

# BIM Facility Management on Utility tunnel

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**Abstract:** With the rise of BIM, Building Information Modeling, technology it subverts process and method of traditional civil engineering industry. It brings different meanings and improve efficacy to each stage of building life cycle. Projects can get different kinds of benefits from BIM technology in plan, design, construction, and operation stages. Utility tunnel, designed according to the variety of pipes and cables, is built under traffic roads, which reduces the traffic impact during maintenance and repair. Establishment of utility tunnel increases urban sustainable development.

Through BIM technology, thousands of drawings are turned into one model. Meanwhile, with real-time update, model will reflect the latest situation. When application extends into operation stage, model connected with site sensors becomes a completed database for operation. BIM facility management (FM), the new integrated method, can monitor and control utility tunnel to ensure steadily supply of water, electricity or gas. Further, it assists authorities to guard city safety.

**Keywords:** utility tunnel, BIM, BIM facility management

## 1. INTRODUCTION

BIM is a rich building data set managed in a 3D form converted from 2D drawings that facilitates efficient property management and well informed decision making (please refer to Fig.1). The model is developed from early design phase, construction, operation, and renovation to demolition. Its huge database contains information from different expertise throughout the entire building life cycle, whereas each project participant is able to keep feeding into the central database or to extract the needed information from the model. BIM model, in other words, is considered as an information pool, built up by many different participants in different stages of the project.

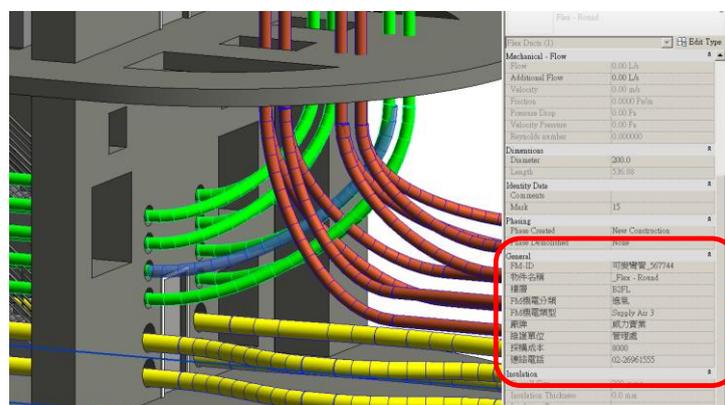


Fig.1 BIM Model

Utility tunnel is a passage built underground with racks inside that carry supply pipes and utility lines. The tunnel comprises of trunks and supplies. In the trunks, there are equipments and facility pipes such as electricity and water pipes that are well mapped for accommodating the evolving networks and joining the supplies while

the supplies extend to the user end. Utility tunnels are built to coordinate different types of pipes in an efficient way and optimize the accessibility of recurring maintenance and management.

To provide sustainable livelihood resource such as water, power and telecommunication to the households, utility tunnels are designed and installed to support a populated city. The progression of utility tunnel is different based on the development of the areas. Some are at planning stage and some have been in use for long time. The benefits of BIM implementation can be realized at different stages. For example, BIM can integrate all the professions to detect clashes and reduce re-work during the construction. BIM-FM System provides an integrated interface that combines different systems with types of information. It offers operators with complete drawings and maintenance records to make routine efficiently. Moreover, it has the capability to expand data in the future. In a long term, BIM application at operation stage will bring great benefits to projects.

## 2. PROCESS

Operators usually take as-built drawings as the main information resource of utility tunnel; however, drawings are not accurately updated for that sub-contraction leads to incomplete collections. Moreover, utility tunnel is located under road, which makes site inspection more difficult. Existing data is inconsistent with current situation and insufficient information all make facility management harder. The drawings are not reliable and on-graphic information such as maintenance record cannot be shown in 2D drawings, which resulting in dependent on specific maintainers. The reliability and instant maintenance of utility tunnel are crucial for the large-population cities; thus, a complete database for quick query and maintenance stands important.

In traditional, from design to operation stage, the integrity of data and responsible authority are different. For example, designers have design drawings, constructors have as-built drawings and many maintainers own different parts of maintenance records. Information managed by multi departments is discontinuous. In addition, official document delivery systems make information exchange inefficiently. BIM management means to integrate original processes into digital and logical methodology. During digitalization, it will need to analyze hierarchy of utilities, clarify facilities and content, and examine workflow. BIM-FM System is the combination of all digital information and existed resources, which brings great assistance for sustainability of utility tunnel.

## 3. MODELING

Utility tunnels are mostly shaped in long tubes. For functional considerations, it contains staff entrances, catch basin, special parts and main ducts and pipes. According to different pipes and cables, racks are various. Further in the control room, there are many control cabinets and displays. Modeling plan, methodology, category stratagem and standards are required before modeling BIM. A complete BIM model of utility tunnel should be composed from following items which has the consistence information with 2D drawings or the scene.

### 3.1 Pipeline

- A. Main Pipe
- B. Supply Pipe

### 3.2. Special Parts (Please Refer to Fig.2)

- A. Staff Entrances
- B. Ventilation Shaft
- C. Catch Basin
- D. Material Access
- E. Divergence Room Of Pipeline

### 3.3. Pipe& Cable (Please Refer to Fig.3)

- A. High Voltage Electricity
- B. Low Voltage Electricity
- C. Rainwater

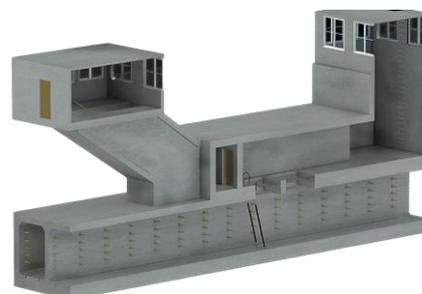


Fig.2 Special Parts

- D. Tap Water
- E. Oil Tube
- F. Telecom
- G. Military
- H. Gas
- I. Sewage
- J. Alarm
- K. Cable Television
- L. Traffic Sign

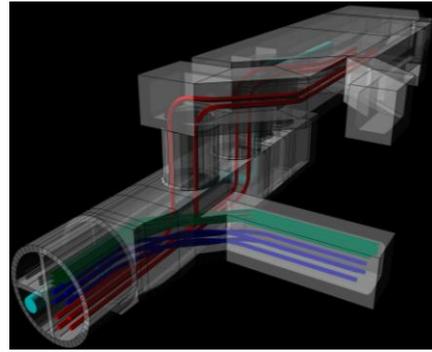


Fig.3 Pipe& Cable

### 3.4. Ancillary Facilities

- A. Ventilating Device
- B. Lighting Equipment
- C. Power Distribution Equipment
- D. Firefighting Equipment

In a city utility tunnels are designed, constructed and managed by section. In order to meet the need and control the quality and content of models, BIM standards for utility tunnel model stand necessary, which should include the followings:

- A. Software
- B. System Classification
- C. Modeling Standards
- D. Element Classification
- E. Naming Standards
- F. Coding System
- G. Information Installation
- H. File Format

## 4. SYSTEM ARCHITECTURE

Utility tunnel is design to run with the city growth; therefore BIM system should be strong enough to support its sustainability. With clear goals and standards, BIM system should take multi-tier architecture, application interface and future extension into consideration (please refer to Fig.4). It provides following components:

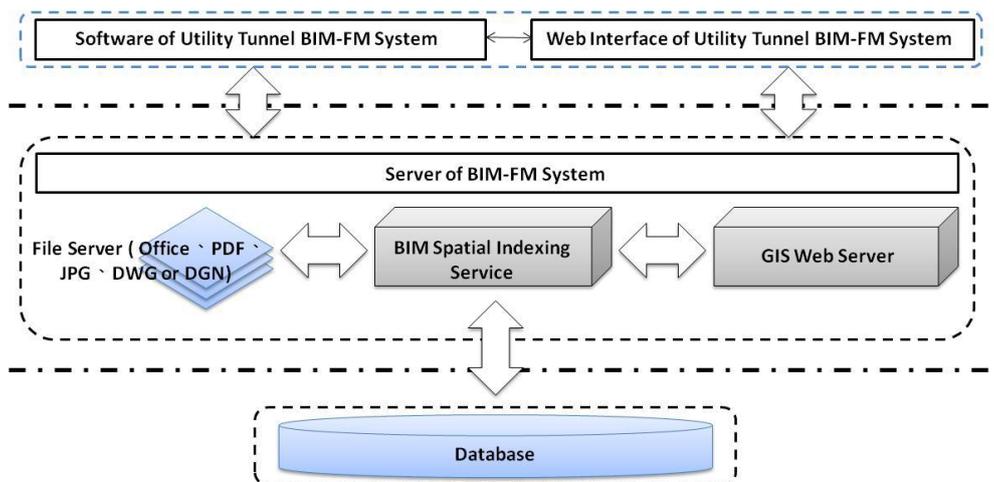


Fig.4 BIM System

### 4.1 Geo-3D Map Positioning System

The system provides quick positioning in wide range. System should include GIS system, scope, direction and depth efficiently.

#### **4.2 BIM FM System**

The purpose of digitized BIM-FM System is to assist and improve the existing management, not to renew organization, processes and items. The system offers operators and city government to manage utility tunnels in single entrance system, which accumulates data for consistence and sharing. Besides, it supports data analysis and report for decision making. Since utility tunnel is important in a city, the stability and satisfaction of system should match users' expectations. Releasing a conceptual system for comment and improvement before carrying out can reduce the obstruction and help popularization.

The features of the system are designed for maintenance, facility record, monitoring and remote control. The real-time data assists operators to guard the safety of utility tunnel.

#### **4.3 WEB Publishing Platform**

The platform offers an online open service for inquire, usage status, and other civil services such as E-application.

### **5. CONCLUSION**

After finishing trunk, city government offers basic pipelines, such as water, electricity to citizens. Commercial lines will be added gradually according to request of companies. Therefore, as-built drawings cannot reflect the actual situation of types of pipelines and cables in racks. Moreover different operators keep partial maintenance records. Distribution of drawings and texts leads to the discontinuity of information.

Through BIM process, the date is integrated into a single digital 3D model. The logically process combines record and elements together, which is a great boost for management. During operation, with steadily upgraded model and information, reliability and usage of utility tunnel BIM system will be increased.

#### **Acknowledgements**

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