Experiments on the Density of Tsunami Inundation Water and its Influence on the Tsunami Run-up and Deposit

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1. Background

Density
is
Profound *!!*

Central part of Miyako (Upper)

Aims

◆The advancement of the tsunami load evaluation

◆**The advancement of the historical and future tsunami scale evaluations**

　　・ the dependency of the density ρ on F_{ri}

　　・ the dependencies of the tsunami run-up distance L_R, deposit distance L_{RS}, mean deposit thickness Z on ρ
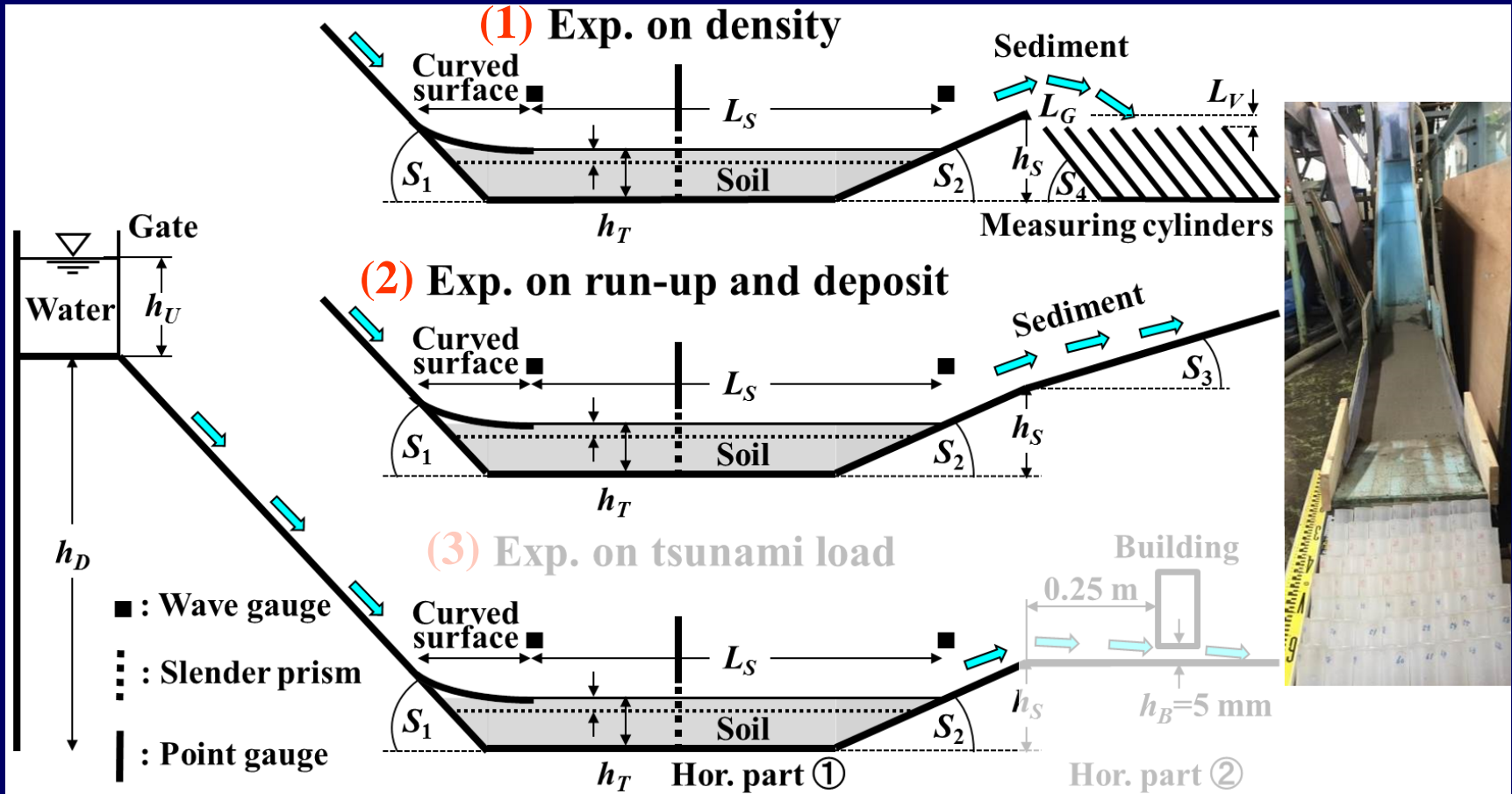
2. Experiments
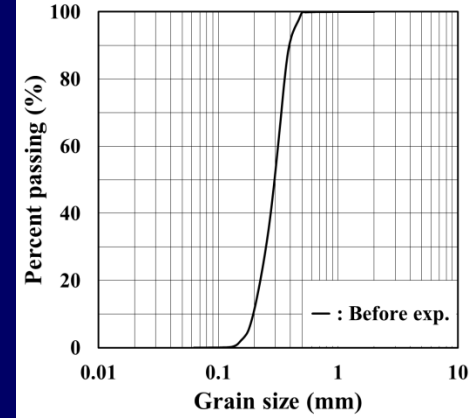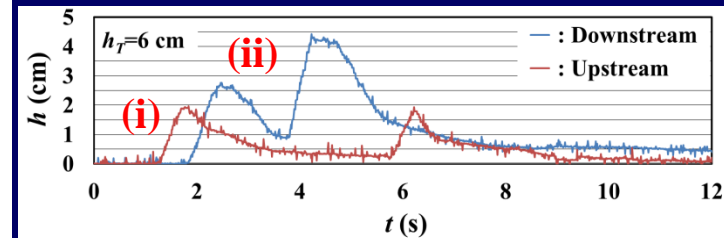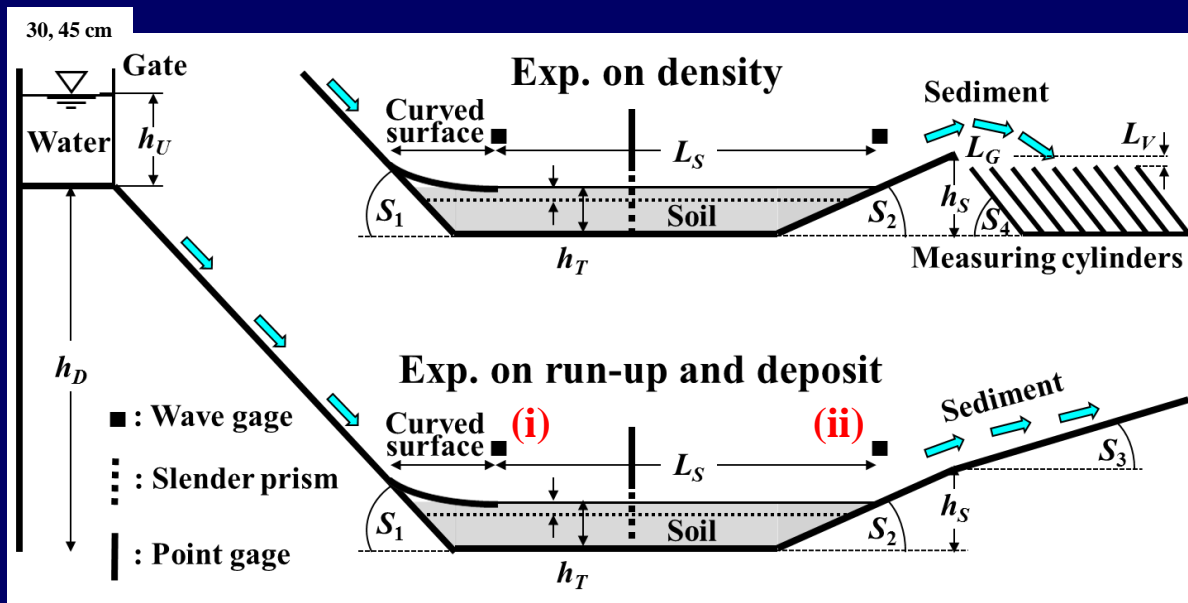
◆Experimental Method

Fig. 1 - Outline of experimental flume, its frontal view (right side), arrangement of measuring equipment and definition of symbols

◆Experimental Conditions

Table 1 - Experimental Conditions

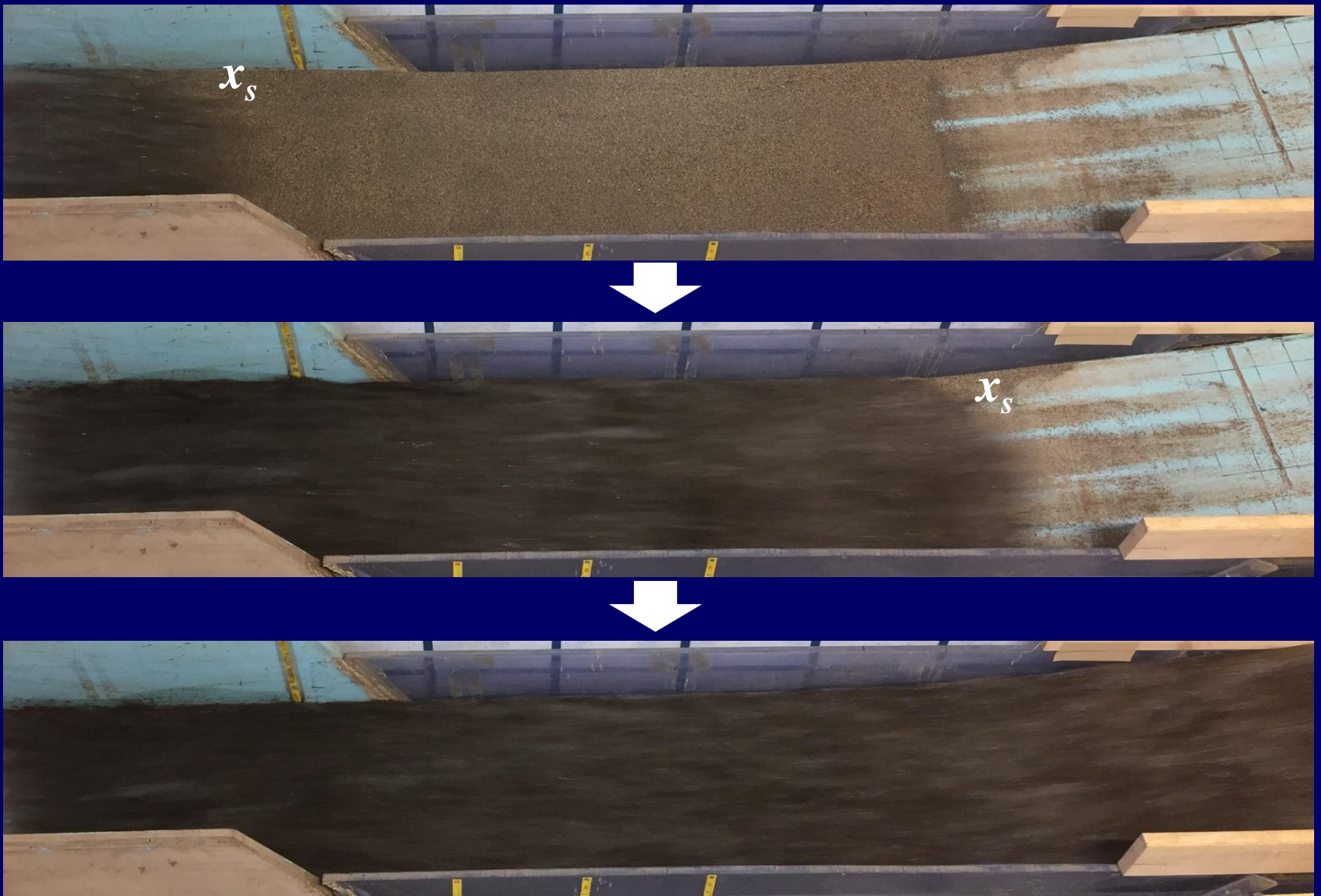| h_D (cm)	h_U (cm)	S_1 (°)	L_S (cm)	h_S (cm)	S_2 (°)	S_3 (°)	S_4 (°)	L_G (cm)	L_V (cm)	h_T (cm)
50~ 200	20~ 30	8~ 35	85~ 301	8~ 23	5~ 30	0~ 7.3	45~ 90	-1~ 5	0~ 11.5	0, 0.5, 1, 2, 6

Fig. 2 - Snapshots (video images) of the inundation flow contained a large amount of sediment (L_s=0.85 m, h_T=6 cm: early experiment)

3. Results and Discussion
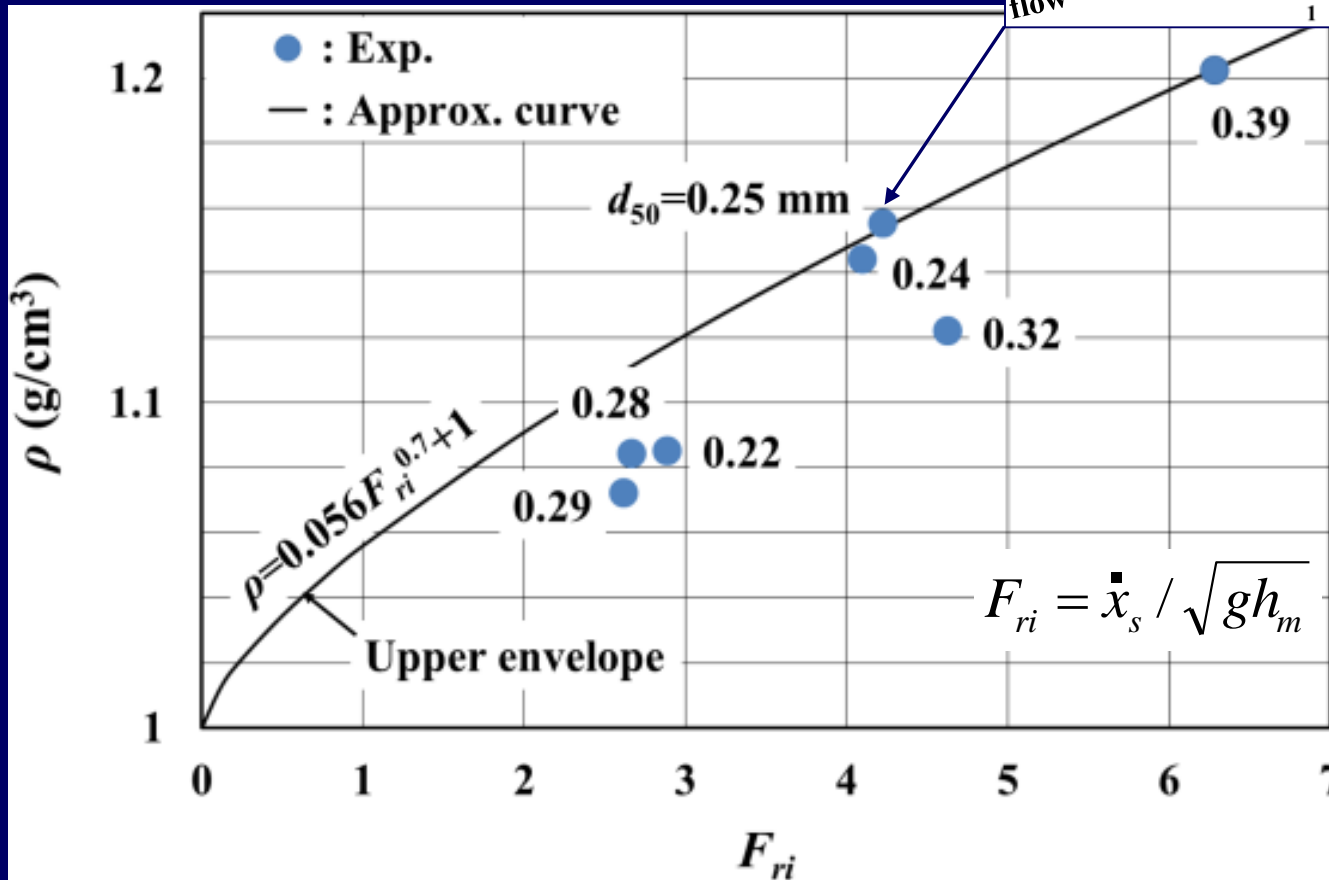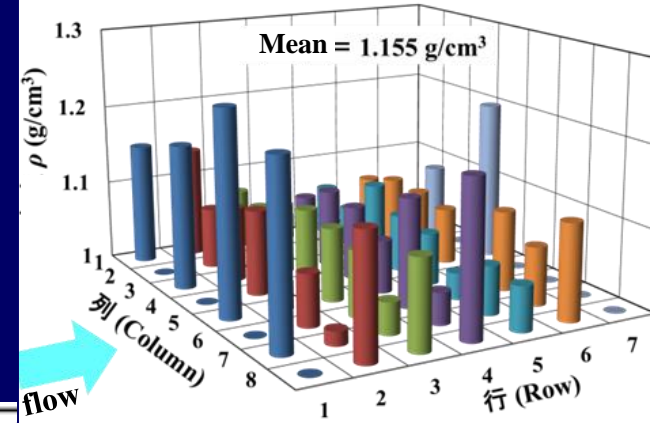
◆Density of Inundation Water ρ

Fig. 3 - Relationship between the Froude number F_{ri} of incident inundation flow and the density ρ of inundation water in the case of $h_T = 6$ cm
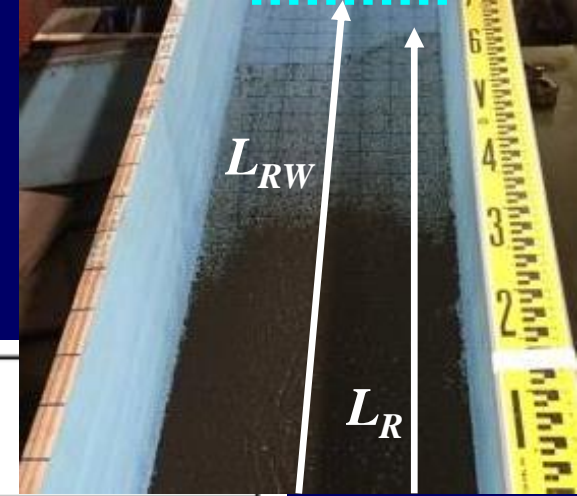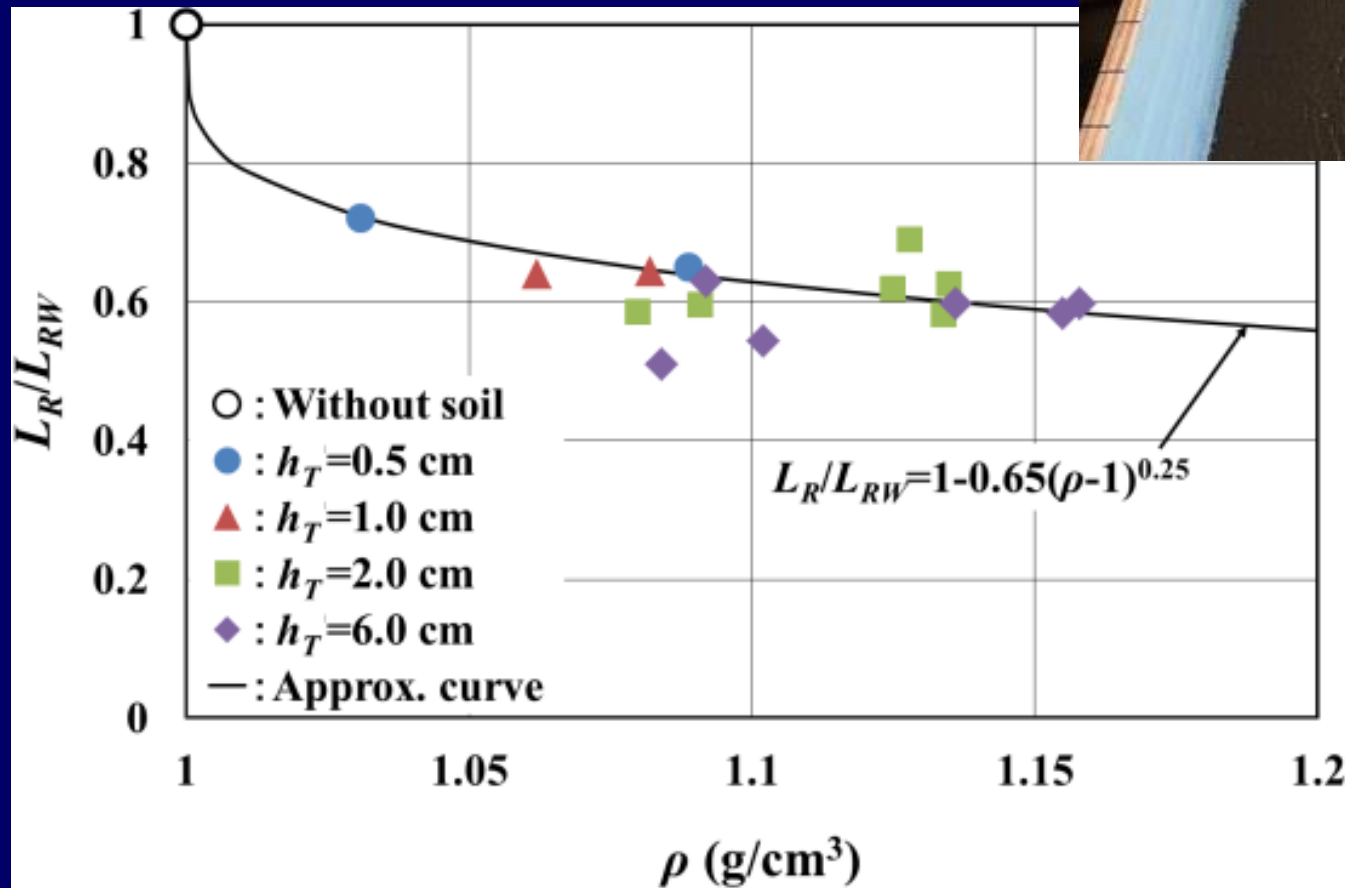
◆Ratio L_R/L_{RW}

Fig. 4 - Relationship between the density ρ and the ratio L_R/L_{RW} of the run-up distance of the inundation flow with sediment to that without sediment
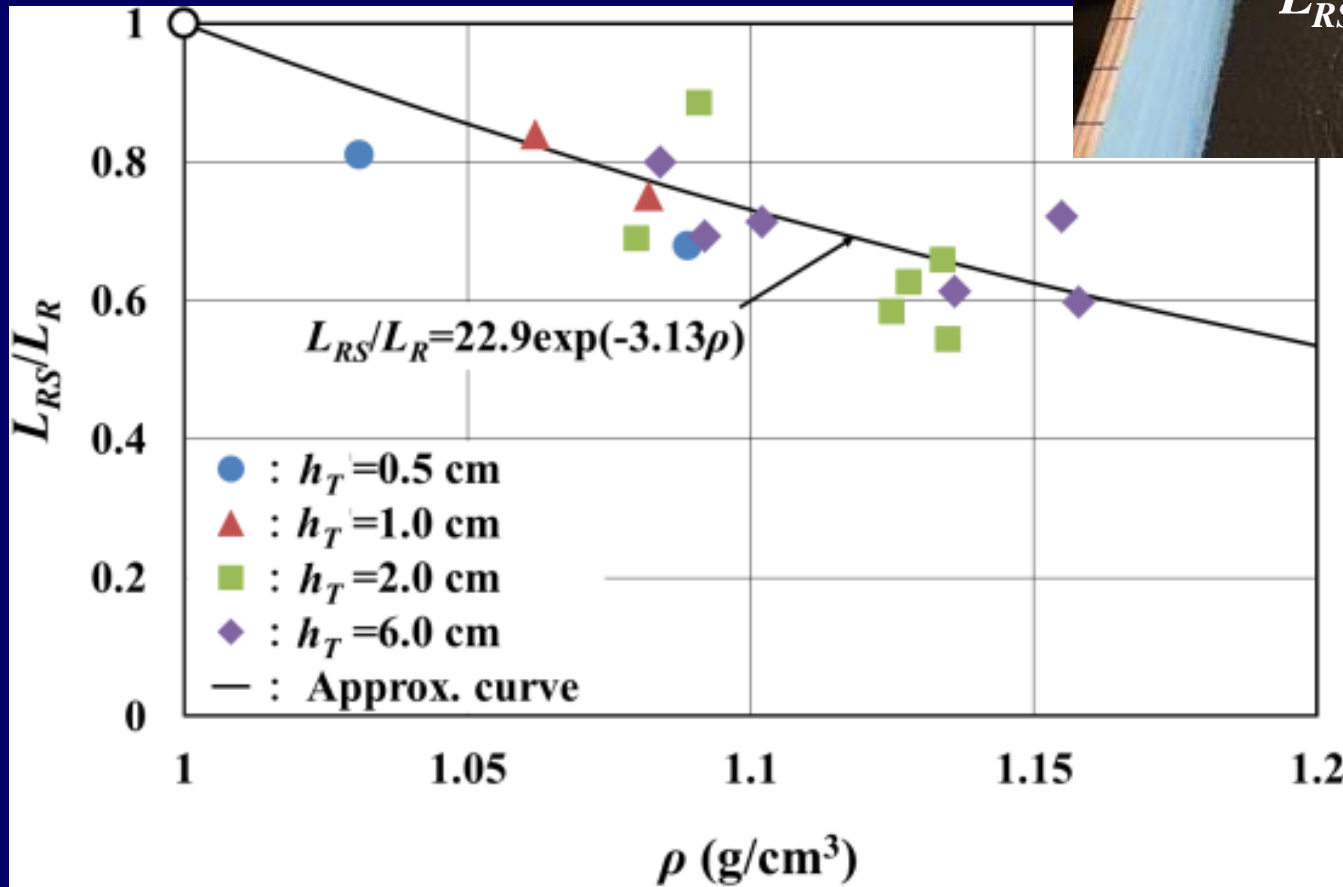
◆Ratio L_{RS}/L_R

Fig. 5 - Relationship between the density ρ and the ratio L_{RS}/L_R of the deposit distance to the run-up distance
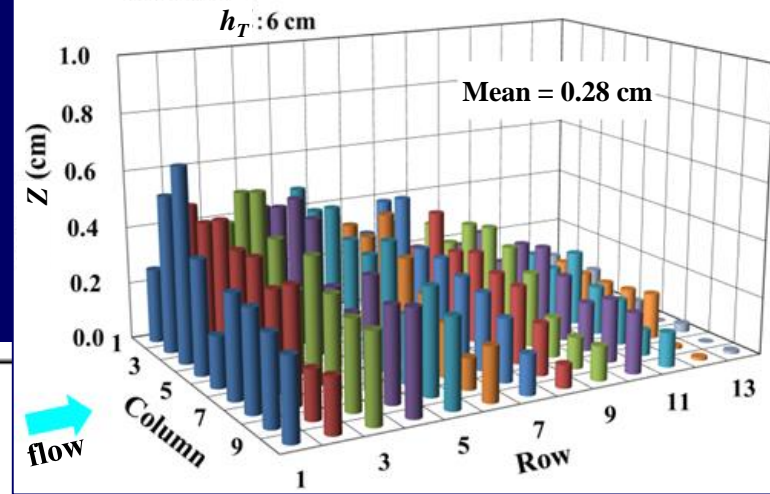
◆Ratio Z/L_{RS}

h_T : 6 cm

Mean = 0.28 cm

Z (cm)

Column

Row

flow

Z/L_{RS}

- ● : h_T=0.5 cm
- ▲ : h_T=1.0 cm
- ■ : h_T=2.0 cm
- ◆ : h_T=6.0 cm
- — : Approx. curve
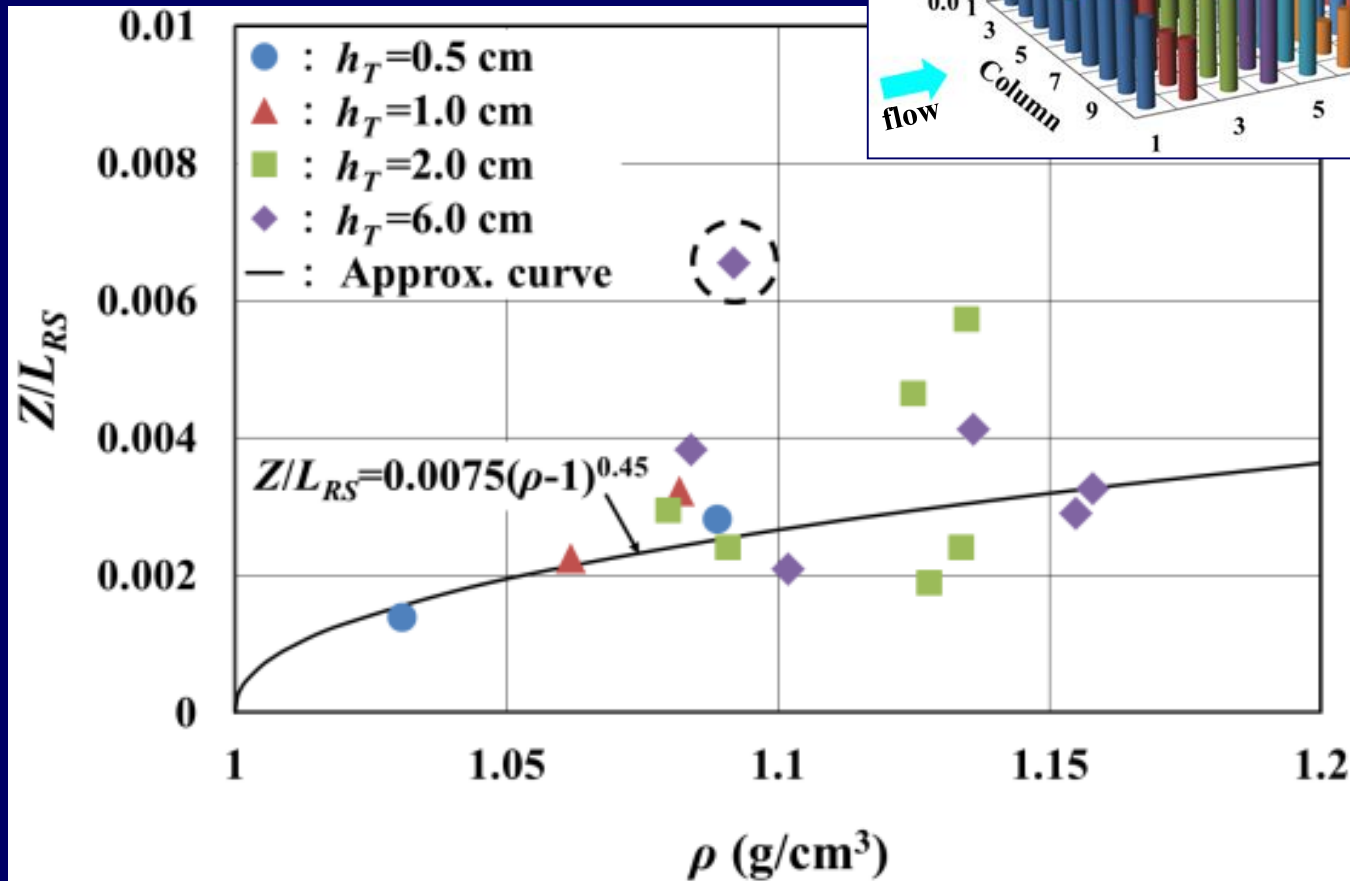
Z/L_{RS}=0.0075$(\rho-1)^{0.45}$

ρ (g/cm^3)

Fig. 6 - Relationship between the density ρ and the ratio Z/L_{RS} of the mean deposit thickness to the deposit distance

4. Main Results

(1) The density ρ (or the specific gravity) depends on the Froude number F_{ri} (~ the Shields number) of incident inundation flow, and the sediment grain size d_{50} (Fig. 3).

(2) The ratio L_R/L_{RW} of the run-up distance of the inundation flow with sediment to that without sediment (Fig. 4), ratio L_{RS}/L_R of the deposit distance to the run-up distance of the inundation flow with sediment (Fig. 5), ratio Z/L_{RS} of the mean deposit thickness to the deposit distance (Fig. 6) **depend on the density ρ.**

(3) Four empirical formulas for the above dependencies are proposed, which are expressed in Figs. 3 to 6 respectively.

(4) It is verified that the tsunami load (horizontal force F_x and vertical force F_z) on the building depends on the density ρ.

Thank you for your kind attention.