Construction Debris Management Plan for Sustainable Structures

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Abstract—*Construction, maintenance & operations (M&O) and demolition of structures are engineering activities that could have an adverse impact to the environment when a Waste Management Plan (WMP) is not implemented before, during and after each of the above mentioned activities started. In order to Owners and General Contractors reduce the risk of having additional project costs due to federal and state environmental legal claims, they shall take in consideration including as part of the operations a WMP that could be implemented throughout any of the structure life cycle (Construction-M&O-Demolition.). Modern construction practices require sustainable design and planning for managing waste and pollution reduction. Including a WMP as part of any of the above mentioned engineering activities, will definitely reduce the possibility of having an environmental violation that could have a negative effect to the project budget. In this article, I presented a case summary and suggested recommendations that can be helpful to Owners and General Contractors for managing construction debris by the implementation of waste reduction, diversion, reuse and recycling techniques, as part of a WMP.*

Key Terms —*Asbestos, Autoridad de Edificios Públicos, NESHAP, Waste Management Plan.*

DEFINITIONS

Clean Air Act (CAA) – Comprehensive federal law that regulates air emissions from stationary and mobile sources.

Clean Water Act (CWA) –establishes the basic structures for regulating discharges of pollutants into the water of United States and regulating quality standards for surface water.

Construction Debris (C&D) – Nonhazardous material resulting from construction, remodeling, repair or demolition of utilities, structures and roads, including packaging.

Disposal – Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfills, or material used as fuel in waste-to-energy processes.

Diversion – Avoidance of demolition and construction waste sent to landfill or incineration.

Environmental Protection Agency (EPA) – Federal agency in charge of protecting human health and the environment.

Hazardous – Exhibiting the characteristic of ignitability, corrosiveness, toxicity or reactivity.

National Emissions Standards for Hazardous Air Pollution Compliance (NESHAP) –Stationary source standards for hazardous air pollutants. Hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other health effects.

Puerto Rico Environmental Quality Board – Principal environmental protection and regulatory agency in Puerto Rico.

Recycling – The process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form.

Reuse – Recovery of demolition or construction waste and subsequent incorporation into the work.

Salvage – Recovery of demolition or construction waste and subsequent reuse or sale on another facility.

Waste Management Plan (WMP) –A plan which objective is reduce the total quantity of waste transferred to landfills using a series of waste reduction techniques.

INTRODUCTION

As defined by EPA, construction and demolition debris (C&D) is nonhazardous materials resulting from construction, remodeling, repair or demolition of utilities, structures and roads, including packaging [1]. Some of these materials are concrete, masonry, soil, wood, wall coverings, plumbing fixtures, electrical wiring, glass, plastic, metals and asphalt, among others. When one or some of these materials get contaminated or mixed with a hazardous material like asbestos, automatically creates a difficult situation to the handling and hauling operations to any project, affecting the scheduling and project budget.

Through the years, construction debris have been impacting the landfills and also creating a problem of illegal dumping. This situation have been developing health risks, decreasing the properties values and increasing the cleanup cost to governments. Therefore, the implementation of a WMP during a construction activity or during the M&O of a structure can save money to owners, general contractors and the government leading them to achieve a sustainable certification. Also, will conserve resources and preserve the environment.

Objective

This article presents a legal case as result of not implementing and monitoring a WMP during a construction activity. The case analysis will be useful to Owners and General Contractors understanding the importance of having a WMP for handling and hauling the project C&D and also will present them a way to approach C&D management in 3 steps; preconstruction, construction and postconstruction.

Contribution

The suggested recommendations will guide the Owners and General Contractors to have a general overview on how to design and implement a WMP having a positive impact to the project production and efficiency with emphasis in preserving the environment.

LITERATURE REVIEW

In this section, a summary of a legal case will be presented discussing why a construction company was charged by a grand jury in the federal district court for the District of Puerto Rico due to illegal removal of asbestos during the renovation of the 9th floor of the Minillas North Tower in May 2012.

As stated by EPA in the Environmental Crimes Case Bulleting of July 2015, the case investigations reads as follows:

"A grand jury charged Aireko Construction Company with five counts of failing to comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) by failing: (1) to adequately wet the asbestos during the removal; (2) to have a properly trained supervisor on site during the removal; (3) to properly place the asbestos in leak tight bags; (4) failing to properly label the asbestos containing waste material; (5) to properly dispose of the asbestos containing material at an authorized landfill. Count six charges the defendant with failing to notify immediately the appropriate government agency of the release of a reportable quantity of a hazard substance-asbestos.

The indictment alleges that between Saturday 12 and Sunday May 13, 2012, subcontractors, working within the scope of their employment and at least in part for the benefit of Aireko, removed ceiling materials containing more than 1 percent of asbestos and placed the asbestos containing materials in the trash area in back of the Minillas North Tower. The failure to notify charge focuses on conduct of corporate officials who discovered the release of asbestos on Monday, May 14, and failed to make the appropriate notifications.

The illegal removal of the asbestos containing ceiling material and transporting it down to the trash area without following the NESHAP work practice requirements resulted in the contamination of the entire office building. The building was ordered closed by the Public Building Authority on May 20,

2015. Clean up required almost one year to complete.

In a related matter, an Aireko Project Manager (PM) and the VP of operations was charged with failing to notify immediately the appropriate government agency of the release of a reportable quantity of a hazard substance-asbestos. In this case the PM was responsible for supervising the 9th floor renovation" [2].

As result of this situation, the scheduling and project budget was negatively impacted to the General Contractor and also to the Owner. The General Contractor was charged with a fine of $1.5 million dollars and three years of probation for violating the Clean Air Act. Also was ordered to pay $172,020 to cover a baseline medical examination and follow up on victims. For confidential reasons, impact detailed cost to the Owner will not be discussed as part of this article.

METHODOLOGY

The methodology for analyzing the case and present the suggested recommendations for preparing a WMP was performed on a question and answer format using Chicago Illinois & Orlando cities WMP as guides [3] [4]. Also, EPA Regulations and Fact Sheets [5] [6] [7], and FEMA Debris Management Plan Workshop Student Handbook [8] were used with the intention of providing an understanding of the statutory and regulatory requirements governing construction and demolition debris.

It is important to mention that the methodology used was not share with any private or governmental entity to guarantee the objective and independence of the analysis. For a more in deep future student investigation, interviewing the owner, contractor and EPA will definitely add more weight to the case investigation, but not necessary to the suggested recommendations.

Managing Construction and Debris

According to EPA, for managing the C&D of a Project, you need to consider as the first option the waste reduction and finally the landfill option as shown in Figure 1.

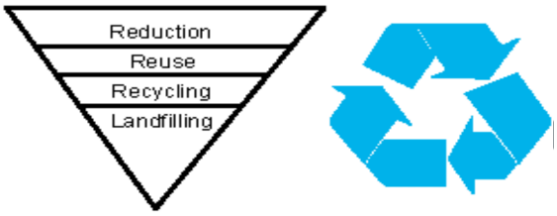

Figure 1
Manage C&D Debris

The Illinois Department of Commerce and Community Affairs (DCCA) "Construction and Demolition Site Recycling Guidebook" and "Construction and Demolition Site Recycling Directory" [3], provides general guidelines on how you can reduce the construction waste and reusing and recycling the C&D.

In the other hand, according to the Construction and Demolition Waste Management guide developed by Hinkley Center for Hazardous and Waste Management in Florida [9], states that C&D disposal could be managed in compliance if we divided the process in pre-construction tasks, construction tasks and post-construction tasks.

Under each process, they suggest the following:

- **Pre-construction tasks**
  - ✓ Develop the main goals of the WMP in relation to waste reduction, recycling, employee participation on the plan and monitoring progress and efficiency.
  - ✓ Explore the required materials using as reference a Construction Material Purchasing and Planning Guide, a Waste Diversion Assessment Plan to estimate anticipated waste and setting the project diversion goal by weight.
  - ✓ Select a Waste Management Coordinator.
  - ✓ Set up project for the success of the Waste Management Plan at the site and at the office.
- **Construction Tasks**
  - ✓ Follow the Construction Material Purchasing and Planning Guide to ensure

proper use, handling, reuse, recycling and disposal.

- ✓ Managing the waste diversion process. Management shall supervise the Waste Management Coordinator and the Coordinator must oversee the proper implementation of the WMP.
- ✓ Documentation filing and Jobsite C&D Debris Log.

- **Post-construction Tasks**
  - ✓ Use logs and documentation to evaluate the WMP efficiency in order to be more productive in future projects.
  - ✓ Give some recognition or awards as symbol of appreciation to all subcontractors for being part of the WMP goal. Will probably ensure future participation.

C&D Disposal Contaminated with Asbestos

EPAs NESHAPs [5] are part of the Clean Air Act and include air quality regulations for a large number of hazardous airborne pollutants, many of which are from chemical origin. The Asbestos NESHAP regulation addresses the reduction of potential exposure from asbestos for facilities undergoing renovation and demolition. The regulation is a guide for identifying asbestos containing materials and follow a process for categorize, abate, package, label transport and disposal.

Before continue, let's first define what is asbestos. Asbestos is a mineral fiber. There are different types of asbestos fibers and it can be positively identified only with a special type of microscope. In general, asbestos was added to a variety of products to strengthen them or to provide heat insulation and fire resistance. Some of them could be spray applied fireproofing, thermal systems insulation, decorative textures, flooring felt, roll board and corrugated commercial or specialty paper.

Asbestos fiber can cause serious health problems. Exposure increases the risk of developing lung cancer among others health diseases. It could take between 15 to 30 years after the first exposure for symptoms to occur. Medical investigations have shown that inhalation is the principal route of entry leading to asbestos related diseases.

Many investigations suggest not using the age of the building as the only reference to determine the possible presence of asbestos. Since 1973 EPA have been banned asbestos containing products. However, asbestos continues to be used in many current building products that can be purchased today; referred as the new use of asbestos.

NESHAPs Asbestos Program [10] suggests six steps to follow in order to be in compliance with regulations. A summary of them are:

1. Facilities regulated by this program – Facilities are defined by EPA as "any, including government owned or operated, institutional, commercial, public, industrial or residential structure, installation or building excluding residential building having four or fewer dwelling units; any ship; and any active or inactive waste disposal site".
2. All demolitions activities are regulated by Asbestos NESHAPS whether or not asbestos containing materials are present.
3. Before a demolition and/or renovation started, the facility shall be inspected to determine the presence of asbestos containing material and categorize them.
4. The building inspector shall prepare a report categorizing the material, if encountered, in three types. They are:
   a. Regulated asbestos containing materials (RACM).
   b. Category I non friable asbestos containing material. Under this category will be classified all materials containing more than one percent of asbestos than can be pulverized by hand pressure.
   c. Category II non friable asbestos containing material. Any material not included in Category I, that when dry, can't be pulverized by hand pressure.
5. NESHAPS notification – The owner or operator of the facility that will be demolished or renovated shall notify EPA before starting any work. Also shall notify the agency immediately

if a special situation happens during the demolition or renovation activities and will drive the situation to not be in compliance with regulations.

6. Emissions controls – NESHAP regulates the wetting, packaging, labeling, manifesting, and disposal of waste. Therefore, the owner or operator of the facility must ensure that all NESHAPS and OSHA regulations are met in order to minimize exposure of the public and the environment to the asbestos fiber.

CASE STUDY

As explained before in the methodology, the case study was performed on a question and answer format using as reference the Hinkley Center for Solid and Hazardous Waste Management process [9]. This process is a guide that outlines the activities and tasks that should be followed during preconstruction, construction and postconstruction. It can be used as a tool to verify the Owner and General Contractor quality control compliance with a WMP that were supposed to be prepared according to EPA, NESHAP and also with FEMA requirements in case of an atmospheric disaster.

The case study is presented in Table 1.

Table 1
Case Study
PRECONSTRUCTION

Question 1:	Is a Waste Management Plan required by EPA and/or any other federal or state agency?
Answer:	No
Comments:	In general EPA just requires reporting quantity of hazardous material among other requirements. But, in case of a disaster, FEMA states that jurisdictions with a WMP are better prepared to restore public services and ensure public health in addition to be better positioned to receive the full level of assistance available.

Question 2:	Did constructions contracts require having technical specifications and supplementary conditions to ensure compliance with environmental regulations?
Answer:	Yes
Comments:	Many of these contracts are Master Contracts that are used from project to project. Sometimes technical specifications are too general or not related to the scope of work. This situation can increase the risk of not be in compliance with EPA.

Question 3:	Having a WMP as part of a contract in addition to technical specifications and supplementary conditions, will help Owners and General Contractors to monitor compliance, progress and efficiency?
Answer:	Yes
Comments:	Definitely. I will assume that this contract don't have a WMP as part of it. I based my assumption on the possible absence of monitoring reports from the Owner to the General Contractor.

Question 4:	Did all governmental construction contracts require a WMP as part of the contract in addition to the technical specifications and supplementary conditions?
Answer:	No
Comments:	Most governmental construction contracts just rely the environmental compliance on the technical specifications. Based on my experience, Federal and Pharmaceutical contracts strictly enforce the clean house concept.

Question 5:	Did you think that including a Construction Material Purchasing and Planning Guide, a Waste Diversion Assessment Plan and a Project Diversion Goal as part of a WMP will help Owners and General Contractors identifying areas or materials that could have asbestos or any other contaminated agent?
Answer:	Yes
Comments:	It will, but, I think that an assessment from a certified Inspector will give additional information to delineate the project scope. Under this contract, it seems to be more a lack of supervision from the Owner and the General Contractor rather than not having an assessment before demolition started.

Question 6:	It's is required by EPA having a Waste Management Coordinator and/or trained personnel on site during C&D removal?
Answer:	Yes
Comments:	It's required by EPA and also shall be trained under OSHA and NEHAPS regulations. If the General Contractor was charged for not having a trained supervisor, it could be possible that the Owner don't request evidence for qualification of employees before signing the contract.

Question 7:	Did you think that governmental agencies verify or required that all personnel that will participate directly or indirectly on C&D disposal projects are in compliance with OSHA and NEHAPS trainings?
Answer:	No
Comments:	Not always, but sometimes the assigned personnel don't have the required academic education or required trainings to work with a scope of work like the one of this contract.

CONSTRUCTION

Question 8:	Technical specifications on contracts and supplementary conditions, shall be verified with EPA regulations to ensure compliance depending on the scope of work?
Answer:	Yes
Comments:	As mentioned before, sometimes these specifications are from a Master Contract. Specifications probably rely on reminding the General Contractor the environmental compliance requirements, but the Owner is responsible to monitor compliance. Having a WMP will reduce the risks for not being in compliance.

Question 9:	Did you think that the Owner and the General Contractor on this case follow the technical specifications and/or supplementary conditions of the contract?
Answer:	No
Comments:	Assuming that the contract doesn't have a WMP, the problem is that technical specifications and supplementary information just give the General Contractor a list of Regulations to comply with. Most of the time they don't read this information until a situation happens; this is why monitoring is so important.

Question 10:	In the absence of a WMP, the Owner should rely only on the technical specifications and/or supplementary conditions of the contract to monitor the General Contractor compliance?
Answer:	No
Comments:	If a representative of the Owner was in charge of monitoring the General Contractor execution and also request all the necessary information for environmental compliance, probably this situation doesn't happens. Because the situation takes place during a weekend, probably the Owner representative was not on site.

Question 11:	Did EPA require reporting any condition that can result on a regulatory violation?
Answer:	Yes
Comments:	EPA requires reporting any suspected contaminated condition before, during and after a demolition and/or renovation activity started. In this case, the General Contractor was charged for not be in compliance but I think that also the Owner was not responsible in relation to project supervision among other requirements.

Question 12:	Did you think that the Jobsite C&D Debris Log on this contract were accurate?
Answer:	No
Comments:	I think that in addition to not having a WMP, this was the main reason that gives place to this situation.

Question 13:	Documenting with photos and filling out a Jobsite C&D Debris Log shall be required on a contract like this one?
Answer:	Yes
Comments:	Always. Most of the times, logs are just a written report without any photo that can be used as evidence. Not always a photo will guarantee compliance, but at least give additional information to any report.

POSTCONSTRUCTION

Question 14:	Having a final report of total waste diverted, will help Owners and General Contractors to be in compliance with EPA reporting requirements?
Answer:	Yes
Comments:	Just if regulations were followed as stated by EPA on the WMP or contract technical specifications.

Question 15:	The suggested report on the previous question, can be used on future projects?
Answer:	Yes
Comments:	It can be used for planning and monitoring compliance, production and efficiency of future project. Also helps to have an evaluation of the General Contractor compliance.

Question 16:	Awarding a General Contractor for being in compliance with EPA regulations and following the WMP, will help the Owner and General Contractor management on future projects?
Answer:	Yes
Comments:	Compensate the General Contractor can result in the benefit of both; that will depend on each project.

CONCLUSION

Currently, PR has pollution conditions that can be considered acceptable, but the government needs to be proactive and invest on sustainable structures or work on converting existing structures on sustainable structures. Like this situation, many happen on different sites before been detected and reported to EPA and local agencies.

PR infrastructure needs an innovative alternative to manage C&D disposal involving the reuse and recycling of material before transporting them to landfills. If a WMP is implemented or required as part of new constructions and operations of existing structures, definitely the impact to the landfills can be reduced in addition to eliminate illegal dumping. A good WMP will not only manage C&D of any building, it also will manage and control others factors like energy and water consumption. Visiting the Willis's Tower in Chicago Illinois [11], will definitely be a recommended experience to see in operation a good WMP.

Finally, the absence of a WMP on this contract was the main reason to give place to the asbestos situation. Apparently, the Owner just rely on the contract technical specifications and/or supplementary conditions without execute a good supervision over the General Contractor scope of work. If a WMP continue to not be required as part of a construction contract, it is very probable that this situation could happen again.

RECOMMENDATIONS

As discussed before and also as stated on NESHAP regulations and FEMA suggested Debris Management Plan outline, the success of a WMP will depend on the commitment to efficient and effective plan development, implementation and evaluation.

Base on the case analysis and my conclusion, I will suggest the following recommendations to Owners and General Contractors:

- Before developing a WMP, and after inspecting the site, verify, clarify and review the actual environmental regulations that will apply for the scope of work. Validate and confirm the information with the technical specifications and/or supplementary conditions.

Figure 2
Health & Safety

- Have in mind that all Plans, including a WMP shall be reviewed from time to time. Also, have in consideration that all projects are unique.

Figure 3
Plan Development Process

- Create an organizational structure involving the Departments that you think will be in charge of implementing and monitoring the WMP.

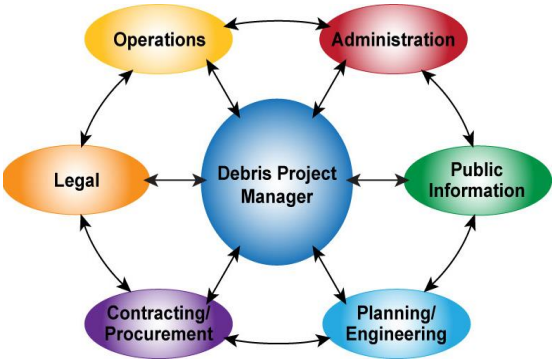

Figure 4
Staff Roles & Responsibilities

- In case a situation went out of control, have available all the required protocol to be followed by the personnel in charge of supervision.

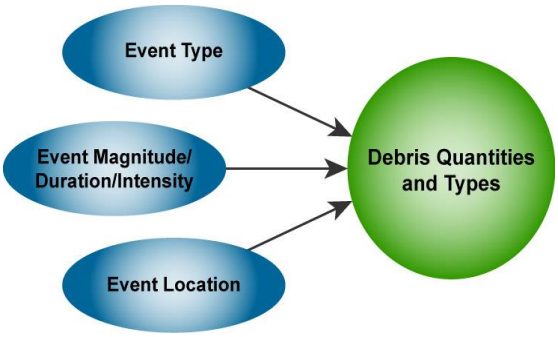

Figure 5
Situation & Assumptions

- Describe the specific process that will be followed to reduce waste in the Project by implementing the techniques of reuse, recycling or final disposal.

Figure 6
Debris Management Sites

- Describe the approach for managing the C&D nonhazardous and hazardous, including the reporting and job logs.

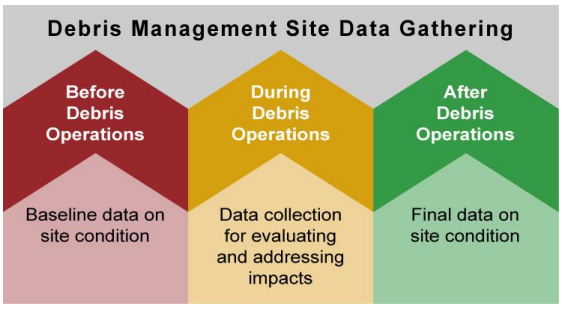

Figure 7
Management Site Data

- When monitor a contractor, require all the necessary information before, during and after the C&D started.

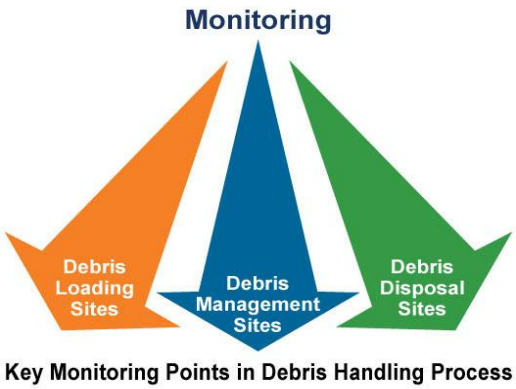

Figure 8
Contracted Services

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