Computer-Assisted Drafting and Design
Programs for Presenting Architectural History and Archaeology

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The computer revolution has been going on long enough now that no one attending these meetings would be surprised to hear a discussion of any one of several forms of computer-generated "reality." A few years ago the phrase was walk-through or fly-by for a computer-simulated journey through space. Today the phrase is virtual reality - a term which conjures up thoughts of versions of reality - whether true-to-life or imagined - which can be created on the computer screen.

A virtual world is simply a computer-generated scene which simulates a physical world to a greater or lesser degree, depending upon whether one includes elaborate paraphernalia for enhancing the sense of reality, simply a computer screen, or some middle level of equipment. In any case, the computer creates a sense of verisimilitude which can be truly awe-inspiring, and we can all imagine the wonder which can be brought into a museum if the visitor can participate in such a process and truly see the setting from which objects came - whether that be an individual building or a complex urban landscape. To give one simple example, imagine what a difference it would make if the British Museum could take visitors to Athens and let them see the Elgin marbles as if they were standing on the Acropolis in the Fifth Century B.C. rather than in a museum in modern London.

At the root of a virtual world (or a walk-through) is an image or group of images of the world being portrayed. The root image may be a manufactured one, made up completely of whole cloth, or it may be a real one, carefully made to represent reality. If the latter, the root image must finally be based upon dimensions and spatial positions so that it can conform to reality.

This is where computer-assisted drafting and design (CADD) programs come in, because these are the programs which can create the root images for virtual reality systems - root images based on the real world rather than an imaginary one.

CADD programs were developed for architects and designers; so they are ideal for representing real-world objects. Indeed, good CADD programs are fully 3-dimensional (as they must be to provide appropriate information for virtual reality systems). They can deal with complex surfaces, and they make it possible to represent virtually any real geometry with accuracy and precision. In fact, the representation is so full that it is best to refer to it as a model; nothing else expresses the completeness of the representation.

The computer model of a building can be so full and complete that one may even ask the computer to give dimensions between points or to give the exact coordinates of a single point. Provided only that the data collection and input process is good, any dimension or position in space can be accurately reported. The accuracy is a natural result of the fact that the computer does not store the dimensions or locations at a reduced scale; all information is stored at full scale so that no precision, once gained, will be lost.

This accuracy is important to our virtual realities, because it means that, with CADD at the core of a virtual world, we can be sure that the images we create, the realities we simulate, are true reflections of what has been found and studied, not idealized or casually created images intended only to give the impression of reality. A CADD-based image of the Parthenon must be as accurate as the information used to create the original model, and one need not fear that there have been freedoms taken with the actual information.

It may seem pedantic to worry about the level of accuracy which lies at the heart of these virtual worlds. Their purpose, after all, is to give an impression of the physical world; for most purposes the difference between a CADD-based and a more casually produced virtual world might well be imperceptible to the typical user. In some ways, it surely is pedantic, but it is important that we use the technology self-consciously, that we take care not to let the machines seduce us. By insisting on CADD-based images, we can help to assure that we do not find that we have, in the end, allowed ourselves to let scholarship slip as if it were necessary to have the high-tech results.

There are other important reasons to insist upon CADD as the base for any virtual reality systems to be used in museum settings. CADD properly used for archaeological sites or architectural monuments provides a particularly important tool to enhance understanding. This tool is the segmentation of the CADD model and the consequent ability to display specified segments of the model on command.

Let us turn again to the Parthenon as an example of the importance of this data segmentation. The Parthenon has been a temple, a church, a mosque, a harem, a gunpowder magazine, and a tourist attraction. We have remains which belong to all periods as well as remains which belong to one or another individual period, and we also can infer now-missing material from each of the periods on the basis of remaining material or other sources.

Since we have material from so many different periods, it is helpful if not essential to divide the model into segments so that each segment contains only material which was used in a common period or a common group of periods. We would then have a segment for material which was common to all the periods, a segment for material used on the temple alone, a segment for material used only on the mosque, and so on. Having so segmented the model, it is then possible to have the computer show only selected segments (called layers in a CADD system). One could, then, select only those segments or layers which were used in the temple, and no others would be displayed. The same could be done, of course, for the mosque or the church.

But the segments of the model can be even more helpful, because we can also put reconstructed material of a given period in its own layer so that the church, for example, may be shown with only the material actually remaining in situ or with that material plus the reconstructed material required to finish it off. (Please note that this reconstructed material must also be entered into the computer as dimensioned physical objects, not just drawn or sketched additions to the model.) Furthermore, we can keep more than one scholar's version of the reconstructed building in the model at once, simply by putting the differing reconstructions on different layers.

Imagine the result. The model, properly executed, provides all the extant parts of all the phases of the Parthenon as well as the reconstructed parts of each phase, including competing versions of those reconstructions. The visitor to the museum with such a model positions himself to view the model, selects the time he is interested in, selects the reconstructed version or only the in situ material, and then views the model from wherever he likes. He can move about in space to get a better view - even entering the building to look around the inside. Then, if he is viewing the reconstructed building, he can strip away the reconstructed portions and see only that which remains in situ today.

It is possible to go even further with the data segmentation. Portions of the building may be placed on different layers according to date or phase, as has already been described, but one may also make distinctions according to material (limestone vs. marble, for instance), use in the building (door frame vs. column drum), condition (whole or damaged), or any other criterion the model builder chooses. So, in addition to the possibilities already mentioned for the Parthenon, one might ask to see only the foundations, only the marble portions, all portions not of marble, or only the colonnade. The possibilities are virtually endless, but the system is so flexible that it is easy to call up or exclude layers in large groups or individually.

As exciting as this is for a building, it is equally impressive when used to model an excavation. Architectural remains, small finds, artifacts of any type, can be put into the model and placed on separate layers. They may then be seen together or separate, in groups or individually, and the entire excavation or any part of it can be examined at will. Segments may be based on excavation season, original date, type of find (architectural material vs. coins vs. animal bones), and so on.

It should be made explicit that what one may see on the screen one may reproduce on paper - with relative ease and at modest cost. The museum goer can take home a copy of his own unique view of a model to remind him of his visit - and to keep reminding him of what he learned.

All these possibilities depend only upon the features of CADD. Virtual reality systems and rendering programs add the possibility of photorealism to CADD, which can produce line drawings without their aid. But at the core of either of the photorealistic processes must be a CADD model. CADD is the necessary starting point for both systems.

CADD is also the scholar's most valuable tool for recording the features of buildings and excavations. Since measurements are maintained at full scale and completely three-dimensional models are created, the CADD model is by far the most effective form of record-keeping. It also provides important advantages for publishing the work of the archaeologist or architectural historian. Therefore, the creation of a CADD model of an archaeological site or an important building is of benefit to the scholar himself, provides a valuable tool for any museum wishing to put it to use, and will serve as the base for photorealistic images in the future. So the future may point toward virtual reality and rendering displays, but in the present, with CADD, we can already add immeasurably to the ability of the museum goer to understand the world from which our objects come. We should not be waiting for virtual reality; we should be putting CADD to use now with the understanding that it will be the basis of more realistic systems to come and that it serves important purposes independent of the photorealistic display technology.

