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Wave Induced Flow in Seawater Exchange Structures for Improving Seawater Quality

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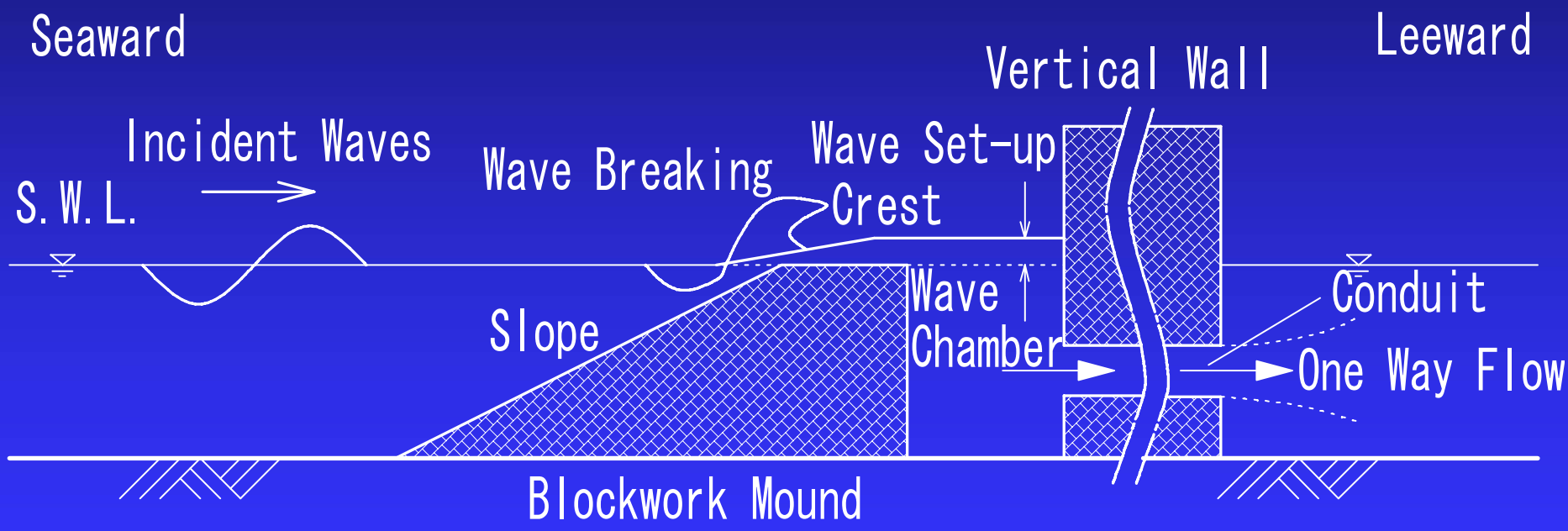
Purpose

Purpose of the study is to develop the seawater exchange structures based on the mechanism of wave set-up induced flow for the wide range of applicability. The mechanism was originally developed by Yamamoto *et al*. as a breakwater, in which one-way flow is excited by wave set-up in the wave chamber.

Both of physical model tests and theoretical considerations were employed in order to investigate hydraulic characteristics on the modified structures.

Figure - Mechanism of Wave Set-up Induced Flow in Seawater Exchange Structures with Blockwork Mounds



Experimental Setup

Hydraulic model test was carried out in a basin with regular waves.

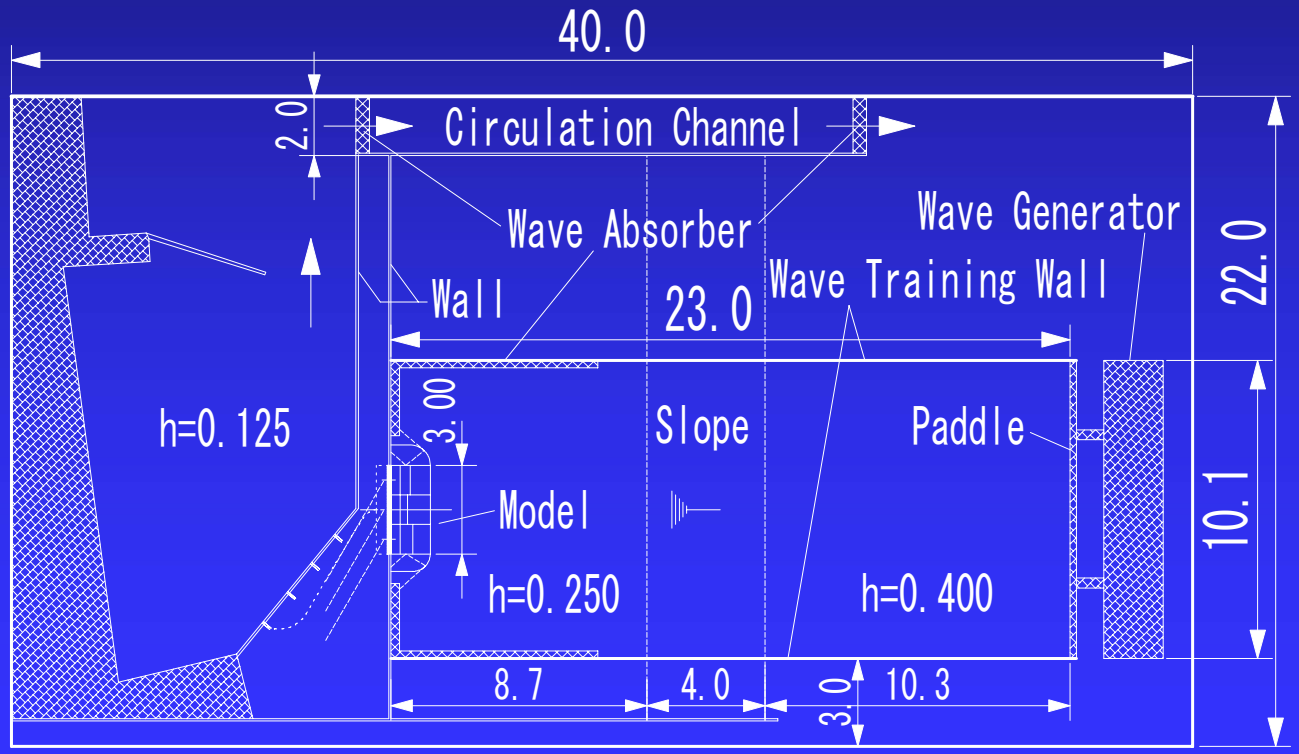
Wave Height: H_0=2, 4, 6, 8cm, Wave Period: T=1.0, 1.5s

Water depth (7 Levels): h=25.0, 28.1, 31.3, 34.4, 37.5, 40.6, 43.8cm

Typical measurement items:

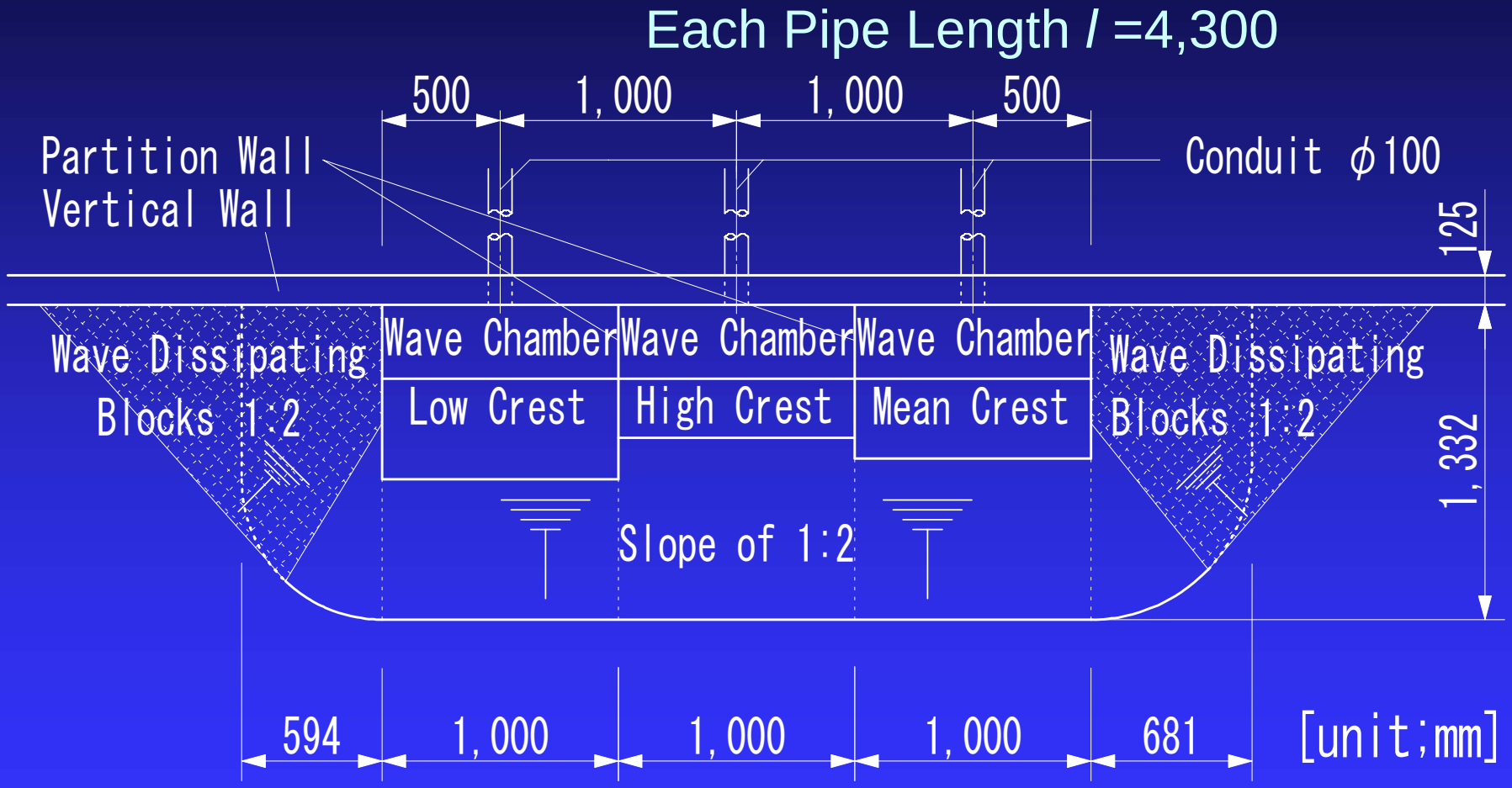
Surface elevation by capacitance type wave gages

Velocity in center of pipe at the exit by electromagnetic velocity meters



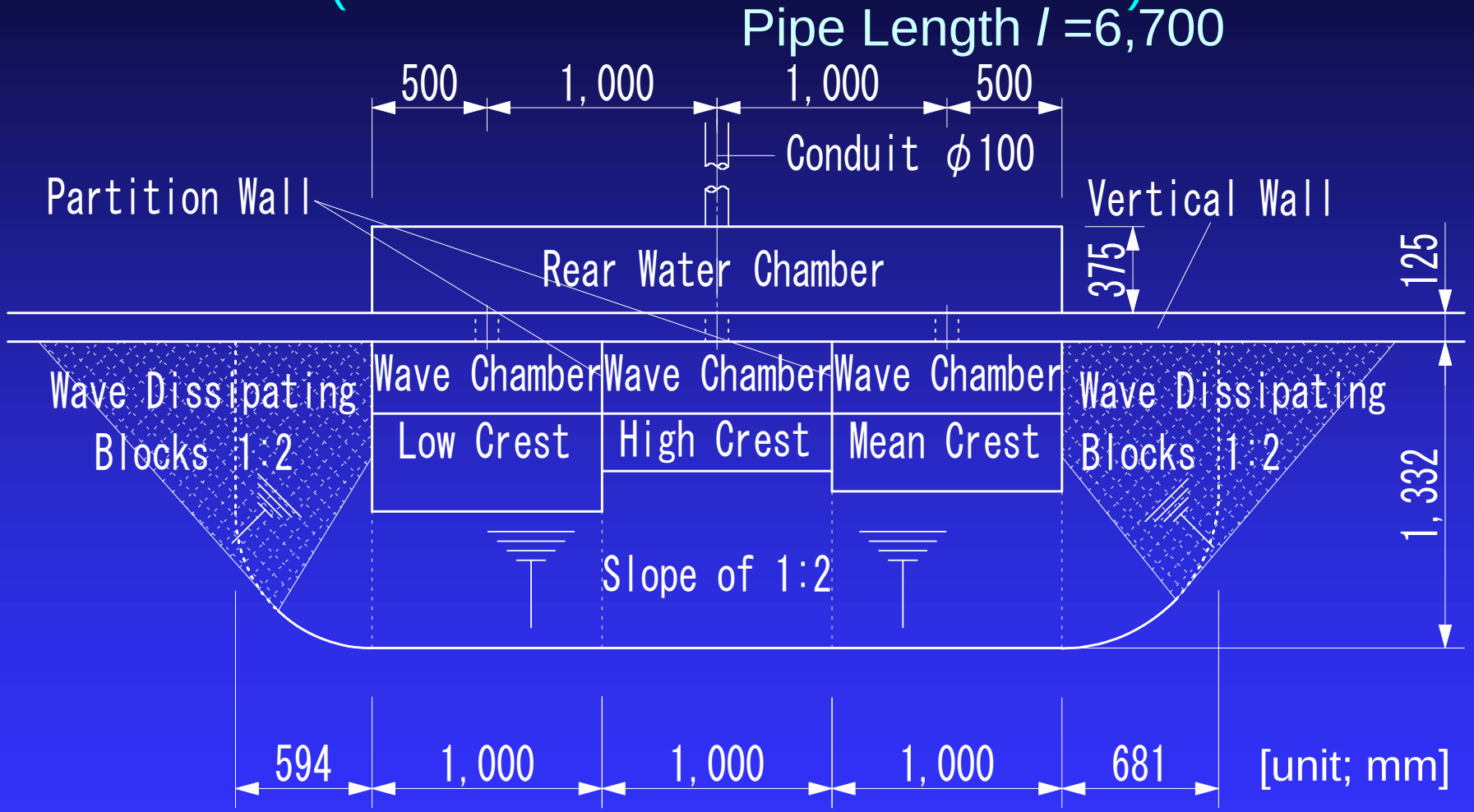
[Units in meters]

Figure - Specifications of the Basic Model in the Experiment
(Model Scale is about 1/10 to 1/20)



a) The basic model with 3 different crests heights

Figure - Specifications of the Modified Model in the Experiment
(Model Scale is about 1/10 to 1/20)



b) The modified model with rear water chamber

Figure – Cross Section of both Models

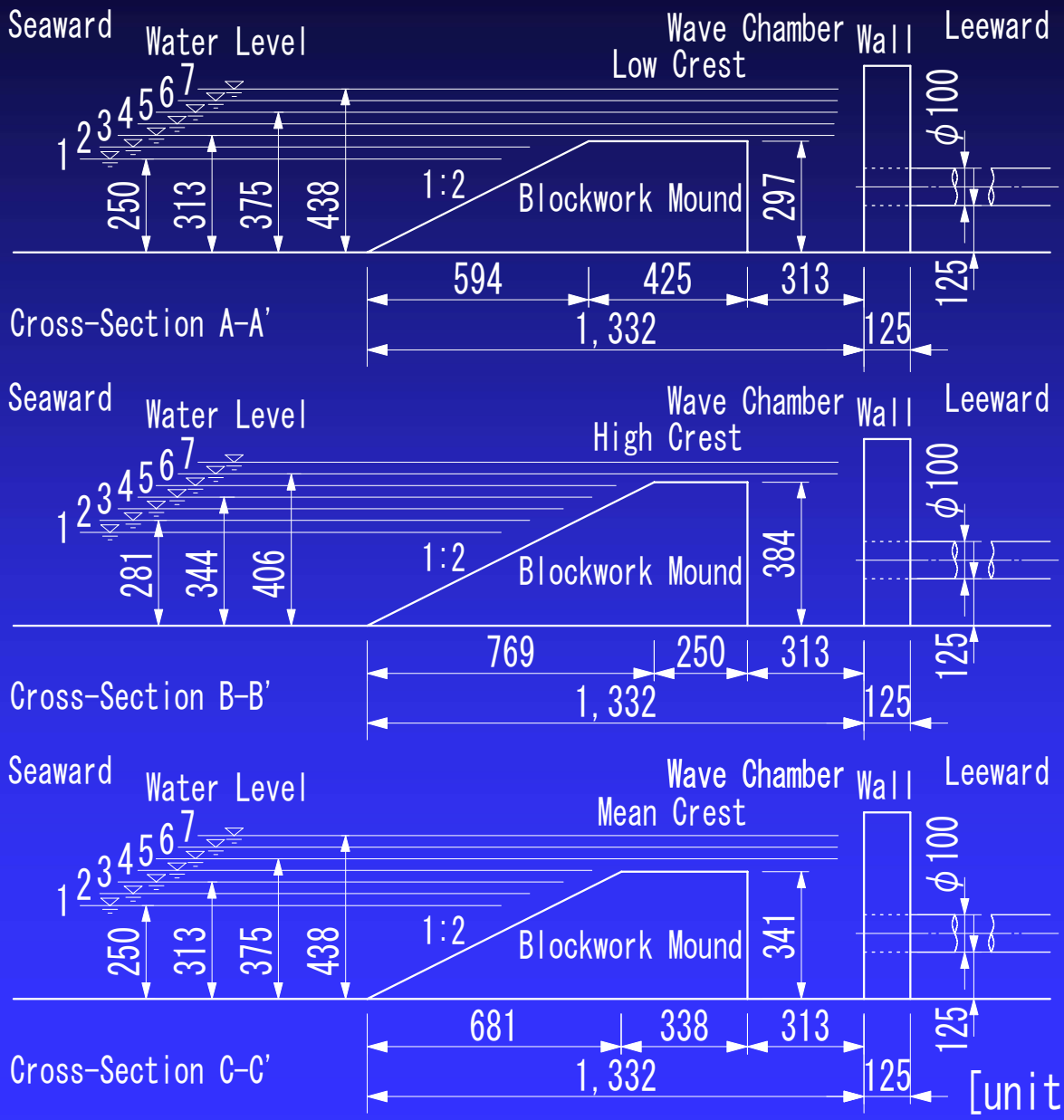
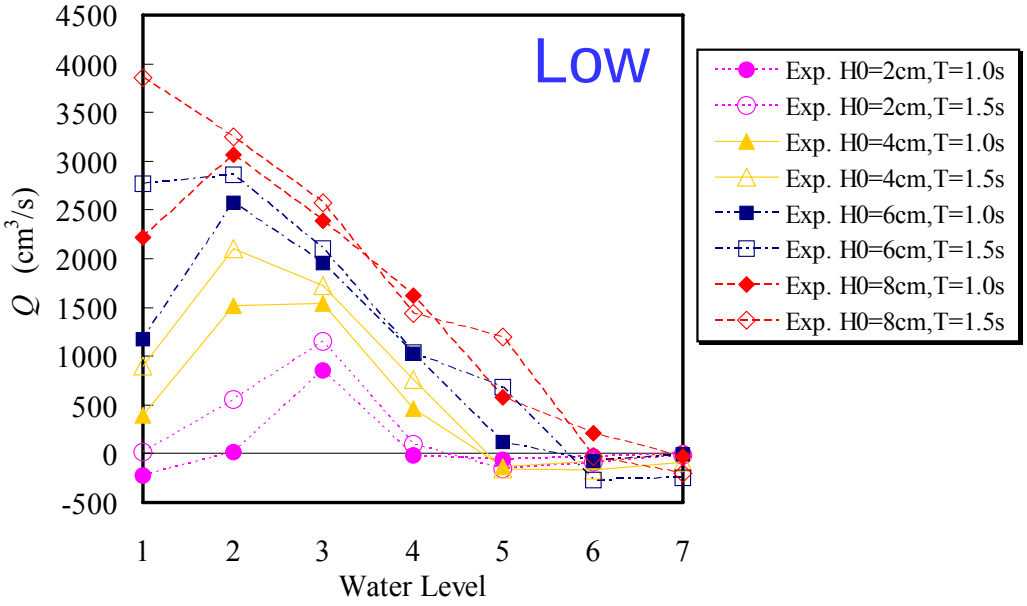
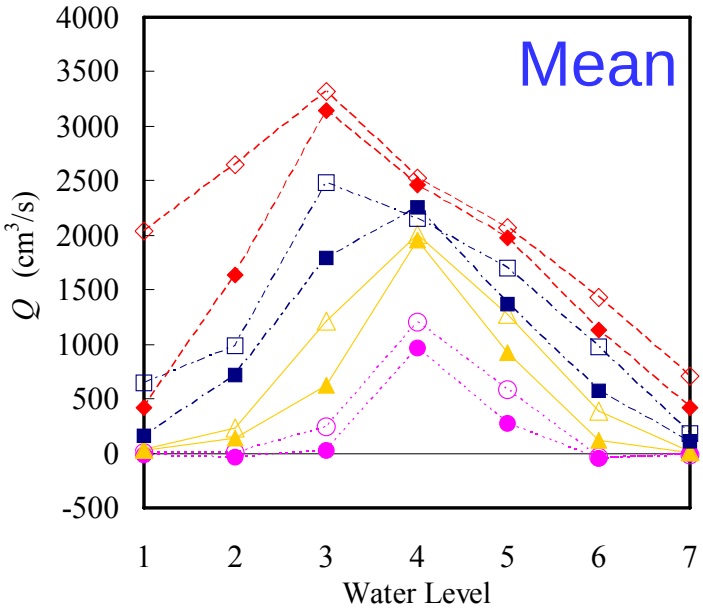


Figure - Volume Rate of Discharge for Inlet Flow from Each Mound for the Basic Model





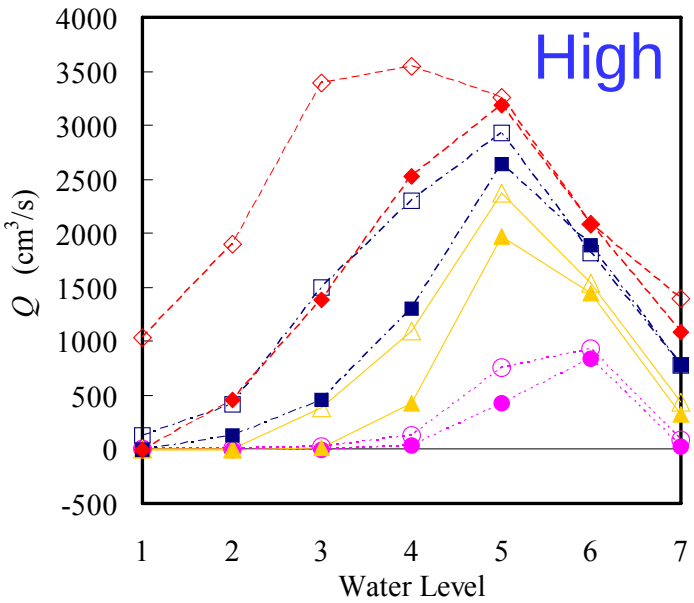


Figure - Time-averaged Water Transport Rate for the Basic Model

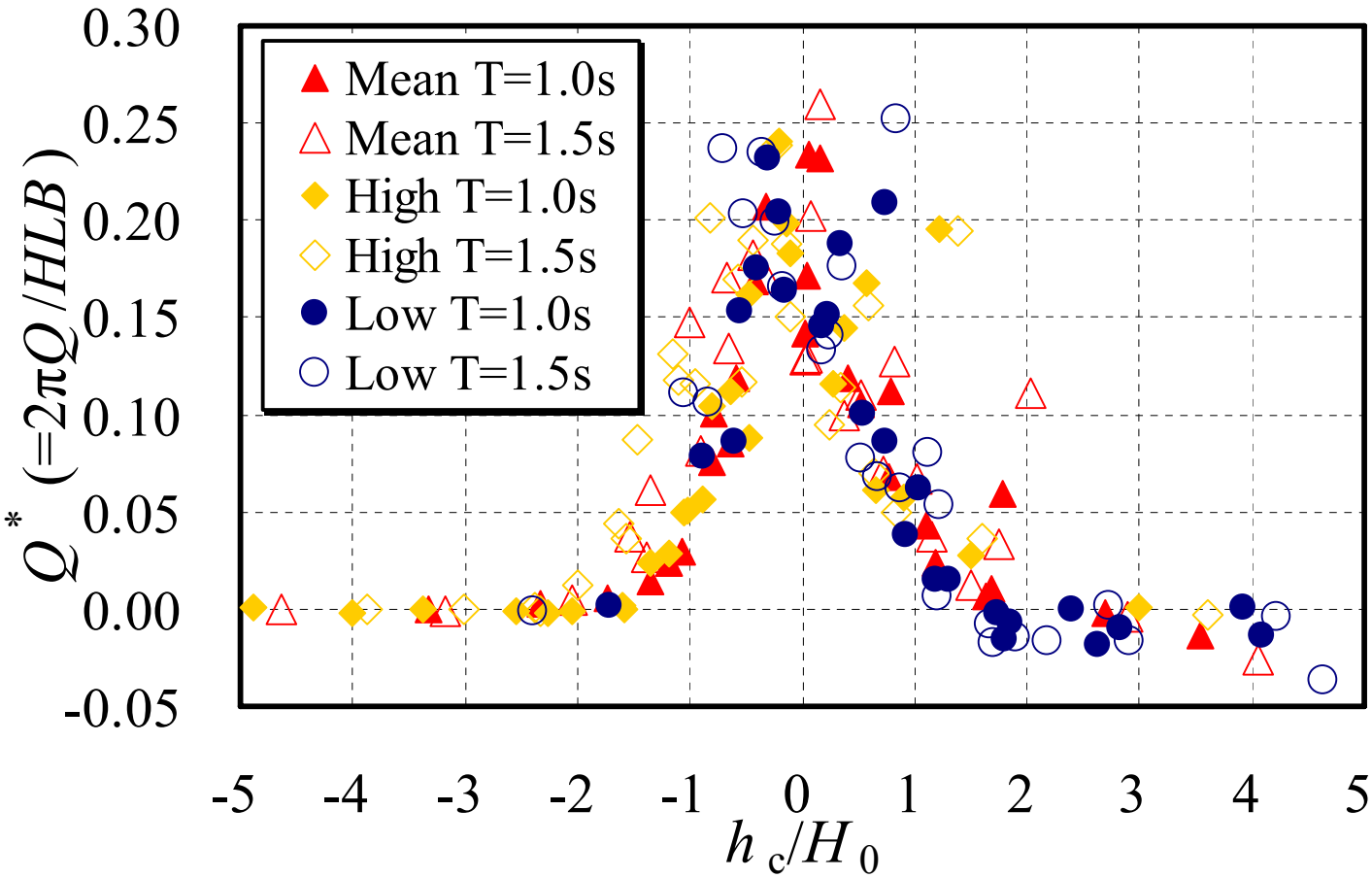


Figure – Time-averaged Surface Elevation in Wave Chamber for the Basic Model

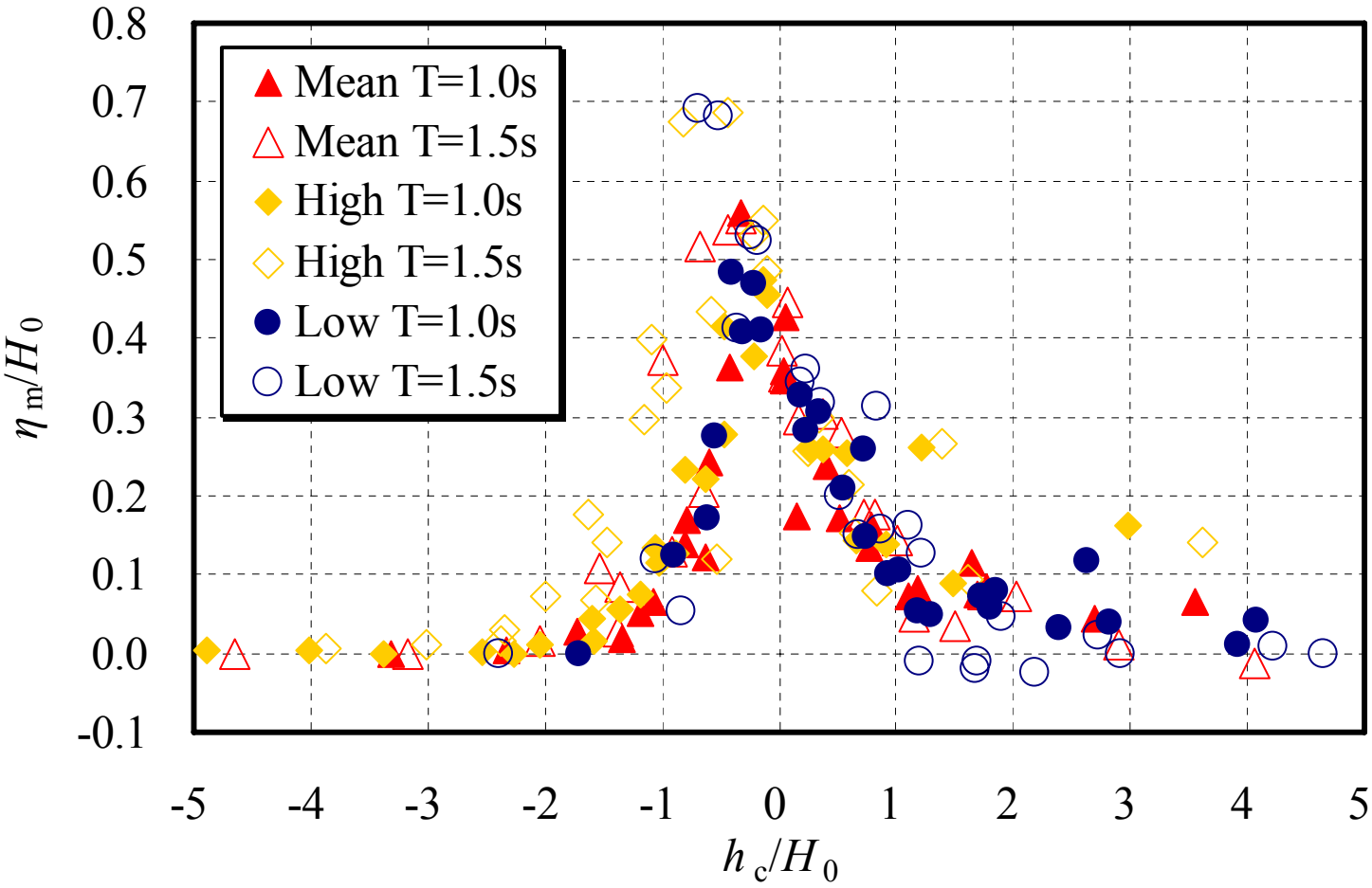


Figure – Comparison of Measured and Calculated Time-averaged Surface Elevation in Wave Chamber for the Basic Model

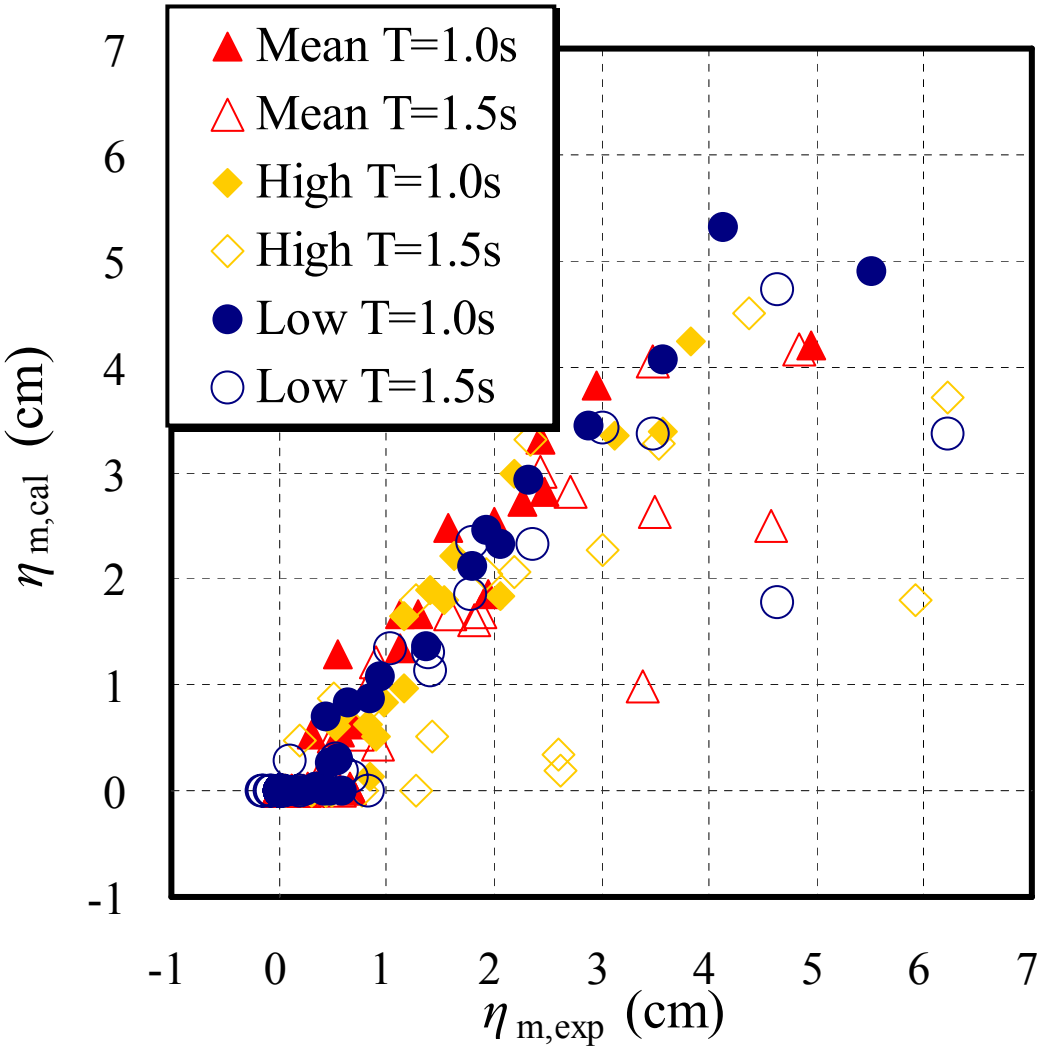


Figure – Comparison of Measured and Calculated Volume Rate of Discharge for Inlet Flow for the Basic Model

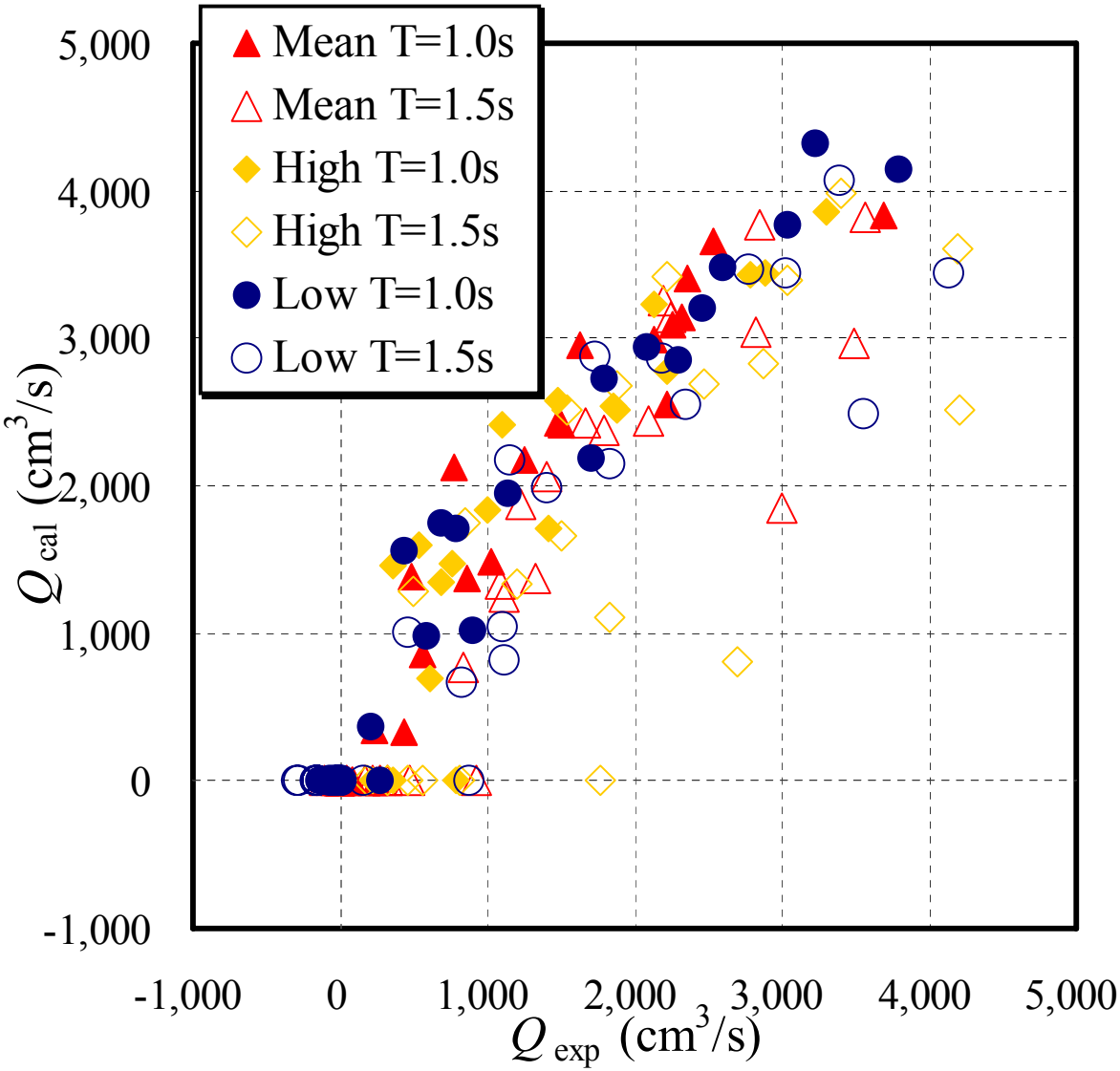
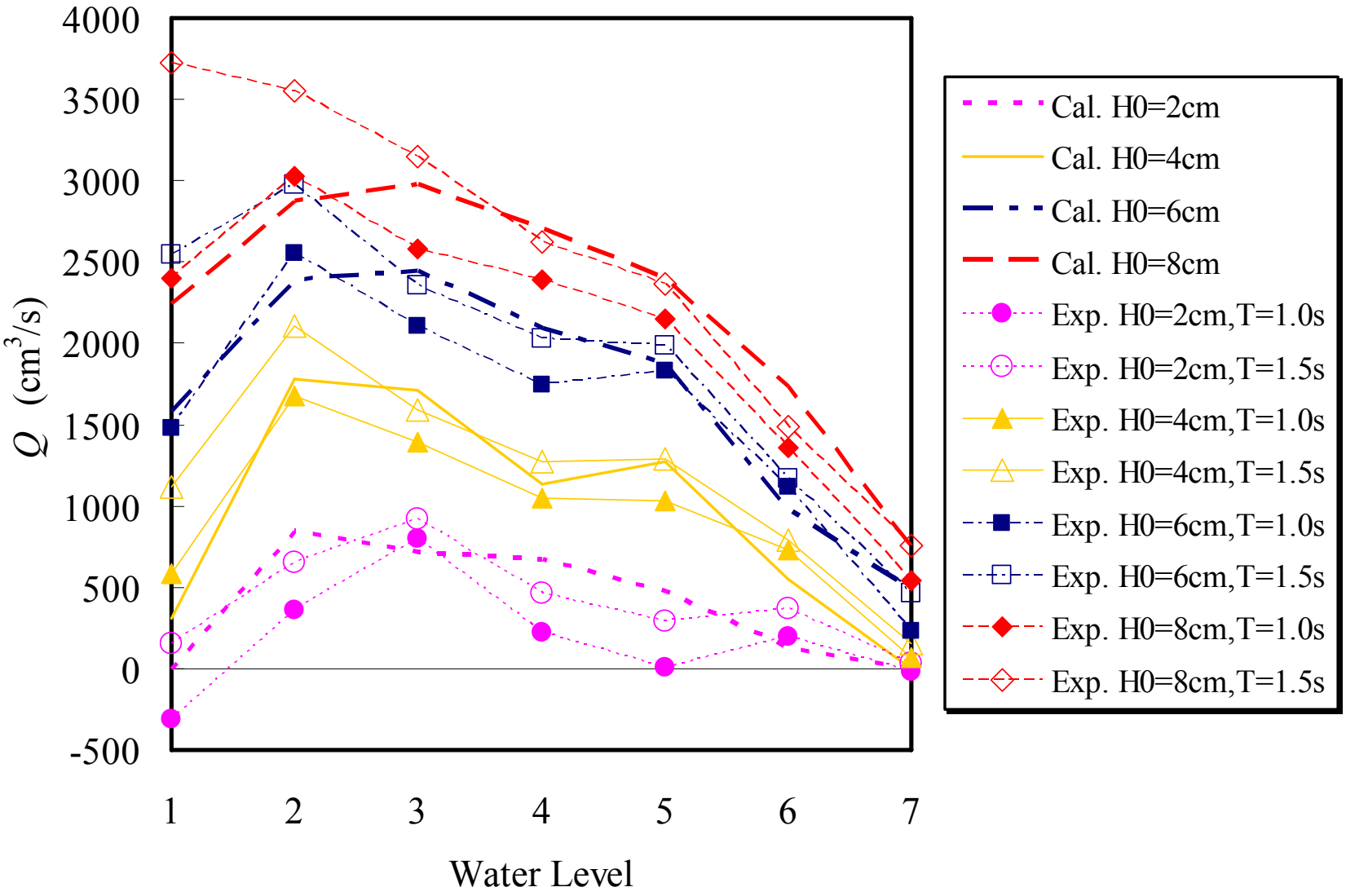
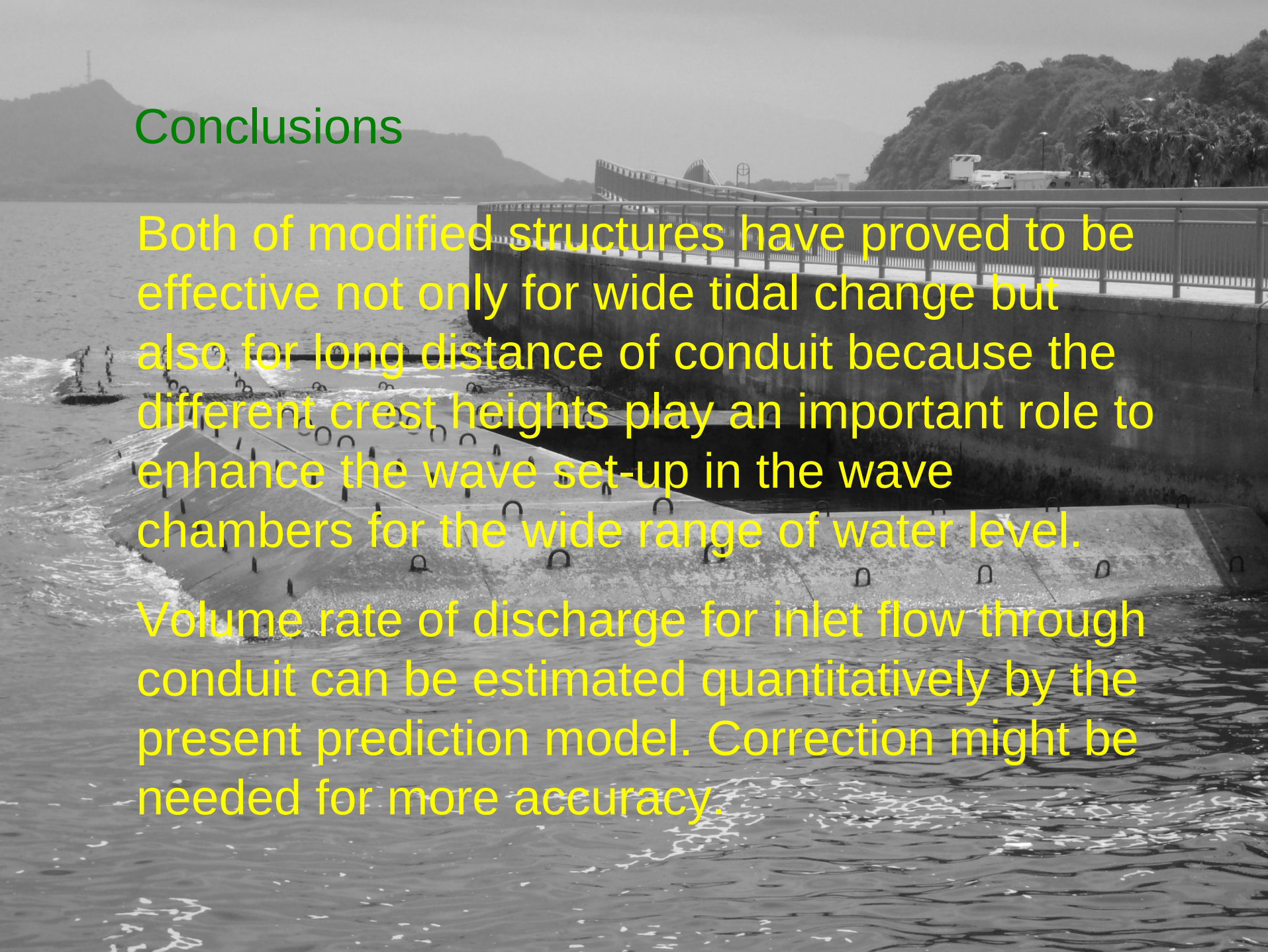


Figure - Volume Rate of Discharge from Rear Water Chamber for the Modified Model





Conclusions

Both of modified structures have proved to be effective not only for wide tidal change but also for long distance of conduit because the different crest heights play an important role to enhance the wave set-up in the wave chambers for the wide range of water level.

Volume rate of discharge for inlet flow through conduit can be estimated quantitatively by the present prediction model. Correction might be needed for more accuracy.