

PRACTICE FOR BUILT ENVIRONMENT AWARENESS: FROM SURVEY TO 3D MODELLING AND RELATED DATABASE

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ABSTRACT:

In these pages we present a research project the Faculty of Architecture of the University of Bologna is carrying out, concerning new methods and instruments for the representation of the urban historical heritage.

These are the documents realized during the first year of work:

- photo-plans and digital drawings of the urban facades along the streets of the city centre, represented as a whole from corner to corner – blocks;
- virtual tours of the most important nodes in the city centre;
- data-base collecting a specific report per each façade – about 2000 – of every building placed in the area studied.

Right now, we are working on the second phase of the project, concerning the three dimensional modelling of the urban blocks of the Cesena city centre. These virtual models are going to become the main instrument to browse the big amount of quantity and quality data collected, related to the evaluation and communication of the historical urban heritage.

1. Introduction

Growing attention to preservation of historic urban constructions is taking place, in Italy as well as around European area, according to different methods of testing and depiction and communication; so far, these methods are finalized to urban planning and knowledge. Developed environment quality requirements and new demands from communities are giving back to Architecture the key assignment to assure life settings, often neglected to quantitative and economic requests.

Inner city requalification, as well as contemporary city one, are main topics which demand very knotty answers.

New urban environment knowledge methods are urgently necessary: we need new skill processes aimed at a proper reading of existing systems – architectural space, details, etc. – and at a proper reorganization and representation of qualitative characters. In fact, these elements are of crucial importance and we believe have to be taken into consideration, as they typify a city and define its identity.

2. Historical centres: analysis, representation, awareness

The main matter we had to deal with, concerns the current urban and architectural heritage documentation, which is not qualified to describe the real complexity of architectural environment and urban convolution, or to manage with new involvements, and hold up troubles.

Well-acquainted gears are absolutely unable to depict an overall and deep representation of urban landscape and to explain the reasons of its mutations. Typology, function, geometrical outlines are essential features, but they describe only a partial view of real urban quality regression. Whereas a comprehensive and exhaustive representation must include spatial and perceptual elements, perceived by beholders, in order to let

them understand the real meaning of built-up development.

To have this thorough account, we need new detecting and designing tools and new standards, as 3D scanning equipment and urban virtual model combined with proofed tools as photogrammetry, direct measuring and digital file of data.

The research project we present here, was carried out in order to answer to these matters; this project was developed by Architecture Faculty “Aldo Rossi” of Cesena (University of Bologna), under the scientific guide of professor Fabrizio Ivan Apollonio and with the support of a local Bank Foundation (Fondazione della Cassa di Risparmio di Cesena).



The project purpose was to snap city background portrait by a coordinate use of different analysis methodologies: topographic survey, different graphic and photographic designing, digital pictures processing, mosaic photoplans, 3D virtual models of built-up space and an inclusive data-base [DB] of inner-city buildings facades, going over simple plans scheming.

We decided to use photography as main survey instrument, to convey huge amount of quality and factual information, combining snapshot with topographic relief.

As final result we arrived to a full photogrammetric image of city roads, with the comprehensive detail of an architecture sketch, matching in a single document the icon of inner-city facade system with an architectural description of buildings details and any key information about materials, colours and preservation conditions.

We used the camera work – harmonized with topographic and active relief – as survey instrument to define dimensional information and quality control. These orthophotoplans were a precious and tough base for further investigation and examinations – structural, creative, typological, stylistic, historical, etc. –; they revealed as a precious tool, an hybrid document matching the desire to prove a comprehensible representation and to attest an accurate device of technical design.



Literature and Cinema are able to convey urban historic centre atmosphere, much better than technical drawings and documents; the present project was outlined to fill up this gap, proposing a deep overview of urban surface and spaces, underling light and colour features. Urban scene relief is going to be a strong knowledge instrument of the ancient city centre, to ease the experience of the city; its goal is to become a supervise tool, to stimulate a makeover of buildings facades, and not a super-command instrument for the planning red tape.

The data-base we were keen to use then, was just a part of our project, an essential part, but not comprehensive; its value, but also its flaw, is to synthesize the complexity of the reality in single item, good to over simplify a single operation, but the risk was that of get a limited overview of the complete urban scene. So, we planned a bendable data-base able to go over single card system frontiers, excluding a gis-based system, too compound for project's goals.

The data-base, which in its complete version will count over 2000 "relief cards" – concerning the selected area –, is structured by different records with information on any single building and distinct element and it allows to be explored by any single query and specific enquiry.

2.1. Survey procedures: photoplans and rendering

The first survey step of our research project – focused on a part of Cesena historical centre called "Malatestian Area" – has been an experimental phase aiming to setup and tune a consistent and verifiable operative procedure.

The object of the survey offered the opportunity to experiment the combined use of different integrated tools, the digital photogrammetry, direct and indirect surveying methodologies, the organization of the procedural aspects of the survey itself. The operative procedure had necessarily to simplify each scheduled sub-procedure and meanwhile maintain the quality of the results, and separating the whole single process and its flux of data in different procedural steps.

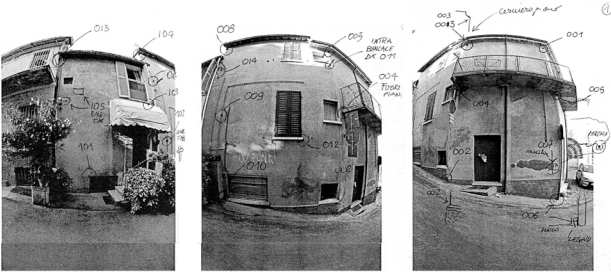
The starting phase has been the photographic shooting, carried out with a digital reflex camera within some shooting constraints – maximization of the facade coverage, alignment of the windows, doors and balconies, fix exposure – with which we obtained the complete coverage of the street facades. The main problems have been caused by the ratio within the buildings height and the road width – generally extremely narrow –, which often forbade to shoot the whole façade in a single picture, neither using wide angle lenses.



This particular problem implies an enlargement of the number of photos to manage with and elaborate in the following phases. So, with the aim at keeping the number of photos as lower as possible, a fish eye lens has been used – an ultra wide lens allowing a shooting field of about 140°. Pictures taken with this kind of lens are unfortunately characterized by a spherical distortion deforming linear elements in curves. It was therefore necessary a digital elaboration of the image to correct these distortions. The same kind of elaboration it was anyway necessary also the use of wide angle lenses to eliminate other kind of optical distortions – barrel shapes, dark borders, chromatic aberration.

The second phase consisted in an instrumental survey, achieved with a no-prism topographic station – laser theodolite – a tool capable to detect the position of points onto building facades. This survey had a double goal: surveying the geometrical and dimensional façade profile and obtaining the spatial position of indicative points across the façade, which were necessary to the digital "straightening" of the pictures.

The spatial position of four or six points has been measured for each single image that had to be straighten. These points have been chosen in the spatial proximity of frame vertex and during the survey campaign they were graphically noted and named on a printed view.

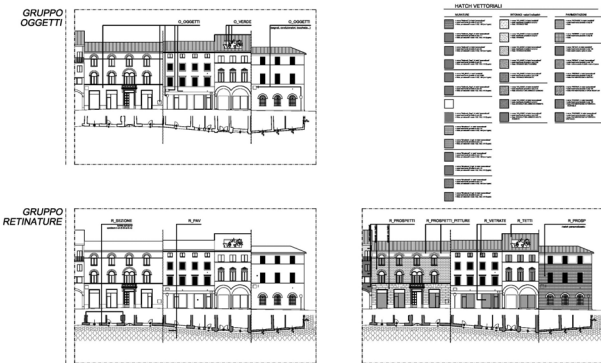


Then instrumental data, spatial distribution of the indicative points, needed to be repositioned on a single plan, so it was necessary to spherically-translate the plans of the different buildings fronts – that in the real space are displayed following a polygonal –, flattening all the fronts on a single plan. The obtained coordinates were now correctly prepared to be sent to an image “straightening” software; the straightening took place by associating the four or six noted and named points – and its spatial coordinates – to the image. Images were affected by an inverse perspective transformation that eliminates the curved lines and scales the data from metric units to pixel units.

Every single straighten frame, previously cropped and balanced for brightness and contrast, were then inserted in a digital mosaic, so that with the helpful control of those surveyed points, we obtained the view of the whole facades development per each street. This process involves two steps: in the first one we had to settle the single building unit, in the second one recomposing the whole road.



The use of an appropriate graphic encoding, as well the use of simple procedures related to the modality of rendering out of plan objects were necessary to obtain a uniform and homogeneous final rendering. Actually, the reduction of error in the encoding application has been accomplished by creating explanatory graphically organized templates.



All the elaborated data and materials have been finally stored in an application designed for this purpose, integrating the graphic documentation, the detailed photographic survey and a synthetic evaluation of the conservative state of the buildings. The final output of the application is consisting in a A4 form, obtained as a report of a single building, classified per each road by road number. This kind of instrument was projected to be easy and quick to read, to point out fundamental data, to highlight photographic contents and to be easily interpreted.



2.2 Identity cards data-base

The digital system of scheduling and marking we propose, offers a meaningful instrument for the acquisition information over the urban scene of the city. In fact, it fixes and documents – by the moment of its realization – an enormous amount of general indications and details, on the image of the urban environment.

This project gave to our research team, the chance to inquire and to monitor with the rigor of a systematic methodology, the "skin" of the historical center buildings. That skin was recognized as the key-interface between public space and private property.

So, addressing to that particular "limit", the urban scene is made of, and studying such border, we had the chance to evaluate the state of health of the image of the city and therefore of the quality of its identity.

The realized data-base has been planned so as to be implemented over and over, whenever the information

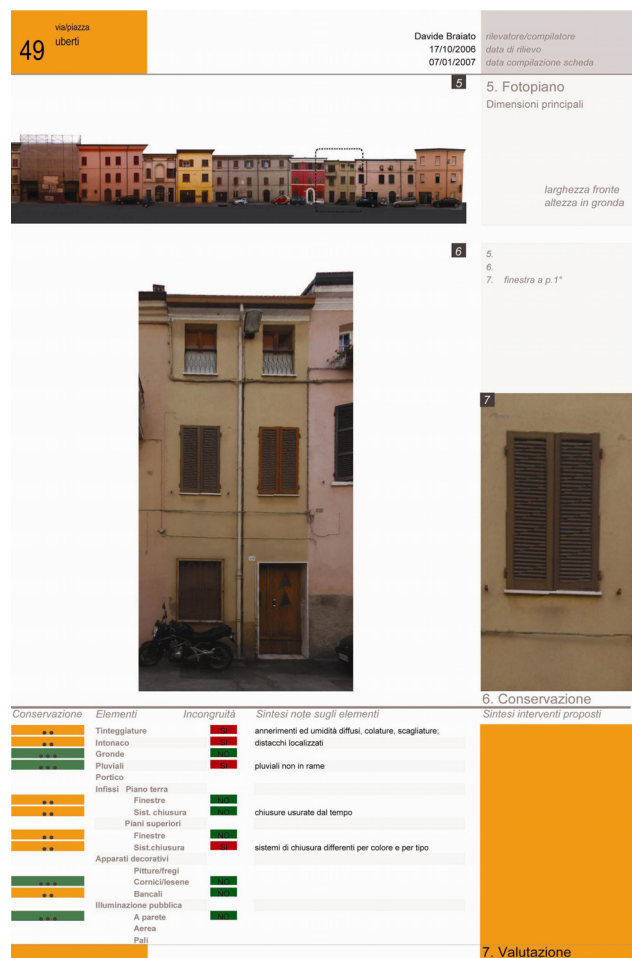
collections related to the facades real estate particles are acquired.

The interface that the surveyor-researcher had to manage with was a master-page, a sort of form, he or she had to fill in all its fields linking all the images that were going to be displayed in the data-base output. For each civic number per each street, a printable file has been designed: here it is the "identity card" of each building of the city centre, where per each façade the state of conservation facade is analyzed.

The output system offers for sure a precious and innovative product: the layout of the document in which all the information are synthesized proposes a the description of the front examined on the first side of the card. While, on the second page, there are those elaborations, which are the result of an articulated procedure of data acquisition. We refer to images extracted from the ortho-photos of the street fronts.

In this identity document there are firstly the information about its localization inside the built historical environment, secondly, its position in relation with close neighbor constructions. As the aim was that of describing the city curtain the real estate parcel is part of, we decided to display two images which let the instrument user have an idea about the surrounding context the examined unity has to deal with: again we fix our attention on the relationship between punctual fact and collective fact.

After the first part that take into consideration a description of the building examined, we decided to analyze it with the ortho-photos and after again by the appraisal of the various constructive systems and architectural details. We decided to propose an extract of the photo-plan of the street the building belongs to, and then put a frame where the façade of the building can clearly be seen. The last images proposed are related to the architectonic elements or the meaningful details that were displayed in order to let one make a deepen analysis concerning the preservation conditions.



The result of our research is now at Public Administration disposal, being it a useful and flexible instrument, that can be spoiled for several aims. It must be noticed that it can be consulted by various modalities: offering each time answers to the various interrogations on the single facades or about architectural elements.

Our data-base gives back for every building taken into account, a document which is like – as previously mentioned – an "identity card" of the front of the building.

The last part of the document is constituted by a board whose voices synthesize the description of the state of conservation of the front of the single real estate unit. The table is compiled from the surveyor-researcher by choosing the designation for each voice among evaluations that in practice "are guided", or "previously designed".

The matter was that of detecting each time a range of fitting descriptions to be systematically adopted by all different surveyors, in order to give back a common way of evaluation. Thus, the designers of the data-base decided to introduce a pre-

determined multiple choice tool per each voice examined in the evaluation board. This choice to control the description of the elements was indispensable as the aim was possibly that of obtaining an homogenous reading and a proper scientific rigor. In some cases, like for example that of stone materials, the various predisposed options, have been chosen following the indications of Normal Rules – 1/88 and 16/84.

With this particular kind of study we wanted to focus our attention over two main aspects: the preservation conditions of all the elements examined, but mostly, their proper relationship in regard of the single architectural organism – architectural scale – and the context they belonged to – urban scale.

Therefore, the evaluation of conservation conditions the facades examined were classified by, was the result of a complex series of analysis. They were based on a system of parameters we decided were meaningful in order to define the quality of the urban relationship our studio intended to focus on: the *liaison* between the single “tessera” and the mosaic, between private and collective space, between facade of the single building fact and city scene.

3. Conclusions

The innovation of the work we realized stands in its practice application and utility. It is not a common fact that a campaign of survey was undertaken over a such extensive area and that the survey took into consideration each one of the buildings located on the historical area, and not only architectural excellences. The “ortho-photo views” often has been realized for the restitution of single streets, maybe because these streets were interested by the presence of some important architecture or monuments. But rarely, because of all the difficulties this kind of work presents – both in terms of economical and time investments – this kind of representation methodology has been applied to the “minor” built environment.

Here stands the key worth of our research project: we focused our analysis – and caring – on those parts of urban center, indeed making the face of the city, to those parts usually object of uncontrolled mutations – demolition-reconstructions, transformations, evolutions, etc..

We have realized an instrument of knowledge and analysis that in its outputs tools finds the force of the realistic photographic representation; this kind of representation has become an instrument of measurement and again of communication, thanks to the use of digital techniques. In fact, we believe that today the photogrammetry approach is fundamental, in order to reach a great metric precision and direct communication power.

Actually, we have realized ortho-photo views and drawings per each street of the city centre of Cesena, printing theme at a scale 1:100: all together they gave 40mt. of length, recreating a unique and unusual vision compared to the direct experience.

The final composition of the facades together with the related drawings and horizontal sight in a synthetic frame revealed the double valence of the final research results, as they became an instrument both of analysis and design. The results achieved by our research were capable to let emerge possible processes internal to the city, and those transformations tracing directions for the city evolution. In this sense the work carried out at the Faculty of Architecture of the Bologna University, constitutes a turning point in experimentations on the awareness of the city built heritage. Also, the open work confirmed a successful partnership between Cassa di Risparmio di Cesena Foundation, City Government and University.



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