V-147 A STUDY ON WORKABILITY LOSS DUE TO PUMPING OF SUPER WORKABLE CONCRETE

Somnuk TANGTERMSIRIKUL*
Takefumi SHINDOH*
Yasunori MATSUOKA*
Kazunao YOKOTA*

1. INTRODUCTION

Application of no-vibration super workable concrete with excellent filling ability has been attracting engineers' interest since high performance concrete was introduced many years ago. Since there is little experience on field practice, many problems are involved when utilizing this concrete in practice. One of them concerns workability loss when the concrete is conveyed by pumping[1]. Severe loss can limit the applicability of the concrete if the problem is not solved.

2. SCOPE OF THE STUDY

This paper provide informative data on some factors affecting workability loss due to pumping of the super workable concrete developed by the authors. Tests were conducted using a statically pressurized chamber with undrained condition, therefore, considered to simulate the condition of plug flow in straight pipe where shear is not the significant deformation mode. Undrained condition was selected because there have been no reports indicating water leakage during pumping and this is in accordance to the author's site observation. The parameters studied are level and pattern of pressure, also length of time after mixing.

3. EXPERIMENT

Apparatus consists of a pressurized chamber, in Fig.1., in which concrete samples were filled and pressurized with a piston. Pressure was applied to the concrete sample for a period of 5 minutes, corresponding to the time to move concrete from inlet to outlet of 5-inch pipeline with distance and rate of pumping of about 150m and 20 cu.m/hr., respectively. After being pressurized, slump flow and flow time of the concrete were measured. At the same time, the non-pressurized sample, collected from the same mixing batch of the pressurized one, was measured for the same data. Flow time was specified by the time when slump flow of concrete reached 50cm starting from removing slump cone[2].

Powder materials used were ordinary portland cement, blast furnace slag and fly ash. Superplasticizer was napthalene based and viscosity agent was a polysaccharide. Table.1 summarizes the mix proportions and conditions of test. Loading patterns which were designated by pattern 1 and 2 are illustrated in Fig.2.

4. TEST RESULTS AND DISCUSSIONS

Table.1 shows test results and the associated mix proportions and test conditions.

4.1 EFFECT OF LEVEL AND PATTERN OF PRESSURE

Fig.3 shows that slump flow loss occurred when the concrete was pressurized. It was considered by comparing cases 1 and 2 that pressure level did not have significant effect on slump flow loss. Also the condition of periodic loading did not cause more loss than the case of sustained loading.

It was confirmed by a preliminary test that absorption of the aggregates did not change

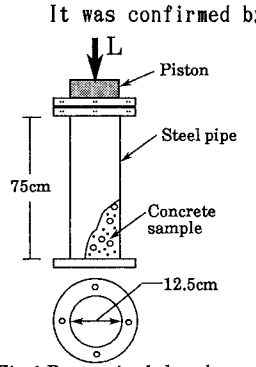

Fig.1 Pressurized chamber

Table.1 Cases of experiment and test results

Case	W (kg/m³)	Powder (kg/m³) P	Super plasticizer (%P)	Viscosity agent (kg/m³)	Air (%)	Pressure (kg/cm²)	Loading pattern	Slump flow (cm) Flow time (sec) (non-pressurized, pressurized) initial	30min	60min	120min
1	160	500	1.1	1.0	3.2	10	1	67.5 9	-	60.5,52.5 14,41	-
2	160	500	1.1	1.0	3.4	50	1	67.5 10	-	64.0,56.5 14,40	-
3	160	500	1.1	1.0	3.6	50	2	69.0 9	-	65.5,60.0 15,33	-
4	165	500	1.8	1.0	5.4	50	1	67.0 8	66.0,64.0 12,21	67.5,63.5 13,29	65.0,58.0 18,40

Powder proportion = Cement:Slag:Fly ash = 2:2:1, s/a = 45%

* Technology Research Center, Taisei Corporation

when applied by water pressure. This means that unlike the light weight concrete of which the aggregates are high in porosity, intake of free water into the aggregates when being pressurized is not the cause of workability loss in pumping. This is also confirmed by the test result which show independence of slump flow loss on the pressure level.

4.2 EFFECT OF LENGTH OF TIME AFTER MIXING

Shown in Fig.4 and Fig.5 are the results of slump flow and flow time versus length of time after mixing. Fig.4 indicates almost constant slump flow within 2 hours for non-pressurized sample. However, slump flow of the pressurized sample became smaller when the sample was pressurized at longer time after mixing.

Fig.5 shows that flow time of pressurized sample is greater than that of the non-pressurized one. This means that velocity of deformation decreases after being applied pressure. The value of flow time has been utilized by the authors to evaluate velocity of deformation[2]. The results also show that flow time of both non-pressurized and pressurized samples increase when time after mixing is longer and the increase of flow time of the pressurized sample is more severe. These results clarify that loss of deformability will be more arrogant when the concrete is to be pumped at longer time after mixing.

5. CONCLUDING REMARKS

These conclusions can be made based on the parametric studies on workability loss due to pumping of super workable concrete with a statically pressurized undrained test condition.

1) Loss of slump flow occurs when the concrete is pressurized.
2) The amount of slump flow loss is not dependent on the level of applied pressure. The periodic loading does not cause more flow loss than the case sustained loading.
3) Slump flow loss is more rigorous when the concrete is pressurized at longer time after mixing.

REFERENCES

1) Sakamoto, J., Tangtermsirikul S., Shindoh, T. and Matsuoka, Y., "Pumpability of Super Workable Concrete," Proc. of the 46th Annual Conference of JSCE, Vol.5, Sept., 1991, pp.624-625
2) Tangtermsirikul, S., Sakamoto, J., Shindoh, T. and Matsuoka, Y., "A Study on Velocity of Deformation of Super Workable Concrete," Proc. of the 14th Annual Conference of JCI, Jun. 1992

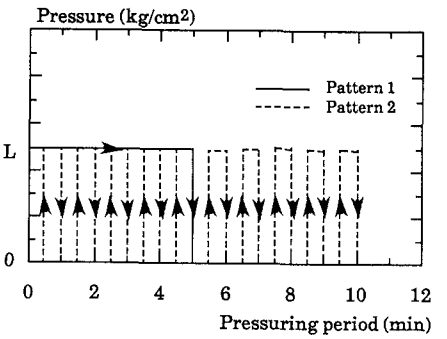

Fig.2 Loading pattern

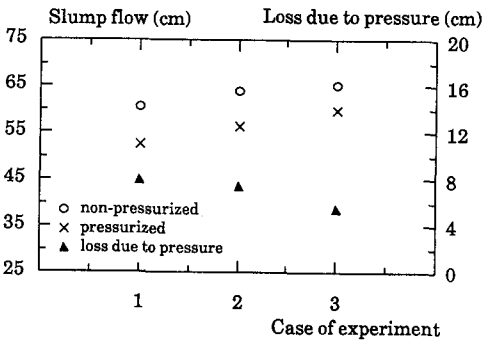

Fig. 3 Effect of level and pattern of loading

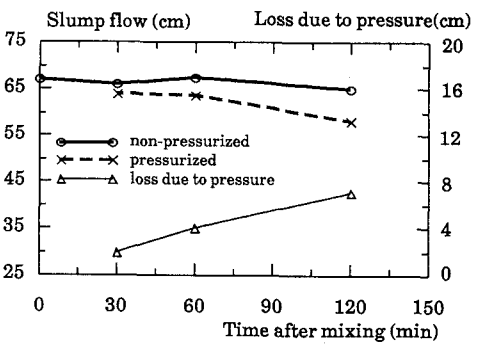

Fig.4 Effect of time after mixing on workability loss

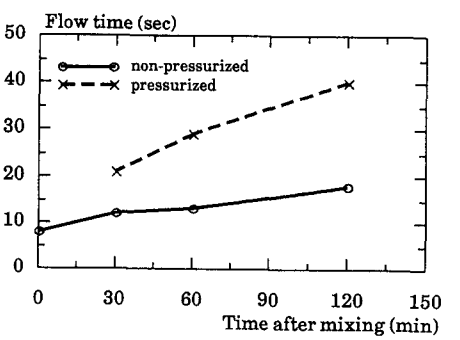

Fig.5 Effect of time after mixing on flow time