

The Evaluation of Construction Waste Management in Northern Cyprus

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Abstract: *The modern construction is immensely bounded with waste management and waste minimization as it contributes to an increase in construction and post construction expenses in order to collect, handle, transport and transfer waste materials.*

In this study, the current situation of waste management in Northern Cyprus and more specifically the situation in of Famagusta are analyzed. In addition, available governmental codes and regulations were taken into account and the implementation of the aforesaid regulations was investigated.

The most important problem behind the waste management system being ineffective was established to be the lack of awareness among different members of industry about advantages of waste reduction and disadvantages of a defective system.

In Northern Cyprus, there is minimal technology available for recycling materials such as paper recycling and mostly reusing methods for on-site construction. Therefore, the most efficient resort to enhance the current situation of waste management in construction industry of Northern Cyprus, is to minimize the generated waste, or to try to use materials which could be reused on construction site.

As the result, weak areas were highlighted and suggestions and recommendations were made in order to enhance the waste management system and to reduce the generated waste.

Keywords: Construction Waste Management, Construction Waste Minimization, Northern Cyprus, Residential Construction, Architectural Design

1. Introduction

The modern construction is immensely bounded with waste management and waste minimization as it contributes to an increase in construction and post construction expenses in order to collect, handle, transport and transfer waste materials.

Even if materials are totally recycled after or during the construction, regardless of transportation, collection and handling fees, noticeable amounts of money must be spent to recycle materials. Therefore, it seems more logical to minimize waste in the first place so it is not needed to try to recycle or reuse great deal of materials. However, it is thoroughly unexpected that during the complete life-cycle of a construction process, even as small as a residential unit, waste materials are avoided [1].

To pursue the right approach to recycle or reuse construction materials, is another prominent step to be followed, in order to compensate for unnecessary expenses which had been invested on extra materials during the construction phase, or building elements after the life of the project is officially over.

There are several types of materials which are wasted during the construction of a house but, regarding the reuse and recycling issues, major waste materials fall into five different categories which account for approximately 80% of total construction phase [2].

First and foremost category is concrete and mortar which are the result of landing ash, dabbing and cut pile heads, concrete and rest mortar and open holes and formwork leakage in construction site. Concrete and mortar are stated to be the largest category amongst [3].

Second category is bricks and blocks category which are the result of damage in construction, damage in delivery and removal for changes and disqualifications [1].

Lumber and formwork on the other hand, is the third category. Special shaped formwork and expiration of formwork are the main reasons behind the generation of these types of construction waste. However, the role of off cuts, cannot be neglected and as the matter of fact is quite comparable to the other two [1].

Fourth category is fencing bricks and tiles. The responsible factor for this type of waste is generally damages in delivery and discharge, as well as removal for changes and inferior quality. Off cuts likewise, contribute to this category to a great extent [3].

The last category which popularity is roughly the same as the fourth category, is the steel bar and other metals which are generated because of surpluses of steel bars which are produced by blanking, sheared steel bars and blots through walls [4].

There are several reasons behind the generation of construction waste and the most important one is not implementing a proper waste management measure and not being aware of saving materials and protection of the environment.

In addition, lack of supervision on construction sites is another important factor and should be encouraged not only by owners of projects, but also by contractors and project managers. Besides, short of communication and coordination between different managers and contractors, as well as between contractors themselves, can lead to an increase in the amount of waste produced [5].

Moreover, in addition to the factors related to human knowledge and performance on the construction sites, economical facts and material physical facts somehow would be able to dominant human mistakes and low performances. For instance, if the discharge fee of waste is comparatively negligible which in most cases is, recycling option cannot be encouraged easily [4].

Reusing on the other hand, depends on the demolition technique as well as the type of materials and building elements used in the building and the installation method. Normally, materials are used again in the construction of new buildings without going through a recycling process [2].

The attributed savings for deconstruction can be increased significantly if considered at the design stage so reusable elements and materials are used in the building, and a noticeable rise could be happening for the salvage value of the building [2].

1.1 Construction Waste Management

Waste management is a broad concept and conventionally implies the process during which waste materials as the result of the activities by human being is collected from generation points and transferred to destination for the purpose of disposing or being made use of.

The scale of waste generation depends on the sector within which the waste material is generated, namely residential and industrial, the activity as the result of which waste is generated, such as municipal activities, construction or industrial activities, and the process during which the waste is managed is attributed to the each type of activity.

Construction waste management (CWM) by definition is to eliminate the waste material if there is no other options, to recycle the waste material in the case of being feasible, and to reuse the material which would become waste if they are not reused.

The main objective of construction waste management is to apply these solutions where possible, to accomplish sustainable management of construction materials and resources which could also be time and workforce.

There are three most important stages at which waste management could be implemented. At project level to which the majority of waste materials are attributed, at organizational level and disposition level. In each stage the material is considered important, since the usage, and reuse of it will be effective in generating construction and demolition waste (C&DW) plans.

The foremost step in managing construction waste materials is to identify them on the construction site and sort them according to the type, volume and priority. Taking this step would efficiently help the manager to prevent materials from disposition in landfills and would direct them to a more environmental-friendly solution [6].

In most developed countries in terms of waste management, there are regulations regarding construction waste materials. It is important to consider codes and regulation of the state or country in which the project is being constructed and mention them in contracts and subcontracts related to diverse section of construction [7].

Finally, materials that can be used for producing new products are recycled, those that can be process for using again in new products are reused and those that are contaminated with waste materials or there is no market for them available are disposed in landfills [7].

1.2 Stages of Construction Waste Management

Researches, which focus on the criteria of construction waste management, are classified in specific stages; starting from the design level until the phase of demolishing buildings. The priority that drew attentions to create plans for such purposes has been involved with environmental and economic impacts of the building sector on the society. For instance, different countries run surveys and researches within vast criteria in the field of waste management at different levels; while the results are giving a picture of their present situation in this field and also same results are to be used for organizing management plans.

According to OECD report in 2003, three specific targets are mentioned in C&DW in general. Policy instruments are designed in three stages related to the life cycle of buildings for the purpose of minimizing the C&DW. Regarding to this study the three stages are: Upstream stages: the stage of design and construction, regarding to improve characteristics of the building related with waste generation such as recyclability or reusability, Demolition stages: disposal wastes generated by demolition of buildings and Downstream stages: recycling and reusing the waste material after demolition.

1.3 Comparison of Construction Waste Management for the Three Leading Countries

Although construction waste management is implemented at different scales and levels, there are some countries in which the management of construction and demolition (C&D) waste materials is carried out more systematically and under the specific rules of government, state or municipality. Hence, overtime they developed frameworks for their management applications.

For instance, in the United Kingdom, the most important part of implementation and supervision of waste management plan must be carried out by construction manager and their crew members. Actually, it is required that the construction manager of every project to monitor and report the ongoing waste management, which must have been designed for every individual project. Besides, the regulations in United Kingdom are implemented at the national scale while in Canada and especially in Australia; the waste management-related regulations are issued, followed and implemented independently and differently in each individual state.

Additionally, In Canada and Australia, the regulations are required to be reflected in construction contracts and could be diversified to different contractors of the project separately, rather the principal construction manager.

In all three countries, it is regulated that a waste management plan must be designed and tailored for each individual residential construction project, prior to the initiation of construction phase.

1.4 Construction Waste Management and Northern Cyprus

In Northern Cyprus, compared to the population, there are a vast volume of construction waste annually and there is not a proper waste management condition exist in the industry so most of the waste from construction is dumped into the existing landfills similar to the solid municipality waste. Besides, apart from plastic and paper, there are no significant recycling technologies to be applied to the construction waste in order to increase the

salvage value of the building. Hence, the only options left are reusing and deconstruction which seem to be comparatively more beneficial for the industry. The aforesaid options are to be investigated in the current study.

Furthermore, it should be taken into account that after the demolition, to apply reusing techniques to the remains, need proper technology, as the result of which it seems more logical to invest the time and effort on the possible improvements of deconstruction measures at the design stage as well as the construction phases of residential construction.

Northern Cyprus is not an exception; and since natural resources in this region is very limited, managing waste in design and construction projects will face different challenges. Therefore, there is a potential to propose alternatives for C&DW management in different stages for construction projects. This way there will be more space for considering sustainable design in the building market and industry.

The main aim of this study, which was basically written as a master thesis by Milad Najafy [8] with supervision of Ercan Hoskara, is to investigate the existing construction waste management condition in Northern Cyprus and possibilities to improve it.

2. Methodology

More specifically, considering detailed questions, the possibility, problems and improving suggestions for reuse or recycle materials and more importantly, reducing the generated waste are highlighted and investigated. Focusing on each phase and each category of participants, after performing the analysis on collected answers, suggestions for future improvements could be drawn and be presented.

Every single category is a member of construction industry in term of generation or management of construction waste and play a significant role in creating or managing the waste.

The aforesaid participants are divided by the phase of a construction life cycle as well as the role that is played by each. The foremost participants are designers which can be divided into 3 types of architecture design, structural design and map design. It is established that the effect of a proper design in which the possible waste materials are forecasted and minimized is exceptional.

The second important category is the authorities category which could play a significant role in waste reduction by issuing related regulations and force other participants specially contractors and project managers to follow instructions in order to reduce waste materials. In the current study, Municipality of Famagusta, the central government and environmental board are going to be interviewed. The third category is contractors which are conventionally believed that will follow the limitations, regulations and restrictions if they exist in the industry. Their motivations and problems with regard to waste management is going to be analyzed by means of the correct interview. For this study, Northernland, Noyanlar and Onlar construction companies are going to be interviewed. The final category is the category of material providers which are believed to have the least impact on and transfer it to the factory.

3. Results And Analysis On The Current Situation Of C&Dwm In Northern Cyprus

In the current study, problems, possibilities and the current situation of waste generation and waste management in Northern Cyprus and the city of Famagusta is analyzed. 20 interview sessions are designed and carried out with random contributors to the industry from different sections and result were collected and organized.

In order to gain an analytical result about the current situation of construction waste material and management plans the results from organized data, which have been collected form the interviews are demonstrated and figures are discussed accordingly.

According to the interviews and surveys 30% of the result came from the government members who actually play their part in the municipality of Famagusta. On the other hand, 20% of interviews were done with material providers, similar to developer construction companies totally accounted for 40% of completed sessions.

Contributors from the municipality were engineers and environment professionals from garbage public health. In contractor section on the other hand, mostly managers and engineers in architect and civil engineering departments took part.

Considering material providers sector, quantity surveyors and managers were the dominant group of participants while for developing construction companies, architects and managers were the majority.

The majority of generated waste material is believed to be attributed to the construction phase, while the least percentage is attributed to the operation phase of the life-cycle of a residential unit. Operation phase is believed to generate waste material at a mediocre rate of 20%.

It is demonstrated that the majority of waste is generated as the result of concrete construction in the city of Famagusta. The minority is attributed to the generated waste from scaffolding, maintenance and other activities beyond the ones which are proposed.

It could be concluded that handling materials contributes to waste generation to a considerable extent in comparison with other factors except from concrete construction which is normal as the majority of construction in Northern Cyprus is concrete construction. It could be concluded that an increase in the awareness level of workers can reduce the generated waste from handling materials which is 23% of the whole generated waste.

Packaging ranks third in waste generation, which could be minimized by ordering materials in bulk and plan ahead for material ordering so they are transferred to the construction site in large volumes and waste generated as the result of packaging materials is minimized.

It is unanimously believed that concrete waste is the largest volume amongst other types of waste on construction site. This fact is foreseeable as the dominant construction method is concrete construction in residential construction of Famagusta and Northern Cyprus. Brick and timber both rank second and believed to have the largest share of waste generation on the construction site.

Conversely, steel waste is believed to be minimized among well-known waste generating materials due to the fact that steel construction is not familiar in conventional residential construction in Northern Cyprus.

Some other materials such as asphalt which was suggested by DogncVeysioğlu [9] and TahsinTranstürk [10], ceramic, tiles and paint are mentioned by Gökhan Noyan [11] to be the source of waste on the site, but their contributions were considered minimal.

Undoubtedly, trying to reduce waste materials is not encouraged by contractors, owners and engineers as each and every sectors tend to minimize cost and completion time of the project. This issue contributed to a surge in waste generation in the industry.

It seems that government members and contractors are believed to be more willing than other contributors to reduce waste materials. On the other hand, 40% of interviewees believed that designers and clients are willing to reduce waste generation in their works but, for clients, the unwillingness figure is 10% less, which implies that waste reduction is a less important priority for designers in comparison with clients.

The fact that only 10% believed that government members are unwilling to reduce waste materials and 60% believed that they are actually willing to make changes, implies that there is a considerable potential to implement waste management plan and regulations among government members who contribute to construction industry.

The most important reason behind the unwillingness to reduce the generation of waste materials reported to be lack of awareness. This is followed by cost factor and priority which could be apposite result in the potential for waste management plan implementation as it is believed that by increasing the awareness among members of the construction industry, waste could be reduced dramatically.

Another important factor in poor profile of waste reuse or recycle in Northern Cyprus is that there are no strict regulations towards waste disposal and management. This idea is confirmed by the result of interviews, which shows that 90% of interviewees believed that there are no governmental regulations towards waste management, waste disposal and waste reduction in the city of Famagusta. Only 10% including an environmental law (18/2012) and a municipality law (19/1995), which demonstrate that even though there are such regulations, they are not implemented seriously as the majority are unaware of their existence.

As experiences toward waste management on construction site timber was mentioned to be reused of pallets, and when divided into smaller pieces could be reused for scaffolding purposes and marble fixing supporting as mentioned by TolgaHatay [12]. Concrete on the other hand is mentioned to be reused only for filling purposes.

Another material to be reused on the site was brick, which is used for backfilling and landfilling purposes, and steel was mentioned to be collected and exported abroad. Steel was mentioned to be capable of being sold for 400 Turkish Lira for each ton of waste material.

There were also other materials mentioned such as marble which is used as spacing in order to make stable formworks, reusing or selling for spacing purpose between iron and concrete as mentioned. Additionally, aluminium claimed to be able to be sold for 2250 Turkish Lira per ton of waste material. Besides, PVC was claimed to be able to be recycled in Alayköy.

Limitations and possibilities of WMP implementation is analysed based on which lack of education, awareness and training along with unavailability of a competitive market, which is closely followed by low financial incentives.

3.1 Suggestions to Improve WM in Northern Cyprus

According to the observations and the analysis of the market, the following suggestions are made in order to improve the waste management situation of Northern Cyprus:

- Codes and regulations should be focused on construction phase.
- Concrete construction must be the focal point of limitations.
- Standards should be issued for handling and packaging materials.
- Increase financial incentive by subsidizing recycling and reusing activities.
- Provide a list of useful material for recycling.
- Propose method to reduce packaging waste
- Propose on-site waste separation method.
- Propose on-site waste reusing methods

Education, training and awareness increasing programs must be designed and carried out, in order to make members of the industry be aware of the available solutions and possibilities to reuse and recycle waste in the city, and to be informed about the consequences, advantages and disadvantages of such considerations.

In terms of introducing recycling technology, concrete, timber and brick should be the foremost materials to be considered.

Members of the industry must be informed about the existing and future governmental regulations and they should be forced to implement these rules by considering penalties for those who do not.

In addition, by comparing existing regulations in other countries and Northern Cyprus, it is suggested that the following codes are added to the regulations of construction industry in Northern Cyprus:

- The most important factor is considerations at the design stage, such as designing according to available materials in terms of size and applicability, and forecasting every single aspect in construction, operation and demolition in order to minimize waste materials.
- Each project with estimated cost greater than a specific amount of money, must have waste management plan.
- The quantity and type of waste materials which is forecasted to be produced during the project should be described.
- For each material, there must be an action proposed for managing the waste that is going to be produced from that specific material, in order to reuse, recycle, or reduce.

A declaration should be included in the documents of the plan, in which client as well as the main contractor is responsible for efficient handling and proper managing of waste materials.

4. Conclusion

In this study, the waste generation and waste management situation of the residential construction in Northern Cyprus the city of Famagusta is investigated. Besides, governmental limitations and restriction in order to encourage waste minimization and reducing construction waste generation was taken into account.

One of the most important results of the aforesaid interviews was the reasons behind the unwillingness to reduce waste materials, which is reported to be the lack of awareness about the benefits and consequences. Priority and cost were also mentioned as impeding factors in waste reduction. For this reason and also for achieving other purposes it would be helpful to establish a supervision department in order to control and improve C&DWM projects. Although there are existing regulations for this matter but yet there should be strict supervision on application of these regulations by individual projects. Since the waste material is needed to be sorted out due to recycling and reusing plans, it is necessary for the responsible organizations to create plans for separation of waste material on site. As it has been mentioned before, C&DWM is an individual process for construction projects; and therefore plans for this purpose will be various according to variety in the nature of individual projects. Yet, authorities should perform processes to lead contractors, designers and constructors to create and perform C&DWM plans in the Northern Cyprus. Since the natural resources of material are limited in this country and also awareness and willingness to use new materials in this country are so restricted, governmental organizations can be very effective regarding to organization of C&DWM plans and this will take a huge step towards sustainability in architectural design and construction.

Finally the suggestions mentioned in the previous section could be a way for controlling and improving waste management plans in case of methods for disposal and also to manage the procedure in Northern Cyprus.

5. References

- [1] Napier, T. *Construction Waste Management*. U.S. Army Corps of Engineers, Engineer Research and Development Center / Construction Engineering Research Laboratory. Retrieved from National Institute of Building Science, March, 2012.
- [2] *Environment and Energy*. (July 2008). Retrieved from The Cambridge: Green Challenge: Available: <http://www.environment.admin.cam.ac.uk/resources/guidance-documents/construction-site-waste-management>
- [3] CHBA. CHBA Policy Position on Construction and Demolition Waste Management and Extended Producer Responsibility. CHBA. (2010).
- [4] *EdgeEnvironmentPtyLtd. Construction and Demolition Waste Guide -Recycling and Re-use Across the Supply Chain. Australian Government. (2011).*
- [5] HyderConsultingPtyLtd. *Management of Construction and Demolition Waste in Australia*. Queensland: Department of Sustainability, Environment, Water, Population and Communities, 2011.
- [6] Cambridge. (July 2008). *Environment and Energy*. Retrieved from The Cambridge Green Challenge. Available: <http://www.environment.admin.cam.ac.uk/resources/guidance-documents/construction-site-waste-management>
- [7] Laquatra, J., & Pierce, M. R. *Waste Managemet at the Construction Site*. Cornell University. 2002.
- [8] M. Najafy, "the evaluation of costruction waste management in Northern Cyprus," M.S. thesis, department of Architecture, Eastern Mediterranean Univ., Famagusta, Northern Cyprus, September 2014
- [9] Doğan Veysioğlu - (2014). Personal communication.
- [10] Tahsin Transtürk - (2014). Personal communication.
- [11] Gökhan Noyan - (2014). Personal communication.
- [12] Tolga Hatay - (2014). Personal communication.