# ANALYSING THE KINEMATIC RUNOUT BEHAVIOUR AND DEPOSITION PROCESS OF ASO-BRIDGE LANDSLIDE USING COUPLED EULERIAN-LAGRANGIAN FINITE ELEMENT METHOD

Final Project Report
The requirement to obtain a Bachelor's Degree from
Universitas Atma Jaya Yogyakarta

Compiled by :
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INTERNATIONAL CIVIL ENGINEERING PROGRAM
FACULTY OF ENGINEERING
UNIVERSITAS ATMA JAYA YOGYAKARTA
YOGYAKARTA
JULY 2019

**VALIDATION SHEET**

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## DECLARATION

I hereby declare that the Final Project entitled:

**ANALYSING THE KINEMATIC RUNOUT BEHAVIOUR AND DEPOSITION PROCESS OF ASO-BRIDGE LANDSLIDE USING COUPLED EULERIAN-LAGRANGIAN FINITE ELEMENT METHOD**

Is my original work and not plagiarized from the work of others. Idea, results and quotations, either directly or indirectly sourced from others have been clearly stated in this Final Project. I further agree that my name typed on the line below is intended to get my degree cancelled and must return my diploma to the Rector of Universitas Atma Jaya Yogyakarta if this Final Project is found as plagiarism in the future.

Tainan, July 2019,

Calvin Wijaya

# ACKNOWLEDGEMENT

This final project entitled " Analysing The Kinematic Runout Behaviour and Deposition Process of Aso-Bridge Landslide using Coupled Eulerian-Lagrangian Finite Element Method" is compiled to fulfil the graduation requirement of undergraduate study in Civil Engineering in Faculty of Engineering, Universitas Atma Jaya Yogyakarta.

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The author is fully aware that this Final Project is still far beyond the word 'perfect'. Thus, developing critics and suggestions are expected to make this Final Project better. The author really hopes that this report can be beneficial to all sides and readers.

Tainan, July 2019

Author,

Calvin Wijaya

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# ABSTRACT

**ANALYSING THE KINEMATIC RUNOUT BEHAVIOUR AND DEPOSITION PROCESS OF ASO-BRIDGE LANDSLIDE USING COUPLED EULERIAN-LAGRANGIAN FINITE ELEMENT METHOD,** Calvin Wijaya, Student Number 151315805, the Year 2019, Field of Specialization Geotechnical Engineering, International Civil Engineering Program, Faculty of Engineering, Universitas Atma Jaya Yogyakarta.

Finite element method (FEM) is a powerful yet effective tool for studying the onset of incipient landslide failures. The FEM has advantages over the traditional limit equilibrium method due to the inclusion of the initiation time, and the propagated runout behaviour of landslides. However, traditional FEM mostly is using the Lagrangian approach which may be limited to model large deformation material behaviour and the obtained results may experience numerical convergence difficulty and not reliable. To solve the complex large deformation problems, coupling both Lagrangian and Eulerian approach may have better accuracy and feasible results. The study of coupled Eulerian-Lagrangian (CEL) technique and its application is very limited in Indonesia. In this study, CEL finite element technique is introduced and discussed through the application of Aso-Bridge Landslide.

This study presents the investigation of the kinematic behaviour of sliding mass on Aso-Bridge slope using Coupled Eulerian-Lagrangian (CEL) finite element technique. The features of this study are the pre-failure mechanism (initial condition) and post-failure runout behaviour. The sliding mass is analysed as a Eulerian material type while the base is fixed and specified rigid in a Lagrangian description. Eulerian elements will be used to undergo the extreme deformation as the reference configuration to observe the kinematic behaviour of the sliding mass when it deformed, while the meshing stays undeformed. The result of the simulation will be validated by comparing between the study and the published results to observe the kinematic behaviour and deposition process.

The simulations results show that Coupled Eulerian-Lagrangian (CEL) formulation is stable and able to demonstrate the landmass transport large deformation with convergent results. The proposed simulation indicates that the meshing size and friction coefficient contribute a strong influence on the landmass runout. Based on the analysis, smaller meshing size gives a more reliable and realistic visual illustration of the deposition process while the friction coefficient of µk = 1 has a better agreement in term of results with those published for the previous study.

**Keywords**: Landslides, Coupled Eulerian-Lagrangian method, Large deformation, Finite element method.