Integration of sustainability issues into the design process of temporary event infrastructures

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

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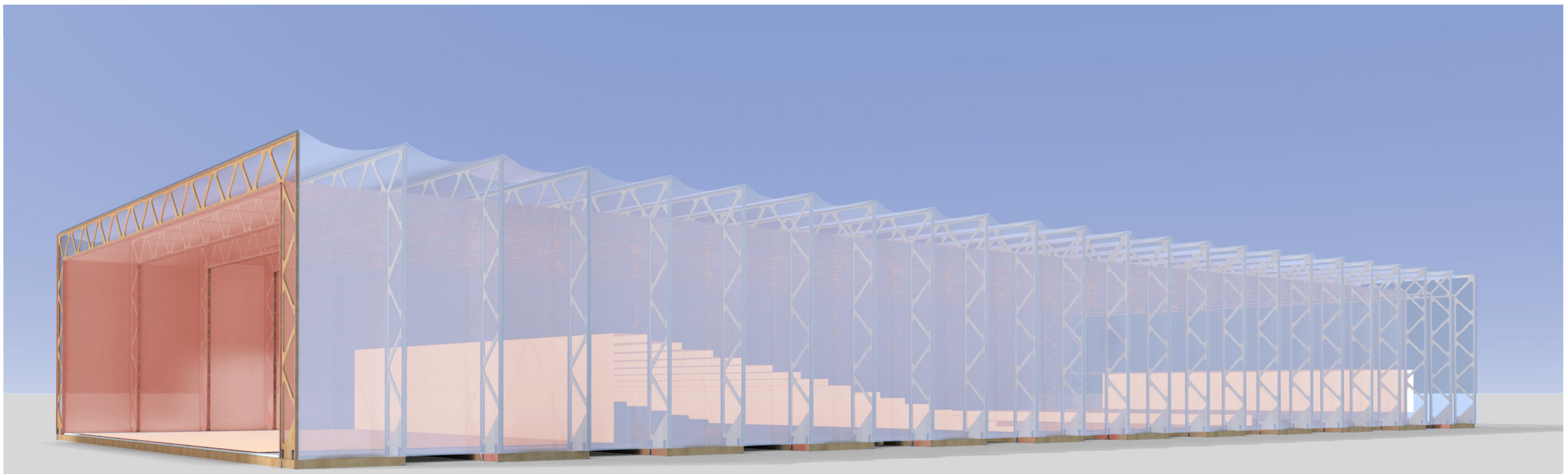
Author: Loïc Fumeaux[1]
PhD Advisor: Prof. Emmanuel Rey[1]

[1] Laboratory of Architecture and Sustainable Technologies (LAST)



1-PROBLEM

In consideration of the especially significant number of cultural manifestations (festivals, shows, exhibitions), commercial (trade fairs, fairs, exchanges), sportive or political festivals, where the assembly of temporary infrastructures is necessary, a tangible need regarding the material is manifested and induces an impression of the real growth in the event branch.

In terms of the entirety of the European countries, the average of the population attending a "live" performance in 2006 was around a little bit more than 40 % of the population [1]. These different figures accentuate the high potential of developments in this branch and consequently the essentially increasing demand for temporary event infrastructures.

When the model offers advantages of fast assembly and certain flexibility, it has some significant disadvantages at the same time, especially regarding comfort and sustainability. Following the lead of other constructive systems, it seems to be relevant consequently, to research new ways to integrate sustainability criteria into the design process of event infrastructure.

2-STATE OF THE ART

In order to comprehend more precisely the advantages and the disadvantages of the usual practice of event infrastructure, a case study has been conducted on a representative model, focusing on the most significant limits of the common practice considering criteria of sustainability.

Thermal comfort
In term of heating and aeration the efficiency is very bad, due to the light construction energy is very quickly dispersed.

Acoustic comfort
The acoustic comfort is also influenced by the light construction, the more acoustic quality you have inside the more emissions sound to the neighborhood.

Architectural quality and sustainability
The first aim is to comply with the functional requirements without caring for architecture. Even such an infrastructure is temporary, it represents a spatial impact that is important for the site and this aspect must be handled carefully.

Fig.1 - Cross section of the analysed tent with position of the data loggers.

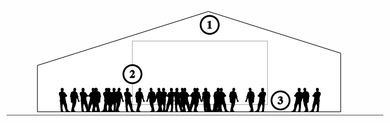


Fig.2 - Measuring of the temperatures during the period of utilization (March – April 2011).

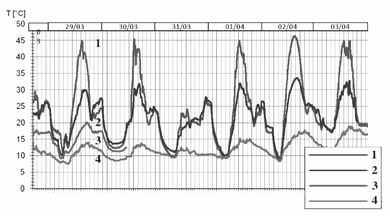


Fig.3 - Basic drawing of the principle of overheating at daytime and at night determined during the phase of analysis. This situation results from the difficulty to react on two main factors that influence the climate inside (direct solar radiation, internal heat gain)

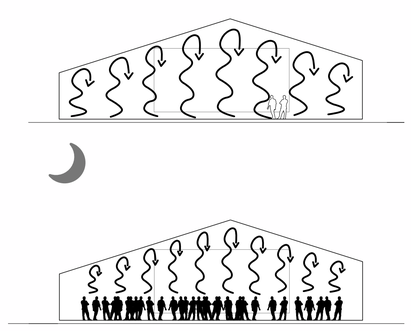
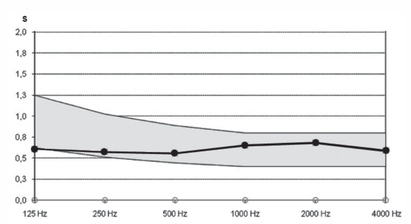


Fig.4 - Measurement of the time of reverberation during a concert on the occasion of the Cully Jazz Festival (2011) – it is possible to stay within the optimum area for jazz but with one time measuring around the limits for the bass frequencies, as a consequence of the light construction of the model.



1. EUROSTAT, (2011). Cultural statistics (2011). Bruxelles : Pocketbooks.

3-GOALS & METHODOLOGY

From this point of view, the objective of the PhD thesis is to develop new ways of construction and design in order to reach high performances in several environnemental, sociocultural and economic dimensions for such infrastructure.

After a preliminary phase of diagnostic, targeted objectives are formulated for the process of development and a first design sketch is made. This preliminary design model is the first step and constitutes a working basis for a process of integrated design which implies in a repetitive way the interdisciplinary competences (civil engineers, specialist for thermal and acoustic, carpenters, specialists for photo-voltaic technology and operators). Such workflows can be characterized by iteration loops involving actors in each phase [2]. The design can be upgraded and improved at each loop, in order to progress toward targeted objectives.

The objective of the next stages of the strategy is to arrange a reliable basis in the long run for the realization of a first prototype, verified not only on the architectural, constructive and technical level, but also regarding regulations and economic efficiency.

Fig.5 - After a phase of diagnostic, targeted objectives are formulated for the development and a first design sketch is made. This basis project is the first step of a process for integrated design which will allow the repetitive optimization of the different dimensions of the project.

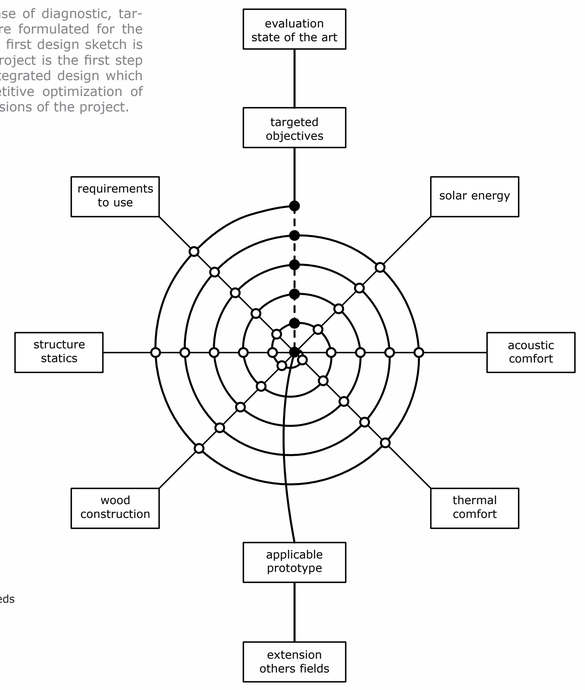
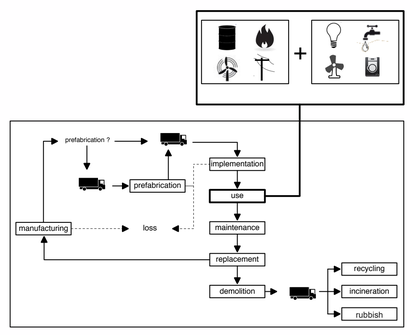


Fig.6 - A comparative analysis of the life cycle (LCA) between the current practice and the new infrastructure will likewise be realized for taking into consideration the energy needed and the impacts on the environment during the process of constructing, using and recycling phases of life.



2. Appleby P., (2011). Integrated Sustainable Design of Buildings. London : Earthscan, p. 185-203.

4-PRELIMINARY STUDY

Regarding the analysis and the significant points mentioned, the following targeted objectives are formulated.

Flexibility and efficient exploitation
The first objective of the project is being able to offer adequate advantages for the classic tent, especially regarding the aspects of flexibility.

Optimization of comfort
The objective is to keep the inner climate in a comfortable zone [3]. In this sense, the project must offer a certain mass in order to minimize the variations in temperature and to control the acoustic aspects.

Optimal use of resources
To increase the sustainability, the model will include architectural bioclimatic principles, especially regarding the thermal insulation, natural ventilation and passive refection, in order to reduce energetic demand (warmth and cold) and the prior valorization of resources that are locally disposable (solar,geothermal) [4].

Fig.7 - Illustration of the modularity of the system, shown constructively. Wooden elements prefabricated in the workshop and assembled on site, compose the structure. An inner casing is fixed consisting of wooden panels to comply with the acoustic requirements and to offer a certain thermal insulation. Finally, a sheer cloth including photovoltaic system on the roof completes the model.

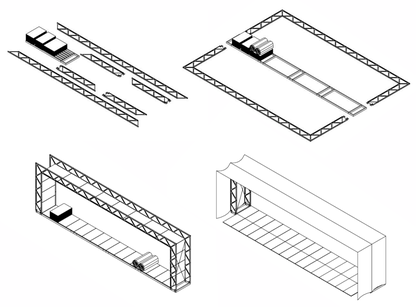


Fig.8 - Scheme of the natural ventilation principle to control the situations of overheating at night and at daytime. The assembly of this double casing allows the reduction of the amplitude of variations in temperature and the optimization of controlling the internal output by allowing at the same time the reduction of further energy input, determined on the occasion of the analysis of the current practice.

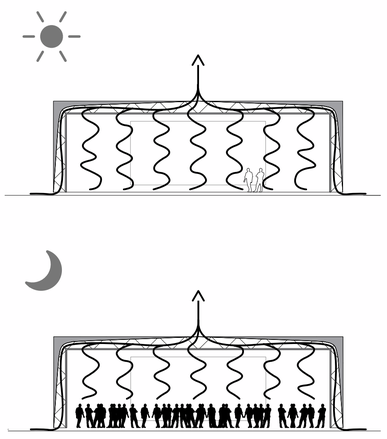
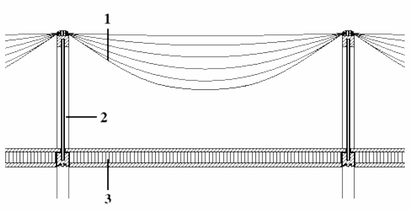


Fig.9 - Cross-section of the projected casing. The project uses the space between the two layers of the casing as a sealed space assisting the bioclimatic control of comfort (1-photovoltaic cloth, 2-wood structure, 3-acoustic panels).



3. Roulet C.-A.(2010). «Le rôle du bâtiment habité» in Santé et qualité de l'environnement intérieur dans les bâtiments. Lausanne : PPUR, p. 3-4.
4. Aiulfi D., Rey E., (2010). «Les technologies vertes, matières premières pour la créativité des architectes». MICRO 10 Conference, Neuchâtel, Aula des Jeunes-Rives, 2nd September 2010.