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TOTAL BUILDING PERFORMANCE AND ACTIVE HOUSE CONCEPT

BY

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Abstract. The building analysis domain arouse as one of the most fast-pacing development area of interest nowadays. This paper presents the common points for two new way of studies related to building domain, nominated as Total Building Performance- TBP- and Active House Concept. This two concepts are first sharing the subject of analysis: buildings, and continues with methods, interest points, quality criteria, modes of work and, eventually, the final scopes. Although the time of developing for this two concepts differ for three decades-spanned from the eighties until last five years, they are representing different ways of focusing interest on further building quality development. Ecological approach seams to become as stronger as time goes by, to increase in importance especially in last 10 years and it was revealed long time ago and is reevaluated in present. The holistic approach in building analysis develops new work areas as new trends seams to become important for buildings. We are trying to reveal that this two field of work are sharing more that it seams on a first sight and to identify future common ways of integrating the two concepts.

Key words: users requirements; space comfort; environment; performance assessment.

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1. Introduction

Building domain is one of the most important for humanity, a place to sustain the most primordial human need: protection against the weather violent variations. This demands are developing since the first construction erected to improve interior/exterior space for users need as these needs knows an accelerated pace augmentation. The users level of satisfaction assessment became as well one of the most important domain connected with the major building one, very dynamic and enriching itself with new directions.

Total Building Performance (TBP) deals with estimation of performance levels from the occupants point of interest. Both domains of building analysis are focused on creating healthier and more comfortable lives for users and Active House concept enriches the definition with the adding aim to avoid negative impact on the climate. Environmental concerns are more detailed in Active House concept, although TBP stretches its objective through life- cycle and become more similar to environmental goals.

2. Total Building Performance – Important Moments and Definitions

TBP concept (as stipulated in SUA during middle eighties) is a complex evaluation system for global building quality. The process goes through estimating of users satisfaction for essential quality demands towards a diagnose that should be used to improve buildings quality and to draw new levels of performance for further building design.

In order to improve the complex and the objective process of users level of satisfaction assessment for each quality need are to be used a mix between subjective methods- statistic analysis for users demands- and objective ones- simulations, mathematical calculus, PC aided programs. The final scopes of this concept is to constantly improve interior environment, a major defining characteristic for building system.

2.1. Historical Considerations

TBP appears in the last decades of the XX-th century and was defined as it is in USA. For the first time it was defined the need for creating tools for building performance assessment using all performance requirements: interior air quality, thermal comfort, acoustical and visual comfort, energy and spatiality performance and structural integrity. This scientific directives influenced many studies with diverse application modes (Hartkopf *et* al.,1986).

In Singapore the Total Building Performance Center works with local Building and Construction Authority (BCA) and the National University of

Singapore for better results in this domain of urban development. The declared aim is to develop complex methods based on systematic studies and to apply the Total Building Performance concept identifying users requirements and performance criteria and integrating them in general building system (Po Seng Kian, 2001).

International trend is to better understand and exact evaluation of building's total performance. Coordinated programs exists in many countries or communities- for example Sweden, USA, Japan, European Community- and have declared scopes to evaluate the performance influence factors for buildings and interconnect them with local natural or urban environment.

Legal concerns about this trend are developed as presented below:

a) P-Mark-Sweden-Anneling, 1998;

b) Housing Quality Assurance Law- HQAL- Japan, 2000;

c) ETAG 007 – European Technical Approval Guideline for Timber-frame Building Kits- European Community, EOTA – 2001;

d) LEED^{TM} -USA- US Green Building Council, 2003;

e) R- 2000 Program- Canada- NRCan, 2005;

f) Novoclimat-Quebec, Canada, Quebec Agency for Energy Efficiency, 2005.

International programs developed for performance requirements assessment in buildings are, on the Atlantic sides, LEED for USA and Canada and CEPHEUS- Cost Efficient Passive Houses as EUropean Standards. Inside European Community we can find BREEAM (United Kingdom), HQE- Haute Qualité Environnement (France), DGNB- Deutsche Gesellschaft für Bauen Nachhaltiges (Germany), MINERGIE (Switzerland), Protocolo Ithaca (Italy), Lider A (Portugal), Verde (Spain), and others.

2.2. Performance Criteria – Defined for TBP

In a simple direct way *performance* could be defined as a *product behaviour during it's use*. Traditional aspect of performance is linked to noise control, fire-safety, thermal efficiency, interior air quality, space safety, and so on. To estimate how well a building will behave on holistic terms and on long term the Total Building Performance seams to become more important.

This goal can be realised by applying the right building solutions even from design stage a correct using of the construction throughout life cycling by assuring optimal condition for interior comfort, by cutting-off pollutants and continuously monitoring indoor air quality, monitoring the structural elements behaviour and this impact on interior and exterior space quality.

Buildings are, in an incipient level of definition, systems that creates protected environment controlling temperature, humidity, light and ventilation needed to sustain human life and productivity. Multiple ways of

understanding the possible ways of interpretation are developed inside the more important idea of estimating building's success. The field spread out from the basic and cynical financial ones until functional and esthetical criteria.

The act of assessing inside the more general process of performance measure and comparing with estimated performance criteria leads to conclusion about the level of performance a building has achieved. Recommendations, aside with their estimations, are to be used as future directions for similar building performances (Fig. 1).

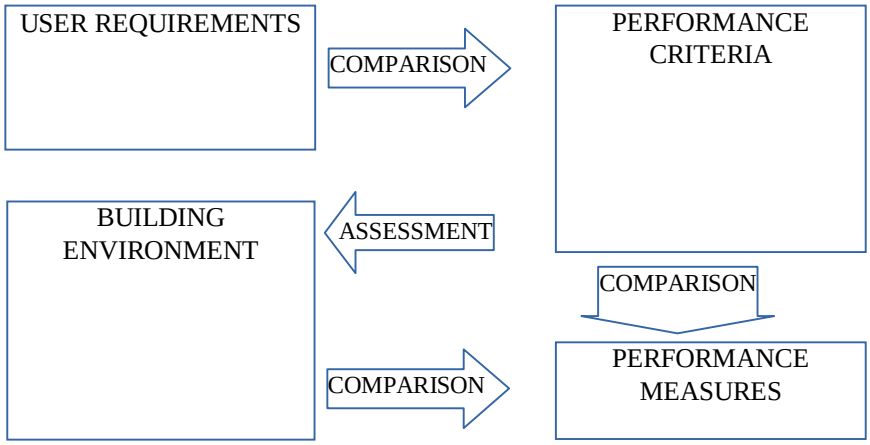

Fig. 1 – Performance concept in buildings.

Objective goals in building performance evaluation is directly influenced by the level of precision in users satisfaction level assessment. This process can be realised on many different ways with minor differences among them, as proved by tradition. Building systems are exponentially developing as well as users requirements, together with technological and social evolution, proving that coordinating this system becomes complex on a daily base.

The defined criteria are:

a) Spatial Comfort (SC);
b) Indoor Air Quality (IAQ);
c) Visual Comfort (VC);
d) Thermal Comfort (TC);
e) Acoustical Comfort (AC);
f) Structural Integrity (SI).

The last process is to integrate user requirements levels of satisfaction in different modes into TBP using mathematical formulas, quality function deployment (QFD), or adding satisfaction levels multiplied by weight factors

determined by specialists. The final score can be presented as percentage from the maximum level expected from an idealistic situation for need obtained from users. This can be helpful to compare two buildings, to improve future design process and to identify objectives to be increased for the same building types. The analysis is to be done in a holistic mode, integrating any domain involved alongside the connection between them.

3. Active House Importance for Building Assessment

Building impact on near environment deals with important issues concerning improving air quality, reducing acid rain incident, slowing climate changes, reducing water consumption and energy impact on surroundings. As from reducing energy consumption point of view the sustainability can be defined as "a vision of buildings that create healthier and more comfortable lives for their residents without impacting negatively on the climate and environment". This direction began in political trend on reducing the emission of CO_2 and security of supply. One of the first movement sustaining this concept was toward the need of building Near Zero - Energy Buildings in European Union by the end of 2020 - 2018 for public buildings.

The Active House strongly believe in decreasing the amount of building process waste as long as global resources are limited. We have to get over the Life Cycling Assessment (LCA) and to put some weight on holistic modes of analysing buildings with their Comfort, Energy and Environment levels.

As TBP realised and presented above this position demands to start the specific analyses from the design stage, as it is the easier mode of influencing the final product, rather than further trying to improve an already realised building.

The most important goal of Active House concept is to "create healthier and more comfortable lives for their occupants without negative impact on the climate" (Kurt, 2013) as Kurt Emil Eriksen, the General Secretary of Active House Alliance stipulated last year in HVAC Journal. The graphic presentation, already well-known, presents the interconnection of this three areas of importance (Fig. 2).

The three components have different meanings, with important connections to TBP concepts. First of all, comfort area shares the most with TBP directives, creating a healthier and comfortable interior environment for users exists among TBP criteria, in terms of fresh air – IAQ and daylight – VC. In this area can be fitted spatial and acoustical comfort – SC and AC.

The second domain deals with Energy, meaning to energy balance of the entire building. The Active House concept assumes that the energy

consumed is obtained from renewable energy sources. TBP equivalent criteria are thermal comfort (TC).

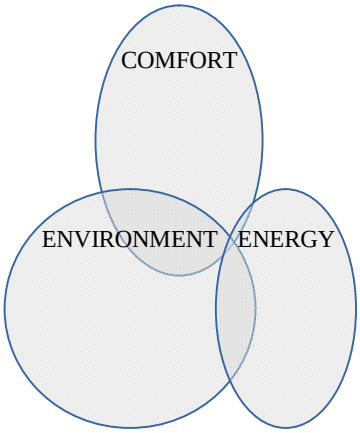

Fig. 2. The graphic relation of sustainability components.

The only domain that appear to be different is connected with environment, meaning that the building has to realise a positive impact on the surrounding. The most important TBP criterion connected with environment is thermal comfort- TC- and the mode to obtain it. The optimised connection with the local context enriches the definition so it could mean the natural environment and urban fabric. Because it is related with the building impact throughout life cycle the structural integrity criterion can be taken into consideration.

The three general areas of interest are splitting like this:

1. Comfort: -1.1 Daylight;
   -1.2 Thermal environment;
   -1.3 Indoor air quality;
2. Energy: -2.1 Energy demand;
   -2.2 Energy supply;
   -2.3 Primary energy performance;
3. Environment: -3.1 Environment load;
   -3.2 Freshwater consumption;
   -3.3 Sustainable construction.

The graphic connection of balance between active house principles is named the Active House Radar and present the levels achieved by each active criteria on a scale from 1- the highest- to 4- the lowest as shown in Fig. 3.

The performance criteria defined for each parameters are shared with TBP ones and the fact of been balanced with others is a common approach.

As presented above the main analysis quantitative criteria are: daylight factor and direct sunlight availability for *optimal daylight*, maximum and minimum operative temperature for *thermal environment*, standard fresh air supply for *indoor air quality*, annual energy demand for *energy demand*, origin of energy supply and annual primary energy performance for the same principles, primary energy consumption, GWP (Global warming potential), ODP (Ozone depletion potential), POCP (Photochemical ozone creation potential), AP (Acidification potential) and EP (Eutrophication potential) during entire life cycle for *environmental loads*, minimisation of freshwater consumption during building's use, recyclable content and responsible sourcing for *sustainable construction*.

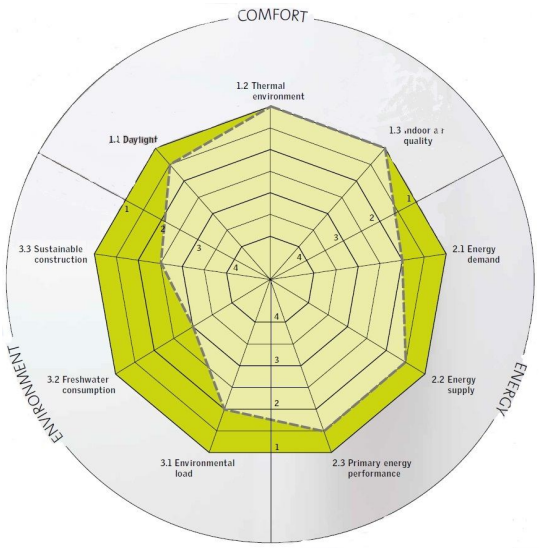

Fig. 3 – Example of active house radar.

Alongside another set of qualitative parameters the process of building assessment modifies only the weight of the TBP defined parameters and creates the final graphic score of interrelated criteria in a more intelligible way. The main objectives of analyse, estimation, correction through interior relations, intention of hierarchize different buildings and focus on occupants comfort with concern in reducing consumption are common for Total Building Performance and Active House concept.

4. Conclusions

The two building assessment concepts presented above have a lot of common points in their defining aspects. The primary concern to improve

further design objectives reveals to be the same for both of them, with levels of importance criteria oriented on users needs evolution and issues specific with different times. Total Building Performance has been evolving for more than a decade while the newer Active House concept is in its first decade.

Assessing a human product is a very old goal- building domain integrated itself in this direction. As the products are so complex, the system became also a very hard to be deployed, too. Goals are uninterrupted in their expansion and calibrating the tools to evaluate the product seams reasonable. Active House concepts integrated a more accentuated environment concerns, putting some emphasis on preserving the nature and reducing the human habitat pressure on it. In fact, the two concepts presented are to be evaluated together and from this perspective they have to be improving each other.

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PERFORMANȚA TOTALĂ ÎN CONSTRUCȚII ŞI CONCEPTUL CASEI ACTIVE

(Rezumat)

Domeniul analizei construcțiilor se dovedeşte ca unul cu o dezvoltare accentuată în perioada actuală. Lucrarea de față prezintă punctele comune pentru doua moduri de abordare a studiului şi denumite drept Performanța Totală în Construcții (TBP) şi conceptul Casei Active. Ca prim domeniu comun se dovedeşte subiectul analizei, construcțiile, şi continuă cu metodele, punctele de interes, criteriile calitative, modul de lucru şi scopul final, desigur. Deşi perioadele de apariție a celor două concepte sunt separate de trei decenii, între anii 80 şi ultimii 5 ani, ele reprezintă moduri diferite de concentrare a interesului pe îmbunătățirea calității mediului construit.

Preocupările ecologice par să devină importante pe zi ce trece, să sporească în greutate în ultimii 10 ani şi de fapt este o preocupare veche dar care creşte în importanță spre perioada actuală. Tendințele holistice de analiză înglobează de fapt noile domenii ce apar şi în domeniul construcțiilor conform noilor tendințe. Încercăm să prezentăm faptul că cele două domenii nu sunt aşa de diferite cum par şi să identificăm noi direcții comune de lucru.