

## ENVIRONMENTAL SUSTAINABILITY ASSESSMENT METHODOLOGY PROPOSAL FOR HERITAGE BUILDINGS' RESTORATION

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### ABSTRACT

'Sustainable construction is seen as a way for the building industry to respond towards achieving sustainable development on the various environmental, socio-economic and cultural facets'. <sup>[1]</sup> The herein presented study sets heritage buildings and their restoration activities as a focal interest in achieving sustainability through construction sector.

Restoration projects primarily aim for the conservation of the heritage buildings and preferably for the restoration of these buildings for a specific use. Thus, the best scenario for a heritage building's participation in sustainability is its physical continuity with an actively participating role in the life of its context where it responds to all: environmental economic, social and cultural, credentials of sustainability.

As the interest of the study, the environmental sustainability of heritage buildings can be achieved through continuity of the building with its apparent heritage values and alteration of its life time performance. Accordingly, the assessment of the environmental sustainability of heritage buildings shall base on understanding how and with what environmental impacts the laterally mentioned criteria are achieved.

It is the aim of this paper to present a specifically developed methodology to assess the environmental sustainability performance of heritage buildings' restoration projects in correlation with other assets of sustainability.

Methodology is set as a structure that classifies, integrates and quantifies different groups of numeric and written information to assess the environmental sustainability of heritage buildings', specific to, adaptive reuse projects. It is developed as a comprehensive scheme that utilizes LCA as a backbone for delivering environmental sustainability performance values.

## 1. INTRODUCTION

The built environment and intrinsically building industry is one of the vital medias for achieving sustainable development. In reference to the values presented at the Habitat II Agenda, United Nations conference in 1996 in Istanbul, that construction sector is the leading industrial sector within EU that contributes to GNP by 11%<sup>[1]</sup> covers around 25% of the EU employment and is responsible for 7% of global CO<sub>2</sub> emissions<sup>[2]</sup>. Having this burden, construction sector focuses uniquely and/or comprehensively on environmental, economical and socio-cultural sustainability over construction related actors.

The interest area of the studies can be grouped as for sustainable constructions and sustainable use of buildings. For sustainable constructions, it meticulously studies the system and each component, namely base materials, production of construction materials, design, construction, use, maintenance and further recycling of constructions while for sustainable buildings it concentrates more on the achievement of sustainability credentials along the use of the built space.

Up to recent times, sustainability studies have been mostly conducted on new building practices with relatively less interest on already built ones. Heritage buildings have been out for sustainable construction studies primarily due to disregard of construction market as the new design related market was more appealing. Secondly, the heritage buildings have already been attributed sustainable by being built with local materials, labor, and technique and designed corresponding to the necessities of its climatic conditions and demands of its context. Concisely, heritage buildings have got on the agenda of sustainability studies of construction market through its triggering role in economical and socio-cultural sustainability, albeit the primary interest on achieving environmental sustainability. The emergence was first initiated through United Nations policy framework in 1996, as quoted, *'conservation, rehabilitation and cultural sensitive adaptive reuse of urban, rural and architectural heritage are also in accordance with the sustainable use of natural and human-made resources to protect the global environment'*

In reference to the interest areas of construction sector and the potentials of heritage buildings, the sustainability discussions shall concentrate on continuity of the building with its apparent heritage values and alteration of its life time (physical) performance through an environmental friendly approach. Accordingly, the assessment of the sustainability of the heritage buildings shall base on understanding how and with what environmental impacts the laterally mentioned criteria are achieved.

Apparently, heritage buildings are listed buildings of a kind; as monumental or secular heritage and yet, their related practices vary widely from preventive maintenance to adaptive reuse restoration or reconstruction. Specification of a restoration project depends on the status of the building as well as on the extent and timing of the interventions to be practiced. Regarded the apparent wide range of practices, as also, Alonso, V. I. and V. M. Meurs state, "specific methodologies need to be developed locally, that may only work for certain types of interventions or certain types of restoration projects"<sup>[3]</sup>. Henceforth, it is the intend of this paper to introduce the methodology developed to assess the environmental sustainability of heritage buildings', specific to, adaptive reuse projects through steel intensive interventions.

Adaptive reuse of heritage buildings is focused due to its globally acknowledged attentive role to answer the spatial, functional, social and economic demands of contemporary time and sustainable development besides its input on environmental sustainability. Additionally, steel intensive projects are favoured regarded the common adoption of the material in adaptive reuse of heritage buildings in reference to its sustainable profile that also matches fairly with the demands of restoration methodology.

## 2. HERITAGE BUILDINGS' SUSTAINABILITY ASSESSMENT

Sustainability assessment of buildings has an extensive coverage of studies which has enhanced the fundamental environmental impact evaluations or profiling to integrated studies where through a comprehensive approach each credential of sustainability is considered as a complementary input for any classified sustainability study. In parallel, the subject of the assessments increased from production and erection stages of building components to cover the use, renovation and management processes of buildings.

As for the interest of this study, environmental sustainability studies that initiated to bring out solutions for reduction of the environmental impact of the construction activities, today, also concentrates on environmental performance, building performance, economic performance and social concern of buildings.

Consequently, the commonly adopted instrument to assess sustainability, LCA got altered to comprehensive assessment methodologies, enabling diversity in assessment approaches. These, basically, appear as LCA based and LCA inclusive comprehensive assessments.

Concisely, LCA based assessments take the building as a product with an expiry date and so several ends like demolition, recycling and reuse of the building and its components are described to run the environmental

impact assessment of the building. Following, LCA inclusive comprehensive assessment scores and ranks a building, regarded its performance in management, sustainable sites, indoor environmental quality, quality of service, outdoor environment, energy, materials, resources & material, off-site environment, transport, water, land use & ecology, emissions/pollution, innovation, health & well-being like categories that correspond to social and economic sustainability through environmental sustainability point of view.<sup>[4]</sup>

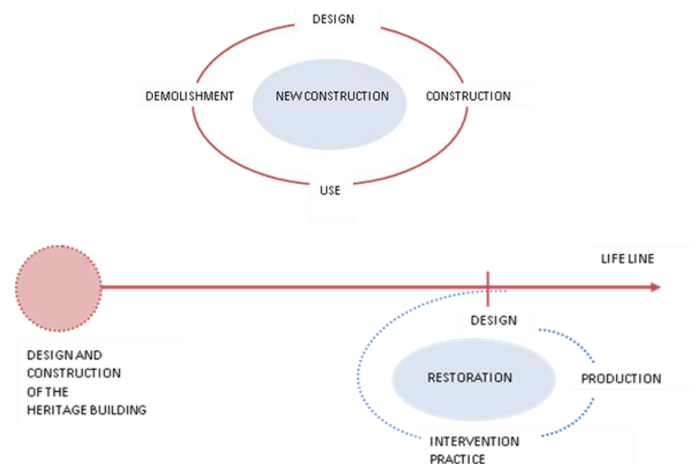
Today, despite the fact that no globally acknowledged heritage building oriented assessment tool exist, several methodological studies are being brought up that base on previously described LCA approaches. Regarded the scoped studies that date dominantly 2011 and onward, the approaches on sustainability assessment of heritage buildings build on both LCA based and LCA inclusive comprehensive methodologies. The Australian Practice presented by U. Iyer-Raniga and J.P.C. Wong originates for evaluating energy efficiency of heritage buildings. It references to LCA based methodology to assesses retrofitting for energy efficiency.<sup>[5]</sup>

Dirlich presents the German practice where he describes how and with what criterion to integrate a category of assessment for heritage building oriented practices into the comprehensive scheme, DGNB.<sup>[6]</sup> In parallel, Triple Bottom Line approach developed by John Elkington is being adapted to assess heritage building oriented projects in a more comprehensive point of view, more specific to UK.<sup>[7]</sup>

Furthermore, assessment of the sustainability of heritage buildings is also being discussed along the assessment of adaptive reuse potentials and/or practices. Conejaos, Langston and Smith bring out a model to assess the adaptive reuse potential of buildings to encourage sustainability through heritage buildings. The assessment bases on seven groups of criterion, as named, physical, economic, functional, technological, social, legal and political to rate the appropriateness of the adaptive reuse of the building to deliver a sustainable design decision.<sup>[8]</sup> More concentrated on assessment of adaptive reuse of heritage buildings, Elsodary presents in detail how to determine and assess the criterion over Alexandria Museum practice.<sup>[9]</sup>

Having reviewed all, it has become clear that there has not been a shared study addressing a heritage building related project to assess its sustainability in a level corresponding to its counterpart, new building activities. Yet, nor a version of an existing assessment scheme or a tool like LEED nor SBtool exist. Within the framework of the study, the following remarks are noted to be considered in structuring the methodology and the scheme:

1. Regarded the assessment of adaptive reuse potentials and practices of a heritage building
  - the input of the heritage value of the building
  - prerequisites of the legislation that depends on the principles of the conservation and restoration of heritage buildings
  - the authenticity of the architectural and constructional characteristics
  - the condition of the building at the time of the project
2. Regarded the LCA oriented environmental sustainability assessments
  - LCA assesses through the 'cradle to grave' or 'cradle to cradle' approach. 'Heritage buildings of the age of the skilled craftsman, were traditionally designed, constructed and maintained on the assumption that their service lives could be extended practically without limit by suitable maintenance measures'<sup>[10]</sup>. Henceforth, heritage buildings are to be long-lived products that have life expectancies many times longer than those of their maintenance repairs, interventions and their users. How would a building conceived to have an endless life line be assessed with an end scenario oriented, cyclic methodology?



**Figure 1** Life cycle approach for new constructions and life line for heritage buildings

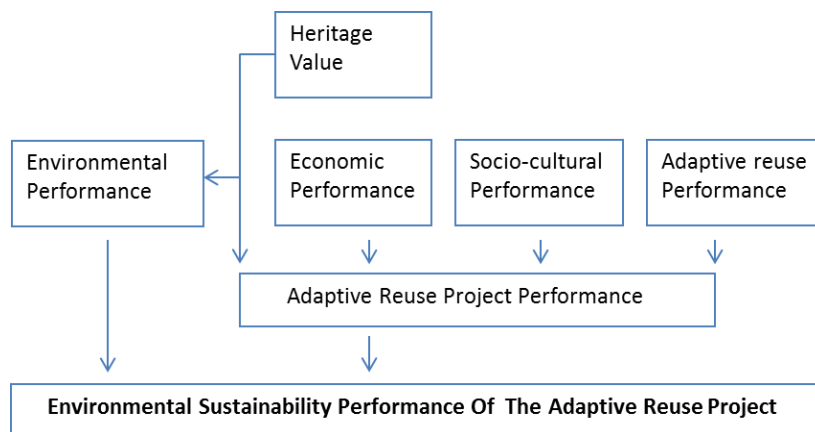
- valuations regard mainly the embodied energy and relevant issues of the initial construction to develop evaluations on environmental impacts but for heritage buildings this information is mostly impossible to possess.
- in a LCA inclusive comprehensive assessment study, a construction activity is assessed through new criterion of modern times; how would heritage values and economic valuation of the heritage building be achieved and/or got integrated to the prevailing methodologies?

### 3. ASSESSMENT METHODOLOGY PROPOSAL

The above sections have aimed to describe the initially underestimated but increasing role of heritage buildings in achieving sustainability, the agenda of the assessment methodologies that relate heritage buildings and sustainability and finally, the outcomes are revised. In reference to all, the methodology is developed specifically to define and score the environmental sustainability performance of adaptive reuse restoration of heritage buildings which also enables a more thoroughly understanding and assessment on the role of steel.

The methodology is created in a comprehensive approach that adopts LCA as a backbone for environmental assessment. The scheme, categories and criterion are noticed to comply with the fundamentals of ISO and CEN descriptions on sustainability assessment whilst following the principles and terminology of globally acknowledged charters on restoration. Namely, Burra and Venice Charter together with ICCROM reports are highly referenced for the determination of the criterion that relate to heritage and adaptive reuse restoration.

Basically, the methodology is set to assess environmental sustainability through the input of economical, socio-cultural and intrinsically the heritage value and adaptive reuse performances. (Fig.2) Apparently, the described model necessitates both, new entries to the content of prevailing methodologies and reinterpretation of existing descriptions to be heritage building oriented. Besides, it has to be noted that the scheme is structured to have a ‘phase by phase method’ in parallel to the project, to be referred as a guideline by all beneficiaries and to deliver an assessment on the appropriateness of the project, independent of environmental sustainability concern.



**Figure 2** Structure of the comprehensive assessment scheme

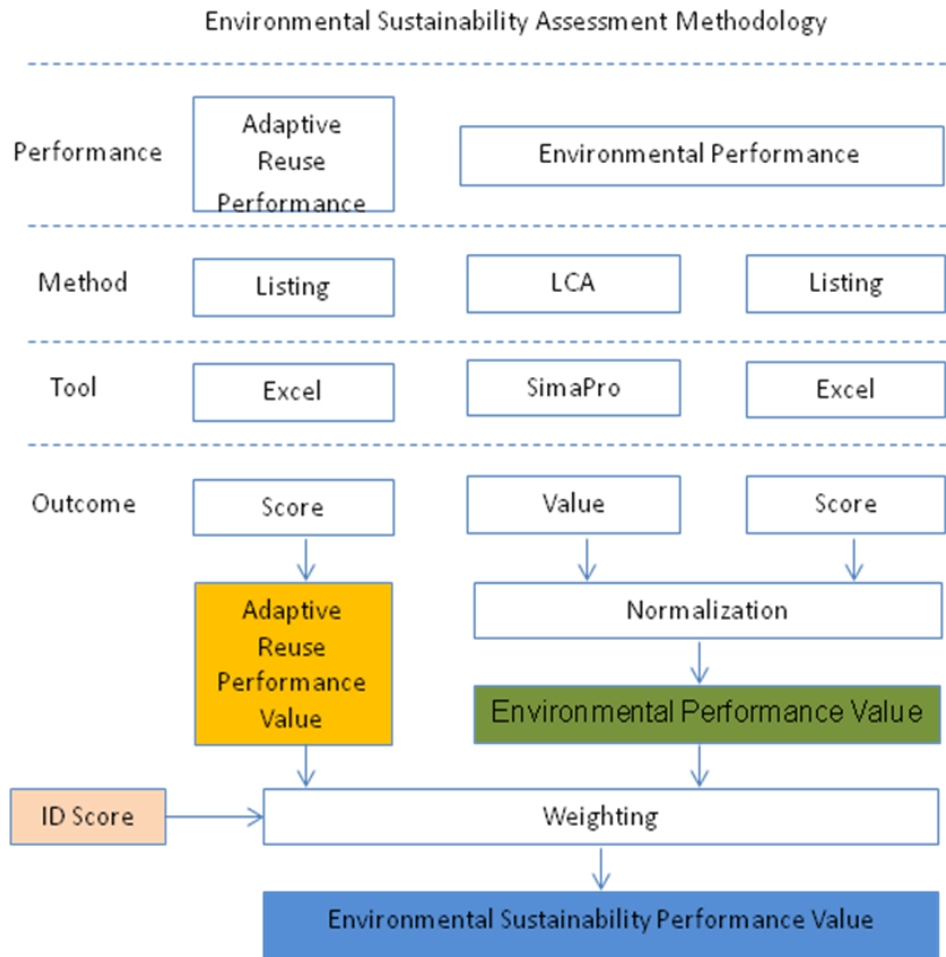
To start with, heritage value refers to define and assess the cultural significance, building integrity and authenticity status of the heritage building at the moment of the project. As shall be followed in Figure 2, this is the pioneer and influential part of the assessment which later on affects environmental and adaptive reuse project performances.

Environmental performance is where the environmental imprint of the project is depicted. The assessment subjects each intervention to add up a score, unlike other performances that evaluate the whole project. The interventions are subjected to three different environmental profiling. Their LCA study on ecological impact and energy consumption profiling add up with their environmental profiling which is assessed through a listing of criteria. Following, adaptive reuse performance is basically to define the appropriateness level of the new function and its related interventions for the heritage building and its context. The change status of the heritage building is evaluated through the architectural design, structural characteristics, and comfort condition descriptions to define the performance value.

Economic and socio-cultural performances are the two fundamental credentials of sustainability which are also adopted in this assessment with a reinterpreted scope. Economic performance describes the role and validates the positive impact of the project on economy related concerns. Unlikely to life cycle cost studies, space, activity and jobs related return are considered as criterion to define the economic performance of the

project. Similarly, socio-cultural performance concentrates on the social role and cultural influence of the project. It evaluates the project through its effect on quality of life, social capital, tourism and safety.

As shall be perceived, the methodology necessitates various but known media for assessing different groups of numeric (quantitative) and written (qualitative) information and configure a new systematic for their integration to deliver an environmental sustainability performance score/value. The following figure 3 outlines the methodology and the tools of the assessment. It has to be noted that non-existing environmental and socio-cultural performances share the same content that adaptive reuse performance column represents. Additionally, ID Score refers to heritage value.



**Figure 3** Environmental sustainability assessment methodology

#### 4. CONCLUSIVE REMARKS

To this end, a methodology proposal with its performance categories and assessment structure is being described. Behind the herein presented study, the criterion, indicators and their threshold values are also being studied. This information together with the derived numerical values of the assessment will be shared in following environments. As stated before, the study presented in this paper aims to bring out a proposal to exercise bridging the gap in assessment methodologies of construction sector that directly and uniquely addresses to heritage buildings and their related construction activities.

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