OF COMPUTER MEMORY AND HUMAN REMEMBRANCE:
History of Urban Form Through Three-Dimensional Computer Modeling

Robert-Jan van Pelt and Thomas Seebohm
School of Architecture
University of Waterloo
Waterloo, Ontario
Canada, N2L 3G1

ABSTRACT

After a discussion of the problematic relationship between architectural history, computer aided design and the design studio, a course is described which provides an overview of the history of urban form through readings and three-dimensional modeling by computer. One objective of the course was to model a hypothetical, archaic Greek city on a hypothetical but realistic site and to transform the model of that city through time to the 20th century. An overview is given of the computer modeling techniques, of the successes and failures of the first offering of the course and of suggestions for improving future offerings of the course.

INTRODUCTION

The practical requirements which underlie every historical judgement give to all history the character of "contemporary history" because, however remote in time events there recounted may seem to be, the history in reality refers to present needs and present situations wherein those events vibrate.

Benedetto Croce, "Truth in History Books," from History as the Story of Liberty

Twenty years ago no school of architecture offered a studio using computer aided design, and few offered courses in architectural history as an integral part of the design curriculum. Both fields of enquiry, which have gained such a prominent if not always appreciated place in architectural education in recent years, did not feature in the blueprint of architectural education delineated in the ambitious Geddes-Spring report, A Study of Education for Environmental Design (Geddes, 1967). The report was published seven years before Donald P. Greenberg's seminal article in Scientific American on the future potential of computer graphics in architecture (Greenberg, 1974) and five years before Robert Venturi's Learning from Las Vegas (Venturi, 1972), the text which was to send architects back to their history books in order to become literate in the new discourse which treated the city like an intangible fabric of historical texts composed of buildings conceived as an increasingly insubstantial system of signs. Robert Geddes and Bernhard Spring's educational utopia centered on the present: an updated version of Gropius's "integrated studio" which was meant to simulate the actual world of practice—a world as yet without computer screens and history texts.

More than two decades later the utopian edifice of the integrated studio has crumbled and the champions of both computer and historical memory have erected their habitations within its ruins. Yet the relationship between the computer studio, the historical seminar and the design studio remains unresolved. Most readers of ACADIA will have experienced some if not many of the problems which arise in the integration of computer graphics and computer aided design in the general curriculum; not all of them, however, will have considered the problematic relationship
between the teaching of architectural history and design education. Therefore we will begin with a consideration of the predicament of the architectural historian in some detail.

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The historian who desires to make a useful contribution to the design education of aspiring architects must critically engage the dominant paradigm which structures contemporary historiography: the assumption that the nature of history is change, the Heraclean idea that history is a powerful torrent. The academic historian tends to consider time as a continuous "stream of becoming, which makes all relative and dissolves everything in waves" (Meinecke, 1959). This is problematic if she wants to convince students that they can learn something from history. She will have to face the debilitating implications of what some call historical relativism, others the problem of relativism and historicism, and what C.S. Lewis labeled in his Screwtape Letters as the "Historical Point of View." The Screwtape Letters are undoubtedly one of the more entertaining and penetrating critiques of the human condition in general, and the modern (and postmodern) situation in particular. Lewis believed that the present historiographical paradigm--i.e. the relativist one--served what he straightforwardly identified as a satanic purpose. He argued that if people were to learn from history, they would realize that crime does not pay. Therefore it is in the interest of Satan to prevent them from learning from history. In the candid confession of a high-ranking bureaucrat in the Kingdom of Satan, the devil Screwtape, Lewis described the success of the satanic plot. Screwtape instructs a low-ranking "Tempter" (his cousin Wormwood) as to how to guarantee a steady supply of human souls to Hell. Referring to "the intellectual climate which we have at last succeeded in producing throughout Europe," Screwtape notices scoffingly that Wormwood could rest assured that hell would remain fully booked as people have lost their ability to learn valuable lessons from the past. First of all the link between past and present is broken by the functional illiteracy of the masses. As Screwtape reasoned, "only the learned read old books and we have now so dealt with the learned that they are of all men the least likely to acquire wisdom by doing so." This brings Screwtape to explain to Wormwood the sterility of historical knowledge.

We have done this by inculcating The Historical Point of View. The Historical Point of View, put briefly, means that when a learned man is presented with any statement in an ancient author, the one question he never asks is whether it is true. He asks who influenced the ancient writer, and how far the statement is consistent with what he said in other books, and what phase in the writer's development, or in the general history of thought, it illustrates, and how it affected later writers, and how often it has been misunderstood (specially by the learned man's own colleagues) and what the general course of criticism on it has been for the last ten years, and what is the "present state of the question." To regard the ancient writer as a possible source of knowledge--to anticipate that what he said could possibly modify your thoughts or your behavior--this would be rejected as unutterably simple-minded. And since we cannot deceive the whole human race all the time, it is most important thus to cut every generation off from all the others; for where learning makes a free commerce between the ages there is always the danger that the characteristic errors of one may be corrected by the characteristic faults of another. But thanks be to our Father and the Historical Point of View, great scholars are now as little nourished by the past as the most ignorant mechanic who holds that "history is bunk". (Lewis, 1961)

Applied to architecture, Screwtape's observations would read more or less as follows: the historian cannot ask whether a historic building is good or bad (as we cannot know) is true or false, right or wrong (on the plea that we cannot know), but only report that so-and-so designed it, that he derived the inspiration for the form from such-and-such sources, that it resembled certain other buildings (or pictures in books, or descriptions in texts), that various later architects were influenced by the building, that they imitated it, or readapted the original to a new purpose, that it became a national symbol or not, that it gained recognition as a masterpiece and became the focus of costly restoration campaigns, or that it was allowed to fall into ruin to be finally pulled down as
a safety hazard to the public. This, indeed, is an outline of what architectural historians would consider to be a solid outline of an architectural-historical investigation. Screwtape's Historical Point of View summarizes the dominant ideology which has shaped the historiography of the West for the past two centuries. It informs the methodology and ambitions of the standard of architectural history courses offered in architecture schools. 

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One of the co-authors of this paper teaches in the history program at the University of Waterloo's School of Architecture. In his classes he has discussed at times Screwtape's reasonings, and suggested that if it were indeed true that the historian can only interpret a historical fact within its proper historical context we cannot but conclude that a student of architecture wastes her time when she studies architectural history in order to retrieve some normative knowledge which allows her to design in the present. History is fragmented, and one epoch is not connected to another. As an untutored architectural history teacher he was less than pleased with the logic of his own argument, and so he sought a way out. He found one in the works of the Italian philosopher Benedetto Croce. Croce was firmly committed to the relativist position that each age (or architectural-historical development) should be considered in its own terms. Yet Croce radicalized the relativist position when he asserted that "humanity in every epoch, in every human person, is always whole." (Croce, 1941a) Throughout history, Croce argued, people have been the same in their relationship to the future as the field of action, the past as the domain of judgement and the present as the realm of decision. Croce did not deny the validity of the historicist assertion that historical situations are determined by the specific conditions of time and place. But he also recognized that every historical situation is open to the as always unresolved future, that its horizon is the actuality of decision. Rudolf Bultmann summarized Croce's "deeper understanding" of historicism as an almost prophetic apprehension of man as a being "who can never possess his genuine life in any present moment, but is always on the way and yet is not at the mercy of a course of history independent of himself."

Every moment is the now of responsibility, of decision. From this the unity of history is to be understood. This unity does not consist in a causal connection of events, nor in a progress developing by logical necessity; for the historical process falls to the responsibility of men, to the decisions of individual persons. In this responsibility, as responsibility over against the past as well as over against the future, the unity of history is grounded. (Bultmann, 1962)

Croce argued that we encounter the same dialectics of necessity and freedom within the determinate and historical tasks as our ancestors faced. Like them we have to decide which of all the possibilities open to us are relevant to our choice and action. This implies that we also have to decide which interpretation of history, of all possible readings of the past, is relevant to the task we are to fulfill. Thus Croce identified the sameness of people to be located in their relationship with the world understood as a task to be performed. "Therefore in the accomplishment of that task, humanity expresses itself in its wholeness, and when other tasks supervene it will express itself in these from time to time, always in its entirety" (Croce, 1941b). Within the actual moment of decision, faced by real people who are confronted with real tasks and real choices, the past and future gather each time anew, each time in the same way. What does this mean for the teaching of history? Simply this: the historian must study the past that became in relationship to the pasts that might have been. In his Valedictory Lecture, held on May 20, 1980 in Oxford, the Regius professor of history Hugh Trevor-Roper demanded that the historian should consider history as a future to be faced. The historian must "restore to the past its lost uncertainties, to reopen, if only for an instant, the doors which the fait accompli has closed." This, so he admitted, "requires an effort of the imagination. But it is surely a necessary effort if we are to see history as a reality, and not as a convenient scheme" (Trevor-Roper, 1981).

The kind of "open" history which Croce and Trevor-Roper called for is not completely alien to
traditional architectural history. After all, architectural historians have fruitfully studied with the help of abandoned schemes the processes of design which led to the creation of this building or that urban arrangement. Yet this method only applies to the history of architecture of the past four or five hundred years. It cannot be applied to the history of ancient or medieval architecture. Furthermore, the fragmentary character of thus recovered alternatives of the past has undermined its revelatory character. Most important, however, is the fact that the kind of attitude and forward-looking imagination which Croce and Trevor-Roper recognize as essential, demands a sense of existential commitment to the situation studied. To study the alternatives of the past means to become involved as if one were a participant, experiencing the dread and anxiety generated by an undecided future already past. A few texts on (or beyond) the periphery of architectural-historical discourse seemed to provide a model for such a history. They center on imaginary towns such as the Galilean town of Makor in James A. Michener's historical novel The Source or the French city of Clusy in Viollet-Le-Duc's Histoire d'un hotel de ville et d'une cathedrale. In both books the writer constructed an imaginary setting and showed its development over time. The city becomes a protagonist, and the reader becomes involved with it. The way these "histories" involve the reader differs quite considerably from ordinary survey histories of architecture and urban form. In the latter academic category the writer is obliged to search for the important examples: for example a history of the city does well to consider in its chapter on Hellenic Greece the city of Athens, but in its chapter on hellenistic urban planning Priene and Pergamon are more exemplar, and whilst the Romans did contribute some important buildings to Athens it is more likely that the discussion on the Roman city will concentrate on more "typical" examples such as Timgad or Djemila. And so on. The result is a fragmentation of the reader's attention which leads to her inability to become involved with one or another example. As there is no commitment on the side of the historian to one or another site, so there can be no real interest on the side of the reader to ponder the possible alternatives which the inhabitants of Athens faced when they set out to transform their public places according to the visual conventions of Hellenistic art and science. This issue is probably most clearly represented in Karl Gruber's Die Gestalt der deutschen Stadt (The form of the German City), published in 1952. This superb history of urban form contains illustrated analyses of historical situations, a number of images which show a "typical" cathedral city, abbey city, merchant city, a typical city established by the teutonic order and so on. Yet the most memorable and poetic part of the book is the sixth chapter which presents in four pairs of drawings the history of a prototypical south German city "situated perhaps along the Neckar or the Main" over more than five centuries. Figures 1 & 2 Carefully constructed this city reveals in four historical situations (1200, 1350, 1550 and 1750) a development that is plausible, but, also, because it did not actually happen, suggests also other options. The reader is forced to challenge Gruber's judgement as to what the most likely history would have been, and, implicitly, is forced to challenge history itself. This challenge is possible because the reader can appropriate not only one situation, but a continuity of development which offers a firm foundation for both debate, decision and judgement.

The power of the sixth chapter of Gruber's Die Gestalt der deutschen Stadt suggested a new approach to the teaching of a survey of the history of urban form in which the study of the paradigmatic models of the various developments (Athens, Priene, Pergamon, Timgad, Djemila) would be completed by the creation of one model city in which the various developments would be shown in one place. The assumption was that the students would settle a site as Greek colonists, transform it according to Hellenistic insights, adapt it after the city's incorporation in the Roman empire as a Municipium, rebuild it after the year 1000 AD, expand as trade expands in 1550, modify it to fit a succession of republican, ducal and royal governments in the 15th, 16th and 18th centuries and so on. Each epoch would inherit the fabric, or remainder thereof, of the earlier, and the assumption was that each addition or transformation would challenge the students to rethink the earlier one and, also, the canonic examples of urban history. The original idea was that each student would work out his or her own city, and produce a plan every week depicting the developments of the next epoch. Gruber's example revealed, however, that the secret to the success was based on the quality of the imagery, and so the first author of this paper, a historian,
Figure 1  Gruber's ideal prototypical German city, 1550

Figure 2  Gruber’s ideal prototypical German city, 1750
turned to the second author, an instructor of computer modeling.

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In the Fall of 1989 they discussed the possibility to offer a course which would provide students with a survey of urban history from Hippodamus to Haussmann and which would introduce them to McDonnell Douglas' GDS (Graphic Design System) software for three-dimensional modeling and rendering. This software was developed by Applied Research Cambridge (ARC) in England in the mid seventies. ARC was originally involved in computer aided building systems such as the Harness system for the design of modular hospitals. Subsequently, ARC developed the more flexible, interactive OXSYS system for the design of hospitals by the Oxford Method of Building. Both Harness and OXSYS were in use by 1972. The OXSYS system was relatively flexible in comparison with the Harness system (Mitchell, 1977). Yet it was still based on modular building systems and therefore only applicable to a limited range of building types. To achieve a greater flexibility ARC eventually gave up the development of software for integrated building systems and began to develop GDS or "General Drafting System," a sophisticated electronic drafting system specifically tailored for architectural drawings. In 1985 McDonnell Douglas bought ARC keeping the software development office in Cambridge. It began to market GDS, now referred to as "Graphic Design System." The University of Waterloo's School of Architecture acquired McDonnell Douglas GDS software in 1987. GDS includes both two and three-dimensional software for architecture and other applications in the built environment. Five of the modules seemed to be useful for the construction of the prototypical city. These were:

1. Site Modeler (XSITES) for creating a model of the city's site.
2. XGDS for creating and maintaining two-dimensional drawings and drawing files.
3. Solid Modeler (XSOLID) for creating three-dimensional solid objects such as building models.
4. Assembly Modeler (XPAM) for placing solid objects in relation to other solid objects in three dimensional space and over two-dimensional drawings which provide reference lines.
5. Scene Viewing System (XSVS) for assigning colors to surfaces, for assigning light source positions and for rendering shaded (and shadowed if desired) images.

The wide-ranging capabilities of this software seemed to match the historiographical ambition. It allowed the students not only to model buildings and groupings of buildings with relative ease, but also the large site and territory. The software allowed them to place buildings into an irregular three dimensional landscape. Most important the combination of hardware and software gave the students an opportunity to place large quantities of buildings on an uneven and complex site as would be required in the making of a city. Only two of the modules had to be learned thoroughly by the students, namely the Solid Modeler and the Scene Viewing System. The other modules were generally used with the assistance of one of the course instructors, although all modules were discussed in the seminars and demonstrated with simple case studies.

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We began the (officially experimental) course in January 1990. Part of the syllabus read as follows:

This course will provide an overview of the history of urban form through readings and three-dimensional modelling by computer. The results of the readings and the seminars will be summarised in a computer model of a hypothetical city named Kara, located somewhere in the vicinity of Trieste. This model will trace the city's development from a small pre-historic settlement to the 20th century. Students will learn to use McDonnell-Douglas's sophisticated
three-dimensional computer modelling and rendering system. This new and powerful modelling system is presently not used in any other courses taught at the school.

The course will consist of:

a) 3 hours per week lectures:
   i) First five weeks: 1.5 hours history of urban form;
      1.5 hours of instruction in computer modelling.
   ii) The last eight weeks: 3 hours history of urban form.

b) 3 hours per week computer studio.

Class size: 8 students.

Week 1: January 8
INTRODUCTION TO THE COURSE; PREHISTORY.

a) Introduction to the course.
b) Discussion of the nature of pre-historic settlements.
c) Introduction to three-dimensional computer modelling: overview, coordinate system, viewing conventions.
d) Allocation of assignment 1: the preparation of data for the site of the hypothetical city of Xara, presently the provincial capital of the province of Vara, located in the Republic of Lycia which is the seventh republic of the Yugoslav confederation.

Week 2: January 15
THE ARCHAIC CITY: [-]3000-[-]1200.

a) Discussion of the ideology of the archaic city: the immortality power of the gods.
b) Discussion of the architecture of the ancient city.
c) Computer modelling: object creation, saving and naming; contour models and digitizing contours.
d) Allocation of assignment 2: creation of a contour model of the site. Sketch design for the layout of the Greek polis which forms the core of the present city of Xara.

Week 3: January 22
THE POLIS: [-]600-[-]400.

a) Discussion of the ideology of the polis: the immortality power of enduring deeds.
b) Discussion of the architecture of the classical Greek polis: the immovable past and the necropolis: the enduring future and the acropolis: the dynamic present of the agora; the recapitulation of the theaere.
c) Computer modelling: editing objects, assembling large models.
d) Allocation of assignment 3: creation of building models for use in the Greek city of Xara.

Week 4: January 29
THE HELLENISTIC CITY: [-]300-150.

a) Discussion of the Hellenistic transformation of the Hellenic city. The pursuit of the good life versus the pursuit of the noble death.
b) Discussion of the sketch-design of the polis.
c) Computer modelling: plotting and rendering including hidden line removal, rendering techniques, light sources, shadows and colors.
d) Allocation of assignment 4: creation of the model of the Greek city of Xara.

Week 5: February 5
1) Discussion of the Roman theory of the city: the urbs, the civitas and the officium.
2) Discussion of the architecture of the Roman city.
3) Computer modelling: miscellaneous topics.
4) Allocation of assignment 5: completion of the model of the Greek city of Xara.

Week 6: February 12 \ THE MERCHANT'S CITY: 1250-1700.

1) Discussion of medieval understanding of the city: the Lord, the market and the corporation.
2) Discussion of the architecture of the medieval city.
3) Discussion of the computer model of the Greek city of Xara.
4) Allocation of assignment 6: preparation of computer model of i) the Hellenistic city of Xara; ii) the Roman city of Xara. (4 students per group)

And so on.

The syllabus suggested a lot of work, yet enough students volunteered to join the course. What the syllabus did not suggest, and what the teachers did not sufficiently realize when they designed the course was the chasm between historical ambition, available time and technological capability. The project was to strain the capability of both the hardware and the software which resulted in a number of difficult conditions which had to be overcome.

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Before we reach the story of breakdown and recovery it is good to give more detailed overview of the computer content of the course. We will discuss the use of the five modules used to build the Greek city of Xara in turn.

Site Modeler (XSITES)

The site for the city of Xara, being entirely imaginary, was first sketched on an 8 1/2 x 11 piece of paper. In conjunction with the XGDS system, the Site Modeler was used to digitize spot heights from a large contour map taping to a digitizing tablet (the large map was an elaboration of the sketch map). The digitizing process produced spotheight objects (graphic text objects) on a computer drawing displayed on the screen. These objects display the digitized elevation as text and store it as a non-graphic information. The spotheights were then triangulated automatically to create a surface model of the digitized landscape consisting of triangular faces. The surface model, in turn, was used to automatically create an accurate drawing of the contours using spline curves. This contour drawing, in turn, was used later in the Assembly Modeler to guide the placement of buildings on the site of the city. The final application of the Site Modeler was to create, again at the touch of a command, a three-dimensional model of the site, based on the triangulated surface, for use in the Solid Modeler.

The site model as created for the city of Xara consists of one peninsula which juts out into the Adriatic from the coast. At the southside of the peninsula is a wide bay which is suitable as a harbor. The peninsula has a suitable outcropping for an acropolis and a lower hill which can serve as the site for a capitol. High mountains rise inland. The entire site covers an area of 2.6 x 4.2 kilometers, excluding the sea, and required 4400 spotheights. The site was actually too large for the software to triangulate. This required that the high inland mountains had to be triangulated separately and grafted onto the remaining site late. This accounts for some spurious artifacts in the mountain region on some of the illustrations (The latest version of GDS no longer has this limitation).

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XGDS

This module was used for its two-dimensional drawing and editing facilities which are required by the Site Modeler and by the Assembly Modeler. Both modules carry out certain operations over two-dimensional drawings. Although the capabilities of XGDS and its submodules are extensive, this module was not required to be understood in depth because its main use was primarily to start new drawings, to display them and to save them after changes had been made by the Site Modeler or the Assembly Modeler.

Solid Modeler (XSOLID)

The Solid Modeler was used to create all the buildings and structures comprising the city of Xara other than the site itself. The Solid Modeler provides facilities for creating shapes such as houses out of more primitive shapes such as boxes, cylinders, wedges and all kinds of extrusions and objects of revolution. Dimensional accuracy and reference points for placing objects next to each other is obtained by using reference lines which can be drawn in three-dimensional space (these lines are known as C-lines). Intersections, endpoints, midpoints and other reference points on these lines are available for snapping when creating or relocating objects. Among the most convenient functions of the Solid Modeler are the Boolean operations whereby solids may be added together to become one, or solids may be subtracted from other solids to create window or door openings, for example. Boolean operations were even used on the site itself to trim the height of the acropolis mountain and to excavate for a stadium and a theatre (the site modeler does, however, allow more irregular changes to be made to the landscape with revised local surface patches). Completed solid objects (e.g. houses, stoa, tombs, arsenals, temples) are stored in special files called codices for later retrieval and placement in the Assembly Modeler. Before storing buildings and structures in the codex files there were two possible strategies to follow. One course of action was to place all the buildings in relation to the origin of the three-dimensional coordinate system used for the whole site of the city so that the buildings and structures would fall automatically into the right location on the site. The other strategy, used for all structures other than those on the acropolis, was to locate a structure with the origin on a reference point on the structure so that this point could be used later to place the structure on the site at a location selected with the cross hairs on the screen (i.e. at an unpredictable location).

Assembly Modeler (XPAM)

The Assembly Modeler was used to place buildings and structures and even the three-dimensional model of the site itself over the two-dimensional drawing showing the contours of the site. The contours provided both a guide to the location of buildings and structures in plan and the elevation above the origin at which these objects were placed in space. We were obviously exploring new territory, literally and figuratively, with this software when most of the structures with columns, in particular certain temples and houses (of which eventually some 500 were placed, i.e. one quarter of the intended number) lost their columns on placement. After much agony Boolean operations were finally used to weld the columns and other components of a temple or house into a single solid object. This solution was found by trial and error after anxious phone calls to McDonnell Douglas headquarters in St. Louis and hearing that similar mysterious disappearances had been experienced by an architect in New York and by McDonnell Douglas staff.

Scene Viewing System (XSVS)

The Scene Viewing System was used to produce rendered images. Some of these, showing the model in different stages of completion, are depicted in figures 3 to 9. The model of the city as assembled in the Assembly Modeler was simply pulled into XSVS with a special command and rendered in accordance with a specific position of the sun, a specific viewing position and a specific look-at position (these positions were determined by plotting coordinate positions on the
Figure 3  Overview of the Archaic Greek city of Xara showing the acropolis, residential quarter, the harbour with sea walls, the city wall and high mountains

Figure 4  Detailed view of the city of Xara showing boat houses, residential quarter and acropolis
Figure 5  Overview of the acropolis of Xara before the placement of other structures showing the location of the agora and theatre at its foot
Figure 6  The acropolis of Xara looking South

Figure 7  The acropolis of Xara looking North West
Figure 8  On the acropolis of Xara looking south with a view of various temples

Figure 9  Closeup of structures on the acropolis of Xara
overall contour map). Colors were selected for the land, sea, sky, buildings, walls and roofs. A special command allows one to choose a ground color (the sea in this case) and a sky color so that sky and ground meet at the horizon without requiring that the model extend to the horizon. Other parameters which could be manipulated are the amount of ambient light which determines the brightness of surfaces not facing the sun and a zoom angle which determines how much of the scene is visible in the same manner as one adjusts the focal length on a camera's zoom lens. Rendering each image, despite the complexity of the model of the city, took between one and a half and two hours per image. An attempt to create an image with shadows failed because the computation required more virtual memory paging to the hard disk than the computer could provide.

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When the instructors wrote the syllabus they hoped that the Greek city of Xara would be created within a month. The project took three times as long, and even the final result was incomplete. First of all only one of the five students who finally signed up had any experience with the software. Lack of the proper documentation on how to carry out various procedures related to modeling a city with the McDonnell Douglas software compounded the problems generated by the inexperience of the students with the software. Too much time was spent on developing the site. This was partly the result of the fact that the software could not treat the entire site—the high mountains had too be patched on later—and partly this was due to inexperience with contours at such a large scale. Too much time was spent on modeling buildings. The temples, houses, stoas and even tombstones were developed in great detail. The group was divided about the appropriateness of the amount of work which went into each individual building. Some felt that more simple shapes would have sufficed, and that a simpler terrain model should have been adopted (one which offered, for example, a more level site). Then there were those who believed that a certain measure of detail was justified for the public buildings, but that the work spent on the individual houses had been a waste of energy. Others believed that the visual quality of each individual piece made an important contribution to the success of the whole. Gruber's example seemed to justify their case. The level of detail used in the model of the Greek city of Xara had the minimum level of detail to be interesting, to look like a city and to create that sense of attachment and commitment which would suggest new explorations or transformations. The group judged the (partly) completed model to be modestly successful. Its creation had given the students a feeling for what a Greek city was all about which went beyond the absorption of the information provided by the readings and lectures. Yet all felt that the same kind of involvement with the Greek city could have been achieved through more economical means. The slow start meant that the pressure to produce enough buildings to make the whole exercise worthwhile tended to fragment the group: by the beginning of March each student desperately tried to finish the assigned task and the interactive negotiations, which were to simulate the actual process of decision in the making of a Greek polis, did not unfold as desired. The model discloses this lack of feedback. The seams are less than elegant: the acropolis, the agora, the neighborhoods, the emporium and harbor areas and the necropolis remained virtually unconnected to each other. The Scene Viewing System was an unqualified success, and all involved felt that the diverse images of Xara brought a sense of realism to the project which stirred the imagination. In the final analysis all agreed that the Greek city of Xara had acquired a measure of reality which inspired further studies into Greek urbanism. A real problem was our lack of computer power (a VAX 11/785). This meant that various operations, such as the triangulation of the site from spot heights, the creation of a solid model of the triangulated site, the creation of models and the rendering of images became very time consuming. The simultaneous demands for computer power, occasioned by extended batch operations that were initiated by other departments in the faculty to which the School of Architecture belongs, resulted in additional long waiting times. Software bugs also slowed down the process of modeling the city. Most disconcerting was the bug which caused columns to disappear from temples and houses as they were placed onto the site using the Assembly Modeler.
Despite these problems both the students and the instructors felt that the computer part of the course—to keep things in perspective: the students had to read every week one or two books to fulfill the "academic" part and suffer a three hour historical lecture on the relationship between the form and ideology of Greek, Roman, Medieval, Baroque etc. city—had been a success. The instructors decided to continue their cooperation in the future, and offer the course at a regular basis. Their intention is to correct the various deficiencies of the site (lower the ridiculously high mountains which resulted from the plains folk’s ignorance of heights and slopes, possibly decrease the height of the outcropping on which the acropolis was placed) and provide this model at the beginning of each offering with some parts or the whole of the city produced the year before. They will also create a library of buildings which can be used by subsequent courses. The result of this year’s effort is a collection of temples, tholoi, treasuries, stoa, monuments, houses, stoas, a theatre, a stadium, a bouleuterion, an arsenal, sheds to protect ships etc. In short McDonnell Douglas GDS seems to have found a place within the resources available to support the teaching of history at the University of Waterloo’s School of Architecture, a fact which demonstrates in an unexpected way Croce’s judgement that all history is in fact contemporary history.

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Croce, 1941b, op. cit., p. 280.


