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Use and Acceptability of Reduced-Weight Portland Cement Bags in Masonry Construction: An Observational Pilot Study

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ABSTRACT

Background Mason tenders are involved in semi- and unskilled work in support of bricklayers and block layers. Their work consists of manually transporting building materials and equipment, supplying individual brick/block layers with materials, and mixing and stocking mortar.
Objective The purpose of this pilot study is to determine the current availability and acceptability of reduced-weight Portland cement bags among mason contractors, cement suppliers, and manufacturers as a vehicle to decrease the exposure of mason tenders to physical risk factors for musculoskeletal disorders (MSD).
Methods Forty-six producers, suppliers, and contractors that use Portland cement bags were used in this observational exploratory study. A questionnaire was administrated over the phone and data were collected regarding availability, practice of use, and preferences between full- and reduced-weight Portland cement bags.
Results Only 17% of the companies produce/supply/use the reduced-weight cement bags. The main factors mentioned by the companies that influence the nonuse of small bags are reduced demand; increased cost; storage, shipping, and handling difficulty; special equipment requirements; and special packaging. Only 11% of companies interviewed are aware of the National Institute for Occupational Safety and Health (NIOSH) lifting recommendations that the maximum lifted weight should be 51 lb.
Conclusions This exploratory study suggests that reduced cement bags may not be in wide use by producers/suppliers/users of Portland cement. A full-scale study is recommended to confirm these practices and find ways to significantly reduce the risk to which masonry workers are exposed.
Application The potential application of this study can be the development of new guidelines regarding the production/supplying/usage of 47 lb cement bags. © 2008 Wiley Periodicals, Inc.

1. INTRODUCTION

1.1. Background

The costs associated with the manual handling of heavy objects is staggering. Musculoskeletal disorders (MSD) account for 33% of all injuries and illnesses with days missed from work in the private industry and an estimated $50 billion in annual costs in the United States (Hess, Hecker, Weinstein, & Lunger, 2004; Landis & Koch, 1977). Lower back pain in particular is the most prevalent, disabling, and costly musculoskeletal disorder experienced by construction workers (Goldsheyder, Nordin, Weiner, & Hiebert, 2002). The research relating construction workers (bricklayers, carpenters, plumbers, concrete workers, electricians) is extensive, yet remains limited for mason tenders.

In one study, the prevalence of MSD among mason tenders was 82% (Goldsheyder et al., 2002) and lifting full-size cement bags was identified as an "ergonomically hazardous" activity performed by mason tenders (Washington Industrial Health and Safety Act [WIHSA] Policy and Technical Services, 2002). Mason tenders do semi- and unskilled work in support of bricklayers and block layers on masonry building sites. This work includes transporting building materials and equipment; transporting, erecting, and dismantling scaffolding; supplying individual brick/block layers with materials; and mixing and stocking mortar. On small and medium building sites, mortar is typically mixed manually or with a portable power mixer. In either case, the materials, including the Portland cement, are manually placed inside the trough or the barrel of the power mixer.

For commercial use, Portland cement is available in bulk and bags. Typically, masonry workers utilize cement that is available in two sizes of bags: reduced weight (47 lb/21.36 kg) and full weight (94 lb/42.72 kg) bags. Lifting full-weight bags (94 lb) exceeds the National Institute for Occupational Safety and Health (NIOSH) recommended lifting weight (51 lb) and is a risk factor for MSD, especially lower back pain, among mason tenders who have to manually lift the cement bags and empty them into the mixer (Waters et al., 1999). A recent study of mason tenders revealed the high prevalence of MSD among participants, focusing on lower back (65%), shoulder (42%), and knee (41%) problems (Goldsheyder et al., 2002). Another recent study conducted in Washington described lifting full-size Portland cement bags as a "hazardous" activity performed by mason tenders and recommended substituting reduced-weight for full-weight bags (WIHSA, 2002). In response, NIOSH sponsored a meeting in March 2004 where masonry stakeholders expressed their support for more usage of the reduced-weight (47 lb) Portland cement bags and recommended an evaluation of the intervention in order to assess its practicality and effectiveness.

Several countries around the world, including Australia, Ireland, and the United Kingdom, are currently discussing means to eliminate the hazard of full-weight cement bags (Health and Safety Authority [HSA], 2003; Health and Safety Executive, 2002; Victorian Workcover Authority, 2005). In Ireland, a deal was struck between the Health and Safety Authority and cement manufacturers to eliminate the use of full-weight cement bags and to restrict the supply to reduced-weight bags (HSA, 2003).

In addition to the manual handling of cement bags, mason tenders are exposed to additional physical and nonphysical work factors that can magnify the risk of musculoskeletal disorders. Repeated manual handling of bricks, tools, and scaffolds is another physically demanding aspect of their work that requires further attention. Repeated work, time pressure, and working under extreme climatic conditions can exacerbate work-related stress and job dissatisfaction. In a recent study by NIOSH, job dissatisfaction was a strong predictor of lower back pain—even after control for the physical work demands (National Research

Council [NRC] and Institute of Medicine [IM], 2001). Although substituting the heavy bags will eliminate one important aspect of the problem, it is crucial to consider other risk factors. In the complex web of risk factors surrounding MSD, especially among mason tenders, the improvement achieved in one area can be easily masked by another.

To evaluate the impact of the intervention, a holistic approach, such as work compatibility (Salem et al., 2008), needs to be adopted. It is defined as a latent variable integrating the positive and negative impact characteristics of work-related variables in the human-at-work system in the form of a prescribed relationship. Work compatibility considers the balance between and across the different work-related stressors. The confounding effect of the different risk factors (physical and nonphysical) can be assessed and accurately accounted for. A priority list of different stressors can be compiled, suggested interventions can be implemented, and their perceived effect on the workers can be measured in a relatively short period of time (Genaidy & Karwowski, 2003). In addition, work compatibility avoids the usual lag that occurs between the introduction of a new intervention and the time it takes to influence the health outcomes, especially with cumulative chronic health effects like MSD. The strong ties established through this pilot study with contractors and mason tenders will allow for further evaluation of the different stressors in their work environment (both physical and psychosocial).

1.2. Hypothesis and Specific Aims

This pilot study holds the premise of identifying the current practices and the barriers to using reduced-weight cement bags. Once such barriers are identified and addressed, the hazard of heavy bag lifting can be eliminated by substitution

This pilot study will provide input from different stakeholders on how to overcome the barriers to using reduced-weight bags, utilizing a scientifically sound research approach. It is in accordance with the research-to-practice objective set by National Occupational Research Agenda (NORA) for the second decade. Construction is one of eight sectors identified by NORA for future research in health and safety. This pilot study will pave the way for future studies that follow the same principle where input from workers and contractors is combined with research findings to identify problem areas, suggest intervention strategies, and allow the review of the early evaluations of the interventions once implemented. Identification of the different stakeholders and establishing research ties with them is a major goal of this pilot study.

The main purpose of this pilot study is to determine the current availability and acceptability of reduced-weight Portland cement bags among mason contractors, cement suppliers, and manufacturers as a vehicle to decrease the exposure of mason tenders to physical risk factors for MSD. To achieve the purpose of the study, the following hypotheses were tested.

Hypothesis 1.a: Will determine if the reduced-weight Portland cement bags are actually produced by cement manufacturers and, if so, whether they are available at different suppliers in the specified regions.

Hypothesis 1.b: Will determine the relative production and availability of the reduced-weight bags in comparison to the full-weight bags and the factors associated with different practices among manufacturers and suppliers (e.g., not produced, not available, produced by limited manufacturers, available at limited suppliers, produced by all manufacturers, and available at all suppliers in limited quantities).

Specific Aim 1—Determining the availability of reduced-weight Portland cement bags for small- to medium-sized brick and block building projects.
Specific Aim 2—Determining the relative volume of production and supply among Portland cement manufacturers and suppliers in regards to the full-weight (94 lb) and reduced-weight (47 lb) Portland cement bags.

Hypothesis 2: Will test the same aspects of availability and practice as they apply to contractors and mason tenders, and explore which factors contribute to such practices.

Specific Aim 3—Determining the relative volume of usage of the full-weight (94 lb) and reduced-weight (47 lb) Portland cement bags among small- to medium-sized brick and block building contractors.
Specific Aim 4—Identifying the different barriers to adopting more reduced-weight (47 lb) Portland cement bags among contractors (small- to medium-sized brick and block building), suppliers, and manufacturers.
Specific Aim 5—Determining if the contractors and cement providers are aware of the potential health hazards associated with the use of full-weight bags.

2. METHODS

2.1. Study Design

An observational study was conducted using a questionnaire administered over the phone. The questionnaire collected data regarding the availability, practice of use, and preferences in regards to the full- and reduced-weight Portland cement bags.

2.2. Study Participants

The study participants consisted of 46 companies located in Washington, DC, Seattle, WA, Chicago, IL, and Dallas, TX. The subjects were recruited from local manufacturers, suppliers, building contractors (small- to medium-sized, brick and block) and mason tenders in the above-mentioned metropolitan areas. The companies' names and contact information were obtained from the Yellow Pages, Internet, and local trade unions.

2.3. Study Methods

The companies participating in the study were classified into 14 producers, 26 suppliers, and 6 contractors. The companies were contacted by phone and the interviewer gave a brief description of the study to the person answering the phone. If he/she was not able to provide the requested information, the interviewer asked for the person who could answer or asked for an appointment to speak to him/her. Once the interviewer reached the subject, he/she gave a brief description of the study objectives and the subject was asked if he/she was willing to participate in the study. The participants gave a verbal consent over the phone to answer the questionnaire (see the Appendix).

The questionnaire consisted of items that covered all five specific aims of the hypotheses. For Specific Aim 1, the survey collects data regarding the availability of reduced-weight bags at the cement providers (manufacturers and suppliers). For Specific Aim 2, the manufacturers

and suppliers participating in this pilot study were asked about the relative amount of production and supply of both types of cement bags. For Specific Aim 3, participants were asked about their use of reduced-size cement bags (yes or no) and the relative volume in relation to the full-sized bags. For Specific Aim 4, participants were asked specifically about factors influencing the different practices solicited (e.g., not available/not utilized, only available and utilized in limited volumes, widely available but only utilized in limited volumes). A list of potential factors was presented to participants and they were asked if they agree or disagree with each factor. In addition to the list, participants were asked about other factors not presented to them. And finally, for Specific Aim 5, participants were asked specifically about their knowledge of health hazards associated with the full-weight bags and were asked to identify the factors that will encourage them to switch to more usage of the reduced-weight bags.

2.4. Data Analysis

The questionnaire was designed in a simple and concise format to allow for soliciting the information over the phone without interrupting the participant's time. The questionnaire consists of two parts. The first part collects quantitative data regarding the practice of using and the relative volume of both reduced- and full-weight cement bags, in addition to information regarding the company size and years in the cement industry. The second part collects qualitative data regarding the reasons behind current practices and suggestions to encourage the use of reduced-weight bags on a larger scale.

2.4.1. Quantitative data. A database was created using the Statistical Analysis Software (SAS). The initial testing of the questionnaire reliability was assessed using the *Kappa* statistic (FREQ procedure of SAS). Descriptive statistics about the study subjects were generated. In testing the first hypothesis, the percentage of manufacturers/suppliers reporting producing/supplying reduced-weight cement bags was calculated and tested if significantly different from zero at the 5% level of significance. The second hypothesis was tested by calculating the manufacture/supply average percentage of reduced-weight cement bags and using the normal distribution to test if it is significantly different from zero ($\alpha < 0.05$). A similar analysis was employed in testing the third hypothesis, the average percentage of reduced-weight bags utilized by contractors and mason tenders, which was calculated and tested if significantly different from zero ($\alpha < 0.05$). A one-tailed test was employed in testing all hypotheses.

2.4.2. Qualitative data. The responses regarding the barriers in usage of reduced-weight cement bags and suggestions to overcome such barriers were grouped according to common causes and their importance. They were presented in terms of relative frequency.

3. RESULTS

3.1. Production/Supply/Usage of Reduced-Weight Cement Bags

The study participants were asked if they produce/supply/use 47 lb cement bags, and if they answered yes, they were asked to reveal in what percentage. They had to choose from <5% (considered *poor*), 5–10% (considered *less than satisfactory*), 10–30% (*satisfactory*), and 30–50% and >50% (*good*).

TABLE 1. Frequency and Percentage for the Companies That Produce/Supply/Use 47 lb Cement Bags

		No production 0%	Poor production <5%	Less than satisfactory 5–10%	Satisfactory 10–50%	Good >50%	Total
Production companies	a	9	3	1	1	0	14
	b	19.57	6.52	2.17	2.17	0	30.43
	c	64.29	21.43	7.14	7.14	0	
	d	23.68	100	50.00	50.00	0	
Supply companies	a	26	0	0	0	0	26
	b	56.52	0	0	0	0	56.52
	c	100.00	0	0	0	0	
	d	68.42	0	0	0	0	
End users	a	3	0	1	1	1	6
	b	6.52	0	2.17	2.17	2.17	13.04
	b	50.00	0	16.67	16.67	16.67	
	d	7.89	0	50.00	50.00	100	

a. Frequency of companies that produce/supply/use reduced-weight cement bags; b. Percentage related to total number of companies; c. Percentage related to row (producers, suppliers, or users); d. Percentage related to column (the quantity of small bags that are produced, supplied, used).

The results are presented in Table 1. As shown, from the total of 46 companies, only 17.39% (95% CI 0.06–0.28) produce/supply/use reduced-weight cement bags. This percent is significantly different from zero. Only 5 producers (35.71% from the total of 14 production companies) interviewed produce 47 lb cement bags and only in small quantities (3 less than 5%, 1 between 5–10%, and 1 between 10–30%). None of the supplying companies have reduced-weight cement bags in their inventory. From the end users, only 3 companies (50% of the contractors) interviewed were using small bags; one of the companies uses between 5–10% from the total quantity of cement, another between 10–30%, and another uses 100% reduced-weight cement bags.

3.2. Factors Influencing the Usage of Reduced-Weight Cement Bags

The companies were interviewed about the factors that may influence their decision in producing/supplying/using 47 lb cement bags.

Table 2 summarizes the factors mentioned by the production companies. The factors considered in the questionnaire were reduced market demand, increased cost, difficulty in storing and handling, shipping problems, necessity of special equipment, special packing, and different production process. From these factors, only the reduced market demand had a high percentage of agreement over the companies (77.8%). The smallest agreement was met by the difficulty in the storing factor (6.7%) and difficulty in handling (7.1%).

Table 3 summarizes the factors that influence the supplying companies in their decision to commercialize large-weight cement bags. The factors enumerated by the questionnaire were limited market demand, limited production, increased price of reduced-weight bags, difficulty in storage and handling, shipping problems, requirement of special equipment, and packaging. From all these factors, the higher percentage of the agreement was met

TABLE 2. Factors Influencing the Production/Nonproduction of Reduced-Weight Cement Bags

		Little demand	Expensive	Difficult to store	Different production process	Shipping problems	Difficult to handle	Require special equipment	Special packaging
Count	Disagree	4	7	13	7	11	12	8	7
	Agree	14	7	1	5	4	1	4	6
	Not sure	0	3	1	3	0	1	2	1
	Total	18	17	15	15	15	14	14	14
Frequency	% Disagree	22.2	41.2	86.7	46.7	73.3	85.7	57.1	50.0
	% Agree	**77.8**	**41.2**	**6.7**	**33.3**	**26.7**	**7.1**	**28.6**	**42.9**
	% Not sure	0.0	17.6	6.7	20.0	0.0	7.1	14.3	7.1

Note. Across all producers/suppliers/users.

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TABLE 3. Factors Influencing the Supplying of Large-Weight Cement Bags

		Limited demand	Limited production	More expensive	Difficult to store	Shipping problems	Difficult to handle	Require special equipment	Special packaging
Count	Disagree	1	4	5	8	9	8	10	9
	Agree	11	6	6	3	2	3	1	1
	Not sure	1	2	1	0	0	0	0	1
	Total	13	12	12	11	11	11	11	11
Frequency	% Disagree	7.7	33.3	41.7	72.7	81.8	72.7	90.9	81.8
	% Agree	**84.6**	**50.0**	**50.0**	**27.3**	**18.2**	**27.3**	**9.1**	**9.1**
	% Not sure	7.7	16.7	8.3	0.0	0.0	0.0	0.0	9.1

Note. Across all producers/suppliers/users.

TABLE 4. Factors Influencing the Usage of Large-Weight Cement Bags

		Increases savings	Availability	Saves time	Increases productivity
Count	Disagree	5	6	5	4
	Agree	10	7	6	5
	Not sure	1	2	4	6
	Total	16	15	15	15
Frequency	% Disagree	31.3	40.0	33.3	26.7
	% Agree	**62.5**	**46.7**	**40.0**	**33.3**
	% Not sure	6.3	13.3	26.7	40.0

Note. Across all producers/suppliers/users.

by the limited market demand (84.6%) and the smallest percentage by the requirement of special equipment and packaging (9.1%).

Table 4 summarizes the factors that may influence contractors to use large-weight cement bags. These factors are increased savings, availability on market, time savings, and increasing productivity. The highest percentage of agreement was met by the increased savings factor (62.5%).

In addition to these factors, the companies mentioned a few extra factors that can influence the usage of reduced-weight cement bags, such as nonexistence of any Occupational Safety and Health Administration (OSHA) requirements to use small bags, simplifying the inventory, increasing the usage of ready mix in detriment of Portland cement, reduced quantity of trash, ASTM specifications on how to mix, and difficulty in training workers in something new.

3.3. Producer/Supplier/User Suggestions to Increase the Volume of Reduced-Weight Cement Bags Used

The final question from the survey was "What do you think can be done to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags?" Only 19 companies interviewed answered this question. Their answers can be summarized into the following suggestions: (a) an increased market demand (4 of 19 companies); (b) to diminish the price for reduced-weight cement bags (2 of 19); (c) to provide incentives to the producers to produce small bags (4 of 19); (d) to make more available on the market (4 of 19); (e) to educate people on health risks/benefits (4 of 19); (f) to train people on manual lifting procedure (2 of 19); and (g) to make it OSHA required (3 of 19).

3.4. NIOSH Recommendations

As we mentioned in the introduction, NIOSH recommend that the maximum manual lifted weight should be 51 lb (23 kg). As our survey showed, only 17.39% of the companies interviewed use reduced-weight cement bags; the rest of the sample uses the 94 lb cement bags. When asked "Are you aware that the practice of lifting full-sized bags is considered hazardous and exceeds the NIOSH lifting recommendation?" only 7 companies (15%) answered the question, from which only 5 companies (11%) answered yes. This shows that

the producers/suppliers/users of Portland cement may not know the "basic" risk factors that can produce MSD, such as manual material handling of materials that are over the recommendation limits.

4. DISCUSSION

Construction is the oldest and most conservative industry where work is still physically straining (Koningsveld & van der Molen, 1997). Musculoskeletal disorders among certain construction workers have been extensively studied, but research among mason tenders is limited (Goldsheyder et al., 2002).

The work of mason tenders includes mortar mixing; supplying of bricks, blocks, mortar and other construction materials; construction and repair of highways, bridges, cement and concrete works; and asbestos and hazardous waste remediation. Up to 90% of their tasks involve manual handling of different construction materials, work equipment, and tools, including frequent lifting, pushing, pulling, carrying, bending, and kneeling. As part of their job, mason tenders lift 94 lb cement bags and place them in the mixer. The total number of this type of lifting may exceed 100 every day (Goldsheyder et al., 2002).

A study of mason tenders revealed that 82% of them experienced at least one musculoskeletal symptom in one year, with lower back pain being the most frequently reported problem (Goldsheyder, Weiner, Nordin, & Hiebert, 2004). Mason tenders considered awkward bending and twisting as the most stressful activities. The study revealed that 11% of the mason tenders had apprentice training. The lack of training, especially when most time is spent lifting heavy weights, may be a high contributor in development of MSD. The majority of workers reported a high interest in learning about safety, health, and prevention of musculoskeletal disorders. The study presented in this article revealed that the majority (83%) of the companies involved in work with cement (producers, suppliers, contractors), produce/supply/use only 94 lb cement bags. Only 17% of the companies interviewed produce/supply/use 47 lb cement bags. This means that only 1 in 6 companies produce/supply/use reduced-weight cement bags, a very small ratio. The percentage of reduced-weight cement bags used is under 30%.

The study participants enumerated several factors that influence them to use large-weight cement bags. These factors are related to economic variables. The producers consider that the production of reduced-weight cement bags is more costly than the production of large-weight cement bags. This is due to the fact that they need different equipment to pack smaller bags, that is, they have to invest in new equipment. The larger bags are less costly relative to the smaller bags, and the time to fill a larger bag is shorter compared with the time needed to fill two smaller bags.

From the suppliers' point of view, the commercialization of reduced-weight cement bags is more costly. They considered that the reduced-weight bags will take more space for storage and will need special equipment for handling. They were also concerned that the reduced-weight cement bags will be more costly when bought from the producers.

The contractors use the large-weight cement bags because they save time, that is, it takes less time to handle a large bag relative to two smaller bags; large bags increase productivity and savings.

Collectively, the aforementioned factors point to the demand and availability of reduced-weight bags. The contractors reiterated that they do not use reduced-weight cement bags because they are not available in the suppliers' warehouses. The suppliers pointed out that the reduced-weight cement bags are not in high demand; therefore, they do not order them

from the producers. Last, the producers do not manufacture the bags because there is no high demand.

None of the companies take into account the worker-related factors. Only five companies answered positively when asked if they are aware that NIOSH recommends the maximum lifted weight to be 51 lb. According to Mital, Nicholson, and Ayoub (1993), only 10% of the male population has the capacity to lift 59.4 lb safely, even if it is one lift during an 8-hour shift. Since the majority of the companies use 94 lb cement bags, this means that their employees are at great risk of developing MSD due to lifting heavy weights.

The results of the survey may suggest that it is immediately necessary to implement intervention to ensure the workplace health and safety of workers. These interventions can be classified into design and administrative (Workplace Health and Safety, Queensland, 2001). The design interventions are preferred because they can provide a long-term solution that may prevent or minimize the risk. The following design interventions may be considered: (a) mechanization of job by using mechanical handling equipment that can eliminate manual lifting and carrying; (b) load redesign by substituting 94 lb cement bags with 47 lb cement bags; (c) task redesign, which may include replacing bagged products with a bulk purchase and handling system and planning the work to minimize the manual handling of cement bags; (d) change of storage design by locating the weights as close as possible to where they will be used; and (e) modification of the work area by maintaining clear access to the area where the cement bags may be used so the workers do not have to twist or bend during lifting. On the other hand, administrative interventions may include: (a) changing the task order by intercalating the heavy handling tasks with lighter tasks; (b) rest breaks during which the workers can rest for a few minutes; and (c) specific training and supervision of workers (including appropriate lifting techniques and the use of correct mechanical aids).

This exploratory study may be limited by a number of factors, including the way the survey was conducted (over the phone) and the selection of subjects asked to participate in the study (there were only four companies used from metropolitan areas). Since this is a pilot study, the number of companies involved is relatively small (46 producers/suppliers/users). Also, the number of subjects grouped by company is very small (14 producers, 26 suppliers, 6 contractors). This is why the confidence interval was calculated across all companies.

Following the results from this observational exploratory study, it is recommended that a full-scale study be done so the actual findings can be verified. The next study should include a larger number of companies and different methods of collecting data, and also the involvement of the workers.

5. CONCLUSIONS

The findings of the reduced-weight Portland cement bags questionnaire revealed that a large proportion of the companies produce/supply/use large-weight cement bags. The implied results suggest that the workers from these companies are at an increased risk of MSD and there is an urgent need to implement interventions that can reduce the risk of developing MSD.

Concerning OSHA efforts to identify and address workplace safety and health hazards, primary prevention plays an important role (Goldsheyder et al., 2002). Primary interventions include reducing external loads, matching the physical demands of the job with the physical capabilities of the individual, improving organizational factors, and improving individual skills (NRC and IM, 2001). The ergonomic interventions provide a set of strategies and innovative models that can help to prevent work-related MSD (NRC and IM, 2001).

APPENDIX A

Reduced-Weight Portland Cement Bags Contractor Questionnaire

Interviewer's Name:_____ Date: / /2006
Company Name:_____ Duration Company in Business:_____
Person Interviewed Name:_____ Job title: _____
Duration with the company:_____

1- Does your company employ mason tenders (i.e. laborers, helpers, assistants)?
Yes No
2- Does your company use reduced-weight (47 lb) Portland cement bags?
Yes No
If "No" skip to question number 4.
3- In relative terms, what is the percentage of reduced-weight bags (47 lb) used by your company when compared to full-weight bags (94 lb)?
<5% 5–10% 10–30% 30–50% >50%
4. a- Different factors may favor you to [follow the above practice, e.g., use more of reduced-weight bags (47 lb) than the full-weight bags (94 lb)]. Please indicate if you agree or disagree with each of the following statements:
We [follow the above practice]

- Because it increases savings	Agree	Disagree
- Because of the availability	Agree	Disagree
- Because it saves time	Agree	Disagree
- Because it increases productivity (more bricks laying per hour)	Agree	Disagree

4. b- Apart from savings, availability, time, and productivity; what other reasons, if any, are behind such practice?
5. a- Cement suppliers stock more full-weight bags (94 lb) than reduced-weight bags (47 lb). Based on your experience, please indicate if you agree or disagree with each of the following statements:
Cement suppliers stock more full-weight bags than reduced-weight bags because:

- There is limited demand for reduced-weight bags	Agree	Disagree
- There is limited production of reduced-weight bags	Agree	Disagree
- Reduced-weight bags are more expensive	Agree	Disagree
- Reduced-weight bags are more difficult to store	Agree	Disagree
- Reduced-weight bags cause more shipping problems	Agree	Disagree
- Reduced-weight bags are more difficult to handle	Agree	Disagree
- Reduced-weight bags require special equipment	Agree	Disagree
- Reduced-weight bags require special packaging	Agree	Disagree

5. b- Apart from demand, supply, cost, storage, shipping, handling, equipment, and packaging issues, what other reasons, if any, lead cement suppliers to stock more full-weight bags (94 lb) than reduced-weight bags (47 lb)?

6. a- Like cement suppliers, cement manufacturers provide more full-weight bags (94 lb) than reduced-weight bags (47 lb). Please indicate if you agree or disagree with each of the following statements:

Cement manufacturers provide more full-weight bags than reduced-weight because:

- There is limited demand for reduced-weight bags	Agree	Disagree
- Production of reduced-weight bags is more expensive	Agree	Disagree
- Reduced-weight bags are more difficult to store	Agree	Disagree
- Reduced-weight bags require a different production process	Agree	Disagree
- Reduced-weight bags cause more shipping problems	Agree	Disagree
- Reduced-weight bags are more difficult to handle	Agree	Disagree
- Reduced-weight bags require special equipment	Agree	Disagree
- Reduced-weight bags require special packaging	Agree	Disagree

6. b- Apart from demand, cost, storage, production process, shipping, handling, equipment, and packaging, what other reasons, if any, are behind cement manufacturers providing more full-weight bags (94 lb) than reduced-weight bags (47 lb)?

7- Are you aware that the practice of lifting full-sized bags is considered hazardous and exceeds the NIOSH lifting recommendation? Yes No

8- Do you think it is worthwhile trying to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags? Yes No

9- What do you think can be done to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags?

Reduced-Weight Portland Cement Bags Production Questionnaire

Interviewer's Name:_____ Date: / /2006

Company Name:_____ Duration Company in Business:_____

Person Interviewed Name:_____ Job title: _____

Duration with the company:_____

1- Does your company produce reduced-weight (47 lb) Portland cement bags?

Yes No

If "No" skip to question number 3.

2- In relative terms, what is the percentage of reduced-weight bags (47 lb) produced by your company when compared to full-weight bags (94 lb)?

<5% 5–10% 10–30% 30–50% >50%

3. a- Different factors may favor your company to [follow the above practice, e.g.,manufactures more full-weight bags (94 lb) than reduced-weight bags (47 lb)]. Please indicate if you agree or disagree with each of the following statements:

Interviewer:

If the company produces more of the reduced-weight bags, then in ALL the following questions replace "reduced-weight" with "full-weight."

We produce less reduced-weight bags because:

- There is limited demand for reduced-weight bags	Agree	Disagree
- Production of reduced-weight bags is more expensive	Agree	Disagree
- Reduced-weight bags are more difficult to store	Agree	Disagree
- Reduced-weight bags require a different production process	Agree	Disagree
- Reduced-weight bags cause more shipping problems	Agree	Disagree
- Reduced-weight bags are more difficult to handle	Agree	Disagree
- Reduced-weight bags require special equipment	Agree	Disagree
- Reduced-weight bags require special packaging	Agree	Disagree

3. b- Apart from demand, cost, storage, production process, shipping, handling, equipment, and packaging, what other reasons, if any, favor your company to provide more full-weight bags (94 lb) than reduced-weight bags (47 lb)?
4. a- The use of full-weight bags (94 lb) is more common than reduced-weight bags (47 lb) among mason contractors. Based on your experience, please indicate if you agree or disagree with each of the following statements:

Mason contractors use more full-weight bags than reduced-weight bags:

- Because it increases savings	Agree	Disagree
- Because of the availability	Agree	Disagree
- Because it saves time	Agree	Disagree
- Because it increases productivity (more brick laying per hour)	Agree	Disagree

4. b- Apart from savings, availability, time, and productivity; what other reasons, if any, are behind such practice?
5. a- Like cement manufacturers, cement suppliers stock more full-weight bags (94 lb) than reduced-weight bags (47 lb). Please indicate if you agree or disagree with each of the following statements:

Cement suppliers stock more full-weight bags than reduced-weight bags because:

- There is limited demand for reduced-weight bags	Agree	Disagree
- There is limited production of reduced-weight bags	Agree	Disagree
- Reduced-weight bags are more expensive	Agree	Disagree
- Reduced-weight bags are more difficult to store	Agree	Disagree
- Reduced-weight bags cause more shipping problems	Agree	Disagree
- Reduced-weight bags are more difficult to handle	Agree	Disagree
- Reduced-weight bags require special equipment	Agree	Disagree
- Reduced-weight bags require special packaging	Agree	Disagree

5. b- Apart from demand, supply, cost, storage, shipping, handling, equipment, and packaging issues, what other reasons, if any, lead cement suppliers to stock more full-weight bags (94 lb) than reduced-weight bags (47 lb)?
6- Are you aware that the practice of lifting full-sized bags is considered hazardous and exceeds the NIOSH lifting recommendation? Yes No
7- Do you think it is worthwhile trying to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags? Yes No

8- What do you think can be done to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags?

5.1. Reduced-Weight Portland Cement Bags Supply Questionnaire

Interviewer's Name:_____ Date: / /2006
Company Name:_____ Duration Company in Business:_____
Person Interviewed Name:_____ Job title: _____
Duration with the company:_____

1- Does your company supply reduced-weight (47 lb) Portland cement bags?
Yes No
If "No" skip to question number 3.
2- In relative terms, what is the percentage of reduced-weight bags (47 lb) supplied by your company when compared to full-weight bags (94 lb)?
<5% 5–10% 10–30% 30–50% >50%
3. a- Different factors may favor your company to [follow the above practice, e.g., stock more full-weight bags (94 lb) than reduced-weight bags (47 lb)], please indicate if you agree or disagree with each of the following statements:
Interviewer:
If the company supplies more of the reduced-weight bags, then in ALL the following questions replace "reduced-weight" with "full-weight."
We stock less reduced-weight bags because:

- There is limited demand for reduced-weight bags	Agree	Disagree
- There is limited production of reduced-weight bags	Agree	Disagree
- Reduced-weight bags are more expensive	Agree	Disagree
- Reduced-weight bags are more difficult to store	Agree	Disagree
- Reduced-weight bags cause more shipping problems	Agree	Disagree
- Reduced-weight bags are more difficult to handle	Agree	Disagree
- Reduced-weight bags require special equipment	Agree	Disagree
- Reduced-weight bags require special packaging	Agree	Disagree

3. b- Apart from demand, supply, cost, storage, shipping, handling, equipment, and packaging issues, what other reasons, if any, led your company to stock more full-weight bags (94 lb) than reduced-weight bags (47 lb)?
4. a- The use of full-weight bags (94 lb) is more common than reduced-weight bags (47 lb) among mason contractors. Based on you experience, please indicate if you agree or disagree with each of the following statements:
Mason contractors use more full-weight bags than reduced-weight bags:

- Because it increases savings	Agree	Disagree
- Because of the availability	Agree	Disagree
- Because it saves time	Agree	Disagree
- Because it increases productivity (more brick laying per hour)	Agree	Disagree

4. b- Apart from savings, availability, time, and productivity; what other reasons, if any, are behind such practice?
5. a- Like mason contractors, cement manufacturers provide more full-weight bags (94 lb) than reduced-weight bags (47 lb), please indicate if you agree or disagree with each of the following statements:

Cement manufacturers provide more full-weight bags than reduced-weight because:

- There is limited demand for reduced-weight bags	Agree	Disagree
- Production of reduced-weight bags is more expensive	Agree	Disagree
- Reduced-weight bags are more difficult to store	Agree	Disagree
- Reduced-weight bags require a different production process	Agree	Disagree
- Reduced-weight bags cause more shipping problems	Agree	Disagree
- Reduced-weight bags are more difficult to handle	Agree	Disagree
- Reduced-weight bags require special equipment	Agree	Disagree
- Reduced-weight bags require special packaging	Agree	Disagree

5. b- Apart from demand, cost, storage, production process, shipping, handling, equipment, and packaging, what other reasons, if any, are behind cement manufacturers providing more full-weight bags (94 lb) than reduced-weight bags (47 lb)?
6- Are you aware that the practice of lifting full-sized bags is considered hazardous and exceeds the NIOSH lifting recommendation? Yes No
7- Do you think it is worthwhile trying to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags? Yes No
8- What do you think can be done to minimize the use of full-weight bags and ultimately promote the use of reduced-weight bags?

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