REBUILDING ARCHITECTURE

An analysis and critical investigation practice

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Abstract. The Cooperative Design Environment Laboratory (CoDE Lab) is carrying out a research with students, trainees and seniors who have previously participated to CAAD-assisted design courses. These courses were developed with the aim of making participants independent from the pre-analytical phase project to the renderings of the final artifact. The programs that have been used so far are Autodesk Revit, Graphisoft Archicad and Nemetschek Allplan. The teaching workgroup has always believed that analyzing, deconstructing and reconstructing the architecture teaches much in terms of understanding. If the process is done correctly, it entirely re-traces the creative dynamics developed by the original designer. Subsequently, the educational practice is to choose a notable architectural work, designed and/or created by a Master of architecture, and to reproduce it in all details: aesthetical-formal, morphological, technological, structural, modular, etc. The final result is an archive of well-developed reconstructed models of great specific interest. The students on the other hand thoroughly learn how to control the tools and all BIM planning procedures.

1. Introduction

The Politecnico di Milano, Faculty of Architecture and Society, has a strong educational and research tradition on new technologies and computer-assisted design tools. This article deals with a research carried out by the CoDE (Cooperative Design Environment) Lab with the students of the "3-D Parametric CAAD Design" class (Leonardo Campus - Milano) and
“Automatic Drawing for Architectural Design” (Arata Campus - Piacenza), with trainees and dissertationists.

Both classes deal with all the subjects concerning CAAD-assisted design, with the aim of teaching students how to work autonomously from the analytical pre-planning phase to the final rendering of the artifact. The most frequently used programs are: Autodesk Revit, Graphisoft Archicad and Nemetschek Allplan.

The workgroup, reporting to the Italian Chapter of IAI (International Alliance for Interoperability), relies on the cooperation of qualified professionals.

Focus of both classes is the main tutorial, consisting of three-dimensional reconstruction of buildings built by great masters of architecture from the Modern Movement to contemporary architecture.

Subjects of analysis and reconstruction were not the projects, but the already created buildings that supply a wider choice of sources and information.

We analyzed the formal, morphological, historical and architectural aspects.

For the time being we only deal with Aalto, Botta, Bottoni, Holl, Le Corbusier, Meier, Mies van der Rohe, Niemeyer, Ponti, Terragni and Wright. In the current Academic year we will also deal with Ando, Eisenman, Khan, Isozaki, Nouvel, Siza and Venturi.

As you can see, the subject deals with architects of great stature and professional capabilities, who based their work and their carrier on the
application of original "methods", rules and logics representing the foundation of their architecture.

These masters of architecture created currents and schools of thought because of their ideas and the substantial theory supporting their research and design work.

Students will have to choose among the architectural (or, more rarely, town-planning) works by the mentioned architects, to find an adequate bibliography with the help of teachers. The subsequent step is finding out adequate iconographic materials (drawings, sketches, photos, models, etc.) for the accurate reconstruction of the architectural model by means of CAAD tools.

![Steven Holl, Sun Slice House (Aimo)](image)

*Figure 2. Steven Holl, Sun Slice House (Aimo)*

The required level of work is not the mere three-dimensional reconstruction of the building: the analytical comprehension of the author's original designing method must also be proved and, if possible, visualized and represented. This is the only way to obtain an excellence level that 3D reconstruction alone - even a top-level one - could not reach.

Therefore the aim is not only learning how to master one or more CAAD modelers, but also learning how to use these tools to assess and understand architecture itself; a formal and geometrical, but also methodological and planning understanding.
There are also other survey levels. Those who can leverage the "multi-disciplinary" aspects offered by CAAD technologies will be rewarded.

Students should cooperate with other teachers, especially from the technological field of architecture, in order to deepen interesting aspects, such as structures, systems, bills of quantities, etc. Not being a subject of examination, of course this is not a mandatory educational aspect, but I still believe it is an important academic scope that would allow overcoming the different academic viewpoints, typical of Italian (and maybe not just Italian) universities.

2. Transformations

The simulation applied to the transformations that some important functionalist buildings have undergone during their existence. Sometimes the changes were due to a difference or adjustment of their intended use, and sometimes the changes were quite substantial and due to design and/or assembly mistakes.

We often just observed the remarkable differences between the designed and the created building.

The abundance of information also allows to understand the reasons of the project changes and to assess them from an architectural-methodological viewpoint.
This type of simulation led to a whole series of remarks on the alleged/real flexibility of the analyzed buildings and on the building techniques and technologies of the time, with their pros and cons, and we realized how experimental certain futuristic works were at the time.

3. Never created or destroyed

As far as created and lost works are concerned, we deepened only certain specific cases that seemed most interesting. This type of choice is also due to the shortage of traceable sources, thus making the real/virtual barrier too thin: we often had to interpret drafts or drawings that were too partial to deduce the whole object and we therefore had to reconstruct by subsequent suppositions.

The whole technological aspect of the building would also be further neglected, since in project representations of the past it isn't always possible to understand and extrapolate the building's structure, facilities and many constructive details. Although this operation looks quite interesting, we have not applied it very often, being "non-scientific" and unverifiable.

4. Operation and modularity

We especially analyzed the development of these architectures: how plans and prospectuses turn into volumetric drawings, where and how certain situations seem to be solved in a difficult or complex way.
The constituent proportional analysis of the modularity on which the design is based is another subject we are currently investigating, from masters of the Modern Movement to contemporary architects. We are browsing a whole series of works and looking for the expressive language of modular grids and symmetries, thus producing three-dimensional constituent morphological analyses.

5. Trends and mathematics

Another fascinating aspect, almost consequential to the previous one, has been the rediscovery of the appeal of certain buildings' analysis, which - for previous or subsequent analyses - disclosed a trend, a morphology and/or a plasticity shaped on mathematical-physical or proportional elements. The analyses and their computerized audit highlighted some very complex relationships and extraordinary design solutions.

The final result is CAAD Digital Model Archive, directed by Andrea Cammarata, which presently boasts approximately 250 models generated by means of different techniques and programs. We must also consider that the archive increase estimated for this academic year is approximately 150 additional units.

This huge 3D model archive has a limitation: it consists of models reproduced on different matter-formal investigation levels. The problem is actually partial and must be considered more as a wider view of the problem of three-dimensional representation than as an objective limit.
Because of its wide and diverse investigation levels, the 3D model, especially the 3D CAAD model, represents a frontier of IT innovation in the architectural field. We can therefore state, for instance, that two geometrically identical models can still be quite different, if analyzed from the viewpoint of resources provided by the CAAD designer.

From the analytical and project definition viewpoint of the architectural artifact, a 3D model is in fact just a geometrical representation of project stages, and it only potentially shares some common features with the model of the artifact itself, defined in its structural, matter, hydraulic, physical, economic-assessing, plant engineering components.

Geometry and physical shape represent just one of CAAD model's aspects, maybe the most significant from many points of view, and certainly the most typical.

In the near future, if time and resources allow, we will proceed to a partial rationalization of the archive content in order to make the model deepening level more consistent. We will reference some models to create a leading "standard".

The subsequent reclassification will be aimed at creating typological categories and overall interpretative case studies.

6. Dynamic projects

There are many possible future uses of CAAD Digital Model Archive, with different convincing confirmations in the field of research and education.
During a series of recent meetings of the Italian Chapter of IAI, some partners highlighted the need of applying one of the technological audits in the IFC (Industry Foundation Classes) environment.

More specifically, we should start by testing the capturing, importing and exporting steps of the different existing parametric CAAD modeling programs. The aim is validating the often mentioned, but less operatively verified compliances of the various modelers with the IFC standard, but also checking on-field compliances and possible mutual interactions of the modelers themselves (based on other formats).

We will then proceed to deepen the subject of compliance of the IFC standard format with other programs dealing with metric calculation, structural calculation and energy rating of the building. "How to" guides will be published in order to convey well-finalized information on the subject to third parties and to interested users. The wide range of available models is certainly interesting for this kind of operation.

The workgroup has been participating for almost a year, also with the mentioned models, to the MACE European project http://portal.mace-project.eu/ and http://portal.mace-project.eu/demos/.

MACE (Metadata for Architectural Contents in Europe) is a EC-funded research, “eContentplus” program. Its aim is developing architecture e-learning methodologies, by supplementing and relating a plethora of existing content, already saved in digital archives and/or databases.

MACE is aimed at indexing the contents of all Learning Objects saved in the system with an approach based not only on the features of the medium itself, but also on the contents and the concepts it hosts and conveys.
MACE will supply users (students, teachers, researchers, professionals, public administration) with a service for the research, acquisition, use and discussion on e-learning contents that were previously dedicated only to small user communities. The development environment is IT and especially metadata.

The MACE consortium consists of eleven partners from academy and industry. It builds on the WINDS project (Web based INtelligent Design tutoring System, an EU-funded E-Learning Platform containing 21 courses spread over Europe. It offers an on-line Virtual University for Architecture and Engineering Design through cognitive approach application to teachers' Course Authoring and Students' design modeling), in the ARIADNE Foundation (one of the early pioneers on a vision of “share and reuse” for education and training has a large amount of heterogeneous content objects and thus makes ARIADNE a good environment for trying things out like Federated Search and connection of distributed content repositories), in the ICONDA (Fraunhofer IRB - Information Centre for Planning and Building - hosting 650,000 references and referencing 300 journals monthly - offers databases for online utilization divided into three categories: bibliographic databases, full text databases and research project) and DYNAMO (Architectural Projects Repository - multimedia platform filled with an ever-growing collection of concrete design projects, in the field of architecture, offering students/teachers and professional designers a rich source of inspiration, ideas and design knowledge - K.U.Leuven, complemented with 5000 learning objects from many different universities worldwide through ARIADNE and the GLOBE network of learning object repositories).
The CAAD Digital Model Archive contents will shortly be indexed within the PiacenzaLabs repository, presently at an advanced development stage. The project uses different types of metadata to rank contents: traditional and ontological, media and contextual, linked to skills and planning processes. Such metadata are compatible and consistent with the pattern outlined by the MACE project. Once started, the Piacenza database will be Web-linked to the integrated MACE filing, indexing and searching system. Its intelligence will therefore be widely available and coordinated with MACE knowledge (at a European level).

Due to the nature of the Internet and the lack of intellectual copyright protection, the three-dimensional models will be available only in 3D DWF, DWFX and PDF formats, which for the time being seem to be the most secure.

In 2008 the CAAD Digital Model Archive also participated to the eContentPlus Call for Project of the European Community with the paper “ARCHISTEMA. A multidimensional system to elicit and build knowledge using repositories of architectural objects in learning scenarios”.

The purpose of the project is to facilitate access to shared educational digital contents in the field of architecture, allowing learners (students and teachers, professionals and non-professionals) in different contexts (formal and informal education, vocational training) all over Europe to elicit and build knowledge (building design solutions, environmental influences, construction techniques, energy performance) interacting with a wide range of repositories.
A diversity of contents (texts, images, animations, videos, 3D models…) from existing architectural repositories developed in previous research projects will be integrated through innovative learning strategies that promote participation of the different learners in the elicitation of knowledge stored in the digital repositories. In these educational contexts, learners will contribute to increase the quality of the content of the existing repositories, as well as provide new content.

The metadata gathering techniques developed in the MACE project will be refined and improved to retrieve content from a variety of repositories and to combine them in meaningful architectural learning objects which encompass different forms of representation (texts, images, models) of architectural objects. Besides textual tagging, visual metadata will be introduced for the concept classes that turn out to be the most suited to be conveyed by this language.

The outcome of the project will be the creation of a multidimensional (multiple kinds of contents, multiple types of users, multiple learning activities) structure integrating architectural repositories with educational activities. This structure will work as a collective memory, which will allow learners to enlarge their knowledge by recognizing, grasping and relating the contents in a variety of educational scenarios, from case study analysis to design. Specific educational tools will be developed based on the index structure (MD) created in MACE to exploit the conceptual association mechanisms and support the principal learning paradigms. Through the implementation of the educational activities, the project will contribute to
promote understanding and appreciation of the wealth and variety of the architectural heritage in Europe.

Figure 11. Mario Botta, Monte Carasso housing (Pascucci)

7. Future possibilities

Among other possible uses we could mention:

7.1. MONOGRAPHIC VIRTUAL EXHIBITS OF MASTERS OF ARCHITECTURE

Thinking to organize monographic virtual exhibits on the mostly dealt-with architects of the archive, some of the Modern Movement masters are long deceased. A tribute with temporary or permanent online exhibits of their works could be a good cultural operation if supported by a proper cooperation with the disciplinary scientific field of architecture history scholars.

The possibility of making the models interactive and servable (through special downloadable plug-ins) could make the experience much more involving and educational.

The possible cooperation with foundations that are presently spreading and preserving their works and their memory could turn the project into a global large-sized and interesting operation.

7.2. PERMANENT VIRTUAL MUSEUM OF MODERN AND CONTEMPORARY ARCHITECTURE

An alternative to the previous proposal, if too fragmentary, could be the creation of a virtual museum of modern and contemporary architecture. Also in this case the cooperation with modern architecture history scholars would
be essential, in order to deal with all the related subjects with the utmost precision and the deepest investigation. In this case the effort and the burden would be justified only by a project of a permanent virtual museum, modularly conceived in order to be updatable and expandable.

Figure 12. Mario Botta, Rotonda house in Stabio (Vitolo)

7.3. SPACE IN THE 20TH CENTURY DESIGN

To organize a shared online virtual space for the study of the architectural space designed by masters of architecture, the use of navigation and interaction tools on the architectural models is mandatory to this aim, in order to exploit the digital building mockups and to fully appreciate their logics and the subtended planning method.

7.4. EDUCATIONAL TOOL FOR IN-DEPTH STUDY OF THE INDIVIDUAL ARCHITECTS

To design monographic lessons aimed at investigating the architectural design technique and theories linked to an individual and specific master of architecture, it will be possible to navigate the architectures, by means of the three-dimensional approach. CAAD technologies will allow to carry out in-depth multi-disciplinary investigations on the architectural artifact.

References

Pevsner, N., 1949, Pioneers of Modern design from William Morris to Walter Gropius, NY.