

# Urban-CAD, A Tool for Urbanistic Design

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*The existing CAD, CAAD programs and design applications hardly support the urbanistic design activities. The conceptual difference between architecture and urbanism necessitates developing new CAD software based on the urbanistic design process. Our developed Urban-CAD system assists designers with urbanistic design activities.*

**Keywords.** *Urban design; scaling; profile design; CAAD.*

## Introduction

A lot of CAD and CAAD programs and design applications exist to assist designers with architectural and urbanistic design activities. Although those applications are useful means to be utilized in design tasks, they are not suitable tools for supporting the whole design process. We have been working on a research project to develop a CAD program that will assist the urbanistic designers with their design process (Chitchian et al., 2001). Two points were our main concerns in the development of Urban-CAD. First, the separation of the design elements and the information associated with those elements. Second, considering different scales or abstraction levels that designers want to work in the different design stages.

## The Urban-CAD components

The Urban-CAD system consists of some components each carries different aspects of the urban design process. This section describes these components, their features and the functions that they achieve.

### The architecture

The Urban-CAD consists of four components. The architecture of the system is depicted in figure 1. The Urban-CAD system provides a complete and integrated environment for designing or re-structuring an urban space. The well known and advanced CAD tool, MicroStation from Bentley Systems, as a general-purpose computer-aided design and drafting package for 2D and 3D mod-

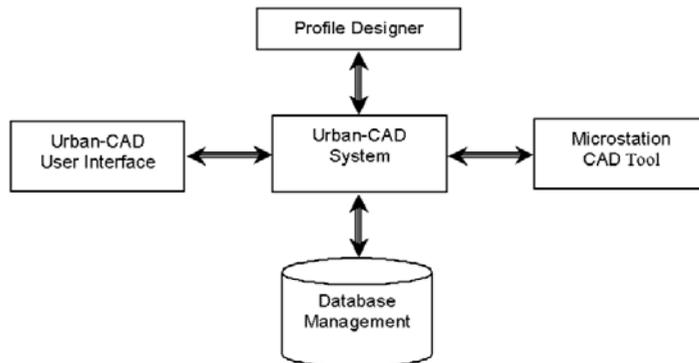


Figure 1. The architecture of the Urban-CAD System.

eling and representation has been used. Therefore the system has been developed on top of this CAD tool, we have added some utilities and functionalities to it to support the urban design process.

### The profile designer

The profile designer tool of the Urban-CAD allows designers to create sub-elements of a street such as a green-part or a pedestrian-part without drawing those parts in the design file. Manipulating and modifying those parts of a street will be achieved using the provided menus in this tool without changing the design file. The associated information with the mentioned parts are kept in the database, so displaying those elements at the desired scale will be done on fly while refreshing the screen by selecting the appropriate options in the provided menus.

Usually a street consists of some parts or sections with different function. For instance, a part which is used by vehicles also in some countries a separate part of any street is used only by cyclists. Pedestrians also use the specific part of a street. Green parts, tram/train or bus lines and canals or rivers may be other parts of a street as well. In the existing CAD programs designers must draw or design these parts separately, so

after designing such parts if they want to change or modify any parts they must first delete it and then redraw or redesign that again. Therefore designing an urban space containing many streets with various profiles using any CAD program is a boring task.

The profile designer of the Urban-CAD eases designing streets' profiles. In fact designers don't design or draw any parts of a street at all while they work on an urban space, rather they do this task using a graphical environment in a drag and drop manner. The graphical profile designer environment is shown in figure 2.

### The user interface

The Urban-CAD user interface is the main interface of the system. This user interface is much similar to that of the MicroStation CAD tool. This is not exactly the same; rather we have added extra functionality to it to support the urbanistic design activities. Facilities like Topography, Lines, Areas, Junctions and DBTools are added to the menu items of the user interface.

Each added item to the menu bar includes specific functions and utilities associated with that item. Clicking on those items a window pops up containing some options. Each option does certain task. For instance, the Lines menu item

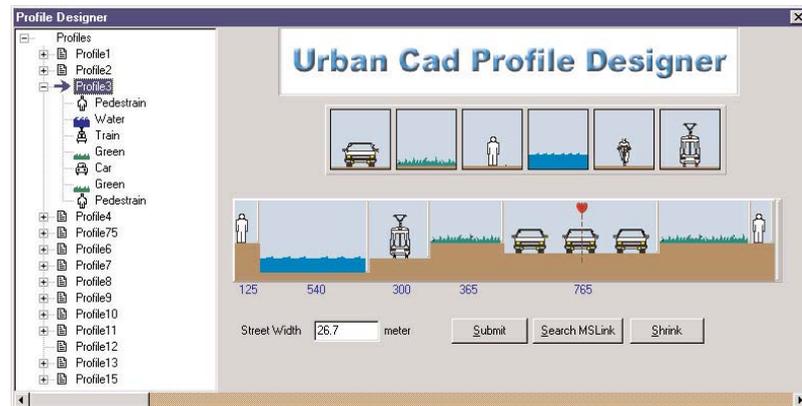


Figure 2. The Profile Designer of the Urban-CAD System.

includes: split line, merge line, reverse line, attach line and identify line functions.

### **Database repository**

In any CAD program each graphical element on a design file has a lot of information. Such information has been stored in a certain structure and attached to that element. This way of storing information within the graphical elements make the designs file a very big size file

To keep the design file so small and to retrieve the graphical element's information easily a database repository has been used in the Urban-CAD system. In this repository we store the associated information with the elements or objects of an urban space. Using a database as an information repository not only has the aforementioned advantages, also it helps to keep all information in the system at one place. Also this database system can be used by other programs such as GIS systems. This allows taking the advantages of these programs as well.

### **The Urban-CAD features**

The useful features among the others are: storing and retrieving information mechanism, the scaling methods, displaying and viewing of the urban space objects. Supporting the Urban-CAD system with such features provides an integrated environment for urban designers to help in their design tasks. These features are explained in this section.

#### **Object manipulation mechanism**

An urban space is composed of many objects that somehow are related. The related objects contain particular elements and details which can be seen differently in detailed or abstracted viewing levels. Three different objects exist in the Urban-CAD system. They are: streets, areas and junctions (or intersection). The first two objects consist of several other elements or parts. These elements are not drawn or designed separately in Urban-CAD

as another objects, rather the system keeps descriptive information in the database that represents the object's elements. Therefore, designers only draw the main objects but their composing elements or sub-objects are defined as the associated information with those objects using the provided mechanism in the system.

Street objects may have other elements such as a green-part, a pedestrian-part, and bus/tram-part. Also these parts may contain other elements such as trees, lightening, bus stops and so on. Although a street is not a single object rather it has many other elements as well still in the Urban-CAD system a street is drawn as a simple line (representing the heartline of the street) in the design file and its elements will be defined using the profile designer of the system.

An area may have some elements such as a green area, public or private areas, a residential or industrial area and others. An area in our system is drawn as a simple shape, but its associated information such as its elements, type, height and others are not drawn rather they are defined and stored in the database. It is the responsibility of the system to find out the associated information with an area while it displays that area. The system can display the sub-objects of an area as well.

#### **Scaling mechanism**

Almost any CAD application provides a certain mechanism to manipulate graphic objects differently with respect to the viewing points. Designers use some means such as levels or layers to reduce (generalize) the amount of information or refine (specialize) in a design file. Therefore a design file containing graphic objects can be as detailed or abstracted as the designers want. Designers have to turn on or off some 'layers' to focus or work only on the right information. This takes a lot of time and slows down the design process.

The predefined scales in our system are

based on the research done by De Jong (1995) the relation between the scale and the perception of information has been explained. The mathematical relation between a certain scale and the objects seen at any scale has been discussed too. So we considered six different scales of observation, they are: 1:10000, 1:3000, 1:1000, 1:300, 1:100 and 1:30.

Main objects, streets or areas, in the Urban-CAD must belong to one of the six predefined scales. To manipulate objects designers use the provided scaling dialog window in the system. Through this window a designer selects a certain scale and then chooses options for viewing. When the system displays for instance at the scale 1:1000 all street objects belonging to this scale and the higher scales (in this case the scales 1:3000 and 1:10000) will be displayed.

#### **Information processing mechanism**

In the Urban-CAD system we separated the graphic element with the information associated with it. The system has its own database to store the related information to any urban object. Having a separate database management system provides flexibility. In most CAD applications information associated with any graphic elements has been stored within those elements in the design file.

A street or an area object in an urban space represented simply in the design file as a line or polygon element respectively in the design file. The associated information with that street or the area object is stored as descriptive information in the database.

#### **Conclusions**

With respect to the inadequacy and the limitations of the existing CAD applications for urbanistic design process and needs of the urban designers for new software made us to work on a research project to develop a CAD program to support the urbanistic design process (Heeling and et al.,

1997). Not to discover the wheel again, we used the well known and advanced CAD tool, MicroStation from Bentley Systems, as the main graphical environment and the system has been developed on top of it.

The profile designer of the system is one of the outstanding modules that helps the designers to design the profiles of the street objects of an urban space in a user friendly and graphical manner. Also the scaling mechanism of the system is another outstanding feature that is missing in almost all the existing similar applications.

The main goal was the development of a computer application to make the urbanistic design process by computer easier, quicker and more effective. We expect that the students will work with the Urban-CAD software in their education program starting September 2002.

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