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Construction glass and glazing job description: a qualitative case study

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Construction workers regularly experience heavy workloads and various physical stressors that can result in work-related musculoskeletal disorders (WRMSDs). According to the Bureau of Labor Statistics, construction glass and glazing (CGG) workers had a higher rate of injuries and illnesses than the national average for all occupations. In 2010, CGG contractors presented the highest rate of back injuries reported by the Center for Construction Research and Training. This study aimed to develop a detailed job description that includes the CGG definition, tasks, activities and work conditions. A qualitative case study was conducted, and data were collected through CGG workers' interviews and observations. This information is not currently available in government publications, published research or job training materials for CGG workers and contractors. The results of this study can help facilitate the ergonomics analysis in future studies to eliminate or reduce the risk of WRMSDs in CGG work.

Keywords: construction; glass and glazing work; job description; qualitative study; case study

1. Introduction

Construction workers regularly experience heavy workloads and various physical stressors that can result in debilitating work-related musculoskeletal disorders (WRMSDs) of the upper extremities as well as lower back discomfort, pain and injury. In 2015, the incident rate of WRMSDs in the construction industry was 34.6 per 10,000 full-time employees (FTEs) compared to a rate of 32.2 per 10,000 FTEs for all industries combined [1]. Construction glass and glazing (CGG) workers had a higher rate of injuries and illnesses than the national average for all occupations [2]. In 2010, CGG contractors reported the highest rate of back injuries, 97.8 per 10,000 FTEs, followed next by masonry contractors with 45.3 per 10,000 FTEs [3]. However, the ergonomics risks of this trade have not yet been adequately investigated. To conduct an ergonomics job analysis of this trade, a detailed work task analysis including CGG tasks, detailed work activities and work context was needed.

A literature search was performed to find a CGG detailed work task analysis. The Occupational Information Network (O*NET) website provided some information that was not enough to conduct an ergonomics job analysis. According to the O*NET [4] job description, glass and glaziers install glass in windows, skylights, storefronts and display cases, or on surfaces, such as building fronts, interior walls, ceilings and tabletops. The purpose of this study was to provide a job description for common CGG work to support future ergonomics analysis of this trade; in

other words, the purpose was to answer what it means to be a CGG worker. Job descriptions can take many forms, but they typically have at least four parts: a job summary, a list of job functions, a requirements section and other information such as working hours, travel requirements, etc. [5]. The results of this study provided an accurate job description and a list of job tasks in the CGG trade. This valuable construction information is not currently available in government publications, published research or job training materials for glass and glazing workers and contractors. The results of this study can help facilitate the ergonomics analysis in future studies to eliminate or reduce the risk of back injuries in CGG work.

2. Study design and approach

A literature search was performed to decide about the study type, approach, design and data collection sources. According to Creswell [6], qualitative research begins with assumptions, a worldview, the possible use of a theoretical lens and the study of research problems inquiring into the meaning that individuals or groups ascribe to a social or human problem. The final written report or presentation includes the voices of participants, the reflexivity of the researcher and a complex description and interpretation of the problem, and it extends the literature or signals a call for action. Qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds and what meaning they attribute to

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their experiences [7]. Glesne [8,p.283] defines ‘A type of research that focuses on qualities such as words or observations that are difficult to quantify and lend themselves to interpretation or deconstruction’. This study was purposed to gain deep, rich and detailed descriptions of glass and glazing jobs by encouraging individuals to share their stories. Words and pictures, rather than numbers, were used to convey research/data, so qualitative research was the best fit.

There are numerous qualitative approaches cited by different scholars. However, five approaches have more frequently appeared over the years. These approaches are narrative, phenomenology, grounded theory, ethnography and case study [6,9–12]. Creswell [6] defines case-study research as a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audio-visual material, and documents and reports), and reports a case description and case themes. The unit of analysis in the case study might be multiple cases (a multisite study) or a single case (a within-site study). This definition was well matched with this study purpose, which was an in-depth study of the CGG trade.

Although conducting multiple studies can be helpful to show different perspectives of the same problem, the more cases in an individual study, the less the depth in any single case [6]. Yin [13], on the other hand, recommends conducting multiple case studies over single case studies to increase understanding of the variety of contextual situations affecting the issue. Qualitative analysis methods research recommends that it is best to limit the number of cases or case organizations to no more than four or five single studies [6]. The type of design for this case-study research was multiple-case (embedded) design. The study research cases were construction sites and the units of analysis were CGG supervisors and workers.

3. Materials and methods

3.1. Institutional Review Board approval and recruitment process

A research proposal was submitted to the University of Nebraska Institutional Review Board (IRB) in December 2016 and approved in September 2017 (IRB No. 20170216717EX). An online search was conducted to find glass and glazing companies in Nebraska who could be recruited to participate in the research project. Ayars & Ayars (Lincoln [NE]) helped the research team and provided support by contacting construction glass and glazing companies in Nebraska via email and telephone call(s), to inform them about the opportunity to participate in this research study and recruit participants. Participation in this study was voluntary and we targeted small to

medium-sized companies located in Lincoln and Omaha because this size range is most common in the state of Nebraska. The study geographical location of the Lincoln and Omaha urban areas contain approximately 40% of the state’s population [14]. Five CGG companies agreed to participate and sent their letters of support to the research team: City Glass Company (Omaha; 70–75 employees), Bil-Den Glass (Omaha; ±56 employees), Keystone Glass Company (Omaha, 51 employees), Glass Edge (Lincoln; ±45 employees) and Lincoln Glass (29 employees). Thirty volunteer CGG supervisors/workers were recruited for this study from the interested construction glass and glazing companies. The CGG companies that supported our project were not unionized. The construction glass and glazing companies provided employee candidates from all skill levels of their team of construction field glaziers and supervisors/managers for job task interviews. The construction glass and glazing companies allowed work site observations for as long as the research team needed to do their ergonomics evaluation.

To address the ethical issues for our study, all researchers completed the Collaborative Institutional Training Initiative (CITI) training as required by the University of Nebraska IRB. Participants in the research would benefit from their research participation both directly and indirectly. Directly, each participant received a gift card valued around USD 25 in appreciation of his participation. The purpose of the case study after developing a job description for construction glass and glazing work was to study the underlying reason(s) for high rates of back injuries among these workers (ergonomics analysis) and it was hoped to increase the participants’ knowledge about their job and work-related risks that they may encounter in the workplace, an indirect benefit.

All interview sessions were recorded with the interviewee’s explicit permission. In order to protect our research participants during the data collection and data analysis processes, all names and locations were kept anonymous by using pseudonyms. All materials were kept confidential and secured in a locked filing cabinet, and digital files were stored on password-protected computers accessible only to the research project investigators. The research project investigators have access to the participants’ information and interviews. The files will be destroyed according to the University’s IRB protocol 10 years following completion of the project.

3.2. Data collection process

Case-study researchers usually use multiple sources of data collection; this strategy enhances data credibility [13,15]. Potential data sources may include, but are not limited to, documentation, archival records, interviews, physical artifacts, direct observations and participant observation [13,16,17]. Interviewing the participants is the most common form of data collection [7,16] and is defined

as a process in which a participant and a researcher are engaged in a focused conversation on questions related to the research study [15]. There are different types of interviews, including structured/standardized, semi-structured and unstructured/informal [7]. The semi-structured interview with open-ended questions was chosen to collect data. Tape-recording the interview is an option to avoid losing data by verbatim transcription of recorded interviews [7]. All interviews were recorded with the participant's permission. CGG tasks, descriptions, detailed work activity, work context, required skills, experience, education, tools and technology were collected through supervisors' and workers' interviews.

Observation is another key tool for collecting data in qualitative research [6]. In direct observation, researchers make a field visit to the case-study 'site' and witness the behavior in the first person [13]. Observational evidence is often useful in providing additional information about the topic being studied [16]. Site observations were scheduled to collect information about the CGG trade. Different stages of glass and glazing jobs and related operations for each stage were obtained from managers/supervisors and workers on site.

The purpose of this qualitative research was to define CGG workers, so purposeful sampling was used in our case-study research. Deciding on the type of purposeful sampling, a combination of maximum variation and criterion sampling was chosen. Fulfilling the participation criteria, any English-speaking construction glass and glazing employee who was 19 years of age or older was eligible to participate in this study. Informed consent needed to be signed by each participant who was willing to participate.

Creswell [6] suggested not including more than four or five case studies in a single study. Five construction glass and glazing companies participated in this study. According to the Bureau of Labor Statistics (BLS) employment-population data, Nebraska had 400 glazing workers in May 2016. We selected a common sample size of $N = 30$ and then calculated the marginal error for this sample size based on a total glazing worker population of approximately 400 [1]. Using the Yamane formula [18], the marginal error for this sample size and the population was 9% with a confidence interval of 95%. Data were collected through the interview participation of construction glass and glazing managers/supervisors and workers. For each CGG company, the aim was to collect data from one manager/supervisor and five workers.

Volunteer managers/supervisors from participating CGG companies were interviewed to provide a job description for construction glass and glazing (construction glass and glazing project managers and supervisors job description questionnaire). Each participant was interviewed for 15–40 min. The questionnaire included 11 open-ended questions and asked about the managers'/supervisors' job

title, the specialty of the company, job categories, essential job functions for each glass and glazing worker job category, training opportunities, required education, skills, experience and certificates.

Company managers/supervisors helped us to recruit construction glass and glazing workers. Further information was gathered from workers who participated voluntarily in interview sessions (construction glass and glazing workers job description questionnaire). The questionnaire included 12 open-ended questions that were designed to discuss the worker's job title, years of experience, working condition/environment, job tasks, tools, required education, skill, experience, certificates and training. *The Job Description Handbook* [5] was the main source to design questionnaires. Each interview lasted approximately 15–40 min per worker. These questionnaires were completed in person with audio-recording.

A pilot study (four interviews) was conducted to examine the feasibility of the approach that was intended to be used in a larger-scale study. Participants' ideas were asked regarding interview questions and the process. A total number of 30 CGG participants were interviewed, including four presidents/owners/managers, one operations manager and subsafety, human resource administrator, two superintendents, two supervisors, four glazing lead/foremen, 16 field glaziers and one service technician, in 16 sessions. Some participants had glazing experience before starting their job in a glass and glazing company, some of them had construction backgrounds in jobs such as painter, carpenter, house builder, house remodeler, mason, framer or roofer and some came from other trades without construction/glazing experience including auto mechanics, tile delivery and grocery store employee. Average years of work experience was 14.39 years (minimum, 10 months; maximum, 32 years).

4. Results

Both qualitative and quantitative analysis of data was performed. All data collected from the interview sessions were analyzed using the qualitative features of MAXQDA Analytics Pro version 12. MAXQDA is a world-leading software package for qualitative and mixed-methods research which gives researchers the freedom to analyze an increasingly diverse range of data types [19]. The recorded interview sessions were imported to the MAXQDA software, transcribed and coded. In the context of qualitative research, a code is more of a label used to name phenomena in a text or an image. In technical terms, a code is a character string that can consist of up to 63 characters in MAXQDA, be it several words or more cryptical strings like 'CR128' [19]. The interview scripts were coded to a better understanding of CGG work by providing a detailed job description. A total number of 2944 segments were coded. An example of the code system with the total number of codes in each section is presented in Figure 1.

Code System	2944
Interviewees' Info	386
Date	30
Interviewee Number	30
Years of Experience	26
Job Title/Category	300
Safety Manager	1
Field Crew/Glazier	27
Apprentice	28
Foreman/Lead Man	43
Job Function	2
Apprentice Job Function	6
Foreman/Leadman Job Function	20
.....	
Project/Job Info	396
Type of Project	42
Type of Jobs	121
Work Schedule	21
Job Location	24
Working Condition/Environment	47
.....	
Glazier's Definition	36
Requirements	527
Job Requirement	6
Educational Requirement	69
Certificate/Licence/Training Program	82
.....	
Injury/Discomfort/Posture Experience	157
Cuts	21
Wrist Soreness	2
Back Injury/Discomfort	48
Shoulder Pain	25
.....	
Equipment	716
Machinery/Equipment	82
Hand tools	210
Powered Equipment	164
Personal Protective Equipment	244
Work boots, steel toe boots	18
Harness	43
Comfortable?	24
.....	
Job Tasks	409
Curtain Wall	70
Manual Materials Handling	1
Loading	0
Carrying	1
Lifting Frame	0
Carrying Frame	0
Frame Installation	12
Glass Installation	10
Finishing Jobs	13
Storefront	37
Doors	54
.....	

Figure 1. Code system.

As a result, the construction glass and glazing operations, tasks, activities and all required experiences, skills and certificates were determined.

The CGG companies' projects were mostly commercial (universities, schools, office building, shopping center, malls, hospitals, small street malls, skylight, trophy case) and some residential. Interview-reported types of jobs were as follows: storefront, curtainwall, doors/automatic door operators, aluminum metal paneling, window, interior glass and framing, fish tanks, aquariums, handrails,

mirrors, tabletops, showers, closets, sneeze guards, handicap operators, skylights, sunshades and glass replacement. Regarding glaziers' work schedules, participants reported that they usually work 8 h per day, 5 days a week, Monday through Friday, and for the most part 07:00–15:30 or 08:00–16:30 with 30-min lunch and two 15-min breaks, so 40 h per week. However, sometimes they need to work 9–10 h. There are times that they would work 7 days a week to stay ahead or stay caught up. It is rare to work on Sundays but not uncommon to work on Saturdays. Typically,

their jobs are in Lincoln (for companies located in Lincoln) and Omaha (for companies located in Omaha) but when there is not enough work in town they outsource. The Lincoln companies did projects in Omaha, Sioux City, Hastings, Grand Island, North Platte, Rapid City South Dakota, Chadron, Lyons at western Nebraska, Arapahoe, Sandhills, Fallbrook and Wayne. But, for the most part, work is usually within approximately a 60–70-mile radius. One company also worked in Kansas and Oklahoma. The companies located in Omaha performed the majority of their business in Omaha and Lincoln, with a little work outside that, approximately 3 or 4 h away. They did some projects in Iowa, Wayne and Wisner.

4.1. Construction glass and glazing worker definition

According to the O*NET [4] job description, glass and glaziers install glass in windows, skylights, storefronts and display cases, or on surfaces such as building fronts, interior walls, ceilings and tabletops.

CGG responsibilities are far beyond just setting glass, which is what many people think. Based on interviews, anybody who works for a glass company is a CGG worker whether he is installing glass or building frames. One interviewee mentioned that CGG workers are essentially taking business away from steelworkers because steelworkers used to do glazing work, which is fabricating and installing frames, and not necessarily the glass part of it. So the CGG workers are fabricators when they cut all of the metal to fabricate the frames and then install the frames on the job sites, later returning to install the glass and, finally, caulking around the entire perimeter of the system to make sure that is watertight, so glass is actually a small part of that process. They also engage in a great deal of manual materials handling (MMH) when loading and unloading materials. It could be a small project like a street shop, or a high-rise building where they use basket lifts, scissor lifts and heavy machinery to get to the required height. The following are direct quotes for CGG workers' definitions of glass and glazing work:

Glaziers, it's ... just kind of been lifelong name that ... people that handle glass are called glaziers ... I would say we are much more than people that set glass, we are craftsmen, you know fabricators, the installers, the glass installers, the caulkers.

I think they came up with the name glazier because back in the old days they used glazing compound instead of vinyl, so they call them glaziers.

I think the actual definition of glazier ... involves old storm windows and using putty and push pins. But I think the modern definition would be someone who installs commercial windows and doors and possibly residential windows, whether it be fixing them or installing them on a new house.

A lot of people think glaziers are all glass, we are a whole lot more metal than we are glass. It's so much more metal

other than it is glass, I've been doing this a long, back in the day it was a lot more glass and iron workers did a lot of the metal work.

I know that they classify this as laboring, but it is so much more than that, I mean it's absolutely ... I mean if you just take it a day and drive around town and look at some glass job, it's just, a labor job category can't do that. You know, there is just, there is some much more that goes into it and let you know it's an art.

The glazing trade as I know, the way I feel about it it's at one of the more specialized and talented skilled trades, it's finished work. I mean when you go by a building, it's one of the things that you see ... and it's skill work ... a lot of time we have been categorized under labor.

I am just trying to say there so much more to it. You just don't go install the glass; you know a lot of times that is the easy part is installing the glass.

4.2. Construction glass and glazing tasks

A list of CGG tasks was determined according to interviews and job task observations (Figure 2). The following questions were asked to determine the construction glass and glazing tasks:

- Construction glass and glazing project managers and supervisors questionnaire
 - What are the glass and glazing worker job categories/job titles in your company?
 - What are the essential job functions for each glass and glazing worker job category/job position in your company? Can you rank in order the essential job functions from most important to least important? If yes, please proceed.
- Construction glass and glazing workers questionnaire
 - What are your various job tasks? Describe a typical day in terms of your job tasks, work schedule, type of construction project and location.

Based on interviews and site observations, tasks were divided into two categories called 'general tasks' and 'job-specific tasks'. Job-specific tasks were those tasks that CGG workers performed as a result of their glass and glazing responsibilities while installing the frame and glass or performing finishing jobs and MMH. Drilling, screwing, hammering, caulking and carrying materials were examples of job-specific tasks. General tasks were not specific to the CGG job, e.g., holding material, walking and house-keeping. Figure 2 shows the CGG job tasks that were determined through interviews and job site observations.

4.3. Interview-reported construction site work conditions

Construction site work conditions (Table 1) were investigated by asking the participating field glaziers the

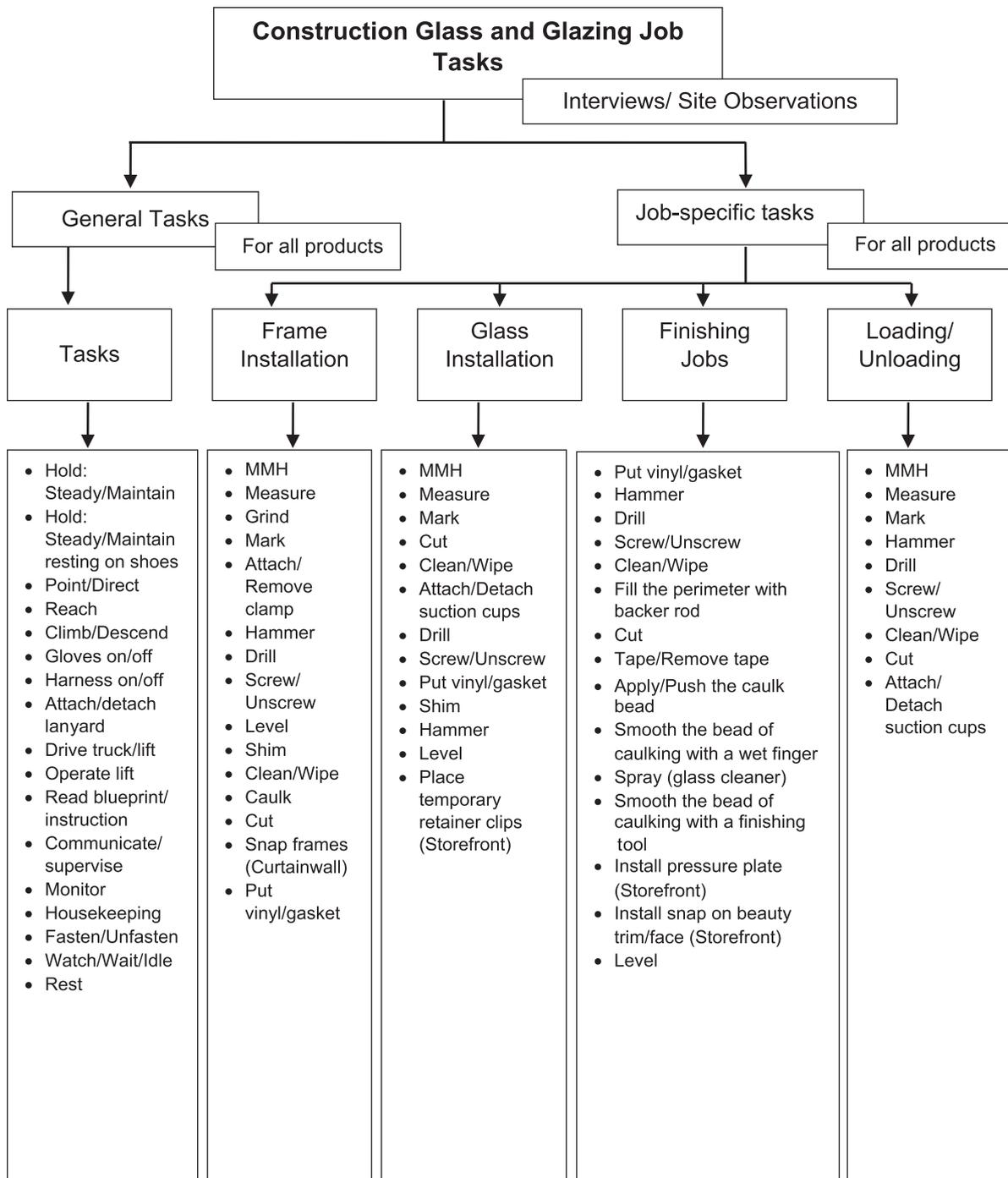


Figure 2. Interview reports and job task observations for construction tasks. Note: MMH = manual materials handling.

following question: what are the usual working conditions/working environments for your job?

According to the interviews, the conditions vary from job to job; some job sites are messy and congested, and some are wide open and clean, specially if glaziers come in toward the end of the projects when there are fewer people compared to the job in its beginning stages.

The following question helped to collect more data on the CGG trade: what types of hand tools, powered equipment and other things do you use in your job? Participants were also asked about personal protective equipment (PPE), and they also used the name of machinery/equipment in their response. Table 2 presents a summary of machinery, equipment and tools.

Table 1. Construction glass and glazing site conditions.

Work site condition	Participants' typical quote
Working outside	'Probably 90% of it', 'about 75% outside ...', '... most buildings 65–70% of the work is outside ...', 'outside I say probably 80% of the time', '70% of the time you are working outside ...'
Dealing with other contractors	'There are all kinds of other trades around ... a lot of other jobs are doing their job around us, so we got to, you know tiptoe around them, get over them, through them whatever we going to do work together'
Working around moving machinery	'... exposed to dust, fumes, and gases ...' 'We are always around drywall dust, concrete dust, tile dust, [and] people just sweeping the floor. I mean all kinds of dust'
Dealing with hot, dry, cold, windy, rainy, snowy, muddy and wet conditions	'We work through rain, sleet, and snow. It could be cold, really cold outside, and we'd still be working' 'The wind is the main thing we're going to go on the heat and the cold ...', 'It can get a little risky in that when it's wintertime and [you are] having to carry a glass, walking on snow and ice', 'Rainy days, the glass can get slippery ...'
Dealing with noise	'... noise comes from a lot of equipment including pouring concrete, moving dirt or testing fire alarms. Glaziers also create their own noise using hammer drills, impact drills, cordless drill, hammer, and different types of saws. Working up in the lifts while the engine is running make some noise as well ...'
Working at heights, working out of a boom lift, aerial lift, scissor lift or in a swing stage, or working on a scaffold or on a ladder	'... Anytime we are over 6 feet in the air we have to wear the harnesses or inside the equipment like a JLG or some sort of man lift ...', '... have to be certified to operate big lifts'

Table 2. Machinery, equipment and tools.

Equipment	Interview-reported list
Machinery	Forklift, scissor lift, man lift, aerial lift, JLG lift, boom lift, basket lift, Lull and company trucks
Hand tools	Bar hand tools: paddle shovel wedge packer, flat bar, pry bar and crowbar; Caulking tools: manual caulking gun, caulking knife/tooling knife, multifunction glazing knife and putty knife; Cutter/plier hand tools: utility knife, wire stripper, razor, plier and snip; Marking tools: chalk line, tape measure, marker/pencil and square; Miscellaneous hand tools: suction cup, hacksaw, vinyl roller, level, screwdriver, cleaning brush, Allen wrenches, clamp, hammer/mallet and glass installation hook tool
Powered tools	Drills: hammer drill, right angle driver, impact drill and regular cordless drill; Saws: SKILSAW, chop saw, Sawzall saw, contour saw, jig saw, miter saw, portable band saw, oscillating saw and circular saw; Other: battery-powered screw gun, battery-powered caulking gun, cut gun, nail gun, laser and grinder
Personal protective equipment	Head protection: hard hat; Eye and face protection: safety glasses and sunglasses; Hand/arm protection: gloves, rubber gloves, heavy rubber gloves, rubber-coated glove and gauntlets; Foot protection: steel toe boots, work boots, metatarsal guard and muck boots; Hearing protection: ear plug; Respiratory protection: mask; Fall protection: harnesses, lanyards, yoyos and ropes for swing stages; Protective clothing: sleeves, long sleeve shirt, short sleeve shirt, jeans, high-visibility collar, neck cover and high-visibility clothing

Regarding fall protection equipment, although some participants were comfortable wearing harnesses, some complained about it. Sometimes they got twisted up in the lanyard, sometimes they tripped over it and sometimes their leg got caught on it. Wearing the proper-size harness is important, which makes it somewhat uncomfortable because of tightness. Another issue mentioned was that some of these harnesses have too much padding to them so in the summer they get hot:

The new ones have like more stuff on them, they got a lot more pads and there is bulkier ... they just got me a new one, I prefer wearing my old one, it is lighter ... a lot of people don't like the new one.

Wearing a harness all day, I mean it's kind of weights on your shoulders, a bit.

Usually when we are in our harness, it feels good but then whatever we attached to us, it is always pulling against you.

It was uncomfortable because it's a constant pull on your back and sort of fighting that as you were moving around if you were working next to somebody, he has got one on too and sometimes you get your stuff crossed and whatnot. So, I recalled that being of not the most pleasant situations, but we were safe having those on.

Participants were asked about glass and glazing job requirements and qualifications, including educational requirements, certification and licensing, work experience, and job-specific skills and abilities. Participants' responses to these questions were summarized and presented in the job description for the construction glass and glazing trade.

4.4. Interview-reported employer provided job training opportunities

CGG managers/supervisors were asked what types of job training opportunities they have for their glass and glazing workers. Then, workers were asked how they were trained

to do their jobs. For all participating companies, once they hired a person and identified them as someone they would want to retain long term for the company, they provide not only on-the-job training but also obtain certifications to operate equipment, first aid certification or whatever they identify as an important certification for workers:

Trial and error and learn from the experienced guys.

I was 20 when I started, and I was in the fabrication department and so I was waxing screws and cutting a little piece of metal and learning from the ground up, how everything went and the older guy next to me was, had the wonderful privilege of training me.

Another type of training is that when installing a new system, they need to get a video or other material from the manufacturer; they would spend a couple of hours looking at the system. The 'National Glass Association (NGA)' and 'myglassclass.com' websites were mentioned as training websites:

For time to time, we will send some people that we feel are really in it for the long haul to classes as an example we sent four people to Texas to one of the manufacturers of the metal and they spent a week . . . four days of classes 8:00-16:30 learning the systems.

All participating companies have their safety meetings and toolbox talks regularly (quarterly, monthly), which cover fall protection, proper ways of lifting, proper ways to handle glass, proper ways to rack the scaffold, using ladders, using appropriate PPE, electrical safety, housekeeping, reviewing site injuries and different safety issues. Some companies also have everyday discussions before starting the job that covers what dangers may present that day, the tasks to be performed, what might happen and daily things around the site:

Our safety trainer is an OSHA [Occupational Safety and Health Administration] certified instructor so he is able to teach the OSHA 10-hour class and the OSHA 30-hour class which is a huge plus for us and he does that all the time, he is at job sites where he is making sure that our guys are working safely, If they are up high, they need to have a harness on, if they are above 6 feet they have to have harnesses on and be tied off . . . if you are setting glasses, you have to be wearing gloves . . . if you're using a ladder you need to be using it the right way, if you are using a hammer you need to be using it in the right way otherwise you can hurt yourself.

4.5. Construction glass and glazing job description (product of study)

A construction glass and glazing job description was recommended using *The Job Description Handbook* guideline by Mader Clark [5]. The job description aimed to provide the following information: job summary, essential functions, job requirements and qualifications (education, licenses, certifications or specialized training programs, skills and abilities, and experience), and other information (see Appendix 1).

5. Discussion

This qualitative case study aimed to provide a job description and CGG job tasks and activities in common CGG work to support future ergonomics analysis of this trade that will help facilitate the design and testing of ergonomics interventions that can eliminate or reduce the risk of WRMSDs in construction glass and glazing work. This valuable construction information is not currently available in government publications, published research or job training materials for glass and glazing workers and contractors. The job description was developed to provide the following information: job summary, essential functions, job requirements and qualifications (education, licenses, certifications or specialized training programs, skills and abilities, and experience), and other information. Based on interviews and site observations, tasks were divided into two categories called 'general tasks' and 'job-specific tasks'. Job-specific tasks were those tasks that CGG workers performed as a result of their glass and glazing responsibilities while installing frame and glass or performing finishing jobs and MMH. Drilling, screwing, hammering, caulking and carrying materials were examples of job-specific tasks. General tasks were not specific to glass and glazing job, e.g., holding material, walking and housekeeping.

The purpose was to answer what it means to be a CGG worker. In other words, what type of job tasks and work processes do CGG workers do in glass and glazing work? The study showed that CGG responsibilities are far beyond just setting glass, which is what so many people think; based on interviews, anybody who works for a glass company is a CGG worker whether he is putting in the frame/glass or building the frames.

Through interviews (qualitative design), construction glass and glazing workers had the opportunity to tell their stories and experiences, which greatly helped the research team in picturing the real work environment of this trade. Using observational methods was another strength of this study such that no interference was made with CGG job tasks.

There were some limitations in conducting this study. This research is a limited-scale 'pilot project' in Nebraska and the conclusions are limited to commercial construction sites. Therefore, it is not possible to generalize the results of this study to the rest of the USA. The recruitment process took more time than expected because most construction companies were not willing to participate. Construction companies need to be educated and encouraged to participate in safety/ergonomics-related research. Cold weather made data collection challenges. All participating construction companies were performing exterior glazing tasks requested by general contractors due to the cold weather, so only three products including curtainwalls, storefront and paneling were observed.

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APPENDIX 1.

RECOMMENDED JOB DESCRIPTION

CONSTRUCTION GLASS AND GLAZING JOB

JOB SUMMARY

Construction glass and glazing workers are frame fabricators and frame/glass/panel installers who install frames, anchor the frames, shim the frames, screw the frame, carry the glass/panel, put the glass/panel in place, install the glass/panel and caulk. They are also involved in manual materials handling (MMH) while they are loading and unloading materials. It could be a small project like a street shop, or a high-rise building where they use basket lifts, scissor lifts and heavy machinery to get to the required height.

ESSENTIAL FUNCTIONS

- Loading/unloading the truck (fabricated metals/glass) that gets to the job site.
- Staging the material where they need it.
- Carrying the frames to the openings.
- Installing the fabricated frames.
- Anchoring the frames.
- Shimming the frames.
- Screwing the frames.
- Carrying the glass/panel.
- Putting the glass/panel in place.
- Installing the glass/panel.
- Caulking.

JOB REQUIREMENTS AND QUALIFICATIONS

EDUCATION

- No formal education is required.
- Ability to read (being able to read a tape measure) and write and do basic mathematics functions such as fractions, add, subtract, multiply, divide and angles.
- Ability to follow instructions is required.

LICENCE, CERTIFICATIONS, OR SPECIALIZED TRAINING PROGRAMS

- OSHA 10-h or 30-h card is preferred.
- Lifts (Lull, JLG lift, boom lift, forklift, basket swing stage, scissor lift, aerial lift) certification is preferred but not required.
- Specific tools (a specific type of saw and pneumatic nail gun, power actuated gun) certification is preferred.
- First aid certification (cardiopulmonary resuscitation) is preferred.
- Valid driver's license and good driving record.

SKILLS AND ABILITIES

Physical abilities	Skills
<ul style="list-style-type: none"> • Being able to lift, carry, bend, reach and kneel frequently • Being able to execute medium lifting (9.5–22.7 kg) on a frequent basis • Being able to lift up to 4.5 kg frequently, and 23.1–45.4 kg, which would be considered heavy, occasionally • Being able to lift 34–45.5 kg or more occasionally • Being able to walk and stand to work • Being able to climb stairs, ladders and scaffolding unassisted • Being able to use hands for repetitive action such as grasping, grasping and turning, and fine manipulation • Being able to work at height, and not be afraid of heights 	<ul style="list-style-type: none"> • Being able to work with others and have communication skills • Having management skills • Having the desire to work hard • Being positive, motivated and patient, and have some intelligence • Having good hand–eye coordination • Being able to read, write and understand instructions and shop drawings • Knowing how to add and subtract fractions, multiply and divide, all basic mathematics they use every day • Being observant with situational awareness of what is going on around you • Having common sense and learn from people • Being able to be good with powered tools (drills and saws) and hand tools (suction cup, tape measure, cutting hand tools, level, caulking gun/tools, bars, etc.)

EXPERIENCE

- Having construction experience or at least have done some kind of construction.
- Having knowledge about personal protective equipment (PPE) and know how to use them.

OTHER INFORMATION

- Full-time job (usually work 8 h per day, 5 days a week, Monday through Friday and 07:00–15:30 or 08:00–16:30).
- Occasional travel is possible.
- Occasional work overtime.
- No on-call situations.
- No shift works.
- No irregular working hours.
- Occasional (2 days a month) strenuous working conditions when receiving a big load of glass.
- Possession of hand tools is required.

Note: Based on Mader Clark [5].