Building Carbon Footprint(BCF) Evaluation for Social Amenities and Education Center in Taipei

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Abstract –

The United Nations in 1992 through the "United Nations Framework Convention on Climate Change (UNFCCC)" on the "Anthropogenic Greenhouse Gas" emissions to make global control of the declaration, so "carbon reduction" has become the topic of concern to countries around the world. (Energy Efficiency and Carbon Reduction in New Taipei City from the Perspective of Carbon Emissions and Absorption , 2014) This study will be based on the National Energy Conference on the requirements of building energy certificates, as well as the international PAS2050 and ISO16064 for the carbon footprint of the trend of inspection, to carry out the architectural design stage carbon footprint exposure and labeling system research. The Ministry of Interior Construction Research Institute has been a considerable basis for the study of life cycle CO2 emissions assessment, and now combines the building energy passport system with existing building energy efficiency regulations to establish a comprehensive building life cycle carbon footprint assessment method. Based on the above research motivations, this study will compile and analyze the relevant carbon footprints of existing buildings at home and abroad, and with examples of verification(Cultural and Social Society Hall), to develop BIM (Building Information Model) to evaluate the building "planning stage "And" design phase "and provide a" carbon reduction design strategy "to understand the relationship between building and the" cost "of the building so that owners and designers can use the BIM model at the planning and design stage Analyze and get the smallest carbon exposures of buildings and the largest carbon reduction .

Keywords –

Building Carbon Footprint (BCF); Building Information Modeling (BIM) ; Evaluation

1 Introduction

Since April, the Public Works Committee has selected a number of road, bridge and building demonstration projects to start piloting the "Carbon Footprint Assessment" business. New North City has already asked for all environmental impact assessment of the building development case, must perform 50% The end of this year, Taichung City Water and Economic and Trade Park has begun to require all the development of the case must be implemented carbon exposure of the "Kaohsiung International Convention Center" Following the "Southport Exhibition Hall", has commissioned international consultants to complete the "carbon inventory" business; Certification. Japan's carbon tax system in 2012, for gasoline, natural gas, and coal tax, mainly want to establish the principle of polluter pays, so that polluters bear the relevant social costs, the implementation of the carbon tax also hope that through the environmental tax The concept of the establishment of the environment phase 12 fund to provide the necessary expenditure for environmental conservation. Although the carbon tax does not directly charge taxes on electricity and other energy, the power company will transfer the carbon tax cost to the electricity user, which is equivalent to the carbon tax borne by the electricity user.

The current government to maintain national competitiveness, to avoid consumption in high-priced energy, continue to promote energy conservation and carbon reduction work, so that the country can continue to develop; energy-saving carbon in Taiwan, not just slogans, but new life action.

Research Objectives

The main purpose of this study is to use BIM to plan and design the Social Amenities and Education Center. At this stage, we examine the carbon footprint of the Social Amenities and Education Center and link it with the building materials database to revise the

architectural design direction to achieve the design of low-carbon buildings and give them back to the architect and owners.

2 Problem statements

Taiwan and the world are facing global warming and water scarcity of the environmental crisis, but also accept the economic development of the deterioration of the quality of environmental challenges. Greenhouse gas emissions come from carbon dioxide emissions from energy use. Although Taiwan is a party to the United Nations Framework Convention on Climate Change, but as a member of the global village should be dedicated, and according to the basic principles of climate commitments to bear a common but different responsibility for the reduction.

Promote green building and promote the use of energy-saving carbon-saving green building materials, including the promotion of new buildings to obtain green building certificates and green building signs related measures, building energy efficiency improvement plan, the development of building energy conservation design technical specifications and enhance building energy Benefits, incentives for civil buildings green building design and improvement of demonstration work and handling of building energy efficiency and energy saving materials, recycled materials related research.

In 2002, the Federal Republic of Germany Environmental Protection Agency began preparations for carbon emissions trading, after the establishment of the emissions trading agency, began to investigate all enterprises of machinery and equipment emissions to establish the carbon emission standards. The emissions trading agency will give the firm the maximum permissible carbon footprint limit. The enterprise can trade unused free carbon emissions. The emissions trading agency will register the approved carbon offset limits for each enterprise and set up an account to record the Enterprises free of carbon emissions trading situation, companies must go to the exchange (Leipzig) in accordance with the transaction price of free carbon emissions transactions, the enterprise's free carbon emissions need to run out before the end of each year next year to re-determine the enterprise Of the carbon quota and the re-opening of the free carbon emissions between enterprises, enterprises to improve the amount of free carbon or carbon emissions, will use more low-carbon machinery and equipment to reduce carbon emissions. However, from the 2014 Commission on Public Works has begun to require all development cases must be implemented carbon exposure certification, but non-public works buildings are also the future trend of low-carbon, so Taiwan must study the issue.

3 International norms for carbon footprint assessment

Any carbon footprint assessment must be in line with international norms, otherwise the words, no agreement is difficult to support the Earth's environmental protection action. The international norms on carbon footprint assessment can be grouped into the following three categories:

(1) ISO14040 series of international standards

ISO14040 is the product of the life cycle assessment of the international norms of the source, but also the source of Taiwan CNS14040 national standards. According to the ISO 14040 series of standards, the implementation of the life cycle assessment procedures can be divided into (a) the purpose and scope of the definition: define the scope of inventory operations; (b) inventory analysis (Inventory Analysis): data collection and inventory calculation to quantify the system (3) Impact Assessment: Evaluate the environmental impact of the life cycle by applying the analysis of the life cycle inventory; (4) Interpretation: The results of the merger analysis and impact assessment, and the results of the impact assessment The definition of the scope of integration, to conclusions and recommendations to the type of decision makers, as a product design, material selection or production process improvement reference.

(2) PAS 2050

PAS 2050 is the requirement for Carbon Footprint Verification (CFV). This specification is developed by the British Standards Association (BSI) for the assessment of conformity requirements for the carbon footprint of the product and service life cycle in response to the broad community and industry requirements. PAS 2050 believes that organizations have the potential to use this approach in order to have a better understanding of the carbon footprint of the product supply chain and to provide a common basis for comparison and communication with PAS 2050.

Carbon footprint inventory is the basic source of PAS 2050 confidence. With this inventory, regulators, customers, employees, shareholders, potential investors, environmental groups, media, and even competitors, are confident that the organization's carbon footprint is accurate, complete and transparent. Regardless of size, industry, or location, any organization who actively measures carbon footprints or programs to achieve carbon reduction targets will benefit from the additional accuracy and expertise associated with the carbon footprint review process.

Calculating the carbon footprint: The carbon footprint of the product can be calculated by means of direct measurement, mass balance or emission factors, but in

the construction industry, only the emission factor method is used, that is, using the basic formula " Data (mass / volume / kWh / km) x emission factor (per unit of carbon dioxide equivalent).

(3) ISO 14067

The aim of this standard is to provide a clear and consistent description of the quantification, notification and verification of the carbon footprint of the product as an international prevailing standard for the assessment, monitoring, reporting and verification of carbon footprints. There are differences in the calculation criteria for carbon footprints on the market today. All international manufacturers have gradually changed the carbon footprint standard of the products from PAS2050 to ISO14067. Most international buyers have adopted ISO14067 into the global supply chain management system.

(4) The computer database software for the current carbon footprint lifecycle assessment includes Boustead, RF Weston, ChemSystems, EMPA (Switzerland), PIRA International, Charlimers Industriteknik (Sweden), Environmental Conscious Design Support System (United States), SimaPro (Netherlands) and so on. In the country, by the ITRI developed the localization of life-cycle assessment software "DoITPro", its database contains Taiwan's electricity, oil, fuel, metals, chemicals, plastics and so on a level of data, compared to foreign database data software , But also make the results consistent with the needs of domestic manufacturers and in line with the actual situation. In order to understand the overview of the raw material carbon sequestration database at home and abroad, some information is compiled here by the website of the Ministry of Economic Affairs (http://www.idbcfp.org.tw/2013.5.26). (Study on Carbon Disclosure Marking in Building Design Stage (1)- Study on Carbon Disclosure Method and Carbon Emission Database of Buildings (2013))

Table 1:A Summary of Carbon Footprint Database at Home and Abroad

Country	**Database**	**Coverage**
Taiwan	ITRI Database (DoITPro)	Taiwan
Japan	Japan National LCA Project	Japan
	Carbon footprint database	
Korea	Korean LCI Database Information Network	Korea
	Carbon footprint database	
The European Union	European Platform on Life Cycle Assessment (ELCD)	Europe
Sweden	SPINE@CPM	Global
Denmark	EDIP	Denmark
	LCA food	
Netherlands	IVAM LCA Data	Netherlands
	Dutch Input Output	Netherlands
	Franklin US LCI	United States
Switzerland	ecoinvent	Global/ Europe/ Switzerland
	BUWAL 250	Switzerland
	LCAinfo	
	Swiss Agricultural Life Cycle Assessment Database (SALCA)	Switzerland
Germany	German Network on Life Cycle Inventory Data	Germany
Thailand	Thailand LCI Database Project	Thailand
Australia	Australia Life Cycle Inventory Data Project	Australia
Canada	Canadian Raw Materials Database	Canada
United States	US LCI Database Project	United States

Study on Carbon Disclosure Marking in Building Design Stage (1)- Study on Carbon Disclosure Method and Carbon Emission Database of Buildings (2013)

4 Building Carbon Footprint Evaluation Method

4.1 Building Carbon Footprint Type

According to Dr. Lin Hsien-Te, "Building Carbon Footprint - Assessment Theory", the Carbon Footprint Assessment Method (BCF) was used to evaluate the Carbon Footprint. BCF is a series of building materials, building use of energy statistics and charcoal theory to estimate the formula to simulate the construction of carbon footprint method. BCF can be divided into four systems: (1) BCFs (Schema Evaluation System of BCF), (2) BCFd (Design Evaluation System of BCF), (3) BCFr (Residential Advanced Evaluation System of BCF), (4) BCFp (Public Building Advanced Evaluation System of BCF).

BCFs system is used in the very early stage of building financial planning, BCFd system is used to complete the architectural design but the equipment design is not completed stage, BCFr and CFp system for the construction and equipment of the details of the design are complete stage, but were applicable to

residential Building and Public Buildings. The four systems are constructed from a series of rough to fine carbon footprints in order to correct the direction of low-carbon design at any time, and are in line with the financial investment of the industry, as the design information progresses from the planning to the completion stage Planning procedures, but also for the future of the Government in the environmental assessment, urban review, license, license and other stages of the implementation of low-carbon building management policy. (Building Carbon Footprint - Assessment Theory,2015).

Table 2: Building carbon footprint assessment of the four major system content

Item	BCFs	BCFd	BCFr	BCFp
Applica-ble stage	Environm-ental assessment, urban design	Licensing	Completion stage	
Graphic requirem-ents	Space plane, building height, tectonic system, air conditionin g system planning finalization	Construct-ion plane, profile, building constructio n drawings completed, and air conditionin g system planning finalizati-on	All buildings, air conditioning, hydropower, electromecha -nical, sent to complete the design	
Building size input	Virtual size input	Design condition-n input	Design condition input	
Building materials input	Default standard value input	Detailed theoretical formula input	Detailed theoretical formula	
Equipmen -t material input	Default standard value input	Default standard value input	Detailed theoretical formula	
Energy consump-tion data input	Energy consumptio n system value input	Energy consumptio n system value input	Detailed theoretical formula	
Device efficien-cy input	No input	No input	Heat source, water pump, windmill, hot water equipment	
			design power and efficiency input	
Evaluati-on function	Carbon footprint classificati-on assessment	Carbon footprint classificati-on assessment	Comprehens-ive assessment and evaluation of carbon footprint	

Building Carbon Footprint - Assessment Theory(2015)

4.2 A Simple Method of Building Carbon Footprint

Detailed inventory of building materials and then calculate the carbon row of the algorithm seems to be sophisticated, but it is difficult to implement. The first obstacle will be encountered for the construction of the new building case, because there is no real energy consumption data can not be implemented can not provide prior to the improvement of energy saving and carbon reduction to improve the recommendations, and then its large building materials, equipment, Quantity, the authenticity of energy-saving documents simply can not audit, can not prevent the problem of intentional fraud.

In view of this BCF method does not use the product carbon label, such as the detailed carbon inventory method, but the introduction of a building carbon footprint reduction algorithm, it is building materials and equipment materials do not take the actual construction estimation data to actuarial, and engineering design factor to estimate The analysis of the energy consumption of the building, not the use of electricity to calculate the single gas to calculate the energy consumption to calculate the formula to simulate it is called the effective is the original carbon mark function is more important is to quickly diagnose and Immediate feedback Carbon reduction is known as the subtraction method because its workload is less than one thousandth of the way to check the carbon footprint of the product. Because the BFC method to master the building carbon footprint of the effective reduction algorithm can be effective feedback low-carbon design of the building carbon reduction policy have immediate benefits.

4.3 Low Carbon Footprint of Cultural and Social Society Hall

This study will establish a Social Amenities and

Education Center model with BIM to assess the carbon footprint of the planning and design phase. The building is located next to the Miramar Shopping Center in Taipei City. It is designed with 8 floors above ground and basement 3 floors. The floor area is 17,635 square meters which can accommodate 2300 people to use sitting hall, office, wedding hall, multi-purpose rally and dormitory, as shown in Figure 1 to Figure2

Figure 1: Daytime simulation building design

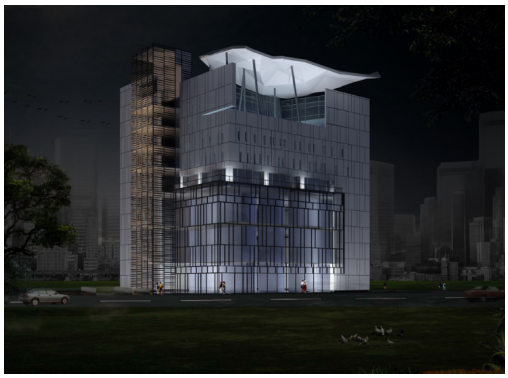

Figure 2: Night simulated building design

5 Conclusion

Building carbon footprint has been in foreign countries for some years, but only in the embryonic stage of Taiwan, the future needs of more on the assessment of building carbon footprint supplemented by the use of low-carbon building materials in order to achieve the popularity of low-carbon buildings, We make extensive use of BIM in building planning and design, to use the Taiwan Library of Materials, the award will help the efficiency of low-carbon building planning. Look forward to the future can push up the concept of green environmental protection, and to achieve the concept of sustainable social resources.

References

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