Waste Management Relating to Sustainable Practices in Construction Management Today

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This study is a combination of research from previous studies as well as interview to evaluate the effects of the various sustainable systems and rating systems, how they are working to improve waste management, and how this has plays into the current and future practices of construction. Construction and demolition (C&D) waste is one of the largest waste flows in the world, reaching 30–40% of the total solid waste because of the large-scale construction and demolition activities resulting from accelerated urbanization and city rebuilding (Islam, 2019). To evaluate the difference between LEED certified construction in comparison to non-LEED certified construction, we can better understand the different approaches to waste management strategies and their overall impact to the project and the overall environment. This project paired with Balfour Beatty Construction in San Diego, California to analyze two different projects, one LEED certified and the other non-certified. A research case study was performed to analyze the different approach to waste management strategies, and it was found that the LEED certified buildings ultimately have more substantial and significant waste management practices and are more beneficial impact to the environment compared to those of non-LEED certified buildings.

Key Words: Construction Management, LEED, Waste Management, Construction & Demolition, Sustainability, Recycling

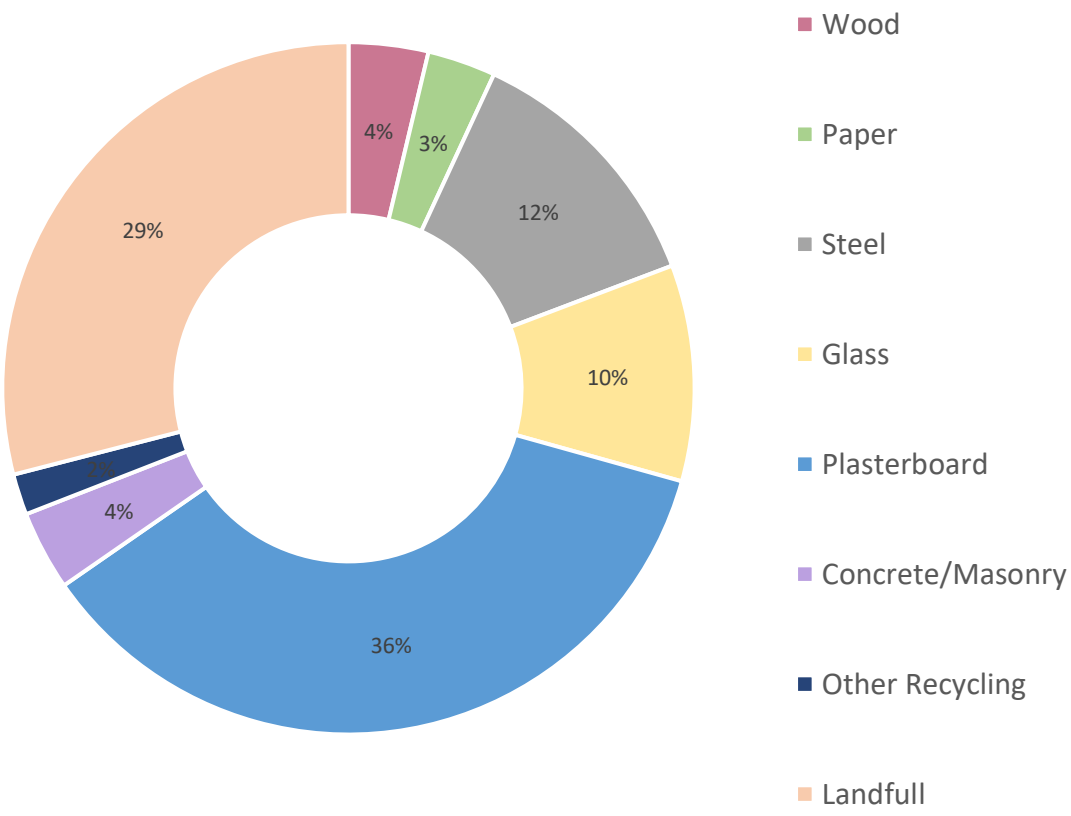
Introduction

In the current world of Construction Management, there has been an increasing movement in thinking sustainably when it comes to building construction. With the large impact buildings have on everyone in the world, by analyzing the impact they have on the environment, starting with the construction of the building and reaching to the purpose and use it holds, we can better understand the extent of this impact. One large practice incorporated into sustainable building is waste management. As construction and demolition (C&D) waste has reached 30–40% of the total solid waste, this is in part due to increased urbanization. This urbanization however is not only responsible for the increased usage of non-renewable sources according to Islam (2019), but also for the generation of large quantity of C&D waste as well as the relevant environmental concern. One way in which countries have chosen to approach construction waste as well as global energy, CO2 emissions, resource consumption, and wastewater production is through developing building rating tools (Khan 2018). According to Khan (2018), Leadership in Energy and Environmental Design (LEED) was created in 1998 by US Green Building Council (USGBC) to assess business interiors, and structures utilized for various purposes and neighborhood advancements. This system uses a score checklist to assess the

projects impact sustainably. LEED certifications vary from Certified, Silver, Gold, to Platinum and are awarded based on the number of points achieved from the checklist. By evaluating waste management practices broadly and specifically through example projects, we can view how approaches differ or concur on LEED certified projects compared to non-LEED certified projects.

Current Waste Management Strategies

Conventional construction waste disposal methods include landfill and incineration, which not only rapidly consume invaluable land resources, but also give rise to environmental degradation (Lu, 2019). Construction waste, according to Lu (2019), is classified as either inert or non-inert depending on whether or not is has stable chemical properties. Inert materials, such as soil, earth, slurry, rocks and broken concrete, account for the vast majority of all construction waste. The non-inert waste, including bamboo, paper, and timber, cannot be reused and/or recycled and is normally landfilled. A typical breakdown of construction and demolition waste components can be seen in the chart below. As a result of the environmental impacts construction waste has caused, according to Bakchan (2019), industry practitioners are increasingly under pressure to promote more effective construction waste management (CWM) practices at the site level, through the 3Rs principle; reduce, reuse, recycle.



Below we will evaluate projects which have been completed and the comparisons and differences between LEED certified projects and non-LEED certified projects. Overall, requirements between certified and non-certified projects differ depending on whether the non-LEED projects are falling under a different standard of certification, such as the Living Building Challenge, BREEAM (the Building Research Establishment Environmental Assessment Method), WELL Building Standard, etc. Requirements may also differ as a result of whether the project includes demolition of existing structures or if it is new construction.

LEED Projects

In general, LEED projects without the inclusion of existing structures demolition will require the separation of waste on the jobsite, including wood, concrete, metals, trash, etc. In addition to separation of waste, close management of dump tickets is required to track recycling percentages and diversion of waste. According to Britani Harris, Project Manager LEED GA at Balfour Beatty Construction, LEED projects with existing structural demolition will likely have mixed construction and demolition (C&D) waste during construction providing up to 60% recycling from each waste haul. The majority of this recycling will occur during the demolition phase. Buildings which are heavily composed of concrete and rebar have a high recyclable content to weight ratio; far beyond that of the waste made during the construction process. The aggregate percentage of recycled weight compared to total waste weight will generally reach upwards of 90% when incorporating existing building waste recycling. In a study completed regarding a sustainable circular economy, recycling practice for C&D waste is as a gateway for the production of recycled aggregates that can replace natural aggregate in various applications. (Hahladakis, 2020). This replacement of aggregate by using recycled aggregate provides for a more sustainable alternative by avoiding landfilling of waste and depletion of natural aggregate resources. On LEED projects, this use of recycled aggregate would earn points in the Materials & Resources credit category. These construction waste related credits, normally under the category of “Materials”, account for 8–12% of all the attainable credits in these systems (Lu, 2019). In addition to recycled materials, if the design of a project is integrated, concrete and masonry structures are beneficial overall because this waste is able to be diverted. Waste diversion is closely monitored on all certified projects as their dump tickets are closely monitored and all data is tracked to ensure they are staying within the bounds of the credit scorecard.

Non-LEED Projects

In comparison to LEED certified projects, non-LEED certified projects with no existing structure demolition will generally have mixed C&D waste for up to 60% recycling in total. For projects which are not certified, specifically school sites, they can fall under CHPS (Collaborative for High Performance Schools) sustainability requirements. For these projects, depending on existing building demolition, companies would follow the options listed about for LEED projects, however, not receive the LEED certification title. Some construction projects may not be working towards achieving LEED certification however still are working to meet a waste diversion goal. On these projects, according to Connor Miller, Project Manager LEED AP BD+C at Balfour Beatty Construction, management of the project dumpsters is elevated as well as there is more reporting required to track these diversion rates. According to a study at UC Merced (2015), waste diversion is the process of diverting material from the landfill to prevent waste generation. Waste diversion includes reducing, reusing, recycling, composting, and converting waste to energy. Different diversions of waste coming from a project site can include diverting to a landfill, which generally accepts mixed recycling as well as composting of grass, leaves, trees, and wood. Another diversion is recycling, which accepts paper, cardboard, plastic film, mixed rigid plastics, Styrofoam, scrap metal, glass, and aluminum. This diversion of waste plays

into a life cycle analysis (LCA) method-based thinking, consisting of assessing the environmental performance of a product or system, according to Wu. et. al (2019). BY evaluating the environmental impacts of a product system 'from the cradle to the grave', we are able to analyze the life cycle stages from the raw material extraction, manufacturing, transportation, to use and end-of-life treatment and final disposal (Wu, 2019). By evaluating the materials by their life cycle, the diversion of waste from a project site is able to be better evaluated based off of which materials are able to be recycled, reused, or dumped.

Research Design

The research approach taken throughout this case study was completed to compare waste management strategies on LEED certified projects compared to non-LEED certified projects. Different waste management strategies were analyzed in order to determine the most beneficial strategy as well as to create new knowledge for future waste management strategies. By researching two projects completed from the same construction company, Balfour Beatty Construction, located in San Diego, California, we are able to better understand the approach to LEED specific building. We can evaluate their waste management strategies implemented to these projects and see which resources are required and used and what extra steps are taken when needing to fill out the scorecard. Additional results able to be concluded include the outcomes on cost, schedule, and the overall emissions and waste generated which is beneficial for future buildings in the industry. The two projects analyzed in San Diego were the construction of a college stadium and a middle school modernization. Through interviews with project team members and company leaders, the research conducted lead to results which were concurrent with my original hypothesis.

Results

As a result of research conducted on two different project sites from the same construction company, we are able to see the different approaches to waste management for LEED certified projects and non-certified projects. In comparison, the ideas for waste management strategies follow the same path and overall methods, however LEED projects come in above and beyond as more impactful for the community as well as most beneficial for costs as well as schedule. For LEED projects, multiple dumpsters are provided with labels according to how the specific site wants to separate, i.e. concrete, cardboard, co-mingled etc. All trades are contractually required to comply to these labels; however, people are additionally required to dumpster dive occasionally to separate items when items are thrown in the wrong bins. Waste tickets are tracked thoroughly and documented to receive the proper credits. For some general contractors, they will report all waste and recycling to sustainability managers for reporting. All waste tickets are tracked internally as well as through LEED efforts for clients. By having additional sustainability managers, the responsibility of the more specific tasks for certification, such as data sheets, dump tickets, and inspection sheets are able to be closely monitored, tracked, and organized. In comparison, on non-certified projects, there are typically fewer dumpster types as these diversion goals are not as strict because a project is not looking to hit marks on a LEED certification scorecard. The non-certified job does not have a specific sustainability manager and the responsibility of waste management strategies falls to the environmental subcontractor coordinating with either a project engineer or superintendent. In addition to these strategies, an asset the College Stadium project possessed was a thorough waste management plan which coalesced together waste management and water management on site. This plan implemented the use of synthetic turf on site to minimize future water usage and wastewater in future use. This project also contained two chillers, two cooling towers, four boilers and thirteen pumps, providing high-efficiency cooling and heating for new and existing campus buildings. The non-certified Middle School modernization did not have as

extensive waste management strategies implemented into their plan as this was not a requirement needed to meet any certification. Wastewater is being diverted off site for environmental benefits as laid out in the site SWPPP plan, however the extensive future water management strategies are not as high priority compared to certified projects. As seen in the table below, there is a comparison of the two projects and their respective highlights of their waste management strategies. It is evident that the LEED certified project has a more calculated plan to reduce construction and demolition waste on site.

LEED Gold - College Stadium Modernization	Non-certified Middle School Modernization
Separated waste containers for different types of material	Two waste containers for trash and recycling
Each subcontractor had sustainability and LEED requirements included in each contract	No LEED requirements in subcontractor's contract
Trash separation requirements by material	Only material separated from trash and recycling was concrete waste
Dumpster ticket reports documented and saved	Dumpster ticket reports not required to be documented and saved
Sustainability manager hired specifically to manage project and initiate site changes	Responsibility on project engineer to receive report from environmental subcontractor and initiate site changes
Daily dumpster inspections	Weekly dumpster inspections
Weekly site inspections	Weekly site inspections
Cost savings for maintenance and operations, energy, emissions, and water	No impactful cost savings, some additional costs for additional dumpster trips

Less future maintenance required, can shorten schedule with less dumpster trips required	No impact to overall schedule
Strategies determined by credit necessities and past certified projects	Strategies determined by past non-certified projects
Additional dumpsters necessary, access to material dump areas in close proximity to site	No additional dumpsters needed, access to material dump areas
Waste management strategies beginning in planning and design phase	Waste management strategies beginning during construction in coordination with environmental subcontractor

Challenges & Future Recommendations

Challenges faced while completing this case study was being able to get ahold of multiple team members from the respective projects. While there was information regarding overall LEED strategies compared to non-LEED strategies, in the specifics of waste management, there was not an abundance of information to evaluate. Additionally, there were challenges faced to the projects themselves. For the non-certified Middle School modernization, the waste management strategies put into place were not placed in very high regard, which shows the stark contrast to the College Stadium project where LEED Gold was achieved. As a result of not focusing on these strategies, there was not a clean organization of dumpster tickets or pickups when needed, many materials were combined in the incorrect dumpsters, and schedule and cost impacts were minorly impacted because of improper disposal and organization on site. As for the impact on future building and the environment, we are able to clearly see how LEED certified projects have an overall better impact on the current and future environment. Future recommendations for both certified and non-certified projects would be to begin the waste management strategy planning during the planning and design phase of the project. This will then extend into the construction of the project and future occupancy and management of the project, ultimately mitigating issues which could arise during construction and through the life cycle of the building. In addition to early planning, completing life cycle analysis on materials can ultimately reduce environmental impacts on landfills and increase economic value in the reuse of materials, reduced production of new materials, and the recycling or building materials. By having an efficient waste management program, this allows for early implementation of new waste strategies to ensure all members of the project understand what is necessary for each party. This also ensures the management of waste on the project will be properly handled as well as tracked for necessary certification purposes.

Conclusion

To summarize, the goal of this project was to analyze the different waste management strategies in LEED certified projects in comparison to non-LEED certified projects. There is still an abundance of information which could be analyzed further about LEED certified projects as well as the many other certification programs in the world. Information is consistently being discovered about green building

which is why the construction industry is always changing and adapting. For another student in the future if they were to continue my research, I would recommend looking deeper into additional certification programs in addition to LEED and evaluate their similarities and differences. I believe the Cal Poly Construction Management program would be able to benefit from this research by incorporating it into sustainability classes such as Sustainability and the Built Environment as well as standard materials classes. Throughout the research of sustainable building focusing specifically on waste management strategies, we are able to discover what currently is most beneficial for the environment as well as what can be improved to continue working towards a sustainable future in construction.

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