticated solutions for energy production will lead to a considerable reduction of energy consumption, providing at the same time comfortable living conditions. This reduction has been estimated and summarized in the following diagram (Fig 7).

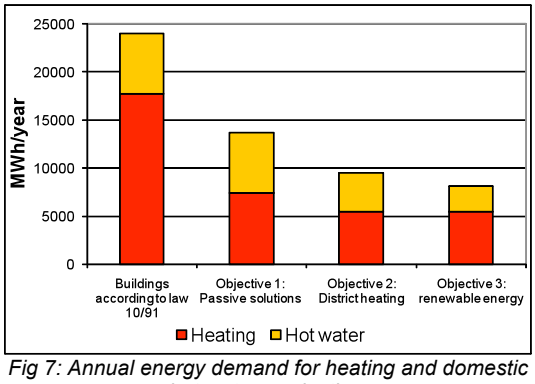

Fig 7: Annual energy demand for heating and domestic hot water production.

The achievement of the three mentioned objectives will lead to energy savings of about 65%. Still, this estimation must be considered precautionary as many buildings will be even more sophistcated from the energy point of view than those assumed in the calculation.

4. Sustainability of mobility

In the planning phase for the new district, great attention was also given to the mobility concept, which should be excellent for sustainability and reduction of car traffic. Therefor the following measures were implemented:

- Street network: only one street will lead across the new district (Fig 2). This street will be winding strongly in order to lower the speed of traffic and to reduce parasitic traffic;
- Bike and pedestrian ways: the district will feature sufficient pedestrian and bike ways embedded extensive grid of Bolzano;
- Railway: The CasaNova district will obtain its own station on the regional railway that connects Merano to Bolzano. There will also be the terminal of a new bus line within the comprehensive public transport network of Bolzano.

5. Activities in the SEE Campaign

From the very beginning of the planning phase, the municipality of Bolzano has pursued the aim of realizing a sustainable district. In this spirit, the district participates at the SEE Campaign (Sustainable Energy Europe Campaign), an initiative of the European Commission financed through the "Intelligent Energy Europe" Programme. The aim of this programme is to raise the awareness of end users and stakeholders and to promote the production and the use of sustainable energy in Europe.
The Italian Ministry for the Environment intends to showcase the "CasaNova" district of Bolzano as "best practice" for new districts in Italy. One of the measures enabling this aim will be the conduction of a comprehensive monitoring campaign which is expected to be launched within 2008. The energy balances and performances within the district will be examined at different levels of detail.

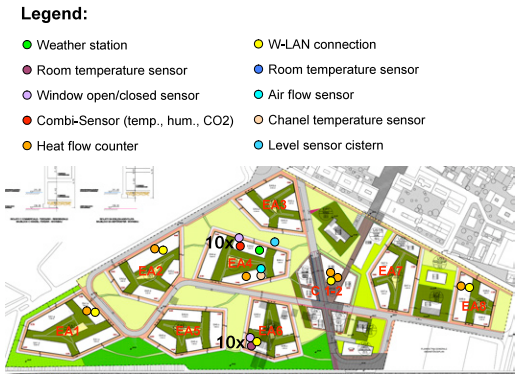

Fig 8: District CasaNova with the placement of sensors.

5.1 Phase 1: Global balance of the district

On the 1st level data concerning the whole district are gathered, including the public structures (street illumination, etc…). Focus is given on space heating and electricity consumption. The result will allow a comparison between the CasaNova district and other districts in Bolzano and in Italy.
The major part of data will be provided by the administration of the district heating plant and by the electricity provider. At this level, the task will consist in the elaboration and interpretation of the received data and a comparison with the data of other districts of interest (e.g. Concerto districts).

5.2 Phase 2: Global balance of the buildings

The eight "building castles" will be constructed by four different companies and institutions. As a consequence the chosen solutions for energy systems and passive aspects will strongly differ (e.g. only some of the buildings will have a system of forced ventilation). The monitoring of the energy flows will allow a comparison of energy balances of a great range of technical solutions in one urban context.

5.3 Phase 3: Detailed analysis

At this stage some of the buildings and several apartments will be monitored on a detailed level. These buildings and single apartments will be equipped with a range of sensors enabling the evaluation of energy balances and living comfort (heat and electricity counters, temperatures, humidity and CO_2 sensors, weather station).

6. Conclusion

Projects of this size and particular features are inevitably involved in polemics. Much criticism was raised regarding the unusual shape of the buildings, regarding the slightly higher price of the apartments as well as regarding the reputed inadequate street connection of the new district to the city centre.
The province of Bolzano assumes the responsibility for the audacious decisions, the project CasaNova aims at promoting a lifestyle of sustainability, from which the tenants and the entire city will be able to profit. The major aspects of this decision are:

- to create the most favourable conditions for future low energy building solutions and low production of pollution;
- to make the tenants save money in the long term despite a higher initial investment;
- to create conditions avoiding traffic generation by discouraging car use in favour of public transport and of the bike.

With this project, the province administration wants to abate scepticism and distrust by presenting a functioning, highly innovative, sustainable urban model.
This spirit was taken up by some constructors which have adopted different solutions going even beyond the CasaNova guidelines, achieving very low energy needs even compared with some other buildings of the district.

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