A Study on Estimation of Inner Part of Concrete using Elastic Wave Traveltime

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1. INTRODUCTION

It is difficult to predict the condition in concrete structures, and therefore, it is important to perform non-destructive tests to find local damage inside concrete. In this study, we investigated the possibility of estimation of the condition inside concrete, using the elastic wave traveltime.

2. OUTLINE OF TESTS

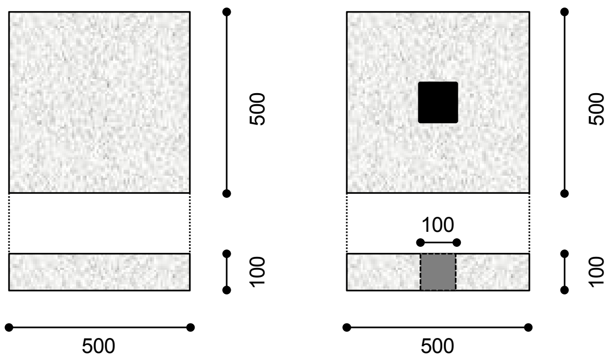
Two concrete specimens were prepared for this study. Each specimen measures 50cm wide by 50cm long by 10cm thick (Fig.1). One was a stuffed concrete specimen (Slab A) and the another a concrete specimen which includes a cubic rubber 10cm on each side in the central part of the specimen (Slab B). The mix proportion of concrete can be found in Table 1.

Both specimens were put on three fixed iron balls. We set 12 accelerometers on the side of the specimen as shown in Fig.2 and Fig.3. The 6 shooting points (SP) were selected for the tests (No.2,3,4,5,6 and 7), and the traveltimes at other 11 receiving points (RPs) were observed for each shooting point.

Vibration was introduced by hitting the point just 5mm above each accelerometer on each SP. Using the vibration, we measured the traveltimes between SP and RPs.

3. TEST RESULTS

The observed traveltimes are shown in Fig.4 and Table 2. Note that these traveltimes are mean values conducted through



a) Slab A　　b) Slab B

Fig.1 Specimen dimensions (unit in [mm])

Table 1 Mix proportion of concrete

Gmax [mm]	W/C [%]	Unit content [kg/m^3]				
		W	C	S	G	AE
15	62.6	176.1	281.3	799.7	1012.0	0.563

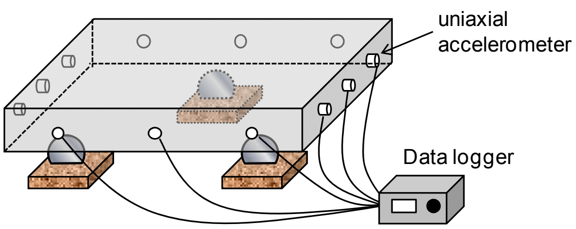


Fig.2 Traveltime observation system overview

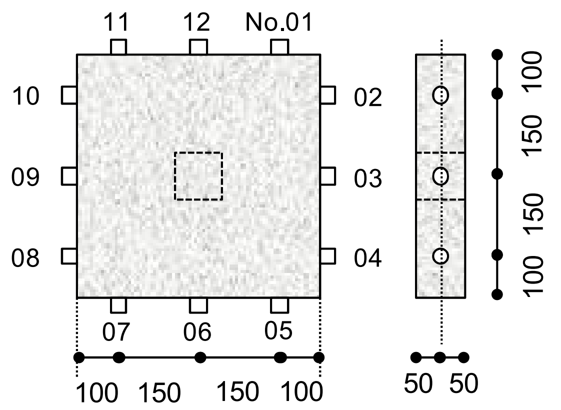


Fig.3 Arrangement of accerelometers (unit in [mm])

Keywords : Linear traveltime interpolation, Slowness distribution, Concrete slab

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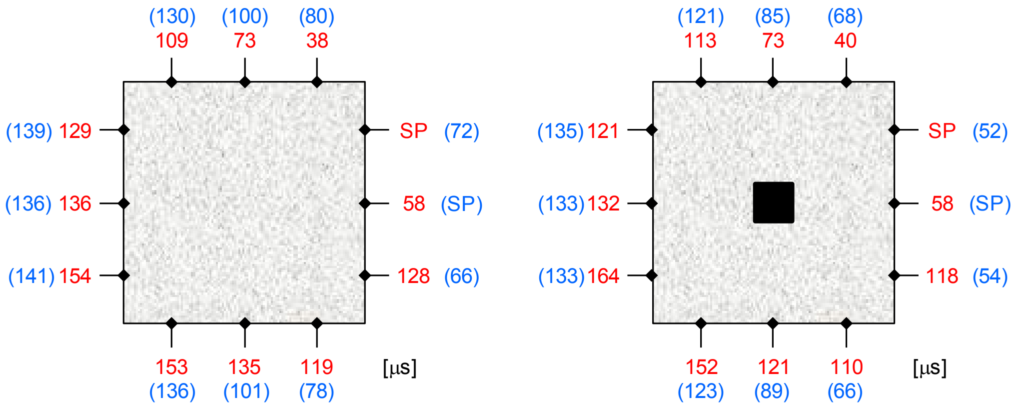
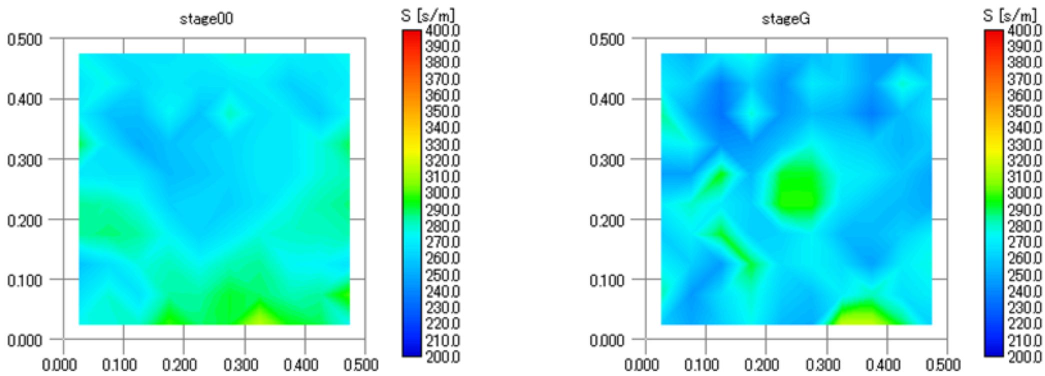


a) Slab A b) Slab B

Fig.4 Observed traveltimes between shotting points and receiving points (SP = No.02 and 03)

Table 2 Observed traveltimes [μs] between shotting points and receiving points (SP = No.04, 05, 06 and 07)

No.	01	02	03	04	05	06	07	08	09	10	11	12
Slab A	113	120	61	SP	36	70	116	129	139	148	153	129
	133	123	85	48	SP	88	132	121	145	156	161	146
	145	139	101	90	81	SP	73	80	103	135	137	131
	156	153	136	126	131	64	SP	40	83	116	131	137
Slab B	107	119	55	SP	40	80	116	131	138	159	154	125
	126	112	67	35	SP	63	111	117	134	164	163	138
	130	123	89	67	60	SP	60	74	95	130	124	133
	156	152	123	111	108	56	SP	32	60	105	118	128



a) Slab A b) Slab B

Fig.5 Analytical results of slowness distribution in the specimens

t-test statistical procedures.

4. ANALYTICAL RESULTS AND CONCLUSIONS

In this study, we apply the linear traveltime interpolation method which was suggested by Asakawa and Kawanaka to the analyses. The slowness distribution predicted by the method are shown in Fig.5. These figures indicate that slab B has the range with large slowness at the center of the slab, in comparison with that of slab A. From these analytical results, using traveltimes, it will be possible to estimate the condition inside concrete.

REFERENCES

1) E. Asakawa and T.Kawanaka : Seismic Tracing Using Linear Traveltime Interpolation, Geophysical Prospecting 41, pp.99-111, 1993