DESIGN, REPRESENT AND COMMUNICATE A TEMPORARY AND SUSTAINABLE CONSTRUCTIVE SYSTEM. METHODS AND ISSUES BETWEEN TRADITIONAL CONCEPTS AND DIGITAL TOOLS

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Summary

Universities play a key role in training future architects according to the principles of the sustainable development, and this topic is now developed in different ways in various universities. In this paper the working methodology used in an educational experience, to design, represent and communicate a sustainable (low tech) and reversible constructive system is presented with the awareness of the importance of sharing and discussing these experiences. This methodology is summarized in three main phases: preliminary phase, design phase and communication phase. The main objective of the planning experimentation is the design of facilities/tourist welcoming points to be located in four rural areas of the Abruzzo Region (Italy). Besides the design phase, particular attention has been also given at the representation and communication of the constructive systems, also in prevision of the meeting/exhibition that has been held after the conclusion of the academic course.

Keywords: communication, design, representation, reversibility, sustainability.

1 Introduction

In recent years we are witnessing a gradual increase of interest in the philosophical and practical principles of sustainable development, both in the professional and academic field. In this topic, universities play a key role in shaping future architects. In many schools of architecture worldwide, this issue is widely in use in various teaching courses at different levels, workshops, researches and other experiments, as demonstrated by the papers submitted during the 2010 edition of this conference in the section "Education and information" (see as examples [1] and [2]). However, sustainability is a topic that is likely to be handled in a multitude of different ways and therefore has many facets. This feature makes the sharing and discussion of the experiences gained in the universities belonging to different nations particularly interesting from a cultural and operational point of view. With the awareness of the important role that the sustainability of actions, also in a communication form, has acquired in the education sector, in this paper it is presented and proposed the working methodology used in an educational experience to design, represent and communicate a sustainable and reversible constructive system, with a specific attention to the assembling/dismantling phases. The projects have been elaborated together with the students during the course of "Designing of constructive systems" ("G. d'Annunzio" University, Chieti-Pescara, Italy – Prof. A. Sonsini, teaching assistant Arch. D. Di Mascio).

2 General objectives of the course

The general objectives of the course have been the following:

- to introduce the students to the technological matters of the architectural project;
- to supply the students with a methodological basis that, starting from a set of defined needs, allows to determine spaces, materials, technical elements and constructive systems (for the definitions the Italian Normative UNI has been used [3][4][5]).

These objectives have been achieved through theoretical lessons and a practical application. Moreover, at the end of the course, it has been organized a meeting, where the best projects have been awarded. In this paper it is presented the methodology synthesized in three main phases: preliminary phase; design phase and communication phase.

3 Introductory phase

3.1 The themes of the planning experience

Four synergic themes have been chosen for the design experimentation, because they belong to a strategy of integrated development of the territory. The general objective was to design some artifacts in order to allow and improve the tourist fruition of the territory.

The main themes of the project, divided into areas, have been the following:

- Village: San Valentino; Place: the square in front of the Church and the ancient medieval castle;
- Theme: to design a constructive system that could be transformed into a sale point of food farming products made up by 10 locations for the sellers, modeled after the farmer's markets (daily reversibility);
- Village: San Valentino; Place: small square on one side of the main street;
- Theme: to design a constructive system for a telematic info point able to serve contemporaneously 4 users, and to welcome 40 users (seasonal reversibility);
- Village: Roccamorice; Place: green area on the hills, close to the town;
- Theme: to design a constructive system for an intermodal exchange, where the tourist can leave his/her car, get some information and make an excursion by foot, bicycle or do some horse riding in the mountains (seasonal reversibility);
- Village: Sant'Eufemia; Place: green area on the side of the main street;
- Theme: to design a constructive system for a refreshment stand able to host 20 users, with a view on the countryside (seasonal reversibility).

3.2 On-site inspections

Guided on-site inspections to the four project sites have been done to comprehend in a direct way the natural and cultural values, the genius loci of each single area. Four different themes and four sites, with different characteristics, have been chosen to allow students to tackle and reason on different issues.

Fig. 1 *Part of the historical buildings that overlook the square of San Valentino: the church and the castle.*

Fig. 2 *The green area located near the village of Roccamorice.*

3.3 Theoretical lessons

A further objective of this preliminary phase has been to supply students with a theoretical basis on different subjects to allow them to comprehend and reflect on issues to tackle during the design phase, in synthesis: 1) aspects of the constructive system; 2) the building process and the building system; 3) the matter of the environmental sustainability.

4 Design phase

The design phase has been developed in three main steps: a first step of analysis, a second step of design development and a third step of preparation of the final works for the exam. The working groups were composed by a variable number of students, from 2 to 4.

4.1 Preliminary analysis

In this first phase, defined metadesign, it has been carried out a series of analysis of the site (orientation, natural and artificial elements of the context, etc.), activities and spaces. The last step was to develop two ideograms, one without real dimensions, and the other dimensioned, the latter starting from the identification and dimensioning of equipments and space needed for the use of the client/user. In the ideograms the flow of movements and levels of communication are also shown.

4.2 Design development

The project has been developed in the classroom through a participatory manner concluded within a two-day workshop. The content of the dimensioned ideogram has been extended and enriched through the use of various methods and tools: 1) handmade sketches and schemes; 2) schemes, diagrams, drawings, 3d models and rendering created with the computer using various software packages; 3) physical models in wood and paper/corrugated paper.

4.3 Some choices linked to the sustainability and reversibility of the projects

Each project has been elaborated with reference to the principles of ecological and energetic sustainability. The reversibility was achieved using various technical solutions: temporary basis/supports (linear shaped concrete elements, of about 80–100cm long, very similar to the kerbs employed to border the walkways) to avoid damaging the soil with permanent foundation/anchoring systems, dried connections, with bolts and wood joints, etc. All the students designed a constructive "low tech" system easy to assemble/dismantle that took into consideration various parameters during all the life cycle phases, among which:

- optimization and saving of energy consumption;
- use of renewable materials, such as wood, or recycled materials like aluminum;
- selection of lightest materials to reduce the overall weight of the artifacts, in a way to limit also the bearing structure;
- attention to water consumption.

In the projects the students have defined the position/arrangement of the activities taking into consideration the site orientation; moreover, having in mind the different functions/ activities they used various roof systems and vertical closures, such as:

- brise soleil in wood or aluminum;
- wood panels, where required sliding on rails;
- wood frameworks covered by vegetation;
- sun-shading systems with clothes, adaptable to the different hours of the day;
- stone cage walls built with a dry system, also useful to close off the toilet areas;
- in some cases, where permitted (Sant'Eufemia), tree platforms have been realized, in order to be used as panoramic points; these platforms have been designed with wood elements, dry connections and without the necessity to use joints that could permanently damage the trees.

Particular attention has been given to the study of a basic modul that allows a flexible allocation of the spaces/activities through the addition or subtraction of new modules/ elements (Figure 3).

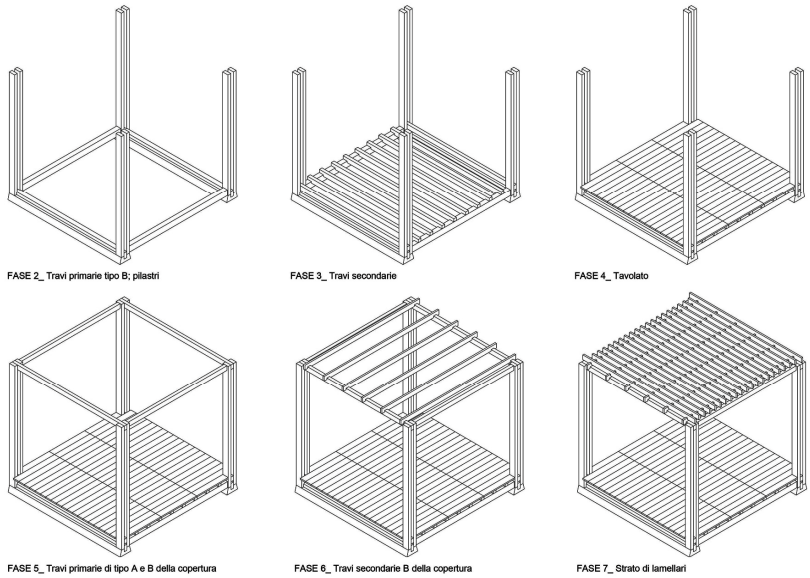

Fig. 3 *Example of an assembling sequence of a basic module.*

The outcomes are projects which generally differ from each other (Figure 4) [6].

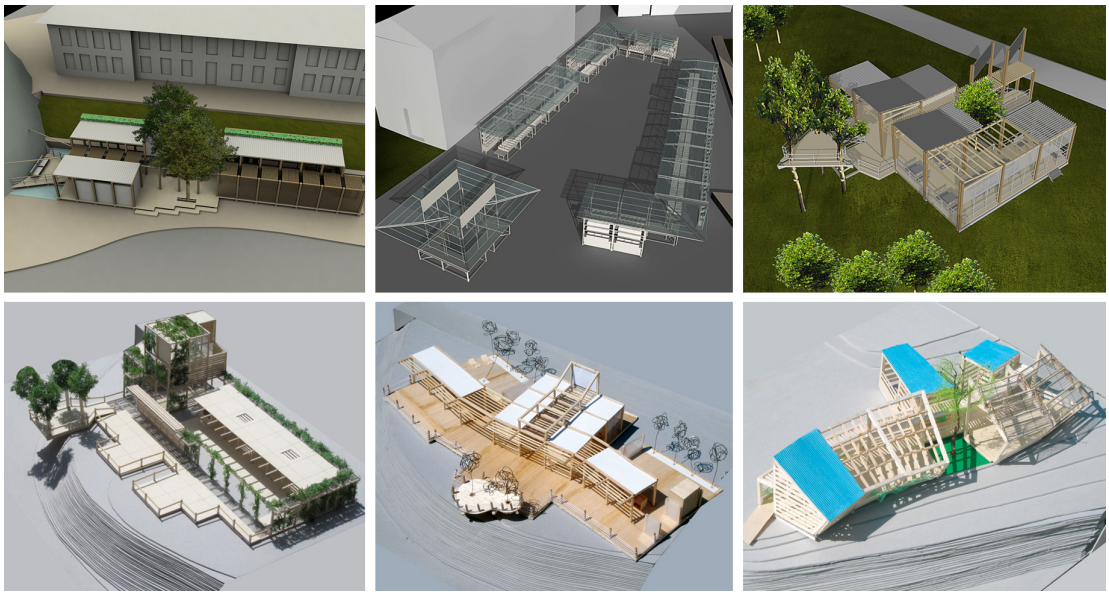

Fig. 4 *Examples of the students' projects (rendered images and physical models).*

4.4 Examination works

The drawings, texts, diagrams and schemes have been spread on four A1 boards to represent and communicate the project starting from the territorial scale, going through the constructive details of a basic module, to end up with performance evaluations (Figures 5, 6, 7, 8). Besides the boards, a physical model has been prepared.

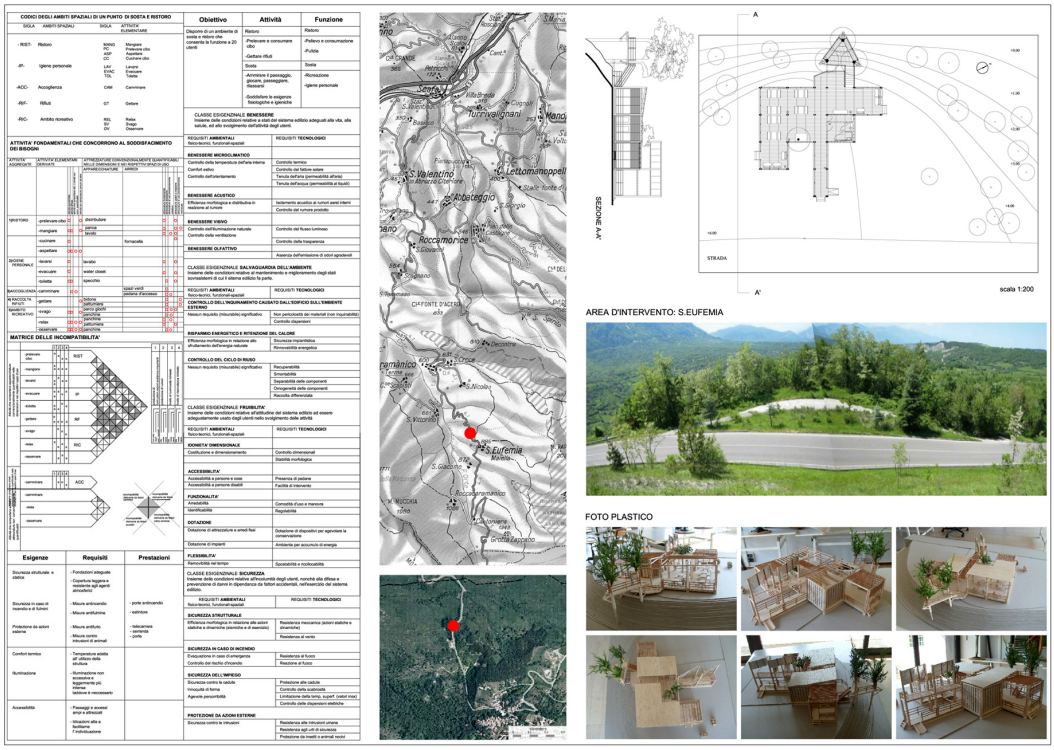

Fig. 5 *An example of the board number 1 that contains the analysis on the activities and site.*

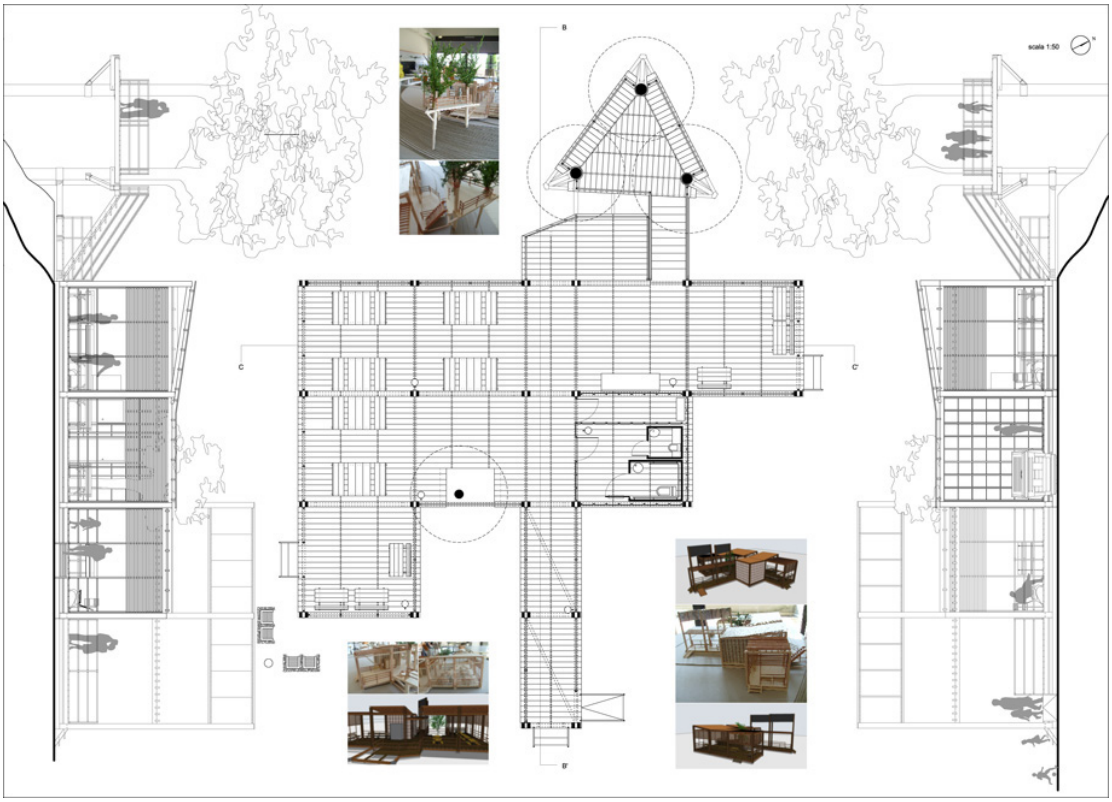

Fig. 6 *Example of a board number 2 that shows a plan view, an elevation, a section, pictures of the physical model and rendered images of the 3d digital model.*

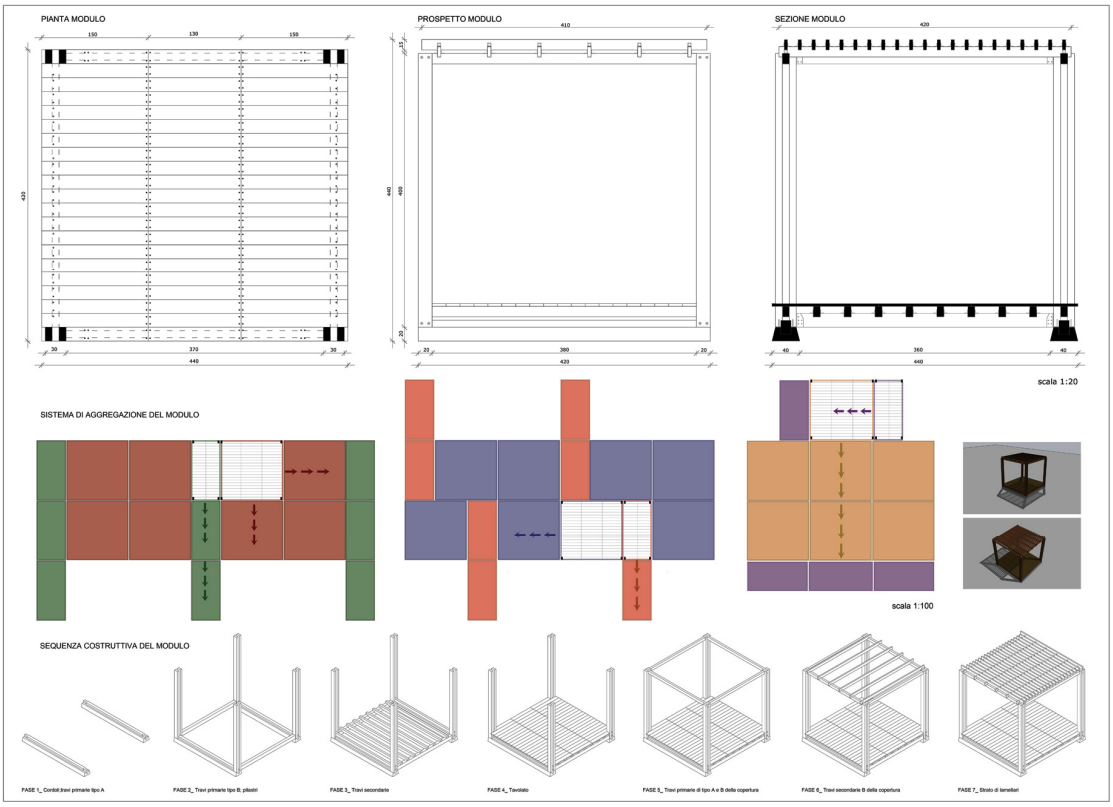

Fig. 7 *Analysis of a constructive module on the board number 3.*

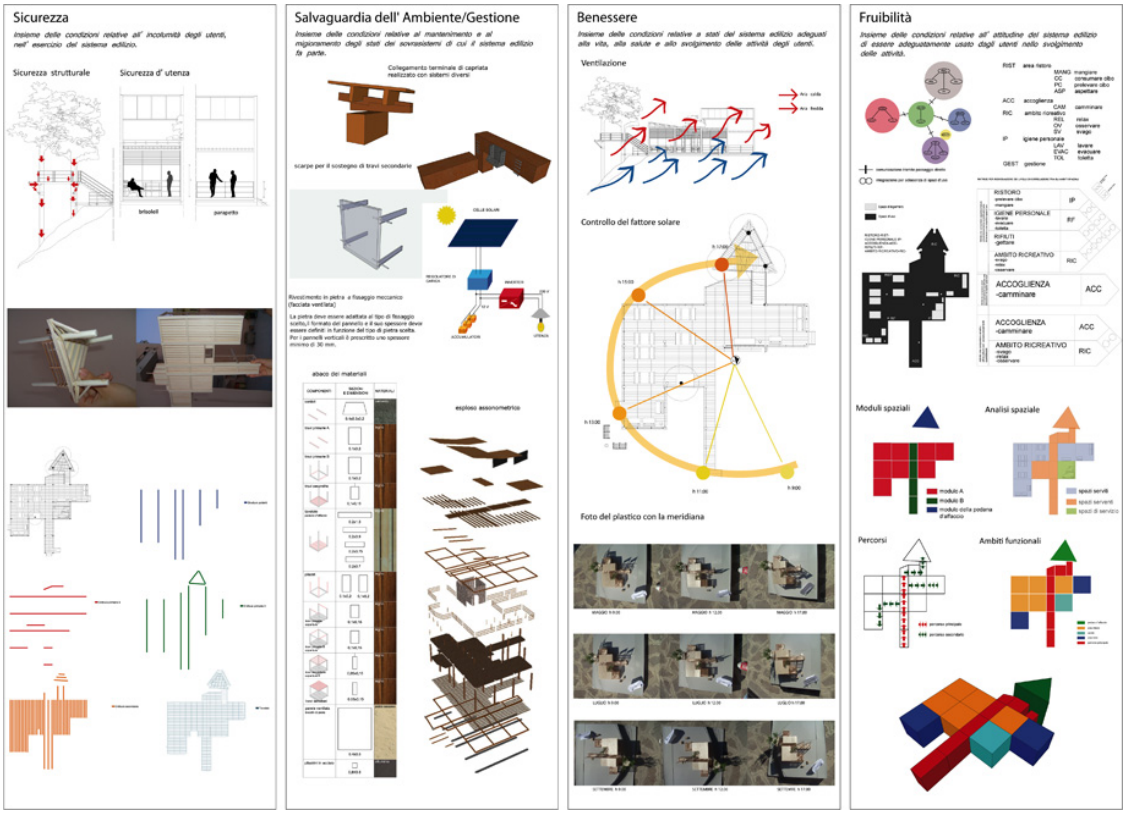

Fig. 8 *Example of a board number 4 with the performance evaluations.*

5 Final exam and assessment of the results

All student projects had to meet certain requirements stated in the Italian Normative UNI [4], namely:

- *security:* set of conditions related to the safety of the users as well as to the defense and the prevention of the damages occurred by accidental factors, in the use of the technical system;
- *wealth:* set of conditions related to the state of the building system suitable to life, health and the development of the activities of the users;
- *usability:* set of the conditions related to the attitude of the building system to be used by the users in the development of the activities
- *aspects:* set of the conditions related to the users' perceptive usability of the building systems;
- *environmental safeguard:* set of the conditions related to the maintenance of the states of the upper systems belonging to the building system

Evaluations have been made during the final exam, to verify whether and how the design choices made by the students have met the requirements foreseen by the UNI norms. In this case, particular attention has been given to table 4 (Figure 8), where they submitted a series of drawings, diagrams, charts and descriptions that show how the choices made in their project meet the "requirement classes" described in the regulations (UNI). For example, with respect to usability design solutions to the following questions have been analyzed:

- what major activities have been chosen? are they appropriate to the overall objective of the project?

- may the layout distribution of activities create situations of incompatibility between them?
- is the size of the spaces adequate to perform the selected tasks and to use the chosen equipments and furnishings?

6 Communication phase

At the end of the course, together with the mayors of the above mentioned villages, we decided to publicly present the projects to the citizens, through a conference/exhibition, in order to sensitize them on a new sustainable planning approach. For people outside the architectural field it is difficult to clearly understand the projects only through conventional graphic works (plans, sections, etc.). After some considerations, we decided to create some animations to represent and communicate in an effective way the assembling/dismantling phases of the technical elements, taking inspiration from some cinematographic experiences and techniques (storyboard). This methodology has been further developed by the author in part of his Ph.D. research [7] and in a peer reviewed paper [8].

The constructive phases of the artifacts have been synthesized in eight main steps (Figure 9, 10, 11, 12):

- foundations;
- main and secondary floor beams;
- tiled floor;
- pillars;
- main and secondary beams + furniture and equipments;
- roof;
- closures;
- vegetation.

During the development of the animation the best works have been selected; reorganized and improved the 3d digital models and solved various incompatibility issues between the various file formats; prepared a storyboard to analyze the construction sequences; created some animations inside the same software package (3ds Max), and in the end assembled in Adobe Premiere.

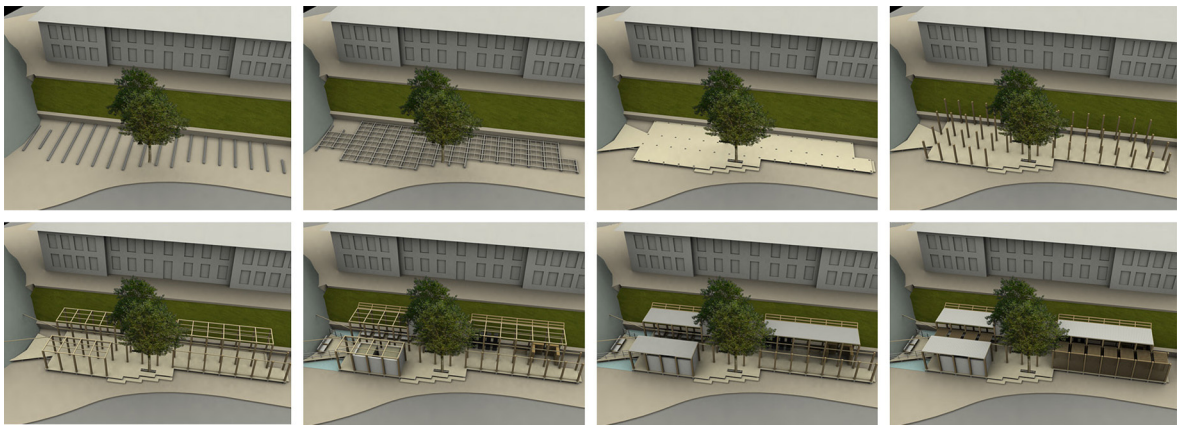

Fig. 9 *The sequence of the assembling phases of a project Located in San Valentino (Square).*

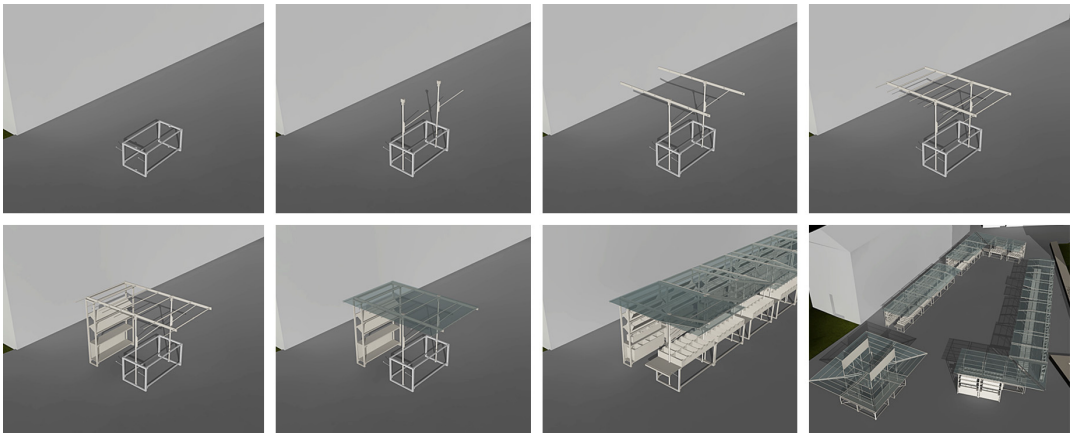

Fig. 10 *The sequence of the assembling phases of a project located in San Valentino (Castle).*

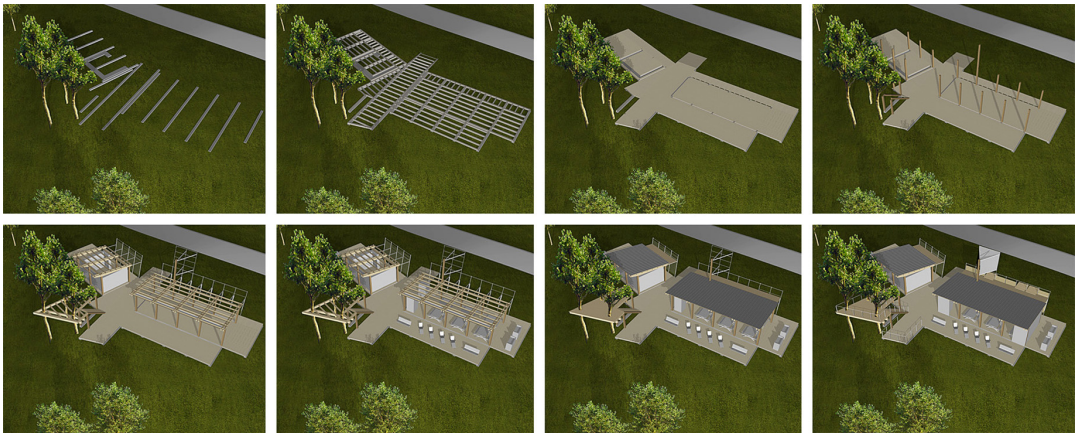

Fig. 11 *The sequence of the assembling phases of a project located in Sant'Eufemia.*

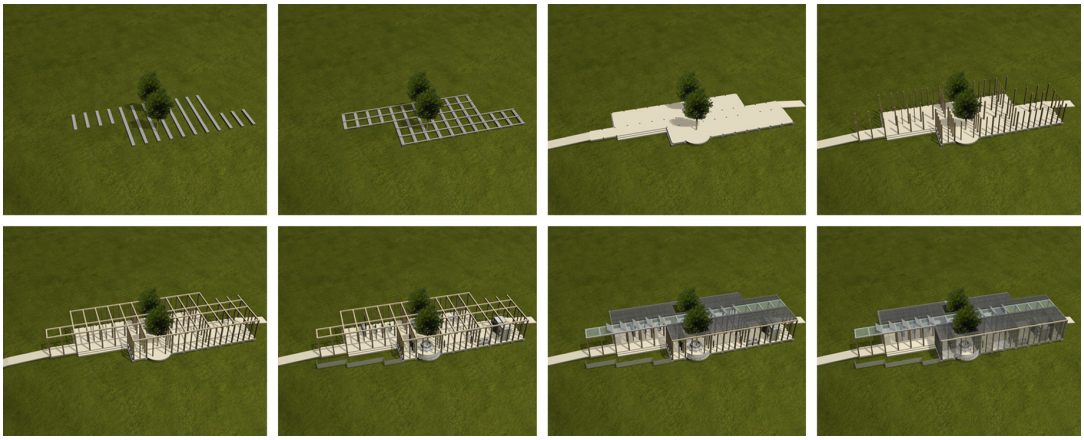

Fig. 12 *The sequence of the assembling phases of a project located in Roccamorice.*

7 Conclusions

The educational-planning experience described in this paper, established by three fundamental phases, namely preliminary phase, design phase and communication phase, have proved their effectiveness in making aware and involving the students to the themes

of the sustainability and reversibility of the interventions linked to the valorization of the natural and historic-architectural characteristics of fragile contexts, that have to be safeguarded. Four project themes, in four different contexts, gave the opportunity to the students to understand and confront themselves with different issues and to use various methods and tools. More information and images are presented in the extended version of the paper.

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[6] The pictures presented in this paper have been selected from the examination works of the following students (in alphabetical order): Baldassarre M., Caniglia C., D'Aniello A., Faieta L., Frattarola S., Graziano M., Longo. D., Perdonò C. M., Saccoccia L., Salustri E. L., Sollazzo A., Spadaccino F., Spadafina V., Stefanelli. P., Terrenzio M., Ventresca M., Viccione M. e M., Vicentelli G., Zucaro S.

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