"A REVIEW ON APPLICATION OF COMPUTER SOFTWARES IN CIVIL ENGINEERING"

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***Abstract*— The evolution of computer technology encourages the engineering sector's change. People eventually come to appreciate how convenient computers are. The primary area of expertise for construction engineers is civil engineering. Numerous engineering disciplines are included in civil engineering. Numerous issues in civil engineering have been resolved as a result of the development of computer software. Many pieces of computer software have been created by experts . This paper explores the diverse applications of computer software in civil engineering, including its use in design, analysis, simulation, and project management. The review examines how software technology has revolutionized civil engineering practices by enabling engineers to accomplish tasks with greater speed, accuracy, and efficiency. The paper discusses various software tools used in the industry, including Building Information Modeling (BIM), Computer-Aided Design (CAD), Finite Element Analysis (FEA), and Geographic Information Systems (GIS). The review also highlights the benefits and challenges of using software in civil engineering, such as the need for specialized training, software compatibility issues, and potential errors in data input. In conclusion, this paper demonstrates the significant role that computer software plays in the field of civil engineering and the need for continued research and development to maximize its potential for future applications.**

***Keywords*— Computer Software, Technology , Civil Engineering , Development , Potential , BIM , FEA , CAD**

I. INTRODUCTION

Civil engineering involves the design, construction, and maintenance of infrastructure that supports modern society. Computer software has evolved into a crucial tool for civil engineers due to the complexity of these projects and the desire for more effective and affordable solutions. To increase accuracy, efficiency, and work speed, this software technology is applied to a variety of civil engineering tasks including design, analysis, simulation, and project management.

An easy way to comply with IJRASET paper formatting requirements is to use this document as a template and simply type your text into it. Computer software has enabled civil engineers to visualize, simulate, and test designs before construction, reducing the risk of errors and minimizing costs. It has also enabled engineers to analyze complex structures and systems, such as bridges, dams, and buildings, with greater accuracy and precision. Moreover, software tools such as Building Information Modeling (BIM) have facilitated collaboration among project stakeholders, resulting in more streamlined and efficient construction processes. Despite its many advantages, the use of software in civil engineering also presents challenges. For example, engineers require specialized training to use software tools effectively, and compatibility issues between different software programs can arise, leading to data transfer errors. Moreover, the quality of the input data can affect the accuracy of the output, and software errors can occur, leading to potential safety hazards. This paper aims to review the applications of computer software in civil engineering, examining the benefits and limitations of software technology and exploring the latest developments and trends in the field. The review will provide insights into the potential of computer software in civil engineering and its impact .

A. REVIEW OF PAPERS

1. Soil-structure interaction using BEM–FEM coupling through ANSYS software package

G. Vasilev et.al(2014) - This work develops, verifies and applies an efficient hybrid approach to study seismic response of a soil-structure system. It is based on the boundary element method (BEM1) and finite element method (FEM2). The hybrid numerical scheme is realized via the substructure approach, direct BEM1, conventional FEM2 and insertion of the BEM1 model of the seismically active far-field geological media as a macro-finite element (MFE3) in the FEM2 commercial program ANSYS.With the development of contemporary computer technology, numerical approaches such as the boundary integral equation method, the finite element method, and the finite difference method are now commonly utilised and are ideal for examining complicated structures including sedimentary basins, layered media, and layered media with a complex topography.

Layers with arbitrary shapes, inhomogeneous media containing inclusions, etc Often these approaches need a lot more CPU and memory.Using the direct time-domain approach or the transformed-domain method is the foundation for BEM-based formulations that employ elastodynamic fundamental solutions. By performing a Fourier, Laplace, or other integral transform with respect to the time variable in the latter scenario, temporal dependency is eliminated.

2. Seismic Response Analysis of Tower Crane Using SAP2000

Huang Li-Jeng et.al(2014) This study employs SAP2000 to simulate the seismic response of a conventional tower crane frame. The numerical model is constructed using three-dimensional beam elements and bar elements for the vertical, horizontal, and tie rod frames, respectively. The 1940 NS component of the El Centro earthquake and the 1995 Kobe accelerations are two different types of earthquake ground accelerations that are tested. According to the results of the numerical simulation, the tower crane's topmost position can experience maximum displacements of over one metre and related maximum velocities and accelerations of more than four metres per second and forty metres per second, respectivelyIn civil engineering, tower cranes are used to construct high-rise buildings, and just like the main objective structure, their structural stability and safety are crucial. The static, stability, and dynamic behaviours of the tower crane for high-rise buildings have been the subject of preliminary investigations. Tower crane-related disasters have happened in Taiwan and other nations as a result of earthquake shaking-down, member fracture, and flexural collapse

3. Features of BIM Implementation Using Autodesk Software

Alexander Vysotskiy et.al(2015) - Today, all businesses are gradually converting to BIM technology. It expedites work and increases the effectiveness of designers' efforts. Sadly, it is not so simple. The purpose of this paper is to give professionals who are switching to BIM technology the necessary practical advice.BIM technology is gaining popularity, speeding up work and improving designers' efficiency. Correct software integration can give quick and accurate data sharing, speed up rectification by 100%–200%, and eliminate errors by 30%–70%.In recent years, there has been a trend towards deepening and expanding the applicability of BIM. For the first time in 2012, there were more builders using BIM than there were architects.When discussing the design process, the 3D model of the building was created first. The information and documents needed to create this model are then gathered.The global method enables you to incorporate all the data through the integration of the design concept with the BIM model.

4. A critical analysis of Building Information Modelling systems used in construction projects

F.H. Abanda et.al(2015) -Building Information Modelling (BIM) is a modern, widespread digital technology that many feel has the ability to completely transform the building sector. This is mostly due to global government programmes that encourage the use of BIM to increase project delivery efficiency and quality. A huge number of BIM software systems have been released and are currently on the market as a result of this effort. Although this might be viewed as a positive development, it is impossible to overlook how many professionals have been overwhelmed and are finding it difficult to differentiate between the various ways these software systems are used.The scope of prior studies on various BIM systems has typically been constrained, with a primary focus on operational concerns.In this study, a wide range of BIM software solutions currently in use for handling construction project information will be thoroughly and critically evaluated. A systematic study of the literature, a structured questionnaire survey, action learning, focus groups, and email surveys are the five basic techniques used. The study takes a comprehensive approach, looking at 122 examples of application in the AEC sector and the majority of the major BIM system types.

5. AUTODESK 3D CIVIL

Harshil S. Shah et.al(2016) To successfully handle their transport needs, developing countries must build a new road network. The proposed bypass route for Rajkot, Gujarat, was created using Autodesk Civil 3D Software, which used 3D modelling to generate values for geometric design features including alignment and superelevation. The transit system now covers a much wider area.Traffic increased as a result, especially on the network of private transit. Congestion set in as a result of there not being enough open road space to accommodate the growing number of vehicles. Capacity analysis, which is essential to the planning, design, and operation of roads, provides the basis for determining the highway width to be given at any site on a road network with respect to the number and composition of traffic. As a result, there will be issues like accidents and slower traffic, among others. The population of Rajkot is growing every day.There has been a large rise in the volume of traffic and the number of pedestrian crossings, but the width of the road has not been expanded. Increasing traffic demand can surpass the capacity of the road for a number of reasons, including development in the population, industry, commerce, and auto ownership.

6. REVIT SOFTWARE

P. Zotkina et.al (2016) - The technique for exporting building construction parameters from Autodesk Revit to the structural analysis programme is covered in the article. The programme initially makes use of the C# plug-in, which pulls construction element parameters from the Revit design and writes them to a text file. The parameters can be geometric (size, coordinates, cross-sectional shape), physical (material qualities), or other. A specialised program-converter then scans the file, creates a beam frame model, and stores the data in a new format that is compatible with the structural analysis programme the authors previously designed.This programme enables the addition of loads and moments to any node of the beam frame, whether they are vertical or horizontal. For structural analysis, the finite element approach is employed. As a result of doing a finite element analysis under loads, the deformation schema is displayed. It is possible to obtain a Microsoft Word document that lists the key elements of beam construction.The act of developing, gathering, and utilising data about a building throughout its life cycle is known as building information modelling (BIM). Information modelling, in contrast to CAD design, includes a graphical representation as well as building-related data that is maintained in a database. The availability of information about the building or structure, which can be used at many stages including architectural design, engineering calculations, construction, maintenance, and reconstruction, is the main benefit of BIM over alternative modelling techniques.

7. ETABS AND STAAD

Ramanand Shukla et.al(2017) - As the urban population grows, reinforced concrete building structures are becoming more and more common. This is because better craftsmanship, high-quality real-time model analysis data, and finite element analytical and design software programmes like Staad Pro, ETABS, and SAP2000 have all been developed. These computer programmes can handle various geometries, static and dynamic loads, and various material properties. variable forms, static and dynamic loadings, and variable material qualities can all be handled with ease with Staad Pro and ETABS.In the current article, STAAD Pro and ETABS are both used to analyse a G+10 story structure with a fairly simple plan dimension. The scope of the current investigation is mostly restricted to a basic comparison of their analytic outcomes under vertical loadings. The research was then expanded, a horizontal load was applied, and the lift wall's (the shear wall's) plan location was optimised for the horizontal base shear that would form at various support positions. It was discovered that the model with a shear wall positioned in the centre of the plan is the most effective at handling the base shear.

8. MATLAB SOFTWARE

Arturo S. Leon et.al (2019) -In order to estimate the best flow releases in a multi-storage system for flood management, this research introduces a MATLAB framework. It incorporates four models for optimising hourly ideal flow releases, simulating river flooding, and hydrologic analysis. Based on the study's results, it might reduce floods.Anybody with an interest in almost real-time flow control is the work's target audience. This might involve engineers in charge of managing flooding and preventing immediate flooding. Researchers and students interested in open-source methods for flood mitigation are also targeted by this initiative. The focus of this book is on flood control, therefore wetlands that sustain long-lived aquatic creatures would not be included in the storage utilised to mitigate floods. Integration of hydrological and hydraulic models within an optimisation framework would be necessary to enable the coordinated functioning of a multi-storage system for flood mitigation.

9. ABAQUS SOFTWARE

B. Pavan Venkata Naga Sai (2020) - Precast structures, as used in this paper, are buildings built of concrete that are manufactured in a factory and properly cured. The purpose of this study is to use ABAQUS software to analyse the failure of the beam-column junction with dry mechanical and wet connections in a moment resistant frame. The patterns of spatial displacement, the load versus displacement of the J-bolt connection, the cleat angle with stiffener connection, the wet precast connections, and the monolithic frame are the most significant findings. To determine the ideal precast connection, additional factors including interaction and convergence are also examined.

10. ABAQUS

Hemanth Balineni et.al(2020) - The ABAQUS software is used in this study to examine the behaviour of precast beam-column joints with two types of dry mechanical connections and two types of wet connections. For monolithic and precast elements, M30 grade concrete was explored. For wet concrete connections, M40 grade fibre reinforced concrete, which uses Alkali Resistant Glass Fibres in place of some of the cement, was investigated.The moist connections demonstrated greater fixity, which is a prerequisite for the precast technology's emulative approach.The performance of the dry connections evaluated here might be enhanced by intricate mechanical component details as opposed to monolithic and wet connections, which performed more efficiently.

11. Etabs & Staad Pro

K. Surender Kumar et.al (2020) -The goal of this study is to develop a better analysis for developing load cases, applying load combinations, supporting reactions and strengthening of columns and beams, and evaluating whether a column or beam successfully withstood the loads or not.Buildings with several stories serve two purposes: to extend the floor space without expanding the land area, and to save costs. Developing load instances, applying load combinations, supporting responses, reinforcing columns and beams, and determining if a column or beam successfully survived the stresses are the main objectives of this study. It is a case study of an ongoing construction project in Hyderabad, and standard code manuals (IS 456: 2000, SP 16) were used to conduct the building analysis.The concrete structure is developed and assessed utilising the Limit state design philosophy in line with IS 456:2000 using ETABS 2017, Staad.Pro .for the analysis and design of the construction. The structural analysis and design technique utilised to satisfy functional requirements and ensure the structural integrity of the structure in accordance with the applicable safety standards are described in this Design Verification document In this study, the functional requirements for structures, loads and load combinations, material characteristics, and the techniques used for structure analysis and design are all presented. The results of the G + 8 analysis and design in Staad.Pro & ETABS 2017 are presented in this essay.

12. STAAD PRO

Chintakrindi V. Kanaka Sarath et.al (2020) - This paper aims to layout a whole building relaxation on a single column due to the rapid increase in population and scarcity of land. The building plays a vital role in improving various activities, such as prompting people to action for earnings. Structural planning and design is an art and science of designing with economy, elegance, and durable structure. Standards are used to ensure and enhance safety, keeping a careful balance between economy and safety.

13. STAAD PRO

Shaik Kalesha et.al (2020) - The main objective of this paper is to understand the concepts of PEB and to minimize the usage of cost and time. PEB is more sustainable and stands top position when compared to other technologies in construction. Materials used in this concept are reusable, recyclable and eco-friendly.Pre-engineered building concept involves pre-designed and prefabricated steel building systems. It is a modern-day concept that utilizes the steel structure and optimizes the design by ensuring economical integrity.

14.***ETABS***

CH. Lokesh Nishanth et.al (2020) - The purpose of this work is to analyze and design a commercial building with different slab arrangements, using ETABS software. Load combinations are taken as per IS 456-2000 code book, with wind speed of 55 m/s and earthquake zone 5.The analysis and design of buildings are influenced by earthquakes. The technique of studying a structure's behavior under specific load combinations. Finding the right specs for the building is the process of design. The manual process of structure analysis and design would take a long period. Any structure's study and design may be completed fast utilising software. This work's main goal is to study and design a commercial structure with various slab configurations, including conventional slabs, flat slabs with drop panels, grid/waffle slabs, and structures with load-bearing walls. A building is considered to be commercial if at least 50% of its floor space is put to use for business purposes.
Structures' susceptibility to seismic and wind forces

15. Dam break analysis using HEC-RAS and HEC-GeoRAS: A case study of Hidkal dam, Karnataka state, India

A Bharat et.al (2021) - This paper examines dam break/breach analysis for the Hidkal dam using a one-dimensional hydraulic model called Hydraulic Engineering Center's River Analysis System (HEC-RAS). It involves the prediction of breach parameters, breach flood hydrograph, peak flow, flood arrival time, and generation of inundation maps.A dam is a river crossing construction used to store and supply water for a variety of uses. Despite the many advantages of the dams, the possibility of cataclysmic dam collapse floods exists
constantly. In order to comprehend the severity of a dam break flood and identify regions at risk, it is crucial to analyse and simulate dam failure scenarios. Doing so aids in planning for land use and creating emergency response strategies. The Hydraulic Engineering Center's River Analysis System (HEC-RAS) is a one-dimensional hydraulic model that is used in this work to conduct a dam break/breach analysis for the Hidkal dam. The Cartosat-1 digital elevation model (DEM) is used to extract river geometry data, which is then utilised to create an inundation map to show the impacted areas.

16. ***ETABS SOFTWARE***

Rachakonda Divya et.al (2021) - This paper's major aim is based on the key factor i.e. span of the column, which can also play a major role along with the height of the building in design and analysis of a structure which in turn depends on the cost of the building.Today's age believes that time is more valuable than money, and there are many building techniques available that are time-consuming. Steel-framed structures are regarded as due to its rapid erection technique, as a revolution in the new building age. The best course of action is to pick the type of building based on the acceptable circumstances and functional needs in order to have a wise and effective structure design.The comparison between steel structures with RCC designFrame We may pick the form of construction that best meets the circumstances and type of structure with the aid of "Structures based on columns span." The primary goal of this study is based on the important component, or span of the column, ,

17. Civil engineering stability inspection based on computer vision and sensors

Hongfen Nian (2021) - This white paper gives an overview of the most recent advancements in computer vision technology and uses them to assess the status of private infrastructure. Several computer vision applications, including context identifiers, local and global characteristics, visible damage, and changes in the reference picture have all benefited from the use of deep learning. Context identifiers, regional and global characteristics, obvious damage, and adjustments to the reference image are all examples of review applications. Applications for monitoring include measuring displacement and doing static and dynamic strain modal analyses. In order to overcome some of the persistent problems in our ..work, difficulties are still moving towards the automation of civil infrastructure and the monitoring of vision-based infrastructure

18.Systematic approach to generate Historical Building Information Modelling (HBIM) in architectural restoration project

Juan Moyano et.al(2022) - This paper presents a systematic approach to working with heritage, which involves data acquisition, insertion of point cloud data, ontologies, data classification, and evolution towards the Digital Twin concept.Projects involving heritage are frequently complicated and involve scientific, structural, and documentary assessments. Each stage needs to be approached methodically, with an analysis of the many specialists' contributions to historic asset conservation done in accordance with the project execution phase's logical flow. There are yet no scientific works that capture the entire process, though. A logical progression, referred to as a "systematic approach" in this paper, should begin with data collection using remote sensing techniques, the integration of point cloud data into a Building Information Modelling (BIM) environment, the application of ontologies to HBIM (Historic BIM), the classification of data, and development towards the Digital Twin (DT) concept. This essay also examines the modeling process of a case study and the building of a column foundation.

19. Impacts of retention basins on downstream flood peak attenuation in the Odaw river basin, Ghana HEC-HMS and HEC-RAS

Johnmark Nyame Acheampong et.al (2023) - In Ghana's Odaw River Basin (ORB), the study looked at how a retention basin affected flood maxima downstream of it as a hydraulic structure. Forecasting floods in terms of peak flows and results forced into the 2D Unsteady flow HEC-RAS model to simulate flood inundation zones was done using calibrated and validated HEC-HMS and HEC-RAS models. Across all possible flood scenarios, the retention basin lengthened the basin lag time by an average of 4 hours.Floods are now a common natural calamity in many nations, raising concerns on a worldwide scale (Singh et al., 2018). In comparison to the 1990s, the number of flood cases worldwide has roughly doubled since the 2000s (Guha-Sapir et al., 2004). Floods pose a major threat to people's health and socioeconomic well-being. (CRED, 2018). African extreme events, The impact of climate change in contributing to an increase in flood incidences is evident across Europe and Asia. Floods are related to urbanisation trends as well as climate change (Hassan et al., 2022).

20. Integrated BIM-SHM techniques for the assessment of seismic damage

Simone Castelli et.al(2023) -The possible use of BIM technology for structural health monitoring is investigated in this study. To discover damage after a seismic event and display damaged portions in a digital twin model, a framework has been developed. After an effort was made to examine the data flow acquired by anticipated sensors and evaluate the structure's health through post-processing, the data was merged into a BIM environment. After years of investigation in SHM, designing, implementing, and maintaining tracking initiatives is difficult. These include of (but are not limited to) the quantity, distribution, and types of sensors required to address the phenomenon of interest, the accuracy of damage recognition methods, and the simplicity of project comparison. due to variations, restrictions on signal processing, ongoing maintenance of the sensors, and efficient access to and use of the data. BIM technology provides the essential storage and visualisation capabilities for facilitating information sharing among stakeholders. The current study examines a potential framework to connect SHM and BIM technology for the damage assessment following a seismic event in order to achieve this goal.

II. CONCLUSIONS

In the discipline of civil engineering, there is no other way to process and sort information except by utilising a computer, which makes it possible to analyse and modify designs and information more quickly than ever before.

In civil engineering, operations may be carried out as precisely and error-free as possible thanks to the precision of computer software.The structures that are in place were developed to ensure that engineering work could be done without running into any problems. They also possess the speed and accuracy required for success, guaranteeing that everything will go as smoothly as possible to avoid mistakes or issues down the line.

Computers might ensure that every measurement is as precise as possible and that you are completely aware of your responsibilities.We can learn that without computer software, civil engineering would be considerably more difficult and that some tasks would require more time to execute properly. In our line of work, we couldn't do jobs as quickly or to the best level as we could without the assistance of computers.

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