Discoursing on Urban History Through Structured Typologies

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Imaginary cities

How can urban history be studied with the aid of three-dimensional computer modeling? One way is to model known cities at various times in history, using historical records as sources of data. While such studies greatly enhance the understanding of the form and structure of specific cities at specific points in time, it is questionable whether such studies actually provide a true understanding of history. It can be argued that they do not because such studies only show a record of one of many possible courses of action at various moments in time. To gain a true understanding of urban history one has to place oneself back in historical time to consider all of the possible courses of action which were open in the light of the then current situation of the city, to act upon a possible course of action and to view the consequences in the physical form of the city. Only such an understanding of urban history can transcend the memory of the actual and hence the behavior of the possible. Moreover, only such an understanding can overcome the limitations of historical relativism, which contends that historical fact is of value only in historical context, with the realization, due to Benedetto Croce and echoed by Rudolf Bultmann, that the horizon of "deeper understanding" lies in "the actuality of decision" (Seebohm and van Pelt 1990).

One cannot conduct such studies on real cities except, perhaps, as a point of departure at some specific point in time to provide an initial layout for a city knowing that future forms derived by the studies will diverge from that recorded in history. An entirely imaginary city is therefore chosen. Although the components of this city at the level of individual buildings are taken from known cities in history, this choice does not preclude alternative forms of the city. To some degree, building types are invariants and, as argued in the Appendix, so are the urban typologies into which they may be grouped. In this imaginary city students of urban history play the role of citizens or groups of citizens. As they defend their interests and make concessions, while interacting with each other in their respective roles, they determine the nature of the city as it evolves through the major periods of Western urban history in the form of three-dimensional computer models.

My colleague R.J. van Pelt and I presented this approach to the study of urban history previously at ACADIA (Seebohm and van Pelt 1990). Yet we did not pay sufficient attention to the manner in which such urban models should be structured and how the efforts of the participants should be coordinated. In the following sections I therefore review what the requirements are for three-dimensional modeling to support studies in urban history as outlined both from the viewpoint of file structure of the models and other viewpoints which have bearing on this structure. Three alternative software schemes of progressively increasing complexity are then discussed with regard to their ability to satisfy these requirements. This comparative study of software alternatives and their corresponding file structures justifies the present choice of structure in relation to the simpler and better known generic alternatives which do not have the necessary flexibility for structuring the urban model. Such flexibility means, of course, that in the first instance the modeling software is more time-consuming to learn than a simple point and click package in accord with the now established axiom that ease of learning software tools is inversely related to the functional power of the tools. (Smith 1987)
Requirements for effective urban modeling

Convincing realism

With the benefits of hindsight gleaned from two attempts to teach urban history as outlined, it has become clear what the essential requirements are for this mode of learning to be successful. Perhaps most important, is the requirement that the model of the city provides a sufficient degree of realism to enable the participants to imagine themselves to be citizens in another era to such an extent that the issues which have bearing on the city's future development become so convincing as to engender the participants' commitment. The computer model must therefore include a high enough level of detail and the rendering techniques must be effective enough to impart the required sense of realism through the simulation of sunlighting, shadows, sky and ground illumination. (Photo realistic rendering is not required, however, because this would only demand more detail). Guidelines as to the level of detail maybe obtained by studying hand made models of cities such as that of Constantinian Rome in the Museo della Civiltà Romana in Rome or the axonometric drawings of city precincts in Stambough's The Ancient Roman City. As a general rule, important buildings such as temples and churches require more detail than repetitive housing for example (except when the latter is viewed at close distances). A corollary to this is that the city itself should be situated in a convincing landscape with appropriate topography rather than being limited to flat terrain. The model of the terrain must encompass several kilometers in order to provide an adequate backdrop for the city.

Flexible data structure

We have also found that to create models of buildings with the required level of detail is extremely time consuming and can easily detract from the objective of studying urban history. From this we have concluded that libraries of previously assembled models of buildings should be available to the participants. Given that urban models consist of hundreds, possibly thousands, of buildings and consequently even more building components, it would be difficult to find appropriate buildings in the library if there was not a clear and meaningful data structure. The structure of the libraries should allow retrieval of building components and buildings on the basis of building component, building type, historical period and urban typology. The urban typology, which consists of groupings of buildings, should provide a meaningful way to understand the structure of cities both at the level of function and at the level of meaning and the aspirations of the citizens. In the following discussions, urban typologies are presented and a justification is attempted in the Appendix, for four periods in the development of urban history, namely, the Archaic and Hellenistic phases or Greek Urban History, the Roman and the Medieval periods. A clear data structure is, however, not only important to facilitate the retrieval of buildings from libraries, it is also important for analyzing and altering completed models of cities. It should be possible to lay out a plausible course of development for a city and then have participants place themselves into the proposed altered city, criticize it and make further revisions. A useful structure would allow moving all of the objects comprising a building as one collectivity and it would allow moving groups of buildings as a collectivity. In order not to test the patience of the participants while investigating alternative courses for the development of the city and to allow timely feedback, rendering of an entire city model, even with shadows, should not require more than five to ten minutes. This requires RISC (Reduced Instruction Set Computers) based workstations. Even with such workstations, experience has shown, however, that the urban models can become too large for quick rendering without exceeding the required memory or the space on the hard disk needed for swapping pages of memory. To avoid such problems we have occasionally limited the model to those parts which lie within the field of vision. This strategy requires a flexible data structure so that parts of the city model can be suppressed on the basis of spatial location. We have discovered, furthermore, that line drawings of urban models with hidden lines removed generally have too much detail at points distant from the eye point, causing a blackening of distant objects on account of the excessive density of line work there, and too little in the foreground. This suggests the need for a data structure which allows the degree of detail to be varied with distance from the eye point (This effect is not so strong in scanline renderings but it can cause aliasing artifacts. In
theory, a sophisticated modeler can be programmed to reduce the amount of detail with distance from the eye point while renderers could be programmed to ignore polygons smaller than a certain size relative to their distance from the eye point or relative to the size of a pixel in the image).

There are two other important requirements for the structuring of the model. The first is that it support simultaneous collaborative work on the same urban model and the second is that it allows for archiving of entire city models at particular phases of historical development so that all or parts of the archived city models can be reused.

To some up, the requirements for the data structure of the city model should reflect the needs for understanding, the needs to retrieve building models from libraries, the needs to alter and view alternative possible futures, the needs for rendering in minimum time and with minimum aliasing and other artifacts and, lastly, the needs for archiving and reuse of entire city models.

Characteristics of the models of imaginary cities

The models of imaginary cities needed for these urban studies differ from purely architectural computer models in several important ways. Instead of focusing on a single building and its immediate surroundings, these urban models include hundreds or even thousands of buildings. While no individual building is as detailed as a very detailed architectural model, the overall number of objects significantly exceeds that of most architectural models. To this complexity must be added the complexity of a site encompassing several kilometers of undulating topography of perhaps some five thousand to ten thousand polygons. The model must contain large numbers of repetitive buildings, and have sufficient detail to be viewable over a wide range of distances from a few meters to several kilometers.

Appropriate computer tools for urban modeling

Consider now some possible ways in which three-dimensional modeling systems might be organized with regards to the file structure for creating and storing three-dimensional shapes and for building up three-dimensional models, taking into account the needs for urban modeling outlined so far.

Simple modeler

A simple modeling system such as scheme (a) in Figure 1, stores all the geometry of the three-dimensional model in a single file. This file describes a three-dimensional world where shapes, also called objects, are located with respect to a Cartesian system of x,y,z coordinate axes. Primitive objects are created directly in this three-dimensional world, added to the model and stored in the file. Alterations to the model, by cutting or drilling, are done on the objects in the model while previously made objects may be added by retrieval from library files in some systems of this type. Replication creates additional objects each of which is stored separately in the file. Objects within the model may be suppressed, by placing them on layers which can be turned on or off. Although the appearance of the model can be changed by turning layers on and off, the basic content can only be changed by adding objects to the model or deleting objects from it.

Simple modelers such as this require that the user point and click on objects with a mouse or puck in order to select them for manipulation (An example might be Upfront running on a Macintosh). Our urban models are so complex, however, that this approach would be extremely time consuming. When there are thousands of objects one must be able to select named groups of objects.

More complex modeler

A somewhat more complex structure is represented by scheme (b) in Figure 1. As in scheme (a), the entire model is stored in a single file and additional objects are created in the same three-dimensional world as the model. In this case, however, the file contains a separate dimensional objects (also called blocks). Objects from the block section are named and can be inserted multiple times or duplicated without significantly increasing the storage requirements of the model because multiple insertions only reference an inserted object in the block section at display time. References do not store the geometry of an inserted shape. The objects themselves may be hierarchical nestings of sub-
Figure 1: File structure of different modeling systems
objects (for example, a building object would include sub-objects of building components such as columns.). Objects from library files may be added to the block section or to the model, although this is cumbersome and indirect and, once added, removal of objects from the block section is time consuming. Short of removing objects from the file, parts of the model may be suppressed by layering. Also noteworthy is that in scheme (b) two- and three-dimensional line entities may be stored with the model in the same file.

Scheme (b), which is similar to that used by AutoCAD, to name one very common example, satisfies some of our modeling requirements. With the possibility of naming shapes and of grouping them in nested structures, it satisfies the need to group all of the components of a building into one object and even to group buildings into urban types. Once the urban types are defined, however, other groupings of the same objects by period, say, or by spatial position may no longer be possible. It satisfies the need to duplicate objects without incurring additional storage penalties. With the capability to store two-dimensional line entities, it satisfies the need to use two-dimensional drawings as a guide for placing buildings over contours and street layouts. Multiple drawings, say, of different contour intervals, can only be accommodated, however, by placing them on different layers and turning some layers off.

The disadvantage of this scheme is that the entire model, both two-dimensional and three-dimensional, must be stored in the same file thereby creating one large unwieldy file. Much of the structure must be anticipated in advance while changes are only possible by deletion or insertion of additional two-dimensional and three-dimensional data. After objects have been inserted from the library files into the block section, the only structure for retrieving objects from it is that given by the naming convention of the objects or blocks because one cannot insert objects directly from library files (Library file names can give a clue as to their content). Lastly, there are no features to allow simultaneous collaborative work so that the individual contributions of the participants can be combined to form a complete urban model.

The limitations of scheme (b), in summary, are therefore ones of insufficient flexibility in the structure of the model and a lack of features for simultaneous collaborative work.

Recommended modeler

Consider now the recommended scheme illustrated as scheme (c) in Figure 1. Library objects from which models can be built up are stored in any number of separate files called codices, after being created in the Solid Modeler. These codex files, or codices, take the place of the library files in scheme (a) and the block section in scheme (b). Unlike scheme (b), objects may be added directly from the codices into the model. Only in this case the modeling world in which the model is assembled from the constituent objects is situated over a two-dimensional drawing onto which the objects are placed by means of a software module called the Assembly Modeler (Strictly speaking, only projections of the corresponding three-dimensional objects in the codices are stored on the drawing although the software knows the location of each object in the three-dimensional world of the model. The projections are referred to as components and a drawing with components becomes an Assembly Modeler drawing.). What the Assembly Modeler accomplishes is analogous to placing objects in the three-dimensional file of scheme (b). Ideally, the Assembly Modeler would allow objects to be placed in a fully three-dimensional world but, even without this capability, the present scheme has all the necessary functionality, albeit at a price of some awkwardness. To assemble models consisting of objects stored in codices, the Assembly Modeler links all the codices containing the objects to be placed on an Assembly Modeler drawing to the drawing file in which the Assembly Modeler drawing is stored (Note that more than one drawing can be stored in one drawing file in scheme (c) unlike systems of the AutoCAD type.). After linking up to ten codices per drawing file, objects may be projected onto an Assembly Modeler drawing into areas called “views”. Views, of which there must be at least a plan view but possibly also elevations, sections and isometrics, must previously have been created in the Assembly Modeler. The position of the boundaries of the first plan view created on the Assembly Modeler drawing, in relation to the position of the coordinate axes on the drawing, determines where the objects are placed. Once
placed in a plan view, the projections of the objects (components) appear automatically in other views. Further, these components are two-dimensional drawing entities and therefore can be moved or otherwise altered in any view using two-dimensional drawing commands.

An Assembly Modeler drawing may be used in the rendering system, called the Scene Viewing System, to set up a scene for rendering by recalling all the necessary objects from the codices and by placing them in the correct locations in the three-dimensional world of the scene. In other words, the Assembly Modeler drawing is a script for recalling objects into the correct locations in a scene. For this reason the Assembly Modeler drawing does not store the geometry of the three-dimensional objects placed on it as components. It only stores references or instances of the placed components which refer to the corresponding objects in the codices. In a sense, every placement of a component is like a block reference when a block is inserted into the three-dimensional world of scheme (b).

A scene may be built up from one or more Assembly Modeler drawings. Assembly Modeler drawings can therefore be used to structure a model in various ways such as spatially, by the designer of a part of the model or by historical period. Additional flexibility is derived from the ability not to recall all of the objects on an Assembly Modeler drawing. This is accomplished with selective recall using wild card naming of the objects.

The concept of building up a scene is another difference between the recommended modeling system in scheme (c) and the AutoCAD-like system in scheme (b). This concept allows great flexibility as to the content of the model to be rendered whereas in scheme (b) the complete model must be built up and stored in one large, cumbersome file. Although it is not recommended in practice, it is possible to recall objects directly from a codex into a scene for rendering. Thus by storing the objects in the proper relationships to each other in space, before saving them in a codex, it is possible to build up complex models. This does not, however, permit replication of multiple objects nor does it make available many of the features available through the Assembly Modeler. Rendering objects directly from a codex is used primarily to check the appearance of objects or small groups of related objects.

Multiple copies of objects can be created on an Assembly Modeler drawing by duplicating components in linear or other arrays in a plan view or any other view using two-dimensional drawing functions. When an Assembly Modeler drawing with multiple copies of a component is used to recall objects for rendering in the Scene Viewing System, the duplicated components act as references to recall the corresponding objects from the codex and place them in the scene corresponding to the position of the duplicated components on the Assembly Modeler drawing. The size of the codex file needed to store models is therefore minimized because only one copy of the duplicated object needs to be stored in the codex. Duplicated components therefore behave similar to duplicated block references in scheme (b).

**Copying components from other drawings**

Another source of objects for use in the Assembly Modeler can be other Assembly Modeler drawings. To copy components from another Assembly Modeler drawing, the drawing file containing that drawing is linked to the drawing file containing the current Assembly Modeler drawing, also called the Main Drawing File, by being designated the External File (there can be only one external file open at any one time). Both the External File and the Main Drawing File must have the same codices linked to them and in the same order for a maximum of ten each. While it is possible to copy individual components from external files, what is more useful in the present context is that unions of components, such as all of the components representing a building including replicated ones, can be copied from external files (Unions, incidentally, represent one way of allowing hierarchical nesting corresponding to the nested blocks in scheme (b)). With the ability to copy unions it is possible to assemble individual buildings and so to develop library drawings of the buildings needed for creating models of cities. The advantage of library drawings is that one can assemble the buildings on their own Assembly Modeler drawings without having to attempt the assembly of building components right on a complex model of the entire city. The library drawings can be arranged by period and building type, they can
be plotted to create reference documents and they can be rendered in the Scene Viewing system to permit visual selection of buildings prior to placement into the city model.

The concept of copying unions of components represents an advance over the strategy previously reported (Seebolm and van Felt 1989) whereby all the objects, including duplicated objects were separately stored in a codex and placed directly on the Assembly Modeler drawing of the city using wild card naming to recall all the objects constituting a building. A much greater number of objects had therefore to be stored in the codices. Consequently the recall of objects into a scene took very much longer than presently.

*Windowing*

Windowing permits collaborative work in the present modeling scheme by allowing Assembly Modeler drawings to be overlaid in such a manner that each participant can see the Assembly Modeler drawings of every other participant. (The scene of the entire city model can then be created from the Assembly Modeler drawings of all the participants). The drawings are overlaid in windows with each window being defined to contain up to fifty two phases into which drawings may be slotted. (Phases are like conventional layers in other computer-aided design systems but, rather than being associated with a drawing, are associated with windows which are views of drawings). What one sees in a window is a series of overlaid drawings each of which appears in a different color on the screen. At any time the drawing currently in a phase of the window may be interchanged with another. Further, the drawing in a phase may be in one of three states: hittable, if points on the drawing can be snapped to but not altered or deleted; editable, if the drawing is changeable; and viewable, if it cannot be changed or used to snap to. Lastly, it is possible at any time to suppress components on a drawing in a particular phase by specifying lists of components to be included or excluded from the window. Drawings in a user’s window which are from drawing files other than the user’s currently open Main Drawing file are said to be auxiliary drawing files. These need not necessarily be Assembly Modeler drawings but may be regular two dimensional drawings such as contour maps and street plans which are required for the placement of buildings. Auxiliary drawings must be specified before they can be inserted into phases of a window and the owners of the auxiliary files (such as students working on different workstations in different directories and different accounts) must give read permission. This collaborative arrangement implies that the recommended software scheme runs in a multi-user environment such as UNIX.

**Applying the tools to the modeling of cities in history**

**Naming objects and codices**

To fulfill the objectives set earlier for the structure of the model of the imaginary city, all of the objects which represent parts of buildings from particular periods in the history of the city’s evolution are stored in a codex named after that period. On the assumption that the imaginary city is located somewhere on the Adriatic coast between Italy and Greece, the periods after which the codices are named have been identified as the following: the Archaic of ancient Greece (650-480 BC), the Hellenistic (400-100 BC), the period of Roman colonization (27 BC-284 AD), the Medieval (750-1420), the Renaissance (1420-1560), the Baroque (1550-1750), the Industrial (1750-1845) and the Consumer city (1945-).

Consider now the naming of objects within codices. Objects within codices may be given names with up to six facets separated by colons of which the following are acceptable examples of object names:

```
temple: , temple:nike , temple:nike:001
```

Wild cards may be used to invoke operations on more than one object with a single command. Thus "temple:*" would apply to all objects with temple as the first facet. With a suitable naming convention there is therefore great flexibility as to how objects are grouped together for various operations. One could, for example, move all of the objects constituting a temple together or all of the temples on the acropolis of a city if each object had a facet referring to the fact that these temples are situated on the acropolis.

For the present urban studies, the objects within the codices are given names consisting of six facets as shown in Figure 2, with the first four
# Object Naming Convention for the Imaginary City

All names used in Litrix are in lowercase unless otherwise noted.

<table>
<thead>
<tr>
<th>1st Facet</th>
<th>2nd Facet</th>
<th>3rd Facet</th>
<th>4th Facet</th>
<th>5th Facet</th>
<th>6th Facet</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 LETTERS</td>
<td>2 LETTERS</td>
<td>8 LETTERS</td>
<td>8 LETTERS</td>
<td>8 LETTERS</td>
<td>5 NUMBERS</td>
</tr>
</tbody>
</table>

**Period**
- **pl:**

**Type**
- **ac:**

**Building Type**
- **temple:**

**Building Name**
- **nike:**

**Part**
- **column:**

**Number**
- **00001**

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**Abbreviations:**
- ac - Archaic
- he - Hellenistic
- ro - Roman
- mv - Medieval
- re - Renaissance
- bq - Baroque
- id - Industrial
- cs - Consumers

**Easily identifies period and thus, source codex.**

**Always displays representative of each period to be displayed & manipulated directly in XSVS.**

**Additional Notes:**
- Buildings can be manipulated on an individual basis.
- Editing and substitutions can be performed on specific buildings, e.g. for enhanced detail.
- First four facets form name of a union.

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**Abbreviations:**
- ne - Neighborhood
- ce - Cemetery
- ac - Acropolis
- ag - Agora
- em - Emporium
- th - Theater

**Based on urban types employed by Dr. Van Pelt.**

**Allows for quick groupings within a single drawing & view while in XSVS.**

**Must be included to allow proper auto-numbering in XSVS.**

**Should be 00001, as this number is meant as the starting point, & must allow enough room for all versions of any one object.**

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facets also serving as the name of a union. The first facet on the left identifies the historical period, the second the urban type to which the building belongs, the third the building type, the fourth the name of the building, the fifth the part of the building (such as a column) and the sixth a number from which the software will start automatically creating new names for duplicated objects by counting upward from that number. Of these facet names the second and third need further clarification. Consider first the urban types which are based on earlier work by the author's colleague, R. J. van Pelt, as recorded in the book *Architectural Principles in the Age of Historicism* (van Pelt and Westfall 1991). These refer to essential parts of the city without which the city would not be a city of the period under consideration. Each urban type is necessary for the existence of each of the other types and each urban type encompasses a number of building types which may or may not be in physical proximity to each other. For the Archaic and Hellenistic city six urban types are used, namely: the neighborhood, the cemetery, the acropolis, the agora, the emporium, and the theater. Each of these urban types, alternately referred to as urban realms or political places, are characterized by a primary building type. Thus the neighborhood is characterized by the house, the cemetery by the stela, the agora by the stoa, the acropolis by the shrine (temple), the emporium by market stalls and the theater by its namesake. The primary building and the other buildings of each urban realm which are related to the primary building type are classified under the same urban type and hence the objects from which they are built up are given the same first facet. Tables I, II, and III list the building types for each urban type for the Archaic and Hellenistic, for the Roman and for the Medieval city, respectively. Archaic and Greek cities are considered together in the same table because the urban types are the same for each although the building types belonging to particular urban types may differ. Thus specifically Hellenistic building types are identified as such in Table I.

Figure 3 shows a portion of the library drawing for the Archaic Greek city with views of temples corresponding to the acropolis urban type in Table I. Figure 5 shows the corresponding temples rendered in the Scene Viewing System. Similarly, for the Medieval period, to give another example, Figure 4 shows a portion of a library drawing with Medieval Churches and cathedrals.

Figure 6 shows a rendering of these churches and cathedrals.

**Structuring drawing files, drawings, and codices**

The relationships between various drawing files and codices can now be described. Figure 7 shows the arrangement schematically.

In the left of the figure, under SOLID MODELER, are the codex files containing objects needed for assembling buildings in each of the historic periods of the city. There are also two codices called "site" and "materials" for storing solid objects representing the site topography and the materials for rendering the site and buildings, respectively. Materials describe the color and reflective properties of surfaces for rendering (the material names are assigned to the surfaces of objects in the Solid Modeler). The middle section of the figure shows Assembly Modeler drawings. Those on the bottom left, which are linked to the codices of historic periods, are the library drawings, one for each historical period, all of which are stored in a drawing file called "library". The drawing file called "master" is linked to the "site" and "material" codices and contains a drawing of the site called "w92-site". The drawing of the site may be superimposed, in a window, over a drawing showing the contours of the site, such as "contour1", which is also stored in the "master" drawing file (The contour drawings, "contour1", "contour2" etc., were created in another module, the Site Modeler, not discussed here. They show the contours at different intervals, so that for detailed work, a drawing with more closely spaced contours may be substituted, whereas for less detailed work, a drawing with more widely spaced contours may be used in order that the contours do not appear so close together as to obscure the view).

Student drawings are kept in drawing file "w92-student", at the top left of the middle section of Figure 7, and each represents the work of one student in 1992, for example. Individual student drawings are named after the student followed by two letters representing the historical period in which he or she is working. Thus: "stud1-he" represents a student "stud1" working in the Hellenistic period. The student drawings each
FIGURE 3:  Portion of a library drawing showing Archaic Greek temples
VIEW - ref: [religious reason]

- cathed: hwang
- cathed: sato
- church: alau
- church: simmons
- campbell
contain the same Assembly Modeler view of the
plan of the city (and several other standard views
such as the plan of the built up area of the city
in addition to that of the whole site). The student’s
drawings are superimposed on each other in
windows which the students define, each drawing
being inserted in a phase of the window. The

student drawings are also windowed over the
site drawing “w92-site” and one of the “contours”
drawings. In order to be able to use the student
drawings for the placement of components, each
drawing file is linked to the same codices and in
the same order as the codices are linked to the
library drawing file. The library file is thus made
external to the student drawing files thereby allowing unions of building components to be copied from the library drawings to the student drawings. The "master" drawing file and the drawing files of the other students are designated as auxiliary to permit their insertion into phases of windows. Figure 8 summarizes what drawings are overlaid in a typical student's window assuming that each student has only one Assembly Modeler drawing.

![Figure 8: File structure of a student window](image)

For rendering, all of the drawings in all of the phases are used to build the scene in the Scene Viewing System. Colors, eye positions, look at positions, exposure viewing angle and other viewing parameters are set here as well as the rendering method. A typical rendering, to use an example of an Archaic Greek city, is shown in Figure 9. Figures 10 and 11 show views of the Hellenistic city.

**Conclusion**

A file and object structure for three-dimensional modeling has been described to permit the study of urban history in a fundamentally new way. It is a way which transcends the memory of the actual evolution of cities and strives to gain a deeper understanding through a confrontation with the decision making process that determined the future course of cities in history. No doubt, as Jordan has observed recently, this is but one example of how computer aided design "raises serious questions about the fundamental assumptions of the profession " (Jordan 1992) and thus helps us to see the basis of architecture (and urbanism) in a new light. In a sense, the proposed studies reexamine the place of buildings in their urban and cultural context.

Although the capabilities for modeling, which have been described closely resemble those of the GDS suite of software (with which the above drawings and images have been prepared), the recommended structure represents the essential features of what is required regardless of the software used for modeling. Indeed, GDS in its present form does not make the recommended strategy as easy to use as it might be because...
unions cannot be placed at the desired elevation in plan without additional operations and, as noted earlier, because the Assembly Modeler is not fully three-dimensional. Clearly, however, not all three-dimensional modeling software will allow the recommended structure. It is not an exaggeration to say that without this structure the proposed urban studies will become mired in administrative confusion and be impossible to conduct in a reasonable amount of time (even if perfectly reasonable urban models can be built without the suggested structure).

FIGURE 9: Rendering of the Archaic Greek city showing houses and the Acropolis

FIGURE 10: Rendering of the Hellenistic city showing the Hellenistic stadium at the left, a temple of Poseidon and treasury houses and the Acropolis in the distance
Appendix

A justification of the urban types

The most important aspects of the typology used in the model is the creation of an urban type that assigns a certain significance to the elements of urban design (the buildings). The urban type allows the student to consider the politics that makes an agglomeration of buildings into a city. As discussed above, following reasoning presented in Architectural Principles in the Age of Historicism (van Pelt and Westfall 1991), it can be argued that the Greek city had six urban types. The first one, the neighborhood, located the private realm. Ownership of property was a precondition to political franchise. It provided a person with the autonomy that, in turn, allowed responsibility. The three following urban types frame the public realm. The purpose of the public realm was to create the conditions that allowed citizens to attain what Lifton has labeled as "symbolic immortality." It was, in Hannah Arendt's terminology, "the space of appearance." Participation in the public life of the city would ensure the citizen the possibility to attain a greatness that allowed him to share in the enduring nature of the city, and, by extension, in the everlasting cosmos. The city, in other words, was the place where a citizen could produce works, deeds and words that would give him a lasting place in the order of things. In this way, so the Greeks believed, man would be able to overcome the limitations of his own mortality.

These three places were the cemetery, the acropolis and the agora. These realms defined the city's immutable past, the city's enduring future and the city's active present. The cemetery gathered the dead and honored those who had lived excellent lives by means of tombs and markers. The achievements of the dead provided examples for the living and, consequently, a normative foundation for the political life of the city. Hence the cemetery was a place of education. It was also the place where the old oppositions between the feudal clans was sealed. One of the brilliant pieces of legislation Solon enacted was the simple law that no-one could speak ill of the dead, "for piety requires us to regard the dead as sacred, justice to refrain from attacking the absent, and political wisdom to prevent the perpetuation of hatreds." The result of this was that politically all the dead belonged to all the citizens, transforming the rifts of the past into a stable foundation of the present.

The acropolis was the place that celebrated the city's enduring future. The whole claim of the city to provide a place which would allow individuals to gain a place within the lasting order of things depended on the shared assumption that the city itself would last. The acropolis attested to this belief in various ways.
Its temples celebrated the patronage of the god(s), which attested to the city's justification as city. It celebrated the founding of the city as an act of supernatural origin, and as such preserved the notion of the city as a magical and miraculous event. In that sense the acropolis contrasted to the necropolis, which traced the natural history of the city, with its beginnings and ends—a history of births and deaths. In marking the foundation of the city the acropolis also held fast to the aspiration of what the city ought to be. And in the quality of workmanship and design the buildings in the acropolis would preserve that aspiration, and with that the city's future, even if the city itself would have been reduced to ruins.

The third part of the city's public realm was the agora. It was the place that connected the natural history of the city, commemorated in the cemetery, to the enduring aspiration of the city, celebrated in the acropolis. It was a place of government and political dynamism, and as the political changed, so also the agora. If the cemetery was a place of addition, and the acropolis of preservation, the agora was subject to constant alteration, adaptation and renovation. Buildings were put up and pulled down, or meeting places expanded or even turned around to satisfy the specific needs or ideologies of the present.

The two last urban types have a significance that in some way transcend the dichotomy of the public and the private. The emporium locates the connection of the city to the countryside, to its sources of food. It is the place of exchange without which there can be no city. Yet the markets, shops and stores are not enough to make a city. And then there is the theater, the urban type that, significantly, is represented by only one building type: the theater. It is the place of reconciliation. As a building type it architecturally and ideologically recapitulated the significance of the other types. This reconciliation was one that explored the tragic potential of the contradictions generated by the opposition between the neighborhood and the triad of cemetery, acropolis and agora, and between the claims of the immutable past, the enduring future and the dynamic present. The theater represented the dichotomy between the city's lofty ideal and its dirty reality, brought personal suffering on the public stage and revealed civic responsibility in its relationship to private tragedy. In the theater, the city made itself into an object of representation and played itself before the public.

A description of the city in these terms allows for an exploration of the relationship of architectural production as it relates to the life of the city and as its is framed by memory and aspiration. Thus the category of urban types provides an essential part of the rules that allows for a game of historical simulation.

The urban types of the Roman and Medieval city differ from that of the Greek polis. In the Roman city the most important differences are the reduction of the theater as a "quintessental" urban type into a "normal" urban type that encompasses a variety of building types. It reveals the abandonment of the theater as a place of reconciliation and its reduction into a form of entertainment. Two new types not available in the Greek polis are those of the armature and service. They impose order on the city and justify the magistrate's and hence the emperor's authority.

The difference between the urban structure of the medieval city and the Greek polis is even more radical. The neighborhood resembles the Greek neighborhood, yet the urban type entitled "civic realm" encompasses in a fundamental way the triad of cemetery, acropolis and agora. Then there are three additional urban types: the realm of the sovereign (King, Duke, Count or other Lord of the city), the aristocratic realm (the courts of the nobles living in the city) and the religious realm (the Church). The civic position of the latter is radically different from that of the Greek acropolis. In the latter case the temple affirmed the political life of the city; in the case of the medieval city it often opposed it in the same way as the lord would oppose the city, or the aristocracy.

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References


### Table I

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ACADIA 1992
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<td>Temple, Cult Building</td>
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<td>Armature</td>
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