Evaluating The Viability and Impediments of Structural Design Software (STAAD, MIDAS, And ETABS) In the Cabanatuan City: An In-Depth Analysis

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Abstract— The construction industry in Cabanatuan City, much like in many other urban centers, relies heavily on advanced technologies and software tools to meet the demands of modern engineering projects. Among these tools, structural design software such as STAAD, MIDAS, and ETABS play a crucial role in aiding engineers and architects in analyzing and designing complex structures. These software programs offer a range of functionalities, including finite element analysis, structural optimization, and dynamic analysis, which are essential for ensuring the safety, efficiency, and functionality of engineering projects. However, despite the widespread use of these software programs in the construction industry, their viability and effectiveness in meeting the specific engineering requirements of Cabanatuan City have not been thoroughly examined. This research seeks to address this gap by evaluating the suitability of STAAD, MIDAS, and ETABS software in the context of Cabanatuan City's engineering needs.

*Index Terms—* Structural Design, Structural Analysis, Software Program, Designer, Application.

# Introduction

One of the primary benefits of using structural design software like STAAD, MIDAS, and ETABS is their ability to perform complex analysis and design tasks with a high degree of accuracy. These software programs enable engineers to simulate real-life conditions and predict the behavior of structures under various load conditions, thereby allowing them to make informed decisions throughout the design process.

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Additionally, the automation features offered by these software programs help streamline the design process and reduce the likelihood of errors, ultimately saving time and resources.

Despite these advantages, it is essential to identify any potential impediments to the effective use of these software programs in Cabanatuan City. Factors such as the availability of skilled personnel, compatibility with local building codes and regulations, and the cost of software licenses may all impact the adoption and utilization of STAAD, MIDAS, and ETABS in the region. By examining these factors, this research aims to provide valuable insights that can help improve engineering practices and decision-making in Cabanatuan City's construction industry.

The evaluation of the viability and potential impediments to using STAAD, MIDAS, and ETABS software in Cabanatuan City is crucial for enhancing the efficiency and effectiveness of engineering projects in the region. Engineers and architects can enhance construction project quality and optimize technological utilization by developing a more comprehensive comprehension of how these software programs can be tailored to the unique requirements of Cabanatuan City. As a result, it is justifiable to conduct this research, as its objective is to fill a significant knowledge void and make a contribution to the development of the construction sector in Cabanatuan City.

# Review Of Related Literature

The construction industry is continuously evolving, and structural design software plays a crucial role in enhancing the efficiency and accuracy of engineering projects. In Cabanatuan City, engineers and architects rely on software programs like STAAD, MIDAS, and ETABS to design and analyze complex structures. However, the viability and effectiveness of these software tools in the context of Cabanatuan City's unique engineering requirements remain to be thoroughly examined. This research aims to evaluate the viability and identify potential impediments to using structural design software in Cabanatuan City, offering insights to enhance engineering practices and decision-making.

Odeyemi et al. (2020) emphasized the pervasive influence of technology in contemporary society, permeating diverse domains like social interactions, construction, business management, medicine, and engineering. The synergy between science and technology is evident, each contributing to the advancement of the other, fostering a dynamic collaboration. Notably, a few years ago, during the nascent stages of personal computers and operating systems, the processes related to architectural planning and construction were laborious and time-consuming. Civil Engineering has undergone remarkable transformations driven by technological revolutions, enabling construction firms to expedite projects while ensuring structural robustness and quality. The era of protracted construction timelines has become obsolete. Integrating structural analysis and design software tools has revolutionized construction, streamlining analysis, design, and construction phases.

Software applications in Civil Engineering fall into three broad categories: architectural, structural, and project management. Architectural software facilitates interior and exterior design and planning. Structural software aids in analyzing, designing, and sometimes detailing structural components. Project management software empowers organizations to plan, organize, control resources, and estimate resource requirements efficiently. Contemporary advancements continually enhance the capabilities of Structural Engineers, particularly when grappling with complex architectural designs. Many software applications are available to analyze and design large-scale projects swiftly. These tools encompass both 2-dimensional and 3-dimensional options, with the latter being favored by most Structural Engineers due to its user-friendly interface and operational ease. These applications streamline tasks like structural modeling, element analysis, error detection, and report generation, significantly improving efficiency.

Reflecting on history, Jarrah (2021) points out that the roots of structural engineering trace back to ancient times, notably in the construction of the great pyramids of Egypt around 2700 BC, showcasing early engineering prowess (Kirby, 1957). Throughout history, luminaries such as Archimedes, Galileo, Hooke, and Newton meticulously examined and refined the field. In the early 20th century, they witnessed the introduction of finite element analysis, a computationally intensive method for analyzing intricate structures (Turner et al., 1956). With the advent of computers, finite element analysis transitioned from theory to practicality, thanks to software applications (MacNeal & McCormick, 1971). Presently, various software packages cater to the analysis and design of diverse structural elements, each with its scope and functionality.

Furthermore, Jarrah (2021) highlights that software pricing can fluctuate based on demand and prevailing economic conditions, influencing our research's focus on software cost and pricing. Moreover, the structural engineering software landscape is diverse, with various programs offering distinct features and compatibility levels. Users often employ multiple programs for analysis, guided by structural complexity, employer-provided software, or personal preferences. Licensing fees for these programs can be exorbitant for individual users, necessitating communication with software developers through their organization's IT or procurement departments. Consequently, a software's market share might not accurately reflect user preferences.

# Scope And Limitation of The Study

 This research will focus and be limited to the three widely used structural design software programs: STAAD, MIDAS, and ETABS. The study will primarily involve professional civil engineers, structural engineers, and construction professionals working on various engineering projects in Cabanatuan City. The research will not delve into software development processes or technical aspects beyond the scope of structural design and the software’s purchased price. The study's findings will be limited to the specific context of Cabanatuan City and may not be fully applicable to other regions or countries. The study will also be limited to the experiences of its users.

# Respondents Of the Study

The 24 out of 25 respondents will include licensed civil engineers, structural engineers, and construction professionals actively engaged in structural design projects within Cabanatuan City. A random sampling method, specifically simple random sampling, will be employed to determine the number of respondents. This technique will utilize a Sample Size Calculator available at (https://www.calculator.net/sample-size-calculator) to estimate the sample size. Initially, due to a limited population of 25, a sample size of 24 was chosen. This study maintained a confidence level of 95%, resulting in a margin of error of 5%.

Table.1.

Actively engaged in structural design projects

|  |  |  |
| --- | --- | --- |
| Types of Respondents | Number of Respondents | Percentage of Respondents |
| Licensed Structural Engineer | 3 | 12.5% |
| Structural Engineer Practitioner | 21 | 87.5% |
| Total: | 24 | 100 % |

# Research Instrument

Analysis of the study unveiled several noteworthy observations. To begin with, an analysis revealed a notable prevalence of private entities operating within the structural engineering sector of Cabanatuan City, comprising the majority of practitioners. This indicates that the market for structural design software among independent contractors and private contractors in the city is prospering. Additionally, the data revealed that a significant proportion of professionals possess less than five years of experience in their respective fields. This indicates that an increasing number of youthful professionals are influencing the trajectory of the industry. Their software utilization preferences and strategies are critical elements to consider.

Table.2.

Analysis of the study unveiled several noteworthy observations.

|  |  |  |
| --- | --- | --- |
| Assigned Weight | Rating Scale | Verbal Interpretation |
| 4 | 3.25 – 4.00 | Strongly Agree | Excellent |
| 3 | 2.50 – 3.24 | Agree | Good |
| 2 | 1.75 – 2.49 | Disagree | Average |
| 1 | 1.00 – 1.74 | Strongly Disagree | Poor |

# Results And Discussions

Table.3.

Respondents’ Demographic Profile

|  |  |  |
| --- | --- | --- |
| **Workplace/Institution** | **Frequency (F)** | **Percentage (P)** |
| Cabanatuan LGU | 2 | 8.33% |
| DPWH | 2 | 8.33% |
| NIA UPRIIS | 2 | 8.33% |
| NEUST (SUC) | 3 | 12.50% |
| Private Contractor | 7 | 29.17% |
| Freelancer | 8 | 33.34% |
| Total | 24 | 100% |

|  |  |  |
| --- | --- | --- |
| **Years of Experience** | **Frequency (F)** | **Percentage (P)** |
| 0 – 5 | 18 | 75.00% |
| 6 – 10 | 4 | 16.67% |
| 11 – 15 | 2 | 8.33% |
| Above 15 | 0 | 0% |
| Total | 100% | Total |

Table 3 shows the distribution of respondents across various workplaces and their respective years of experience in the structural engineering industry based in Cabanatuan City, Nueva Ecija. Notably, respondents from Cabanatuan LGU, DPWH, and NIA UPRIIS each constitute 8.33% of the workforce, while NEUST accounts for 12.50%. However, the majority, comprising 62.50%, hail from the Private Sector, with Private Contractors and Freelancers representing 29.17% and 33.34%, respectively. When examining respondents' years of experience, a significant proportion, 75%, have 0-5 years of experience, indicating a predominantly new workforce in structural engineering. This suggests a potential gap in experienced professionals within specific institutions like NEUST, potentially due to recruitment challenges or preferences for independent work, reflected in the dominance of Freelancers and Private Contractors. Consequently, there's a critical need for strategies to retain experienced professionals and attract talent to both institutions and traditional sectors, ensuring a balanced and skilled workforce in the structural engineering industry.

Table.4.

Viability Assessment

|  |  |  |  |
| --- | --- | --- | --- |
| **Questions** | **Mean** | **Rank** | **Verbal Interpretation** |
| 1. I have encountered challenges/ limitations when using structural design software in Cabanatuan. |
| STAAD | 1.67 | 1 | Strongly Disagree |
| MIDAS | 1.83 | 2 | Disagree |
| ETABS | 1.75 | 2 | Disagree |
| 2. The compatibility between the software and other tools or systems commonly used in the city's construction industry is adequate. |
| STAAD | 3.33 | 4 | Strongly Agree |
| MIDAS | 3.25 | 4 | Strongly Agree |
| ETABS | 3.25 | 4 | Strongly Agree |
| 3. The software is user-friendly and easy to navigate. |
| STAAD | 3.25 | 4 | Strongly Agree |
| MIDAS | 2.83 | 3 | Agree |
| ETABS | 3.04 | 3 | Agree |
| 4. financial or licensing challenges are associated with using the selected software in Cabanatuan City. |
| STAAD | 1.83 | 2 | Disagree |
| MIDAS | 2.58 | 4 | Agree |
| ETABS | 1.63 | 1 | Strongly Disagree |
| 5. Accessing technical support or timely assistance from the software provider is readily available. |
| STAAD | 3.38 | 4 | Strongly Agree |
| MIDAS | 3.46 | 4 | Strongly Agree |
| ETABS | 2.83 | 3 | Agree |
| 6. There are legal or regulatory compliance issues related to using the software in Cabanatuan City's construction projects. |
| STAAD | 1.63 | 1 | Strongly Disagree |
| MIDAS | 1.63 | 1 | Strongly Disagree |
| ETABS | 1.63 | 1 | Strongly Disagree |

Table 4 illustrates the usage, user experience, and perceived effectiveness of structural design software among respondents in Cabanatuan City. STAAD emerges as the most widely used software, followed by ETABS and MIDAS, indicating their prevalence in local engineering projects. This aligns with the literature, which often recognizes STAAD and ETABS as popular choices among structural engineers due to their robust features and capabilities (Odeyemi et al., 2020). Respondents report excellent experiences with all three software tools, reflecting positively on their usability and functionality. This corroborates findings from previous research, which often highlights the high performance and user satisfaction associated with STAAD, MIDAS, and ETABS (Jarrah, 2021).

Additionally, respondents strongly agree that the software meets the specific requirements of engineering projects in Cabanatuan City and integrates well with other commonly used design and engineering tools. This indicates the software's adaptability and compatibility with local industry practices, facilitating seamless workflows and collaboration among engineering professionals.

Table.5.

Impediment Identification

|  |  |  |  |
| --- | --- | --- | --- |
| **Questions** | **Mean** | **Rank** | **Verbal Interpretation** |
| 1. I have encountered challenges/ limitations when using structural design software in Cabanatuan. |
| STAAD | 1.67 | 1 | Strongly Disagree |
| MIDAS | 1.83 | 2 | Disagree |
| ETABS | 1.75 | 2 | Disagree |
| 2. The compatibility between the software and other tools or systems commonly used in the city's construction industry is adequate. |
| STAAD | 3.33 | 4 | Strongly Agree |
| MIDAS | 3.25 | 4 | Strongly Agree |
| ETABS | 3.25 | 4 | Strongly Agree |
| 3. The software is user-friendly and easy to navigate. |
| STAAD | 3.25 | 4 | Strongly Agree |
| MIDAS | 2.83 | 3 | Agree |
| ETABS | 3.04 | 3 | Agree |
| 4. financial or licensing challenges are associated with using the selected software in Cabanatuan City. |
| STAAD | 1.83 | 2 | Disagree |
| MIDAS | 2.58 | 4 | Agree |
| ETABS | 1.63 | 1 | Strongly Disagree |
| 5. Accessing technical support or timely assistance from the software provider is readily available. |
| STAAD | 3.38 | 4 | Strongly Agree |
| MIDAS | 3.46 | 4 | Strongly Agree |
| ETABS | 2.83 | 3 | Agree |
| 6. There are legal or regulatory compliance issues related to using the software in Cabanatuan City's construction projects. |
| STAAD | 1.63 | 1 | Strongly Disagree |
| MIDAS | 1.63 | 1 | Strongly Disagree |
| ETABS | 1.63 | 1 | Strongly Disagree |

Table 5 shows that the table presents an assessment of impediments associated with using structural design software in Cabanatuan City. Respondents generally reported minimal challenges or limitations when using the software, with STAAD, MIDAS, and ETABS all receiving low scores indicating disagreement with encountering significant issues. This aligns with literature emphasizing the user-friendly nature and robust functionality of these software packages (Jarrah, 2021). Furthermore, respondents expressed strong agreement regarding the compatibility of the software with other tools commonly used in the city's construction industry, as well as their user-friendliness and ease of navigation. This indicates that the selected software options integrate well with existing workflows and are accessible to users of varying technical expertise levels.

Financial or licensing challenges were identified to a higher degree with MIDAS compared to STAAD and ETABS. However, overall, respondents disagreed with encountering significant obstacles in this regard. This suggests that while cost considerations may exist, they do not pose major impediments to the successful implementation of these software tools in Cabanatuan City. Additionally, respondents indicated readily available technical support from the software providers, further enhancing the usability and reliability of the software. Finally, no legal or regulatory compliance issues were perceived, indicating that the software options align with applicable laws and regulations in Cabanatuan City.

In summary, these findings suggest that the selected structural design software options are well-suited for use in engineering projects in Cabanatuan City, with relatively few impediments to their successful implementation.

# Findings And Conclusions

The findings from the data analysis reveal valuable insights into the use and perception of structural design software among practitioners in Cabanatuan City, Nueva Ecija. Here are the key findings:

*Workplace Distribution* - The respondents' workplace distribution shows that the majority of practitioners (62.50%) come from the private sector, with a significant representation from private contractors (29.17%) and freelancers (33.34%). This indicates a strong presence of private entities in the city's structural engineering industry.

*Years of Experience* - The years of experience data indicate that a large percentage of respondents (75%) have 0-5 years of experience in the structural engineering industry. This suggests that most practitioners in Cabanatuan City are relatively new to the field, which may influence their preferences and approaches toward structural design software.

*Software Performance* - The evaluation of different structural design software reveals that STAAD and MIDAS consistently demonstrated excellent performance across various functions related to different types of structures. On the other hand, ETABS showed weaknesses in specific functions such as Tower design, Roads/Bridges/Highways, Retaining Walls, Drainage/Canals, and Foundation Design. These findings provide valuable guidance for professionals in choosing the appropriate software for specific projects.

*Software Usage* - STAAD is the most widely used structural design software among respondents, followed by ETABS and MIDAS. All three software options received excellent ratings from the practitioners, indicating a positive user experience and satisfaction.

*Impediments* - The data shows that respondents did not encounter significant challenges or limitations when using the structural design software in Cabanatuan City. The software was compatible with other tools, was user-friendly, and was supported with technical assistance. The only identified challenge was related to financial or licensing issues with MIDAS.

Analysis of the study unveiled several noteworthy observations. To begin with, an analysis revealed a notable prevalence of private entities operating within the structural engineering sector of Cabanatuan City, comprising the majority of practitioners. This indicates that the market for structural design software among independent contractors and private contractors in the city is prospering. Additionally, the data revealed that a significant proportion of professionals possess less than five years of experience in their respective fields. This indicates that an increasing number of youthful professionals are influencing the trajectory of the industry. Their software utilization preferences and strategies are critical elements to take into account.

Upon comparing and contrasting various structural design software, it was determined that STAAD and ETABS consistently exhibited superior performance across a multitude of functions. Notwithstanding certain shortcomings identified in ETABS, specifically concerning functions such as Tower design and Foundation design, the software alternatives' overall favorable user experience and satisfaction suggest that they are highly suitable for engineering endeavors in Cabanatuan City. Furthermore, the limited obstacles faced by professionals highlight the software solutions' compatibility, user-friendliness, and provision of technical support.

*RECOMMENDATIONS:*

In order to augment comprehension regarding the utilization of structural design software in Cabanatuan City, a number of recommendations have been put forth. To begin with, enhancing the sample size to encompass a greater variety of practitioners representing distinct sectors and levels of expertise can yield a more comprehensive understanding of software usage patterns and preferences. Furthermore, by supplementing quantitative data with qualitative insights obtained from in-depth interviews, a more comprehensive understanding of the experiences and perspectives of practitioners can be attained. Longitudinal studies would facilitate the examination of enduring patterns in software adoption and perceptions, whereas cost-benefit analyses and comparative assessments of software updates could provide valuable insights into the ongoing enhancements and financial ramifications associated with software implementation. In addition, incorporating the viewpoints of software developers, user training, technical support, and geographic expansion can contribute to an industry-wide comprehension of software utilization dynamics and facilitate well-informed decision-making. By implementing these recommendations, future researchers can enhance the depth and scope of the study, contribute to advancing knowledge in the field of structural engineering, and offer valuable guidance to practitioners and policymakers in Cabanatuan City.

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