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An Engineer-Oriented Life Cycle Assessment Tool for Building Carbon Footprint: The Building Carbon Footprint Evaluation System in Taiwan

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Abstract : The purpose of this paper is to introduce the BCFES (building carbon footprint evaluation system), which is a LCA (life cycle assessment) tool developed by the Low Carbon Building Alliance (LCBA) in Taiwan. A qualified BCFES for the building industry should fulfill the function of evaluating carbon footprint throughout all stages in the life cycle of building projects, including the production, transportation and manufacturing of materials, construction, daily energy usage, renovation and demolition. However, many existing BCFESs are too complicated and not very designer-friendly, creating obstacles in the implementation of carbon reduction policies. One of the greatest obstacle is the misapplication of the carbon footprint inventory standards of PAS2050 or ISO14067, which are designed for mass-produced goods rather than building projects. When these product-oriented rules are applied to building projects, one must compute a tremendous amount of data for raw materials and the transportation of construction equipment throughout the construction period based on purchasing lists and construction logs. This verification method is very cumbersome by nature and unhelpful to the promotion of low carbon design. With a view to provide an engineer-oriented BCFE with pre-diagnosis functions, a component input/output (I/O) database system and a scenario simulation method for building energy are proposed herein. Most existing BCFESs base their calculations on a product-oriented carbon database for raw materials like cement, steel, glass, and wood. However, data on raw materials is meaningless for the purpose of encouraging carbon reduction design without a feedback mechanism, because an engineering project is not designed based on raw materials but rather on building components, such as flooring, walls, roofs, ceilings, roads or cabinets. The LCBA Database has been composited from existing carbon footprint databases for raw materials and architectural graphic standards. Project designers can now use the LCBA Database to conduct low carbon design in a much more simple and efficient way. Daily energy usage throughout a building's life cycle, including air conditioning, lighting, and electric equipment, is very difficult for the building designer to predict. A good BCFES should provide a simplified and designer-friendly method to overcome this obstacle in predicting energy consumption. In this paper, the author has developed a simplified tool, the dynamic Energy Use Intensity (EUI) method, to accurately predict energy usage with simple multiplications and additions using EUI data and the designed efficiency levels for the building envelope, AC, lighting and electrical equipment. Remarkably simple to use, it can help designers pre-diagnose hotspots in building carbon footprint and further enhance low carbon designs. The BCFES-LCBA offers the advantages of an engineer-friendly component I/O database, simplified energy prediction methods, pre-diagnosis of carbon hotspots and sensitivity to good low carbon designs, making it an increasingly popular carbon management tool in Taiwan. To date, about thirty projects have been awarded BCFES-LCBA certification and the assessment has become mandatory in some cities.

Keywords : building carbon footprint, life cycle assessment, energy use intensity, building energy
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