

Stone-for-Stone in Roman Corinth

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Abstract. An interactive actual-state drawing of aspects of the excavated city of Roman Corinth is now available on the web at <http://corinth.sas.upenn.edu>. The drawing features the digitized actual-state drawings of the excavated buildings and monuments from the area of the forum. All of the buildings and monuments have been geo-rectified with respect to an electronic total station survey of all the above ground buildings and monuments of the ancient city. Each digitized drawn line of each building is identified by means of a layering system including chronology, function and material. The Autocad Whip® plug-in offers a variety of functions which allow an Autocad drawing file to be manipulated within a web based format.

Keywords: Autodesk Whip®, AutoCAD, Roman, ancient cities, Corinth, electronic total station, Roman city planning, *agrimensores*.

1 Introduction

The Corinth Computer Project, a computerized architectural and topographical survey of Ancient Corinth, has been underway since 1988. The project has been run from the Mediterranean Section of the University of Pennsylvania Museum, D.G. Romano, Director, and the summer fieldwork has been carried out under the auspices of the Corinth Excavations of the American School of Classical Studies at Athens, Charles K. Williams II, Director.¹ The primary objectives of the research project have been to study the nature of city planning in the Roman period, to gain a more precise idea of the order of accuracy of the Roman surveyor and to create a new, highly accurate computer generated map of the ancient city whereby one could discriminate between and study the successive chronological phases of the city's development.²

1.1 Field and Laboratory Research

There have been several different components of the project. An electronic total station survey of all of the above ground buildings and monuments of the city during ten summer field seasons comprise the framework for the study.³ In addition, supplemental information has been added from notebook drawings, published actual-state plans, topographical maps, air

photos and satellite images. During the academic terms of these years, laboratory research has been carried out in Philadelphia to supplement the summer work and to further the goals of the project.

One of the important elements of this laboratory research has been the accurate digitization of previously published actual-state plans of the buildings and monuments excavated in Corinth by the American School of Classical Studies. Through this work and the subsequent fitting of these drawings to the highly accurate electronic total station survey of the monuments and structures of the city, it has been possible to create a new comprehensive map of the Roman city (as well of other chronological periods of the city's history), which is far superior to any existing map or drawing. The fitting of the actual-state drawings to the electronic total station survey means that the actual-state drawing, once digitized, is geo-referenced to various control points of the electronic total station survey of the city to guarantee accuracy of location, size and orientation. This new map is quite literally a stone for stone drawing of the entire excavated city and each feature of the drawing includes certain basic information.

2 Methodology

The Corinth Computer Project laboratory utilizes much of the latest technology in the study of Roman Corinth.⁴ Currently the equipment includes Pentium class PC's operating on a Windows platform. The project has utilized AutoCAD as the principle software of the project over the past 15 years and it has served as the engine for digitizing over 300 archaeological actual-

¹ We thank Dr. Williams for his interest in and support of this project since its inception. We also thank Dr. G.D.R. Sanders, the current Director of the Corinth Excavations, since 1998, for his continuing interest.

² For a current account of some of the results of the Corinth Computer Project see below, Romano 2000.

³ Earlier articles describing the work of the project have appeared in CAA 94, CAA 95 and CAA 2001 (see below).

⁴ For a more detailed discussion of the current hardware and research methodology used by the research project, see Romano and Stapp, 1998.

state drawings taken mainly from the published drawings of the Corinth Excavations. Currently the method used to digitize the actual-state drawings is to utilize an additional component of Autodesk, CAD Overlay 2000, a raster software module that can enable a raster image to be digitized in AutoCAD. In this way the original actual-state drawing is scanned and the digitization process takes place on the computer screen without the need for a digitizing tablet. We have found this to be an advantageous methodological approach in most circumstances.

2.1 Actual-state drawings

As with any archaeological urban center, many of the published actual-state plans of Corinth overlap with the publications of other structures. The inclusion of structural overlap highlights a serious procedural problem. The inherent error that results from joining an actual-state plan to other digitized plans from the Corinth Excavations is due to different drawing techniques that have been adopted during excavation. Furthermore, the excavations of the American School of Classical Studies have been ongoing since 1896, and as a result, methods of recording and depicting actual-state drawings have changed over the years making it more difficult to follow drawing techniques. This has produced a large collection of actual-state plans that cannot always be stitched together visually.

A process for correcting the overlap error had to be developed. This action has allowed the research lab to take numerous actual-state plans and effectively create one large actual-state plan for the entire city. Each plan has been meticulously digitized, scaled and rectified to surveyed data. Neighboring digitized actual-state plans were inserted and overlapping duplication was eliminated. This process rendered the actual-state plans into a format that can be used for analytical purposes. The usability of this data was further addressed by introducing a standardized tabular layering system within AutoCAD.⁵

2.2 Layer conventions

The layer identification system utilizes the excavation reports provided in the actual-state plan publication and identifies three properties of every single drawn feature on the state plan: *chronology*, *function* and *material*. Each layer is given an abbreviated 12-character name, and the abbreviations are de-coded in a supplemental booklet. Furthermore, the layering system is color-coded to the chronology, with a result that the chronology of the structure is visible in the digitized actual-state plan. The benefit of this coding system is that the drawings can be manipulated and analyzed by

turning layers on and off by one of the three main categories.

Filtering and searching can be conducted either textually or visually when using AutoCAD. Combining a database of identifiers with the accuracy of the rectified state plan allows users to identify and document renovation campaigns, water system locations and materials used for construction. For example the hard limestone paving slabs of the *cardo maximus* of the Roman colony, the Lechaion Road, receives the following layer.

ROMVES RDS LMS referring to "Roman – Vespasian, roads, limestone"

Another example, a stone mosaic in the odeum from the period of Marcus Aurelius would receive the following descriptive layer.

ROMMAR MOS STO referring to "Roman – Marcus Aurelius, mosaic, stone"

A final example documents a poros foundation of the Greek North Building which would receive the following designation:

GRKGEN FDN POR referring to "Greek – generic, foundation, poros"

This layering system, which has been in the testing phase since 1997, has proven to be extremely successful. Although our specific research goals focus on the Roman city, the research lab documents all of the non-Roman chronological phases of each actual-state plan digitized in the lab. This process allows pre/post Roman research to be conducted on any building or monument in Corinth.

3 Technical Methodology

One of the goals of the project has been to make the digitized data accessible outside of the lab because the data had to be converted into a usable format for the field and for publication. One problem is that not everyone has the software or the hardware to view and manipulate this type of vector or tabular data. One successful, secure solution was to convert this data into a medium for HTML and the Internet. The Corinth Computer Project has recently (March 2000) a new website, <http://corinth.sas.upenn.edu>. It replaces an earlier website from February 1997. Historically, HTML has proven to be useful for text and static images, but it is fairly ineffective for the detailed printing and manipulation of data. A solution was discovered at the web page of Autodesk, which has developed a plug-in called Autodesk Whip!®.

3.1 Autocad Whip®

This plug-in allows digitized data to be viewed on the internet or on an intranet. Autodesk Whip!® works

⁵ By standardizing the layering system, it is possible to take the documentation process a step further by classifying what the archaeologist identified during excavation.

with any internet browser, and it is free to download and use. The plug-in allows a user to view, zoom, pan, print, and manipulate layers from AutoCAD drawing files. In addition, a raster image can be inserted behind the vector file and viewed as image data on a web page, using the Whip plug-in. This type of functionality allows the user to turn on/off the raster data through the layering system. By introducing an additional visual dimension to the plug-in, the user can fill in the blanks that a vector image produces.

The following will explain how to use the Autodesk Whip!® plug-in and the discussion is taken directly from the Corinth Computer Project web site. After accessing the interactive archaeological state plans, the following layout appears (Fig. 1).

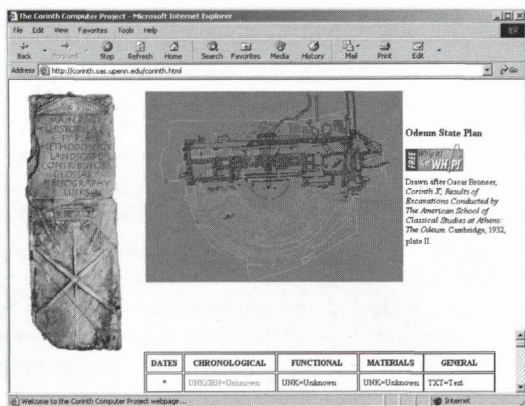


Fig. 1. An example of an interactive archaeological state plan from the Corinth Computer Project website: The Odeum

The Autodesk Whip!® plug-in offers a variety of functions which allow an AutoCAD drawing file to be manipulated within a web based format. These functions include:

- Panning and zooming within the archaeological plan
- Manipulating the layer information that corresponds to the drawn lines contained within the archaeological plan
- Tabular coding system
- Printing a desired view of the archaeological plan

NOTE: clicking on the archaeological plan with the right mouse button for pc's and holding the command key and single clicking for Mac's access all of these functions.

3.2 Panning and Zooming

To pan, hold the left mouse button down and move the mouse in any direction over the drawing (Fig. 2). To zoom, right click on the archaeological plan and a menu appears. Either choose zoom or zoom rectangle (Fig. 3). Zoom allows for real-time zoom by holding the left mouse button down and moving up or down. Zoom rectangle allows any specified area to be zoomed into.

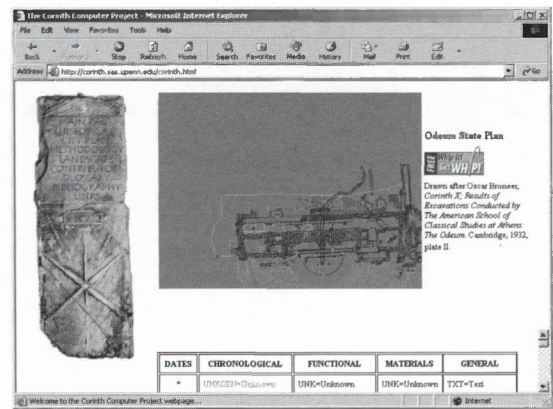


Fig. 2. An example of the interactive archaeological plan after using the pan option. Detail of the Odeum

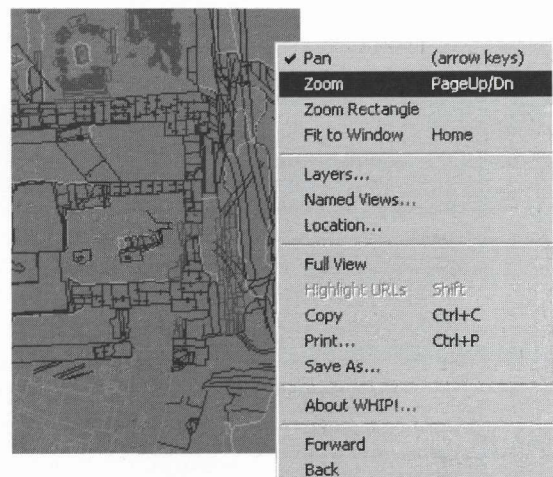
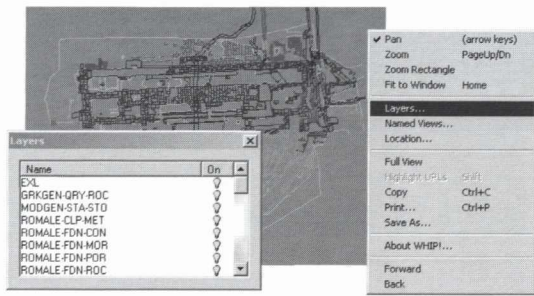


Fig. 3. An example of using the zoom option within the interactive archaeological plan. Detail of the Odeum

3.3 Layer Manipulation

AutoCAD allows unique identifying characteristics to be assigned to each drawn line within the archaeological plan. To access the layer option, right click on the interactive archaeological plan. The Autodesk Whip!® plug-in allows the unique layers of each building to be brought up and turned on/off by selecting the yellow light bulb on the right side of the layer dialog box. Using the tabular chart at the bottom of each interactive archaeological plan by decoding the layered code system can do further interpretation (Fig. 4). This coding system uniquely identifies three main components of all the archaeological state plans on the Corinth Computer Project web site, *chronology*, *function* and *material*. Note that this system is color dependent upon chronology. For example, any shade of blue would fall within the Roman category.



DATES	CHRONOLOGICAL	FUNCTIONAL	MATERIALS	GENERAL
*	UNKOEN=Unknown	UNK=Unknown	UNK=Unknown	TXT=Text

Fig. 4. An example of using the layer option within the interactive archaeological plan. Detail of the Odeum

3.4 Tabular Coding System

All of the layers contained within the interactive archaeological state plans have either 3 or 12 alphabetic characters. This coding system documents the evidence identified within the archaeological publication (Fig. 5).

DATES	CHRONOLOGICAL	FUNCTIONAL	MATERIALS	GENERAL
*	UNKOEN=Unknown	UNK=Unknown	UNK=Unknown	TXT=Text
900-700BC	GEOGEN=Geometric Genetic	MSC=Miscellaneous	MAR=Marble	RES=Restored
700-500BC	ARCOEN=Archaic Genetic	RBT=Robbers- trench	LIM=Limestone	EXL=Excavations- limits
500-323BC	GRKOEN=Greek Genetic	FDN=Foundation	POR=Poros	SCA=Scarp
323-36BC	HELCOEN=Hellenistic Genetic	COL=Column	CON=Concrete	
*	ROMGEN=Genetic Roman	PAV=Paving	STU=Stucco	
44BC	ROMCAE=Caesar	MOS=Mosaic	BED=Bedrock	
(43BC)- 27BC- 14AD	ROMAUG=Augustus	DRN=Drain	BRU=Brick	

Fig. 5. An example of the tabular coding system, depicting color dependency upon chronology

3.5 Printing a View

After decoding the interactive archaeological state plan and choosing which layers are to be turned on/off, specify what is to be printed by zooming to the desired area (Fig. 6). Right clicking on the interactive archaeological plan can make a print. The plug-in will scale the desired view of the plan to fit the paper size that is the default on the users system printer.

Taking the above features into account, there are several additional advantages to using this type of internet application. It allows users anywhere in the world to access the Corinth Computer Project's digital data for research and education purposes and it also introduces a level of research, interactive accessibility and accuracy never before seen on an archaeological

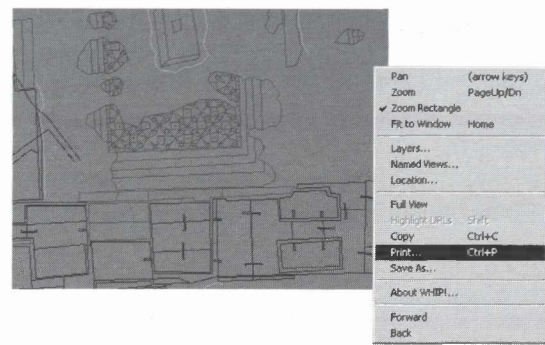


Fig. 6. An example of zooming in to an area of interest, turning off unwanted layers and selecting the print option. Detail of the Odeum

website. There are, however, several disadvantages to using this type of internet application. Firstly, the Autodesk Whip!® plug-in must be downloaded from either the Corinth Computer Project website or the Autodesk website. The file to be downloaded is approximately 3.54 megabytes in size and this process could be a time consuming exercise. The speed of this download is dependent upon the dial-up speed of the user's modem connection. Additionally, there are several steps to install the plug-in into the user's web browser. Although these steps are clearly explained in a tutorial provided on the Corinth Computer Project website, the installation process can be complicated.

It is hoped that Autodesk will make future refinements to the Autodesk Whip!® plug-in that will include allowing this application to be embedded into a server, to allow users to visit a website without downloading the plug-in. Additionally, Autodesk could add a search/filter application to the layer manipulation option, allowing users to quickly find layer information singularly or by groupings. Finally, an isometric view or 3-dimensional rotation could be added to the layer manipulation menu setting, this will allow the user to view elements that have 3-dimensional attributes.

4 Publication

An important issue to be considered is the publication of the data created by the Corinth Computer Project. This includes the digitized actual-state plans and the comprehensive city plans of Corinth. The objective is to have the data converted into a useable format for the field as well as for publication. As envisioned, the published data will be available as a book in the final series of the Corinth Excavations and as a map gazetteer as well as in a digital format in the form of a compact disc or discs with an accompanying website. A publication of this type will be not only unusual but also unique to archaeological site publication because it will allow the reader to view and analyze the existing data and it will allow the digital data to serve as a foundation for future research to be added to the original dataset.

5 Conclusions

The new Corinth Computer Project web page <http://corinth.sas.upenn.edu> includes discussions of a new methodological approach to research, study and publication. Representative examples of the web page are included here as illustrations. Other elements of the new web page include a tour of the major monuments and structures of Roman Corinth, including actual-state plans, photographs, literary references (courtesy of the Perseus Project), bibliography and restored drawings.

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