The quality control method of the self-compacting concrete using the testing apparatus for self-compactability evaluation

Hiroyuki AOKI, Production Engineering Dept, Tokyo Gas Co., Ltd, Japan
○ Masanori KUBO, Civil Engineering Technology Div, Obayashi Corp., Japan*1
Shigeru SUGANO, Civil Engineering Construction Div, Obayashi Corp., Japan
Masahiro OUCHI, Kochi University of Technology, Japan

1.Introduction

Self-compacting concrete (SCC) was adopted in the lower side wall of the LNG underground storage tank at Tokyo Gas Ohgishima terminal. Though this tank is big structure, the inside area is very small (Fig.1). Concrete was placed 3 times, and around 1700-2700m^3 was placed once. Therefore, self-compacting concrete needs characteristic of the high flowability in addition to the narrow space passage performance. As for SCC, the quality control is important, and there is more frequency of sampling inspection than usual concrete. In this case, the frequency of sampling inspection increases in proportion to the much amount of concrete placed. Therefore, the testing apparatus for self-compactability evaluation[1] which could judge a self-compacting was improved, and we investigated whether the flowability and viscosity could be judged.

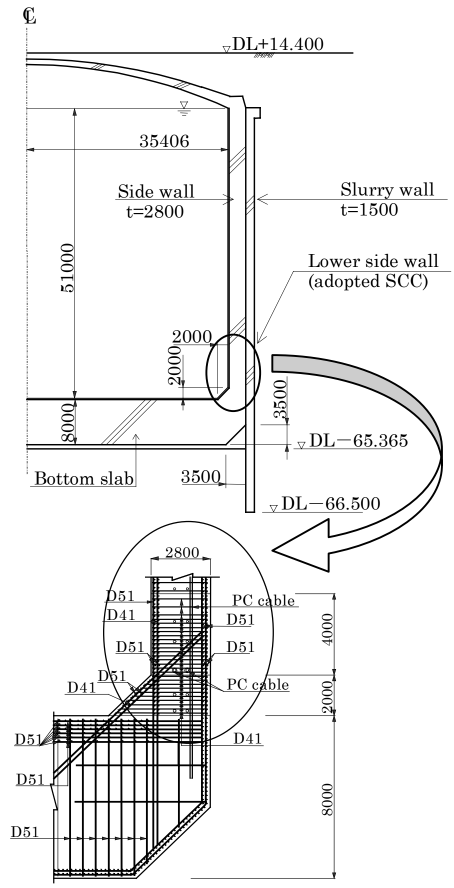

Fig.1 Structure of LNG underground storage tank

2. The mix proportion of SCC

The mix proportion of the side wall concrete is the high strength of the design strength 60N/mm^2 (Table 1). Cement is low heat portland cement, and lime stone powder which has high blaine value is mixed. Chemical admixture of air entraining and superplasticizer is a polycarboxylic acid type are used. Since it was necessary to secure the flowability because of 2.8m thickness of the wall, slump flow was used as an index of the flowability, and the target value was set to be 60-70cm. Moreover, there were much placing concrete simultaneously, and we had to raise a placing speed, so O-funnel time was used as index, and the target value was set to be 9-15 seconds.

Table 1 Mix proportion

W/C (%)	W/P (%)	s/a (%)	Unit quantity (kg/m^3)					SP (P×%)
			W	C	LF	S	G	
38.0	30.2	52.4	160	421	108	858	810	1.4

P=C+LF

3.Summary of experiments

The testing apparatus for self-compactability evaluation of the existent prototype[2] (the type No.1) is the box type with the obstacles of the reinforcing bars, and the concrete is evaluated the quality of self-compacting by passing through the obstacles of the reinforcing bars without any force (Fig.2). The improvement of the testing apparatus was tried based on the prototype. The dynamic force was reduced after the concrete bumped against barriers which were installed in the apparatus. The horizontal distance of the apparatus was lengthened to pass uniformly through the testing apparatus (Fig.3:the type No.2). The purpose of the improvement is as the following.

Key Words : self-compacting concrete, LNG underground storage tank, testing apparatus for self-compactability evaluation

*1 : Obayashi corp, Shinagawa Intercity B 2-15-2, Konan, Minato-ku Tokyo 108-8502, Japan, Phone : (03)5769-1324

(1) The flowability and viscosity are judged in addition to the narrow space passage performance, and the frequency of usual sampling inspection is reduced.
(2) The speed of placing plan is secured.

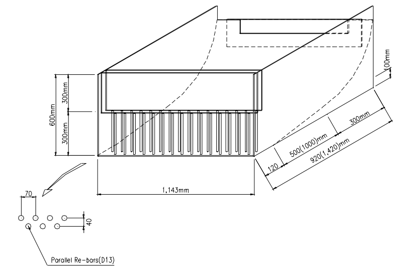

Fig.2 Testing apparatus for self-compability evaluation (the type No.1)

4. Experimental results

In case of the type No.1, even if slump flow and O-funnel time changed, there was no big difference in passage speed of the testing apparatus for self-compactability, and all concrete passed through the testing apparatus. When concrete was thrown into the testing apparatus from an agitator truck, the dynamic force is given to concrete. By the influence of this dynamic force, the flowability and viscosity were not appeared clearly, and the quality of the performance could not be judged. In case of the type No.2, Fig.3 and 4 show a tendency that the passage speed became slower as slump flow was smaller and O-funnel time was bigger. Concrete was blocked by barrier, in case of about 45cm of slump flow. Though the passage speed became slow, all the quantity passed through the testing apparatus in case of about 55cm of slump flow that was the lower limit value. Moreover, the U-type filling height did not reach at 30cm in case of being blocked with the testing apparatus for self-compactability evaluation. The opening size of barriers was 30cm or 25cm in the experiment. These figures show a tendency that concrete passed easily in case of the barrier opening size of 30cm (Fig.4～5).

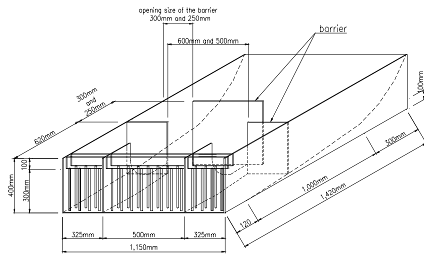

Fig.3 Testing apparatus for self-compability evaluation (the type No.2)

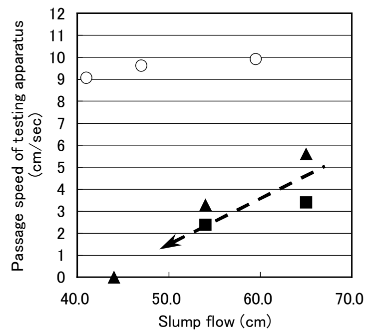

Fig.4 Relationship between passage speed of testing apparatus and slump flow

5. Conclusion

This time, barriers were installed in testing apparatus for self-compactability evaluation, and the evaluation of the flowability and viscosity was tried in the experiment to make the opening size of barriers appropriate. As a result, concrete which was extremely far from the standard limit value could be judged because the flowability was lost in the testing apparatus. The experiment showed a tendency that the passage speed in the testing apparatus became slower as the flowability was less and the viscosity was higher. Though it was difficult to judge the flowability and viscosity quantitatively, it is possible to catch the change appeared in the observed conditions of concrete passed through the testing apparatus for self-compactability evaluation. It was possible to save labor in the quality control by reducing the frequency of sampling inspection.

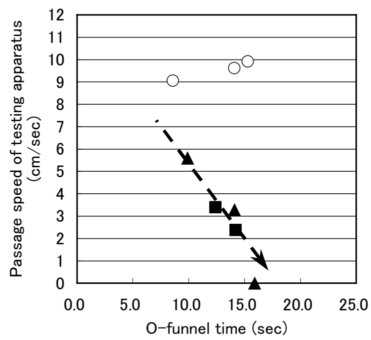

Fig.5 Relationship between passage speed of testing apparatus and O-funnel time

○: The type No.1
▲: The type No.2 (opening size of barrier: 30)
■: The type No.2 (opening size of barrier: 25)

Reference

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2. Ouchi, M, Ozawa, K, Okamura, H. Development of a Self-Compactability Testing Method for Acceptance at Job Site, The JSCE Seminar on Self-Compacting Concrete, No.19, pp89-94, 1997.5