CONTEMPORARY MASTER'S ARCHITECTURE: NEW ARCHITECTURAL HERITAGE.
APPROACHES FOR SURVEYING AND REPRESENTATION

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ABSTRACT:

We are used to consider as architectural heritage that part of architecture belonging to "historical" periods and events.
It is obvious that this classification, through the years, is always growing and the architecture "of interest" appears to be closer to our times. The different conception of architecture reflected in XX century's buildings appears even through a different cognitive approach and representation.
Even if surveying methods can be the same (topographical and photogrammetrical integrated with new instrumentations), surely its representation invites to research alternative ways respecting, chiefly, the evolution in documentation and preservation standards.
Texture acquisition becomes of primary importance, to be employed in orthogonal projection and in rendering models, to better describe materials and their state of maintenance. It's fundamental that digital photographic documentation is realized controlling scientifically radiometric values, that is by colour space calibration, to allow absolute valuations on colorimetry state and to offer the possibility to compare values in different times, especially respect to maintenance and restoration works.
The introduction of laser scanning instruments (underlining the 3D nature of survey) and the contemporary architecture's being require to use different methods in representation: from orthogonal projection, with vectorial drawings and ortho-rectified images loaded, particularly meaningful if we think about a material knowledge of buildings, to three-dimensional models, suddenly employed directly in the design genesis (such as in the latest architectural trend).
Questions about a 3D representation are many, such as the concept of nominal scale, that is fundamental in every survey campaign, because it's not correct to bind it to the representative scale of all the projections originated from the model. Another matter is the way of model fruition: the possibility to explore its space, to query it about position, dimension, distances, area, volumes. These matters are strictly bounded to the choice of specific software: actually no one has the capability to answer simultaneously to the previous requirements. Moreover there are some other questions on the way to realize the model: by surfaces triangulating (2- or 3-dimensionally) clouds of points, or based on geometric solid primitives, or on voxel.
All these subjects bring to consider the necessity of a revision of the rules in execution and representation of survey, to enlarge the canons already fixed in previous specifications.

Generally, it would seem natural to consider only architectures from the past as belonging to the architectonic heritage to conserve and restore. It seems impossible that contemporary works, which we use and frequent everyday, can have possibly endured such decay and deterioration to warrant conservative interventions beyond normal everyday maintenance.
But the truth is somewhat different: even modern materials (for example, iron and concrete) can decay to the point that they lose both their structural and aesthetic function. Therefore, it becomes important not only to conserve and salvage the "new materials" with new techniques, but to define new cognitive approaches and new forms of representation.
The need to survey, as a cognitive act of architecture, some of the works by one of the greatest Italian masters of contemporary architecture, Carlo Scarpa, seemed to be a significant example to use for experimentation on the most recent tools in the area of documentation of the form and the colour and to study forms of representation that may be alternative or complementary to traditional ones with a view to building a system of documentation and knowledge focused and structured in accordance with the characteristics of modern and contemporary works.
Precisely because of the characteristics of the architecture in question - in the specific case, the Sculpture Garden inside the Italian Pavilion of the Biennale of Venice and the Fondazione Querini Stampalia -, survey plotting must also employ several different methods of representation.
As Scarpa's works are highly plastic in nature, orthogonal projections remain essential (for the representation of plans and elevations) executed with vectorial drawings integrated with ortho-rectified images, but 3D models are also fundamental for its representation, models which can be realized today by processing 3D data.

Recently, we've seen a few exploratory attempts to realize numeric models at the computer always perceived as a complement to the mongian representations.
The need for documentation, together with the possibility of computer management of the infographic models, seems to be shifting the discipline towards a co-existence of the traditional static representations and the dynamic models. This conflicts with the needs of designers to have two-dimensional supports that, as we know, represent a spatial and functional model of the architecture.
The solution would seem to be to bring together innovative concepts with the traditional methods, in other words, bringing together 3D digital models and orthogonal projections.
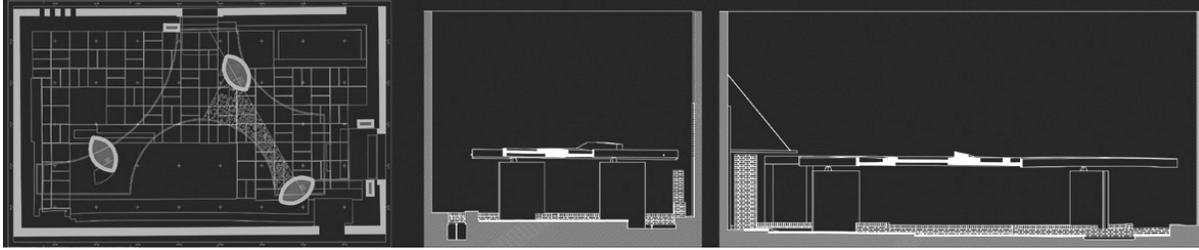
fig. 1 Plan and sections of Sculture Garden of Carlo Scarpa in Venice

Among the newest techniques that provide a deeper understanding of the works, the scientific management of colour is surely important and closely related to modelling. The importance of photography in documentation is widely recognize: just think of the desire to document materials (stone, metal, glass, concrete and wood components) and their state of conservation. Today, we have the possibility to quantify colour in a strict and exacting way: this quantification would add to the quality evaluation that we usually make on photography, the precise measure of the subtle changes in colour that are caused by chemical or physical changes in the material.

Considering the current state of the art, in the case of Scarpa's architectures, we used the most innovative techniques in survey and representation, which provide us with a cognitive apparatus appropriate to the work of Scarpa by using the most established methods in the field of cultural heritage such as photogrammetry, in addition to laser-scanning, modelling, and the controlled use of digital images.

Laser-scanning

Use of the laser-scanner along with 3D modelling might still be considered in the experimental phases, even though there are already interesting and complete applications available.
Laser-scanners, as it's well known, have been developed to scan 3D data (point clouds) of structures of any complexity. The clouds must be geo-referenced in a single reference system defined topographically analogously to photogrammetry. The georeferenced clouds represent a single set of points which provide the possibility to obtain traditional representations in orthogonal projection and 3D models for surfaces and, after appropriate processing, solid models.
During post-processing we can achieve documents such as: 3D volumes and surfaces, mathematical models of the terrain (DTM), processing curved planimetries of level, profile extraction, cross-section, 3D views, axonometric projections, elevations, rendering, etc.

New possibilities are given by the integration of laser scanner and digital calibrated camera (p.e. Riegl laser scanner integrated system), expecially in ortophoto production and edge extractions.
Some applicative sperimentations lead us to conclude that laser scanning is best viewed as a survey technique that does not replace the others, but incorporates them. To achieve a "geometrically" accurate survey, the surveyor must use topography, photogrammetry, direct survey and laser scanning, each used according to its characteristics.

3D Modelling for representation

While the utility of the 3D model of an architecture is quite clear, it can be fairly clumsy to use in practice. Several problems are yet to be solved. It is not clear, for example, the concept of nominal scale for a model, since it seems incorrect to relate it to the scale of representation of the orthogonal projections that can be drawn from the model.
On the other hand, we have to consider that a model always has a certain degree of uncertainty and we have to strictly declare its metric accuracy, unrelated to the scale of representation.
Ideally, we should introduce statistical parameters relating to the uncertainty but this make the model more complicated and difficult to manage.
This approach is the choice of the system of realizing the model. Models can be realized for surfaces or based on primitive solids, on voxels or simple 2 or 3D triangulation, of point clouds. The point cloud is essentially a fairly reliable 3D model of the surface of the object.
We must also explore the possibilities of use by the final users both in terms of the metric characteristics and the possibility for browsing: it has to take into consideration the possibility of free exploration and guided exploration as well as the ability to query the model as regards position, dimensions, distance, areas, and volumes. All this is still related to the choice of specific software products and currently no one is able to respond simultaneously to the above listed needs.

fig. 2 Point clouds union. In the second image points are colored by RGB data acquired with calibrated digital camera
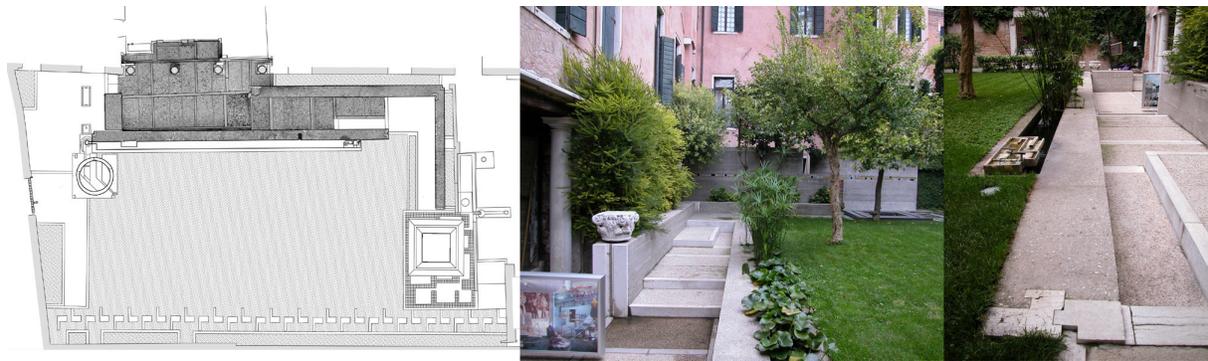
fig. 3 Plan of Querini garden with pavement rectifications. On the right, Some views of the garden
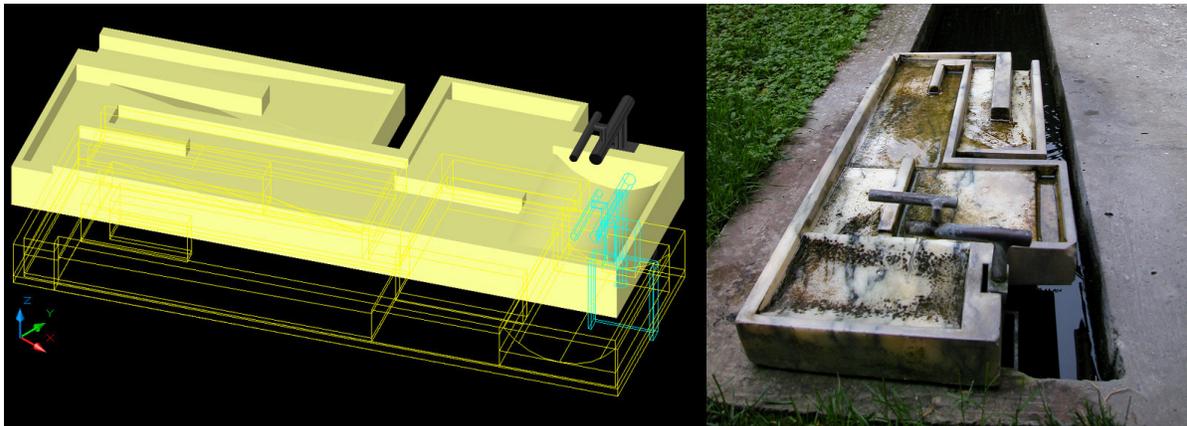

fig. 3 Detail of the garden of Querini: the alabaster labyrinth

In the specific case given as an example, *solid* constructed through Boolean operations on primitive solids obtained from primitive geometrics directly derived from topographic, photogrammetric, and direct survey.

Texture mapping

The need today is to place more and more attention on the quality of the photography since the demand for high quality photographic results has grown steadily, starting with analogical and digital rectification to photoplanes, orthophotos, and texture mapping on 3D models. These products have become a substantial part of the photogrammetric production that serve as support for the historic, physical and chemical analyses which are usually done on the monuments. You can see how initially (for example, in analogical rectification) photography mainly served to measure sheet coordinates (surveyors often rectified from negatives). Since rectification began to develop, not only in vectorial form (line drawing) but also in photographic form, the need arose to have images where a certain degree of colour fidelity, in addition to the metric reliability, could be ensured. Today, we are experiencing the need to acquire calibrated colours that become a specific theme analysis for the monument: colour must be able to be verified in space as well as time.

On the model of Scarpa's architectures that we surveyed, digital images calibrated radiometrically are used as textures to obtain a colour map.

3D models with mapped surfaces are surely the most versatile representation: mappings can be not only simple integrations of

the geometric model but they may be the result of specific analyses.

The opportunity offered by the geometric 3D models that warrants extensive further investigation and the peculiar characteristics of Scarpa's architetture lead to evaluate the possibility to realise multiscale models, that can be used on various nominal scales of representation considering not only the entire building but even each plastic detail.

fig. 4 Color calibration with cromatic table

In addition to the static images, it is also possible to use the 3DSMax animation module to create highly useful videos. While the advantage of this type of animation, as for *rendering*, is the complete autonomy in the machine movements, its limit lies in the fact that it is a representation impenetrable by any interaction in real time.

fig. 5 Inner facade of Sala Luzzato of Querini. Mosaic of rectified images for texture mapping
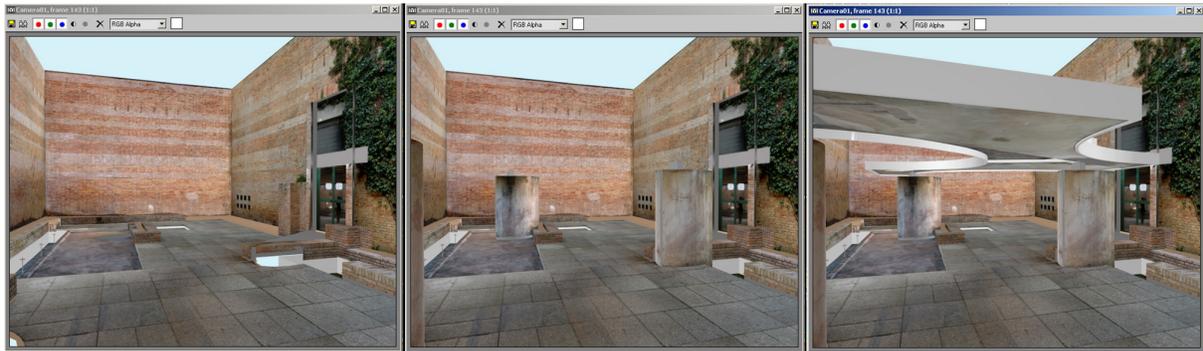

fig. 4 Textured rendering phases

Conclusions

The issues discussed above are the objective of both research and concrete applications. This situation shouldn't seem unusual since research cannot be applied in areas such as survey: the work of survey takes shape only through experience. We find the need for constant dialogue and exchange between researchers and experimenters in a process of gradually refining the techniques that fuel the definition of theoretical concepts. The rule is defined through the applications and at the same time the applications are implementing while respecting the rules.

References:

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