



Evaluating water conservation measures for Green Building in Taiwan

Cheng-Li Cheng *

Department of Architecture, National Taiwan University of Science and Technology, 43 Keelung Road, Section 4, Taipei, Taiwan, ROC

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Abstract

Green Building evaluation is a new system in which water conservation is prioritized as one of its seven categories for saving water resources through building equipment design in Taiwan. This paper introduces the Green Building program and proposes a water conservation index with quantitative methodology and case study. This evaluation index involves standardized scientific quantification and can be used in the pre-design stage to obtain the expected result. The measure of evaluation index is also based on the essential research in Taiwan and is a practical and applicable approach. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Green Building; Evaluation system; Water conservation; Building equipment

1. Introduction

The environment was an issue of deep global concern throughout the latter half of the 20th century. Fresh water shortages and pollution are becoming one of the most critical global problems. Many organizations and conferences concerning water resource policy and issues have reached the consensus that water shortages may cause war in the 21st century [1], if not a better solution. Actually, Taiwan is already experiencing significant discord over water supply. Building new dams is no longer an acceptable solution to the current water shortage problems, because of the consequent environmental problems. Previous studies have concluded that water savings are necessary not only for water conservation but also for reducing energy consumption [2,3].

Taiwan is located in the Asian monsoon area and has an abundant supply of rainwater. Annual precipitation averages around 2500 mm. However, water shortages have recently been a critical problem during the dry season. The crucial, central issue is the uneven distribution of torrential rain, steep hillsides, and short rivers. Furthermore, the heavy demand for domestic water use in municipal areas, and the difficulties in building new reservoirs are also critical factors. Government departments are endeavoring to spread publicly the concept of water-conservation. While industry and commerce have made excellent progress in water conservation, progress among the public has been extremely slow.

Due to this global trend, the Architecture and Building Research Institute (ABRI), Ministry of Interior in Taiwan, proposed the “Green Building” concept and built the evaluation system. In order to save water resources through building equipment design, this system prioritizes water conservation as one of its seven categories. This paper focuses on the water conservation measures for Green Building in Taiwan and a quantitative procedure for proving water-saving efficiency. The purpose of this work is not only aimed at saving water resources, but also at reducing the environmental impact on the earth.

2. Water conservation index

The water conservation index is the ratio of the actual quantity of water consumed in a building to the average water-consumption in general. The index is also called, “the water saving rate”. Evaluations of the water-consumption quantity include the evaluation to the water-saving efficiency within kitchens, bathrooms and all water taps, as well as the recycling of rain and the secondhand intermediate water.

2.1. Goal of using the water conservation index

Although Taiwan has plenty of rain, due to its large population, the average rainfall for distribution to each individual is poor compared to the world average as shown in Fig. 1. Thus, Taiwan is reversely a country short of water. Yet, the recent improvements in citizens’ standards of living have

* Tel.: +886-2-2737-6510; fax: +886-2-2737-6721.

E-mail address: ccl@mail.ntust.edu.tw (C.-L. Cheng).

Nomenclature

AR	Adoption rate of water-saving equipment (dimensionless)	Q_2	Real flush volume of urinals or two-sectioned water closet adapted in evaluating project (l/flush)
a_1	Rate of adoption of water closet (dimensionless)	Q_3	Actual flush volume of tap adapted in evaluating project (l/flush)
a_2	Adoption rate of urinals or two-sectioned water closet (dimensionless)	R	Primary adoption rate of water saving equipment (dimensionless)
a_3	Adoption rate of saving water tap (dimensionless)	T_s	Water closet use (times/day)
a_4	Adoption rate of saving water bathtub or device (dimensionless)	T_u	Daily number of urinations per person (time)
B	Volume of water saving of bathtub (l)	T_w	Number of tap use daily (time)
C	Special weighting for water recycling equipment for reusing water or rain (dimensionless)	W_c	Average water closet flush volume (l)
Q_1	Real flush volume of the water closet adapted in evaluating project (l/flush)	W_d	Primary demand of daily water use (l)
		WR	Actual Water-saving Rate (dimensionless)
		W_t	Typical flush volume of tap adapted in evaluating project (l/flush)

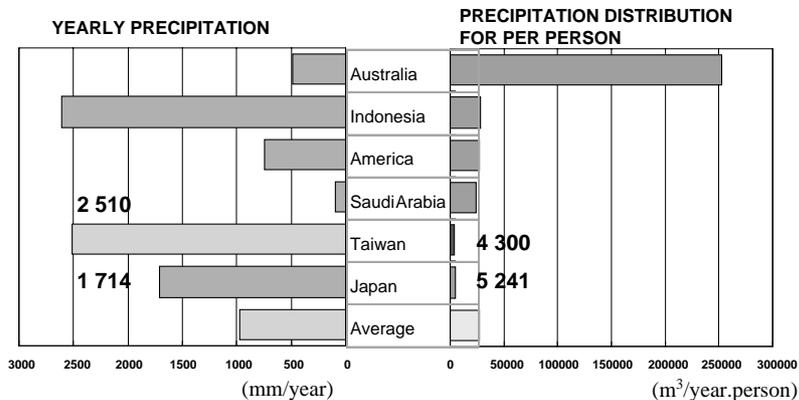


Fig. 1. Partial comparison of rainwater resource in the world.

led to a big increase in the amount of water needed in cities, as shown in Fig. 2, which, accompanied by the difficulty of obtaining new water resources, makes the water shortage problem even worse. Due to the improper water facilities designs in the past, the low water fee, and the usual practical behavior of people when using water, Taiwanese people have tended to use a large quantity of tap water. In 1990, the average water-consumption quantity in Taiwan was 350 l per person per day, whereas in Germany it is about 145 l per person per day, and in Singapore about 150 l per person per day. These statistics reveal the need for Taiwanese people to save water.

The promotion of better-designed facilities which facilitate water-saving will become a new trend among the public and designers, because of concerns for environmental protection. The water conservation index was also designed to encourage utilization of the rain, recycling of water used in everyday life and use of water-saving equipment to reduce the expenditure of water and thus save water resources.

2.2. Methodology for efficient use of water resources

Some construction considerations and building system designs for effective use of water resources are described below.

2.2.1. Use water-conservation equipment

A research of household tap-water consumption revealed that the proportion of the water used in flushing toilets and in bathing, amounts to approximately 50% of the total household water consumption, as given in Table 1. Many construction designers have tended to use luxurious water facilities in housing, and much water has thus been wasted. The use of water-saving equipment to replace such facilities is certain to save a large amount of water. For example, the amounts of water used in taking a shower and having a bath is quite different. A single shower uses around 70 l of water, whereas a bath uses around 150 l. Furthermore, current construction designs for housing in Taiwan tend to put two sets of bathtubs and toilets, and quite a few fami-

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