Global Leadership Training Programme in Africa 2015

RESEARCH REPORT

Trend of Sustainable Buildings and The Possibility of an Assessment System for Built Environment Efficiency in South Africa

Taichi HINOTSU[1]

< English Summary (1 page)>

The Global Warming which is caused by greenhouse effect gas threaten the life of animals and people. It is clear that in order to address the global priorities of climate change and scarce resources, the environmental impact of buildings requires urgent focus and improvement. Furthermore, industry stakeholder are increasingly implementing green building practices as a result of demand from market consumers, investors, shareholders, employees, the community and government. The benefits that can accrue to them include reduced infrastructure and plant and equipment costs, enhanced reputation or brand and reduced operational costs. However there are some barriers to the construction of green buildings and the application of energy saving technologies in developing countries like South Africa. One of the barriers is a lack of education and knowledge of their costs and associate benefits, where to obtain green products, green features and general approaches to green design (Maddew, 2006). Hence, it is important to show how buildings are addressing environmental issues by using an assessment tool which is not used in South Africa. In this report, the author assessed the No.1 Silo and Portside buildings according to CASBEE criterion. Those two buildings are six and five star Green Star SA rated buildings respectively. CASBEE is Japanese scheme for the measurement of the environmental performance of buildings. The results according to CASBEE confirmed that both the No.1 Silo and Portside are high quality green certified buildings. This research based on measurement of the room temperature, humidity, air current velocity, light measurement and carbon dioxide and the several interviews conducted with some institutions (e.g. Facilities Managers of Allan Gray/Sustainable Buildings Specialist of Arup/ Facilities Managers of Portside). As

[1] Dept. of Architectural Eng., Graduate School of Eng., OSAKA University, JAPAN
Host University : University of Cape Town
The period of this field research conducted : 29 Mar. 2015

a result, No.1 Silo was awarded S rank and Portside building awarded A rank according to the CASBEE rating tool. This CASBEE certification demonstrates those building capabilities for design and construction projects in South Africa and around the world. However, this result driven by the author`s main research objective. If CASBEE is to be implemented to access South African commercial buildings, then training will be required in order to educate building professionals.

< Japanese Summary (1 page)>

温室効果ガスを原因とする地球温暖化が人や動物の生活を脅かしつつある。よって地球温暖化の主たる要因である二酸化炭素排出量の減少に対し建築分野において環境配慮建物と環境促進技術の普及に取り組むことが急務とされる。さらに、ビジネスとしての環境配慮建築も昨今の話題とされている。省エネ技術の取り込まれた建物への出資が増え、その建物は高い賃料で使用者に貸し出される。そしてその使用者は割高なイニシャルコストを払い、ランニングコストの削減、環境に取り組む企業という社会へ向けたアピールを行うことで利益を得ることができる。しかし南アフリカ共和国のような新興国において環境配慮建物への普及にはいくつかの障壁が存在し、その一つが環境配慮建物や省エネ技術促進により生じる利益やコストに関する知識や教育の不足だ。以上のことから、南アフリカの建物がどれだけ環境性能が高いかを南アフリカ以外の国による評価とその評価データを南アフリカの公共機関への提供は非常に意義のあることだ。本調査において、筆者は No.1 Silo と Portside という南アフリカを代表する二つの環境配慮建物を CASBEE によりその環境性能を評価する。CASBEE は建物の環境性能を評価する日本の評価指標であり、日本においてその評価結果は建物の賃料と使用者のブランドイメージに大きく影響を与える。調査は室温、湿度、室内風速そして光度の測定と複数の会社のインタビューにより行われた。結果として CASBEE で Allan Gray は S ランク、Portside は A ランクという評価であり、南アフリカを含む世界中でこれらの建物が施工と計画段階において素晴らしい環境性能を持つことを証明した。しかし、この評価結果は筆者による簡易な調査で行われており、結果をビジネスに用いるためには専門家による正確な調査が必要だ。また、日本は地震が多く湿度が高いのでこれらへの対応に重点が置かれ、CASBEE においても多くの評価項目がある。しかし、南アフリカでは地震と湿度がないので南アフリカの建物を評価する際に これらの評価項目において不利な結果が出てしまう。今後 CASBEE の国際進出を考える際に環境に応じて評価項目の重みを変えられる仕組みの必要性を感じた。

< OUTLINE >

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3. Methodology
4. Research Findings
5. Conclusion
6. Reflection on the GLTP in Africa (What you learned through this programme and how to make use of this experience to your future career development)

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1. Introduction

The Global Warming which is caused by greenhouse effect gas threaten the life of animals and people. In South Africa, 28% of total emissions is from commercial and residential buildings (GBCSA, 2012). It is clear that in order to address the global priorities of climate change and scarce resources, the environmental impact of buildings requires urgent focus and improvement. Furthermore, in business case, industry players are increasingly implementing green building practices as a result of demand from market consumers, investors, shareholders, employees, the community and government.

The benefits that can accrue to them include reduced infrastructure and plant and equipment costs, enhanced reputation or brand and reduced operational costs. However there are some barriers to the construction of green buildings and application of energy saving technologies in developing countries like South Africa. One of the barriers is a lack of education and knowledge which is for obtaining green products, green features and general approaches to green design (Maddew, 2006). That is why it is important to show how buildings are addressing environmental issues by using an assessment tool which is not used in South Africa.

Firstly, BREEAM was launched in the early 1990s as the first building environmental assessment scheme, and then, there has been a significant rise in the number of building environmental assessment schemes that promote sustainable building developments. The more widely known include the Green Star in Australia, BEPAC in Canada, the Evaluation Standard for Green Building (ESGB) in China, the Eco-Management and Auditing Scheme (EMAS) in the European Union, BEAM Plus in Hong Kong, CASBEE in Japan, GBCC in Korea, the Green Building Labelling System in Taiwan, and the LEED, CHEERS and Green Building Program in the United States and Green Star SA in South Africa. Green Star SA is a South Africa scheme for the

measurement of the environmental performance of buildings. The minimum Green Star SA rating is One Star and the maximum is Six Stars (only four, five and six star buildings are considered to be green certified buildings). In this report, the author assessed the No.1 Silo and Portside building which are representative green building in South Africa according to the CASBEE rating tool. CASBEE is Japanese scheme for the measurement of the environmental performance of buildings. The results according to CASBEE confirmed that both the No.1 Silo and Portside are high quality green certified buildings.

2. Study Area

This study was conducted in Cape Town, South Africa. The national population of South Africa is about 52million including various tribes. South Africa is a relatively dry country, with an average annual rainfall of about 464 mm, compared to a world average of about 860 mm. While the Western Cape gets most of its rainfall in winter, the rest of the country is generally a summer-rainfall region. Temperatures in South Africa tend to be lower than in other countries at similar latitudes – such as Australia – owing mainly to greater elevation above sea level (SOUTH AFRICA YEARBOOK 2013/14). The World Economic Forum ranked South Africa second in the world for the accountability of its private institutions, and third for its financial market development (2013/14 Global Competitiveness Report). According to the results for 2012, South Africa was also the only African country to be ranked in the top 15 emerging economies worldwide. The two buildings measured by CASBEE are located in Cape Town, which is located in the south west of South Africa.

3. Methodology

In this research, CASBEE for New Construction 2010 Edition was used as a scheme for the measurement of the environmental performance of the building. CASBEE is a joint governmental, academic, and industrial sector approach used in Japan. The main four aspects of CASBEE include energy efficiency, resources efficiency, local environment and indoor environment which comprise a total of 80 sub-criteria which are further re-categorised into two main groups: Q (Quality), and L (Loadings) (Horvat & Fazio, 2005). L is first evaluated as LR (built environment load reduction). In order to evaluate the sustainability of green building, CASBEE introduces the value of BEE (Building Environmental Efficiency).

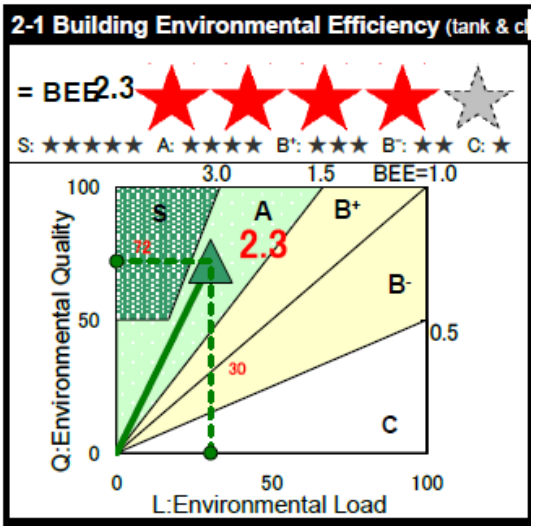

Figure-1 BEE Value and Red Star Ranking

Figure-1 shows the enlarged image of section 2-1 in the assessment result sheet. Assessment scale for Q and LR ranges from 1 to 5. As SQ represents the score of Q category, the numerator Q is derived from SQ. Similarly, the denominator L is calculated from SLR.

$$BEE = Q / L = 25*(SQ-1) / 25*(5-SLR)$$

SQ= Score for Q category

SLR= Score for LR category

BEE is presented as a graph on the left, with Q on the Y axis and L on the Y axis, so that BEE is the gradient of the line joining the point with coordinates equal to the Q and L values to the origin (Q=0, L=0). The higher the Q value and the lower the L value, the steeper the gradient and the more performance assessment classification from C (poor, BEE≤0.5) through B- (0.5< BEE≤1.0), B+ (1.0<BEE≤1.5), A (1.5<BEE≤3.0) and S (excellent, 3.0<BEE and 50<Q), corresponding to regions divided according to the line gradient. CASBEE is differentiated from other assessment systems like BREEAM, LEED and SBTool by its unique approach to the completion of its final result. Rather than relying upon an approach of simply adding individual criteria scores, CASBEE introduces the concept of Building Environmental Efficiency (BEE) with weighting coefficients for the assessment of different kinds of building (Chew & Das, 2008). These are based on the outcome of a questionnaire survey of key stakeholders such as designers, building owners and operators and subsequently the responses are analysed by analytic hierarchy process (CASBEE, 2011).

The No.1 Silo and Portside Building were assessed in this research. In a first-ever achievement for a South African building, The No.1 Silo has been awarded a 6 Star 'As Built' rating in Green Star South Africa (GSSA) for its impressive and environmentally-friendly construction. One of the more unique green initiatives is the use of seawater from the Atlantic Ocean. The system functions by drawing in seawater from the harbour through a titanium plate heat exchanger system in the basement. On the other hand, Portside building received a 5 Star Green Star rating for Design and 5 Star Green Star Office v1 'As Built'. Portside has focused on the environmental initiatives associated with GSSA projects, including energy reduction through an efficient air conditioning system; the capturing, storage and reuse of rainwater and grey water for use in toilets thus reducing potable water use; the use of low embodied energy materials such as recycled reinforcing steel, and cement replacement with industrial waste products; and the maximisation of natural light through the provision of a high quality double glazed façade (AGAMA, Ann-Mari Malan).

This research based on measurement of the room temperature, humidity, air current velocity, light measurement and carbon dioxide and the several interviews conducted with several respondents (e.g. Facilities Managers of Allan Gray/Sustainable Buildings Specialist of Arup/ Facilities Managers of Portside). **Figure 2** shows a part of the list of the measurement and **Figure 3** shows a part of the questionnaire used in the interviews. Since it is difficult to get all answer of the criteria of CASBEE in one meeting, the questionnaire was sent to the respondents prior to the meeting, so that they could familiarize themselves with the questions and arrive with several prepared answers.

Measuring Title / Comment	Page(EG,JP) / Score
Q1.1.1.1 Background noise level	55,39
Q1.1.3 Sound Absorption	69,47
Q1.2.1.1 Room Temperature	70,48
Q1.2.3 Type of Air Conditioning System	87,58
Q1.3.1.1 Daylight Factor	90,60
Q1.3.1.3 Daylight Devices	93,64

Figure-2 The list of the measurement

Questionnaire for Estimating of Building Environment

1. Can you tell me the background noise level [dB] in the office?

2. Can you tell me the sound transmission losses [dB] of the opening (like sash windows and other fixtures)?

3. Can you tell me the sound transmission losses of walls?

4. Can you tell the ventilation system (and ventilation rate) in the project?

Figure-3 The questionnaire used in the interviews

4. Research Findings

4.1 No.1 Silo

Figure-4 shows assessment results sheet of the No.1 Silo. The building achieved S rank under the CASBEE (BEE=5.2). That is why the building comprises many sustainable features, some of which are: a sea water cooling system and a high performance façade that controls the thermal performance and comfort inside the building. However, as the radar chart (2-3) shows, in the some sections the building was not awarded a good result. There are two reasons that contribute to this result. Firstly, CASBEE has many criteria about construction because of many earthquake in Japan. In those criteria, the No.1 Silo awarded a low score. Secondly, although CASBEE has 87 criteria, only 69 criteria has been assessed. In this research, if a criteria cannot be assessed, then the default score for the criteria is 3.

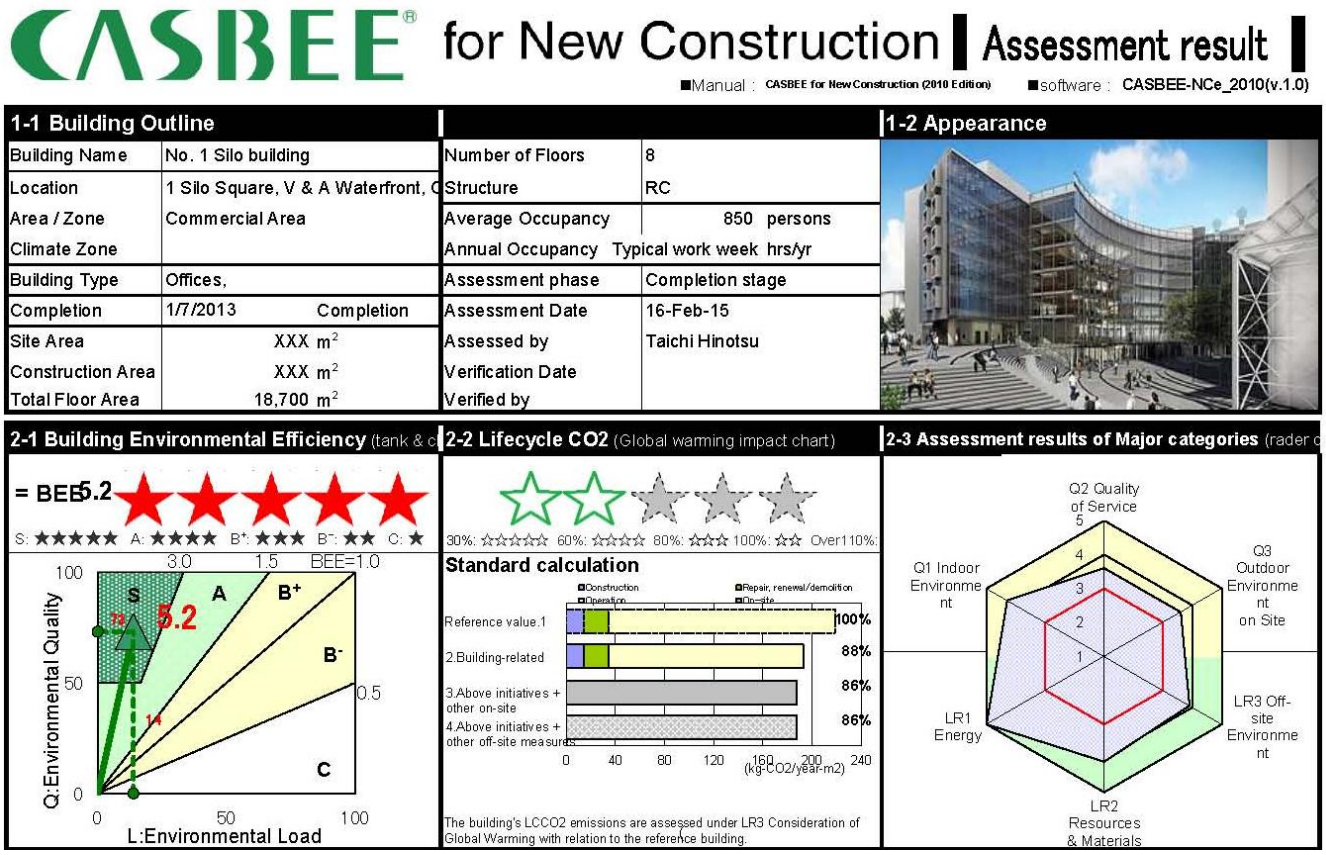

Figure-4 Assessment results sheet of Allan Gray Building

4.1 Portside building

Figure-5 shows assessment results sheet of Portside. The building achieved A rank under the CASBEE (BEE=2.3). This is due to Portside containing many sustainable features. However, as the radar chart (2-3) shows, in the some sections the building was not awarded a good result. There are two reasons that contribute to this result. Firstly, the environment surrounding South Africa is different from Japanese environment. For example, Japan has a high earthquake risk, which is not an issue in South Africa. In addition, it is important to consider humidity in order to ensure comfortable indoor environmental quality in Japan. That is why there are many criteria about these issues. However, in these criteria, Portside building was awarded a low score. Secondly, although CASBEE has 87 criteria, only 65 criteria has been assessed. In this research, if a criteria cannot be assessed, then the default score for the criteria is 3.

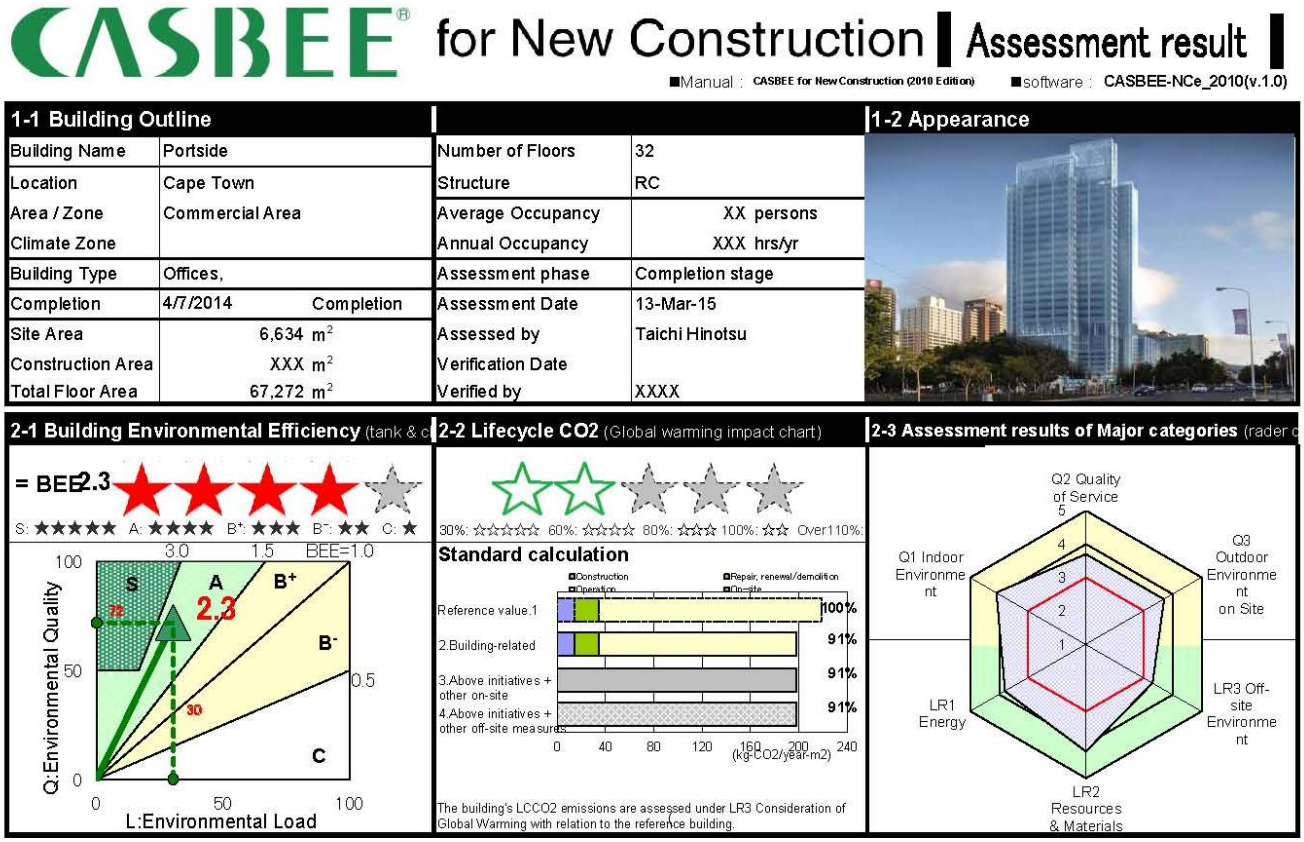

Figure-5 Assessment results sheet of Portside Building

5. Conclusion

In this report, the author assessed the No.1 Silo and Portside building by CASBEE. The No.1 Silo was awarded S rank and Portside building awarded A. This CASBEE certification demonstrates that both of buildings have capabilities for design and construction projects in South Africa and around the world. However, this result was driven by the author's main research objective. If CASBEE is to be implemented to access South African commercial buildings, then training will be required in order to educate building professionals.

6. Reflection on the GLTP in Africa

Before this program, I thought the buildings of South Africa had many trouble involved with design, construction and facility of architecture and Japanese institutions had to teach technology and send people who can teach architecture. However the completion of my research in South Africa, I realized I was mistaken. It is true that the average quality of commercial buildings in South Africa is lower than Japan, but the highest level of the buildings in South Africa are on the almost same level with Japan. That is shown in my research. In addition, when the Allan Gray facilities manager exhibited the No.1 Silo building management system, I realized the No.1 Silo facilities are equivalent or superior to that of Japanese commercial buildings. Therefore, what we can do for developing countries like South Africa is not to give money or technology, but to help them to spread their building technology throughout South Africa.

Acknowledgement

I would like to thank all members for supporting my research activity. Because my research needed the support of the company, it was a very big challenge to make contacts and acquire information with my terrible English. I am confident that I could never have completed my research without the support of Prof. Kathy MICHELL (UNIVERSITY OF CAPE TOWN), Saul NURICK (UNIVERSITY OF CAPE TOWN), interviewers and all my supporting team members in South Africa. Lastly, I also appreciate the opportunity of joining the Global Leadership Training Program in Africa.

References

CASBEE for New Construction Technical Manual (2010 Edition), JSBC

GSSA OFFICE V1.1 2014 Technical Manual, GBCSA

The Rands and Sense of Green Building 2014, GBCSA

Appendix

Questionnaire for Estimating of Building Environment

1. Are ozone-depleting substances associated with either the manufacture or the composition of all thermal insulants in the project?

2. Are humidification and dehumidification equipment available, and planned to keep humidity in a range of 45-55%?

3. Do all composite wood products either have low formaldehyde and other VOC emissions?

4. Can you tell the ventilation system (and ventilation rate) in the project?

9. Have 50% (by cost) of all timber products used in the building and construction works been sourced from any combination of the following:
   - Reused timber;
   - Post-consumer recycled timber; or
   - Forest Stewardship Council (FSC) Certified Timber?

10. Are environmentally friendly materials used in the refrigerants that are used in the building?

11. Do you use boilers and generators that minimize harmful emissions?
    (Do all gas boilers have NOx emissions of < 100 mg/kWh (at 0% excess O_2);
    AND
    Do all generators comply with the Tier 3 emissions standards as defined by the United States Environmental Protection Agency (EPA) or the equivalent European Stage IIIA standard?)

12. Does the building addresses sewerage discharge minimization?
    In addition, can you tell me the developments that minimize discharge to the municipal sewerage system in this project?

13. Can you tell me the efforts related to use of bicycle and efforts provide car parking space?

14. What efforts do you do to sort, reduce and compact waste in this project?

15. What efforts be taken to minimize light pollution into the night sky and reflected solar glare from building walls?

16. Can you tell me the background noise level [dB] in the office?

17. Can you tell me the sound transmission losses [dB] of the opening (like sash windows and other fixtures)?

18. Can you tell me the sound transmission losses of walls?

19. Can you tell the ventilation system (and ventilation rate) in the project?

20. Are there separate air conditioning systems for each orientation direction, and for perimeter and interior, allowing more detailed zoning (broadly, zones of 40m2 or less)? The air conditioning system can provide either heating or cooling separately to each zone.

21. What is the ventilation rate [m3/(h*human)]?

22. Have measures been applied as necessary to extend the period before large-scale refurbishment work is required to three generations (around 75-90 years)?

23. Can you tell me the necessary renewal interval for main interior finishes?

24. What does air conditioning and ventilation ducts made from? For example, Zinc-plated steel or stainless steel?

25. Can you tell me the necessary renewal interval for HVAC and water supply and drainage pipes?

26. Can you tell me the necessary renewal interval for major equipment and services?

27. In HVAC system, do you consider measures against the event of natural disasters or major accidents?

28. In water supply & drainage, do you consider measures against the event of natural disasters or major accidents?

29. In electrical equipment, do you consider measures against the event of natural disasters or major accidents?

30. In communications & IT equipment, do you consider measures against the event of natural disasters or major accidents?

31. Can you tell me the ease of water supply and drain pipe renewal, electrical wiring renewal, communications cable renewal, equipment renewal?

32. Do you have planned provision of space for backup equipment?

33. Check list 1

34. Check list 2

35. Can you tell me the PAL value [MJ/m2*year] of the building, thermal load consumption (air conditioning, ventilation, lightning, hot water supply, elevators and other energy consumption) [MJ/year] and natural energy use [MJ/year]?

36. Check list 3

37. Check list 4

38. Are environmentally friendly materials used as fire retardant?

39. Did you use simulations or other means to confirm effects in mitigating deterioration of the heat environment?

40. Has a preliminary study of wind damage or prevention from wind damage been performed and measures taken to avoid or reduce wind hazard?

41. Do you have a provision of LCCO2?

Building outline

Building Name	No. 1 Silo building
Location / Climate	
Completion(Scheduled / Completion)	1/7/2013
Site Area	m2
Construction Area	m2
Gross Floor Area	18,700.00 m2
Number of Floors	9 F
Structure	RC
Occupancy	Occupants(assumed)
Annual Occupancy	hrs /yr(assumed)

○Check list 1

Efforts to be evaluated

Assessment Item	Description	Points
I. Identification of local characteristics and biotope plan policy	[1] Local characteristics of the site and surrounding areas regarding habitat are identified and an appropriate biotope plan policy has been established	2
II. Conservation and restoration of biological resources	[1] Biological resources on site are protected or restored (e.g. flora and fauna, topsoil, wetland area composition)	2

III. Use of Green Space	[1] Green areas account for 10% or more but less than 20% of the total outside property area AND mid/high trees are planted (1 pt) Green areas account for 20% or more but less than 50% of the total outside property area (2 pts) Green areas account for 50% or more of the total outside property area (3 pts)	1 to 3
	[2] Building greenery index is measured at 0.05 or higher but less than 0.2 (1 pt) Building greenery index is measured at 0.2 or higher (2 pts)	1 to 2
IV. Quality of Green Space	[1] The greenery plan facilitates conservation of native/local species	1
	[2] The greenery plan is appropriate for site and building characteristics	1
	[3] The greenery plan facilitates conservation of natural areas inhabited by small animals	1
V. Management and use of biological resources	1) Equipment necessary for the maintenance management of green areas at the building operation stage have been installed, and management policies have been established.	1
	2) An environment and facilities have been provided in which building users and local people can encounter living creatures and enjoy nature.	1
VI. Other	1) Independent efforts other than the above evaluated items have been implemented to protect and create habitat.	1

○Check list 2

Efforts to be evaluated

Assessment Item	Descriptions	Point
I. Continuation of unique local character, history and culture	1) Conservation of historic built spaces etc. Historic interior and exterior spaces building remains preserved, restored or regenerated, contributing to local culture.(Do not evaluate if measures here overlap with areas evaluated under urban context and scenery).	1
	[2] Use of locally-significant materials Local materials are partially used in the building's structure, interior finishes or exterior space (do not include measures evaluated under the local landscape section).	1
II. Local contribution through provision of functional spaces and facilities	[1] Local contribution by provision of space Structural measures such as provision of alcoves, piloti and eaves are used to provide amenity for people using urban spaces, in the form of places to shelter from rain or wait for people. Or, Space is provided in plazas, paths and side streets to provide amenity for people using the local area, in the form of rest areas and similar spaces.	1
	[2] Local contribution by provision of facilities and functions Part of the building is equipped to provide public facilities and functions, such as meeting rooms, community halls and exhibition spaces, community centers, and community use of schools, contributing to greater activity in the community.	1

III. Formation of rich intermediate zones linking the building interior and exterior	[1] Formation of rich intermediate zones linking the building interior and exterior Open spaces that allow the passage of wind and light, such as courtyards, terraces, balconies, sun rooms, roofed plazas, light and air voids, and atria are skillfully linked to interior spaces. Or, In areas where private and public spaces intersect, such as around entrances and balconies, light and air voids, flower beds, pergolas, deep balconies and similar elements have been built to form rich intermediate spaces which give a lived-in atmosphere.	1
IV. Consideration for crime prevention	[1] Consideration for crime prevention Crime prevention performance is considered, so that in spaces outside the building, such as plazas, trees are placed to avoid blocking lines of sight, nocturnal lighting and security cameras are installed, windows are placed where they will be useful for crime prevention, and other measures are used. Or, If there are no plazas or pedestrian walkways, consideration is given to crime prevention in the form of avoiding the creation of blind spots, such as blind alleys and paths out of lines of sight, placing windows where they will be useful for crime prevention, and other measures. Or, If there are boundary barriers around the site, crime and disaster prevention are considered, in the form of fences or low hedges which afford clear lines of sight, rather than continuous walls or similar barriers which block lines of sight.	1
V. Participation of building users etc.	[1] Participation of building users etc. User satisfaction assessments (POE) are used to involve building users in the design process for cooperative housing etc. Or, Residents and occupants work directly on plant management and cleaning activities and formulate operation plans, and are otherwise participating in the maintenance management of the building.	1
VI. Other	8) Other (State content)	1

○Check list 3

Point	Efforts to be evaluated
1 point	The structure of finishing materials can be separated easily.
1 point	Interior finishes and equipment are not entangled, and each can easily be removed separately for demolition, refurbishment and remodeling.
1 point	Reusable unit materials are used.

○Check list 4

Category	Building materials to be evaluated	Category	Building materials to be evaluated
Adhesives	For vinyl tile floors and seating	Paints	For fittings (wooden and metal)
	For tile		For wooden parts (frames for floor and ceiling)
	For wallpaper		For structural materials
	For floor board		For walls
Sealants	For sash	Anti-corrosion treatment	For frames
	For glass		For materials other than frames
	For tile joint	Undercoats	For materials for coated floors
	For wall joint	Floor coverings	For finishing wax
Waterproofing materials	Primer for waterproofing	Preservatives	For wooden parts
	For paint (surface coating)		

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Q1.2.1.1 Room Temperature	70,48
Q1.2.3 Type of Air Conditioning System	87,58
Q1.3.1.1 Daylight Factor	90,60
Q1.3.1.3 Daylight Devices	93,64
Q1.3.3 Illuminance Level	97,66
Q1.3.4 Lighting Controllability	99,68
Q1.4.2.3 Consideration for Outside Air Intake	109,74
Q1.4.3.2 Control of Smoking	113,77
Q2.1.1.1 Provision of Space & Usability	114,78
Q2.1.1.3 Barrier-free Planning	116,80
Q2.1.2.1 Perceived Spaciousness & Access to View	117,81
Q2.1.2.2 Space for Refreshment	118,82