

CABR: An Institution's Activity in the Cause of Human Settlements in China

by
Prof. Dr.-Ing. WANG Tiehong
President of China Academy of Building Research

Foreword

It goes without saying that the cause of human settlements in China at the present stage is one of the greatest causes bringing benefit to the people in the world. The construction scale and the numbers of benefited people come to the top either in the world, or in the history.

CABR, as an institution, takes an active part in the cause of human settlements in four aspects:

- Promoting the research on the safety, durability, suitability, cost effectiveness and friendly environment for human settlements in China and writing the relevant standards and codes;
- Working hard on the development and dissemination of the application of new technologies and materials to promote the technology and product innovation concerning energy efficiency and environment protection in human settlements and working effectively on the demo projects to popularize the products and technologies of energy efficiency and friendly environment through international cooperation;
- Being engaged in the research on the disaster mitigation and prevention associated with human settlements, providing the technical solutions for human settlements in the earthquake regions, flood storage areas and retarding basin and the regions with other kinds of geological disasters and writing the relevant standards and codes;
- Undertaking the obligation entrusted by the governmental departments to carry out the national – level testing and inspection on the quality control for human settlements, bettering the engineering quality of human settlements in China.

CABR is the biggest research organization in building industry in China, with 12 research establishments:

Institute of Building Structures

Institute of Soil & Foundation Engineering
Institute of Earthquake Engineering
Institute of Building Materials
Institute of Building Decoration
Institute of HVAC (including air cleanliness and energy efficiency)
Institute of Building Physics (including environment)
Institute of Building Fire Research
Branch Institute of Constructional Mechanization
Institute of Comprehensive Building Machinery
Housing Estate Research & Design Center
Technical Personnel Training Center.

Institute of Comprehensive Design and China Building Technique Development Corporation of CABR are the entities of technical innovation to introduce the technologies into the market.

Nearly 100 professors and 300 associate professors are working in 72 research fields related to human settlements. More than 100 items of research projects and standards development are under way each year.

China National Center for Quality Supervision and Test of Construction Engineering, China National Center for Quality Supervision and Test of Air Conditioning Equipment, China National Center for Quality Supervision and Test of Elevators, Constructional Engineering Department of China National Center for Test of Chemical Building Materials are set up in CABR.

Eight National Technology Innovation Promotion Centers are technically supported by CABR.

Thirty-five national-wide academic organizations set the secretariats in CABR.

CABR has established the scientific and technical cooperation with the relevant organizations of 30 countries and regions.

CABR, being the most primary writing organization, has been in charge of writing 435 copies of standards and codes related to human settlements.

CABR has made 1740 scientific research achievements associated with human settlements, 130 patents and more than 4000 published papers.

CABR, as an institution, generally plays a unique and indispensable role in the cause of human settlements in China.

1. To promote the research & standard development on the safety, durability, suitability, cost effectiveness and friendly environment for human settlements

CABR has been appointed by the governmental department as the technical support organization to develop and administrate the standards and codes

concerning human settlements.

1.1 CABR has been in charge of writing the standards and codes for the structures in different shapes and with different materials subjected to both static load and earthquake load, making sure of safety and durability of house buildings.

1.2 CABR has developed the “Compulsory provisions extracted from building engineering and construction standards (house building division)” (hereinafter referred to “the Provisions”)

The Provisions serve for the “Regulations for management of building engineering and construction quality”, issued by the government. They are related to the safety of the people and property, health, environment protection and public interests in house buildings, which must be followed. The provisions become the most important lawful technical document to inspect the safety, durability, suitability and friendly-environment of the buildings of human settlements through out the China.

1.3 Guideline of complete set of technologies for house building structure system has been developed by CABR.

1.4 CABR has been in charge of writing the code for fire prevention design of interior decoration of buildings and other standards related to building decoration design and construction, making sure the people and property won't suffer damage caused by incorrect decoration either in peacetime or on fire.

CABR has written the standards related to sound insulation, lighting and thermal environment for buildings, to make the building environment comfortable.

1.5 CABR has developed series of CAD software running on the platform with CABR' property right. It covers architecture, structures, foundations, equipment, decoration, rough estimate and budget and construction. By the end of 2000, the software had been used by more than 8000 customers. It is the most popular software in the building industry in China. It plays an active role in the implementation of standards, the improvement of design level and efficiency and the insurance of construction quality.

2. To innovate new technologies, materials & products concerning energy efficiency and environment protection

China is large at territory, over subtropical zone, temperate Zone and frigid Zone. It is freezing in winter and hot in summer in most parts of China. With the

development of Chinese economy and the rise of people's living standard, it is urgently needed to improve the habitat environment and living quality.

In China, the dwelling house is in great demand. It is unnecessary to conceal the truth that the energy consumption per unit area of the building is quite high. The energy consumption for buildings in the northern part of China accounts to 20% of total energy consumption there. The energy consumption for air-conditioners in cold-winter & hot-summer areas and the southern hot areas is greatly growing, reaching 70-80% of total amount of electricity consumption in some cities. Though the energy consumption per capita in China does not parallel with that in the world, the total amount of energy consumption has come to the top second in the world and will keep going up, which is an undisputed fact. According to the strategy target of China – by the middle of the 21st century the economy will reach the level of moderate developed countries, the living level of the Chinese people will uplift to higher standard and consequently the energy consumption for buildings and construction will be huge. We must save the energy and meanwhile explore it to realize the sustainable development of our economy. Thus it is an urgent task for China to save the energy and improve the environment.

To improve the indoor quality and building energy efficiency technologies, to protect environment and to realize sustainable development, CABR, cooperating with policy makers, has contributed its efforts in the cause.

2.1 R & D on the technologies of building energy efficiency and habitation environment

For years, CABR, relying on its qualified personnel and technical superiority, has successfully carried out hundreds of R & D projects related to energy efficiency buildings and indoor quality:

- Heating by power-driven heat pump in the north,
- Co-supply of heating, cooling and hot water for house buildings,
- Gas-burning heating/cooling unit for house buildings,
- Application of solar energy for heating house buildings,
- Application of water heat pump for heating house buildings,
- Heat-electricity co-generator technology for heating house buildings,
- Heating system charged by heat allocation in concentration heating areas.

CABR has also undertaken the fundamental research projects to serve the government:

- Building energy efficiency and indoor heat environment in transition areas,
- CAD software for analysis of indoor heat environment of energy efficiency building,
- Incentive policies for building energy saving,
- Technologies suitable for building energy saving,

- Analysis of energy consumption for heated civil buildings,
- Energy saving methods for windows and doors.

The research results have promoted the technology development of energy efficiency and heating/cooling for house buildings, provided the theoretical foundation for governmental departments to work out policies on this aspect and given the support to the development and application of the products.

On the basis of researches, CABR has developed heating system equipment for house buildings:

- Crucial balancing devices for heat water supply system,
- Heat exchange equipment for heating system,
- Device for managing the operation of heating system,
- Temperature control device,
- Measurement device for energy consumption.

CABR has also developed the products and technologies for building envelope. The products and technologies have been widely applied in the thermal insulation for house buildings, which has improved the energy saving by building envelope.

Now the Chinese people work for the objective: “Adequate shelter for all” and “Everyone is healthy to enjoy life”. To improve the indoor air quality of house building, CABR has conducted the R & D and standards development on the heat comfortability and indoor air quality for the rooms, kitchens and bathrooms of house buildings.

2.2 Promote the development of intelligent system for habitation quarters

The rapid development of technologies of information, computers, automation and Internet promotes the construction of habitation quarters with intelligent system in China.

Entrusted by the governmental departments, CABR has participated in writing the “Outline and technical guide of demo intelligent system for habitation quarters in China”. It offered consultation and guidance to the national demo projects of intelligent system for habitation quarters in some cities in the year 2000.

In the human settlements, CABR has been mainly involved in the overall design, system integration, software development for property management, and sub-systems for heating & ventilation, fire safety and elevator control. CABR is devoted itself to the popularization of these technologies in the Chinese human settlements.

2.3 Work on the demo projects related to building energy efficiency through international cooperation

In the course of pushing the development of building energy efficiency and environment technologies, CABR has established the cooperation with many

countries and organizations in various forms and at different levels. For example:

China-Sweden project (1988)

Sponsored by UNDP, CABR and Lunde University worked together on the energy efficiency demo project in Wuxi of Jiangsu Province

China-Canada (CIDA) project (1997)

CABR participated in the building energy efficiency project and was in charge of two sub-projects: one was about energy efficiency standards and codes, another was about energy efficiency products.

China-Finland project (1998)

CABR worked with VTT on 3 demo house buildings of energy efficiency.

China-France project (1999)

CABR worked with CSTB on 3 demo house buildings of energy efficiency.

China-US project

CABR collaborated with American Energy Source Foundation and Lawrence Lab. to write “Standard of energy efficiency design for residential buildings in hot-summer & cold-winter areas”.

China-Japan project

CABR collaborated with Japan counterpart on indoor environment technology – windows and doors, lighting environment and sound insulation.

2.4 Popularization of building energy efficiency technologies

2.4.1 CABR works for the governmental departments to make out the technical policies and documentation related to building energy efficiency and indoor environment, such as: technical policies of building energy efficiency in the 10th “Five-year plan” and the targets for the year 2010, development planning of district heating in cities and towns, standard of performance assessment for house buildings, technical policies for heating/cooling in cities, comments on energy efficiency of civil buildings, and technical guide of district heating reform, etc.

2.4.2 Write books, manuals and training materials

2.4.3 Hold seminars and training courses:

- Hold the building energy efficiency seminars of China-Canada, China-US, China-Denmark, China-France, China-Finland, China-Germany, and China-Sweden
- Establish the cooperation with WB, ADB, UNDP and EU etc.
- Host the 8th international heat pump conference in Beijing in the year 2002
- Hold the training courses for developers, designers and site engineers each year.

3. To be engaged in the research on the disaster mitigation and prevention associated with human settlements

China is a country with frequent natural disasters such as earthquake and flood, being one of the countries that suffer the most serious disasters in the world. CABR has been working on a lot of researches, technical development, dissemination and training and has made remarkable achievements.

3.1 To be in charge of writing the standards and codes related to disaster mitigation and prevention for human settlements

CABR has been in charge of or involved in writing several hundred of standards and codes for engineering, among which some are related to the disaster mitigation and prevention for human settlements, playing a vital role. They are about the seismic design, seismic diagnosis and strengthening, seismic protection classification, building and construction technologies for flood storage and retarding basin areas, and the seismic design and evaluation for pipelines.

3.2 To carry out the post-disaster investigation

Since 1960s, CABR has been involved in the site investigations after earthquakes, floods and storms, such as Tangshan earthquake in 1976, Lanchang (Yunnan Province) earthquake in 1988 and Anhui flood in 1991, to sum up the lessons and develop new disaster prevention technologies. The unique technologies of RC construction columns and ring beams developed by CABR have been widely used in earthquake regions. CABR also gives out the technical solutions of reconstruction for the governmental departments to make decisions.

In 1996, CABR suggested to strengthen the Jiujiang embankment while making seismic planning for the city. CABR provided the relevant governmental departments with the solutions of reconstruction for the villages in flood storage and retard basin areas. The solutions played an important role in reconstruction.

3.3 To research on the engineering measures to mitigate/prevent disaster

The proper measures are taken for both new and existing buildings.

3.3.1 Engineering measures to mitigate/prevent earthquake disaster

The objective of seismic protection for engineering in China is: “no damage in minor earthquake, repairable damage in moderate earthquake and no collapse in major earthquake”.

For new buildings, after minor earthquake, the structures keep well and can be used in normal way; after moderate earthquake, the structures are allowed to have some damage but can be repaired; after major earthquake, the structures are destroyed but don't collapse so as to keep the life and property safe.

For the existing buildings that haven't met the seismic requirements, more than 1 billion square meters have been strengthened through out the country. Recently, CABR has developed the strengthening technologies using earthquake isolators, shaking dampers, carbon fibers and apply them in many projects. The buildings strengthened with the measures keep well after earthquake.

3.3.2 Engineering measures to mitigate/prevent flood disaster

Facing the features that the buildings in flood are soaked in water and suffer the impact of wave, the measures combined by resistance and dredging are taken to reduce the impact of wave directly on the buildings. The measure won't cost much money. The main measures taken are: to restrict the proportion of building configuration and dimension to improve its overall flood capability; to develop the flood structure system with wall, wave column, ring beam, cast-in-situ band as a main strong structure and some weak locations and movable floor slabs to let wave pass easily and reduce the impact of wave to keep main structure safe.

3.4 To place emphasis on the research of non-engineering measures to mitigate/prevent disaster

The non-engineering measures refer to disaster planning, modern disaster monitoring/alarming/predicting system and emergency rescue scheme. The non-engineering measures can be called preventive measures.

3.4.1 Seismic disaster prevention planning for cities

Seismic disaster prevention planning for cities includes seven parts: seismic prevention zoning, evacuation, lifeline engineering (supply of water, electricity, gas, food, telecommunication, transportation, medical care and fire fighting), secondary disaster prevention, building strengthening, emergency rescue and professional training.

China started the seismic disaster prevention planning for cities from 1980s. Up to now, 300 cities have been planned among 400 cities in earthquake regions. CABR has been in charge of or involved in the planning for almost half of the numbers.

3.4.2 Flood disaster prevention planning for flood storage and retard basin areas

Flood disaster prevention planning made by CABR includes: to build public buildings stronger to resist flood as shelters; to select flood shelters (houses, safe embankment, safe platform and platform high than water level); arrangement of village houses and buildings; location of safe floors and layout of lifeline engineering.

3.5 Benefit from seismic disaster mitigation and prevention measures

After the catastrophic earthquakes happened in Baotou of Inner Mongolia Region, Lijiang/Ninglang/Puer-Simao/Wuding of Yunnan Province, Jiashi of Xingjiang Region, Zhangbei of Hebei Province and Jingtai of Gansu Province, the conditions proved that the new buildings built as seismic design code or the existing buildings strengthened as strengthening specifications behaved well under earthquakes. The low-cost village buildings kept safe even though they had been built in rather simple seismic measures. We can say seriously that the seismic strengthening design ideas and principles for human settlements in cities and towns in China are successful and effective.

3.6 Benefit from flood disaster mitigation and prevention measures

In 1996 Dongting Lake area suffered catastrophic flood. Before the flood, 234.3 thousand m² of safe shelter buildings and 69.6 thousand m² of safe platform had been built, by which 200,000 lives and 0.2 billion yuan of property were protected in the flood. Each 1.5 m² of safe area protected one person and 1000 yuan of property.

3.7 Application of IT in disaster mitigation and prevention

GIS and multi medium technologies have been fully used in the disaster prevention planning for cities. Taking Tangshan as an example, lifeline system of the city developed by CABR plays a primary role under earthquake. At present, the system is being applied in other earthquake regions.

3.8 Actively being involved in the international academic activities relating the disaster mitigation and prevention

China-US disaster mitigation and prevention seminar (1997 in Beijing),
China-Japan earthquake engineering seminar (2000 in Kunming).

4. To carry out the national-level testing and inspection on the quality control for human settlements

The Building Engineering Testing Center of CABR(CABR/BETC) has been accredited by China National Accreditation Committee for Laboratories (CNACL) and obtained the mutual recognition through CNACL, ILAC and APLAC. It is a national centre authorized by the government for the quality supervision and test of construction engineering,

4.1 The responsibilities of CABR/BETC are to undertake testing and experiments for the quality of major engineering projects, components, products and materials for human settlements; to assess structure safety and building functions; to participate in the appraisal on the achievements of new building structures, new technologies and new products; to unify the testing methods for building and engineering quality in the whole China; to give technical guidance to the building & construction quality inspection and testing by local centres.

4.2 For ten years since its establishment, CABR/BETC has devoted itself to the inspection and testing on the safety, durability, suitability, cost effectiveness and friendly environment for human settlements; to conduct the random sample tests of products assigned by the governmental departments; to fulfill arbitration testing and appraisal for quality disputes of building construction entrusted by justices departments.

4.3 To test whether the quality of energy efficiency products and heating/cooling equipment meets the requirements specified in the design codes, CABR has set up the following laboratories to provide services:

- Performance of windows and doors
- Indoor heat comfort
- Acoustic performance
- Day-lighting performance
- Room air conditioners, radiators
- Ventilation system
- Hydraulic performance of heating system
- Radiator thermostats and heat meters

4.4 Apart from the direct involvement in testing work for the major projects, CABR also makes efforts to promote the testing on the engineering quality of China:

- To check and assess the qualification of the organizations which are undertaking dynamic testing on pile foundations all over the China, working for the governmental departments;
- To be in charge of or involved in writing relevant national and industrial standards and codes;
- To give professional administration and guidance to local quality control centres; to hold seminars and training courses;
- To import from foreign countries or develop the advanced testing equipment.
- To edit the journal “Engineering Quality Control”, which is related to quality management for building engineering sector.

4.5 At present, the testing organization system of quality control for building engineering in China has been formed by different levels of organizations: national, provincial, municipal and county level. The local testing organizations undertake their own obligations within their locations of administration, playing a very important role.

In conclusion, CABR, as an institution, is proud of its unique and indispensable activities in the cause of human settlements in China.

China Academy of Building Research
30 Bei San Huan Dong Lu
Beijing 100013, China
Tel: 010 84272233
Fax: 010 84281369
E-mail: master@cabr.ac.cn
<http://www.cabr.ac.cn>

China Building Technique Development Corporation, CABR
30 Bei San Huan Dong Lu
Beijing 100013, China
Tel: 010 84281356
Fax: 010 84288992

Branch Institute of Construction Mechanization, CABR
61 Jin Guang Boulevard
Langfang 065000, Hebei Province, China
Tel: 0316 2012874
Fax: 0301 2010248

Shenzhen Branch Institute, CABR
28th Floor, Nanguo Building 2, Yuanling
Hong Ling Zhong Lu
Shenzhen 518028, Guangdong Province, China
Tel: 0775 2408479
Fax: 0775 2408480

Shanghai Advanced Technology of Building Construction Co. Ltd, CABR
Unit 12D, Haili Building
88 Dapu Road
Shanghai 200023, China
Tel: 021 53964684
Fax: 021 53964806

JOSHEK Development Ltd. (Hong Kong) of CABR
9A, Hennessy Building, 123 Hennessy Road, Wanchai
Hong Kong