# Management Material and Waste Reduction using 3R's Methodology

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**Abstract: In these modern days the Buildings are made to fulfill our basic aspects and better Serviceability. It is not an issue to construct a Building any how its, important to construct an efficient building which will serve for many years without showing any failure. The Project aims in finding Better technique for optimum utilization of the available Resources. The Project considers the management of materials and reduction of construction waste at building construction sites. In this study, method of material procurement practice on construction site, factors affecting material management on building construction site and the cause's wastages on construction sites are determined. The study further suggests measures for effective material management and reduction of construction waste using 3R's methodology. This Result clearly indicates that the cost of wastage after using 3R's method can be saved up to some extent of estimated quantity and materials also. We reduce the main causes of material wastage on building construction sites also. Damage by mishandling, inadequate storage facilities on site, delay in material supply, inadequate supervision, poor site security, other natural occurrence, Rework, alteration of designs. Based on the findings in the work, appropriate recommendations were being made for effective material management on building construction sites. In this paper, the challenges being faced and opportunities to minimize the amount of waste generated on construction of project sites.**

***Keywords* — Serviceability, efficient, waste reduction, Recycled, Reduction, Material Management**

## I. INTRODUCTION

This chapter reviews materials management practices on construction projects. Firstly, it describes the definition of materials management, managing construction materials and the process of materials management. Secondly, it discusses the current problems that often occur with materials management practices and the approaches to address these problems, followed by a discussion of the implementation of current technologies, advantages and the limitations. Finally, this chapter presents the implementation of 3 R's technologies i.e. Reduce, Reuse and Recycle into materials management, and also reviews the potential use of 3 R's into construction and others business applications. Materials management is an important function in order to improve productivity in construction projects. Materials management include "material requirement planning and material take off, vendor evaluation and selection, purchasing, expenditure, shipping, material receiving, warehousing and inventory, and material distribution". This is concerned with the planning and controlling process to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, obtained at reasonable cost and are available when needed. Materials management involves the logistics of the materials components of a supply chain which involves the process of planning, implementing and controlling of the movement and storage of raw materials, work-in-process inventory, and finished goods from point-of origin to point-of consumption The efficient procurement and handling of material represent a key role in the successful completion of the work. It is important for the contractor to consider that there may be significant difference in the date that the material was requested or date when the purchase order was made and the time at which the material will be delivered. These delays can occur if the contractor needs a large quantity of material that the supplier is not able to produce at that time or by any other factors beyond his control. The contractor should always consider procurement of materials is a potential cause for delay. Poor planning and control of materials, lack of materials when needed, poor identification of materials, re-handling and inadequate storage cause losses in labor productivity and overall delays that can indirectly increase total project costs.

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## II. METHODOLOGY AND THEORETICAL ASPECT

### Construction Material Wastage

Building materials account for about half of all materials used and about half the solid waste generated worldwide. They have an environmental impact at every step of the building process—extraction of raw materials, processing, manufacturing, transportation, construction and disposal at the end of a building's useful life .Concept of 3R and 4R can be also beneficial to reduce the wastage of construction materials, which includes Reduce, Reuse, Recycle, and Reduction at source. These can be applied to the entire lifecycles of products and services. The free-flow mapping presentation technique can be adopted in the study for investigating the waste flow practice on construction sites. The technique has been considered advantageous in presenting flows of processes logically, clearly, and in the simplest way .The prediction of waste flow can be modelled through the building elements at the construction stages.

**Fig.3.1, Shows Wastage of AAC Blocks**

**Fig.3.2, Shows Wastage of Bricks**

**Fig.3.3,Shows Wastage of Steel.**

**Fig.3.4,Shows Wastage of Tiles.**

**3R'sMethodology in Construction Management.** The Construction waste hierarchy consists of 3 R's as follows:-

1 Reduce

2 Reuse

3 Recycle

Called the "three R's" of Construction waste management.

1. The First 'R' – Reduce

The concept of reducing what is produced and what is consumed is essential to the Construction waste hierarchy. The logic behind it is simple to understand – if there is less waste, then there is less to recycle or reuse. The process of reducing begins with an examination of what we are using, and what it is used for.

2. The Second 'R' – Reuse

Re-use of some materials and resources is becoming industry standard practice. For example, landfill charges provide an incentive for high recycling rates of massive materials, such as masonry materials (asphalt, bricks and concrete). Reclamation rates for high-value materials, such as metals and hardwood timbers, have also increased.. Learning to reuse items, or re-purpose them for a use different then what they are intended for is essential in waste hierarchy.The level of recovery of a material stream and market demand for associated products is related to geography and pricing. Materials that are heavy and generated in large volumes cost more to dispose of to landfill, especially where there is an appropriate disposal pricing structure, which may include an associated levy. This results in these materials receiving priority attention for recovery and market development in the C&D sector. These materials, such as metals and masonry, are mostly generated from the commercial demolition sector and civil activities such as pavement maintenance or site excavation works.

3. The Third 'R' – Recycle

The last stage of the waste hierarchy is to recycle. To recycle something means that it will be transformed again into a raw material that can be shaped into a new item. There are very few materials on the earth that cannot be

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recycled. One of the issues facing communities that want to become more involved with a recycling effort is that while the relying collection and sorting process may be affordable to implement, there still has to be a facility to receive and transform the discarded waste into a raw material. More progress is being made toward uniting recycling plants with industries that can process the waste material through agreements and incentive credits.

## III DATA COLLECTION AND PERMORMANCE ANALYSIS

Wastage data of the Material has been collected at different Stages of Construction. Data was Studied and Analysied to Compute and Reduce the total cost of Construction.

**Table 4.1 Estimated Quantities, Actual Consumed Quantity and Wastage of Different Material.**

| Sr No | Items | Estimated quantity | Actual Consumed Quantity | Wastage | Percentage Wastage |
|---|---|---|---|---|---|
| 1 | Steel | 654742.66Kg. | 674583.60Kg. | 19550.94Kg | 2.98 % |
| 2 | AAC 6" | 1031.28 cum | 1059.43 cum | 28.15 cum | 2.7 % |
| 3 | AAC 4" | 109.20 cum | 113.77 cum | 4.57 cum | 4.18 % |
| 4 | Bricks 6" | 363766.3 nos | 364182 nos | 415.7 nos | 0.11 % |
| 5 | Bricks 4" | 30185.00 nos | 33750.00 nos | 1114.00 nos | 3.69 % |
| 6 | Cement | 8651.20 bags | 9193.00 bags | 383.80 bags | 4.43 % |
| 7 | Crushed Sand | 40128.56CFT | 41216CFT | 1087.44CFT | 2.7 % |
| 8 | Aggregate | 71519.16 CFT | 72583CFT | 1063.84CFT | 1.48 % |

**Table 4.2 Cost Of Wastage of Different Material**

This table shows that the estimated qty. required for steel is 654742.66 kg. but the actual consumed qty is about 674583.60 kg. which clearly indicates that around 19550.94 kg of steel is used in excess . Also the estimated qty. required for AAC 6" is 1031.28 cum, but the actual consumed qty is about 1059.43 cum, which clearly indicates that around 28.15 cum of AAC 6" is used in excess. The estimated qty. required for AAC 4" is 109.20 cum, but the actual consumed qty is about 113.77 cum, which results in wastage of around 4.57 cum of AAC 4". The estimated qty. required for Bricks 6"is 363766.3 nos, but the actual consumed qty is about 364182 nos, which results in wastage of around 415.7 nos cum of Bricks 6". The estimated qty. required for Bricks 4" is 30185.00 nos, but the actual consumed qty is about 33750.00 nos, which clearly indicates that around 1114.00 nos of Bricks 4"is used in excess. The estimated qty. required for Cement is 8651.20 bags, but the actual consumed qty is about 9193.00 bags, which results in wastage of around 383.80 bags of Cement. The estimated qty. required for Crushed Sand is 40128.56 CFT, but the actual consumed qty is about 41216 CFT, which clearly indicates that around 1087.44 CFT of Crushed Sand is used in excess. The estimated qty. required for Aggregate is 71519.16 CFT, but the actual consumed qty is about 72583 CFT, which results in wastage of around 1063.84 CFT.

| S | Items | Estimated quantity | Actual Consumed Quantity | |
|---|---|---|---|---|
| r No | | | | Cost of Wastage |
| 1 | Steel | 19550.94K.g. | Rs. 44 / K.g | Rs. 860242 |
| 2 | AAC 6" | 1240 nos | Rs. 73 / unit | Rs. 90520 |
| 3 | AAC 4" | 302 nos | Rs. 70 / unit | Rs. 21140 |
| 4 | Bricks 6" | 415.7nos | Rs. 7.5 / unit | Rs. 3117.75 |
| 5 | Bricks 4" | 1114nos | Rs. 5.75 /unit | Rs. 6405.5 |
| 6 | Cement | 383.80 bags | Rs. 245 / bag | Rs. 94031 |
| 7 | Crushed Sand | 1087.44 CFT | Rs 28 / CFT | Rs. 30448.32 |
| 8 | Aggregate | 1063.84 CFT | Rs. 20 / CFT | Rs. 21276.8 |

This table clearly indicates that the cost of wastage for steel is Rs. 860242,AAC 6" is Rs. 90520 , AAC 4" is Rs. 21140 , Bricks 6" is Rs. 3117.75, Bricks 4"is Rs. 6405.5 , Cement is Rs. 94031, Crushed Sand is Rs. 30448.32 and Aggregate is Rs. 21276.8.

**Table 4.3 Estimated Quantity, Actual Consumed Quantity using 3R's and Wastage of Different Material**

| S.no Items | Estimated Quantity | Consumed Quantity by 3R's | Wastage | Percentage Wastage | S.no Items |
|---|---|---|---|---|---|
| 1)Steel | 654742.66K.g. | 667737.66K.g. | 12995K.g. | 1.98 % | 654742.66K.g. |
| 2)AAC 6" | 1031.28 cum | 1044.53 cum | 13.25 cum | 1.28 % | 1031.28 cum |
| 3)AAC 4" | 109.20 cum | 112.09 cum | 2.89 cum | 2.6 % | 109.20 cum |
| 4)Bricks 6" | 363766.3 nos | 363966.3 nos | 200 nos | 0.05 % | 363766.3 nos |
| 5)Bricks 4" | 30185.00 nos | 30819.00 nos | 634 nos | 2 % | 30185.00 nos |
| 6)Cement | 8651.20 bags | 8933.2 bags | 282 bags | 3.2 % | 8651.20 bags |
| 7)Crushed Sand | 40128.56 CFT | 40849.56 CFT | 721CFT | 1.7 % | 40128.56 CFT |
| 8)Aggregate | 71519.16 CFT | 72255.16 CFT | 736 CFT | 1.02 % | 71519.16 CFT |

This table shows that after using 3R's methodthe wastage of material can be reduced to some extent, here the estimated qty.required for steel is 654742.66 kg. but the actual consumed qty.is about 667737.66 K.g. which clearly indicatesthat around 12995 K.g.of steel is used in excess . Also the estimated qty. required for AAC 6" is 1031.28cum, but the actual consumed qty.is about 1044.53 cum, which clearly indicates that around 13.25 cum of AAC 6" is used in excess. The estimated qty. required for AAC 4" is 109.20 cum, but the actual consumed qty.is about 112.09 cum, which results in wastage ofaround2.89 cum of AAC 4". The estimated qty. required for Bricks 6"is 363766.3 nos, but the actual consumed qty is about 363966.3 nos, which results in wastage of around 200 nos cum of Bricks 6". The estimated qty. required for Bricks 4" is 30185.00 nos, but the actual consumed qty is about30819.00 nos, which clearly indicates that around 634 nosof Bricks 4"is used in excess. The estimated qty. required for Cement is 8651.20 bags, but the actual consumed qty is about 8933.2 bags, which results in wastage of around 282 bagsof Cement. The estimated qty. required for Crushed Sand is 40128.56 CFT, but the actual consumed qty is about 40849.56 CFT, which clearly indicates that around 721CFTof Crushed Sand is used in excess.The estimated qty. required for Aggregate is 71519.16 CFT, but the actual consumed qty is about 72255.16 CFT, which results in wastage of around 736 CFT.

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**Table 4.4 Cost Of Wastage of Different Material by using 3R's**

| S . n o . | I t e m s | Wastage | Cost Per Unit | Cost Of Wastage |
|---|---|---|---|---|
| 1 | S t e e l | 12995 K.g. | R s . 4 4 | Rs.571780 |
| 2 | A A C 6" | 13.25 cum | R s . 7 3 | Rs. 42632 |
| 3 | A A C 4" | 2.89 cum | R s . 7 0 | Rs. 13440 |
| 4 | Bricks 6" | 2 0 0 nos | R s . 7 . 5 | Rs. 1500 |
| 5 | Bricks 4" | 6 3 4 nos | R s . 5 . 7 5 | Rs. 3634.5 |
| 6 | C e m e n t | 2 8 2 bags | R s . 2 4 5 | Rs. 69090 |
| 7 | Crushed Sand | 7 2 1 C F T | R s 2 8 | Rs. 20188 |

This table clearly indicates that the cost of wastage after using 3R's method can be saved upto some extent, here cost of wastage for steel is Rs.571780,AAC 6" is Rs. 42632, AAC 4" Rs. 13440, Bricks 6" is Rs. 1500, Bricks 4"is Rs. 3634.5, Cement is Rs. 69090, Crushed Sand is Rs. 20188and Aggregate is Rs. 14720.

## IV RESULT

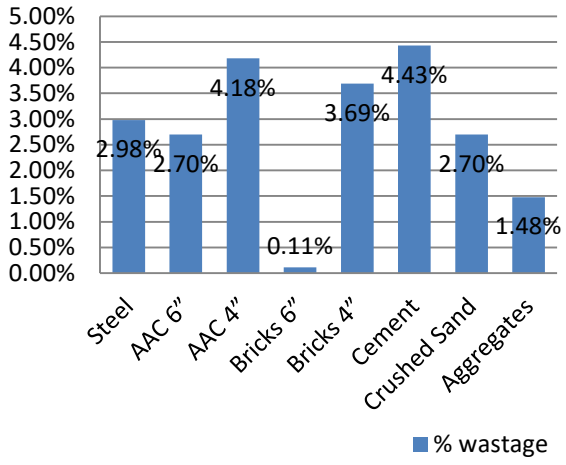


**Fig 5.1, Shows Wastage of Different Material.**

Figure 5.1 Shows the Wastage of materials like Steel, AAC Block, Bricks, Cement ,Crushed sand and Aggregates in terms of percentage which are used during the Entire Project work.It is been observed that Improper Material Management may leads to wastage of Raw Materials which in turn increases the Construction Cost of the Project.

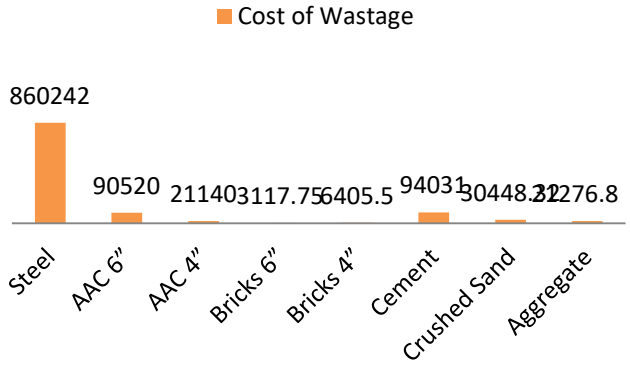


**Fig 5.2, Shows Cost of Wastage of Different Material in Rupees.**

The above figure gives idea about the Cost of wastage of different material in Rupees. The wastage of steel nearly costs Rs.8,60,242. On the other hand 6" AAC Costs Rs.90520,4"AAC costs about Rs.21140,6" Bricks costs Rs.3117.75,Cement costs near about Rs.94031,Crushed sand costs Rs.30448.32 and Aggregate costs Rs.21276.8.

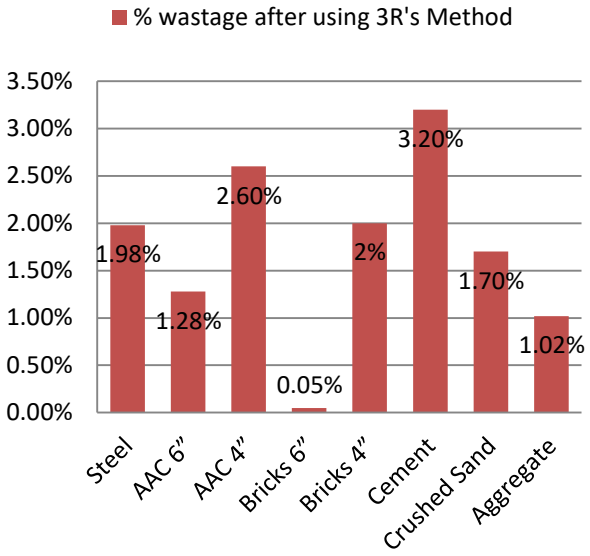


**Fig 5.3, ShowsWastage of Different Material after using 3R's methodology**.

Figure Shows the Wastage of materials like Steel, AAC Block, Bricks, Cement ,Crushed sand and Aggregates in terms of percentage by using 3R's Methodology.It is been observed that by using 3R's Method the wastage produced or generated from different materials can by brought down by 8.5% which in turn Reduces the Construction Cost required for the Project.

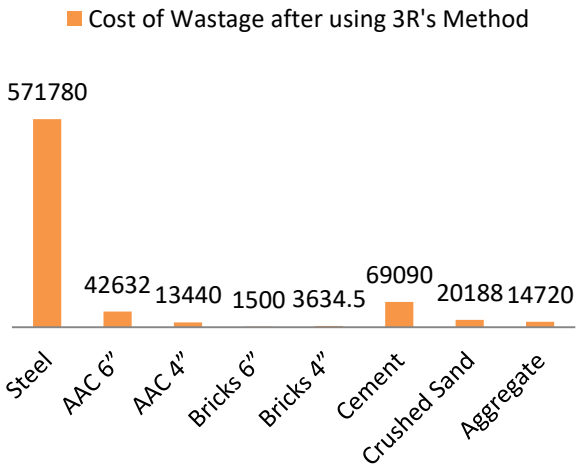


**Fig 5.4, Shows Cost of Wastage of Different Material after using 3R's Method in Rupees.**

The above figure gives idea about the Cost of wastage of different material after using 3R's Method in Rupees. The wastage of steel Reduces to nearly Rs.5,71,780.On the other hand 6" AAC Costs Rs.42,632. 4"AAC costs about Rs.13,440. 6" Bricks costs Rs.1500. Cement costs near about Rs.69,090. Crushed sand costs Rs.20,188 and Aggregate costs Rs.14,720

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**Relative % wastage wrt Cost.**

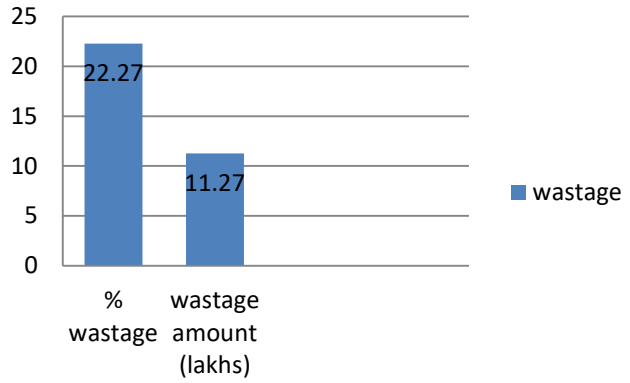


**Fig 5.5, Shows Relative percentage Wastage of Different Material With respect to Cost.**

The above chart clearly gives idea that lack of Proper Material Management results in about 22.27 % of wastage of materials is being generated during the project work which results in about Rs.11.27 Lakhs of extra capital required for the purchase of different materials.

**Relative % wastage wrt Cost after using 3R's Method.**

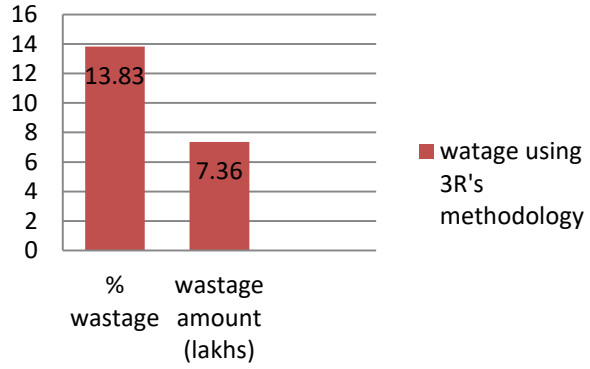


**Fig 5.6, Shows Relative percentage Wastage of Different Material with respect to Cost by using 3R's Methodology**

The above chart clearly gives idea that by using 3R's Methodology about 7.36 % of wastage of materials is being generated during the project work which is 8.5% less than the wastage generated during entire work which results in saving of about Rs.3.91Lakhs of capital which will be required for the purchase of different materials.

## V. CONCLUSION

In this methodology, considering a couple of parameters estimations of viability It is been observed that by using 3R's Method the wastage generated from different materials can be brought down by 8.5%. The wastage of steel, Bricks & Aggregates Reduces to maximum extent. which in turn Reduces the Construction Cost required for the Project. The fact of the matter is to make 3R's as objective, sensible and genuine as possible without controlling its outcome to Satisfy particular inspiration.

a) Waste Management has been ignored at maximum stages of Construction Process.
b) Lack of awareness has been observed within the Managers, Engineers andLabours regarding waste Management.
c) 3R's Methodology is Suitable for Medium and Large Scale projects.
d) By using 3R's Methodology around additional 8.5 % waste can be Reduce.
e) By using 3R's Methodology Economy around Rs.3.91 lakhs can be saved for this Project.

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