SURVEY AND REPRESENTATION METHODOLOGIES IN TEACHING EXPERIENCE

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ABSTRACT

A profitable cooperation between experts of metrical and critic survey built up a common Survey and History of Art Laboratory. This course takes place on the third year in the course of study of construction engineering at Politecnico di Torino. Teachers work in an interdisciplinary way with students in practical lessons about the survey and representation of historical significant buildings of the rich Turin city-centre. This paper reports this teaching experience with the considerations it has brought, not only about theoretical topics, but also and mainly on the students achieved results. Theoretical lessons are aimed to show methodologies and tools to face different kind of problems that can arise. The proposed solutions depend also on the adopted representation scale of the object. The graphical examination papers which the students have to produce, include: the results of a historical archive research, fields preliminary sketches, and different metrical survey techniques results (direct measurements, instrumental measurements using: total stations, LIDAR, etc.); the adopted working methodology; the build-up of a 3D model able to communicate the formal image of the object.
This experience can lead to a new "integral survey" concept for architectonic and urban objects. In fact, because of their complexity, the only way to achieve a critic synthesis is to integrate the use and cooperation of specific skills and knowledge.

1. INTRODUCTION

For some years now a collaboration has existed, in the field of the Survey Laboratory and History of Architecture in the third year course of Building Engineering, between the experts in "metrical surveying" and "critical surveying", and the History of Architecture teaching staff.
This wish to collaborate is a consequence of a didactic project that, drawn up together, in the ambit of a 112 hour laboratory course, offers the students the possibility of undergoing a complete experience on a specific theme which includes: critical analysis, historical assignment , instruments and methods for a metrical survey.
The objective is therefore that of teaching the student how to arrange a synthetic cognitive and culturally responsible knowledge.
The knowledge method is considered a complex operation, as is the structure of any historical building where the different components contribute to define the geometric structure of the present state of the investigated object.
These components could be:

- the aesthetic and functional applications that characterise the basis of its design;
- the building skills used to put together the design concept; the physical consistency of the materials and the building techniques that were used to construct it;
- the interventions that have modified/transformed the object over the years.

All this, without ever forgetting the knowledge of the aesthetic formation of the stylistic individuality of the author, obviously inserted into the cultural ambit of his era.
The components that have been listed are only some of those that must be investigated and assessed in order to be able to reassemble a cognitive picture that allows one to understand the architectonic individuality of the constructed object through a critical path that leads to a contribution to the attribution of value.
A complex construction of different types of information, like those just mentioned, requires the mandatory collaboration of people from different scientific fields with different cultural and technical backgrounds. Unfortunately, communication between different people working on the same theme is often rather difficult.
The value of the experience carried out in the teaching laboratory in fact lies in the integration of different forms of knowledge and different technical and design abilities through an orchestration of investigation times and methods.
This allows the contents of the different contributions to be orchestrated, during the experience of a "survey", with a subsequent verification step carried out to highlight the relative problems connected to relationships and integration.
The teaching staff work in an interdisciplinary manner with the students during the laboratory activities; they propose a practical exercise theme connected to surveying and to the representation of particularly significant historical buildings which characterise the Turin urban texture.

2. LABORATORY ORGANISATION

A teaching experience that was carried out is dealt with in this work which led to some considerations, not only in reference to the subjects dealt with in the theoretical lessons, but also, and above all, to the results that were obtained by those students who were called on to synthesise methods and contents from the different stages that are necessary to follow in order to perform the survey of a complex structure.
The experimental work method can be divided into the following steps.

2.1 Reading of the architectonic basis of the object

In this stage the student tries to recognise the geometric base of the object: the architectonic components that characterise the formal image of the object, the presence of decorative details, the materials and the building techniques. The students have to try to reconstruct the geometric and morphological shapes of the building using drawings of the plans, views and sections with contents in a scale of 1:200.

The elaborations in orthogonal projection are often accompanied by axonometric and/or view sketches to relate the individual components to the constituent structure of the object through the identification of the hierarchic relationships.

Figure 1. First reading of an object

2.2 Choice of the suitable instrumental methods

For purely didactic purposes, the choice of the representation system according to the Euclidean system of orthogonal projection forces the students to connect the results of the different metrical surveying methods (point coordinates; angles, distances) to the uniform description of the object for all of its components.

The used instrumental measurement methods (Total Stations, Photogrammetry and Laser Scanners) in fact give spatial coordinates as the results and these allow a tri-dimensional model to be built, discretisised by points, of the physical shape of the building. The students, using this model, must then define the geometrical elements (straight lines and planes) that synthesise the surveyed object in an exemplifying manner in the required orthogonal projections.

The initial reading operations through the previously described orthogonal projections, oblige the student to critically identify the geometric shapes of the significant elements that characterise the overall shape of the object. This identification could be based right from the beginning on the basis of a preliminary, manually drawn tri-dimensional model of the investigated object; these are often difficult and too demanding for the graphic "capacity" of the "average student" in our degree course.

Only at the end of this first graphic reading are the students able to choose, in a correct way, the significant elements (points) that must be taken into consideration during the metric measuring operations.

In this first phase the cognitive process is divided into two distinct stages:

- the recognition of the principal elements that are essential for a definition of the geometric characterisation of the investigated object;
- the metrical survey of these and the subsequent construction of a first geometric model with a metric value.

The delicate step encountered in these years of teaching experience is above all concerned with the identification of the "Base" components of the general shape of the object. The recourse to the representation in orthogonal projection during this stage obliges the student to make a critical decomposition of the geometries of the building using, amongst others, the same system that is used in the design courses.

The choice of the metrical survey methods that have to be used is obviously influenced by the number of students enrolled in the Laboratory (about 90) and by the number of practical exercise teams permitted by the offer of the didactic services of the University (at present 2).

The instruments that are used are: the Total Station in order to be connected to the National Topographic Network and for the surveying of the significant points identified during the previous stage; the Laser Scanner (at a demonstrative level of the most advanced technologies for the metrical survey); the Laser Distancemeter and the Tape-measure for the integration of the topographic data. The Distancemeter in particular is used to measure the points that are necessary to define the section.

Figure 2. Metric survey

2.3 Graphic representation of the surveyed elements

Together with the diversity of instruments used during the metrical surveying, there is also a diversity in the degrees of precision with which the object is surveyed.
During the first graphic restitution in plans, views and sections, the possible "diversities" and dimensional incongruencies are immediately obvious and often create problems of "Interpretation" for the students.
During this first graphic restitution stage, the student normally has to return to the site for a more precise and detailed check and in order to integrate the surveyed data. Though the plan restitution is simple, and almost all the measurements are carried out manually, the integration of the data relative to the measurements performed of the views and sections, where the manual measurements must be integrated with instrumental measurements, is particularly difficult.
The students are asked to use different geometrical and analytical correction programs (RDF, Archis, Geos) for the restitution of the views which are not always suitable for the geometrical shapes of historical building façades, given the great number of plains due to the presence of the decorative parts and to the fact that the structures were composed in different historical eras.
During the graphic restitution, the students are therefore asked to show, through the use of colour, the results that have been obtained with the different instruments that were used and with the consequent different degrees of precision.

Having made these preliminary remarks, it is obvious that the possible representation scale in this type of survey experience cannot be any higher than that of 1:100, as the dimensional tolerance is conditioned by the quantitatively relevant component of the manual survey.
Any possible significant construction details are gradually defined between the teacher and students who, together, decide on the most opportune representation scale and, as a consequence, on the suitable measurement instruments.
The final design represents the results of the critical interpretation of the dimensional data with which the previous graphic documents were elaborated.
At the end of all these graphic reading and synthesis operations of the studied elements, the students can then pass to the setting up of a tri-dimensional model of the whole investigated object. The students have more difficulty at this stage than in the orthogonal projection stage in the graphic schematisation of the elements in function of the representation scale. They in fact tend to represent the individual elements in an "iconographic" manner, "simulating" the setting up of a tri-dimensional model in a 1:1 scale of which they do not have the correct metric parameters. This model (which requires a remarkable effort) is considered as exemplifying of the formal image of the building, but it cannot be used to obtain metric information. This however reflects the tradition of the descriptive geometry, which attributes a metric value (associated to the various dimensioning systems) of the orthogonal projection and not of the axonometry or of the views.

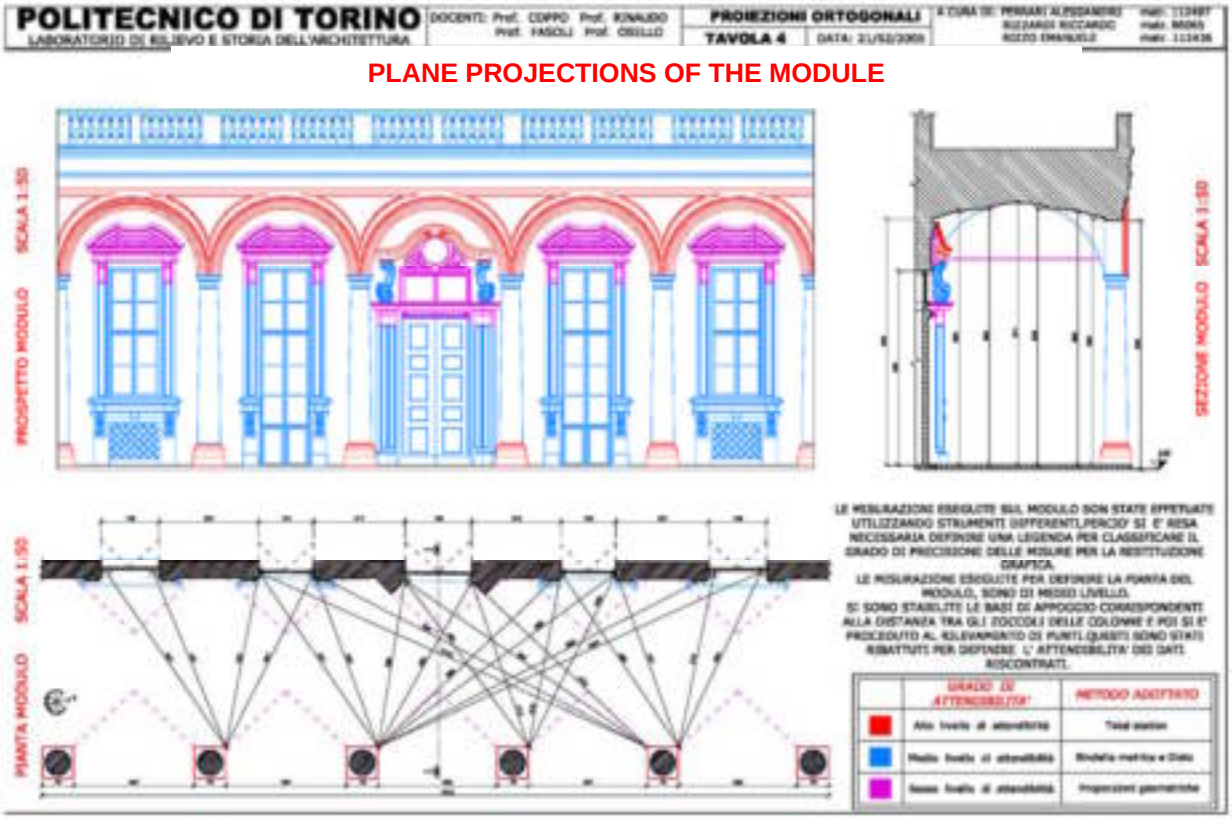

Figure 3. Plane projections of the module

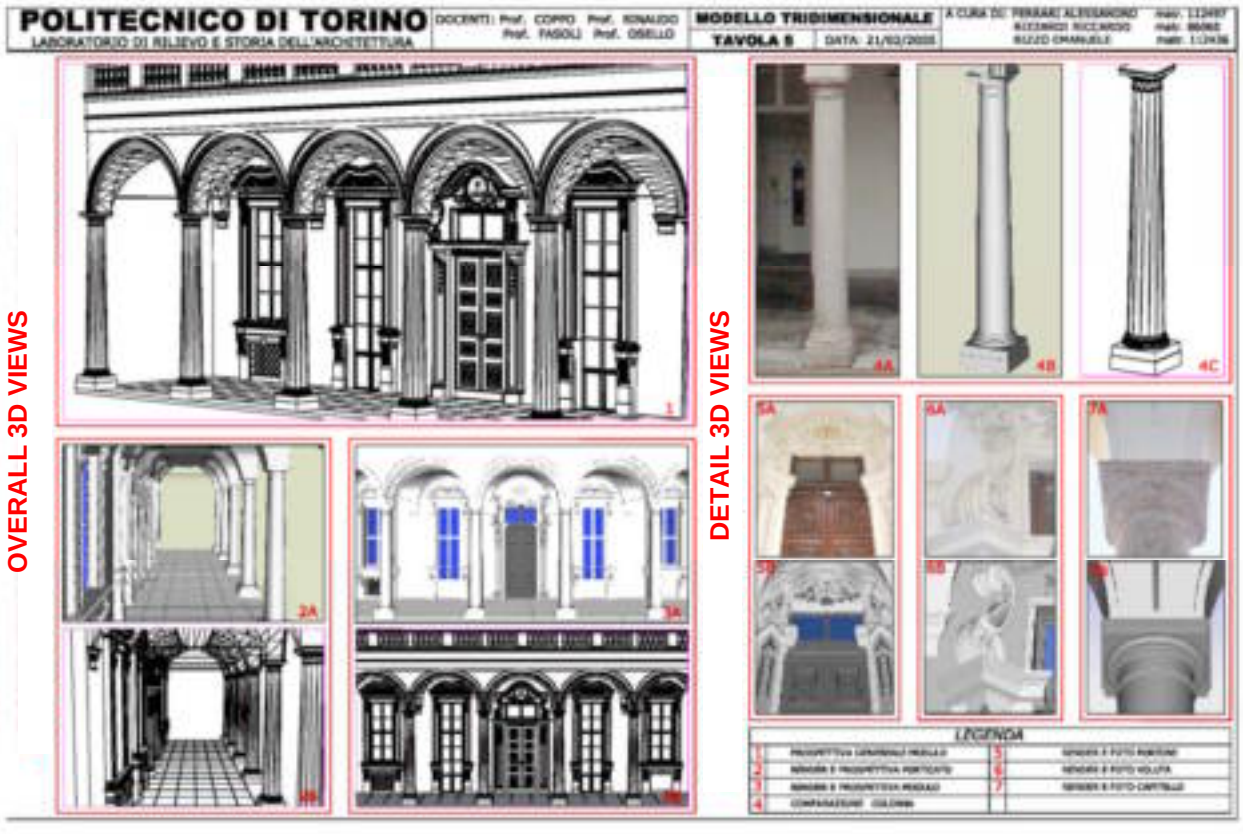

Figure 4. 3D views of the module

2.4 Historical- archival analysis of the studied building and of its urban context

In an operation of this type, it is not possible to avoid considering the historical knowledge of the elements which, in different ways, can have characterised/conditioned the conception, construction and transformation of the studied buildings. The history, an integral part of a survey, contributes towards an understanding and knowledge of the various portions that are sometimes not observable and/or verifiable, but it also helps in the correct search for the components that are essential for a critical interpretation of the investigated object.
The students are also asked to carry out, together with the on site survey operations and the graphic restitution operations of the data obtained from the survey, historical researches that will help them to perform: a comparison the original design elaborations (if they exist) and the graphic elaborations derived from the survey operations in order to identify the parts that have not been changed and possibly those that were foreseen but never done or the parts that have been transformed at different times; a comparison of the object and some of its characteristic components (for example, the orders, the portions, the decorative parts) with the historical treatise writing of different authors to obtain the equalities, similarities and the differences; a comparison of the object with contemporary constructions still present in the urban texture of the city from which it is possible to obtain variations and invariants.

3. CONCLUSIONS

The thus divided teaching experience foresees that the teachers, during the theoretical lessons, propose methodologies of approaches to the different problems and to the instruments that on each occasion it is better to use, in relation to the hypothesised representation scale for the graphic restitution of the investigated object. The students, still assisted by the same teachers, apply what was proposed to them at a theoretical level during the practical lessons in a practical manner and when they encounter a series of different problems they are obliged to use a critical, and not only applicative, work method. This type of approach will surely be extremely useful for all of them in the carrying out of the profession they choose after graduating.
This experience can lead to the concept of "integrated survey" of an architectonic/urban reality marked by characteristics of complexity in which only the integration of the specific competences can lead to a critical synthesis operation. The experience is surely positive.

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The images that are shown in the paper represent a exemplifying synthesis of the work that was carried out during the 2004-2005 academic year by a group of students (made up of Alessandro Ferrari, Riccardo Rizzardi and Emanuele Rizzo), and they follow the training process that has here been illustrated in sequence.

Figure 5. Urban context of the building