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Automation of Embodied Energy Calculations for Buildings through Building Information Modelling

Authors : Ahmad Odeh

Abstract : Researchers are currently more concerned about the calculations of energy at the operational stage, mainly due to its larger environmental impact, but the fact remains, embodied energies represent a substantial contributor unaccounted for in the overall energy computation method. The calculation of materials' embodied energy during the construction stage is complicated. This is due to the various factors involved. The equipment used, fuel needed, and electricity required for each type of materials varies with location and thus the embodied energy will differ for each project. Moreover, the method used in manufacturing, transporting and putting in place will have significant influence on the materials' embodied energy. This anomaly has made it difficult to calculate or even bench mark the usage of such energies. This paper presents a model aimed at calculating embodied energies based on such variabilities. It presents a systematic approach that uses an efficient method of calculation to provide a new insight for the selection of construction materials. The model is developed in a BIM environment. The quantification of materials' energy is determined over the three main stages of their lifecycle: manufacturing, transporting and placing. The model uses three major databases each of which contains set of the construction materials that are most commonly used in building projects. The first dataset holds information about the energy required to manufacture any type of materials, the second includes information about the energy required for transporting the materials while the third stores information about the energy required by machinery to place the materials in their intended locations. Through geospatial data analysis, the model automatically calculates the distances between the suppliers and construction sites and then uses dataset information for energy computations. The computational sum of all the energies is automatically calculated and then the model provides designers with a list of usable equipment along with the associated embodied energies.

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