

既 / 有 / 建 / 筑 / 绿 / 色 / 改 / 造 / 系 / 列 / 丛 / 书
SERIES OF GREEN RETROFITTING SOLUTIONS FOR EXISTING BUILDINGS

既有居住建筑 绿色改造技术指南

Green Retrofitting for Existing Residential Buildings-Technical Guide

李向民 编 著



中国建筑工业出版社

既/有/建/筑/绿/色/改/造/系/列/丛/书

既有居住建筑绿色改造技术指南

李向民 编著

中国建筑工业出版社

图书在版编目 (CIP) 数据

既有居住建筑绿色改造技术指南/李向民编著. —北京: 中国建筑工业出版社, 2016. 4
既有建筑绿色改造系列丛书
ISBN 978-7-112-19238-0

I. ①既… II. ①李… III. ①住宅-改造-无污染技术 IV. ①TU746.3

中国版本图书馆 CIP 数据核字 (2016) 第 059116 号

责任编辑: 张幼平

责任校对: 陈晶晶 张 颖

既有建筑绿色改造系列丛书
既有居住建筑绿色改造技术指南

李向民 编著

*

中国建筑工业出版社出版、发行 (北京西郊百万庄)
各地新华书店、建筑书店经销
霸州市顺浩图文科技发展有限公司制版
北京君升印刷有限公司印刷

*

开本: 787×1092 毫米 1/16 印张: 15 $\frac{3}{4}$ 字数: 382 千字
2016 年 5 月第一版 2016 年 5 月第一次印刷
定价: 78.00 元

ISBN 978-7-112-19238-0
(28469)

版权所有 翻印必究

如有印装质量问题, 可寄本社退换

(邮政编码 100037)

既有建筑绿色改造系列丛书

Series of Green Retrofitting Solutions for Existing Buildings

指导委员会

Steering Committee

名誉主任: 刘加平 中国工程院 院士, 西安建筑科技大学教授

Honorary Chair: Liu Jiaping, Academician of Chinese Academy of Engineering, Professor of Xi'an University of Architecture and Technology

主 任: 王 俊 中国建筑科学研究院 院长

Chair: Wang Jun, President of China Academy of Building Research

副主任: (按汉语拼音排序)

Vice Chair: (In order of the Chinese pinyin)

郭理桥 住房和城乡建设部建筑节能与科技司 副司长

Guo Liqiao, Deputy Director General of Department of Building Energy Efficiency and Science & Technology, Ministry of Housing and Urban-rural Development

韩爱兴 住房和城乡建设部建筑节能与科技司 副司长

Han Aixing, Deputy Director General of Department of Building Energy Efficiency and Science & Technology Ministry of Housing and Urban-rural Development

李朝旭 中国建筑科学研究院 副院长

Li Chaoxu, Vice President of China Academy of Building Research

孙成永 科技部社会发展科技司 副司长

Sun Chengyong, Deputy Director General of Department of S&T for Social Development, Ministry of Science and Technology

王清勤 住房和城乡建设部防灾研究中心 主任

Wang Qingqin, Director of Disaster Prevention Research Center of Ministry of Housing and Urban-rural Development

王有为 中国城市科学研究会绿色建筑委员会 主任

Wang Youwei, Chairman of China Green Building Council

委 员: (按汉语拼音排序)

Committee Members: (In order of the Chinese pinyin)

陈光杰 科技部社会发展科技司 调研员

Chen Guangjie, Consultant of Department of S&T for Social Development, Ministry of Science and Technology

陈其针 科技部高新技术发展及产业化司 处长

Chen Qizhen, Division Director of Department of High and New Technology Develop-

ment and Industrialization, Ministry of Science and Technology

陈 新 住房和城乡建设部建筑节能与科技司 处长

Chen Xin, Division Director of Department of Building Energy Efficiency and Science & Technology, Ministry of Housing and Urban-rural Development

李百战 重庆大学城市建筑与环境工程学院 院长/教授

Li Baizhan, Professor and Dean of Urban Construction and Environmental Engineering, Chongqing University

何革华 中国生产力促进中心协会 副秘书长

He Gehua, Deputy Secretary General of China Association of Productivity Promotion Centers

汪 维 上海市建筑科学研究院 资深总工 教授级高工

Wang Wei, Senior Chief Engineer and Professor of Shanghai Research Institute of Building Sciences

徐禄平 科技部社会发展科技司 处长

Xu Luping, Division Director of Department of S&T for Social Development, Ministry of Science and Technology

张巧显 中国 21 世纪议程管理中心 处长

Zhang Qiaoxian, Division Director of The Administrative of Center for China's Agenda 21st Century

朱 能 天津大学 教授

Zhu Neng, Professor of Tianjin University

《既有居住建筑绿色改造技术指南》
Technical Guide on Green Retrofitting for Existing
Residential Buildings
编写委员会
Editorial Committee

主 任: 李向民 上海市建筑科学研究院(集团)有限公司 教授级高工

Chair: Li Xiangmin, Professor of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

副主任: 姜益强 哈尔滨工业大学 教授

张 辉 中国建筑科学研究院 高级工程师

Vice Chair: Jiang Yiqiang, Professor of Harbin Institute of Technology

Zhang Hui, Senior Engineer of China Academy of Building Research

委 员:

张蓓红 上海市建筑科学研究院(集团)有限公司 教授级高工

Zhang Beihong, Professor of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

蒋利学 上海市建筑科学研究院(集团)有限公司 教授级高工

Jiang Lixue, Professor of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

郑 迪 上海市建筑科学研究院(集团)有限公司 高级工程师

Zheng Di, Senior Engineer of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

王 琼 上海市建筑科学研究院(集团)有限公司 高级工程师

Wang Qiong, Senior Engineer of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

许清风 上海市建筑科学研究院(集团)有限公司 教授级高工

Xu Qingfeng, Professor of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

王立璞 中国建筑科学研究院 高级工程师

Wang Lipu, Senior Engineer of China Academy of Building Research

高润东 上海市建筑科学研究院(集团)有限公司 高级工程师

Gao Rundong, Senior Engineer of Shanghai Research Institute of Building Sciences (Group) Co., Ltd

苗启松 北京市建筑设计研究院有限公司 教授级高工

Miao Qisong, Professor of Beijing Institute of Architectural Design

程之春 上海江欢成建筑设计有限公司 教授级高工

Cheng Zhichun, Professor of Jiang Architects & Engineers

沈祖宏 上海市房屋建筑设计院有限公司 高级工程师

Shen Zuhong, Senior Engineer of Shanghai Municipal Housing Architectural Design Institute Co., Ltd

孙洪磊 哈尔滨圣明节能技术有限责任公司 高级工程师

Sun Honglei, Senior Engineer of Harbin Promlite Energy Saving Technology Co., Ltd

编辑部:

Editorial Staff:

主 任: 许清风

Director: Xu Qingfeng

副主任: 高润东

Vice Director: Gao Rundong

成 员:

Members:

(以下按姓氏笔画排列)

王娟 Wang Juan 王亚斯 Wang Yasi 王卓琳 Wang Zhuolin 叶剑军 Ye Jianjun

仲小亮 Zhong Xiaoliang 刘琼 Liu Qiong 孙明明 Sun Mingming

孙洪磊 Sun Honglei 杜佳军 Du Jiajun 杜巍巍 Du Weiwei 何春凯 He Chunkai

邹寒 Zou Han 邹斌 Zou Bin 张富文 Zhang Fuwen 陈宁 Chen Ning

陈亘 Chen Gen 陈溪 Chen Xi 陈玲珠 Chen Lingzhu 范国刚 Fan Guogang

林茂松 Lin Maosong 林静 Lin Jing 罗红 Luo Hong 金艳萍 Jin Yanping

郑昊 Zheng Hao 郑乔文 Zheng Qiaowen 房志明 Fang Zhiming

胡艳鹏 Hu Yanpeng 钟建军 Zhong Jianjun 施凯捷 Shi Kaijie 夏文丽 Xia Wenli

钱耀丽 Qian Yaoli 高月霞 Gao Yuexia 曹毅然 Cao Yiran 梁云 Liang Yun

梁晓丹 Liang Xiaodan 董建锴 Dong Jiankai 董翠丽 Dong Cuili 蒋璐 Jiang Lu

谢晓东 Xie Xiaodong 管文 Guan Wen

既有建筑绿色改造系列丛书

总 序

截止到 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”。该项目包括以下七个课题: 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”项目实施组对项目的研究方向、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作出应有的贡献。

中国建筑科学研究院院长

王俊

“既有建筑绿色化改造关键技术与示范”项目实施组组长

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 retrofitting 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 policy support 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

“宅者，人之本也。人因宅而立，宅因人得存。人宅相扶，感通天地。”（引自《黄帝宅经》）这种“宅”与“人”和谐共融的人居理想，贯穿了中国五千年文明史。这是一个双向变化、动态平衡的过程。人的需求发生变化，就会对居住建筑进行改造以适应新的需求；而居住建筑及其周围环境发生变化，又会引起人生活行为的改变，从而可能产生新的需求。

在既有建筑中，既有居住建筑是使用最多、分布最广的建筑类型。但我国部分既有居住建筑存在资源消耗水平偏高、环境负面影响偏大、生活环境需要改善、使用功能有待提升等问题，严重影响了居住品质。针对既有居住建筑庞大的数量和诸多的缺陷，绿色改造无疑是解决上述问题的最好途径之一。

自 20 世纪 70 年代后期，我国就开始了既有居住建筑的改造工作，大致经历了四个发展阶段：① 1978～1985 年，起步阶段；② 1986～1995 年，安全性改造为主阶段；③ 1996～2005 年，功能性改造为主阶段；④ 2006 年至今，综合改造出现以及绿色改造萌芽阶段。从安全到功能到综合再到绿色，我国既有居住建筑改造的发展历程与我国经济发展水平以及人们不断增长的居住品质要求紧密相关。随着《绿色建筑行动方案》（国办发〔2013〕1 号）的发布，可以预见，未来我国既有居住建筑改造将逐步迈入新的发展阶段——大规模绿色改造阶段。

根据我国既有居住建筑的现状，既有居住建筑绿色改造的需求主要包括以下方面：改造再生设计、结构加固与抗震性能提升、功能完善、绿色建材应用、节能改造、可再生能源利用以及环境改善等。要推进我国城市发展进程中大规模既有居住建筑的绿色改造实践，应根据改造的核心需求，以不同气候地区既有居住建筑为研究对象，进行绿色改造关键技术研发，建立符合我国国情的既有居住建筑绿色改造技术集成体系和系统化解决方案。基于此，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与示范》（2012BAJ06B00），其中的课题二《典型气候地区既有居住建筑绿色化改造技术与工程示范》（2012BAJ06B02）重点关注存量最大、分布最广的不同气候地区既有居住建筑绿色改造，旨在提升我国既有居住建筑绿色改造技术水平、加快我国既有居住建筑绿色改造工作进程。

既有居住建筑绿色改造是一个促进建筑、资源与环境协调发展的过程，应坚持“以人为本”的核心理念，采取“因地制宜、追求实效、合理提升”的基本策略，从而实现我国既有居住建筑绿色改造的可持续发展。“十二五”国家科技支撑计划课题《典型气候地区既有居住建筑绿色化改造技术与工程示范》（2012BAJ06B02）秉持上述核心理念和改造策略，经过近四年持续研发，已取得了系列成果。

为了宣传科研成果，加强技术交流，更好地指导实际工程，“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与示范》(2012BAJ06B00)实施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。本书结合“十二五”国家科技支撑计划课题《典型气候地区既有居住建筑绿色化改造技术与工程示范》(2012BAJ06B02)的研究成果,并广泛参考了相关文献,主要章节内容及编写负责如下:1. 绪论(李向民、许清风负责);2. 绿色再生设计技术(郑迪负责);3. 性能化结构检测鉴定与改造技术(蒋利学、李向民负责);4. 选材策略(王琼负责);5. 节能改造技术(姜益强、张蓓红负责);6. 水系统改造技术(张蓓红负责);7. 环境提升技术(张蓓红、张辉负责);8. 可再生能源利用技术(姜益强负责);9. 绿化技术(张辉、王立璞负责);10. 工程案例(李向民、姜益强、张辉、许清风、高润东、苗启松、程之春、沈祖宏、孙洪磊等负责)。全书由李向民、许清风统稿。本书系统介绍了既有居住建筑绿色改造的各个主要方面,内容翔实,可供既有居住建筑绿色改造工程技术人员、大专院校师生和有关管理人员参考借鉴。

为了保证书稿质量,编委会于2015年1~4月先后邀请中国建筑科学研究院王清勤教授级高工(审稿组长)、上海市建筑科学研究院(集团)有限公司韩继红教授级高工和李德荣教授级高工、上海市房地产科学研究院赵为民教授级高工、上海市建交委科技委王绍义教授级高工、上海市住房保障和房屋管理局陆锦标教授级高工、上海市房屋安全监察所李宜宏教授级高工、同济大学蒋欢军教授、哈尔滨工业大学郑茂余教授等专家对书稿进行了审查,并提出了修改意见和建议。书稿根据专家意见修改后,编委会又于2015年7月10日再次召开现场会,务求书中介绍的技术和案例简洁、准确。本书在编纂过程中得到了审稿专家的大力支持,在此向他们表示由衷的感谢。

由于本书编写时间仓促以及编者水平所限,疏漏与不足之处在所难免,恳请广大读者朋友不吝赐教,批评指正。

上海市建筑科学研究院(集团)有限公司 李向民
“典型气候地区既有居住建筑绿色化改造技术与工程示范”课题负责人
2015年10月16日

Foreword

‘Dwellings, foundation of human being. Human being live by dwellings and dwellings exist for human being. Human being and dwellings support with each other, which conforms to the universe.’ (from Huang Di Zhai Jing) This harmonious living ideal has run through the history of China’s 5000 years of civilization. This is one process of two-way change and dynamic balance; when people’s demands change, the residential buildings will be retrofitted to adapt to new demands; when the residential buildings and surroundings are retrofitted, people’s life behaviors will be changed, which in turn may bring about new demands.

Among existing buildings, the residential building is the type of the largest use and the widest distribution. But most of existing residential buildings have such problems as high energy consumption, negative environment impacts, poor working and living conditions and inadequate functions. These problems have brought serious influences on people’s living quality. Aiming at vast quantities and many defects of existing residential buildings, green retrofitting is undoubtedly one of the best solutions.

Since the late 1970s, China has started retrofitting for existing residential buildings. Up to now, about four stages have been experienced: initial stage from 1978 to 1985; safety retrofitting—based stage from 1986 to 1995; function retrofitting-based stage from 1996 to 2005; comprehensive retrofitting-based stage with embryonic green retrofitting from 2006 to now. The development history of retrofitting for existing residential buildings is inseparably linked with economic development level and people’s growing demands to living quality. With release of ‘Green Building Action Plan’ (GuoBanFa [2013] No. 1), the prospect can be predicted that large-scale green retrofitting-based stage is coming.

According to present situations of existing residential buildings in our country, the demands of green retrofitting mainly include regeneration design for retrofitting, structural reinforcement and seismic performance promotion, function improvement, green building materials use, energy-saving transformation, renewable energy utilization, environment renovation, and so on. In order to push forward large-scale green retrofitting for existing residential buildings in the process of China’s urban development effectively, based on these core demands, we should take existing residential buildings in different climate areas as objects to conduct R&D on key technologies of green retrofitting, and in further establish green retrofitting technologies-integrated systems and comprehensive solution schemes for national conditions in China. Therefore, the Ministry of Science and Technol-

ogy 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*’ (hereinafter referred to as ‘2012BAJ06B00’) which belongs to the part of Key Technologies R&D Program during the 12th Five-Year Plan Period. This project’s second subject of ‘*Research and Demonstration of Key Technologies of Green Retrofitting for Existing Residential Buildings in Typical Climate Areas*’ (hereinafter referred to as ‘2012BAJ06B02’) focuses on existing residential buildings of the largest use and the widest distribution. The purpose of this subject is to upgrade green retrofitting technology and accelerate green retrofitting work progress in our country.

As a harmonious development process of construction, resource and environment, green retrofitting for existing residential buildings should insist on the core concept of ‘people foremost’, and take the basic strategies of ‘adapting to local conditions, pursuing substantial effects and promoting rationally’, so as to realize sustainable development. Upholding the core concept and the basic strategies, after nearly four years of continuous R&D, the subject of ‘2012BAJ06B02’ has obtained a series of achievements.

In order to disseminate R&D achievements, strengthen technical exchanges and provide better guide for practical engineering, the promotion team of the project of ‘2012BAJ06B00’ decide to publish a series of books on green retrofitting for existing buildings. As one of the series, this book has combined achievements of the subject of ‘2012BAJ06B02’ and related references. Main contents of this book and writing divisions as follows: 1 Introduction (preside by Li Xiangmin and Xu Qingfeng); 2 Green regeneration design technologies (preside by Zheng Di); 3 Performance-based assessment and retrofitting technologies (preside by Jiang Lixue and Li Xiangmin); 4 Building materials selection strategies (preside by Wang Qiong); 5 Energy-saving retrofitting technologies (preside by Jiang Yiqiang and Zhang Beihong); 6 Water system retrofitting technologies (preside by Zhang Beihong); 7 Environment promotion technologies (preside by Zhang Beihong and Zhanghui); 8 Renewable energy utilization technologies (preside by Jiang Yiqiang); 9 Greening technologies (preside by Zhanghui and Wang Lipu); 10 Engineering cases (preside by Li Xiangmin, Jiang Yiqiang, Zhanghui, Xu Qingfeng, Gao Rundong, Miao Qisong, Cheng Zhichun, Shen Zuhong, Sun Honglei, etc). The organization of the whole book is finished by Li Xiangmin and Xu Qingfeng. This book describes almost all the aspects on green retrofitting for existing residential buildings with informative materials. This book may be of interest to engineering technicians of green retrofitting for existing residential buildings, college teachers and students, and relevant management personnel.

In order to guarantee the quality of this book, from January to April, 2015, the editorial committee invited Prof. Wang Qingqin (Head of the Review Team) from China Academy of Building Research, Prof. Han Jihong and Prof. Li Derong from Shanghai Research

Institute of Building Sciences (Group) Co. , Ltd, Prof. Zhao Weimin from Shanghai Research Institute of Real Estate Sciences, Prof. Wang Shaoyi from Science and Technology Commission of Shanghai Municipal Urban and Rural Construction and Management Commission, Prof. Lu Jinbiao from Shanghai Housing-ensuring and Real Estate Management Administration Bureau, Prof. Li Yihong from Shanghai Housing Safety Supervision Institute, Prof. Jiang Huanjun from Tongji University and Prof. Zheng Maoyu from Harbin Institute of Technology to review the manuscripts and put forward revision suggestions. After revised according to suggestions from experts, the editorial committee held a writers' meeting on Jul. 10, 2015 to make sure that technology and case introductions are concise and accurate. The editorial committee would like to thank the review experts for their support during the compilation.

Because of time constraint and limited level of editors, omissions and errors can hardly be avoided, so any constructive suggestions and comments from readers are greatly appreciated.

Li Xiangmin

Shanghai Research Institute of Building Sciences (Group) Co. , Ltd

Subject Director of '*Research and Demonstration of Key Technologies of Green Retrofitting for Existing Residential Building sin Typical Climate Areas*'

Oct. 16, 2015

目 录

1. 绪论	1
1.1 我国既有居住建筑现状	1
1.1.1 发展历程	1
1.1.2 改造核心需求	2
1.1.3 技术研发的主要瓶颈	3
1.2 我国既有居住建筑改造历程	3
1.3 既有居住建筑绿色改造的核心理念与基本策略	5
1.4 既有居住建筑绿色改造技术体系	6
1.5 既有居住建筑绿色改造评价	7
1.6 本指南主要内容	8
参考文献	8
2. 绿色再生设计技术	10
2.1 功能改造技术	10
2.1.1 套型合并技术	10
2.1.2 扩建改造技术	12
2.1.3 局部功能改造技术	13
2.1.4 公共空间的改造技术	15
2.2 空间整合技术	18
2.2.1 空间重组技术	18
2.2.2 空间可变技术	21
2.3 性能提升技术	23
2.3.1 外墙改造技术	23
2.3.2 屋面改造技术	26
2.3.3 复合型外窗改造技术	27
参考文献	28
3. 性能化结构检测鉴定与改造技术	29
3.1 既有居住建筑性能化结构检测鉴定技术	29
3.1.1 既有结构可靠性评定与提升的基本策略	29
3.1.2 基于后续使用年限的既有结构可靠性分级标准	33
3.1.3 既有居住建筑结构的精细化检测评定技术	35