

**Review Article:**

## Identifying Wastages of Construction Materials in Residential Building

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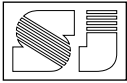
### Abstract

Wastage of construction materials can be estimated by the difference between the value of materials delivered and accepted on site and those properly used as identified and exactly computed in the work. The elements of construction wastage are wastage due to labor, material and machine. This research study organized to identify the percentage of construction materials wastage and the main factors which cause wastage in residential houses in Erbil. The questionnaire form was designed and sent to foremen, masons, supervisor engineers at construction sites as respondents who have at least 10 years' experience in construction of houses. Data analyzed by the statistical package SPSS program (version 22). The results showed that the maximum percentage of wastage were in the sand, gypsum, wall tiles and floor tiles with relative average percentage of 13.7, 12.08, 12.03 and 9.10 respectively, while the minimum percentage of wastage in construction material are false ceiling and paints with relative average percentages of 4.70 and 4.67 respectively. The most effective causes of wastages are due to cutting uneconomical shapes, ordering additional amount more than required, damages due to transportation, storage and handling. The best ways for reducing wastages of materials are procuring, handling, and storing properly.

### 1. Introduction

Construction performs an essential role in developing the basis infrastructure of the country. Nevertheless the troublesome faced by the industry is the waste of construction material. Construction activities create extra waste

materials contrasted to other industries. All the construction materials consumed in the construction activities become wasted, which in turn arises the cost and decrease the profit for contractor and provides a negative influence to the environment (Teshome and Thakur, 2018).



Construction materials characterize as a major cost element of a civil engineering structure. The cost of construction materials could be more than 65% of the entire budget, acquired from the building of a Civil Engineering structure. Though, it is founded upon the kind of project, the construction method, technique, and the plant used (Kanimozhi and Latha, 2014).

Wastage of construction materials signifies to solid wastage having and including no liquids and hazardous materials. The main causing of wastage in the procedure of building of structures, involving construction of each type of buildings (both residential and nonresidential) in addition to bridges and roads (Chen et al., 2002).

Wastage of construction materials can be estimated by the difference between the value of materials delivered and accepted on site and those accurately used as identified and exactly computed in the work after subtracting the cost saving of replacement materials transmitted elsewhere, in which excessive cost and time may be incurred by the wastage of materials (Enshassi, 1996).

Building material wastage can be specified to two kinds: direct waste and indirect waste. The Direct waste, loss of those materials, which are defeated or damaged and cannot be repaired and consequently used, or which were lost throughout the building procedure. Indirect waste was differentiated from direct waste because it normally symbolized only a financial loss and the materials were not lost actually. Such losses arise mainly from replacement of materials, from use of materials more than the quantities permissible under the contract, and from mistakes. The failure to classify and record wastage from these causes creates accounting for materials meaningless. Therefore, a simple and straight measure of wastage on site could be the difference between the materials used as identified and the amount of material transported to site as a percentage of such deliveries (Shen et al., 2000).

Lee et al. (1999) established the causes of waste for the period of the construction procedure such

as: defect of material, rework or repair, waiting time, delays, poor material distribution and inadequate material handling.

Ekanayake and Ofori (2000) organized the causes of construction waste according to four classes: design, operations, material handling and procurement. Generation of waste at any construction site can be the result from absence of attention being paid to the size of products used, lack of interest by the contractors, absence of information about construction throughout design activities and additional factors for instance inadequate materials handling which may direct to broken portions.

Wastage of construction materials can be classified into three main elements: material, labor and machinery waste. It is directly required for accounting for these waste parts.

The principal purpose of accounting for wastage is to support management in improving the distribution of resource, reducing wastage and increasing output or efficiency (Alwi et al., 2002).

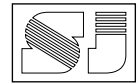
## 2. Objective of study

- 1- This paper is performed in order to:  
Gather the information about wastages of construction materials.
- 2- Determine the approximate percentages of wastage of construction materials that are used in private houses.
- 3- Investigate the factors that cause wastage in construction materials.
- 4- Find out the sources of wastage in order to minimize the wastage from construction materials.

## 3. Review of Literature

Many previous studies involved in wastage of construction materials, Ajayi and Oyedele (2018) studied wastage of construction material to construct a structural model of critical success factors .

The study aimed to explore and confirming plans and strategies in order to achieve the waste-



efficient materials procurement in construction activities. The study recommended that to improve waste minimization for materials procurement in construction projects, the procurement process would be characterized with four characteristics.

These included a suppliers' commitment to low waste measures, effective materials delivery management, low waste purchase management and bill of quantity with waste-efficient, all of which had major influences on waste minimization. Ajayi et al. (2017) stated that while occurring of construction waste throughout the real activities of construction, there was an understanding that it was caused by activities and acts at design, materials procurement and construction stages of the project. (Won et al. 2016) conducted a study to approximate the quantity of wastage of construction materials prevented by Building Information Modeling (BIM) -based design validation process founded on the amount of construction wastage that could be produced as a result of a design error .

Two cases in South Korea projects, studies with 381 and 136 design error discovered respectively throughout BIM-based design validation. Each design error was categorized according to its causes and likelihood of detection before construction. The case study showed that BIM -based design validation could prevent 4.3% - 15.2% of construction materials that might generate without using BIM.

Kanimozhi and Latha (2014) researched on wastages of a contractor company in Indonesia, focusing on the infrastructure projects and non-residential buildings. Based on data from questionnaires and followed up by personal interviews to determine the significance of wastage and the main causes of wastages. The conclusions presented that founded of six factors to be the principal causes of wastages, involving finishing work repairs, waiting or delay of materials, time overrun in schedule, slowness of tradesmen, wastage of raw materials from the site and absence of supervision. While the basic causes of wastage were: variation in design, lack of skill

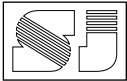
of tradesmen, inappropriate in the construction process, inadequate coordination between project members, delay from delivery of materials to site and improper scheduling and planning.

AL-Hamadani et al. (2014) expressed that the main problem in the construction industry was material wastages. Material waste had a negative influence on the success and effectiveness of construction project, furthermore, had impact on construction cost, construction time, productivity and sustainability aspects. The study identified the major causative factors of material waste in China construction sites, their preventive measures and the relations between them. These causative factors categorized into eight classes: handling, design, procurement, operation, worker, management, site condition and external factors also major causative factors of each category and preventive measures of waste were determined.

Oko John and Emmanuel Itodo (2013) discovered that in the United State from 2009 to 2010 as a result of dealing with 20,000 tons of construction and demolition waste classified these percentage of wastage of several construction materials; aggregate and fines, 20%, wood 30%, gravels, dry wall 3%, concrete 5%, ferrous and non-ferrous metals 9%, asphalt roofing 5%, plastic 1%, disposal as refuse 5% and cardboard, paper 3%.

Enshassi et al. (2011) conducted a study to recognize the cause of wastage of construction materials in the Gaza Strip because of wastage was respected as a main trouble and difficulty in the construction industry of Palestinian. The research approach adopted was questionnaire survey or surveyor. The results indicated that the main factors that causes of wastage in construction materials were:

rework due to poor performance such as poor concrete fixing, using timbers with low quality, using steel bars lengthier than required, mixing the amount of aggregate more than needed, poor performance causing re-plastering, defects from manufacturing, excessive thickness from asphalt mixture, and using paints that not within specification and standards.



Tam et al. (2007) conducted a study in Hong Kong to determine the level of wastage of various construction materials and also to recognize the greatest wasteful material on a construction site in Hong Kong, with specific concentrate on block, concrete, reinforcement, formwork and tiles to conclude that how private and public projects and subcontracting selections influence the levels of wastage of material. Nineteen construction projects were inspected through 2003-2005. The study showed that percentage of wastage of materials with labor for concrete, formwork, reinforcement, tiles and block/ brick were 8.99%, 20%, 7.7%, 15.58% and 8.9% respectively.

To minimize the wastage of construction material, Moghany (2006) recommend attitude development of wastage minimizing, preventing wastage design, prefabrication instead of in-situ method, proper procurement and handling of material, and adopting site waste management plan.

#### 4. Research Methodology

In order to achieve main objective, a review of the literature is conducted to investigate further awareness about wastages of construction materials. The data gathered in the private houses build on 125m<sup>2</sup> plot areas with two floors. For this purpose questionnaire form was designed to show percentage of wastages of construction materials and their sources.

The questionnaire form is delivered to foremen, mason and supervisor engineer as respondents involved directly in the construction of houses in order to determine the most principal wastage sources of construction materials, and also to indicate approximately the percentage of wastage of sixteen different types of building materials. Degree of influence of factors that causes wastage for each type of construction materials identified according to five Likert scale 1=very low effect, 2=low effect, 3=moderate effect, 4=high effect, 5=very high effect. The questionnaire distribution was done by the direct visit to the construction site. The typical form is shown in Appendix. Out of 30 questionnaires filled and information was

analyzed with statistical software (SPSS version 22) to determine the average, maximum, and minimum percentage of wastage of each construction material. The mean computed for each factor causing wastage by applying equation (1) and ranking to determine the significant factors that had influence on wastage of each type of construction materials.

$$M = \frac{\sum(f*s)}{N} \quad (1)$$

Where:

S = Score given to each wastage factor by respondents ranging from 1 to 5

f=Frequency of each rating (1-5) for each factor

N= Total number of respondents

#### 5. Result and Discussion

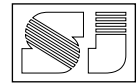
The result of profile of respondents and the results obtained formal percentage of wastages and causes in most of the construction materials are presented in the following sections:

##### 5.1. Profile of Respondents:

The profile of respondents which are the professions and year of experience of respondents is organized in Table 1. The average years of experience as surveyed ranged between 10 and more than 20 years.

##### 5.2. Wastage of construction materials

The wastages of construction materials in Table 2 shows that there are significant variations in resulting of material waste. The diverse of range of range of wastage is most likely due to variation in applying of technology and construction practices from construction staff to another construction staff. The results revealed that the sand is the most wasteful material at the rate of 13.07%, followed by gypsum (12.83%) and wall tiles (12.03%) while aggregate (5%) , ceiling (4.7%) and paint were found to be the least



wasteful material. On the other hand, it appears that the materials, floor tiles, water pipe and drainage pipe are of moderate wastages with rates of 9.1%, 8.87% and 7.17% respectively. There is also diversity in the range of wastage for each material, for example, the range of wastage in the sand is between 2.0% to 20% (18%, difference) of the highest range, while the range in wall tile is between 10.0% and 15% (5%, difference) of the lowest range. The diversity may be attributed to the nature of material and/or its handling. The overall materials wastages can be classified into three classes 0-5, 5-10 and 10-15. Most of materials wastage percentage is between 5 and 10. Table 3 shows these distribution classes.

### **5.3. Causes of wastage of construction materials**

The causes of wastage of construction materials are shown in Table 4. The causes for each type of material are ranked according to percentage of wastages.

#### **5.3.1. Causes of wastage of concrete**

The highest ranked cause of concrete is "Insufficient estimation of the amount of concrete" and "Requiring an extra allowance of concrete" with relative means of 4.0 and 3.89 respectively.

#### **5.3.2. Causes of wastage of reinforcement**

The most effective cause of waste of reinforcement is due to "improper cutting of bars" with means 3.72 at first rank. The three later factors by approximate means 3.62, 3.6 and 3.57 are "using lengthier bars than required", "type of reinforcement method (bend bar cut bar)" and "overlapping because of improper length of steel bars" respectively.

#### **5.3.3. Causes of wastage of formwork**

The effective causes of formwork are: "non optimized cutting of timber boards", "low durability and reusability of formwork", "Cutting for interior fittings and finishing", "Wrong storage" with means of 4.1, 3.95, 3.83 and 3.67" respectively.

#### **5.3.4. Causes of wastage of sand**

The two top ranked causes of sand wastage are "excessive or unnecessary consumption of sand" and "Damaging the remained quantities in the work place" with means of 3.99 and 3.95 respectively. The other later causes are "inadequate storage method" and "theft the sand".

#### **5.3.5. Causes of wastage of cement**

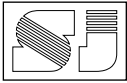
The causes of cement wastage are numerous like "excessive or unnecessary consumption of mortar in joints", "damaging result of severe weather conditions", "mixing in unsuitable places", "mixing of amounts greater than the required", "inappropriate way of transportation", "wrong storage", "and "excessive thickness of plaster (cement plaster)" with means of 4.12, 3.98, 3.92, 3.84, 3.73, 3.70, and 3.63 respectively.

#### **5.3.6. Causes of wastage of aggregate**

The three main causes of the aggregate of "mixing excessive amounts greater than required", "far distance between the place of mixing and casting", and "wrong handling", with relatively means of 3.92, 3.68 and 3.64 respectively.

#### **5.3.7. Causes of wastage of block/ brick**

The causes of block and brick wastages are "defects from the manufacturing of block", "lack of halves and quarters of blocks", "excessive cutting of blocks", "damaging of blocks during the process of cutting", and "damaging of blocks



during unloading and transportation", with relative means of 4.32, 3.96, 3.82, 3.69, and 3.07 respectively.

#### **5.3.8. Causes of wastage of gypsum**

The causes of gypsum wastage are "mixing amounts greater than the required", "ordering excessive quantities of gypsum", "damaging result of severe weather conditions", "poor storage method", with relative mean of 3.98, 3.73, 3.65 and 3.42 respectively.

#### **5.3.9. Causes of wastage of wall and roof tiles**

The effective wastage causes of wall and roof tiles are "damaging the tile during the process of necessary cutting", "damage or broken during transportation", "excessive quantities of tiles, over ordering" and "damage during finishing" with relative means of 4.1, 3.88, 3.67, and 3.55 respectively. The lowest effective wastage cause is due to inadequate skill workers.

#### **5.3.10. Causes of wastage of water pipe and drainage**

The most effective causes of Water pipe and drainage are "ordering additional quantities greater than required", "cutting the pipes inappropriately", "poor storage method", "theft and vandalism" with relative means of" with relative 4.23, 3.94, 3.81, and 3.54 respectively.

#### **5.3.11. Causes of wastage of false ceiling**

The most effective wastage causes of a false ceiling are "wastages from necessary cutting process", "ordering additional quantities greater than required", "unsuitable storage leading to deterioration or damage" and "damage from handling or transportation" with relative means of 3.97, 3.78, 3.62 and 3.43 respectively.

#### **5.3.12. Causes of wastage of paints**

"Paint damage under weather conditions", "directly exposing the paint area to dust", "inappropriate cleaning of walls and slabs before painting process", "damaging result from the addition of other materials to paint" with relative means of 4.1, 4.04, 3.96 and 3.47 respectively. The less effective cause is "wrong storage".

#### **5.3.13. Causes of wastage of electrical wires**

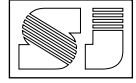
The causes of Wastage related to electrical work of electrical wires. The effective causes are Excessive quantities required, over ordering", "excessive cutting of wires at ends", "excessive cutting of wires at the ends" and "using additional amount more than required". Their relative means are 3.98, 3.85 and 3.56 respectively.

### **6. Conclusion**

The study identified the approximate mean percentages of wastage and the significant cause(s) of each material. The highest percentage of wastages of material are in sand, gypsum and wall tiles with relative average means of 13.07, 12.83 and 12.03 - respectively. While the lowest percentage of materials are ceiling and paint by relative means of 6.33 and 6.07 percentages respectively.

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## تحديد هدر مواد البناء في المباني السكنية

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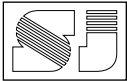
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## المستخلص

يمكن تقدير إهدار مواد البناء بالفرق بين قيمة المواد المسلمة والمقبولة في الموقع وتلك المستخدمة بشكل صحيح كما تم تحديدها وحسابها بالضبط في العمل. عناصر هدر البناء التي هي هدر بسبب العمل والمواد والآلة. تم تنظيم هذا البحث لتحديد نسبة الفاقد من مواد البناء والعوامل الرئيسية التي تسبب الهدر في المنازل السكنية في أربيل. تم تصميم نموذج الاستبيان وإرساله إلى الملاحظين والبنائين ومواقع البناء المشرفين على الهندسة كمتحيين للذين لديهم خبرة لا تقل عن 10 سنوات في بناء المنازل. البيانات التي تم تحليلها بواسطة برنامج SPSS للحزمة الإحصائية (الإصدار 22). أظهرت النتائج أن النسبة المئوية القصى للهدر هي الرمل والجبس وبلاط الجدران وبلاط الأرضيات بنسب مئوية للمعدلات التي تبلغ 13.7 و 12.08 و 12.03 و 9.10 على التوالي، في حين أن النسبة المئوية الدنيا للهدر هي لسقف الكاذب والدهانات بنسب مئوية وهي 4.7 و 4.67 على التوالي. يرجع السبب الأكثر فاعلية للهدر إلى قطع الأشكال غير الاقتصادية، وطلب كمية إضافية أكثر مما هو مطلوب، والأضرار (الهدر) الناجمة عن النقل والتخزين والمناولة. تتمثل أفضل الطرق لتقليل هدر المواد في الشراء والتداول والتخزين بشكل صحيح.

**الكلمات المفتاحية:** الهدر، هدر الأنشائي، تقليل الهدر، مواد البناء، مواد الأنشاء، البيوت السكنية.

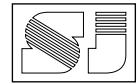


**Table 1: Profile of Respondents.** (Source: Researcher)

Profession	Percentage of Respondents
Engineer	25
Mason	32
Foreman	43

**Table 2: Percentage of Wastages of Construction Materials.** (Source: Researcher)

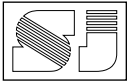
Construction materials	Mean %	Median %	Mode %	Minimum%	Maximum%	Rank
Sand	13.07	14.0	13.0	2.0	20.0	1
Gypsum	12.83	13.0	12.0	8.0	15.0	2
Wall tiles	12.03	12.0	10.0	10.0	15.0	3
Floor tiles	9.10	8.0	3.0	5.0	14.0	4
Water pipes	8.87	9.0	15.0	1.0	15.0	5
Drainage pipes	7.17	8.0	9.0	3.0	10.0	6
Electrical work	6.82	7.0	10.0	1.5	10.0	7
Block	6.50	5.5	5.0	1.0	10.0	8
Concrete	6.33	7.0	9.0	1.0	9.0	9
Brick	6.07	6.0	9.0	2.0	9.0	10
Cement	5.80	6.0	5.0	2.0	9.0	11
Formwork	5.27	4.5	2.0	0.2	15.0	12
Reinforcement	5.04	4.5	3.0	0.2	12.0	13
Aggregate	5.00	4.5	4.0	1.0	9.0	14
Ceiling	4.70	5.0	3.0	2.0	8.0	15
Paint	4.67	5.0	5.0	0.1	8.0	16

**Table 3: Grouping of construction material wastages.** (Source: Researcher)

<b>Construction Materials</b>	<b>Range %</b>
Sand, Gypsum, Wall tiles	10-15 %
Floor tiles, Water pipes, Drainage pipe, Electrical Work, Block, Concrete, Brick, Cement, Formwork, Reinforcement, Aggregate	5-10%
Ceiling, Paint	0-5%

**Table 4: Causes of wastage of construction materials.** (Source: Researcher)

<b>Causes</b>	<b>Mean</b>	<b>Rank</b>
<b>1- Concrete</b>		
Insufficient estimation of the amount of concrete required	4.00	1
Requiring an extra allowance of concrete	3.89	2
Flaws in the framework assembling process	3.78	3
Insufficient use of vibration which causes problems in concrete	3.72	4
Use of insufficient equipment's and tools	3.37	5
Far distance between the place of mixing and casting	2.95	6
<b>2- Reinforcement</b>		
Improper cutting of bars	3.72	1
Using lengthier bars than required	3.62	2
Type of reinforcement method (bend bar, cut bar)	3.60	3
Overlapping because of improper the length of bars	3.57	4
Lack of skill workers	3.50	5
Damage during storage and rusting	2.97	6
<b>3- Formwork (timber)</b>		
Non optimized cutting of timber boards	4.10	1
Low durability and reusability of formwork	3.95	2
Cutting for interior fittings and finishing	3.83	3
Wrong storage	3.67	4
Use of low quality timber	3.50	5
Breaking of timber boards during the removal of the frames	2.88	6
<b>4- Sand</b>		
Excessive or unnecessary consumption of sand	3.99	1
Damaging the remained quantities in the work place	3.95	2
Inadequate storage method	3.83	3
Theft the sand	3.67	4



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**5- Cement**

Excessive or unnecessary consumption of mortar in joints	4.12	1
Damaging result of severe weather conditions	3.98	2
Mixing in unsuitable places	3.92	3
Mixing of amounts greater than the required	3.84	4
Inappropriate way of transportation	3.73	5
Wrong storage	3.70	6
Excessive thickness of plaster (cement plaster)	3.63	7
Damage the external plaster due to rainfall	3.23	8
Damaging of fall mortar during plastering	2.71	9
Broken cement packages during handling	2.7	10

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**6- Aggregate**

Mixing excessive amounts greater than required	3.92	1
Far distance between the place of mixing and casting	3.68	2
Wrong handling	3.64	3
Losing the aggregate during passing the equipment's on it	2.96	4

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**7- Block/Brick**

Defects from manufacturing of block	4.32	1
Lack of halves and quarters of blocks	3.96	2
Excessive cutting of blocks	3.82	3
Damaging of blocks during the process of cutting	3.69	4
Damaging of blocks during unloading and transportation	3.07	5

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**8- Gypsum**

Mixing amounts greater than the required	3.98	1
Ordering excessive quantities of gypsum	3.73	2
Damaging result of severe weather conditions	3.65	3
Poor storage method	3.42	4
Excessive thickness of gypsum plastering	2.81	5

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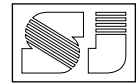
**9- Wall and floor tiles**

Damaging the tile during the process of necessary cutting	4.1	1
Damage or broken during transportation	3.88	2
Excessive quantities of tiles, over ordering	3.67	3
Damage during finishing	3.55	4
Inadequate skill workers	2.86	5

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**10- Water pipe and drainage**

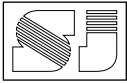
Ordering additional quantities greater than required	4.23	1
Cutting the pipes inappropriately	3.94	2
Poor storage method	3.81	3
Theft and vandalism	3.54	4



<b>11- Ceiling false</b>		
Wastages from necessary cutting process	3.97	1
Ordering additional quantities greater than required	3.78	2
Unsuitable storage leading to deterioration or damage	3.62	3
Damage from handling or transportation	3.43	4
<b>12- Paints</b>		
Paint damage under weather conditions	4.10	1
Directly exposing the paint area to dust	4.04	2
Inappropriate cleaning of walls and slabs before painting process	3.96	3
The damaging result of the addition of other materials to paint	3.47	4
Wrong storage	2.91	5
<b>13- Electrical wires</b>		
Excessive quantities required, over ordering	3.98	1
Excessive cutting of wires at ends	3.85	2
Using the additional amount more than required	3.56	3

**Table 5: The high ranked cause(s) of each of material are as following table.** (Source: Researcher)

<b>Type of waste</b>	<b>High ranked cause</b>
Wastage of Concrete	Insufficient estimation of the amount of concrete
Wastage of Reinforcement	improper cutting of bars
Wastage of formwork	non optimized cutting of timber boards
Wastage of sand	excessive or unnecessary consumption of sand
Wastage of cement	excessive or unnecessary consumption of mortar in the joints
Wastage of aggregate	mixing excessive amounts greater than required
Wastage of block.	defects from manufacturing of block
Wastage of gypsum	mixing amounts greater than the required
Wastage of wall and roof tiles	damaging the tile during the process of necessary cutting
Wastage of water pipe and Drainage	ordering additional quantities greater than required
Wastage of false ceiling	wastages from necessary cutting process
Wastage of paints	The highest ranked cause is "paint damage under weather conditions
Wastage of electrical wires	Excessive quantities required, over ordering



**Appendix**

A sample of form of questionnaire

Profession: Engineer

Foremen:

Mason:

Year experience:

**Section 1: Percentage of wastage in construction materials.**

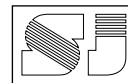
No.	Construction materials	Percentage of wastages%
1	Concrete	
2	Reinforcement steel	
3	Formwork	
4	Cement	
5	Sand	
6	Aggregate	
7	Block	
8	Brick	
9	Gypsum	
10	Floor tiles	
11	Wall tiles	
12	Water pipes	
13	Drainagepipes	
14	Ceiling	
15	Painting	
16	Electrical works	

**Section 2: Scale used for measurement of wastage.**

- 1 Very low affect
- 2 Low affect
- 3 Moderate affect
- 4 High affect
- 5 Very high affect

**Section 3: Assessment of Factors Form.**

Factors	1	2	3	4	5
<b>1. Concrete</b>					
1 Use of insufficient equipment's and tools					
2 Far distance between the place of mixing and casting					
3 Insufficient estimation of the amount of concrete required					
4 Requiring an extra allowance of concrete					
5 Flaws in the framework assembling process					
6 Inadequate use of vibration which causes problems in concrete					



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**2. Reinforcement**

- 1 Lack of skill workers
  - 2 Damage during storage and rusting
  - 3 Type of reinforcement method (bend bar, cut bar)
  - 4 Overlapping because of improper the length of bars
  - 5 Improper cutting of bars
  - 6 Using longer bars than what is required
- 

**3. Formwork**

- 1 Cutting for internal finishing and fittings
  - 2 Wrong storage
  - 3 Non optimized cutting of timber boards
  - 4 Use of low quality timber
  - 5 Breaking of timber boards during the removal of the frames
  - 6 Low durability and reusability of formwork
- 

**4. Sand**

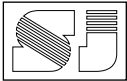
- 1 Inadequate storage method
  - 2 Excessive consumption of sand
  - 3 Damage the remained quantities in the place work
  - 4 Theft of sand
- 

**5. Cement**

- 1 Inappropriate way of transportation
  - 2 Mixing of amounts greater than required
  - 3 Excessive or unnecessary consumption of mortar in joints
  - 4 Wrong storage
  - 5 Mixing in unsuitable places
  - 6 Damage resulting from severe weather conditions
  - 7 Excessive thickness of plaster (cement plaster)
  - 8 Damage the external plaster due to rainfall
  - 9 Damaging the fall mortar during plastering
  - 10 Broken cement packages during handling
- 

**6- Aggregate**

- 1 Wrong handling
- 2 Losing the aggregate during passing the equipment's on it
- 3 Mixing excessive amounts greater than required
- 4 Far distance between the place of mixing and casting



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#### **7- Tiles**

- 1 Excessive quantities of tiles, over ordering
- 2 Damage during transportation
- 3 Damage during finishing
- 4 Damaging the tile during the process of necessary cutting
- 5 Inadequate skill workers

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#### **8- Block**

- 1 Excessive cutting of blocks
- 2 Damage the blocks during unloading and transportation operation
- 3 Defects from manufacturing of block
- 4 Lack of halves and quarters of blocks
- 5 Block damage during the process of cutting

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#### **9- Gypsum**

- 1 Mixing quantities greater than the required
- 2 Poor storage method
- 3 Damage resulting from severe weather conditions
- 4 Excessive quantities of gypsum required
- 5 Excessive thickness of gypsum plastering

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#### **10- Pipes (water pipes, sewerage pipes)**

- 1 Cutting the pipes inappropriately
- 2 Poor storage method
- 3 Ordering additional quantities greater than required
- 4 Theft and vandalism

---

#### **11- Paints**

- 1 Inappropriate cleaning of walls and slabs before painting process
- 2 Damage resulting from adding other materials to paint
- 3 Paint damage under weather conditions
- 4 Directly exposing the paint area to dust
- 5 Wrong storage

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#### **12- Ceiling**

- 1 Ordering additional quantities greater than required
- 2 Unsuitable storage leading to deterioration or damage
- 3 Wastages from necessary cutting process
- 4 Damage from handling or transportation

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#### **13- Electrical work**

- 1 Excessive cutting of wires at ends
  - 2 Using the additional amount more than required
  - 3 Excessive quantities required, over ordering
-