CONSTRUCTION AND DEMOLITION WASTE RECYCLING SYSTEM: A STUDY

Sanjay Pathak[1], Lokesh Kumar[2], Ujala Mishra[3], Amit Choudhary[4]

[1] *M.Tech Scholar, Construction Engineering, Civil Department, Bhagwant University, Rajasthan, India*
[2] *M.Tech Scholar, Construction Engineering, Civil Department, Bhagwant University, Rajasthan, India*
[3] *M.Tech Scholar, Civil Department, Bhagwant University, Rajasthan, India*
[4] *Assistant Professor, Civil Department, Bhagwant University, Rajasthan, India*

ABSTRACT

In this paper stakeholders are asked to give further insights in the barriers towards high quality recycling of C&D waste materials. We elaborated on the three distinctive phases of the lifecycle of buildings, i.e. pre-building phase, building phase and post-building phase. The pre-building phase includes raw material production and building material production (prefab material). When the building materials are available, the building is constructed. Once the building is completed, it can be inhabited. Even though users have a minor impact on the waste generated, they are included within the stakeholders because the use phase of the building is a vital part of the life cycle of the materials. The demolition phase follows after the use phase of the building has ended. The waste material recovered during the demolition – or construction - phase is sorted. The customer, the petitioner of the demolition, is the starting point of the waste recycling system. The client has an influence on the decision-making related to waste treatment. For instance, the time available for demolition is a result of the choices made by the petitioner. Studying the relationships between actors operating in the system, an insight regarding the possible barriers that hamper the recycling of C&D waste can be revealed.

Keyword : - *C&D, Waste, Phase, Construction, Materials etc.*

1. INTRODUCTION

According to findings of survey, the most dominant reason for not adopting recycling of waste from Construction Industry is "Not aware of the recycling techniques". While 70% of the respondent has cited this as one of the reasons, 30% of the respondent has indicated that they are not even aware of recycling possibilities.

- Concrete and masonry constitute more than 50% of waste generated by the Construction Industry. Recycling of this waste by converting it to aggregate offer dual benefit of saving landfill space and reduction in extraction of natural raw material for new construction activity.
- Recycled aggregate can be used as general bulk fill, sub-base material in road construction, fills in drainage projects and for making new concrete.
- Construction and demolition waste is generated whenever any construction/demolition activity takes place, such as, building roads, bridges; fly over, subway, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc.
- It constitutes about 10-20 % of the municipal solid waste (excluding large construction projects).
- Out of 48 million tonnes of solid waste generated in India, C&D waste makes up 25% annually.
- Projections for building material requirement of the housing sector indicate a shortage of aggregates to the extent of about 55,000 million m3. An additional 750 million m3. Aggregates would be required for achieving the targets of the road sector.
- Retrievable items such as bricks, wood, metal, titles are recycled, the concrete and masonry waste, accounting for more than 50% of the waste from construction and demolition activities, are not being currently recycled in India.

- According to a study commissioned by Technology Information, Forecasting and Assessment Council (TIFAC), 70% of the construction industry is not aware of recycling techniques.
- Estimated waste generation during construction is 40 kg per m2 to 60 kg per m2. Similarly, waste generation during renovation and repair work is estimated to be 40 kg per m2 to 50 kg per m2. The highest contribution to waste generation comes from the demolition of buildings. Demolition of pucca (permanent) and semi-pucca buildings, on average generates between 300kg per m2 and 500 kg per m2 of waste, respectively.
- The presence of C&D waste and other inert matters make up almost one third of the total MSW on an average.
- The Bureau of Indian Standards (BIS) and other codal provisions do not provide specifications for the use of recycled products in construction activities.
- The demolition of old buildings usually generates wastes such as brick, wood and steel. In India most of the old buildings are mainly made up of good quality bricks. The foundation of the old buildings is of load bearing type where a huge number of bricks were used. When an old building is demolished, almost all the materials are sold at reasonable price.
- This estimate only accounts for new construction. Demolition and renovation/repair-related waste of the older stock generates additional waste. The waste produced per sq m of demolition is 10 times that generated during construction: as per TIFAC, 300-500 kg of waste per sq m. If it is assumed that five per cent of the existing building stock gets demolished and rebuilt completely annually, then about 288 MT more of C&D waste would have been generated in 2013 alone because of demolitions.
- Thus, the total C&D waste generated in India just by buildings in one year — 2013 — amounts to a humungous 530 MT, 44 times higher than the official estimate. Imagine the scenario if the waste generated by infrastructure projects such as roads and dams is added. Not surprisingly, in India, if C&D waste is quantified, it will be more than all the other types of solid waste put together.
- Where is all this C&D waste going? A lot of it is being used by land sharks to illegally fill up water bodies and wetlands around urban centers for real estate development. The rest is just being dumped into rivers and open spaces.

2. **MATERIAL FLOW ANALYSIS**

Material flow analysis is a tool by means of which complex systems can be described regarding the materials involved. The system itself needs to be well defined. Since virtually every system interacts with other systems, drawing boundaries is of first interest. Let's say if we've got a big enterprise, it makes quite a difference whether we focus on one machine, on the department or on the whole enterprise. We can also make simplifications; procedures which need not to be looked at in detail in this context we place in a black box and give it the name of a process. Processes may be an action, a transport, but may also be quite static in the instance of deposits. They are usually displayed in rectangular shapes that are linked by arrows signifying the material flow between the processes. Several methods can be applied to make the diagrams more readable, for instance varying the thickness of the arrow, or attaching a label telling the quantity of the flow.

3. RECYCLING AND REUSE OF CONSTRUCTION AND DEMOLITION WASTE FOR SUSTAINABLE DEVELOPMENT

As we are living in 21st century, new technologies are being invented in almost every sector to make human life fast and easier. Beside this we are still finding the solutions to problems related to our environment, energy and natural resources. Construction industry produces large amount of waste throughout the year. Most of the time construction and demolition waste ends up in landfills disturbing environmental, economic and social life cycle. Construction and demolition waste is the waste materials that are produced in the process of construction, renovation or demolition of residential or nonresidential structures. Components of construction and demolition waste typically include concrete, asphalt, wood, metals, gypsum wallboard, roofing, paper, plastic, drywall and glass. Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs; and can be considered as one of the solution to solve construction and demolition waste.

Recycling of Construction and demolition waste has many benefits such as reduction in transportation cost, it keeps environment clean and reduces natural resource exploitation. To promote recycling and reuse of waste, awareness about its effects and benefits should be communicated with people, contractors, engineers and architects. More numbers of recycling plants should be installed and allowing the use of recycled aggregate instead of natural aggregate for some purpose. In this paper I am going to focus on different recycling techniques and reuse of construction and demolition waste.

4. CONSTRUCTION AND DEMOLITION WASTE

The demolition phase follows after the use phase of the building has ended. The waste material recovered during the demolition – or construction - phase is sorted. This can be executed by the demolition company or by an off-site sorting company. The sorted material can re-enter (after appropriate treatment, see chapter 3) the raw material, prefab material or the construction phase. The customer, the petitioner of the demolition, is the starting point of the waste recycling system. The client has an influence on the decision-making related to waste treatment. For instance, the time available for demolition is a result of the choices made by the petitioner. Studying the relationships between actors operating in the system, an insight regarding the possible barriers that hamper the recycling of C&D waste can be revealed. Next to that, a look into the future through the eyes of the stakeholders gives the opportunities and threats of a project like Cirkelstad. These topics are approached in order to give answer to the third sub-question: Which barriers impede high quality recycling of construction and demolition waste?

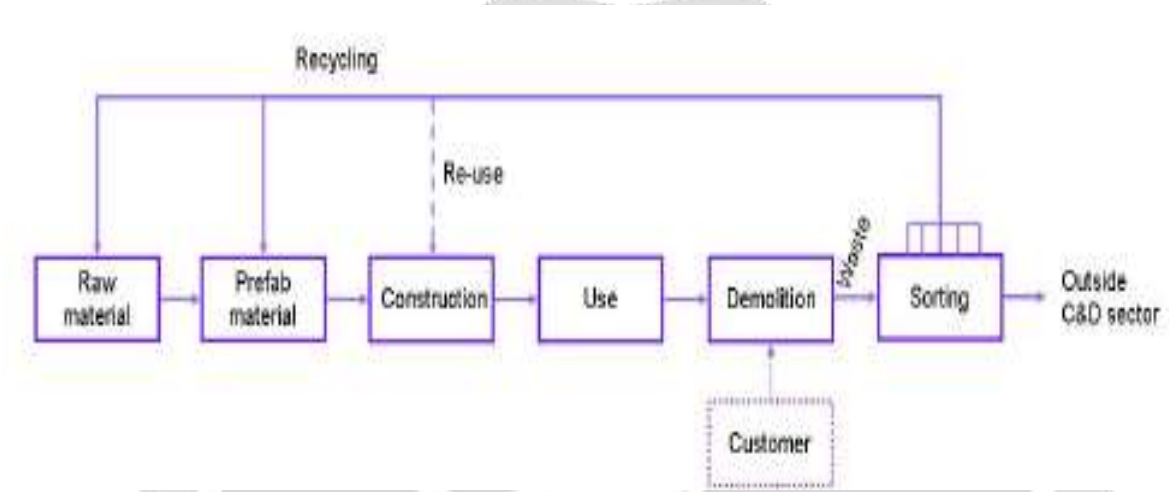

Figure 6.1: The system of C&D waste recycling. The flow of the (waste) material is depicted over different parts of the system. The customer has an influence, without interfering with the material itself.

5. NATIONAL WASTE POLICY: LESS WASTE, MORE RESOURCES

Endorsed by Australian environment ministers in November 2009, TheNational Waste Policy: less waste, more resources (National Waste Policy) is a collaborative approach that aims to avoid the generation of waste, reduce the amount of waste for disposal, manage waste as a resource and ensure that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally-sound manner. The National Waste Policy sets a clear direction for Australia for the next 10 years and will update and integrate Australia's policy and regulatory framework. Through the National Waste Policy, the Australian Government aims to support development of best practice across all states and territories. The policy includes a strategy specifically focused on C&D waste, as follows:

Strategy:

All governments continue to encourage best practice waste management and resource recovery for construction and demolition projects.

6. COMPARISON WITH EARLIER FINDINGS

In general, all actors agree that the recycling rate of C&D waste is fairly high in the Netherlands. At least the largest streams, stony material metals and to a lesser extend wood, are recycled to a sufficient degree. Nevertheless, the high quality recycling is considered to be still in an infant stage (company F). For stony aggregates, for example, manufacturer B put forward that it is cheaper and easier to use it as base material for roads. Therefore, most of the material finds its way towards this purpose. The MFA constructed. This finding, as 93% of the stony aggregates was used as base-material for roads. Wood is seen as a renewable material, implying that incineration with energy recovery is an acceptable treatment option. For smaller materials, like insulation material, the separation is more difficult since it may comprise different materials. As a result, the recycling of these materials lags behind.

Furthermore, the manufacturing companies have technologies and practical knowledge for including recycled aggregates in their production process. The most used method for secondary aggregate preparation is crushing, sifting and washing. Other methods are still in development, but have high expectations, like the smart crusher. Hence, technologies for recycling are available or in development, the cause of the low recycling rate within the sector seems to be at another point in the system. Therefore recycling technologies are not assigned as a problem regarding high quality recycling. Almost all stakeholders do, however, indicate that separation and sorting of the waste as starting point of improving the quality of the material. Less contaminated material is easier to process in building material production processes. They expect that, in case separation of the C&D waste provides clean mono-streams of materials, high quality recycling of building material will increase.

7. CURRENT SYSTEM

According to the stakeholders the current C&D waste recycling system is being hampered by the economic crisis, the availability of suitable waste materials and the project planning.

Economic climate

All actors mention that the current economic climate makes it difficult for the sector to recycle C&D waste materials. Due to the crisis, the price of raw materials is rather low. At least, it is lower than the price of secondary materials, except for metals. As a result, secondary aggregates which are designated for use in the production of concrete are piled up having a difficult market position, at least according to company D. Another consequence of the lower economic activity is the decrease of construction and demolition projects in the Netherlands. This leads to a stagnation of the amount of C&D waste that is released and the projects in which the C&D waste can be recycled.

Availability

Manufacturer B and C claim that, next to the price, not enough suitable aggregates are available to include secondary aggregates in their production process. Two barriers are mentioned for the low availability of proper aggregates. First, the materials are preferred to be separated correctly. The materials included in production processes require certain quality, which can be reached by good separation. Second, for stony aggregates, it is cheaper to recycle the material as base material (company B). In order to use stony aggregates as base material, lower requirements are set to the composition of the aggregates. The stony material may contain concrete, masonry, other bricks, glass etc. Leaving minor amounts of clean aggregates for recycling at high quality. Another barrier to promote high quality recycling is that incineration is cheap at the moment (company E). Thus, attempts towards recycling of combustible materials, e.g. plastics and wood, have to compete with the low disposal costs of waste incineration plants.

Planning

There is a contrast in the plan of action regarding construction and demolition, in the opinion of demolition companies. For construction each step is included in a time plan. In case the space of the newly constructed building is occupied by an old building, the latter is needed to be demolished in a short amount of time. This leaves no time for careful material separation. According to company E, the attitude of customers for demolition towards demolition is disrespectful. This needs to be changed in order to be able to demolish buildings sustainable, which requires more attention and time.

8. CONCLUSIONS

According to the stakeholders the current C&D waste recycling system is being hampered by the economic crisis, the availability of suitable waste materials and the project planning. All actors mention that the current economic climate makes it difficult for the sector to recycle C&D waste materials. Due to the crisis, the price of raw materials is rather low. At least, it is lower than the price of secondary materials, except for metals. In general, all actors agree that the recycling rate of C&D waste is fairly high in the Netherlands. At least the largest streams, stony material metals and to a lesser extend wood, are recycled to a sufficient degree. The demolition phase follows after the use phase of the building has ended. The waste material recovered during the demolition – or construction - phase is sorted. This can be executed by the demolition company or by an off-site sorting company. They are usually displayed in rectangular shapes that are linked by arrows signifying the material flow between the processes. Several methods can be applied to make the diagrams more readable, for instance varying the thickness of the arrow, or attaching a label telling the quantity of the flow.

9. REFERENCES

[1]. http://www.gesundbauen.at/BER3BTE.htm
[2]. http://de.wikipedia.org/wiki/Teak
[3]. http://www.bma.go.th/
[4]. http://www.bma.go.th/
[5]. http://de.wikipedia.org/
[6]. http://en.wikipedia.org/
[7]. http://www.suva.ch/
[8]. http://www.pic.int/
[9]. http://www.admin.ch/ch/d/sr/814_610_1/app1.html
[10]. http://www.vevaonline.ch
[11]. http://europa.eu.int/eurlex/en/consleg/pdf/2000/en_2000D0532_do_001.pdf
[12]. Agentschap NL. (2012). Afvalverwerking in Nederland, gegevens 2011. Utrecht, The Netherlands, AgentschapNL and Vereniging afvalbedrijven – Werkgroep Afvalregistratie: Author.
[13]. Ansems T., A. Pásztor, T. Ligthart and M.Willems. (2009). Prioritaire afvalstromen in beeld: Bouw- en sloopafval. TNO Bouw en Ondergrond (TNO-034-UT-2009-00616_RPT-ML). TNO, Utrecht.
[14]. Betoniek. (2011). Oud beton wordt jong beton. Betoniek 15/19. Æneas, Boxtel.
[15]. CBS, PBL, and Wageningen UR. (2012a). Vrijkomen en verwerking van afval per doelgroep, 1990-2010. (indicator 0206, versie 11, 10 september 2012). www.compendiumvoordeleefomgeving.nl. CBS, Den Haag; Planbureau voor de Leefomgeving, Den Haag/Bilthoven and Wageningen UR, Wageningen.