

Structural Assessment and Rehabilitation Option for Yudaganawa Dagoba in Buttala

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Abstract

Yudaganawa dagoba in Uva province is one of the largest stupas in Sri Lanka which dates back to 2nd century BC. Presently, this colossal stupa with a diameter about 91.2 m and reaching a height of 13 m is undergoing several issues which necessitate it to be rehabilitated. The stupa was found in ruins and grown with vegetation until it has been preserved by subsequent restoration efforts in the recent past. However, it is not standing at its original height well-matched with the circumference at its base. Further, existing formation of the structure, existing foundation and ground condition are unknown. This paper presents structural assessment of existing stupa and proposal for rehabilitation in order to build the stupa to its full height.

A literature survey has been carried out to investigate the structural formation of stupas in ancient Sri Lanka. The geometry of the present stupa and the soil profile under the stupa were assessed. Material properties have been found with adequate laboratory testing. Present condition was modelled using finite element analysis employing SAP 2000 and PLAXIS 2D. The results show that the stresses generated within the existing stupa due to its self weight is well below than the compressive strength and the tensile strength of bricks. Based on the results, several alternative methods are proposed for rehabilitation and the options are analysed with respect to structural performance along with the existing condition and the religious beliefs, attitudes and rituals concerning the stupas. The possibility of cracking in the masonry due to the self weight in each alternative method was checked using a failure criteria developed based on the modified Von Mises theory. The final option was selected so as the stresses generated in the existing brickwork are satisfying the failure criteria and has the minimum intervention to the stupa in the context of ancient value and the concerns related to stupas. Consistent with that, it is shown; the existing stupa is capable of taking the load of proposed solid brick superstructure without showing any possibility of cracking.

Keywords: Ancient stupas, rehabilitation, finite element analysis, failure criteria, alternatives