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A SMART CITY INFRASTRUCTURE PLANNING BY USING NAVISWORKS AND CIVIL 3D. A CASE STUDY ON DHOLERA SMART CITY, GUJARAT.

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Abstract

Introduction: The Dholera Smart City project, located in Gujarat, India, exemplifies a pioneering approach to urban development, aiming to create a sustainable and technologically advanced urban environment. This case study explores the conceptualization, planning, and implementation of Dholera as a smart city, focusing on its innovative infrastructure, integrated technology, and sustainable practices. By analyzing the key components such as transportation systems, energy management, water supply, and waste management, this study highlights how Dholera aims to enhance the quality of life for its residents while promoting economic growth.

Methods: While planning the smart is by using smart knowledge as well as technology there are several tools and method engineer use such as we use Autodesk Civil 3D, Navisworks as well as Infraworks. Autodesk Civil 3D we used for Developing Land as well as Modelling the project such as Pipe Network, Pressure Network, Proposed Ground surface, existing ground. Sometime we need to create the cut fill report. Infraworks used for assigning the coverage as well as for Road furniture and city furniture. Navisworks Is used for animation as well as 4d simulation and utilities clash detection.

Results: The project manager or stakeholders, clients will get to know How the project will look like. It can easy to detect the utility clashes, engineer can analysis the cut fill quantity of surface. So that it will help to reduce the time and cost and easy to observe each activity which will go on site. Repetitive work can be eliminated and try to find best option to achieve the quality goal.

Conclusions: The Dholera Smart City project represents a significant step forward in urban development, showcasing a comprehensive approach that integrates advanced technologies, sustainable practices, and community engagement.

Keywords: Smart City, Land Development, Civil 3D, Navisworks.

Introduction

The Dholera Smart City project represents a transformative initiative aimed at addressing the rapid urbanization challenges faced by cities in India. Located approximately 100 kilo meters from Ahmedabad in Gujarat, Dholera is envisioned as a model for smart urban development, integrating cutting-edge technologies with sustainable practices to create a liveable and efficient urban environment. India is experiencing unprecedented urban growth, with projections indicating that nearly 600 million people will reside in urban areas by 2031.

This rapid influx has strained existing infrastructure, leading to issues such as overcrowding, inadequate services, and environmental degradation. In response to these challenges, the Government of India has launched the Smart Cities Mission, aimed at promoting sustainable and inclusive urbanization across the country.

Dholera stands out as one of the first greenfield smart cities in India, designed from the ground up to incorporate advanced urban planning principles. The project emphasizes a holistic approach, combining smart infrastructure, efficient public services, and community engagement to create a vibrant urban ecosystem. Key features of Dholera include smart mobility solutions, integrated waste management systems, renewable energy initiatives, and extensive green spaces, all aimed at enhancing the quality of life for residents. This case study aims to provide an in-depth analysis of the Dholera Smart City project, examining its vision, planning processes, and implementation strategies. By exploring the successes and challenges encountered during its development, this study seeks to offer valuable insights into the potential of smart cities in reshaping urban landscapes in India and globally. Through this analysis, we aim to understand how Dholera can serve as a blueprint for future urban

development, contributing to sustainable and resilient cities that can accommodate the needs of growing populations. The concept of Smart Cities is rapidly gaining traction worldwide, driven by the need to address urbanization challenges such as overcrowding, infrastructure inefficiency, pollution, and lack of sustainable growth. A Smart City integrates information and communication technologies (ICT) to enhance the quality of life for citizens, improve efficiency in urban services, and reduce the ecological footprint.

One of the key aspects of Smart City development is the meticulous planning and design of infrastructure. To ensure the efficient execution of these large-scale urban development projects, advanced design and simulation tools are indispensable. Among these tools, Navisworks and Civil 3D are emerging as vital resources for architects, engineers, and planners in the smart city ecosystem.

This case study explores the use of these tools in the infrastructure planning of Dholera Smart City in Gujarat, India. Dholera is envisioned to be a futuristic city, serving as a model for urban transformation in India, where high-tech infrastructure, sustainability, and smart technologies are integrated into the city planning process. This study examines how Navisworks and Civil 3D are utilized to design, simulate, and optimize the city's infrastructure.

- Navisworks is used primarily for project visualization, allowing the integration of various design models (architectural, structural, MEP, etc.) into a unified 3D environment. It provides a platform for detecting clashes, enhancing coordination among multiple teams, and simulating real-world scenarios.
- Civil 3D plays a crucial role in site development, especially in designing the terrain, roads, drainage systems, and utilities. With its robust tools for land grading, corridor modeling, and stormwater management, Civil 3D aids in ensuring that the city's infrastructure meets the needs of a rapidly growing urban population.

The use of these technologies is transforming how urban planners and engineers approach the design and construction of smart cities, reducing errors, optimizing resources, and ultimately creating sustainable, livable urban spaces. Through this case study, we will analyze the role of these tools in the development of Dholera Smart City, shedding light on the technological innovations that contribute to efficient and intelligent urban planning.

Literature

The concept of Smart city is essential now a days so that all the activities of construction can be planned. It can helpful to achieve the quality of project. It also helps to planning the resource allocation as per their skills sets. According to [3] Joshi Sujata, Saxena Saksham, Godbole Tanvi, Shreya as urban populations grow, cities face unprecedented challenges like pollution, resource scarcity, and traffic congestion. These issues, coupled with economic, political, and technological demands, require urgent action to ensure sustainable development. Smart city initiatives, leveraging technology, can optimize resource use and address these challenges. Key factors, often summarized as SMELTS (Social, Mobility, Environment, Learning, Technology, Security), are critical to understanding and managing urban growth. Swift adoption of smart solutions is essential for sustainable urban development and improving quality of life. According to Ashish Gupta and Piyush Tiwari [4] in India each state has different rules and regulation to develop the land. Each department has different laws. Thera are so many main objectives such as land assembly, recovering the cost of infrastructure or servicing the land, to capture unearned increment in land value etc. According to Hemant Chakole and Dr. Prafull J. Wadhai [5] Civil 3D software plays important role to design road, Highways as per IRC Standard as well as AASHTO Standard. The safety as well as design criteria can be achieved or maintain in minor level. It will reduce the time and reduce unnecessary cost of the project. Highways should ensure user comfort and safety, efficient traffic flow, low construction and maintenance costs, minimal environmental impact, and aesthetic appeal. Geometric design addresses these needs by optimizing road operation and safety while considering social and environmental factors. According to Raveena Marasinghe, Tan Yigitcanlar, Severine Mayere, Tracy Washington, Mark Limb [6] AI, particularly

computer vision (CV), is increasingly applied in urban planning to enhance analysis, predictive modelling, stakeholder engagement, and planning processes. CV helps urban planners analyse large datasets, make informed predictions, automate design, and improve monitoring and evaluation. This paper uses a systematic literature review following the PRISMA protocol to explore CV's role in urban planning. Computer vision (CV), a key aspect of AI, offers valuable tools for urban planning, yet its applications in this field remain underexplored. This paper reviews the use of CV in urban planning, highlighting its potential and the challenges urban planners face in adopting it. The findings show that CV can support tasks such as data collection, issue prioritization, public participation, and plan evaluation. While CV enhances decision-making with visual data, its limitations must be considered. The use of CV also aids in sustainable urban development. This study provides insights into CV's contributions, its transformative role in planning, and the challenges of its adoption.

Theory

Components of the Dholera Smart City

The Dholera Smart City project encompasses several key components that collectively contribute to its vision of a sustainable, efficient, and technologically advanced urban environment. Below are the main components of the case study:

Urban Infrastructure

✓ Road Network: A well-planned road network, including arterial roads, expressways, and internal roads that facilitate smooth traffic flow and connectivity. Intelligent Traffic Management Systems (ITMS) will be implemented to manage traffic congestion.

✓ Public Transport System: A robust and eco-friendly public transport system, including metro lines, buses, and other electric vehicles, aims to reduce reliance on private cars, reduce pollution, and provide affordable mobility.

✓ Water Supply & Distribution: A comprehensive water supply network with a focus on ensuring clean and sustainable water access. The city will incorporate advanced water treatment, recycling, and distribution systems, ensuring equitable access for all citizens.

✓ Waste Management: A smart waste management system that incorporates waste segregation, recycling, and composting technologies. Smart bins and waste collection systems will use sensors to optimize waste collection routes and reduce environmental impact.

✓ Stormwater Management: An integrated drainage and stormwater management system designed to prevent flooding and ensure the city's resilience during monsoon seasons.

Energy & Sustainability

✓ Renewable Energy: Dholera Smart City will prioritize renewable energy sources such as solar power, wind energy, and biomass to reduce dependency on fossil fuels and minimize its carbon footprint. Solar rooftops, wind turbines, and energy-efficient buildings will be widespread.

✓ Smart Grids and Energy Management: The city will deploy smart grids to optimize energy distribution, reduce transmission losses, and provide real-time monitoring of energy usage. Smart meters and sensors will allow consumers to track energy consumption and reduce waste.

✓ Energy-Efficient Buildings: Buildings in Dholera will be designed with energy-efficient standards, including better insulation, efficient HVAC systems, and the use of sustainable materials, contributing to the overall reduction of energy consumption.

Information and Communication Technology (ICT)

✓ Smart Infrastructure: Dholera will implement Internet of Things (IoT) technology for real-time monitoring and management of various systems, including traffic, utilities, waste management, and security.

✓ Data Centres and Cloud Services: Centralized data centres will host the city's data, providing critical infrastructure for smart services such as traffic control, energy management, public safety, and more.

✓ High-Speed Internet and Connectivity: A high-speed broadband network will connect homes, businesses, and public spaces, ensuring that residents have access to the best internet services for work, entertainment, and communication.

Healthcare & Education

✓ Healthcare Facilities: Dholera Smart City will feature state-of-the-art healthcare facilities, including hospitals, medical centres, and telemedicine services. Healthcare will be powered by telecommunication technologies and integrated health management systems.

✓ Educational Institutions: The city will host schools, colleges, and research institutions equipped with modern educational infrastructure. E-learning platforms, smart classrooms, and online educational resources will ensure quality education for all.

Housing & Commercial Spaces

✓ Affordable Housing: Dholera will provide affordable, well-planned housing that accommodates a growing urban population. The city will feature mixed-use developments, including residential, commercial, and recreational spaces.

✓ Commercial Zones: Well-defined commercial zones with offices, retail outlets, and service businesses will foster entrepreneurship, innovation, and employment opportunities. These zones will benefit from the city's advanced infrastructure and connectivity.

✓ Green Buildings and Public Spaces: The city will prioritize the creation of green spaces, parks, and recreational areas, as well as eco-friendly public buildings, promoting sustainability and a high quality of life.

Safety and Security

✓ Smart Surveillance: Dholera will integrate surveillance systems, including CCTV cameras and drones, monitored by central control rooms, to enhance public safety and provide real-time security.

✓ Emergency Services: The city will be equipped with smart emergency services, including fire departments, police, and ambulance services, linked through a unified platform for quick response times.

✓ Disaster Management: Advanced disaster management systems will be implemented to predict, monitor, and respond to natural and man-made disasters, ensuring the safety of residents.

Smart Governance and Citizen Services

✓ E-Governance: Dholera will implement e-governance platforms to provide seamless government services to citizens. This includes online applications, digital payments, and access to government information.

✓ Citizen Engagement: A robust citizen engagement platform will enable residents to communicate with authorities, participate in decision-making processes, and provide feedback on various city services.

✓ Smart Policing: Use of technologies like facial recognition and AI-based analytics will aid law enforcement in maintaining law and order efficiently.

Transport & Mobility

✓ Smart Parking: Automated and sensor-based smart parking systems will optimize parking spaces and reduce congestion. Real-time data on available parking spots will be shared with users through mobile apps.

✓ Electric Vehicles (EV) Infrastructure: The city will have an extensive network of EV charging stations, encouraging the adoption of electric vehicles as part of a sustainable transportation solution.

✓ Pedestrian and Cycling Infrastructure: Pedestrian-friendly pathways and dedicated cycling tracks will promote non-motorized transportation, contributing to better health and a cleaner environment.

Smart Water Management

✓ Water Conservation Technologies: The city will use cutting-edge technology for water conservation, including rainwater harvesting, wastewater treatment, and water recycling, to ensure a sustainable and reliable water supply.

Smart Environment

✓ Air Quality Monitoring: Dholera will be equipped with smart air quality monitoring systems to track pollution levels and take corrective actions when required.

✓ Urban Farming and Green Initiatives: Urban farming initiatives will encourage local food production, while green roofs, vertical gardens, and eco-friendly waste processing methods will be incorporated into the city's design.

Urban Planning and Design

✓ **Land Use**: Mixed-use zoning to integrate residential, commercial, and recreational spaces.

✓ **Smart Infrastructure**: Development of roads, public transportation, and utilities designed for optimal efficiency and accessibility.

Transportation and Mobility

✓ **Smart Transport Systems**: Implementation of intelligent traffic management systems, public transit options, and non-motorized transport facilities (bicycle lanes, pedestrian pathways).

✓ **Connectivity**: Integration with major transportation networks, including highways and airports.

Energy Management

✓ **Renewable Energy**: Emphasis on solar power and other renewable energy sources to reduce dependency on fossil fuels.

✓ **Smart Grids**: Implementation of smart grid technology for efficient energy distribution and management.

Water Management

✓ **Sustainable Water Supply**: Development of efficient water supply systems, rainwater harvesting, and water recycling facilities.

✓ **Wastewater Management**: Advanced treatment and reuse of wastewater to ensure sustainability.

Waste Management

✓ **Integrated Waste Management Systems**: Implementation of waste segregation, recycling programs, and composting facilities to minimize landfill use.

✓ **Smart Bins**: Deployment of smart bins that monitor waste levels and optimize collection routes.

Public Safety and Security

✓ **Smart Surveillance**: Use of CCTV and other monitoring systems to enhance safety in public spaces.

✓ **Emergency Response Systems**: Integration of technology for efficient emergency management and response.

Sustainability Initiatives

✓ **Green Spaces**: Creation of parks, gardens, and open spaces to promote biodiversity and improve air quality.

✓ **Eco-friendly Construction**: Adoption of sustainable building practices and materials in all development projects.

Community Engagement

✓ **Stakeholder Involvement**: Active participation of local communities, businesses, and government bodies in the planning and implementation process.

✓ **Education and Awareness**: Programs aimed at educating residents about sustainability practices and smart city initiatives.

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Fig. 1

Town Planning:

1. Transportation
2. Public Services and Utilities
3. Zoning
4. Land Use

Town planning, also known as urban planning, is the process of designing and organizing the layout of towns or cities. It involves developing strategies for land use, infrastructure, transportation, housing, and public spaces, all while considering the environmental, social, and economic impacts of those decisions. The goal is to create functional, sustainable, and livable urban environments that support the needs of residents, businesses, and the community.

Vehicle Tracking:

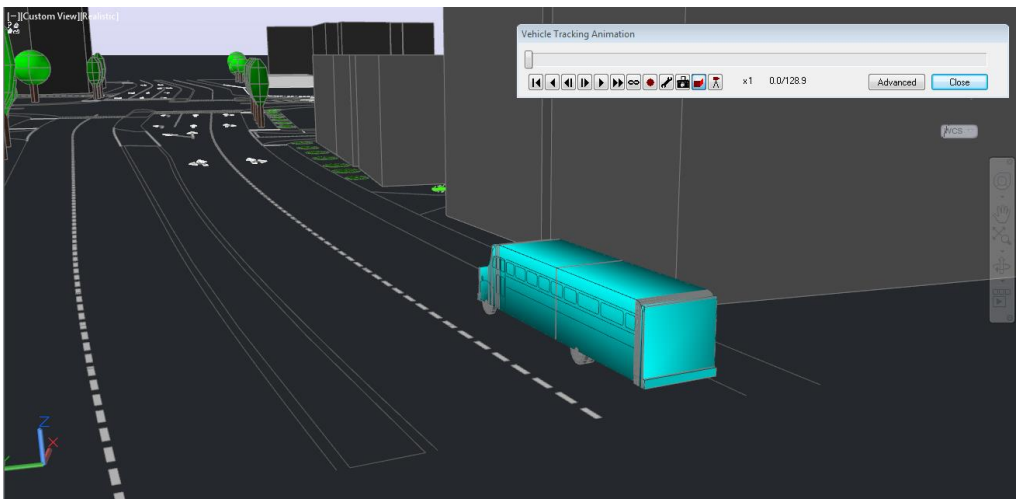
1. It helps to create Parking Layout.
2. It helps to create Intersection/Roundabout Layout.
3. Swept Path Analysis can be done.
4. It also helps to analysis Vertical clearance path.

Land development Benefits:

Efficient Design: Automates tasks like grading and pipe design.

- **Accurate Analysis**: Provides precise volume, drainage, and utility calculations.
- **Collaborative**: Easy sharing and coordination with stakeholders.
- **Visualization**: 3D modelling helps present and refine design concepts.

Fig. 2



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- **Visualization**: 3D modelling helps present and refine design concepts.

Sustainable Urban Development

- **Objective:** To develop a city that is environmentally sustainable and reduces the ecological footprint.
- **Action:** Dholera Smart City will incorporate green building standards, renewable energy systems (solar, wind), water recycling, and waste management solutions to ensure minimal environmental impact.

Economic Growth and Job Creation

- **Objective:** To create a thriving economic environment that encourages entrepreneurship and attracts investment.
- **Action:** The development of mixed-use commercial zones, industrial parks, and business incubators will foster innovation and job creation. Dholera is expected to become an economic hub with a focus on high-tech industries, manufacturing, and services.

Improved Quality of Life for Residents

- **Objective:** To enhance the standard of living for residents through the provision of modern amenities and services.
- **Action:** The city will offer quality housing, healthcare, education, transportation, public spaces, and recreational facilities, ensuring a high quality of life for its citizens.

Smart Governance and Citizen Engagement

- **Objective:** To implement efficient governance systems that are transparent, responsive, and citizen-centric.
- **Action:** Dholera will employ e-governance platforms, allowing citizens to access services online, participate in decision-making, and engage directly with authorities. Smart citizen engagement tools will also be used for feedback and suggestions.

Safety and Security

- **Objective:** To ensure a safe and secure environment for all residents and businesses.
- **Action:** The city will deploy smart surveillance systems, real-time crime monitoring.

Fig. 3

Fig. 4

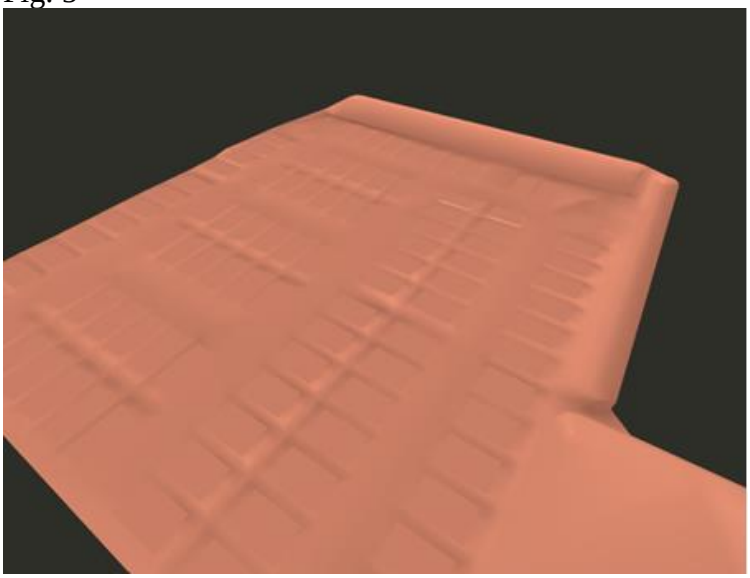
LAND DEVELOPMENT AND MODELLING BY USING CIVIL 3D AND NAVISWORKS

Autodesk Civil 3D: Autodesk Civil 3D is a civil engineering design and documentation software developed by Autodesk. It is primarily used for civil infrastructure projects, such as road design, land development, and site grading. Civil 3D integrates both 3D modelling and 2D drafting tools, enabling civil engineers to design, analyse, and visualize projects with a high level of precision.

Key Features of Autodesk Civil 3D -

1. Surface Modelling
2. Corridor Modelling
3. Alignments and Profiles
4. Grading and Earthworks
5. Pipe and Pressure network.

Fig. 5

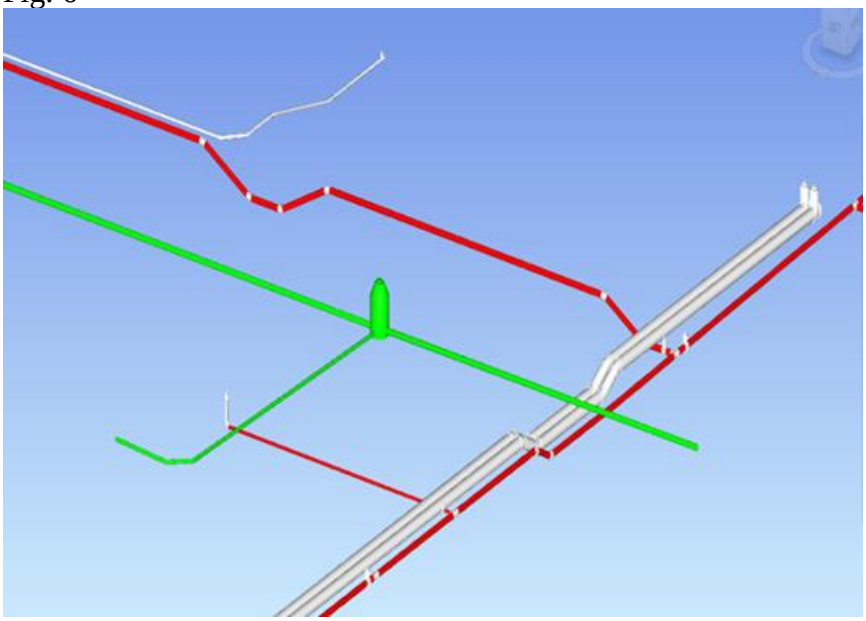


Navisworks: Navisworks is a comprehensive project review software developed by Autodesk, primarily used for **3D model visualization**, **coordination**, and **simulation** in the fields of architecture, engineering, and construction (AEC). It allows project teams to integrate various 3D models and data from different disciplines, identify potential conflicts, and simulate the construction process to improve project planning and execution.

Key Features of Navisworks -

1. Model Aggregation and Coordination.
2. Clash Detection.
3. 3D Model Navigation.
4. Collaboration and Markups.
5. Animation and Presentation

Fig. 6



Conclusions

The Dholera Smart City project represents a significant step forward in urban development, showcasing a comprehensive approach that integrates advanced technologies, sustainable practices, and community engagement. As one of India's first greenfield smart cities, Dholera is designed to address the multifaceted challenges of urbanization, aiming to create a livable, efficient, and resilient urban environment.

Through its innovative planning and infrastructure development, Dholera aims to improve quality of life for residents while fostering economic growth. The integration of smart technologies, such as IoT and data analytics, enhances service delivery and governance, enabling real-time monitoring and responsiveness to community needs. Sustainable practices in energy, water management, and waste disposal contribute to environmental preservation, making Dholera a model for future urban developments.

However, the project also faces challenges, including land acquisition, financing, and stakeholder collaboration. Addressing these issues requires ongoing commitment from government authorities, private investors, and the community to ensure successful implementation and realization of the city's vision.

Overall, the Dholera Smart City case study provides valuable insights into the potential of smart cities to transform urban living. By highlighting both the achievements and obstacles encountered, this project serves as a blueprint for other cities in India and worldwide, emphasizing the importance of integrated planning, technological innovation, and community involvement in building sustainable urban futures.

The Dholera Smart City project exemplifies a pioneering approach to urban development, integrating advanced technologies and sustainable practices to create an efficient and liveable environment. As one of India's first greenfield smart cities, it addresses the challenges of rapid urbanization through smart infrastructure, sustainable resource management, and enhanced governance.

Dholera's focus on IoT, renewable energy, and community engagement promotes not only economic growth but also environmental sustainability. However, challenges such as land acquisition and financing must be navigated to ensure successful implementation.
Ultimately, the Dholera case study serves as a valuable model for future smart city initiatives, illustrating the potential for technology-driven solutions to foster sustainable and resilient urban living.

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