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GREEN PUBLIC PROCUREMENT
INNOVATION OF THE BUILT ENVIRONMENT PRODUCTION PROCESS

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Abstract
The final implementation of the Minimum Environmental Criteria (CAM) for public buildings (Ministerial Decree 11/10/2017), besides having resolutely pushed the design to internalize technical-constructive choices with a more complete and complex environmental and energy profile, induces the operators of the supply chain to a greater and more aware environmental qualification. Although, despite their mandatory nature, the rate of application of CAM is still limited, this results in a strong process innovation. The proposed contribution compares two design experiences concerning buildings for educational activities, one developed in 2016 within the design Program Schools of Central Italy Earthquake, and an ongoing one at 'Sapienza' University as part of the BEI 2017 multi-year investment plan.

Keywords
green public procurement, detailed design, process innovation, technical information

The final implementation of the Minimum Environmental Criteria (CAM) for buildings, which occurred with the issuance of the Ministerial Decree 11/10/2017, has had a significant impact on the evolution of environmental awareness in the construction sector in Italy. Architectural design has been definitively induced to internalize technical-constructive choices with a more complete and complex environmental and energy profile. However, above all, design is now called on to describe and to make the process of choosing materials and components more traceable, in the technical control of both the design and the construction stage, which means incorporating in the project definition also the environmental impact of the entire life cycle of each chosen material. The performance profile of the public work, as defined by the new set of CAM, proposes the process of carrying out interventions of different nature on public buildings, as an exemplary process for the entire construction system and as a lever for a greater, more aware and structured qualification of the operators of the design and construction phases. The economic impact induced on the construction sector could be very positive, both in the selection and gratification of virtuous operators, and in terms of increasing the volume of business thanks to green investments. By simply raising the performance standard of the building fabric as a whole, these investments will lead to an increase of standard costs for public works and of the related economic investment frameworks, with a beneficial expansionary effect on the construction sector's economy.

The systemic impact of these measures is already consolidating some virtuous practices: the effective control of specific aspects of the design and the building fitting in the urban and landscape context; the more aware choice of architectural-constructive solutions; the adoption of design strategies for the building-plant system, definitively assuming the final target of the nZEB standard (ENEA et alii, 2015), as well as promoting the adoption of environmental management systems certified by recognised organizations. Currently, however, the rate of application of the Ministerial Decree 11/10/2017 by public contracting authorities throughout the Country, is still rather limited. A survey carried out by the Association 'Comuni Virtuosi' on a sample of 40 Municipalities, proves that out of 119 tenders linked to construction contracts awarded in 2017 in Italy, only 6 tenders were conducted with the application of CAM (Punto 3, 2019), which means a 5% rate. The situation is different for the application of CAM for interior furnishings (Ministerial Decree 11/01/2017), which, on the same sample of public administrations, were applied in 2017 to 50% of the tenders, all of which for school furniture.

A further survey, on a larger sample of Provincial Capitals (54 out of a total of 104 consulted in the research), was carried out in 2018, and will be periodically repeated, by Fondazione Ecosistemi with Legambiente. The survey shows that only 7.1% of the Public Administrations consulted apply Minimum Environmental Criteria for buildings (Nuova Ecologia, 2018): a rate which is still unsatisfactory. It is hoped that this will be progressively increased on one side by the training activities of contracting authorities and by the tenders' control, both initiated by the National Anti-Corruption Authority (ANAC) in agreement with the Ministry of the Environment, Land and Sea (MATTM)[1]; on the other side, by the adaptation of the supply chain, in terms of response capacity. In addition to the qualification of the operators of the design and construction process, the most significant and tangible effect of the implementation of CAM for buildings and, in perspective, the most powerful driver of innovation in the sector, is certainly the necessary ongoing investments by the industry producing building materials and components. This entails adapting production chains in coherence with the new requirements defined by the regulatory framework and creating a new green standard for the codification of technical information on construction products.

The phase of the building process most affected by the effects of this regulation is that of the final design, when the designer is asked to translate the environmental requirements expressed in the Minimum Environmental Criteria, as well as in the other technical standards referred to therein, in the final technical-constructive choices and in the selection of materials and components. This stage involves integrating the energy and environmental performance profile of the single materials and the interconnected system of the construction choices made in the technical description of the project, enriching the structure and the articulation of the consolidated project documentation. However, the application of the Decree to the other project levels (the outline and the detailed proposals) should be equally reflected in choices that, although less detailed, must necessarily contemplate the technical and economic feasibility of integrating all the indispensable and appropriate solutions in the subsequent design levels. Some criteria, such as the one relating to natural lighting (Ministerial Decree 11/10/2017, par. 2.3.5.1), also entail repercussions on morphological and typological aspects of the building, above all – but not exclusively – in the case of a new construction, which should be consistently planned already from the first stages of the design process.

Green Public Procurement for social architecture: potentialities for buildings for education and research – The approach adopted by the Italian Ministry of the Environment in the development of Minimum Environmental Criteria for buildings has seen, at first, the issuance of CAM on individual building components, in particular with Ministerial Decree 25/07/2011 on external doors and windows. In 2015, then, the first version of currently in force CAM for buildings was issued which, instead, looked at the building in a unitary way, taking into consideration its environmental behaviour both in the indoor spaces and in its interaction with the context, in relation to all the different flows of resources (microclimatic factors, energy, water, materials). In adopting this method of defining the Minimum Environmental Criteria, aimed at favouring a holistic approach to both design and construction, Italy has chosen not to differentiate the Criteria based on the functional destinations of public buildings. In this sense, the approach of the European Commission (2016) is different: Green Public Procurement (GPP) Toolkit on Office Buildings, for instance, focuses on the selection of criteria applicable to the building fabric itself and to the typical energy behaviours related to the typology of occupant use, developing a specific approach for office buildings.

In particular, Section B – Detailed Design and Performance Requirements (European Commission, 2016, p. 16 et seq.) specifies the quality criteria of the spaces intended for the tertiary sector, referring to the respective standards and promoting the programming of staff mobility and the arrangement of devices and equipment designed to help minimize the daily impact due to moving to the workplace. A stronger specification of the GPP Criteria tool, in relation to the different types of building interventions, would allow a better and more targeted management and verification of the single criteria, also resulting in a significant improvement in terms of technical and economic effectiveness of the project forecasts, inserting the model of use of the building among the elements that characterize the design, especially during the technical economic feasibility project development stage.

As regards public buildings in Italy, the application of GPP to interventions on school buildings is particularly strategic. In fact, educational architecture is a substantial part of the widespread civic infrastructure of the built environment, identified with the social model in which it operates and, more generally, it reflects the political, social and cultural attitude of a State with respect to issues such as Welfare and Heritage. With this in mind, the application of the Minimum Environmental Criteria, both in the construction of new buildings and in the deep retrofit of existing ones, affects the regeneration of the social and environmental infrastructure of the community, through a profound renewal of the operating methods of professional practice, as well as the quality of architecture in a broader sense. In this context, quality refers to the ability of the project to be able to interpret the demands of change of a society that bends to the particular needs of a global technological revolution. A society which evolves in the ways of choosing and consuming urban spaces, which lives and ages within increasingly distant and less numerous family groups, which finds in sustainability not only an urgency, but a response in terms of effectiveness and optimization of material and immaterial resources. In their current formulation, Minimum Environmental Criteria for buildings are considered to be an effective tool precisely because they result in design principles pertaining to the entire construction sector. However, it is believed that a document of regulatory recognition and proposition of specific strategies relating to specific end uses, as in the case of the previously mentioned Toolkit relating to Offices, needs to be elaborated in the programming phase of the intervention, in order to be prescriptive in the subsequent phases of planning and management.

With reference to the design experiences presented below, the main aspects will be analysed in which the requirements of educational architecture converge, both from a functional and a constructive point of view, with the performance framework outlined by the Ministerial Decree 11/10/2017: a) the centrality of the correct evaluation and planning of the quality of indoor spaces, which only recently have been attributed a decisive weight in the strategies of building development and retrofit, so far concentrated exclusively on increasing the efficiency of the building envelope; b) the need to systematize the data relating to the construction in terms of performance, in order to allow not only a more agile evaluation of the design choices, but also to retrace the phases and the history of the building, in the subsequent intervention campaigns, without costly and sometimes impracticable diagnostic investigations; c) the morphological and typological rethinking of educational architecture, connected with the planned transformability of the buildings, needed to absorb the necessary variations of the use pattern of spaces over time, reducing the impact of the consumption of soil and the costs of disposal due to technical obsolescence and functional inadequacy of the buildings.

The quality of indoor environments in social architecture – Particularly relevant, within the Ministerial Decree 11/10/2017, are the criteria relating to indoor environmental quality (par. 2.3.5) and in particular to indoor thermo-hygrometric comfort (par. 2.3.5.7), extremely significant aspects in the social architecture project. The evolution of the envelope's performance and the consequent indoor microclimatic adaptation have significantly changed the subjective perception of thermal comfort levels[2], so structured, especially in the use habits of the most recent building stock, that today they can be considered as a cultural factor. The entire homeostatic balance relies on the plants system installed in the building. The obvious consequence in terms of increase of energy consumption is compensated in new buildings, as well as in existing ones subjected to major redevelopment, mainly by the adoption of more efficient plant systems, with profits exceeding 90%.

The effects of indoor air quality on occupants, also included among the Minimum Environmental Criteria for buildings (Ministerial Decree 11/10/2017, par. 2.3.5.5) represent an equally significant issue, even though less resonant in communication and less burdensome in evaluating interventions on existing buildings. As evidenced by the reports produced over the years by the World Health Organization (WHO), the everyday life of the populations in industrialized countries takes place mainly in closed artificial spaces. Thus, indoor air contamination becomes a public health issue, weighing on people already living in fragile conditions as well as on subjects in good health conditions (World Health Organization, 2010).

With reference to the subject of social architecture, one of the many studies emphasizing the issue of indoor air contamination is the European Project Schools Indoor Pollution and Health - Observatory Network in Europe (SINPHONIE), which carried out a systematic research campaign aimed at the restitution of an analytical and operational framework on the quality conditions of school environments (Annesi-Maesano et alii, 2013). The polluting sources are identified as follows: i) state of conservation of the building fabric, i.e. deterioration of the integrity of building components and plant systems; ii) finishing and furnishing materials, which contain polluting components not identified at the time of adoption and installation, never replaced even after having ascertained their toxicity; iii) contaminants in water, soil and air, as for example radon emissions, on whose danger attention has developed only recently, certainly after the construction of the largest part of the scholastic building stock; iv) chemical and mechanical processes taking place in school environments, for example the use of machinery releasing particulate such as photocopiers, or the operation of air conditioning and ventilation systems; v) activities and behaviour of the occupants, from the use of chemical products, to the control of plant devices, to the physical actions on the building impacting on the composition of indoor air.

The issue of the quality of indoor environments occupies a consisting space of paragraph 2.3 of Ministerial Decree 11/10/17, within the section Technical Specifications of the Building, as a condition connected to the energy performance of the building and to the characteristics of the materials used, subject to verification along the life cycle, as prescribed by the Work Maintenance Plan. Moreover, the Decree underlines the need to insert ICT solutions, aimed at optimizing and managing resources, in the project from the very first planning stages, and then to implement them in the detailed design. Solutions which might be connected to the building fabric as well as to the plant system, and/or operated by the aware user, the prosumer (Clemente et alii, 2019). The adoption of models linked to the use of SCC solutions influences the use possibilities of the building, therefore the consistency and the degree of spatial and functional flexibility of the project.

Informed modelling: the operating memory of the project – The Ministerial Decree 11/10/2017 meets the need for systematization of construction data and strengthens the unique qualification of materials and components for the sustainable project, through a clear reference to the standards and an accurate description of the assembly requirements. With a view to transparency and the possibility of verifying compliance with the requirements on the recycled content of construction products (as per paragraphs 2.4.1.2 and 2.4.2 of the Ministerial Decree 11/10/2017) and on the level of emissions of materials (as per par. 2.3.5.5), the availability of both technical information and environmental product certifications become fundamental. This entails, among other things, the need to adapt Regional Price Lists with the introduction of CAM-compliant entries, in order to facilitate the specification and inclusion of these products in the metric estimate calculations. At the same time, gathering data from the aformentioned documentation to implement in hte Building Information Modelling (BIM) platform, opens up an important opportunity to trace the characteristics of the materials and their methods of installation.

In a first extreme and voluntary generalization, Building Information Modelling can be intended as the parametric elaboration of a domain of knowledge that relates to the construction and organizes, at a given moment in the life cycle, the technical and functional information. Architecture, Engineering, and Production inter-operate in a common environment by adopting a language that is not only descriptive and graphic, but also physical and must be necessarily congruent. As in the case of CAM for buildings, the requirement, the process and the product characterize the design process passing through it from the ideational phase to the end of life stage. In the informed modelling activity, the product is specified as a factual, material and productive datum, and not as its synthetic representation. The so-called BIM Decree (Ministry of Infrastructure and Transport, 2017) completes, with the progressive adoption of the instrument, the qualification and information process and, therefore, it allows transparency in the comparison of intervention alternatives. Today, a reliable and uniform survey of the CAM-compliant building materials and components is still lacking, having been implemented only partially in a few Regional Price Lists. This is one of the main factors of delay and difficulty in the CAM implementation within the design system. The definition of the technical and economic performance of a constructive solution fully compatible with the CAM specifications today is only available when it is already codified because of other existing binding regulations (for example, the passive acoustic requirements of buildings, referenced to in par. 2.3.5.6 of DM 11/10/2017), recalled and harmonized in the CAM Decree. Much more often, it must be built and codified, by collecting the necessary information in order to be inserted in the modelling of the building.

Implementation of CAM in a School Building in Accumoli – The following considerations derive from an early experience in the implementation of CAM for buildings in the design phase, carried out by the Working Group[3] (WG) within the extraordinary Program for the reopening of the schools for the 2017/2018 school year, contained in the Ordinance of the Government Commissioner for reconstruction in the territories affected by the earthquake of 24 August 2016 (No. 14 of 16 January 2017). In the development of the final project of the Accumoli complex in the Province of Rieti (Fig. 1), part of the all-inclusive scholastic institute of Amatrice, a school building for 31 students, single-storey and with an area of 700 square meters, the WG experienced the complexity of the integration of the Minimum Environmental Criteria into the design process. This was due to the limited budget available, as well as to the inexperience of the stakeholders involved in the process for the unprecedented implementation of the Ministerial Decree 11/10/2017, and to the necessary balancing with the other technical regulations, in particular the stringent anti-seismic criteria required in the area. A further significant constraint was represented by the need to develop a final project ready for a subsequent tender for design and construction, which should have led to the construction of the works in a very narrow time frame.

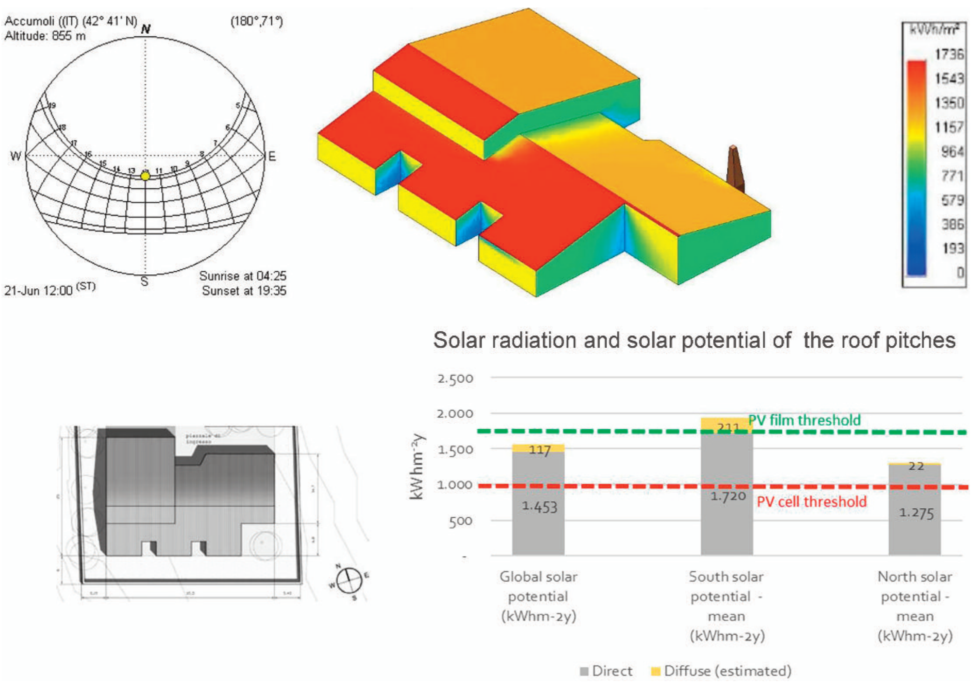
Fig. 1 - Accumoli School Complex, *overall view (credit: Working Group University Sapienza, 2017).*

In the school building, containing a classroom for the kindergarten, two classrooms for the primary school, a multipurpose classroom, a modular and multi-functional space (atrium/gym/laboratory), a teachers' room, a canteen with connected kitchen services and hygienic services, it was also necessary to guarantee different purposes of use of the spaces, with entrances usable also independently both for safety reasons and to allow the use of the community outside the time scheduled for the didactic activity. This was a necessary condition also to allow the use of the school as a strategic building and refuge in case of emergency. Given these contextual constraints, the CAM-compliant technical design solutions have been oriented in particular on the following topics, referring to the respective paragraphs of the Decree: energy performance and energy production (par. 2.3.2 and 2.3.3); indoor environmental quality, with particular reference to thermo-hygrometric comfort (par. 2.3.5.7); natural lighting and sun protection devices (par. 2.3.5.1 and 2.3.5.3); design for disassembly (par. 2.4.1.1).

With regard to the first topic, the design stage was carried out in order to balance the passive behaviour of the building envelope, to contain energy needs, with the active one, thanks to plant systems simple but highly efficient and to the realization on the roof of a thin film photovoltaic system, to obtain a class A4 building, qualifiable as nZEB.

In order to enhance the solar resource, given the particular local climate of Accumoli, mountainous with harsh winters despite the latitude of the central Mediterranean, a preliminary evaluation of the amount of solar energy received from the enclosure elements during the different seasons was carried out, through which the possibility of adopting thin-film photovoltaics on the roof (Fig. 2), as well as the need for solar screening (Fig. 3) occurred. Therefore, shelters and covered spaces have been provided for protecting the entrances which, combined with the use of vegetation, ensure the best protection against the weather and the solar radiation, in addition to extending the space available for educational, training and recreational activities outdoors.

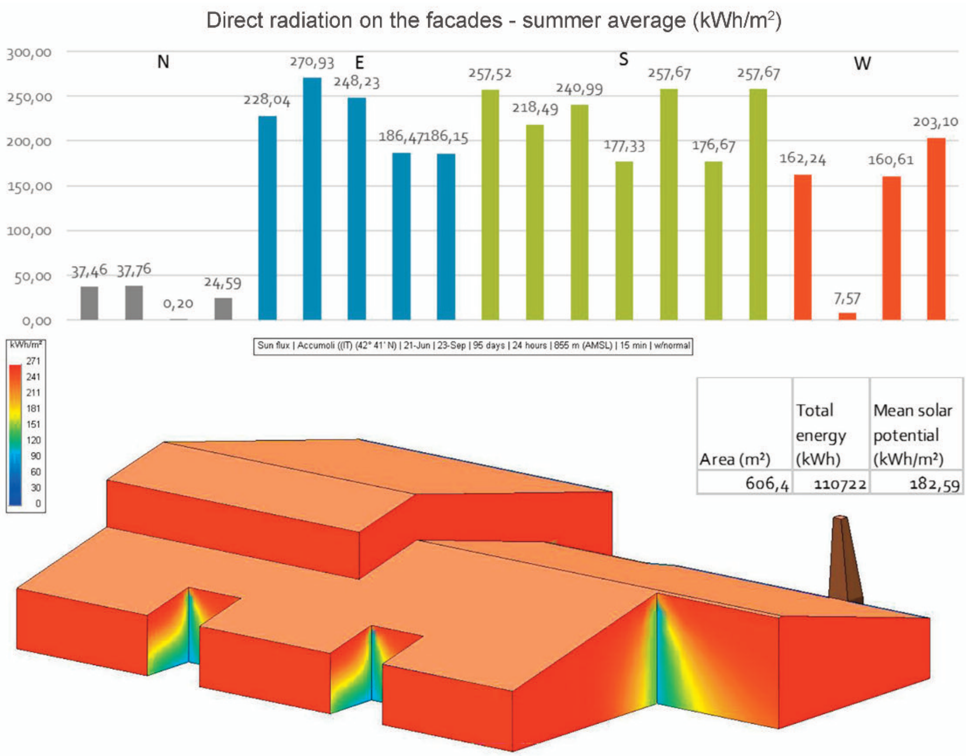
The construction system adopted aims to reduce seismic vulnerability and risk, in compliance with the strict requirements of the Contracting Authority Guidelines. Thus, a continuous structure was planned, composed by reinforced concrete partitions cast into mineralized wood fibers permanent formwork, and a X-LAM roof: these choices ensure excellent seismic behaviour and, at the same time, high thermal inertia and durability. In the developed design phase, in order to increase the level of disassemblality of the building components, the whole structure was developed with the X-LAM panel system which contributes significantly, in addition to optimizing the construction phase, to the achievement of the target set by Ministerial Decree 10/11/2017



Figg. 2, 3 - Accumoli School Complex: *Analysis of the solar potential of the roof's surfaces; Analysis of solar radiation on facades in summer (credits: Working Group University Sapienza, 2017).*

in paragraph 2.4.1.1[4]. With the Contracting Authority Guidelines and with CAM, all the components used for the envelope system and for the internal partitions can be disassembled. In particular, for the façade system and the roofs, a ventilated cladding of pre-painted aluminum sheet was provided, while the internal partition systems consist of plasterboard and dry-assembled mineralized wood, in order to optimize the requirements of flexibility, reusability throughout the life cycle, recyclability of individual components and basic materials.

Implementation of CAM in a building replacement intervention: Faculty Building of Sapienza University in Rome, Borghetto Flaminio – The rehabilitation of the Borghetto Flaminio area by the Sapienza University was included among the interventions funded under the University and Facilities Rehabilitation Plan financed by the EIB (European Investment Bank) in the spring of 2017. On the one hand, the University is called to plan the development and the territorial articulation of its structures, abandoning the practice of constant emergency. On the other hand, the Municipal Administration had to manage an extremely degraded central area of particular urban, historical and environmental importance. The site is located along the Via Flaminia, nearby Piazzale Flaminio and two other buildings used by the Faculty



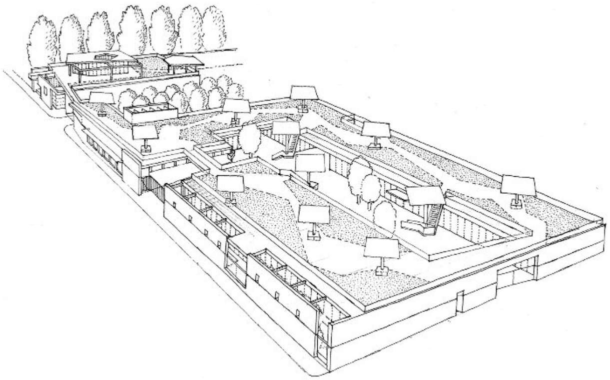


Fig. 4 - General view of the new Sapienza Faculty Building in Borghetto Flaminio (credit: G. Rebecchini, 2014).

of Architecture of Sapienza for teaching and research activities. Previously occupied by the Company S.I.A.R. (also referred to as the former FIAT), the district configuration is characterized by an open courtyard space delimited by heterogeneous single-storey buildings, some of which are decaying, and the area with an artifact in an advanced state of decline, once used as a fuel depot.

The design stage, to which the Working Group[5] also contributed adapting the project to the CAM requirements for the building sector, concerned the project of the new Borghetto, a complex with an exemplary vocation, open to citizenship for classrooms and educational laboratories of the Faculty of Architecture. The complex, directly accessible from the Via Flaminia, is articulated around a central courtyard, an open semi-private area of relationship and connective, with green areas and parking facilities (Fig. 4). Green roofs are provided as a system of terraces connected to each other by pedestrian bridges that create a usable elevated garden, in strict perceptive relationship with the exceptional natural environment constituted by the slopes of the Strohl-Fern and Poniatowski villas. Given the particular context, characterized by a consolidated and very dense urban fabric, in order to comply with the criterion for reducing the impact on the microclimate and air pollution (as per paragraph 2.2.6 of the Ministerial Decree 11/10/2017), the design foresees the realization of a dense biomass green surface in open spaces to guarantee an adequate absorption of polluting emissions, a sufficient evapotranspiration and an adequate microclimate.

Native trees and shrub species with reduced water requirements and resistant to phyto-pathologies are used for the new plantings. The management of the green area, entrusted to Sapienza, will be able to rely on an irrigation system fed by rainwater recovered from the roofs and stored on site, in compliance with the criterion in par. 2.3.4 of the Ministerial Decree 11/10/2017. For external surfaces for pedestrian or cycle circulation, the use of permeable floors with a high Solar Reflectance Index (SRI) has been planned. Consistently and compatibly with the technical and safety regulations in force, specific flooring solutions are also envisaged for areas destined to public and appurtenant parking to reduce the effects of the local heat island and to optimize the deep permeability of the soil.

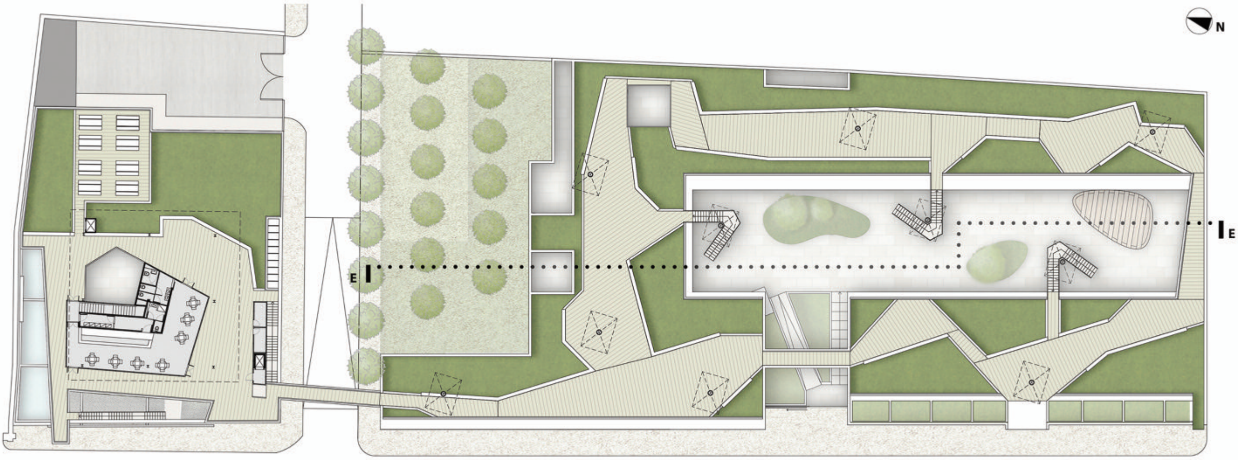
In compliance with the provisions of par. 2.2.8.1 of Ministerial Decree 11/10/2017, it was also planned to cover more than 10% of the gross area of the car park with proper trees to guarantee good shading of parking spaces, and to delimit them with a green belt of a height greater than 1 meter and over 75% opacity. Moreover, the possibility of inserting additional photovoltaic shelters to serve the parking lighting system and the parking access road has been evaluated. The decision to build the roof system with an intensive green roof (Figg. 5, 6) also provides excellent thermal insulation of the underlying environments, both in the winter and summer cycle thanks to the strong thermal inertia of the solution, optimal conditions of acoustic insulation from noise aerial, as well as improving the local microclimate, reducing the effects of urban heat island, due to the low reflectance of the exposed surface, and the volatility of surface dust (par. 2.2.6 of the Ministerial Decree 11/10/2017).

The following fundamental guidelines oriented the design of the building complex (Fig. 7): verified passive behavior of the building envelope; use of high efficiency plant systems; achieving high levels of energy from renewable sources, both thermal (aerothermal) and electric (photovoltaic systems). The latter have been integrated into specific structures, called ‘technological umbrellas’, able to support photovoltaic panels and designed to shade during the day and illuminate the green roof in the evening. It was decided to design an ‘all-electric’ building, with heat pumps for the thermal energy production (for heating and domestic hot water), replacing the classic combustion boilers. The target is to minimize energy withdrawal from external networks, configuring the construction as A4-class nZEB, fulfilling the Ministerial Decree 11/10/2017 (par. 2.3.2 and 2.3.3).

Besides complying with the regulations in force concerning environmental quality and comfort of interior spaces, the design of the new Borghetto complex carries out the prescriptions specified in the par. 2.3.5 of the mentioned Decree. In particular, the natural lighting levels are assured (par. 2.3.5.1): in fact, is verified that in all the spaces continuously used a daylight factor that exceeds 2% is continuously guaranteed. In compliance with the specific requirement profile of each space, a system of solar shading was envisaged, fitted for the regular and comfortable performance of different activities (teaching, study, reading, projection, etc.) such as to guarantee the regulation of the intensity of sunlight, the best conditions of visual comfort (par. 2.3.5.3 of the Ministerial Decree 11/10/2017) and, where necessary, to guarantee the complete or partial blackout necessary for the use of multimedia devices. The geometric-spatial configuration of the technical elements (roofing, closures and vertical partitions) also contributes to the management of daylight through the seasons, on the different fronts of the building.

Particular attention was paid to the interior acoustic performance, related to the specific use of each environment with a complex and differentiated performance profile, to reach the values indicated for the acoustic range defined by UNI 11367[6] and those related to the reverberation time and the indoor Speech Transmission Index (STI), referred to UNI 11532-1[7], in accordance with par. 2.3.5.6 of Ministerial Decree 11/10/2017 for what concern acoustic comfort. The materials have been chosen to guarantee the optimal conditions of isolation and sound absorption in relation to the different use, with

East façade



First floor plan

Section EE

special regard to the classrooms intended for teaching. The technological and constructive choices finally lead to the management optimization, applying dry construction system as widely as possible, in order to boost in order to favor the industrialization of the process and, largely, a more ordinary and extraordinary maintenance effective. The complete and direct disassembly of the components as well as the possibility of selective demolition of building parts at the end of their life allow the re-use / recycling of the materials and prefabricated elements used (par. 2.3.7 of Ministerial Decree 11/10/2017 on the 'end of life'). For what concern the point 2.4 of the Decree related to the Technical Specifications of the Building Components, the project identify materials that can easily reach the prescribed recycle content thresholds, which will be further specified in the executive design phase.

Conclusions – Substantial adhesion by the design and technical control of the process to CAM leads to a new cultural revolution in public building sector, on the condition that the public administration is prepared to become interpreters in their implementation at the operational level. The growth and stratification of a complete and conscious design culture is necessary for the competitiveness of every professional structure in an increasingly tough and selective design market. Even more, the real place of technical competence capitalization can only be in the public client structure, increasingly called upon to develop and nurture multi-scalar process management and building product skills. The systemic mission proposed with the set of measures related to Green Public Procurement (GPP), introduced in Italy since 2008 with the GPP National Action Plan[8], points out important levers of deep redevelopment of public administration processes. In addition to the environmental demands contained in the Action Plan, the method indications to be applied to the building sector take on a central role; in other words «[...] Protection and improvement of the competitiveness of companies, Stimulation of innovation, Rationalization of public spending, Efficiency and saving of resources natural, in particular energy, Enhancement of the skills of public purchasers [...]»[9], could represent a financial driver for the building industry, which has paid a very high price to the recent economic crisis, due to the intentional or unintentional hesitation to evolve with the necessary speed, compared to consolidated and rearguard development models (Rossetti, 2011).

These instances should have more important value in public construction sector where the administration's aware behavior should be exemplary for the private action. However, even though the Public Contracts Code explicitly calls for the adoption of CAM, in practice the Decree is still difficult to be implemented in its complete form. The absence of adequate standard costs, necessary for the evaluation and comparability of the offers calls for not allow the crucial revision of the planned works economic frameworks (ANAC, 2019). Public administration does not seem to be structured to

Figg. 5, 6 - Next page. Borghetto Flaminio Building: *Plan of the intensive green roofs and longitudinal sections; View of the central courtyard (credits: Studio Speri srl and Arch. M. Giannini, 2018).*

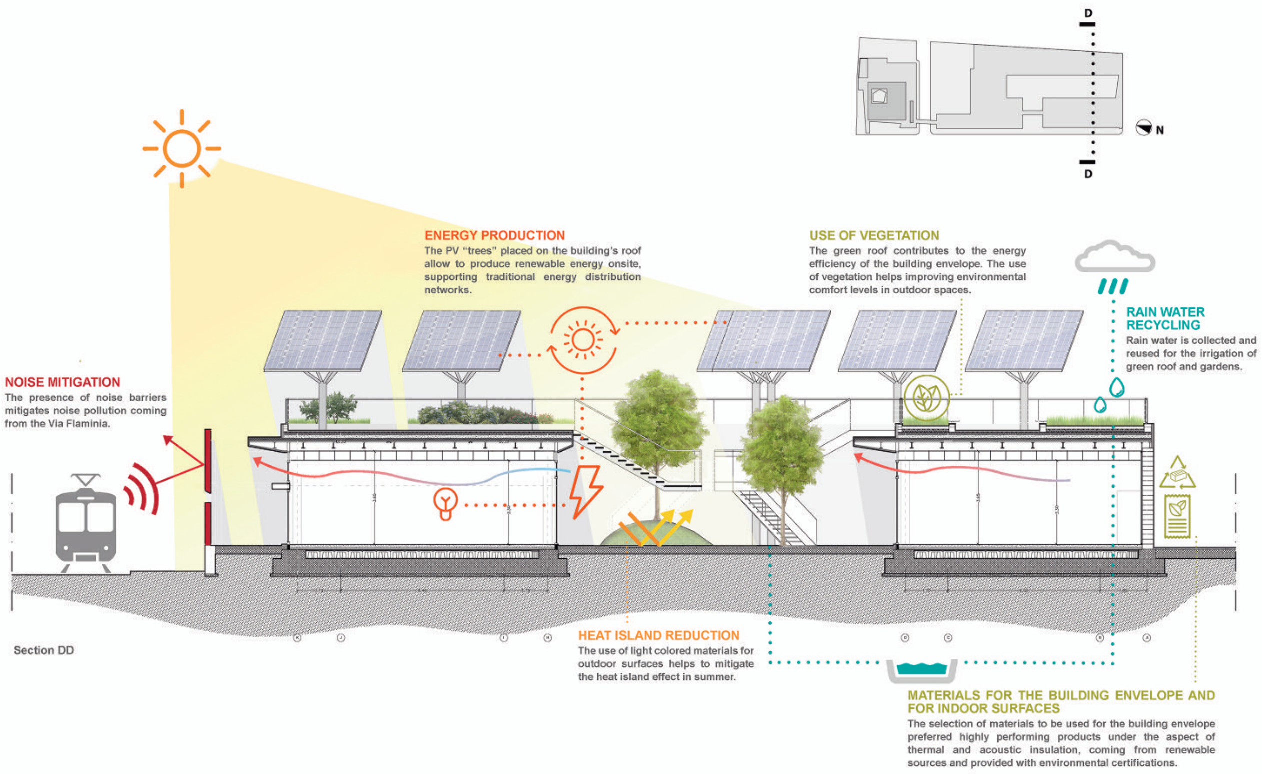


Fig. 7 - Functional section of the Borghetto Flaminio Complex *with the main environmental design strategies (credit: Studio Speri srl and Arch. M. Giannini, 2018).*

support the technical progress of the production world, which is already prepared in complying with CAM. On the one hand, industry has invested in green processes and products, on new technical data adapted to new system requirements and product performance certification. On the other hand, the design sector is adopting the GPP policies, rearranging the operational and communication processes and the elaboration of technical offers, with a public client in the background that is not yet able to consciously manage an offer from the already substantially mature market. The cases illustrated in this contribution therefore testify the possibility to build a common ground for skills development , when Public Administration is willing to in invest in process innovation.

NOTES

1) The action derives from the Protocol of Understanding between the National Anti-Corruption Authority (ANAC) and the Ministry of the Environment, Land and Sea (MATTM), aimed at ensuring compliance with the Legislative Decree April 18, 2016, n. 50 (New Procurement Code) on environmental matters, through monitoring and supervision of the application of Minimum Environmental Criteria, regulatory activity and guidelines, training activities.
2) For completeness, the definition of ASHRAE 55-66 definition of 'thermal comfort' adopted by Fanger (1970, p. 13) as «that condition of mind which expresses satisfaction with the thermal environment», is reported.
3) The plan was elaborated in 2017 within a Convention between Sapienza University of Rome and

the central Commissioner – Special offices for Reconstruction, for technical and scientific support activities for the design and construction of new definitive school buildings, within the framework of 'Extraordinary Program for the re-opening of schools for the 2017-2018 school year'. Scientific Responsible: Prof. O. Carpenzano. Interdepartmental working group Sapienza DIAP, DPTA, DISG, DICEA, DIAEE. DIAP project center manager: M. Alecci. Operational coordinator: F. Lambertucci. In the Working Group for the Institute's comprehensive project of Amatrice, Accumoli School (RI), C. Clemente was in charge of the technological aspects.
4) At least 50% weight / weight of the building components and of the prefabricated elements, excluding the systems, must be subjected, at the end of their life, to selective demolition and to be recyclable or reusable. Of this percentage, at least 15% must consist of non-structural materials.
5) The Plan was elaborated by the AGE (Building Management Area) of *Sapienza*. Architectural design consultancy: Prof. Arch. G. Rebecchini, Technical Support to Design: Studio Speri srl and Arch. M. Giannini. The final project is currently being approved by the Conference of Services of the local Public Works authority of Lazio, Abruzzo and Sardegna.
6) UNI 11367:2010 *Acustica in edilizia – Classificazione acustica delle unità immobiliari – Procedura di valutazione e verifica in opera | Building acoustics – Acoustic classification of building units – Evaluation procedure and on-site verification* (authors translation).
7) UNI 11532-1:2018 *Caratteristiche acustiche interne di ambienti confinati – Metodi di progettazione e tecniche di valutazione – Parte 1: Requisiti generali | Indoor acoustic characteristics of confined environments – Design methods and evaluation techniques – Part 1: General requirements* (authors translation).
8) The Plan, adopted with the Interministerial Decree of 11 April 2008 (Official Gazette No. 107 of 8 May 2008), was updated with the Decree of 10 April 2013 (Official Journal No. 102 of 3 May 2013) and is currently undergoing further revision.
9) Authors translation.

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