既有建筑绿色改造系列丛书

Series of Green Retrofitting Solutions for Existing Buildings

医院建筑绿色改造工程案例集

Green Retrofitting for Existing Hospital Buildings-Case Studies

赵 伟 狄彦强 张宇霞 等编著

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本书共收录国内严寒地区、寒冷地区、夏热冬冷地区和夏热冬暖地区医院建筑绿色改造及扩建案例38项，其中改造案例23项，改扩建案例7项，美国、挪威、韩国等国家的绿色医院案例8项，这些不同领域、不同等级的医院典型改造案例，均从工程概况、改造目标、改造技术、改造效果、改造经济性、改造思考与启示等方面进行了阐述和分析；改扩建案例亦从“四节一环保”的角度进行了详细介绍，比较客观地反映了当前绿色技术在医院建筑中应用的实际情况，使读者对绿色改造技术的应用有了进一步的认识，对下一步指导既有医院建筑的规模化绿色改造及新建医院建筑的绿色建设提供了有益的参考。

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总　序

截至2014年12月31日，全国共评出2538项绿色建筑评价标识项目，总建筑面积达到2.9亿m^2。其中，绿色建筑设计标识项目2379项，占总数的93.7%，建筑面积为27111.8万m^2；绿色建筑运行标识项目159项，占总数的6.3%，建筑面积为1954.7万m^2。我国目前既有建筑面积已经超过500亿m^2，其中绿色建筑运行标识项目的总面积不到2000万m^2，所占比例不到既有建筑总面积的0.04%。绝大部分的非绿色“存量”建筑，大都存在资源消耗水平偏高、环境负面影响偏大、工作生活环境亟需改善、使用功能有待提升等方面的不足，对其绿色化改造是解决问题的最好途径之一。随着既有建筑绿色改造工作的推进，我国在既有建筑改造、绿色建筑与建筑节能方面相继出台一系列相关规定及措施，为既有建筑绿色改造相关技术研发和工程实践的开展提供了较好的基础条件。

为了推动我国既有建筑绿色改造技术的研究和相关产品的研发，科学技术部、住房和城乡建设部批准立项了“十二五”国家科技支撑计划项目“既有建筑绿色化改造关键技术研究与示范”，该项目包括以下7个课题：既有建筑绿色化改造综合检测评定技术与推广机制研究，典型气候地区既有居住建筑绿色化改造技术研究与工程示范，城市社区绿色化综合改造技术研究与工程示范，大型商业建筑绿色化改造技术研究与工程示范，办公建筑绿色化改造技术研究与工程示范，医院建筑绿色化改造技术研究与工程示范，工业建筑绿色化改造技术研究与工程示范。该项目由中国建筑科学研究院、上海市建筑科学研究院（集团）有限公司、深圳市建筑科学研究院股份有限公司、中国建筑技术集团有限公司、上海现代建筑设计（集团）有限公司、上海维固工程实业有限公司等单位共同承担。

通过项目的实施，将提出既有建筑绿色改造相关的推广机制建议，为促进我国开展既有建筑绿色改造工作的进程提供必要的政策支持；制定既有建筑绿色改造相关的标准、导则及指南，为我国既有建筑绿色化改造的检测评估、改造方案设计、相关产品选用、施工工艺、后期评价推广等提供技术支撑，促使我国既有建筑绿色化改造工作做到技术先进、安全适用、经济合理；形成既有建筑绿色改造关键技术体系，为加速转变建筑行业发展方式、推动相关传统产业升级、改善民生、推进节能减排进程等方面提供重要的技术保障；形成既有建筑绿色改造相关产品和装置，提高我国建筑产品的技术含量和国际竞争力；建设多项各具典型特点的既有建筑绿色改造示范工程，为既有建筑绿色改造的推广应用提供示范案例，促使我国建设一个全国性、权威性、综合性的既有建筑绿色改造技术服务平台，培养一支熟悉绿色建筑的既有建筑改造建设人才的队伍。为有效推动本项目的科研工

作，“既有建筑绿色化改造关键技术研究与示范”项目实施组负责对项目的研究方向、技术路线、成果水平、技术交流等总体负责。为了宣传课题成果、促进成果交流、加强技术扩散，项目实施组决定组织出版既有建筑绿色改造技术系列丛书，及时总结项目的阶段性成果。本系列丛书将涵盖居住建筑、城市社区、商业建筑、办公建筑、医院建筑、工业建筑等多类型建筑的绿色化改造技术，并根据课题的研究进展情况陆续出版。

既有建筑绿色改造涉及结构安全、功能提升、建筑材料、可再生能源、土地资源、自然环境等，内容繁多，技术复杂。将科研成果及时编辑成书，无疑是一种介绍、推广既有建筑绿色改造技术的直观方法。相信本系列丛书的出版将会进一步推动我国既有建筑绿色改造事业的健康发展，为我国既有建筑绿色改造事业做出应有的贡献。

中国建筑科学研究院院长

“既有建筑绿色化改造关键技术研究与示范”项目实施组组长　王俊

Series of Green Retrofitting Solutions for Existing Buildings
Preface

By Dec. 31, 2014, altogether 2538 projects had obtained green building evaluation labels in China with a total floor area of 0.29 billion square meters, among which 2379 projects had obtained green building design labels, accounting for 93.7% with a floor area of 0.271118 billion square meters, and 159 projects had obtained green building operation labels, accounting for 6.3% with a floor area of 19.547 million square meters. At present, the floor area of existing buildings in China has exceeded 50 billion square meters, among which the total floor area of projects with green building operation labels is less than 20 million square meters, accounting for less than 0.04% of the total floor area of existing buildings. Most non-green"stock" buildings have such problems as high energy consumption, negative environment impacts, poor working and living conditions and inadequate functions. Green retrofitting is one of the best solutions. Along with the promotion of green retrofitting for existing buildings, China has released a series of regulations and measures relevant to existing building retrofitting, green building and building energy efficiency to support R&D and project demonstration of green retrofitting technologies for existing buildings.

To promote research on green retrofitting solutions for existing buildings and development of relevant products, the Ministry of Science and Technology and the Ministry of Housing and Urban-Rural Development approved the project of "Research and Demonstration of Key Technologies of Green Retrofitting for Existing Buildings" (part of the Key Technologies R&D Program during the 12th Five-Year Plan Period). This project includes the following seven subjects: research on comprehensive testing and assessment technologies and promotion mechanism of green retrofitting for existing buildings, research and project demonstration of green retrofitting technologies for existing residential buildings in typical climate areas, research and project demonstration of green integrated retrofitting technologies for urban communities, research and project demonstration of green retrofit-

ting technologies for large commercial buildings, research and project demonstration of green retrofitting technologies for office buildings, research and project demonstration of green retrofitting technologies for hospital buildings, and research and project demonstration of green retrofitting technologies for industrial buildings. This project is carried out by the following institutes: China Academy of Building Research, Shanghai Research Institute of Building Sciences (Group) Co., Ltd., Shenzhen Institute of Building Research Co., Ltd., China Building Technique Group Co., Ltd., Shanghai Xian Dai Architectural Design (Group) Co., Ltd., Shanghai Weigu Engineering Industrial Co., Ltd., and so on.

The targets of this project are to provide policysupport for accelerating green retrofitting for existing buildings by putting forward promotion mechanisms; to provide technical support for testing and assessment, retrofitting plan design, product selection, construction techniques and post-evaluation and promotion of green retrofitting by formulating relevant standards, rules and guidelines, so that green retrofitting for existing buildings in China can be advanced in technology, safe, suitable, economic and rational; to provide technical guarantee for accelerating development mode transfer of the building industry, promoting upgrade of relevant traditional industries, improving people's livelihood and promoting energy efficiency and emission reduction by establishing key technology systems of green retrofitting for existing buildings; to produce products and devices of green retrofitting for existing buildings and to increase technical contents and international competitiveness of China's building products; to build a national, authoritative and comprehensive technical service platform and a talent team of green retrofitting for existing buildings by establishing demonstration projects of typical characteristics. To push forward scientific research of the project, a promotion team of "Research and Demonstration of Key Technologies of Green Retrofitting for Existing Buildings" are in charge of research fields, technical roadmap, achievements and technical exchanges and so on. In order to spread project accomplishments, promote achievement exchanges and to strengthen technical expansion, the promotion team decides to publish series of green retrofitting solutions for existing buildings, which will summarize project fruits in progress. Published in accordance with research progress, this series will cover green retrofitting technologies for various types of buildings such as residential buildings, urban communities, commercial buildings, office buildings, hospital buildings and industrial buildings.

Green retrofitting for existing buildings involves diversified subjects and technologies such as structure safety, function upgrading, building materials, renewable energy, land

resources, and natural environment. Publication of research results of the project is no doubt a visual method of introducing and promoting green retrofitting technologies. This series is believed to further push forward and make contributions to the healthy development of green retrofitting for existing buildings in China.

Wang Jun
President of China Academy of Building Research
Head of the Promotion Team of "Research and Demonstration of
Key Technologies of Green Retrofitting for Existing Buildings"

前　言

随着社会经济持续稳定增长，人们生活水平日益提高，我国的医疗事业也在不断发展，医院建设进入了一个新的发展时期。除新建医院之外，我国既有医院也正在进行着不同程度、不同规模上的改造和扩建。据2014年6月国家卫生和计划生育委员会发布的统计报告，截止2013年末，我国共有医院24709个，其中公立医院13396个，民营医院11313个。如果按床位数划分，200张床位数以下的医院18625个，200～499张床位数的医院3624个，500～799张床位数的医院1428个，800张及以上床位数的医院1212个，平均折算下来，全国每千人病床数约为4.55张。由此可见，我国目前拥有的医院数量及床位数远不能满足当今社会的基本医疗需求。此外，现有的医院当中有很多建筑建造年代较为久远、规模较小、设施落后，已远无法适应现代医学科学的发展。

调研发现，我国既有医院建筑供能系统呈现多元化、分散化等特点，耗能数量巨大，浪费也较为严重，整体能源支出约占到医院总运行费用支出的10%以上。不仅如此，我国不少医院的室内外环境污染和交叉感染状况也令人担忧，节能与污染控制的矛盾始终无法解决。此外，医院空间环境布局混乱、标识系统不明显、室外绿地不足、空气品质不良、三废处理单一以及人性化设计缺乏等已经成为目前我国既有医院建筑中普遍存在的问题，而对医院进行绿色化改造无疑是解决这些问题的最佳途径。推进既有医院建筑绿色化改造，可以集约节约利用资源，提高建筑的安全性、舒适性和生态性，亦是顺应绿色医院发展的必然趋势。

目前我国在既有建筑改造、绿色建筑与建筑节能方面已出台一系列相关政策及措施，为相关技术研发和工程实践的开展提供了有力支撑。2012年5月24日，科学技术部发布《“十二五”绿色建筑科技发展专项规划》，重点任务之一即为“既有建筑绿色化改造”。2014年10月，住房城乡建设部、国家发展改革委和国家机关事务管理局联合发布《关于在政府投资公益性建筑及大型公共建筑建设中全面推进绿色建筑行动的通知》（建办科[2014] 39号），该通知强调，凡政府投资公益性建筑和大型公共建筑必须以绿色建筑的标准进行建设、设计和施工，并对全过程管理及保障机制做出了说明。

医院建筑绿色化建设及改造中的“绿色”，代表一种概念或象征，指通过相应技术的实施，实现建筑对环境无害，并能充分利用当地自然资源，且不破坏环境基本生态平衡。医院建筑的绿色化建设及改造主要集中在建筑功能布局、装饰装修材料、暖通空调系统、

给水排水系统、电气与控制系统、室内外环境质量、改造施工和运行管理等方面。为了宣传科研成果，加强技术交流，“十二五”国家科技支撑计划项目——“既有建筑绿色化改造关键技术研究与示范”实施专家组决定组织出版既有建筑绿色改造系列丛书，本书即是系列丛书中的一册。该书收录的医院建筑绿色改造及扩建案例分别由中国建筑技术集团有限公司、上海建工集团股份有限公司、广东省建筑科学研究院集团股份有限公司、北京住总集团、天津市建筑设计院、天津大学建筑设计研究院、哈尔滨工业大学、同济大学等近二十家科研院所、高校、医院、设计院所、施工企业提供，在此向所有协助提供资料的单位表示由衷的感谢。

本书共收录国内严寒地区、寒冷地区、夏热冬冷地区和夏热冬暖地区医院建筑绿色改造及扩建案例38项，其中绿色改造案例23项，改扩建案例7项，共收录美国、挪威、韩国等国家的绿色医院案例8项。这些不同地域、不同等级的医院典型改造案例，均从工程概况、改造目标、改造技术、改造效果、改造经济性、改造思考与启示等方面进行了阐述和分析；改扩建案例亦从“四节一环保”的角度进行了详细介绍，客观地反映了当前绿色技术在医院建筑中应用的实际情况，使我们对绿色改造技术的应用有了进一步的认识，对下一步指导既有医院建筑的规模化绿色改造及新建医院建筑的绿色建设提供了有益的参考。

本书中的案例可为从事医院建筑绿色化改造建设的相关管理、咨询、设计、施工等技术人员提供重要的参考。

中国建筑技术集团有限公司副总裁

“医院建筑绿色化改造技术研究与工程示范”课题负责人　赵伟

2015年8月10日

Foreword

With the social and economic sustained and stable growth, and the improvement of people's living level, Chinese medical industry develops constantly. At the same time, hospital construction has entered a new development period. In addition to the new hospital, Chinese existing hospitals are also carrying on renovation and expansion of different degrees, different size. According to the statistical reports issued by National Health and Family Planning Commission on Jun 2014, there are 24709 hospitals in china by the end of 2013, in which 13396 public hospitals and 11313 private hospitals. If classified by bed number, there are 18625 hospitals with beds less than 200, 3624 hospitals with beds between 200 and 799, and 1212 hospitals with beds more than 800. On average, the number of beds per thousand people is about 4.55. This shows that the number of hospitals and beds cannot meet the basic medical needs nowadays in china. In addition, many of the existing hospitals have characters such as a relatively long construction time, small scale, and backward facilities, making them in capable of adapting to the modern medical science development.

Energy supply system in Chinese existing hospitals is found diversified and decentralized by the survey. It has huge energy consumption and serious waste. The overall energy expenditure accounts for more than 10% of total hospital operating expenses. Moreover, the indoor and outdoor environmental pollution and cross infection of many hospitals are also worrying. The contradiction between energy saving and pollution control is still to be solve. In addition, hospital space environment layout confusion, obscure system identification, lack of outdoor green space, poor air quality, single waste treatment and lack of humanized design have became the common problems existing in the hospital building. The green transformation of the hospital is undoubtedly the best way to solve these problems. Promoting the transformation of the existing hospital building will help to conserve resources, improve building safety, comfort and ecology, and comply with the trend of green hospital development.

At present, China has introduced a series of policies and measures in the existing

building construction, green building and building energy efficiency, providing a strong support for the development of related technologies research and engineering practice. In May 24, 2012, the Ministry of Science and Technology issued the "Twelfth Five Year" green building technology development special planning; in which one of the key tasks is "the green transformation of existing building". In October 2014, the national Ministry of Housing and Urban Rural Development, National Development and Reform Commission, and the national Government Offices Administration jointly issued a circular on comprehensively promoting the green building operation in construction of public welfare building invested by government and large public building. The circular stressed that public welfare building invested by government and large public building should be planned, designed and built in accordance with the green building standards, and illustrated the whole process management and protection mechanism.

"Green" in the green transformation of the hospital represents a concept or symbol, that achieves environmentally friendly building construction, local natural resources fully utilization and basic environmental ecological balance through implementation of the corresponding technology. Green construction and transformation of the hospital emphasize "Green" in building functional layout, decoration materials, HVAC system, water supply and drainage system, electrical and control system, indoor and outdoor environmental quality, construction process and operation management. In order to promote scientific research achievements and strengthen technical exchanges, the panel of "12th Five Year" National Science and technology support program Research and demonstration of key technologies of green transformation of existing buildings decided to organize the book series publication of existing buildings green transformation. This book is one of the book series, including hospital building green transformation case provide by nearly twenty scientific research institutes, universities, hospitals, design institute, construction enterprise such as China Construction Technology Group Co. , Ltd, Shanghai Construction Engineering Group Limited by Share Ltd, Guangdong Academy of Building Science Research Group, Beijing Uni-Constructron Group co. ltd, Tianjin Architecture Design Institute, Tianjin University Recearch Institwte of Architecturt Design &. Urban Planing, Harbin Institube of Technology. Tongji University. Thank all units and personal for assisting in providing information.

This book contains 38 hospital building green transformation and expansion cases, from climate zones of severely cold, cold, hot summer and cold winter, hot summer and

warm winter. 23 cases are hospital buildings under green transformation, and 7 cases are under green modification and extension, and 8 cases are green hospital from America, Norway and South Korea. These typical cases in different region and different grade contain description and analysis of project overview, transformation objectives, techniques, effect, economy, thinking and inspiration. These cases also give a detailed description from the perspective of "energy saving, land saving, water saving, material saving and environmental protection", reflecting the actual situation of green technology application in hospital building. It helps people have a further understanding of green technology application, also provides a useful reference for guiding existing hospital building large-scale green transformation and green construction of the new hospital building.

The cases in the book can be referenced by technical personnel in the field of engineering management, consulting, design, construction related to green transformation of the hospital building.

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