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### The Urban Simulation and Projects Evaluation Laboratory at the Politecnico di Milano: An Educational and Research Facility

At the beginning of 2007 an Italian Urban Simulation Laboratory was founded at the Politecnico di Milano, Department of Architecture and Planning. The laboratory, coordinated by prof. Fausto Curti, has been developed thanks to the one year presence of the visiting professor Peter Bosselmann, professor of Urban Design and director of the Environmental Simulation Laboratory at the University of California at Berkeley. The laboratory has an interdisciplinary approach and a threefold mission: to *experiment*, using the laboratory setting to study urban projects at different scales; to *communicate*, aiding public communication by making urban projects understandable to everyone; to *integrate and innovate*, working on different kind of simulations techniques in an integrated way to support knowledge about the dynamics of city changes.

In its initial experience the laboratory is primarily a didactic and a research facility. Students can join the work and participate actively to the research. Until now about 40 students have worked with us, more than a half were foreign students from all over the world. The majority of them did an internship of about 150 hours (bachelor of science) or 300 hours (masters of science and specializing masters) and some of them have continued working after this period developing a thesis. The provenance from different courses degree and years of attendance provides the opportunity for exchanges among the students otherwise hardly feasible.

The work at the laboratory has a weekly attendance over two days, preferably consecutive. This allows to work with greater continuity and helps to create an environment similar to the professional one. Students work is not an end in itself but is part of a broader research already under way in which they feel involved; this is an important stimulus which often led to increase their initiative and creativity. It is not unusual that after the internship period they ask to go on with a thesis that becomes an occasion for developing some research topics as well. Even after being graduate some students continue to keep themselves informed about research progresses and a few of them have continued to work at the laboratory and are now colleagues.

At the moment the case study, used as a pilot research, is the Porta Nuova project at the Garibaldi-Repubblica area in Milan. The 300.000 square meters of the total area and its well served central position make this place strategic for Milan. In this area the adopted urban transformation plan is creating a new business



Figure 1: The Garibaldi-Repubblica area in Milan. In evidence the Porta Nuova urban transformation project



Figure 2: The use of the microcamera inside the maquette

Figure 3 (opposite): Milan skyline from the top of the Duomo cathedral: existing and future condition

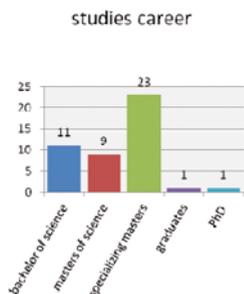


Figure 4: Analysis of the students' background (upgrade 2009)



Figure 5: Maquette at 1:500 scale of the Porta Nuova project in Milan



Figure 6: Approaching the Porta Nuova project from corso Garibaldi: frame extracted from the video

center that embraces redevelopment projects, new infrastructures, and a park. The overall project will overhanging the surroundings city center with some of the highest buildings of its skyline; following a common trend, the skyline of Milan will change from the typical horizontal one to a new vertical one. As a matter of fact the Porta Nuova project is just one of the urban transformations of the city that will be developed in height, a subject that does not have a long and consolidate tradition in Italy. This reveals the urgent need for our country to develop some tools and approaches for supporting evaluations for this kind of transformations.

The importance of the site and the dimensions of the project make this case significant to test the use of simulation for supporting evaluations concerning morphological aspects, comfort conditions, visual impacts, and other features that directly influence the quality of the new urban spaces. We are now applying different simulations in order to better understand the peculiar usefulness of each type as a tool to support evaluation. Since any kind of simulation has its own limits we work with different typologies at the same time.

We modeled 1 km<sup>2</sup> of the project area both in a virtual and in a physical way (1:500 and 1:1000 scale). Three-dimensional models represent a fundamental part of the work for many reasons: they allow to bring a portion of the city inside the laboratory setting, they make it possible to test future development proposals or different alternatives in their context, and they are the basis for achieving different types of simulations.

Physical models in particular support the discussion and the sharing of ideas about the morphological changes of an urban area, with a concrete reference at hand. The advantage over digital models is that physical ones do not require a specific expertise to be made, especially when the scale of details is that of micro-urban; this provides a nonselective involvement of students in the laboratory work and ensures an active participation. Furthermore, physical models can work as a reference for testing the accuracy of views, and in doing this they give transparency to the other simulations. Moreover, physical models help students to develop the sense of scale. The observer can see the whole (maquette) in a glance or choose to look at it closely maintaining a correct sense of the relative size, while in digital models views are confined to the screen size and the user need to pan and zoom in order to observe the urban area at the desired distance.

The use of photorealistic facades provides a proper sense of proportion and ensures a greater sense of reality that put the observer within the urban scene. The production of facades images with simple tools takes long time but allows students to learn some techniques and improve their ability in using software that they will currently use in the profession. This is even more important because our study program includes only few and basic software courses. In the first stage of the internship at the laboratory students cooperate to this assignment, that allows them to be gradually involved in the research, to better know the study area, and become familiar with the teamwork.

Hundreds of photographs have been taken on site to reproduce the existing condition of the urban fabric. Texture for the building projects were created from similar existing facades. Ideally, each student is responsible for an entire block, he has to take pictures, model physical and digital volumes and put on it the facades and roof images at the correct scale. After this first stage we are able to decide together how to go on, trying to identify an exploration which is useful for the research program and at the same time that reflects and stimulates students' interests.

To better understand the cumulative impact of the design project we have identified some representative points of view both at the local and urban scale and we have produced different types of simulations. The comparison between the existing and the future condition allows students to better understand city changes and the implications of the design project.

Two-dimensional photomontages of static images have been used in different ways. At the city scale we chose panoramic views from symbolic urban places. Zooming in at the local level inside the context, we tried to understand how it will look like to walk along the site. For achieving this goal we used different typologies of simulation that can reproduce a sense of motion. The simplest type consists in sequences of photomontages of different walks towards the project, but we also used video techniques.

For this purpose we developed, with a private firm, named Betanit (held by an architect and an engineer graduated at the Politecnico di Milano), a semi-mechanic micro-car that allows to move a micro-camera inside the physical model. The machinery is hand-held and allows to make real-time subjective dynamic views in the laboratory setting. This tool is used to explain project implications to students or to identify interesting and representative points of view which require a deeper study. It is



Figure 7: Approaching the Porta Nuova project from corso Como: sequence of photomontages

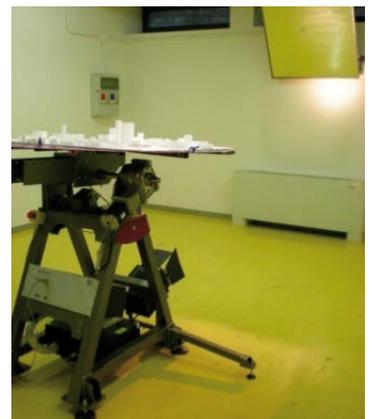


Figure 8: The Heliodon



Figure 9: Shadows' simulation using the 1:1000 scale maquette inside the heliodon: future condition



Figure 10: Shadows' simulation using the digital model: future condition

1 Canzanella, Nicola, Secchi, Francesco, Simulazioni urbane del progetto Porta Nuova: confronto tra tecniche, relatore prof. Fausto Curti, correlatore arch. Barbara E. A. Piga, tesi di laurea triennale in Urbanistica, Politecnico di Milano, a.a. 2007-2008

2 Signorelli, Valerio, Metodi di simulazione energetica e climatica alla scala microurbana. Un approccio sperimentale e un'applicazione sul progetto Porta Nuova, relatore prof. Fausto Curti, correlatore prof. Gian Luca Brunetti, tesi di laurea specialistica in Architettura, Politecnico di Milano, a.a. 2007-2008



Figure 11: Shadows' simulation using the 1:1000 scale maquette in the heliodon: future condition

also possible to shoot videos that can be showed in other occasions, but the final video quality is not totally satisfying, and the eye level of the micro-camera still needs to be adjusted. Nevertheless, the device is really useful in the firsts stages of evaluation, because it allows to test in a very immediate way different points of view, to identify the most significant views, and to compare the visual impact of project alternatives. Other techniques can better show the dynamic perception of the urban future.

To achieve this goal two students, who have done their internship at the laboratory, developed their bachelor of science thesis trying to experiment the use of cinematographic techniques for urban studies purposes (1). To reproduce in a better way some relevant walks through the transformed site they have produced some videos obtained by superimposing the real existing context and the virtual projects. In order to have a stabilized video an operator filmed a promenade through the context site using a professional steady-cam. With the same point and angle of view students produced an equal video-render from the 3D digital model that was superimposed to the real one. Volumes of the existing condition were rendered with the project in order to verify the correctness of the superimposition. Details of the existing area make the outcome very effective and clear. The result was amazing even if the quality of the project rendered was not so good.

Another student, who did his internship with us, developed a master of science thesis comparing different typologies of simulation techniques to evaluate comfort conditions (2). In particular, he explored the theme of shadows' impact using the *Porta Nuova* project as a case study. The 1:1000 scale model was used in the Heliodon to analyze the effect of shadows cast by the projects on public spaces; the results of this analysis were compared with similar simulations carried out from the 3D digital model, which confirmed the reliability of simulations and pointed out some projects deficiencies. With this thesis we have started an interdepartmental collaboration that has the goal to promote the laboratory as a place of convergence for an integrated approach of different disciplines that traditionally work in a separate manner.

We have recently started to work with the wind tunnel to understand some other comfort implications of the project at the micro-urban scale while with other students we are developing other kinds of analysis about public spaces, green structure and

sound. In the future we would like to use the laboratory setting to test its usefulness in supporting the design phase.

The multilayer and interdisciplinary approach of the laboratory, while improving the knowledge about the correct use of simulations, contributes to clarify to students the multidimensional impacts of urban projects. In this way the laboratory preforms as a learning set, stimulating the creative process of design and supporting the assessment of the cumulative implications of different aspects of projects. We hope that in the future the laboratory will be also used to support urban project evaluations for professionals and administrations.

**Figure 12:** Milan skyline from the top of the Branca Tower: existing and future condition

**Figure 13:** Skyline of the Garibaldi-Republica area from the 26th floor of the Pirelli building: existing and future condition

