

China Residential Solar Building Design



Overview

Building integrated photovoltaic (BIPV) is a promising solution for providing building energy and realizing net-zero energy buildings. Based on the developed mathematical model, this paper assesses the solar irradiation resources and BIPV potential of residential buildings in different climate zones of China. It is found that roofs are the first ch. ••The solar irradiation resources of building façades including the north façade are examined. ••The photovoltaic contributions to net zero energy residential buildings are assessed in China. ••Partial shading is considered for modeling the building integrated photovoltaic (BIPV) system. ••A research framework for assessing the potential of residential BIPV system is proposed. Building integrated photovoltaics Residential building Energy consumption Energy potential Abbreviations BHI beam horizontal irradiance (W/m²) BIPV building integrated photovoltaic DHI diffuse horizontal irradiance (W/m²) GHI global horizontal irradiance (W/m²) GIS geographic information system NOCT normal operating cell temperature (°C) NZEB net-zero energy building PV photovoltaic SCR self-consumption ratio SF shading factor STC standard test condition SSR self-sufficiency ratio ZEB zero energy building Latin symbols APV active PV area (m²) D north-south distance between adjacent buildings (m) E load building load (kWh) EPV PV generation (kWh) EPV-load PV generation directly supplies the load (kWh) h solar altitude angle (°) H building height (m) H1 distance from windowsill bottom to ground (m) I solar irradiance on the inclined plane (W/m²) I_b beam irradiance on the inclined plane (W/m²) I_d diffuse irradiance on the inclined plane (W/m²) I_r reflected irradiance on the inclined plane (W/m²) I_s solar irradiance under shading effects (W/m²) n date number in a year PPV PV power output (W) R_b ratio of beam irradiance on the inclined plane to horizontal plane S_{Fb} shading factor for beam irradiance S_{Fd} shading factor fo. To limit the global temperature rise to 1.5 °C, emission reductions are imminent issues over the world (Li et al., 2021). In 2020, China, as the world's largest energy consumer, announced its goal to reach t...

Article Content

A new approach for indoor environment design of passive solar buildings ...

Building energy consumption has accounted for over 34 % of global world energy consumption and is responsible for 40 % of greenhouse gas emissions , leading to accelerating global warming .Reducing this consumption is an urgent necessity to achieve carbon peaking and carbon neutrality .Accurately forecasting energy heat consumption plays ...

The evolution of residential PV in China

China''s residential PV market has experienced a major boom since 2019, when a specific budget and fixed feed-in tariff incentive was announced, which also...

Towards zero-energy buildings in China: A systematic literature ...

The use of solar energy in zero-energy buildings in China primarily includes solar thermal and photoelectric utilization (Yu, 2015). ... Research on Heating and Energy Saving Design of Residential Buildings in Hot Summer and Cold Winter Region. Xi'an University of Architecture and Technology (2016) Google Scholar. Dong, 2017.

History of passive solar building design

The passive solar design of buildings includes consideration of their orientation to the sun and their thermal mass, factors which have been incorporated to a greater or lesser extent in vernacular architecture for thousands of years.Ancient Greeks, Romans, and Chinese were the first to refine and develop the basic principles of passive solar design, but European ...

Energy-Saving Design Strategies of Zero-Energy Solar Buildings ...

Solar Decathlon is a multi-disciplinary international competition that integrates energy-saving design strategies to design, build and operate zero-energy solar houses. This study focused on the 15 entries in the third Solar Decathlon China. It summarized their energy-saving design strategies into strategies of architectural design, equipment management, energy ...

Economic analysis of rooftop photovoltaics system under different ...

First, the building geometry models under three shadowing conditions for the 20 cities were constructed using QGIS. Then, 60 building models with PV systems and ...

Research on the integrated design of solar thermal ...

The design practice of the integration of solar water heater and building in the design of residential buildings in Northeast China Example analysis. Journal of Jilin Institute of construction ...

Energy Efficiency Retrofit for Existing Residential Buildings in China ...

Retrofitting existing residential buildings in China's hot summer and cold winter (HSCW) zones significantly improves building energy efficiency. Current studies on retrofitting existing residential buildings mostly concentrate on single scenarios, primarily in ...

China's newest design of apartment buildings with modernized ...

The development of housing design in modern China mainly started after 1978 and took the form of apartment buildings. According to existing studies and practices (An et al., 2023), this study summarized the evolution of modern China's housing design into three generations. Each generation of residential housing has a different spatial design focus (see ...

Design of Seaside Buildings in China

10 Design of Seaside Buildings in China 221 Fig. 10.4 View of the central area of the new sea site district with residential green buildings in Weihai Fig. 10.5 The green building envelope and integration of passive cooling strategies in the new sea site district in Weihai 222 10.3 M. Sala and A. Trombadore Green Villas and Solar House ...

Potential of residential building integrated photovoltaic systems in ...

This study assesses the solar irradiation resources and the potential of residential building integrated photovoltaic (BIPV) systems in different climate zones of China. ...

Solar water heating system integrated design in high-rise ...

With the development of urbanization in China, more and more high-rise residential buildings are constructed, mostly with 10–15 stories. Solar water heating system has been widely used in low-rise residential buildings in China, while its application in high-rise apartment is still in the initial stage. In this paper, the current application situation of solar water ...

Building-integrated photovoltaics (BIPV) in architectural design in ...

This paper discusses issues concerning BIPV in architectural design in China, including how to choose between BIPV and building-attached photovoltaics (BAPV), whether it ...

A morphology-based evaluation on block-scale solar potential for ...

Rapid urbanization process has made urban buildings have huge development potential for solar energy in China, especially in residential areas that occupy large parts of the city. ... Code for fire protection design of buildings, 2014, Design code for residential buildings, 2011, Residential building code, 2005, Uniform standard for design of ...

Solar Energy Utilization Potential in Urban Residential ...

Given the low-density layout and high-intensity development of China's residential blocks, China's residential communities have great potential for solar energy development. However, while BIPV and SWH technologies ...

Evaluation of solar energy potential for residential buildings in ...

Therefore, the solar utilization and PV installation of the building are greatly influenced by the complex urban built environments, such as building layout, height, mutual occlusion, etc. Due to the restrictions on sunlight and fire-protection evacuation of urban residential buildings in construction regulations (Rismanian & Zarghami, 2022 ...

Photovoltaic technology in rural residential buildings in ...

Targeted modular design and factory production should be carried out based on the characteristics of rural residential buildings in China, and installation technologies that match the existing construction capabilities are ...

An Extensive Design Approach Integrating Offshore Residential Buildings ...

To promote the integration between the solar water heating systems and residential buildings, China has successively issued policies and specifications, and made continuous efforts to truly realize the integration between the solar energy and buildings. ... Design of solar-powered aeration system for shrimp ponds of farmers in Thailand ...

Energy performance of a residential zero energy building energy ...

The energy system and its energy performance of R-CELLS, a residential zero energy building from team Tianjin U+ in the Solar Decathlon China 2022, is introduced in this paper. When designing and constructing the R-CELLS energy system, two sets of challenges are encountered. Firstly, from an architectural perspective, the limited construction timeframe (only ...

Solar water heating system integrated design in high-rise ...

Solar water heating system has been widely used in low-rise residential buildings in China, while its application in high-rise apartment is still in the initial stage. ... There are two important issues involved in the integration of solar water heating system and building design. One is about solar water heating system, which is composed of ...

Impact of urban form on building energy consumption and solar ...

Urban form can significantly affect building energy consumption and solar energy potential, which is essential to sustainable urban development. However, few studies have proposed a comprehensive framework to discuss this. In addition, how to bridge the gap between theory and practice, and how to combine quantitative research results with urban form design ...

(PDF) Heating solutions for residential buildings in China: Current ...

from 4°N to 53°N latitude, residential building heating demand in China shows different 79 characteristics from south to north. Building design climate zone is often demarcated into 80

Multi-Objective Optimization for the Energy, Economic, and ...

This paper, focused on high-rise residential buildings located in two areas of Northwestern China with different solar radiation, introduces a multi-objective optimization method, which was implemented through the Grasshopper simulation and optimization platform coupled with a TOPSIS method to find the optimal design solution that minimized the ...

The application of solar technologies in building energy efficiency ...

So the BISE design could lower the barriers for adopting solar-power in residential buildings. China is a large country and regional resources differ from each other, so it is necessary to develop local technology to realize the wide use of BISE design in residential buildings.

Vectorized solar photovoltaic installation dataset across China in ...

Across the expansive and fertile land of China, solar energy resources are abundant, with most regions having an annual average daily solar radiation of over 4 kWh/m² and more than 2,000 hours of ...

Solar Water Heating Systems Applied in High-rise Residential Buildings ...

Peer-review by the scientific conference committee of SHC 2015 under responsibility of PSE AG doi: 10.1016/j.egypro.2016.06.278 Energy Procedia 91 (2016) 408 – 414 ScienceDirect SHC 2015, International Conference on Solar Heating and Cooling for Buildings and Industry Solar water heating systems applied in high-rise residential ...

Low-energy envelope design of residential building in hot summer ...

With the increasing of population and the improvement of living standards, the percentage of residential buildings with AC in metropolitan of this zone had been up to 80% by 2000 , and accordingly, the AC system accounted for 50–60% energy consumption in residential building .A tested data in Chongqing (one city in hot summer and cold winter of ...

A review of approaches to low-carbon transition of high-rise ...

In terms of the definition of an HRB, different countries and organizations have different interpretations. In the United States, according to the Planning and environmental criteria for tall buildings, an HRB is defined as a building “in which "tallness" strongly influences planning, design, and use” and “whose height creates different conditions in the design, construction, ...

(PDF) Passive solar systems for buildings: performance indicators ...

Passive solar system design is an essential asset in a zero-energy building perspective to reduce heating, cooling, lighting, and ventilation loads.

Solar Buildings

Ji et al. investigated a building (Hefei, China) in which novel solar space heating and cooling and solar-hot water systems were utilized. By using TRNSYS simulations, the study showed that the solar building can reduce energy consumption by more than 30% in the heating season compared to a similar type of office building. The ...

Potentials of Passive Cooling for Passive Design of Residential ...

Selection and/or peer-review under responsibility of ISES. doi:

10.1016/j.egypro.2014.10.161 2013 ISES Solar World Congress Potentials of Passive Cooling for Passive Design of Residential Buildings in China ZHANG Qingyuana,* , LIU Yub aThe University of Shiga Prefecture, 2500, Hassaka-cho, Hikone-City, Shiga 522-8533, Japan bNorthwestern ...

Evaluation of solar energy potential for residential buildings in ...

It is valuable to evaluate the solar energy potential of buildings in the design stage, because how to efficiently apply PV technology in urban buildings is being concerned (Liao, Zhang, Jia, Xiong, & Han, 2022; Liu, Liu, Zhang, & Yan, 2023; Tian, Ooka, & Lee, 2023; Yan et al., 2023; Zhang et al., 2023). Especially the residential buildings, which occupy the main part of ...

Solar energy potential using GIS-based urban residential ...

Residential areas play an essential role in a city and consume a substantial amount of energy. As (U.S. Energy Information Administration, 2016) reported, since 2012, China's residential energy consumption has risen 2% annually. Therefore, as an alternative to conventional building materials, BIPV can generate electricity while reducing CO₂ emissions, ...

Photovoltaic technology in rural residential buildings in China: a ...

The most widely used and technologically sophisticated photothermal product in rural residential buildings in China is solar water heater (Yu Citation 2021). However, the market share of solar water heaters has gradually shrunk in recent years (Hu et al. Citation 2021). On the one hand, solar water heaters are greatly affected by the ...

A review on research and development of passive building in China

The research and development of passive solar buildings in China began in the 1990s. In 1992, Zhang summarized the construction requirements of passive solar buildings according to the real construction experience in the rural area. ... Optimization of passive design measures for residential buildings in different Chinese areas. Build ...

Energy-Saving Design Strategies of Zero-Energy ...

Solar Decathlon is a multi-disciplinary international competition that integrates energy-saving design strategies to design, build and operate zero-energy solar houses. This study focused on the 15 entries in the third Solar ...

Responding to the double carbon goals: Delta International Solar ...

The Delta Cup International Solar Building Design Competition is organized by the International Solar Energy Society, China Construction Technology Consulting Co.,Ltd. Academia Sinica, and China Architecture Design & Research Group, with the National Housing and Residential Environment Engineering Technology Research Center as the organizer.

Heating load reduction characteristics of passive solar buildings in ...

China's Tibet autonomous region has abundant solar energy resources, cold winters, and cool summers. These are ideal conditions for the application of passive solar heating methods. However, differences in climatic conditions and building types can significantly affect passive solar technology's feasibility, which makes it challenging to promote passive solar buildings in Tibet.

Optimization of passive design measures for residential buildings ...

In China, residential building sector consumed 192.7 million tons of standard coal in 2003, which accounted for 11.3% of the total primary energy used in the nation and continuously rise to 17.2% in 2006. Every year, approximately 34.1% of total energy in building sector is used for household space heating Passive solar design ...

Photovoltaic technology in rural residential buildings in ...

China's rural residential photovoltaic system has been greatly developed in recent years. However, most existing researches, are difficult to reflect the real development situation of the ...

A morphology-based evaluation on block-scale solar potential for ...

Rapid urbanization process has made urban buildings have huge development potential for solar energy in China, especially in residential areas that occupy large parts of the city. However, the residential blocks in China show differences in the morphological layout and parameters, which means they have diverse potential for solar energy ...

Harvesting Sunlight: The Dynamics of Rooftop Solar ...

The expansive rooftop area of rural buildings in China, estimated at 27.3 billion square meters, presents a vast potential for residential PV installation. This could translate to an installed capacity of nearly 2 billion ...

Passive solar systems for buildings: performance indicators ...

In the last years national and international legislations have mainly focused on active solar systems setting specific building design parameters. As a result, passive solar strategies miss the economic benefits of active devices. The proper evaluation of passive strategies, unlike

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