

Solid Modelling by Low-cost Hardware and Software: The Crystal Palace's Node.

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Summary

This paper describes the approach to the solid modelling by low-cost hardware and software, developed by a workgroup composed by staff members, young researchers and students of the University of Naples - Faculty of Architecture. The work was born in need of exposing to the students the project of Crystal Palace, designed in 1850 by J. Paxton, and used in the Italian universities as an example of first prefabrication by components and the organization of the yard. Using commercial programs and the students's computers, we had done a 3D model of the Crystal Palace's structural node, making an interesting experience based on the cooperation between university structures and private resources.

The context

The faculty of Architecture of Naples has, every year, over 1000 new students, and the total amount is about 7000 units.

A small part of them (5-6 per cent) has a medium-low experience about computer systems, but it is possible to come by some students with very high capabilities of programming and solving hardware problems.

The rest of students doesn't possess any possibilities of making make experience, during the university studies, about computer systems, because we haven't specific courses or informatic laboratory.

The only possibility is offered by an semi-external course about Computer Aided Drafting, for 70 students that can use 3 computers.

In these conditions every attempt of teaching CAAD is destined to fail.

However a small group of staff members and researchers is trying to diffuse the use of CAAD for teaching and designing, for experimenting, by the free collaboration of volontair students, alternative forms of co-operation.

The Subject of the Research

The Crystal Palace, designed by J. Paxton and built in 1851 for the Universal Exposition in London, is often used as the first example of prefabricated components and represents a new deal for the architectonical design and the yard organization. The work was composed of modules of 42 feet for 42 feet, tested before mounting and assembling by special equipments, designed for this specific use. The construction is one of the biggest never built in the world. The structural node between the beams and the pillars, pivot of the module and, consequence, of the whole construction, coming out from a very simple idea, has a not immediate understanding.

Which Was the Need?

For this reason we began thinking about a new way of representing it, that allows us to teach the students the shape of this component, the relations between them and the others and the mounting phases and the machines built for this purpose.

The Possibilities

To make that, we began listing several possibilities:

- a) To use a 3 dimensional wood, steel or polystirol model.
- b) To use assonometrics drawing, sections and plants,
- c) to use a 3 dimensional model made by a specific software program.

The first choice required high ability of working with many technical machines and an appropriate manual experience.

Even if this model gives the possibility of making a very affordable model, assemblable and de-assemblable with facility and, a very important aspect is to test our right interpretation of the original drawings.

This way was lost for the absence of the working laboratory.

The second choice is the traditional choose, very simple to make.

The final product, in this way, could be a poster or a schematic diagram, assembled, may be, in a course book.

This way was lost for the possibilities given us by a third hypothesis.

The third choice draws mostly the interest of the students for several motivations:

- The students are very interested in using a new presentation media.
- The students could have the possibility of observing the model in a very simple way, both assembled and in pieces.
- Some of the students have already an experience in using computer and software.
- We have the possibility of testing, by three dimensional models, the right interpretation of original drawings.
- The students have the possibility of observing and plotting the object from never ending points of view.
- The synthesis images have a high attraction for the students.
- The possibility of creating a movie by synthesis images (a coming out later aim)

Made this choice we ask ourselves: what kind of organization have to follow.

The Resources

The hardware resources

Our group is a young group, and we haven't our own computers, programs and workrooms. The computers and the programs are shared with the Department, and even if we are the principal occupyngs of the laboratory, we have a low disposability of operators place. For this reason we can't give a large number of students the possibility of learning and training the use of computer systems. We must, for logical motivations, choice the students with a deep experience, and, if possible, to place, side by side them, some beginners. We haven't workstations or minicomputers, such as Sun, Silicon Graphics or IBM RISC Series. Our laboratory is simply composed of:

Hardware:

- 2 Intel 486 computers based, 33 Mhz, 8 Mb ram, S-VGA card, 210 Mb HD
- 1 plotter Hewlett Packard Draftmaster MX
- 1 Color Printer Hewlett Packard XL-300
- 2 Digitizers

I would underline we have also numerous Apple computers, but we preferred the PC based system for the large diffusion that this system has with the students world, in comparison with the Macintosh systems, may be most user-friendly, but not very diffused.

The software resources

The computers we have in our department laboratory are PC- IBM compatible and the software installed in them for solid modelling, 2D and 3D drawings and photorealism is very common and *known* (the sense of this last assertion will be cleared later on). All these programs are in educational version, and they have cost like these only for the educational structures:

-for 2D and 3D drawings, about 730 \$*

-for solid modelling, animation and photo-realism, about 615 \$ [*]

[*] This price is available only for Universities and Educational Structures, not for the students.

The Human Resource

Which kind of students are working with us?

As a matter of fact there are many people studying at University whose capability in working on computers goes lost. Most of them are self-taught people and as they own a PC IBM-compatible (386-486) on which they work at least 2 or 3 hours per day, especially in the evening.

The problem is that in this way they waste a lot of time training on unproductive objectives, such as photorealism, solid modelling, computer aided drawing, programming, videogames ...

The unproductivity is due at the fact that their experience is not shared with others students, which could work together on a common aim.

Then we choosed 6 students with medium-high capacity of working on computer, selected by a colloquial and founded by a list made during an experimental seminary on CAAD made in 1992 by us.

The organization of work

The first step was to take more material, if possible, about the Crystal Palace, searching in books, reviews and specialized publications.

Even if we found several sources, the level of deepness of that was not sufficient to began the realization of the 3D model of node.

We must looking for in the original books, kindly given us by British Council of Naples, to find all the information concerning the structure and the construction phases.

Later we shared the six students in two equal groups: the first one worked about the system pillar/joint, and the second one about the beam and the wind-bracing.

The work-place

At the first we tried to work in our laboratory, but too often we had to give it up for the following reasons:

-There are not enough computers (just 2)

-Our laboratory and work-room is used also for others activities so that it is always very crowded and not quiet enough.

-The students work with us without any rewarding. They use, for this experience, our free time, that is concentrated in the night hours, Our department open at 9:00 a.m. and close at 7:30 p.m., they are hours incompatible with the students free-time, concentrated in the last hours of the day.

-The students prefer to work on their own computers, with their own organization and their favorite times.

Every group organizes him-self the meetings between the components and has a meeting with us every one or two weeks in the department.

In this meeting we spoke about the problems concerning the right interpretation of the original drawings, their modellization by software and others.

If the pieces, observed in the meeting, were tested rightly, this was copied for distribution to all the students, which have the possibilities of using it for the next phases.

This way gives us the certainty of working all in the same "virtual space", even if it is shared in single computer not linked with others.

To do that is necessary for all to work all with the same software.

And to work with the same software we might have bought all of us the same software, and that is not true.

The illegal software problem

How is it possible that the students that work with us know software programs, costing from 3500 \$ to 6000 \$ (list prices), so well ?

How is it possible that a student, compelled of buying a "assembled compute" for economical restrictions (spending about, for a 486 about 1600 \$) , knows many programs for a value of over 20.000 \$?

The answer is in the parallel distribution of the software, in piracy and the illegal sale.

This isn't a local problem, but it is a worldwide habit.

But the students, from my point of view, are justified. They do not use the software for external uses, like work or piracy, and simply training on the use of.

And for training it is not possible paying 3 or more times the price of the computer, expense very heavy.

We would have liked to land our software, but this possibility was rejected: the license of the program is propriety of the University, and the license can't go out of the department.

We asked the software house, and the answer was that the programs can't be lent out.

Even if the University would have bought and give the students them, it is not allowed to because the license doesn't permit that.

This is, for us, an incredible mistake, because the software, in Italy and also in all Europe, is protected like a book, or any artistic work.

To borrow a book at the University Library I need not a license: I can get it for a lot of time, I can read it and I can give it back when my work is over.

If the software is protected like a book, why can I not brought it ?

Maybe a proposal to put on sale educational versions addressed to make a "University Software Library", in which every student could take the product he needs.

In this way the students could realize the importance of original copies, using original manuals and consulence on-line, and we can concentrate our expenses on the software and not on the hardware, that have high costs and rapid obsolescence.

Conclusions

Now we are working for ending the work, but the intermediate results are very encouraging.

- The students have high autonomy about the organization of work, and the improving of the performances, when they work on their computers, is considerable.

- The students are working in a "common virtual space", linked with "weekly net", that takes form during the meeting in the department.

- The students have begun a collaboration each other, and they shared experiences, suggestions and advice.

- They are very enthusiastic for the results obtained by this first experience.

- The students have a very deep knowledge about the structure of Crystal Palace and the construction phases.

- They proposed the possibility of making a movie about the decomposition of the node, sharing the rendering time on the computers we have at disposal.

We have also made a critical discussion about the problems of the illegal copies, and the Students are very interested in solving this aspect. They are disposed to buy original programs, but the condition is the lower of the price of the educational versions. The actual price of the educational version (if present) is often too high, they say. We hope, in the future, to make them in need of returning in the right way.

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