平房手册

北京平房低碳修缮手册

BEIJING HUTONGS HOUSES LOW CARBON RENOVATION HANDBOOK

THE PING FANG BOOK

致敬
ACKNOWLEDGMENTS

This handbook is the result of a collaborative effort between BAO Architects, ENTRE architecture, the French Embassy in China, Beijing Urban Planning Institute, and Hua Rong Jin Ying development company.

北京市城市规划设计研究院
Beijing Municipal Institute of city Planning &Design

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序言
FOREWORD

Sustainable architecture and sustainable urban planning have been at the heart of the Franco-Chinese cooperation for many years now. Within this context and long-standing commitment, we signed, in 2013, a bilateral agreement which has since then initiated many projects all around China and dozens of Chinese and French professionals travelling between the two countries each year for training, exchanges, studying sessions, and seminars. Together, professionals from both countries have strived for and propose forward-looking and innovative solutions capable of responding to the global challenges posed by urban development and climate change.

The problems caused by the rapid expansion of our cities have led us to consider the topic of urban renewal as a crucial matter for our century. We need to reconstruct the city onto itself and repurpose and reutilize as much as possible the existing urban fabric by restoring it and readapting it to the changing contemporary conditions.

Historical districts are, both physically and ontologically, a major part of the urban fabric. They are the invaluable witness of a city's cultural and social identity but have often been neglected in the recent race for urban economic growth. Yet, it seems obvious that they are an absolutely fundamental element of sustainable urban development and consequently need to be the focus of a particular attention. The development of knowledge in this area and the deployment of conscientious urban renewal practices are key elements for us today.

France has a long-standing experience and expertise in this field. The first urban conservation zones were established as early as 1963. In a spirit of exchange of ideas, we are keen on sharing with China both our successes and the difficulties, and sometimes failures, we've encountered. Hence, since 2016, we have pushed forward a very ambitious cooperation program between the two countries on the themes of cultural and natural heritage protection.

Environmental protection and the fight against climate change are immense challenges for the XXIst century. As a testimony of our commitment and the breadth of our partnership on the subject, we have launched this year the Franco-Chinese Year of the Environment.

The traditional courtyard pilot project in Baitasi we undertook together with Beijing Municipal Institute of City Planning & Urban Design and Beijing Huarong Jinying Investment & Development Group, tries to respond to all the above-mentioned challenges: preserve the cultural heritage while adapting the buildings to contemporary usages and minimizing their carbon footprint.

This handbook has been realized as part of this project and this larger framework. It details the typical architectural problems that residents encounter in their traditional Beijing courtyards and introduces renovation techniques that have minimal environmental impact. They respect and protect the historical value of the buildings while giving concrete methods to transform them into energetically efficient homes. We sincerely hope this handbook will be a helpful companion in your renovation projects!

Robert Lacombe
Cultural Action and Cooperation Counselor
The French Embassy in China
Beijing, the 30th of November 2018

序言
FOREWORD

On April 26 2013, the French Ministry of Ecology and Sustainable Development and the Ministry of Housing and Urban-Rural Development of the People's Republic of China signed a bi-national cooperation agreement. Within this diplomatic framework, France and China agreed to lead joint projects focusing on the protection and the sustainable restauration of the Chinese vernacular and historical heritage. The White Pagoda Temple (Baitasi) historical and cultural neighborhood was chosen as one of the first site to conduct a pilot project pertaining to the pressing question of Beijing traditional hutongs preservation and renewal. The French Institute, an organization affiliated to the French Embassy in China, Beijing Huarong Jinying Investment & Development Group., and Beijing Municipal Institute of City Planning & Urban Design jointly decided to select the 429 Zhaodengyu Road courtyard as the test site for this pilot project. The ambition was to transform a small vernacular courtyard in a historically responsible and respectful while demonstrating the potential of low carbon construction methods.

The 429 Zhaodengyu Road is a typical one-story courtyard residence in a hutong in the White pagoda Temple neighborhood. It covers a total area of 184.64 square meters with a floor area of 65 square meters. The renovation project of this courtyard started on May 10, 2018 and was completed on December 5, 2018. While the three parties worked together on this tangible renovation project, they engaged in a meaningful discussion and sharing of experiences in the challenging endeavor of cultural heritage

protection, low-carbon building techniques, and the necessary updating of old one-story hutong structures. Alongside this pilot project, they launched a study focusing on the typical issues hutong residents face every day with their homes. This several months study culminated in the realization of this handbook. This manual reveals a wide range of practices, techniques, and materials, pertaining to traditional courtyards renovation that we hope will help individual residents and professionals alike in applying more effective and responsible methods for the refurbishment projects in Baitasi as well as in other old Beijing neighborhoods.

429 Zhaodengyu Road will become a space dedicated to diverse cultural activities that we hope will set an example for the necessary reactivation of Beijing's traditional urban fabric, promote social openness, support local cultural development, and contribute meaningfully in the preservation of the traditional courtyards in Beijing capital core region.

Beijing Huarong Jinying Investment & Development Co. Ltd.
Beijing, the 30th of November 2018

序言
FOREWORD

Beijing's historical core, with an area of 62.5 square kilometers, contains important relics and several centuries of built heritage dating back from the Liao, Jin, Yuan, Ming, and Qing dynasties, all the way to the Republic of China, and the People's Republic of China. Among them, Beijing had city walls, city gate towers, imperial palaces, princes' mansions, guildhalls, temples, rivers, lakes, and gardens. The old city's urban fabric consists of innumerable courtyard houses, hutongs, alleys and lanes, as well as larger urban axis. Our unfortunate past destruction of a large part of this heritage leaves us with a profound sorrow. However, a still extensive portion of this urban legacy has survived and has since been listed as protected cultural relics, historical buildings, historical and cultural city blocks, and urban-scape harmonization areas. Those protected zones account today for nearly half of the area of the old city.

That said, we are still facing a dilemma: time is ruthlessly eroding our treasures. Wood is decaying, tiles are breaking, bricks and stones are eroding and deteriorating. This unremitting state of dilapidation is particularly evident when looking at the thousands of traditional courtyard houses constituting the very essence of the old city. Historical neighborhoods are the most charming part of the old city. Walking though the hutongs, one can hear children playing and laughing. Looking up, an aerial ballet is performed by the much-loved hutong pigeons. Whichever seasons, whether it's sunny, windy, warm, cold, rainy or snowy, one can always feel the ancient charm and vitality of the city. How can we deal with these hundred-year-old houses that have provided us with such well-being and protected us throughout our history? Should we keep them just the way they are or try to restore them to their original state in order to maintain our yearning for traditional life? Or should we strive to inject a new kind of energy into them and redevelop them into nurturing environments in phase with the reality of modern life in the capital?

We, the "selfish" ones, out of the love for traditional culture, hope that we could keep them just the way they were. However, out of a justified necessity for modern comfort, we have to consider updating them to today's standards. Thus, the central question becomes: how can we find a balance between those two aspirations for the best of the two epochs? This is a difficult subject that requires a serious commitment to continuously explore new methodologies in historical preservation and urban renewal.

Heritage protection is a crucial topic today in China and the world at large. In our dedication to Beijing's old city preservation, we are eager to broaden our horizons and learn from all sides. In this forward-looking spirit, we have, over the years, created a bridge between China and France for discussing and sharing our respective expertise. Thanks to this collaborative bridge, we hope the French architectural community will share its experience in heritage protection, preservation techniques and other architectural knowledge with us. We also would like to thank Beijing Huarong Jinying Investment & Development Co. Ltd. in Xicheng District for generously providing the site for the joint Sino-French pilot project, a small courtyard located in Baita Temple historical and cultural neighborhood.

While simultaneously working on the physical renovation of this pilot courtyard, the architects produced this manual exhibiting a wide range of good refurbishment practices for vernacular houses. In a well-written concise language, and supplemented with clear pictures, it comprehensively and meticulously presents the problems common to one-story houses in the hutongs. It summarizes the causes of disrepairs and the corresponding maintenance and repair methods that can be applied. It gives advices on responsibly using water, electricity and heating amenities so as to guarantee both environmental protection and comfort. It pays special attention to rainwater drainage and natural seepage methods in the exterior courtyards so that they can be intelligently coupled with planting patterns and help creating a green efficient city. It is hoped that this small handbook will provide good technical supports for houses owners and relevant professionals.

Those experiments are just the beginning. It is important that we keep working together to promote the protection and renewal of historical and cultural heritage. There will be more and more opportunities for experts' cooperation on those crucial subjects in the future.

Feng Feifei
Beijing Municipal Institute of City Planning & Urban Design
Beijing, the 9th of November 2018

前言
PREFACE

ON PRESERVATION

Anyone with a basic understanding of the last 40 years of onslaught on Beijing's hutongs will agree that preservation is a must. But what exactly are we trying to protect and how exactly are we going to do it? Are we choosing to only preserve the remnants of a lost traditional epoch? The chosen fragments that are deemed historically significant? Or should we preserve everything? Are we trying to go backward or forward? Are we trying to safeguard a culture that we see as being endangered? Against what? Who are the key actors of this preservation? Who decides? What is the purpose? For whom?

Heritage shouldn't be limited to a simplistic understanding of tradition or to the preservation of first-rate cultural relics, it's in the small things, in the everyday, in the vernacular, in the exceptions as well as in the norm, in the people as much as in the built structures. It is multilayer and multi-epochs, it traverses time. History isn't and never has been a fixed concept; history never stopped. The idea that there was a specific moment, a clear-cut date at which the hutongs were a perfectly harmonious urban fabric, an "original state" that we should strive to recover, seems ludicrous at best. This reasoning dangerously implies that any later action or transformation performed on this supposed "original" is viewed as a mistake, a historically invalid, if not subversive, urban development. The mutation of the traditional hutongs into the current ad-hoc, sometimes messy, sometimes irrational, but also sometimes extremely pleasurable urban fabric, cannot in our opinion be considered a historical incident, an error in the city's evolution. It could be understood instead as an expression of the extraordinary inventiveness, resilience, and active commitment of its people toward their living environment. Any action that negates this incredible richness in the name of preservation is reactionary. The demolition of the existing physical, social and cultural structure of the city we've witnessed in the past years for the rebuilding of an idealized past seems utterly counterproductive. Additionally,

it's also been incredibly offensive, not to say violent, towards the hundreds of thousands of people who live in the hutongs, maintain them, transform them, and deeply cherish them. Preservation shouldn't be a limitative process, something that relentlessly tries to go back to some nostalgic idea of a supposedly lost urban splendour. It should be an empowering process, an opening up of the rich, diverse and extremely complex heritage of the city. Part of this rich heritage is the way inhabitants have actively engaged with and transformed the historical city into the incredibly exciting urban space it is nowadays.

That said, let's avoid being too romantic. In many ways, the hutongs are in a state of alarming decay. We, the hutongs inhabitants, for reasons that might have been pragmatic at one point, have too many times acted crudely on our dwellings and our city. Choosing the easiest quickest solution to temporarily fix an issue, our negligence has resulted in a gradual loss of some of the hutongs best qualities. If the city's preservation and its evolution are to be considered as collective undertakings where each of us have a potential crucial role to play, the responsibility not to self-sabotage falls on all of us. It belongs to each inhabitant, each person repairing or transforming their houses, to think more carefully on how they can increase their comfort in old structures without losing their inherent architectural qualities. It might sometimes be a bit costlier, sometimes a bit more complicated to plan and execute, you might even have professional builders telling you that you'd better get rid of the old and renew or cover-up everything. Still, there are many ways this can be done without even being technically or financially too demanding. The question isn't to adopt a rear-guard conservationist point of view declaring that older structures shouldn't be touched and condemning new modern constructions in the hutongs. On the contrary, new is good but… so is old! Yes, things might have got damaged and yes, we have to find ways to provide modern standards of comfort in ageing structures. But we cannot throw the baby out with the bathwater nor can we carelessly slap temporary Band-Aids on our issues. We need to make our homes better by combining the virtues of contemporary know-hows with the qualities of the past.

前言
PREFACE

WHY THIS HANDBOOK ?

To live in a house, big or small, right in the middle of the booming Beijing metropolis is by any account exceptional. To be surrounded by buildings that embody the efforts, beauty, and intelligence of past generations is something each of us should be proud of and feel responsible to protect. Yet, not everyone lives in a palace or a pristine Siheyuan and hutong life can be one of many challenges and hardship. Most of us live in little ping fangs, historical or not, traditional or not, nice…or not. Spaces are small and congested, structures are sometimes insalubrious, in need of constant repairs, amenities are insufficient, comfort is… limited. Years after years many of our houses have suffered successive damages that seem extremely difficult or too costly to repair. Previous repairs were sometimes inadequate either because the material used were of bad quality, or the execution lacked expertise. Time and again, we tried to patch-up our houses' problems without actually understanding and treating the source of the matter. When, for example, our walls are damp, the plaster is peeling, and moisture is appearing, what do we do? We scrape down the wall and hastily reapply a fresh coat of damp-resistant plaster. Like a cover-up job, we hide the problem and hope the patch will hold long enough. The same issue will of course pop up again a year or two later because the cause, a wall that shouldn't be humid in the first place, was left untreated. Modern materials, although cheap and readily available, are sometimes inadequate for the hutongs particular situations and prove to be ineffective solutions. Traditional techniques, on the other hand, are sometimes difficult to apply and do not guarantee the level of comfort needed nowadays. The lack of information on proper ways to assess where the problems are and what are the best ways to resolve them is further exacerbating our inability to responsibly

and effectively repair our homes. Contractors are sometimes not sufficiently trained, ill-equipped, or themselves misinformed, and will direct you towards solutions that are easier and quicker for them (the patch-up). Where's the problem? How can it be fixed? What are the best materials to use? What are the required expertise and know-hows? What are my options? Answers are hard to find or subjected to personal speculations from specialists and amateurs alike.

The objective of this handbook is precisely to help fill the gaps and inform hutong inhabitants on responsible ways to maintain, repair, or transform their houses. It is not a recipe book where the illustrated techniques can magically adapt to each and every situation, nor is it a highly technical book for professionals describing standard renovation procedures. It is a rudimentary "Do It Yourself" guidebook helping inhabitants understand and properly diagnose the everyday issues they might experience in their houses. Whether you are planning to work on your house yourself or hire a contractor to do it, this manual gives you advices on the things that you need to consider and presents basic principles on how to proceed. It is not a construction manual per se but an informative companion assisting you in taking responsible and informed decisions.

What do we mean by "Responsible and informed decisions"? Two fundamental notions have been explored and explained at length in this work: a responsibility towards the historic heritage in which you are to act, and a responsibility towards the environment at large.

First, the historic heritage issue. Each project inevitably starts with the question of what to keep and what to change. At that point, it belongs to each inhabitant to carefully assess the pre-existing features that should or could be maintained and have their place in the new refurbishment. It seems awkward that many times what seems to be a beautiful vernacular house from the outside ends up being a boring white cubic space inside. Floor to ceiling, everything has been covered up. The beautiful wooden roof beams are hiding behind plasterboards flat ceilings, walls are white and slick, the space is low, ordinary and dull. Behind all of this, lays authentic handmade wood structures, beautiful masonry walls, or exquisite stonework. Why not try to preserve and expose the roof structures and build a properly insulated ceiling that follows the natural slope of the roof? Why not recover the generosity of the original volumes, the height that permit air and light to circulate freely? Why not recapture the character of a house that was built as much to stand up and protect you against the harsh climate as to create a pleasurable space for you and your family?

Preservation is not only about safeguarding or exposing traditional features such as an old stone or a wood beam, it is also about perpetuating whenever possible the traditional know-hows. Let's take the example of windows updating. It is today extremely easy to buy industrially-produced aluminium or fiberglass windows. That said, one needs to be aware that if everyone makes this choice, a long-standing carpentry tradition will slowly disappear. A remarkable know-how and expertise on window-making has been accumulated by Chinese carpenters for hundreds of years. Shifting from custom-made wood frames windows produced by a local carpenter to industrial products manufactured hundreds of kilometres away means that this knowledge and crafts will fade. Today's carpenters still have the skills to build a wooden window façade for your house and can do so with a high level of quality, comfort, and integration of new materials and technologies. Choosing this method will give your much more control and freedom for your project, preserve the material coherence and appearance of your house, give work to local carpenters and guarantee the preservation and further enrichment of local know-hows. Heritage protection is not merely about preserving artefacts of a bygone era, it is about safeguarding people's knowledge and building up on the intelligence that precedes us.

The second theme that we have developed throughout this handbook is the idea of a low carbon renovation and sustainable low carbon living. The logic is twofold: trying to limit the environmental impact of our construction project, and guaranteeing that the renovated space helps us reduce our everyday energy waste. The material and technical choices are obviously important factors in conducting an eco-friendly renovation project and should be the subject of special attention. Basic tips on the environmental impact of typical refurbishment materials are given throughout the handbook to help you navigate through the thousands of choices that are available today. The way those materials and refurbishment techniques can enable energetic savings and decrease your utility bills is an equally crucial question. A properly insulated and properly ventilated house will guarantee a comfortable and enjoyable space while drastically lowering your electrical consumption for heating and cooling. In addition, it is important in a city notorious for its excessive pollution, that each of us try our best to adjust our behaviours and strive for a lower environmental impact in our everyday life. Low carbon living will not result in the sacrifice of personal comfort or higher costs but, on the contrary, make our homes better and healthier. Sustainability is about using resources intelligently and making more out of less. Hutong inhabitants, willingly or not, can be said to have over the years mastered the motto of "more with less", now the question is: can we extend this spirit towards a workable "less waste = more comfort"?

This handbook is dedicated to the long-standing hutongs inhabitants and the newcomers, to the laobaixings and the new generations that decide to settle in the city's oldest districts. It is an attempt at stimulating a more positive take on urban renewal for the inhabitants, by the inhabitants. It is grounded in a sincere admiration for the qualities of an exceptional part of the city that is made of supposedly ordinary, supposedly dilapidated, supposedly problematic, small houses. It touches upon notions of historical preservation but avoids only focusing on traditional typologies. Whether you live in a traditional structure or a more recent construction, it tries to integrate the multiple realities and the variety of situations we face in the hutongs. It puts forward extremely down-to-earth ideas on how to cope with houses that need constant tending, maintenance and care. It tries to demonstrate that it is possible to improve while preserving and that it belongs to each of us to value our homes and build upon their prevailing qualities.

Benjamin Beller
BaO Architects
Beijing, the 9th of October 2018

北京平房修复手册

墙 WALLS

顶 ROOFS

地 FLOORS

木 WOOD

门窗 WINDOWS

技术 TECH

院 YARD

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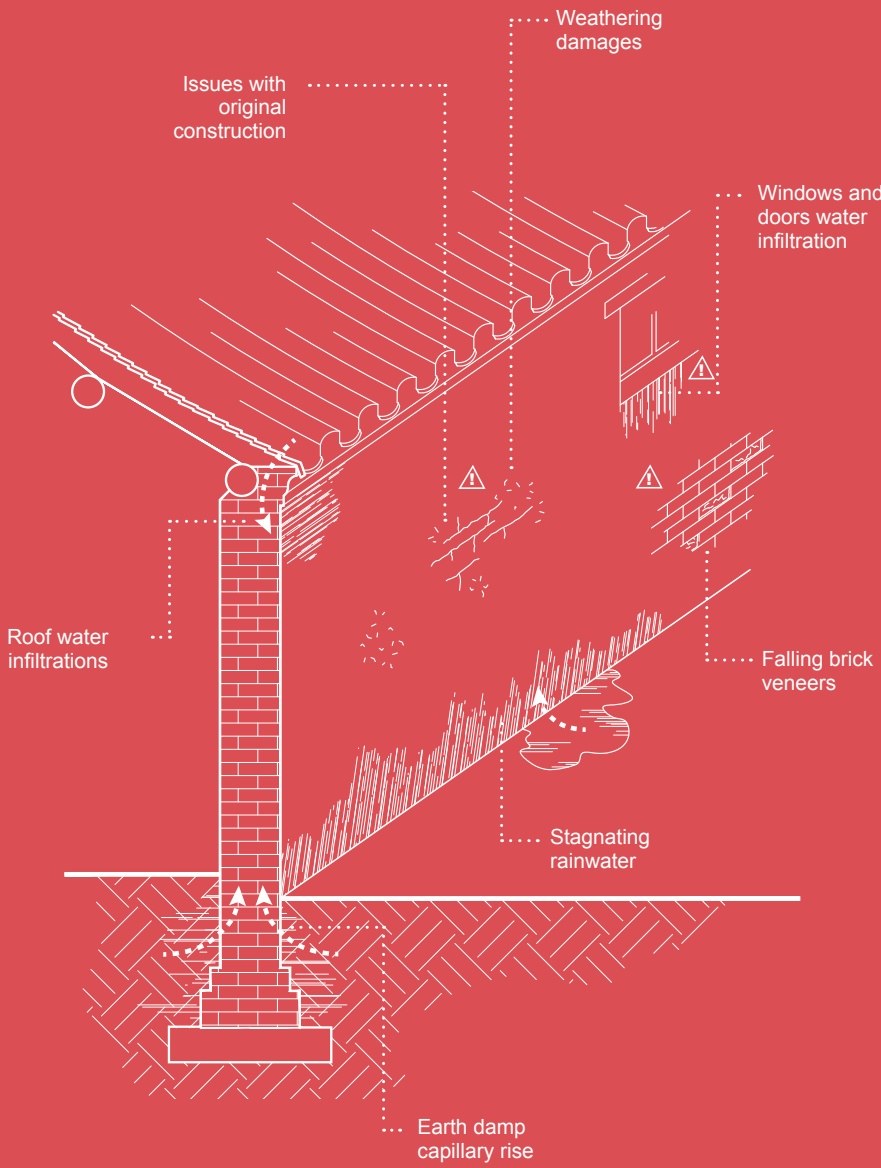
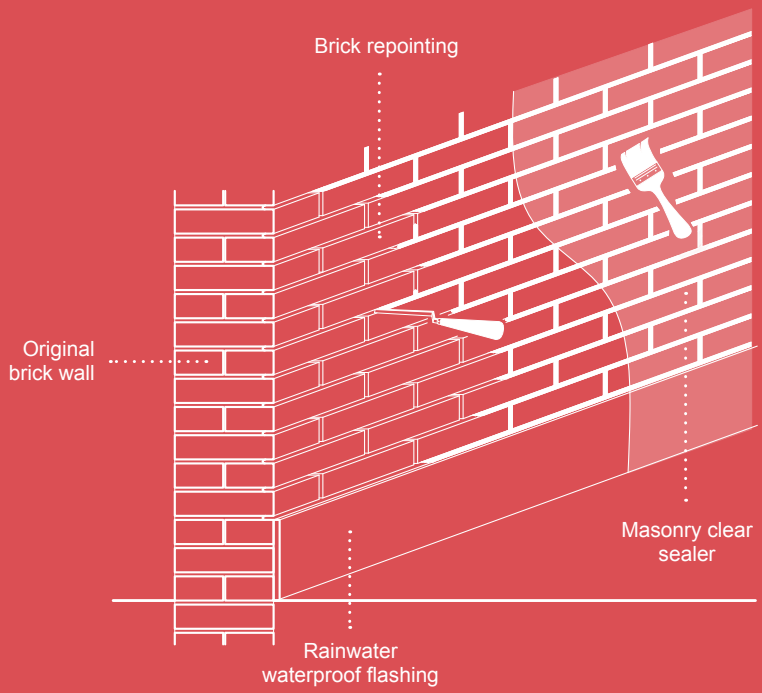


老砖墙修复
OLD BRICK WALLS REPAIRS



Repairing mortar joints

- Carefully cut 2 cm deep grooves in cracked or deteriorating mortar with an angle grinder and chip out the loose mortar with a hand chisel
- Thoroughly clean the joints so that no dust or loose mortar remains
- Carefully refill the joints with a newly prepared water-resistant mortar with the help of a “repointing trowel”. Pack the mortar tightly with no voids to get the strongest, most water-resistant joints. Avoid spilling and clean mortar on the brick face before it dries.
- Finish the joints as either raked joints, V-joints, flush joints or concave joints using the specific tool for each of those finishes.

Seal the wall:

- Thoroughly clean the whole wall so that no dust, dirt, pollution, old bricks dust, grease marks or humidity remains (it is possible to use pressure washing equipments for better results)
- Apply a transparent, environment friendly, breathable “masonry waterproofing sealer” with either a pulveriser, a roller, or a large brush

墙面抹灰修复1

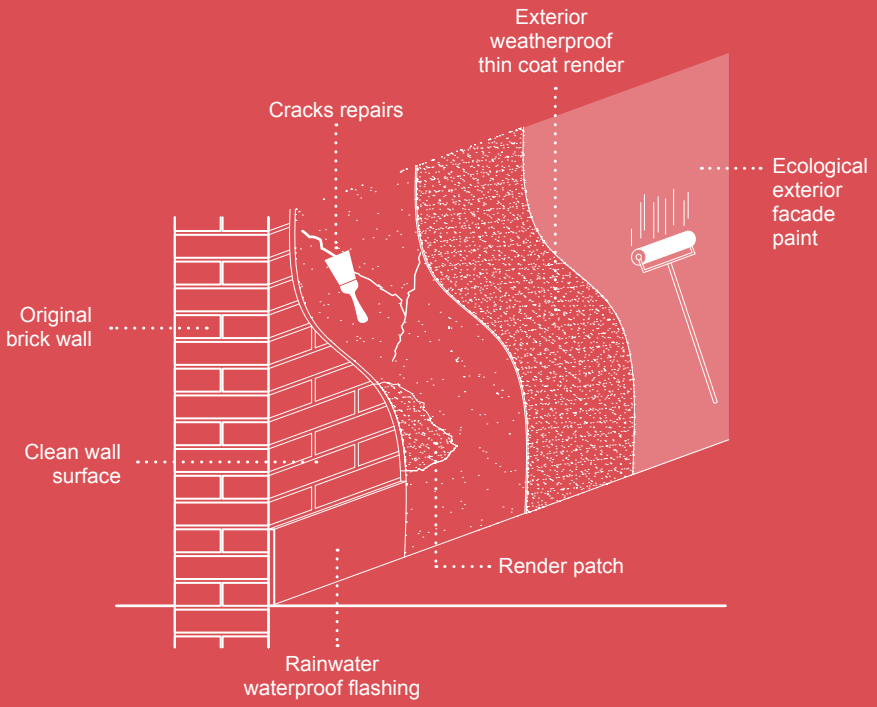
PLASTERED WALLS REPAIRS #1

Clean and repair

- Clean thoroughly the wall with a scraper or bristle brush and household detergent so that no dust, pollution, grease stains, fungus or loose elements remain. Treat any water infiltrations before repairing the render coat
- If the wall has major and deep cracks, the problem might be structural, please consult a specialist
- If the cracks or damages are small and non-structural, use an exterior wall filler to repair and/or reapply a thin coat render on the whole wall
- If large parts of the existing cement-based render are falling, cracking or always damp, it means it wasn't properly made in the first place. You might need to entirely tear it down, properly resolve the humidity issue, let it dry completely and rerender the whole wall with a breathable render specifically made for exterior walls use (e.g 3 layers rendering composed of cement, lime, sand, and water).

Weatherproofing and Painting:

- Do not apply fully waterproof paint on the wall. It will not be able to breathe and vapour will get trapped inside with no way of escaping which can result in serious damages.
- A whole range of eco-friendly exterior facades paints are available now. The paint should be water-based, specifically for "exterior walls weatherproofing", breathable (no vapour gets trapped in the wall), and low to zero VOCs (volatile organic compound that are harmful to you and the environment).

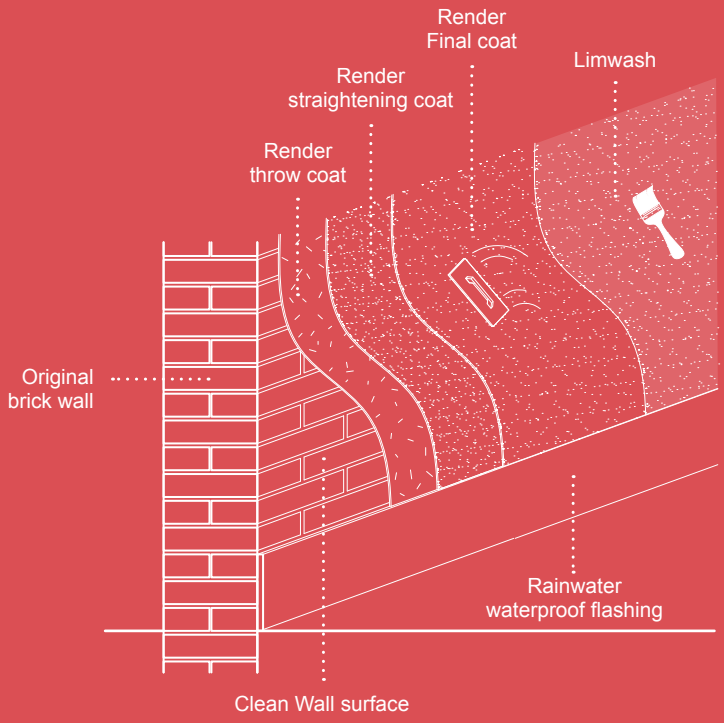


墙面抹灰修复2

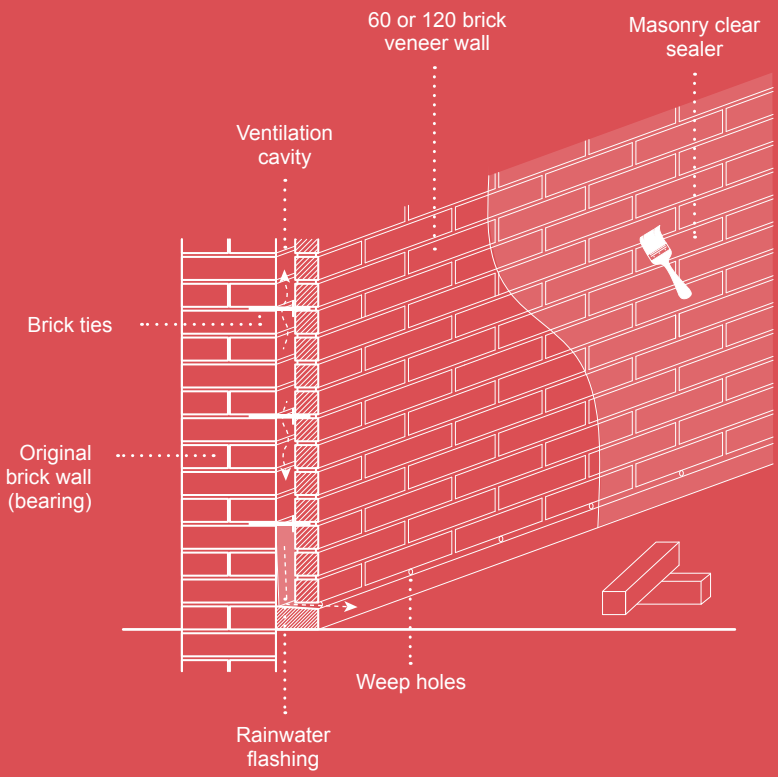
PLASTERED WALLS REPAIRS #2

Traditional ecological lime rendering and limewash:

- Traditional lime rendering are preferred to cement based rendering because they avoid trapping vapour in the wall and are more environmentally friendly. Lime is better applied in spring or autumn and in shaded conditions so that it doesn't dry too quickly. Because of its causticity, proper protection is needed when working with lime (mask / glass / long sleeves gloves)
- After tearing down the former exterior plastering, the wall needs to be cleaned (no loose elements or dust). If there are traces of water infiltrations, their causes need to be treated before any new plastering can be done.
- Lime rendering is applied in 3 coats (throw coat, straightening coat, final coat) with a mix of coarse sand, hydraulic lime, and water. Hemp fibres can be added to increase the strength of the render and mineral pigments can be incorporated in the mix if a specific colour is desired.
- It is recommanded to apply 3 to 5 coats of grey limewash (hydraulic lime + grey mineral pigments + water) on top of the lime rendering to further protect the wall from weather aggressions.



新砌砖墙修缮
BRICK VENEERS WALL REPAIRS



Ventilated exterior brick veneer:

- If the space permits it, is recommended to build a ventilated brick veneer wall utilizing real 120mm or 60mm Beijing grey bricks instead of 10mm decorative brick-like claddings that we see being used a lot recently. The fake bricks veneers don't allow the wall to properly breath and will never give you the desired aesthetic quality of traditional walls
- A ventilated brick veneer consists of leaving a 50mm air ventilation gap between the existing structural brick wall and the new "one brick" veneer wall. Small steel members called "brick ties" connecting the two walls have to be placed at regular intervals to guarantee the stability of the brick veneer. A rainwater flashing and weep holes need to be built on the lower part of the wall to avoid water infiltration and to guarantee proper ventilation.
- It is recommended to apply a transparent brick sealer on the finished brick veneer to ensure a longer lasting wall
- With this technique, it is also possible to add a layer of external insulation (please refer to the chapter on walls insulations)

墙体受潮典型问题

WALLS HUMIDITY TYPICAL ISSUES

Interior lower walls humidity

Exterior walls humidity

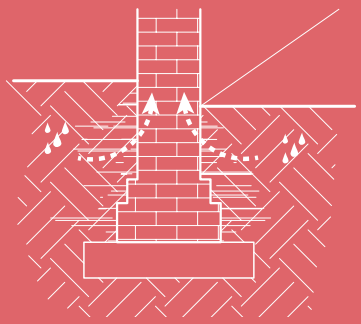
Falling plaster, peeling paint, air bubbles

Saltpeter

Weathering

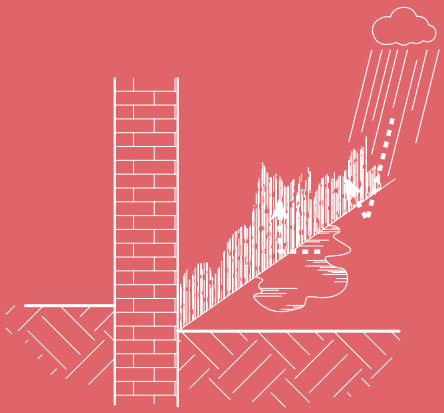
墙体受潮可能原因

WALLS HUMIDITY – POSSIBLE CAUSES



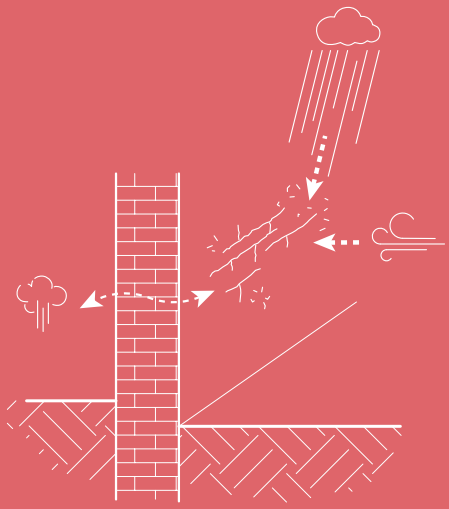
Rising damp:

- Soil water and alkalis infiltrate the foundations and naturally rise in the wall (capillary rise)



Rainwater infiltrations:

- Stagnating rainwater seeping into the wall
- Lack of rainwater flashing
- Roof, gutters,windows leakages



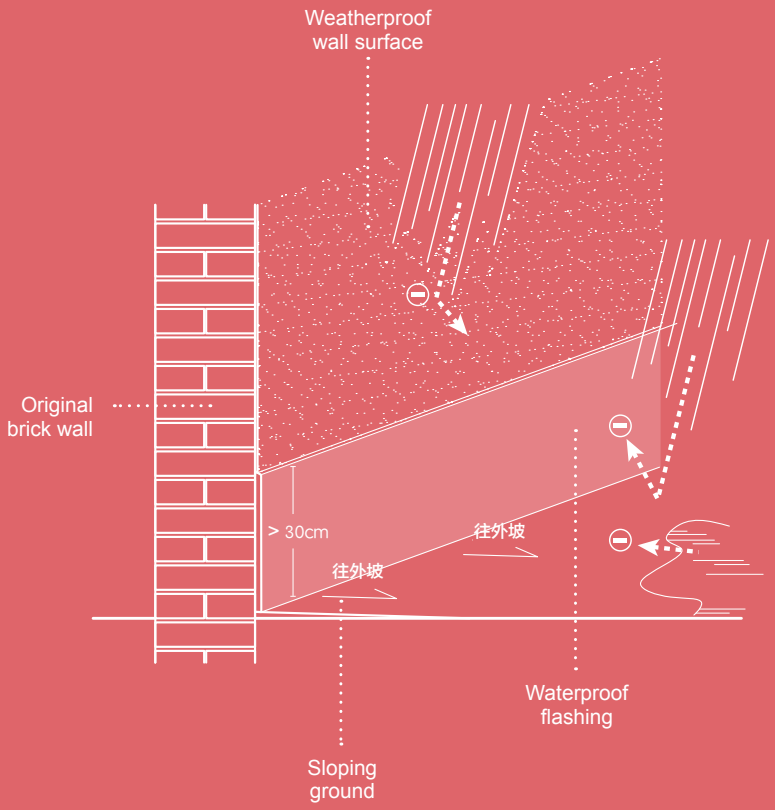
Vapour and weatherproofing:

- General weatherproofing issue
- Walls can’t dry naturally
- Interior vapour seeping into the wall

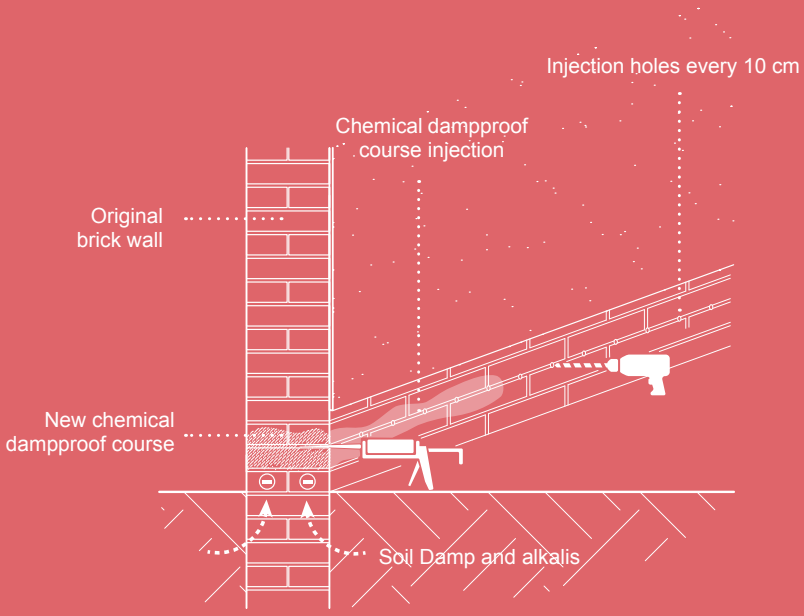
雨水渗入处理
RAINWATER INFILTRATIONS

Rainwater infiltrations:

- To avoid rainwater infiltration, it is important to first verify that there is no leakage from the roof, the gutters, or the doors and windows. If rainwater gutters are installed, they should always eject water at a safe distance from the wall to avoid infiltrations.
- Walls surface should have a weatherproof capability (weatherproof sealer or weatherproof renders and paints). Weatherproofing does not mean waterproofing. Waterproofing consists of entirely sealing the wall from both air and water. Weatherproofing on the other hand means applying a protection layer that tolerates water and dries naturally, it is breathable.
- The lower part of the wall needs particular attention and treatment to prevent stagnating or splashing rainwater to damage the wall. To this effect, a rainwater flashing built in fully waterproof material (cement-based waterproof, bitumous waterproof, stone, treated metal) needs to be installed with a minimum height of 30 cm.
- In order to avoid rainwater stagnating at the foot of the wall, the ground should always be built with a slight slope directing the water away from the wall.



墙体返潮处理
RISING DAMP TREATMENT



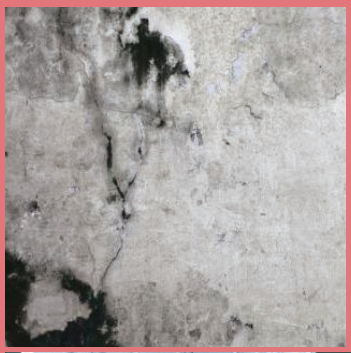
Injection chemical dampproof course

Rising damp is a typical problem in old houses because the foundations were not properly waterproofed and no foundation drainage was built, or because no damp-proof courses were installed in the wall. Simply plastering the surface of a damp wall will not resolve the problem. Water and alkalis from the ground naturally rise within the wall itself and thus create damege from the inside. The best solutions is to rebuild a horizontal damp-proof course by injecting a waterproof chemical at the base of the existing wall.

- Damp plastering and renders need to be removed and the wall cleaned
- 15cm above ground, holes are drilled every 10cm and air-cleaned so no dust remains
- A chemical damp-proof course in either liquid or cream form is then injected into the holes. Those chemicals low viscosity enables them to seep into the wall and rebuild a strong waterproof barrier that will stop rising damp from reaching upward
- A water and alkali resistant plaster can then be applied again on top of the drilling holes before repainting and installing the floor plinths.

内墙典型问题
INTERIOR WALLS TYPICAL ISSUES

General damaging

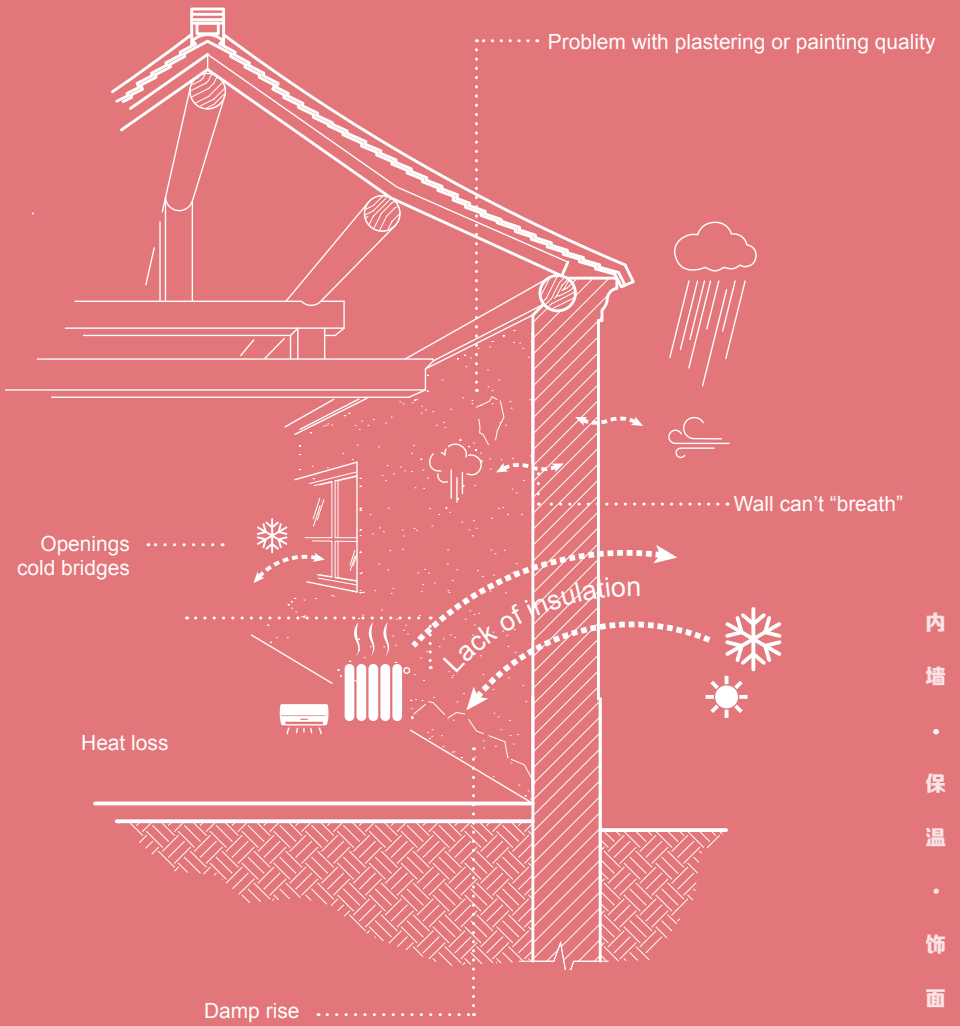


Falling plaster and paint peeling

Heat loss

内墙问题可能原因

INTERIOR WALLS ISSUES – POSSIBLE CAUSES



墙体饰面技巧
WALL FINISHES TIPS

Traditionnal stucco:
Lime-based stucco is a traditional plastering method that has been used in China and abroad for centuries. It is particularly well adapted to old brick wall refurbishment. It is strong, flexible, and “breathable”, meaning it absorbs and regulates humidity in the room and in the walls. This “breathability” results in a natural air quality regulation that is much more comfortable and healthy than typical industrial plastering. It also has a beautiful natural aesthetic quality and can be easily coloured with different types of natural pigments.

Lime stuccos have a lower carbon footprint than cement or other plasters and absorbs CO2 during the curing process. It is not particularly complicated to realize but needs a little bit more attention than typical plastering.

Paints tips:
Paints are a major source of indoor pollution as they continue to release solvents and Volatile Organic Compounds (VOCs) even long after they have dried. Those compounds can have a particularly harmful effect on the environment and on your health. It is thus advised to choose more sustainable and healthier products such as *zero-VOC* or *low-VOC acrylics* (water-based paints) or *natural paints* that use natural ingredients such as linseed or citrus oils and plant-derived solvents.

保温材料介绍
INTRODUCTION TO INSULATION MATERIALS

With Beijing extreme temperatures, it is absolutely essential to properly insulate your home. It will greatly increase your comfort and quality of life both in winter and summer, as well as drastically reduce your heating and cooling energy consumption. Altogether, home insulation is one of the most efficient way to help reduce our carbon footprint, and tackle our city's air pollution problem. It represents a rather small investment that will be quickly recovered with the amount of money you'll save on your electricity bills.

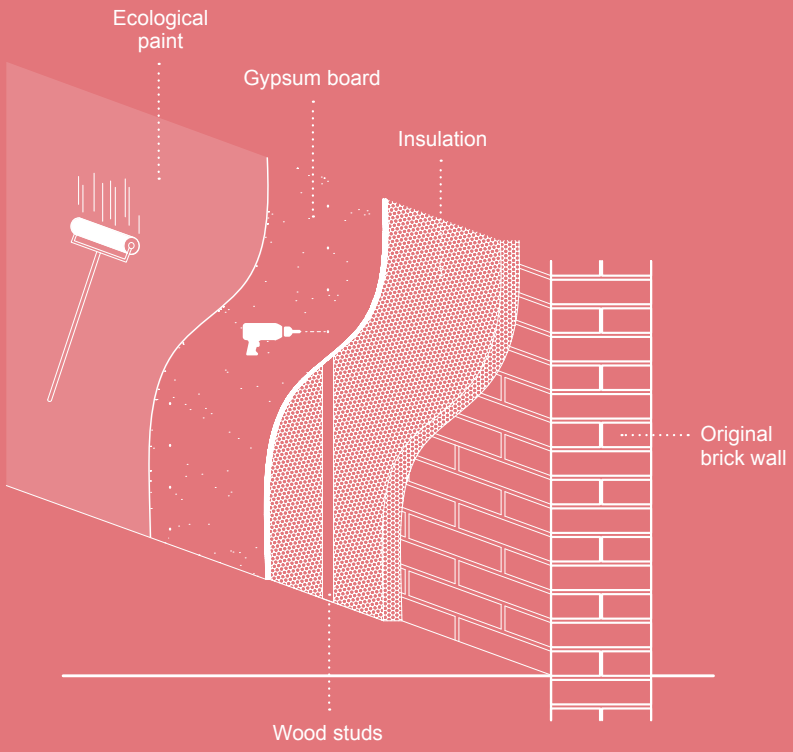
A common misunderstanding is to think a wall is insulating if it is sturdy and very dense. On the contrary, air = insulation, thus the insulation efficiency of materials directly depends on the amount of air they "trap inside". A wall's insulation efficiency is called *Thermal resistance (Rvalue)* and depends on the properties of the material used and thier thicknesses. A rather good thermal resistance for a cold place like Beijing would be to reach a Rvalue=3.

Insulation materials comparison for a wall of Rvalue=3 (same insulation capacity)

Necessary thickness	Insulation Material	Insulation Efficiency	Cost	Environmental impact
7cm	Rigid Polyurethane (PU)	+ + +	$$$	
9cm	Extruded polystyrene (XPS)	+ +	$$	
10cm	Glasswool	+ +	$$	
11cm	Cellulose	+ +	$$	
18cm	Hemp-lime	+	$	
66 cm	Wood			
225 cm	Bricks			

内墙体保温做法1

INTERIOR INSULATED WALL #1



内墙·保温·饰面

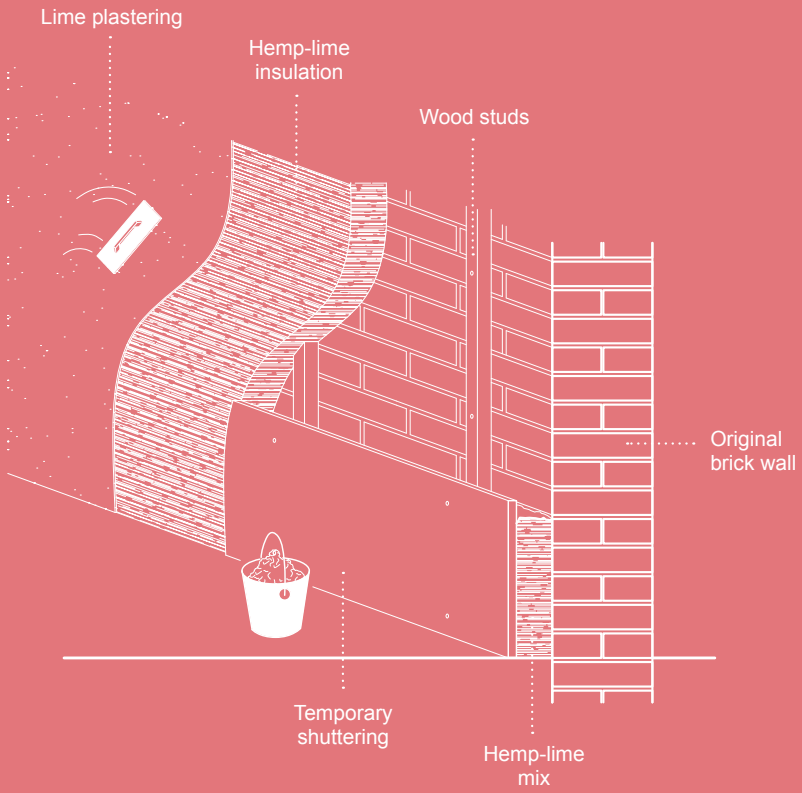
Interior insulation + gypsum boards:

- Make sure the original brick wall is healthy and doesn't have water infiltration. If it is the case, you should treat it before building the insulation complex (e.g fix possible leakages or treat rising damp with a chemical injection)
- Mechanically fix vertical wood studs to the wall at 60 cm interval with the thickness of the insulation material you wish to use (e.g 9cm XPS).
- Install the insulation material between the wood studs (beware, softer materials need further fixing if you don't want them to shrink downwards)
- Fix good quality gypsum panels with good vapour resistance directly on the wood studs, fill screw holes and board slots with plaster filler, and sand down flat
- Paint, using a low-VOC acrylic or a natural paint the new interior gypsum boards wall in any colour you wish

Note : If you also insulate your ceiling and/or floor, try to connectthe wall, ceiling, and floor insulation without gaps. This continuous insulation will permit to greatly reduce heat losses or what we call cold bridges (insulation gaps = hot air escape).

内墙体保温做法2

INTERIOR INSULATED WALL #2



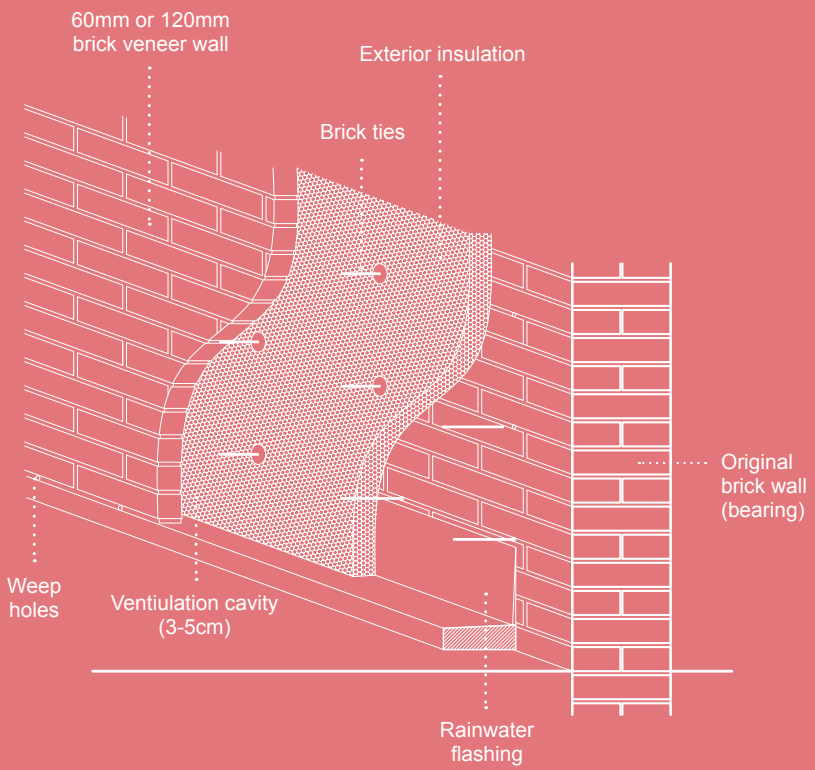
Hemp-lime and lime plaster insulated wall:

- Make sure the original brick wall is healthy and doesn't have water infiltration. If it is the case, you should treat it before building the insulation complex (e.g fix possible leakages or treat rising damp with a chemical injection)
- Mechanically fix vertical wood studs to the wall at 60 cm interval. Use those wood studs to fix a temporary shutter permitting the building up of the hemp-lime insulation
- Because of its causticity, proper protection is needed when working with lime (mask / glass / long sleeves gloves)
- Mix hydraulic lime, hemp shivs, and water following the manufacturer prescriptions and slowly fill and compact the mix in the shuttering by hand. Once the first shuttering board is filled up, fix the second one on top of it and fill it with the hemp-lime mix. work your way up the wall in this manner until the whole wall is done.
- Ensure good ventilation and let the wall dry for at least 10 days
- With a floater, apply 2 coats of 3mm each of a lime plaster consisting of lime, sand, and water, as well as natural pigments if you wish to have a specific colour. It is traditional in China to add hemp fibres to the mix ensuring an even better cohesion of the lime plaster.

外墙体保温做法
EXTERIOR INSULATED WALL

Insulated exterior brick veneer wall:

- If the space permits it, is recommended to build a ventilated brick veneer wall utilizing real 120mm or 60mm Beijing grey bricks instead of 10mm decorative brick-like claddings that we see being used a lot recently. The fake bricks veneers don't allow the wall to properly breath and will never give you the desired aesthetic quality of traditional walls
- Mechanically fix rigid insulation panels specially made for exterior uses (e.g XPS) to the original wall.
- Fix the brick ties directly onto this insulation all the way through the structural brick wall and leave a 50mm air ventilation gap between the insulation and the new "one brick" veneer wall
- A water flashing and weep holes need to be placed on the lower part of the wall to avoid water stagnation and to guarantee proper ventilation.
- It is recommended to apply a transparent brick sealer on the finished veneer to ensure a longer lasting wall



项

坡屋顶典型问题
SLOPED ROOFS TYPICAL ISSUES

Disrepaired roof

Heat loss

Eaves damages

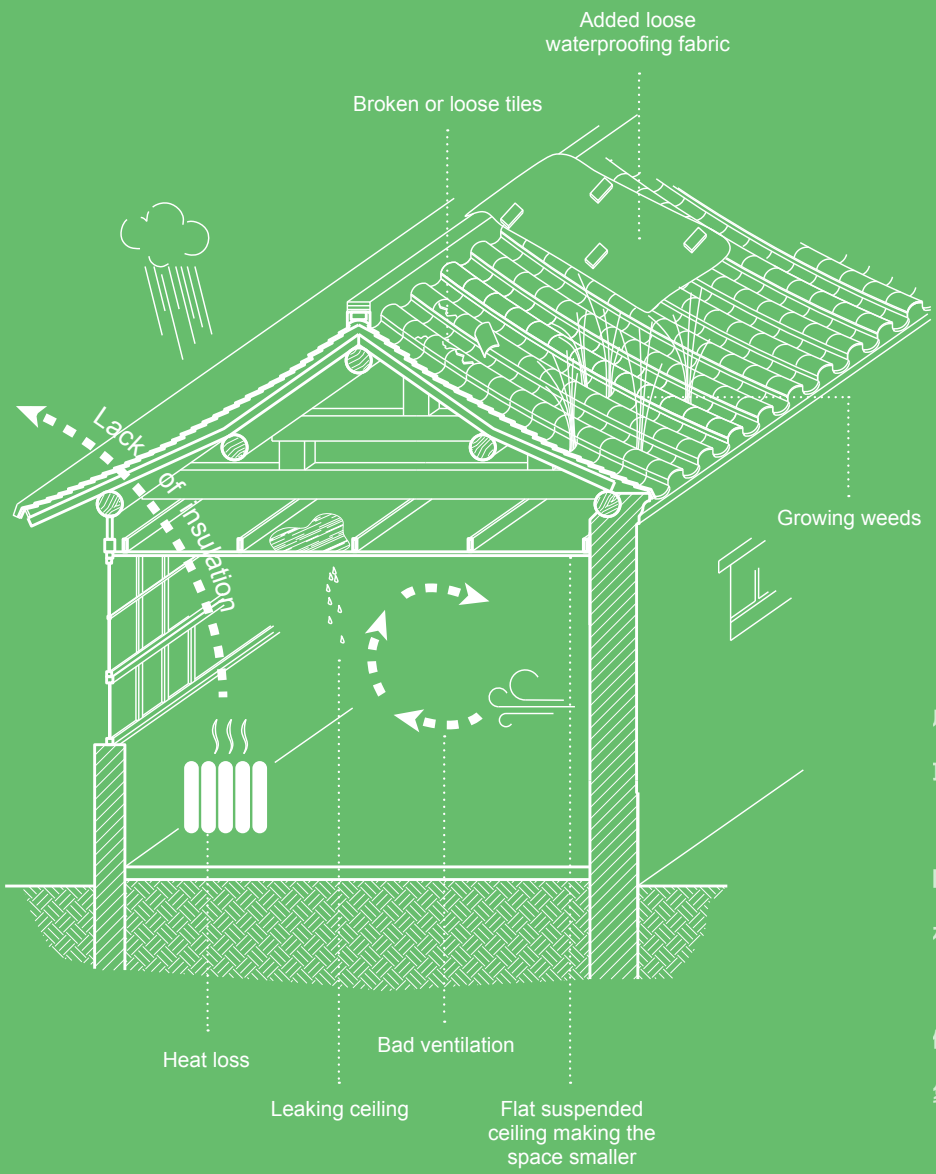
Patch-ups

Leakages

Drainage issues

坡屋顶问题可能原因

SLOPED ROOFS ISSUES – POSSIBLE CAUSES

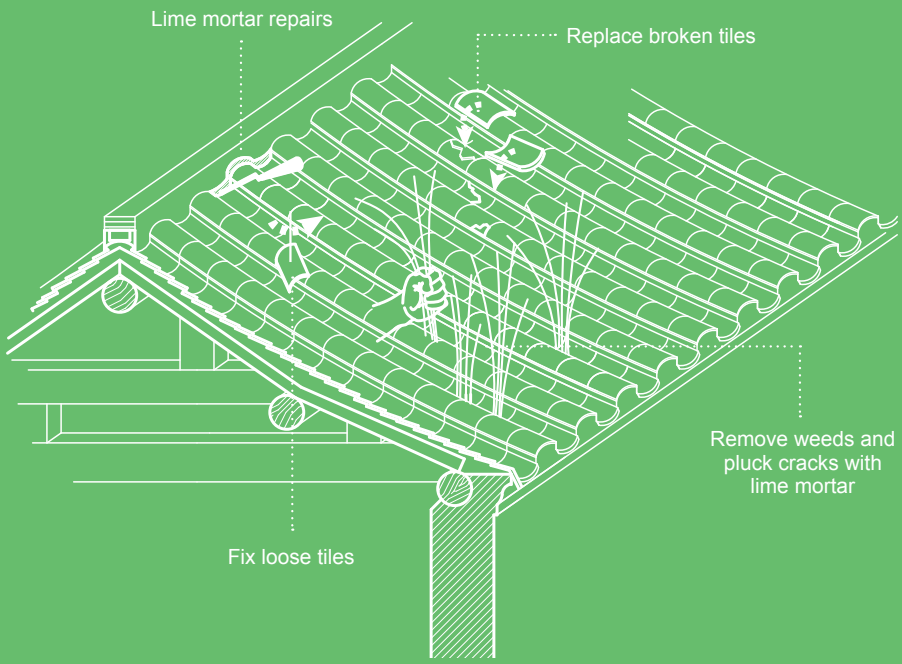


坡屋顶基本修复
SLOPED ROOFS BASIC REPAIRS

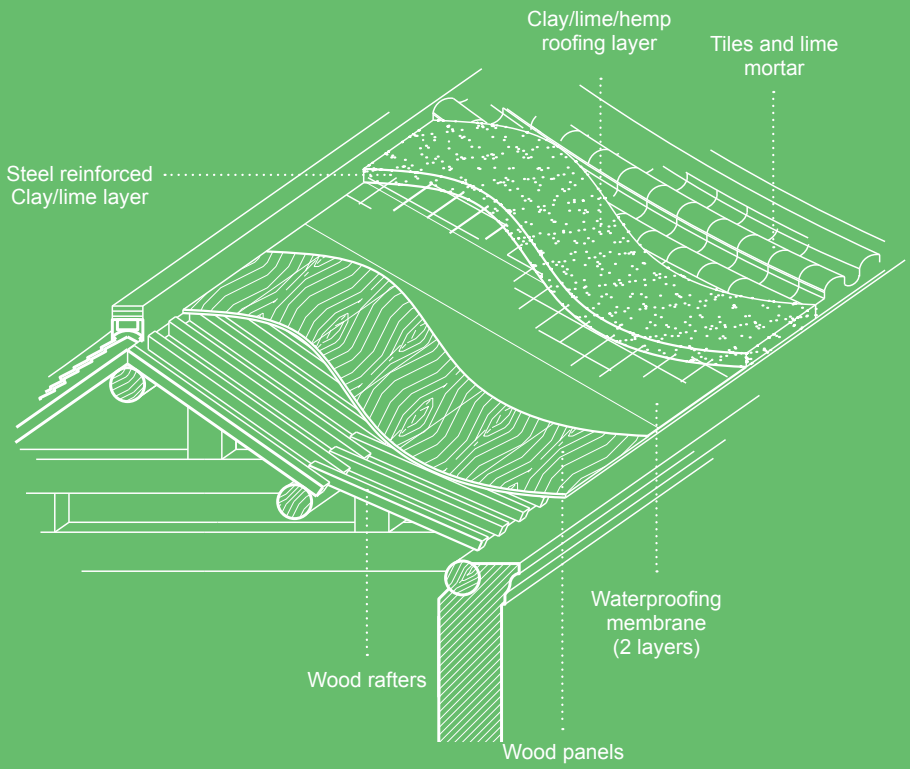
Seasonal maintenance:

One of the most common issues in hutong houses is roof leakages and water infiltrations. If the problem is not tackled immediately, it will become more and more serious, difficult, and costly to repair. It is recommended, particularly in old Beijing houses, to do a basic roof maintenance each year before the rainy season and perform small repairs if necessary.

- Remove weeds and plants that took roots in the roof, destabilized the tiles and created potential rainwater infiltration routes.
- Replace missing, loose, or broken tiles and check that no problem occured on the roof ridge, roof eaves, edge tiles, and places where the roof is in contact with neighboring walls or other elements.
- Inspect the tile fixing mortar for cracks or damages and repair if necessary with traditional waterproof roof lime mortar (madaohui 麻刀灰).
- Clean the roof of its dust, loose objects or tree leaves so that the rainwater flow isn't disturbed by obstacles (pay special attention that gutters and drains are not blocked by mud or tree leaves)
- Avoid as much as possible adding Tar or plastic sheets on top of your tile roofs. It might hide and fix your problem temporarily but won't resolve the issues. Those temporary fix can also be dangerous and not so cost effective since you'll have to change them or add a new layer on top of them almost every year.



坡屋顶整体换新
SLOPED ROOF RECONSTRUCTION

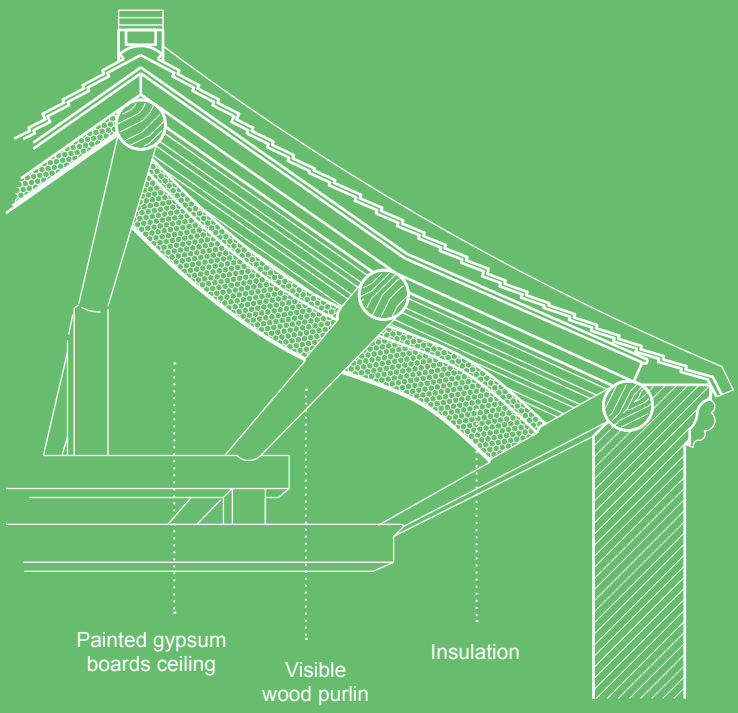


Roofing reconstruction

- When the roof is too damaged and simple repairs can't resolve the leakages problems anymore, you might want to consider entirely rebuilding the whole roofing complex. This is a job for professionals trained in traditional roofing construction. They should do a diagnostic of the existing roof before designing a specific project for you.
- Traditional techniques can be coupled with modern materials to ensure better waterproofing performances:
  - Fix wood panels mechanically on top of the existing wood rafters
  - Install a double layer of self-adhesive waterproofing
  - Build-up a traditional base clay-hemp-lime layer (nibei泥背) reinforced with a steel mesh
  - Lay and fix the tiles atop the traditional yellow clay bed layer (Huangni黄泥)
  - Seal the tiles, ridges and eaves with traditional roofing mortar (madaohui麻刀灰)

坡屋顶室内吊顶

SLOPED ROOF INTERIOR CEILING



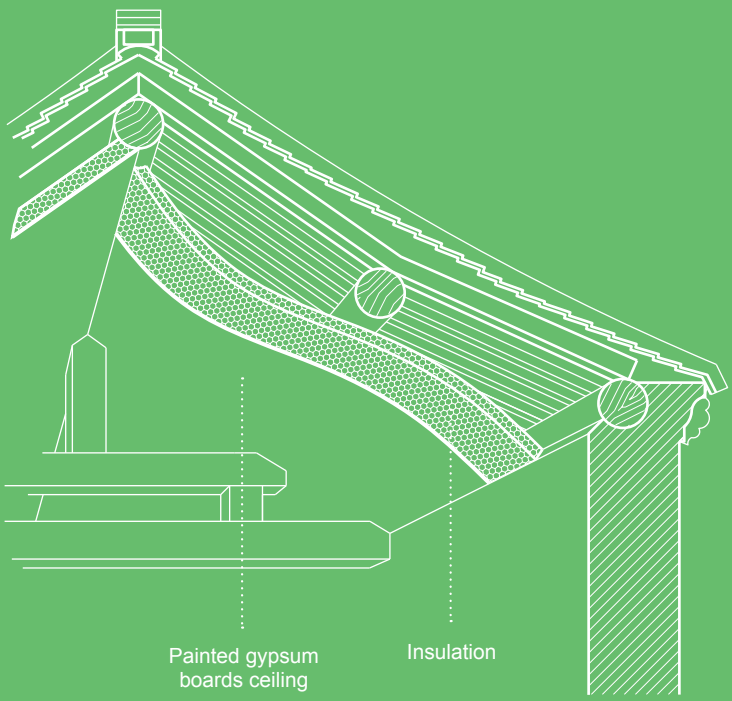
Insulated ceiling – between purlin beams

- It is recommended to build a sloped ceiling following the form of the house instead of a flat suspended ceiling because it maintains the generous volume of the house, exposes the wooden structure of the roof, retains the aesthetic experience of traditional houses, and ensures a better ventilation in the house.
- Ceilings need to have thicker insulation than walls because heat naturally goes up so most of the heat losses occur there. In Beijing, it is recommended to reach a thermal resistance of at least Rvalue= 3.5 for roofs which means that if you use rigid insulation panels such as XPS, you will need at least 12 to 15cm thickness (the thicker, the better)
- The insulation layer can be placed between the round roof beams called purlins so that the finished ceiling can expose and integrate them visually.
- The most commonly used ceiling material is gypsum panels. You might want to purchase panels with good vapour resistance, particularly if you use it in a kitchens or bathroom.
- Same as for the walls, try choosing a zero-VOC water-based or an ecological paint for the finishing touch to your ceiling.

Note: If you insulated your walls and floors as well, try to connect seamlessly the insulations to ensure that no cold bridge are created (places where heat can escape).

坡屋顶室内吊顶

SLOPED ROOF INTERIOR CEILING



Insulated ceiling – Hidden purlin beams

- It is recommended to build a sloped ceiling following the form of the house instead of a flat suspended ceiling because it maintains the generous volume of the house, exposes the wooden structure of the roof, retains the aesthetic experience of traditional houses, and ensures a better ventilation in the house.
- Ceilings need to have thicker insulation than walls because heat naturally goes up so most of the heat losses occur there. In Beijing, it is recommended to reach a thermal resistance of at least Rvalue= 3.5 for roofs which means that if you use rigid insulation panels such as XPS, you will need at least 12 to 15cm thickness (the thicker, the better)
- The insulation layer can be placed under the round roof beams (purlins) so that the final ceiling appears as a smooth surface only interupted by the beautiful typical Beijing transversal beams.
- The most commonly used ceiling material is gypsum panels. You might want to purchase panels with good vapour resistance, particularly if you use it in a kitchens or bathroom.
- If possible, try useing zero-VOC water-based or ecological paints for the finishing touch to your ceiling.

Note: If you insulated your walls and floors as well, try to connect seamlessly the insulations to ensure that no cold bridge are created (places where heat can escape).

平屋顶典型问题
FLAT ROOFS TYPICAL ISSUES

Water leakages

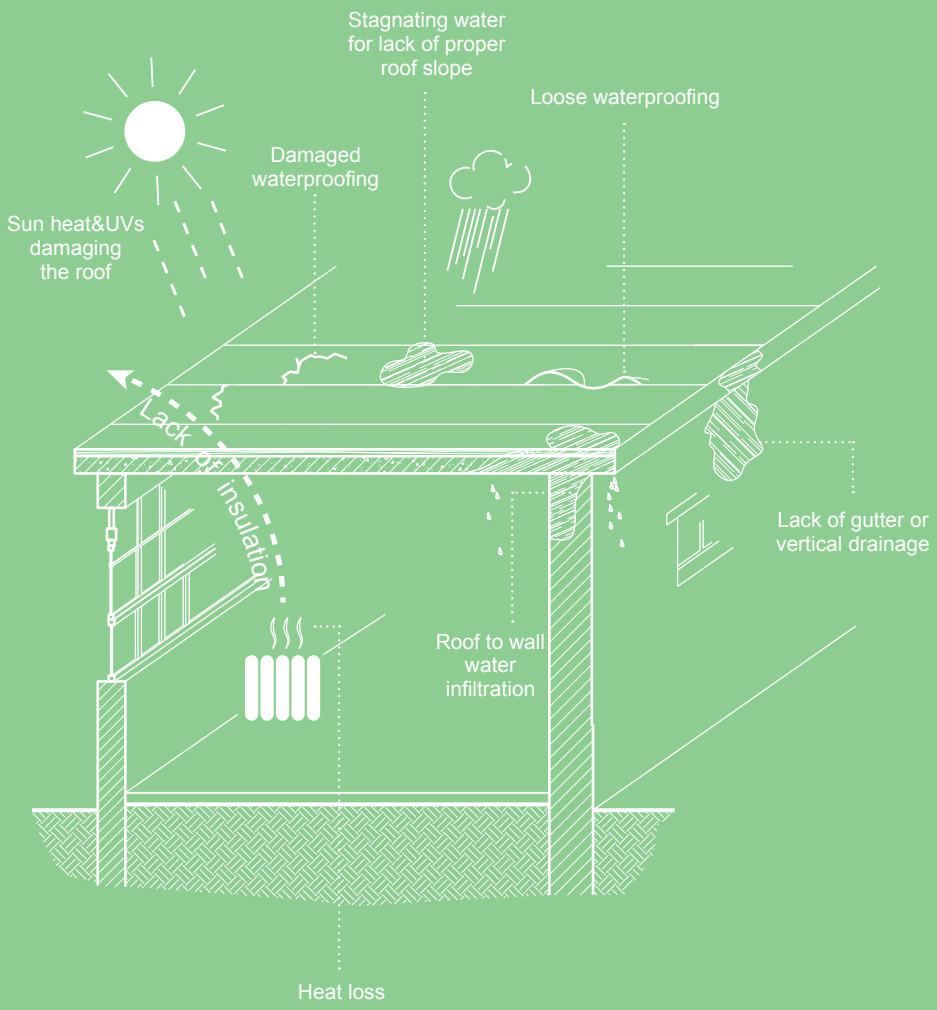
Low quality construction

Problematic edges

Water stagnation

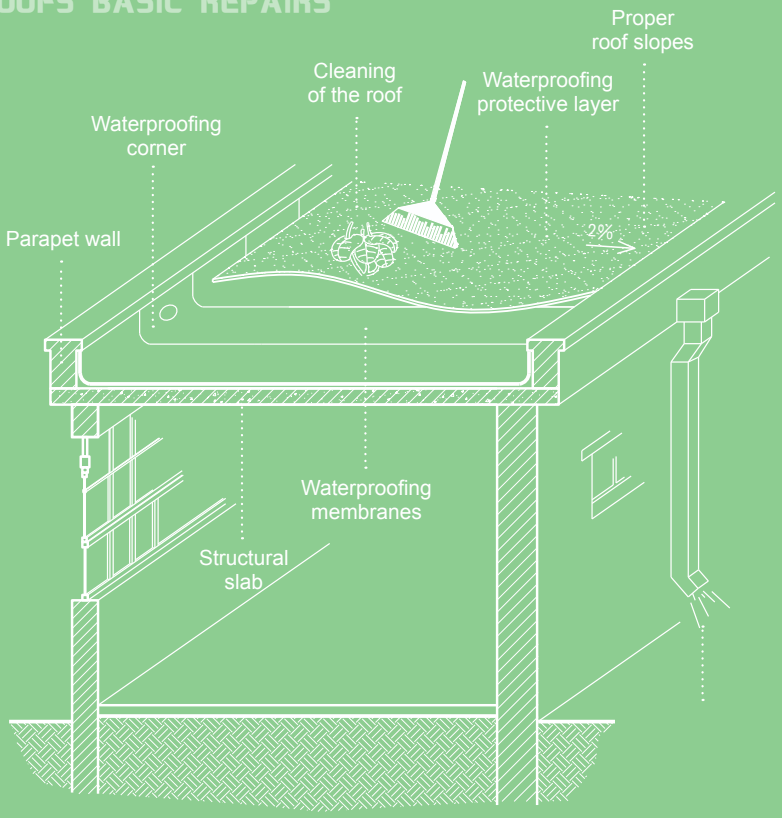
平屋顶问题可能原因

FLAT ROOFS ISSUES – POSSIBLE CAUSES



平屋顶基本修缮

FLAT ROOFS BASIC REPAIRS



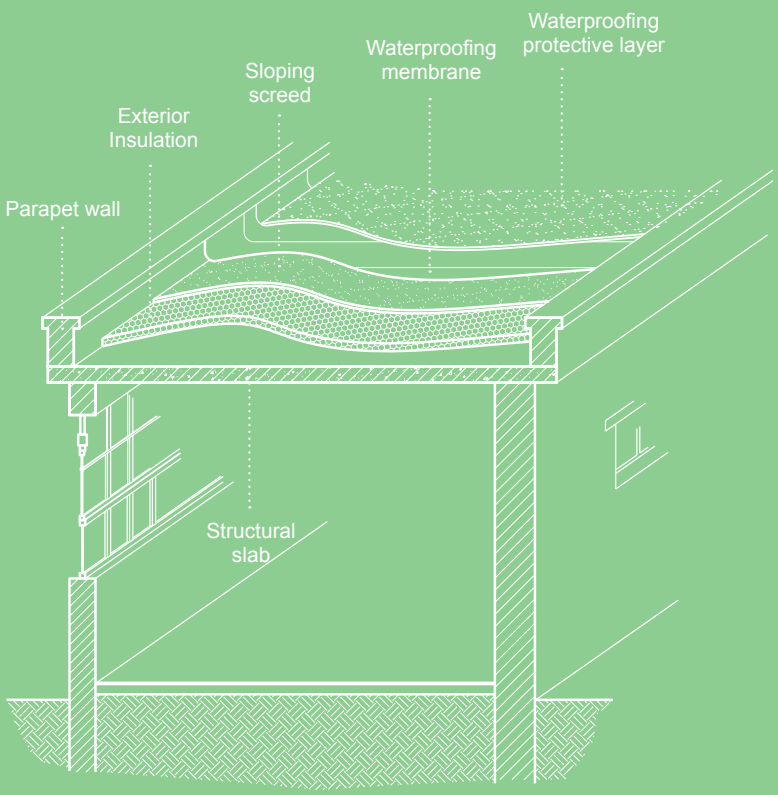
Basic repair and transformations

- One of the most common issues in hutong houses is roof leakages and water infiltrations. It is thus recommended to do a basic roof maintenance each year before the rainy season, small repairs if necessary and remove any debris that can prevent water flow.
- A flat roof won't leak if the waterproofing has properly been done and the rainwater can easily and quickly flow out of the roof. That means that roofs must have slight slopes (2% to 5%) that direct the water flow toward a vertical drainage system or a gutter.
- It is advised to build a parapet wall in order to form a fully waterproofed corner and help easily direct water towards the vertical drains.
- Make sure the existing waterproofing layer isn't damaged and that no leak occur If the waterproofing has a serious issue, either repair it by patching the problematic areas or entirely remove itand replace it with a new one.
- Typical roof waterproofing membranes are not designed to be exposed and will be damaged by temperatures shifts, humidity, and the sun's UVs rays. It is illogical, expensive and ineffective to add, as many do in the hutongs, a new layer of waterproofing every year because the one from the year before was damaged during the winter. Waterproofing membrane simply require a protection to be installed on top of them. Typical protection layers for flat roofs are outdoor floor tiles, cement screed or a simple thickness of pebbles.

平屋顶整体改造
FLAT ROOFS TRANSFORMATION

Exterior insulated roof

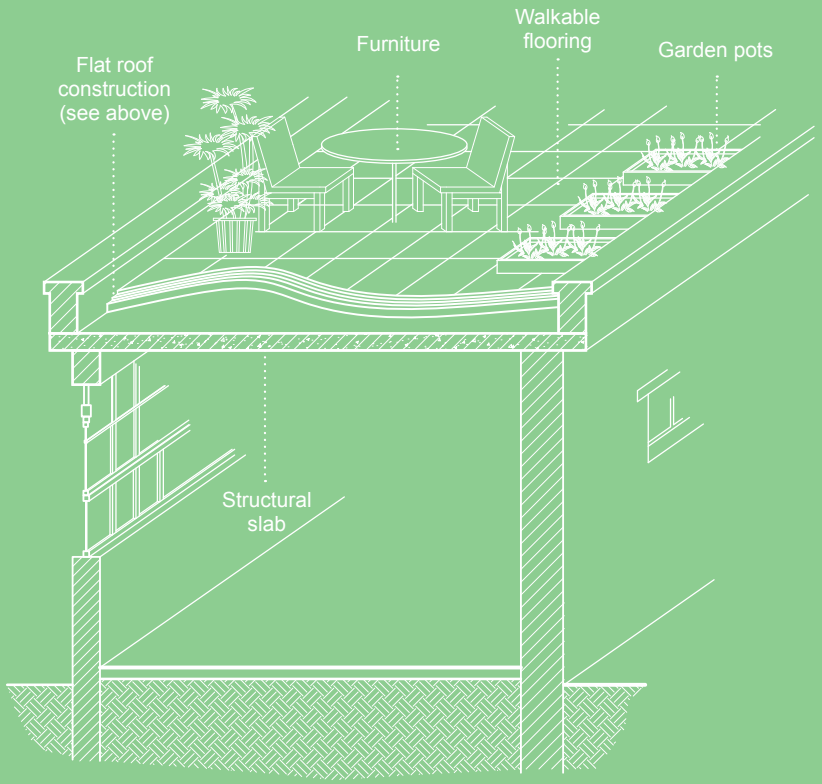
- If your house's insulation and its waterproofing are both problematic, you might want to consider entirely rebuilding your roofing complex with an added layer of insulation (select a rather high-density exterior rigid insulation materials specially made for roofs insulation)
- It is important for a flat roof to have a parapet wall so that water doesn't come out from every sides but is instead controlled and directed to one or two drains (vertical gutter pipes are recommended). The parapet also permits to form a sealed corner with the roof's waterproofing so that no leakage can occur.
- Once your parapet wall is built and your vertical drainages positions decided you can start building your roofing layer by layer: On top of the existing roof slab, add 15 to 20 cm rigid insulation panels, a sloping cement screed directing the water towards drainage points (minimum 2% slopes), a double layer of waterproofing, and a protective layer (pebbles or cement screed ensuring your waterproofing won't be damaged by the weather).



上人平屋顶
TERRACE ROOFS

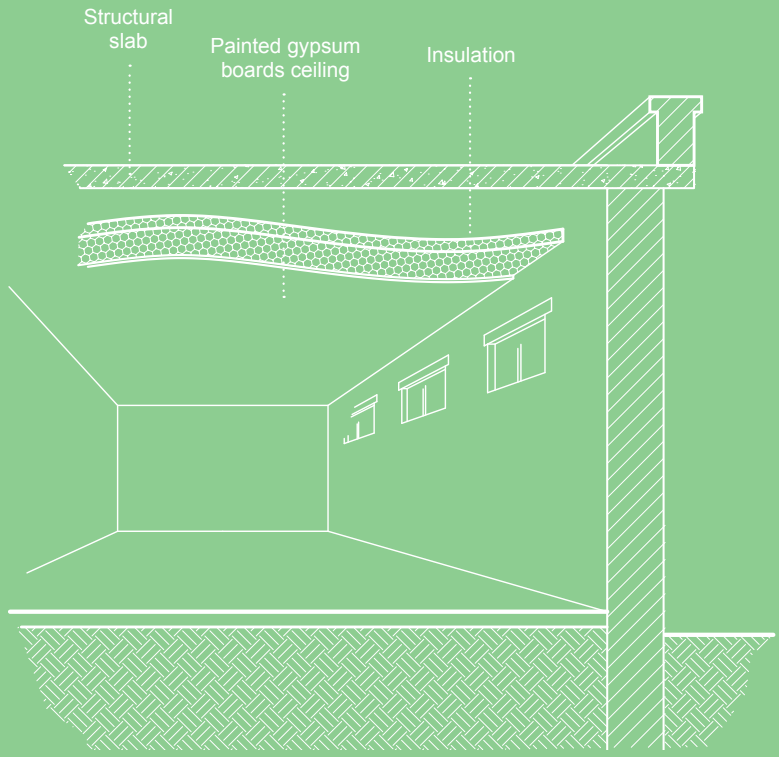
Terrace roof

- If your house's structure allows it and you have a safe vertical access, it is possible to transform your roof into an enjoyable outdoor terrace or even a small garden.
- Ensure that the waterproofing protective layer is made of walkable materials and that your parapet is high enough or equipped with a handrail to guarantee your and your family's safety.
- You can easily place outdoor furniture and flower or vegetable garden pots to make your roof an enjoyable and useful space in your home.
- It is also possible to consider building a "green roof" with a thick layer of planting soil. Many green roofs systems exist today on the market that are not very expensive or complicated to build. That said, it is important that you first verify that your house and your roof's slab can actually safely support the added weight of such installations. Secondly you will need the help of professionals to ensure the green roof and the rainwater system are properly designed.
- In addition to enriching your comfort and increasing your house's usages, green and terrace roofs can increase your thermal insulation capacity, help beautify the neighborhood, and reduce the city's heat island effect.



平屋顶室内吊顶

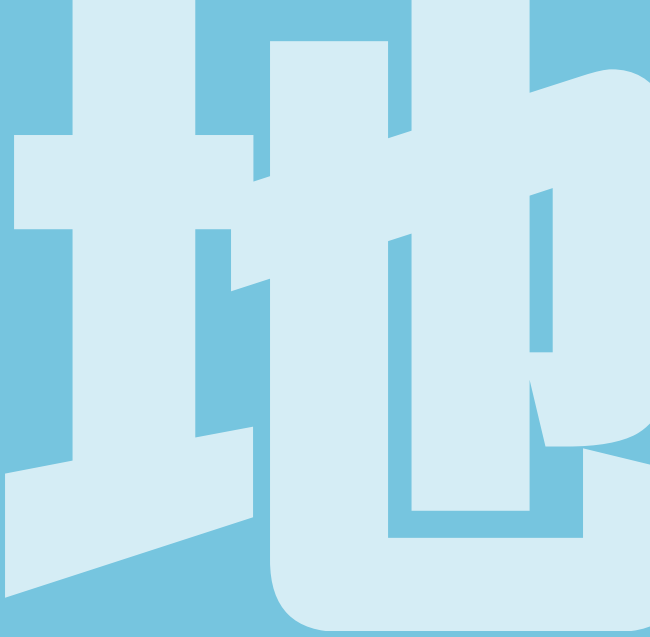
FLAT ROOFS INTERIOR CEILINGS



Indoor insulated suspended ceiling

- If your roof hasn't been insulated from the exterior, you can always choose the cheaper and easier solution to insulate directly from the inside.
- Ceilings need to have thicker insulation than walls because heat naturally goes up so most of the heat losses occur there. In Beijing, it is recommended to reach a thermal resistance of at least Rvalue= 3.5 for roofs which means that if you use rigid insulation panels such as XPS, you will need at least 12 to 15cm thickness (the thicker, the better)
- Start by building a typical suspended ceiling system (hangers-railings – gypsum panels) and add you chosen insulation material directly on top of the gypsum panels.
- The most commonly used ceiling material is gypsum panels. You might want to purchase panels with good vapour resistance, particularly if you use it in a kitchens or bathroom.
- If possible, try useing zero-VOC water-based or ecological paints for the finishing touch to your ceiling.

Note: If you insulated your walls and floors as well, try to connect seamlessly the insulations to ensure that no cold bridge are created (places where heat can escape).



地面典型问题
FLOORING TYPICAL ISSUES

Dilapidated flooring

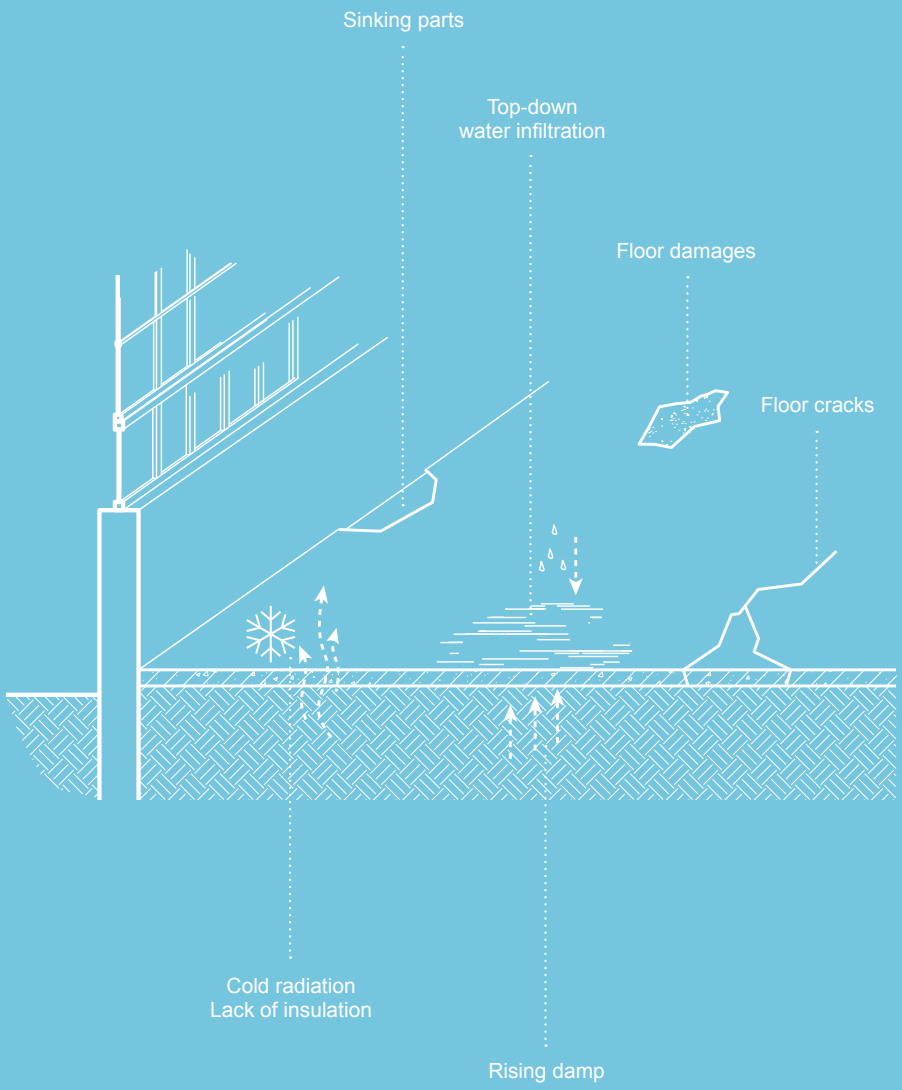
Water infiltrations

Cracking

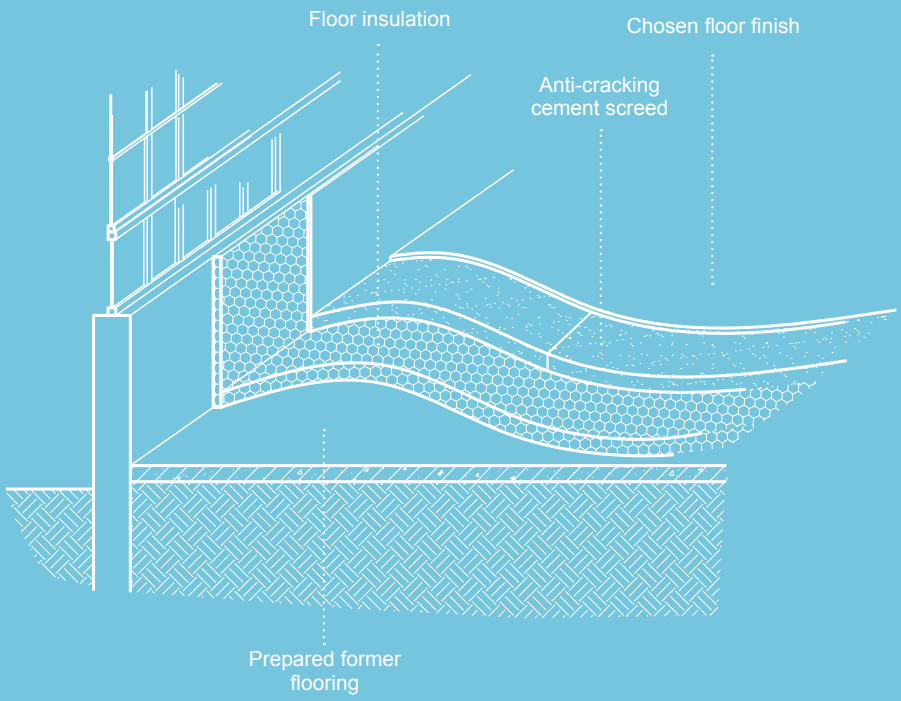
Heat loss

地面问题可能原因

FLOORING ISSUES – POSSIBLE CAUSES



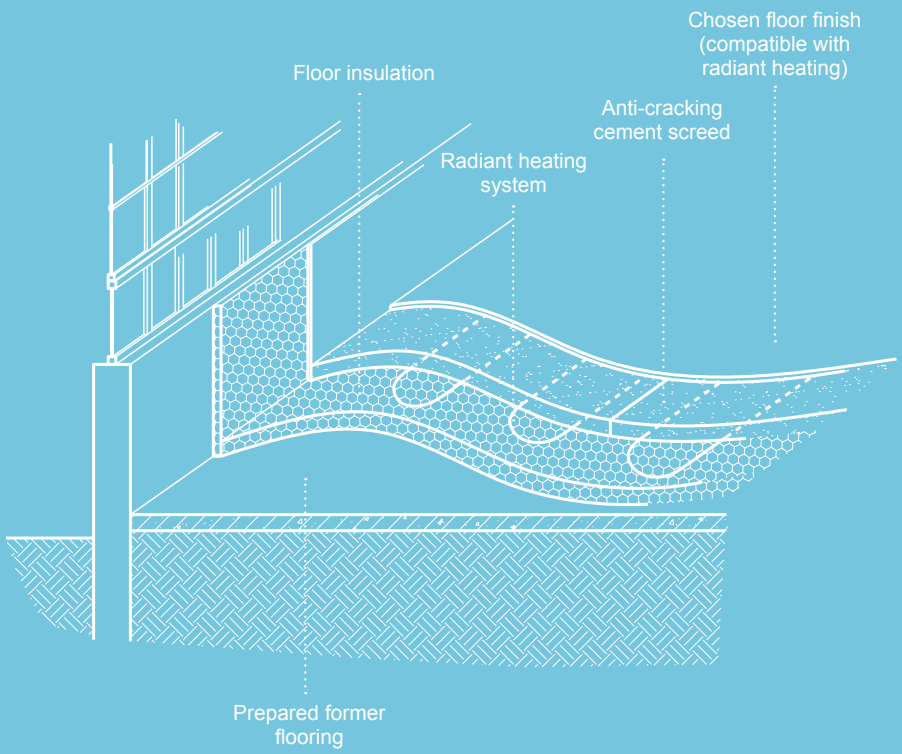
地面保温
INSULATED FLOORING



New floor on top of existing :

- If your existing floor is made of concrete or ceramic tiles, it is possible to build the new flooring system directly on top of it. If you had carpet, parquet, or synthetic floor finishes, they will first need to be removed in order to retrieve the concrete screed underneath.
- The floor radiates a lot of cold air in the house in winter. Insulating your floor will greatly reduce this phenomenon, help you save on your heating bills and increase your comfort.
- The new floor thus consists of 3 to 5 cm of rigid floor insulation (usually XPS) on top of which 5 to 8 cm of reinforced anti-cracking cement screed is laid. The screed needs to be realized by professionals as flat and robust as possible with good quality material and thorough mixing. An expansion joint needs to be placed every 10-15m2 so no major crack can occur.
- The screed needs a minimum of 20 days with good ventilation to stabilize, dry and release all its moist before the floor finish can be installed.
- Depending on the floor finish you choose to install, further preparations and flattening of the screed layer might be necessary.

地暖
RADIANT FLOOR HEATING



Radiant heating floor :

- After a thorough preparation of the subfloor and installation of the insulation layer, it is possible to consider installing a radiant floor heating. Two types of floor heating exist: electrical systems made of electrical cables heating at low temperature and water systems that are basically a network of water pipes through which a preheated water circulate. Electrical systems are simpler and more straightforward to install because they don't require a water boiler to be installed somewhere in the house.
- Radiant floor heatings are rather low consumption compare to typical heating systems, gives a constant very comfortable heat throughout the house, and have the big advantage of not taking any space at all (no more bulky electric convectors needed).
- The floor radiant heating system (electric or water) is directly installed in the screed layer above the insulation and necessitate at least 50mm of concrete around it to be efficient.
- A typical cement screed and floor finishes can be laid on top of it once the radiant system screed has properly cured. Beware when you select your flooring material that it is compatible with radiant floor heating systems.

地面材料建议
FLOORING MATERIALS TIPS

Ceramic tiles

$

Ceramic tiles flooring are a quite usual choice in the hutongs because easy to purchase, rather cheap, and easy to install. Nevertheless, their production is a rather polluting process and they are very difficult to recycle which makes them not very environmentally friendly. Although they are very easy and practical to maintain and clean, ceramics floors can also be very cold and not very comfortable floors (temperature and acoustics)

Natural stones

$$

Stone floors are a good alternative to artificial tiles but still have a big environmental impact as quarries are exhausting natural resources and the industry is quite polluting. Like ceramics, their easy maintenance and installations are still a plus but their cold temperature, while enjoyable in summer, can be difficult in winter.

Concrete floor

$

The structural slabs being made of concrete, it is possible to choose not to add another material on top of it but instead to prepare, polish and seal it to protect it from water and stains. A simple concrete slab preparation with further protective treatment is easy and rather cheap. A professionally-made polished concrete floor is on the other end a technically very challenging floor to build and can be extremely expensive.

Carpets

$$

Although new natural carpets are appearing on the market, most of them are entirely made of synthetic materials and thus rather polluting. Carpets also have the tendency to trap dust and bacteria and necessitate a lot of maintenance. Beijing being a rather dusty city, it might not be the best option for hutongs houses.

地面材料建议
FLOORING MATERIALS TIPS

How to select your flooring:

When choosing a flooring material for your home, several criteria might be worthwhile considering. First, each materials has a different environmental impact .Their production can be more or less polluting, their everyday usage can be more or less harmful to the environment, and their recyclability can be more or less difficult. Secondly, some are healthier for you and your family than others. A healthy flooring doesn't release chemicals in the air or trap dust and bacteria that can be harmful to your health. Finally, some require more maintenance than others, some are easier to install, and some are pricier $$. All propose different types of comfort and advantages that you'll need to consider.

Wood floors

$$
$$$

There are three different types of wood floors: hardwood floors, laminated hardwood floors, and laminated floors. This latter, although being the cheapest, is actually made of wood dust and plastics, of very low quality and full of chemical glues. It is thus best to either buy laminated hardwood floors or real hardwood floors. If properly harvested and responsibly produced hardwood floors are very sustainable and very comfortable but necessitate more care in maintenance than other floorings. Prefer oil or wax treatments instead of varnishes as they are more ecologically friendly and will retain a very pleasing natural aesthetic.

Bamboo floors

$$

Bamboo floors are a very good option because bamboo grow very quickly and, if the resources are managed properly, is considered a very sustainable flooring. It is nevertheless important to enquire on the the quantity and quality of glue contained in the flooring product, on where the raw materials were sourced and if it has been produced responsibly. As in the wood floor, bamboo will give you a very comfortable, very warm aesthetic.

PVC floors

$

PVC is a synthetic material produced in a rather polluting industry. Although very good quality pvc flooring can have a controlled ecological impact and new sustainable glues are appearing on the market, most of those types of flooring are known to be releasing chemical compounds even long after their installation.

Linoleum

$$$

Although it ressembles pvc, linoleum is not to be confused with pvc florring. It is a material entirely made of natural ingredients such as linseed oil, cork dust, tree resins, wood flour, pigments and ground limestone. It is thus environment friendly, comfortable and very easy to maintain.

木结构典型问题
WOOD STRUCTURE TYPICAL ISSUES

Structural issues

Wood cracking

Wood rotting (columns footing)

Wood rotting (wall column)

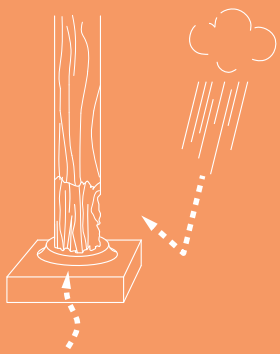
Exterior wood protection issues (peeling paint, lack of varnish /oil)

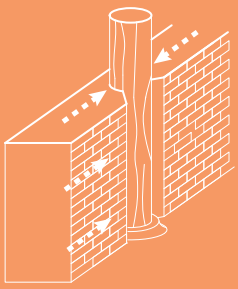
木结构问题可能原因

WOOD STRUCTURE ISSUES – POSSIBLE CAUSES

Wood columns base damages:

- Rising damp from the ground infiltrates the wood and slowly rots the column base
- Rainwater damages





Walls wood columns damages:

- Moist contained in the wall migrates into the wood column that slowly rots and become dangerously weak

Structural issues:

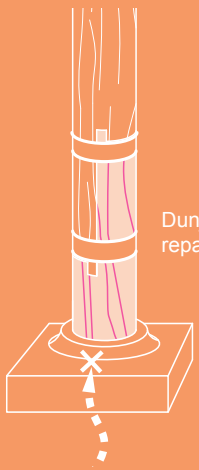
- Overall structural deformations
- Sinking columns and roof (foundations issues)
- Beams or columns large cracks

General wood damages and rotting:

- Protective paint pealing
- No protection (varnish, oil, paint)
- Wood ageing
- Insects damages

木结构评估和修复
WOOD STRUCTURE DIAGNOSTIC & REPAIR

If you notice any structural deformation (columns not straight or bulking, sinking beams, roof not straight, leaning structural frame), large cracks in beams or columns, or rotting wood elements, you should call a professional as soon as possible to do a structural diagnostic and propose repair solutions to you. Most of the damages in old wood structure comes from either ageing of the wood or water infiltration and rotting.



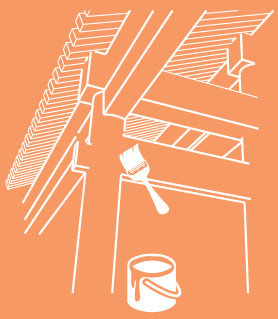
Dunjie repair

Columns

It is quite typical to notice rotting of the wood columns because water from either the wall or the soil is rising within the wood fibres.

You'll notice the columns hidden in the walls are the one most damaged by this phenomenon and also the most complicated to repair. After building a temporary structure holding the house in place and releasing pressure on this column, you'll have to entirely open-up the wall and liberate space around the columns to replace it with a waterproofed new column. A damp proof course between the column and the plinth stone it is resting upon ("zhudingshi" 柱顶石) is also necessary so that water doesn't rise in the wood.

Another typical issue is the rotting of the lower part of the front column that means damp is rising from the foundations and attacking the wood. It is possible to replace a portion of this column by what is called a "dunjie" 墩接 which is basically an embedded new wood piece connected with the former column with steel rings. Don't forget to place a damp proof course between the zhudingshi and the column. Beware, for safety reasons, only professionals are able to perform those types of structural repairs.



Repair and protect

Beams and rafters

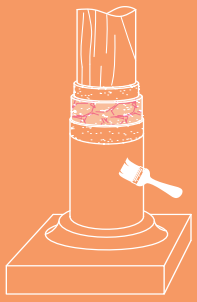
Cracking can occur when the wood beam is slowly drying over the years. A professional will be able to tell you if the cracking are structurally endangering the beam or not. It is possible to add steel rings around the beam to secure it further. Rotting can occur on the outdoor tip of the beam and typically on the outdoor rafters that carry the roof eaves. Those elements are typically protected with either oil based varnishes or the very typical traditional Beijing red plastering technique. If damaged, you should sand down the previous coats of paint or plastering, treat the rot or replace the element, and protect them again with oil or plaster (avoid varnishes).

木材保护技巧
WOOD PROTECTION TIPS

Beijing red

Traditional method to build up a typical red column or an outdoor red door is a rather complex assemblage of different layers called “2 plasters, 3 oils” (liang dao hui, san dao you). The plaster layers are made of ingredients such as lime, brick dust, Tung oil, and even pig blood and wheat flour. This hard skin protects and gives the smooth appearance to the final object, no wood is visible . Three layers of dyed oils are then applied to give the red colour and seal the column from weather damages. Today, most of the contractors won’t go through the trouble of using this traditional technique and will directly plaster an epoxy-based wood fillers, sand it smooth and paint red. This often results in cracking and slow disintegration of the finish.

Note: Beijing red is actually a Qing Dynasty technique that non of the previous dynasties were using. Older techniques are ones resembling techniques used in the south of China with exposed wood protected by dark colours oils.



Liang dao hui
San dao you

Oils, wax and varnishes

A variety of wood protective finishes with very different aspects and qualities are available today.

Varnishes are typically oil-based synthetic resins and contain solvents that are not very environment friendly and will have the tendency to yellow overtime. They are usually applied with a brush or sprayed on the wood, give a bit of a glossy effect and form a hard shell on the surface without penetrating the wood. Water-based varnishes are a good option as they are less toxic and usually have a more matte render.

Oils are for the most part entirely natural product derived from either linseed, teak, or Tung (Tung oil was traditionally used in China for centuries). Oils are penetrating and hardening within the wood, are very good and durable protection against water and rotting, and have a more natural look than varnishes. Some are clearer than others, some darker, and some have dyes added to them so it is possible to choose from a wide array of colours. Oils are applied, like wax, by rubbing them into the wood with a simple cloth.

Waxes such as beeswax or carnauba wax will protect the wood by sinking into the surface and have a very natural feeling that will even improve with age without colour changes. It is very ecological and easy to apply but will necessitate to be reapplied every once in a while.

门窗典型问题
WINDOWS TYPICAL ISSUES

Heat loss

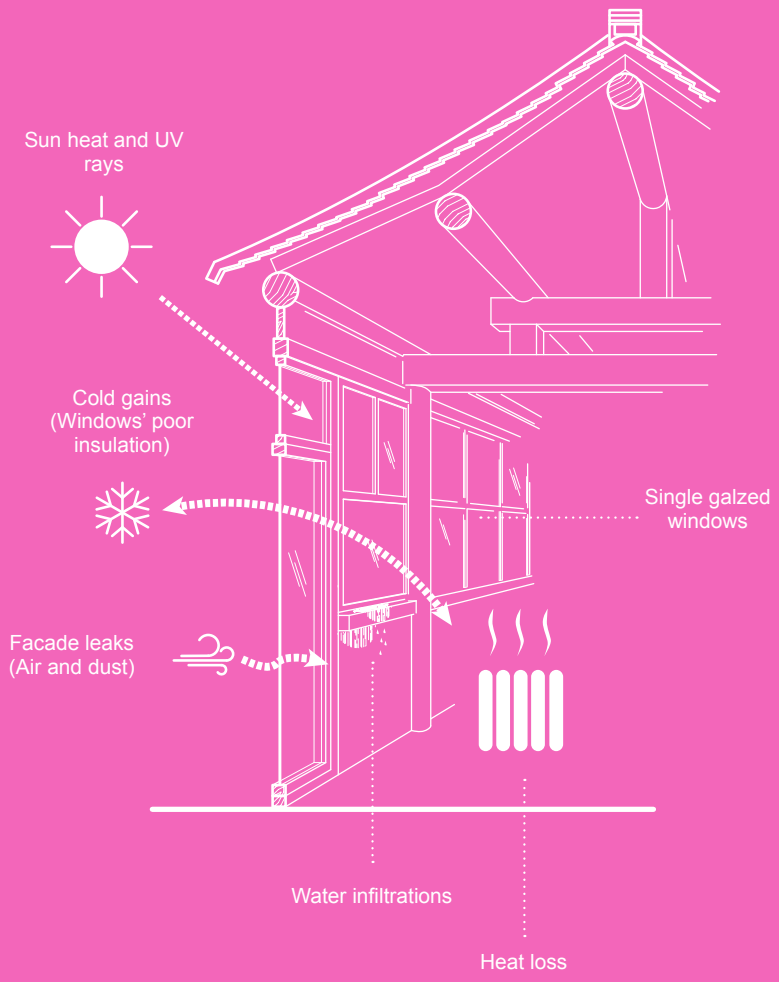
Air leakages

Water infiltrations

Wood damages

门窗问题可能原因

WINDOWS ISSUES – POSSIBLE CAUSES



门窗设计技巧
DOORS AND WINDOWS TIPS

Industrial or traditional?

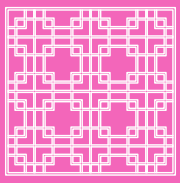
Exterior doors and windows have traditionally been built in wood with single glazing for the simple reason that they were realized by craftsmen and no other material or technology was available in the past. This feature highly contributes to the distinctive beauty and authentic character of hutong houses. Today a wide range of industrial products give the homeowner different choices with different advantages and costs but will greatly affect the aesthetic qualities of the house.

$	PVC windows	PVC windows and doors are very low cost but their production is very polluting, they have the tendency to deform, and are not very durable.
$$	Aluminium windows	Aluminium windows and doors are strong and durable but have a rather poor thermal capacity and aluminium production has a big environmental impact. They can be very well-made with good detailing ensure good operation but can also be quite expensive.
$$$	Wood windows (Industrial)	Industrially produced wood windows are not so easy to come by in China but more and more companies are developing very well-made products. They are comparatively more ecologically friendly and have good thermal performance but are also more expensive than other options.
$	Wood windows (Handmade)	A local carpenter is capable to build simple customized wood frame windows and doors that, depending on the quality of execution and the details, can have good thermal properties. The quality of the openable elements might not be able to match industrially produced windows and doors but it is a very viable solution with rather low costs.

Preserving the know-hows

It is important to consider that there is a very long tradition of wooden window-making in China. This impressive craft is not only an aesthetic delight from the past but also a know-how that it seems critical to maintain and support. It might be much more practical to choose and buy a product on a catalogue but the impact on a larger scale would be the loss of traditions and the impossibility of finding ways to extend this knowledge with modern technologies.

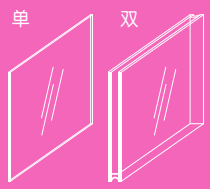
For this reason, this handbook choses to only presents ways of upgrading your traditional handmade wooden windows instead of changing them with industrial products



门窗设计技巧
DOOR AND WINDOWS TIPS

Insulation and glass tips

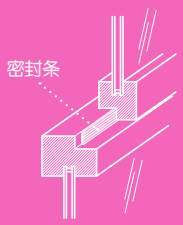
Windows and doors are elements that permit natural light and heat to enter your home while protecting you from the sometimes harsh weather outside. A lot of the heat we manage to gather inside in winter unfortunately escapes or leaks through those windows either because the glass is not well insulated (single-glazing), because the window frames are made of a material that conducts and radiates cold, or because the facade is not sealed properly and the heat seeps and escapes through the hundreds of small gaps. In winter, although the house is constantly cold, heating bills are high. In summer, the space is so hot we consume even more electricity for air conditioning. The resulting environment impact of this waste of energy is enormous. Good window design, good choices of materials, and smart behaviours can help tackle many of those issues;



Glass

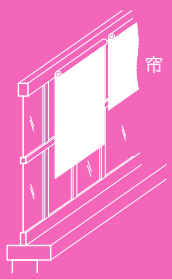
Double or triple glazing are multiple panes of glass with a cavity trapped in between. This cavity can be “filled” with different types of gas that will give you different thermal insulation performances (i.e air + / vacuum ++ / argon gas +++). The choice of a good double-glazing will greatly change the cold and heat exchange of the windows.

Different types of glasses will also affect how much of the sun heat crosses the window. For example, a Low-E glass can help reduce heat gain of up to 50%



Sealing

Whether we’re talking about fixed window panes or operable windows, particular attention needs to be taken on sealing all the gaps. A variety of sealing strips, mainly made of rubber, can be used to make sure no air can seep through the window frames. Wherever a window or door can open, the detailed design of the elements guaranteeing that no air can pass is paramount.

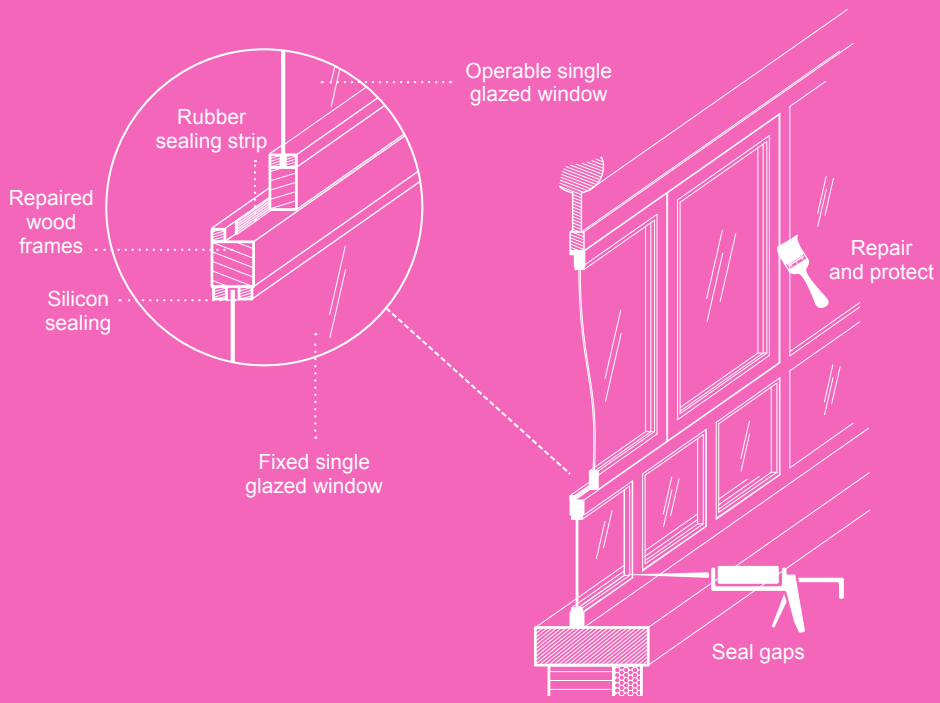


Mobile shading

Shading apparatus can be installed so that in summer one can control the amount of light and heat entering the house. As a rule, it is better to stop or dim the light before it reaches the windows meaning the shading apparatus will be more effective if installed outside. Planting and particularly trees in the courtyard are also perfect shading elements since their canopy will protect you from the sun in summer and let light heat-up your home in winter when they lose their leaves.

单层玻璃窗快速修复

SINGLE-GLAZING WINDOWS QUICK FIX



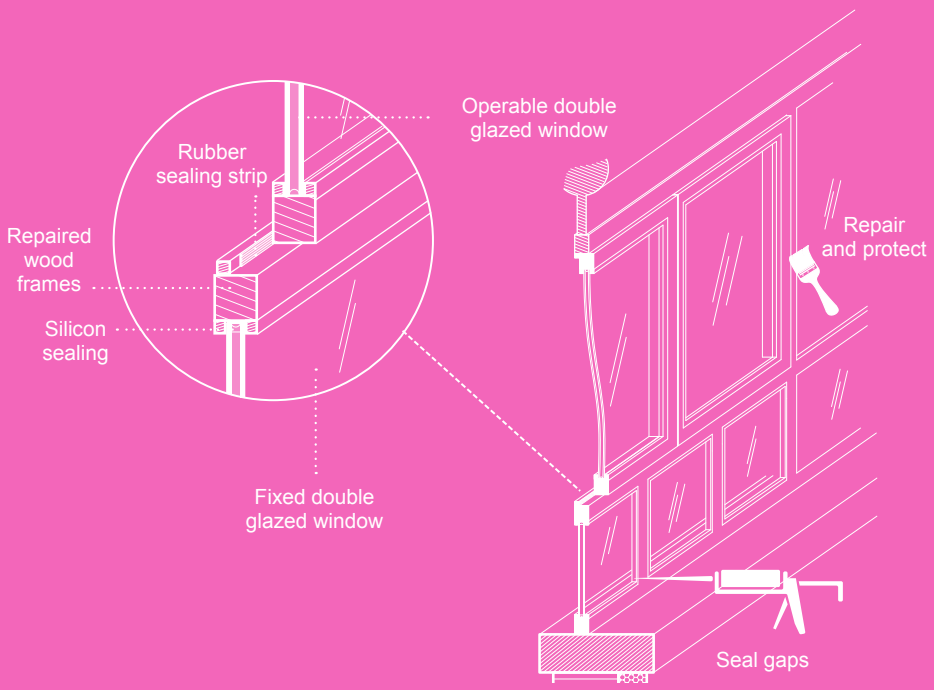
Single glazing windows

- Most of the hutongs houses are only equipped with single glazing windows that have extremely low insulation properties. Nevertheless, if you're not ready to entirely redo your facade, few quick fixes can help you improve your comfort.
- If the wooden windows frames are damaged and have cracks, you might need to sand them down, fill the cracks with a wood filler and protect them again with the finish of your choice (oils, wax, varnish, paint)
- If the joints between the wood frames and the glass panes are damaged, you should repair them with a basic wood filler paste to ensure no leak occur. Pluck any holes, big or small, like for example where electrical wires or AC pipes enter the house.
- Most heat loss occur around the operable window or doors because a gap is necessary to open and close with ease those elements and the wood has the tendency to deform with temperatures and humidity changes. Purchase and install self-adhesive sealing rubber strips all around those elements to ensure proper sealing when they are closed.
- Install door brushes to avoid cold air coming from under the doors.
- Some people install low cost temporary plastic membranes in winter and dismount them in spring. It is a bit of a short-term bricolage solution and will damage your window frames over the years but can help keeping the cold out.
- Thick curtains might also help preserve heat during the night

双层玻璃窗升级
DOUBLE-GLAZING WINDOWS UPGRADE

Upgrade your windows

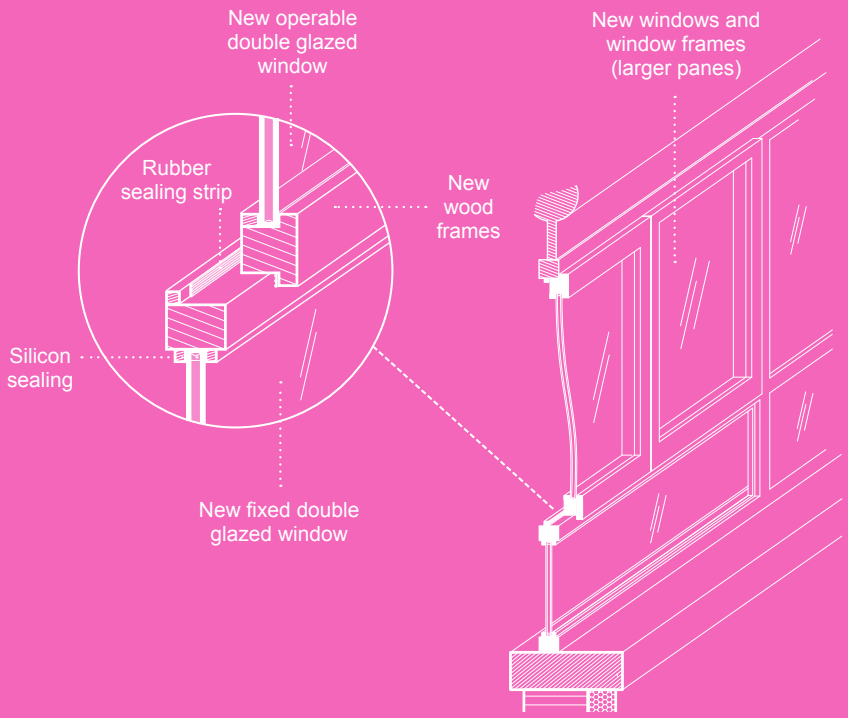
- The first step is to check if the existing wood frames are wide enough to install a double-glazing unit. If your frames are thinner than 50mm it will be possible but much harder to replace your single-glazing with a double-glazing.
- Ask a glass contractor to come and measure on-site all the double-glazing units that will need to be prefabricated. Typical thicknesses have a 9mm, 12mm or 15mm cavity with 6 to 8mm glass panes on either side. The bigger the cavity, the more insulating it will be (also depending on what gas it is filled with). Consider also the possibility of asking for a Low-E glass.
- Dismount the single-glazing glass panes by carefully removing the peripheral small wood studs holding them in place. Clean thoroughly all your wood frames and if necessary repair and redo the protection finish (oil,varnish,or paint).
- When reinstalling the double-glazing, apply silicone or sealing strips in the corners between the glass and the wood studs on both sides to make sure there is no air gaps.
- Most Beijing hutong houses have a large amount of fixed glass that shouldn't be difficult to replace or to seal properly. Particular attention needs to be taken on operable windows and doors. Repair frames, minimize as much as possible air leaks, add rubber sealing strips and door brushes wherever necessary, and make sure the window closes properly and with a good locking system to hold it tightly shut without large gaps.



新双层玻璃木窗
NEW WOODEN DOUBLE-GLAZING WINDOWS

Handmade wood windows

- Typical hutong houses window facades are not structural so it is very possible to entirely demolish them in order to rebuild anew. Still, it is a big job that might take a bit of time and for which a professional carpenter is necessary.
- Once the former wooden facade has been dismantled, check that the window lower wall is in good shape and has no water infiltration issues (i.e rising damp or rainwater exposure issues). If necessary, entirely rebuild this wall with traditional brick masonry, proper damp-proof course, an interior or exterior insulation to avoid heat losses.
- Select good quality wood that has been dried thoroughly and that is hard enough so that big deformations won't occur easily. Beware of the wood frame thicknesses as you will need enough space to easily install the double-glazing units (usually 80x40mm wood studs are a good choice).
- Once the main wood frame structure has been built, protect your wood with your choice of finishes (oils, wax, varnish or paint).
- Install the window glass panes making sure there's no air gaps (use silicone and sealing rubber strips)
- Again, the tricky parts are the ones that have the capacity of opening and closing. Discuss the details of those openings with the carpenter to guarantee that they will be practical to use (good quality hardware) while guaranteeing proper sealing of the gaps (overlapping joinery).



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術

采暖原则
HEATING PRINCIPLES

Electric convectors

电费 $$$$

舒适度

Electric standard convectors, although very cheap to purchase, unfortunately utilize huge amounts of electricity. They also have the tendency to have a very limited heating range as you'll notice that only a small area around them is actually comfortable. They are the least sustainable option and the one that will end up giving you sky-high electricity bills for a house that might still always feel cold.

Electric storage heaters

电费 $

舒适度

Beijing hutong residents have access to subsidies to install electric storage heaters. The principle is that a series of specifically produced bricks inside the heater have the capacity of accumulating and storing heat during the night. During the day, those bricks slowly release or radiate a constant warmth in the house. Two advantages: night electricity is cheaper that day electricity and the heater is actually consuming power only 6 to 8 hours a day which makes it a very sustainable heating system with low electrical bills.

Electric floor radiant heating

电费 $$

舒适度

Electric floor radiant heating is also a low consumption option that transforms all your floor areas into one large low temperature heater. Since heat is distributed much more homogeneously, it doesn't need to be very hot and gives an extremely comfortable warmth in the whole house without consuming much electricity or taking any space that is sometimes an issue in small houses. It's easier to install than water floor radiant heating systems and doesn't require further equipment. The downside is that the installation of radiant heating requires to entirely redo and raise your floor and can be quite expensive.

Water heating

电费 $$

舒适度

Water heaters are still an option but it requires a rather powerful water boiler that will consume large amounts of electricity. You'll also need to maintain the system and make sure water doesn't freeze in the pipes or the heaters if for example you have an electricity break. Contrary to storage heaters, water heaters need continuous heating in order to be effective, meaning your electricity bills might end up being rather high. Water floor radiant heating will give you a much more comfortable environment with lower consumption than radiators but still necessitate a large and powerful boiler to function.

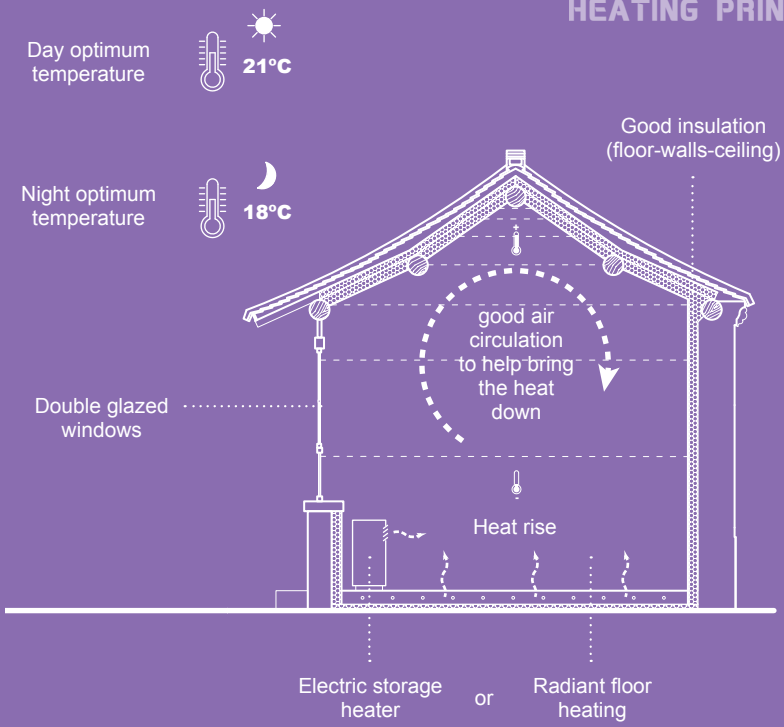
Heat pumps

电费 $

舒适度

Air to water heat pumps are increasingly used all over the world because their electrical consumption is very low and because they can be used with either water radiators or water floor radiant heating while also supplying your domestic hot water needs. Contact a specialist to learn more about heat pumps and which system could be a right fit for you.

采暖原则
HEATING PRINCIPLES



A warm home

- In the previous chapters we have extensively been talking about the importance of insulating your home. Thermal waste is a fundamental flaw in typical hutong houses and, contrary to common thinking, brick walls, traditional Beijing roofs, or even thick concrete slabs have all very poor insulation capabilities. It is thus absolutely essential to further insulate your walls, ceilings, and even your floors. A good insulation will increase your comfort for both winter and summer periods while drastically decreasing your utility bills and your overall environmental footprint. It is not difficult or very expensive to install and will be a game changer for you and your family.
- Heat needs to be distributed evenly in the house. Hot air naturally rises upward and thus sometimes concentrates in the higher part of your house. A slight controlled air flow will help the redistributing the heat and move the warm air where you need it, down there with you.
- Some heating systems consume more power and waste more energy than others. Please refer to our tips on heating equipment to see which solution is better suited to your needs and which solutions are eco-friendlier.
- A low carbon living style also implies a responsible consumption of resources. When it comes to heating, try to regulate your consumption in accordance to your needs. For instance, you need less warmth in the night when you are sleeping (usually 18ºC is enough) and you don't need to overheat during the day (21ºC is optimum) or when you are not home. Try to balance comfort and waste.

通风和制冷原则
VENTILATION AND COOLING PRINCIPLES

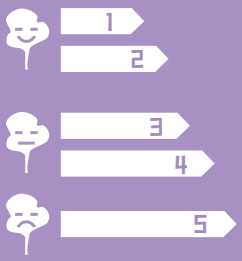
Air-conditioning

Air-conditioning has become ubiquitous in China and helps people cope with the sometimes extreme summer heats. Nevertheless, its impact on the environment is worrisome to say the least. AC units release CFC gases that are extremely harmful to the atmosphere (it is said that by 2050, 27% of global warming will be caused by those CFC gases). They are also consuming a lot of electricity which non-renewables production is still one of the major pollution source. Finally, the heat that "escapes" your house is released outside and create what we call heat bubbles or urban heat islands that disturb the natural weather patterns. The AC technology is promisingly evolving and hopefully will transform into a more sustainable industry.

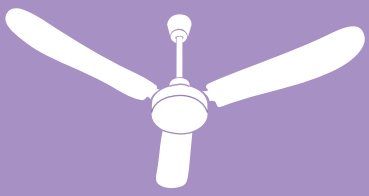
AC units

If you decided that natural cooling and ventilation are not enough for your needs and you wish to purchase an air-conditioning unit, you might still want to consider a few things:

- Some models are more efficient and eco-friendly than others. The *China Energy Label,* that all those equipment have to comply with, can guide you in buying an AC unit with lower environmental impact.
- Choose the right size of AC unit for your space to avoid waste
- Closing all doors and windows when cooling your space will greatly reduce waste.
- Maintain and clean your AC. A yearly check-up by a professional is recommended as it will greatly prolong the unit's efficiency and its lifespan thus avoiding landfills filled with AC units.
- The best temperature for your body is between 22-25ºC during the day and around 18-20ºC during the night. Since it is unnecessary and wastefultry not to set your AC unit too cold.
- Try only using the AC's dehumidification mode and coupling it with other ventilations such as fans or ceiling fans, you will notice that your energy consumption will be much lower for the same comfort.
- Whenever you can, consume responsibly. Turn off the AC when you're not home or when the outdoor temperature doesn't require air-conditionning.



China Energy label



Natual ventilation and ceiling fans

通风和制冷原则

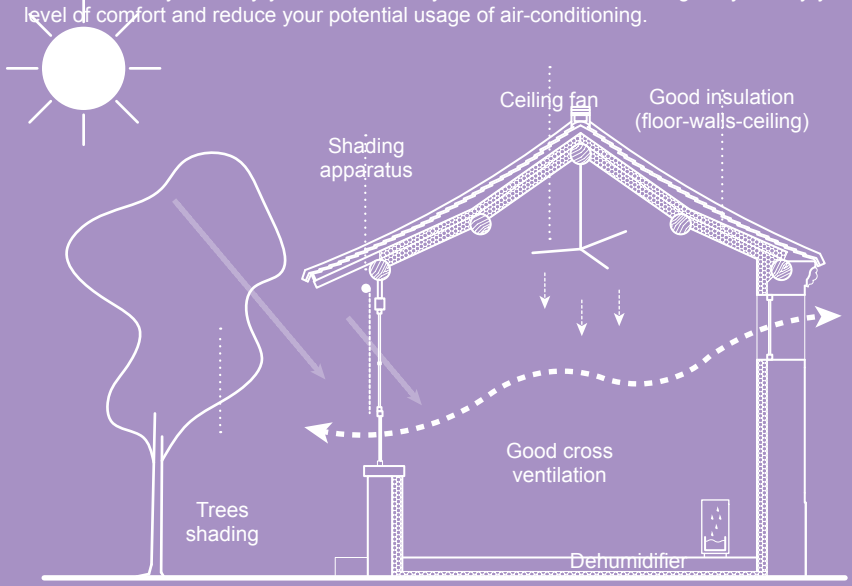
VENTILATION AND COOLING PRINCIPLES

Prevent heat from entering:

- Insulating your house is not only useful in winter but also in summer because it prevents hot air accumulating in the walls and the roof to enter the house.
- Another simple apparatus is day shading where the logic is to prevent solar heat from entering the house. The best shadings are the ones installed outdoor before the sun reaches the window glass. Shading can be acheived by simple outdoor curtains but also by a well-thought planning of your courtyard trees and plantings.
- The shade a tree can help protect from the sun heating up the windows as well as prevent your roof from overheating.

Cooling and ventilation:

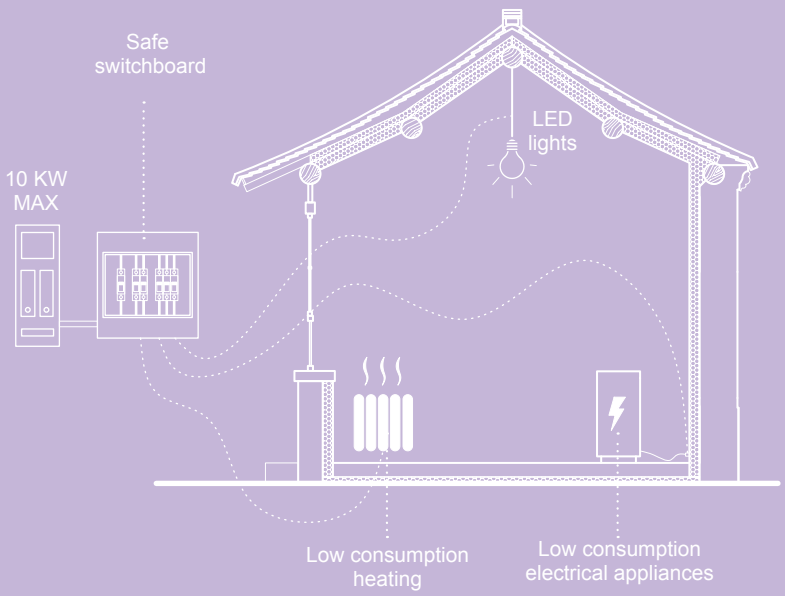
- It is best to have at least two windows placed on opposite sides of a room so as to be able to create a natural cross-ventilation air flow.
- Shading during the day and fully ventilating the house in the night to bring the cooler air of the evening in (night flushing) will also greatly reduce your needs in cooling
- Another effective way to cool the space by simple ventilation is to either have high openings or mechanized ventilation equipment placed sufficiently high so that they suck out the hot air that accumulates in the house.
- Ceilings fans have been used for decades all over the world in much hotter climates than Beijing. They create a refreshing continuous air flow in the house that, coupled with good shading, should be largely enough to feel cool and comfortable
- Air humidity is also an important element that changes the way we experience heat. The use of dehumidifiers, natural or electrical, will thus also greatly improve the effective cooling down of a space.
- Again, there is a usage and behaviour factor in the management of a house cooling. Whether by using the above-mentioned techniques or adjusting to the seasons and the times of the day, the way you live and use your house's features will greatly modify your level of comfort and reduce your potential usage of air-conditioning.



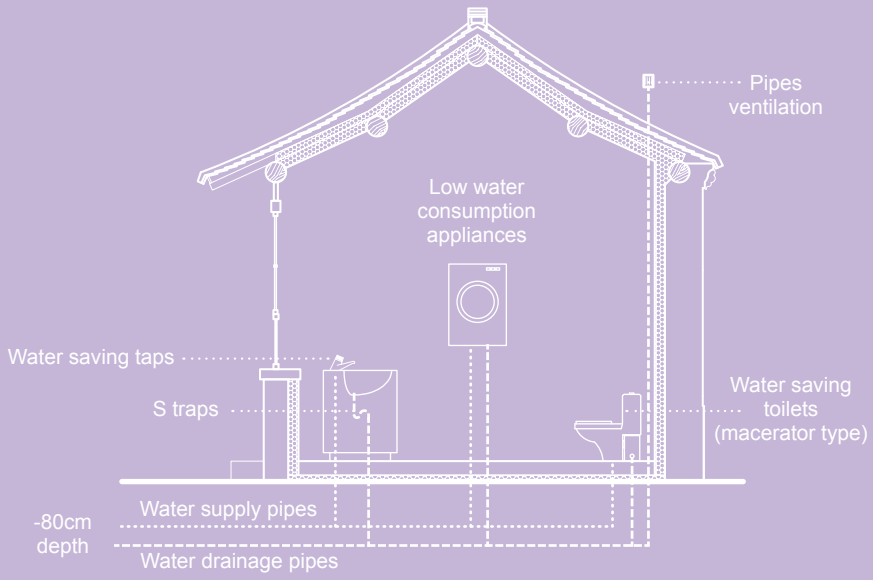
供电设计技巧
DOMESTIC ELECTRICITY TIPS

The electrical system of each house needs to be assessed by a professional to guarantee maximum safety and minimize fire risks. The amount of electricity you can use will greatly depend on the power (number of electrical meters) reaching your house and the type and thickness of the electrical wires you use.

- As a rule, you should not install more than 10000W per meter and the circuits breakers need to be of excellent quality. The way your appliances are distributed on the switch board and what type of circuit breakers need to be used will have to be specified by a professional.
- The equipment that consume the most are heating systems, air-conditioning, and water heaters. Please refer to the chapters describing those systems for specific tips on those appliances.
- Choose your appliances in accordance to what they consume in power (Watts) ; the higher the watts, the more they use (or waste) electricity and, accordingly, the higher your bill we'll be. Compare appliances to see if you can find some that are as performant but use less electricity. Here too, you can look at their *China Energy Label* notation to have an idea of how eco-friendly they are.
- Lighting can play a big part in your electricity consumption. Incandescent light bulbs, halogens, neon lights, and LEDs are the most common light sources. LEDs are becoming standard in the industry because they are consuming much less electricity than their counterparts and come in every colour you wish. Light colours refer to what is called light temperatures; a 3000K (Kelvin) light is very warm (i.e yellow) as a 5000K light is said to be cold (i.e white-blue). A neutral light temperature would be located around 3500 to 4000K.



给排水设计技巧
DOMESTIC WATER TIPS



The plumbing system depends greatly on each specific situation, on where are located and what is the nature of the urban amenities (supply and drainage), and on what are the specific needs. Generally speaking, those amenities are not very good in hutongs and blockages or freezing are frequent. A professional will need to be contacted to do a diagnostic and advise on the best solutions. Here are a few tips:

- One needs to make sure that the supplies and the drainages pipes are buried deep enough to avoid freezing in winter (usually below 80 cm deep)
- S trap pipes need to be installed under every water outlet in order to avoid bad smell coming into your house and to avoid blocking the pipes with objects, food, or hairs.
- Floor drains need to be installed in wet spaces such as the kitchen or the bathroom
- An aeration pipe needs to be part of the drainage system to avoid having smell returns in the house
- Water taps can be equipped with water saving apparatus that can reduce water consumption up to 50%. Water saving shower heads mixing air with water also exist and are becoming standards in the industry.
- If you have the possibility to install a toilet, try choosing one that doesn't consume too much water and look for the ones equipped with a macerator that will crush and grind waste before exiting through a small diameter pipe and thus help avoid blockages.
- Water equipment such as laundry machine and electric water heaters also have very different consumption performances depending on the model you choose. Look out for the *China Energy Label* that will give you good indications on whether your appliance is eco-friendly or not and how much energy it can help you save.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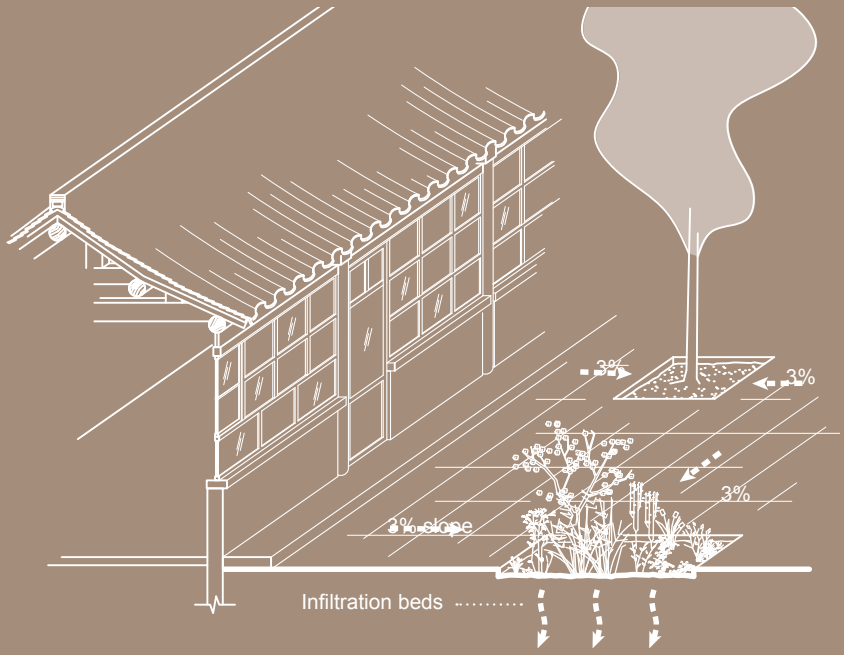
雨水和室外地坪
RAINWATER AND GROUND CONDITION

Although Beijing is not a particularly rainy place, summer storms can be pretty violent and sometimes cause a lot of problems. The poor rainwater management systems and the fact that most of the ground has been covered by hard surfaces makes it difficult to cope with the sudden rainstorms. In small one storey hutong houses, the courtyard can become quickly flooded and water can seep back into the foundations of the house and create damages.

- As a rule, one should try to always direct rainwater away from the house with either vertical gutters discharging water at a certain distance from the walls or slight slopes of the courtyard floors (usually 3% slope) in order to avoid water stagnation.
- Rainwater flows should be directed towards drains that connect directly with the urban storm water system (nb:different from the wastewater drainages). If no such connections are possible you can choose to direct the water towards infiltration areas or pre-installed infiltration wells.
- If you plan on having infiltrations areas (i.e planted zones in the original courtyard soil), try to set them at a safe distance from the house so that water infiltrate the ground without endangering your walls. It is better to have a series of smaller infiltration zones spread around in the courtyard than one large area in one spot. Those small infiltration beds will act as sponges distributing the excess water more homogeneously.
- It is also possible but more costly to build an infiltration well which is basically a deep pit where the rainwater can accumulate during the storms and slowly seep deep into the soil afterwards.
- You might also want to consider recuperating parts of the rainwater in small cisterns or pots to use as gardening water for your plants and thus avoid using clean water



Trees, flowers, plants, and vegetables

Trees are an extremely important elements of the Beijing hutong culture. Apart from the delightful beauty they add, they provide shelter, shading and a habitat for insects, birds, and small animals that constitute the city's fauna. Typical hutongs trees include:


Jujube
枣树


Persimmon
柿子树


Pomegranate
石榴树


Camphor
香椿树


Walnut
核桃树


Eucalyptus
槐树


Hardy begonias
海棠树


Ginkgo
银杏树

Of the hundreds of indigenous species, the typical Beiijing courtyards flowers are:


Chrysanthemum
菊花


Peonies
牡丹


Jasmine
茉莉


Citron Daylily
黄花


Oleanders
夹竹桃


Wisterias
藤萝

In the courtyard, on the roofs, in the streets, in pots, and even in disused sinks, Beijingers always loved growing all sorts of vegetables in the hutongs. Some of the famous homegrown veggies we see popping out in the city every summer are: peppers, loofah, bitter gourd, eggplant, cucumber, pumpkin, cabbages, spinach, broccolis, tomatoes, beans, beans, and more beans!

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