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Evaluating Environmental Performance of Vernacular Architecture through CASBEE

Cappadocia, Turkey[2], [3]

Sandakan, Malaysia[2], [3]

Ardakan, Yazd Province, Iran[2], [3]

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Edited by Japan GreenBuild Council(JaGBC)/
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What's vernacular architecture?

Activities aimed at promoting sustainable architecture are now underway in countries throughout the world. One aspect of this trend is the keen interest being shown in the high environmental performance of vernacular architecture. The term “vernacular architecture” is used here to refer to traditional buildings that have been designed and built to match the local climate and culture. Much research has been carried out on vernacular architecture, but mostly from humanities or social science perspectives, and very little from an environmental engineering angle.


① Igloo (Canada)[7]


④ House with a wind catcher (Iran)[2], [3]


⑤ Stilt house on water (Malaysia)[2], [3]

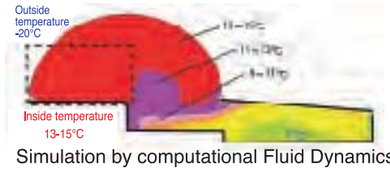

⑦ Stilt house (Indonesia)[2], [3]

Quantitative assessment of indoor thermal environment

Many vernacular housing environments employ passive technology that was developed for such purposes as safety, hygiene, health or comfort using the limited technical resources available in the days before modern technology existed. Such housing environments can be analyzed from the perspective of environmental engineering by taking on-site measurements and using computer simulation.

Analysis of the indoor thermal environment of the igloos used by Canadian Inuit during winter hunting trips showed that even when the outside temperature is -20°C, the temperature of the main indoor space was an ideal 13-15°C. On-site measurement of the indoor thermal environment of cave dwellings in Turkey showed that they maintain a relatively comfortable temperature around the year despite large seasonal differences in outside temperature. The local people of this region made up for the lack of building materials by carving out dwellings that take advantage of the homoeothermic properties of rock.

Computer simulation



Simulation by computational Fluid Dynamics[1]


Igloo (Canada)[7]

On-site measurement


Cave dwelling (Turkey)[2], [3]


Stilt house on water (Malaysia)[2], [3]


Filed measurements[2], [3]

Environmental performance of vernacular architecture

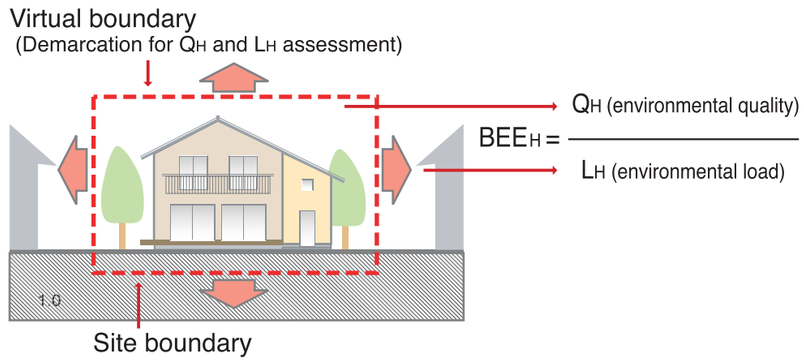
Another remarkable feature of vernacular architecture is the use of local building materials to construct housing that makes such good use of passive energy that almost no extra energy is required to maintain the housing. In other words, vernacular architecture provides the local inhabitants with a comfortable living environment while at the same having minimum impact on the natural environment.

CASBEE for Home (Detached House)

Announced in 2007, CASBEE for Home (Detached House) is a tool for quantitatively and comprehensively assessing the environmental load (L) and environmental quality (Q) of detached housing. This tool can be used to measure the environmental load and quality of the indoor environment of vernacular housing, enabling the elucidation of the environmental efficiency of vernacular architecture and providing hints for housing design aimed at improving sustainability.

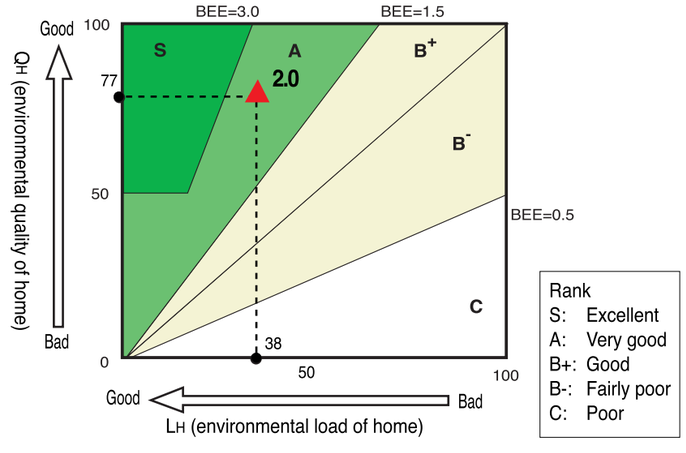
Virtual boundary and BEE_H

CASBEE sets a virtual boundary around the assessment site that is defined by the boundary of the site. Based on this concept, BEE_H (Building Environmental Efficiency – Home) is an indicator for assessing the environmental efficiency of a home in terms of the environmental quality (Q) and environmental load (L).



Rating environmental performance of buildings according to BEE_H

CASBEE provides an at-a-glance indication of the environmental performance of buildings by rating them in five categories – S to C – according to their BEE_H value. Because it enables the display of results as a simple figure (or number of stars), CASBEE's BEE concept has won favor around the world for its universality, measurability, and simplicity.



CASBEE assessment results

1 Igloo(Canada)[7]

2 Compound(Cameroon)[4]

3 Kasbah(Morocco)[4]

4 House with a wind catcher(Ilan)[2], [3]

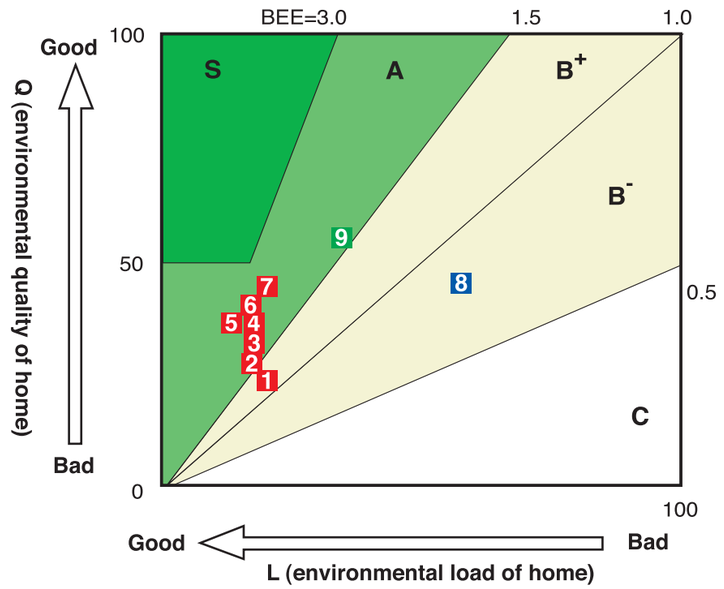
5 Stilt house on water(Malaysia)[2], [3]

6 Cave dwelling(Turkey)[2], [3]

7 Stilt house(Indonesia)[2], [3]

8 Modern Turkish home(Turkey)[2], [3]

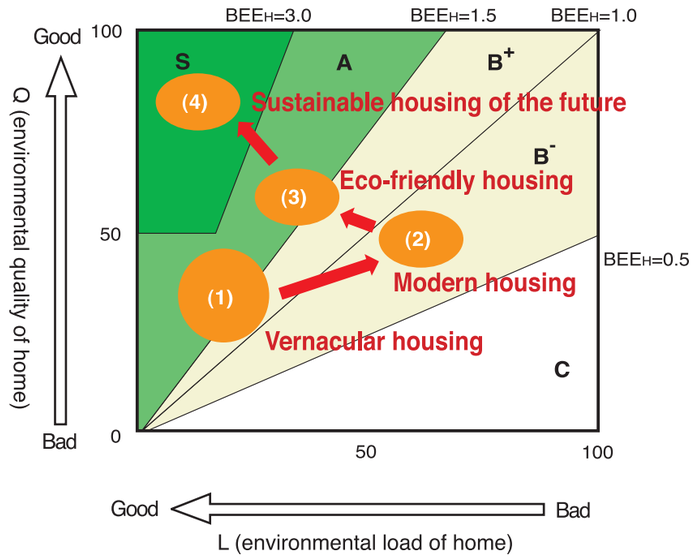
9 Modern residential building in Hanoi[2], [5], [6]



Vernacular housing
Modern cohabitation-type housing
Eco-friendly housing

Assessing the environmental performance of vernacular housing and comparing it with that of modern housing promises to offers new insights and possibilities for developing housing with lower environmental load (L) and higher environmental quality (Q) – a vital requisite in this era when environmental issues are of paramount concern. For this study, CASBEE assessments were conducted on (1) 7 types of vernacular housing (igloo, cave dwelling, house with wind catcher, stilt house, stilt house on water, compound, kasbah), (2) a modern residential building in Hanoi that incorporates passive technology elements found in Hanoi's vernacular architecture into its environmental design, and (3) a modern house in Cappadocia, Turkey. Results showed vernacular housing to be either equal to or superior to modern housing in terms of environmental efficiency when both environmental load and environmental quality are taken into account. CASBEE, a tool developed to assess modern architecture, proved to be more effective than we had anticipated in demonstrating the outstanding environmental efficiency of vernacular architecture.

Promoting sustainable architecture based on the principle of environmental efficiency



Step 1 ((1)→(2)) From vernacular to standard modern housing

The shift from vernacular to modern housing has resulted in an improvement in environmental quality through the use of energy for machines , as well as an increase in environmental load. With the advance of globalization, the motivation to use homegrown architectural innovations that take advantage of passive energy also disappeared.

Step 2 ((2)→(3))From standard modern to eco-friendly housing

Eco-friendly technology is spreading, with current environmental design encouraging the use of passive technologies that make the most of renewable energy sources, and the deployment of appliances and fixtures featuring high energy efficiency enabled by technological advances.

Step 3 ((3)→(4))Towards sustainable housing with even higher environmental efficiency

Further boosting environmental efficiency ((3)→(4)) is vital to the creation of a sustainable society. The environmental design elements incorporated into all of the examples of vernacular housing shown here provide valuable hints for achieving this end.

The way in which vernacular architecture and lifestyles defined by such architecture make effective use of passive design adapted to local climate and other conditions in cold and hot, arid and humid regions provides valuable hints for environmental design that offers great possibilities for improving architectural sustainability. Vernacular housing deserves our attention for the way its low environmental load boosts environmental efficiency. The assessment introduced here demonstrates both the outstanding environmental performance of vernacular architecture from multiple perspectives and the effectiveness of CASBEE as an environmental performance visualization tool. Looking ahead, we feel that there is a need to guide the construction market towards sustainability through concrete initiatives and proposals for applying such knowledge of the merits of vernacular housing to modern architecture.

What is CASBEE

Promotion of sustainability is one of the great challenges facing humankind. Since the building industry started to move toward the promotion of sustainable building in the latter half of the 1980s, various techniques to evaluate the environmental performance of buildings have been developed.
In Japan, a joint industrial/government/academic project was initiated with the support of the Housing Bureau, Ministry of Land, Infrastructure and Transport (MLIT), in April 2001, which led to the establishment of a new organization, the Japan GreenBuild Council (JaGBC) / Japan Sustainable Building Consortium (JSBC), with its secretariat administered by the Institute for Building Environment and Energy Conservation. JSBC and a subcommittee under it are together working on R&D of the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). Today, the enhancement and diffusion of CASBEE are being promoted under the MLIT Environmental Action Plan (June 2004) and the Kyoto Protocol Target Achievement Plan (approved by the Cabinet on April 28, 2005). In recent years, several local authorities introduced CASBEE into their building administration. Consequently environmental performance assessment of buildings is now carried out in many buildings in Japan.

CASBEE Tools Family

CASBEE is a method for assessing and rating the environmental performance of buildings, ranked in five grades: Excellent (S), Very Good (A), Good (B+), Fairly Poor (B-) and Poor (C). The first assessment tool, CASBEE for Office, was completed in 2002, followed by CASBEE for New Construction in July 2003, CASBEE for Existing Building in July 2004 and CASBEE for Renovation in July 2005. CASBEE is unique to Japan for its introduction of an innovative concept: it evaluates a building from the two viewpoints of environmental quality and performance (Q = quality) and environmental load on the external environment (L = load) when evaluating the environmental performance of the building and defines a new comprehensive assessment indicator, the Building Environmental Efficiency (BEE), by Q/L. CASBEE comprises the four basis tools, tailored to the building lifecycle, and expanded tools for specific purposes (Japan Sustainable Building Consortium). These are called collectively as the “CASBEE Family,” as shown in Figure 1.

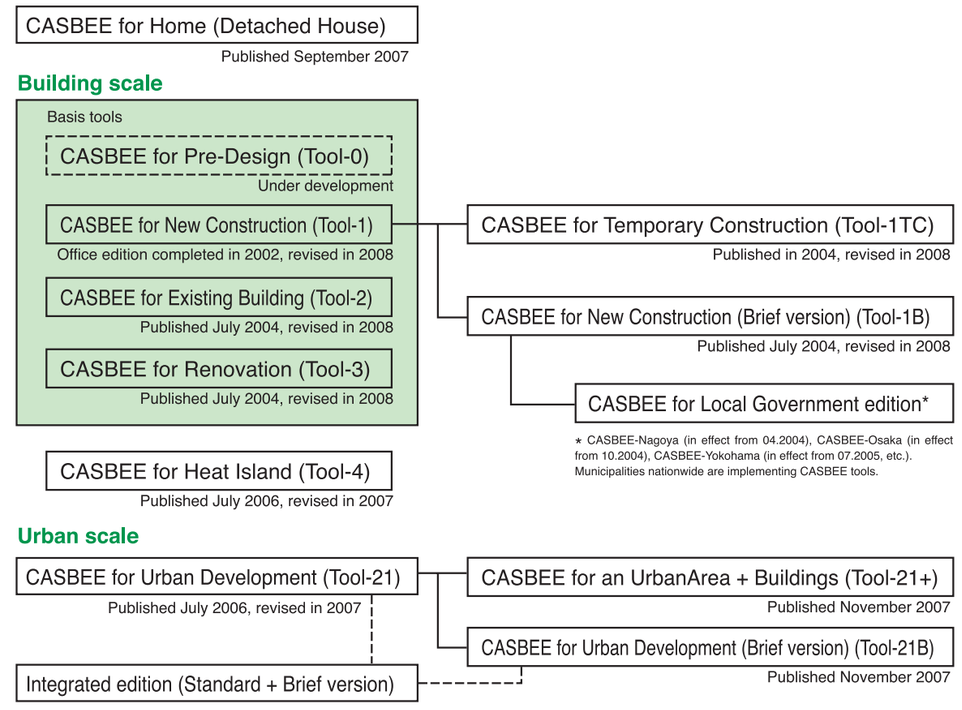


Figure 1 Structutre of the CASBEE Family