Investigating the attitude of Guangzhou private university architecture graduates towards construction safety management

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Abstract

With the rapid economic and social development, there were more and more construction projects in China, which puts forward newer and higher requirements for construction safety. Safety management was an important part of the entire construction process. Doing a good job in safety management was not only conducive to ensuring the safety of construction personnel's lives and property, but also can greatly improve the quality of project construction and effectively reduce enterprise production costs. This paper analyzes the existing problems of construction safety management by consulting related documents, and then studies the attitudes of construction graduates of Guangzhou's private colleges and universities towards construction safety management, using literature collection methods and statistical procedures to analyze the data, and draw conclusions: 1. Personnel System management, attention to construction safety, and the severity of accidents have a significant positive impact on safety management attitudes, and reflect the existing problems of construction safety management from the side, and finally give suggestions to solve the problems. 2. Construction safety management was mainly the responsibility of management personnel and on-site construction personnel, followed by laws and safety management systems, and safety protection facilities. Based on the results, it was hoped that this research will enable construction graduates to realize the importance of safety management before entering the construction industry and pay attention to safety management in their future work. It was also hoped that this research will enable everyone in the construction industry to pay attention to safety management.

Keywords: building construction, building safety management, personnel and management system

1. Introduction

With the development of the global economy, the construction industry was also moving towards a new era: green buildings, energy-saving buildings, and smart buildings. These new concepts have put forward newer and higher requirements for the construction industry. Buildings were closely related to people's lives and work. Building users were most concerned about the quality and safety of buildings. Under the background of the continuous expansion of the scale of buildings, the difficulty of construction continues to increase. Some objective and subjective factors exist, which

bring certain quality and safety to the project. Safety hazards (Guo Manwei, 2020) from the perspective of enterprises, strengthening the safety management of construction can improve the economic benefits of construction enterprises, reduce unnecessary costs, and improve the reputation of an enterprise in the construction industry. From a social point of view, strengthening the safety management of construction could be standardized the management of the entire construction industry, reduced the occurrence of engineering construction, reduced the casualties of construction personnel, and improved the happiness of the people. This study explored the attitude of construction graduated towards construction safety management from the perspective of construction graduated. When Yu Jingyu studied the relevance of college students' employment and majors, he found that 55 percent of graduated were engaged in occupations related to their majors, and 17 percent of graduated were engaged in occupations that were exactly the same as their majors (Yu Jingyu, 2017). Which mean that more than half of architectural graduated will be engaged in construction-related jobs. Therefore, this article took construction graduated as the main body, and their views reflected the basic attitudes of people with construction knowledge towards construction safety management. The purpose of this research was to reflect what factors will affect their attitudes toward construction safety management, and indirectly reflected the reason of the problems in construction safety management, and finally gave suggestions on method to alleviate the problems existing in construction safety management.

2. Literature review

2.1 Concept definition

In the process of company management, safety management took safety as the intention. The basic task was to discover, analyze and eliminate various risks in the production process, prevented the probability of incidents, reduced unnecessary losses, and ensured employees' health, personal safety. Safety management effectively promoted the smooth development of the company's production and improved the company's social and economic benefits. It was the general term for program activities, organization activities, coordination and control activities surrounding security (Song Shichao, 2017). Liu Jidong believed that construction safety management refered to the behavior of achieving the goal of eliminating or reducing accidents in construction projects through specific arrangements, coordination, and control methods (Liu Jidong, 2019). Jianghua believeed that construction safety management mainly refered to the management activities of construction-related departments and enterprises in accordance with relevant laws, regulations and technical standards to plan, organized, commanded, controled, supervised, adjusted and improved the safety of construction (Jianghua, 2016).

2.2 Domestic and international research

Despite the used of traditional and novel approached to improve construction safety management, safety performance in the construction industry was still considered as poor, especially when compared with other US industries (Ifeanyi Okpala, et al.,2020), compared with other industries in the world, the construction industry had the highest accident rate (C.Q. Poh, 2018).

In order to minimize the problem of high accident rate in the construction industry, the European Directive 92/57/EEC stipulated mandatory safety and health requirements and stipulated a safety and health plan (Martínez Rojas María, et al, 2020). After analyzed the industrial accidents in the construction industry in Jeddah, it was concluded that the main cause of accidents and injuries in the construction industry in Jeddah was lack of occupational safety awareness and experience of workers (> 82%).The most common types of accidents and injuries was felt from heights (80%) and were electrocuted (60%) (Abukhashabah Emad, 2020). The occurrence of construction accidents not only caused serious losses to the construction of the project, but also posed a serious threat to the life and safety of construction personnel. The high accident rate mean that companies and even the government must strengthen preventive measuring to reduce the accident rate. Xie Jingwen showed in his research that the management personnel of some construction enterprises lacked the awareness of safety responsibility, which not only reduced the level of safety management in construction, but also increased the possibility of potential safety hazards during construction. After a safety accident, there was a phenomenon of shirking responsibilities, which greatly reduced the safety management effect of the construction site, and could not effectively play the important role of safety management (Xie Jingwen, 2020).

Look at the relevant literature, there were not too many studies on the use of data to reflect the problems and measured in the safety management of building construction. The previous research mainly focused on directly reflecting the existing problems and finding solutions. In addition, there were few studies that take into account the views of students. The future was an era when knowledge changed fate. The current and future construction industry will be led by college students who had studied professional knowledge. Most of them would be directly engaged in construction-related work. If they were allowed to pay attention to the safety management of construction, then in the future, in their era, the safety accidents in the construction industry may also decreased.

3. Research methods

This research mainly used three methods, namely: literature analysis, questionnaire survey, and quantitative analysis. In the past 10 years, the development scale of higher education in Guangdong Province had reached an unprecedented level in history (Lu Xiaozhong, 2003). Higher education in Guangdong Province had achieved a gradual expansion in scale by increasing investment and improving the efficiency of running schools (Chen Xiaojuan, 2016). The higher investment in higher education, the wider ways for students to learn professional knowledge. Therefore, the sample range selected for this study was the higher education institutions in Guangdong Province. In addition, more than half of China's higher education institutions were clustered in municipalities and provincial capitals with strong comprehensive strength in politics, economy, and technology (Shi Meng, 2016). Therefore, the provincial capital city of Guangdong Province, Guangzhou City was further selected. Compared with students from public universities, students from private universities were more concerned about their own development and employment situation after graduation (Tian Jianwei, 2018). The more private college students cared about their development after graduation, the more

they knew about their professional fields. Therefore, on the basis of the previous research, a private university in Guangzhou was selected for this study. By looking up the official website of the Guangdong Provincial Department of Education, only six universities have been established a major in architecture. Therefore, 600 questionnaires were distributed to those six universities equally. Through the research purpose of this article, first used the literature analysis method to find out what problems exist in the construction safety management, and then made the corresponding questionnaire, obtain the data to be studied through the questionnaire survey, and then used the quantitative analysis method, which included reliability analysis and effectiveness. Degree analysis, correlation analysis, regression analysis, using this method could get what factors will affect the attitude of construction graduates to construction safety management. Finally, the descriptive statistics method was used to find out the causes of problems in construction safety management and put forward suggestions to alleviate the problems of construction safety management.

4. Result analysis

4.1 Descriptive analysis

A total of 600 questionnaires were issued, as shown in Table 1, 494 data were recovered, of which 7 were invalid data and 487 were valid data. The recovery rate reached 82.33 percent, exceeding the expected 80 percent. From the questionnaire found that 98.6 percent of the 494 graduates survey believed that there was a problem with construction safety management, and the remaining 1.4 percent were invalid data (as shown in Table 1). Chen Shaohua stated in his research that construction safety management problems occur frequently, and the problem rate was second only to coal mine problems (Chen Shaohua, 2020). This showed that students who had not yet entered the construction industry realized that there were problems with safety management, the development of economy and technology. The problems of the construction industry had not improved, but became more and more serious. Architecture graduates had realized this problem before they enter the construction industry. Therefore, the construction industry must be reformed, not only changing other people's attitudes towards construction safety management, but also paying attention to safety management to reduce the occurrence of safety accidents.

Table 1: Basic attitude statistics

	Options	Quantity	Percentage
Q1. Do you think there are problems with safety management in the construction industry?	Yes	487	98.6%
	No	7	1.4%

4.2 Reliability analysis

Reliability reflected the consistency and stability of the scale's measurement results, that was, it measures the consistency of the results of different subjects' answers to the scale items at different times and situations. It was generally considered that the Cronbach Alpha coefficient was more than 0.7, Suitable (Liao Min, 2016). As shown in Table 2, this study was divided into four variables, which

were calculated by statistical procedures, the Cronbach's Alpha value of variable 1 "personnel and system management" was 0.766, the value of variable 2 "construction safety attention" was 0.898, the value of variable3 "incident awareness" was 0.804, and the value of variable4 "safety management attitude" was 0.804. The four Cronbach's Alpha coefficients were all greater than 0.7. The reliability analysis results shown the internal consistency of the four variables were very good, and all were at the acceptable level. Therefore, the scale of the questionnaire has good internal consistency and very high reliability. The Corrected Item and Total Correlation (CITC) of each topic included in personnel system management, construction safety attention, severity of accident, and safety management attitude was greater than 0.5. From the perspective of "deleting the Cronbach's Alpha value of this item", deleting any one of the questions will not cause Cronbach's Alpha value Increase, so the questions of the four variables meet the requirements.

Table 2: Reliability analysis

		Scaled average after deleting the item	Scaled variance after deleting the item	Corrected item and total correlation (CITC)	Cronbach's Alpha after deleting item	Cronbach's Alpha
Personnel and system management	Q2	12.2546	3.248	0.637	0.674	0.766
	Q3	11.9918	3.457	0.519	0.734	
	Q4	12.0021	3.311	0.536	0.727	
	Q5	12.0041	3.218	0.575	0.705	
construction safety attention	Q6	27.2279	17.086	0.614	0.891	0.898
	Q7	27.0411	15.192	0.787	0.875	
	Q8	27.3409	16.180	0.645	0.889	
	Q9	27.4723	16.501	0.680	0.885	
	Q10	27.3901	15.436	0.701	0.884	
	Q11	27.4538	16.043	0.678	0.885	
	Q12	27.3737	16.547	0.660	0.887	
	Q13	26.8789	16.802	0.711	0.884	
Severity of the accident	Q14	12.0103	3.611	0.674	0.729	0.804
	Q15	12.0308	3.828	0.579	0.774	
	Q16	12.0842	3.620	0.630	0.750	
	Q17	12.0903	3.609	0.596	0.767	
safety management attitude	Q18	7.8090	2.155	0.629	0.754	0.804
	Q19	7.4846	1.876	0.655	0.728	
	Q20	7.7043	1.995	0.670	0.710	

4.3 Validity analysis

Through the statistical procedures operation, an exploratory factor analysis was performed on 19 items, and the results were shown in Table 3. The Kaisar Meyer Olkin (KMO) value was 0.899 greater than 0.5. At the same time, the results of Bartlett's sphere test show that the approximate chi-square value comparison was 4124.404, and the probability of significance was 0.000 (P value was less than 0.05). Explain that the survey data was suitable for factor analysis. According to the lithotripsy chart as figure 1, there was an inflection point at the fifth factor, so it was set to extract 4 factors. The principal component method was selected for extraction (see Table 4 exploratory factor analysis), and the cumulative variance explanation rate of the four factors was 62.546 percent, indicated that the four common factors extracted in this study could effectively explained the 19 questions of this research questionnaire, and achieve reduction dimension. After using the direct oblique method to rotate, the load of each item on the factor was greater than 0.50 and there was no multiple load, and the factor structure was clear. Factor 1 was named as the importance of building safety, which contained 8 questions, factor 2 was named as the severity of the accident, contained 4 questions, factor 3 was named as personnel system management contained 4 questions, and factor 4 was named as safety management attitude, contained 3 questions.

Table 3: KMO and Bartlett

KMO sampling appropriateness quantity		0.899
Bartlett's sphericity test	Approximate chi-square	4124.404
	Degrees of freedom	171
	Significance	0.000

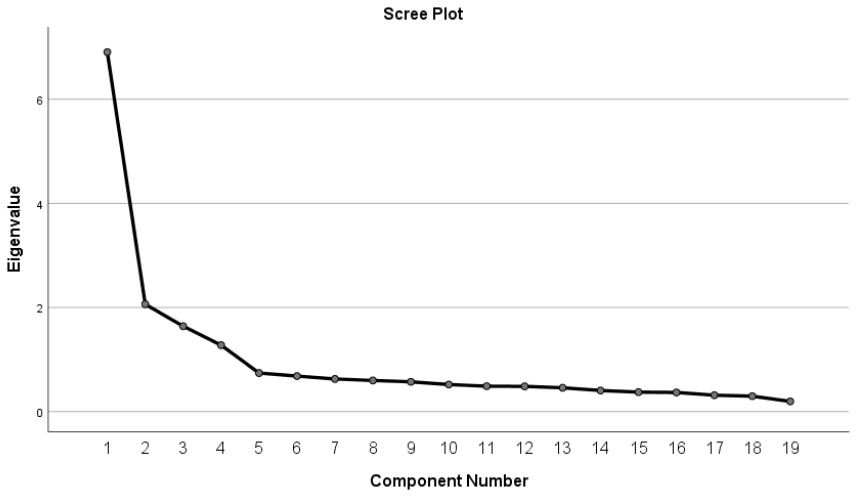

Figure 1 Inflection Point At The Fifth Factor

Table 4: Exploratory factor analysis

	Ingredient				
	1	2	3	4	Degree of commonality
Q6	0.694				0.734
Q7	0.805				0.705
Q8	0.674				0.593
Q9	0.733				0.59
Q10	0.778				0.547
Q11	0.681				0.546
Q12	0.716				0.509
Q13	0.762				0.556
Q14		0.786			0.632
Q15		0.741			0.561
Q16		0.757			0.603
Q17		0.707			0.627
Q2			0.826		0.684
Q3			0.716		0.645
Q4			0.66		0.593
Q5			0.718		0.596
Q18				0.806	0.711
Q19				0.784	0.718
Q20				0.784	0.732
Eigenvalue	6.906	2.062	1.64	1.276	-
Variance contribution rate%	24.254	14.143	12.859	11.291	-
Cumulative contribution rate%	24.254	38.396	51.255	62.546	-

4.4 Correlation analysis

Correlation analysis adopts the Pearson correlation coefficient estimation, the absolute value of the Pearson correlation coefficient was between 0 and 1. Generally speaking, the absolute value of the correlation coefficient was less than 0.3 as a low correlation, and 0.3 to 0.6 was a medium degree of correlation., 0.6 or more was high correlation. It can be seen from Table 5 that personnel system management ($r = 0.327$, significant $P < 0.01$) has a significant positive correlation with safety management attitude; construction safety attention ($r = 0.436$, $P < 0.01$) has a significant positive correlation with safety management attitude Relationship: The severity of the accident ($r = 0.461$, $P < 0.01$) has a significant positive correlation with safety management attitude.

Table 5: Correlations analysis

		Personnel and system management	construction safety attention	Severity of the accident	safety management attitude	M	SD
Personnel and system management	Pearson Correlation	1	0.412**	0.387**	0.327**	4.021	0.584
	Sig. (2-tailed)		.000	.000	.000		
	N	487	487	487	487		
construction safety attention	Pearson Correlation	0.412**	1	0.421**	0.436**	3.880	0.550
	Sig. (2-tailed)	.000		.000	.000		
	N	487	487	487	487		
Severity of the accident	Pearson Correlation	0.387**	0.421**	1	0.461**	4.018	0.618
	Sig. (2-tailed)	.000	.000		.000		
	N	487	487	487	487		
safety management attitude	Pearson Correlation	0.327**	0.436**	0.461**	1	3.833	0.676
	Sig. (2-tailed)	.000	.000	.000			
	N	487	487	487	487		
**. Correlation is significant at the 0.01 level (2-tailed).							

4.5 Regression analysis

Correlation analysis can only simply describe the role of two variables, and cannot exclude the interaction between influencing factors. Therefore, we need to further adopt linear regression analysis. Linear regression can exclude the interaction between independent variables and get the relationship between independent variables and dependent variables. For example, as shown in Table 6, the multiple regression analysis was carried out with personnel system management, construction safety attention degree, accident severity as independent variables, and safety management attitude as the dependent variable. The results show that there was no serious collinearity problem between the independent variables (VIF was between 1.291-1.334), and the regression model fits well, $F = 66.258$, $P < 0.001$, $R^2 = 0.292$. The three attitudes towards safety management were statistically significant. The regression equation was: safety management attitude = 0.744 + 0.113* a1 + 0.326* a2 + 0.342*a3 (a1: personnel system management, a2: construction safety attention degree, a3: accident severity). Personnel system management ($\beta = 0.097$, $P < 0.05$) has a significant positive impact on safety management attitude; construction safety attention ($\beta = 0.265$, $P < 0.001$) has a significant positive impact on safety management attitude; accident awareness ($\beta = 0.312$, $P < 0.001$) has a significant positive impact on safety management attitude

Table 6: Coefficientsa

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	0.744	0.229		3.252	0.001		
Personnel and system management	0.113	0.050	0.097	2.236	0.026	0.775	1.291
construction safety attention	0.326	0.054	0.265	5.986	0.000	0.750	1.334
Severity of the accident	0.342	0.048	0.312	7.151	0.000	0.768	1.302
R^2	0.292						
$\triangle R^2$	0.287						
F	66.258***						
a. Dependent Variable: safety management attitude ***P < 0.001							

5. Conclusion and recommendations

5.1 Conclusion

For this part of the students who collected data, through this questionnaire, they can reflect their understanding of the current situation of the construction industry and understand what problems there are in the construction industry. If they can turn these problems into motivation to engage in the construction industry in the future, then construction accidents may be reduced.

From the questionnaire data, we can know that: personnel and system management, construction safety attention, and accident severity all have a significant positive impact on safety management attitudes. These three factors will affect the attitude of construction graduates to construction safety management. Whether in the construction industry or in the construction industry, the more attention to construction safety, the better the students' attitude towards safety management. This shows that if the importance of building safety can be emphasized, not only will students' attitudes towards safety management become better, but more importantly, building safety accidents due to insufficient attention to building safety will also be reduced accordingly. The more serious the accident, the poorer the students' attitude towards safety management. In addition, personnel and system management were mainly embodied in four aspects, namely, legal and safety systems, safety protection facilities, management personnel and construction personnel.

In his research, Wang Jianquan showed that the implementation of the legal system related to construction safety management was insufficient, and the on-site system was not perfect (Wang Jianquan. 2020), and in Table 7, the reasons that affect the construction safety management (as shown in Table 7) Was mainly due to insufficient enforcement of laws and security systems (51.5%), followed by insufficient laws and security systems (33.5%). When analyzing the causes of construction accidents, Xiong Junhui showed that the imperfect safety facilities of construction companies led to safety accidents in buildings (Xiong Junhui, 2019). In this study, the proportion of poorly managed safety

protection facilities was 65percent. When researching the problems in construction safety management, Ren Qi found that in construction management, some project leaders paid more attention to the construction period and progress of the project, and did not pay much attention to safety in production, which would also cause the development of safety supervision work. Adverse effects (Ren Qi, 2020). In Table 7, the proportion of managers who do not pay attention to safety management was 65.9percent. Gao Yang said: The construction workers have insufficient understanding of the importance of safety management, and they did not actually construct in accordance with relevant safety management standards (Gao Yang, 2020). In this study, the proportion of construction workers who lack safety awareness was 54.8 percent.

Therefore, the enforcement of laws and safety systems was not strong enough, the management of safety protection facilities was not in place, the managers do not pay attention to safety management, and the safety awareness of construction personnel was not enough. These four aspects were the reasons for the problems in construction safety management.

Table 7: Reasons and suggestions

		Number	Percentage
Q21. In your opinion, which factor of the law and safety system has the greatest impact on construction safety management?	Inadequate supervision of laws and security systems	66	13.6%
	Insufficient enforcement of laws and security systems	251	51.5%
	The law and security system are not perfect	163	33.5%
	Others	7	1.4%
Q22. What do you think should be done to solve the impact of laws and safety systems on construction safety management?	The government must constantly update the law and security system	66	13.6%
	The government strengthens the enforcement of laws and security systems	249	51.1%
	The implementation of government regulation law and security system	163	33.5%
	Others	9	1.8%
Q23. What do you think, what factor of safety protection facilities of construction safety management have the greatest impact?	Safety protection facilities design does not comply with the requirements	53	10.9%
	Safety protection facilities management does not reach the designated position	317	65.1%
	Safety protection facilities to be of poor quality	111	22.8%
	Others	6	1.2%
Q24. What do you think, in order to solve the security protection facilities of construction safety management, how should do?	Safety protection facilities design standard	58	11.9%
	To strengthen the management of safety protection facilities	316	64.9%
	Strengthen the quality inspection of safety protection facilities	108	22.2%
	Others	5	1.0%

		Number	Percentage
Q25. What do you think, management of which factors the biggest impact on construction safety management?	Managers do not take the safety management work	321	65.9%
	The management personnel did not supervise the operation of the construction personnel to meet the requirements	120	24.6%
	Managers do not take the safety management work	40	8.2%
	Others	6	1.2%
Q26. Do you think, in order to solve the management of construction safety management, how should do?	Managers must first strengthen safety awareness	324	66.5%
	To strengthen the supervision of all security work	115	23.6%
	Strengthen the management of the safety training before taking up their	42	8.6%
	Others	6	1.2%
Q27. Do you think, which factors on construction safety management of construction personnel have the greatest impact?	Construction personnel safety awareness is not enough	267	54.8%
	The quality of construction personnel is relatively low	176	36.1%
	Construction personnel qualifications do not meet the requirements to enter the site construction	41	8.4%
	Others	3	0.6%
Q28. What do you think should be done to address the impact of construction personnel on building safety management?	Strengthen the safety awareness of construction personnel	254	52.2%
	Strengthen the safety education of construction personnel	200	41.1%
	Strengthening the qualification examination of construction personnel	30	6.2%
	Others	3	0.6%
Q29. Which of the following causes causes a "falling height" construction safety accident	Protective measures are not in place at the height	89	18.3%
	Construction personnel safety awareness is not enough, illegal operation	195	40.0%
	Management personnel for construction personnel safety management is not in place	200	41.1%
	Others	3	0.6%
Q30. Which of the following reasons leads to the occurrence of "electric shock" construction safety accidents	The construction site management is chaotic	181	37.2%
	Electrical equipment is not safe and is not maintained regularly	93	19.1%
	The construction personnel operate in violation of regulations	209	42.9%
	Others	4	0.8%

		Number	Percentage
Q31. Which of the following causes causes "object strike" construction safety accidents to occur	The construction site management is chaotic	199	40.9%
	The equipment is not safe and is not maintained regularly	83	17.0%
	The construction personnel operate in violation of regulations	201	41.3%
	Others	4	0.8%
Q32. Which of the following reasons leads to the construction safety accident of "cave-in"	The construction personnel violated the technical specifications and did not pay attention to the requirements of safety management	205	42.1%
	The managers didn't manage it properly	217	44.6%
	There are some problems in the design of foundation pit structure	63	12.9%
	Others	2	0.4%

5.2 Recommendations

5.2.1 Recommendations for students

The subject of this survey --- architectural graduates, they will also enter the construction industry as "construction workers" or "managers" in the future. Therefore, I hope these architectural students. The problems in the construction industry learned in this questionnaire can be transformed into a motivation to learn more professional knowledge. After entering the construction industry, safety was the first of practical work and the importance of safety in construction.

5.2.2 Recommendations for the construction industry

This study collects the attitudes of construction graduates towards construction safety management, reflecting that they were also aware of the importance of safety management. Accidents occur frequently in the construction industry. If no measures were taken, the frequency of accidents and the number of casualties will only increase. Therefore, the construction industry must proceed from two perspectives. For managers, first enhance safety awareness, put interests behind safety, and it was absolutely forbidden to ignore the importance of safety management in order to maximize interests. Secondly, it was necessary to supervise all construction activities in accordance with the safety management system, whether it was college students who have professional knowledge as a basis or migrant workers who have not systematically learned professional knowledge. To conduct safety training, it must not be a mere formality, but a real implementation. Those who were not qualified for the training were not allowed to enter the construction site. For the construction personnel, first of all, they must strengthen their safety awareness, and they were not allowed to enter the construction site without wearing safety protection facilities. The construction personnel must standardize the operation steps, especially for migrant workers, not only operate based on work experience, but must refer to the safe construction standard for their own behavior. In addition, construction units must strengthen the management of safety protection facilities (accounting for 64.9

percent), and the construction industry must also standardize safety management laws and systems, and continuously improve them to adapt them to actual construction on site.

5. Acknowledgement

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