The Mechanism of a Rapid Long Run-out Slide

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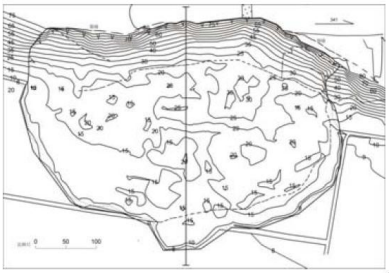
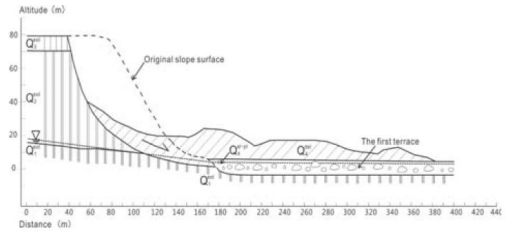
Overview of the Dongfeng landslide

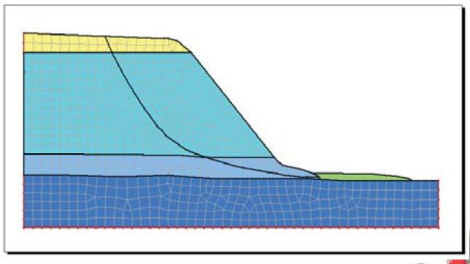
Relief map of the Dongfeng landslide



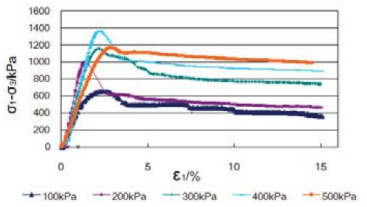
The main geological profile of the Dongfeng landslide



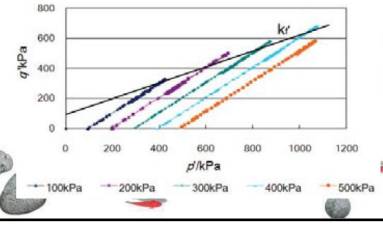
Two-dimensional model of the original slope



The CU tri-axial tests results of the Q2 loess with the moisture content of 6%

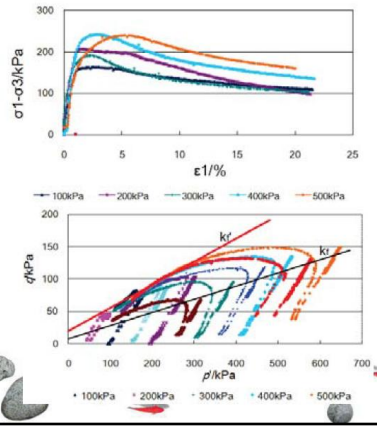


The principal stress difference(σ_1-σ_3) vs axial strain(ε_1)



Maximum shearing stress(q) vs Mean principal stress(p)

The CU tri-axial tests results of the saturated Q2 loess



The principal stress difference(σ_1-σ_3) vs axial strain(ε_1)

Maximum shearing stress(q) vs Mean principal stress(p)

Physical and mechanical properties of the soil for the two-dimensional model

Soil	Elastic Module kN/m²	Poison ratio	Cohesion kPa	Friction Angle °	Unit Weight kN/m³
Q3 Loess (Dry)	80000	0.35	23	15	17.5
Q2 Loess (Dry)	100000	0.35	62	31	19.0
Q2 Loess (Saturated)	50000	0.30	12	8	20.0
Q1 Loess (Saturated)	30000	0.30	17	12	20.8

$$\sigma_\alpha = \frac{\sigma_x+\sigma_y}{2} - \frac{\sigma_x-\sigma_y}{2}\cos 2\alpha - \tau_{xy}\sin 2\alpha$$

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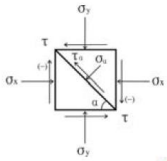
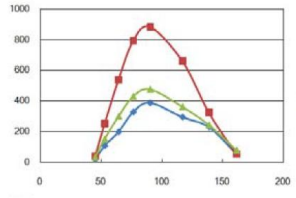
$$\tau_f = c' + (\sigma_\alpha - \mathrm{u})\cdot\tan\varphi'$$

$$F_s = \frac{\int_{x_A}^{x_B}[c' + \tan\varphi'(\sigma_\alpha - u)\mathrm{d_x}}{\int_{x_A}^{x_B}\left(\tau_\alpha + \frac{\mathrm{dQ}}{\mathrm{d_x}}\right)\mathrm{d_x}}$$





The result of the two-dimensional model

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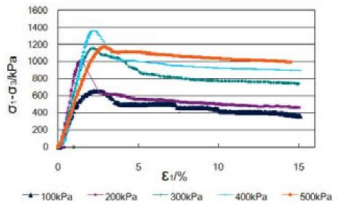
The result of the original slope ,Q2 loess with the moisture content of 6%,is Fs=1.132. The moisture content of the soil will increased by irrigation influence.

The result of the second condition， Q2 loess is saturated ,is Fs=1.013.The slope begin to fail.

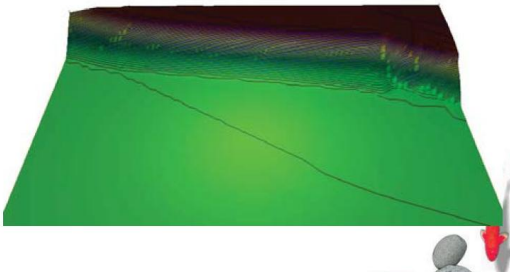


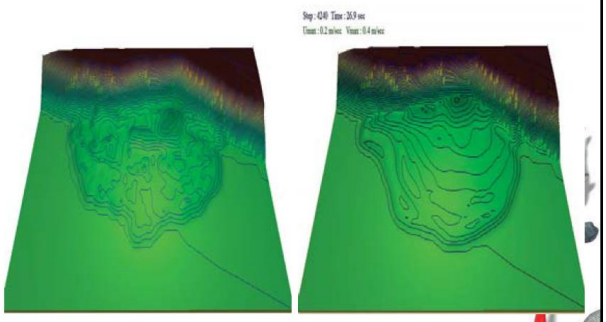
The shearing resistance discount remarkably causes the sliding mass moving far away and quickly.

Physical and mechanical properties of the soil for the three-dimensional model

Point	c' (kPa)	τ_{ss}(kPa)	φ(°)	k	B_{ss}	γ(kN/m³)
Sliding surface	32	2.0	17	0.50	0.6	19
First terrace	26	6.0	35	0.60	0.95	

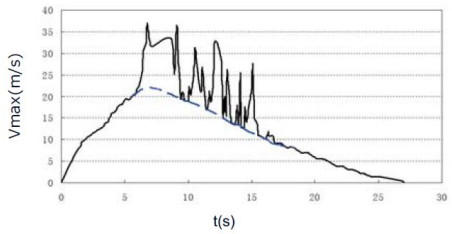
Three-dimensional model of original slope





The actual relief map of Dongfeng landslide

The result of the three-dimensional model



During 0 ~ 6 seconds is the phase of acceleration, 7 to 15 seconds is a relatively uniform stage, the speed of the sliding mass in this phase reaches the highest is 37m/s, 16 to 27 seconds out of the stage of deceleration.

As the sliding mass separated from the slope and slumped down quickly, it hit on the first terrace and caused liquefaction of the saturated gravels and silt-clay, which produced a very high speed and a long distance.

Conclusions

- **1. GeoStudio-SIGMA 2D simulation combined with LS-RAPID 3D simulation could reflect The mechanisms for initiation and motion of rapid long run-out slide better.**
- **2. The shearing resistance of the loess discount remarkably,which is the important reason that lead to rapid long run-out slide.**

Thank you for your attention!