

An Estimation of Carbon Dioxide Reduction of Kaohsiung Park Planting

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Abstract: *With the fast development of the technology and energy resources, cause the situation of global warming. The Kyoto Protocol signed by 159 countries in 1997. Make the regulation to reduce the greenhouse gases and carbon dioxide and hope to alleviate the greenhouse effects with the impact on the earth.*

Currently, a large number of greenhouse gases in the atmosphere increased, causing global warming and climate changing, and thus lead to disaster. How to reduce emissions of greenhouse gases (especially CO²), is a very important direction which people in all walks of life work hard and research on to. The greenery index is one of the ecological indices of Green buildings and the basic item for Green environmental assessment, which can have a direct impact on the quality of modern lives. Focusing on if the greenery meets the standard may contribute to the environmental sustainability.

This study was to determine how the distribution of plants affected people and TCO₂, by evaluating the green index regarding the Kaohsiung city. The methods used in this study were examining accessible regulations, field study and records, and historical references.

The main purpose of this thesis is to study the greenness of the labeling system for Kaohsiung city environment impact in order to reduce CO² emission and assessing greenness eco-efficiency to improve greenhouse effect. We hope it will promote research achieving on sustainable environment and facilitate joint existence and prosperity of environment. Thus we can achieve the goals of improving the quality of living environment and encouraging building sustainable development. One, introduction

Keywords, Carbon reduction, Green building index

Section Title

One, introduction

1-1study motivation

Urban rapid development, excessive concentration of population, industry, development continues, massive destruction of the original ecological environment, artificial buildings filled the whole urban space, forming the so-called "concrete jungle", urban central plains and some natural land have been covered with artificial structures, impervious land area increased, green area gradually reduced, every summer, the urban temperature rising, as hot, each and every family to use air conditioning equipment to reduce the indoor temperature, and a large number of waste heat and waste heat of exhaust gas, large outdoor; steam locomotives and other vehicles release, so that the whole city is like an oven in the summer, also cause more serious high energy consumption the vicious spiral, not natural cooling.

Lin Xiande (1994) studies pointed out that urban heat island effect is due to the presence of the number and amount of facilities, body building of great and hard surfacing in the city, and these high heat accumulator compressed into the city green area, causing urban production

rising heat flux, and as a seat heating Island, forming symmetrical air circulation phenomenon updraft again by suburban inflows cooled flow added, environmental factors for urban development in the production and also ignore, causing all kinds of urban environmental problems.

In recent years, the Taiwan area every year summer temperatures continue to rise, in fact, not only Taiwan, studies show that global climate is extremely unusual, climate warming will lead to reduced, biology, an increase in extreme weather events, the lack of water resources, infectious diseases increased population, crops, sea level rise. Future global climate change situation brings hitherto unknown test

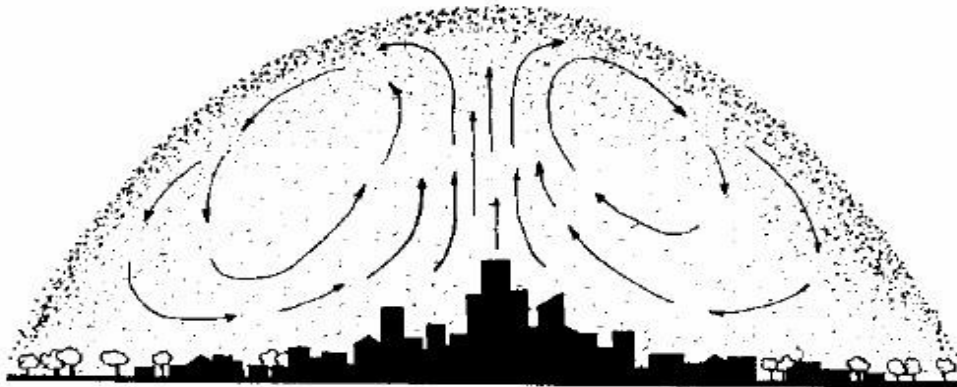


Imagen 1 Urban heat island effect and over the formation of dust cover

Data sources: the urban heat island and ecological community assessment handbook, 2010

According to the study, every 10% increase in the ratio of green cover the local area, in the summer night can effectively reduce the overall area is $0.17\text{ }^{\circ}\text{C} \sim 0.22\text{ }^{\circ}\text{C}$. On the basis of metropolitan Taiwan area in 1996 planned land use area of statistics, the existing statutory green area has been opened only the total urban 3.4% project area, Taiwan a serious shortage of urban green space. So the public urban landscape planting carbon reduction has become a topic of this study, in order to increase the outdoor space in the city of comfort, improve the urban micro climate, parks, green space has become one of the indispensable part of urban development, can purify the air pollution, providing residents daily recreational space, but also an important urban public landscape a ring

1-2The purpose of the study

According to the above issues, this research hope through green assessment index architecture, shaping the quality of park landscape space, and, the results can provide the designers in the design of park landscape of base, can also provide reference Park assessment has been completed in the evaluation of landscape.

According to the above issues in this study, through data collection and field investigation to collect and taking Kaohsiung city most Park as the main object, and explore its planting greening whether can reach the required amount of carbon reduction,



The green building and green ecological index of indicators for assessing -RS2 (system scores) as the research object, to explore the greening of Kaohsiung City Park status and amount of greening index requirements gap, so as to understand its room for improvement

Two, research methods

The research method of this thesis is to explore, greening of field survey and recording, and review of the literature and through the green building in the green index and related literature as the theoretical basis, and examples of survey as the research method, based on green indicators of vegetation planting methods to calculate the amount of CO² fixed

The greenery index is to plant photosynthesis capacity as evaluation criteria, i.e. to form a plant forty years fixed amount of CO² as the conversion standard greening effect;

The type of Planting		The fixed quantity of CO ² Gi(kg/m ²)	The Overburden Depth	
			The roof, balcony, terrace	Others
Eco-stratified	The size of trees, shrubs, flowers planting mixed area (tree spacing below 3.5m)	1200	more than 1.0m	
Arbor	Large-leaved Arbor	900	more than 0.7m	more than 1.0m
	Small-leaved trees, coniferous trees, sparse leaves Arbor	600		
	Palm class	400		
Shrubs (per square meters at least planting more than two plants)		300	more than 0.4m	more than 0.5m
Perennial vine		100		
Flower garden, natural wild grass, aquatic plants, lawn		20	more than 0.1m	more than 0.3m

Table 1- various plants per unit area of carbon dioxide fixation Gi (kg/ m)
 Source: Green Building debriefing and evaluation manuals, 2012

This data is made into a large building research institute according to the leaf photosynthesis of foreign warm climates to value, climatic conditions and sunshine Taichung tree, leaf area measured values, and the analytic and forty year cumulative CO² fixed effects, the maximum function in the relative conversion mechanism to provide different plant environment efficiency, eliminate past landscape policy for all kinds of plants can only be separated for obstacles, avoid alone thick trees green and ignore the shrubs, vines, herbaceous or deletion of



stratified greening. "Green index" score of RS2, but because of the plant CO² fixed two weights of evaluation, which is the design of index value TCO₂ and table two (unit of green fixed amount of CO²β) of the reference value TCO_{2c} in typ[system score of RS2=6.81x ((TCO₂-TCO_{2c}) /TCO_{2c}) +1.5, 0 ≤ RS2 ≤ 9] conversion.

Zoning or land use	CO ² fixed amount reference value β (kg / m ²)
The school land, the park land	500
Business and industrial districts (not including science parks)	300
Building base outside the former two types	400

Table 2 - Units green CO² fixation amount reference β (kg / m)
 Source: Green Building debriefing and evaluation manuals, 2012

The design value of TCO² is the index of total plant fixed amount of CO², the base all planting according to table 1 plants per unit area of carbon dioxide fixation G_i (kg/ m) standard CO₂ fixed quantity according to type [design of index value TCO₂= (∑ (G_ixA_i)) x α] the total amount

The TCO₂ reference value for building technical regulations is the fixed amount of CO² reference value of 1.5 times, that is to base the minimum green area A 'according to type [TCO_{2c} = 1.5x statutory basis = 1.5x (0.5xA' X β) Since TCO₂-TCO_{2c} may be negative, the system must have a score of RS2 limit of 0.0 ≤ RS2 ≤ 9.0

The evaluation formula of the relevant provisions as the following some points:

1. Reference: about TCO_{2c}: in the formula of green building green total fixed amount of CO² prospective value (kg) of the significance, such as an office building area is 10000 square meters, the legal building coverage ratio is 0.6, the minimum green area A '= (A₀-AP) x (1-r) = (10000-0) x (1-0.6) =4000 square meters, the total amount of CO² fixed reference value TCO_{2c} for 1.5x (0.5xA' x β) =1.5x (0.5x4000x400) =1200000kg is the total amount of greening the base must be CO² gas fixing 1200000kg in 40 years, before they could reach the "green index" reward level, meaning the numerical representation of greening the manual 1.5 index needs than the current technical regulations qualified reference value to strengthen the 50% meaning; another numerical 0.5, said half of statutory vacant space shall be green, while the other half space can be used for non Green Lane, trails, ditch, if green is slightly low Also, you can use Arbor or the roof flowergarden to make it.
2. Area and base check minimum green area: this formula has the smallest green area A 'A', i.e. there must be at least above the base a total area of 15%, the intention is to prevent high statutory coverage building base, achieve green award index with low greening level
3. Test planting interval and Overburden Depth: this evaluation regulations should be maintained at least a large arbor planting is shown in Table 3 the distance and area.



Evaluation object		Plant spacing	Crown projection area A_i
The new development base species trees (Note 1) or has been developed base general tree evaluation	The city street or small building base	4m	16 m ²
	The school, a small community park, industrial zone or a hectares or more base development	5m	25 m ²
	Metropolitan Park, Science Park, or more than five hectares.	6m	36 m ²
Has been developed base trees and protected tree assessment (Note 2)	Any base	Based on the actual crown projection area calculation	
<p>Note 1: tree spacing greater than or equal to the distance, in the A_i reference value to calculate the fixed amount of CO²; tree spacing of less than the distance, to square the actual spacing area calculation of the fixed amount of CO².</p> <p>Note 2: the old meters diameter more than 30cm or 20 years of age of the tree is called, but by the transplanted trees like the new tree, not to discount calculation</p>			

*Table 3-CO²calculated using a fixed amount of plant spacing and planting trees planted area A_i benchmark
Source: Green Building debriefing and evaluation manuals, 2012*

Tree spacing greater than or equal to the distance, as shown in the tables crown projection area A_i reference value calculation of the fixed amount of CO²; tree spacing of less than the gap, to square the actual spacing area or to plant spacing in drawing the actual crown projection area of the fixed amount of CO². On the other hand, in order to maintain the growth of plant root sufficient space, the plant must maintain soil cover depth enough, this assessment regulations covering depth conditions, trees and palms is more than 1.0m, shrubs and vines above 0.5m, garden and lawn is more than 0.3m, if without the condition, the green quantity is negligible

4. Planting trees and preferential assessment ecological restoration layer green: there are many garden is made of high density tree hybrid way to green, or the size of trees, palm, plantains are mixed, even the trees planted on Peach shade tolerant shrubs, spacing of each tree is higher than that of the 3.5m (area of 12.25 m²) J. This does not need to examine, one one plant species, distance, area is calculated using the fixed amount of CO², we can almost



completely identified these hybrid trees have reached the tree top CO² fixed effect 1200kg/ m², as long as all the ecological compound layer and planting forest canopy total projection area (and tree heart as the radius 3.5m) overall by 1200 kg/ square meters to calculate

5. Preferential evaluation trees and native plants: table three presents the CO² fixed amount discount on assessment of old trees, i.e. the fixed amount of CO² and not be confined to crown projection area of Ai reference value to calculate, but actually the old tree crown projection area calculation. So, sometimes crown projection area of up to hundreds of meters square old trees, can get preferential evaluation several times over, in order to perform the convenience, the so-called old trees, defined as the meter diameter more than 30cm or 20 years of age of the tree, if not up to the same old as new trees to general crown projection area Ai reference value calculation

6. Three-dimensional green assessment: this index to CO²fixed effects into the assessment system. The index in the formula [system score of RS2=6.81x ((TCO2-TCO2c)/TCO2c) and +1.5, 0 ≤ RS2 ≤ 9] on the roof, balcony level empty land greening, calculated based on the actual planting varieties and planting area. For the vine plants in the wall, slope block, pavilion, flower on greening, actually to cling to the calculation area. And of course vines cling situation often for change, but the actual application status is calculated only by

7. Determination of size of trees: in Table 1, the so-called large tree, the tree height up to 10m above average growth of trees; and small trees, tree growth only average tree height below 10m

Three, literature review

(1) Green refers to the cultivation of protection forest, roadside trees, and park plants and crops, increased nearly ecological benefits of activities to improve the environment, beautification, greening and also contain the meaning of. Green space according to the size, including land greening, city greening and road greening, greening can improve sanitation and maintain the balance of the ecological system, the benefits of at least one of the following items: 1. Supplemental oxygen in the air 2. Absorption of harmful objects in the atmosphere 3. To prevent dust 4. To prevent the wind 5. Reduce the noise 6. Sterilization 7. Improve the micro climate 8. Purification of water quality 9. Keep the ground dry 10. Improve the appearance of the city

(2) According to the world consensus in recent years, "sustainable development" means: to meet the needs of the present without compromising the future generations, and to meet its own development needs (Wang Xin, 1999)

(3) Green building interpretation and assessment manual "green index" is the world's first CO² to the fixed volume as the greening of total quantity control of scientific evaluation method, all of the plant community environmental contribution, are on a fixed amount of CO² to conversion, is a dynamic and three-dimensional evaluation, is also a kind of really encourage ecological index of plant diversity (Lin Xiande, 2005)

Four, conclusion and suggestion



The effects of global warming, has become the pursuit of human factors on the economic sustainable development must be considered, when the damage states generally aware that the greenhouse effect brought about by and large, multinational cooperation to restrain the emission of CO² consensus, pressure part and the international convention in China based on the earth village, if CO² emissions the amount of unchecked, not only can not escape the international discussions, will be detrimental to our country in the international trade, so how to maintain sustained economic growth, and protect our living environment is not affected, to achieve the objectives of sustainable development to become the current important issues.

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