Date of Submission	

IPL Project Proposal Form 2022

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title:

   Study on catastrophic dynamics and affected area prediction of high altitude and long runout landslides in southeast Tibet

2. Main Project Fields

   Select the suitable topics. If no suitable one, you may add new field.

   (1) Technology Development

   A. Monitoring and Early Warning, **B. Hazard Mapping, Vulnerability and Risk Assessment** ☑

   (2) Targeted Landslides: Mechanisms and Impacts

   A. Catastrophic Landslides ☑, B. Landslides Threatening Heritage Sites

   (3) Capacity Building

   A. Enhancing Human and Institutional Capacities

   B. Collating and Disseminating Information/ Knowledge

   (4) Mitigation, Preparedness and Recovery

   A. Preparedness ☑, B. Mitigation, C. Recovery

3. Name of Project leader

Fawu Wang, Professor in Engineering Geology

Affiliation: Department of Geotechnical Engineering, College of Civil Engineering, Tongji University

Contact: (Tel) 0086-021-65983089; (E-mail) wangfw@tongji.edu.cn

(Address) No. 1239, Siping Road, Yangpu District, Shanghai, 200092, China,

Core members of the Project

Names/Affiliations: (4 individuals maximum)

Gonghui Wang, Full Professors, Kyoto University, Japan

Mingjian Hu, Full Professors, Institute of Rock and Soil Mechanics, CAS

Shuai Zhang, Assistant Researcher, Institute of Geomechanics, CAGS

Zhen Guo, Assistant Researcher, Tongji University, China

4. Objectives: The main objectives of this project are to: (i) illustrate spatial distribution and geological environmental effect of the high-altitude and long-runout landslides in southeast Tibet, (ii) reveal triggering mechanism and kinetic process, to simulate by multiscale fluid-solid coupling models, and (iii) establish an advanced risk management strategy for mitigation and reduction of the geohazards. The main mission is to serve increasing construction of major infrastructures in southeast Tibet.

5. Background Justification: Because of its special geographical location, geomorphological characteristics and abundant water resources, the southeast region of Tibet is a location of strategic importance in China, and many major projects are planned and built in this area. At the same time, due

to factors such as tectonic uplift, seismic activity, oceanic glaciers, and three-dimensional climate, high-altitude and long-runout landslides in the area are intensively developed. Frequent occurring high-altitude and long runout landslide disasters have become the main threats to major projects because of their strong concealment for happening, large impact and wide range of disasters when occurring.

6. Study Area: The study area is southeast region of Qinghai-Tibet plateau, especially at areas surrounding Sichuan-Tibet transport corridor and lower reaches of Yarlung Zangbo River.
7. Project Duration: The project will last for 5 years from January 1st 2023 to December 31st 2027.
8. Resources necessary for the Project and their mobilization

   The personnel of this project involve three full professors, four assistant professors and three post-doctoral researchers as main participants. The facilities include the ring shear apparatus, rock surface friction test machine, centrifuge equipment, flume equipment. The total budget of this project is 3 million RMB
9. Project Description: Aiming at the main scientific problems such as the high-altitude landslide mechanism, impact loading effect, sliding to flow conversion mechanism and wide disaster-causing effect of the high-altitude and long runout landslide in this area, this project is proposed to focus on the following research: 1) Based on remote sensing interpretation, on-site detailed geological investigation, in-situ measurement, laboratory test, such as rock friction test and ring shear test, correlation analysis and numerical calculation, etc., the disaster forming environment and initiation mechanism of the high-altitude and long runout landslide will be revealed; 2) The impact loading and shear mechanical behavior of the loose deposits in front of the source area will be quantitatively characterized based on the ring shear test. The constitutive relationship of the soil in the sliding zone will be established considering the impact effect caused by falling down of the sliding mass; 3) Based on centrifugal test and flume test, the catastrophic dynamics behavior of impact loading on long runout sliding process will be analyzed in different scales, and the transformation mechanism of landslide to debris flow will be revealed; 4) Based on the impact loading effect and shear mechanical behavior of the three-layer structure of sliding mass-sliding zone-sliding bed, the key indicators of the affected area prediction by high-altitude and long runout landslide will be sorted out, and a high-altitude and long runout landslide dynamic model will be constructed to achieve the prediction of the affected area by the high-altitude and long runout landslide. The research results are aimed at providing a theoretical basis for the prevention of high-altitude and long runout landslide disaster risks in the planning and construction of major projects in southeast Tibet.
10. Work Plan/Expected Results:

    1st phase (2023): Collect data from existing literatures and field investigation of high-altitude and long-runout landslide in study area; Conduct trial-manufacture of the centrifugal test chamber, large-scale flume, and renovation of ring shear test apparatus; Establish the assessment system of environmental factors on triggering and runout process of high-altitude and long-runout landslides.

    2nd phase (2024): Conduct interface friction test of rocks in source area, and ring shear test for loose deposits on sliding path; Carry out centrifugal experiments for high-altitude sliding mass; Reveal the

effect of primary geo-environmental factors on the geometrical characters of landslide, and conclude the volume changing law caused by shearing-triggered grain broken in sliding zone.

3rd phase (2025): Conduct ring shear test to study the effect of earthquake load on triggering process of high altitude and long runout landslide, and to demonstrate the effects of shear velocity and temperature on the runout process; Establish quantitative relationship between volume changing of sliding zone and pore pressure variation.

4th phase (2026): Reveal effect of glacier surging and slow melt on the triggering process of the high-altitude and long-runout landslide; Conduct ring shear test to illustrate performance of the loose deposits in front of source area under different impact conditions. Carry out flume test to study motion mechanism and build a multiphase model integrating sliding mass, potential sliding zone and sliding bed.

5th phase (2027): Analyze experimental results to reveal impact mechanism of high-altitude failed mass on kinetic process of sliding mass on long-runout path, and summarize motion pattern of high-altitude and long-runout landslides. Comprehensively summarize the research and apply runout prediction model of high-altitude and long-runout landslide in the proposed study area.

11. Deliverables/Time Frame:

Milestones: (1) Initiation models of Sliding zone weakening and earthquake / snow melt triggering of high-altitude and long runout landslide in study area (by December 2026). **(2)** Strength change law of loose deposits during long-distance shear under different drainage conditions (by December 2026). **(3)** Catastrophe dynamic mechanism of loose deposits under the impact of high-altitude sliding mass. (by December 2026) **(4)** Affected area prediction model, and motion model of high-altitude and long runout landslide considering the multi-effect in the whole process of initiation-impact-motion. (by December 2027)

Deliverables: (1) More than 25 high-level, peer-reviewed journal papers in the field of geohazard and the related field, including more than 10 Chinese Journal papers (by December 2027). **(2)** Four~Six patents on design of laboratory equipment (by December 2027).

12. Project Beneficiaries:

Local residents, infrastructure designer and managers, subjected to potential high-altitude and long-runout landslides in southeast Tibet; Policy-maker on risk management in the geohazard-prone areas; Researchers involved in academic studies on physical knowledge behind triggering mechanism, runout process and prediction of the landslides and on geodetic survey, experimental modeling and numerical simulations of such landslides.

13. References (Optional):

Wang F, Okuno T, Matsumoto T. Deformation characteristics and influential factors for the giant Jinnosuke-dani landslide in the Haku-san Mountain area, Japan[J]. Landslides, 2007, 4(1):19-31.

Wang F, Sassa K. Landslide simulation by a geotechnical model combined with a model for apparent friction change[J]. Physics and Chemistry of the Earth, Parts A/B/C, 2010, 35(3-5): 149-161.

Wang F, Dai Z, Okeke C A U, et al. Experimental study to identify premonitory factors of landslide dam failures[J]. Engineering Geology, 2018, 232: 123-134.

Note: Please fill and submit this form by 15 September 2022 to ICL Network <icl-network@iclhq.org> and KLC secretariat <klc2020@iclhq.org>