【展望】

Current Status of Passive Solar Building Applications in the Republic of Korea

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ABSTRACT

In the past few years, the subject of passive heating has been the major area of our concern due to the specific climate conditions prevailing in our region. More recently, however, other improtant issues such as retrofitting, passive cooling, optimized integration of conservation and passive solar, and daylighting have emerged as the areas of feequent discussions.

KIER, the sole R&D organization in solar energy technologies, has accomplished significant results in passive building designs and actual demonstrations of experimental passive buildings. As a result of such endeavor by KIER, the passive solar buildings have been very well received by the Korean public. The current number of passive solar buildings in Korea is well over 1,600 (as of Dec. 1986).

In this paper, broad aspects of the present status of passive solar technology utilization in Korea are presented.

KEYWORDS

Republic of Korea; passive solar building; passive solar application; current R&D status; current commercialization status; Korea Institute of Energy & Resources (KIER).

INTRODUCTION

The utilization of passive solar energy for the human comforts seemed to appear a long time ago as seen in an old Korean style house made out of rice straws, bamboos and clay. Although the scientific application of passive technology has about 8 years of short history in Korea, it has been proven to be technically adequate and economically viable for developing countries like Korea.

In Korea, R&D work for solar energy was initiated at several scientific institutions on a small scale around 1976. However the main R&D efforts under the auspices of Korea government, i.e. Ministry of Energy & Resources (MER), were started with the creation of the new R&D institution, called then Korea Solar Energy Research Institute (KSERI) in

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May 1978 after the world oil crisis. Now KSERI is an integral part of the new institution, called Korea Institute of Energy & Resources (KIER), which is a sole government supported R&D institution in the areas of new & renewable energy and of energy conservation.

Korean MER has been funding the adequate amount of R&D expenses to KIER since 1978. As a result, KIER has accomplished significant progress in passive building designs and actual demonstrations of experimental passive buildings. Moreover, passive solar technology has been very well received by the Korean public.

CLIMATE DATA

Because of continental influences, the climate of Korea is characterized by a cold winter and a hot summer. The annual range of temperature fluctuations is greater in the north and in interior regions than in the south and along the coast. The average monthly temperature in January drops below freezing except along the southern coast, and the July average monthly temperature rises to about 25°C. The average monthly temperature in January at Seoul is about 5°C, and about 25°C, in August; at Pusan, on the southeast coast, the average January temperature is 2°C, and the August average is about 25°C, as in Seoul.

The climate types and variables, as applicable to building design and community & urban planning, can be classified as follows in our region.

a. Climate Type
   - o Spring and autumn: mild & warm
   - o Summer: hot & humid
   - o Winter: cold & arid

b. Climatic Variables
   - o Heating degree-day(18°C) : 1,600-3,500 deg. day
   - o Mean temperature (annual) : 6°C-15°C
   - o Duration of bright sunshine (annual): 2,000-2,300 hours
   - o Number of cloudy days (annual) : 110-190 days
   - o Number of clear days (annual) : 40-110 days

PASSIVE SOLAR BUILDINGS

In order to design a house or a building we often have to consider the following aspects: (1) architectural beauty, (2) functional utilization, (3) environmental control, and (4) energy efficiency.

For a building design, therefore, it would be appropriate that three different people, i.e. : architect, engineer and owner, should all be involved with their combined efforts. For an energy efficient building, energy conservation comes first, then available solar energy input to the building should be optimized usually on the basis of prevailing economics.

The construction cost of a typical residential house in Korea (e.g. 165m^2

of living area) would be;

- o 800,000 won/3.3m^2 of LA with minimum insulation
- o 900,000 won/3.3m^2 of LA if well insulated
- o 1,000,000 won/3.3m^2 of LA if passive solar
- o Over 1,100,000 won/3.3m^2 of LA if active solar

In other words it costs about 100,000 won/3.3m^2 (of living area) to make a typical Korean house to the solar level of insulation. Additional 100,000 won/3.3 m^2 is needed for passive solor construction, or more than 200,000 won/3.3m^2 for active solar building.

The performance of a well designed passive solar building under Korean weather conditions varies from 40% SSF (for residential buildings) to 80% SSF (for office, school buildings, etc.).

R&D STATUS

Areas of interests in passive solar technology have been in the residential applications in early days of mid-1970. For past 7-8 years, scope of the interested areas has been expanding. Listed below are the areas of current interests in passive solar applications in Korea.

- o Single-family residental buildings
- o Multi-family residential buildings: condominiums, town-houses, apartments, etc.
- o Public & commercial-scale buildings: post offices, schools, army buildings & structures, warehouses, factory buildings, etc.
- o Free-standing greenhouses
- o Passive domestic hot water systems

The following R&D areas are the types of passive solar technology which could be advantageously implemented in Korea, but which are not yet adequately developed in our region.

- o Indirect gain system with water wall
- o Daylighting system for commercial buildings
- o Earth-bermed housing
- o Use of deciduous trees for passive summer cooling
- o Use of chimney effect for passive summer cooling
- o Use of automatic movable night insulation

COMMERCIALIZATION STATUS

The benefits of possessing passive solar homes are the favorable economics. They cost usually 8-12% more than the constructions with well insulations but the payback periods of these homes are 5-10 years with yearly energy saving of 40-80%. In developing countries like Korea, where winter heating occupies a large portion of home energy consumption, passive solar would have first priority over other energy options for the wide spread commercialization and vigorous introduction of the technology is in progress by the Korean government.

The current status of commercialization of Korean passive buildings are summarized in Table 1 (as of Dec. 1986; statistics from Korea Energy Management Corp.)

Table 1. Current Status of Korean Passive Solar Buildings

Building types \ Yr.	'83	'84	'85	'86	Total
Residential	36	290			326
Multi-residential, apt., etc.	32	2	172	40	246
School rooms	269	133	258	366	1,026
Post office, etc.			9	2	11
Total	337	425	439	408	1,609

Training programs for the passive technology have been in the forms of conferences, seminars and workshops. For instance, university level lectures have been given to graduate students, government employees and other people related with building industries in Korea.

CLOSING REMARKS

The need of energy options, especially for the countries scare of conventional energy resources, is real. The passive solar technology which has higher economic feasibility over others, is now actively emerging. In the past few years, the subject of passive heating has been the major area of our concern in our region. More recently, however, other important issues such as retrofitting, passive cooling, optimized integration of conservation & passive solar, and daylighting have emerged as the areas of frequent discussions.

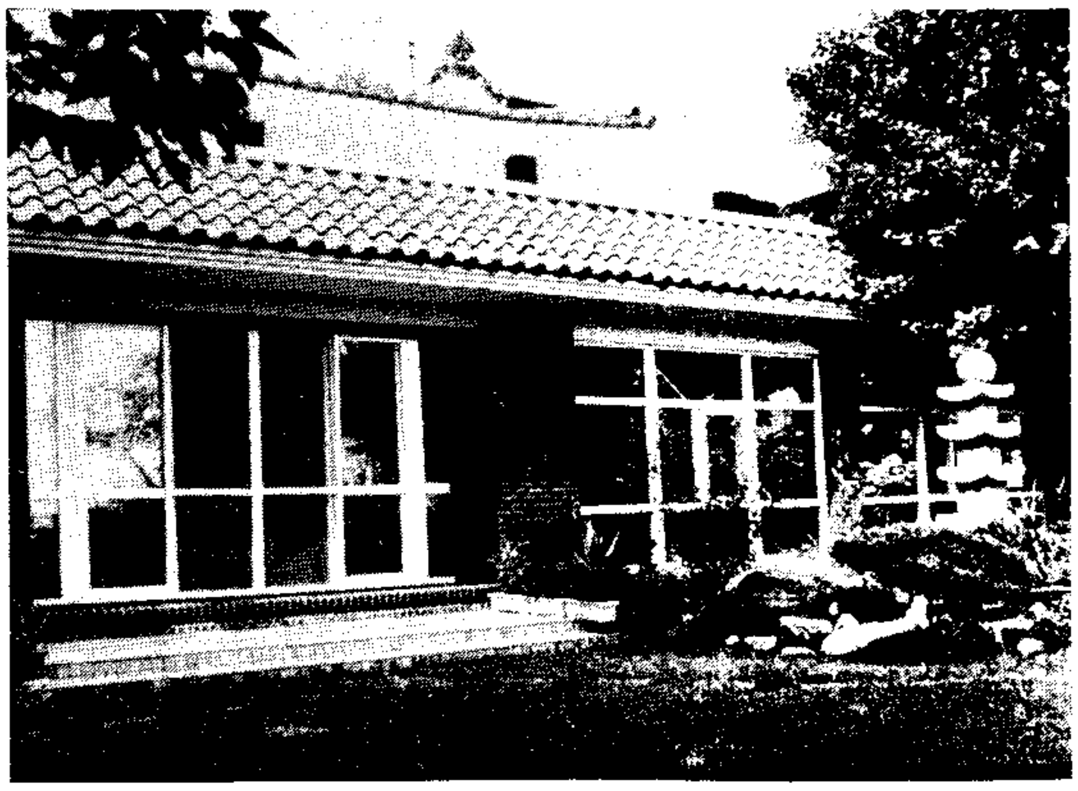
It is believed that the passive solar systems would have the greatest impact on energy savings in our region in the following areas.

- o Urban and rural housing applications (all types of buildings)
- o Commercial applications (indoor swimming pool, post offices, army structures, etc.)
- o Agricultural applications (crop drying)
- o Educational facilities and school buildings applications
- o Passive domestic hot water systems (batch, thermosyphon, PCM DHWS, etc.)

It is now expected that the future concerns on passive solar technology would be in the following fields.

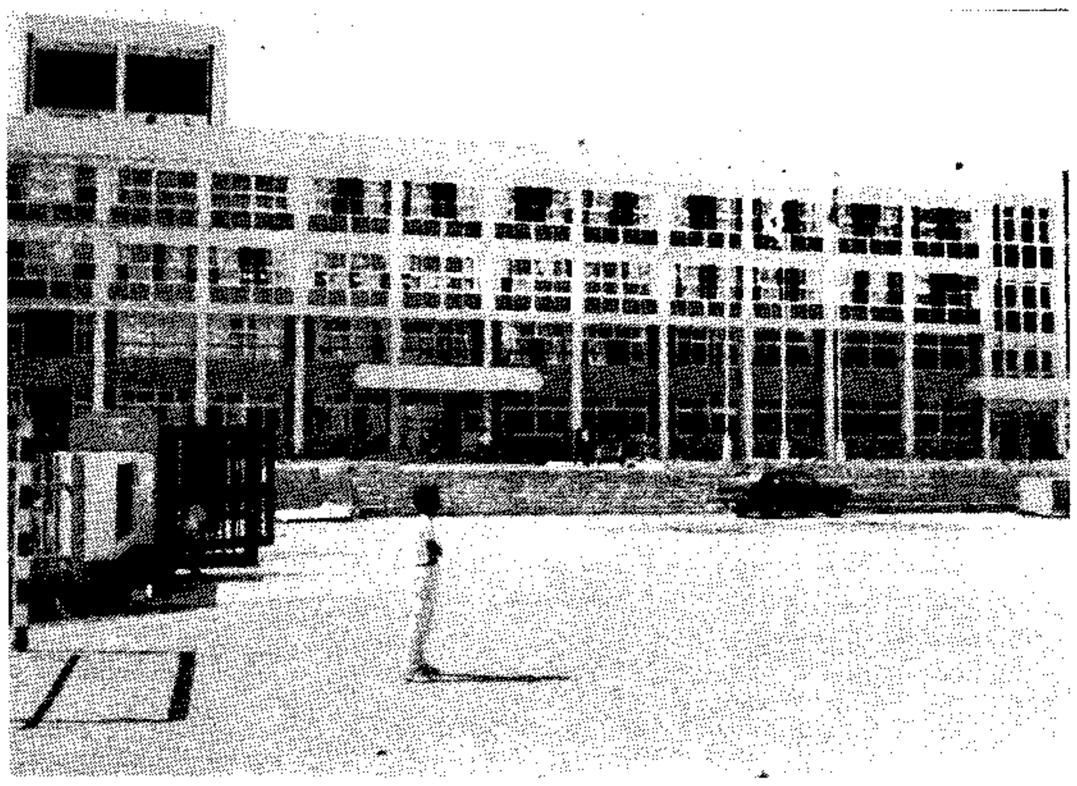
- o Passive cooling, and daylighting
- o Thermal energy storage & distribution of heat flow
- o Optimized integration of conservation, passive heating, passive cooling, and daylighting in views of both engineering and architectural senses
- o Material and component R&D for cost reduction & marketability
- o Education & training

With vigorous introduction of the passive technology to the public at large, the effective energy utilization is expected to make a significant contribution to the efforts of energy conservation of our region.



a) Single family house

b) Multi-family house



b) School building

d) Apartment

e) Post office

f) Indoor swimming pool

Fig. 1. Some design examples of Korean passive solar buildings.