Rehabilitation of Old City Through Bim Technique For Effective Transportation

Kunal D. Pawar[1], Prof.P.L.Naktode[2]
[1]Dept of Civil Engineering
[2]Proffesor, Dept of Civil Engineering
[1, 2] Sandip University, Nashik, India

Abstract- *This project is the study of Effectiveness of Autodesk BIM (Building Information Modelling) Technology for urban planning of old city Infrastructure to develop BIM city model and to provide ease of services to the citizen. Due to rapid urbanization it becomes necessary to study and plan Infrastructure of the old city, and to serve and improve the standard of living of the growing population, it is required to develop Infrastructure of old cities to smart cities using appropriate tools and Technologies, BIM Technology is One of the technology which helps for the Effective planning, rehabilitation and Infrastructure management of old city and buildings through various BIM Techniques like Infraworks 360, Naviswork, Revit, Etc.*

Keywords- Rehabilitation, Smart City, BIM Technology, Infra-works 360, GIS, Revit, Navisworks.

I. INTRODUCTION

While many people intuitively think of BIM as software, in reality BIM is the process of creating and using digital models for design, construction and/or operations of building projects. Software is simply the mechanism by which the BIM process is accomplished.

The BIM process involves participants from the entire project life cycle (architect, engineer, contractor, owner, facilities management, etc.) who all contribute and communicate through the shared models. These models combine intelligent 2D and 3D objects used to define a building design, along with external factors such as geographic location and local conditions, into a virtual building database that provides a single, integrated source for all information associated with that building's design.

The "intelligence" attributed to the objects includes parametrically-defined graphical and non-graphical information, giving the architects, MEP engineers, and contractors the ability to represent geometric and functional relationships between building elements.

This information feeds an integrated database, which in turn feeds all design documents and schedules for the building project. When a change is made to the building model, all graphical views (plan, elevation, detail, and other construction drawings), as well as non-graphical views such as the design documents and schedules, automatically reflect the change

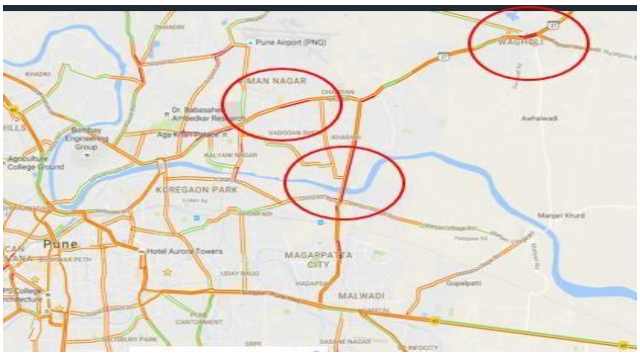
1.1 Key advantages of BIM

1. Improved information flow
2. Better design visualization
3. Improved cost estimating
4. Change Management
5. Data management
6. Sustainable Design
7. Improved energy analysis
8. Reduced construction costs
9. Building history

1.2 Problem statement

Most metropolitan areas are facing significant transportation-related challenges, including excess recurrent and pollution, critical infrastructure protection, and unsustainable energy consumption, due to increasing population and travel demands, as well as sometimes century-old transportation infrastructure.

Larger cities of today are confronted with immense problems in terms of development, inclusion, housing, transport, climate, infrastructure, security and many more.



Picture 1: Picture of map showing areas with traffic conjunction problem

1.3 Objectives

1. To provide suggestion for efficient urban mobility and public transport using BIM.
2. To study the effectiveness of BIM for affordable housing and in Building Technology.
3. To provide suggestions for safety and security of citizens reducing road accidents due to traffic problem.

1.4 Scope of project work

Building Information Modelling process (BIM) is a rapidly growing technology In the field of architecture, town planning and engineering, with the ease of planning and design of the BIM model. Currently, the Building Information Modelling (BIM) methods are used greatly to capture the information of building.

Due to rapid urbanization there is a need to find out efficient solutions for the urban mobility, which will enhance the quality of city in terms of traffic problems. And for the planning or the rehabilitation of city it is important to use appropriate tools and technology which will help for the easy and rapid work progress in terms of management and model of the city.

There is need to find out such technologies for the rapid enhancement of city model for traffic and various other urban problem for its management with economy as a constraint of design and model making

1.5 Our focus

Our focus to use BIM technology in the development of city model, due to constraints of time and collection of data from various government and Municipal authorities we have concentrated on the problem of traffic, and its solutions.

Traffic congestion is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing. The most common example is the physical use of roads by vehicles. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, this results in some congestion of traffic. Traffic congestion occurs when a volume of traffic or modal split generates Demand for space greater than the available road capacity; this point is commonly termed saturation.

In our project we have concentrated on the problems causing the traffic for the selected city areas and in the same sense providing suggestions for its solution using BIM technology. BIM technology is being used for the development of city model for the traffic solutions.

We also focused the building constructions as an important element in city; our focus is for the study of effectiveness of BIM in the construction of building technology

1.7 Literature Review

Paper 1: Building Information Modelling (BIM)- International Research Journal of Engineering and Technology, Shrikant Bhuskade, ISSN: 2395 -0056, May, 2015

In this paper study shows the levels of detail (LOD) in BIM model and allocation of resources on 4D BIM model to analyze and plan the resource usage based on the most updated design and even simulate the resource allocation. Linking time and cost parameters concurrently to BIM components in the building model to deliver a scheduled financial analysis. BIM does enhance the traditional scheduling and cost estimating methods with a more reliable and automated technology.

Paper 2: Advancing Civil Infrastructure Design Workflows- Autodesk benchmark study (2016)

The report details the evolution of the software, efficiency improvements inherent with software that focuses on workflows, and the time savings that can be achieved across many functions and design progressions. The comparison is meant to illustrate how these software packages works in tandem on preliminary and detailed design, and to convey time savings and the elimination of tedium. Performance improvements are relayed here, but no effort was made to standardize computer hardware or the size and complexity of these project scenarios, so results on time savings vary, and some fluctuation on projects may be experienced.

Paper 3: Life cycle analysis of a road infrastructure project using Building Information Modeling (BIM), Shreekant Harsha, Sutapa Sarkar, Siddharth Oswal, September 2015

This paper suggests the implementation of Building Information Modeling (BIM) for a road infrastructure project. BIM has been used in India but majorly in vertical construction. This paper has identified the bottlenecks in the road project management, and tries to solve the problem through BIM. The problem in the project management has first been identified and then through BIM lens these problems has been viewed and suggestions have been made to introduce the BIM throughout the lifecycle.

Paper 4: The Business value of BIM for Infrastructure, Autodesk Smart Market Report,

This paper provides the results of ground-breaking study to measure the use of BIM in infrastructure design and construction. The results reveal an industry in early stages design and construction. The results reveal an industry in the early stages of adaptation, but they also demonstrate an even more exciting picture of expected growth in few years.

Paper 5: White paper on smart city, imran zaman (31st march 2015)

Smart cities are the future reality of all municipalities around the world. By he for2050, an estimated nine billion people will inhabit earth and seven in ten people will live in the cities. To manage this large-scale urbanization system into various technical system and infrastructure, thereby setting the stage foe smart cities.

Smart cities rely on integrating and analyzing massive amount of data to address day-to-day issues. For example, data can be leveraged to intelligently reroute traffic and reduce accident, pinpoint crime hotspots and deploy resources accordingly to reduce crime, and to connect citizens.

In 2008, BIM began working on similar vision to make cities smarter as part of the smarter planet initiative. BIM Focused on analytical algorithms and data processing technologies to make sense of the oceans of data that is collected on a daily basis.

Paper 6: Virtual modeling for cities of the future, State-of-the art and Future challenges

Rendering three-dimensional environments is a task well solved by different software tools able to design, create, and model spatial structures, both simple and complex, effortlessly and with a high degree of realism. Basically the starting point is a 3D model, from CAD files or modeling software, and a set of measurements that are added to its features and proprieties. In order to achieve photorealistic effect, textures and lighting models are also applied.

II. BIM IMPLEMENTATION

2.1 BIM implementation for building construction:

Our project has two aspects one is to rehabilitate the city for urban mobility and second is to study the effectiveness of BIM in Building construction. For the infrastructure development we have used the Infraworks 360 software and for the development of building model we have used the Revit software along with the Naviswork software for scheduling and time estimation.

For the development of building model we worked on the same model through cloud by which we can modify and suggest the view about the project. In Revit model the building is designed for 3D and then it is converted to 4D model by finding fourth parameter scheduling and time using the Naviswork software. The same building model is then converted to fifth dimension (5D) for the Estimation and costing in Revit software. The energy analysis of building is also done in Revit which is considered as the sixth parameter (6D).

2.2 Level of Development in BIM:

There are 5 Levels of Development:

•LOD 100 - Concept
•LOD 200 – Design Model
•LOD 300 – Construction Model
•LOD 400 – Fabrication Model
•LOD 500 – As-Built Model

Level of Development is nothing but the extent to which BIM model users such as various contractors and fabricators within a project can use and rely on the model for scheduling of elements, pricing, fabrication and construction. LOD only applies to an individual model element.

2.3 Steps for design of Building model:

Step 1: In the first instance we developed the plan of different floors of the building and ground floor for the parking purpose.
Step 2: After the drawing of plan 3D model of building, the building is made energy efficient by providing solar roof panel, and reducing carbon emission material in the building.
Step 3: After detailed drawing of building the quantities of material and costing is done in Revit.

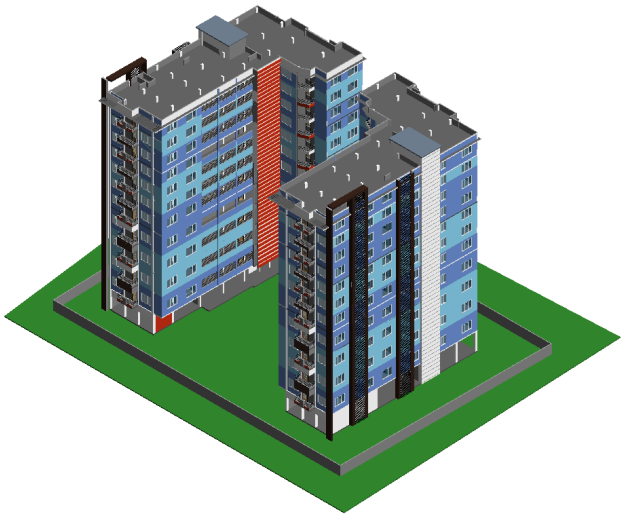


Image 1: 3D project building model

Step 4: The building model is extracted in Naviswork software for the scheduling and time and for analysis, simulation, and project information.
Step 5: For energy analysis the geographical data is taken from the web network and various analysis is carried out.
Step 6: Cloud rendering is done through web and the rendered model is shared through collaboration.

2.4 Development of model in 4D using Naviswork:

Autodesk Navisworks Manage software is a comprehensive review solution for analysis, simulation, and coordination of project information. Multidisciplinary design data can be combined into a single integrated project model for interference management and clash detection. Navisworks Manage helps design and construction professionals anticipate and avoid potential problems before construction.

4D Scheduling Simulate construction schedules and analyze project activities, and helps to reduce delays and sequencing problems. In project we used the scheduling for developing construction sequences that link model geometry to times and dates import times, dates, and other task data from project management software to dynamically link schedules with project models; and set up planned and actual times to visualize deviations from the project schedule.

With the use of Collaboration Toolkit we communicated design intent and encourage teamwork with the ability to add markups to viewpoints with advanced redlining tools. The software's object animation features help you create animations of objects for clash and interference analysis. You can create interaction scripts that link animations to specific events, triggers, or key comments, and link animations to tasks in a 4D schedule or improved construction planning.

Clash and Interference Detection anticipate and avoid potential problems before construction, reducing expensive delays and rework. Clash and interference detection features in Autodesk Navisworks Manage software enable to perform clash tests against specified geometry to more easily find and resolve conflicts. Link clash tests to 4D simulations and object animations to analyze issues in space and time.

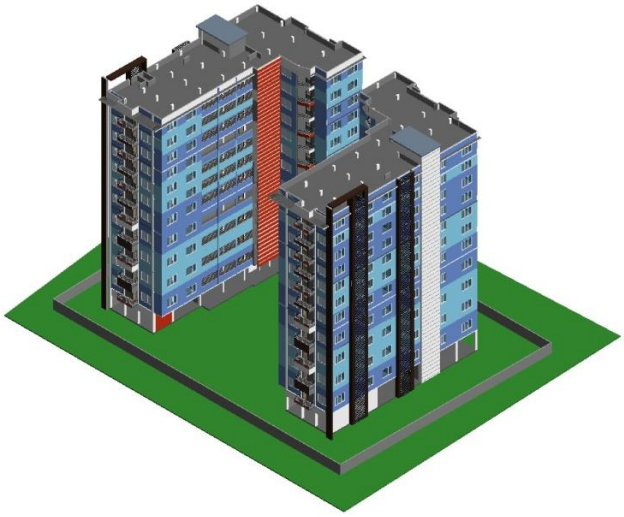
Real-Time Navigation Explore your integrated project model using advanced navigation tools that produce a realistic, real-time experience. Real-time navigation capabilities are included in all Autodesk Navisworks products.

2.5 Estimation and Costing (5D):

Estimation and costing is done in the Revit software, In this quantities of various items of building works like, wall schedule and quantities, door schedule and quantities, windows quantities, in terms of area Sq.m, Volume in Cu.m etc. is found out for the proposed building.

To find out the cost of each material Current DSR (District Scheduled Rate) 2016-17 of Pune district is preferred. The respective rate of items is taken to calculate the amount requiredfor the calculated quantity. The amount of each quantity is calculated and the overall building cost can be decided by taking grand total.

2.6 Energy analysis of building:



Building Performance Factor

The building is situated at kharadi bypass, which an area of 4,713 square meter with 3,813 square meter of exterior wall area is exposed to whether. The outdoor temperature is 39˚C is Maximum and 7˚C is Minimum, the electrical cost for this building is $ 0.08/kWh and fuel cost is $0.78/Therm

Energy Use Intensity

The use of electricity for this building is 178 kWh/sm/yr and the energy use intensity of fuel is 122 MJ/sm/yr

Life Cycle Energy Use/Cost

By considering the life of building 30 years and 6.1% discount rate for costs, the Life Cycle Electricity use is 12,341,538 kWh and fuel used up to 30 years life span is 8,477,439 MJ thermal, energy cost is $476,833

Renewable energy potential

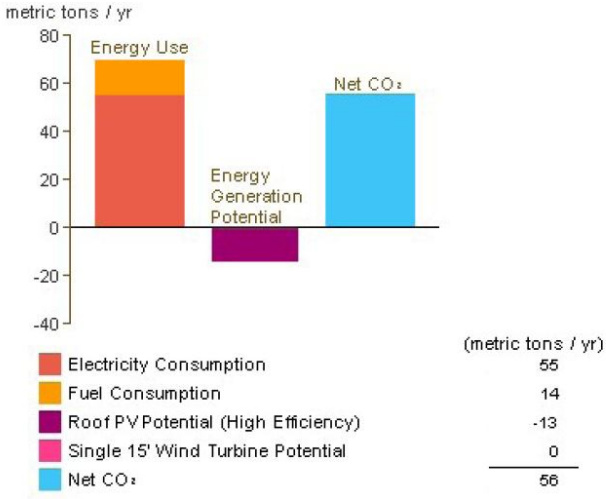
By considering the efficiency of pv system to be 5%, 10%, 15% for low, medium, high respectively.

So the roof mounted PV system for low efficiency is 34,590 kWh/yr, for medium efficiency it is 69,179 kWh/yr and for high efficiency pv system it is 103,769 kWh/yr.

Single 15’ Wind Turbine potential is 904 kWh/yr

Energy analysis Report

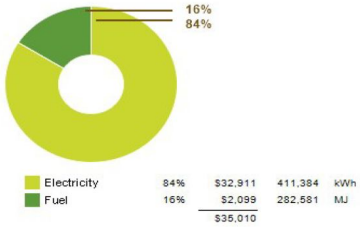
Annual Carbon Emissions



Graph 1: Annual Carbon Emissions

Above chart shows that the carbon emission, due to electricity consumption is 55 metric tons/yr and due to fuel consumption, carbon emission is 14 metric tons/yr. The use of pv system and wind turbines do not produce any carbon so the net carbon emission is 56 metric tons/yr

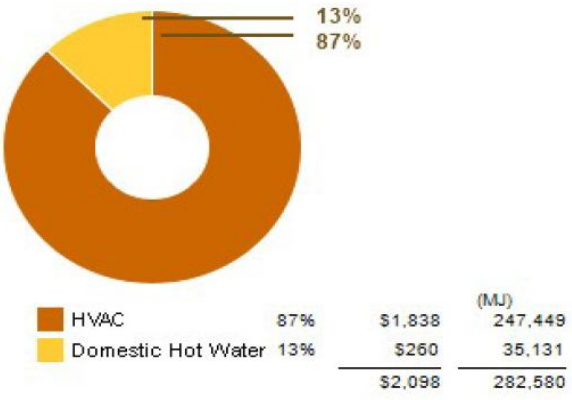
Annual Energy Use and Cost



Graph 2: Annual Carbon Emissions

The above chart shows the cost spent annually on electricity and fuel consumption, for electricity $32,911 and for fuel $2,099 annually

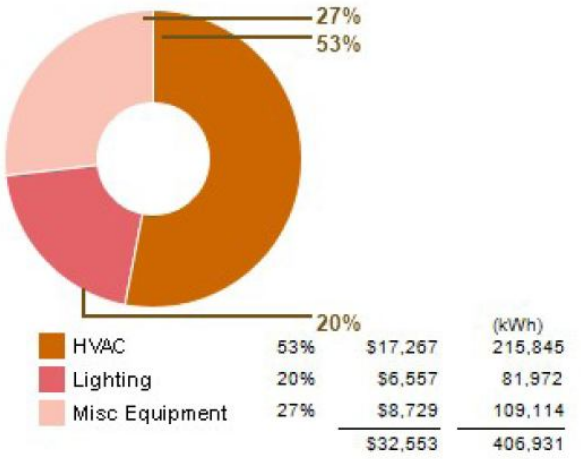
Energy Use: Fuel



Graph 3: Annual energy use: Fuel

In above chart shows that fuel consumption for HVAC and domestic hot water in building annually. In this case fuel consumption is 247,449 MJ for HVAC and 35,131 MJ for domestic hot water, the total cost spent on fuel consumption one both the systems is $2,098.

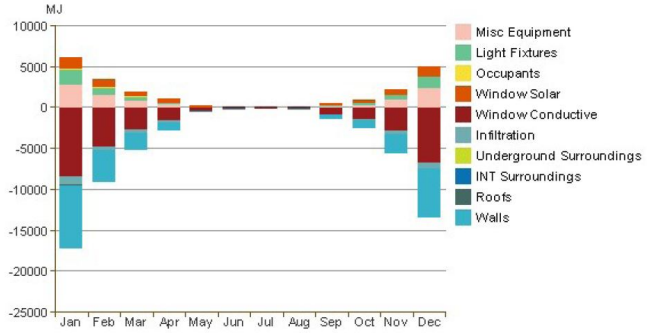
Energy Use: Electricity



Graph 4: Annual Carbon Emissions

In above graph shows that electricity used for HVAC, lighting and Misc equipment, in this case electricity used for HVAC ,Lighting and Misc Equipment are 215,845 kWh, 81,972 kWh and 109,114 kWh respectively.

Monthly heating Load



Graph5: Monthly heating Load

The above chart shows monthly heating load in building, here considered all possible ways which can contribute in increase temperature in the building

Monthly cooling Load

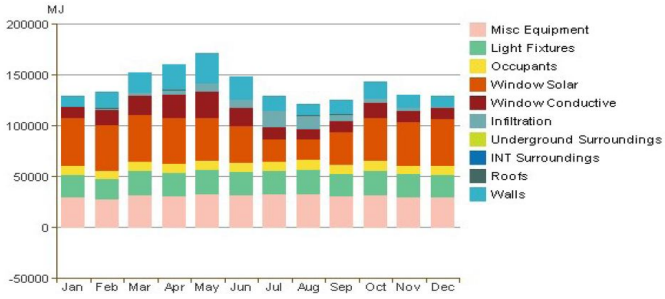


Fig no 1

The above chart shows monthly cooling load in building, here considered all possible ways which can contribute in decrease temperature in the building

Monthly Fuel Consumption

Fig no 2

Above chart gives the overall idea about the fuel consumption for every month. In this considered all systems which consume fuel.

Annual Wind Rose (Speed Distribution)

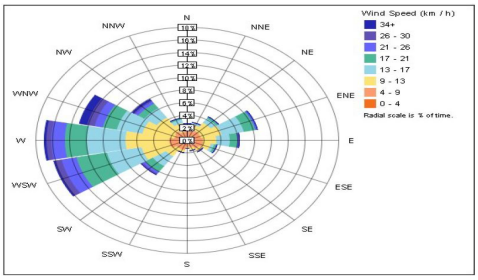


Fig no 4

Above chart provides the wind analysis data, it gives the wind direction and the wind speed around the building

III. CASE STUDY

.

A. Effectiveness of BIM in planning of old city

For the planning of infrastructure development of any old city BIM Technology can be implemented through Infraworks 360 Software it can be used for Infraworks of city to select an area on a map to quickly create a model with the available topographic condition ,aerial geometry, buildings, present roads and water. In this the area up to 200 square kilometers, in any shape can be selected, then the available data im an accurate picture of the selected site.

B. Benefits of BIM Infraworks 360 in the project

a) Large data can be managed with the use of Infraworks 360 So that we can create models from existing data and manage infrastructure of city models. We can combine detailed data from existing 2D-3D CAD drawing, GIS data, raster, City GML, satellite imagery. It transforms the way of creating 3D models with large scale data.

b) Complete detailed design model with little rework in the context from the start more accurately at the appropriate level of detail in order to help and increase confidence in project scope and budget as we tend to move into detailed design. Combining detailed models from Autodesk Revit products, AutoCAD Civil 3D, AutoCAD Map 3D, 3ds Max, Autodesk Navisworks software products, among others.

c) We can develop design model of city more accurately with easy to use and industry specific tools with realistic visual effects, better communication design concepts with rendering tools for better visual effects, identification of environmentally sensitive areas and important sites such as Educational, Commercial and business locations to avoid delay in the design process. We can easily import and adjust multiple types of building facades or roofs for height and slope.

d) With Autodesk Infraworks 360 we can speed the approval process by sharing models and specific scenarios with stakeholder's engagement more securely with cloud environment. It is possible to design quickly, collaborate with model, and communicate project intent visually via 3D models, freely navigate through a rich visual environment, and view multiple scenarios in real time.

e) InfraWorks 360 supports decision making with collaborative, quantitative and real-time feedback and the ability to simultaneously manage multiple design options in the project.own data by surveys, Revit, DWG models to create

It encourage team collaboration which\provides cloud-based capabilities that enables project stakeholders in various offices to publish, store, and manage large models centrally and more securely in the cloud. Geographically dispersed team can review design model and provide suggestions from anywhere, at any time. Additionally, project review can be given by generating animations with varying narratives and annotating key concepts and locations in models. With Infraworks 360 it is possible to transform and collaborate model without any difficulties and can be managed big data at any time and from anywhere.

Picture 2: Picture of GIS map showing whole city of the project

Picture 3: Picture of map showing realistic 3D buildings in Infraworks 360

f) Infra-Works 360 give the ability to access and view design model via a web viewer or mobile devices which helps to verify conditions. With access from web, desktop, mobile, it explores the 3D design models, exposing the data behi design concepts. Due to access, more quickly can arrive at an effective solution and decisions are backed by information and field validation.

C. Model making in BIM through Infraworks 360

In the context of this research, For the Rehabilitation of old city the Kharadi region in Pune district

is taken for the study and development of model. For the planning and development of city model through BIM technique, the overall study of the city is carried out in terms of its topography, roads, existing buildings, etc. survey was made to find out various urban mobility problems in the city and to provide suggestions for the solution it

In the survey, occurrence of major traffic conjunction study for different region at various times on different day is made and major traffic is found out at Kharadi bypass region, Magarpatta city, and Wagholi region. The corresponding picture of map is shown in picture 1.This collected data can be used in the Infraworks 360 for the model making, in the model making probably one of the most important steps when starting a new project.

In InfraWorks 360 it is to create multiple proposals. It is easy to create multiple design concepts with ease in design of Infraworks 360, which allows the; developers to select the best feasible design concepts for the project. It is also beneficial to crate multiple design proposals, so that the project can get reviewed and approved much faster, so construction work can begin at an earlier stage. Infraworks 360 by default creates the master proposal, whether we create a new project from scratch or use the Model Builder. The existing condition of project is represented by master proposal. For the creation of model existing GIS objects and features will be imported into this proposal such as existing terrain or topographic data, aerials, roads, buildings, hydrological data, and city Infrastructure. you have complete this step by accessing the proposal feature on utility bar, we create a new proposal.

After taking the actual GIS and map in the project we enhance the visual effects in 3D by various building facade which is unique for different buildings. We can assign different facade style to building face in Infraworks 360. It makes model more realistic to 3D site model. By changing the system settings, building facade can be done. Settings and utility feature in order to assign different facade to each building face has to be set to medium or high. Now we can start designing buildings. Several ways are there which can be used for the design and creating buildings in Infraworks 360. One way is by importing linework data either as a shape

Picture 5: Picture of project model (Flyover Bridge designed using Infra-works 360

file or simple data format (*.shp) or (*.sdf), and then converting the data into building features also simply we can use the building feature tool, we select a building facade in the Select Draw Style asset card, and sketch out the building footprint manually. Once we have completed creating all our proposed buildings, now we can take our design a step further with the Styles palette open, we can select a building facade and drag and drop a new facade style onto a building face.

To provide solutions for the effective rehabilitation of old city to overcome for traffic conjunctions we proposed to design a flyover at Kharadi bypass road in the city model. To add bridges design roads or component roads in Ifraworks 360 use in-canvas sliders, then specifying the start and end station locations of a bridge within a design road and thus determining its length bridge or roads can be laid. In working with Infraworks 360 to delete a bridge press the delete key and it will be removed from a model or proposal. Add a bridge to a design road, sketch a design road or select a design road, convert a planning road to a design road using the right click context menu. In Edit mode, right click on the design road to open the context menu, then click Add Bridge, use the slider grips that appear on the design road. Place the start station and end station of bridge structure by clicking or we can input exact values of start and end stations in mini toolbar then press Enter to finish. We can change it later in Edit mode at any time using the sliders, then start by defining a height for bridge in the Stack, then vertical profile is updated. Show Clearance Envelope and Update Vertical Profile.

Picture 4: Picture of map showing proposed area for the flyover design

IV. CONCLUSION

With the use of BIM urban planning for urban development and mobility models can be made with less efforts and cloud collaboration. Better Project solutions by BIM can create and operate on digital databases for collaboration, and can manage change throughout those databases so that a change to any part of the database is coordinated in all other parts.

BIM is a effective process for which can be used not only for the building model but also for the design and planning of the urban mobility of the the city.

In this research of BIM Infraworks 360 model it can be suggested that the traffic conjunctions at the Kharadi by pass in Pune can be minimized by constructing a fly over and the same can be planned with the ease of design effort using BIM Infraworks 360.

In Infraworks 360 software we can use GIS maps of city so it is possible to understand and plan the Infrastructure of the city without any conflict with the available data.

REFERENCES

[1] Er. Jashandeep Singh Arora, Er.Navneet Singh, A review paper on modernization of City into smart city, ISSN:2320-8163, May-June, 2016

[2] Michael Batty, Kay Axhausen,GiannottiFosca ,Alexei Pozdnoukhov, Armando,Bazzani, Monica Wachowicz, Georgios Ouzounis, Yuval Portugali, "Smart Cities of the Future" Centre for Advanced Spatial Analysis University College London , ISSN 1467-1298, October 5, 2012

[3] Esri India, "White paper –GIS for smart city", Esri India, September 2014

[4] Imran zaman," White paper on smart cities", Daywateacher.com, 31st March 2015

[5] UN Habitat, "habitatiiiissue paper", United nation conference on housing and sustainable urban development, New York, 31st May 2015

[6] Govt. Of Hong-Kong," Central policy unit", The government of Hong-Kong special administrative region, September 2015

[7] Govt of UK, "Department of business development and skills", October 2013

[8] Pune municipal corporation, "Yearwise arrears, demand and collection details"21 Aug 2016

[9] "ZTE Smart City White Paper"

[10] R. Chandrashekhar President, " Smart Solutions for Cities", NASSCOM, 25th June 2015

[11] PUNE MUNICIPAL CORPORATION "Adar Poonawalla Clean City movement "

[12] PUNE MUNICIPAL CORPORATION "Environmental Sustainability Pune: Maximum Solar City**"**

[13] https://m.yourstory.com/2015/03/smart-water-solutions/

[14] https://m.yourstory.com/2015/04/water-energy-conservation-internet-of-things

[15] https://smartcities.gov.in

[16] http://smartcitieschallenge.in

[17] http://www.autodesk.com/solutions/bim/overview

[18] http://opendta.ounecorporation.org