DYNAMIC RESPONSE BEHAVIOR OF REINFORCED CONCRETE COLUMN UNDER WATER

Saitama University, Student Member ○ Basit Sarfaraz
Saitama University, Regular Member, Takeshi Maki
University of Tokyo, Fellow Member, Koichi Maekawa

1. INTRODUCTION

Design of reinforced concrete structure under water, the influence of water was not considered in present codes and specifications. . It has been well known that the fatigue lifetime of reinforced concrete slabs in wet or saturated condition is relatively shorter than that in dry condition. Due to viscosity and incompressibility of water, at the rate of crack opening and closing, the water will entered in cracks and cannot move out of the cracks when the cracks are about to close. The closing of cracks, the resultant is very high water pressure induced in the cracks which may shatter and flatten the rough crack surfaces. The possible high internal water pressure due to the viscosity and incompressibility of water and the resultant smoothing of crack surfaces may lead to the reductions in the lateral capacity. Based on experimental consideration clarify the influence of water on the dynamic response behavior of reinforced concrete columns under water. Many bridge piers have been constructed under water over river and lakes. When these bridge piers were going into the seismic excitation under water, due to pressure of water on the opening and closing of cracks leads to a major change in stress distribution inside the concrete. Thus, this excited stress condition makes the enhancement in cracks and is effective in preventing failure. The damage potential is mainly based upon the influence of the water during the sever earthquake motion. The experiments have been performed to investigate the differences in the inelastic dynamic behavior of reinforced concrete bridge columns subjected to simulated input motion with different time duration in addition to columns were in air and in water. The dynamic behavior of reinforced concrete columns was evaluated by comparing the results of static tests with those of dynamic tests. Also presented were evaluations on the differences in the damage potentials of input motion by providing the two different medium. The main objective of this study was to investigate the possible enhancement of cracks and degradation of seismic performance of RC columns under influence of water.

2. EXPERIMENATL APPARATUS AND PROCEDURE

The cross sectional dimensions is shown in Fig. 1. Four specimens have been constructed with same structural details like longitudinal and shear reinforcement. Specimens are flexure dominant type with 16-D13 main reinforcement and D6 @ 50mm c/c shear reinforcement.

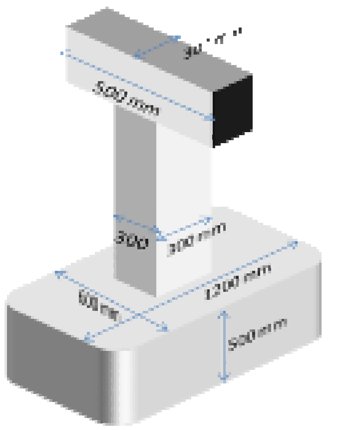

Fig. 1 Cross-section Dimension

Fig. 2: Arrangement into water tank

In order to investigate the internal behavior of reinforcement and concrete, strain gauges were attached especially at the plastic hinge location. For the external behavior of column laser displacement, level gauge and accelerometer were used. Experiment has been performed under dynamic cyclic loading. Input wave is sinusoidal wave with step by step increase in amplitude and two time repetition for each cycle. Displacement rate is Low (static) and high (dynamic) which is 1 mm/sec and 200 mm/sec maximum respectively. The test has been performed under two different as shown in plan of

Keywords: Plastic hinge, Dynamic cyclic loading, internal behavior
Contact Address: 255 Shimo-o-kubo, Sakura ku, Saitama shi, Saitama 338-8570, Japan, Mobile: 08044207860

loading in table. 1. The specimen is tested in air and water. Arrangement in water tank is shown in Fig. 2.

Table.1 Plan of loading

Column No.	Environment	Loading
1 & 2	air & water	static
3 & 4	Water & air	dynamic

3. RESULTS AND DISCUSSIONS

Dynamic response of the specimens is shown in Fig. 3, which indicates that response of the structure in term of displacement under two different state of loading with two different environments. In dynamic and static loading test the ultimate load carrying capacity is remain same. Result shows that the rate of strain does not affected on the ultimate load carrying capacity weather specimen is in water or in air. Ductility of the specimens is calculated at each maximum cycle of load. As shown in Fig. 4.

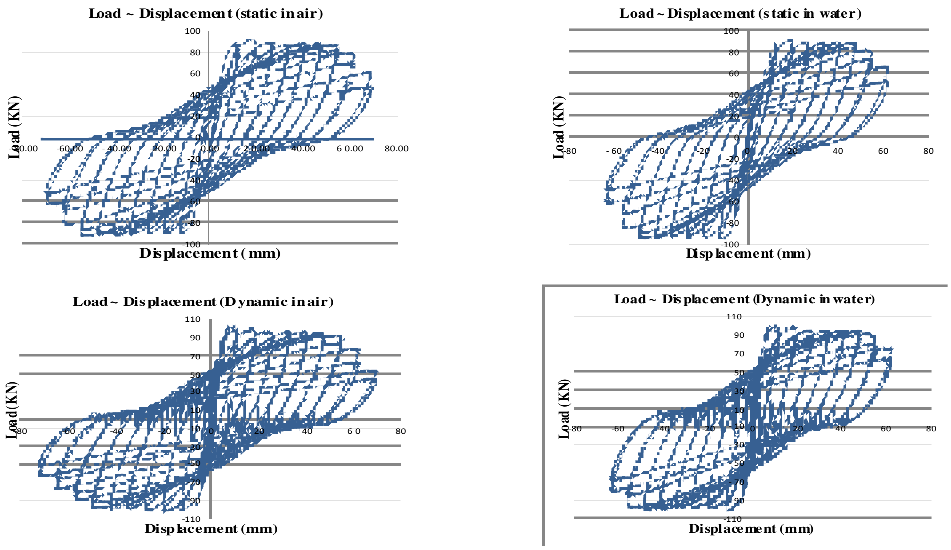

Fig. 3: Response of column in term of displacement (Static & Dynamic loading)

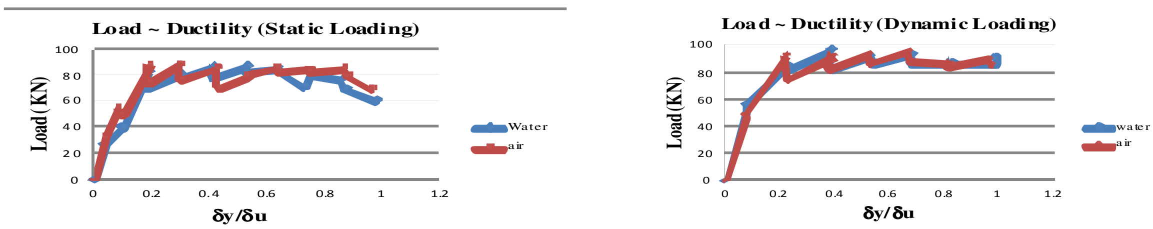

Fig. 4: Response of column in term of Ductility

4. CONCLUSIONS

Based on this study the following conclusions can be drawn

1. Strain rate does not affect on ultimate load carrying capacity of specimen under different environment.
2. Maximum load of the dynamically-loaded specimen was about 10% higher than that of the statically-loaded specimen both in air and in water.

5. REFERENCES`

Hong-Gun Park a, Eun-Jong Yu b, Kyung-Kyu Choi c; Shear-strength degradation model for RC columns subjected to cyclic loading; Engineering Structures 34 (2012) 187–197

H. Mutsuyoshi, A. Machida; Behavior of reinforced concrete member subjected to dynamic loading; JSCE vol. 354/ V-2 (1985-02)

Mahin, S.A, and V.V. Bertero; Rate of loading effects on un-cracked and repaired reinforced concrete members; Report no. EERC 72-9 Earth quake engineering research center Uni. Of California, Barkeley, December 1972.