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FACTORS RESPONSIBLE FOR MATERIAL WASTAGES ON CONSTRUCTION SITES IN JOS, NIGERIA

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ABSTRACT

This paper presents the results of an empirical study of building material wastages as a recurrent problem on construction site in Nigeria and proffered solutions for curtailing of these wastages. The focus is on three areas, namely; factors responsible for material wastages on building sites and their frequencies of occurrence; materials susceptible to excessive wastages; and effectiveness of factors for the minimization of material waste. The results show that management; construction and client related factors are most frequently occurring and contribute most to overall wastages of materials on sites. The paper concludes that taking into account the suggested level of effectiveness of the factors identified in this study and implementing them in order of priority is a panacea for excessive wastages on project sites.

INTRODUCTION

It is universally recognized that wastages of materials occur on building sites, which can be minimized if the circumstances leading to it are taking into cognizance. This is because building construction is a highly organized activity involving the building team, materials, the site for construction and the type of structure to be erected. A building material becomes classified as waste if it may have been broken, disintegrated, misshapen, damaged or completely lost.

Material wastage is defined by the Chartered Institute of Building (1979) as "the difference between the value of those materials delivered and accepted on site, and those properly used as specified and as accurately measured in the work, after deducting the cost saving of substitute materials and those transferred elsewhere". With the cost of material components contributing significantly to overall construction cost (Wyatt, 1978), high rates of material wastages on building site as currently experienced could be partly responsible for the prevalence of project cost overruns.

Studies had been undertaken in the past on the problem of material wastage in construction. The identified factors responsible for material wastage include; design errors (Samman, 1999); contractors failures to adopt effective on-site control of materials (Skoyles, 1987); inadequate material scheduling, delivery, checking and offloading of materials and components on site, delivering more materials than are actually required on site due to over-estimation, poor materials handling and placing, and inadequate care and protection of materials (Wyatt, 1978). According to Butler (1979), planning aims at laying down the direction in which a move is to be made forward taking into account the resources that are available in terms of the 5M's of management i.e. men, materials, machines, money and methods.

Construction project planning is an activity requiring a mature and balanced outlook, thorough knowledge and experience in construction technology and practice, purchasing and general financial control. It equally requires a systematic and analytical approach (Ngoka, 1987). Project planning also involves the determination of ways of carrying out a company's operations which entails the identification of the company's objectives, the overall plans, the assessment of cost and organizational requirements, the scheduling of equipment, the preparation of working instructions and techniques as well as the balancing of personnel

requirements for the execution of contracts (Butler, 1979). The ultimate objective of construction project planning is to minimize the input of resources in order to reduce production costs, so as to maximize profit.

The importance of planning and control in project execution is to gain economical operations, to offset uncertainties and change, to focus attention on objectives, to facilitate project cost and time tracking, to resolve delays and change orders (variations) on a predefined and equitable basis and to allocate contractual responsibilities and provide for clear lines of communication. (Nwachukwu, 2003).

In whatever form, material wastages have serious implications to the stakeholders in the building procurement process. To the contractor, it reduces the expected profit from a project; to the client or developer, it escalates the development costs and undermines values; to the consumers and the society at large, it results in high purchase prices and rental charges. (Motete, et al., 2003).

This paper examines the key factors affecting material wastages peculiar to some building sites in Jos. The work also addresses the issues of construction project planning and control as they relate to effective (successful) project execution in the Nigerian construction industry. These have serious impact on effective waste minimization hence the focus on them as the objectives of this paper.

METHODOLOGY

The study utilized structured questionnaire to collect the necessary data. This was carried out in two stages. The first stage involved non-standardized in depth interviews conducted for 12 heads of building construction companies who are registered with the Corporate Affairs Commission and are operating as general contractors within the Jos metropolis. The responses obtained at the exploratory survey stage were used to design questionnaire, which was later administered.

The data analysis involved the computations of mean rating (MR) of each variable by respondents within a given subset. In each computation, the total number of respondents (TR) rating each variable, was obtained and used to calculate the percentages of the number of respondents associating a particular rating point to each variable. This was done as follows:

Mean Rating (MR): This was calculated as the sum of the products of each rating point (Rp) and the corresponding percentage response to it (R%) out of the total number of responses (TR) involved in the rating of a particular variable. This is given in equation 1 as:

$$MR = \sum_{i=1}^{5} (R_{pi}R_i\%) \quad \text{.....(1)}$$

Where

R_{pi} = Rating point ranging from 1-5
R_i = Percentage response to rating point i.

RESULTS AND DISCUSSION

Exploratory Survey

Sixty questionnaires were distributed to the target population of contractors, out of which twenty-seven usable responses were received, representing 45% useful response rate. An analysis of the demographic characteristics of respondents showed that 75% had upward of twelve years experience in the construction industry with first degrees as their highest academic qualification. Possessing these profiles of long experience and sound educational background, the respondents' opinion was adjudged to be adequate for the research.

Factors responsible for material wastages

The exploratory survey results revealed six basic groups of factors responsible for material wastages on building sites. They include storage factors, client, management and construction related factors. Others are design and force majeure. Table 1 presents the results of respondents rating of the degree of contribution of each of the factors to material wastages.

TABLE 1: DEGREE OF CONTRIBUTION OF FACTORS AFFECTING MATERIAL WASTAGES

Factors responsible for material wastage	Levels of contribution to material wastage VH 5 %	H 4 %	AV 3 %	L 2 %	VL 1 %	MR	RO	TR
1. Management Related								
a) Poor planning and organisation	76	13	0	11	0	4.54	2	27
b) Poor control and monitoring.	60	30	10	0	0	4.50	3	27
c) Poor material management.	70	25	0	0	5	4.55	1	27
d) Overestimating the required quantity	3	37	50	10	0	3.33	15	27
e) Indiscriminate use of materials	0	60	40	0	0	3.60	11	27
2. Construction Related								
a) Misinterpretation of drawings	2	44	0	50	4	2.9	18	27
b) Faulty workmanship	40	37	23	0	0	4.12	5	27
c) Productivity Problems e.g. use of female operatives	0	42	38	20	0	3.22	16	27
d) excess input due to excavation	32	40	28	0	0	4.04	6	27
e) Pilfering and vandalism	20	45	0	35	0	3.50	13	27
f) Poor supervision	65	20	0	5	10	4.25	4	27
3. Force Majeure								
a) Act of God and site Accidents	0	2	50	48	0	2.54	21	27
b) Negligence/damage by other trades	0	10	30	60	0	2.50	22	27
c) Damage by inclement weather	0	16	44	40	0	2.76	19	27
4. Client Related								
a) Expectation of high standard	0	40	0	45	15	1.85	24	27
b) Repeat works/late changes	0	0	27	33	40	1.87	23	27
c) Too much pressure to deliver project	0	28	2	70	0	2.58	30	27
d) Unnecessary interference to deliver project	0	0	10	50	40	1.70	25	27
5. Design Related								
a) Uneconomic designs due to client brief.	0	20	60	20	0	3.40	14	27
b) Architects variation instruction	40	12	40	0	8	3.76	8	27
c) Detailing errors	0	20	47	33	0	3.53	12	27
d) Wrong material & standard specification	0	50	36	0	20	3.10	17	27
6. Supply and Storage								
a) Improper material handling	33	27	0	50	0	3.73	9	27
b) Poor storage	50	0	30	20	0	3.80	7	27
c) Mode of delivery e.g. loose as against packaged forms.	34	11	48	0	7	3.65	10	27
						83.32		

Levels of contribution to materials wastage: very high = VH, High = H; Average = AV; Low = L; Very Low = VL; Ro = Rank order; TR = Total no. of Respondents;

From Table 1, based on mean rating (MR) values using equation 1, management and construction related group of factors were perceived to exert the most significant impact on

overall wastage of materials on site. In the management related group of factors, poor control and monitoring is the most significant contributor to material wastage. In the construction related group of factors, poor supervision features as the most significant contributor to wastage. These factors, poor control and monitoring and poor supervision appeared very significant in terms of their rate of contribution to material wastages in this study. Since the degree of control and monitoring and supervision has a direct bearing on wastages of material, this result is expected. From Table 1, supply and storage factors and design related factors attracted low rating from respondents. This is however questionable given the prevalence of poor storage facilities which often give rise to premature material deterioration in quality and incompetent design consultants and quacks carrying out design commission and specifications resulting in building failures and risk of lives and safety of occupants.

From Table 2, the mean rating (MR) values were computed using equation 1 based on the frequency of occurrence. Table 2 shows that management related factors and construction related factors were most frequently occurring indicating that the respondents perceived them to contribute most to material wastages.

TABLE 2: BASIC CATEGORIES OF FACTORS CONTRIBUTING TO MATERIAL WASTAGES AND THEIR FREQUENCY OF OCCURRENCE.

	Categories of Factors	Frequency of Occurrence					MR.	Rank order
		5	4	3	2	1		
		VVF	VF	F	SF	NF		
1.	Management related	50	30	20	0	0	4.30	1
2.	Construction related	0	50	50	0	0	3.50	2
3.	Client related factors	25	20	45	0	0	3.40	3
4.	Design related factors	0	45	35	10	10	3.15	4
5.	Supply and storage	30	20	0	0	50	2.80	5
6.	Force majeure	0	10	40	50	0	2.60	6

Very Very frequent = VVF; Very Frequent = VF; Frequent = F; Somewhat Frequent = SF; Not Frequent = NF

Table 3: Effectiveness of Factors for the Minimization of Material Waste

	Effectiveness of Factors	Levels of effectiveness 5 % VE	4 % E	3 % SE	2 % LE	1 % NE	MR
1.	Effective material planning and control policy	90	10	0	0	0	4.9
2.	Strict site supervision and monitoring	80	20	0	0	0	4.8
3.	Proper storage, handling and use of materials	70	30	0	0	0	4.7
4.	Correct and comprehensive design and detailing	40	50	10	0	0	4.3
5.	Motivation and training of site personnel	36	44	20	0	0	4.1
6.	Recovery and recycling of materials	0	55	45	0	0	3.55
7.	Site security	0	37	63	0	0	3.37
8.	Avoidance of undue interference	2	80	18	0	0	3.34
							33.56

Level of effectiveness VE = Very Effective 5; E = Effective 4; SE = somewhat effective 3; LE = Less Effective 2; NE = Not Effective = 1

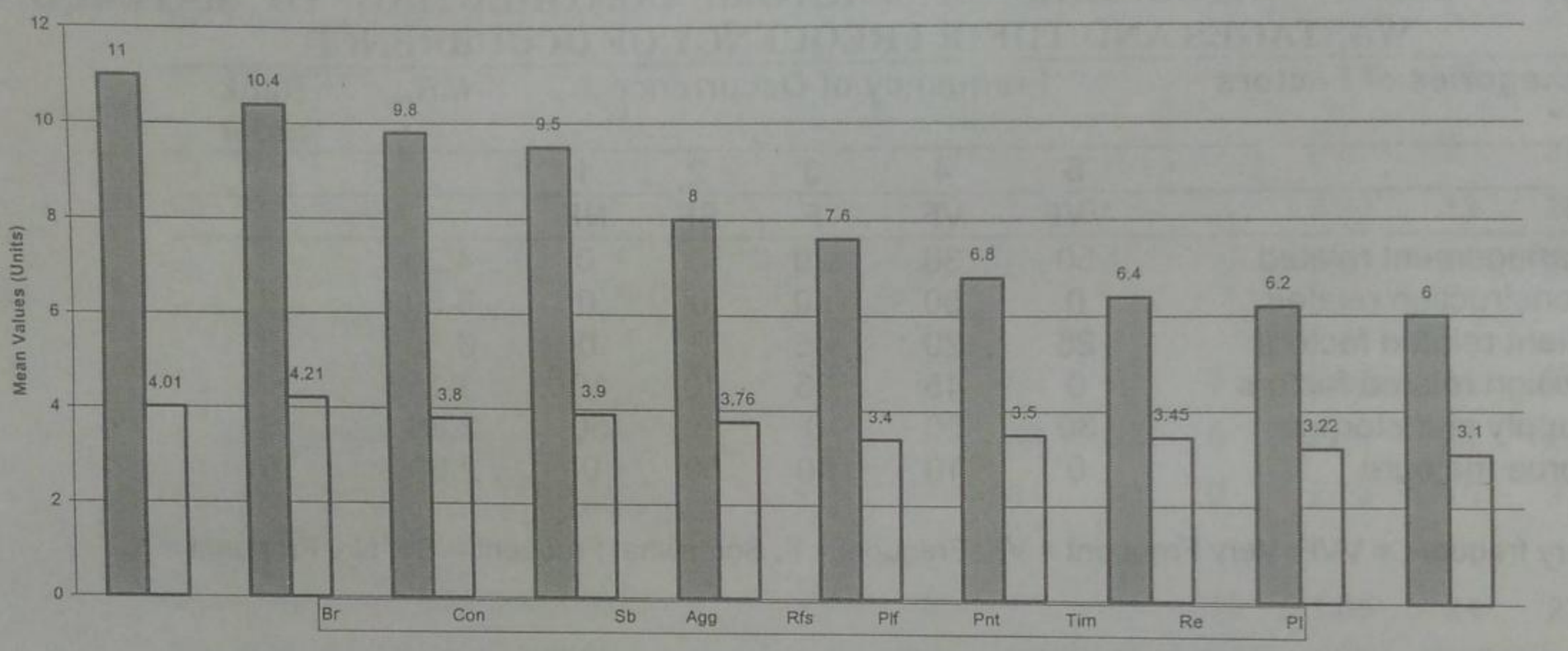
The suggested level of effectiveness and factors for minimizing material wastages were analysed from the respondents rating. The Mean Rating (MR) values were computed using

equation 1. It is evident from Table 3 that majority of the respondents favoured planning, control and monitoring as effective measures for curtaining material wastages. This is also consistent with earlier findings for instance Lampert, (1990) and Motete et al (2003), laments on the "serious lack of awareness and care amongst management and supervisory staff regarding the utilization of materials and equipment." What appeared to be at variance with the expectation of this study is the perception of respondents rating of site security as not very effective considering the level of daily pilfering on sites.

Materials Liable to Excessive Wastages

Materials: Bricks (Br); Concrete (Con); Sandcrete (Sb); Aggregate (Agg); Roofing Sheet (Rfs); Plumbing fitting (Plf); Paint (Pnt); Timber (Tim); Reinforcement (Re); Plastic (Pl)

Fig. 1: Histogram showing wastage levels and contribution to cost overrun



The prevalence of materials prone to excessive wastages were analysed from respondents rating and their relative conuribution to project cost overruns. The materials studied are Reinforcements, Plastics, Timber, Aggregates, Concrete, Plumbing fittings, Roofing sheets, Bricks, Sandcrete, Blocks, Aggregates and Paints (Fig. 1). From the respondents rating, concrete, bricks and sandcrete blocks have the highest mean values signifying their levels of contribution to project cost overrun. The sights of broken bricks and wasted heaps of concrete littering most construction sites further give credence to this study. They are not only hazardous but pose serious threat to safety and health of workers on site.

CONCLUSION

The research was an attempt to critically examine material wastages on building sites and measures for curtailing of these wastages. The conclusion drawn from this study is that the factors underlying material wastages on building sites can be grouped into six, namely; design, supply and storage, client, and management related factors. These are the most frequently occurring and are responsible for overall wastage of materials on most sites. The most outstanding factors in all the groups are poor planning, control and monitoring which are management related. Bricks, concrete and sandcrete blocks features as the materials prone to excessive wastages and contribute significantly to project cost overrun. The most effective strategy for curtailing material wastage is to prevent wastage from occurring in the first place. Findings from this study show that planning, control and monitoring are most reliable strategies

for curtaining material wastages on building sites. Taking into cognizance the factors responsible for material wastages and putting into practice the strategies for curtailing wastages identified in this study is a panacea for excessive material wastages on building sites. However, the results provide building blocks for future study in this area of concern.

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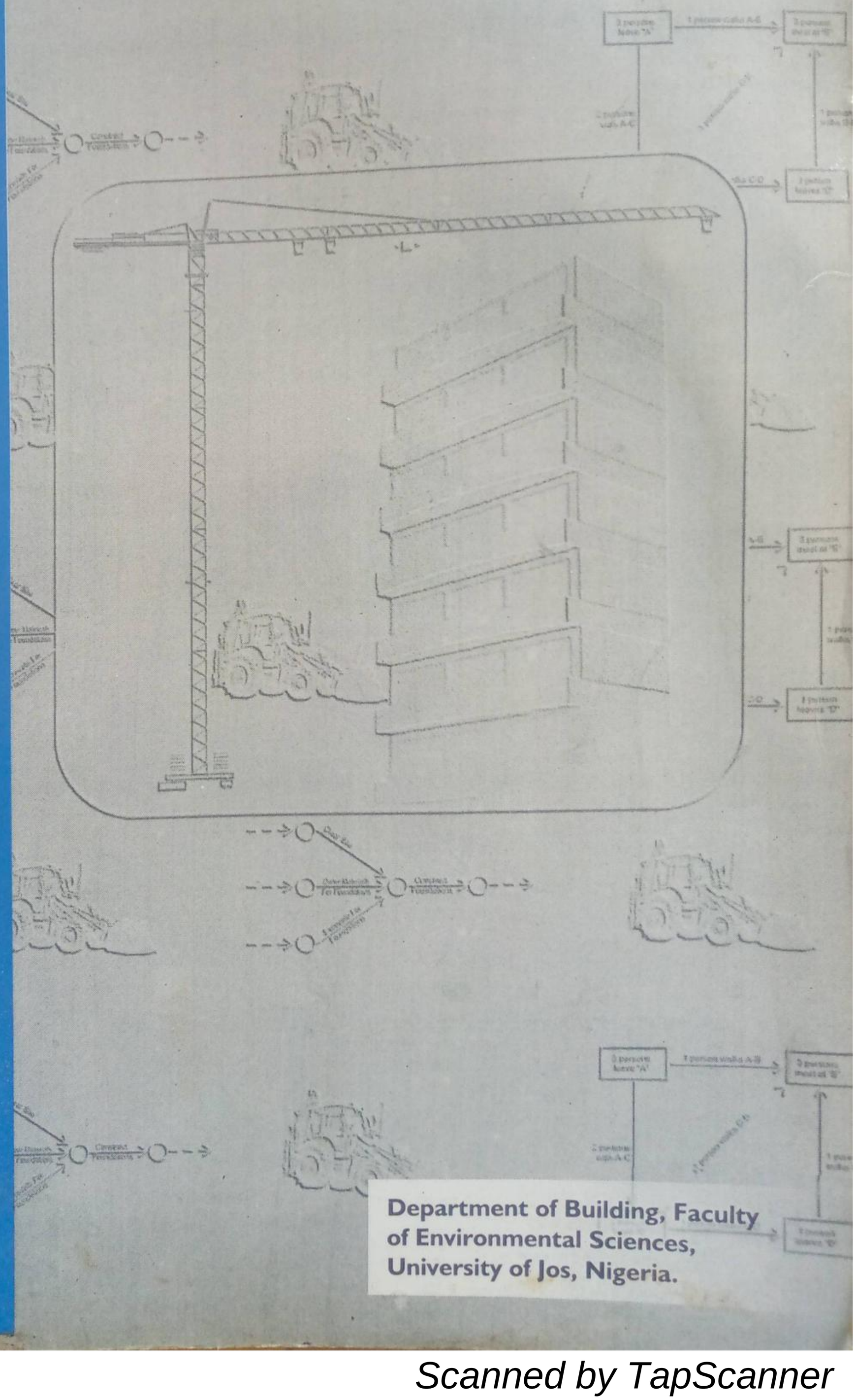

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