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I. Introduction

Analysis of the construction process is commonly expressed in terms of establishing equilibrium among the three primary concerns of time, cost and quality. Any client would want to construct a facility of the highest quality; and it is the goal of the project team to maximize quality while minimizing cost and time. Modern buildings are complex edifices and the design, construction and commissioning of a new building is a long complicated process that involves input from a number of parties. There is the need for structured and formal systems of construction management to address the aspects of performance, workmanship and quality. The concept of building performance shows that satisfactory performance, site organisation and methods must be carried out to the highest level of integrity and competence so as to ensure the concept of buildability (Obiegbu, 2004).

Buildability as a term is not well known, and in fact, this term is not found in dictionaries, but in practice the concept has been known since the beginning of the construction industry. In ancient times, the design was dictated about how the project should be built, and the construction was done by the master builder (Uhlik and Lores 1998). Bamisile (2004) defined buildability as the ability to construct a building efficiently, economically and to an agreed or specified standard from its constituent materials, components and sub-assemblies. A widely accepted definition of buildability is that of the Construction Industry Research and Information Association (CIRIA, 1983), which quite explicitly states that 'buildability is the extent to which the design of a building facilitates ease of construction, subject to the overall requirements for the completed building. Buildability, as defined by the Construction Industry Institute (CII, 1986), has the "optimum integration of construction knowledge and experience in planning, engineering, procurement and field operations to achieve overall project objectives". Fisher and Rajan, (1986) defined buildability as a measure of the ease or expediency with which a facility can be constructed." Also, buildability is often described as integrating construction knowledge, resources, technology and experience into the engineering and design of a project.

Buildability is increasingly becoming a major requirement in building practice. The industry's clients are continuously demanding the best value for money, in terms of the efficiency with which the building is carried out. The integration of good buildability into good overall design is the responsibility of the design team. Research in Uganda and elsewhere in the world have shown that good buildability leads to major cost benefits for clients, designers, and builders (Tindiwensi, 1996; Gray, 1990). Secondly, the achievement of good buildability depends upon both designers and builders being able to see the whole construction process through each other's eyes. This is the biggest problem because it requires expertise in the two aspects by both roles and moreover, the procurement practices do not favour this. Involving people with construction knowledge and experience at the very beginning of the project results in maximizing benefits. It has been shown that the integration of construction knowledge during the planning, design and procurement phases of a project brings extraordinary benefits into the delivery of the project. This is due to the fact that these are the phases in which one is able to influence the overall project the most (Lores, 1997).

To review the design after completion is not a buildability programme. It has to start from the beginning, because it is very difficult to make substantial

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changes in the design once you are through with it. Buildability considerations have to be started at the same time as the initial project planning and should continue during the entire life of the project. In short, buildability optimizes the following elements from start to finish: Overall project planning, Planning and designing, Construction – delivering schedule, Cost and estimate, Construction methods (Russell et al. 1992). The Construction Industry Institute (CII) made many case studies to highlight the importance and the effectiveness of buildability. In one case study (Residence Community in San Antonio, Texas), the resulting savings reduced project costs by approximately 10 percent ($3.5 Million) and enabled the project to be completed on schedule. In another case study (Refinery Expansion), the project was completed 14 months ahead of schedule with a 23 percent ($253 million) savings from the original estimate. A third one; (Arctic Oil Production Facility in Alaska) had a project cost reduction from $3.8 billion to $ 1.4 billion.

II. Need for the Study

Construction projects usually involve heavy total cost. Therefore, time and resources play a vital and critical role in deciding the cost factor of every project. Hence, by doing the job right the very first time, total project cost can be reduced substantially by identifying mistakes, analyzing the situation and solving any problem. The construction industry in Nigeria is one of the biggest industries and any extra cost means huge losses to the contractors and higher expenses to the clients. To avoid such loss in construction rework, extensive research on buildability needs to be conducted to improve the construction process. Buildability in Nigeria is a new concept, and not many studies have been done on this subject. To bring this subject of buildability to light will benefit the owners, constructors and designers; and therefore to consider buildability in their projects could prove highly beneficial in the industry. The need for buildability was not given much importance in the past, in spite of a major development plan in the region. Buildability implementation in the region could be of great importance to achieve overall project cost benefits, as this concept has already been tested and used in many countries around the world and proved to be very effective at optimizing the total cost throughout the project life cycle. Hence, the study aims at determining the extent of occurrence of buildability problems on construction projects, to examine the factors that cause buildability problems and evaluate the level of buildability problems on construction projects in Nigeria.

III. Conceptual Issues on Buildability

Buildability has been used since the beginning of construction and it is not new. People may not have known the term "Buildability" but they used the basic concept of buildability. "In ancient times, the design was dictated by how the project was going to be built, and the design and construction were done by the "Master Builder". The construction was based on traditions, general rules, and the trial and error method (Uhlik and Lores, 1998). Historical facts prove the existence of a buildability concept since long time ago. But the need for development of the concept began to be felt seriously in the construction industry due to great number of problems and difficulties that were faced during the 1960s and 1970s. During this period, the construction industry in many parts of the world declined in efficiency and quality. In 1983, the Construction Industry Institute (CII) was officially established at the University of Texas at Austin. It was an association of owners, contractors, academic institutions, and other construction professionals. The mission of the CII is to improve construction industry cost-ineffectiveness, and provide continuing research in construction. One area of research funded by the CII is the interface between design and construction practices, for which it has designated a Buildability Task Force. Two primary objectives of the buildability task force are to promote the benefits of buildability improvement to industry professionals, and to provide a package of concepts for improving buildability (Kartam, 1996). The benefit of buildability can occur at all stages of project Although, the Pareto Principle dictates that, the earlier in the process that buildability is implemented, the greater will be the potential of time and cost savings and quality improvements. Chen et al (1991) claimed that the implementation of buildability management can lead to significance quantifiable improvements in project performance in terms of time, cost and quality. In addition to the quantifiable measures, buildability management can also lead to qualitative improvements in the project process as well as the building project.

Buildability and buildability programme are two different terms with only a minor change in the meaning. Buildability was early defined in the most simple words as "the ability of construct effectively". In order to effectively construct, integration of construction knowledge, resources, technology and experience into the engineering and design of a project become very essential. To make this process; integration more effective and achievable, a buildability program is applied. A buildability programme is the application of a discipline, systematic optimization of the construction-related aspects of project during the planning, designing, procurement, construction, test and start up phase by knowledgeable and experience construction personnel who are part of the project team. The programme's purpose is to enhance the project's overall objective. Developing a buildability programme for a project results in lower costs, better productivity, earlier project completion and earlier start-up: in short a totally better project (ASCE, 1991). In order to effectively apply a buildability programme, the involvement of experienced construction personnel with the project right from the earliest stage is necessary to ensure the construction focus and experience to properly influence the owners, planners, designers and material suppliers. Such experienced and knowledgeable construction personnel to manage the buildability programme could possibly be staff members of the project owner, a separate construction management firm, the designer, or the constructor.

IV. Research methodology

By looking at the subject from various different angles, and to avoid any potential conflicts and discrepancies in the collected data; general contractors, structural engineers, architects were the only type of parties selected for use in this survey. Other parties were not included in this survey. Sample size consists of a comprehensive list of the entire element in a sample. It has to do with people the researcher intends to contact directly. For this study, the sampling size comprises the 30 numbers of contractor, 30 numbers of engineers and 30 numbers of architects in construction companies in Lagos. Questionnaire was used to collect data of the study. The questionnaire was designed in two sections. The first section, section A was to obtain information about the characteristics of the organization; the second section, section B involved questions on procurement and buildability.

In this research, two methods of data analysis were used: descriptive and statistical analyses. The Relative Occurrence Index (ROI) was used to know the extent of occurrence of buildability problem within a particular period of time on construction sites. The ROI for each occurrence of buildability problem was computed. The likert's scale used was (i = 1-5) where i= 5 is for many time, i = 4 is for three time, i=3 is for two time, i = 2 is for one time, i = 1 is for 0 time. The nearer the ROI to 5, the higher is the degree of occurrence of buildability problem on construction sites. The aggregate importance attached to the various occurrence of buildability problem on construction sites is denoted by ROI.

The Relative Causes Index (RCI) was used to know the degree of each factor that causes buildability problem on construction sites. The RCI for each cause of buildability problem was computed from the analysis of the rating indicated by the respondents. The likert's scale used was (i = 1-5); where i= 5 is for very high causes, i = 4 is for high causes, i=3 is for average causes, i = 2 is for below average causes, i = 1 is for not a cause. The nearer the RCI to 5, the higher is the degree of causes of buildability problem on construction sites. The aggregate importance attached to the various causes of buildability problem on construction site is denoted by RCI.

The Relative Impact Index (RII) was used to know the degree of the each factor that cause buildability problem on construction site. The RII for each impact of causes of buildability problem was computed from the analysis of the rating indicated by the respondents. The likert's scale used was (i = 1-5), where i= 5 is for very high impact, i = 4 is for high impact, i=3 is for average impact, i = 2 is for below average impact, i = 1 is for not an impact. The nearer the RII to 5, the higher is the degree of impact of causes of buildability problem on construction site. The aggregate importance attached to the various impacts of causes of buildability problem on construction site is denoted by RII.

V. Discussion of results

A total number of one hundred (100) questionnaires were administered but fifty- seven (57) questionnaires were retrieved. Table 1 shows the characteristics of the respondents. It shows the general information on the size of the company, year of experience, age, year of experience and sex. The table shows that the respondents, architects were equally engaged in the employment of both medium and large sized firms (50.00%); but the structural engineers were more in the medium sized firm (66.70%) than in the large sized firm (33.30%). The table shows that most of the respondents have been involved in construction works between 6-10 years with an average of about 50.00%. Most of the respondents had bachelors' degrees in related disciplines in construction industry. This indicates that the qualifications, years of experience and sizes of companies of the respondents, averagely medium would give them opportunity to have reliable information on issues related to buildability.

Table 1: Sample Characteristics of the Respondents

Characteristics	Architect		Contractor		Structural Engineer	
Size of Company	Frequency	%	Frequency	%	Frequency	%
Medium	10	50.00	11	57.90	12	66.70
Large	10	50.00	8	42.10	6	33.30
Total	20	100.00	19	100.00	18	100.00
Year of Experience	Frequency	%	Frequency	%	Frequency	%
1-5	4	20.00	0	0.00	3	16.70
6-10	10	50.00	10	52.60	7	38.90
11-15	5	25.00	7	36.80	7	36.80
16-20	1	5.00	2	10.60	1	5.60
Total	20	100.00	19	100.00	18	100.00
Qualifications	Frequency	%	Frequency	%	Frequency	%
HND	13	22.00	1	15.30	8	44.40
B.Sc.	45	72.00	15	78.90	10	55.60
M.Sc.	1	6.00	3	15.80	0	0.00
Total	18	100.00	19	100.00	18	100.00
Age	Frequency	%	Frequency	%	Frequency	%
31-35	6	31.60	3	17.60	3	16.70
36-40	10	52.60	7	41.20	11	61.10
41-45	3	15.80	6	35.30	4	22.20
45-50	0	0.00	1	5.90	0	0.00
Total	19	100.00	17	100.00	18	100.00
Sex	Frequency	%	Frequency	%	Frequency	%
Male	19	100.00	19	100.00	17	100.00
Female	0	0.00	0	100.00	0	0.00
Total	19	100.00	19	100.00	17	100.00

VI. Index of Occurrence of Buildability Problems

Table 2 shows the rate of occurrence of buildability problems among the three classes of respondents selected during the course of the study. The nearer the ROI to 5, the higher is the degree of occurrence of buildability problem on construction sites. The aggregate importance attached to the various occurrence of buildability problem on construction site is denoted by ROI. The table shows that the occurrence of buildability problems was noted to be more at a period of one year with an index value of 4.55, 4.53 and 4.20 among the architects, contractors and structural engineers. Buildability problems occurred least in a period of one week with an index value of 1.10, 1.05 and 1.10 among the architects, contractors and structural engineers respectively.

Table 2: Relative Occurrence Index of Buildability Problems

Occurrence of Buildability Problems	Architects		Contractor		Structural Engineer	
	ROI	Ranking	ROI	Ranking	ROI	Ranking
One Year	4.55	1	4.53	1	4.20	1
Six months	3.70	2	3.68	2	3.60	2
Three months	3.05	3	2.85	3	2.70	3
One month	2.05	4	2.00	4	1.90	4
One week	1.10	5	1.05	5	1.10	5

VII. Index of Factors That Cause Buildability Problems

The factors responsible for the occurrence of buildability problems were shown in Table 3. The hypothesized factors were analyzed by the use of Relative Causes Index (RCI). The Relative Causes Index (RCI) was used to know the degree of each factor that causes buildability problem on construction sites. From the table, the following causes of buildability problem: 'complexity of the project' (5.00), 'faulty defective of working drawing' (5.00), 'lack of tools and the equipment by the contractors' (5.00), 'incomplete specification' (5.00), 'Lack of construction experience by the client' (5.00), 'budgetary limitation' (5.00), 'non-standardization of design' (5.00), 'resistance of client to buildability programmes' (5.00) are the very high causes of buildability problem. Causes such as 'separate design and construction operation' (4.90), 'lack of awareness of construction technology by designers' (4.90), 'lack of awareness of buildability concept' (4.80), 'poor communication skill' (4.80), 'no documentation of lesson learnt' (4.75) are above the value of high causes of buildability problem and are approximately in value of very high causes of buildability problem.

Causes of buildability problem such as 'adversarial relationship between designers and contractors' (4.00) was within the value of high causes of buildability problem. Causes such as 'construction input is requested too late to be of any value' (3.75), 'Reluctance of contractor to offer pre-construction advice' (3.45), 'discontinuity of key project personnel' (3.45), 'maintenance of stating quotation' (3.30) are above average causes and below high cause but construction input is requested too late to be any of value is approximately in the value of high causes of buildability problem. Causes such as 'no commitment from client' (2.72), 'lack of financial incentive for designer' (2.58), 'lack of mutual respect between designer and contractors' (2.50), 'perception that buildability delay projects' (2.35) are above the value of below average causes but below the value of average causes. They are approximately in the value of average causes of buildability problem. Among the structural engineers, the table shows the following causes of buildability problem: 'complexity of the project' (4.94), 'Lack of tools and the equipment by the contractors ' (4.94), 'incomplete specification (4.94), 'faulty defective of working drawing' (4.94), 'budgetary limitation' (4.94), resistance of client to buildability programmes (4.94) and standardization of design,'(4.94), Poor communication skill (4.94), are very high causes of buildability problem. Causes such as 'Separate design and construction operations' (4.89), 'Lack of awareness of construction technology by designer (4.83), 'lack of awareness of buildability concept' (4.83), 'No documentation of lessons learnt' (4.83), 'Lack of construction experience by the client' (4.50), are above the value of high causes of buildability problem and are approximately in value of very high causes of buildability problem., 'Reluctance of contractor to offer pre-construction advice' (4.11) is below the value of very high causes of buildability problem and are approximately in value of high causes of buildability problem 'construction input is requested too late to be any of value' (3.67) is above the value of average causes of buildability problem and are approximately in value of high causes of buildability problem. Causes of buildability problem such as 'discontinuity of key project personnel' (3.39), Lack of mutual respect between the designers and contractor'(3.33), 'No commitment from client'(3.17),'maintenance of stating quotation' (3.06) are below the value of high causes of buildability problem and are approximately in value of average causes of buildability problem. 'lack of financial incentive for designer' (2.89) is above the value of below average causes of buildability problem and is approximately in value of average causes of buildability problem, 'perception that buildability delay projects' (1.78) is approximately in value of below average causes of buildability problem.

Table 3: Relative Index of Factors that Cause Buildability Problems

Causes of Buildability Problems	Architects RCI	Architects Ranking	Contractor RCI	Contractor Ranking	Structural Engineer RCI	Structural Engineer Ranking
Complexity of the project	5.00	1	5.00	1	4.94	1
Faulty defective working drawing	5.00	1	5.00	1	4.94	1
Lack of tools and equipment by contractors	5.00	1	4.56	11	4.94	1
Incomplete specification	5.00	1	4.95	6	4.94	1
Resistance of client to buildability programmes	5.00	1	5.00	1	4.94	1
Budgetary limitation	5.00	1	5.00	1	4.94	1
Non-standardization of design	5.00	1	5.00	1	4.94	1
Lack of construction experience by the client	5.00	1	4.58	9	4.50	13
Separate design and construction operations	4.90	9	4.95	6	4.89	9
Lack of awareness of construction technology by the designers	4.90	9	4.58	9	4.83	10
Lack of awareness of buildability concepts	4.80	11	4.72	8	4.83	10
Poor communication skills	4.80	11	4.53	12	4.94	1
No documentation of lessons learnt	4.75	13	4.16	14	4.83	10
Adversarial relationship between designers and contractors	4.00	14	4.40	13	2.83	21
Construction input is requested too late						

to be of any value	3.75	15	2.74	20	3.67	15
Discontinuity of key project personnel	3.45	16	4.05	14	3.39	16
Reluctance of contractor to offer preconstruction advice	3.45	16	3.32	16	4.11	14
Maintaining the stating equation	3.30	18	3.11	18	3.06	19
No commitment from client	2.72	19	3.32	16	3.17	18
Lack of financial incentives for designer	2.58	20	2.00	21	2.89	20
Perception that buildability delay projects	2.35	21	1.79	22	1.78	22
Lack of mutual respect between the designers and contractors	2.5	22	2.95	19	3.33	17

VIII. Index of Impact of Causes of Buildability Problems

The Relative Impact Index (RII) was used to know the degree of each factor that causes buildability problem For the architects, Table 4 shows the following impacts of the causes of buildability problem. Complexity of the project has an index value of (5.00), 'resistance of client to buildability programmes (5.00), 'non- standardization of design' (5.00), 'faulty defective of working drawing' (5.00), 'budgetary limitation' (5.00), are very high impact of the causes of buildability problem. Impact of the causes such as 'lack of tools and the equipment by the contractors' (4.95), 'Lack of construction experience by the client' (4.9), 'separate design and construction operation' (4.8), 'incomplete specification' (4.8), 'lack of awareness of buildability concept' (4.8), 'lack of awareness of construction technology by designers' (4.8), 'poor communication skill' (4.8), 'no documentation of lesson learnt' (4.75), are above the value of high impact of the causes of buildability problem and are approximately in the value of very high impact of the causes of buildability problem. Impact of the causes of buildability problem such as 'adversarial relationship between designers and contractors' (4.14), 'construction input is requested too late to be of any value' (3.65), are approximately in the value of high impact of cause of buildability problem. Impact of the causes of buildability problem such as 'discontinuity of key project personnel' (3.45), 'maintenance of stating quotation' (3.30), 'reluctance of contractor to offer pre-construction advice ' (3.25)), are below the value of high impact of the causes of buildability problem and are approximately in the value of average impact of the causes of buildability problem., 'no commitment from client' (2.89), 'perception that buildability delay projects' (2.55), 'lack of financial incentive for designer' (2.50) are above the value of below average impact of causes but approximately in the value of average impact of causes of buildability problem 'lack of mutual respect between designer and contractors' (2.40) is approximately in the value of below average impact of causes of buildability problem.

From the table, the following impact of causes of buildability problem can be seen: 'complexity of the project' (5.00), 'lack of tools and the equipment by the contractors' (5.00), 'resistance of client to buildability programmes' (5.00), 'non- standardization of design' (5.00), 'faulty defective of working drawing' (5.00), 'budgetary limitation' (5.00), are very high impact of causes of buildability problem. Impact of causes such as 'incomplete specification' (4.95), 'separate design and construction operation' (4.89), 'poor communication skill' (4.74), 'no documentation of lesson learnt' (4.71), 'lack of awareness of construction technology by designers' (4.53), 'Lack of construction experience by the client' (4.53), 'lack of awareness of buildability

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concept' (4.50) are above the value of high impact of causes of buildability problem and are approximately in value of very high impact of causes of buildability problem. Impact of causes of buildability problem 'adversarial relationship between designers and contractors' (4.00), is in the value of high impact of causes of buildability problem. 'discontinuity of key project personnel' (3.95) is above the value of average impact of causes of buildability problem but approximately in value of high impact of causes of buildability problem.. Causes such as: 'reluctance of contractor to offer pre-construction advice ' (3.32), 'maintenance of stating quotation' (3.26) 'no commitment from client' (3.16), 'are below the value of high impact of causes but are approximately in the value of average impact of causes of buildability problem. Impact of causes such as 'lack of mutual respect between designer and contractors' (2.84); 'construction input is requested too late to be of any value' (2.68), 'lack of financial incentive for designer' (2.58) are above the value of below average impact of causes but approximately in the value of average impact of causes of buildability problem. Impact of causes 'perception that buildability delay projects' (2.00) is in the value of below average impact of causes of buildability problem.

From the table above, the following impact of the causes of buildability problem: 'complexity of the project' (5.00), 'resistance of client to buildability programmes (5.00), 'non- standardization of design' (5.00), ' 'budgetary limitation' (5.00), are very high impact of the causes of buildability problem. Impact of the causes such as 'incomplete specification' (4.94), faulty defective of working drawing' (4.94), 'lack of awareness of construction technology by designers' (4.8), 'lack of awareness of buildability concept' (4.83), 'separate design and construction operation' (4.83), 'lack of tools and the equipment by the contractors' (4.80), 'no documentation of lesson learnt' (4.78) are above the value of high impact of the causes of buildability problem and are approximately in the value of very high impact of the causes of buildability problem. 'Lack of construction experience by the client' (4.44), 'construction input is requested too late to be of any value' (3.72), 'construction input is requested too late to be of any value' (3.72) are approximately in the value of high impact of causes of buildability problem. 'adversarial relationship between designers and contractors' (3.44), 'discontinuity of key project personnel' (3.39), 'no commitment from client' (3.11), 'maintenance of stating quotation' (3.06) are below the value of high impact of causes but approximately in the value of average impact of causes of buildability problem. 'lack of financial incentive for designer' (2.94), 'lack of mutual respect between designer and contractors' (2.72) are above below average impact of causes of buildability problem but are approximately in the value of average impact of the causes of buildability problem, perception that buildability delay projects' (1.33) approximately in the value of not an impact of causes of buildability problem.

Table 4: Relative Index of Impacts of Buildability Problems

Causes of Buildability Problems	Architects RCI	Architects Ranking	Contractor RCI	Contractor Ranking	Structural Engineer RCI	Structural Engineer Ranking
Complexity of the project	5.00	1	5.00	1	5.00	1
Faulty defective working drawing	5.00	1	5.00	1	4.94	6
Lack of tools and equipment by contractors	4.95	6	5.00	1	4.80	11
Incomplete specification	4.80	8	4.95	7	4.94	6
Resistance of client to buildability programmes	5.00	1	5.00	1	5.00	1
Budgetary limitation	5.00	1	5.00	1	5.00	1
Non-standardization of design	5.00	1	5.00	1	5.00	1
Lack of construction experience by the						

client	4.90	7	4.53	11	4.44	13
Separate design and construction operations	4.80	8	4.89	8	4.83	9
Lack of awareness of construction technology by the designers	4.80	8	4.53	11	4.89	8
Lack of awareness of buildability concepts	4.80	8	4.50	13	4.83	9
Poor communication skills	4.80	8	4.74	9	5.00	1
No documentation of lessons learnt	4.75	13	4.71	10	4.78	12
Adversarial relationship between designers and contractors	4.14	14	4.00	14	3.44	16
Construction input is requested too late to be of any value	3.65	15	2.68	20	3.72	14
Discontinuity of key project personnel	3.45	16	3.95	15	3	17
Reluctance of contractor to offer preconstruction advice	3.25	18	3.32	16	3.72	14
Maintaining the stating equation	3.30	17	3.26	17	3.06	19
No commitment from client	2.89	19	3.16	18	3.11	18
Lack of financial incentives for designer	2.50	21	2.58	21	2.94	20
Perception that buildability delay projects	2.55	21	2.00	22	1.33	22
Lack of mutual respect between the designers and contractors	2.40	22	2.84	19	2.72	21

IX. Conclusion and Recommendation

From the analysis and interpretation of the result, it was observed that the occurrence of buildability problem is increasing in proportional to the period of time. Hence, the occurrence is increasing in ascending order with period of time (the highest occurrence of buildability problem occurred at period of 1 year and descending from six months, three months one month and lower at one week period of time. The very high causes of buildability problem from the comparison of the result of three different parties of respondent are: complexity of the project, faulty defective of working drawings, resistance of client to buildability programmes, budgetary limitation, non standardization of design which are ranked as 1 by the three different parties. Incomplete specification, separate design and construction operation, lack of awareness of construction technology, lack of awareness of buildability concept, poor communication skill is approximately in the value of very high cause buildability problem. Other causes such as no document of lesson learnt, adversarial relationship between designer and contractor, construction input is request too late to be of any value, discontinuity of key project personnel are between high cause and average causes of buildability problem. Also, from the analysis, interpretation and comparison of three different types of respondents, it can be observed that the causes of buildability that have very high impact on construction site are ranked as 1, namely; complexity of the project, resistance of client to buildability programme, budgetary limitation, non standardization of drawing follow by faulty defective of working drawing, lack of construction experience by the client, separate design and construction, incomplete specification etc.

This research has identified some causes of buildability problems as having very high impact on construction site. The following suggestions if well adhered to could bring about possible reduction in the causes of buildability problem on construction project. The project should not be so complex in a way that leads to buildability problem. Working drawings should be designed by the practicing design experts with construction experience in order to avoid faculty defective of working drawings. Clients should not be resisted to the buildability programme. Sufficient fund must be budgeted for construction work and design must be of the standard one. The specifications should be complete and comprehendible. Both designers and contractors should be aware of construction technology. The parties involved in the construction project should be aware of buildability concepts. The communication skill among the parties involved must be effective. Also, those causes of buildability with high impact on the construction project must be understood by all the parties involved in the construction of the project.

References Références Referencias

1) ASCE, C. M. C. o. t. C. D. (1991). Buildability and buildability programs: White papers. *Journal of Construction Engineering and Management, 117*(1), 67-89.
2) Bamisile, A. (2004). Building Production Management. Foresight Press Limited, Lagos, Nigeria, pp. 23-145.
3) Business Roundtable, Integration Construction Resources And Technology into Engueering, Report B-1. A Construction Industry Cost Effectiveness Project Report .New York, The Business Roundtable,1982.
4) Chen, S.E., McGeorge, D. and Vernam, B.L. (1991). Report to the Government Architect Construction. New South Wales, Buildability stage 1. Tundra, University of New Castle.
5) CIRIA (1983) Buildability: an assessment. London: Construction Industry Research and Information Association (CIRIA).
6) Construction Industry Institute, Buildability: a Primer, Publ. 3-1, University of Texas at Austin, TX., 1986.
7) Fisher, D.J., and Rajan N. (1996). Automated Buildability: Analyze of Workzone Traffic Control Planning, J. Constr. Engineering and Management, vol, 122, No. 1, March.
8) Gray, C (1990) Buildability; the Construction Contribution. Occasional Paper No. 29, The Chartered Institute of Building, Englemere, Kings Ride, Ascot, UK.
9) Kartam, N.A. (1996). Making Effective use of Construction Lessons Learned in Project Life Cycle. J. Constr. Engineering and Management Vol. 122, No. 1, March. Pp. 14-21.
10) Lores HG.V. Assessment of Buildability Practices among General Contractors in the South East of the United States. Thesis, University of Florida, Gainesville, f.L. 1997
11) Obiegbu, M.E. (2004). Buildability and Maintainability Analysis. The Professional Builder, Journal of the Nigerian Institute of Building, pp. 3-8.
12) Russell, J.S. and Gugel, J.G. (1992). Comparison of Two Corporate Buildability programs. Journal of Construction Engineering and Management, Vol. 119. No 4. Pp. 23-32.
13) .Tindiwensi, D (1996) Steel Structure Buildability Considerations in Developing Countries. Paper to Structural Steel Developing Africa, Conference'96, Sandton, Gauteng, South Africa.
14) Uhlik, F.T., and Lores, G.V. (1998). Assessment of Buildability Practices among General Contractors. Jour. Of Architectural Engineering, Vol. 4 No.3.