

既有建筑综合改造系列丛书

Series of Integrated Retrofitting Solutions for Existing Buildings

# 既有建筑综合改造工程实例集 2

Integrated Retrofitting of Existing Buildings – Case Studies (2)

李朝旭 王清勤 主编

Li Chaoxu & Wang Qingqin

Editor in Chief

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本书是《既有建筑综合改造工程实例集 (2)》, 是继《既有建筑综合改造工程实例集 (1)》之后的再续补充。内容包括 25 项既有建筑综合改造的示范工程实例, 由公共建筑、居住建筑、历史风貌建筑三个部分组成; 每一项工程项目分别按照工程概况、改造目标、改造技术、改造效果分析、改造经济性分析、改造的推广应用价值、思考与启示进行编制。

本书可供建设、设计、施工、管理、科研和大专院校等人员参考。

\* \* \*

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既有建筑的综合改造是建设资源节约型、  
环境友好型社会的重要举措，是走可持续发展  
道路的理想选择。

科技部社会发展科技司 司长 马燕合

“The integrated retrofitting of existing buildings is a significant move forward in building a resource-efficient and environment-friendly society and an ideal option in pursuing sustainable development.”

**Ma Yanhe**

Director-General

The Science and Technology Department of Social Science

Ministry of Science and Technology

People's Republic of China

# 总 序

改革开放以来，我国城乡建筑业发展迅速，全国既有建筑面积总计超过 400 亿平方米。由于受当时经济条件所限，设计标准偏低，绝大多数既有建筑存在着抗灾能力弱、能耗高、使用功能差等问题。但是，把存在问题的既有建筑全部拆除是不现实的，也是不可能的，对其进行合理改造是解决问题的最好途径。正确对待和处理既有建筑是关系到实施节约资源、保护环境、建设节约型社会和可持续发展的重要问题，为此也就提出了对既有建筑进行综合改造的技术需求。

为了推动我国既有建筑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了“十一五”国家科技支撑计划重大项目“既有建筑综合改造关键技术研究示范”。该项目包括以下十个课题：既有建筑评定标准与改造规范研究、既有建筑检测与评定技术研究、既有建筑安全性改造关键技术研究、既有建筑功能提升改造关键技术研究、既有建筑设备更新改造关键技术研究、既有建筑供能系统升级改造关键技术研究、重点历史建筑可持续利用与综合改造技术研究、城市旧住宅区宜居更新技术研究、既有建筑改造专用材料和施工机械研究与开发、既有建筑综合改造技术集成示范工程。该项目由中国建筑科学研究院、中国建筑材料科学研究总院、住房和城乡建设部科技发展促进中心、中国城市规划设计研究院、哈尔滨工业大学、天津大学、同济大学、东南大学等单位共同承担。

该项目的的主要目标是研究开发既有建筑结构加固、地基基础加固、专用改造机械和材料、防火安全改造等关键技术并申请相关专利；研究制订和修订标准规范和政策文件，包括既有建筑地基基础加固技术规范、房屋渗漏修缮技术规程、古建筑木结构维护与加固技术规范、民用房屋修缮工程施工规程、钢结构检测评定及加固技术规程、建筑抗震加固技术规程、既有建筑室内环境改善技术规范、既有建筑隔声改造技术规范等；完成既有建筑隔声改造施工图集、既有建筑地基加固施工图集、混凝土结构加固施工图集等；完善我国既有建筑改造的政策和标准规范体系；建设既有建筑综合改造工程，为推广应用提供示范案例。

为了有效推动本项目的科研工作，住房和城乡建设部成立了“既有建筑综合改造关键技术研究示范”项目实施专家组，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，实施专家组决定组织出版既有建筑综合改造技术系列丛书，及时总结项目的阶段性成果。本系列丛书内容将

涵盖既有建筑安全性改造技术、检测评定技术、功能提升技术、设备改造技术、专用改造材料和施工机械、改造工程案例等多个方面，根据课题的研究进展情况陆续出版。

既有建筑综合改造涉及结构设计、功能提升、建筑材料、可再生能源、历史文化、土地资源、自然环境、人文环境等，内容繁多，技术复杂。将科研项目研究成果及时编辑成书，无疑是一种介绍、推广综合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改造事业的健康发展，为我国既有建筑的综合改造事业作出应有的贡献。

中国建筑科学研究院 院长  
“既有建筑综合改造关键技术与示范”项目实施专家组 组长 **王 健**

## Preface

Since reform and opening-up, urban and rural building industry in China has been developing rapidly with total area of existing buildings exceeding 40 billion square meters. Due to economic conditions of the time, design standard was relatively low, and most existing buildings have such problems as weak disaster resistance capacity, high energy consumption, and unsatisfactory application function. However, since it is both unreasonable and impossible to remove all these existing buildings, the best solution is proper retrofitting. How to approach and tackle with the existing buildings has great significance on the implementation of such strategies as energy saving, environmental protection, establishment of a resource-efficient society and sustainable development, and therefore technical requirements for retrofitting existing buildings are put forward.

To promote research on retrofitting solutions for existing buildings and development of relevant products, Ministry of Science and Technology and Ministry of Housing and Urban-Rural Development approved the significant project of “Research and Demonstration of Key Technologies of Integrated Retrofitting for Existing Buildings” (project code: 2006BAJ03A00, part of the Key Technologies R&D Program during the Eleventh Five-Year Plan Period). This project includes the following ten subjects: research on assessment standard and retrofitting code for existing buildings, research on testing and assessment technologies for existing buildings, research on key technologies of safety improvement for existing buildings, research on key technologies of function upgrading and retrofitting for existing buildings, research on key technologies of equipment renovation and retrofitting for existing buildings, research on key technologies of upgrading and retrofitting for energy supply system of existing buildings, technical research on sustainable utilization and integrated retrofitting of key historic buildings, research on livable renovation technologies for old residential communities, research and development of special retrofitting materials and construction machinery, demonstration project of integrated retrofitting technology for existing buildings. This project is carried out by the following institutes: China Academy of Building Research, China Building Materials Academy, Science and Technology Promotion Center of MOHURD, China Academy of Urban Planning and Design, Harbin Institute of Technology, Tianjin University, Tongji University, Southeast University, and so on.

The main targets of the project are to study and develop key technologies of structure reinforcement, improvement of soil and foundation, special retrofitting machinery and materials and fire safety retrofitting for existing buildings and to apply for relevant patents; to develop and revise standards, codes and policies including Technical Code for Improve-

ment of Soil and Foundation of Existing Buildings, Technical Specification for Repairing Water Leakage of Houses, Technical Code for Maintenance and Strengthening of Ancient Timber Buildings, Specification for Repairing Construction of Civil Buildings, Technical Specification for Inspection Assessment and Strengthening of Steel Structures, Technical Specification for Seismic Strengthening of Buildings, Technical Code for Indoor Environmental Improvement of Existing Buildings, Technical Code for Sound Insulation Improvement of Existing Buildings; to complete collective drawings of sound insulation improvement construction of existing buildings, foundation improvement construction of existing buildings, strengthening construction of concrete structures and so on; to improve policies and standard and code systems for retrofitting of existing buildings; and to build integrated retrofitting projects of existing buildings as model examples for promotion.

To push forward scientific research of the project, MOHURD establishes a project promotion team of “Research and Demonstration of Key Technologies of Integrated Retrofitting of Existing Buildings” to be 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 integrated retrofitting solutions for existing buildings, which will summarize project fruits in progress. Published in accordance with research progress, this series will cover various fields such as technologies of safety improvement for existing buildings, inspection assessment technologies, function upgrading technologies, equipment renovation technologies, special retrofitting materials and construction machinery and retrofitting project cases.

Integrated retrofitting for existing buildings involves diversified subjects and technologies such as structure design, function upgrading, building materials, renewable energy, history and culture, land resources, natural environment and cultural environment and so on. Publication of research results of the project is no doubt a visual method of introducing and promoting integrated retrofitting technologies. This series is believed to further push forward and make contributions to the healthy development of building retrofitting in China.

Wang Jun

President of China Academy of Building Research  
Team leader of “Research and Demonstration of Key Technologies  
of Integrated Retrofitting for Existing Buildings”



# 前 言

当前我国既有建筑面积超过 400 亿平方米，城镇既有建筑超过 140 亿平方米，而且绝大多数的既有建筑都存在着抗灾能力弱、运行能耗高、使用功能差等问题。很多既有建筑在耐久性、安全性、节能性、舒适性、环境性等方面都难以满足人们的需要。频繁发生的火灾、风灾、地震、雪灾等自然灾害，除了对既有建筑造成巨大损害外，还严重威胁到人民的生命财产安全。

如何解决这些问题呢？显然，把存在问题的既有建筑全部拆除是不现实的，也不符合我国政府的可持续发展战略。解决问题的最佳途径是对其进行合理改造，延长使用寿命，提高安全性，改善节能性，力求使其与人文环境衔接，包括对历史风貌的保护和继承、与本土文化的结合、对城市或周边环境的融合等。

为了推动我国既有建筑综合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了“十一五”国家科技支撑计划重大项目“既有建筑综合改造关键研究与示范”。该项目包括了既有建筑综合改造有关的政策法规、标准规范、检测评定技术、安全改造技术、功能提升技术、设备改造技术、专用改造材料和施工机械、示范工程等多个方面，力求系统研究既有建筑综合改造相关问题，推动我国既有建筑综合改造事业的健康发展。

“既有建筑综合改造技术集成示范工程”是该重大项目中的课题之一，由中国建筑科学研究院牵头，住房和城乡建设部科技发展促进中心、上海市建筑科学研究院、住房和城乡建设部住宅产业化促进中心、河南省建筑科学研究院、天津市保护风貌建筑办公室、哈尔滨工业大学、天津大学、湖南大学等单位共同承担，主要任务是示范既有建筑改造技术，建设既有建筑检测评定与改造技术平台，研发既有建筑信息数据库，研究既有建筑改造示范工程建设的相关措施等。

为了宣传项目成果，加强技术扩散，“既有建筑综合改造关键技术与示范”项目实施专家组于 2009 年 2 月在北京召开会议，决定组织出版既有建筑综合改造系列丛书。本书即是系列丛书中的第二本，汇集了 25 项既有建筑改造工程案例，其中居住建筑 5 项，公共建筑 15 项，历史风貌建筑 5 项。每个项目包括工程概况（建筑类型、面积、层数，

建筑特性，完成改造的时间)、改造目标(工程背景、存在的缺陷与需求、改造的主要目标、安全性、环境性、适用性等)、改造技术(建筑改造、结构改造、采暖空调改造、给排水改造、电气自控改造)、室外环境改造、改造效果分析(安全、功能、舒适性、室内环境质量、节能、节水、节地、改造后运行的实际效果、社会效益、环境效益)、改造经济性分析(单项改造费用、综合改造费用、投资回收计算)、改造的推广应用价值。

本书可供既有建筑改造的工程技术人员、大专院校师生和有关管理人员参考。

因为编写时间仓促，编者水平有限，疏漏和不足之处在所难免，敬请广大读者及相关专业人士批评指正。

中国建筑科学研究院 副院长  
“既有建筑综合改造关键技术与示范”项目实施专家组 副组长 **李朝旭**

2010年4月5日

## Foreword

At present, the area of existing buildings in China has surpassed 40 billion square meters, among which 14 billion square meters are that of urban existing buildings. Most of these existing buildings have such problems as weak disaster resistance capacity, high energy consumption, and unsatisfactory application function and can hardly meet people's need in aspects like durability, safety, energy efficiency, amenity and environmental quality. Such disasters as fire, wind, earthquake and snow not only bring enormous damage to existing buildings but also seriously threaten people's life and property.

How to solve these problems? Obviously, it is unreasonable to remove all these existing buildings, which goes against strategy of sustainable development of the Chinese government. The best solution is to carry out proper retrofitting to extend life length, enhance safety, improve energy efficiency, and fit into cultural environment, including reservation and inheritance of historic features, integration with local cultures and mergence into urban and surrounding environment and so on.

To promote research on retrofitting solutions for existing buildings and development of relevant products, Ministry of Science and Technology and Ministry of Housing and Urban-Rural Development approved the significant project of "Research and Demonstration of Key Technologies of Integrated Retrofitting for Existing Buildings" (one of the key projects of the National Science and Technology Pillar Program in the Eleventh Five-Year Plan Period). This project covers the following subjects: relevant policies and regulations, codes and standards, inspection and assessment technologies, safety improvement technologies, function upgrading technologies, equipment renovation of integrated retrofitting for existing buildings, special retrofitting materials and construction machinery and demonstration projects. Making systematic research on relevant subjects of integrated retrofitting for existing buildings, this project aims to promote the healthy development of integrated retrofitting for existing buildings in China.

Demonstration Project of Integrated Retrofitting Solutions for Existing Buildings is one of the subjects of the project, and is carried out by China Academy of Building Research together with Science and Technology Promotion Center of MOHURD, Shanghai Research Institute of Building Sciences, The Center for Housing Industrialization of MOHURD, Henan Provincial Academy of Building Research, Protection Office of Featured Architecture in Tianjin, Harbin Institute of Technology, Tianjin University, Hunan University, University of Science and Technology Beijing, and so on. The main tasks are to demonstrate retrofitting technologies of existing buildings and to build platform for inspection and assessment and retrofitting technologies of existing buildings, to develop informa-

tion database of existing buildings and study relevant measures for construction of demonstration retrofitting projects of existing buildings.

In order to spread project accomplishments and to strengthen technical expansion, project promotion team of “Research and Demonstration of Key Technologies of Integrated Retrofitting of Existing Buildings” held meeting in Beijing in Feb. 2009, and decided to publish the series of integrated retrofitting solutions for existing buildings. As one of the series, this book demonstrates 25 project cases of retrofitting of existing buildings, among which 5 are that of residential buildings, 15 public buildings and 5 featured buildings. Each project introduction covers project overview (type, area, floor number, characteristics, completion date), retrofitting technologies (architecture retrofitting, structure retrofitting, heating and air-conditioning retrofitting, water supply and drainage retrofitting and electric auto-control retrofitting), outer-door environment retrofitting, retrofitting effect analysis (safety, function, amenity, indoor environment quality, energy-saving, water-saving, land-saving, actual effect of operation after retrofitting, social benefit, environmental benefit), economical analysis on retrofitting (individual-project retrofitting cost, integrated retrofitting cost, investment yield calculation), and promotion value of retrofitting.

This book should be of interest to engineering technicians of retrofitting for existing buildings, college teachers and students, and relevant management personnel.

Any constructive suggestions and comments from readers are greatly appreciated.

Li Chaoxu

Vice President of China Academy of Building Research

APRIL 5, 2010

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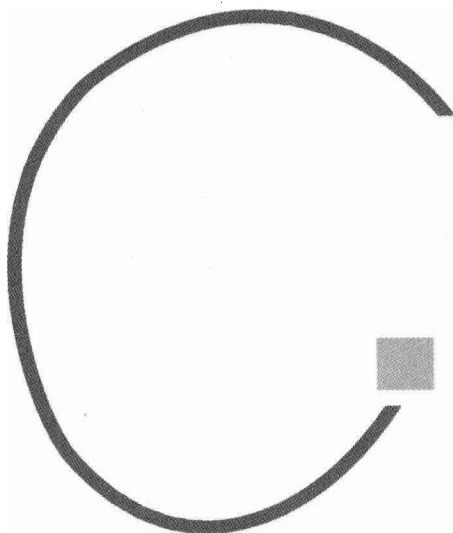
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**公 共 建 筑**  
**Public Buildings**





# 广东省立中山图书馆改扩建一期工程

Phase[Retrofitting and Expansion Project of SUN YAT-SEN Library, Guangdong

项 目 名 称	广东省立中山图书馆改扩建一期工程
Project Name	1st Phase reconstruction and extension project of SUN YAT-SEN Library of Guangdong Province
建 设 地 点	广州市文明路 213 号
Construction Site	213, Civilization Road, Guangzhou
改造设计时间	2006 年 8 月
Design Time	August, 2006
资料提供单位	广州市亮建节能科技有限公司
Information provided by	Liang Jian Energy-Saving Technology Co., Ltd., Guangzhou
改造施工单位	广东省建筑工程集团有限公司
Construction Company	Construction Engineering Group Co., Ltd., Guangdong Province
建 筑 面 积	7.63 万 m <sup>2</sup>
Floor Area	76300m <sup>2</sup>
改 造 面 积	3.19 万 m <sup>2</sup>
Retrofitted Area	31,859 m <sup>2</sup>
结 构 类 别	框架混凝土结构
Structure Type	Frame concrete structure
竣 工 时 间	2010 年 6 月
Time of Completion	June, 2010
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## 1. 工程概况

广东省立中山图书馆（下简称图书馆）的图书馆大楼改造工程是图书馆改扩建项目一期工程的重要组成部分。整个项目从 2006 年开始设计施工，计划 2010 年 6 月全部完工。