The Integrative Application Study on Solar Energy Technology Used In a Student Dormitory [1]

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Abstract：It is more and more clear that the shortage of general energy sources has limited economic development. How to use renewable energy to replace general energy in construction becomes the new study in modern construction technology development. Shandong Jianzhu University has carried an integrative application study on solar energy technology used in student dorm and proof-tested the energy conservation efficiency after completing the study. This has provided new, significant data for construction technology development.

Key words: Solar Energy, student dormitory

1.THE BRIEF INTRODUCTION OF THE PROJECT

Shandong Jianzhu University solar energy student dorm is the key energy conservation demonstrate project. It is complished by the cooperation design between The International Center for Sustainable Cities (ICSC) and Shandong Jianzhu University. The sudent dorm appearance is shown as Fig. 1.

This project adopted one part of the who student dorm as a demonstration. The construction acreage is 2,300 square meter, takes up 385 squrae meter land, construction hight is 21 meter, configuration form is brick-concrete. It is now used as post-graduates dorm.

2.CLIMATE CONDITION[1]

The location of this project, Jinan City,

Fig.1 The appearance of the dorm

Shandong Province, is cold area. The heating period is 101 days. During heating period, the outside everage tempture is 0.6 degree. Degreedays of heating period is 1757 ·d , quantity of heart costing target is 20.2W/m^2. The main dominant wind during winter is east north wind and west south wind during summer. The annual everage day sun radiant quantity is 1744KJ/m^2.

3.SOLAR ENERGY INTEGRATIVE USAGE TECHNOLOGY

3.1Heating Vertilation System of SolarWall

Solar energy heating vertilation technology is a hot topic recently studied by national and international experts. It can effectively reduce heating cost in winter, lower environmental polution, realize the

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sustainable development of energy usage. Solarwall System is a new type of solar energy heating ventilation system empoldered by Canadian Conserval Company.The principium of the solarwall system working is shown as Fig.2 It has the advantages such as: high effiency, preferably combined with construction stand-side, provide abundance fresh air to the room, etc. It can widely used by room heating, ventilation warm-up, factory heating, agriculture drying and deice.

Main Characters:

1) In winter, when the weather is sunny, solarwall system can warm up the air from 17 to 45 degree. Even in cloudy, the system can also exert function as it can absorb 25% diffusion of annual sun eradization. When it snows in winter, the snow covers the land can reflect the sun eradization so that the collector can gain more radiant heat.

2) Solar wall air collector can satisfy the need of the improvement of inner air quality because the complete fresh air is one of the key advantages of solarwall system.

3) Solar wall collector can be designed as part of the construction stand side. The solar wall on the market uses nice plate and has multi-colors to glorify the outside of the construction.

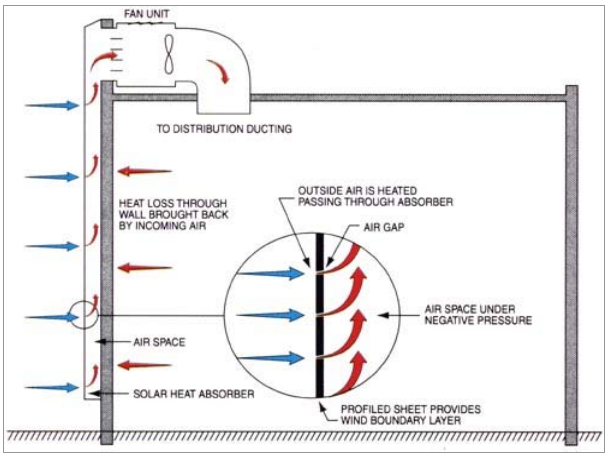

Fig. 2 The heating ventilation system of solarwall

4) During summer, solar wall, system controlled by temperature transducer, sends night cold wind to room to lower the inner temperature effectively

5) Solar wall collector recycling cost cycle is 4 to 6 years in old construction alteration project, and only 3 or even shorter period in new construction without any maintenance.

The solar wall system usage situation of the student dorm:

Shandong Jianzhu University student dorm uses 143 square meter solar wall on the wall between windows and cornice on south stand side. It can provide 5800m^3/h quantity of wind to 36 rooms facing north.The sketch map of the system is shown as Fig.3. According to the measuremnt of 8 months usage annally, it can produce 212GJ quantity of heat. The highest temperature of wind can reach 45 degree. The part which has not enough heat will be supplied by general heating system. It is the first solar wall project in our country.

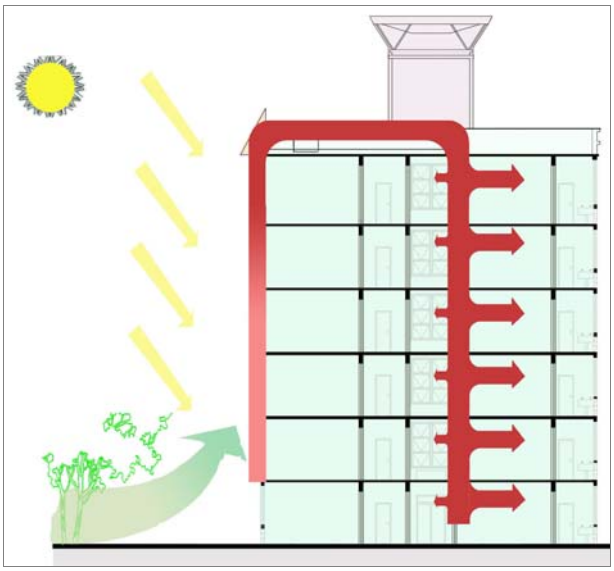

Fig. 3 The sketch map of the solar wall

3.2 Solar Energy Water Heating System

The student dorm also adopts centralized solar energy water heating system. This system is natural circulation system. It is composed by collector, water tank and circulation pipe. It carries the temperature differences circulation mainly caused by consistency differences produced by the differences in water tempertature between collector and water tank. The circulation pump also timing a short circulation time constraintly. The water in the water tank heated continuesly by passing the collector and sent to every room by the pipe linked with the tank. The heating collect acreage of the collector is 72m^2. It provides 9 tons hot water every day. The solar water heating system is shown as Fig.4.

Fig. 4 The solar water heating system

lower the temperature, in order to improve the current condistion which is unbearable hot weather during spring and summer.

On airstream set up, by great acreage flat open window to adhibit air stream and lead the air stream to the corridor by the windows above doors, then goes through the corridor, through the 2100x2400 big window at the end of the corridor, the airstream, which carries inner heat gets out of the building. The student dorm fully uses the solar energy and wind force to strengthen the chimney effect by a solar chimney, guarantee the natural vertilation. The solar chimney is located in the middle of west wall of the student dorm. The chimeny ektexine attached with black plate. When the sun reaches the black plate, it absorbs heat. The heated air in the chimney increase the pressure. At the same time, at the top of the chimney, because of the great wind speed, the chimney effect also gets stronger to ensure there is a certain air stream speed in the room. The sketch map of solar chimney is shown as Fig.5. Solar chimney is 5500mm high than the roof to ensure enough pressure. In the winter, only need to close the windows in the corridor and the chimney effect can not increase the infiltration of the cold wind. The solar chimney has windows on the side to provide light to the corridor. It also has wire netting on the top to stop the birds.

3.4 Photovoltaic System

The student dorm also adopts high effective exactitude following type Photovoltaic System to follow the movement of the sun accurately so that the Photovoltaic battery board always upright to the sun ray. The efficiency is twice higher than fixed Photovoltaic system. Under the same electricity need,

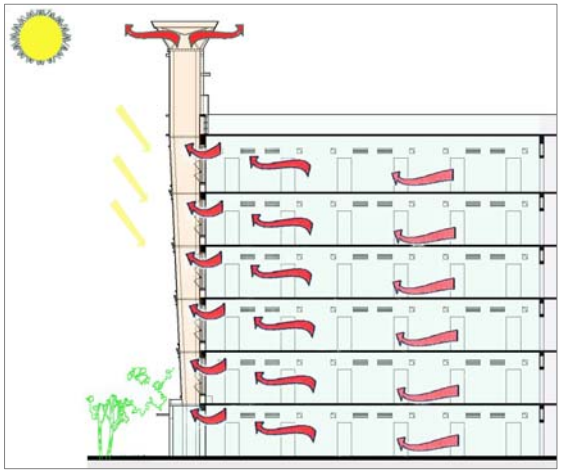

Fig. 5 The solar chimney

the usage of the Photovoltaic battery board can reduce harlf of the quantity, which lower the cost to1/3. The HS-15KWH exactitude following Photovoltaic generate electricity system , which is adopts by the student dorm, uses east and west level and fluctuate upright direction, both axes automatically follow system, to drive the Photovoltaic battery board array precisely follow the movement of the sun so that the Photovoltaic battery keep upright to the sun ray in order to receive the maximum sun radiant energy, greatly increase the effiency of the Photovoltaic system.The appearance of the Photovoltaic system is shown as Fig.6

The Photovoltaic system install capability is 1500W, during sunny days, it can generate 15kwh. This electricity is deposited in the piles for public lights in the building and square lights.

According to the calculation, by using all kinds of solar energy technology, comparing with general constructions, it can save more than 75% energy. First investment can be taken back within 5 years. In addition, the usage of solar energy technology can reduce 175 tons of CO_2 exhaust, realize the ecology environmental protection and sustainable development.

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