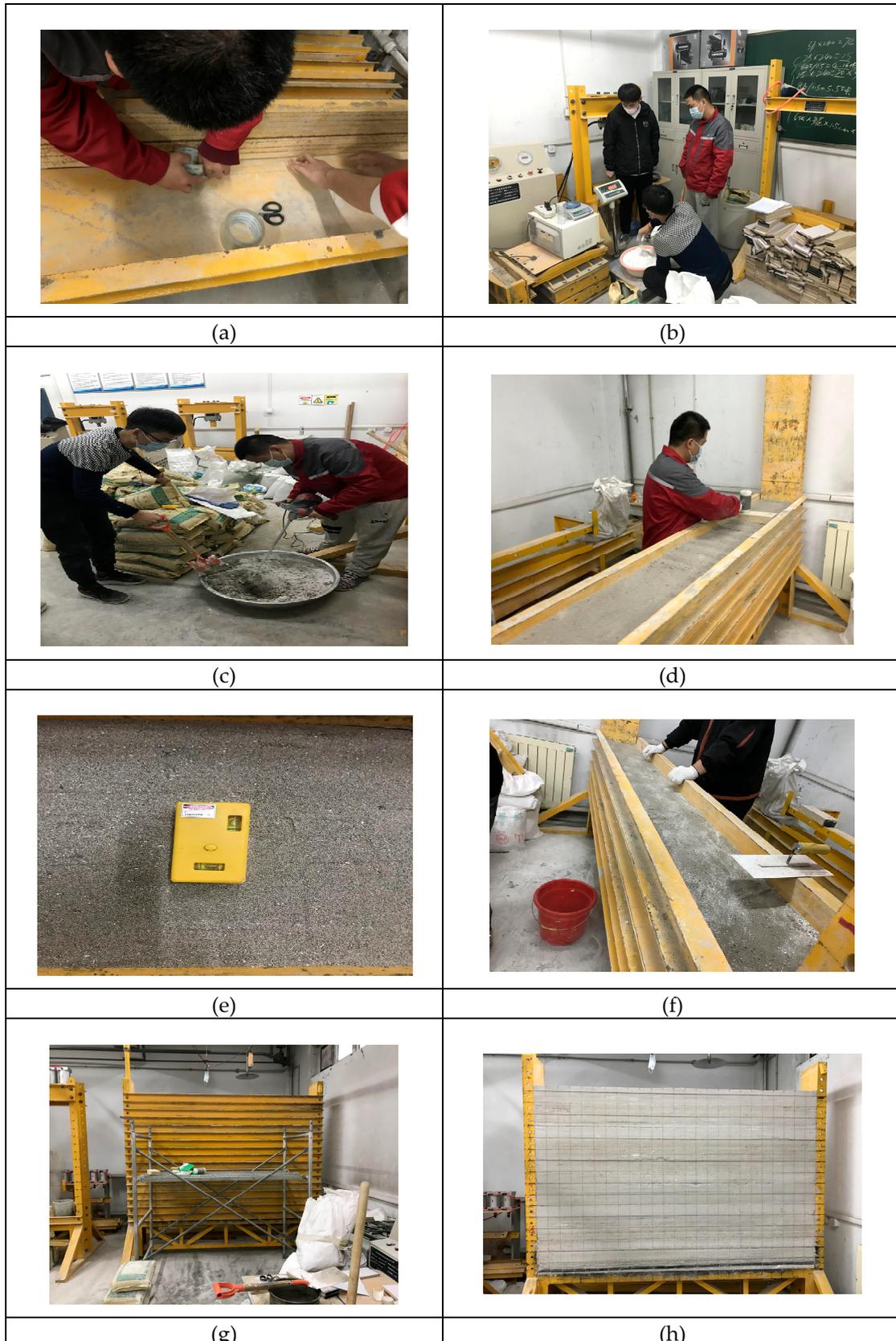


Supplementary Material



Figure S1. tests performed on the samples: (a) Weighing ingredients; (b) Stirring; (c) Molding; (d) Compaction; (e) Smoothing; (f) View of the test samples; (g) Demoulding; (h) Uniaxial compressive strength measurement on the prepared test samples.



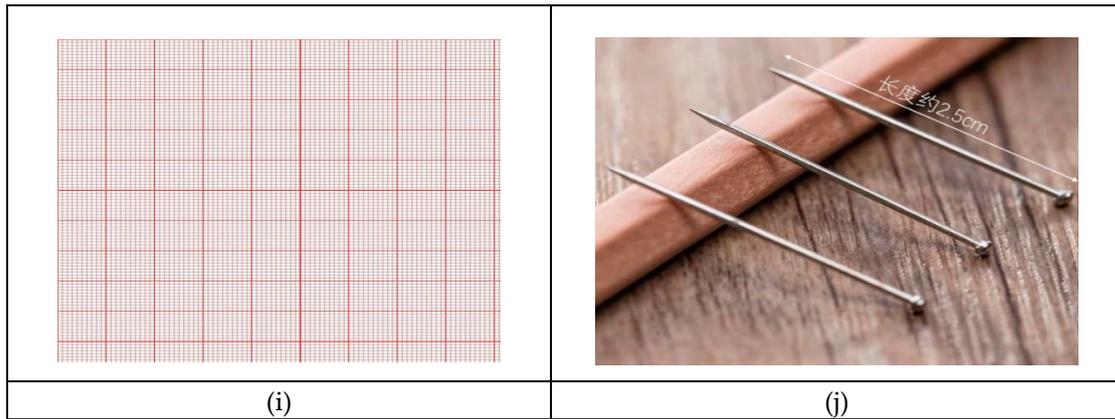


Figure S2. Laying of physical analog model: (a) Install the shield and tape seal; (b) Weigh; (c) Stirring; (d) Tamping; (e) Level leveling; (f) Layering using mica sheets; (g) Curing; (h) Remove shield; (i) Coordinate paper; (j) Pins.

The load of the 1-st mudstone induced by the self-gravity can be calculated as:

$$q_1 = r_1 h_1 = 25.3 \times 3 = 75.900(\text{KPa}) \quad (\text{S1})$$

The load of the 2-th stratum on the 1-nd stratum can be calculated as:

$$(q_2)_1 = \frac{E_1 h_1^3 (r_1 h_1 + r_2 h_2)}{E_1 h_1^3 + E_2 h_2^3} = 0.081(\text{KPa}) \quad (\text{S2})$$

According to the calculated results, $(q_2)_1 < q_1$, suggesting that the 1-st stratum was hard. When calculating the fracturing distance of the 1-th stratum, only the gravity-induced load was considered. The load on the 1-st stratum was 75.900 KPa, and the fracturing distance was calculated as:

$$l_1 = h_1 \sqrt{\frac{2R_{T1}}{q_1}} = 29.056m \quad (\text{S3})$$

The load on the 2-nd siltstone induced by the self-gravity was as:

$$q_2 = r_2 h_2 = 25.6 \times 39 = 998.400(\text{KPa}) \quad (\text{S4})$$

The load of the 3-rd stratum on the 2-nd stratum was as:

$$(q_3)_2 = \frac{E_2 h_2^3 (r_2 h_2 + r_3 h_3)}{E_2 h_2^3 + E_3 h_3^3} = 1292.764(\text{KPa}) \quad (\text{S5})$$

The load of the 4-th stratum on the 2-nd stratum was as:

$$(q_4)_2 = \frac{E_2 h_2^3 (r_2 h_2 + r_3 h_3 + r_4 h_4)}{E_2 h_2^3 + E_3 h_3^3 + E_4 h_4^3} = 1470.953(\text{KPa}) \quad (\text{S6})$$

The load of the 5-th stratum on the 2-nd stratum was as:

$$(q_5)_2 = \frac{E_2 h_2^3 (r_2 h_2 + r_3 h_3 + r_4 h_4 + r_5 h_5)}{E_2 h_2^3 + E_3 h_3^3 + E_4 h_4^3 + E_5 h_5^3} = 1576.556(\text{KPa}) \quad (\text{S7})$$

The load of the 6-th stratum on the 2-nd stratum was as:

$$(q_6)_2 = \frac{E_2 h_2^3 (r_2 h_2 + r_3 h_3 + r_4 h_4 + r_5 h_5 + r_6 h_6)}{E_2 h_2^3 + E_3 h_3^3 + E_4 h_4^3 + E_5 h_5^3 + E_6 h_6^3} = 1749.111(\text{KPa}) \quad (\text{S8})$$

The load of the 7-th stratum on the 2-nd stratum was as:

$$(q_7)_2 = \frac{E_2 h_2^3 (r_2 h_2 + r_3 h_3 + r_4 h_4 + r_5 h_5 + r_6 h_6 + r_7 h_7)}{E_2 h_2^3 + E_3 h_3^3 + E_4 h_4^3 + E_5 h_5^3 + E_6 h_6^3 + E_7 h_7^3} = 973.760(\text{KPa}) \quad (\text{S9})$$

According to the calculated results (See Equation (S1-S7) in Supplementary Material), $(q_7)_2 < (q_6)_2$. Only the loads of the 2-nd, 3-rd, 4-th, 5-th, and the 6-th strata were considered. The load on the 2-nd stratum was 1749.111 KPa, and the fracturing distance was as follows:

$$l_2 = h_2 \sqrt{\frac{2R_{T2}}{(q_6)_2}} = 118.836\text{m} \quad (\text{S10})$$