

Garden City – A Virtual City for Undergraduates

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ABSTRACT

The Department of Civil and Environmental Engineering at Rowan University (RU), with support from NSF and Rowan, will adopt “Sooner City”, a virtual city developed by the School of Civil Engineering and Environmental Science at the University of Oklahoma (OU). A more portable version of Sooner City will be created, to ease adoption by other institutions. To be named “Garden City” at Rowan, the portable civil city will be used in the CEE-RU undergraduate program. Garden City will provide continuity for the undergraduate degree program. Undergraduates will go to the Garden City website to obtain data and design criteria for homework and projects, and to access photos. They will also be able to store their projects and designs in the city, allowing them to record their accomplishments. Finally, the Garden City website will provide a central location for course webpages, tutorials, etc. Faculty will use Garden City to demonstrate the context (i.e., human communities) of many civil engineering projects. The purpose of this paper is to provide detail on the Garden City project, including how other institutions can adopt it.

INTRODUCTION

The following text is the Project Summary of “Sooner City - Design Across the Curriculum”, NSF grant # 9872505 (CEES 1998). It is included here to provide a brief summary of the Sooner City project, as this is the best way to introduce the reader to the project.

The School of Civil Engineering and Environmental Science (CEES) at the University of Oklahoma (OU) is embarking on a curriculum reform project entitled Sooner City. The project is in response to the call for more design in the curriculum, a call being made by the engineering accrediting agency, by practitioners who are dissatisfied with the design skills of graduates, and by faculty who want to promote higher-level thinking skills and improve retention.

For the project, incoming freshman will be given a plot of undeveloped land that, by the time they graduate, will be turned into a blueprint for certain segments of the city (time constraints prevent the design of an entire city). Design tasks include all facets of the traditional civil engineering program, such as site planning and layout, sewer and water infrastructure, water supply, wastewater treatment, buildings, transportation systems, channel design, floodplain analysis, and geotechnical work. A common, four-year design project unifies the curriculum and allows material learned in early courses to carry forward, unlike

the “traditional” paradigm wherein courses frequently stand as independent entities with no apparent connection. Also, the project allows students to develop a professional design portfolio that can be presented to perspective employers, be used as a valuable reference for future design tasks, or be used as part of CEES’s outcomes-based assessment. Furthermore, Sooner City provides a natural forum for incorporating other pedagogical reform initiatives, such as just-in-time learning, collaborative learning, and laptop computing.

The primary goal of the project is to produce graduates who can consistently think at a higher level, and who are thus capable of handling open-ended design projects that require creativity, exploring alternative solutions, self-analysis, and awareness of economic, social, and political issues. The extent to which we meet this goal is being assessed through formative and summative evaluations by an external reviewer.

The project is unique in that it threads a common design theme throughout the curriculum, yet does so in a flexible, cost-effective manner that requires no change in the traditional sequencing of courses. Because it does not require major institutional support, nor lock faculty into a fixed syllabus, we expect the reform effort will be attractive to many institutions (with an obvious name change for the city) and be portable to other disciplines. Reform details will be disseminated via the Web and CDROM, and through traditional outlets such as conferences, journal articles, and local and national media.

Key elements of Sooner City, exactly as presented in the OU proposal, are given below (CEES 1998)

- It is comprehensive. The design project starts in the freshman year and continues for the entire undergraduate civil engineering curriculum.
- It is novel. We are not aware of any curriculum reform project that utilizes a common, four-year design theme. Sooner City builds on our own successes, and those of other institutions, with respect to integrated projects, yet it does so in a more economical manner.
- It is flexible. The project does not lock an individual instructor or course into one track, nor does it preclude transfer or advanced placement students. Furthermore, it provides a natural forum for proven pedagogical methods, such as collaborative learning.
- It is highly portable. Other institutions can readily adopt the methodology, and the associated educational materials, because it requires little change in the structure of the curriculum. This will also promote the longevity of the program.
- It addresses a national need. The engineering accrediting agency, ABET, now promotes, among other issues, more design, active, collaborative learning, and outcomes-based assessment.

Sooner City has already been recognized as educational reform worthy of widespread adoption. NSF has showcased the project for two consecutive years in the NSF Project Showcase at the ASEE national conference. Invitations have also been received to present Sooner City at the

ASCE national conference (1998) and an NSF CAREER Workshop (1998). The project has been described in ASEE Prism (Bert 1998) and Engineering Times (Siegel 1999).

RU has received funds from the NSF CCLI program to adapt Sooner City, creating a portable civil city to be called Garden City at RU. Garden City will rest firmly on the foundations of Sooner City. Where possible and appropriate, elements within the Sooner City web-site will remain intact, as the primary objective is the adaptation of Sooner City. The basic elements of Sooner City are currently being repackaged, creating an integrated set of dynamic web pages that can be installed on any Microsoft web server (or asp enabled web server) using an installation/customization wizard, allowing any institution to quickly create their own civil city. For example, the institution could select a city name, create links to its own courses, and select the main elements to be included in the city. The adaptation program can also be configured to allow users to select existing projects or design criteria/codes from Sooner City or add their own.

DESIGN OF A PORTABLE CIVIL CITY

Sooner City, itself still under development, currently exists as a system of web pages, both dynamic and static. The main features are Courses, Design Criteria, Modules, and Photo Gallery, all of which are incorporated into the new portable civil city. The Course page is simply a list of links to OU course web pages. Currently, design projects reside in course pages. Students use the Design Criteria page to find design specifications for projects. For example, a student designing a sanitary sewer could go to the Design Criteria page to find out the allowable minimum or maximum velocities in sewer pipes. Modules are microsites that help students with courses work. Some microsites are executable files that students use to simulate civil engineering activities or design civil engineering products. For example, Sooner City currently has a microsite that allows students to simulate a geotechnical site investigation. A data center microsite is under construction within Sooner City. Students will use the data center to obtain city data (from population to soil characteristics) needed to complete projects. In an earlier version, the data center was an image containing links to physical information students used to complete projects, e.g., river data and soil characteristics. The Photo Gallery contains pictures relevant to Civil Engineering. It can be used to make slide shows.

Unfortunately, not only is Sooner City still under development, but also it is not optimized for portability. For example, projects often reside in OU course web pages. OU logos and University-specific information abounds. RU, in creating Garden City from Sooner City, will create a portable civil city that can be easily adopted by any Civil Engineering department. A portable civil city requires two things: portable content and a portable operating shell.

Content

The content associated with the portable civil city consists of: Projects, Modules (especially the Data Center), Design Criteria, and Photos. Table 1 is used to show the interaction between projects, the data center, and design criteria in a hypothetical multi-class design activity. Each project is associated with a particular course. The projects listed in Table 1 would be assigned in a number of different courses in the water resources, geotechnical, environmental, and structural areas. As students work on a given project, they obtain needed data from the data center microsite or from previously completed projects. Students obtain design criteria from the design criteria page, which may contain criteria developed for specific projects, or links to actual design codes, such as BOCA codes.

Table 1: Multi-Class Design Activity – Water Supply and Treatment

Project	Data Center	Design Criteria
Design Reservoir	Population, Water Demand, River, Topography, Soil	Reservoir
Design Dam	Design of Reservoir, River, Topography, Size, Soil	Dam
Design Pipeline from Dam to Water Treatment Plant	Water Demand, Topography	Water Conveyance
Preliminary Design of Water Treatment Plant	Water Demand, Water Characteristics (Raw and Final)	Water Treatment
Detailed Design of Water Treatment Plant Unit Operation	Preliminary Design of Water Treatment Plant, Water Demand, Water Characteristics (Raw and Final)	Specific Unit Operation
Detailed Design of Steel or Concrete structure in Water Treatment Plant	Detailed Non-structural Design	Steel or Concrete
Design Distribution System	Water Demand Distribution, Topography	Water Conveyance
Design Elevated Water Storage Tower	Design of Distribution System, Soil	Steel

Both OU and RU are developing portable projects. OU is working on the Data Center. OU has developed a Sooner City Design Criteria code, based on a typical community ordinance covering construction. When installing the portable civil city, the user will have the option of installing only content, i.e., projects, the data center, and/or design criteria.

Operating Shell

The user will also have the option of installing an operating shell for the portable civil city. This will create a dynamic web site that the user can use to manage the content described in the previous section. This creates a single web site that students recognize as their city, where they go for all of their city-oriented projects. Alternatively, users can create their own operating shell or utilize existing systems, such as Blackboard and WebCT. This will probably require extra initial effort, e.g., to create a unified web site that students will view as their own city, but may save on long term maintenance, e.g., managing a separate system of accounts.

The remainder of this section is used to describe the portable civil city operating shell. The main web pages of the portable civil city are given in Table 2. Database tables used to create and manage these web pages are given in Table 3. The city administrator uses the databases to quickly create a custom city on a local server. For example, the city administrator can customize the city name, link the local institution's courses, determine which main pages will be included, select from existing projects and criteria/codes and create new ones. The city administrator does not need to be familiar with web page development to do this. Professors can upload files, such as modules and design codes, onto the civil city server.

Examples of two web page templates are given in Figure 1 and 2. Figure 1 is the city home page. It contains links to the other pages. Guest users can view almost all of the city; however, users must log in in order to save work in the city. Figure 2 shows the course page for a user logged in as a professor. Many of the city pages (modules, projects, etc.) use this same format. The left side of the screen shows links, only visible to professors, used to change the content of the courses page. The Add, Edit, and Delete links are used by professors to create the specific list of links, in this case to courses, that students using the city will need. The right side of the screen provides links to the city courses; students and guests see only this list.

When the city administrator logs onto the city, he or she sees an additional button on the home page, titled "Admin". The "admin" button is a link to a number of screens that allow the administrator to manage the city site. For example, the administrator can, in addition to the customization features already discussed, manage accounts, change messages on the homepage, change the contact information, and add custom links.

The portable civil city is used just like Sooner City. In class, students are assigned projects. They access project descriptions using the project page. If they need conceptual help, they can use the course page to access the appropriate course web pages. They use civil city to access data and design criteria needed to complete projects. They can save current and access past work using the work page. Students will be able to access the city for some time after graduation, allowing them to use their saved work as a portfolio.

Table 2: Main Web Pages of the Portable Civil City

Name	Description
Home	Contains links to the other main web pages, a brief description of Civil City, and an area where the local user can present news.
View	Allows user to select the types of courses, modules, etc. to view, by year (freshman, sophomore, junior, senior or any combination).
Courses	Contains links to courses associated with the city (with brief descriptions).
Modules	Contains links to modules associated with the city (with brief descriptions). Modules are software programs students use to simulate and design civil engineering facilities.
Projects	Contains links to design projects associated with the city (with brief descriptions).
Data	Provides access to data used by students to complete projects. Exact format to be determined by OU.
Design	Contains links to design criteria and codes students use to complete projects (with brief descriptions).
Work	Page students use to store their completed projects.
Photos	Provides access to photos used by professors and students alike.
Log in	Log in page. Users log in as students, professors, or administrator, with different levels of access.
? (Help)	Contains information that helps users navigate the city.
Contact	Contains contact information for the city administrator.
About	Contains information about the development of Sooner City, Garden City, and the local city.
Admin	Gives administrator access to pages that allow her or him to customize the city, manage accounts, etc.
More Links	Allows administrator to add more links to the city.

Table 3: Database Tables of the Portable Civil City

Name	Contains Information used to:
Accounts	manage user accounts.
Classes	store student classes (graduation year).
Courses	link user to classes associated with the city.
Data	store data (and/or related link information) associated with the city.
Design	store design codes and criteria (and/or related link information) associated with the city.
Modules	store modules (and/or related link information) associated with the city.
Photos	store photos (and/or related link information) associated with the city.
Projects	store projects (and/or related link information) associated with the city.
Links	store information used to provide additional links (user defined).
Setup	store information used to customize city.
Work	store student work (and/or related link information).



Figure 1: Homepage for Garden City



Figure 2: Professors' Course page for Garden City (similar in format to many City Pages)

RESULTS TO DATE

Currently, the Garden City project is focused on three main areas of development: Content, Management and Customization, and Installation. Each area is under parallel development, for smoother integration of the entire system. The Garden City Beta can be viewed at <http://nebula.eng.rowan.edu/default.asp>. Significant evaluation of Garden City is planned; however it has been delayed as some content is still under development.

Content

The content of the city is the projects, modules (especially the data center), design codes, and photos students use as they learn to design civil engineering facilities. A significant amount of content has been developed at OU, with additional development under way at OU and RU, especially regarding the method used to provide students with design data. Additional content will be developed by future adopters. OU and RU intend to develop a web site where city users can trade content.

Management and Customization

The city is a collection of dynamic and static web pages that allow an administrator without any knowledge of web development to:

- (a) manage a large amount of data, including accounts, photos, documents, and executable files; and
- (b) customize the city by giving it an institution specific name, selecting the web pages of local interest, and adding content.

A Beta version of the city, with management and customization features in place, is undergoing testing in 2002.

Installation

The installation wizard will be created using InstallShield Express. The installation wizard is a crucial part of the entire portable civil city project. Portability is the main motivation for the installation wizard, with the goal that this system should be easy to install, similar to commercial software. Users will be able install content only or the entire civil city (content plus the operating shell). The installation wizard will be developed during spring and summer 2002, with a goal of making a Beta version of the portable city available during summer 2002.

CONCLUSIONS

Garden City is an adoption of Sooner City, a virtual city on the web that supports design throughout the Civil Engineering curriculum. The goal of Garden City is to convert Sooner City into a more portable software package, one that can be easily adopted at any institution. Currently, work continues at OU and RU on content, with RU also working on the software that will make Garden/Sooner City portable, particularly in the areas of management, customization, and installation.

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BIOGRAPHY

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Jess W. Everett is an Associate Professor of Civil and Environmental Engineering in the College of Engineering at Rowan University. He also serves as chair of the Landfilling and Composting committee of the Air and Waste Management Association. Dr. Everett is a registered Professional Civil Engineer in Oklahoma and is actively involved in environmental research and education. Dr. Everett received B.S.E., M.S., and Ph.D degrees in Civil and Environmental Engineering from Duke University in 1984, 1986, and 1991, respectively.

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Django Cisse, Eric Hansen, Brian Cleary, and Laura Coleman are juniors in the Electrical and Computer Engineering program at Rowan University. They helped build the city in Fall 2001 and Spring 2002.

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