

Investigation of the Safety, Efficiency, and Cost-Effectiveness of Self-Dumping Trash Bins

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Trash removal on a jobsite is a messy proposition. The controlled mayhem of tossing or loading debris in a bin and then flying the container by crane from the top of a high-rise structure to a dumpster on a ground level could be very risky and may result in severe injuries or fatalities. This research study shows the perceptions of the construction industry professional regarding the safety, efficiency, and cost-effectiveness of a new self-dumping bin as compared to traditional bins (and other common methods) used for the same purpose. Questionnaire survey and semi-structured interviews were conducted to collect the necessary data. The results indicate that levels of safety, productivity, and cost-effectiveness are significantly improved when self-dumping bins are utilized over other traditional methods of trash collection.

Key Words: Trash bins, Construction waste, Trash collection, Safety, Construction jobsite management

Introduction

Construction companies face a variety of challenges on the jobsite that have the potential to jeopardize their ability to perform work safely and efficiently. One such challenge faced by every contractor is the task of jobsite cleanup (or trash collection). Building construction produces large volumes of material waste. A jobsite cluttered with construction waste or debris poses a number of threats to workers. If workers constantly step over or otherwise avoid debris as they move on a jobsite, productivity and safety can be adversely affected. Workers are more prone to accidents when walking surfaces are not kept relatively clean and obstruction free. According to the Occupational Safety and Health Administration (OSHA), “Slips, trips, and falls constitute the majority of general industry accidents. They cause approximately 15% of all accidental deaths, and are second only to motor vehicles as a cause of fatalities” (OSHA, 2008). Not only debris increases potential for worker slips and falls, but also the chance of cut or puncture wounds associated with falls.

Contractors employ a variety of methods in routine for onsite trash collection. This research is focused on those methods where machinery is utilized to lift or hoist debris from several locations to a centralized trash container. One of the most common methods of trash collection is utilized on sites where a crane is in use. On such sites, a dumpster or trash bin intended for stationary ground use is rigged with chains at each of four corners. The chains are then attached to the hook of a crane, allowing the bin to be lifted to a location, filled with debris, and lifted back to a larger trash receptacle. After lowering the bin into a larger, centralized receptacle, a worker is required to climb into the larger bin and detach the chains from two corners of the bin. The bin is then lifted again by the crane in order to dump the contents. Figure 1 shows a loaded bin being lowered into a larger receptacle and a worker climbing in to detach two of the chains. After the debris is cleared, the bin is placed back on the ground, a worker reattaches the chains, and the process is repeated as needed. For the purposes of this research, the method just described will be referred to as the *traditional method*.

The traditional method is simplest; however, both safety and productivity are called into question due to couple of factors. First, the bins used are not manufactured for hoisting purposes. Therefore they are not load-rated. Contractors are forced to guess the weight of debris that a bin can handle safely. “Bins have failed and collapsed due to overloading on several projects” (Junkersfeld, 2008). Secondly, the fact that a worker is required to step in to a debris-filled receptacle to detach rigging puts the worker at risk of injury via contact with sharp debris as well as

back or ankle injury associated with climbing/jumping in and out of a dumpster. Productivity can be adversely affected by the same requirement. It takes time to attach/detach/reattach rigging to the corners of the bins. This amount of time is multiplied by the number of cycles a cleanup crew performs in a day. Additionally, the location at which rigging is typically attached to bins does not always allow for complete clearing of debris when dumped (even with one sloped end). Debris left in a bin means either lower potential capacity for the next cycle, or that a worker must spend additional time to climb in and manually remove the debris (again adding to safety concerns).



Figure 1: Traditional Trash Collection Method

One possible solution to this problem is the use of Self-Dumping Bins (hereafter referred as SDB's). SDB's are a relatively new product designed with the intent of reducing those concerns of safety and productivity related to the current methods of jobsite trash collection. SDB's are designed strictly for the purposes of trash collection. Each bin is load-rated, allowing contractors to more safely load the bins (Cherokee Erecting, 2008). They are also designed with a swinging arm and single pick point centered at the top of the arm. A locking mechanism is incorporated at the back of the bin that catches the arm when fully lowered. With the lock engaged, the bin can again be lifted, turning the bin upright and emptying the contents. This removes the worker previously required to detach and reattach rigging from the process. The whole operation of self-dumping bins is depicted in Figure 2 while a video can be viewed at <http://www.cherokeeerecting.com/pages/HMT/video/self-dumping-video.html>.

There is some evidence supporting a growing demand for SDB's. Minimal initial testing has been conducted by some companies to compare the new bins to the traditional bins (Junkersfeld, 2008). A field operations manager at a construction company located in Houston, Texas claims that "The difference in our guys' attitudes about cleanup is phenomenal. In the five months that we have been using them, cleanup is faster and the men appreciate staying out of the dumpsters. We have two SDB's now and have ordered two more" (Junkersfeld, 2008).

Due to the relative newness of SDB's in the construction market, there is not much literature to be found on the subject. Only one company in the entire country currently provides SDB's. The somewhat improvised nature of most bins used for hoisted trash collection is in fact evidence that few products intended for such activities are in the market. There have been no other studies conducted using SDB's. Perhaps the most crucial factor concerning SDB's is OSHA. What is commonly known as the General Duty Clause, section 5(a)(1) of the OSHA act requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees" (OSHA, 2008). If SDB's are deemed a substantially safer alternative to traditional methods of trash collection, they could potentially fall under the call of the General Duty Clause of the OSHA Act.



Figure 2: Self-Dumping Bins in Use on a Construction Site

This notion is further supported by the fact that OSHA identifies trash collection as “one of the most dangerous jobs in the United States during the 1992-1997 period” (DOL, 2008a). This includes other forms of trash collection outside of the construction industry, but the issues faced by all refuse collectors are similar. “While occupational workers struck by vehicles account for a major portion of these fatalities, other workers are killed by contact with objects and equipment according to the Bureau of Labor Statistics 2001 data.” At least six crushing fatalities caused by shifting dumpsters were recorded by OSHA between 1999 and 2003 (DOL, 2008a). If a product is available which does not require that workers be in the vicinity of dumpsters while dumping is taking place; using a product which does require workers to be in close proximity could be construed as a “willful violation of the OSHA Act for failing to supply employment or a place of employment free from recognized crushing hazards” (DOL, 2008b).

Research Question

The introduction of SDB's to the construction market poses a following question to construction companies and their decision of whether to purchase these bins or not.

Could the safety and efficiency during trash collection operation be improved by the use of self-dumping bins (SDB)? If so, are SDB's a cost-effective option?

This research study attempted to find the answer of this question.

Research Scope and Objectives

The objective of this research is to investigate current usage of SDB's and other methods of trash collection and accurately answer the research question, offering evidences in support. Evidences are collected from current construction professionals via a questionnaire survey and interviews.

Research Design

As indicated earlier, this research study attempts to determine perceived improvements in safety, efficiency, and cost-effectiveness of SDB's over traditional trash collection methods. The opinions of construction professionals both with and without experience with SDB's are included in this study.

Preliminary literature review and a meeting with a provider of SDB's were used as a basis for developing a questionnaire. The questionnaire comprised of 19 questions was designed to obtain a general overview of the construction industry's perception of self-dumping bins as well as opinions about current trash collection methods. The questionnaire was divided into four sections as follows:

- Section 1: Company profile
- Section 2: Existing method of hoisted trash collection and dumping
- Section 3: Self-dumping bins evaluation (for companies currently using a self-dumping bin)
- Section 4: Self-dumping bins evaluation (for companies not using a self-dumping bin)

Included in the questionnaire was an overview of SDB's and photographs depicting both the traditional method of trash collection and the SDB's. The respondents having no prior experience with SDB's were asked to submit their opinions based upon the information provided as an attachment to the survey. Four semi-structured interviews with construction professionals currently using self-dumping bins on a project were also conducted to verify the research results and conclusions.

Results and Discussion

Questionnaires were sent out to 15 companies currently using SDB's and approximately 250 companies (including ENR top 100 contractors) without SDB experience. A total of 38 questionnaires were returned. Twelve (12) questionnaires were received out of the 15 sent to companies currently using SDB's. The remaining questionnaires (26) were collected from companies who had no prior experience with SDB's. Although the response rate is quite low but it may be used to drive some initial conclusions and provide foundation for further research. The questionnaire results are broken down by question in the remainder of this paper.

Section 1: Company Profile

The majority of responding companies were involved in commercial and institutional (schools, hospitals, etc.) projects. Eleven (11) responding companies have yearly revenues in excess of \$500 million, 12 have yearly revenues between \$100 million and \$500 million, and 15 have yearly revenues of under \$100 million. This indicates that companies of all sizes participated in this study. The majority of the respondents were project managers and superintendents. The overall average experience was 17.4 years. This indicates that the respondents had reasonable experience within their companies and were competent to answer the questionnaire.

Section 2: Existing Method of Hoisted Trash Collection and Dumping

More than half of the companies (21) polled currently employ only the traditional method of trash collection. The remaining companies (17) use a variety of methods (including self-dumping bins). It is important to include the responses of those not currently using the SDB's in order to gain an understanding of how the industry views other methods with respect to safety, efficiency, and cost-effectiveness. If SDB's are concluded to be far safer and more cost effective than other methods, some companies may choose to utilize cranes in situations where they may not

use under usual circumstances. However, if upon further testing, SDB's do not yield a large enough margin of improvement over other methods, companies will likely be reluctant to incur the additional expenses associated with crane rental necessary for implementation of SDB's.

In your opinion, does your current method of hoisted trash collection and dumping create an unsafe working environment for the workers? ☐ Yes ☐ No ☐ Not Sure

Twenty (20) respondents answered Yes (that their current method of trash collection created an unsafe working environment for workers) and 18 answered No. All who had used SDB's answered *no*. This might be attributable to a sharp contrast between perceived safety of traditional and SDB's that is more noticeable after having witnessed SDB's in action. A potential problem with this question is that answering yes may be self-incriminating. If a contractor is willfully placing their workers in unsafe conditions when there is a viable alternative, they could be punished heavily in the event of an accident taking place. Therefore respondents may not be as inclined to answer honestly.

Does your company has accident(s) which are directly or indirectly related to the use of traditional style bins? ☐ Yes ☐ No ☐ Not Sure

The majority of respondents (25) answered that they did not have accidents related to the use of traditional bins while 8 were unsure and 5 answered yes. There are two potential problems with the wording of this question however, that may have skewed the results. First, the question should have read "your current method" rather than "traditional style bins." Speaking of traditional bins presupposes that the respondent is in fact using them in the first place. Second, answering yes to this question may be self-incriminating to a degree. Respondents may be less likely to answer the question honestly because of the highly negative implications of answering yes. For this reason, this question is not considered in the final analysis.

Section 3: Self-Dumping Bins (SDB's) Evaluation (for companies currently using a SDB)

Does SDB's improve safety, productivity and cost-effectiveness as compared to traditional bins?

Of the respondents that answered this portion of the questionnaire (12 respondents), all claim that SDB's improve safety, productivity, and cost-effectiveness of the trash collection method. The mean scores were 4.6, 4.3, and 4.1 respectively as shown in Table 1. The self-dumping action may also significantly lower cycle time as compared to the traditional method. This could translate to save crane time and allow for other hoisting activities to resume more quickly.

Table 1: Does the Self-dumping Bins Improve Safety, Productivity and Cost-effectiveness?

Parameter	Mean	Standard Deviation
Safety	4.6	0.45
Productivity	4.3	0.69
Cost-Effectiveness	4.1	0.45
1-No Improvement; 2-Little Improvement; 3-Some Improvement; 4-Fair Improvement; 5-Significant Improvement		

How do you rate the ease of use with SDB's as compared to traditional bins?

All respondents agreed that ease of use of SDBs is better than with traditional bins (Table 2). The average rating given was 4.5.

Table 2: How do you Rate the Ease of Use with Self-dumping Bins?

Parameter	Mean	Standard Deviation
Ease-of-use	4.5	0.36
*1-Much worse; 2-Worse; 3-Same; 4-Better; 5-Much Better		

Based on your experience, do you prefer to use a self-dumping bin over the traditional style of bins in your future projects? ☐ Yes ☐ No ☐ Not Sure

Eleven (11) respondents indicated that they would prefer to use SDB's over traditional bins. No one said that they would not. Only one (1) respondent answered that he is not sure.

Do you have any concerns regarding the self-dumping bins? ☐ Yes ☐ No ☐ Not Sure

Three (3) respondents had some concerns about SDB's which were, *whether the bins would hold up over time, the bins could not be rolled around on the interior of a building, and their limited capacity* (not enough capacity). They suggested to *add retractable casters on the bottom of the bins and to offer bins with larger capacities* (Note: The SDB's manufacturer has recently addressed these issues and now SDB's are available in 4 different capacities (3000 lbs, 5500 lbs, 6500 lbs and 10,500 lbs) and with retractable casters).

Section 4: Self-Dumping Bins (SDB's) Evaluation (for companies not using a SDB)

These companies were provided a document containing an overview of SDB's and photographs depicting both the traditional method of trash collection and the SDB's. Contact numbers of researchers were provided to clarify any information or to get additional details. Twenty six (26) companies answered this part of the questionnaire. Semi-structured interviews were also conducted with some of the respondents to discuss their responses in depth.

Does SDB's improve safety, productivity and cost-effectiveness as compared to traditional bins?

Respondents either indicated that SDB's could improve safety, productivity, and cost-effectiveness of the trash collection method or were neutral. None of the respondents gave any negative comments. The mean scores were 4.26, 4.13, and 3.84 respectively (Table 3).

Table 3: Does the Self-dumping Bins Improve Safety, Productivity and Cost-effectiveness?

Parameter	Mean	Standard Deviation
Safety	4.26	0.42
Productivity	4.13	0.32
Cost-Effectiveness	3.84	0.38
*1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Strongly Agree		

Would you consider using one of the new self-dumping bins? ☐ Yes ☐ No

All respondents mentioned that they would be willing to use an SDB in the future. Ten (10) respondents indicated they may purchase an SDB in the next 6 months while 16 mentioned that they would consider its purchase in the next one year.

Do you have any other comments/concerns about self-dumping bins?

The respondents indicated two concerns. The first was doubt expressed regarding the stability of the swinging arm. The second was a suggestion. The respondent said that he would consider using a bin if it were to be provided by a rental company. He indicated that only a portion of his jobs required hoisted trash collection.

Conclusions

Analysis of the questionnaire survey results and semi-structured interviews indicates that a majority of respondents feel that SDB's either do (in the case of those currently using SDB's) or would (in the case of those not currently using SDB's) improve safety, efficiency, and cost-effectiveness of the method of trash collection. Opinions regarding whether current methods of trash collection posed negative impacts on the above criterion were

inconclusive among those not currently using SDB's. However, the majority of those currently utilizing SDB's felt that current trash collection methods do indeed pose negative impacts on safety, efficiency, and cost-effectiveness. The majority of persons polled (or interviewed) who are not currently using SDB's indicated purchasing an SDB within the next 6 months to one year period.

Recommendations for Future Research

Further research concerning SDB's could lead to a deeper understanding of their potential benefits. One suggestion is to carry out timed field tests to compare and determine SDB's advantages over traditional methods. More extensive polling of contractors across the nation could also be carried out to gain a more complete representation of the industry's perception of SDB's.

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Disclaimer

The opinions and recommendations expressed in this report are based on the feedback collected from the respondents who participated in this study. They may not necessarily reflect the authors' personal opinions and do not necessarily represent the official position of any participating organization.

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