Environmental Value Engineering

Environmental Value Engineering (EVE) was pioneered and copyrighted by Dr. Wilfred H. Roudebush in 1989. The methodology was developed into his Ph.D. dissertation entitled Environmental Value Engineering (EVE): A system for analyzing the environmental impact of built environment alternatives (University of Florida, 1992). This analysis methodology combines the late Dr. Howard T. Odum's emergy analysis with traditional value engineering. Environmental Value Engineering accounts for the inputs to built environment alternatives and can be used to compare multiple built environment alternatives over a life cycle consisting of 10 phases: natural resource formation, natural resource exploration and extraction, material production, design, component production, construction (assembly), use, demolition, natural resource recycling (feedback), and disposal. Because these phases successively accumulate the results of work, emergy tends to increase with each phase. Advantages of using emergy: versus Embodied energy in BTUs of coal equivalent that has been used to evaluate energy inputs to alternatives, but does not consider energy quality; versus money that has been used to evaluate inputs to alternatives, but only pays for services (labor). Emergy is more complete by including environmental work and other non-fuel inputs as either contributions or losses due to environmental impact. The dissertation applied the new analysis system to two alternative exterior wall construction systems of concrete masonry units and concrete tilt-up panels.

Energy systems diagrams (models) and language were used to represent detailed and aggregated emergy inputs. Inputs were calculated on emergy analysis tables. Data from calculations were input into a DYNAMO simulation program. The analysis system was used to evaluate alternatives with detailed and aggregated emergy tables and signatures. Simulation results included graphical output of cumulative emergy.

Environmental value engineering emergy indices were used to compare emergy per unit of built environment alternative. The highest environmental impact occurred during the first three phases of material transformity for both alternatives, with 56% of total emergy for the concrete masonry unit (CMU) alternative and 69% for the concrete tilt-up panel alternative. The emergy per unit of built environment alternative was 2.35E13 solar emjoules (SEJ) per square foot for the CMU alternative and 2.10E13 SEJ per square foot for the concrete tilt-up panel alternative. Environmental impact of the CMU alternative was 11.9% higher.

Sustainable development selection of built environment alternatives which contribute the most emergy to the economy while drawing the least from it are possible through use of environmental value engineering.

Environmental Value Engineering is referenced in the following documents:

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