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Rapid material estimation for reinforced concrete construction utilizing a parametric tool for Aceh's post-disaster case

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Rapid material estimation for reinforced concrete construction utilizing a parametric tool for Aceh's postdisaster case

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Abstract. This paper offered a new open-source parametric tool for reinforced-concrete construction estimation for post-disaster based on Aceh's case. The tool aimed at introducing and providing an innovative solution of estimation for building materials more dynamically and rapidly. The tool was initiated by the fact that the delay of relief shelter deployment in 2004 post-tsunami in Aceh of Indonesia was caused by the inability to provide a rapid calculation for building materials as a result of a massive request [1]. Further, the reinforcedconcrete constructions had become a positive preference by the Acehnese [2]. In order to offer a new tool for rapid and dynamic estimation specifically for reinforced-concrete construction, the authors utilized visual scripting of Grasshopper with GHPython extension for optimization of the proposed tool. The tool introduced in this paper was the improvement of previously explored workflows by the authors and ended up with an innovative tool for modeling, visualizing, and estimating. Furthermore, the tool enhanced users' experiences to construct a workflow based on users' specific logic. The tool allowed alterations in the design without comprising time for estimation. In this way, the specific need of the victims in post-disaster was accommodated without obstruction to an estimation of building materials, thus, improved quality and management of the relief shelters for a post-disaster.

Keywords: *Reinforced-concrete Construction, Relief Shelter, Parametric Estimation, Aceh Post-Disaster, GHPython, Grasshopper, Visual Scripting.*

1. Introduction
Aceh, an Indonesian province, was the second-worst affected by natural disasters. It was recorded more than 5 million people affected by the disaster from 2000 to 2017 [3]. The immediate need for the aftereffect of a disaster was the availability of shelter for the victims. a shelter was a very important entity that must be rapidly fulfilled for a disaster besides foods, water, and medicines. A good shelter ensured the victims appropriate safety and health. Therefore, the immediate availability of the shelter was a significant aspect in a post-disaster setting such as in Aceh.

Reinforced concrete construction had become a positive preference for post-disaster relief shelters in Aceh. This was confirmed by the author's survey conducted in 2017 for the type of relief shelters available for post-disaster in Banda Aceh, Pidie Jaya, North Aceh, and East Aceh. The main reason for the preference was its durability. Moreover, the role of government regulation, instructed by the Bureau of Reconstruction and Rehabilitation Aceh-Nias, was an important aspect in shaping reinforced-concrete construction for the shelter preferences [2]. For the 2004 post-tsunami, the type of construction with bricks infill as its wall was widely available after ten months of the disaster [1]. It was not an appropriate timeframe for relief shelters. One of the problems that liable for the delay of the relief shelter was the ability to quantify construction materials as the result of a massive request of

the shelter [1]. The positive preference toward the reinforced-concrete shelter, in a post-disaster setting, was not supported by the ability for a rapid material estimation to fulfill the shelter demands. Building material estimation was a crucial aspect for the success of construction, particularly, for an emergency case such as a post-disaster situation where rapidity was a requirement. Şener & Torus [4] advised rapidity as one important factor for post-disaster relief shelter. A parametric framework that puts