

# Literature Review - Material Wastage on Construction Projects

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**Abstract** — Development of infrastructural facilities is accompanied by construction, and demolition of buildings, roads, bridges, flyover, subways, runways, factories and other similar establishments. Construction industry consumes huge amount of natural resources and often generates large quantities of construction waste.. These wastes are heavy, having high density, very often occupy considerable storage space. In general, a very high level of waste is assumed to exist in construction. In construction, Material, Manpower, Money Machine plays a crucial role. Depending on the type of a construction project, Building materials account for 60 to 70% of the project cost. Observational research has shown that this can be as high as 10 to 15% of the materials that go into a building, a much higher percentage than the 2.5-5% usually assumed by quantity surveyors and the construction industry.

During the last few years, enormous growth in infrastructure found, by wide range of diversity construction organization. This produces a large range of waste, created at all the stages of construction right from site preparation, demolition to final product. Minimizing the waste and optimizing the profitability is possible by reducing cost of material with proper planning, scheduling, purchasing, procurement, receiving, inspecting, handling, storing and warehousing.

The purpose of this project is to study the sources of material wastage and to suggest the possible way to optimize it.

**1. Introduction** - This section provides a literature review on material wastage in construction, definition of waste, construction waste, construction waste types, materials waste and amount of waste in construction. Existing data and literature on construction material wastages, causes, barriers and solutions in construction industry is collected. This formed the reference for framing the questionnaire for survey.

**Definition of waste** - Waste is less efficiency in proper use of man, machineries, materials and money than considered as required in construction of building. Waste contains materials losses, executing extra works, which consumes extra cost but value of product remains same. This study clears, there is one limit up to reducing waste is possible with improving technological development of company. Waste can be identifies as natural waste or unavoidable waste, for that energy required minimizing is more than value produced and avoidable waste for that energy required is less than value produced. Quantity of unavoidable waste is depending on type of company and nature of construction sites. Waste can occurred by various processes involved in productions , like – materials procurement, materials receiving and storing on site, transportation of materials on site, failure of designs, changing operational procedures, planning and training failures, restudies left etc. By providing proper control on materials flow start from to its purchase to its utilization in final product, considerable amount of waste reduction is possible.

**Construction waste** - Construction waste is any kind of unwanted entity generated on construction sites. Construction waste gets generated during construction of new structures, modification of existing structures, redeveloping of existing structures and maintenance of structures etc. Construction waste generates due to excess material receiving on site, design changes, workers mistakes, environmental and social conditions, rejection by clients, failure of transport system, bad operational procedures, using poor methods for materials handlings etc. There are various kind of construction materials gets wasted on construction sites are, tor steel, structural steel, timber, cement, sand, metal, admixtures, chemicals, sheeting materials, tiling materials, glass, aluminium materials, painting materials, insulations, premixed mortar, etc.

**2. Types of construction waste** - Wastes in construction are of three main types; waste of materials, waste of time and waste of machinery. However, this study focuses on materials waste at the construction stage.

**Material waste** - Materials waste on construction site is waste which is not consumed in any productive purpose and requires removing from site. It is material which does not add any value to construction project and needs to remove from site or gets utilized in other places other than its required purpose.

### **3. Present theories and practices in construction material waste.**

**1) Bossink et al. (1996)** - He studied about materials wastages on building construction projects in Duch. He noted about 10% materials gets wasted on site as compared with its purchase. Sources promoting materials wastages on sites are – faulty design and documentations, poor methods of materials using, non-proper operational methods adopting and residue left on site. Main materials wasted on site are rubble, concrete, sand, lime, bricks, sheets, mortar etc.

**2) Wilson et al. (1997)** – He studied construction materials waste management for residential projects in Queensland, Australia. He carried out the questionnaire survey of construction peoples on site to find out involvement to waste minimization, causes of materials waste, materials handling methods, difficulties and influences in waste management etc. From the result of this case study he provided ways such as, training and process optimization, for the achievement of a waste management principle in a construction project.

**3) Gamashta et al. (2006)** – He studied that braking of structures, maintenance of structures, renewing of existing structures, is increased all over the world, and it is found more in developing country. As per study there was lot of concrete and bricks materials get wasted during development works. He suggested that re using of various waste materials like concrete and bricks obtained from development of existing structures will help improving life of natural resources of raw materials. Aggregates obtained from demolition of concrete can be utilized in lean concrete by proper grading and washing it. Bricks obtained from dismantling can be useful for walls if its texture is good. Re suing of materials obtained from demolition will reduce impact on environment and maintains space for land fill.

**4) Meghani (2011)** – According to this study role of machineries, money, materials and manpower is very important in any type of construction projects. Controlling material waste is major issue found in all types of construction projects. He highlights construction material wastages causes on construction projects are, excess production, using higher side materials as replacement, more time required to purchase and receiving material on site, failure of transportation system, errors in processing, nonstandard inventories control, changes, faulty works execution, and residue left etc. He also provided the solution for minimizing the waste. In construction industry achieving zero waste is very difficult for all type of project. So some allowances for materials wastages are considered in all types' projects, if wastages remain

in these permissible limits then project will run in profit but if wastages exceed considered allowances then project will suffer losses

**5) Jain (2012)** – Studied that large amount of material wastages, poor site management, less awareness for material waste reductions attitude are found common in major construction sites in India. According to him 80 to 90% construction material waste recycle is economically possible in European countries. Lots of difficulties are being faced by the construction projects in our country for waste minimization and recycling are, peoples in industry shows less awareness, clients shows less interest, insufficient training and educations to construction peoples, un availability of skilled workers, less competition, less rules compulsion from government agencies, less interest from architects, low attention to waste minimization, non-awareness about on environment impact etc. By adopting well established system, for construction waste management considerable cost saving is achieved. Govt. Policies like dumping yard tax, more tax for using natural resources materials, incentives for recycling materials etc, will play primary step towards promoting construction industries towards recycle and reuse of construction wastage.

**6) Nagapan et al. (2012)** – According to this study fast growth in construction activities are responsible creating wastage problems in the world. Increasing waste problems provides bad impacts on nature, increases the cost, increases the production time, reduces productivity, and affects social health of country. To overcome such various negative effects there is needs to proper understanding of causes of waste generations and its management. Study shows that there are sixty three matrix factors contribute generation of waste in construction industry. In this study materials wastes causes were grouped into

the seven categories like changing design and documentation, poor material handling, bad attitude of worker, site management system, location and situation of site, poor planning, purchasing systems and local and social conditions.

**7) Ahankoob et al. (2012)** - According to these study conventional methods are helpful to reduce materials wastages in construction industry. Suitability of conventional methods to reduce wastage is applicable at construction stage only. He stated that building information method will helpful to reduce wastage at design and reconstruction stage. This method involves proper sequencing of construction activities, proper planning of construction activities, controlling various rework, accurate synchronizing site layouts and design, findings of errors and omissions by clash detection, accurate quantity estimation and execution, conflict, interference and collision detection etc.,

**8) Thomas et al. (2013)** - Studied that, now day's construction industries faces natural aggregates crises for production of concrete. It is found cost of construction project contains nearly 60 to 70 percentage of materials cost. By following suitable method of material wastage minimization on construction projects considerable cost saving is possible. It is found that demolition and construction waste generated is about 11 to 15 million tonnes. So he proposed 3R concept for material waste minimization on site.

**9) Adewuyi et al. (2013)** - He carried out study on construction waste in Rivers State, Nigeria. He collected data and analysed. From result it found that rework due to design and drawings changes, cutting materials in non-economical shapes and specifications changes contributes wastages on studied construction sites. He carried out questionnaires survey on seventy four factors contributing materials wastages on constructions sites among consultants and constructors. All factors are considered important for contributing to generation of wastage on site by respondents, and opinion of consultants and contractors are remains approximately same on causes of material waste generations. He proposed waste management plan for waste minimization at every level of constructions.

**10) Shetty (2013)** – According to this study magnitude of construction waste generation in India is increased due to its rapid economic growth,

which boosts various construction activities. So minimization construction waste has become important now days. Author suggested waste source reduction; reuse of materials obtained from dismantling, and recycles of demolished materials to control material wastage issues in India. In our country total solid waste production is approximately 960 million tonnes. Out 14.5 million tonnes consists construction waste. In 2010 it is found as 24 million tons of demolition & construction waste generated in India. According to author materials waste should be controlled at during progress of constructions and required necessary attention should be given to reusing and recycling of materials.

**11) Priyadarshi (2013)** – According to author minimizing construction materials waste is important to improve productivity and to protect environment. Extra utilization of resources many times contributes generation of wastage more than allowances considered at initial stage and last stage of projects. Minimizing construction waste will help to increase productivity considerably. Dumping ground scarcity and difficulty in clearing landfill area are major problems in now days. This report consists to find out causes of concrete waste and its quantification in housing projects. In this study data is collected from five constructions projects located in various cities of Maharashtra state. Obtained data analysis shows that concrete wastage occurring on sites is about 4.7%, and is more than allowance provided of 2%, approximately double concrete wastage is observed on site. Author also proposed suitable waste reduction plans consisting – improving project management, providing training to construction peoples, maintaining proper materials managements on sites etc.

**12) Abhijith et al. (2014)** –According to this study wastage of non-wanted construction materials happens on site directly or indirectly during construction process. Materials such as tor steel, structural steel, cement, sand, aggregate, woods, paints, tiles, bricks, blocks, concrete, unused materials etc. contributes materials wastages on

construction projects due to various reasons. It is found that wastage of such materials occurring on site is as 10% to 15 %, it is much extra than allowances considered by estimation engineer of 2.5 % to 5%. Author identified the following measures for Indian construction industry to handle waste issues - re-utilization of waste generating from various construction industries for reconstruction of various infrastructures, and recycling of dismantled construction waste, reusing construction materials obtained from demolition for many times, removing of residual waste left on construction sites, utilization of recycled material should be adopt to minimize waste, it will also promotes to reduce the space requirement for removing the material.

**13) Rao et al. (2014)** – According to author handling of material waste is one of the basic problems identified in construction industry. Material wastage promotes bad impact on environment and economy of the country. Total project cost consists about 60 to 70% of materials cost. Author carried out questionnaires survey on causes of wastages of construction materials on site, causes of client supplied construction materials wastages, attitude and participation of construction peoples on west management on site, and obstruction to follow waste reduction on site. Author suggested possible frame work to reduce materials wastages on site by analysing data obtained from survey.

#### **4. Sources of construction materials waste.**

Main sources contributes material wastages on sites identified from literature are,

- 1) Faulty design and documentations, design changes.
- 2) Faulty procurement, error in purchase process.
- 3) Non proper material storage and handling.
- 4) Using non correct operational methods on site during execution.
- 5) Residues left on site, needs to be remove from site.

Generation of construction materials waste consumes both time and efforts without adding

value to customer. Sources of material waste are grouped in following two basic categories. Like un avoidable waste (natural waste) and avoidable waste (direct waste and indirect waste).

**Natural waste** - Natural waste is the un avoidable waste, cost required to minimize is more than value produced. Avoiding natural wastage is possible up to certain limit, beyond that any measures adopted to reduce it will not be economical. So some percentages of natural wastages are allowed in tenders.

**Direct waste** - Direct materials waste is anything of unwanted materials developed during building construction, like unwanted structures and rejected materials, extra ordered and received on site, discarded on site. Construction material wastage is the gap between amounts of materials received on site and gets utilized on site. Material waste also consists, except earth materials, excess materials removed from site or dumped on same site for filling other than its specific required use. Material wastages happens on construction site is due to faulty design and documentations, poor method of purchasing and materials controls on site, utilizing nonstandard methods of operations, residues left etc. Most of the times, the cost of direct waste do not vanish in the cost of material, but followed with the cost of removing and disposing. Thus, by preventing direct waste straightforward financial benefits can be obtained. This waste can happens at any stage of the building construction activity, before the delivery of material to the site and after incorporating the materials at the building.

**Forms of direct waste identified from literatures are,**

- 1) Deliveries waste including all losses during transporting to the site, receiving and stacking into the first required storage.
- 2) Wastage due to bad storage at first place and during internal transporting materials from place to place, during placing materials in position and stacking near to work.
- 3) Wastages due to cutting non-economical dimensions, e.g. timber, sheeted goods.

- 4) Wastages occurs during installation like dropping, throwing away of materials.
- 5) Wastages due to materials cuttings in irregular sizes.
- 6) Wastages of materials during its applications on site like extra use of mortar for brick work and plaster, spilling of paint, materials remains un used etc.
- 7) Wastages of materials due to keeping unused at the end of day, like cement mortar kept unused on site at the end of the day so it gets hardened.
- 8) Wastage due to extra utilization of plants and machineries. Like concrete making mixers running ideals.
- 9) Wastages due to poor project management and bad supervision, faulty instructions.
- 10) Wastages due to excess purchase of materials and utilizing materials rather than its specific purpose.
- 11) Wastages of materials on project due to theft of materials.
- 12) Waste due to bad quality of materials purchasing, rejection by client etc.
- 13) Waste due to mistakes of staff and workers.

Avoiding direct waste is possible by taking proper care during transporting, storing and using of materials. Like by avoiding double handling - due to double handling materials wastage occurs in braking, cutting materials in required and economical shapes, ordering materials as per requirement and using it before expire date to avoid hardening of materials in container or cans, by increasing supervision to avoid throwing away of materials by workers, by making proper selection of materials to reduce rejection inferior quality of materials.

**Indirect waste** - Indirect wastes are those wastes which do not produce physical losses but causing only a monetary loss.

**Forms of indirect waste identified from literatures are,**

- 1) Wastage due to replacement of materials, e.g. using steel higher diameter for raft due to late purchase of materials to accommodate urgency- substitution waste.

- 2) Wastages due to excess utilization of materials e.g. additional concrete thickness in slabs due to poor finishing and levelling- production waste.
- 3) Wastage due to using materials in non-accountable (temporary) site work for that no allowances have been provided in the tender documentation, e.g. tower crane foundation, foot paths etc. – operational waste.
- 4) Negligent waste – like purchasing extra RMC and dumping it in filling.  
Thus indirect waste occurs due to casting of slab thicker than required. Indirect waste arises mainly from replacement of materials, waste caused by over utilizations, where materials are applied in better quantity of those required or not clearly indicated in tender documents, from errors, and waste caused by negligence, where extra materials are used along to the required quantity by the specifications due to the constructors own negligence. Indirect wastes can be eliminated by proper planning and using of materials, like using required material at right place instead of substitution, by using and correcting proper specifications, contract documents and taking care during executions to avoid excess and unnecessary work execution than required.

### **5. Causes of construction materials Waste -**

Many factors contribute to construction waste creation on site. Waste may happens due to single or a unitization of many causes. There are many contributory factors to the occurrence of waste; these include both human and mechanical activities. Main factors contributing material waste on site are,

#### **Wastage due to material handling and storage**

Forms of wastage of construction materials due to storage and handling identified are,

- 1) Providing extra load on transport equipment.
- 2) More materials consuming on site than required or billed.
- 3) Use of whatever material close to working place.
- 4) Damage to materials on site due to transportation system failure.

- 5) Materials receiving on site with manufacturing defect.
- 6) Material supplied in loses form.
- 7) Shifting of store frequently on site.
- 8) Change or transfer of store manager.
- 9) Loss of records.
- 10) Natural conditions.
- 11) Local and political influences.
- 12) Failure in material control on site.
- 13) Unsuitable method of material using and storing on site.
- 14) Faulty methods using for handling of materials.
- 15) Transportation method adopted for material transfer is not up to mark.
- 16) Damages to materials during unloading and loading on site.
- 17) Less awareness of workers and site peoples.
- 18) Waste arising from cutting nonstandard, non-economical sizes and shapes.
- 19) Extra production of a quantity than necessary required.
- 20) Lack of training for handling of materials and storage.
- 21) None required materials receiving on site, remains as it is or needs remove.
- 22) Theft of materials, security failure.

#### **Wastage due to operational factor**

Forms of wastage of construction materials due to operational factors identified are,

- 1) Faulty work execution by meson or worker.
- 2) Selection of faulty execution process.
- 3) Mistakes of workers and site staff during execution.
- 4) Required quantity is un clear due to poor planning.
- 5) No proper batching and mixing of materials on work.
- 6) Material transportation system failure.
- 7) Using materials by cutting instead of searching to conduct work.
- 8) Obstruction from client and consultant.
- 9) Rework due to quality issue, bad supervision.
- 10) Safety and daily work permission issues.
- 11) Conducting works with alternative material without permission.

- 12) Lack of drawing study and planning.
- 13) Delays in passing of information to the contractor on sizes and types of products use.
- 14) Communication gaps between workers and site staff.
- 15) Non supportive nature of site team and workers.
- 16) Non awareness of technology and process of work.
- 17) Disturbance to execute work due to political and social conditions.
- 18) Non availability of equipment's and machinery in time for executing work.
- 19) Frequent maintenance of equipment's, breakdowns.
- 20) Rework or damages to job due to non-satisfaction.
- 21) Unsuitable material supply and use.
- 22) Accidents due to negligence.
- 23) Damages due to equipment failure.
- 24) Damages to work due to climate change.

#### **Wastage due to design and documentation**

Forms of wastage of construction materials due to design and document are,

- 1) Making delay in providing drawings and detailing on site.
- 2) Design failure.
- 3) Less attention by consultant on site in checking.
- 4) Giving oral instructions for execution and then refusing.
- 5) Poor documentations of works.
- 6) Lack using of pour cards and check list.
- 7) Incomplete contract documents at commencement of project.
- 8) Overlapping of design and construction.
- 9) Mismatch in drawings and tender specifications.
- 10) Mismatches in drawing to drawing, like plan and sections.
- 11) Frequently revision in drawings.
- 12) Consultant and designers are un aware about construction friendly designs.
- 13) Un clear specifications.
- 14) Less knowledge about construction techniques during design activities.

- 15) Design changes due to site conditions and execution difficulty.
- 16) Designers and consultants not update as per changes in market.
- 17) Rework due to instructions from client and consultant.
- 18) Mistakes in forwarding instructions, decisions from client and site peoples including workers and staff.
- 19) In complete drawings and designs issued for executions.
- 20) Drawing mistakes, design mistakes, wrong instructions from consultant.
- 21) Poor site layout.
- 22) Making and issuing design and drawing with non-standard sizes, like for windows, doors, tiles, plumbing etc.
- 23) Complexity of detailing in the drawings.
- 24) Wrong material and work specification providing for execution.

#### **Wastage due to procurement factor**

Forms of wastage of construction materials due to the procurement identified are,

- 1) Late delivery of materials required for constructions on project.
- 2) Difficulty in purchasing small orders.
- 3) Changing purchase officer.
- 4) Late material supply.
- 5) Payment issue.
- 6) Purchasing material beyond required specifications.
- 7) Wrong selection of vendors and suppliers.
- 8) Local and political, social issues.
- 9) Purchasing excess material.
- 10) Poor purchase documentation.
- 11) Poor purchase system.
- 12) Late purchasing.
- 13) Due to urgency replacing material by costly one.
- 14) Placing wrong material requisition and order.
- 15) Changes in material prices.
- 16) Purchasing low quality materials.

#### **Wastage due to residual factor**

Forms of wastage of materials due to the residual factor identified from literature are,

- 1) Wrong method of purchasing.
- 2) Transfer of staff and workers.
- 3) Poor documentations and records.
- 4) Materials obtained due to demolition.
- 5) Rejection of material.
- 6) Bad quality of material received on site.
- 7) Material remains balance due to design change.
- 8) Material remains balance due to termination of work contract.
- 9) Cutting materials in un economical shapes.
- 10) Over mixing of materials than requirements.
- 11) Excess purchase of materials than requirement etc.
- 12) Environmental conditions.
- 13) Materials remains un used due to poor inventory control.
- 14) Local, social, and political influence.
- 15) Material remains un used due to workers mistake.
- 16) Purchased material kept balance unused due to product change.

Reduction of wastages of construction materials is not only a responsibility of the construction company. The client and the designer can make environmentally-friendly choices in the programme of demands and the design. Sources responsible for generating material waste have been identified are, faulty design and documentation, poor procurement process, adopting poor material handling methods, using nonstandard operation process and residual left activities. To minimize the magnitude of waste generated in construction, the principle source of waste generation must be identified. The study asked construction peoples to identify the main causes and sources of construction material wastages in their construction operations.

#### **6. Benefits of construction waste minimization**

Material waste minimization benefits are in the form of financial and environmental.

##### **Financial benefits include:**

- 1) Reduced transportation costs for waste materials.
- 2) Reduced disposal costs of waste materials.

- 3) Reduced purchase quantity and price of raw materials by waste minimization.
- 4) Reduced buying price of required materials when considering recycling and reuse.
- 5) More gains can be obtained by providing waste material to be recycled and reused site.

##### **Environmental benefits include:**

- 1) Reduced quantity of waste generated.
- 2) Efficient use of generated wastage materials.
- 3) Reduced pollutions in terms of noise, dust, emissions of carbons etc.
- 4) Transportation of waste to dumping ground is reduced.

**7. Construction materials waste minimization** -It is any method which reduces or avoids generations of wastages on construction projects. Construction waste minimization is about common sense and a change of attitude, rather than new technologies.

##### **Measures identified for materials waste minimization - Are as follows,**

- 1) Material reconciliation and stock accounting should be done regularly.
- 2) Controlling wastage during placing, transporting, mixing and batching, at place.
- 3) Improving attitude of constructing people towards material handling and controlling.
- 4) Intensifying security.
- 5) Introducing incentive schemes.
- 6) Use of readymade made materials like window frames and doors etc.
- 7) Sufficient purchasing of required materials and in required time.
- 8) Consuming materials earlier to expiry dates.
- 9) Efficient and proper use of construction equipment.
- 10) Posting of skilled workmen for related works.
- 11) Minimizing design changes.
- 12) Weekly programming of works to avoid sudden planning.
- 13) Using good construction management practices.
- 14) Adherence to standardized dimensions, avoid by passing.
- 15) Controlling materials supplied for right, quality, quantities and volumes.

- 16) Obtaining to earliest information about new product arrivals of material.
- 17) Vigilance of supervisors.
- 18) Training of construction site peoples about material waste minimization.
- 19) To avoid wrong ordering by store provide accurate specifications of materials.
- 20) Proper handling and storing of construction materials on project.
- 21) Suitable planning of material delivery schedule.
- 22) Implementing reuse, recovery, and recycling technique for wastage reduction.
- 23) Maintaining coordination between store and site peoples to avoid extra ordering.
- 24) Waste management officer or personnel employed to handle waste issues.
- 25) At the pre-planning stage of the project, proper material scheduling and material requirements at the right position and the right time will reduce the waste.
- 26) Proper communication among all parties will reduce construction waste.
- 27) The government can provide the strict conditions to follow the waste management.
- 11) Difficulty in understanding waste minimization and its importance concepts.
- 12) Incomplete designs and instructions to execution.
- 13) Presenting more in-situ materials and components rather than standardized
- 14) Extensive use of subcontractors.
- 15) Lack of long-term relationship with suppliers.
- 16) Lack of adoptions of construction and waste management policies and plans.
- 17) Lack of information sharing, ego issues among peoples working on site.
- 18) Poor professional wages to construction staff and workers.
- 19) High level of illiteracy, less education.
- 20) Traditional construction culture and behaviour.
- 21) Existing regulations are difficult to operate in practice.
- 22) Lack of supply chain integration.
- 23) No penalty faced by contractor for if waste minimization is not adopted on site.
- 24) Communication gap between divisions working on site.
- 25) Non availability of industry norms for managing materials wastage on site. .
- 26) Non availability for recycling market.
- 27) Lack waste reduction education at university level.
- 28) Poor distribution of financials incentives to operators.
- 29) Priority is given to achieve only commercial profit.

### 8. Barriers to the implementing of waste reduction in construction

The cause which opposes the implementation of wastage minimization in constructions identified from literature is presented as.

- 1) Making late in decision taking.
- 2) Less of higher management support and commitment.
- 3) Communication gap between peoples working for construction site.
- 4) Inadequate pre-planning on site.
- 5) Corruption.
- 6) Waste management responsibilities for individuals are poorly defined. .
- 7) Making late in materials delivery.
- 8) Lack of equipment and its maintenance.
- 9) Shortage of required materials at required time.
- 10) Unsuitable organizational structure to execute site.

### 9. Measures to counter barriers to adoptions of waste minimization -Are as follows

- 1) Team peoples should be involved in decision-making to make partnerships.
- 2) Service experience with recycled materials.
- 3) Development of specification, guidelines for the recycled materials to be use.
- 4) Provide site space for conducting waste management process.
- 5) Introduction and implementation of less construction waste technologies on site.

- 6) Making available equipment and machines for material waste reduction on site.
- 7) Improving workers' skills.
- 8) Assistance or information from suppliers.
- 9) Management should educate employees on waste management concepts.
- 10) Communication should be improved among peoples in construction projects.
- 11) Construction should ensure or maintain continuous improvement:
- 12) Construction managers must be committed to changes.
- 13) Workers need to be promise to work in teams.
- 14) Preventive solutions to avoid defective manufacturing should be adopted.
- 15) Promoting compulsory waste reduction culture within the organization.
- 16) Promoting the image of the company.
- 17) Improve market share/competition.
- 18) Following what the competitors have done.
- 19) Creating awareness about environmental losses due to generation of waste.
- 20) Firms should consider client requirements, expectations & position accordingly.
- 21) Companies should be more clients focused.
- 22) Standardized construction elements should be promoted in the industry.
- 23) Firms should be promised to change organizational cultures
- 24) Gov. Needs to revise rules that could provide required support to waste reduction.
- 25) To maximize team building and development of trust partnering should be promoted.

From above it is clear that constructions materials using and storing on site is major responsible source of material wastage creation on construction site. Materials wastage found due to collapse of transport system, due to poor method of storing it on site, damages to materials during loading and unloading, double handling, bad inventory control, extra purchasing, no proper coronations between store manager and site peoples, etc. So this study focused on analysis of materials wastages due to storage and handling.

## 10. Conclusion

Construction activities generate avoidable and unavoidable waste. Identifying and categorizing the types and causes of avoidable waste help in its minimization. This chapter reviewed literature on the wastages of construction material, causes and sources of construction materials wastage on site, waste minimization measures, barriers to its implementation, wastages of basic construction materials and deviations between actual material wastage against standard wastage allowance considered on construction site

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