

© Prof. Dr.-Ing. Hans-Peter Leimer

# renovation and restoration

of existing buildings in China

BBS INTERNATIONAL Ltd.  
BBS 莱默建筑设计工程咨询(上海)有限公司  
University of Applied Sciences and Arts - HAWK Hildesheim/Germany  
Hefei University - Anhui/China  
Nanchang University - Jiangxi/China  
BBS INSTITUT - Germany/China

info@building-physics.net  
www.building-physics.net



---

---

---

---



---

---

---

---

Residential building  
Shanghai build before 1980



---

---

---

---

---

---

---

---

What to do with existing buildings?

demolition? or restoration?



---

---

---

---

---


---

---

---

What to do with existing buildings?

Let it be old? or restoration?



---

---

---

---

---

---

---

---

Restoration of existing buildings

### Restoration

- saves identity of buildings and cities
- take care of the residents

is

- economic
- ecologic
- save resources



---

---

---

---

---

---

---

---

plan-build-refurbish

---

---

---

---

---

---

---

---

restoration of buildings basics

- What to do?
  - Renovation of the existing building
  - Retrofit of the existing building
  - Restoration of the building
  - Modernization of the HVAC systems
  - Guarantee of a health and comfortable indoor climate
  - Implementation of a adequate modern user comfort
- What to take care?
  - dwelling
  - building
  - Regional conditions
  - surrounding
  - Quarters
  - City and region
- Sustainability!
  - Investment costs
  - Restoration costs
  - Facility management costs
  - Quality, Durability



---

---

---

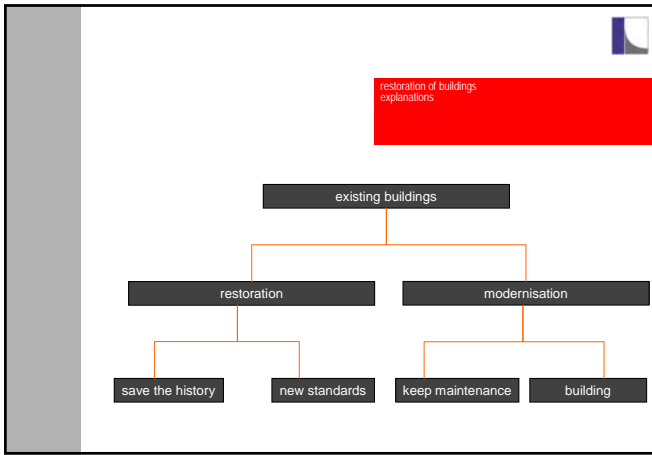
---

---

---

---

---



---

---

---

---

---


---

---

---

restoration of buildings requirements

- Implementation in the city quarters
- Implementation in established sub cities and infra structure
- Estates are inhabited
- No information about the building / building quality / exist. HVAC systems
- Many workers on one time at the site
- Material transport into the building
- Only a shot restoration time is possible



---

---

---

---

---

---

---

---

**restoration of buildings solutions**

**Need for:**

- Orientated to the users demand
- Implementation of the government
- Cooperation with regional partners
- interdisciplinary concepts
- Innovation of concepts and products

**Need for:**

- Guidelines for restoration
- Strict organisation of the work structure
- Certification of
  - Planners
  - Companies
  - Products
- Quality control
  - Of the planning concepts
  - On site
  - Of the materials

---

---

---

---

---

---

---

---

**restoration of buildings requirements**

**New buildings**

↓

**national standards**

↓

- Chineses standards
- German standards
- British Standards
- ...

**Existing building**

↓

**No requirements**

↓

- WTA-Merkblätter
- standard building techniques

---

---

---

---

---

---

---

---

**sustainability**

Most important is the time period hoe long to use the building

Influenced by

- Investment costs (for the old building)
- Restoration cost
- Energy costs
- Operation cost
- Utilisation costs
- Maintenance costs

---

---

---

---

---






---

---

---

City planning

- Better infra structure of the city area
- Better medical and social maintenance
- Shops, markets and needed facilities for daily needs
- Cultural facilities
- Education
- Increase the residential and city infra structure
- Demolition of old and useless buildings
- New special buildings



---

---

---

---

---

---

---

---

Examples of restoration

---

---

---

---

---

---

---

---

.BBG-I-Punkt\* Hochhaus


Restoration of a residential high tower building „BBG-I-Punkt“

Building data:

- 17 floor building
- 1969 build
- 96 apartments
- Floor area 11.200 m<sup>2</sup>
- Volume area 30.200 m<sup>3</sup>
- Time pired of restoration 08/2003 - 11/2004

Work plan:

- Restoration of the facades
- Thermal insulation
- New windows and doors
- New design
- Work had to be done during the occupancy
- New Heating systems
- New supply circuit
- New bath and shower rooms



---

---

---

---

---

---

---

---

examples: planning build in existing buildings


Restoration of a residential building

Building data:

- 10 floor building
- 1964 build
- 96 apartments
- Floor area 11.200 m<sup>2</sup>
- Volume area 30.200 m<sup>3</sup>
- Time pired of restoration 08/2003 - 11/2004

Work plan:

- Restoration of the facades
- Thermal insulation
- New windows and doors
- New design
- New supply circuit
- New bath and shower rooms
- Work had to be done during the occupancy



---

---

---

---

---

---

---

---

Restoration of an existing residential building

Restoration of the facades



---

---

---

---

---

---

---

---

Restoration of an existing residential building

Restoration of the entrances



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

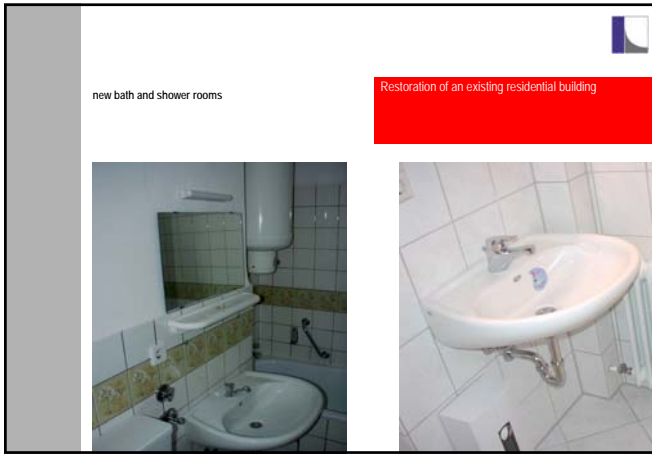
---

---

---

---

---



---

---

---

---

---

---

---

---

**moisture**  
**In facades/ext. walls**

Hydrothermal Simulations  
Analysis of thermal insulations for buildings  
in different climate zones of China

---

---

---

---

---

---

---

---

**Moisture problems**  
inside ..... outside  
in the wall layers

Mould growing  
behind internal thermal insulations

strength problems of the WDVS - etics facades  
influenced by moisture/condensation in the system



---

---

---

---


---

---

---

---

**Climatic regions in China by Köppen**  
依据 (Köppen) 的中国气候带



**Temperatur-Regime**

- 1. Subtropisch
- 2. Subtropisch
- 3. Subtropisch
- 4. Subtropisch
- 5. Subtropisch
- 6. Subtropisch
- 7. Subtropisch
- 8. Subtropisch
- 9. Subtropisch
- 10. Subtropisch

**Arktische**

- 1. Subpolare
- 2. Subpolare
- 3. Subpolare
- 4. Subpolare
- 5. Subpolare
- 6. Subpolare
- 7. Subpolare
- 8. Subpolare
- 9. Subpolare
- 10. Subpolare

**Subarktische**

- 1. Subpolare
- 2. Subpolare
- 3. Subpolare
- 4. Subpolare
- 5. Subpolare
- 6. Subpolare
- 7. Subpolare
- 8. Subpolare
- 9. Subpolare
- 10. Subpolare

**Wärmegeographische Klimazone**

- 1. Subtropisch
- 2. Subtropisch
- 3. Subtropisch
- 4. Subtropisch
- 5. Subtropisch
- 6. Subtropisch
- 7. Subtropisch
- 8. Subtropisch
- 9. Subtropisch
- 10. Subtropisch

---

---

---

---

---

---

---

---



**Climatic regions in China**  
中国的气候带 依据 GB 50189-2005

中国的气候带  
依据 GB 50189-2005

1. I-寒冷地区
2. Ia- A类城市...
3. Ib- B类城市...
4. II-温带
5. III-温带
6. IV-冬冷夏热地区
7. V-冬季温和夏季炎热地区
8. A-北方 - 仅居住时
9. B-南方 - 仅居住时

中国气候带的城市

---

---

---

---

---

---

---

---

---

---

**analysis of Climate - Shanghai**  
气候分析 - 上海

城市	坐标	海拔	气候带 (Climate) 的气候带	中国气候 带划分	采暖期 Heating Period	日照时数 H <sub>h, tot</sub>	全年日照总时 - h/a <sub>tot</sub>	制冷期 Cooling Period	日照时数 H <sub>h, cool</sub>	全年日照总时 - h/a <sub>tot</sub>
上海	北纬31° 东经121°	4 m	温和湿润 夏季炎热	IV-冬冷夏热	144 d (10.11... 03.04)	1545 kWh/m <sup>2</sup>	北方: 140 kWh/m <sup>2</sup> (HP) 南方: 328 kWh/m <sup>2</sup> (HP) 热带: 1038 kWh/m <sup>2</sup> (HP) 寒带: 372 kWh/m <sup>2</sup> (HP)	187 d (06.04... 11.10)	904 9,28KCP	北方: 275 kWh/m <sup>2</sup> (KPI) 南方: 340 kWh/m <sup>2</sup> (KPI) 热带: 214 kWh/m <sup>2</sup> (KPI) 寒带: 703 kWh/m <sup>2</sup> (KPI)

---

---

---

---

---

---

---

---

---

---

**restoration of existing buildings**  
thermal insulation

**Insulation**  
is possible to implement

outside

inside

---

---

---

---

---

---

---

---

---

---

Solution!  
 modern Simulation tools for moisture

**WUFI®**  
 PC-Program for calculating the coupled heat and moisture transfer in building components

Realistic calculation of the transient hygrothermal behaviour of multi-layer building components exposed to natural climate conditions.

- Calculation of the heat and moisture behaviour of retrofit facade systems
- Real situations can be calculated (ready state models)
  - No need to measure
- Differed climate situations and climate regions can be analysed
- Different variances of the construction can be optimized
- Different users behaviour can improved
- Specified material properties can be implemented

---

---

---

---

---

---

---

---

---

---

moisture transports in materials

Exterior Interior

Rel. Humidity Pressure

Vapor Diffusion Vapor Diffusion Surface Diffusion Capillary Conduction

Dry Moist Wet

Fig. 4: Moisture transport phenomena in the pores of a massive exterior wall in winter, for different levels of moisture content

---

---

---

---

---

---

---

---

---

---

results

WDVS - Systems				Internal Insulation	
WDVS - EPS		WDVS-MN-Fiber		Intern. EPS Plaster	Intern. MN-Fiber without water-membrane
Monitor Plaster / EPS	Monitor EPS / Concrete	Monitor Plaster/MN-Fiber	Monitor MN-Fiber/concrete	Monitor Concrete / EPS	Monitor Concrete / MN-Fiber

---

---

---

---

---

---

---

---

---

---

Strength properties influenced by moisture		
	$u_{pr}$ [%]	[%]
Min. Fibers	7,3	61
EPS	21	27,6

System 1:	Mineral Plaster System, ca. 7 mm.
System 2:	Mineral Plaster System, ca. 13 mm.
System 3:	Basis Plaster System, ca. 13 mm.
System 4:	Basis Plaster System without final layer, ca. 9 mm.
System 5:	Silicate Plaster System, ca. 7 mm.

relative strength losses	
crack width	[%]
without	0
0,1 mm	- 32,8
0,2 mm	- 42,5
0,4 mm	- 50,4
1,0 mm	- 52,4



Foto: TU Berlin - Link

---

---

---

---

---

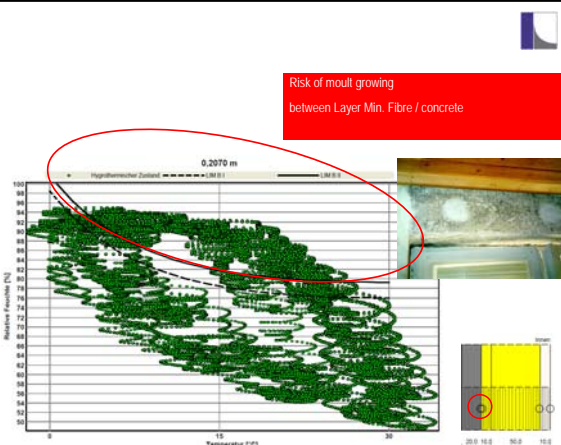
---

---

---

---

---



Risk of mould growing  
between Layer Min. Fibre / concrete

---

---

---

---

---

---

---

---

---

---