SOLAR SHADING SYSTEM CONTRIBUTION FOR ENERGY EFFICIENCY OF RESIDENTIAL BUILDING. BEST PRACTICES IN ROME MUNICIPALITY.

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ABSTRACT

Residential building stock in Italy is characterised by stereotyped layouts with little innovative technological input. The housing market is defined by the quantity/quality equation: the perception of an inadequate quantity of existing stock, believed to be insufficient for current demand, and an awareness of the need to establish a new relationship with the surrounding environment. To resolve these problems, Rome Town Council established new measures for the transformation of a number of areas within the Rome Municipality area. Traditional guidelines on technical regulations for residential building have been joined by a system of best practices, a Code of Practice that contains innovative guidelines on environmental quality in building and on appropriate energy and environmental management of sites and buildings. In line with the climatic conditions of Rome and its region, and as a result of the features of the existing building stock, the Code paid particular attention to the theme of solar screens, architectonic components that are able to respond to the multifaceted differences relating to the demands of the position of the architectonic object.

The external envelope is vital in terms of a building project’s sustainability: its features must coherently guarantee the correct climatic control of the building that is not covered by volumetric and spatial design. For this reason, the design of solar screens requires an evaluation based on a number of specific aspects, such as the building’s climatic context and location, the movement of the sun during the year, morphological characteristics and the direction the building faces, its juxtaposition to other buildings, and the functional role of each area in the building.

Sunlight captured by the screen has different intensity and height in relation to the horizon; every side of the building will have a different and specific range of sunlight, and therefore different requirements. Simulations and checks are required to ensure the correct amount of screening will be reported in particular screened areas (depending on the screen's size and shape and the distance between the screen and the occupied area); the presence of other buildings (that may create shade in certain moments of the day and in particular seasons); the quality of shade and the thermal effect caused by the screen (depending on the screen’s shape, the materials used and the morphology, colour and transparency of the elements involved).

The analysis achieved by the Code, underlines the legislative gap on this theme and aims to turn the attention of planners to questions relating to solar screens, and has led initially to a classification and synthesis of the intensity of sunlight; this was followed by a dimensional analysis of screens, in line with the theoretical direction the building faces. This analysis led to an accurate classification and synthesis of guidelines relating both to the choice and the preferential use of the main types of solar screens considered.
DEFINITION OF QUALITY CRITERIA FOR RESIDENTIAL BUILDING

The residential building sector in Europe, and in particular in Italy, is characterised by a building stock made up largely of buildings that are low quality from the architectonic and construction point of view.

Because of the need to satisfy the post-war housing shortage, and against a background of growth thanks to the economic boom and population explosion, between the end of World War II and the ’70s, the aim was to quickly provide housing in quantity, paying little attention to the quality aspect. The technical solutions employed are limited to requirements that today are completely unsatisfactory in meeting new energy-efficiency and environmental-quality needs that have appeared and been developed in the last few years following the Kyoto Protocol.

Alongside these new needs, we have to consider changes in the Italian social and economic context that have profoundly altered lifestyles and the use of principal homes. New forms of family living, new ways of working, homeworking, the mixing of traditional domestic activities with free-time and leisure activities in the same space, have profoundly changed and rendered the system of guidelines for the planning of buildings much more complex.

Despite this, the Italian residential building market, until only a few years ago, appears to have ignored the consequences of this new context. On the one hand, in fact, there is an urgent requirement to provide lodgings to meet a quantitative need, stemming from the strong demand for homes for the most disadvantaged sectors of society, which at the same time has to take into consideration what is emerging from the definition of the new framework of requirements for residential building. On the other hand, there is a need to promote the attainment of established quality levels in relationship to the surrounding environment, while attempting to make a contribution to the improvement of the technical solutions that already exist in the construction sector that are often limited to construction choices that are very traditional and lacking in technological innovation.

For this reason, many local authorities have promoted and supported initiatives that are capable of directing new residential housing projects to provide a result that doesn’t simply answer a demand based on quantity but that also responds to the expectations of improved environmental quality.

CODE OF PRACTICE FOR ROME COUNCIL’S NEW PEEP: SUPPORT GUIDELINES FOR SUSTAINABLE PLANNING

Rome Council’s Code of practice for the New Zoning Plans for Low-Cost and Social Housing is set against this background.

Rome Council, working with the company Risorse per Roma s.p.a. and the Architecture Faculty “Valle Giulia” of Rome “La Sapienza” University, has promoted, in support of the norms contained in the new Plans for Low-Cost and Social Housing (Piani per l’Edilizia Economica e Popolare – 2nd PEEP), the drawing up of a Code of Practice, an instrument to direct and support in the preplanning phase that is capable of working alongside and overcoming the limitations that are found in traditional urban planning.

Using the indications contained in the Code, planning for low-cost and social housing has been directed not only to answer the need for a certain quantity of housing, but also to try to answer the demand for greater quality from the point of view of sustainability.

The themes dealt with regard the environmental planning of interventions through morphological, typological and technological analysis. In particular, with regard to the technological aspect, the indications contained in the code refer to the environmental and energy management of sites and buildings and the use of technological solutions aimed at an overall improvement in the uses of a building and the context in which it is situated.
It is an instrument that isn’t legally binding, that directs and supports sustainability controls in construction, and proposes an approach to resolving the housing question in terms of economic, social, functional, environmental and energy sustainability.

**THE CONTRIBUTION OF THE BUILDING ENVELOPE TO ENERGY EFFICIENCY IN THE BUILDING SYSTEM**

The Code of Practice pays particular attention to the planning of the building envelope, intended as an element that is capable of making a significant contribution to the energy balance of a building.

The correct functioning of a building’s “frontier” element that controls the relationship between interior and exterior offers a fundamental contribution for the control of heating efficiency and the attainment of comfort levels within the environment it encloses. The possibility of guaranteeing ideal conditions for operating inside a building and thus the wellbeing of all the users therein depends on the attainment of these comfort levels.

So the envelope, therefore, defines, contains and protects the activities that take place within the building; the protective role that is made explicit by the envelope, that of a membrane, a connective element between cold and heat, noise and silence, intense light and controlled lighting, provides the building with the possibility of functioning, to carry out the role for which it was planned and built. Connecting two neighbouring environments that respond, nonetheless, to very different logics and control systems, such as the exterior and interior of a building, means planning in an intelligent way the element that render the connection possible. This operation of understanding outlines the limits that identify and design the framework of the building.

Planning a framework means, furthermore, not only relating to the users who are able to carry out their indoor activities thanks to levels of comfort guaranteed by the framework’s characteristics, but also relating to how much the technological planning of the envelope element might influence, at a morphological and perceptual level, the envelope’s external environment.

The results that derive from the planning of a building envelope, therefore, relate to two different but very closely related aspects; the first stems from the possibility of defining and identifying the characteristics of the internal environment, carrying out action to guarantee suitable levels of thermal, acoustic and visual comfort, and the possibility of increasing the energy efficiency of the building system, and influencing the relationship between interior and exterior through the planning of suitable technological choices. The second is related to the formal and morphological consequences that the technical choices in defining the envelope, framework and so external “clothing” of the building, might have on the perception of space and on the relationship between technical elements, closure and sealing systems, and again cold and heat, direct light and controlled light, noise and silence.

The quality of the architectonic envelope influences, from a morphological and formal point of view, both the quality of the architecture as well as, on a wider scale, the city. At the same time as evaluating what has been achieved thanks to new technologies, therefore, it is necessary to reflect on how much they can influence at a perceptive and morphological level the design of the envelope, with the aim of promoting the overcoming of the conditions of formal and technological decrepitude which is to be hoped for in the panorama of Italian social housing.

**SOLAR-SCREENING SYSTEMS: THE REGULATION IN ITALY**

The first external element, immediately recognisable and understood, that has to be examined when we speak of internal-external relationships, consists of controlling sunlight.

This is even more important if we are referring to countries in the Mediterranean basin, in which, apart from the need for protection from the cold, there is also the requirement to provide suitable protection from the heat during summer, to avoid or minimise the use of air-conditioning or cooling plant, thus limiting their impact of energy consumption.

This protection can be carried out by using elements of protection and screening, capable of mitigating and controlling the effects of sunlight.
From a legislative point of view, Italian law, using legislative decrees 192/2005 and 311/2006 – acknowledging European Directive 2002/91/CE – revolutionised the concept of solar screening. Before the passing of these decrees, screening meant the protective system, inside or outside a building, that could be made up of any of the various elements used mostly to filter direct light, among which we find internal elements made of fabric (curtains) or external elements made of wood or aluminium (blinds, shutters), designed without any specific technical criteria.

With the new norm, the planner “has to evaluate exactly and document the efficiency of screening systems, of glassed surfaces, external or internal, fixed or movable, so as to bring about a reduction in heat caused by sunlight”.

This requirement changes the conception of the term “screening” and allows it the possibility of intervening directly in a building’s energy balance, not only in relation to increased living comfort but also in relation to thermal wellbeing and energy efficiency.

With the term “solar screening” we mean a device capable of impacting on the effects of sunlight on glassed surfaces or reducing the thermal impact on opaque surfaces. In reality, this definition contains multiple technological solutions corresponding to different formal choices. From the interior curtain to a hi-tech screening system that might include within it elements of integrated planning, to the simple overhang of an upstairs balcony which, depending on the direction the building faces, might produces shadow on the wall and window below, to plant screens that protect the walls from the sunlight in summer and let it through in winter, there is a whole range of technical solutions capable of answering different levels of need and, at the same time, offering their own contribution to the design of the envelope.

For this reason, it is felt necessary, firstly, to pay attention to defining what is meant by “solar screening”, and laying down a number of classification parameters.

Secondly, we have to reflect on the fact that the presence of an element capable of creating shade, offers benefits that have to be evaluated and calculated. To what extent and how these benefits manifest themselves must be defined by precise criteria: the size and positioning of the screening elements have to be evaluated by accurate means that can justify and direct the choice of a determined technical solution.

**THE CODE OF PRACTICE: A PROPOSAL FOR THE CLASSIFICATION AND USE OF SOLAR SCREENING.**

The Code of Practice contains a proposal for the classification of solar screening, and attempts to identify precise parameters that will able to direct planning. In particular, it analyses the following:

1. The relationship between the direction a building faces/intensity of sunlight.

The positioning of the screening follows the path of the sun’s rays to place itself against them and block their passage. For this reason we should study the possibility of using different screening elements with, as a result, different morphologies, depending on the direction the buildings face.

In south-, southeast- and southwest-facing buildings, the positioning of the screens has a dual function: that of intercepting heat and at the same time filtering light, thus contributing to both thermal and visual comfort. For this reason, for buildings facing these directions, it’s preferable to use external screening, which is much more effective than internal screening for solar control, since it blocks the sunlight before it reaches surfaces further behind. In north-, northeast- and northwest-facing buildings, on the other hand, there is the need to guarantee a suitable level of internal light to limit energy consumption deriving from the use of artificial lighting, and at the same time ensuring the privacy of the interior of the buildings. In this last case, it will be necessary to identify preferably internal screening capable of not blocking the light flow but still able to offer suitable protection for whatever activities take place within the building.

The control of light flow and the protection of privacy furthermore are strictly linked to the type of activity being carried out in the single environments, that may require different modulations in the flow of light depending on the activities carried out therein. The screenings, therefore, could
consist of more or less screening elements capable of balancing the need for privacy with that of allowing light in line with the specific needs of each environment.

2. The type and height of rays to be screened.

The market offers a huge and varied range of products for solar screening: from the simple internal curtain to hi-tech screening that includes the use of capturing panels, there are multiple possibilities for controlling light and heat, that correspond to just as many technical solutions with uses and potential adaptable to every need.

In reality, before choosing, the type of sunlight to be blocked and the climatic and seasonal characteristics of the geographical area under consideration should be considered. The Code of Practice specifically examined the city of Rome and elaborated a classification of screening elements considering a number of parameters relating to type, position, relationship to the building’s façade, texture and morphology of the screen’s components, and the possibility of its housing elements of integrated plant.

So within the range of possible technical solutions we find the possibility of making significant planning choices with respect to the image of a building: once the uses that need to be satisfied have been defined, we can turn to a market that is characterised by evermore pleasing and innovative products from a formal point of view, that are able to contribute significantly to the aesthetic appearance of the envelope as well as to its capability to make a contribution in terms of energy efficiency.

3. The possibility of integration with plant.

Screenings can be used actively to contribute to the energy balance of a building, housing elements of integrated plant such as solar heating and photovoltaic solar capturing panels. South-facing panels, in fact, allow the use of the energy captured by the screening to produce electrical-heat energy, capable of contributing to the improvement of the building’s energy performance. Here too we should compare the possible technical solutions offered by the market, carry out cost-benefit analyses and find intelligent uses for the energy saving resulting from the protection offered against the sun as well as possible ways to utilise active solar systems.

RESULTS

The results of these observations can be summed up in the following tables.

![Table 1: Analysis of fixed and movable screens](image)

Table 1 shows the classification of screenings. This classification is evaluated in Table 3, where indications of the screen’s efficiency in relation to the direction faced by the building are shown.
Table 2: Classification of solar screens and preferred use with respect to orientation.

Table 2 proposes a classification of screening elements starting from their components and in relation to their role with regard to the direction faced. Furthermore, we should evaluate the possibility of using, depending on need, fixed, movable, internal, or external screens, of different textures and morphologies, and also take into consideration the characteristics of the material used, such as colour and transparency.

<table>
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<th>NORTHEAST</th>
<th>EAST</th>
<th>SOUTHEAST</th>
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<th>SOUTHWEST</th>
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Table 3: Indications on the efficiency of screens with respect of orientation.

Table 3 shows a number of indications about the efficiency of the screening elements in relation to the direction faced by buildings. The classification identified in Table 1 is evaluated by its role, depending on the direction faced by the building, bearing in mind also the possibility of using fixed or movable elements.
REFERENCES


