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Construction & Demolition Waste: A Resource for the Alternate Building Material in the Construction Sector

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ABSTRACT: In the past, prices for raw materials and energy have already risen and are expected to grow further as the Indian construction industry is expecting to see a growth of 6.6% annually, with reports indicating that 70% of India's buildings are yet to be built and the need for construction materials is expected to increase fivefold estimated by outlook sustainability 2015. The demand for construction materials has also caused resource shortage in many parts of India and this is the main reason for delay and failure of a huge number of construction projects. Many innovative initiatives such as fly ash bricks and M-sand have already been introduced in the Indian construction sector. These have had major positive impacts over the past decade. Construction and Demolition (C&D) waste is another material which has the potential to substitute the use of virgin raw materials to a large extent.

The Indian economy is the fastest growing economy in the world (DNA, 2015). According to the Twelfth Five Year Plan, the construction sector accounts for 9% of the total GDP making it the second largest economic activity after agriculture (GOI, 2011). The boom in the construction sector has resulted in an increased demand for construction raw materials which makes resource efficiency of materials in the construction sector a very important subject of discussion for modern India.

I. INTRODUCTION

1.1 DEMOLITION WASTE: A RESOURCE IN THE CONSTRUCTION SECTOR

C&D Waste is defined as 'Waste comprising of building materials, debris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure' (MoEF& CC, 2015). Management of C&D waste is a problem faced not only in India but by the global community and quantum of waste produced occupies a huge fraction of the total solid waste generation by mass. Even though the recyclables (plastic wood and metal) are segregated and reused almost immediately at the source of generation itself, rest of the waste is dumped in low lying areas. Very few ULBs in India have designated dump yards and further few have proper management facilities, resulting in C&D waste becoming a public menace in most situations.

II. INDIAN INITIATIVES & RESOURCE EFFICIENT INDIAN CONSTRUCTION SECTOR – A HOPEFUL FUTURE

The Delhi Municipal Corporation (DMC) has implemented a pioneering project. It has set up a C&D waste processing plant where 2000 tonnes of debris is processed every day to make multiple products such as paver blocks, kerb stones, ready mix concrete and a variety of pre-fabricated structures (DMC, 2010). The processing plant has been running successfully since 2010. DMC is planning to setup two additional processing plants based on the success of this pilot plant. The Ahmedabad Municipal Corporation has also established a pilot scale unit of 1000 TPD processing capacity

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on similar lines (AmdavadEnviro Projects Private Limited) and the Coimbatore City Municipal Corporation has commissioned the establishment of a 200 TPD capacity processing unit (CCMC, 2015).

III. REUSING AND RECYCLING OF C&D WASTE

3.1 REUSING OF CONSTRUCTION AND DEMOLITION WASTE- Reusing of construction and Demolition waste is different from Recycling. It does not require any further processing to convert into a useful product. The items which are usable directly are screened out from the debris and put into the intended use without further processing or the application of any further energy for conversion into the useful product. Thus reusing a waste item is a better service to the environment and the environment is saved from further impacts due to recycling activities. For example, full bricks can be screened out of the demolition debris and used as it is for building a partition wall. Otherwise same would have been converted into smaller pieces for using it as an aggregate or brick bats for plinth protection etc.



Figure.1 Delhi based first C & D waste plants of India, interlocking tiles made by waste material

Since the reusing of C&D waste is always more advantageous, it is essential that to have more and more reusable materials in debris. This is possible, if sufficient precautions are taken while a building is demolished. There should be an effective deconstruction plan instead of just converting the standing structure into debris within minutes. Useful products like doors and windows, bricks, reinforcement, from RCC components, structural steel can be taken out with little extra efforts and put into reuse without much processing.

3.2 RECYCLING OF CONSTRUCTION AND DEMOLITION WASTE-Once the waste generated from Construction and demolition waste has been segregated and reusable items are taken out, the leftover waste is now available for recycling. Recycling of this waste into useful products to extend the service to environment is a challenge.

IV. REUSING AND RECYCLING POTENTIAL OF DIFFERENT MATERIALS

The amount of C&D wastes in India has been estimated to be 10 - 12 million tonnes annually and the proportion of concrete estimated as 23 to 35% of total waste. Considering 30 % percent of C&D wastes of 12 million tonnes as concrete, and 50 % of the concrete as coarse aggregate, the total available recycled concrete aggregate (RCA) in India is of the order of 1.8 million tonnes annually.

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4.1 CONCRETE-Concrete is primarily a composition of cement, coarse aggregates, fine aggregates and water, further processed by addition of industrial products/ by products for enhancing the strength. Engineers are mainly dependent on nature for obtaining the Coarse and Fine aggregates as well as water for the chemical reaction with cement. Scarcity is there for all these naturally occurring materials and need is there to explore alternative sources. Even for the water with required properties, shift is towards the use of waste water after due treatment. One of the alternative sources of coarse aggregates is recycled concrete aggregates (RCA) which are obtained from the processed Construction and Demolition (C&D) waste. During and after the demolition of any concrete structure, the demolished concrete waste is taken to a recycling plant and there crushed into the required sizes which is called the Recycled concrete aggregate (RCA). Sometimes, good sized precast element are also obtained during the demolition, which have a potential of being reused or otherwise, these are also crushed and converted into the recycled aggregates. Limitation is there in use of these recycled aggregates. The production of concrete in India is governed by BIS and IRC codes i.e. IS: 456, IS: 1343 or IRC: 112. All these codes allow the use of naturally occurring aggregates only conforming to IS: 383. To overcome these limitations, it is required to make a special provision of use of Recycled aggregates in combination with naturally occurring aggregates. Thus, use of recycled aggregates can be there with different value of their share by suitable replacing the component of naturally occurring aggregates. It will help out not only in meeting the situation where there is acute shortage of natural resources, but also a step towards the sustainability.

4.2 BRICKS - Bricks are the important building material in the construction of residential as well as non -residential buildings. It is also a significant component of the total C&D waste on new residential construction sites. Bricks are largely treated as waste when broken or damaged from the brick production line or from construction site due to poor internal handling and excessive cutting. Brick is a maintenance-free component of the structure which is durable during the complete service life of the building. The high durability property of the brick makes it environmental friendly in the sense that after the demolition of the structure, it can be reused repeatedly and the left over volume which is non-reusable can be recycled for other beneficial purposes. During the demolition process itself, bricks obtained are stacked for next use in its original form after the removal of mortar which is chiselled out and make the brick ready for reuse or recycling, if not reusable. Bricks, after the removal of the stuck up mortar remain reusable for restoration or for new homes and projects. Recovered bricks can be used like a fresh lot of bricks without any further processing. These can also be laid on as brick pavers or for landscaping or any other artistic creations. Brick paved streets are aesthetically pleasing and rain water also percolates through the pavement. Also, a brick surface is cooler in hot months. These street advantages make bricks a good choice in driveways. Bricks on edge are also sometimes used as economical pavement solutions in smaller compounds.

Construction debris consisting of bricks can be recycled into brick aggregate through screening, crushing, re-screening and blending, which can then be used as pavement base material by proper mix proportions with cement and fly ash. Brick waste which are not suitable for recycling into the pavement base materials can be used in construction/land fill. Concrete prepared from crushed brick aggregate has good engineering and also better thermal properties but has greater shrinkage than ordinary concrete. Sometimes, during the manufacturing of bricks, due inadequate burning, or sometimes due to over burning, whole lot is turned into the production waste. Though this waste is different from construction and demolition waste, but it can also be recycled like C& D waste and can be suitable used for production of precast elements like paver blocks, kerb stones, interlocking tiles by mixing with cement and using as a concrete mix.

4.3 TILES- it is difficult to extract tiles from the walls in proper shape and size in order to find them suitable for reuse. It also depends upon the type of the tiles, their life span and the existing conditions. Seepage behind the walls due to leaking water pipes makes them totally non usable. Still tiles extracted from walls, even if these are broken pieces, provide an excellent opportunity to the artists /designers for making murals or other decorative master pieces. Broken tiles can also be used aggregate after crushing.If the tiles can be extracted or removed from the wall in good shape and size, these are reused for the same purpose after the removal stuck up mortar and then glued with suitable adhesives available in market today. Creative items like artifacts, table tops, special effects in drive ways, pedestrian subways etc. can be smartly created by reusing for a wide variety of projects. The broken tiles can be further crushed into smaller sizes and can be a partial replacement of gravel and crushed stone in making concrete.

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4.4 TIMBER-The waste timber is not only produced from the demolition of the building, but also from construction of wooden building wherein lot of timber waste is generated. Each source has its own system of recycling and reuse of recovered timber from the demolition of a building or the construction of a building. Whenever a building is decided to be dismantled, timber products like doors and windows are the items which are removed as first step and that too in original form. Timber products have a quality of a long service life which is much longer than the life of the building itself. Hence, in general such products unless eaten by the termites or damaged due to fire do not lose the Engineering properties for a long time and can be used multiple times and thus an environmentally friendly product.

The waste timber which has not been recovered in its original form or non-usable in same shape and size can be recycled into new particleboard, medium density fibre boards, animal bedding or used to make renewable energy. Timber used for recycling has to be free from any other demolition products like concrete, mortar, aggregates, sand, bricks, plastic, metals, tiles etc. Wood chips are produced from good quality wooden waste such as large size lumbers. Some of the particleboard producing companies and the pulp and paper producing companies are still using the recycled chip for their products.

4.5 METALS- Amongst the metals, steel and Aluminium are the two major products obtained as waste during the construction as well during the demolition of a building. Structural steel obtained during the demolition of a steel structure or left over steel during the construction can be reused directly without much processing. The members can be resized as per the requirement and can be reused directly. Aluminium scrap can be put into reuse by the solid bonding process. If a care is taken in initial stages i.e. during designing with a valid deconstruction plan, then the reusable scrap can be increased to a much greater extent like house hold appliances, without taking the routing the scrap through a foundry. Reusing a steel beam its existing form is better than re-melting it and rolling a new steel beam, i.e. the energy used to re-melt the beam is saved.

Steel waste occurs during the construction and refurbishment of buildings and when they are ultimately demolished and the material becomes available for recycling. Waste from the manufacture of steel construction products can be easily collected and segregated for recycling. Steel generates almost nil wastage on the construction site. Waste steel which is reusable is equally good in durability criteria and the quality is also well maintained while making products like fire hydrants, steel furniture and also ecologically sustainable. Aluminium is recyclable multiple times and is always in demand with the need to preserve the environment. Recycling scrap aluminium requires very less energy in comparison to the energy requirement of new aluminium. Because aluminium is infinitely recyclable, it can be reused in applications vastly different from its previous purpose, and it can also be recast into its original form. These properties make aluminium an ideal material for use in premium applications, even after being recycled many times.

4.6 PLASTIC- Scrap or waste plastic recovered from demolition or construction site is reprocessed and transformed into the entirely different useful products. When compared to other materials like glass and metals, plastic polymers require greater processing to be recycled. The most-often recycled plastic HDPE (high-density polyethylene) is reduced to plastic lumber, tables, roadside curbs, benches, truck cargo liners, stationery (e.g. rulers) and other durable plastic products and is usually in demand. Other application of recycled plastic is in the preparation of a road surface that includes recycled plastic aggregate, bitumen (asphalt) with plastic that has been shredded and melted at a temperature below 220° C (428 °F) to avoid pollution. Such road surfaces are very durable and monsoon rain resistant.

4.7 ASPHALT-Concrete Demolished asphalt concrete can be utilised as aggregates for asphalt concrete. Also, the demolished asphalt concretes can be used for land fill.

4.8 ASBESTOS- asbestos is disposed as hazardous waste in landfill sites. The demolition of buildings containing large amounts of asbestos based materials have to be deconstructed piece by piece or the asbestos has to be removed carefully before the structure can be demolished. Workers must wear heavy protective equipment. It is important to ensure that asbestos waste has been wetted and sealed in heavy-duty plastic prior to transportation to an approved landfill.

4.9 EXCAVATED MATERIAL- Excavated materials are many times contaminated and require special handling and disposal. It may include hazardous as well as non-hazardous material. Excavated contaminated material that can be re-

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used will be decontaminated prior to re-use, or if not suitable for re-use will be transported to appropriate treatment facilities or approved landfill sites. If the excavated materials are found suitable for re-use as road fill base material, then the cut and fill quantities will be balanced to avoid any off-site disposal. Excavated soils will be retained on site for re-use as backfill while hard rubble will be crushed and re-used on site. Unsuitable material for engineering fill can be used for landscaping.

V. GUIDELINES FOR RECYCLING

The agencies responsible for generation of wastes should separate the generated wastes having potential for reuse/recycling. The in-charge will select structure's type and materials that are suitable for reuse/recycling, use recycled aggregates, and ensure proper treatment of wastes generated from such development. The waste generation from construction should not only be minimised, but should also minimise the hazardous effect from the generated wastes. Various agencies or sub-contractors to be involved are to be linked up with the steps in this process of C& D waste reuse and recycling. Some of such steps can be listed as waste collection and transportation, waste middle treatment i.e. receiving the waste, its segregation and further suitable comprehensive treatment before putting into the use. The cost for C&D waste separation, storage, treatment, reuse/recycling should be included in the Estimated Cost by the Engineer-in-charge while according Technical sanction and preparing tender documents.

VI. CONCLUSION

The use of Recycle product is increasing with innovation in present scenario. The utilization of waste product in the manufacturing of new product is a challenging job. The Natural Resource decreases in a short period and therefore the use of waste product is necessary. There are a number of old buildings and structures are demolished today. The reuse of that demolished debris is a good solution to the problem of an excess of waste material. The studies on the use of recycled aggregates have been going on for few years. Aggregates play important role in strength characteristic of concrete. The processing and reusing of C&D waste is possible in India. Not only does it lead to management of waste but also results in job creation and income generation. This is helping to change the view point of the community from considering C&D debris as a waste to a resource material. In India ULB could adopt these models which would help in greening of the Indian construction sector by minimising waste and by providing alternate green building materials

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