3D Modeling of Urban Scope Generation

Mr. Vishal Kumar Singh

Department of Civil Engineering

Centurion University, Odisha

Ms. Tapasi Parida

Department of Civil Engineering

Centurion University, Odisha

Mr Rahul

Department of Civil Engineering

Centurion University, Odisha

Abstract- As we know the rate of migration is very high; everyday people are moving to the city from a rural area, those cities are becoming denser day by day. In this case, the urban ecosystem needs to be developed which is represented by the development of institutional, physical, social and economic infrastructure of the city. Most of the Indian cities are unplanned, in this case understanding the city before we use comes vital.

3D modelling of the city gives a picture to uses; a digital city model of the existing city can be used as a better way to analyse the city for its best uses. We can actually feel the city in a virtual environment and identify the problems and solutions for it.

In this paper we seek to study of a tribally dominated city called Paralakhemundi in Gajapati district of Odisha. Paralakhemundi is the ancient town and district headquarters of the Gajapati district, Odisha. Majority of the people speaks Odia whereas pew people also speak Telugu as it is situated on the border of the Andhra Pradesh. The city conserves two major heritages, 1. Gajapati Palace, 2. BN Palace; There are two water reservoir: Ram Sagar and Sita Sagar. It is also beside Mahendra Tanya River and a hill called Bhoi Sahi. 3D modelling of heritage will be a pinpoint to attract more tourist.

The main scope of the project is to generate a 3D model using Geographical data and urban area Visualization. Also, to set up, analyse and disseminate urban planning theories and projects, the 3D model serves as a communication and participation medium and 3D visualization power to see the relationship of projects access their feasibility plans and their implementation

CAD software is essentially being used for the making 3D model of any civil structure, whereas it requires some spatial forum to create a 3D model of an existing city, in this case, we use AutoDesk Infrawork. The software has open licence to academia. It has a clear platform to understand the existing city in the 3D model. This also supports data integration to understand the real-time scenario of the city through the virtual walkthrough.

SRTM data is being used for the terrain preparation and Being imagery to create building footage. Hight of the building can be determined manually by visiting the field.

Keywords: SRTM, CAD Software, 3D Model, 3D Visualization, Virtual Tour, AutoDesk Infrawork. 3D City.

1.1. INTRODUCTION

In 3D computer graphics, 3D modelling (or three-dimensional modelling) is the process of creating a mathematical classification of any surface of an object (either inanimate or living) in three dimensions via specialized software. The end-product is called a 3D model. A 3D artiest someone who works with 3D models. Visualization of a scenario with two different direction is known as 3D view, it can be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena.

A computerized model or digital model of a city is also known as 3D city model which has height information. There are several applications of 3D city model in urban planning analysis, disaster management, tourism, telecommunication. However, the applications of 3D city model in urban

planning in INDIA are not extended and the in-depth utility is not yet developed widely. This article introduces the important applications of 3D city model and analyses the explicit model of it.

1.2. Statement of the Problem: The need for 3D city model are growing and expanding exponentially in many fields. In a standard shift from traditional 2D-GIS toward 3D-GIS, a enormus amount of accurate 3D city models have become necessary to be produced in a short period of time and provided widely on the market. 3D city models are very useful and valuable tools for public participation in urban planning. However, in India now, there is inadequate and limited understanding of the impacts that these models may have on the quality of the planning process and consequent hesitation about the appropriate methods of their usage even in the professionals. These indicate a need for

Gajapati Palace, Paralakhemundi

research into how the usage of 3D city models can affect the extent to which urban planning cover the essential planning aspects of the building scenario.

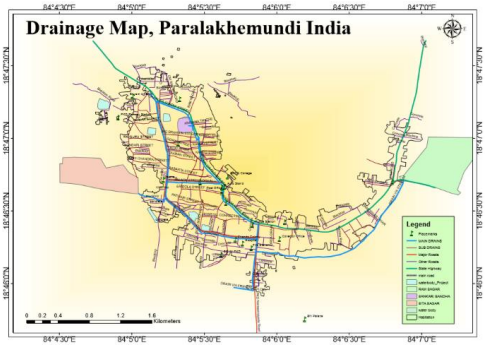
1.3. Statement of the Problem: 3D city models and information technology tools may help urban planners and designers to visualize and interact with design options and scenario plans, large urban data sets, and 3D information more effectively. It can promote pioneer experiments with an advanced form of communication, visualization, and information retrieval to produce more imaginative planning solutions. Simultaneously, it can also facilitate rapid exploration of alternative concepts that would help planners, real-estate developers, officers, and common citizens to comprehend, accept, and participate in the planning process.

More than half of the world's population now lives in cities, and the 21st century is a century for cities. So urban planning is really important for the development of cities. And then, 3D city models are becoming more and more important in the field of urban planning.

2.1. THE STUDY AREA:

In this project, we seek to study of a tribally dominated city called Paralakhemundi in Gajapati district of Odisha. Paralakhemundi is the ancient town and district headquarters of the Gajapati district, Odisha. Majority of the people speaks Odia whereas pew people also speak Telugu as it is situated on the border of the Andhra Pradesh. The city conserves two major heritages, 1. Gajapati Palace, 2. BN Palace; There are two water reservoir: Ram Sagar and Sita Sagar. It is also beside Mahendra Tanya River and a hill called Bhoi Sahi. 3D modelling of heritage will be a pinpoint to attract more tourist.

The Location and North to the east area covered: North 18° 47' 56.43"N to 18° 47' 54.32"N and East 84° 7' 37.35"E to 84° 7' 51.34"E; the total area 15.47 km², the city is 143 m elevated from mean sea level. Hight of the hill is 257.40m from mean sea level. The total population of the city is 46272 as of 2011 census data.



Drainage Map of Paralakhemundi Town

Paralakhemundi is an elderly Zamindari lying in the western corner of the southern portion of than larger Ganjam district (now constitute Ganjam district, Gajapati district, Srikakulam district and parts of Vizianagaram district), and it is bounded in the west by the district of than larger Vizagapatam district (now constitute Visakhapatnam district, Koraput district, Malkangiri district, Rayagada

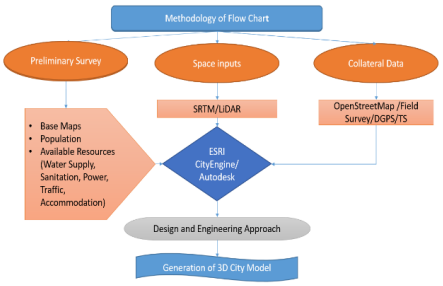
2.2. Space Inputs or remote sensing data: Remote sensing is the art of acquiring information about an object or phenomena without coming into physical contact with it. Those different available satellite data is very much useful to obtain the information for the project such as elevation information. SRTM an open source satellite data available to any registered users with USGS, SRTM provides a 30-meter digital elevation model with is useful to know the surface appearance or terrain preparation.

2.2.1. SRTM (Sutter Radar Topographic Mission district, parts of Vizianagaram district) and on the north side the Jeypore and the eastern ghats which are called Maliyas or tribal agencies. This is an emerging town in a plan much like the letter ‘L’ dispersed around the foot of the well-wooded hill. Most of the houses in the town are long shaped, The horizontal portion of the ‘L’ faces south, and at the corner w ‘L’ and the vertical portion join, is situated, there’s a palace here (Gajapati Palace), a most picturesque group of building.

A 3D model of Paralakhemundi city will bring opportunity to understand the city in the best way to its uses, Available resources of the city can be reorganized for its optimum practices. It will also help for detailed visualization.

3.1. METHODOLOGY OVERVIEW:

The Flow Chart



3.1. Preliminary Survey: This includes preparation of the base map, and gathering some data such as Population, Available resources etc.

The base map provides background detail necessary to orient the location of the map. It also adds to the aesthetic appeal of a map. North 18° 47' 56.43"N to 18° 47' 54.32"N and East 84° 7' 37.35"E to 84° 7' 51.34"E; the total area 15.47 km^2.

Comment [VKs1]: ,,

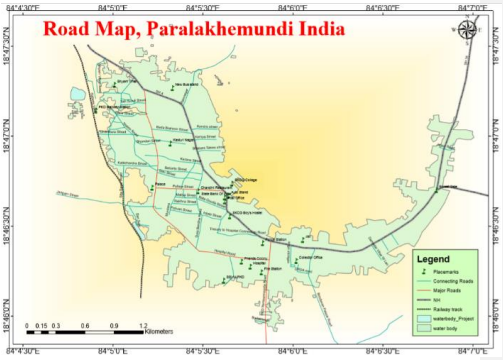
The Methodology Overview

There are two large water reservoirs and a few ponds are available in the city, during the rainy season water from the hill and town runoff to this reservoir, these reservoirs recharge the groundwater level. Also, the available water in the tank is being helpful to irrigate the land nearby.

Municipal authority of the Paralakhemundi town has control over sewage system. And a proper wranglerstm has in line-mark to drain off stormwater, also authority has not established any sewage treatment plant yet.

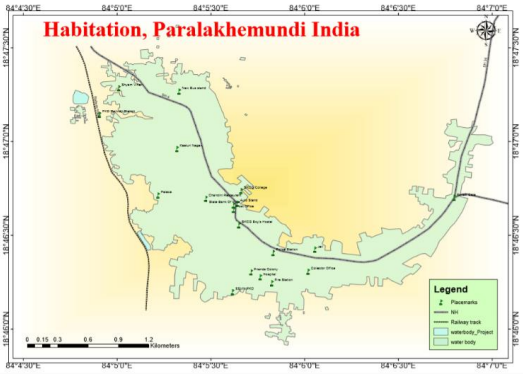
The total citizenry of the city is 46272 as of 2011 census data. Today are approximately 9400 houses being there. Most of the houses are narrow in width compared to the length.

A habitat map shows the geographic distribution of different habitats within an area.



Road Map of Paralakhemundii Town

Habitation Map of Paralakhemundii Town



The road map of the city includes a state highway and major roads connecting to the state highway and connecting road or Gali connecting to major roads. Being satellite imaginary is being used to prepare a roadmap of the Paralakhemundi. Name of the streets and roads was being collected manually field visit. ArcGIS provides excellent cartographical tools to prepare the map with attribute information.

Mainly there are three types of drainage in Paralakhemundi town, 1. The mail drainage line connecting to Rama Sagar and Sita Sagar, the purpose of this drainage is to drain off all the rainwater coming from the hill to the reservoir. This drainage is line-mark near the hill. Subdrainage lines are connecting to through street and Gali. These drainages have a common outlet toward East-South of the city which is the lower elevated place.

): - The Shuttle Radar Topography Mission (SRTM) was flown aboard the space shuttle Endeavour February 11-22, 2000. This was an international project to acquire radar data which were used to create the first near-global set of land elevations. It has open licence to an user on earth explorer.

3.2. SRTM Data Products

The level of processing and the resolution of the data will vary by the SRTM dataset.

SRTM Non-Void Filled elevation data is a product of raw C-band radar signals which is spaced at intervals of 1 arc-second (approximately 30 meters). It was then edited by the NGA to delineate and flatten water bodies, better define coastlines, remove spikes and wells, and fill small voids. The data outside of the United States were sampled at 3 arc-seconds (approximately 90 meters) which is less accurate for a small area. 1 Arc-Second Global elevation data offer worldwide coverage of void filled data at a resolution of 1 arc-second (30 meters) and provide open distribution of this high-resolution global data set.

This is a standard image format for GIS applications. File size is approximately 25 MB for 1-arc-second data files and approximately 3 MB for 3-arc-second data files.

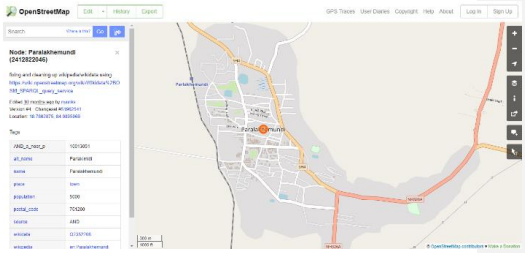
Product Specifications	
Projection	Geographic
Horizontal Datum	WGS84
Vertical Datum	EGM96 (Earth Gravitational Model 1996)
Vertical Units	Meters
Spatial Resolution	1 arc-second for global coverage (~30 meters) 3 arc-seconds for global coverage (~90 meters)
Raster Size	1-degree tiles
C-band Wavelength	5.6 cm

Table-1 SRTM Data Properties

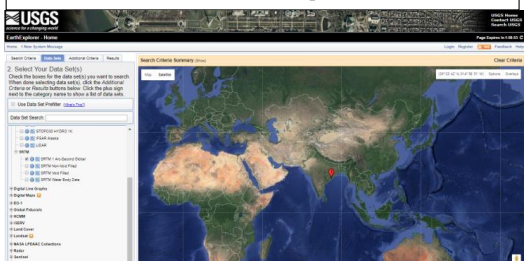
3.3. Instruction to Download SRTM from Earth Explorer: -

The user need to create one account with USGS on the below link https://ers.cr.usgs.gov/register/

After verification, the user can navigate to USGS Earth Explorer to download the data. The user can select the area using search option available at left corner tab, the location can also be selected using latitude and longitude.



OpenStreetMap



USGS Earth Explorer

Once the area got selected user need to select the respective date to download the data, SRTM can be selected in the data set search box.

3.4. OpenStreetMap (OSM): - OpenStreetMap is built by a group of mappers that contributed and maintained data about building roads, trails, cafés, railway stations, and much more, all over the world.

OSM is a collaborative project to create a free editable map of the world. It is a platform where a user can create his/her own data as per the project needs. Rather than the map itself, the platform support storage of the data the data generated by the project in different layers which are considered its primary output. The creation and growth of OSM have been motivated by restrictions on use or availability of map information across much of the world, and the advent of inexpensive portable satellite navigation devices. OSM is considered a prominent example of volunteered geographic information.

The data from OSM is available for use in both traditional applications, like its usage by Craigslist, Osm and, Geocaching, MapQuestOpen, JMP statistical software, and Foursquare to replace Google Maps, and more unusual roles like replacing the default data included with GPS receivers.

In this study we use OSM platform to create building footage, this data can be directly imported in AutoDesk Infrawork.

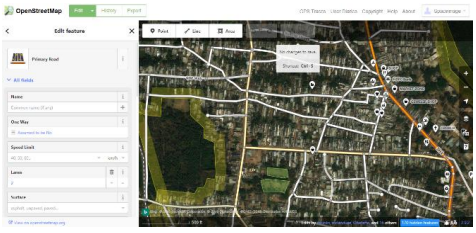
Height of the buildings was being equated with a manual survey done through storey count, the average height of a building storey is considered as 3m, those the no of storey multiplied by 3 gives the approximate height of the building. Most of the building in the town has only 1st and the 2nd storey of height. Whereas the tallest building has 5 stories of height.

3.4.1. Steps to Create data on OpenStreet Map:- User need to browse the below URL to access the data

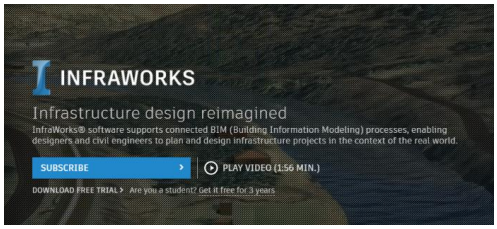
https://www.openstreetmap.org/

to download the existing data user can directly navigate to the area of interest and select export, the data will be exported in .osm file format, this do not required any account with OpenStreetMap, whereas to create your own data it required to have a verified account by OpenStreetMap.

To create the data user need to login to OpenStreetMap account, after login a background satellite imagery appears. Desired features can be digitized in vector format, this allows the user to store attribute information about the object or features.



Create Features in OpenStreetmap



AutoDesk Infrawork an Overview

4.1. AUTODESK INFRAWORK:

Autodesk® InfraWorks® is a planning and design platform that enables engineers/planners to quickly and easily convey preliminary design and pioneer planning intent in a real-world of digital format, It leverages automated, rich 3D digital model building capability with web-based and cloud technology and vertically-specialized functionality to provide infrastructure engineers/planners with the industry's most compelling conceptual design tool.

InfraWorks helps organisations:

Enable stakeholders to confidently envision the full potential of a project at end to end.
Create a competitive environment to win more work.
Empower teams to make decisions where and when needed.
Save time and money through the automated integration of data from multiple sources.

Users enjoy InfraWorks because they can:

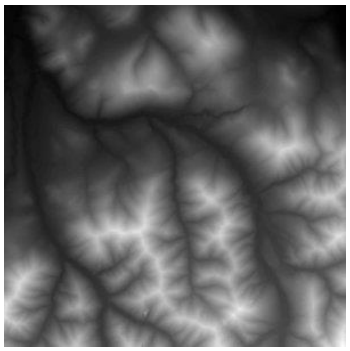
Quickly and easily convey preliminary design intent in a real-world contextual environment.
Effortlessly communicate and collaborate with internal and external stakeholders across the project lifecycle.
Efficiently access and integrate data from multiple sources into a highly accurate model. InfraWorks includes tools for conceptual, bridge, roadway and drainage design.

If you are an academic, Autodesk gives a three-year free term licence, it also supports almost all kind of GIS and CAD data.

4.2. Digital Elevation Model (DEM):

DEM is the 3D computer graphic representation of earth Surface. It has become a widely used tool and product in the last 20 years. They provide a snapshot of the landscape and landscape features while also providing elevation values. It allows user to better visualize and interrogate topographic features.

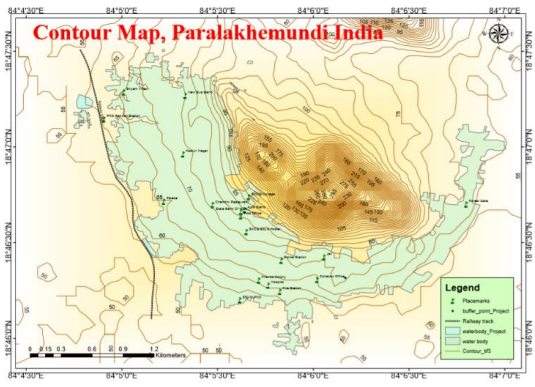
Here digital elevation models are produced by processing SRTM data of pixel resolution 1 arc second or 30m, this is an open source data available for best practices. Also, digital elevation models are produced from contour lines which are compiled from the same sources. Optimum data collection interval and accuracy of digital elevation models are investigated. Accuracies are also investigated according to the resolution of the digital elevation model and slope of topography. Some solutions are suggested for the areas having high errors. Two different test regions are used for the study. Also, the accuracies of digital elevation models changing with the resolution of the digital elevation model and slope of topography.



30m Resolution DEM of Paralakhemundi Town

4.3. The Contour: -

A contour is the elevation referential map for a surface. Line joining the same elevation are known as contour line and elevation difference between two consecutive contour line is known as contour intervals. Natural 3-D surfaces such as topography are extremely difficult to summarize in any quantitative way and for this reason, we invariably look at the landscape in terms of a series of two-dimensional slices.



Contour Map of Paralakhemundi Town

In a formal sense slope is the first derivative of the elevation (E)/distance (D) function, E = f(D). Some of you may not fully appreciate, however, the variety of ways in which slope can be expressed.

The contour shows the highest elevation point on the hill is 285m whereas tower elevated surface has an elevation of 55m, those it is clear now that slope of the town surface is high in gradient.

A terrain profile or topographic cross-section is a diagram showing the rise and fall of the surface of the ground along a line or section between two points. The

the line of section is often a straight line, but it may also be non-linear, such that drawn along a sinuous river course or along a winding road.

The slope at any point on one of this profile is the same as the corresponding slope on the ground only if the horizontal and vertical scales are the same.

This map provides a colourized representation of slope, generated dynamically using a server-side slope function on the Terrain layer followed by the application of a colourmap. The degree of slope is represented by a colourmap that represents flat surfaces as grey, shallow slopes as light yellow, moderate slopes as light orange and steep slopes as red-brown. This service should only be used for visualization.

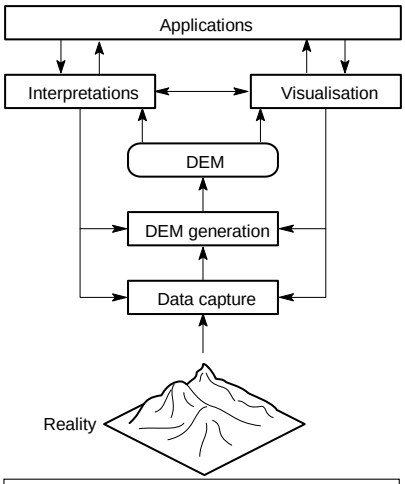
In this case, almost the area covered by the town has an elevation of 89m or more. Whereas few pixels represent the flat surface from 87m to 88m of an elevation. This colourized slope is appropriate for visualizing the orientation of the terrain at a large map scales. This layer can be added to applications or maps to enhance contextual understanding.

5.1. Terrain Preparation: - techniques to know the characteristic of the land surface of the study area. Terrain, or land relief, is the vertical and horizontal dimension of the land surface. Geomorphic resources are the natural phenomena on the earth"s surface, which have originated due to the active geomorphic processes. The resources directly or indirectly control various anthropogenic activities to a great extent

Terrain evaluation is very important for land use planning as it depicts the land suitability for urban development and Digital elevation model (DEM) is a raster representation that used to determine the features of drainage networks and slope of drainage network and to determine the characteristics of basins. There is no universal usage of the terms digital elevation model (DEM), digital terrain model (DTM) and digital surface model (DSM) in the scientific literature. In most cases, the term digital surface model represents the earth's surface and includes all the objects on it. In contrast to a DSM, the digital terrain model (DTM) represents the bare ground surface without any objects like plants and buildings.

DSM and DTM

A DEM can be represented as a raster (a grid of squares, also known as a heightmap when representing elevation) or as a vector-based triangular irregular network (TIN). The TIN DEM dataset is also referred to as a primary (measured) DEM, whereas the Raster DEM is referred to as a secondary (computed) DEM. The DEM could be acquired through techniques such as photogrammetry, lidar, land surveying, etc. DEMs are commonly built using data collected using remote sensing techniques, but they may also be built from land surveying. DEMs are used often in geographic information systems and are the most common basis for digitally produced relief maps. While a DSM may be useful for landscape modelling, city modelling and visualization applications, a DTM is often required for flood or drainage modelling, land-use studies, geological applications, and other application.



Methodology Overview DEM

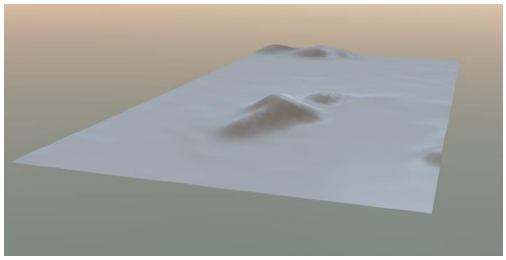
To prepare the terrain in the Autodesk Infrawork, the user needs to open data source viewer, as Infrawork support all types of raster terrain format, one can process the data into ArcGIS than it will be imported in the Infrawork using data source viewer. Given fig shows the types of file format supported by Infrawork. It has an online model builder which allow the user to create a model directly from the clouds by selecting the area of interest. The area of interest may be defined by a manual selection from the map or vector boundary can be uploaded with the geographic reference system.

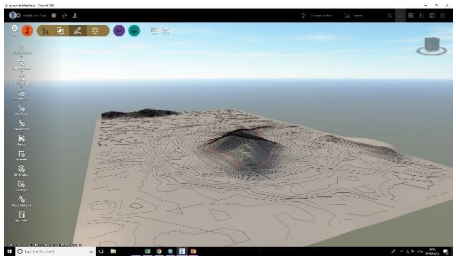
It supports the following file format for raster data:-

File Format Picture	File Extension World	World File Extension
ArcInfo ASCII	*.asc	
Digital Elevation Model	*.dem	
Erdas Image	*.img	*.igw
Jpeg	*.jpg/*.jpeg	*.jgw
MrSID	*.sid	*.sdw
TIFF	*.tif/*.tiff	*.tfw

Table-2 Raster File Format Supported in Infrawork

Hence prepared raster DEM was imported in the Infrawork, the fig shows digital surface model of Paralakhemundi town, a proper visualization of terrain is shown in the below fig. this terrain can be used for delineate natural drainage network and surface flow line of the area.





The terrain is used to generated TIN and contour, the base contour can be either imported from the external source or it can be generated using tools available with the software; the below contour has an interval of 2m and it was generated using the available tools.

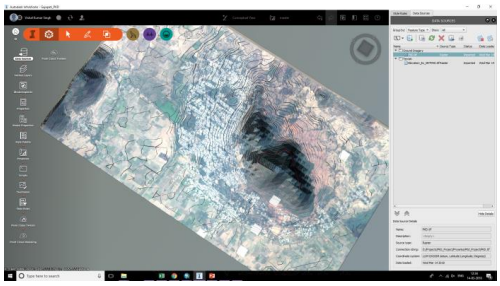
It can be clearly seen in the above terrain the hill is surrounded by several closed loops of contour lines, which indicated equal elevation on the hill.

5.2. Referential Satellite Imagery: -

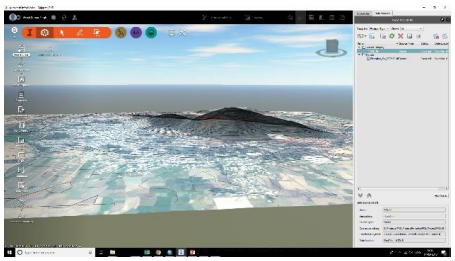
Ground imagery is often called orthophotography or aerial photography. It can include an actual photograph or a scanned topographical map or site plan. It is always in raster format and includes both a picture file (such as aerial photography) and a world file (locating the picture in the real world, or georeferencing.

This terrain contains the Bing Maps aerial imagery web mapping service, which offers worldwide orthographic aerial and satellite imagery. Coverage varies by region. Coverage in different areas within a country also varies in detail based on the availability of imagery for that region. Bing Maps is continuously adding imagery in new areas

and updating coverage in areas of existing coverage. This map does not include bird's eye imagery. The resolution of the satellite imagery is 15m. This resolution is capable enough to visualize the building footprint of the Paralakhemundi town.



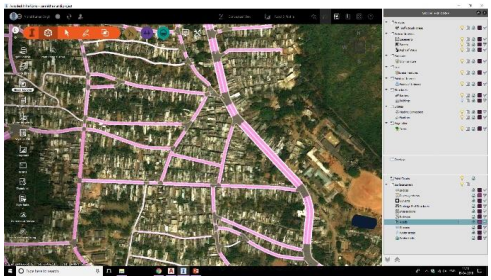
Show Bing satellite imagery imported on the terrain file



Bird Eye's view of the terrain after placing satellite imagery

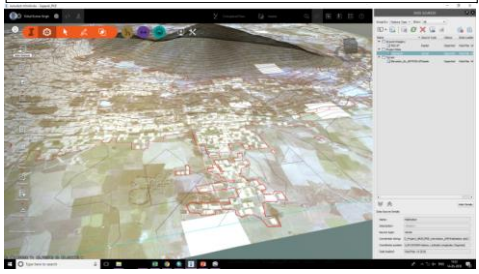
The Bing Maps Aerial service is one of the base maps used in the Intrawork, it can be browsed from the tool available in the model builder. As this does not contain any birds eye's view of the data, a very accurate building footprint will be obtained. Importing imagery on the terrain gives a realistic visualization of the surface. Also, the contour interval discriminates the vertical positioning of the objects or terrain features which can be visualized in the birds eye's view of the terrain.

Another possible visualization is done with the habitat of the Paralakhemundi town, this is essential when we need to understand the boundary outline of the present features.



Road Network of Paralakhemundii Infrawork

Show delineate habitation boundary of the Paralakhemundi Town



6.1. Road and Building Layout: -

Road designing at first requires the study of the nature of the surrounding area to choose the type of road for the area. Different types of road options present are a null road, paved road, rock road, sidewalk etc. After a section of the road type area on which the road to be made is selected. Then hit enter road pattern is created.

A road can be selected, and all its properties can be referred to. The properties include its geometry, orientation, road type, length, width elevation from reference point etc. Further, it can be edited by adding curves where necessary. This can be done by adding PVI points and adjusting it accordingly to get the desired curve.

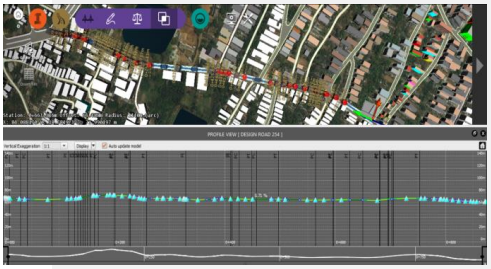
This preview represents the profile view of the selected road network. The x-axis of this graph represents the horizontal distance whereas the y-axis of the graph represents the elevation from the reference point. This profile view is used to check the road and to level the pavement design to maintain the slope and uniformity of the road. Necessary adjustments in the curve can be made by adding PVI points wherever required.

To access this option the user needs to:

i. Select the desired road.
ii. Right click on the road option
iii. Toolbox appears containing the option Road Profile view.
iv. Select the option and start editing

Road Pavement Design in Infrawork

Vertical curve showing Grade In/Out



The pavement design and the road surface were levelled to provide a continuous and uniform slope road. This preview represents the corrected road profile of the design road.
The following are the types of road in the Paralakhemundi Town.

- Road Type: City Highway/StateHighway; design Speed: 60km/hr; Width: 30 feet; Design Standard AASTHO_Metric_2011.
- Road Type: Street/Interstate; Design Speed: 45km/hr; Width: 22 feet; Design Standard AASTHO_Metric_2011.
- Road Type: Street/Interstate; Design Speed: 30km/hr; Width: 12 feet; Design Standard AASTHO_Metric_2011.

With Roadway Design for InfraWorks, we are dealing with design roads which use alignments and profiles rather than the mysterious, but easy-to-use spline-based sketch roads of InfraWorks core. We can also view our road design in profile view and make edits there too. Design roads have zones that change up the number of lanes and the style. Another capability of design roads is that the tie-in slopes can be built according to a constant slope rather than a constant offset. Roadway Design for InfraWorks also performs complex intersection design with more control over design geometry, ability to add turning lanes, and much more. Roadway Design for InfraWorks also has two powerful optimization and analysis tools. The first is Profile Optimization which will upload our current design to the cloud, optimize it based on cut and fill as well as other parameters you can define, and then send us back a better design which is more cost effective.

In the above preview the following design standard were adopted: - Elevation: 58.771 (MSL); Station Point: 1514.226m; Grad In: -4.14% Grade Out: 5.53%; Radius: 21.1m

6.2. Bridge:- The preview represents a concrete bridge designed to cross a water body (a river in this case). The bridge is formed by placing Pile foundation and laying girder above it. The foundation supports the bridge and keeps it intact. This option can be found in the bridge design toolbar indicated by purple colour.

Shows Create Drainage Network

3D Modelling of Bridge Feature

Here the user is given the option to select the type of material which he/ she shall use for the design purpose. Different materials are used depending on the nature of work. The material used here is concrete. After placing the concrete, the software allows running an analysis check on the design. Here the girder is selected indicated by a blue highlight and then the analysis is performed.

Here it can be seen that out of 36 girders that were analysed only 20were able to satisfy the design requirement. Hence it helps the user to check for problems in the design and rectify it.

After running the analysis for the particular bridge and checking all its components the foundations were levelled with respect to the ground surface

Intersection Point.

6.3. Drainage:- Drainage option can be found in the green colour toolbar as shown above. Here one can create the drainage pattern keeping in mind the nature of the terrain. In the above figure after the drainage option is selected, It displays the options which the user can set according to requirements. Each individual component can be edited such as type, size of the inlet can be changed. Manholes can also be edited by defining the required size and type.

Pipelines can also be edited where the type of pipeline (concrete or steel or any other material) to be set is specified along with its other characteristics such as size, slope, material.

In this preview, it is seen that the type of manhole to be laid is selected. Several options can be seen, and the user needs to choose from these seeing the nature of the work. This selection is done manually. Somewhere it has been taken as a flat manhole for roads with no slope. For roads having slope the manhole

selected is somewhat sloping to properly align it to the level of the road surface.

3D modelling of Drainage Network Infrawork

Intersection point Infrawork

This preview shows the planning of the location of the drainage to be laid. Firstly the road for which drainage to be generated is selected. Having selected the road now it is necessary to get the high and low elevation points which would help understand the water flow in an area.

This can be done by following the procedure:

 First, select the road then go to drainage networks. Then select a starting point of the drainage

 Then right click on the mouse. Right clicking would enable us to access the toolbar with different options.

Here we must click on Show high and low-end points and the points with elevation will be shown.

Marking these points now we must lay the drainage in the selected area along a certain length as shown. Following these steps, the drainage pattern for a particular road of interest can be generated. After this, the manhole and the pipeline (inlet and outlet) is placed accordingly. After its generation, it is checked against any problems or issues that could arise in the future.

6.4 City Features: -

In this preview shows the different city features which can be added to the smart city to make people's life easier. Some of these features include

 Street lamp Trash bin Water tower. Traffic Signals Street grate Streetlight

Using these options, one can place the components according to his/her requirement and also edit the features in times necessary.

This preview shows the traffic signals and the street lights placed on the side of the road. Traffic signals are an important part of smart city planning which helps reduce traffic issues arising in the town area.

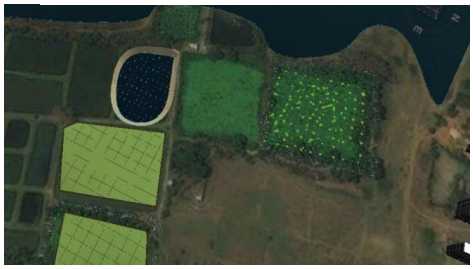
At first, the user needs to mark the area. Having done this one can go to the city feature options and select the desired street light or traffic signal and can place accordingly.

This screenshot tells us the process of generating a desired type of vegetation in a area. The steps are:

I. Selecting the area where the vegetation is to be generated.

II. Selecting the type of vegetation to be generated among different options such as South Carolina Palmtree, Small shrubs, small hedge etc.

III. Size and shape of the generated feature can be edited by selecting the area and right-clicking on it referring to its properties.



3D Model of vegetation features in Infrawork

3D Buildings in Infrawork

It shows the combination of different vegetation combine together in an area to beautify the area and surrounding. This preview tells us about the different city features that can be used to make the free space in a region useful for recreational purposes for the people in the city.

The light green area in the preview represents the agricultural area suitable for growing different crops.

The blue patch in the preview indicates the water body such as a small pond in this case.

Water from this pond area can be taken to irrigate the fields and it will be less costly as it saves the cost of transporting water through distances.

6.5. Building:-

With building design for Infraworks, we can generate different types of building according to the user needs. The building type for a area is selected seeing and observing the terrain conditions. Different editing features such as changing the roof pattern, wall colour, base colour height of the building one can generate the exact look-alike of the original model. In this, after creating the building its lifespan and other detail can be referred for further study. Knowing this was created buildings in different parts of the town. This took time as I had to focus on each building about their location and their type and to plan the pattern for it to be economical.

The building footage was imported from OpenStreetMap, and the height of the building was collected manually by storey count survey. There are total 15700 houses and most of them are of the 1^{st} storey or 2^{nd} storey tall. The tallest building has a height of 16m up to 5^{th} storey tall. The building is very densely situated in most of the cases there is no open space between two building. The Heritages like Gajapati Palace and BN palace are the pinpoint to attract the tourist. The preview shows the building footage of the town with the height, this is an aerial view of the town.

7.1. SIMULATION:

Shadow Simulation; Analysing daylight conditions: - This methodology is intended for urban areas under development, as the final aim is to create possible areas for future urban densification based on the generation of urban open spaces with lighting condition that enhance pedestrian outdoor comfort.

The different procedures explored for the 'inverted' approach method are based on generative and parametric modelling techniques that allow the systematic creation of new urban forms according to different solar access and urban boundaries criteria. According to these criteria, the method is divided into three consecutive parts;

(i) delimitation of the development areas,

(ii) shadow range generation, and

(iii) selection of recreational urban areas. In the end, areas for future building densification are created and extruded in order to generate the final building envelopes (possible volumes for building densification).

Bird's-eye View of Paralakhemundi Town

Aerial view of the town

In this study our objective is to understand daylight conditions in dense urban area and provide them with a tool for designing better, more sustainable buildings and urban spaces also to illustrate the impact of development in terms of sun and daylight access to the surrounding context including surrounding buildings, the public realm, public and private open space.

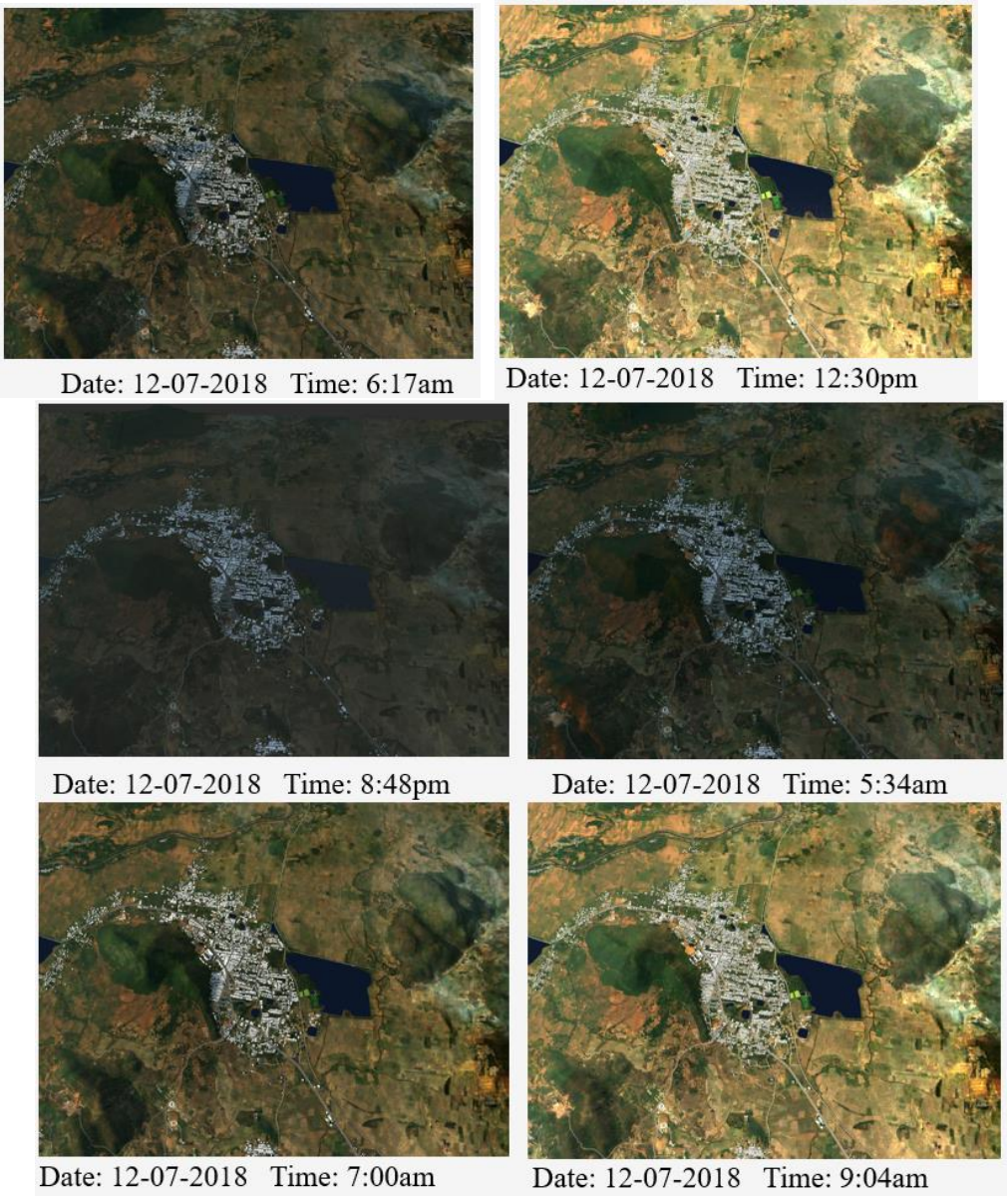


Fig show different lighting condition for a complete day

Paralakhemundi is the old town, most of the buildings are more than 50yr old, and the majority of the building is 1st and the 2nd storey only which cast very less shadow. Whereas the town is consistently dense and unplanned. The tallest building in the town having the 5th storey. The town is situated beside a hill therefore, it has considerably less

lighting than an open space to the sky. Also, the city got two attractive heritages: - 1. BN Palace & 2. Gajapati Palace

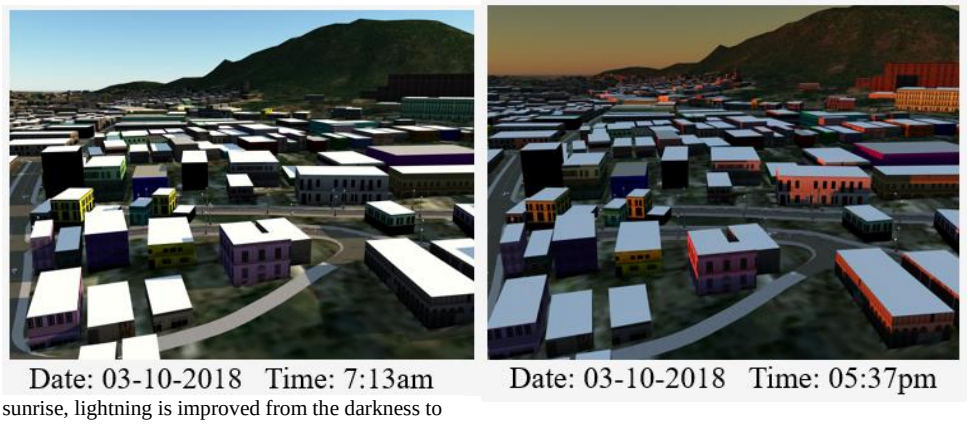
Infra work Support allows the user to perform visualize Sun, sky and Shadow.

Shadow casting of an object can be generated by selecting a particular date and time.

This preview represents the aerial view of the town dated July 12, 2018, at 8:48 pm. Here we can clearly see the building and other feature of the town.

7.2. Visualization in different Lighting Conditions- Aerial view of the town.

In the below figure we can see the adjustment of the shadow from one place to another with the time variant, also the intensity of the light has different throughout the day. It has been observed that 12:30 pm noon the intensity of light in the town is very high, whereas during 8:30 pm complete darkness occurs. during 5:30 am just before the



sunrise, lightning is improved from the darkness to brighter. The area beside of the hill covered under darkness before the sunset, as the height of the hill is 290m approximately it generates a huge shadow near the town during sunset, hence the area is affected in darkness. The area underhill is in lighting during sunrise. The town is complete darkness after 8:30 pm.

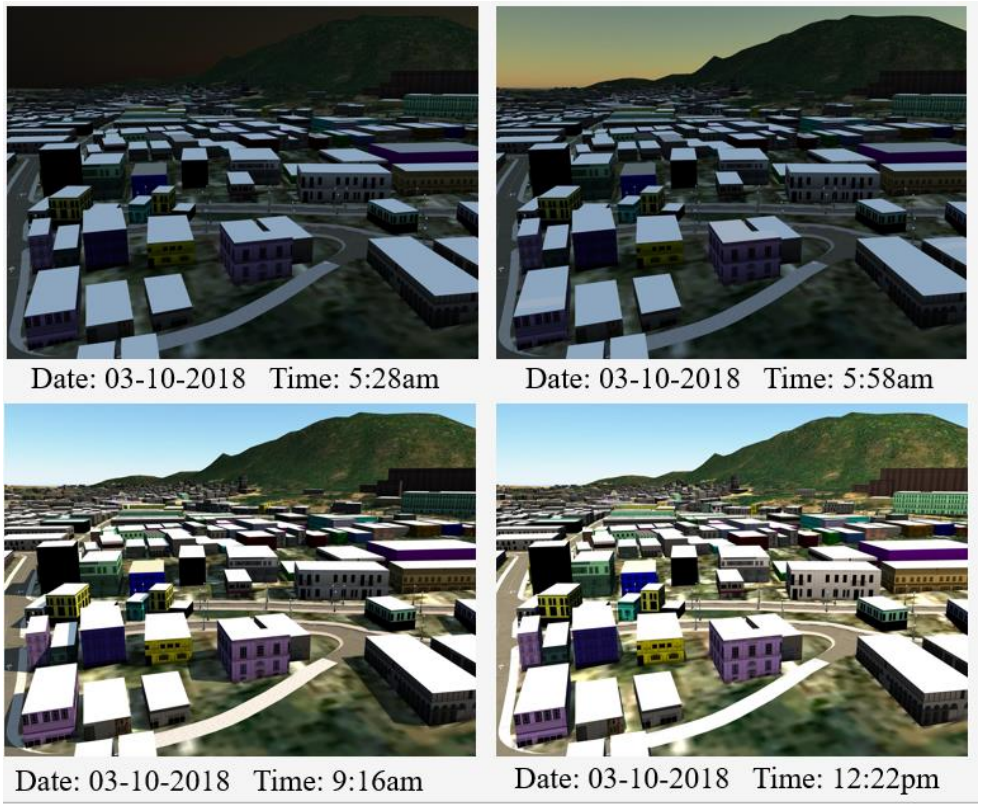
Note: The lightning in the city is an only propositional variant of time, date and climate, as the sun is the only source of light, during raining days the city comes under the cloud's shadow which is the major cause of the city.

bSome of the picturesque moment of the city is being shown in the below picture.

Evening Scenario of Sunset near Palace Street Paralakhemundi. Shadow of one building is being cast on another.

7.3. Different Shadow Caste with time valiant– Near College Chowk Paralakhemundi.

As a result, building envelopes are created from shadow analyses to explore possible directions for climate-sensitive



Shadow Simulation- Areal View

urban growth. This method can work as a process for the open urban visibilities as the final urban envelopes from the 'inverted' approach can be used for the process of controlling solar access for buildings. In this way, not only the urban spaces but also indoor spaces can benefit from solar access. Eventually, this method can contribute to urban planning practices as a decision-support tool for the construction of climate-sensitive urban forms.

8.1. CONLUSION:-

bad quality of infra-works impedes economic growth, keeping in mind to stimulate growth and reduce poverty, it is essential to enhance the supply, quality, and affordability of infrastructure services.

We remodel the city with the placement of a flyover; earlier there was huge traffic problem with this structure people can travel rapidly. “Effective modes of transport, including quality roads, railroads, ports, and air transport, enable firms to get their goods and services to market in a secure and timely manner and to give accessibility to the movement of workers to the most appropriate jobs”.

More people are now living in urban areas than the country for the first time and us need to build several new cities in the next 30 years. This put immense pressure on all areas of daily life: water, air, food, energy, space, and safety. 3D models are the 1st steps toward fulfilment of smart cities; if we imagine, simulate; experience cities for the people then we can create lively, safe, sustainable, and healthy cities.

It has been understood now Paralakhemundi City got very limited space for urban development, most of the resources in the city are sustainable, Urban development is feasible with the maturation of the city fighter in North or in South, whereas tall structures can be planned with the replacement of existing building.

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