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老房子的再生，杭州思路及实践

王少媚

[摘 要] 杭州作为我国七大古都之一,拥有大量珍贵的历史文化遗存，为了有效保护、合理利用这些遗产资源，二十一世纪以来杭州政府开展了大量卓有成效的工作。本文从杭州城市特性分析出发，详细阐述了杭州在建筑遗产保护方面的主要理念、原则及方法，并着重介绍了杭州近几年在历史建筑保护方面的实践和案例。

[关键词] 遗产保护、理念、方法、案例

Rebirth of Old Buildings: Ideas and Practices in Hangzhou

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Abstract

As one of former capital cities in Chinese history, Hangzhou has a great amount of precious cultural heritage. In the new century, Hangzhou municipal government has taken a lot of measures to effectively protect and reasonably utilize these heritage resources. Starting from analyzing the city character of Hangzhou, this paper is to elaborate the main ideas, principles and methods of architectural heritage conservation in Hangzhou, and also to introduce some practical cases of historical building conservation in Hangzhou in recent years.

Keywords

Heritage Conservation, Idea, Method, Case

Diagnostic Condition Assessment of a 180 Year Old Church in Singapore for the Purpose of Restoration

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Abstract

In conservation of a historical building, investigative survey constitutes an essential phase prior to carrying out any actual restoration and preservation works. This is to ensure that all primarily-concerned defects and their relative extents would be adequately recorded. In addition, construction details of the historical components within the building should also be established. Only then effective remedial actions that commensurate with the problems can be developed. Although visual survey is often deemed to be the principal and often the only approach taken for such building assessment, it unavoidably possesses its own limitations in determining the true state of dilapidation. This is due in large part to a lack of understanding of and skills in the use of emerging diagnostic tools. This paper discusses and demonstrates the use of some of these techniques in the assessment of a 180-year-old church in Singapore, which had suffered from extensive salt attack, ground settlement and moisture related damages. A combination of non-destructive testing such as infrared thermography, radar, drill resistance measurement and microwave moisture sensors has proven to be very useful in mapping out the pattern and distribution of various dilapidations of and construction details in the church. Petrography meanwhile was instrumental in the study of the historical masonry in determining the types of materials used, their composition and conditions and their potential serviceability. These helped to better understand the actual mechanism of failure and deterioration.

Key Words

Dilapidation, Petrography, infrared thermography, radar, drill resistance measurement, microwave moisture sensor

RESPONSIBLE ARCHITECTURE
Contemporary interventions on historic buildings in Central Europe

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Abstract

Our paper attempts to introduce some of the contemporary methods and instruments applied at reconstruction works, focusing on the aspects of energy efficiency and sustainability of contemporary architectural interventions – giving an overview of the preservation of built heritage in relation to responsibility. Seven examples from Central Europe illustrate the contemporary tendencies in heritage rehabilitation, with different functions, from different ages and with different design methodologies.

The first example is about continuation: where the construction is following the traditions of vernacular architecture. Than addition: where only A clearly distinguishable, independent new part is added to the complex. With adaptation the large scale architecture of industrial heritage becomes used for another function. When the high-tech elements are interfering with the old structure, we can call it superimposition. Transformation makes radical changes preserving only the original skeleton of the original building. Creating traditional forms by modern structures is some kind of imitation. And at last but not least: reinterpretation can be done when there are no limitations and the architect designs for himself.

Key words

Rehabilitation; reuse; revitalization; sustainability; responsible architecture.

关于传统工艺灰塑的保护与传承

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[摘　要] 灰塑主要是以贝灰、纸浆为原材料精雕细琢而成，具有雅俗共赏、色彩丰富、技法简朴、亦塑亦画等显著特点。灰塑工艺主要应用于祠堂、庙宇、豪门大宅和古建筑居多。在当今社会极速发展下，许多民间传统工艺逐渐被工业技术所替代，灰塑工艺也逐渐流失。在社会稳健发展的条件下，应加强保护传统工艺不被流失和不断探索及传承。

[关键词] 灰塑；工艺；保护；传承

Evaluation and Strengthening of Historic Masonry as a Sustainable Approach for Building Restoration

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Abstract:

Many existing masonry buildings require repair or strengthening to address long-term deterioration effects, structural deficiencies, or concerns regarding seismic performance. The sustainable approach for restoration of historic construction is to recognize the inherent architectural and structural value of existing materials and use those materials to the maximum extent possible. This paper follows a project to retrofit an historic masonry building on a University campus in the Midwestern United States as a case study to present the process of evaluation and structural strengthening using modern technology and newly developed injection materials.

Nondestructive and in-place test methods were used to evaluate existing construction to identify as-built conditions and masonry engineering properties. Microwave radar and borescope examinations provided essential information on internal wall construction and the presence of internal wall voids as well as hidden header courses. Mortar rebound hardness tests were used throughout the building exterior to evaluate the need for mortar removal and repointing. Finally, a series of in situ flatjack tests were conducted to provide material property information including masonry compressive strength and modulus. The information from nondestructive and in situ test methods was used to direct design of stabilization procedures.

The existing building was being renovated and re-programmed internally for use as a modern classroom building. Part of the plan was to remove interior bearing walls and install a series of beams and trusses to carry roof loads to new bearing points at historic masonry walls. Rather than install new structural members at bearing points, the load-bearing capacity of walls was augmented by installation of internal reinforcing bars and injection of voids using a Compatible Injection Fill (CIF). The approach successfully stabilized deteriorated masonry and also increased load-bearing capacity for resistance of new structural point loads at beam bearing locations. Unique to this application was

installation of a series of diagonal stitching bars to confine the masonry and enhance masonry compression response. Nondestructive tests were conducted following injection and strengthening as a form of quality assurance to ensure the strengthening process was completed according to design documents.

Keywords

nondestructive evaluation, masonry, injection, reinforcement, stabilization, repair

International Conference on Sustainable Building Restoration and Revitalization 2013

Bernhard Polt

Abstract

The presentation describes the differences at renovation of old buildings by application of ETICS, compared application of ETICS on newly erected buildings.

The main focus lies on subsurface, project planning, additional fixing of the ETIC-System and possibilities of façade design.

Any subsurface has to be prepared for application of ETICS. What are the necessary working steps to achieve a suitable subsurface? Most problems are caused by unsuitable measures regarding moisture in the walls of the building. What are the reasons for the moisture, what does moisture cause, how to avoid moisture caused damages?

Project planning for renovation has to consider more issues than project planning for new buildings. Drying and protecting walls are crucial.

Additional fixing is compulsory at renovation projects with ETICS. Which suitable methods are possible and on the market? The new StarTrack and it's advantages.

Showing the possibilities to reconstruct old facades with ETICS. Examples of facades already renovated and possibilities with special EPS-profiles.

Key words

Renovation with ETICS; Subsurface; Project Planning; Additional Fixing, Baumit StarTrack; Possible Façade Design

Building Conservation: A Case Study on the Restoration Process of Shanghai Plaster in Singapore

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Abstract

Few studies have been conducted in detail on Shanghai Plaster, a predominantly-used architectural finishing for buildings of significant civic importance in the 1900s, much less the Restoration of it for Building Conservation purposes. Shanghai Plaster embodies a past architectural style and is the prime manifestation of the period of our forefathers. Its restoration plays an important role in the conservation effort of our heritage. This paper presents the entire Restoration Process through careful documentation of a specific case study on a Shanghai Plaster Restoration project in Singapore. Details on all aspects over the course of pre-conservation, conservation, and post-conservation such as paint removal methods, defects identified, respective methods tried and adopted, and usage of materials and equipment are unveiled. Restoration efforts were continuously adjusted to realise the client's ideal effect of the façade. Through the project, it reiterates that widely adopted methods may not necessarily be effective and the best method should always be derived depending on the characteristics of the building or area of defect. The relationship among mix proportions, sizes, colours and angularities of aggregates is also observed and tabulated. Probable maintenance tests and routines are also suggested to maximise the lifecycle of such conserved buildings. With these organised information, this paper shall serve as a good guide to future restoration works especially with regards to the use of Shanghai Plaster in the Building Conservation community.

Key words

Shanghai Plaster, Building Conservation, Restoration, Family and Juvenile Court building, former Ministry of Labour Singapore

杭州历史建筑外墙表层修复技术

探索与实践摘要

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[摘 要]我国近代历史建筑的存在年限比较短，且先前对于近代历史建筑的有意义的修复或改建比较少，历史上对其的介入往往是不尊重的乃至破坏性的。因此，在保持历史沧桑感的前提下，以最小干预的原则，恢复近代历史建筑，特别是文物建筑以外的一般性建筑的历史风貌是保存其自身价值以及提升其对于街区和城市积极影响的正确途径。

本文研究对象主要为杭州范围内历史建筑的清水砖墙、水刷石、水磨石、干粘石、水泥拉毛和水泥（石灰）砂浆表层的修复工艺。此次研究将主要针对杭州具有代表性历史建筑修复工艺创新的探索。同时修复理念的发展也必须建立在修复技术同步发展的基础上，否则保护的原则都是纸上谈兵。因此，必须加强对保护修复技术的研究和探索。当传统材料、技术不能满足要求的时候，考虑使用新的修复技术和材料，是历史建筑保护发展的一个趋势。

本次研究将参照欧洲类似建筑的修复改造经验与技术标准，研究开发出适合杭州历史建筑特征和气候环境的清水砖墙、水刷石等修复核心技术，为科学的保护和利用历史建筑提供技术支撑。同时也以本次的研究对象作为试点项目，为同类型外墙表皮修复提供实践经验，为研究一套适合在以杭州为代表的南方地区推广的清水砖墙、水刷石等修复技术规程奠定基础。

[关键词]历史建筑、墙体防潮、化学注射、毛细水

Exploration and Practice of Outer Wall Reparation Technology of History Buildings in Hangzhou

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Abstract

There are not many intentional practices of conservation and renovation of modern historical buildings as they are not so old, while many cases of interference are often disrespectful and destructive. It should be realized that the correct way for modern historical buildings, especially those having not been listed in the cultural relics, is to protect their age-value with the principle of minimal intervention. In this way, their value can be preserved and they can actively influence the district and the city.

This paper is to study the reparation techniques of wall surface of historical buildings in Hangzhou, such as plain brick wall, granitic plaster, terrazzo, drydash, stucco, and cement (plaster) mortar. The exploration of innovation for representative historical buildings in Hangzhou is emphasized. It is also proposed that the development of conservation idea should also base on the development of conservation technology at the same time, and the study of reparation technique is quite necessary. It is a trend for historical building conservation that new technique and material can be used if traditional one cannot meet the requirement.

This study is to develop a set of reparation techniques for the plain brick wall, granitic plaster and so on which are suitable for the historical character and climate environment in Hangzhou, providing the technological support for protect and utilize historical buildings scientifically. At the same time, this experimental project can provide reparation experiences for outer wall surface of similar types and make the foundation of reparation technique standard for the plain brick wall, granitic plaster and so on in Southern areas such as in Hangzhou.

The Batad Kadangyan Ethnic Lodge Project: Traditional Techniques and Community Involvement in the Restoration and Adaptive Reuse of Historical Indigenous Houses at the UNESCO World Heritage Batad Rice Terrace Cluster Cultural Landscape

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Abstract

The *baluy*, a thatch-roofed wooden hut rose on four posts, is an integral part of the UNESCO World Heritage Rice Terraces of the Philippine Cordilleras Cultural Landscape. Yet, little effort has been made to ensure the continued existence of these indigenous dwellings. Throughout the rice terrace areas, one can find *baluy*s in various states of disrepair and dilapidation. These ecologically responsive houses are progressively being replaced by unsightly modern houses whose corrugated iron roofs turn them into ovens during summer and noisy boxes during the monsoon season. The UNESCO World Heritage Committee even cited this threat in its 1995 inscription declaration.

The Batad Kadangyan Ethnic Lodge Project works to protect these historically and ethnologically important structures through restoration, adaptive reuse and the development of community-based tourism anchored on the vernacular architecture. Using traditional techniques mastered by local Ifugao craftsmen, selected houses are restored and refitted to become tourist lodging. The family-owners of the houses contribute materials and labor, while the project puts in cash for other purposes. Then, a member of the family is trained to host tourists who would like to live in an authentic native house. The income from tourism will then be used to maintain the *baluy*, and possibly to restore more in the future. To date, six houses have been restored, and more are in the pipeline.

Despite the challenges, this project has been able to demonstrate the importance of involving local communities in restoration endeavors. Moreover, The Batad Kadangyan Ethnic Lodge Project promotes the passing on of intangible cultural heritage (Ifugao house-building) by employing a master-apprentice approach in the restoration process. Various structural, design and material modifications were done in order to fulfill the *baluy*'s new function, yet still retain much of its ethnic character. This case study compliments existing technical knowledge in historical building restoration by also looking at the social factors that surround these undertakings in remote rural areas.

江西井冈山红色历史建筑抢救性保护对策研究
——以下七乡刘氏房祠为例

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[摘要] 红色历史建筑是井冈山物质性红色资源的重要组成部分，具有重要的历史、艺术、情感、技术和使用价值，其中下七乡的刘氏房祠就是典型的一例。然而由于各种自然和人为因素，目前建筑遭到严重破坏，亟待保护。本文对刘氏房祠进行了简要的价值评估，重点分析了刘氏房祠的建筑材料与病害机制，并就抢救性保护的原则、现有的保护模式和保护的技术路线进行了探讨。

[关键词] 刘氏房祠；抢救性保护；材料病害；保护原则；技术路线

Proposed Rescue Conservation Strategy of Red Historic Architecture in Jinggangshan, Jiangxi: A Case Study of Liu's Family Ancestral Hall

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Abstract

One of most representative red-cultural material resources is the historic buildings in Jinggangshan, which have important values in aspect of history, art, technology and economic sustainability. Liu's Family Ancestral Hall is one of those valuable heritages. This article studies the deterioration and failure mechanism of the building along with field investigations, and puts forward principles of restoration and strategy of conservation.

Keywords

Liu's Family Ancestral Hall; Rescue; deterioration; principle; conservation

砖石砌体建筑的传统修缮

——论《全国重点文物保护单位-横道河子及车库抢救维修设计方案》

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[摘 要]

横道河子机车库位于黑龙江省海林市横道河镇，1903 年 7 月，东清铁路全线运营通车，辛亥革命以后清东铁路改称为中东铁路。由于横道河子是东清铁路的中转枢纽，聚集了很多的俄罗斯人，是一个十分繁华的镇子，有很多建筑，虽然过去 100 多年了，保存的还很完整。当年从牡丹江到哈尔滨的列车需要翻越张广才岭，在横道河子需要加挂补机助推，最多需要加挂 5、6 辆助推机车。

为了维修和存放这些机车，1903 年也就是东清铁路全线贯通时，修建了这个机车库。这个欧式风格的建筑，虽经百年沧桑，但风采依旧，扇形形状，红砖铁瓦，优美造型，风格独特，车库有 15 个停车位，门前有一个转盘（已拆除），转动后连接各停车位上的机车出入库。于 1990 年停止使用，现在已是游人旅游参观的场所。2006 年 5 月横道河子的“中俄铁路建筑群”被国务院公布为全国重点保护文物单位。

目前《全国重点文物保护单位·横道河子机车库抢救保护方案设计》已经完成设计编制任务和上报工作。

根据结构鉴定报告的结果分析，目前横道河子机车库建筑主体结构的稳固性存在很大的问题，主要由于屋面防水铁皮的风化剥蚀现象严重，致使屋面漏雨。建筑周边后期道路建设和周边民居建设产生大量填挖方产生的地面高差，这些因素使建筑内以及周边的积水无法排出，潮湿的环境让给植物和杂草生长提供了优异的生长条件，导致了建筑屋面防水铁皮、外墙扶壁柱、室内地面、等主要结构遭到严重的植物根系破坏。

方案中延续使用了传统的砖石文物建筑修补方法。贴、挖补砖需专门预制；现制修复料的原料：以面筋灰加相应材料配制并先行做小面积实验，以保证其强度和色泽；门窗等构件修补选用红松干料；屋顶衬方、衬板选用防腐木（产于绥芬河樟子松或落叶松）。

Traditional Renovation of Masonry Structure Building --Discussion about National Key Units for Cultural Relic Protection-the Emergency Maintenance and Design Project for Hengdaohezi Engine House

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Abstract

Hengdaohezi engine house is located at Hengdaohezi Town, Hailin City, Heilongjiang Proveince. In July, 1903, Dongqing Railway was operated for traffic, which was named into Chinese Eastern Railway after the Revolution of 1911. The function of transferring hub attracted many Russians, which drove Hengdaohezi Town into a prosperous town. There are still a lot of buildings, which are reserved in good condition after more than 100 years. Zhangguangcai Ridge was the inevitable section for the trains from Mudanjiang to Harbin in that time, so assisting vehicle was required at Hengdaohezi and sometimes five to six were even required.

The engine house was built to maintain and store the engines in 1903, when Dongqing Railway also was opened for traffic. This European-style building is still elegant and graceful after a century of vicissitude. Fan shape, red brick and iron tile all reflect the beautiful model and unique style. The house consists of fifteen parking lots and the turntable in front of the door has been removed. It connects the go-and-out of the engines on each parking lot. It is stopped in use in 1990 and now serves as a tourist site. In May 2006, Sino-Russian Railway Architectural Complex in Hengdaohezi Town was announced as *National Key Units for Cultural Relic Protection* by the State Council.

At present, *National Key Units for Cultural Relic Protection-the Emergency Maintenance and Design Project for Hengdaohezi Engine House* has completed the task of design revision and report to higher level.

According to the results of structure appraisal report, the stability of architectural body for Hengdaohezi engine house is in poor conditions. The weathering and erosion of water-proof tin on the roof is serious, resulting in roof leakage. Ground elevation is caused by a considerable amount of fill and cut due to the road and houses construction in later period. The ponding inside the building is hard to discharge and the humid environment provides the excellent condition for the growth of plants and grass. The water-proof tin of architectural proof, Exterior buttress, interior ground and other main structures are destroyed badly by the roots of plants.

This emergency protection project follows the *Chinese Cultural Relics Protection Law*.

Key Words

Old buildings; renovation and protection skill; Hengdaohezi engine house

ULTRAslim

The High Performance Future Building Envelope for High Rise Buildings in China

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Abstract

Due to the increasingly urbanization and the increase of population the town population will double until 2050. Therefore inner cities will concentrate because of new buildings. The redevelopment of high rise buildings is getting more important. High performance future building envelope have a very major economical and ecological potential.

杭州历史建筑保护修缮技术管理体系介绍

吴黎梅、楼舒

[摘要] 自 2004 年杭州市政府通过立法正式启动城市历史建筑的保护工作以来，杭州在历史建筑保护修缮技术的指导和管理方面进行了大量研究和探索，已基本构建一套由“历史建筑保护规划图则—历史建筑保护修缮使用导则—历史建筑保护修缮技术规程—历史建筑构造实录”组成的多层次的修缮技术管理体系。本文重点介绍了上述四项技术管理体系的制定目标、过程和主要内容，并通过与国内其他城市的分析和比较，总结该技术体系特征和今后完善方向，为其他城市的历史建筑修缮技术管理提供参考。

[关键词] 历史建筑、修缮技术、管理体系

Introduction of Hangzhou Historical Building Conservation and Reparation Technical Management System

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Abstract

Since 2004 when the Hangzhou municipal government officially launched the protection of historical buildings with legislation, a lot of researches and practices have been done on historical building conservation and reparation technology guidance and management in Hangzhou. A system of multi-level reparation technical management has been set up with planning of historical building conservation, guideline of historical building conservation, reparation and utilization, technical specification for historical building conservation and reparation, and record of historical building construction. This paper highlights the target, process and main contents of the above four aspects of the technical management system. Through comparison and analysis with other cities in China, the paper also summarizes the characteristics of the technical system and improvement possibilities in the future, and provides references for technical management of historical building conservation in other cities.

Keywords

Historical Building, Reparation Technology, Management System

„Saving Historical Buildings" –

a Non Profit Association in Germany

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Abstract

Saving historical buildings depends on a lot of conditions. The influence of climate, humidity, chemical composition of building materials is decisive for durability. Damages have many reasons; this makes a lot of different investigations necessary. What is useful will be described in this presentation.

Key Words

Non-profit association, restoration, methods, sustainability, natural stone, building materials

岭南传统巷道空间热气候适应性分析

高云飞

[摘 要] 巷道是岭南传统村落中最为平常的一种空间，纵横村落，链接着人、建筑、村落与生活。岭南气候夏季湿热，建筑有通风遮阳的需求；冬季和暖温润，宜透气纳阳，本文通过对巷道空间内热环境进行理论计算与现场实测，得到岭南传统巷道空间具有优良热环境特征：在夏季，巷道内具有良好的通风，为村落带走了热量，降低了温度；巷道内具有比较低的温度和比较小的温度变化，降低室外空气谐波对室内热环境的影响；巷道空间狭小，两边的建筑相互遮挡减少了太阳辐射的接受；在冬季，巷道狭窄而高耸的空间，大大减少建筑得热损失。由此，巷道夏可导风遮阳，冬可蓄热，具有良好的气候调节作用和岭南气候适应性。

[关键词] 岭南;传统村落;巷道;热环境

Development of a polymer-modified repair mortar for fair-faced lightweight concrete of a historical building

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Abstract

Reinforced concrete buildings are frequently damaged by cracks, spalling and corroded reinforcement bars. The present article focuses on the damage analysis of a historically important building that was constructed using reinforced lightweight concrete. Furthermore, the development of a repair mortar with lightweight aggregates for the restoration of the aforementioned building is described. The compressive strength, carbonation depth, location and diameter of reinforcement bars as well as moisture and salt profiles were determined. The carbonation-induced corrosion of the reinforcement bars represents in the present case the main damage. Standard repair mortars with lightweight aggregates do not exist. Therefore, an appropriate repair mortar was developed in accordance with DIN EN 1504 and the German guideline for the repair and protection of concrete structures (Rili-SIB). On the one hand, historic preservation requirements, such as: colour of the grout, possibilities of surface patterning, maximum preservation of the original substance and reversibility of any intervention must be met. On the other hand, technical requirements of the Rili-SIB, such as: durability, bonding and mechanical properties must be considered as well.

The developed mix design is based on the identified causes of deterioration and the expected impacts on the building. Swelling and shrinkage of the repair mortar influences the crack formation to a large extent and thus the durability. Furthermore, the different deformation behaviour of the original concrete and the repair mortar can result in delamination. Therefore, special attention has to be paid to the bonding and shrinking behaviour of the concrete repair system. By using polymers, both hardened mortar properties and durability can be influenced positively. These types of repair mortars are called polymer-modified concretes (PCC).
The cooperation of experts in the field of concrete technology, conservation of historical buildings, and public authorities ensures an integral approach for a durable conservation concept.

Key Words
Repair mortar; cultural heritage; listed buildings; lightweight concrete; shrinkage; PCC

杭州地区历史保护建筑高舒适度低能耗修缮技术初探—以平远里历史建筑修缮工程为例

陈建

[摘要]杭州作为中国八大古都之一，历史底蕴丰厚，至今已公布了六批共 336 处历史建筑。许多历史建筑修缮工程尚着眼于修缮工艺和功能利用，而居住舒适度与绿色节能尚未引起重视。为了积极探索木、砖木结构老房子绿色节能问题，杭州市历史建筑保护管理中心以平远里建筑群作为试点开展了历史建筑节能改造试点工作。该修缮工程遵循“舒适、健康、节能的定量节能改造”的设计理念，同时也考虑到杭州作为典型的夏热冬冷地区的气候特点。力求通过对特定项目（主要包括外墙、屋面、楼面、门窗等部位）进行室内外物理环境与建筑节能的改善改造，有效降低历史建筑的能耗，提高内部使用空间的舒适度和健康性。同时对房间内外温度、外墙传热系数、外窗传热系数和隔声效果等项目进行检测，对建筑节能效果进行定量衡量。可以为杭州市历史建筑节能改造工程提供试点，也为杭州市建筑节能数据库提供基础资料，有助于构建杭州地区的历史建筑节能改造模型和评估体系。

A Tentative Research on Reparation Technology of High Comfort and Lower Energy Consumption of Historical Buildings in Hangzhou Area: With Reparation Project of Historical Buildings in Pingyuanli as an Example

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Abstract

Among the 336 historical buildings in Hangzhou, many historical buildings have been repaired with the perspective of crafts and functions, while the problems of comfort and energy consumption are largely neglected. Hangzhou conservation and administration center of historical architecture has actively tried solving the energy consumption problem and taken historical buildings in Pingyuanli as the experimental unit. This reparation project follows ‘Comfortable, Healthy, Energy-saving’ concept, and also takes the climate character of typical ‘hot in summer and cold in winter’ into consideration. In the project, the indoor and outdoor physical environment and energy-saving are improved through specific items repairing (mainly including outer wall, roof, floor, door and window), the comfort and health of indoor space are improved while energy consuming is efficiently lowered. The building’s energy-saving effect is measured by detecting the items of indoor and outdoor temperature, heat transfer coefficient of outer wall outer window, sound insulation effect, etc. This experimental unit has provided basic information to the building energy-saving database of Hangzhou, and also help construct the building energy-saving improving model and evaluation system for historical buildings in Hangzhou area.

Development of Modular Repair Mortar Systems for the Restoration of Natural Stone in Cultural Heritage

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Abstract The increased demand on the protection and preservation of cultural heritage represent a challenging task for the group of restorers and building material researchers. One of the focal points in the conservation of historical monuments is the restoration and reconstruction of natural stone elements. In this respect, a repair mortar system has to adapt (within a certain range of tolerance) the physical properties as well as the given aesthetic and optical appearance of the historic building material. In terms of chemical composition, the content of soluble salts should be reduced to a minimum for an appropriate resistance against salt crystallization. In this context, the BAM Federal Institute of Materials Research and Testing developed a modular repair mortar system for the restoration of natural stone. Therefore, a modular system was defined based on a constant volumetric ratio of different binders (20 vol.-%), aggregates (50 vol.-%), and water (30 vol.-%). The controlled modification of the fresh and hardened mortar properties was analysed as well as the possible colour variation by adding different organic additives and coloured pigments. Furthermore, the durability characteristics were specified by performance tests.

Key Words
Repair mortar, natural stone, stone restoration, stone reprofiling.