

# Identification of Causes for Construction Waste Material in Construction Projects of Sindh Province

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**Abstract** - Construction waste is the global conundrum around the globe by the contractors and researchers. Increasing waste could lead to the failure of the construction project. More specifically, Productivity, sustainability, construction cost and construction time are one of the aspects which are hugely impacted by construction waste. The study was made to identify different factors resulting construction waste in Sindh province. A comprehensive structured questionnaire was set focusing on three branches (i.e Clients, Contractors & Consultants) working in construction projects of Sindh. Statistical software package SPSS was used to integrate the data. Reliability of which was found as 0.89 justifies the reliability of data collected. Mean rank calculations of causes listed the key critical factor to be “unreliable strategies for minimization of waste”, “unreliable management plan for waste”, “ineffective scheduling and planning of the project by the contractor”, “conversion waste from cutting uneconomically shapes”, “use of excessive material quantity more than the required”, “difficulties in obtaining work permit”, “inadequacy of instruction regarding stacking and incorrect material usage therefore it require replacement”. Through methods to identify the causes of construction waste in Sindh province it is aimed to provide good service to construction firms in present and future projects both in terms of environment and the economy.

**Keywords:** Construction Waste, Factors, Sindh, Causes.

## I. INTRODUCTION

The number of incessant and random construction works increase, with increasing population. [1][2] Construction waste, Produced during construction or renovation of residential and commercial projects, is dumped in open pits which has deleterious impact on social life and environment [3]. Construction waste is a financial burden on the project that's why other developing countries are working on a process of systematic regulations to counter the waste. [4] The problem caused by construction waste becomes grave in Pakistan due to a little research available in the field;[5] only analytical survey of the construction site is the technique

available to gather data to sort out the problem caused by such waste. [6][7] Mishandling of the construction waste is one of the severe problems in Pakistan and is due to almost zero awareness regarding the hazards of the waste. [8][9] Construction waste includes fine and coarse concrete aggregates, masonry bricks, full and empty cement bags, reinforcement (Steel) and excavated earth [10]. Waste defined as unnecessary or discarded materials [11,12].

The waste causes global warming problems and ecological disturbance in the planet earth [13,14]. The categories of waste produced include biodegradable waste, urban waste, commercial waste, medical and construction waste. The urban or solid municipal waste is called as trash and garbage and any household [13,15]. The waste usually occurs from construction and industrial areas [16]. Medical waste, also called clinical, can be defined as waste commonly generated through diagnosis, immunization of human beings or treatment in clinics and hospital [17]. The term biodegradable waste is defined as waste which can be decomposed by aerobic or anaerobic process. The waste is wood, textiles, food processing paper etc. [18]. The research study focuses on identifying the causes responsible for generating waste due to construction. The production of wastes at construction sites in non physical forms and physical form are equally dangerous. The physical form of waste is generally from debris, brick metals and paper waste etc, while the non-physical form of waste is cost overrun and time delay in construction projects [19]. Construction waste is an acute problem faced by the contractors and researchers around the globe. Construction waste in the urban areas of developing countries is incessantly increasing [20]. Research studies in USA and Europe have discovered that significant quantity of waste is produced during construction activities [21]. Additionally Srilankan researchers also disclose that manpower in domestic construction firm is unaware of course of activities which produce construction waste [22].

Moreover, Nigerian researcher are of the opine, that construction waste can be categorized in three stages, planning, estimation and construction [23]. During operational, design, material handling and procurement points waste is generated as per research in Singapore [24]. In

addition, failure on the part of construction manager to identify and tackle waste in construction project leads to several environmental causes [25].

Like all developing province, Sindh also faces problems of construction waste in race against the faster progress of construction zone. Huge quantity of construction waste is being produced in sindh with growing need of infrastructure projects and housing development projects, which have massive, project cost and time impact of the project. The main research objectives are identifying the causes of waste due to construction in Sindh province and the possible measures to reduce them.

## II. CAUSES OF CONSTRUCTION WASTE

Serious issues such as safety unhygienic, abysmal insufficient quality and working conditions have been experienced by construction industry as in [26]. Moreover some of the factors like lack of quality material; lack of equipments, naive supervision and rebuild has been identified as influencing productivity in construction industry of Indonesia [27]. A study in Singapore shows, new procurement to substitute wasted materials, modification of mistakes, and administrative delays and dealing with generated wastes causes gigantic economic loss to contractors as stated in [24]. Some researchers have discussed major factors producing waste due to construction at site. Grouped factors can categorize in five aspects. I.e. Procurement, Contractual Documents; Operations at site: Managing Site and Practices and; Supervising Projects. Secondly he discussed essential remedial measures which were resulted by consideration of some critical factors that causes the generation of construction waste [28].

Beside that researcher discussed ways to reduce waste due to construction projects by observing the root cause of waste and the severity of each cause. The identified causes lead to the conclusion that there is an urgent need of adopting waste minimization strategy in construction industry of Pakistan and devolving countries having similar scenarios [29]. In Jordan a study has discussed standard of the contract document that should be improved. Preparing improved storage facilities close to the site, employing qualified administrative staff on-site with help of contractors in order to avoid errors that occurred in over allowances and quantity surveying, labor and supervisors for the work should be done. Introducing secured security systems that include lighting, fencing, and protected storage in order to avoid vandalism and theft. [30] China's construction industries are required to progress rapidly towards urban development these years to come to as a result of huge scale urban development programs in metropolitan cities which ultimately created huge amount of construction

waste, and causing huge ecological effects [31]. Approximately 1 billion tons of construction waste was produced by china in 2013 in report published by National Development and Reform Commission of China, which was 5% of the construction waste recycled or reused [32]. At the end of 2015 in shenzhen, China, catastrophic incident happened, a pile of construction waste unfortunately collapsed [33]. Three dozen structures were covered in landslide of construction waste left 85 individuals missing. China was facing many difficulties for overseeing construction waste with significant urban advancement all through the nation [34]. Articles in this study are referred to collect the factors causing construction waste which are listed and ranked as per mean value rank below.

## III. PRELIMINARY SURVEY

Pertaining to building issue due to waste, from well known considered factors a well equipped development of questionnaire were assimilated in the province of Sindh. In this research we have distributed the questionnaire randomly with help of bi-pronged approach via mail through postal and by proper visits to the relevant departments. We distributed 300 questionnaires and among those questionnaires, 225(75%) of the relevant respondents that were returned once those were filled. We analyzed the Information received from the questionnaires with the help of Statistical Software Package, and we used Mean Rank in this research. The reason behind demography of respondent is to recall the respondent potentialities to understand the main issues of waste due to construction. The initial demography of this observation is the respondents' clusters. It is observed that commonly the respondents were contractors, 59%, by following with help of Consultants, 27% and minimal is the clients, only 14% of overall respondents. With the help of pie chart, statistics are observed that field of contractor hold crucial involvement in this research.

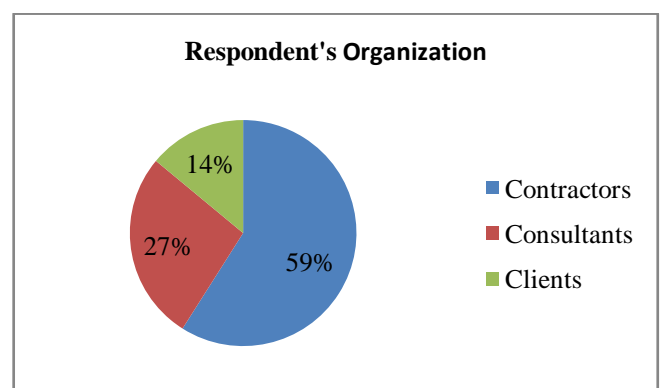


Figure 1: The Organization of Respondents

Subject to the practice in industries related to construction was found in this assessment that large percentage respondents

i.e. 62% were having work experiences from (6 – 10) years, following the statistics 25% respondents possessing working experience from(11 - 15) years. The marginal set of respondents related to work experiences were those with experience less than 5 years, is 13%.

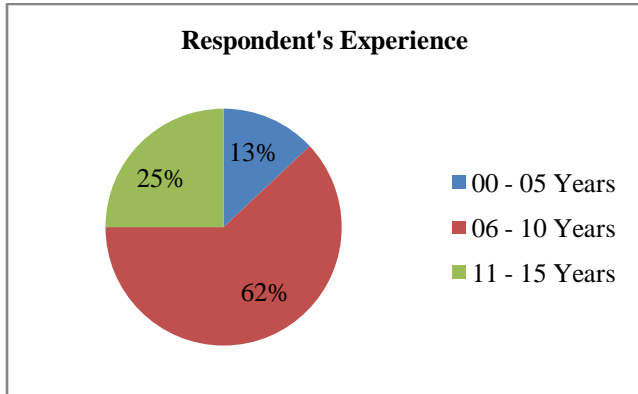


Figure 2: Respondent's Experience in Construction

The respondent specialization respondents as depicted in Figure 3. The Chart signifies 63% respondents acquired B.E. The next highest of respondent's education standard is M.E. 16%.

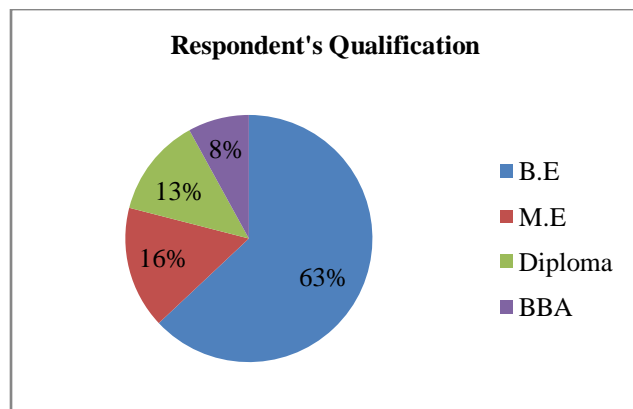


Figure 3: Respondent's Qualification

The Diploma holder consists of 13%, while B.B.A holders contribute the minimal percentage about only 8% of total respondents. This point out, that 71% of respondent holds bachelor's degree. Concluding the respondents to be well educated.

#### IV. SIGNIFICANT CAUSES

Reliability test is conducted to check the consistency and stability of data. In this test Cronbach's alpha (coefficient of consistency) is determined consecutively to specify the data to be consistent. The value of Cronbach's alpha near to unity, higher will be the internal consistency of the data [35]. In this study, the alpha value for the consistency test carried on data collected was ought to be 0.89 which shows the data collected is highly reliable.

#### Mean Rank

Mean Rank approach method is used to determine significance of the factors. Kendall's Wor Mean Rank is a non-parametric value. The factor with high value of Mean Rank is placed at the principal position. The standing of the factors contributing waste is calculated through Mean Rank Calculation as:

$$M_R = \frac{\bar{R}}{M_{MAX}} N$$

Where:

$M_R$  = Mean rank

$\bar{R}$  = Individual Mean Rank of factor

$M_{MAX}$  = Maximum Individual Mean Rank of factor

$N$  = Number of factors

The table shows analysis of each factor, contributing in construction waste with mean value rank and placing in position according.

Table 1: List of the causes of construction waste with mean rank value and rank

| Factors Contributing In Construction Waste                               | Mean Rank Value | Rank |
|--|-----------------|------|
| Lack of strategy to waste minimization                                   | 4.91            | 1    |
| Lack of waste management plan  | 4.83            | 2    |
| Ineffective planning and scheduling of the project by the contractor     | 4.67            | 3    |
| Conversion waste from cutting uneconomically shapes                      | 4.52            | 4    |
| Using excessive quantities of materials more than the required           | 4.38            | 5    |
| Difficulties in obtaining work permits                                   | 4.23            | 6    |
| Insufficient instructions about storage and stacking                     | 4.17            | 7    |
| Use of incorrect materials, thus requiring replacement                   | 4.06            | 8    |
| Lack of workers or tradesmen or sub contractor's skill                   | 3.98            | 9    |
| Inappropriate storage leading to damage or deterioration                 | 3.94            | 10   |
| Rework due to worker's mistakes  | 3.87            | 11   |
| Residual such as off-cuts from cutting materials to length and packaging | 3.80            | 12   |

|  |      |    |
|--|------|----|
| Others such as lack of site materials control and waste management plans     | 3.79 | 13 |
| Poor management and distribution of labors, materials and equipments         | 3.74 | 14 |
| Poor work man ship   | 3.67 | 15 |
| Lack of storage of materials near construction                               | 3.61 | 16 |
| Wrong handling of materials  | 3.58 | 17 |
| Substitution of a material by a more expansive one                           | 3.54 | 18 |
| Poor provision of information to project participants                        | 3.49 | 19 |
| Accidents due to negligence  | 3.42 | 20 |
| Purchased materials that don't comply with specification                     | 3.36 | 21 |
| Damage during laying materials on site                                       | 3.28 | 22 |
| Waiting of workers or materials or equipments to arrive                      | 3.21 | 23 |
| Poor storage of materials  | 3.14 | 24 |
| Waiting for material to be replaced not fulfilling project requirements      | 3.10 | 25 |
| Operation such as tradesperson's error and equipment malfunction             | 3.02 | 26 |
| Poor site layout   | 2.94 | 27 |
| Poor qualification of the contractor's technical staff                       | 2.91 | 28 |
| Effects of sub surface conditions  | 2.86 | 29 |
| Under ordering due to lack of coordination b/w warehouse & construction crew | 2.79 | 30 |
| Choice of wrong construction method  | 2.77 | 31 |
| Poor technology of equipment   | 2.71 | 32 |
| Severe weather conditions  | 2.65 | 33 |
| Subsurface site conditions materially differing from contract documents      | 2.60 | 34 |
| Shortage of manpower (skilled, semi-skilled and unskilled labor)             | 2.56 | 35 |
| Unfriendly attitudes of project team and labors                              | 2.50 | 36 |
| Inadequate stacking and insufficient storage in site                         | 2.47 | 37 |
| Manufacturing defects  | 2.35 | 38 |
| Over-sized any element during execution                                      | 2.30 | 39 |
| Damage materials on site   | 2.26 | 40 |
| Damage due to weather such as temperature and humidity                       | 2.23 | 41 |
| Shortage of tools and equipments required                                    | 2.18 | 42 |
| Equipment frequently breakdown   | 2.07 | 43 |
| Over ordering and under ordering due to mistake in quantity surveys          | 1.92 | 44 |
| Problems between the contractors and his subcontractors                      | 1.83 | 45 |
| Insufficient instructions about handling                                     | 1.77 | 46 |
| Misplacement of material at site   | 1.65 | 47 |
| Using entrained labors   | 1.59 | 48 |
| Changes in material prices   | 1.52 | 49 |
| Theft and vandalism  | 1.40 | 50 |
| Effects of political and social conditions                                   | 1.36 | 51 |
| Security such as damage on construction site due to vandalism                | 1.25 | 52 |

Following 8 factors have the highest mean value rank among the other factors and are considered significant.

- i. Lack of strategy to waste minimization
- ii. Lack of waste management plan
- iii. Ineffective planning and scheduling of the project by the contractor
- iv. Conversion waste from cutting uneconomically shapes
- v. Using excessive quantities of materials more than the required
- vi. Difficulties in obtaining work permits
- vii. Insufficient instructions about storage and stacking
- viii. Use of incorrect materials, thus requiring replacement

**Lack of strategy to waste minimization**

The factor with highest mean rank value of 4.91 ought to be lack of strategy to waste minimization. It is the most significant factor affecting the construction waste [29].

**Lack of waste management plan**

The second most crucial factor with the mean rank value of 4.83 and the critical issue faced by several national and international organizations, imposition of waste management plan in construction sector minimizes the waste generation aside from the major problem of high investment cost [36].

### ***Ineffective planning and scheduling of the project by the contractor***

The ineffective scheduling and planning of project by contractor is placed on third rank by the mean rank value coefficient 4.67, although the factor was determined as key variable contributing in construction waste. It is stated in another study that ineffective scheduling and planning may demand for rework in building [37].

### ***Conversion waste from cutting uneconomically shapes***

Cutting uneconomical shapes has greater impact on generating construction waste [38]. The fourth critical factor suggesting for the skilled labor understanding the value of reducing construction waste.

### ***Using excessive quantities of materials more than the required***

A large quantity of waste also produced while utilizing excessive quantity more than required while the concern about the factor during interview from experts was the contractor's used to order the material in large quantities to make it economical for the project. A study shows that time duration after unloading material at site is examined closely, it is known that massive quantity of materials are being wasted due to negligence and poor material control at building sites [39].

### ***Difficulties in obtaining work permits***

Construction firms have always faced such problems related to the work permits which ultimately delay the scheduled construction activity yet their initial time and cost estimates exceeds which ultimately results extensive delay in project [40]. The pre-ordered material at site was of no use as time exceeds and at end it becomes construction waste.

### ***Insufficient instructions about storage and stacking***

Insufficient instruction about storage and stacking on site is also a chief important reason for waste. Adequate storage facility has an advantage. Contractors seldom realize of the benefits known to them through plenty stock. A thorough practice of management labour in administration and provision of suffice storage is incumbent [37].

### ***Use of incorrect materials, thus requiring replacement***

The last critical factor with mean rank value of 4.06 put concerns on replacing any material on site will generate great construction waste. A study conducted on rivers state, Nigeria which ranks the factor, use of incorrect material on seven with mean scale of 3.69 [37].

## **V. RESULTS AND DISCUSSIONS**

In this study 300 Questionnaires were sent to the professionals out of which total of 225 questionnaires were received. The data was analyzed with SPSS method the mean rank value and the rank of the factors are shown in the table.

The result in table shows eight factors are most critical whose mean rank value is greater than 4. "lack of strategy to waste minimization has been listed on top among other factors with the mean rank value of 4.91 also "Lack of waste management plan", "Ineffective planning and scheduling of the project by the contractor", "conversion waste from cutting uneconomically shapes", "Using excessive quantities of materials more than the required", "Difficulties in obtaining work permits", "Insufficient instructions about storage and stacking", "Use of incorrect materials, thus requiring replacement" are among the most critical factors.

## **VI. CONCLUSION**

Construction industry is found as a key source of construction waste. This study was aimed to found out most critical factors and severity of each factor causing construction waste in the vicinity of Sindh province. The result of this research leads to the conclusion that there is dire need of waste management plan which will not only help in economy of the project but also serves the term "environment".

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