Integration of Building Information Modelling (BIM) with Storm Water Network Using Openroads Designer Software

Dipakkumar Jadav
Lead Engineer
Department of Civil – Infrastructure Engineering
Systra, India

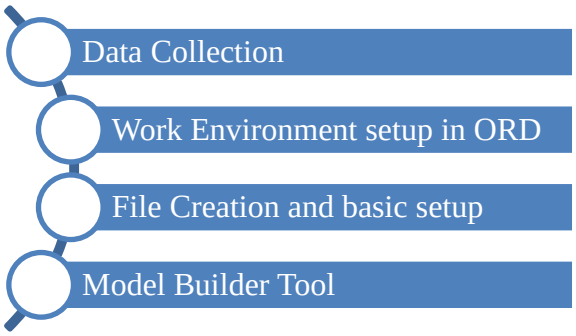
Abstract— Building Information Modelling very commonly known as BIM is a design and management methodology. It is a highly collaborative process that allows architects, engineers, real estate developers, contractors, manufacturers, and other construction professionals to plan, design, and construct a structure or building within one 3D model. BIM (Building Information Model) technology assist in improving the design process of building water supply and drainage, promoting the building water supply and drainage planning, enriching the building water supply and drainage design method, improving the water supply and drainage system design level, and building quality. Combined with fuzzy comprehensive evaluation method to analyse the advantages of BIM technology in building water supply and drainage design as per CPHEEO [1]. Therefore, application prospects of BIM technology are very worthy of promotion.

Key words: Building Information Modelling (BIM), Storm Water Network, Openroads Designer Software

I. INTRODUCTION

With the continuous urbanization process and the rapid increase in improvement of people's living standards, the level of architectural design must be improved to meet people's growing demand for buildings. Especially for water supply and drainage design projects, to improve the overall quality of water supply and drainage works, the design of the rationality, safety and aesthetics is the utmost need. Therefore, in addition to having a very rich experienced engineers for water supply design, there also needs some of the modern auxiliary building water supply and drainage design software, to complete the excellent water supply and drainage designs. Introducing BIM [2] in water and drainage sector, will bring rapid revolution in the design technology as it will help designer to have 3D approach.

II. METHODOLOGY



A. Data collection

Input data for the BIM preparation is based on the results and geometric information of storm water network design which are manhole/inlet data as a node, pipe/conduit data and outfall data.

B. Work environment setup in ORD

A Workspace is a set of standards e.g., Metric, Imperial, UK, ANZ, India Roads. These standards contain different level naming, road templates, superelevation calculations etc. When you select the workspace, you are selecting the standards you want to use in a project or job. A workset is simply a project or job that is using the selected workspace standards.

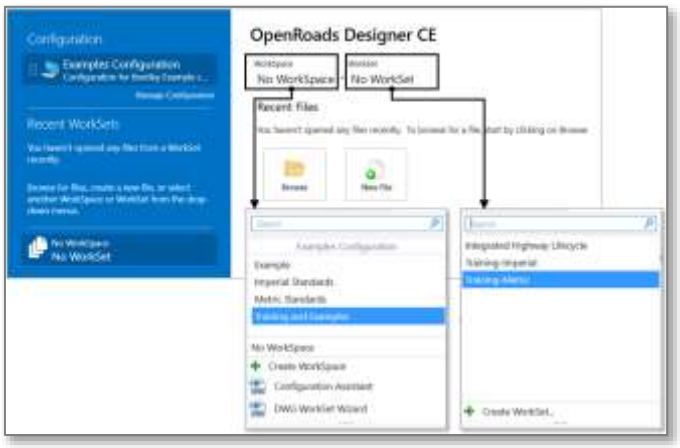


Fig. 1: Dialog box showing workspace and workset section.

Project file open with No WorkSpace and No WorkSet. Form dropdown list, select "Training and Example" as workspace and "Training Matric" as workset for BIM modelling.

C. File creation and basic setup

3D Seed file is used when dealing with Terrain and Survey data only, as these are 3D creations. 2D Seed file is used with geometry, corridors, superelevation, etc. Create geometry in the 'Default' 2D model, and ORD will look after the 3D world in the model 'Default-3D'. For our project, 2D seed fill is preferable option. So, select "Seed2D- Metric Training.dgn" file by browsing from appropriate location. OpenRoads Designer workflow tabs appear when select Drainage and Utilities from the dropdown list which helps to easy access to the relevant tabs and tool groups.

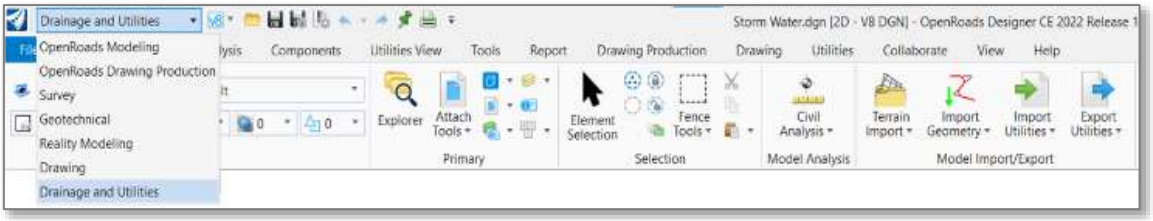


Fig. 2: Workflow selection for tool use

D. Model Builder Tool

The Model Builder Connections manager [3] allows to create, edit, and manage Model Builder connections to be used in the model-building/model-synchronizing process. At the centre of this window is the Connections List which displays the list of connections that have to be defined. After specifying a target, Model Builder will perform the selected operation. As compared to civil storm, data type needs to select in ORD. There are two data types, one drainage and utilities. Drainage data type is suitable for our process of model building in ORD.

When Model Builder completes, it will be presented with a summary window that outlines important information about the build process. Software commend that save this summary so that can refer to it later.

In order to build a full network for storm water, three components have to build in hydraulic model, i.e., manhole, pipes and catchments. Detailed steps with snapshots are mentioned below points and common snapshot are eliminated avoid the repetitions in manhole, pipe and catchment.

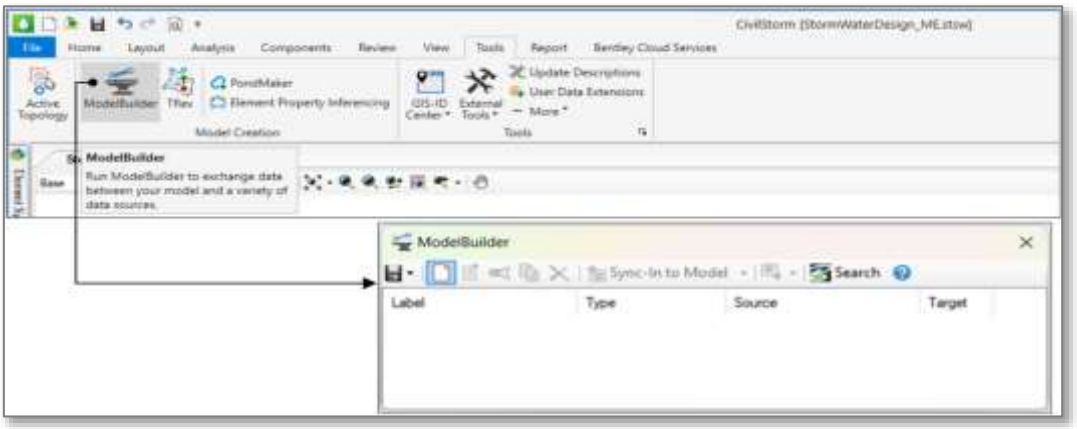


Fig. 3: Model builder tool dialog box

There are many steps during model builder Data Source Specify

1) Select a data source type:

In this step, the data source type and location are specified. After selecting the data source, the desired database tables can be chosen and previewed.

Select a data source file with the following file formats:

- Manhole/Node – Excel 2013/2010/2007 (12.0)
- Pipe – CAD Files
- Catchment – ESRI Shapefiles

2) Specify Spatial and Connectivity Options:

In this step specify the spatial options to be used during the Model Builder Process. The spatial options will determine the placement and connectivity of the model elements. The fields available in this step will vary depending on the data source type.

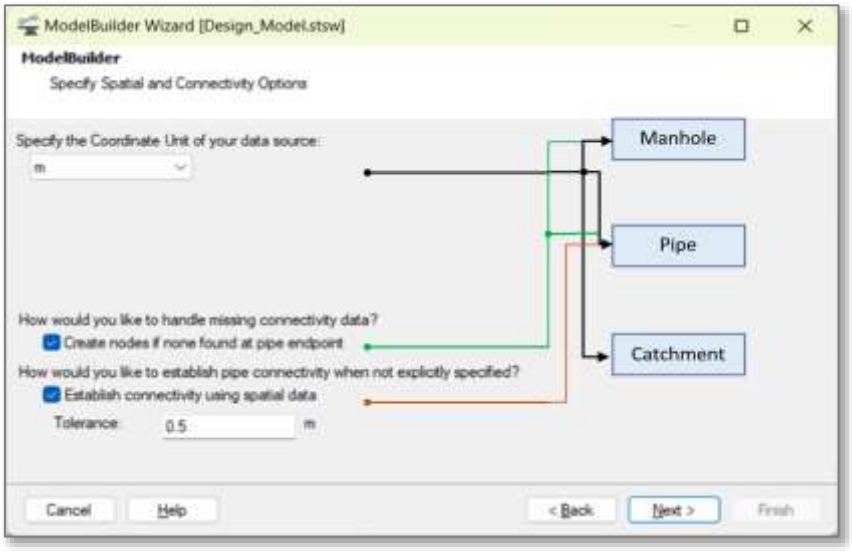


Fig. 4: Connectivity option selections

There are three different selection guidelines mentioned as per three categories namely, manhole, pipe and catchment.

3) Specify Spatial create/remove/update options and specify additional options:

In this step default setting are best practice for the model building process of manhole, pipe, and catchment categories.

4) Specify Field Mappings for Each table:

In this step, data source tables are mapped to the desired modelling element types, and data source fields are mapped to the desired model input properties. Assign mappings for each Table/Feature Class that used in the hydraulic model.

Detail Table is prepared to simplify and easement in comparison. As shown in Table 1 detailed information is provided about mandatory setting for manhole, pipe and catchment.

Table/Type	setting	
Manhole	Table Type	Manhole
	Key Fields	Label
	X Field	X
	Y Field	Y
	Elevation (Ground)	Elevation (Ground)
	Elevation (Invert)	Elevation (Invert)
Pipe	Table Type	Conduit
	Key Fields	Label
	Start	Start Node
	Stop	Stop Node
	Diameter	Diameter
	Invert (Start)	Invert (Start)
	Invert (Stop)	Invert (Stop)
Outfall	Table Type	Outfall
	Key Fields	Label
	X Field	X
	Y Field	Y
	Elevation (Ground)	Elevation (Ground)
	Elevation (Invert)	Elevation (Invert)

Table 1: Mapping Details for Each Components

5) Confirmation of model builder:

In this step, confirmation has to provide to build a new model or update an existing model.

6) Summary and synchronising

After finishing the model building task, model builder summary is appeared. There are two tabs is available which are Statistics and Messages. Statistics includes the connection type, action, source, target, data, connection statistics, and selection statistics. No message is good message but if there is message which will help to identify the mistake or points to be kept in mind during designing.

After closing model builder summary, confirmation window is prompted to warn that the process is not undoable and save existing model if required.

Next steps lead to the dialog box which is related to the synchronizing drawing/model to add, remove, and update elements to match the database.

Completion of synchronizing of drawing/model, built model can be seen in model space of Civil Storm Model.

III. CONCLUSION

This paper studied the implementation and integration of BIM in Storm Network Design. User friendly tools like model builder was used to create the network. Error free and productive methodology is derived for easy usage for designers. With the implementation of BIM in design, designers can create clash free designs by using clash detection tool provided by Open Roads Designer which gives clear pictorial representation and the accurate location where the clash is occurring. This research will enhance the 3D technology in field of Water and Drainage.

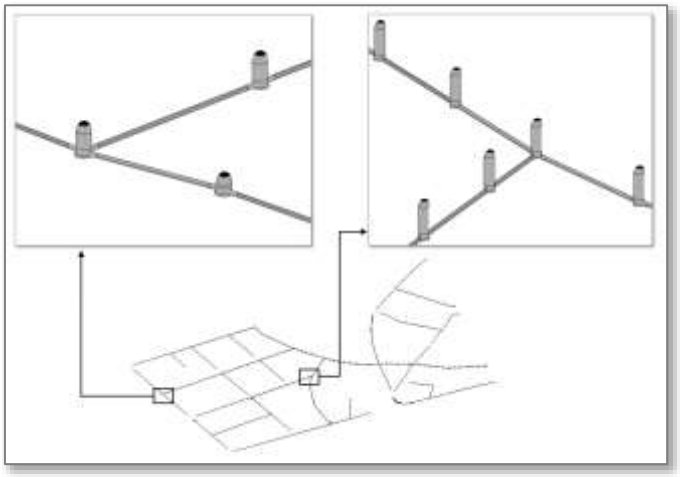


Fig. 5. Illustrations of 3D manholes and pipes

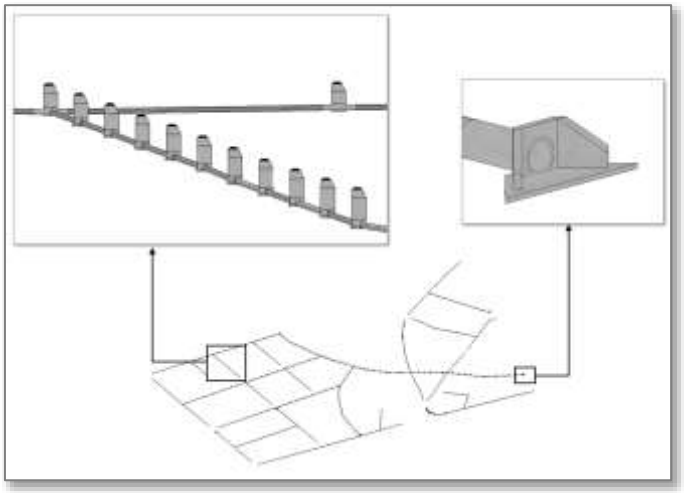


Fig. 6. Illustrations of 3D network along with outfall

REFERENCES

[1] CPHEEO, “Manual on Storm water Drainage, Water Supply and Sewarge”.
[2] “ISO 19650”.
[3] Bentley, “Bentley Support,” [Online].