

# Local Tradition and Bioclimatic Architecture in the Italian Alpine Region

Rossano Albatici

Department of Civil and Environmental Engineering, University of Trento, Trento, Italy

**ABSTRACT:** Nowadays, deep and sudden climate changes are occurring, and the human actions are considered to be widely jointly liable. Such events are connected most of all to the building sector where a reversal of trend is now on going with difficulty, by means of the introduction of design, constructive and management methodologies more respectful of the environment and the use of local climatic sources in order to save energy and to guarantee better comfort conditions for the users: the so called bioclimatic architecture. Anyway, designing following sustainable criteria does not regard only the energy field but even the cultural one, because it means to make up buildings whose characteristics should depend even on the pre-existing situation from a typological, formal and material point of view. Sustainable design, in fact, is often capable of introducing a new self-referential building typology, surely well recognizable and identifiable in the urban context because of its originality but often in contrast with the surroundings. Up to the introduction of “unsustainable” building types that do not interact but deny the local building tradition.

This paper refers of a research carried out at the Laboratory of Building Design of the University of Trento whose main goal is to classify and to critical analyse recent sustainable buildings in the Italian alpine region in order to verify the congruence of new typologies and new materials with the local culture and tradition.

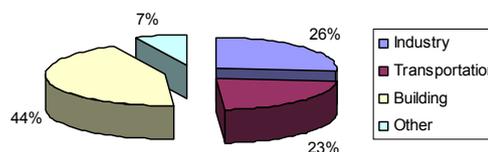
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## 1. INTRODUCTION

Nowadays, deep and sudden climate changes are occurring, and the human actions are considered to be widely jointly liable. The great use of energy for all human activities, the wide use of fossil fuels and the consequent emissions of greenhouse gases in the atmosphere (mainly carbon dioxide CO<sub>2</sub>) represent the main causes of the environment depletion, and this forces to a global afterthought of our model of life. Such events are connected most of all to the building sector: in 2000 the energy consumption in the EU Countries was due for the 41% to the residential sector, and this value rises to the 44% (Fig. 1) facing the Italian situation (from the last analysis published by ENEA now available in the Report on Energy and Environment 2003 [1], it is stated that the 38% of energy consumption in Italy is due to the building sector, plus the 6% of the industrial sector working for the building field). Just in the building sector a reversal of trend is now on going with difficulty, by means of the introduction of design, constructive and management methodologies more respectful of the environment and that lay to the use of as less amount of energy as possible, coming most of all from renewable and non polluting sources, like biomass and the sun.

In the past, solar devices have been used in order to achieve these solutions, both active (solar panels and photovoltaic most of all) and passive ones, that is building elements that, due to their particular shape, materials and exposition, can store the solar radiation

heat so to avoid overheating in summertime and to radiate it back into the living space during the cold season, even after the sun has gone down. Now, due both to the increasing of the average outside temperatures and to the designing mistakes (as the over dimension of some passive solar devices for instance), even in the Italian alpine region, usually characterized by outer average temperatures lower than the other regions ones, cooling problems in summertime are growing up. Usually, passive solar devices designed in the past do not give a satisfactory answer in terms of practical control solutions (a friendly and limited control of the system from the users) and of a quick adaptation to comfort values in inner spaces (a quick and homogeneous cooling of the rooms).



**Figure 1:** Total energy consumption in Italy in 2000.

In the last ten years a new attention towards a sustainable design has grown up with particular reference to the use of natural, recyclable and renewable materials for the building construction, typical of the local tradition. Especially in the alpine regions, this has lead to the use of innovative wooden building systems, both frame and walls systems

realized with overlapped crossed planks, that have introduced a new way to do and to think sustainable architecture from a formal and constructive point of view.

Also the user needs have changed towards a greater demand for comfort conditions in indoor spaces, and in 1997 a specific standard has been issued, the UNI EN ISO 7730/97 [2], concerning the calculation of the discomfort indexes for the improvement of the quality of life in buildings introduced by Fanger [3].

Furthermore, from 4<sup>th</sup> January 2006 the member States of the European Union should have brought into force the laws, regulations and administrative provisions necessary to comply with the Directive 2002/91/EC on the energy performance of buildings, in which specific reference is done to the use of passive and active solar devices, of natural ventilation, of natural lighting, of electricity produced by CHP and of renewable energy sources.

At the end, we must take also into account that designing with sustainable criteria means to make up buildings whose characteristics strongly depend both on the particular local climatic conditions (altitude, seasonal temperatures, presence of trees, of water courses, of mountains or simple relieves, winds and so on) and on the pre-existence from a typological, formal and material point of view, for single buildings as well as at urban scale. These different aspects strongly influence the choice of a certain shape and orientation of the building during the design phase, to the point of becoming so important as to influence the inner distribution of spaces and the materials used, with preference to the ones typical of the local tradition and with minimum effects on the environment. There is a clear "importance of the climatic-environmental dimension of the site influencing the organization and the structure of the building type" [4] following the so called architectonic regionalism principles, for which a building designed in a certain place is modelled according to natural climate control requirements clearly recognizable and identifiable (and running) only in that place and nowhere else.

## 2. THE RESEARCH OUTLINE

To give a contribution to this complex frame, where comfort needs lay together with the respect for environment at micro and macro scale, a research has been carried out in order:

- to point out the real energetic behaviour of sustainable buildings with solar passive devices and traditional materials;
- to set up a methodology that defines and proposes possible design actions to be made in order to improve the energy efficiency and the inner microclimate of the buildings (even in retrofitting situations), both in winter and summertime.

The first stage of the research presented in this paper, is to make a critical analysis and classification of recently built sustainable buildings in the Italian alpine region with solar passive devices to control the inner environmental parameters. In this way, it is

possible to test the congruence of new typologies and new materials with the local culture and tradition. In particular, the Trentino-Alto Adige Region has been taken into consideration.

The result of this first stage are: map-making of the building on the territory; critical data bank of the passive solar devices mostly used (typology, dimensions, shape, materials, exposition) and of the heating/cooling active secondary systems (using renewable energy sources or not); critical analysis of the building typologies and of the materials used in relation to the site.

## 3. OVERVIEW OF THE TRENTO ALTO ADIGE REGION

Trentino Alto Adige is an Autonomous Region placed in the northern part of Italy, near the Austrian border. It is divided into two Autonomous Provinces (realizing a kind of autonomy inside the autonomy): the Autonomous Province of Trento (or Trentino) and the Autonomous Province of Bolzano (or Alto Adige - Südtirol). The two Provinces enjoy a special autonomy in several sectors, between which the energy sector. So, in Trentino and in Alto Adige there are two different energy regulations (that must, of course, integrate with the national one).

In the Italian regions, most of all the alpine ones, sustainability in the building sector has been achieved developing four main intervention strategies for what concerns both the existing buildings and the new constructions: use of natural materials, energy efficiency, energy saving and bioclimatic design.

First of all, the use of natural materials typical of the local building tradition has been incentivized, especially wood for the realization of both single elements and entire building systems. These systems, both the framework and the walls system realized with overlapped crossed planks, have been rediscovered in the last ten years; while during the sixties, seventies and eighties concrete frame systems with brick block walls have been used everywhere, often dressed with wooden planks or half logs in order to "harmonize" the building with the surrounding environment and to safeguard the local building tradition even if in a false and misleading way.

Particular attention has been put towards energy efficiency. Buildings are often designed following passive standards, that is with a low thermal transmission coefficient of the opaque elements (lower than  $0.15 \text{ W/m}^2\text{K}$ ) and of windows (lower than  $0.8 \text{ W/m}^2\text{K}$ ), with the minimization of heat bridges, with ventilation automatic systems using geothermal heat exchange plus heat recovery of the exhaust air, so to have an annual average heating consumption lower than  $15 \text{ kWh/m}^2$ . Passive house standard is considered as a goal but now even low energy buildings with an annual average heating consumption lower than  $75 \text{ kWh/m}^2$  are considered acceptable.

Energy saving is another important issue. Grant in aid are given for the installation of solar panels for the production of hot water and of photovoltaic panels for

the production of electricity, for the introduction of rainwater-saving systems, for the use of low temperature and radiation heating system in order to increase human comfort conditions inside a room.

Then, some bioclimatic criteria and devices have been introduced, such as designing buildings advisably oriented to true south and with a clever shape, greenhouses and thermal masses, ventilated walls and so on.

By a legislative point of view, in Trentino the Provincial Law 29 May 1980 n.14 "Actions towards energy saving and the use of alternative energy sources" is into force, recently modified and improved by the Provincial Law 11 September 1998 n. 10 that introduces a new category of intervention: Low Energy Consumption and Low Environmental Impact Buildings, whose aim is to promote the use of appropriate technologies in order to achieve a better energy saving, most of all by means of alternative energy sources and green architecture criteria. In Alto Adige – Südtirol a particular standard called CasaClima (KlimaHaus) has been introduced [5], giving a certificate to those buildings with a particular high energy efficiency. Recently, new and refurbished buildings in the Province are obliged to reach the standard CasaClima C (heating consumption of 70 kWh/m<sup>2</sup> per year) in order to obtain the habitability certificate.

#### 4. THE MAP MAKING

As stated before, the first step of the research has been the listing of those building built following sustainable and bioclimatic criteria in the Trentino Alto Adige region. The research is still on going and hereafter the first results are shown regarding only the Province of Bolzano. It must be stressed once again that only the shape of the building as well as the innovative use of traditional materials are taken into consideration, so to identify how the new architectonic language introduced by the "sustainable revolution" can integrate and even modify the surrounding environment. The other bioclimatic criteria regarding for example natural materials, the structure of the building as well as the inner energy aspects will be considered in future stages of the research.

##### 4.1 Identification method of the buildings

The identification of those particular buildings of interest for our purpose is not easy because they are just a few, they are dotted around and they are often difficult to discover in urban contexts. In order to have a first list of objects to be photographed and then surveyed in a second moment, three main procedures have been used:

- interview of the responsible of public offices working in the building field and, in particular, relating to the energy aspects of buildings;
- interview of local designers;
- direct search in field.

The first two procedures are useful to trace the existence and then the location of sustainable bioclimatic buildings on the territory by means of

interview with both public and private experts that can indicate existing buildings they knew directly or indirectly. The last procedure, the more extreme and time wasteful, is simpler for what concerns Alto Adige region rather than Trentino for two main reasons. The first one has a territorial nature, and it depends on the fact that in Alto Adige the old practice of "Maso Chiuso" (hereditary farm) has been into force from centuries (introduced in 1526 and then institutionalized by Mary Theresa of Austria in 1770) giving the right to the oldest son to inherit the all property. This ancient law preserved the territorial unity of the region with settlements that are scattered and well identifiable. So, the presence of particular buildings with a new shape in contrast with the traditional one is simpler recognizable. The second reason has a cultural-historical nature, and it concerns the proximity of the Alto Adige region with the Austrian regions and so the great influence that their costumes and tradition have still nowadays on the local people that is German mother language in the greatest part. The great movement of these last years towards a sustainable architecture together with the renovated use of natural materials that has taken place in the middle European countries (most of all Germany and Austria) has had a great influence on the Alto Adige population. For these reasons examples of bioclimatic wooden buildings in Alto Adige are much more numerous than in Trentino where this design procedure has found little space in everyday practice.

Moreover, on the web page of the Autonomous Province of Bolzano the buildings certified CasaClima are listed with pictures. Among them, it is easy to identify buildings of interest for the research.

##### 4.2 Criteria for identification and listing

A first analysis of the buildings leads to the identification of some recurring features. They have been synthesised into four main groups used for the further identification and listing of the buildings:

- Unit shape. In order to guarantee high energy efficiency levels, bioclimatic buildings are characterized by a convenient ratio surface volume, towards simple and unit shapes with square or rectangular plans. In this way volume for volume the total surface in direct contact with the outer environment decreases and the transmission heat losses are controlled.

- Adequate windows arrangement. Generally speaking, southern façade has a greater glass percentage than the eastern and western one, while the northern is almost opaque. This fact is due to energy reasons, in order to increase free solar gains (most of all during wintertime) and to minimize energy waste especially in the north direction (even triple glass layers with krypton inside have an U value greater than well done opaque elements).

- Presence of a greenhouse. Nowadays greenhouses are elements commonly used for two main reasons: they act as heat storage and they realize a closed and entirely glass space in full communication with the outside, so psychologically important.

- The roofing shape. The roofing is generally plane or curved, horizontal or inclined so to protect the northern façade and to expose the southern one to the sun rays. Beyond an energy purpose, the roofing shape is now even a distinguishing element that identifies a new architectonic language nearest to the contemporary stile than the traditional architecture.

These criteria have been summed up by means of some icons used in the sheets of the surveyed buildings in order to identify their features and to make a first listing in homogeneous groups. In Fig.2 the icons for the shape of the façade are shown, regarding the unit rectangular façade and the one made up of two or more parts overlapped and staggered. In Fig.3 the icons for the arrangement of the windows are shown, regarding a façade with a great central window, with an upper length window, with both upper and lower length window, and with windows following no order. In Fig.4 the presence of a greenhouse is shown (S3 means no greenhouse in the building), with a rectangular or curve profile, one floor high or covering the whole façade (under the icon, a little stripe divided into three parts is present; by blacken some of them, the position of the element is represented, if centred, side or along the whole façade). In Fig. 5 the roofing type is shown, plane horizontal or inclined, raised above the building, curved.

#### 4.3 Results

For what concerns the Alto Adige region, 62 sustainable bioclimatic buildings have been listed till now, most of all mono or multi family houses, both new and refurbished ones. In the list even tertiary buildings of small dimensions have been considered, while great interventions such as multi storey houses, public buildings, hotels and so on have been discarded. In fact, it is much more easier to appreciate the great cultural influence that the criteria for a sustainable architecture have on people looking at how the housing situation for single users develops (most of all under their explicit demand).

Buildings are mainly located along the most important valleys of the region (most of all Pusteria Valley and the area near Bolzano that is the capital of the Province). It must be taken into consideration that Alto Adige is a typical Alpine region with a mountainous structure, made of main valleys and secondary littler valleys. In the later ones it is now more difficult to find new sustainable buildings both because the building activity is lower, and because it is much more bounded to local traditions and less in favour of innovation.

### 5. BIOCLIMATIC ARCHITECTURE VS VERNACULAR ARCHITECTURE

Comparing the formal characteristics of the listed buildings with the traditional architecture ones (a wide bibliography of traditional buildings in the Trentino Alto Adige region listed for location, shape, exposure, use, constructive system and materials is available at the Laboratory of Building Design of the University of

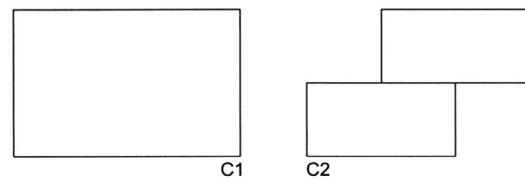


Figure 2: Icons for the shape of the façade.

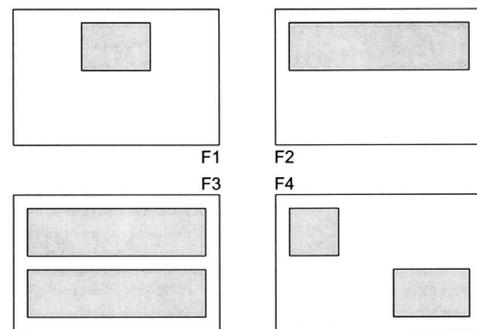


Figure 3: Icons for the windows arrangement.

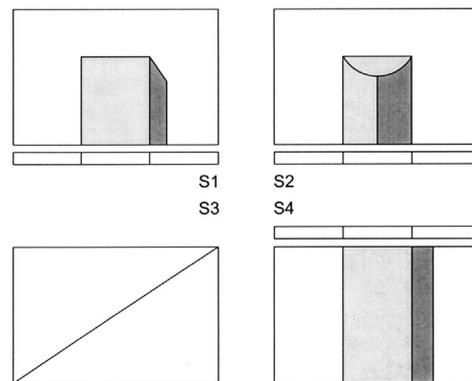


Figure 4: Icons for the greenhouse typology.

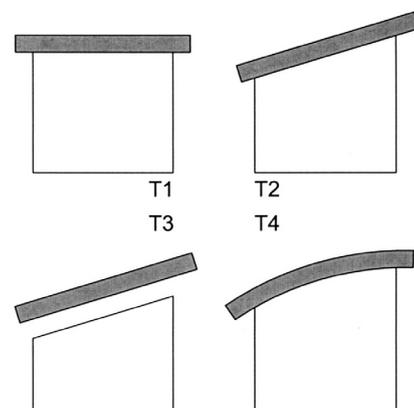


Figure 5: Icons for the roofing shape.

Trento where researches have been carried out starting from 1985 and whose results have been previously published, [6] [7] [8] [9] among the others) it is immediately possible to notice the difference of the architectonic language, often fully in contrast with the local building tradition and, in some way, with the so called “environmental characters of architecture” (they have been defined beside the classical Vitruvian ones – constructive, distributive and formal – “that, even if expressly discussed by Vitruvius, had no a specific definition” and that consider “the climate as a figurative resource, readable in the envelope configuration rather than in the systems, considering the building as a text whose contents are the conveyed functions” [4] ).

These concepts are hereafter clarified by means of some meaningful examples of new sustainable bioclimatic buildings in Pusteria Valley compared with the local existing built environment (see even [11]).

Rubner House at Falzes by arch. G. Mahlknecht (Fig. 6 up right), is a two storey family house with a single pitch flat roof. The building is made of wooden bearing walls of frame panels finished with horizontal planks and it is characterized by a unit shape, by an inner ventilation system with heat recovery, by wide openings on the southern façade where the living rooms are, and by an opaque northern façade where the facilities have been located. The building has been realized in 2000 with a designed annual average heating consumption lower than 30 kWh/m<sup>2</sup>. It shows the typical formal features of the new sustainable buildings designed during the last ten years in the Alpine region, that consist of a unit and squared shape, flat roof, wide openings facing the south where the sun rays come from and a new use of traditional materials matched with modern ones. But the typical building of Falzes levels is a plastered two storey house with a liveable loft, a gable roof, a balcony at the upper floor facing south and balconies along the whole façade on the others two floors. The two typologies are completely different, and the traditional one refers to a design tradition that has a true relationship with the local climate: the north-south orientation of the ridge in order to expose the main façade to the sun path, the use of a massive material at the first floor laying on the ground where the living and the store rooms are located, while lighter wooden elements are used at the last floor in order to guarantee the ventilation of those spaces once used as hay loft by allowing air infiltration through cracks in the planks. Instead, Rubner House deny the local tradition, even if it refers to shared values of environmental sustainability, because the local typical building criteria and characters are never used nor even referred or renewed. Simply, new ones are introduced, characters that could be applied in other valleys, in other places, because they lay on shapes, techniques and materials that are “cross-intended” in a way and that refers to general principles.

Another example is Vieider House at Valdaora di Sopra by arch. K. Egger (Fig. 7 below right), a building with an “heavy” bioclimatic design (windows covering the 59% of the southern façade, a huge greenhouse, a bad rock and a storage concrete wall the main characteristics) that is really different from

the vernacular architecture of the site since it refers to typological-environmental characters that are completely different from the traditional ones. The same for the new wooden buildings at Issengo (Fig. 8 below) whose main characters refer to a new typology that is environmentally sustainable but that perhaps is not completely sustainable for what concerns the relationship with the built estate.



Figure 6: Rubner House at Falzes.



Figure 7: Vieider House at Valdaora di Sopra.



Figure 8: Wooden buildings at Issengo.

## CONCLUSION

The lack of a capacity to read and to reinterpret the environmental characters of the existing architecture could be stressed in all the case studies presented above and, generally speaking, in all the 62 buildings listed during the research activity. A capacity that could give in itself sufficient and adequate ideas in order to propose new shapes able to introduce contemporary sustainable criteria following but developing at the same time an architectural language well recognizable and bounded to the local history, culture and tradition.

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