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Introduction

Building construction is an extremely resource-intensive process and takes a heavy toll on the environment. As such, it is the responsibility of those in the building industry to promote environmentally-friendly, sustainable practices. Today, a variety of environmental assessment tools developed around the world have become crucial components in the advancement of sustainable buildings. The development of the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) began in 2001. CASBEE has been developed by a research committee as part of a joint industry-government-academia project with the support of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). This partnership has been instrumental in developing CASBEE’s clear and solid concept to the benefit of a broad spectrum of users in Japan. Now, a decade after the introduction CASBEE, the assessment system known as the “CASBEE Family” now includes over 15 tools specific to fields ranging from buildings to cities. Recognized for its clear conceptual underpinnings, CASBEE generated considerable interest among government agencies, industries and academics. Ranging from administrative support to design support, property appraisal and building branding, the systemized CASBEE tools enable broad applications. The most significant characteristic of CASBEE is that all the tools are developed and organized consistently with a unified concept. Without such a concept, the creation of a systemized group of tools would be difficult to achieve.

What is CASBEE

CASBEE is a method for evaluating and rating the environmental performance of buildings and the built environment. It is a comprehensive assessment of the quality of a building, evaluating features such as interior comfort and scenic aesthetics, in consideration of environment practices that include using materials and equipment that save energy or achieve smaller environmental loads. The CASBEE assessment is enabled by a pair of different aspects represented by an incompatible vector, that is, improvement of Q (environmental quality) and reduction of L (environmental load) are included for building environmental assessment in this global environment era. Only the CASBEE tool that has been modified from the other standards in Japan. These items for comprehensive assessment cover not only those in the building industry to promote environmentally-friendly, sustainable practices. Today, a variety of environmental assessment tools developed around the world have become crucial components in the advancement of sustainable buildings.

1. Clear definition of spatial boundaries to be assessed

In many tools in use worldwide, the subject of assessment is often vaguely defined as a building or a location. However, the clear definition of spatial zones to be assessed should never be omitted before conducting an assessment. In this regard, of the assessment tools available throughout the world, only CASBEE is explicit on this issue. In CASBEE, the virtual boundary is introduced as an area surrounding the building concerned and is treated as a site boundary. The inside and the outside of the virtual space boundary are specifically framed to be evaluated separately. The key here is that the surrounding area of the building is explicitly included for the on-site assessment.

2. Clear definition of environments to be assessed

As already mentioned, a pair of different aspects represented by an incompatible vector, that is, improvement of Q (environmental quality) and reduction of L (environmental load) are included for building environmental assessment in this global environment era. Only the CASBEE tool system was designed with this point of view. In CASBEE, each item to be evaluated is first associated with either Group Q or Group L and is further assigned to the respective sub-group for more detailed categorization.

3. Scoring method

Many assessment tools have adopted the simple addition of scores attained from the respective assessment items. However, the originality of the CASBEE assessment method stems from use of the aforementioned Q and L to obtain a scalar indicator determined by QL (referred to as the Built Environment Efficiency; BEE). The BEE is a concept akin to Factor Four proposed as the efficiency of resources use by Weitzäcker in Germany. Since 2008, CASBEE has included Lifecycle CO2 (LCCO2) assessment, which evaluates CO2 emissions during the entire building life cycle from construction and operation to demolition and disposal. A new “Standard Calculation” method automatically provides a simplified estimation of LCCO2 based on data already entered in a CASBEE spreadsheet. The feature is especially beneficial to assessors who are not familiar with the LCCO2 evaluation. LCCO2 performance is indicated more precisely by awarding 1 to 5 green stars based on LCCO2 emissions together with the existing BEE assessment (e.g., S: 5 red stars). Specifically, the emissions rate (%) for the assessment target is evaluated relative to the LCCO2 emission level of a reference building (one that satisfies energy standards for building owners according to the Japanese Energy Conservation Law).

4. LCCO2 emission assessment (for housing and building scale)

In CASBEE for Detached House

This tool is used to assess the environmental performance of detached houses wherein the scoring criteria are simplified in anticipation of use by residents or small- to medium-sized building contractors. There are various stakeholders in the housing construction industry such as clients, designers, contractors, and builders. Therefore, “CASBEE-DH,” previously called “CASBEE for New Detached Houses,” was introduced in 2007 which especially focuses on making its structure easy for users to understand. "CASBEE-DH/NC" includes 54 sub-criteria that have been modified from the other standards in Japan. These items for comprehensive assessment cover not only

4. 1. Housing scale

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CASBEE-DH/NC (NC: New Construction)

English version is available as “CASBEE for Home (Detached House) 2007 edition.”

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5. Stratified structure of a scale of defined areas for assessment

CASBEE gradually expanded so as to perform the assessment on a scale of a district (or local area or neighborhood), CASBEE for Cities, which was released recently, is the only tool enabling city-scale assessment.

6. Inclusion of time scale for assessment

Initially, almost all the assessment tools dealt with the new construction of buildings. The subsequent development of tools to assess the existing buildings occurred in many cases. The promotion of environmental assessment of existing buildings is a policy that is challenging but meaningful. In CASBEE for Cities, urban environment can be assessed in the context of past, present and future. Urban development is usually planned and executed over a long time span. The outcomes of urban environment policy can be better presented by comparing how the city was in the past, how it is in the present, and how it would be in the future.

CASBEE FAMILY

CASBEE is comprised of a scale of assessment tools tailored to different scales: construction (housing and buildings), urban (town development) and city management. These tools are collectively known as the “CASBEE Family.”

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the house itself but also the outdoor space of the house, home appliances, information provided to the occupants from house suppliers, and the environmental strategies at the material production and construction stages. Among CASBEE tools, CASBEE-DH/NC was the first to introduce the five BEE ranks using the corresponding number of stars.

### CASBEE-DH/EB (EB: Existing Building)
This is a tool for the assessment of existing detached houses and was developed to enable a resident, an architect, etc., to check the environmental performance of the house in which the resident is living, and to perform effective renovations.

### 2) CASBEE for Housing Unit
This assessment tool was developed as a tool to evaluate the environmental performance individual units within an apartment building, the results of which can be utilized when trading or renting a unit.

### 3) CASBEE Housing Health Checklist
CASBEE Housing Health Checklist is a type of software wherein answering 50 questions allows residents to identify the aspects of their home that affect their health. A health ranking is also available for comparing the result with 6,000 other houses across Japan.

### 2. Building Scale

#### 1) CASBEE for Building Design
CASBEE-BD/NC (NC: New Construction)
*English version is available as “CASBEE for New Construction 2014 edition.”*

CASBEE-BD/NC (formerly called the DfE (Design for Environment) tool) is mainly used by architects and engineers to assist them in increasing the BEE value of a building during the design process. It can be used as a design support tool as well as a self-checklist and makes assessments based on the design specifications and the anticipated performance. The environmental quality and performance of the building and its load reduction performance can be evaluated at any phase of the Preliminary Design, Execution Design or Construction Completion. Reconstruction projects are also assessed by CASBEE-BD/NC.

As the environmental performance and the evaluation may change during operation stage, the results of assessments remain valid only for three years after the completion of construction.

CASBEE-BD/EB (EB: Existing Building)
CASBEE-BD/EB targets existing buildings with an operational record for at least one year after completion and developed to also be applicable to the asset value assessment. CASBEE-BD/EB can be used:
- As a labeling tool to declare the environmental performance of buildings
- To support building maintenance.
- By building owners, such as real estate agencies and large enterprises, as a self-evaluation tool for mid- to long-term management plans.

The results of the performance assessment are valid for 5 years and, since the building condition may change over time, it should be reassessed using the latest version of the assessment tool.

CASBEE-BD/RN (RN: Renovation)
CASBEE-BD/RN was designed to evaluate the performance of existing buildings based on specifications for renovation and the predicted performance. It can be used:
- In renovating existing buildings or making proposals for building-operation monitoring, commissioning and upgrade designs with a view to Energy Service Company (ESCO) projects.
- To evaluate the degree of improvement of environmental performance relative to the level preceding renovation.
- To assess the improvement of specific performance in relation to the purpose of renovation. For instance, the BEE for energy saving can also be evaluated; this is determined by scores for the assessment categories especially related to energy saving renovation, such as Energy (LR1) and Indoor environment (Q1).

The assessment is valid for three years after the completion of renovation work, and assessment should be repeated with the latest version of CASBEE-BD/RN available.

### CASBEE for Temporary Construction (CASBEE-TC)
CASBEE for Temporary Construction was developed as an extension to CASBEE-BD/NC for evaluating temporary buildings constructed specifically for short-term use, such as Exposition Pavilions. Buildings of this type have short-term lifecycles and therefore consideration should concentrate largely on material use and recycling in the construction and demolition phases.

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**Figure 5: Assessment result of CASBEE for Building (New Construction)**
CASBEE for Heat Island Relaxation (CASBEE-HI)
Assessment of the heat island effect is essential in major urban areas such as Tokyo and Osaka. CASBEE-HI is a tool aimed for more detailed quantitative assessment of heat island reduction measures in building design. In CASBEE-HI, the criteria deal with more detailed conditions in the outdoor thermal environment and heat island load on the surroundings. Such issues are also addressed in CASBEE-BD/NC.

CASBEE for Schools
In Japan, there are an enormous number of old school facilities built in the 1960s or earlier awaiting for renovation. CASBEE for Schools was developed to assess primary schools and junior high or high schools and for use especially at the planning and operation stages of buildings. The primary target users are administrative officers in charge of the planning of educational facilities. CASBEE for Schools was modified from the CASBEE-BD/NC, CASBEE-BD/EB and CASBEE-BD/RN for easy assessment of the schools and thereby assisting in the broader promote eco-friendly schools.

Locally Customized Edition for Municipalities
A flexible response to regional characteristics is a common feature of all the tools of the CASBEE family. CASBEE-BD/NC can be used by local authorities for construction administration. Local authorities using this tool can tailor it to local conditions, such as climate and relevant policies wherein changes are generally made by modifying the weighting coefficients. This system is introduced to the local authorities as a way to improve the environmental efficiency of buildings in the respective regions.

2) CASBEE for Interior Space
The assessment of CASBEE for Interior Space covers only the area that the tenant (such as a company) occupies in an office building, because the main purpose of this tool is to evaluate environmental measures and/or environmentally responsible initiatives conducted by the tenant itself. The assessment also includes indoor comfort, energy efficiency and water conservation of the building, earthquake resistance, and intellectual productivity. At present, only office buildings are assessable.

3) CASBEE for Market Promotion (CASBEE-MP) *English version is available.
The CASBEE tools were originally intended mainly for design support use and were not so widely used in the property market. Recently, UNEP-SBCI, United Nations Environment Programme - Sustainable Buildings and Climate Initiative, proposed global common metrics called “the Sustainable Building Index.” A simple, comparable and compatible system is crucial to decision-making regarding investment in green buildings. For investors, it is also necessary to cover the common metrics proposed by UNEP-SBCI. It was therefore decided to have CASBEE tools connected with approaches for property appraisal. CASBEE-MP is the tool developed for property appraisal.

A clear indication of environmental performance value is required in the property market, and it is important to disseminate such ideas. With this in mind, a very simple version of CASBEE was developed with two aspects: the evaluation of environmental performance and the disclosure of environmental performance value. The main categories of this tool cover five issues – energy/CO2, water, materials, biodiversity/habitat site and indoor environment – along with five issues from the Sustainable Building Index. With 21 assessment items in total, each of the five categories contains prerequisite items.

3. District scale
1) CASBEE for Urban Development (CASBEE-UD) *English version is available.
CASBEE-UD is to evaluate urban development projects on the ground where there are several architectural constructions and other areas for various purposes such as roads, public squares and green spaces. In CASBEE-UD, the environmental performance of such constructions and areas is examined collectively. CASBEE-UD has served as a useful tool to developers and city/neighborhood planners.
The key concept is that the assessment of QoC is based on the triple-bottom-line approach and LUD is evaluated according to how effectively low-carbon initiatives are carried out. CO2 emissions induced by a project of interest (on a scale of a district or local area) are calculated and converted into a LE score through a series of procedures to obtain a standardized indicator.

2) CASBEE Community Health Checklist
The CASBEE Community Health Checklist is a type of software used to assess the health of community residence. The checklist conforms to the assessment system based on the International Classification of Functioning, Disability and Health (ICF) of the World Health Organization (WHO). Communities are evaluated from the viewpoints of removal of function-disabling factors and sufficiency of encouraging factors for activities and participation.