Geographical Information System Application to Building Maintenance: Case Study on Maintenance of 13th Asian Games Athlete Village, Thailand

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Summary

This paper is concerned with application of Geographic Information System (GIS) to building maintenance of the 13th Asian Games Athlete Village at Thammasat University, Rangsit campus in Thailand. The Athlete Village, which can accommodate 9,800 persons, is comprised of 23 buildings. The application was done by using the abilities of graphic attachment and capability for storing data of GIS. In addition, the Network Analyst Extension, which is one of the functions of the currently adopted program (ArcView® GIS), was used to deal with the complex building networks such as pipeline system. Furthermore, some maintenance data were stored to provide as database according to building maintenance management.

Keywords : Geographic Information System (GIS), Building Maintenance, Network Analyst, Computer Aided Design (CAD) Drawing, Databases

1. Introduction

The standard and level of maintenance of building in any country is invariably directly related to the strength of its economy. As countries becomes more developed, they are disposed to require higher standard of maintenance of buildings. Due to powerful and cheaper computer facilities, information technology has become the promising tool to create a systematic maintenance of buildings.

Geographic Information System (GIS), as one branch of information technology, has been rapidly developed during the last decade. It is a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purpose. GIS is usually applied for measuring aspects of geographic phenomena and processes by representing action in form of a computer database. Recently, GIS has been widely applied in the maintenance and management of the supply of utility and communication lines in the large cites due to its efficiency in cost and time reduction.

The scope of this paper is to apply GIS for the maintenance and management of 13th Asian Games Athlete Village at Thammasat University, Rangsit campus in Thailand. The Athlete Village is currently used for staff and students of Thammasat University. Inside the Athlete Village, there are 23 buildings which can accommodate 9,800 persons. The GIS program adopted here is ArcView® GIS [1] which can run on personal computer. As a demonstrative example, the maintenance of water supply pipeline will be performed by using GIS. In addition, the database implementation will be done in order to keep the record of building maintenance and management.

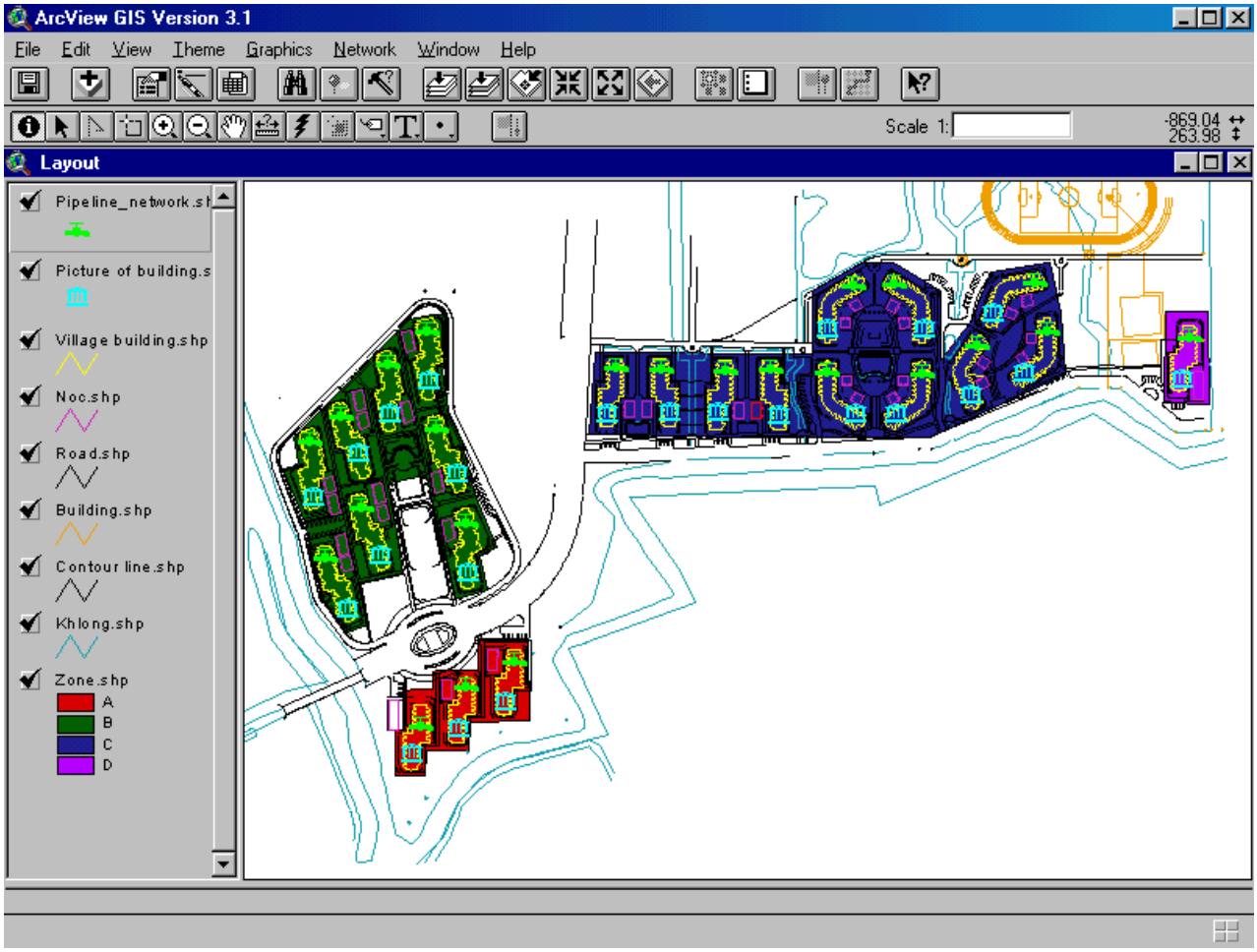

Fig. 1 Outline of 13th Asian Games Athlete Village

2. Outline of 13th Asian Games Athlete Village

After the 13th Asian Games held in Bangkok, Thailand in December 1998, the Athlete Village for the Games located inside Thammasat University, Rangsit Campus was transformed to the accommodation for the University staff and students. The area of Athlete Village is about 47 acres. As shown in Fig. 1, the Athlete Village consists of

- Zone A : 3 buildings; for each of 12-storey building, there are 264 single rooms and the floor area is 16,646 m^2.
- Zone B : 8 buildings; for each of 8-storey building, there are 104 double rooms and the floor area is 12,288 m^2.
- Zone C : 11 buildings; for each of 8-storey building, there are 192 single rooms and the floor area is 12,240 m^2.
- Zone D : 1 building; for each of 14-storey building, there are 308 single rooms and the floor area is 19,208 m^2.

In total, the Athlete Village can serve 9,800 persons with 4,900 units (there are two bedrooms per one single room unit and the size of double room unit is twice the single room unit). It is noted that the 23 reinforced concrete buildings of the Athlete Village were constructed by the fully prefabricated system. In order to fit with the prefabricated bearing wall and floor inside the buildings, the location of utility lines are quite systematic in comparison with the conventional buildings constructed by cast-in-place system. As a result, it is easy to develop the computerized system for maintenance of the utility.

3. Application of GIS to Building Maintenance and Management

3.1 Data Preparation

ArcView® GIS [1] supports many type of data formation such as image, CAD format, tabular data, and databases. Image data may be scanned blueprint drawings in case of no available digital drawings or scanned photographs of site or equipment of building. ArcView® GIS is able to integrate Computer Aided Design (CAD) drawing into the system seamlessly, without converting files. Data inside the CAD drawings is very essential for analysis and kept with a CAD formation as a part of graphic database. The ability to work with CAD drawings in ArcView® GIS is particularly useful because most of current buildings are designed by using CAD. The tabular data and databases in some format such as dBASE can also be input to ArcView® GIS directly.

Prepared data must be clearly input to ArcView® GIS as layers classified as major partition and minor partition. The major partition is composed of building zone layer (zone A,B,C,D as described above), and each zone layer contains layer of buildings with similar utility system. As an example of utility maintenance and management by GIS, the system of water supply pipeline is demonstrated here. In Fig. 2, the side view drawing of water supply pipeline has been set as a layer of each building for management purpose. The major partition is used to show overall view of Athlete village and building utilities. The minor partition is defined as the section inside a layer of major partition. Here, as demonstrative example of maintenance of water supply pipeline, the field name and content in the minor partition are shown in Table 1. These information will be needed for a subsequent network analysis.

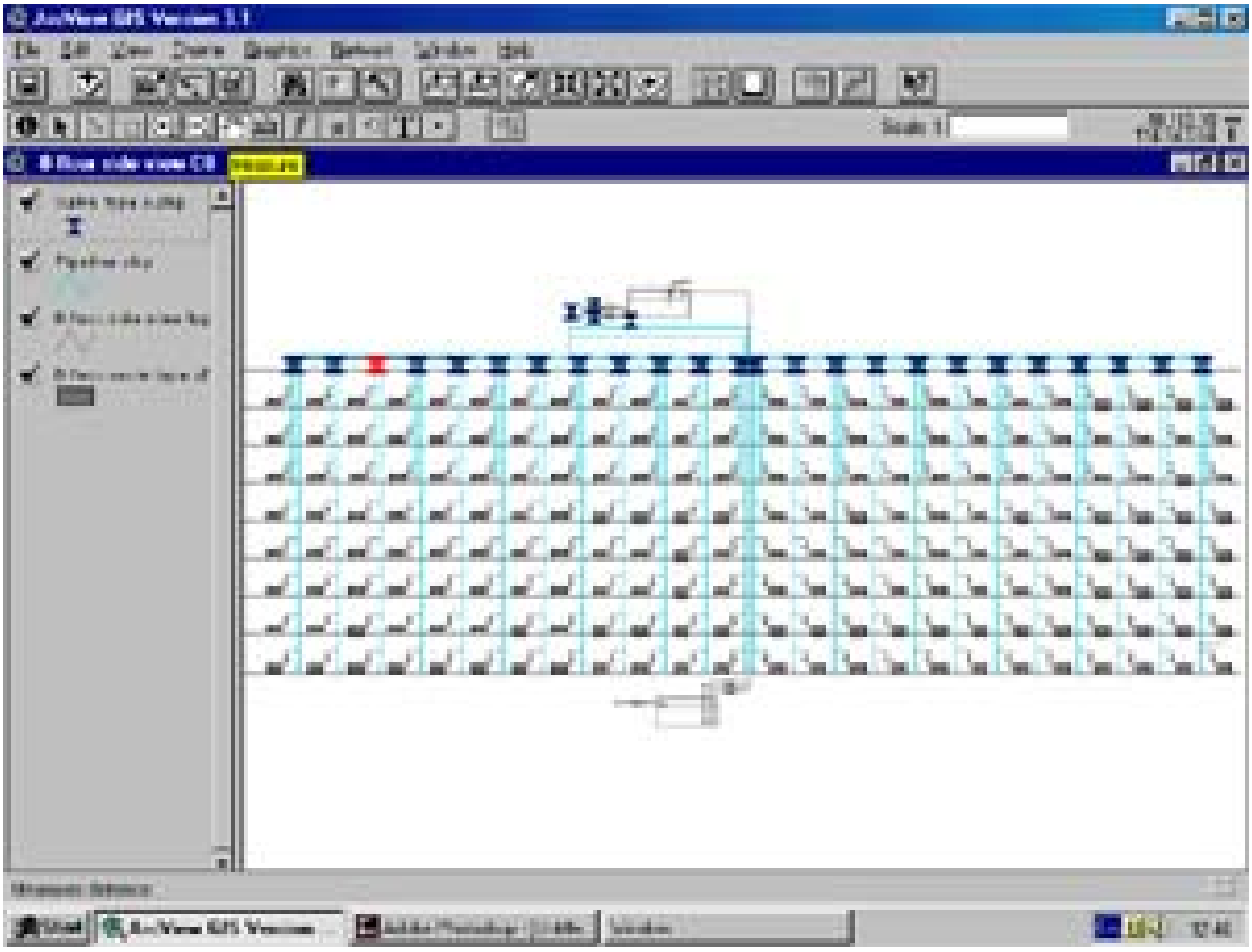

Fig. 2 Side view drawing of water supply pipeline for each building

Table 1 Field name and content in the minor partition for pipeline maintenance in Fig. 3

Field name	Content
Material	Materials such as bronze, PVC, cast iron of any components such as pipe, valve
Manufacturer	The producer of the components.
Model	Model and specification of the components
Size_(inch)	Size of the components such as valve
Valve_no	Number of valve assigned for ease of maintenance
Pipe_diameter (inch)	Diameter of pipe
F_elev	Elevation of the starting point of pipe
T_elev	Elevation of the ending point of pipe
One_way	Flow direction of water inside pipe

3.2 Network Analysis

Network Analyst Extension [2] as an optional tool in the ArcView® GIS program provides additional analytic capabilities which can solve problems associated with any network encountered in building maintenance (pipelines, electric lines, or any utility lines). This will help the maintenance personnel make more informative decisions which leads to economical solutions. Network Analyst Extension can access geographic network data based on computer-aided design (CAD) drawings. It can be used to find the nearest facility, i.e the most direct route between two locations, or find the best way to visit several location, or find the most efficient travel route, or find the closest emergency facility (valves, fire hose, etc.) in case of accident. The properties of data such as water supply pipeline have been set as described in Table 1 for the purpose of network analysis e.g. one-way flowing direction.

The function to find the closest facility in the Network Analyst Extension of ArcView® GIS is mostly used in the building maintenance. In case of incident such as broken pipe or leakage of water supply, the network analysis can be used to find the nearest valve to close the system. Also, for other purpose such as in case of fire accident in the area of Athlete Village, the network analysis can be used to locate the closest fire protection facility (fire hose, fire hydrant) to start fire fighting at the earliest stage.

3.3 Database Implementation

The application of database has been added up to make application of GIS more powerful in building maintenance and management. Information such as maintenance records of each room in building can be easily displayed in the GIS. This will help improve the efficiency of the maintenance work. In addition, for the purpose of building management, the records on personal data of residents in each room of the Athlete village and their utility and room rental expenses can be kept systematically.

4. Concluding Remarks

This paper attempts to demonstrate the application of GIS to building maintenance and management. A case study on the 13th Asian Games Athlete Village at Thammasat University, Rangsit Campus in Thailand is performed. By the capability of GIS, the computerized system for the maintenance and management of 23 buildings inside the Athlete Village can be easily developed. With the use of Network Analyst Extension available in the currently adopted ArcView® GIS, the incident of utility network such as leakage of water supply pipeline can be solved by locating the nearest facility to the incident location.

References

[1] Environmental System Research Institute, Inc., "*ArcView® GIS*", 1996.

[2] Environmental System Research Institute, Inc., "*ArcView Network Analyst*", 1996.