MANAGEMENT OF CONSTRUCTION WASTES BY 3R METHOD

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ABSTRACT: No construction project is wastage free whether if it is building projects, or any other type of construction projects. Managing construction wastes is considered as compulsory for any project to be successful. and references. The purpose of this master thesis is to understand the management of construction wastes by 3R method in the case area of ABCI construction site. In addition, this paper aims to comprehend how 3R method could support waste management in the case area. This paper presents a case area ABCI construction site, and the results are based on observation, site visiting past references. The 3R strategy has been given attention in the current literature to support waste management. To identify construction wastes and study management strategies of 3R method of minimizing the wastage , there should be an education, workshop, and training regarding the concept of" management of construction wastes by 3R method", waste management strategies and benefits of 3R method . This, in turn, can help the case study's firm and the construction projects to attain economical, environmental and social benefit from the thesis.

KEY WORDS: Waste, Construction, Analysis, 3R, management .

I. INTRODUCTION

Construction play an important role in developing the infrastructure of the country. But the problem faced by the industry is the construction material waste. Construction activities generate more waste materials compared to other industries. All the materials used in the construction activities gets wasted, which in turn increases the cost of the project, reduces the profitability and gives a negative impact to the environment. Building material waste is difficult to be recycled. Also there is no sufficient space for the disposal of waste in cities. Generally the materials that gets wasted include concrete, sand, aggregates , steel, bricks ,glass, electrical fixtures and tiles etc...among these materials the materials which gets least wasted but affects the profitability and are paints, pvc pipes, glass electrical fixtures and tiles.

Construction and demolition waste has been defined as „wastage which are arising from construction, renovation , explosion activities ,surplus and damaged products and material arising in the course of construction work and on site work. The primary method is adopted in waste handling is carried through by interviewing professionals like project managers, architects, civil engineers, contractors and government officials.

II. RESEARCH OBJECTIVE

The aim of this study will be focused on the management of construction wastes, that affect the construction project and 3R methods . Based on the literature, survey questionnaire and site visiting of ABCI construction site, the objective of the project is formulated as:

- Identifying the types of construction wastes.
- Determining the Production and wastage of construction wastes
- Determining the approaches being used at the construction site to reduce waste generation.
- identifying possible measures to minimize construction wastes.
- To give recommendations on 3R method as per our methodology.

III. THE '3R' CONCEPT

Reduce

Potential wastes can be identified early in the design process itself and measures should be taken during design stage to minimize the waste that may generate. Waste reduction can be achieved by design with standard sizes for all building materials, design spaces to be flexible and adaptable to changing uses and design for deconstruction.

Reuse

This involves identification of waste that can be salvaged for reuse on the current project or another project or that can be donated. A comparison of the value of the materials "as it is" for salvage and to their value as materials for recycling may be considered prior to reuse in many cases. Some of these materials may be valuable to reuse on-site; others may be sold to be used building material in another site or donated to a charitable organization

Recycle

After adopting all the options to prevent waste, salvage and reuse materials, the next step is to recycle as much of the remaining debris as possible. Recycling saves money by minimizing disposal costs.

IV. METHODOLOGY

This research will be focus on the benefits of the construction waste management, the types of waste used to reuse or recycle and the method used to overcome the construction waste in order to minimize the construction waste in ABCI infrastructure pvt. Ltd. The methodology flow chart is shown as:_

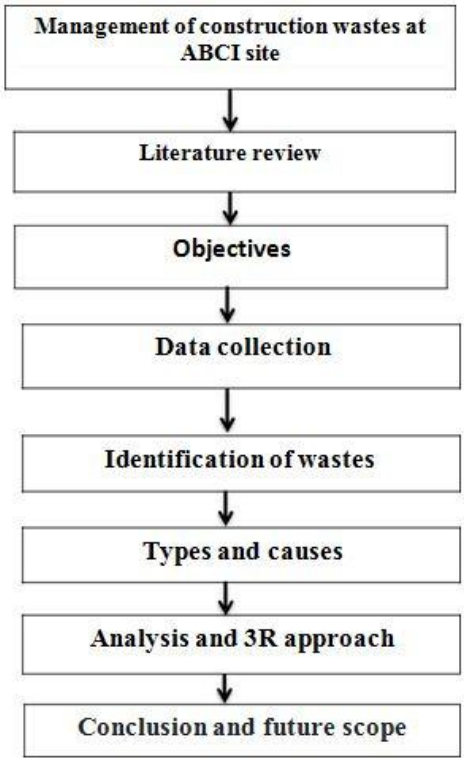

Fig 1. Methodology flow chart

V. DATA COLLECTION & ANALYSIS OF THE STUDY

Data collection is the process of gathering information on targeted sites, which then enables one to get relevant data about the research and evaluate outcomes.

Data was collected from two sites of ABCI infrastructure Pvt. Ltd.

- Anupam Bricks & Concrete Industries Infrastructure Pvt Ltd. (Site1)
- Anupam Bricks & Concrete Industries Infrastructure Pvt Ltd. (Site 2)

ABCI Infrastructure Pvt. Ltd.
SITE 1
Location: Village Tanihal, Banihal J&K
Site: Construction of Railway Tunnel
Site Specification:

01	Length	3km
02	Height	7m
03	Diameter	6m
04	Area	12500m^2

3R measures adopted

- The wastage produced due to concrete (cement, aggregates) can be used as road material for site-2, where construction of road is under process.
- Reducing the amount of over mixing of cement and sand.
- Aggregates wasted during the course can be reused for formation of top layer of road.
- The wasted steel has enough strength to be reused for strengthening road pavement of site-2.
- Concrete can be broken down by mechanical means into small aggregates to be reused for reconstruction of site-2.
- These small aggregates can also be reused for strengthening the retaining walls along side road surface of site-2.

SITE2
Location: Village Tabella Banihal J&K
Site: Construction of the approach road from NH44 to T74R B(N).

1	Length	2km
2	Height	5m
3	Area	1000 m^2

Safety Measures Adopted

- Smaller pieces of concrete are used as gravel for construction of its own road.
- The concrete can also be used as an aggregate in a fresh concrete.
- Larger pieces of crushed concrete may be placed along road side for safety purposes.
- The plastic waste generated should be stored properly and sold to markets on discounts.
- The wastage of wood can be reduced by reusing the timber for doors and window purposes and for strengthening the shuttering mechanism.
- The rocks and stones obtained during road construction can be reused again for constructing the retaining walls along the road side.

In this chapter, the analysis of the study is carried out and the data collected from two sites of ABCI infrastructure pvt. Ltd. is tabulated.The different construction waste materials generated at SITE-1 are tabulated below:-

SITE -1

S.NO	TYPES OF WASTE MATERIALS GENERATED	ACTIVITIES DURING WHICH THEY ARE GENERATED
1	Concrete	During placing, excess production, transportation and carelessness.
2	Bricks	During cutting, poor transportation, unpacked supply, unused bricks
3	Steel	During cutting, damaging during storage, rusting, theft
4	Wood	During storage, C&D, fire, cutting
5	Glass	Poor transportation, improper handling, improper placement, cutting

Table 1. Types of wastes generated at ABCI site 1

S.NO.	PARTICULARS	PER DAY PRODUCTION(KG)	PER DAY WASTAGE(%)
1	Concrete	13102	3
2	Aggregates 20mm	17654	3
3	Aggregates 10mm	17654	2
4	Sand	34670	2
5	Steel	360	2

Table 2. Production and wastage table of ABCI site 1

SITE-2

The different construction waste materials generated at SITE-2 are tabulated below:-

S.NO	TYPES OF WASTE MATERIALS GENERATED	ACTIVITIES DURING WHICH THEY ARE GENERATED
1	Concrete	excess production, transportation carelessness. poor storage
2	Aggregates	During mixing, poor storage, effects of weather.
3	Sand	Poor storage, rain, mixing, over usage.
4	Steel	During cutting, rusting, improper maintenance
5	Plastic	During cutting, poor storage, negligence

Table 3.Types of wastes generated at ABCI site 2.

The per day production and wastage of construction materials is tabulated below:-

S.NO.	PARTICULARS	PERDAY PRODUCTION (KG)	PERDAY WASTAGE (%)
1	Concrete	4734	2
2	Plastic	30	1.5
3	Aggregates (10mm)	8827	1.5
4	Sand	23113	2
5	Steel	140	1.5
6	Wood	20	1

Table 4. Production and wastage table of ABCI site 2

ANALYSIS OF THE STUDY

The analysis of this study will include the manipulation of data obtained from both the sites and analyzing the the factors that will help in reducing the amount of wastage. Moreover, this analysis will also cover the concept of 3R in reducing these above tabulated wastes.

SITE 1

S.NO.	PARTICULARS	PERDAY PRODUCTION (KG)	PER DAY WASTAGE (%)	WASTE PRODUCED(kg)
1	Concrete	13102	3	393
2	Aggregates (20mm)	17654	3	530
3	Aggregates (10mm)	17654	2	353
4	Sand	34670	2	693
5	Steel	360	2	7.2

Table 5 .Waste production table of site 1

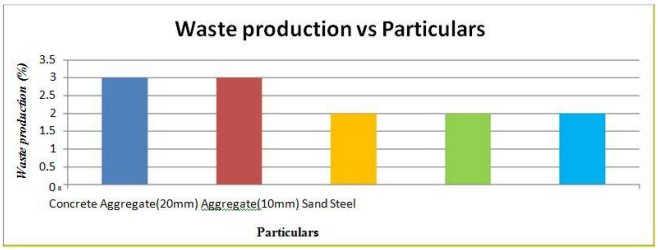

Fig 2 ,Graph indicating relation between particulars and their waste production(%)

From fig.4 table indicates amount of wastage produced by each construction material during their course of activity at construction site-1. The next step is the approach of 3R method towards these wastes and identifying which of these wastes justifies the 3R concept. The 3R method will be justified only if all the above wastes get reduced to a great extent.

The 3R approach developed for site-1

- The wastage produced due to concrete (cement, aggregates) can be used as road material for site-2, where construction of road is under process.
- Reducing the amount of over mixing of cement and sand.
- Aggregates wasted during the course can be reused for formation of top layer of road.
- The wasted steel has enough strength to be reused for strengthening road pavement of site-2.
- Concrete can be broken down by mechanical means into small aggregates to be reused for road construction of site-2.
- These small aggregates can also be reused for strengthening the retaining walls along side road surface of site-2.

SITE-2

S.NO.	PARTICULARS	PERDAY PRODUCTION (KG)	PER DAY WASTAGE (%)	WASTE PRODUCED(kg)
1	Concrete	4734	2	95
2	Aggregates (20mm)	8827	1.5	132
3	Aggregates (10mm)	8827	1.5	132
3	Plastic	30	1	0.3
5	Wood	20(ft)	1	0.2(ft)

Table 6 .Waste production table of site 2

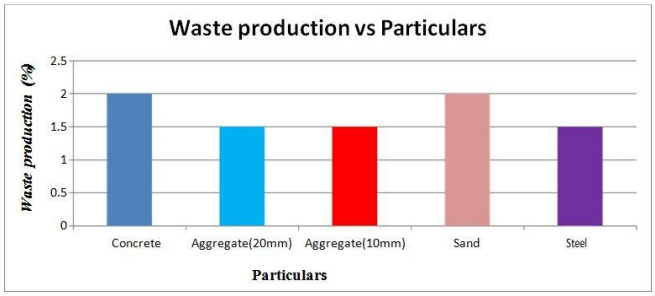

Fig 3. Graph indicating relation between particulars and their waste production (%)

The above table indicates amount of wastage produced by each construction material during their course of activity at construction site-2. The next step is the approach of 3R method towards these wastes and identifying which of these wastes justifies the 3R concept. The 3R method will be justified only if all the above wastes get reduced to a great extent.

The 3R approach developed for site-2

- Smaller pieces of concrete are used as gravel for construction of its own road.
- The concrete can also be used as an aggregate in a fresh concrete.

- Larger pieces of crushed concrete may be placed along road side for safety purposes.
- The plastic waste generated should be stored properly and sold to markets on discounts.
- The wastage of wood can be reduced by reusing the timber for doors and window purposes and for strengthening the shuttering mechanism.
- The rocks and stones obtained during road construction can be reused again for constructing the retaining walls along the road side.

VI. RESULTS AND DISCUSSION

It is possible to minimize the volume of Construction waste generated by identifying the potential waste early in the design. The results obtained from data collection and analysis are manipulated below in a tabular form:-

SITE 1

PARTICULARS	PER DAY PRODUCTION (Kg)	PER DAY WASTAGE (%)	WASTE PRODUCED (Kg)	WASTE REDUCED (Kg)	WASTE REDUCED (%)
Concrete	13102	3	393	300	76.33
Aggregates(20mm)	17654	3	530	285	77.05
Aggregates(10mm)	17654	2	353	200	56.65
Sand	34670	2	693	600	64.93
Steel	360	2	7.2	6.5	76.38

Table 7. Wastage reduction table of site 1.

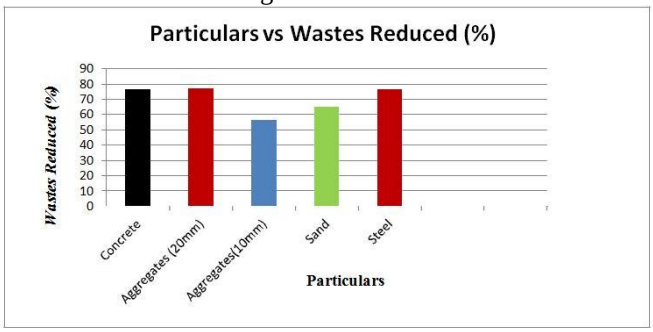

Fig4.Graph indicating relation between particulars and wastage reduced at site1

From table 7, and graph 4, it is clear that by applying the 3R strategies to these wastages, considerably reduces material wastage and this makes the project an economical one. The wastage of concrete is reduced from 393kg to 93kg and recovers 300 kg of concrete for futher ruses. Steel wastage is reduced by 76.38% by applying the 3R concept. Similarly by using 3R method aggregates(20mm), Aggregates(10mm) and sand are also reduced utpo 77.05%, 56.65% and 64.98% respectively.

SITE 2

PARTICULARS	PER DAY PRODUCTION (Kg)	PER DAY WASTAGE (%)	WASTE PRODUCED (Kg)	WASTE REDUCED (Kg)	WASTE REDUCED (%)
Concrete	4734	2	94.68	50	52.80
Aggregates(20mm)	8827	1.5	134.40	97	72.15
Sand	23113	2	462	345	74.67
Steel	140	1.5	2.1	0.9	42.85
Plastic	30	1.5	0.45	0.23	51.11
Wood	20	1	0.2	0.1	50

Table 8. Waste reduction table of site 2

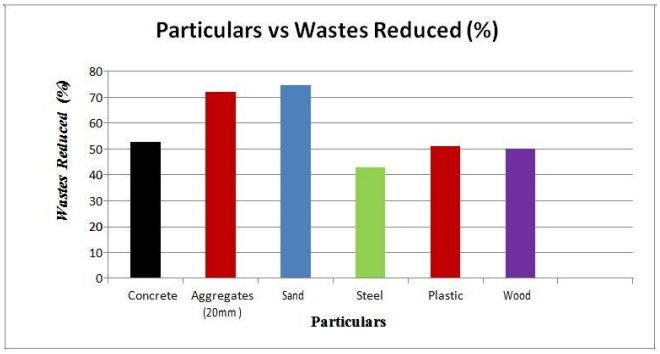

Fig 5,Graph indicating relation between Particulars and Waste reduced at Site 2

From table 8. and fig.5, it is clear that by applying the 3R strategies to these wastages, considerably reduces material wastage and this makes the project an economical one. The wastage of concrete is reduced from 94.68 kg to 50 kg and recovers 44.68 kg of concrete for futher ruses. Steel wastage is reduced by 42.85% by applying the 3R concept. Similarly by using 3R method, wastage of plastic and wood is reduced upto 51.11% and 50% respectively.

EFFICIENCY OF 3R METHOD

The efficiency here refers to the percentage of wastes reduced successfully by reduce, reuse, recycle of the wastes generated at the two sites of Anupam Bricks and concrete industry infrastructure Pvt. Ltd. Efficiency is obtained by dividing the wastage produced column by waste reduced column multiplied by 100.

Site 1

S.NO.	PARTICULARS	PERDAY PRODUCTION (Kg)	PER DAY WASTAGE (%)	WASTAGE PRODUCED (Kg)	WASTAGE REDUCED (Kg)	EFFICIENCY (%)
1	Concrete	13102	3	393	300	76.33
2	Aggregates(20mm)	30	1	0.3	0.2	66.66
3	Aggregates(10mm)	17654	2	353	272	77.05
3	Sand	34670	2	693	450	64.93
5	Steel	360	2	7.2	5.5	76.38

Table 9. Table showing Efficiency of 3R method at site 1

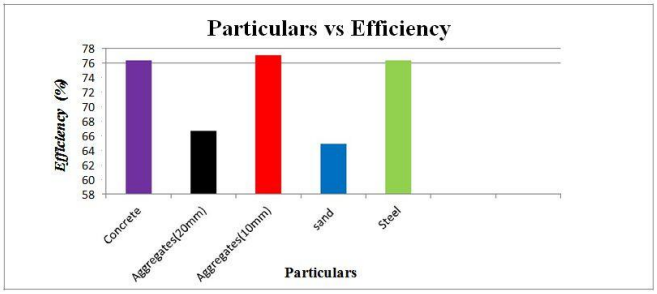

Fig 6. Graph indicating relation between particulars and efficiency at site 1

Site 2

S.No.	PARTICULARS	PER DAY PRODUCTION (KG)	PER DAY WASTAGE (%)	WASTAGE PRODUCED (KG)	WASTAGE REDUCED (KG)	EFFICIENCY %
1	Concrete	4734	2	94.68	50	52.80
2	Aggregate(20mm)	8827	1.5	134.40	97	72.15
3	Sand	23113	2	462	345	74.67
4	Steel	140	1.5	2.1	0.9	42.85
5	Plastic	30	1.5	0.45	0.23	51.11
6	Wood	20	1	0.2	0.1	50

Table 10. Table showing Efficiency of 3R method at site 2

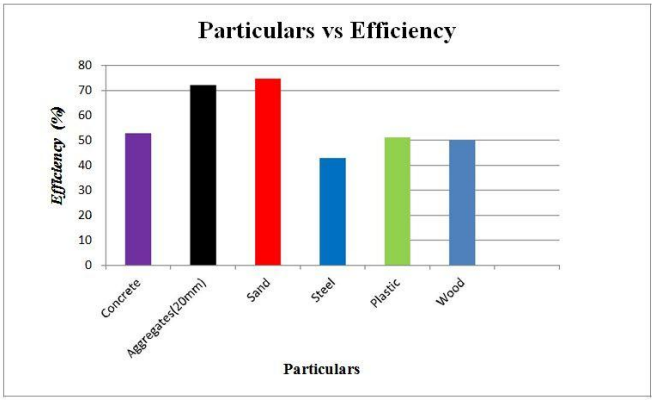

Fig 7. Graph indicating relation between particulars and efficiency at site 2

VII. DISCUSSION

This chapter will include discussion about results obtained by 3R method of construction waste management.

SITE 1

From table 7 and figure 4, it is clear that by applying the 3R strategies to these wastages, considerably reduces material wastage and this makes the project an economical one. The wastage of concrete \ is reduced from 393kg to 93kg and recovers 300 kg of concrete for futher ruses. Steel wastage is reduced by 76.38% by applying the 3R concept. Similarly by using 3R method aggregates(20mm), Aggregates(10mm) and sand are also reduced utpo 77.05%, 56.65% and 64.98% respectively.

The efficiency achieved by reducing the construction waste at site 1 is shown by figure 6 . The graph is plotted between particulars such as concrete, steel, aggregates, sand, etc along x-axis and efficiency(%). it can be seen that maximum efficiency of 76.38 is achieved by reducing aggregate (10mm) waste followed by steel waste (76.38%) and concrete (76.33%). the reason for achieving high efficiency is because large no of reuses of concrete, aggregate and steel are possible. Also the efficiency achieved by 3R method in reducing the wastage of sand and Aggregate (20mm) is 66.66% and 64.93%.

SITE 2

Similarly from the table 8 and figure 5, it is clear that by applying the 3R method to these wastages, considerably reduces material wastage and this makes the project an economical one. The wastage of concrete is reduced from 94.68 kg to 5o kg and recovers 44.68 kg of concrete for futher ruses. Steel wastage is reduced by 42.85% by applying the 3R concept. Similarly by using 3R method, wastage of plastic and wood is reduced upto 51.11% and 50% respectively.

The efficiency achieved by reducing the construction waste at site 2 is shown by figure 7. The graph is plotted between particulars such as concrete, steel, wood, plastic, sand, etc along x-axis and efficiency(%). it can be seen that maximum efficiency of 74.69% is achieved by 3R method by reducing wastage of sand followed by aggregates (72.15%) and concrete (52.80%). The reason for achieving high efficiency is because large no of reuses of concete, aggregate and steel are possible. Also the efficiency achieved by 3R method in reducing the wastage of steel, plastic and wood is 42.85%, 51.11% and 50% respectively.

VIII. CONCLUSION AND FUTURE SCOPE

The present research on the construction material waste management arrived at following conclusions after all data analysis. The construction material waste scenario of two construction sites found to be considerable in cost effectiveness and needs management. Data collection ,site visit,and literature review provides correct assessment for needed things and barriers in construction. The implications of rising cost on construction project arising due to construction material wastage ranges between 5% to 10 % for considered projects. The management policies for material waste reduction on site explore ways to avoid or reduce material wastage by 3R method.

- The techniques adopted in this study could further be applied as a standard for other construction sites in Jammu and Kashmir.
- The parameters drawn out from this study would assist planners, project manager, engineers, and associated officials in achieving desired 3R based goals for their project.
- The study will serve as a first hand information for further waste management strategies at ABCI infrastructure Pvt.Ltd.
- The result of this research will help to construction project companies in Banihal, Jammu & Kashmir to understand how to identify the major wastes and manage them to improve the poor economy of the project[1].
- This study also gives the importance of 3R waste management in construction project.
- The research carried out would assist other construction companies in jammu and Kashmir to reduce the their material wastage and enforce 3R method and other waste management strategies.
- The study will serve as a guiding tool for others who in future will develop their research on the waste management methods in a construction project.

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