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Complementary Digital Visual Manuals of Installations under Construction

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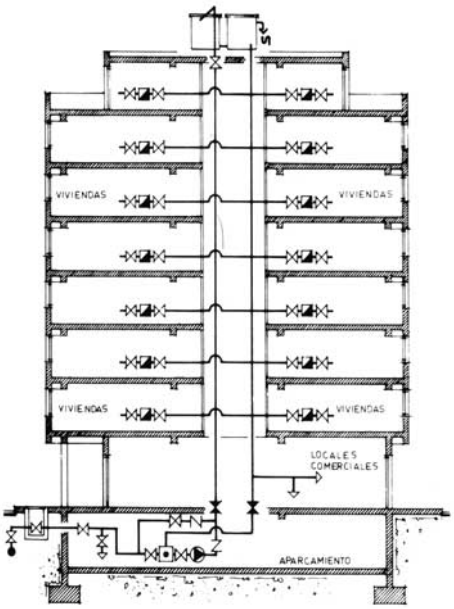
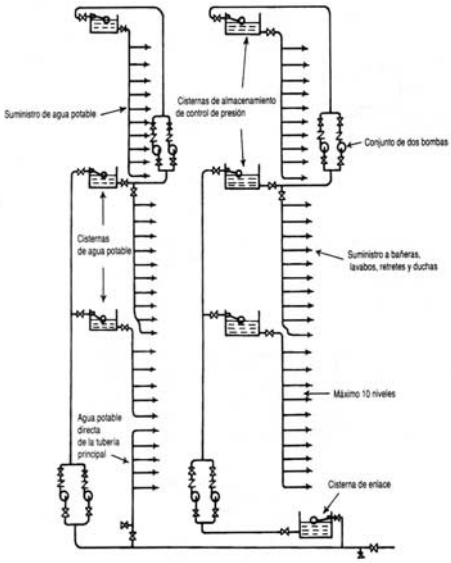
For years, the teaching of installations in Architecture in Spain has been characterised by the use of methodologies based on theoretical presentations complemented by manuals drawn up by the teaching staff themselves. Everything related to the design of initial diagrams tailored to the requirements and spatial characteristics of buildings and later sizing of the installations was normally resolved in practical classes.

The positive values of this methodology are:

1. The in-depth treatment of the design criteria of the initial diagrams.
2. The relationship between the basic physical characteristics of the fluids transported in the installations and their implantation in the conduits of the building.
3. The appropriate presentation of the demands of national and local regulations to be applied to the installations.
4. The easy theoretical and practical development of the scaling of all elements making up the installation.



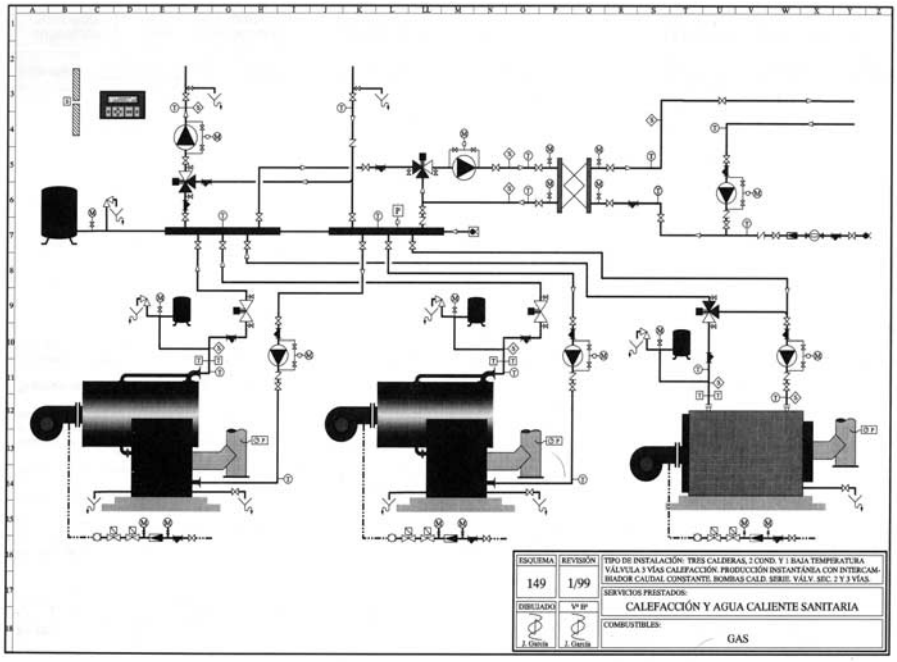
Esquema de instalación con grupo de presión y depósitos en terraza.

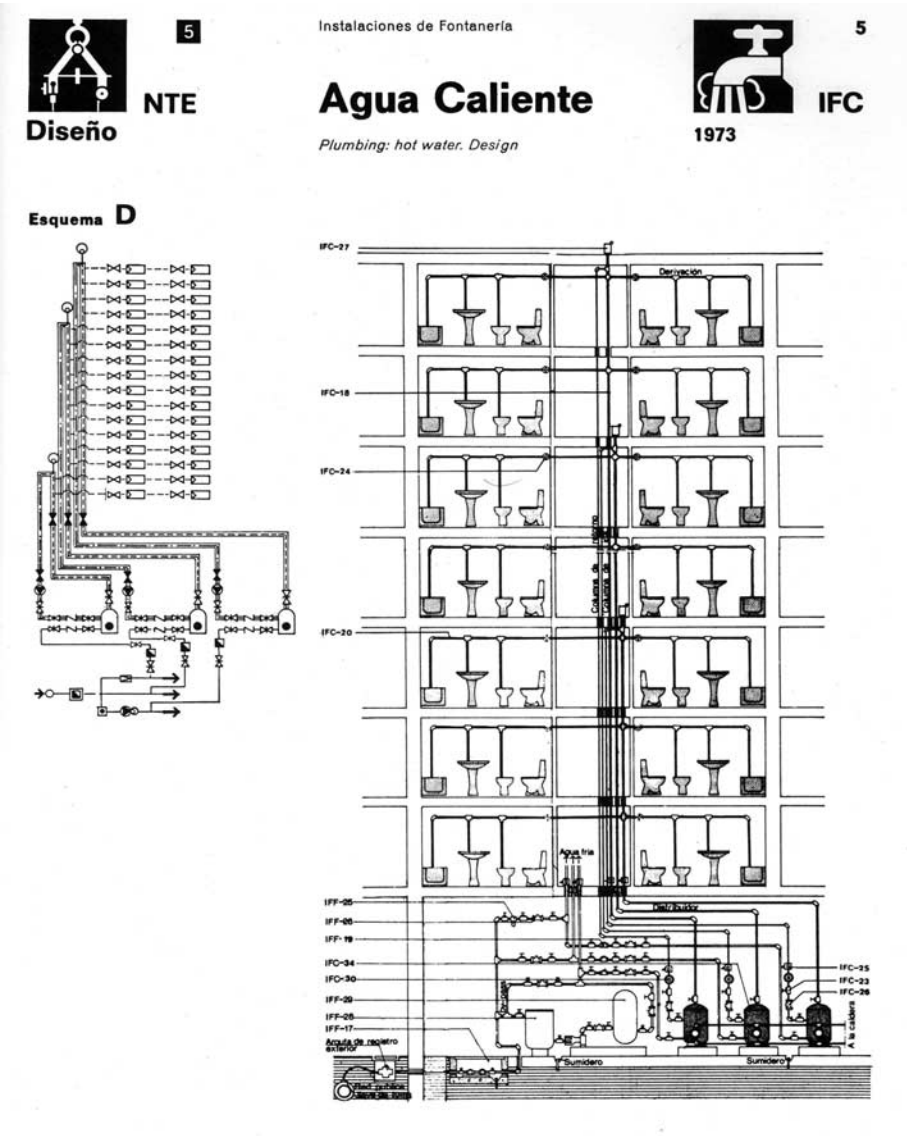


Sistema de suministro de agua para 30 niveles.

However, I have identified certain deficiencies in my experience as a teacher and I believe that my opinion is shared by many of my colleagues:

1. Its assimilation as a teaching methodology for Industrial Engineering and Architecture degree courses, with a total absence of its implications as regards architectural design: floor to ceiling height, false ceilings, the appearance of visible installations, etc.
   Here I would like to mention that, in practice, this terrain is shared by both degree courses in Spain, although the Architect is responsible for the project and the execution of said installations, often shared insofar as civil liability is concerned. However, the Architect, as is my case, can take responsibility for 100% of the installations, except for the Common Telecommunications Infrastructure.
2. Calculating the spaces required to house the equipment, conduits, consumption measurement devices, their arrangement on each floor, service shafts, etc.
3. The absence of training in those aspects associated with the physical execution of each of the installations and their later validation and legalisation, as well as their integration in the overall process of the works and their coordination with the rest of the installations.
4. The problems involved in understanding and following complex initial diagrams, due to the impossibility of enlargement, the use of colour, the limitations of the symbols used, etc.
5. The lack of correlation between the installations described in the manuals and the real elements, mainly due to the lack of images and their low quality.





Six years ago, concerned with the above-mentioned failings, we at the Installations Unit of the Architecture ETS at the University of Alicante began a number of complementary teaching activities aimed at bringing students closer to the reality of the material execution of the installations and their implications for architectural design:

1. Site visits for small groups.
2. Visits to especially interesting buildings on the campus itself.
3. The creation of an installations laboratory with some didactic panels in the Architecture building itself.
4. Photographs of our own works and certain buildings, especially interesting for their height, design quality, the presence of services galleries, etc., in order to facilitate student understanding, etc.

The result of the introduction of these teaching tools was positive, especially as regards air-conditioning, plumbing, sanitary fittings and natural gas. However, we soon came up against the problem of implementing the site visits in the light of the substantial increase in the number of students in class: it simply became impossible for us. In addition, the laboratory is clearly unable to replace said visits, and the same is true of the photographs. The latter are highly didactic but they have no continuity over time: students cannot handle them personally to learn through carrying out their own tasks later. Even if they did have them, they would be able to extract very little information from them.

Aware of the emergence of new teaching technologies, we soon began to research their application to teaching installations in Architecture. We presented our proposals to the call made by the University to foment the use of new technologies in creating new teaching manuals. The Vice-Rectorate for European Convergence and Quality financed the project entitled "Visual Teaching Manual for Plumbing Installations in Building", which I had the honour of directing and that we finished last March. The tools used mainly consisted of the Macromedia Flash program, a digital video camera and a digital still camera.

The aims of the project were as follows:

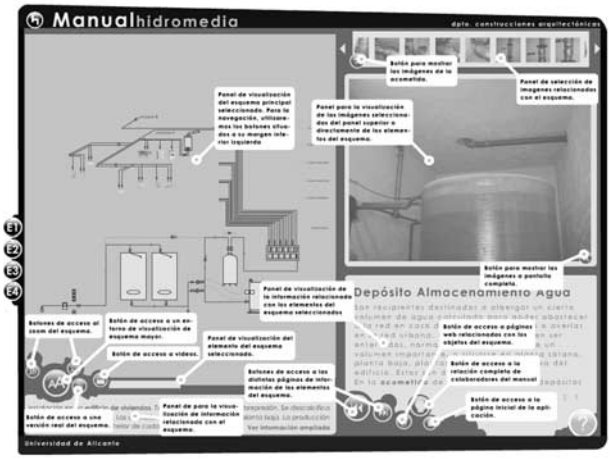
1. Firstly, to complement the teaching manuals with real images of all the components in the facility in an interactive way by using the corresponding "initial diagram", the explanatory texts and the photographs, thus greatly facilitating access to the on-screen information.
2. Secondly, to explain the process of executing these facilities in all their stages with these images, relating them to the construction of the different parts of the building, taking into account spaces for storage, circulation, etc.
3. Thirdly, to experiment with a new teaching methodology, in which the student has the same tool on his computer as the teacher uses in his theoretical explanations in class, so that he can follow the explanation with his laptop and experiment personally.
4. Finally, to give students access to the websites of product manufacturers and all the technical information that said websites usually offer. All in all, to take full advantage of the abundant information available concerning technical specifications, functions carried out, dimensions and costs.

Given the fact that it would have been very ambitious indeed to try and cover all the installations in the project, we simply decided to create a digital manual that complemented those already available for cold and hot water. This experience allowed us to assess its effect on the learning process for the next steps: sanitary fittings, air-conditioning, natural gas, heating, etc.

I would also like to underline the fact that, in my opinion, those being taught in the Architecture department are used to using computers intensively and having access to all kinds of information on Internet, and demand new methods of teacher-student interaction, other ways of transmitting knowledge, other means of becoming involved and interested in the unknown and they have to discover for themselves that something is worth making an effort to do so. In this sense, we considered the type of teaching tool chosen to be the right choice.

At this time, I think it would be best to show some images and aspects of the manual we created, so that you can get a more tangible idea of the features that I have described very briefly in the previous slides.

There is a general introduction and a help button that explains the structure of the manual and how information can be accessed through each of the buttons.



The manual describes four independent installations, each with their respective initial diagrams:

1. A building for dwellings, with a ground floor and five upper floors, with storage tanks, hydraulic pump unit and centralised array of meters. The whole installation is pressurised. Hot water is produced individually in each dwelling.
2. An office building with a ground floor and twelve upper floors, with part of the system under direct pressure and part pressurised, flush valves in the toilets and sanitary hot water with storage.
3. A hotel establishment with descaling throughout the installation, cold water storage tanks for the network, centralised meter and centralised hot water production with storage in tanks. Said sanitary hot water production is combined with

hot water heating by radiators in bathrooms and fan-coils in shared areas and bedrooms. The whole network is pressurised.

4. A tall building, possibly designed for use as offices or as a hotel. Given its complexity, said initial diagram is divided into two. In the first place we have included a very simplified diagram that helps to understand the working of the pressure stages and the production of sanitary hot water. The second diagram is much more detailed and describes a real installation in a 52-storey building, with four hydraulic pump units, four sanitary hot water production boilers and sanitary hot water storage tanks on four service floors at different levels.

The technical difficulty increases with the initial diagrams. Each contains a brief description that shows their key organisational and operational elements.

All diagrams have in common a photographic description of the layout of the urban infrastructures and their connection to the installations into the building.

The whole installation is photographed according to the order of its elements, meaning that it can be accessed by means of a strip from which you can select and view each of the images. In certain cases the installation can be viewed as it is being executed, allowing students to recall all the explanations given in the theoretical classes and organise the different stages required for implementation. Later, a large number of photographs show the final status and finished condition of said installation in normal use. We can see this in Diagram 1, showing the building for dwellings.

Diagram 1

It is interesting to analyse the way the information is accessed from the initial diagram. The zoom provides flexibility and allows the diagram to be studied in detail. Each element is linked to a real photograph of said element, a text explaining its function and other technical specifications that should be borne in mind and, finally, direct links to the websites of the manufacturers of the elements described.

An example of this can be seen in the installation diagram for the building for dwellings. Next image shows a centralised set of meters. As well as the photograph and the explanatory text, we can follow a hyperlink to view the technical specifications of a particular manufacturer.

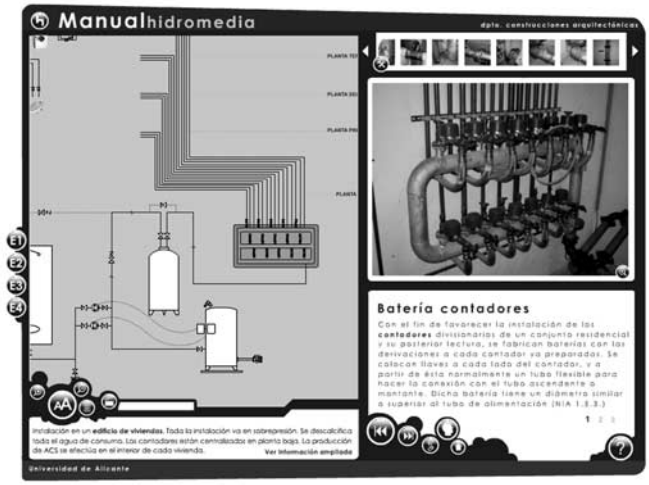


Diagram 2

Diagram 3 refers to a hotel with centralised sanitary hot water and heating by hot water radiators. All the diagrams include videos of the installation rooms. They allow students to get an idea of the scale of the spaces and volumes required to house the installations, as well as their organisation, pipe crossings, space required for boiler maintenance, etc.

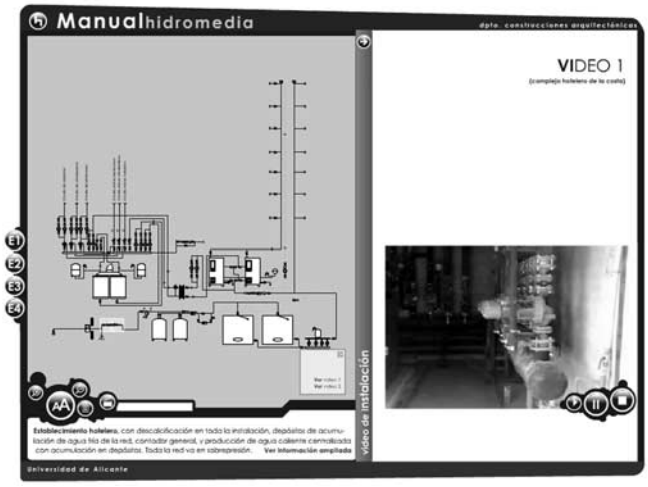


Diagram 3

Diagram 4 is the most complex of all. As we have already mentioned, it refers to a tall building. It has been divided into two diagrams. The first is simpler and is aimed at giving students an overview of how the initial diagram is organised. The second shows the complete installation as it really is.

For example, we can view a video of the room housing the pressure arrays, which are very complex in this case, with water at pressures of 6 Kilos, 10.5 kilos, 14 kilos and 18 kilos. The first array consists of six 25 m^3/hr, pumps, the second has three 13

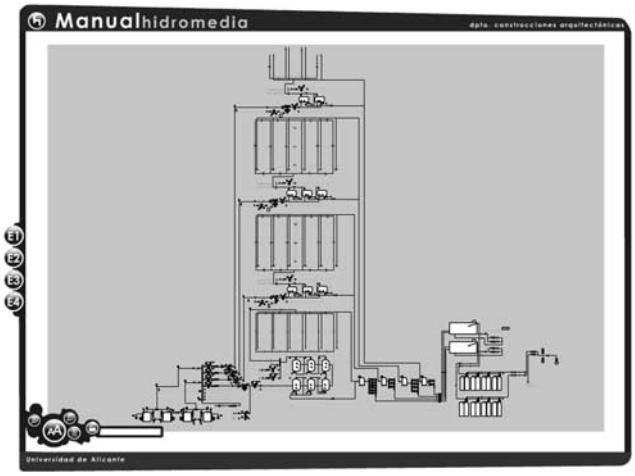


Diagram 4a

m^3/hr. pumps, while the third has four 13 m^3/hr. pumps and the fourth has two 15 m^3/hr. pumps.

We can access the pumps through the initial diagram, with hyperlinks to the web-site of the manufacturers - Salvador Escoda, or to the hot water storage tanks, with a capacity of 5,000 litres each.

I think it is not necessary to carry on browsing the manual, so to conclude I would like to say that up to now we have been unable to apply the manual to a complete academic year – we will start using it as an educational tool in the year 2005/06.

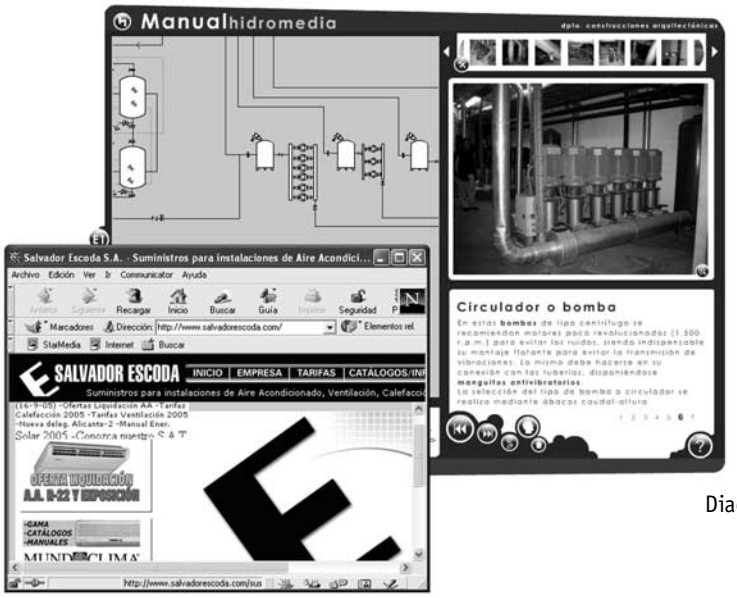


Diagram 4b

However, we have been able to verify its effectiveness with a selected group of students.

We evaluated it using our normal evaluation systems: the drafting of a water installation project for an existing building chosen by the student – a work published in an architectural review – and in the practical work carried out in the workshop every week.

Here I would like to enlighten that at the beginning of every academic year we post on the virtual campus all the practical exercises students have to submit at some stages during the year. Besides these specific exercises students have to design all the installations included into the subject through an initial diagram tailored to the requirements and spatial characteristics of a review published building, and later to size the installations previously designed. They also have to draw these installations over the floors and elevations.

As a teaching and practices complement our students have also to fulfilled two reports about the physical execution of each of the installations which should include initial diagrams, photographs and constructive details. A personal analysis allows to evaluate execution quality, validation and legalisation, as well as their integration in the overall process of the works and their coordination with the rest of the installations. Reports should also include a working description of elements and equipments.

In my opinion this teaching evaluation of installations in Architecture should take into account the following bullet points:

1. Student learning degree about basic concepts related to the installations design.
2. The sizing of all tubes and pipes, machines and equipments, installations rooms, ceiling heights, ducts, etc, included maintenance and accessibility to pipes and equipments.
3. The knowledge of legislation both basic and recommended, and technical regulations.
4. The integration and coordination of these installations with the building design and the rest of construction.
5. The control of correct execution of all the elements, valves, meters, etc., pressure and watertight proofs.

I am sure that these complementary digital visual manuals are very useful to improve installations learning. We hope it will be showed in next evaluations we will carry out during the current academic year.

After carrying out this new educational experience, we will compare it with previous courses and draw conclusions on how to improve the tool. Indeed, we believe that to be one of its most significant virtues - it's very easy to update and to complement with more and better information.