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Contributing Factors to the Effects of Design Errors In Building Construction

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ABSTRACT
In the construction industry, errors in design are bound to happen inevitably. These errors occur when information is applied incorrectly or inaccessible, leading to failures. This study aims to shed light on the contributing factors to the effects of design errors in building construction in the Nigerian building construction sector. To achieve this, the study reviewed works by various authors and collected data from primary sources using a well-structured questionnaire. Ninety-three questionnaires were distributed to contractors, skilled and unskilled labours, and industry professionals, of which eighty were returned, coded, and analyzed using descriptive statistics, percentiles, and mean item scores. The study's findings concluded that inadequate documentation is the primary factor contributing to design errors in building construction projects. Additionally, inadequate quality control, lack of constructability review, inadequate consideration of local regulations, and insufficient structural analysis were identified as other contributing factors to design errors in building construction, albeit with varying degrees of importance as discussed in this study. Based on the study's findings, it is recommended that building construction projects prioritize improving documentation practices to mitigate design errors effectively. Additionally, enhancing quality control measures, conducting thorough constructability reviews, ensuring compliance with local regulations, and conducting comprehensive structural analyses are crucial steps to minimize design errors.

Keywords: Constructability review, design errors, inadequate documentation, structural analysis, quality control

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I. INTRODUCTION

Design plays a pivotal role in construction projects, as errors during this phase can lead to failures in both construction execution and project development. These errors not only compromise the quality of construction work but also result in cost overruns and delays. Additionally, design errors can contribute to engineering failures, potentially causing accidents and loss of life. Therefore, proactive measures to minimize errors are essential. It's crucial to acknowledge that design represents the initial phase of construction, and design errors have historically been responsible for numerous catastrophic accidents, leading to tragic outcomes such as worker injuries, fatalities, and significant project delays. Design errors encompass a range of issues including mistakes, omissions, and conflicts in the design process. Sweiss (2018) characterizes design error as deviations from the original specifications, stemming from imprecision, human error, and mechanical flaws. Musa and Obaju (2016) describe design error as the inability of individuals to complete a specific design aspect within a given timeframe.

II. LITERATURE REVIEW

Contributing factors to the effects of design errors in building construction

Various types of design drawings can harbour differing levels of design errors, often stemming from factors like unclear design overviews, lack of coordination processes, and human errors (Dosumu & Aigbavboa, 2018). In building construction projects, errors predominantly arise from human negligence, leading to slips, lapses, and overall carelessness, resulting in rework, cost overruns, and delays.

Mryyan and Tzortzopoulos (2013) categorized the sources of design errors into several headings, including errors attributed to clients, failure to adhere to regulations and building codes, lack of detail in drawings, and misinterpretation of drawings. They also highlighted factors such as changes in project requirements, inadequate risk assessment, lack of collaboration, software or technology issues, environmental factors, poor design coordination, insufficient project coordination, inadequate quality control, and material selection issues as major contributors to errors in building construction projects.

Asamaoh and Offei-Nyako (2013) attributed design errors to factors such as design complexity, changes in specifications, and lack of knowledge. Muhammad, Keyvanfar, Abd-Majid, Shafaghat, Magana, and Dankaka, (2015) identified impediments to prompt decision-making processes, poor workmanship, lack of strategic planning, changes in design, non-compliance with government regulations, aesthetic considerations, cost concerns, inadequate project objectives, mistakes, and pan errors as additional causes of design errors.

Other causes of design errors include inadequate details in working drawings, changes in schedules, poor workmanship, financial issues on the client's side, design complexity, safety considerations, weather conditions, new government regulations, poor planning by contractors, technological changes, and changes in work procedures (Memon, Rahman and Abdul, 2014; Mohammad, Che Ani, Rakmat, & Yusof, 2010; Aaryan, Emadebeltagi, Eshahat and Dawood, 2014).

III. METHODOLOGY

The efficacy of any data collection process hinges on several factors, including the identification of suitable respondents, establishment of a robust sampling frame, meticulous execution of fieldwork, and the subsequent handling of collected data (Creswell, 2009; Yin, 2009). This study utilized both primary and secondary data sources, focusing specifically on construction sites in Ondo State, Nigeria. Primary data were gathered through a well-structured questionnaire distributed among construction professionals involved in projects within the study area. Random sampling techniques were employed, resulting in the administration of ninety-three valid questionnaires. Of these, eighty were successfully retrieved. Demographic information of respondents was analyzed using frequency and percentage, while data pertaining to contributing factors to the effects of design errors in building construction was examined using mean scores and ranking.

IV. FINDING AND DISCUSSION

Ninety-three (93) questionnaires were distributed among Contractors, Skilled labor, Unskilled labor, and Professionals in the study area, out of which eighty (80) were collected and utilized for analysis, indicating an 86% response rate.

Table 1. Questionnaire distributed and retrieved

No of administered Questionnaire	No retrieved	% of retrieval
93	80	86

Source: Author 2024

Table 1 displays the quantity of questionnaires received from various organizations comprising the population.

Table 2: Years of experience in the construction industry

Classification	Frequency	Percent
1-5	26	32.5
6-10	46	57.5
11-20	8	10
Total	80	100

Source: Author 2024

Table 2: showing the demographic characteristics of the respondents.

The distribution of respondents' experience in the construction industry is as follows: 32.5% have 1-5 years of experience, 57.5% have a range of 6-10 years, and 10% each have 11-20 years of experience.

Table 3: Academic qualification of respondents

Classification	Frequency	Percent
ND	4	5.00
HND	49	61.25
BSC	20	25
PGD	2	2.5
Others	5	6.25
Total	80	100

Source: Author 2024

Furthermore, the respondents exhibit diversity in their educational backgrounds. Among them, 5% possess ND qualifications, 61.25% hold HND degrees, 25% are BSc graduates, and 2.5% have attained PGD. The remaining 6.25% fall into other categories. Notably, the largest portion comprises HND and BSc holders.

Table 4: Area of specialization in construction work

Classification	Frequency	Percent
Contractor	7	8.75
Skilled labour	30	37.5
Unskilled labour	19	23.75
Professional	24	30.00
Total	80	100

Source: Author 2024

Moreover, concerning specialization in construction, 8.75% worked as Contractors, 37.5% were Skilled Laborers, 23.75% were Unskilled Laborers, and 30.00% were professionals.

Table 5: Contributing factors to the effects of design errors in building construction

Factors that lead to design error	Mean	Rank
Changes in project requirement or scope	3.77	1st
Inadequate documentation	3.43	2nd
Inadequate quality control	3.28	3rd
Lack of constructability review	3.28	3rd
Inadequate consideration of local regulations	3.26	5th
Inadequate structural analysis	3.21	6th
Material selection issue	3.21	6th
Budget constraints	3.20	8th
Lack of experience or expertise in the design team	3.16	9th
Poor design coordination	3.16	9th
Design complexity	3.15	11th
Inadequate risk assessment	3.11	12th
Misinterpretation of client requirement	3.09	13th
Software or technology issue	3.07	14th
Complexity of the project	3.05	15th
Environmental factors	3.05	15th
Failure to consider future expansion	3.00	17th
Lack of collaboration	2.94	18th
Inadequate training of construction personnel	2.93	19th
Insufficient contingency planning	2.89	20th
Unrealistic project schedule	2.60	21th

Source: Author 2024

The study aimed to gauge the contributing factors to the effects of design errors in building construction by employing a Likert scale ranging from 1 to 5. Respondents were asked to indicate the level of influence, with 5 denoting a primary cause, 4 a major cause, 3 a moderate cause, 2 a minor cause, and 1 indicating not a cause.

Table 5 presents the mean scores of respondents' responses regarding the contributing factors to the effects of design errors in building construction. These contributing factors encompass changes in project scope requirements, inadequate documentation, deficient quality control, lack of constructability review, insufficient consideration of local regulations, inadequate structural analysis, issues with material selection, budget constraints, lack of experience or expertise within the design team, poor design coordination, design complexity, inadequate risk assessment, misinterpretation of client requirements, problems with software or technology, project complexity, environmental factors, failure to consider future expansion, insufficient collaboration, inadequate training of construction personnel, insufficient contingency planning, and unrealistic project scheduling as key aspects.

V. CONCLUSION

The study's findings concluded that inadequate documentation is the primary contributing factors to the effects of design errors in building construction. Additionally, inadequate quality control, lack of constructability review, inadequate consideration of local regulations, and insufficient structural analysis were identified as other contributing factors to design errors in building construction, albeit with varying degrees of importance as discussed in this study.

VI. RECOMMENDATION

Based on the study's findings, it is recommended that building construction projects prioritize improving documentation practices to mitigate design errors effectively. Additionally, enhancing quality control measures, conducting thorough constructability reviews, ensuring compliance with local regulations, and conducting comprehensive structural analyses are crucial steps to minimize design errors.

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