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Construction and Destruction Waste Management Practices to Reduce Environmental Impact in Bangladesh

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ABSTRACT

Bangladesh is a fast-growing developing country and Buildings of Mymensingh city areas are increasing rapidly in last five years. The management of construction and demolition trash is an issue given the dramatic increase in 20-building construction. Environmental contamination has risen recently due to a lot of development and demolition trash. Building materials, collection techniques, recycling and disposal should all be evaluated to assess this problem. This article demonstrates the Reuse, Recycling and Disposal of Construction and Demolition waste as a way for environmental protection, and Construction and Demolition waste management. The investigation was based on field visits, interviews, secondary data sources, and conceptual methods. We surveyed 300 construction sites (buildings) in Mymensingh city as a new city corporation of the country. We found 31% materials are reused, 26% are recycled and rest of the materials is nominated as construction waste. This paper also examines the management practices for evaluating the result. Different methods could be used to reduce waste and increase profits through recovery, reuse, and recycling of construction and demolition waste. For proper reuse and recycling of Construction and Demolition waste, waste management strategies, reliable and tested case studies are necessary.

Keywords: Construction, Destruction waste, Management, Reuse, Recycle, Pollution, and Environment.

INTRODUCTION:

The increase of the construction activities due to development in developing countries increases the generation of construction waste. The traditional method for the managing construction waste is to dispose of waste at a disposal site, or to burn or bury it at the construction site (Symonds, 1999). Construction and demolition (C&D) trash is not new waste globally, but it is starting to expand with the increase in population and the development in housing (Abdul *et al.*, 2019). In those countries that they are in developing, growth of the population, increased construction and urbanization, on the one hand, and on the other hand, the lack of sufficient landfill space increases the requirement to manage UniversePG | www.universepg.com

reuse and recycling of C&D waste (Saju *et al.*, 2020; Abdul *et al.*, 2019).

The many features of waste products make waste management a particularly difficult undertaking. It is essential to properly manage C&D waste due to the severe negative effects it has on the environment (Abdul *et al.*, 2019). There have been significant research efforts to examine building and demolition waste management (CDWM) in different economies (Abdul *et al.*, 2019). Urbanization and construction development are important for the development of the country. But unstable and unplanned construction can be harmful and dangerous to the environment. Due to unplanned construction and urbaniza-

tion, construction could be rebuilt in a few years (Abdul *et al.*, 2019). More garbage, primarily known as construction waste, can be produced by many construction sites. Construction materials are being used more frequently in new construction every day.

According to projections, there would be an 8.3% annual growth in Cement and concrete additives are in high demand additives worldwide (World Bank 2011). Building Industries is one of the largest sources of greenhouse gas emission and energy consumption. Fire Brick or burnt clay brick is the most popular building material in Bangladesh. Every year a huge amount of burnt clay brick is used for the construction purpose. The most common building material in Bangladesh is fire brick, also known as burned clay brick. A significant volume of burned clay brick is utilized each year for building. Large-scale land loss and environmental degradation are brought on by firebrick production facilities (Sarker & Mahmud, 2018). They also raise temperatures and contribute to global warming. Over 40% of the country's non-renewable natural resources is exploited for construction purposes each year (Pulselli *et al.*, 2007) using almost 70% of the nation's total electricity and 12% of its drinkable water supply (Wang *et al.*, 2005).

The building projects are producing and waste disposed of in landfills. About 17.2 billion bricks are made in Bangladesh every year for housing (World Bank 2011). One million bricks require about 240 tons of coal (Khan *et al.*, 2013). Building has a tremendous impact on the overall environment from the standpoint of environmental impact (Yu *et al.*, 2008). For a very long time, it appeared that waste from construction projects was seriously harming the environment in many places all over the world (Li & Wong, 2002). Domestic household garbage accounts for an additional 10% of the total waste produced (Oyenuga *et al.*, 2015). The need to boost efficiency, minimize waste, reuse, and recycle is growing in the building and demolition industries (Oyenuga *et al.*, 2015). But in Bangladesh, there limited studies within the field of construction waste management because people are not concern. That's why specific measures are set and how effective these really are in practices. So, the researcher needs make an effort to identify acceptable alternative sustainable building materials and low-tech methods (Sarker & Mahmud, 2018). A nation's sustainable development benefits

from using building materials with little environmental impact (Sarker & Mahmud, 2018). So that reuse and recycling are the waste management procedures and changing the waste materials into new materials for reducing environmental degradation. To ensure that building supplies, & activities within adhere with environmental demands through waste minimization process because waste minimization can also contribute positively to reduction of landfill spaces and enhance resource management (Oyenuga *et al.*, 2015). That is a way of the better outcome for managing construction materials in addition environmental degradation and also for the way of sustainable environmental management to the viability.

METHODOLOGY:

Study Area

To fulfil the objective, we select the Mymensingh city as our study area. We surveyed 300 construction buildings in 13 different residential and commercial areas in Mymensingh city, Bangladesh. Ganginarpar Area, Maskanda, Shanki Para, Chorpara and Nuton bazar take the most numbers of buildings for this work. **Fig. 1** displays every research area location.

Data Collection and Analysis

For this research we collected both primary and secondary data and conceptual method is also used. We randomly visited 300 construction sites. The primary data such as field visits, interviews, opinions from contractors and construction workers was collected randomly with the proper questionnaire. As opposed to that, the secondary data includes statistical data, reports from the previous study reports, journals, books, newspapers, etc. The important data were noted from filed visit interviews and observations. **Fig. 2** shows the newly constructed buildings and buildings constructed after replacing the old buildings in the same place. After visiting the field, we collected some data from this study area for data analysis and we analysis the perceptions of different respondents.

Calculation Procedure of Waste Quantity

Construction waste materials are measured by using a basic formula. The formula multiplies the area's length in feet by its width in feet and its height in feet. This number is then multiplied by one-third and divided by 27 to convert the answer into cubic yards. To make it clearer, the equation is as the follows:

(Length (ft) x Width (ft) x Height (ft) x 1/3)/27. We have got the approximate result using this formula.

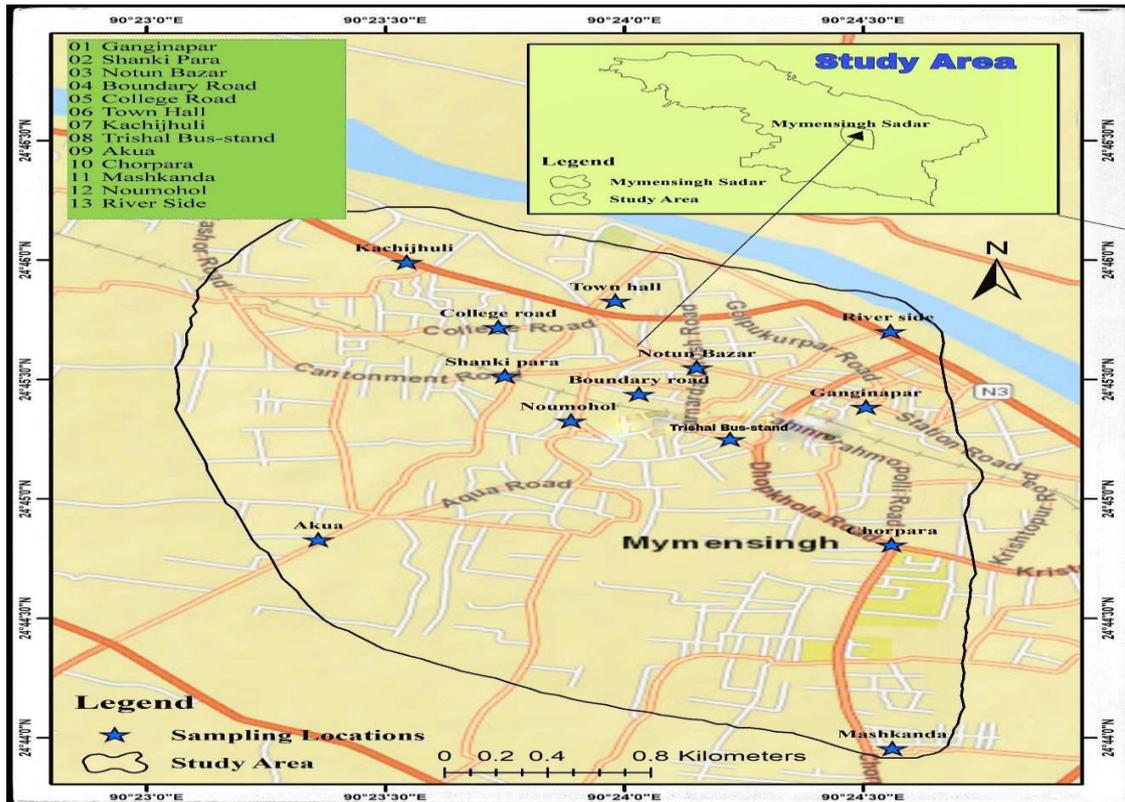


Fig. 1: Map illustrating the field of study.

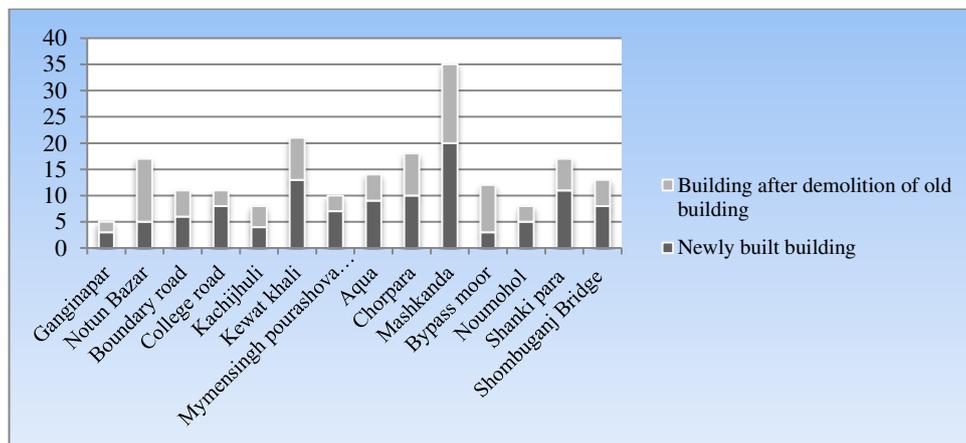


Fig. 2: Different building types.

RESULTS AND DISCUSSION:

Construction and Destruction Waste Generation in Mymensingh City

Construction and destruction waste comprise of building materials. Construction and the destruction waste were sorted for measuring composition. The majority of construction waste is made up of leftover materials from new building or demolition garbage (F. H. Chowdhury *et al.*, 2016). According to EPA almost 30 % of all wastes are nominated as construction and demolition (C & D) waste. C & D waste levels increased more than ten times quicker between UniversePG | www.universepg.com

2005 and 2018 than they did from 1990 to 2005 (Pulselli *et al.*, 2007). As Bangladesh is developing country and Mymensingh is among the newest city corporations, rate of constructions is growing fast and generate a considerable C & D waste in this area. According to the contractor and the building site employees, Mymensingh City generates more than 30% of its garbage as C&D. When buildings are demolished after their useful lives are through, the entire structure, including all of its materials & components, becomes rubbish, increasing the amount of waste produced (Arslan *et al.*, 2012).

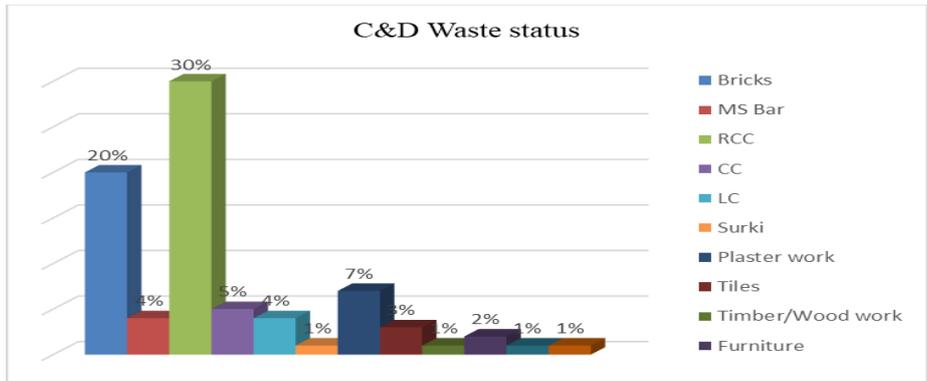


Fig. 3: Construction and destruction waste generation.

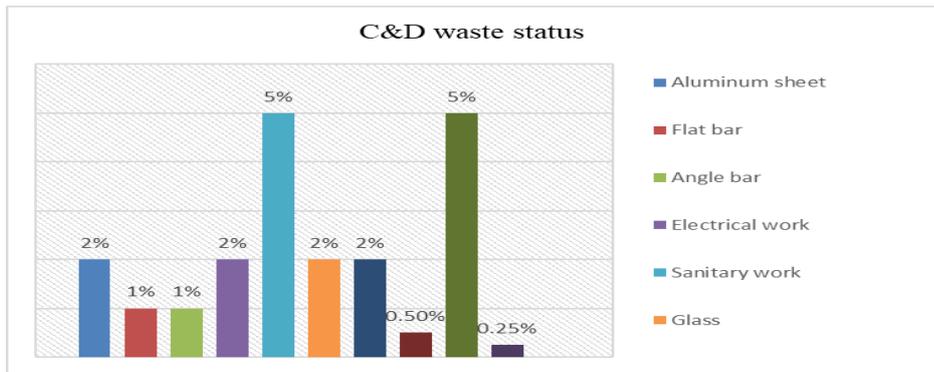


Fig. 4: Others construction and destruction waste generation.

Impact of C&D Wastes on the Environmental Factors (Air, Water, and Soil)

Improper disposal and dumping system of these C&D waste is causing the environmental degradation. This environmental degradation or impact is becoming the major issue in the urban cities for development. Nowadays environmental issue is a major concern regarding the environment. Construction work in Mymensingh is having a direct or indirect negative effect on the environment. C&D garbage raises river flood levels, scours the banks, depletes resources, and allows toxic materials to leach into the stream. Traffic jams are brought on by the dumping system that surrounds the roads, which also clogs the surface drain and produces floods on

the pavement. The problem with treating solid municipal garbage is mainly brought on by C&D waste from minor house demolition (Pulselli *et al.*, 2007). Often, these wastes are buried on the site itself, resulting in the creation of an impermeable layer that prevents the growth of vegetation and prevent infiltration of rain water inside the ground and that’s the problem for environment. Forest and land are negatively affected for improper construction and destruction wastes disposal in Mymensingh city. Besides more, dust generation, vegetation removal, noise and air pollution are also concerned for environmental issues of construction sites. **Fig. 5** shows the problem of C&D wastes on the environment due to improper management.



Fig. 5: Air, water, soil and sound pollution due to construction & destruction waste.

Current Management Practice to the Reduction Environmental Impacts in Mymensingh City Reuse and Recycle of C&DW Materials

After visiting and observing the construction site, we found approximately 31% of waste materials are reused and 26% are recycled. The rest of the 43% of materials are directly or indirectly nominated as demolition debris. Concrete, brick, tiles, timber, steel,

aluminum is recycled and utilized again approximately 60% of total generated waste from the building materials. Concrete and bricks are reused or recycled respectively 40% and 15% of total waste. **Fig. 6** shows several C&D waste kinds and below **Fig. 7** shows the percentages of reused and recycled materials.



Fig. 6: Different types of C&D waste: (A) Concrete from demolition site, (B) Concrete (large size), (C) Road from construction site, (D) Broken glass from construction, (E) Wood waste from construction, (F) Broken brick, (G) Plastic bags, and (H) Brick powder.

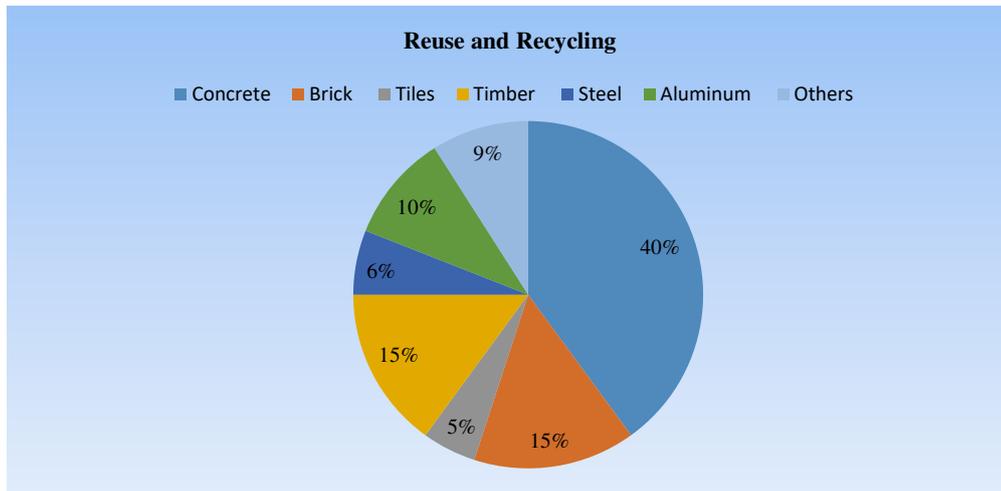


Fig. 7: C&D waste generated to be reused or recycled.

Reutilization or recycling is an important strategy for management of such waste. Not all construction and demolition waste are reusable or recyclable but most waste is recyclable. The strategies decrease raw material extraction reduces transportation costs; improve profits, & reductions environmental impact. Recycled materials from demolished concrete or masonry perhaps utilized profitably in a variety of ways in the industry. A certain amount of Concrete, Tiles & ceramics, Wood, Cement, Plastic, Timber, Soil and stones, Glass, Water, Paints, and varnishes are nominated as waste.

Current Situation of Reuse and Recycling Waste Materials in Mymensingh

We have also discussed with the contractors and workers about the reuse and recycling waste materials from construction activities during field visit. From the interviews, we found that almost half of respondents claim that less than 25% of the building construction & destruction waste produced can be reused or recycled. In addition, there is almost 50% of those surveyed said that between 35% and 50% of the garbage produced can be recycled or repurposed as building materials. Just 10% of the respondents claimed that entire waste and more than 50% of waste are recyclable. The main issue is because they don't know how to reuse or reuse it properly. Fig. 8 depicts respondents' perceptions on the reuse and recycling of C&D wastes as it stands today.

Overall Management Practice in the Mymensingh City

Construction and destruction waste management practice and generation system becomes an important issue. After the field observed that 50% cons-

truction and destruction wastes were used for filling of low land and raising the paving area and others 50% are used for dumping.

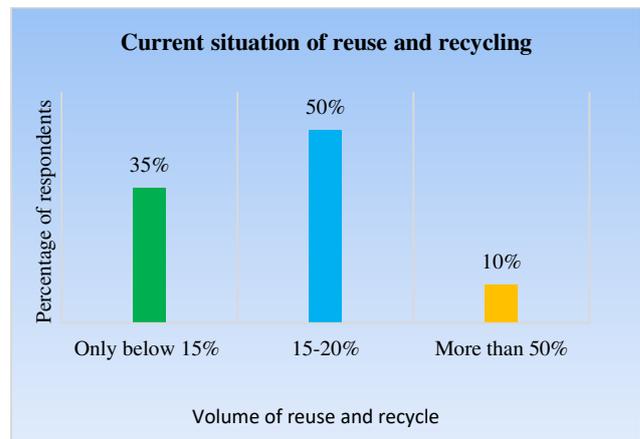


Fig. 8: Respondents' perceptions on the reuse and recycling of C&D wastes.

In the Mymensingh city area, several of the respondents of construction site claimed that waste materials are dumped into the low land or river side. They dumped the construction and destruction wastes for regarding contract. Main site manager contracting with the truck driver or who look after the dumping place. Waste water and plastic bags are generally dumped beside the road or in the drainage line. In many case, trucks or other vehicles are used in transportation of waste material for disposal. To handle much larger volumes, sometimes front-end loader combined with sturdy tipper trucks are used to load and unloading takes less time. Fig. 9 shows C&D waste transportation way for dumping. In dumping place, there are 90% organic and 10% inorganic substances & inorganic substances included rubber, plastic, aluminum, steel, glass, polythene, etc.



Fig. 9: C&D waste transportation for dumping.

In which rubber, plastic, aluminum, steel, glass and other construction and destruction waste materials are recycling and polythene is incinerated. **Fig. 10** shows the dumping place of substances in Mymensingh city, Bangladesh.

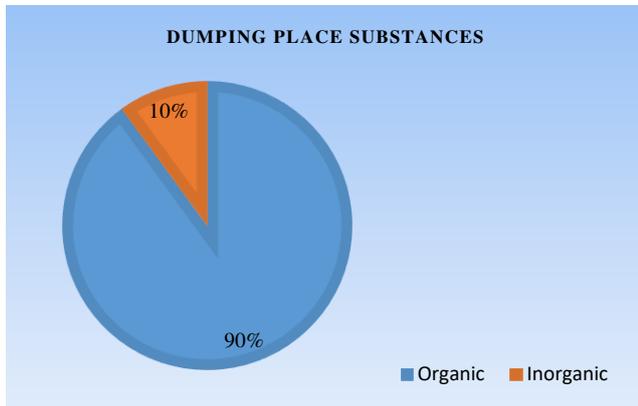


Fig. 10: Dumping place substances.

However, minimizing the waste generation rates utilizing effectively raw materials represents an effective construction manager (F. H. Chowdhury *et al.*, 2016).

Management Practice Challenges in Mymensingh City

All construction and destruction wastes are dumped by the rules of Mymensingh City Corporation. But there are many environmental problems are the occurring which effects on human body. Environmental problems are not properly resolved even after management construction & destruction waste. That to be the most important management practice problem in Mymensingh City. Thus, construction operations have an impact on forestry, agriculture, fishing, and other natural resources. With proper synergy between build environment and natural environment can influence the hydrological system (Dixon, W. 2010). Building and landscape design can play a part in operating construction development activities without producing any environmental degradation when careful planning is used (F. H. Chowdhury *et al.*, 2016). There are some hazardous and non-hazardous construction and destruction waste materials which were also negative effects on the environment. So, proper management and proper dumping system can be reduced the negative effects on the environment. **Table 1** shows the construction and destruction waste classified according to hazardous characteristics.

Table 1: Construction and demolition waste classified according to the hazardous characteristics (Govt. UK, 2016).

Hazardous	Non-hazardous
Insulation and asbestos materials	Insulation and asbestos materials
Concrete, bricks, tiles and ceramics in mixtures	Concrete
Treated wood, glass, plastic (alone or in mixtures) containing hazardous substances	Bricks
Mixed metals containing hazardous substances	Tiles & ceramics
Cables containing oil, coal tar and other hazardous substances	Concrete, bricks, tiles and ceramics in mixtures
Soil and stones	Wood - untreated
Dredging spoil	Glass – uncontaminated
Gypsum materials	Plastic - excludes packaging waste
Un-used or un-set cement	Metallic waste, including cable Copper, bronze and brass, Aluminum Lead, Iron and steel, Tin
Paints and varnishes	Soil and stones
Paint cans	Dredging spoil, Paints and varnishes
Adhesive or sealant containers	Gypsum materials

Best Environmental Management Practices for Construction and Destruction Waste

The most effective way to implement the environmental management system by organizations in a relevant sector and that can result in best environmental performance under given economic and technical conditions (José-Luis Gálvez-Martos *et al.*, 2020). The majority of best practices that have been established, such as those for demolition, are focused on maximizing the re-use of components and facilitating recycling, material recovery, and secondary uses of materials through, for instance, quality assurance programs for materials generated (José-Luis Gálvez-Martos *et al.*, 2020). Due to the avoidance of handling off-cuts and concrete, modern construction techniques have a significant impact on waste formation during construction. The waste reduction potential is up to 90% for techniques such as (José-Luis Gálvez-Martos *et al.*, 2020).

- 1) Volumetric building systems: Off-site manufacturing of three-dimensional modules, e.g., roof and external insulation, roof tiling, brick and block work, etc.
- 2) Substitution of concrete frame: timber.
- 3) Pre-cast panels: panelized building systems for staircases, roofing, basements, etc.
- 4) Steel frames: substitutes concrete and eliminate waste generation.
- 5) Structural insulated panels and prefabricated roof systems.
- 6) Composite panels.
- 7) Pre-cast cladding.
- 8) Light steel frame for building façades.
- 9) Structural pre-cast elements.
- 10) Insulating concrete formwork.

CONCLUSION:

This study has demonstrated the construction and destruction waste management practices to reduce environmental impacts in Mymensingh city, Bangladesh. In this research work, the response of the respondents shows that the rates of the reuse and recycling of the construction waste materials is not increasing properly due to many issues and the challenges. As a result, construction and destruction waste materials effects on our environmental media, such as air, water, soil. After that, our environment is being polluted. Dust pollution also occurs and effects on our human health (mostly construction workers). Also, we found that 31% reused and 26% recycled of

construction waste materials including bricks, steel, concrete and others. In order to practice construction rather than demolition would be able to preserve the most energy possible by reusing and recycling the debris from the previous building. As large numbers of constructions are increasing in Mymensingh city, we should take the proper management system for construction and destruction waste. Using current technology for reuse and recycling should be part of the management of building and demolition waste. Green Building Materials Technology is able to implement appropriate waste management practices by reusing and reusing all major constructions in Bangladesh. So, we can also practice green building technology in Mymensingh city. The construction and destruction wastes are disposed properly considering good safety measures.

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CONFLICTS OF INTEREST:

We have no conflicts of interest to disclose. All of the authors declare that they have no conflicts of interest.

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