Dual Geodesic Dome Stadium

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INTRODUCTION

As of the London Climate Agreement, all domestic construction projects starting from 2015 are subject to specific CO2 emission guidelines. Hence, of critical issue in the current field of architecture concerns the level of CO2 emissions reduction from construction activities. The single largest source of CO2 emission during construction is steel. Steel production is notorious for its CO2 emission in two ways. One, cokes is oxidized which generates an exorbitant amount of CO2. Two, steel mills generally consume large amounts of energy; they indirectly generate CO2 emissions. In the midst of the new to-be enforced law, England and several large European cities have implemented a reward and penalty system based on the level of CO2 emissions on all construction projects. For the Olympics, for instance, England recycled 83 tons of steel from illegal weaponries to build its stadiums. The resulting environmental benefit was a 40% reduction in CO2 emission. While the reduction itself was admirable, the limitation of the effort was that the fundamental structures were steel-based. Amid the circumstances, this paper presents a method that dramatically reduces the use of steel, which directly translates into drastic reduction in CO2 emissions from construction activities.

METHODOLOGY

A dome is a geometric structure optimal for natural air circulation and ventilation for a large space. The geodesic dome, in particular, best exemplifies the economic and structural balance qualities of all dome types. This project applies a double geodesic space frame to reduce the steel demands of a dome stadium. Safety, function, economics, and environmental standards will be considered to the overall stadium architecture. The round surface of a dome enables the horizontal weight to be distributed equally across the entire structure. Naturally, the vertical weight is distributed across the frame's axis to the ground, enabling the optimization of the structural member, which results in less steel usage.

ETFE, ultra-light transparent plastic with high durability, high light transmittance, reduces the load received by the lower steel framework; with less structural materials used, there is less CO2 emissions. This project applies a three-layer ETFE to enhance thermal performance and automatic lighting control.

Midas Gen is used for the structural analysis. Regional site information and KBC2012 code is used to measure load case. Both static analysis and dynamic analysis are considered to provide a realistic structural analysis.

Expected Results

The dual geodesic dome stadium project will create an architectural blueprint for a safe, functional, economical, and environmentally-friendly dome structure. For one, the dual geodesic structure reduces carbon intensive steel demand. Two, the use of stand seats supported by the earth cuts down CO2 emission as no additional substructure is required. By comparing between a dual and a single structure dome, we can estimate the environmental and construction costs. Lastly, a structural analysis of the project from its beginning to its end will enable the economic analysis of the workability and lifecycle of the dual geodesic dome stadium.