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Working environments and clothing conditions in the construction industry

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Abstract

This study collected fundamental data on the current status of construction workers' clothes in South Korea, and categorized it based on construction site environment and job position. The study was conducted via a survey of 102 construction workers comprising both managers and laborers. In addition, a detailed interview-based questionnaire was used to ask three workers at the construction site to adopt working postures and identify the most uncomfortable parts of their workwear. Construction working environments are influenced by seasonal changes and have been recognized as places where dangerous hazards may occur. Workers in the construction industry felt that their faces were the hottest parts of their bodies in summer and their hands were the coldest in winter. With respect to the clothing worn for work, the results showed that most managers wore company-supplied workwear but laborers did not. When personally purchasing workwear, managers bought items at outdoor shops, whereas laborers purchased theirs at local markets. Both laborers and managers indicated a need for new workwear designs with a greater emphasis on function. In the in-depth interviews, the respondents noted that they felt discomfort from the clothing in their backs, upper arms, thighs, knees, and hips as a result of their primary work postures. Furthermore, they noted the need for pockets of appropriate size and position according to their work. The functional requirements demanded from construction workwear were classified based on the study's results.

Keywords: Construction workers, Working environment, Workwear, Comfort

Introduction

Construction industry working environments change frequently when compared to those of other industries (Jeong et al. 2002) and work-related matters are often abruptly altered (Kim and Kim 2018). Therefore, construction workers must swiftly adapt to certain situations to perform their duties safely and effectively. However, they are frequently exposed to hazards because of their relatively high average age and because non-specialists also perform construction work unless particular skills are required. According to a survey of fatal construction accidents in Singapore (Ling et al. 2009), one in five workers are unskilled workers. Despite improved safety performance, the Australian construction industry is one of the four most dangerous industries (Borys 2012). In Korea, the overall industrial accident rate is decreasing due to

government and industry efforts, but is increasing in the construction industry (Cho 2017). These examples provide an objective view of how dangerous it is to work in the construction field.

Despite this, most construction sites are medium or small in scale without properly established safety education or safety experience sites. This is exacerbated by the short duration of the construction process (Shin and Kang 2015). In Pakistan, Raheem and Hinze (2012) found there was no construction safety training program available and no manuals of procedures for managing injury or death records or case investigations. Furthermore, construction workers are generally considered by the public as “working in an industry with frequent safety hazards” and “working in an industry with a substandard working environment” (Shin and Son 2014), demonstrating that perceptions of construction working environments are generally poor.

Because the construction industry records a higher number of casualties and deaths than other industries (Hinze and Teizer 2011), a steady stream of studies have been published related to construction working environments. Research is being conducted from many aspects, including studies in which researchers investigate and analyze a site in person (Choi et al. 2000; Kim et al. 2014) and others that analyze statistics related to the hazardous situations to which construction laborers are exposed (Lee and Lee 2008; Lee et al. 2016; Kim et al. 2017). Additionally, there have been studies on workwear, one of a construction worker’s most intimate environments. For example, Graveling and Hanson (2000) conducted a questionnaire survey of firefighters to improve the comfort and fit of their uniforms. Choi and Park (2007) studied workers’ summer workwear and working environment, while Jeong et al. (2009) performed a similar study of workers’ winter workwear and working environment. Although there has been a range of studies on the workwear of those with specialist jobs, few have limited their focus to construction workers.

Workwear studies have included investigations into the wearing status, satisfaction rate, and requirements of car maintenance workers (Bae 2001; Kim and Kweon 2009), a study on the wearing status of railroad workers (Ha et al. 2008), an analysis of the working conditions and wearing statuses of shipbuilding laborers (Bae et al. 2010), and an analysis of the wearing statuses and satisfaction rates of protective clothing for people who work with pesticides (Oh et al. 2014). Tran et al. (2015) surveyed current workwear to develop a gown based on the preferred design.

On the other hand, ANSI standards (ANSI, ISEA 107–1999 1999), the guidelines for workwear to be worn in the construction industry, require night construction workers to wear high-visibility safety clothing (Arditi et al. 2005). In the US state of Washington, the Outdoor Heat Exposure Rule (2008) was introduced to suggest the work clothes to be worn depending on outdoor temperature levels (Park et al. 2015). In Korea, it has been recommended that welding workers’ workwear be flameproof (Korea Occupational Safety Health Agency 2017). Thus, guidelines for workwear differ according to the job site or job characteristics.

Like the workwear worn in any industrial field, the clothes worn on construction sites are of the utmost importance in enhancing worker efficiency. However, although environmental analyses should precede the development of optimal workwear, there are too few studies of the construction industry working environment.

Therefore, this study identifies the subjective working environments and workwear of laborers and managers in the construction industry. Furthermore, by investigating and analyzing laborers' sensations while clothed in workwear, this study provides base data for the development of improved workwear.

Methods

Survey

The survey was conducted of workers at construction sites to investigate their diverse working environments. The subjects were selected using a random (nonprobability) sampling process, and included workers in Mokpo, Haenam, and Gageodo in Jeollanam-do province. The ages of the subjects in the sample of 102 respondents ranged between 20 and 60. The survey was conducted between August 19th, 2016 and September 22nd, 2016. There were six questions on demographic traits, five on working environments, and eight on the wearing statuses of the workwear. A descriptive statistical analysis, frequency analysis, and multiple response analysis were performed on the research data using SPSS 24.0. For questions with ranked responses, points were assigned corresponding to the ranks and the total number of points was calculated. Additionally, a Chi squared test was performed for questions that showed a discrepancy between laborers and managers.

In-depth interviews

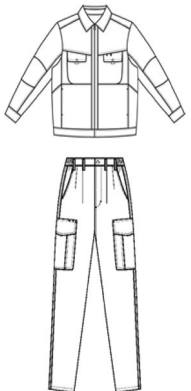
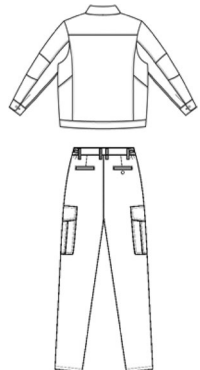
In-depth interviews regarding workwear were carried out with three respondents in their 50 s, each with over 5 years of work experience. The purpose of the interviews was to investigate in detail the areas of discomfort. As the subjects had varying body measurements, they were given workwear currently on the market of identical design and appropriate size to wear during the in-depth interviews. The subject data and workwear sizes are presented in Table 1.

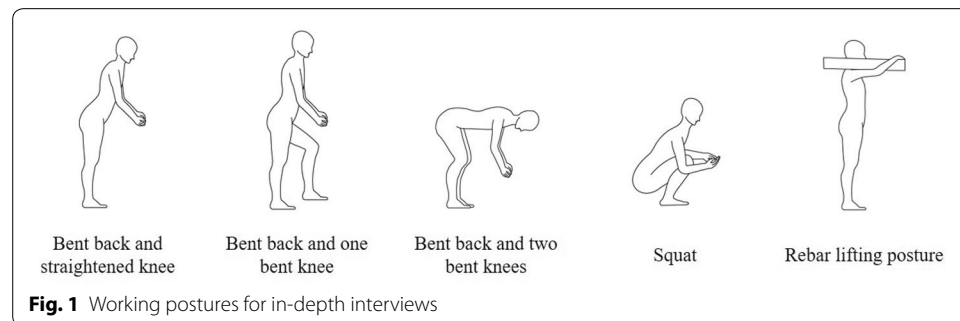
The workwear provided to the subjects each had a satisfactory subjective level of comfort, as established in a preceding study (Lee et al. 2017a, b). However, even for the workwear with good scores, there were potential improvements that were used as in-depth interview material. The material and design of the selected workwear are shown in Table 2. The subjects assumed the working postures of a rebar worker, who has the longest daily working hours and does the most work in a frame construction. A rebar worker is also a carrier, and the job thus requires a lot of manpower (Eom and Lee 2018) while the workwear is being worn. Thereafter, the areas of discomfort and the reasons for the discomfort were freely reported. Furthermore, in a preceding study, Park et al. (2010) showed that the squatting posture of rebar workers was maintained for extended periods

Table 1 Interviewee information

Subjects	Years of experience (years)	Body size			Size of workwear	
		Chest girth (cm)	Waist girth (cm)	Hip girth (cm)	Jumper	Pants
Ⓐ	5	97.0	83.0	97.5	L	32
Ⓑ	8	100.0	93.0	107.5	XL	36
Ⓒ	16	95.5	80.0	93.2	L	30

Table 2 Fabric contents and designs of workwear worn by the subjects

Workwear materials	Jumper	Pants
Composition (%)		
Polyester	100.0	65.0
Rayon	–	35.0
Thickness (mm)	0.82	0.67
Workwear designs		
<i>Front</i>	<i>Back</i>	
		



throughout the day. Thus, this motion was also considered. The five working postures are displayed in Fig. 1, and while the workers assumed these postures, they were asked to freely describe what was problematic and what could be improved. The interviews were recorded with permission and were subsequently analyzed. This study was approved by the IRB (201608-SB-027-01) prior to its initiation.

Results and discussion

Survey results of working environments

The results of analyzing the construction worker survey are as follows. First, the results of the demographic characteristics by position (Table 3) show that 50.8% of the laborers were in their 50 s; and 39.0% and 34.1% of managers were in their 40 s and 30 s, respectively. Although more than 50.0% of the laborers were in their 50 s, 80% of managers were either in their 30 s or 40 s, demonstrating an age discrepancy by position. However, body measurement varied little by position, with most workers being between 170.0 and

Table 3 Demographic characteristics by job category

Item	Laborer N (%)	Manager N (%)
Age		
20s	3 (4.9)	4 (9.8)
30s	7 (11.5)	14 (34.1)
40s	15 (24.6)	16 (39.0)
50s	31 (50.8)	6 (14.6)
60s	5 (8.2)	1 (2.4)
Statue		
< 160.0 cm	3 (4.9)	1 (2.4)
160.0 less < 170.0 cm	19 (31.1)	10 (24.4)
170.0 less < 180.0 cm	32 (52.5)	22 (53.7)
> 180.0 cm	7 (11.5)	8 (19.5)
Weight		
< 55.0 kg	2 (3.3)	3 (7.3)
55.0–64.0 kg	13 (21.3)	6 (14.6)
65.0–74.0 kg	23 (37.7)	11 (26.8)
75.0–84.0 kg	19 (31.1)	12 (29.3)
85.0 kg or more	4 (6.6)	9 (22.0)
Career period		
1 year or less	7 (11.5)	2 (5.0)
Between 1 and 3 years	2 (3.3)	3 (7.5)
Between 3 and 5 years	9 (14.8)	5 (12.5)
Between 5 and 10 years	7 (11.5)	4 (10.0)
10 years or more	19 (31.1)	19 (47.5)
20 years or more	17 (27.9)	7 (17.5)

179.0 cm in height and between 65.0 and 84.0 kg in weight, with weight having a broader range than height. The dependence on work experience for a position was statistically insignificant, but 47.5% of managers had over 10 years of work experience, whereas only 31.1% of laborers had over 10 years of work experience, demonstrating that managers had a relatively longer work period. Furthermore, laborers were employed as rebar workers, crane operators, assistants, excavators, operators, mixers, civil engineers, divers, ground measurement workers, plasterers, in carpentry, and for other related work. Managers were employed in tasks relating to construction management, construction supervision, quality control, equipment management, safety supervision, material control, support tasking, design, and civil engineering survey-related duties.

In addition, “cold and hot environment due to season changes (41.1%)” was the predominant response to the survey question pertaining to construction site environments (Table 4). Because construction sites are outdoors, climatic factors are cognized as intimate environments. The second most dominant response was “working environment with frequent crashes and falls (20.0%),” followed by “working environment with severe noise (17.9%),” and “working environment with frequent slippage (11.6%).”

The three hottest and coldest body parts during summer and winter operations, respectively, were identified and the results of the analysis of total points after allocation according to rank are represented in Table 5. In summer, the hottest body parts

Table 4 Characteristics of working environment

Working environment	N (%)
Cold and hot environment due to season changes	78 (41.1)
Working environments with severe noise	34 (17.9)
Working environment with frequent crashes and falls	38 (20.0)
Working environment with frequent slippage	22 (11.6)
Ergonomically harmful environment	8 (4.2)
Chemically harmful environment	6 (3.2)
Biological harmful environment	2 (1.1)
Other	2 (1.1)

Table 5 Cold body parts in winter and hot body parts in summer (Unit: n, point)

	Body part	1st	2nd	3rd	Total order score ^a
Summer	Head	38	9	10	142
	Face	33	29	8	165
	Neck	1	13	10	39
	Shoulder	1	1	3	8
	Chest	3	6	14	35
	Stomach	0	1	5	7
	Back	6	19	10	66
	Waist	1	0	4	7
	Hip	3	7	6	29
	Arms	4	4	7	27
	Hands	1	1	8	13
	Legs	2	1	6	14
	Feet	0	5	4	14
	Etc.	3	0	0	9
Winter	Head	8	2	3	31
	Face	29	19	24	149
	Neck	1	10	4	27
	Shoulder	0	0	5	5
	Chest	0	0	6	6
	Stomach	0	0	0	0
	Back	0	0	3	3
	Waist	0	0	1	1
	Hip	0	1	0	2
	Arms	0	3	5	11
	Hands	48	16	18	194
	Legs	2	5	4	20
	Feet	9	38	17	120
	Other	0	1	3	5

^a Total order score = 1st(n) × 3 + 2nd(n) × 2 + 3rd(n) × 1

were, in decreasing order, face > head > back. This result is consistent with the findings in a preceding study (Choi and Park 2007), which determined that the face and head are the hottest body parts at a construction site. In this study, the groin was also noted in the

Table 6 Workers who wear workwear

Worker	Yes N (%)	No N (%)	χ^2	<i>p</i>
Laborer	21 (35.6)	38 (64.4)	29.659	0.000
Manager	37 (90.2)	4 (9.8)		

Table 7 Type of workwear given by the company

Item	Laborer N (%)	Manager N (%)
T-shirt	0 (0.0)	26 (100.0)
Jackets, jumpers	3 (7.3)	38 (92.7)
Vest	24 (44.4)	30 (55.6)
Pants	2 (6.5)	29 (93.5)
Coveralls	5 (83.3)	1 (16.7)
Arm warmer	2 (66.7)	1 (33.3)
Other	4 (100.0)	0 (0.0)

miscellaneous feedback section as a perspiratory body part. In winter, the coldest body parts were, in decreasing order, hands > face > feet; this result is also consistent with a preceding study (Jeong et al. 2009), in which the face and hands were found to cause the most discomfort from coldness.

Meanwhile, 16.3% of all respondents stated that they have suffered a disease because of work, with the diseases ranging from skin disease, ocular disease, heatstroke, nervous disorder, respiratory disease, chronic fatigue, and hair loss to personal injury. Although the construction environment, which consists of a number of diverse physical environments, inevitably leads to many diseases, the disease occurrence rate was low. However, protective gear for the eyes, nose, and mouth need to be developed.

Survey results of workwear

The analytical results that revealed a discrepancy between laborer and manager workwear were as follows. Whether workwear was worn was analyzed by position (Table 6), and the results showed that 64.4% of laborers did not wear workwear. On the other hand, 90.2% of managers wore workwear ($p=0.000$). In other words, most managers wore workwear whereas many laborers did not. The fact that many laborers did not wear workwear despite it being an essential factor for them indirectly shows that the company does not intervene regarding workwear and that their current garb is unfit for construction sites.

Furthermore, the results of the survey regarding workwear provided by the company (Table 7) demonstrated that most laborers were only supplied with vests. However, managers were provided with a whole set of clothing, including shirts, jackets, jumpers, vests, pants, etc. A consultation with a construction company regarding this revealed that laborers are usually hired on a day-to-day basis, so they are not provided with a complete set of workwear. The vests are provided to give them a sense of belonging.

When workers did not wear the specialized garments, the clothes they put on were either their mountain climbing attire or daily clothes (Table 8). The results reveal that 31.8% of laborers purchase and wear mountain climbing clothes, which reflects their desire to wear good workwear that considers safety in the workplace. This is also shown in Table 9. To obtain workwear, most workers had to purchase the sets themselves. Furthermore, when making these individual purchases, the laborers usually went to a nearby market or workwear store (Table 10), whereas managers normally bought their clothes at outdoor stores ($p=0.000$). This is likely due to the income discrepancy that is a result of their respective positions in the company. Managers responded that they sought outdoor stores because mountain clothes had better utility than the workwear provided by the company.

Finally, both laborers and managers were asked about the three most important functions of workwear. The total points were subsequently analyzed, as shown in Table 11. The functions were ranked in the order of mobility > safety > insulation > ventilation, again indicating that workwear lacks the appropriate level of mobility for construction sites.

Table 8 Clothes worn when not wearing work clothes

Kinds of workwear	Laborer N (%)	Manager N (%)
Mountain climbing clothes (outdoor wear)	14 (31.8)	5 (71.4)
Daily clothes	26 (59.1)	2 (28.6)
Other	4 (9.1)	0 (0.0)
χ^2	4.204	
p	0.122	

Table 9 Acquiring workwear

Item	Laborer N (%)	Manager N (%)
Workers buying clothes individually	46 (78.0)	3 (7.5)
Workers buying from a company-designated store	2 (3.4)	0 (0.0)
Clothing provided by the company	7 (11.9)	36 (90.0)
Other	4 (6.8)	1 (2.5)
χ^2	59.643	
p	0.000	

Table 10 Retailers of workwear

Retailers	Laborer N (%)	Manager N (%)	χ^2	p
Work clothing store	15 (25.9)	2 (6.9)	25.585	0.000
Outdoor store	9 (15.5)	18 (62.1)		
Online shopping website	9 (15.5)	5 (17.2)		
Neighborhood market	21 (36.2)	1 (3.4)		
Other	4 (6.9)	3 (10.3)		

Table 11 Important functionalities in workwear (Unit: n, point)

Functionality	1st	2nd	3rd	Total order score ^a	Number of importance rankings
Safety and protection	37	11	7	140	2
Activity (movement)	42	34	6	200	1
Thermal insulation	3	20	26	75	3
Breathability	4	11	24	58	4
Night visibility	2	1	6	14	5
Pollution prevention	0	2	1	5	7
Color	0	2	6	10	6
Appearance	2	1	2	10	6
Sense of belonging	0	1	3	5	7
Other	0	0	0	0	0

^a Total order score = 1st(n) × 3 + 2nd(n) × 2 + 3rd(n) × 1

Overall, the disparities between laborers and managers in the survey results regarding wearing workwear were in the worker's age distribution, the tasks they performed, and whether workwear was provided by the company. However, there was a common acknowledgment of the need for new workwear that considers activity, safety, and comfort. Therefore, if new workwear is developed at a reasonable cost, it would be purchased.

In-depth interviews survey

The responses in the in-depth interviews regarding workers' comfort when performing the five selected postures were as follows:

Motion 1: Bent back and straightened knees

"The armpits squeeze when the upper body is bent forward." Subject ①

"The upper part of the princess line tightens." Subject ②

Motion 2: Bent back and one bent knee

"The back is small so that the armpits are uncomfortable. The back feels tight. The thighs and knees pull simultaneously, which causes discomfort." Subject ①

"Despite wearing loose workwear, the area slightly above the knees tugs." Subject ②

"The armpits tug a bit. If the width is too broad, then it scratches. Since the cloth is scratchy at the side, I think the width should be retained while changing the material to elastic." Subject ③

Motion 3: Bent back and two bent knees

"The back hem of the top is tight." Subject ①

"The thighs, knees, and buttocks tug." Subject ②

"The armpits are too tight. The hem of the top is pulled along once I assume the position, but this does not matter." Subject ③

Motion 4: Squat

"The buttocks and the area above the knees are tight. The buttocks pull when sitting down." Subject ⑧

"The buttocks pull. The side of the buttocks. I think it would be preferable to have a spandex material here. Not the entire bottom area, it is just the side that needs an elastic material. I think it would be comfortable to have a material that extends horizontally and not vertically." Subject ⑨

Motion 5: Rebar lifting

"The elbows pull a little, but it's not that impactful." Subject ⑩

"When carrying heavy weights, protectors are not worn. Just put on the shoulders. Because rebar workers experience tension when carrying them, about three to four are carried by one person." Subject ⑪

A summary of the in-depth interviews is as follows. The response to motion 1 (bent back and straightened knees) was that the back armhole was tight and uncomfortable, and the response for motion 2 (bent back and one bent knee) was also that the back of the armhole tightened as soon as the back bent. Furthermore, when bending one knee, the workwear was described as uncomfortable in the thigh and knee of the corresponding leg. The response to motion 3 (bent back and two bent knees) showed identical discomfort to motions 1 and 2. However, pressure was applied in the hip area of the workwear when both knees were bent, which caused discomfort. The response to motion 4 (squat) was that the pull on the buttocks caused such a level of discomfort that an elastic material was demanded for this area. Moreover, the area above the knees was tight. The response to motion 5 (rebar lifting) was that the sensations while wearing the workwear were not unacceptable and that rebar protectors were not worn when carrying rebar, resulting in rebar being placed directly on the shoulders. The main reason given for not wearing protectors was discomfort.

Additional details required for laborer workwear were acquired through the in-depth interviews. A pen holder near the arms of the jumpers was requested for easy access to pens, and it was suggested that the entrance to the pockets be diagonal for more accessible hand movements. Above all else, the former workwear was described as impractical in situations where workers carried large pocket notebooks, so larger pockets were demanded. The side lines of the pants usually have pockets near the knees, but since falls are common on construction sites, pens and tools in this location may pierce the skin when such accidents occur. In other words, these pockets were superfluous in terms of laborer safety. The workwear inconveniences and requirements derived from the in-depth interviews are summarized in Fig. 2.

Finally, the study results were organized to classify workers' requirements from the perspective of Quality Function Development (QFD), as illustrated in step 1, and the design requirements needed are suggested in Table 12. In addition, the required parts in step 2 (i.e., fiber type, type of weave/knit, fabric thickness, and fabric weight), the process or equipment design in step 3 (i.e., making the sloper patterns, grading, and marking), and the actual manufacturing operations in step 4 need to be continuously studied to develop optimal workwear.

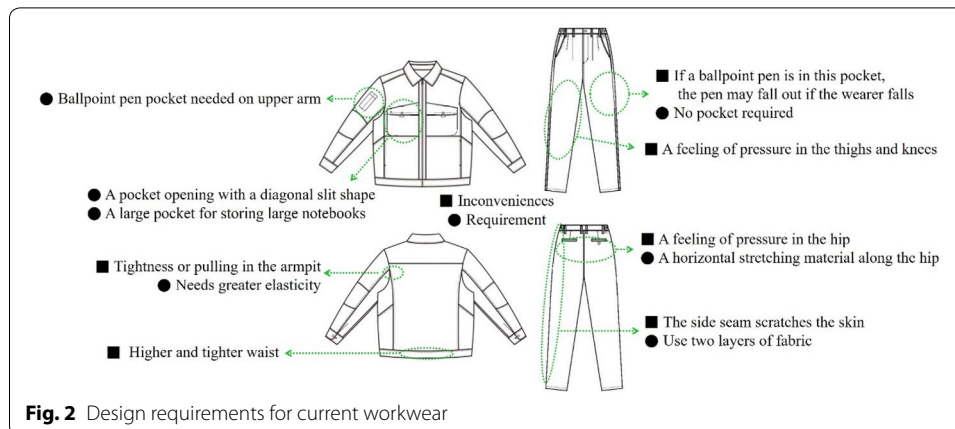


Table 12 Integration of workers' requirements and design requirement suggestions

Design requirements	Garment weight, Garment fabric type, Garment style, Garment value and layer, Garment ease, Protector
Worker requirements	
Size suitability	The appropriate length of the jacket The appropriate girth of the jacket The appropriate length of the pants The appropriate girth of the pants
Easy to move	Comfortable at the back of the armhole of the jacket when the waist bends Comfortable at the thighs and knees when the knees bend Comfortable at the hips when sitting
Comfort	Comfortable in hot environments Comfortable in cold environments
Protection and Safety	Eye protection Nose and mouth protection Pocket sizes Pocket locations

Conclusions

This study investigated the working environments and wearing status of workwear for construction workers. Its objective was to analyze the problems and potential improvements for workwear, particularly with regard to the common motions that workers perform when working. The conclusions derived from the study are as follows.

The construction workers were divided into laborers and managers. Most laborers were in their 50 s, and most managers were in their 30 s and 40 s. As for bodily features, their height ranged between 170.0 and 179.0 cm and their weight ranged between 65.0 and 84.0 kg, regardless of position. Therefore, it was determined that it would be more efficient to subdivide the workers by width rather than length when calculating workwear sizes.

The construction sites are usually located outdoors and are therefore heavily affected by seasonal changes. This calls for the development of workwear that is appropriate for both summer and winter. Coolness needs to be provided for the workers' faces and heads in the summer, and heat retention is required for their hands and faces during

winter. In addition, as workers are exposed to crashes and impacts and may develop diseases of their eyes, noses, and mouths, guards to protect each body part must be developed without delay.

The company provided construction managers with a whole set of workwear, but as most laborers were hired on a day-to-day basis, they were only provided with vests to give them a sense of belonging. However, managers, despite being provided with workwear, privately bought other sets at outdoor stores for improved comfort. Laborers attempted to purchase workwear at work clothing shops for better efficiency, but there were not enough choices of appropriate workwear. Furthermore, all workers felt the need for improvements in terms of activity, safety, and comfort, and so development of a new design for workwear that does not hinder activity, can protect the body, and is appropriately priced is required. However, because laborers and managers have distinctive duties, different designs for workwear need to be developed according to operating procedures to optimize movement functionality.

The problems of the workwear currently on the market relating to the postures of rebar placers and carriers whose work time is the most extensive were as follows: the shirts could not adjust when the worker's back was bent, so the tightened armhole led to discomfort. The back hemline was also pulled by this motion, likely because there is not enough ease at the back and the length of the back is too short, which results in pressure at the back and armpits. Meanwhile, the pants had enough ease but the thighs, knees, and hips turned became uncomfortable when the knees were bent. In other words, the existing workwear poses no problem when the worker is in a standing posture, but results in discomfort when carrying out certain operations. Therefore, further studies are required on the appropriate amount of ease for each body part. Okan and Acar (2017) stated that pants and shirts worn by forest fire workers were limited by their work activities, and this study found that the jumpers and pants worn by workers were inconvenient and uncomfortable because they could not respond to the work activities. Therefore, it is very important to develop work clothes according to the type of work.

Additionally, improvements were called for in the size and orientation of pockets. At construction sites, taking notes of crucial details is necessary, so the pockets at the chest need to be large enough to fit a large notebook. A diagonal pocket entrance was also desired for easier access. Furthermore, pen holders are commonly on the side seams of the thighs, but this may lead to serious injuries when workers fall, so it is more effective to place pen holders on the upper sleeve arms. In other words, the workwear has many pockets as copious storage space is needed, but the inappropriate size and pocket placements are unsafe and may detract from work efficiency. Kolisi (2015) suggested that in any practical environment, it is necessary that workwear fit the wearer's physique and allow freedom of movement. This study also proposes a new workwear design for workers on construction sites.

These results are the outcome of an in-depth analysis of the current situation experienced by construction workers regarding working environments and workwear. This study is expected to aid in the selection of crucial design factors for developing efficient construction workwear. The optimal workwear of the future will be developed by finding a production solution that meets the worker requirements identified here and will be achieved using the step-by-step QFD method.

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Authors' contributions

RE is the leading author of this article, originated the research idea, conducted the data analysis and drafted the manuscript. YL guided the design of the study, and finalized the manuscript. Both authors read and approved the final manuscript.

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Competing interests

The author declares that she has no competing interests.

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