

BEYOND ALL LIMITS CONGRESS 2018

International Congress on Sustainability in
Architecture, Planning, and Design

Proceedings Book of The Extended Abstracts



ÇANKAYA UNIVERSITY



Università
degli Studi
della Campania
Luigi Vanvitelli



UNIVERSITY OF
PLYMOUTH

October
17-18-19
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in Architecture, Planning, and Design

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FOREWORD

It is our great pleasure to welcome you to BEYOND ALL LIMITS 2018 - International Congress on Sustainability in Architecture, Planning, and Design, a joint collaboration of Çankaya University (Ankara-Turkey), Università degli Studi della Campania “Luigi Vanvitelli” (Caserta-Italy) and University of Plymouth (Plymouth-United Kingdom). The congress takes place in the Congress Hall of Çankaya University, Ankara, Turkey, on October 17-18-19, 2018 and supported by SID “Società Italiana Design”, SITdA “Società Italiana della Tecnologia dell'Architettura”, LeNS “The Learning Network on Sustainability” and GRID “Architecture, Planning and Design Journal”.

The congress aims to discuss and redefine the term sustainability with its all dimensions such as environmental, economic and sociocultural in various disciplines including architecture, planning and design, to extend the term's boundaries through fulfilling it with scientific, genuine, innovative and inspiring studies and to foster cooperation within and between different disciplines at international level. Besides, workshops and special sessions are organized.

The scientific program consists of keynote speeches, plenary and parallel sessions of presentations and workshops. The 3-day congress has more than 200 contributing academicians, experts, researchers and professionals attending from several countries of the world. More than 100 presentations are planned in 28 sessions in 2 days. The third day is devoted to workshops which are organized by 8 different groups of academicians and professionals from related various fields. In addition to the contributed presentations and workshops, two invited keynote speeches are given: by Prof. Dr. Susan ROAF, Heriot Watt University's Emeritus Professor of Architectural Engineering and Prof. Dr. Birol KILKIŞ, Başkent University's Professor of Energy Engineering.

This proceedings book of extended abstracts comprises written contributions of the presentations, keynote speeches and workshops contents. Before the congress, all participants were expected to submit extended abstracts of their presentations in a format formed by a short abstract with keywords, introduction, methods, findings and discussion, conclusion and references, not exceeding 1500 words. All submitted extended abstracts were blind peer reviewed and accepted ones now take part in this book.

BEYOND ALL LIMITS 2018: International Congress on Sustainability in Architecture,
Planning, and Design, 17-19 October 2018, Ankara, Turkey

As being Congress Organization Committee, we would like to express our gratitude to all contributing members of Çankaya University, Università degli Studi della Campania “Luigi Vanvitelli” and the University of Plymouth for their superior efforts and enormous support. Furthermore, we would like to thank all participants of the congress for their outstanding contributions for sharing their knowledge, expertise and vision.

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Energy Efficiencies of Cultural Heritage Through Recovery of Damages by Natural Event: The Case of The Gallery of Nations Inside the Church of Michelucci In Florence

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Abstract: The historic and value buildings are the trademark of numerous European cities; they give uniqueness to our cities and are a living symbol of Europe's rich cultural heritage and reflect society's identity. So it is important to fill up the gap between conservation of value buildings and sustainability, which is not an antagonism at all. The work's main objective is to verify the feasibility of a performance improvement of a value building, as national cultural heritage, in terms of energy saving and sustainable materials use. Since reduction in energy demand is assumed as a feasible value, the paper aims to demonstrate that the historic environment and its heritage assets should be conserved and enjoyed for the quality of life they bring to this and future generations although, a sustainable use and preservation of value buildings requires broad and long-term compromises between social, economic and environmental aspects.

Keywords: Energy recovery, sustainable materials, cultural heritage

Introduction

Historic buildings today play an important role for the community compared to what happened in the past. Such buildings, in fact, beyond their beauty and recognition of their value, are essential as the bearers of our historical identity. Cultural heritage is a significant force for 21st century Europe; not only is it at the heart of what it means to be European, it is being discovered by both governments and citizens as a means of improving economic performance, people's lives and living environments.

At the same time, sustainability is about overlapping environmental, social and economic requirements and the need to bring them all into harmony: all of them are relevant to older buildings, but for the purposes of value, the greatest emphasis must lie on the environmental aspect, and specifically the use of fossil energy.

The need for recovery, in terms of energy, the historic building heritage and therefore the possibility to act on to ensure optimal performance, however, pose the difficult question on the evaluation of intervention technology to reduce energy consumption, by means of new materials and techniques, is considered a "threat", while acknowledging that effectively

contributes to the use and the long-term preservation of an existing historic building and then to the preservation of its cultural value.

This work shows the results, about the partial recovery of "San Giovanni Battista Church" (Chiesa dell'Autostrada del Sole) roof, architect Giovanni Michelucci design, damaged in March 2015 by a storm that has caused serious damage.

After the disastrous event, this valuable building reported several damages to the "Nations Gallery" roof; in detail the storm caused the detachment of external copper layer of this church area and the deterioration of underlying layers. The "Società Autostrade", building's owners, instructed the CHM_Lab (Architectural Department of University of Florence), to project the recovering of the roof. The approach of the research group was to propose an improving of global building performance, through the integration of new and sustainable materials for the roof system, without changing dimension, the external language and technological original approach.



Figure 1. The San Giovanni Battista Church realized by Michelucci: the damage of the gallery of Nation roof after the storm

The study is collocated inside the theory of Cultural Heritage refurbishment inside the technical approaches (Plevoets, Van Cleempoel 2011): based on the direct survey and indirect analysis of project design, the study wants to illustrate the possibility of improving the energy consumption and environmental performance of cultural heritage, preserving historic parts of the building (Pfluger R., Baldracchi, P. 2011).

Before starting to refurbish an existing building in fact, it is fundamental to carry out an analysis of the actual existing building's performance and condition to understand how its performance can be improved to achieve current benchmarks in terms of comfort, security

and energy saving. A baseline can be established by conducting an accurate audit, carried out as a systematic examination and measurement of key aspects of all the building.

Methods and approach to the study

The study was divided in two different phases:

1 The survey: direct and indirect study about the technological and historic aspects of the building;

2 The project: definition of technical approach and proposal for the restoration of original layers.

After the first studies, carried on through the definition (in terms of material and technology used) each roof single layer, to evaluate the total performance in terms of energy, the research group developed the proposal project.

In detail the proposal respect the original project in terms of:

- Single layers dimensions
- Recover of peculiar existing elements (copper external layer, structural wood elements)

To develop all the process, was necessary: the analysis of original Michelucci's project first, three invasive essay on the roof system and the investigation of the survey campaigns, developed by the church's owner (Società Autostrade s.p.a.) in the 2007 and 2011¹.

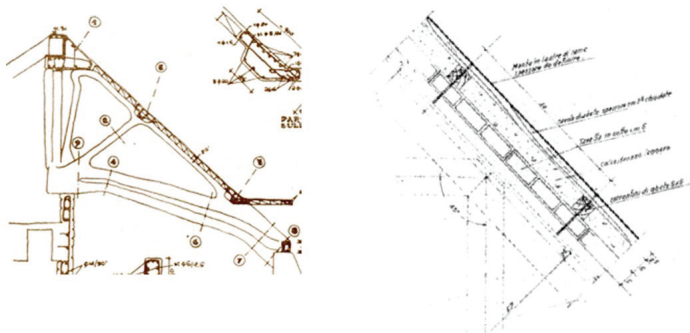


Figure 2. Original technical draw of the roof designed by Giovanni Michelucci architect

¹ Internal reports of surveys by Prof. Ing. Sandro Chiostrini (2007) - Graphic drawings of "*Project of ordinary and extraordinary maintenance works*"; "*Report on the conservation state of building*" by Arch. Capitini (2011).

Discussion and results

Starting from first analysis of the original project, it was possible to hypothesize the structure of the roof "Nations Gallery" covering: flooring blocks and concrete for the principal structure, reinforced by rafters cast in place along the roof slope; the whole laid on reinforced concrete bearing beams. This principal structure would have been completed with a non-reinforced concrete slab with insulation material added, where are fixed the wooden cross beams and floor, useful to support the copper finish. This particular covering was implemented coupled with the double-seaming technique. In parallel a direct analysis was developed through two different test. From the comparison between the direct survey and the original project it was emerged, as was usually in the Church construction period, that the technological solutions adopted, were defined entrusting their execution to the experience of the workers who directly performed them in the construction site. Indeed we find several incongruence from the survey to the original design, especially in the thicknesses of single layers and in the composition of insulating material. Following the damage caused by the storm, the owner realized a temporary covering with a layer of waterproofing sheath, with the aim to reduce the future damage and protect the roof underlay: this type of recover, not programmed, has pointed out some critical deterioration of several roof substrate, making necessary a long-term forecast of maintenance.

So In this context we have defined the real composition of Nation Gallery roof as follow (from inside to outside):

- finishing layer plaster in cement mortar (1cm)
- roof structure (as described above) (18 cm)
- concrete slab non reinforced (2 cm)

On this structure we identified:

- wooden cross beams (in fir wood probably) 5x6 cm, distancing 50 cm from each other.
- Insulation expanded polystyrene panels (4 cm) integrate in the wood cross beams (distance 50cm).
- lightened screed (with vermiculite / pumice) about 2/3 cm in bad conservation: in several area appear crumbled or lacking;

- bituminous covering about 3/5 mm. The state of the membrane in some areas is broke and does not guarantee the perfect water tightness of the underlying layers.

Following this phase, it was therefore possible to develop a simulation through a thermo-hygrometric analysis of the roof, carried out by a software tool (TERMUS-G by Acca); in detail has been developed an investigation on three different case study: the first on the roof system current layers, realized after the urgent recover intervention; the second on the building roof layers still present in the undamaged covering portion; the third on proposed layer, designed to improve building thermal and environmental performance. The last one proposed layer, was designed out aiming at the achievement of the regulatory limits of national rules in terms of energy performance, even if these target are not concerning historical buildings as the San Giovanni Battista Church.

The main objective has been to verify a possible building performance improvement, inside the constraint aspects, since on this building we have two rules level: the first direct, imposed by urban regulation and second indirect, required by landscape protection; both limits the change of the roof external linguistic aspect and its layers composition. This limits constricted the research group to propose a simple intervention aimed exclusively to improve the materials characteristics used, through integration of new material with high energy and environmental performance.

Following this approach the improvement proposed project has foreseen the replacement of the existing polystyrene panels, with an insulating PET panel, produced by the plastic bottles recycling chain, together with the wooden cross beams replacement. Below the three results are showed.

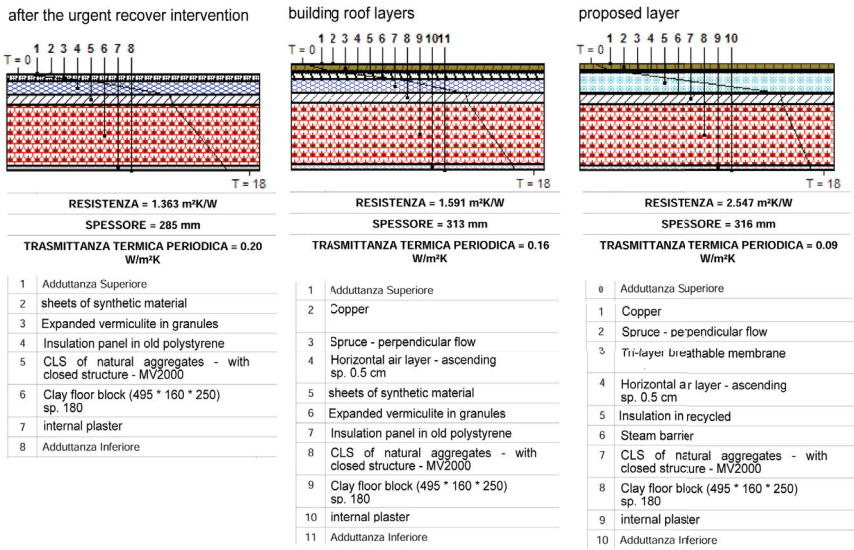


Figure 3. *Simulation results of the three case studies*

Conclusion

In conclusion it's possible overtake the limitations derived by the constraints, through the improvement of qualitative of materials with similar performance: in this case, with replacement the existing insulation material in EPS with a better one, the transmittance value progress from 0,628 W/mq K to 0,393 W/mq K. Though this performance is not comparable with Italian normative limits, defined only for new buildings (ref. 0,28 W/mq K for Florence zone), this type of approach can be used to restore the cultural heritage since the use of congruent materials (new too) in the retrofit bring two important benefit. The first in term of maintenance and management: new material usually, have a long life cycle, so it's possible reduce the number of interventions and improve the time-life building. The second one is related to improving the comfort indoor reducing maintenance cost, in relation to energy consumption. It's important underline that this approach carry out by the restricted research group, has been added in the San Giovanni Battista Church conservation program: one of the results expected by wider research conducted by DM_SHS Lab. In fact the research programme foreseen an user and technical manual in order to simplify and uniform the retrofit activity on this historical value building avoiding useless interventions.

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