

The Way of Improving the Working Environment for Female Workers on Construction Site

Based on Construction Welfare Facilities

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Abstract This paper reports problems of current working environment on construction site in South Korea from a female laborers' point of view and proposes solutions to improve the environment. To investigate and analyze the problems, a questionnaire survey and a focus group interview were conducted with 341 engineers and 557 laborers. Among them female engineers and female laborers were 51 and 136 respectively. Findings are the facilities related with welfare facilities such as lavatories, shower rooms, lounges and changing room, etc. for women were not sufficient and even not installed only for women because all of the planners for the facilities were men and The Standard of Estimate does not consider gender distinction. The data on the trade and the number of female laborers were not recorded¹ and this study confirmed the number and the proportion of female laborers according to construction progress i.e. the proportion of female laborers were 0% ~ 11% (average 6%) at 26 construction sites having 2% ~ 92 % construction progress. In order to solve these problems, gender education for the welfare facility planner is required and the current Standard of Estimate should be revised considering female laborers after collecting the site data for the number of female laborers according progress and the increase in the construction cost should be reflected in the contract amount accordingly. Conclusively temporary work planning related with welfare facilities should be established and conducted in terms of gender equality at construction sites. In addition, improving working environment on construction sites for female laborers will enhance the company's image and also helping solve the labor shortage problem by women laborers engaging in construction industry easily.

Keywords: Construction Site, Female Engineer, Female Worker, Gender-based Management, Welfare Facilities

1. INTRODUCTION

The construction industry is highly dependent on subcontractors and labor-intensive due to the characteristics of one-time production, outdoor production, and division of

labor production system. It relies on laborers' experience rather than technology development and the risk of a safety accident is higher than manufacturing industry. Therefore it is recognized as a 3D industry².

Due to such a poor working environment, the construction industry is known as a male-oriented industry, and accordingly, known as it is impossible for female laborers to work on construction site. In addition, a poor working environment causes the shortage of manpower in the construction industry because no new laborers are coming in and existing worker are aging. However looking at the number of laborers in recent construction sites in South Korea, the proportion of female laborers in 2013 was only 8% (about 140,000), but in 2018 it is increasing to 10% (about 210,000)³. Despite the increase of female laborers, on-site amenities and temporary facilities for

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¹ KOSIS-“Economically Active Population”

² 3D : dirty, dangerous, difficult

³ KOSIS-“Economically Active Population”

female laborers, who are a small number of laborers, are not currently considered systematically. Therefore, this study aims to improve the working environment for female laborers by investigating and analyzing the working environment for female laborers on construction sites from the perspective of gender. And it will help increase the number of new laborers come into the construction industry by wiping out the image as a 3D industry and solve the labor shortage problem.

The scope of this study focused on toilets, showers and lounges, which are facilities that require to distinguish between men's and women's among the welfare facilities.

In order to carry out this research, the precedent research related to the working environment were reviewed. In addition, questionnaire surveys and focus group interviews were conducted with construction site engineers and laborers on the planning procedures of welfare facilities and satisfaction with welfare facilities and the survey results were analyzed and the alternatives were proposed.

2. REVIEW OF PRECEDENT RESEARCH

(1) Women's Movement at Construction Sites around the Globe

In construction industry, female laborers have a difficulty working in the construction site because of gender bias around the globe. Recently, however, women-friendly policies have been actively implemented to overcome the gender discrimination and construction industry started taking into account the concept of gender equality.

In the United Kingdom, the proportion of working women in the field of construction is below 1%, demonstrating the worst gender balance. According to a study by Dillon & Moncaster, women made advances in the field of construction as a result of the Women into Science and Engineering (WISE) campaign in the 1980s, but the data from 2007 to 2017 show a growth plateau. The wage gap between men and women has not decreased, either. In recent years, however, the collapse of a major contractor named Carillion led the construction industry to seek practical change, which concluded that facilitating entry of female laborers is the key solution. Scholars stressed the following strategies: fostering female employees as leading positions in construction companies, mentoring female employees by female leaders, and changing the perception of the correlation between the gender equality policy and company image.

John Holland, a construction company in Australia, had found that female laborers were paid 15% less than male laborers, therefore announced a plan to overcome the discrepancy and realized an environment characterized by gender equality.

In Japan, in order to vitalize the construction industry and also to meet the construction demand of the 2020 Tokyo Olympics, the country is presenting very progressive strategies to encourage women's participation. In addition, to address the manpower shortage, Japanese Government and five industry organizations—i.e., the Japan Federation of Construction

Contractors (JFCC), the National General Contractors Association of Japan, All-Japan Smaller Construction Contractors Association, Kensenren (federation of specialized construction contractors), and the National Federation of Construction Contractors—have been promoting active utilization of female laborers. The strategies to vitalize the participation of women in the construction field can be divided into three execution plans as follows: 1) creating a working environment that allows women to continue their career as they go through different life stages; 2) providing an environment for women that will enable them to take a more active role and further improve their skills; and 3) disseminating information on successful women in the construction industry. In addition, Japan is practising gender equality through a system called 'Nadeshiko', which is a system granting bonus points for companies that give female laborers preferential treatment, at the time of the company evaluation or bidding.

(2) Status of women's participation in construction sites in South Korea

South Korea has traditionally pursued a patriarchal society; however, in the twentieth century, its laws and systems have been steadily reformed to resolve gender discrimination issues by, for example, increasing women's access to educational opportunities, participation in public office, and economic activities. Nonetheless, according to reports from the United Nations Development Program (UNDP) and the World Economic Forum (WEF), women's powers in Korean society are weak and the gender gap is very high. For example, the occupations of female laborers are concentrated in low-wage, non-regular laborers. This is especially true in the construction industry, which is perceived as a male-oriented industry. For this reason, the access and activities of female laborers are restricted in the construction industry.

The economically active population survey of Korea shows that the economically active population was 33.69 million in 2005, and is expected to decline to 31.89 million by 2030, resulting in a noticeable manpower shortage. In order to cope with a declining population due to low birth rate and aging, the active and effective use of female workforce is urgently needed as can be seen from Japanese case above. Hans Rosling stressed the need for a response to changing demographics and said, 'The low birth rate problem cannot be solved only through population policy. The change will start when gender equality is actively promoted through feminism.' Jeffrey Norris, CEO of the Equal Employment Advisory Council (EEAC) also stressed, 'Increasing women's social advancement will make corporate management transparent and profitable.'

Recognizing the importance of female laborers, the Korean government has also established the 'Comprehensive Plan for the Development of Female Workforce' and prepared an 'affirmative action' system. Despite various policies and projects, as shown in Figure I, the construction and heavy industry sectors have become representative in terms of the gender inequality, with low female employment rate and

female manager rate. Furthermore, the construction industry has the problems related to the utilization of female laborers that appeared in previous studies. According to a study by the Ministry of Employment and Labor and Korea Labor Institute, the longer the tenure and the larger the company, the lower the utilization rate of female laborers. Comparing private and public companies, private companies showed the lowest utilization of female laborers, followed by public corporations and the government. From a college education and employment standpoint, a completely different problem emerges. Recently, the number of female students in the architectural engineering major has been steadily increasing. According to education statistics, the female students account for over 30% of the architectural engineering department, and the ratio is higher than the average of engineering colleges. However, many female students cannot find a job because of female evasion. Looking into the construction fields, it is divided into construction management, design, and engineering, and there is a serious employment imbalance among these sectors i.e. the employment rate of female laborers in construction companies are extremely low. As can be seen in Table 1 and Figure 1, the female employment average rate in the construction industry is

only 9.47%, which is the lowest among all industries.

Table 1. Female employment rate and female manager ratio in 2015 (Unit: %)

	Over 1,000 persons		500~1000persons	
	Industry Women employees	Women Managers	Women employees	Women Managers
Total Average	38.22	20.25	36.87	18.79
7 Construction	10.31	2.94	8.18	4.03

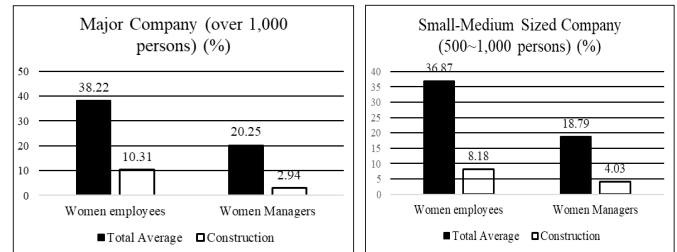


Figure 1. Female employment rate and female manager's average ratio in 2015 (Unit: %)

Table 2. Precedent research on female workforce and gender problems in construction industry

Researchers (Year)	Title	Content	Publication
Shin, W. et al. (2014)	An Evaluation of the Public Image on Construction Industry and Its Improvement Measures	The general public has a negative image of the construction industry. This is due to difficult working conditions and environments, which should be improved.	Journal of AIK
Shin, W. et al. (2013)	An Analysis for Work Performance of Female Field Manager of General Construction Company	This paper investigates the degree of overburden and difficulty by the work contents of the increasing number of female managers at construction sites and evaluates the appropriateness of the work.	Journal of KIC
Son, C. (2012)	An Analysis on the Installation Condition of Convenience Facilities for Construction Laborers and Its Improvements Measures	The current welfare facilities at construction sites are analysed from the perspective of laborers to find ways to improve the satisfaction with the facilities.	Journal of AIK
Son, C. et al. (2011)	A Study on Investigation of Women's Work Performance in Design Stage	This paper evaluates the work performance abilities of the female workforce in the design field, in which the advancement of women is relatively active.	Journal of RAIK
Sang, K. (2012)	Gender Inequality in the Construction Industry	Understanding and finding problems of gender inequality in the construction industry according to P. Bourdieu's frame of thought.	Proceedings 28 th Annual ARCOM Conference
Aulin, R. (2011)	Issues confronting women participation in the construction industry	To create a better path for women's participation, bringing more female role models and clearer equal opportunities.	Advances in Engineering & Technology - Contribution of Scientific Research in Development Conference
Powell, A. (2009)	Exploring gender differences in construction research: a European perspective	Making inquiries about women's career paths in the construction sector and finding differences between the actual field and the area of construction academia.	Construction Management & Economics

(3) Supply and employment environment of construction laborers

According to a precedent research, the number of new laborers in the construction industry has decreased because young people in Korea have a negative perception of the construction industry. Accordingly, much research has been conducted on the supply and demand of manpower.

J. C. Baek (2014) argued job insecurity, uncertain job prospects, and poor working environments as the causes of negative perception of the construction industry and proposed the direct construction system as a solution in 'A study on the direct construction system application to solve the skilled worker lack problem.' U. C. Shin (2004) pointed out the recession in the construction industry, poor working environments, job insecurity, and low welfare level as causes of avoiding and leaving the construction industry in 'Improvement measures for the employment environment for construction laborers.' H. K. Cho (2011) examined the status of supply and demand of construction laborers and problems related to foreign laborers in 'A Study on Current Supply and Demand Status Problems for Skilled Laborers on Construction Sites.' He analyzed the poor working environment at the construction site as the cause of manpower shortage, but his paper lacked data of case analysis and did not discuss the improvement of welfare facilities.

Y. K. Choi (1999) argued the working environment standards for construction sites in the 1990s are different from the present and in the 1990s the working environment was mainly associated with on-site cleaning and separate garbage collection in order to prevent serious disasters in 'A study on the improvement of work environment at construction sites.' M. Yoon (2014) investigated the welfare facilities and standards for apartment construction sites in 'A study on the working environment improvement of construction laborers at apartment building construction site.' Although the working environment at construction sites has improved recently and the basic working conditions have been met, they are mainly focusing on male laborers, not female laborers.

To date, studies have focused on the problems of supply and demand of manpower and improvement plans for construction environment, and many of them concluded that the working environment at construction sites needs to be improved. However, there has been insufficient research on specific laws and systems and practical implementation measures for the improvement of the working environment and it is hard to find the research for the working environment of female laborers.

(4) Institutional standards for working environment on the construction site

The working environment on the construction sites is worse than the working environment in other industries. Large construction companies comply well with the Labor Standards Act stipulating working hours and break times and welfare facilities in the workplace comparing with small and medium-sized construction companies, which even do not have standards on the types, quality, quantity, and sizes of welfare

facilities. In particular, there is no standards for female laborers constituting the minority of manpower at construction sites.

The 'Act on the Employment Improvement, etc. of Construction Laborers' stipulates construction sites should install basic welfare facilities such as lavatories, mess halls, and changing rooms. The installation standards are presented in 'The Standard of Estimate', which is the guidance for calculating the construction cost issued by the Government. This Act provides for the obligation to install welfare facilities and their size and penalty regulations for failure. Construction sites with a contract value of more than KRW 100 million are required to install welfare facilities such as lavatories, mess halls, and changing rooms. In case of violation, up to KRW 5 million will be imposed on the construction site. Article 4 of the Enforcement Rule of the Act defines standards for the installation and maintenance of welfare facilities for laborers, as shown in Table 3. The Enforcement Rule provides regulations on lavatories, mess halls, and changing rooms, but no standards on facilities for resting in construction sites, such as lounges and shower rooms and no standards according to gender division.

Table 3. Standard of Estimate for welfare facilities

Facilities	Division		Standard area	Installation standard
Mess hall	30 or more persons		1 m ²	Per person
Lavatories	Toilets	One per 20 men	2.2 m ²	Per lavatory (toilet and urinal)
		One per 15 women		
	Urinals	One per 30 men		
Changing room	-		2 m ²	Per person
Lounge	-		-	Per person
Shower room	-		2.0 m ²	Per person

Some construction companies do not have installation standards for welfare facilities and in some cases, although the company standards exist, the engineers do not know them accurately. Usually the type and size of welfare facilities on construction site is determined by the site situation and the experience of the site engineers. In 'An Analysis on the Installation Condition of Convenience Facilities for Construction Laborers and Its Improvements Measures' (2012), C. B. Son analyzed the standards for installation of welfare facilities for in-house construction laborers working for the top 20 construction companies as of 2010.

Comparing the company standards with the regulation, for the mess hall the company standards were larger than the standard of the regulation, although there are differences depending on the construction scale. For lavatories, which are the type of container + FRP in general, the standards of construction companies were smaller than that of the regulation in all construction scales. The standards for dressing rooms and shower rooms were also smaller than that of the regulation. In the case of lounges, the quantity is specified as lump sum and

the type is specified as tent-type, which is incomparable to the standard of the regulation.

Both the Standards of Estimate and the standards of the construction companies stipulate the installation standard without gender for the lavatories and dressing rooms. Additionally, there was no standard for the proportion of women and men in all laborers.

Table 4. Installation standards by construction company

Division	Installation status (average)	company standards (average)	Note
Lavatories	0.17 m ² / person	1.5 m ² / person	19.5% of construction companies have the installation standard.
Lounges	0.28 m ² / person	1.5 m ² / person	
Shower rooms	0.15 m ² / person	1.4 m ² / person	23.5% of construction companies have the installation standard.
Dressing rooms	0.15 m ² / person	1.4 m ² / person	23.3% of construction companies have the installation standard.

3. A CASE STUDY ABOUT THE INSTALLATION STATUS OF WELFARE FACILITIES

(1) Analysis of laborers and engineers responding to the survey

A questionnaire-based survey was conducted on the male and female laborers and engineers working at 26 construction sites to investigate the planning procedure for welfare facilities and the satisfaction with the welfare facilities installed at the construction sites. In addition to the survey, interviews were also conducted by visit at 7 sites.

The number of laborers at the surveyed 7 sites varies depending on the progress and size of the site. The ratio of female engineers to the total engineers was 4.5~17.6%, although there were differences according to the progress and the size of the site. The ratio of female laborers to the total laborers was 3.2~10.0%. The ratio of female engineers at the construction sites is larger than that of female laborers, but the actual number of female laborers is larger, as shown in Table 5.

Table 5. Gender proportion at construction sites (top: 26 sites, bottom: 7 sites)

Division	Men (persons)	Women (persons)	Ratio of men (%)	Average ratio of women (%)
Engineers	453	54	89.3	10.7
Laborers	7091	448	94.1	5.9

Division	Men (persons)	Women (persons)	Ratio of men (%)	Ratio of women (%)
Engineers	149	16	90.3	9.7
Laborers	2246	187	92.3	7.7

(2) Installation status of welfare facilities at construction sites

In the 1990s, the welfare facilities for laborers at construction sites consisted of a simple toilet container and a shower container with two or three faucets, and there was no lounge for laborers. And the working environment was so poor that there was no resting space for laborers. In particular, there were very few female laborers at construction sites and no welfare facilities for women in the 1990s.

In this situation, welfare facilities for female laborers at construction sites could not be considered. At present, the welfare facilities for common use at construction sites have undergone significant development; however, they still are not considered satisfactory for most laborers at the construction site. Although the working environment at construction sites has been improved recently and the basic working conditions have been met, they are still focused on male laborers and consideration for female laborers remains insufficient.

Through site visits and questionnaire surveys the installation status of the welfare facilities at construction sites, such as lavatories, lounges, dressing rooms, and shower rooms, and any problems in using the facilities for women working at construction sites were investigated and analyzed.

The types of lavatories installed at construction sites are classified into container lavatories, on-site temporary urinals, and temporary lavatories. Many lavatories are separated for men and women. They have achieved dramatic development compared to the old lavatories at construction sites in the past. However, consideration for women is still insufficient in terms of the number and locations of lavatories.

Lounges at construction sites are installed indoor or outdoor depending on the progress of work. In the case of outdoor lounges, smoking spaces are separated using a tent in the work space and a container was installed outside the work space. In the containers, air conditioners, beds, and lockers were installed.

Many construction sites did not have a separate dressing room. The laborers changed their clothes in the subcontractor's office, warehouse, or they left work in the clothes that they had worn when coming to work.

Most sites had shower rooms, albeit small-sized, using a container at the site, but no shower room for women.

The problem of the lavatories installed at the construction sites was that they were operated as unisex type at some sites and male laborers frequently used the lavatories for women even though they were separated. Temporary urinals were installed in the workspace and many female laborers felt uncomfortable because they could see the male laborers urinating.

The problem with lounges installed on construction sites was that they were not divided into men's and women's at most sites and therefore female laborers could not use the lounges. In the case of container lounges, the space was too small to accommodate female laborers even though they were divided by gender. Even if there is a rest area (lounge), it is not managed, so its use is poor.

Most sites had no dressing rooms. Even if installed, it was

used only for female engineers, not for female laborers. Thus, an installation plan should be established for female laborers who are doing physical work and are greater in number than female engineers.

Shower rooms at construction sites are not used by many laborers. The most prevalent reason is that the shower rooms do not have supplies such as soap, shampoo and towel. Another reason is that most laborers come to work by car or they stay in lodgings near the site. Thus, the frequency of using the shower rooms is smaller than in the past.

Among the above-mentioned sites, the persons in charge of temporary work planning at seven construction sites belonging to three construction companies were interviewed from July 11 to July 25, 2016 in order to investigate the installation status of men's and women's welfare facilities separately when preparing the temporary work plans and the reflection of the increasing cost for installing the welfare facilities. Table 6 and 7 show the background of welfare facility planners and the background of respondents including male and female, engineers and laborers. Table 8~11 and Figure 1~2 summarize the interview questions and answers.

To summarize the interview results, the welfare facility plans were focused on the efficient progress of the construction and no consideration was made for female laborers. Because all of the welfare facility planners were male engineers, they lacked awareness of the discomfort of female laborers.

It was confirmed through the on-site interviews that although the Act on the Employment Improvement, etc. of Construction Laborers, the government standard of estimate (the regulation), and the standards of construction companies for temporary facilities mention the type or number of temporary facilities for laborers, they do not mention the calculation method for the expected number of total manpower or the number of female laborers among the expected total manpower.

Table 6. Background of Welfare Facility Planner

Division	Content
Field position	- Field construction manager - Public affairs Site supporting team at headquarters
Field experience of the planner	- At least 10 years
Gender of the planner	- Male
When planning the temporary work	- Two months before starting construction or - Three months after project approval
Important considerations for the temporary work planning	- Deep well (Dewatering) - Electric distribution board - Temporary office - Lounge - Lavatory (restroom, toilet)
Consideration for female engineers & laborers	- No consideration for gender separation - Planning based on total number of worker on standards

Table 7. Summary of survey respondent

Division	Frequency	Ratio(%)	
Sex	male	711	79.2
	female	187	20.8
Status	engineer	341	38.0
	laborer	557	62.0
Age	20s	65	7.2
	30s	251	28.0
	40s	283	31.5
	50s	235	26.2
	over 60	64	7.1
Education level	middle school	91	10.1
	high school	638	71.0
	university	150	16.7
	Etc.	19	2.1
Work experience	under 5 years	252	28.1
	6-10 years	184	20.5
	11-15years	206	22.9
	16-20 years	113	12.6
	21-25 years	64	7.1
	26-30 years	42	4.7
	over 30 years	37	4.1
	Total	898	100.0

4. QUESTIONNAIRE SURVEY RESULT

(1) Summary of respondents' background and questions

The number of laborers at the surveyed construction sites varies depending on the progress and size of the site. The ratio of female engineers to the total engineers was 4.7~20% (average 10.7%). The ratio of female laborers to the total laborers was 3~10% (average 5.9%). The ratio of female engineers at the construction sites is higher than that of female laborers, but the actual number of female laborers is higher. The questionnaire survey results show that the work trades listed in descending order of the number of female laborers at 26 construction sites were waterproofing work > concrete work > tile work > interior finishing work > masonry work.

Also the questionnaire survey for male and female engineers and laborers working at a total of 26 construction sites investigated their satisfaction with the working environment.

The questionnaire mainly consisted of the following questions: Personal information of respondents: sex, age, education, job trade, career, etc.

Questions about welfare facility plans of the current

construction site: status of each facility, satisfaction, etc.

Questions about the level of welfare facility plans in Korean construction sites : assessment of level, degree of consideration for women, prospect for future increase of female laborers, and improvement directions of temporary work plan.

Progress and outline of construction site

The questionnaire survey was conducted from July 1 to August 11, 2016 and collected 927 sheets in total ; 343 sheets for engineers and 584 sheets for laborers. Among them, 29 sheets were excluded owing to a lack of understanding about the questions and invalidity. Thus, a total of 898 sheets consisting of 341 sheets for engineers and 557 sheets for laborers were used for the analysis. The statistics application SPSS ver. 12 was used for statistical analysis.

Among engineer respondents, 85% are male and 15% are female, and the highest response rate was obtained for the age group of 30~40 year old for men and 20~30 year old for women. In terms of the job trade of respondents, the highest percentage, 57.9%, of men was architecture, whereas the highest percentage, 39.2%, of women was management, followed by architecture and others such as medical service. The average career of field work was evenly distributed for men, but it was within five years in the highest percentage, 64.7%, of women.

Among laborer respondents, 75.6% are male and 24.4% are female. The largest age group of laborers was 40 or older in 76.9% of men and in 89.7% in women, indicating an aging phenomenon. Of the male and female laborers, respectively, 61.9% and 33.8% worked for more than 10 years in the construction sites. Thus, men worked in the construction industry longer than women, proving that it is a male-oriented industry.

(2) Engineers' satisfaction with welfare facilities

As a result of the survey on the satisfaction level of the engineers using the most basic welfare facilities in the construction sites: lavatories, lounges, dressing rooms, shower rooms, and mess halls, 92% of the respondents answered average or higher satisfaction levels with the separate installations for men and women, indicating very good results from the engineers' point of view [see Table 8, 9].

Table 8. Engineers' satisfaction level by gender classification for welfare facilities

		Very insufficient	Insufficient	Average	Excellent	Very excellent	Total
Men	Frequency	6	20	117	131	16	290
	Ratio %	1.8	5.9	34.3	38.4	4.7	85.0
Women	Frequency	0	1	35	13	2	51
	Ratio %	0	0.3	10.3	3.8	0.6	15.0
Total		6	21	152	144	18	341
Total Ratio %		1.8	6.2	44.6	42.2	5.3	100.0

Table 9. Engineers' satisfaction level by facility quality and quantity

		Men		Women	
		Division Frequency	Ratio (%)	Frequency	Ratio (%)
Lavatories	Unsatisfactory/Very unsatisfactory	48	16.9	7	14.0
	Average or higher	236	83.1	43	86.0
Lounges	Unsatisfactory/Very unsatisfactory	25	11.5	2	8.6
	Average or higher	193	88.5	21	91.4
Shower rooms	Unsatisfactory/Very unsatisfactory	16	9.0	0	0
	Average or higher	162	87.1	7	100
Dressing rooms	Unsatisfactory/Very unsatisfactory	18	11.6	0	0
	Average or higher	136	88.4	12	100

The analysis results of the questionnaire for lavatories show that most male and female engineers answered "average or higher" and the reasons for answering "unsatisfied" were 'Insufficient urinals and toilets' and 'Poor maintenance such as cleaning.'

For lounges, frequency is only 218 male and 23 female engineers. The reason seems to be that the engineers working on the site did not answer because they do not have lounges. Most male and female engineers among respondents answered average or higher, but the reasons for answering "unsatisfactory" were 'Poor maintenance such as cleaning' and 'Inconvenient location.' The number of female engineers answering "unsatisfactory" was few, but they were unsatisfied with 'Small area and insufficient seats.'

For shower rooms and dressing rooms, both male and female engineers answered average or higher satisfaction. However, the response ratio of female engineers for shower rooms and dressing rooms was only 13% (7 persons) and 23.5% (12 persons), respectively. The reason is that most construction sites do not have shower rooms and dressing rooms for female engineers and most of the respondents were satisfied with those installed.

The following conclusions can be drawn from the analysis results of the questionnaire survey for male and female engineers.

First, female engineers do not have a high need for shower rooms and dressing rooms because most of them work in offices for management or other jobs (medical service), except for those whose job trade is architecture.

Second, it is realistically difficult to provide lounges and dressing rooms for female engineers who are a minority at construction sites, owing to the nature of temporary facilities.

Third, the dissatisfaction with the insufficient facilities and lack of gender classification is insignificant.

(3) Laborers' satisfaction with welfare facilities

The job trades of female laborers responding to the survey

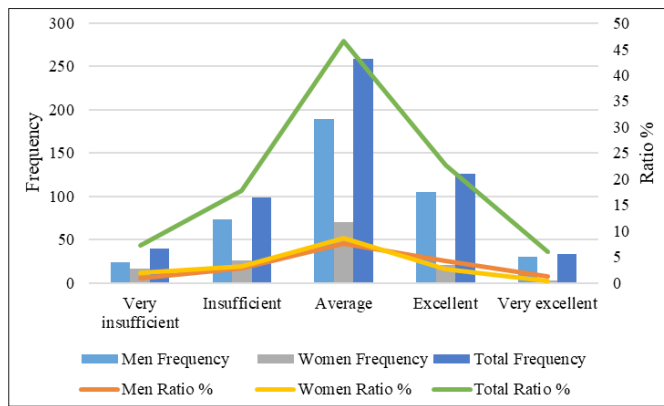


Figure 2. Laborer's satisfaction level by gender classification for welfare facilities

are tiling, painting, mechanical and electric work, direct labor and completion cleaning. They were participating in most job trades related with finishing works which require relatively less physical ability. For example, female laborers in masonry and re-bar work were doing simple tasks such as cleaning or binding steel wire for reinforcement bar.

The analysis results of the satisfaction levels of male and female laborers for the welfare facilities at the construction sites are illustrated in Figure 2 and 3.

According to the analysis results, 77% and 69.1% of the male and female laborers, respectively, answered average or higher satisfaction levels, for the welfare facilities at the construction sites. To analyze the satisfaction level by type of the welfare facilities, the questionnaire survey was conducted for lavatories, lounges, shower rooms, and dressing rooms, and the results are summarized in Figure 3.

The total respondents consisted of 415 men and 135 women for lavatories, 335 men and 115 women for lounges, 218 men and 77 women for shower rooms, and 208 men and 74 women for dressing rooms. Frequency for shower rooms and dressing rooms was smaller than that for lavatories and lounges. This suggests that the construction sites had no shower rooms and dressing rooms or frequency of using them was smaller than that of using lavatories and lounges.

For lavatories, 37.6% of men and 45.2% of women answered unsatisfactory or very unsatisfactory. The reasons were 'Insufficient urinals and toilets,' 'Poor maintenance such as cleaning,' and 'no separation by gender.'

The answer of no separation by gender was not found from the answer by engineers' answer. This shows that the status of facility installation is different between engineers and laborers. It was found that some sites even used unisex lavatories for laborers.

For lounges, 26.6% of male and 34.8% of female laborers answered unsatisfactory or very unsatisfactory. The most prevalent reasons from male laborers were 'Poor maintenance such as cleanliness' and 'Small area and lack of seats.' The most prevalent reason from female laborers was 'no separation by gender' followed by 'small area and lack of seats.' This suggests lack of lounges for women.

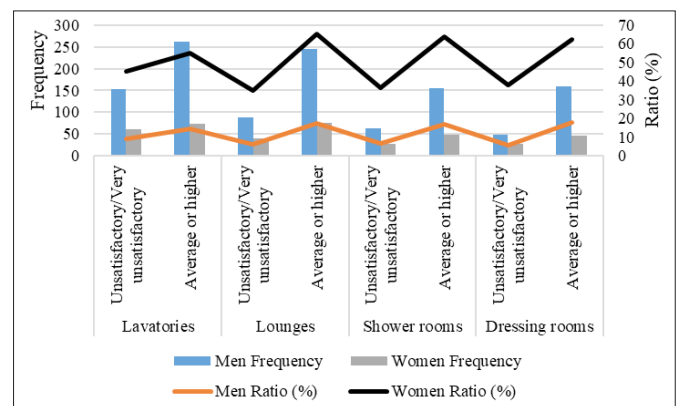


Figure 3. Laborers' satisfaction level by facility quality/quantity

For the shower rooms, 28.4% of male and 36.4% of female laborers answered unsatisfactory or very unsatisfactory. The utilization rate of the shower rooms by female laborers was approximately 56%, of which 63% felt average or higher satisfaction. The reasons for dissatisfaction were 'No division of men and women (insufficient shower rooms for women),' 'Insufficient shower faucets,' 'Poor maintenance such as cleaning,' and 'Defective lock.' The most prevalent reason for dissatisfaction with dressing rooms was 'Small space' from both men and women. However, frequency for dressing rooms was only approximately 50% of the total, which suggests the need for installation of dressing rooms on sites.

(4) Summary of questionnaire analysis

Some remarkable results were found from the cross-analysis of the questionnaire survey.

First, engineers' and laborers' answer about the installation status for welfare facilities and the increase of female laborers were clearly different. The laborers answered negatively at significant level about the gender division level of welfare facilities and their satisfaction with the welfare facilities on site and expressed the needs for improvement of welfare facilities planning more actively[see Table 8, 11]. On the other hand, the engineer group answered more positively about the increase of female laborers on site.

Second, the satisfaction level of women was significantly lower than that of men[see Table 11]. When converted to a Likert 5-point scale, the satisfaction level of men was 3.25, whereas that of women was 2.92, which is lower than the average satisfaction level. This reflects the difficulty experienced by women owing to the poor working environment. Female laborers demanded strongly to improve the working environment and to increase the female laborers on site in the future.

In addition, the opinions on the improvement of the working environment at the construction site and the increase of the employment of female workers in the future are as follows; women are greater than men, engineers are greater than laborers, male engineers are greater than female engineers, and female laborers are greater than male laborers.

Table 10. Cross-analysis of gender division level of on-site facilities: Engineers-Laborers

		The gender division level of on-site facilities					Total
		Very insufficient	Insufficient	Average	Excellent	Very excellent	
Engineers	Frequency	14	67	168	79	13	341
	Ratio in engineers %	4.1	19.6	49.3	23.2	3.8	100.0
	Total %	1.6	7.5	18.7	8.8	1.4	38.0
Laborers	Frequency	61	106	272	84	34	557
	Ratio in laborers %	11.0	19.0	48.8	15.1	6.1	100.0
	Total %	6.8	11.8	30.3	9.4	3.8	62.0
Total	Frequency	75	173	440	163	47	898
	Total %	8.4	19.3	49.0	18.2	5.2	100.0
Pearson chi-square		value		df	asyp.sig.		
		21.661a		4	0.000**		

Table 11. Cross-analysis of satisfaction about the on-site facilities: Men-Women

		Satisfaction about the on-site facilities					Total
		Very unsatisfactory	Unsatisfactory	Average	Satisfactory	Very satisfactory	
Men	Frequency	30	93	306	236	46	341
	Ratio in Men %	4.2	13.1	43.0	33.2	6.5	100.0
	Total %	3.3	10.4	34.1	26.3	5.1	38.0
Women	Frequency	16	27	105	34	5	557
	Ratio in Women %	8.6	14.4	56.1	18.2	2.7	100.0
	Total %	1.8	3.0	11.7	3.8	0.6	62.0
Total	Frequency	46	120	411	270	51	898
	Total %	5.1	13.4	45.8	30.1	5.7	100.0
Pearson chi-square		value		df	asyp.sig.		
		26.054a		4	0.000**		

Table 12. Cross-analysis of perspective about increase of women participation: Men-Women

		Perspective about increase in women participation					Sum
		Very negative	Negative	Average	Positive	Very positive	
Men	Frequency	21	47	182	386	75	711
	Ratio % in Men	3.0	6.6	25.6	54.3	10.5	100.0
	Total %	2.3	5.2	20.3	43.0	8.4	79.2
Women	Frequency	4	4	40	100	39	187
	Ratio % in Women	2.1	2.1	21.4	53.5	20.9	100.0
	Total %	0.4	0.4	4.5	11.1	4.3	20.8
Sum	Frequency	25	51	222	486	114	898
	Total %	2.8	5.7	24.7	54.1	12.7	100.0
Pearson chi-square		value		df	asyp.sig.		
		19.034a		4	0.001**		

Table 13. Cross-analysis of status of convenience facilities in the next 10 years: Engineers-Laborers

		Status of convenience facilities considering women in the next 10 years					Total
		will not change	Will be recognized the need for change	will be similar to the current situation	will be slightly improved	will be actively improved	
Engineers	The number of respondents	3	31	56	220	31	341
	Ratio in engineers %	0.9	9.1	16.4	64.5	9.1	100.0
	Total %	0.3	3.5	6.2	24.5	3.5	38.0
Laborers	The number of respondents	38	105	97	183	134	557
	Ratio in laborers %	6.8	18.9	17.4	32.9	24.1	100.0
	Total %	4.2	11.7	10.8	20.4	14.9	62.0
Total	The number of respondents	41	136	153	403	165	898
	Total %	4.6	15.1	17.0	44.9	18.4	100.0
Pearson chi-square		value		df	asympt.sig.		
		102.817a		4	0.000**		

5. CONCLUSION

Considering the present status of the construction industry, the increase of the female workforce is inevitable. The participation of women is being accelerated by a variety of social factors such as the demographic changes due to aging and the low fertility rate and the change of the construction market such as remodeling project.

However, the working environment of construction sites is still very poor even for the male laborers due the characteristics of construction industry. Especially the temporary facilities are considered as the waste of money by site engineers, which results in the poor working environment especially for minority female engineers and workers. Therefore, when planning temporary facilities, it should be regarded as investment and implemented based on gender concepts, which should ultimately realize gender equality, accident-free construction sites, as follows.

First, the planner for the temporary facilities must consider from the laborer's point of view including women laborers.

Second, an estimation method for the number of laborers according to gender must be developed. A present estimation method for the temporary facilities has considered only the numbers of laborers regardless of gender. Through the empirical study to find the numbers of male and female laborers at construction sites according to construction progress, data on the ratio of men to women should be recorded and accumulated. And for this study, cooperation between government, industry and academia should be required. For the time being, we propose to use the data for employment status by the Ministry of Employment and Labor.

Third, the contract system needs to be improved so that the

concrete cost can be reflected in the contract in case of the installation cost increases owing to the separate facilities for minority female laborers.

Fourth, all concerned to construction industry shall keep the Act on the Employment Improvement, etc. of Construction Workers and the Authorities shall check regularly whether it is kept well.

This paper mainly deals with the working environment and the site management system of the largest construction companies. In order to ease the entry of the female laborers and realize the gender equality, further research is required about the status of small and medium-sized companies, engineering method including material and equipment. In addition, along with the women-friendly working environments, comprehensive policies should be studied and developed that can eliminate women's career break factors such as marriage, parenting, and menstruation leave so that the employed female laborers can continue to work.

Discovering and supporting female leaders to mentor other female laborers, and improving the company's image through the realization of gender equality are meaningful and related topics should be addressed.

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