Standard by People's Republic of China

Evaluation Standard for Green Buildings

GB/T 50378-2006

Articles Instructions

Index

1 General Principle

1.0.1 Building activities is one of human's most influential activities on natural resources and the environment. Our country is now in the phase of rapid economic development, ranking world No. 1 in terms of annual building volume, with significantly growing consumption of resources year by year. Therefore, scientific development philosophy must be steadily created and seriously implemented, and the concept of sustainable development must be adhered to, to strongly develop green buildings. When developing green buildings, state technologic and economic policies that save resources and protect environment shall be implemented and performed. The purpose of formulating this standard is to regulate evaluation on green buildings and promote the development of green buildings.

1.0.2 Due to different functions, different types of buildings have big discrepancy in terms of resource consumption and effect on environment. Considering current construction market in our country, this standard will mainly evaluate residential buildings that are huge in quantities and public buildings that consume much energy and resources, like office buildings, mall buildings and hotel buildings. For evaluation on other buildings, this standard can serve as reference.

1.0.3 A building, from the initial planning and design to construction, operation and final demolition, forms a complete life circle. Focusing on buildings' complete life circle, means that environment-related factors shall be fully considered and utilized in the planning and design phase, and also that effect on environment shall be minimized in construction phase, and that healthy, comfortable, low-consumption, harmless space shall be provided for people in the operation phase, and that the harm to environment shall be minimized after dismantling. For green buildings, it requires that in the complete life circle of the buildings, energy-saving, land-saving, water-saving, materials-saving and environment protection shall be performed as optimally as possible, and also that building functions shall be satisfied. Sometimes there will be contradiction between these. For example, water is used too much for the purpose of beautifying the environment, or materials are consumed too much only for saving energy, both of which are not in line with green building requirements; while decreasing the building's functional requirements and availability is also not what green buildings recommend, though it can consume less resources. The contradictions between the five factors, namely energy-saving, land-saving, water-saving, materials-saving and environment protection, must be comprehensively considered and properly handled within the complete life circle of the building, and meanwhile application of information technology, intelligence technology, and green buildings' new technology, new products, new materials and new techniques shall be emphasized.

1.0.4 There is huge difference in climate, geographic environment, natural resources, economic development and social customs in different regions in our country, so in evaluation of green buildings, differently regions shall be viewed respectively, taking regional specialties into consideration based on fact, and the climate, resources, natural environment, economy and culture of the region where the building locates shall be fully considered.

1.0.5 Laws, regulations and related standards in accordance with state requirement are prerequisite for green building evaluation. This standard doesn't cover all common functional requirements of buildings, but it emphasizes on evaluation of what is related to functions of green buildings, which mainly include the aspects like energy-saving, land-saving, water-saving, materials-saving and environment protection. So basic requirements of buildings, such as structural safety and fire-prevention safety are not included in this standard. To develop green buildings and build a frugality-style society, the concept of consolidation of rural and urban areas as well as recycling economy must be promoted, with participation of the whole society in cultivating potentials of energy-saving, land-saving, water-saving and materials-saving of buildings. Economics shall be emphasized, and economic benefits and cost shall be calculated in the view of the complete life circle of buildings and in line with market development demand and regional economic situation. Frugality shall be promoted against waste and extravagance, in order to realize unification of economic, social and environmental benefits.

3 Basic Regulations

3.1 Basic Requirements

3.1.2 This standard is applicable to evaluation on existing residential buildings, and three kinds of public buildings, i.e. office buildings, mall buildings and hotel buildings. And evaluation on newly built, expanded or reconstructed residential buildings and office buildings, mall buildings and hotel buildings belonging to public buildings, shall be conducted in one year after turnover to the property owner.

3.1.3 Green buildings refer to the buildings which combines resources saving and environment protection within the complete life circle. And although excess utilization of a single technique can improve performance in certain aspect, it may result in new waste. Therefore, the effect between building size, building technology and investment shall be overall evaluated from each stage of the complete life circle of buildings. Based on the main purpose of saving resources and protect environment, take safety, durability, economics, appearance and other factors into general consideration, and compare and confirm optimal technology, materials and equipment.

3.1.4 In creating green buildings, the planning, design, construction and finalizing phases shall be taken under control. Each responsible party shall follow the requirements of evaluation indicators of this standard, set goals, clarify responsibilities, control the processes, and finally produce reports on control over the

processes of planning, design, construction and finalizing. The party which applies for evaluation shall submit basic materials regarding process control for evaluation, as required by green building evaluation institutes. Green building evaluation institutes will analyze the basic materials and issue evaluation reports as on-site project inspection is considered.

3.2 Evaluation and Classification

3.2.1 Green building evaluation indicators system refers to a complete description of green building functions according to definition. It can be used to evaluate differences between as-built buildings and definition-based green buildings in terms of functions. Take international experience in green building evaluation systems as reference, emphasize on energy-saving, land-saving, water-saving, materials-saving and environment protection, as far as regional, economic and social situations of our country are concerned, and build a China-featured green building evaluation indicators system.

Green building evaluation indicators system consists of six indicators, viz land-saving an outdoor environment, energy-saving and energy utilization, water-saving and water resources utilization, materials-saving and materials resources utilization, indoor environment quality and operation management. Currently basic data for green building evaluation in our country are not sufficient. For example, as for data of energy consumption in production process of all building materials, emission amount of CO_2, fixed amount of CO_2 of all different vegetation and trees, there lacks corresponding databases, which makes the standard for quantitative evaluation hard to define scientifically. As a result, those terms that are not mature or impossible to be quantitative now will not be included here. As further development of related basic research, the evaluation will be gradually improved.

Each indicator contains controlling options, general options and prior options. Controlling options are mandatory conditions for green buildings; general options and prior options are optional conditions for classifying green buildings, while prior options refer to those for great difficulty, intensive integration and high degree of green coverage.

3.2.2 There are totally 76 controlling options, general options and prior options for residential buildings, where there are 27 controlling options, 40 general options and 9 prior options. As for public buildings, there are totally 83 controlling options, general options and prior options, where there are 26 controlling options, 43 general options and 14 prior options.

Besides satisfying all controlling options, one-star, two-star and three-star shall also satisfy the requirements of general options and prior options in the list.

When certain article in the standard is not applicable to the conditions of a building, like the region, climate and building type, the article can be excluded from evaluation.

Then total options involved in evaluation will accordingly be reduced, and requirement for the number of options can be adjusted proportionally.
Suppose in the list, the number of general options for one indicator totals a, and that the number of general options required by certain star level is b, and then the proportion is p=b/a. When there are some articles that are excluded from evaluation, the number of general options in evaluation will decline. For this case, adjustment can be made according to the specified proportion p, requirement for the number of general options is adjusted to [number of general options in evaluation×p]. For instance, there are 6 general options for the indicator of energy saving and utilization for residential buildings, and one star requires 2 general options, so p=1/3; since central heating and air-conditioning system is not adopted, the number of general options involved in evaluation is reduced to 4, and in this case, the number of general options required for one star is reduced to [4×(1/3)], and take the result of 1, removing the mantissa.

4 Residential Buildings

4.1 Land Saving and Outdoor Environment

4.1.1 In the process of building, the original terrain of the land shall be maintained as well as possible, so that additional investment on flatting the land and construction workload can be reduced, and also destruction on original ecology due to land construction can be avoided. The valuable trees, pools and water systems of the land not only possess high ecologic value, but inherit historical and culture heritage of the region where the land is located, and they are also important scenery sigh of the region. Therefore, they shall be protected according to related state regulations including Urban Green Coverage Regulations (No. 100, State Council Direction, 1992). If there is indeed a need to renovate the terrain, water system, vegetation and other environmental factors of the land because of construction and development, after the project ends, the construction party will be inspired to take corresponding measures to restore the land circumstance, reduce changes to the original surroundings and avoid damage to the overall urban environment due to excess land development. Evaluation methods for this article are reviewing land terrain maps and related documents.
4.1.2 Confirmation on construction site of green buildings is an important precondition to determine whether outside environment of green buildings is safe or not. This article will bring requirements mainly on site selection for green buildings and avoidance to dangerous sources.
As it’s known that natural disasters like flood and mud-rock flow, can cause fatal damage to construction lands. According to related information, radon, a kind of colorless and smell-less carcinogen that mainly exists in soil and stones, can generate huge harm to human bodies. Electromagnetic wave radiation can generate two kinds of effect on human bodes: one is heat effect by electromagnetic wave, and when

human bodies absorb certain amount, high-temperature physical effect will appear and finally leads to pathological changes like neurasthenia and decline in leucocyte; the other effect is non-heat effect, and when electromagnetic wave affects human bodies for a long time, it will cause physical changes like those on heartbeat frequency and blood pressure and physical effects like insomnia and amnesia, which have big effect on pregnant ladies and fetus and in serious cases can lead to fetus malformation or abortion. Electromagnetic wave radiation has no color nor smell nor shape, and it can penetrate through a lot of substances including human bodies. If human bodies are exposed to certain amount of radiation that crosses the safe line for a long time, cells will be injured or killed in a large scale and it can lead to a slew of illness. There a lot of polluting sources that can produce electromagnetic wave radiation, such as TV broadcast tower, radar station, communication transmission station, transformer substation, high-voltage wires, etc. Plus, in oil depots, gas stations and toxic material workshops, there exist possibilities of fires, explosion and toxic gas leakage. Hence, in selection of sites for green buildings, related state security regulations must be abided by.

Evaluation methods for this article are reviewing site-inspection reports and rationality of replying measures.

4.1.3 At present, it frequently appears that use of residential land per capita exceeds related state standards, which is against requirements on land saving. So the indicator of maximum usage of land per capita is put forward here.

Evaluation methods for this article are reviewing related design documents.

4.1.4 Indoor and out door sunlight environment, natural daylighting and ventilation conditions for residential-related buildings (including residential buildings and corresponding public buildings) are closely connected with indoor air quality and outdoor environment quality, and they are directly affecting livers' mental and physical health as well as living quality. To guarantee basic sunlight, daylighting and ventilation conditions for residential buildings, this article argues that requirements on sunlight standards for residential buildings in GB 50180 of Regulations on Planning and Design of Urban Residential Area shall be satisfied.

When performing under this article, the following items in requirements on sunlight standards for residential buildings in GB 50180 of Regulations on Planning and Design of Urban Residential Area shall be precisely understood:

1. Be clear of definition of small, medium and big cities. Article four in City Planning Law of the People's Republic of China stipulates: big city refers to a city where urban people and non peasants in nearby outskirts come up to a population of more than 500,000; medium city refers to a city where urban people and non peasants in nearby outskirts come up to a population between 200,000 and 500,000; small city refers to a city where urban people and non peasants in nearby outskirts come up to a population of less than 200,000.

2. Residential buildings for old folks refer to the residential buildings that are specially designed for old people and their daily lives, and that are in line with their psychological and physical demand. These buildings include old folks houses, old folks apartments, old folks' home, etc. Old people's physiology, life style and their health need determined the limitation of their movement and their special demand for the environment. So all facilities for old people shall be set at higher standards. Meanwhile, there are no additional conditions when carrying out this regulation.
3. As for some frequent issues in building decoration and city business activities, any fixed outdoor facilities are not involved in original planning and design that have been approved, such as newly added air-conditioners, small articles, statues and billboards, shall not lower the sunlight standards for vicinal residential buildings and houses.
4. Sunlight standards for new residential buildings under the project of old quarters can be properly lowered, which means the standards can be lowered only when the original standards are really hard to meet in old quarters transformation. At the same time, to guarantee residents' benefits, no matter in what situation, the lowered sunlight standards for residential buildings "must not be below 1 hour of sunlight in severe cold days." And more, it's only applicable to new residential buildings under each construction projects to properly lower the standard. The sunlight standards for any other residential buildings must still abide by related regulations.

In regions less than north latitude 25°, it's better to consider visual hygiene requirement. According to overseas experience, when horizontal distance between two residential buildings is not less than 18m, the requirement can be basically satisfied.

Evaluation methods for this article are reviewing design papers and sunlight simulation analysis reports.

5. Native plants have strong adaptive ability. Planting native plants can ensure fertility of plants, reduce insect pest and effectively slash maintenance fees. Evaluation methods for this article are reviewing planning and design proposals as well as plant breeding reports and also verifying the site.

4.1.6 "Green coverage rate" is an important sign to evaluate environment quality of the residential area. Based on planning practice on residential areas in our country, when green coverage rate hits 30%, a good environment is in place. This indicator will be determined after comprehensive analysis of related indicators and feasibility connected with number of layers in the building, density and space between buildings. Green coverage rate refers to the percentage of total green coverage area in total residential area (%). All kinds of green areas contain public green, green beside residential buildings, green affiliated to public service facilities and roadside green (green inside road red lines), including roof green for underground or half-

underground buildings that are built for covering soil by local plant green and for residents to go in and out, excluding manmade green on other roofs and terrace.
"Per capita public green indicator" refers to a precondition to build a relaxation area for different residents in the residential area, and it's also a basic condition for all-level daily relaxation activities of the residents and optimizing living environment as well as improving environment quality. Therefore, according to related regulations in GB 50180 of Regulations on Planning and Design of Urban Residential Areas, and considering that residential areas mostly consist of living quarters, a requirement that "per capita public green indicator shall not be less than $1m^2$ " is requested here.
Layout for public green shall follow the style of combination of concentration and decentralization, big and small, in order to meet the demand of different residents. Basic requirements for centralized green land shall be satisfied: width is not less than 8m, and area is not less than 400 m^2 , in order to facilitate settings of fundamental facilities in the green land and satisfy relaxation need. Public green land shall satisfy the requirements on sunlight environment: there should be no less than 1/3 of green land that is beyond standard shadow line of buildings to make it easy for people's outdoor activities.
Evaluation methods for this article are reviewing planning and design or whether indicators of green coverage and per capita public green is in line with the standard, and also whether green land layout is line with related regulations on "green land" in GB 50180 of Regulations on Planning and Design of Urban Residential Areas.

7. Polluting sources in this article mainly refer to: schools and playgrounds that often produce noises, food stores, repair stores, boiler workshops and garbage transfer stations that often generate smoke, gas, dust and noises. In Planning and design, layout shall be properly made or make proper isolation by means of green coverage, mainly based on project nature.
Evaluation methods for this article are reviewing the layout of planning and design or the rationality of replying measures, or inspecting the environmental indicators related with noises, air quality, water quality and light pollution after put into use.

7. In the process of construction, there may generate various polluting materials that will affect outdoor air quality, mainly including dust from construction and exhaust gas emission. In the construction design proposal submitted by the constructing unit, technical treatment and procedures that can effectively control down the dust have to be presented and actually implemented, to reduce pollution to the air caused by construction.
To decrease damage to the soil during construction, all possible effect on soil caused by various pollution sources and destructive factors shall be recognized based on the features of the construction project and soil conditions of the construction land, and corresponding measures and actions shall be offered to avoid, eliminate, mitigate erosion and pollution against the soil.

Sewage from construction site, if not properly treated and discharged, will cause negative effect on civic drainage systems and water ecologic systems. Therefore, the requirements in GB 8978 of General Standard on Sewage Discharge must be strictly executed.

Noise from construction refers to the sound generated in the time of construction that disturbs the surroundings. Noise-lowering measures shall be established for construction sites, to make noise emission reach or better than the requirement in GB 12523 of Noise Limitation for Construction Sites.

Polarizing light generated from electric welding on construction sites and floodlight used in night work, is a main source of light pollution in construction. Construction units shall select proper lighting methods and techniques, to reduce light pollution to non-lighting area and nearby area at night as much as possible.

To set fences in construction sites, the height and materials must reach related local requirements. And safety measures shall be adopted to secure surrounding people and facilities near the construction site.

Evaluation methods for this article are reviewing related documents regarding the control in construction, including the submitted environment protection proposal written by the project team, documents of practice records (including photos and videos), self-evaluation reports on the result of environment protection, and certification of standard accomplishment on evaluation on environment-influencing factors, like dust, noises and sewage discharge, issued by local environment protection bureau or construction committee or other functional authorities.

7. Pursuant to related regulations in GB 50180 of Regulations on Planning and Design of Urban Residential Areas, corresponding public service facilities in residential area shall include the following nine facilities: education, medical care and hygiene, culture, physical education, business service, financial post service, community service, civic public facilities and administrative management. Corresponding public service facilities in residential area, refer to those facilities for satisfying residents' basic physical and mental needs, and they are also indispensable part to guarantee residents' living quality. Therefore, this article requests corresponding requirements, mainly aiming at:

1. In related projects for corresponding public service facilities in residential area, complex buildings can be centralized to save land and provide convenience for residents to select and use, as well as to improve usage rate of the facilities.
2. The public facilities corresponding to middle schools, clinics, business settings and community clubs, can break up the scope of the residential area and share with nearby areas. This can not only save land but make it convenient to use as well as save investment.

Evaluation methods for this article are reviewing whether the setting of public service facilities can satisfy residents' need in the planning and design, and whether it is

complementary with the facilities in nearby cities, and whether related projects are properly centralized and set.

7. Fully utilizing still usable old buildings is not only an important measure for saving land, but a controlling condition to avoid demolishment and disordered construction. “Still usable old buildings” refer to the old buildings whose quality can ensure safety to use, or those old buildings that can ensure safety after little renovation and reinforcement. As for the utilization of old buildings, they can be retained as the planning requires or their original nature for use can be changed and incorporated into the planning building project.

Evaluation methods for this article are reviewing related design documents.

4.1.11 Surrounding noise is a key evaluation point as for green residential buildings. According to different types of residential areas, current noise situation around the site are required to be inspected. And surrounding noises after the plan is implemented are required to be predicted, to make them in line with the regulations on surrounding noises standards for different types of residential areas in GB 3096 of Surrounding Noises Standards for Urban Areas. As for the residential buildings flanking traffic trunk lines, efficient sound-proof measures shall be taken for street-side windows and fences.

Evaluation methods for this article are reviewing evaluation reports on surrounding effect and on-site test reports after running.

4.1.12 Heat island effect refers to a phenomenon that the temperature in a region (usually referring to within a city) is higher than that of nearby outskirt, which can be indicated by heat island intension, i.e. temperature difference between two representative test points (temperature difference between a place in the city and a weather testing point in outskirt). The coming of “heat island” phenomenon in summer not only increases the chance of sunstroke of people, but meanwhile forms pollution of actinochemistry smoke, and it will also increase energy consumption for air-conditioners of buildings, generating severe negative impact on people’s work and lives. As for residential areas, due to the influence caused by the factors in the planning and design, like building density, building materials, building layout, green coverage rate, water scenery facilities, heat exhaust from air-conditioners, heat exhaust from traffic, and heat exhaust from food cooking, “heat island” phenomenon may also appear outdoor in residential areas.

The feature of heat island intension is strongest in winter, weakest in summer and moderate in spring and autumn. The difference of average temperature in urban and rural areas is around 1℃. This standard adopts the outdoor heat island intension in typical summer days (difference in outdoor temperature in residential area and that in outskirt, viz average difference in temperatures between 8.00 a.m. and 18.00 p.m.) as the evaluation indicator. 1.5℃ is the controlling point, which is based on the average value from the test of temperatures in summer in Beijing, Shanghai, Shenzhen, etc. for lots of years.

Evaluation methods for this article are reviewing heat island simulation forecast analysis reports or on-site test reports after running in the planning and design for the residential area.

4.1.13 These years, the issues regarding re-wind and second wind gradually come into big shape. Because of improper single building design and mass layout, there are a lot of cases that passengers find it hard to walk or strong wind blows off stuff breaking glass. As research result indicates, if the speed of wind above 1.5m from the ground in walking area near buildings（v）is ＜5m/s, it will not affect basic requirements for people's normal outdoor activities. Plus, bad ventilation will seriously prevent air flow, and create windless area or eddying area in some regions, which is very harmful to outdoor heat exhaust and pollution dispersion, so it shall be avoided to the best of abilities. Winter will be the season for major evaluation, since for majority of cities, most cases that wind speed is around 5m/s happen in winter.

Natural ventilation in summer and transitional seasons is very important for energy saving for buildings. And more, it's involved with comfort of outdoor environment. Not only hot and poor environment for large outdoor places in summer will affect the sense of comfort, but when the temperature exceeds ultimate limit, long-time stay will cause uncomfortable ness or even sunstroke in a large proportion of people.

Evaluation methods for this article are reviewing wind simulation forecast analysis reports or on-site test reports after running in the planning and design for the residential area.

4.1.14 Plants to be planted shall represent local features. Arbor is a necessary species of plants for multi-green coverage, since it can not only provide good conditions for residents to shelter from sunshine and relax, but improve ecologic environment of the residential area. If choosing single and big lawn, it will cost much in maintenance and the ecologic performance will not be good.

Evaluation methods for this article are reviewing whether multi-green coverage is adopted and whether number of planted arbor reaches standard in the planning and design or after actual planting.

4.1.15 Prior developing public transportation is an important replying action to solve urban traffic problems. To make it convenient for residents to choose from public transportation tools, in land planning, it shall be emphasized that directional setting of access to residential areas is flexibly connected with urban transportation network.

Evaluation methods for this article are reviewing whether the walking distance between the land and bus stations reaches the standard and whether it's flexibly connected with nearby ground transportation.

4.1.16 Enhancing water penetration ability of land can gradually mitigate increasing temperature in urban and residential areas and dryness in the climate. And it can alleviate heat island effect, adjust micro-climate, increase the retention of rainwater and ground water for the land, improve ecologic environment and reinforce underground permeable ability of natural rainfall, supplement ground water, diminish

ground subsidence caused by decline in water table, mitigate the load of drainage systems, decrease peak radial rainwater flow and improve drainage performance. This article advances related regulations on the area of water penetration. The lands of water penetration mentioned in this article include natural bare land, public green land, green coverage land and the hollowed and planked land whose hollowed area equals or exceeds 40% (like sod bricks). Land of water penetration ratio refers to the proportion of the area of land of water penetration in total outdoor floor area.
Evaluation methods for this article are reviewing whether the area of land of water penetration reaches the standard in the planning and design proposal and whether the adopted measures are reasonable.

4.1.17 Development and utilization of underground space is a major action for urban land saving, and it's one of the measures that land-saving promotes. It shall be noticed that in utilizing underground space, the issues regarding flexible connection of underground access and over-ground, ventilation and anti-leakage shall be properly handled combined with local actual situation (like the height of water table).
Evaluation methods for this article are reviewing the rationality of utilization of underground space in the planning and design proposal.

4.1.18 Urban deserted lands include non-constructive land (the lands that are not used yet or not available for use due to various reasons, such as bare rocks, stone-gravel land, steep slope, subsided land, salt and alkali land, wasteland, swampland, deserted kiln cave), warehouses and factory abandoned lands, etc. These lands shall be the prior option for land-saving for cities, because the deserted can be transformed into benefits to improve city environment, and also there is basically no problems related with demolishment and removal or settlement, and it's easy to acquire these lands. Therefore, deserted lands shall be prior considered when selecting green building land, but the original lands have to be inspected or treated. For instance, as to steep lands, they shall be divided into separate stages and reinforced; as to warehouses and factory abandoned lands, test shall be done on whether the soil contains toxic materials and related treatment shall be conducted before the lands can be used.
Evaluation methods for this article are reviewing land-site test reports and the rationality of replying measures in planning and design.

2. Energy Saving and Utilization

4.2.1 The quality of thermal engineering design and thermal air-conditioner design for residential buildings has a big impact on energy consumption of buildings.
Based on the average temperature in January and July, our country's domain of 9,600,000 square kilometers, is divided into five different building climate zones, i.e. severe cold, cold, hot in summer and cold in winter, hot in summer and warm in winter and moderate zones. Except moderate zone, Ministry of Construction has issued and implemented energy-saving design standards respectively for residential buildings in each building climate zone. The energy-saving ratio in the energy-saving

design standards for residential buildings issued by Ministry of Construction is 50%, which means under the precondition that indoor thermal environment remains the same, heating equipment or air-conditioners in new and reconstructed and expanded residential buildings are required to consume half energy. Saving 50% of energy is not the ultimate goal for energy saving for buildings. In recent years, some provinces and cities have already formulated energy-saving design standards for residential buildings that require more than 50% of energy saving ratio, based on the progress of local energy saving work for buildings as well as the level of local economic and technical development. Therefore, this article is included in the items that must be accomplished.

Requirements on thermal engineering performance of fencing structure are the primary fundament in energy-saving design standards for residential buildings. Thermal engineering performance of fencing structure of residential buildings mainly refer to outside walls, roofs, floor heat-transfer coefficient, heat-transfer coefficient and/or sunlight shield coefficient of outside windows, window area vs. wall area, building figure coefficient.

Evaluation methods for this article are reviewing related design documents and on-site verification.

4.2.2 As for the central air-conditioning systems that are electric-driven, energy consumption of cool sources (mainly referring to cool water unit set and unit-style air-conditioner) is the main body of energy consumption of the air-conditioning system. So the energy-utilization ratio of cool sources is critical for saving energy. Performance coefficient and energy-efficiency ratio are one of the major indicators that reflect energy-utilization ratio of cool sources. Therefore, performance coefficient and energy-efficiency ratio of cool sources shall be included into items that must be accomplished.

As the persistent development of construction industry and further popularization of air-conditioners, China has become a powerful manufacturer of air-conditioning equipment, and most of world-class brands have established joint-ventures or wholly-owned enterprises in China. It greatly improved the level of quality of machinery sets, and the products have been widely applied in all kinds of buildings. General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and State Standardization Management Committee released, on August 23, 2004, three mandatory state energy efficiency standards, including GB 19577 of Energy Efficiency Limitation and Energy Efficiency Class for Cool Water Machinery Sets, GB 19576 of Energy Efficiency Limitation and Energy Efficiency Class for Unit-style Air-conditioners, etc. And the regulations were implemented from March 1, 2005. Products are classified into five classes according to energy efficiency, in the purpose of coordinating with implementation of energy efficiency indication system of our country. Definition of energy efficiency classification: Class 1 is the goal that enterprises strive for; Class 2 stands for the threshold for energy-saving

products (defined based on minimum life circle cost); Class 3 and 4 stand for the average level of our country; products of Class 5 are those to be eliminated. The purpose is to provide definite information for consumers to help them choose to purchase and promote the market of high-efficient products.

In GB 50189 of Energy-saving Design Standard for Public Buildings, a state standard implemented from July 1, 2005, Article 5.4.5 and 5.4.8, two mandatory articles, stipulate the limitation of coefficient of performance (COP) in cooling of water cooler (heat pump) machinery sets and the limitation of energy-efficiency ratio for unit-style air-conditioners. As for the residential quarters where central air-conditioning systems are adopted, or residential buildings where the design of household central air-conditioning systems is already completed in the design phase, the requirements on energy efficiency of cold sources shall be the same as regulations on public buildings. Specifically, comparing to the standard of "limitation of energy efficiency and energy efficiency class", water cooler (heat pump) machinery sets shall adopt the required values in the standard of "List 2 Indicators of Energy Efficiency Class": plunger/eddy style adopts Class 5, and water-cooling and centrifugal style adopts Class 3, and screw units machine adopts Class 4; in unit-style air-conditioners, Class 4 in the standard of "List 2 Indicators of Energy Efficiency Class" is adopted.

Evaluation methods for this article are checking design papers and instructions and checking the energy efficiency value of installed equipment.

4.2.3 If central heating equipment or central air-conditioner sets are used to provide heat (coldness) for residential buildings, it will be involved with issues regarding user payment on heating and air-conditioner fees. As a chargeable service item, it's necessary that users can self-adjust room temperature, so a setting by which users can self-adjust room temperature shall be set up; however, charges are associated with how much heat (coldness) users consume, as a main base for charging, it's necessary to have measuring equipment to calculate the amount of heat (coldness) that user consume as well as calculation methods to determine distribution of payment.

Evaluation methods for this article are checking technical measures relating to room temperature adjustment facilities and distribution of consumed amount by household in papers and instructions.

4.2.4 Residential buildings' shape, heading direction, distance of layers, window area vs. wall area and sunlight-shield measures on windows, will affect not only external quality of the building, but internal quality like ventilation, day lighting and energy saving, etc. As green buildings, architects shall be encouraged to fully utilize advantageous conditions of the land, and try to avoid disadvantageous factors, dedicating to the design of these.

Evaluation methods for this article are reviewing related design documents and on-site verification.

4.2.5 Energy saving design and selection need to be made on all energy-consuming systems and equipment. For example, as to the residential buildings using central

heating equipment and air-conditioning systems, cold and hot water (air) is distributed to users by water pump and fan. And if improper water pumps and fans are chosen, their consumption of energy will occupy a considerable proportion in the whole heating and air-conditioning system. Related regulations have been made in Article 5.2.8, 5.3.26 and 5.3.27 in GB 50189 of Energy-saving Design Standards for Public Buildings (implemented from July 1, 2005), which can serve as reference for execution. The evaluation methods are checking the calculated limitation of energy consumption in transmission of the water pumps and fans selected in papers and instructions.

For another instance, as to energy-saving requirements for water supply systems:

1. Proper zoning of water supply systems for high buildings. Low zones fully make use of the pressure of civic water supply, and when high zones use lowering pressure and zoning, there should not be more than one zone, and water pressure for each zone should not be more than 0.45MPa.
2. As for residential quarters where centralized hot water supply is available, system design is reasonable and effective warm-keeping measures are taken to reduce heat loss in hot water distribution and recycling process. It's required that the difference between temperature of serving water in the water-heating station and the temperature at the least used tap is less than 10℃.

4.2.6 In Article 4.2.2, a controlling option of this section, it's been indicated that energy efficiency of cold sources is a key indicator of energy saving in machinery set operation. As required by general options, energy efficiency of cold sources shall be one class higher than regulated in Article 4.2.2, comparing with GB 19577 of Energy Efficiency Limitation and Class for Water Cooler Machinery Sets and GB 19576 of Energy Efficiency Limitation and Class for Unit-style Air-conditioners.

Evaluation methods for this article are checking design papers and instructions and checking energy efficiency value of installed equipment.

4.2.7 In energy consumption of residential buildings, that of illumination also accounts for a huge proportion, so energy saving as for illumination shall be taken into consideration. As the specialty of residential buildings is concerned, room illumination is in the charge of the individual resident and not easy to interfere with. So this article will not discuss room illumination. Illumination in public places and parts of residential buildings is mainly controlled by design and property management. As green buildings, energy-saving issues on illumination in public places and parts must be addressed. Therefore, this article clearly advances the requirement that high-efficient light source and lightening tools are used and that measures of energy-saving control are adopted.

There is natural light in many public places and parts of residential buildings. For example, there are external windows in stair wells of most residential buildings. In

areas hit by natural light, timing or photoelectric controlling facilities shall be equipped with illumination systems, to properly control on-off of illumination systems, and meet the purpose of saving energy while at the same time ensure their availability. Evaluation methods for this article are reviewing related design documents and on-site verification.

4.2.8 As for the residential buildings where central heating equipment or central air-conditioning systems are set, such as central fresh air and exhaust systems. Because there is considerable amount of energy contained in exhaust air in the heating and air-conditioned area (or room), when technical and economic analysis turns to be viable, centralize the energy mentioned above for recycling in order to harvest remarkable benefits in energy saving and environment. As for the buildings not equipped with central fresh air and exhaust systems, bidirectional fresh air and exhaust ventilation devices with heat recycling function can be adopted. They can not only satisfy people's requirement on fresh air hygiene, but slash energy consumption in large amount on fresh air treatment. This kind of ventilation device usually combines heat-switch equipment, fresh air equipment and exhaust equipment together. And some of them can be installed on outside walls. Due to small amount of air, they are only applicable to not big single rooms, which bring some difficulty in design of vertical side of buildings. But they are strongly independent and applicable to single rooms; another kind of this device needs additional air pipes to be connected, and the positions of entrance and exit of air also need to be taken care of in design, and meanwhile excess pressure at the exhaust point outside of the device as well as requirement on resistance of air route has to be paid attention to, and if not sufficient, corresponding measures shall be taken. Because it's related with the issue of rationality in technical and economic analysis, this is regarded as a general option. Evaluation methods for this article are reviewing related design documents and on-site verification.

4.2.9 Article Two of Renewable Energy Law of the People's Republic of China: "Renewable energy stated hereof, refer to non-fossil energy, like wind energy, solar energy, water energy, biomass energy, geothermal energy, ocean energy, etc." Article Seventeen: "The country encourages units and individuals to install systems using polar energy, like heated water systems powered by solar energy, heating and cooling systems powered by solar energy, electricity generation systems powered by polar energy, etc."

Considering the current situation of renewable energy' application in buildings, the application of polar energy is relatively mature, and it means polar energy is applied in water heater to provide heated water and heat; and also geothermal energy is applied to directly provide heat, or geothermal energy heat pump systems are applied to provide heat and air-condition.

It's a very hopeful undertaking to explore geothermal water between 60~90℃ to be used in northern cities and towns for central heating. It means part of coal with high-

level chemical energy is replaced by low-temperature geothermal energy, and also the pollution of coals to the environment is diminished. It's a job that can save energy and also protect environment. Geothermal resources are developed in longtime geologic times. Like minerals, they cannot be renewed in a short time, which is different from ground water. Geothermal resources shall be developed in separate phases, and exploration and acquisition shall be combined, to gradually get to know the potential of geothermal files in the process of development and utilization; if they are properly utilized or properly irrigated back, they can be regarded as non-polluting resources; different from other minerals, because heat will give off, geothermal water below 90℃ cannot be stored for a long time or delivered in a long distance. Geothermal resources are scattered resources, so they can only be used nearby; due to different depths of the resources, there is huge difference in investment of sinking wells; there is also significant difference in three factors that can affect utilization, namely water amount, water temperature and water quality. And even at the same place, when gaining water from different strata, the three factors may differ a lot from each other.

In recent years, there is rapid development in application of geothermal heat pump in our country. According to GB 50366 of Engineering Technical Regulations on Geothermal Heat Pump Systems, the definition of geothermal heat pump system is: using soil or ground water, surface water as low-temperature heat sources, a heat-providing air-conditioning system composed of water source heat pump set, geothermal energy acquisition system, indoor system and control system. According to different geothermal energy acquisition systems, geothermal heat pump systems are sorted into three forms, i.e. underground buried pipe, ground water and surface water.

Our country started application of renewable energy in buildings not long ago, and due to different climates and economic development levels in different regions, there are no detailed summarized survey data regarding the percentages that energy consumed in heating, air-conditioner, cooling, electric, illumination, cooking and hot water supply respectively account for in the overall. Therefore, there is much difficulty in calculating the proportion of consumption of renewable energy in the total energy consumption of buildings. But everything has to start from the beginning, according to the data collected by experts about energy consumption of buildings by terminal purpose in 2001, which indicates urban heating accounts for 37.4%, rural heating 6.44%, cooling by air-conditioner 11.5%, illumination and home electrics 7.0%, cooking and hot water 37.7%, conclusion can be drawn that hot water, heating and air-conditioners account for majority of energy consumption of buildings.

So, the 5% requested in this article can be identified by using following indicators: (1) if in quarters, more than 25% of households use solar energy water heaters to provide most of hot water for daily life, then it can be regarded that this article is satisfied; or (2) in quarters, 25% of households use geothermal heat pump systems, then it can be regarded that this article is satisfied; or (3) in quarters, 50% of households use geothermal water for direct heating, then it can be regarded that this article is satisfied.

It shall be clarified that when using geothermal heat pump systems (including systems of direct heating by geothermal water), ground water resources must not be imperiled. Here are some mandatory articles in GB 50366 of Engineering Technical Regulations on Geothermal Heat Pump Systems, i.e. 3.1.1 before designing geothermal heat pump system proposals, investigation shall be conducted on the situation of the project land, and inspection shall be done to shallow-stratum geothermal resources. 5.1.1 Heat exchange systems for ground water shall be designed according to the inspection materials on water and geology, and reliable back-irrigation measures must be taken to guarantee that all ground water after replacement of coldness or heat is irrigated back to the same aquiferous stratum, and no waste or pollution is allowed against ground water resource. After the system is put into use, amount of pumped water, amount of back irrigated water and water quality shall be monitored. Plus, if geothermal heat pump systems use ground-buried-pipe heat exchanger, forecast shall be made on the trend of change in soil temperature after long-term application. Because of different duration of application of heating equipment and air-conditioners in the applied regions, as for the regions mainly using heating equipment, the heat absorbed from the soil (in winter) will be higher than the heat discharged from the underground soil (in summer), and after long-time use (like 5 years, 10 years, 15 years), soil temperature will gradually decline so that operation efficiency of machinery sets in winter will decline with less output, and the sets may even not work regularly. As for the regions mainly using air-conditioners, the heat discharged from the underground soil (in summer) will be higher than the heat absorbed from the soil (in winter), and after long-time use), soil temperature will gradually grow so that operation efficiency of machinery sets in summer will also decline with less output. As a result, in the design phase, simulation calculation shall be made on the balance of trend of change in soil temperature after long-term application (such as 25 years). Or consider replying measures to cases that there is decline or increase in underground soil temperature. For example, maybe set up a cooling tower; maybe set a ground-buried-pipe geothermal heat pump to provide hot water; maybe se up supplementary heat sources; or design complex systems, etc.

Evaluation methods for this article are calculating according to design documents and on-site verification.

4.2.10 Under the precondition of Article 4.2.1, limitation for energy consumption of heating equipment or air-conditioners can be figured out, according to the calculation methods for energy consumption of heating equipment or air-conditioners as stipulated by corresponding energy-saving standards for residential buildings. And some energy-saving design standards for buildings have provided definite limitation for energy consumption of heating equipment or air-conditioners. By using the same calculation methods of energy consumption as stipulated in the standard, make calculations on actual energy consumption of heating equipment or air-conditioners of currently evaluated residential buildings. If the result is lower than 80% of limitation

stipulated by corresponding energy-saving standards for residential buildings, it means that the residential buildings under evaluation perform excellently and satisfy the requirements of this prior option. If the actual energy consumption of heating equipment or air-conditioners of the residential buildings can be acquired by monitoring, then the monitored actual can be compared with the limitation stipulated by the standards, and it can be judged whether it satisfy the requirement of this prior option based on the comparison.

Evaluation methods for this article are calculating based on design documents or actual monitoring.

4.2.11 According to the explanations in Article 4.2.9, the 10% requested in the article can be identified by following indicators: (1) if in quarters, more than 50% of households use solar energy water heaters to provide most of hot water for daily life, then it can be regarded that this article is satisfied; or (2) if in quarters, 50% of households use geothermal heat pump systems, then it can be regarded that this article is satisfied; or (3) if in quarters, all households use geothermal water for direct heating, then it can be regarded that this article is satisfied.

Evaluation methods for this article are reviewing related design documents and on-site verification.

4.3 Water Saving and Water Resources Utilization

4.3.1 As for residential buildings, they are involved with not only utilization of indoor water resources, water supply and drainage systems, but drainage of outdoor rainwater and sewage, utilization of regenerated water, green coverage, water supply for scenery, and other issued related with urban macro-water environment. It's a necessary condition to make master-plans for water environment of buildings considering the environment near the buildings. Therefore, before making design for green buildings, systematic planning shall be conducted on the water environment of buildings, based on the consideration of water supply and drainage, water resources, climate and other objective factors of the area. Planning proposals on water system shall be formulated, to increase recycling rate of water resources and reduce civic water supply and sewage drainage.

Planning proposals on water system include confirmation on quota of water consumption, estimate water consumption amount and balance of water amount, design of water supply and drainage system, water-saving tools, sewage treatment, utilization of regenerated water, etc. Based on different situations of water resources and climate features in different regions, planning proposals on water system may involve different content. For instance, sewage recycling doesn't have to be considered for regions with sufficient water. Therefore, specific contents of the proposal shall be based on regional reality.

Quota of water consumption, balance of water amount and confirmation on water consumption amount shall be considered in the framework of water consumption in

the residential area, and shall be scientifically and properly determined based on actual situation in reference with GB/T of Standards of Water Consumption Amount for Urban Residents as well as quota of water consumption stipulated by other related water consumption standards, while considering local economic performance, climate, habit of water consumption and dedicated plans on regional water.

Utilization of rainwater, regenerated water, etc. is an important water-saving measure, but it shall be analyzed based on specific situation. As for rainy regions, utilization of rainwater shall be emphasized, and for inland regions short of water, utilization of regenerated water shall be valued, while for the regions with abundant fresh water, it's not recommended to recycle sewage. But for all regions, utilization of water-saving tools is supposed to be considered.

Evaluation methods for this article are reviewing reports on planning proposals of water (environment) systems of buildings and on-site verification.

4.3.2 To avoid leakage of or damage to pipe networks, following measures can be adopted:

1 Pipes used in water systems must be line with the requirements of current product industrial standards. And new-pattern pipes shall be in line with the requirements of enterprise standards, as well as the standards of the enterprises that passed evaluation or identification by experts as required by documents of related administrative and governmental supervisory authorities.

2 Choose high-performance valves, zero-leakage valves, etc. For instance, additional soft sealed valves or butterfly valves can be installed before washing drainage valves, fire hydrants, ventilation valves.

3 Make proper design for water supply pressure, to avoid sustained high water supply pressure or violent change in water supply pressure.

4 Choose high sensitive water meters, and install graded water meters according to water balance test standards, with 100% of water meter installation rate.

5 Go on basic treatment on pipelines and cover with soil. Control the depth of pipelines, reinforce monitoring the construction of pipeline project and guarantee the quality of construction.

The amount of water leaked from pipeline network in quarters includes: amount of water leaked from indoor bathrooms, amount of water leaked from roof water tanks and that from pipe network.

Evaluation methods for this article are reviewing related design documents on prevention measures against pipe network leakage, and reviewing reports on measuring of amount of water consumption on the spot.

4.3.3 Following the principle of "thrift first", prior choose the equipment, apparatus and tools released in the (product) index of No. 5 Announcement of Water-saving Equipment Currently Encouraged to Develop in China, by State Economic and Trade

Committee of the People's Republic of China in 2001. According to different water consumption situations, water-saving taps, water-saving lavatories, water-saving showering settings, etc. shall be properly chosen. As for the residential buildings that are decorated by industrial standards, water-equipment shall be adopted in all room suites. All water-consuming equipment shall follow the requirements in CJ 164 of Water-saving Equipment and GB/T 18870 of Technical Conditions and General Management Rules on Water-saving Products.

The following water-saving equipment can be selected:

1 Water-saving tap: air-compressed tap, tap with ceramic valve, tap with the function of automatic closure when no water runs, etc;

2 Lavatory: water-pressure, anti-stink and rushing 6L direct-drainage lavatory, 3L/6L two-baffle water-saving siphonal lavatory, direct-drainage water-saving lavatory less than 6L or responding water-saving lavatory less than 6L. For the regions short of water, lavatories with water tank connected to hand-washing tap can be an option, and for the regions in severe shortage of water, non-water vacuum indraft lavatories can be tried;

3 Water-saving shower: water temperature adjuster, water-saving shower, etc;

4 Water-saving electrics: water-saving washing machine, dishwasher, etc.

And also water saving can be effectuated significantly by means of lowering pressure and limiting water flow in water supply systems, like lowering the water supply pressure to not more than 0.2MPa before water comes to household water meters from water supply systems. In the buildings with central hot water supply systems, complete hot water cycling systems shall be set, and hot water shall come out within 10 seconds after the tapping point is opened.

And water saving can also be realized through other means, like non-traditional water resources, high-efficient water-saving irrigation methods.

Water-saving rate in this article refers to the percentage of saved water amount by means of water-saving facilities and non-traditional water resources in the total designed water amount,i.e. total water-saving rate, which can be calculated via the following formula:

$$R_{WR}=(W_n-W_m)/W_n$$

In the formula, R_{WR} ---water-saving rate, %

W_n-----ration of total water consumption amount, following the ration standard, the total water consumption for buildings estimated based on actual population or purpose, m^3 /a;

W_m----total amount of actual civic water supply, a total calculated according to all water consumption approaches in the residential area, m^3 /a.

Evaluation methods for this article are reviewing product instruction book, product test reports and reports on operation data (reports on measuring of water consumption amount).

4.3.4 Water consumption and supplement for scenery in the residential area is part of urban scenery water consumption. Based on the consideration of urban water environment planning, nearby environment, terrain and climate features, a proper area proportion of water scenery in the residential area shall be provided, to avoid much waste in water resources for beautifying the environment. As for scenery water, rainwater and regenerated water shall be the prior option, instead of civic water supply and water from self-prepared wells. And more, cyclic water treatment equipment can e set to recycle the water for scenery.

Evaluation methods for this article are reviewing completion papers, design instruction book and on-site inspection.

4.3.5 Non-traditional water resources like rainwater, regenerated water, etc. in the process of storage, transportation and distribution, shall be guarded with sufficient capability of disinfection and sterilization, and water quality cannot be contaminated to guarantee the safety of water quality. Water supply systems shall be equipped with related switch facilities like back-up water resources, spilling device, etc. to guarantee the safety of water amount. Certain safeguard and monitoring and controlling measure shall be adopted in the whole process of treatment, storage, transportation and distribution for rainwater and regenerated water, in accordance with related requirements in GB 50335 of Regulations on Engineering Design of Sewage Regeneration and Utilization and GB 50336 of Regulations on Water Design for Buildings, to ensure hygiene and safety and not to generate negative impact on human health and the ambience. As to seawater, due to the high percentage of salt, it has to be taken into consideration anti-septic issues for pipes and equipment and then issues regarding drainage after use.

When using rainwater and regenerated water for scenery in residential areas, in the planning and design phase for water scenery, the design and safeguarding measures for water quality shall be combined into consideration. Safeguarding measures include: make use of marsh techniques to perform pre-treatment of scenery water; use mechanical facilities scenery water, to reinforce water cycling and enhance disturbance on the water surface, and to destroy the living environment of algae; adopt biological measures, nourishing aquatic animals and water plants to absorb nutritious salt from the water, and eliminate potential factors that may lead to over-nutrition and corruption in water timely.

Evaluation methods for this article are reviewing completion papers, design instruction book and on-site inspection.

4.3.6 In the planning and design phase, the route of rainwater (including rainwater on the ground and that on building roofs) flow shall be planned and designed well based on consideration of the terrain features of the residential area, to reduce the chance that rainwater is contaminated. Rainwater penetration measures include: use water-permeable materials the pave public activity ground, sidewalk and open parking lot, to make it convenient for rainwater to penetrate, and for example, use multi-hole pitch

road surface, multi-hole concrete road surface, etc.; replace non-permeable tubes with permeable tubes or perforated tubes for draining rainwater, with both functions of penetration and drainage; plus, the following can be adopted to increase penetration, i.e. permeable water storage pool for scenery, roof garden and atrium, permeable well, green land, etc.

Evaluation methods for this article are reviewing completion papers, design instruction book, product instructions and on-site inspection.

4.3.7 It's a very important part of reducing civic water supply to use non-traditional water sources including rainwater and regenerated water as non-drinking water for green coverage, vehicle washing, road washing and garbage workshop washing. There is big potential in green coverage for water saving. If the water for green coverage all or partly comes from rainwater and regenerated water, there will be a significant save in civic water supply. Therefore, as for the regions not short of water, rainwater shall be chosen as the water for green coverage to the best of its advantage; and for the regions short of water, rainwater or regenerated water shall be prior chosen for irrigation. When using rainwater and regenerated water as that for green coverage, water quality shall meet corresponding standards and shall not impose any threat to public hygiene.

Evaluation methods for this article are reviewing completion papers and design instruction book, etc.

4.3.8 In irrigation for green coverage, it's encouraged to adopt water-saving irrigation methods, like spouting irrigation, small-amount irrigation, permeable irrigation, irrigation by low-pressure tube, etc.; it's recommended to use humidity sensor or adjustor that makes adjustment according to climate change; to increase amount of rainwater penetration and reduce amount of irrigation, for green lands, it's recommended to use permeable drainage pipes with both functions of penetration and drainage; when using regenerated water for green coverage, try to avoid the irrigation methods that may lead to aerosol.

The commonly used irrigation methods for green coverage at present are, using special equipment (generator, water pump, pipeline) to add pressure to water, or make use of natural fall of water to distribute the pressed water to irrigation fields, and spout water via sprayer to the air which is then scattered into tiny water drops and evenly spread. It can save 30% to 50% of water than field mass irrigation. Spout irrigation shall be conducted without much wind. When using regenerated water for irrigation, since the microbe in the water is likely to prevail in the air, spout irrigation shall be avoided.

Small-amount irrigation includes dripping irrigation, micro spout irrigation, stream irrigation and underground permeable irrigation. Small-amount irrigation means feeding water to plant roots in a persistent, even and controllable way, by means of low-pressure pipeline and dripping tip or other irrigation device, which saves 50% to 70% of water than field mass irrigation and 15% to 20% than spout irrigation. The

aperture of irrigation device for small-amount irrigation is very small and easy to get blocked. And the water for small-amount irrigation usually has to be purified, precipitated to eliminate big sands and mud, and then filtrated to remove tiny foreign substance. In special cases, medical treatment needs to be done.
Evaluation methods for this article are reviewing completion papers, design instruction book, product instructions and on-site inspection.
4.3.9 Under the principle of "save from the beginning", for the regions short of water, in the planning and design phase, it shall be considered to properly reutilize sewage after treatment, as the water for lavatory flushing and that for outdoor green coverage, scenery, roadside irrigation and vehicle washing. Regenerated water includes regenerated civic water (the source is the water out of urban sewage treatment factories or urban sewage), regenerated water for buildings (the source is the water from daily life drainage, miscellaneous drainage, superior miscellaneous drainage). In selecting what water to use, the following shall be considered, i.e. city planning, environment of the residential area, management methods on water facilities construction in cities, balance of amount of water, etc. and decisions shall be made based on various aspects, namely economy, technology, water quality of the source, stability of water amount, etc.
If there is any central regenerated water factory near the residential area, it shall be considered firstly to use local civic regenerated water or civic regenerated water from the upper reaches; if not, follow the management methods on water facilities construction or other related regulations of the province or city where the building is located, to decide whether to create treatment facilities to treat regenerated water for buildings, while at the same time considering recycling of superior water from miscellaneous drainage, that from miscellaneous drainage and that from daily life drainage one after one. In a word, the selection of regenerated water sources and utilization of regenerated water shall be comprehensively considered in the framework of area master-plan and city planning.
As for regeneration treatment technique, it shall be determined after overall technical and economic comparison, based on treatment scale, features of water quality, utilization and recycling purpose as well as local reality and requirements. Under the precondition that utilization requirements for regeneration are satisfied and operation is stable and reliable, the general fees for infrastructure investment and operation cost shall be controlled at the most economic point. Operation management shall be simple, with convenient control and adjustment. And meanwhile, good security and hygiene conditions are also required. All regeneration treatment technique must have the treatment of disinfection, to ensure the safety of serving water quality.
Evaluation methods for this article are reviewing completion papers, design instruction book, etc.
4.3.10 As for the regions where annual average rainfall is more than 800mm but still shot of water, local climate conditions and features of terrain in residential areas shall

be taken into consideration, besides the measures to increase rainwater penetration, corresponding facilities shall be set to collect, treat, store and utilize rainwater. And rainwater on roofs and other non-permeable surfaces shall also be collected and utilized. In rainwater collection and utilization systems, preliminary rainwater drainage device and rainwater adjustment pools shall be set. The collection and utilization systems can be combined with the design of water scenery of quarters or residential areas. Underdrain is a prior option to collect rainwater, and according to purposes of using water, the collected rainwater shall be separately treated by manpower or imported to water treatment system of the residential area. The quality of treated rainwater shall reach the standards for corresponding purposes, and the water shall be prior considered for outdoor green coverage and scenery.

Rainwater treatment plan and technique shall be determined after comparison of multiple plans, based on local reality. As for separate rainwater treatment, it's recommended to use permeable sink systems which are filled with gravel or other filtrating materials; in southern areas where the climate is suitable, natural purification systems can be used, like oxidative ponds and manmade marsh, and based on the consideration of local climate, local water plants or emergent aquatic plants can be chosen.

Evaluation methods for this article are reviewing completion papers, design instruction book, etc.

4.3.11&4.3.12 Utilization rate of non-traditional water resources refers to the percentage of water used for miscellaneous purposes like scenery, green coverage and lavatory flushing, which comes from non-traditional water resources like regenerated water and rainwater in place of civic running water or ground water, in total water consumption. Based on regulations and standards like GB 50336 of Regulations on Water Design for Buildings, water for lavatory flushing in residential buildings accounts for more than 20%. If this part of consumption is all composed of regenerated water and (or) rainwater (in seaside regions severely short of water, seawater can also be used), and non-traditional water resources like regenerated water is only used for lavatory flushing, then the utilization rate of non-traditional water resources is over 20%; if water for green coverage, roadside irrigation and vehicle washing is also taken into consideration, then there should be more than 10% of outdoor water that can be replace by non-traditional water resources like regenerated water in residential area. Hence, as for the residential buildings that use non-traditional water resources only for lavatory flushing or only for outdoor purposes, the utilization rate of non-traditional water resources can always hit 10%; if non-traditional water resources are adopted for both indoor and outdoor purposes, the rate will be higher, not less than 30%.

If non-traditional water resources adopt the regenerated water from central water regeneration factories or seawater, then there is no problem for the utilization rate to reach 10% and 30%; if non-traditional water resources adopt the regenerated water for

buildings in residential quarters, since the water used for showering and washing in residential buildings accounts for more than 40%, only superior water from miscellaneous drainage is collected as regenerated water resource, and after treatment, the requirement for utilization rate of 10% can be satisfied. If lavatory flushing is also considered, after treatment and regeneration of water collected from miscellaneous drainage, the requirement for utilization rate of 30% can be satisfied; if non-traditional water resources only use rainwater, due to the connection of its utilization amount and rainfall, specific utilization rate cannot be identified. But for residential buildings, economically speaking, if rainwater is collected, treated and utilized as non-traditional water resources, it is usually considered together with superior miscellaneous drainage or miscellaneous drainage. In this case, if only outdoor purposes are considered, then the requirement for utilization rate of 10% can be satisfied only by collection of rainwater and part of superior miscellaneous drainage. If indoor purposes like lavatory flushing are also considered, then the requirement for utilization rate of 30% can be satisfied by collection of rainwater and superior miscellaneous drainage or miscellaneous drainage.

Therefore, no matter from the view of means of utilization of non-traditional water resources, or of the amount of original water from non-traditional water resources, when using non-traditional water resources for residential buildings, it is possible to reach a utilization rate of non-traditional water resources of not less than 10%, 30%. Utilization rate of non-traditional water resources can be calculated by the following formula:

$$R_u=W_u/W_t\times 100\%$$

$$W_u=W_R+W_r+W_s+W_o$$

In the formula, R_u---utilization rate of non-traditional water resources, %;

W_u--- designed amount of water consumption from non-traditional water resources (planning and design phase) or actual amount (operation phase), m^3 /a;

W_t---designed total amount of water consumption (planning and design phase) or actual total amount of water consumption, m^3 /a;

W_R---designed amount of regenerated water consumption (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a;

W_t---designed amount of rainwater consumption (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a;

W_s---designed amount of seawater consumption (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a;

W_o---amount of consumption of other non-traditional water resources (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a.

Evaluation methods for this article are reviewing design instruction book and reports on operation data (reports on amount of water consumption), etc.

4.4 Materials Saving and Materials Resources Utilization

4.4.1 Emission mechanism of indoor harmful substance is very complicated. This article can evaluate the grade of pollution that construction materials generate against indoor environment in the decoration process on a quantitative base. Choosing the construction materials that meet the standards of harmful substance percentage and are friendly to the environment, can avoid indoor air pollution caused by improper materials selected.

Decoration materials mainly include stone material, manmade plate and its product, construction paint, solvent paint for wood, glue, wood-made furniture, wallpaper, PVC floorboard, carpet, carpet cushion and carpet glue, etc. Harmful substance in decoration materials referrers to formaldehyde, VOC, benzene, toluene and xylene, TDI and radioactive nucleus, etc. The harmful substance in decoration materials, stone material and radioactive substance from the decoration materials made from industrial waste residue, can cause damage to human health. The percentage of harmful substance in decoration and construction materials used in green buildings must abide by the following standards:

GB 18580 of Limitation of Formaldehyde Emission from Manmade Plate and its Products for Indoor Decoration

GB 18580 of Limitation of Harmful Substance in Solvent Paint for Wood for Indoor Decoration

GB 18582 of Limitation of Harmful Substance in Inner Wall Paint for Indoor Decoration

GB 18583 of Limitation of Harmful Substance in Glue for Indoor Decoration

GB 18584 of Limitation of Harmful Substance in Wood-made Furniture for Indoor Decoration

GB 18585 of Limitation of Harmful Substance in Wallpaper for Indoor Decoration

GB 18586 of Limitation of Harmful Substance in PVC Carpet for Indoor Decoration

GB 18587 of Limitation of Harmful Substance in Carpet, Carpet Cushion and Glue for Carpet for Indoor Decoration

GB 18588 of Limitation of Ammonia Emitted from Additions to Concrete

GB 6566 of Limitation of radioactive nucleus in decoration materials

Evaluation methods for this article are reviewing product test reports issued by qualified third-party inspection institute authorized by state certification and recognition regulatory committee.

4.4.2 It's not in line with the basic philosophy of green buildings to partially pursue beauty with sacrifice of huge resource consumption. In design, the application of decoration components without functional value shall be controlled. Decoration components without functional value mainly refer to: (1) plate, grid and truss that have no functions of sunlight shield, sunlight import, wind import, weight upholding and supplement to green coverage, and that are mass used as constituent element in buildings; (2) purely for the effect of symbols, set irregular parts like tower, ball and

curved surface on roofs and other places; (3) the height of parapet is twice higher than the required standards; (4) no in line with local climate conditions, the area of double-layer external walls (including curtain wall) that are not beneficial for energy saving exceeds 20% of the total area of external walls.
Evaluation methods for this article are reviewing completion papers and on-site verification.

4.4.3 This article encourages using local produced construction materials, and improving the percentage of the construction products made from local materials. Localization of construction materials is one of the important means to reduce resource and energy consumption in transportation process and to ease environment pollution. Increasing utilization rate of local materials can also promote local economic development.
Evaluation methods for this article are reviewing the list of materials for project settlement. In the list, names and addresses of materials manufacturers shall be indicated. Calculate the weight of construction materials produced within 500km in the construction materials for the project as well as the total weight of construction materials based on this list, and the proportion of them is required to not be less than 70%.

4.4.4 Of current construction materials used in China, the majority are fired solid clay bricks and concreted. Fired solid clay brick is listed as the product that is forbidden and limited to use, for it consumes much land resource. In a long time from now on, the main building structure in our country will be reinforced concrete structure. At present, our country strongly promotes to use pre-mixed concreted, the application technique of which is already relatively mature. Related state authorities have released a series of documents regarding prohibition on on-the-spot mixing of concrete in urban areas from the specified date, clearly stipulating “it’s prohibited to mix concrete on the spot from December 31, 2003 in urban areas in 124 cities including Beijing, and it’s prohibited to mix concrete on the spot from December 31, 2005 in other provinces (autonomic regions) municipalities”. Compared with on-the-spot mixed concrete, using pre-mixed concrete can reduce noises on construction sites and dust pollution, save energy and resources, and reduce material damage and loss.
Evaluation methods for this article are reviewing the list of total amount of concrete used for the project offered by the construction unit as well as the amount of pre-mixed concrete consumption in the pre-mixed concrete delivery note offered by the concrete-mixing station.

4.4.5 In green buildings, the construction materials that are good at durability and materials saving shall be adopted. High-performance concrete and high-strength steel are very superior in terms of durability and materials saving. As for construction projects, using durable materials is the biggest saving measure. Using high-performance concrete and high-strength steel can solve the problems with fat girder and pillar and increase the area for buildings. Using steel bars of Class HRB 400 and

(or) high-performance concrete that meets design requirements in the main body structure of steel-bar concrete, can be seen as accomplishment of requirements of this article.
Evaluation methods for this article are reviewing the usage of steel bard in the list of materials for finalizing, and reports on concrete-mixing rate in the construction records, and concrete test reports issued by third-party test institute (the indicator of durability is mandatory).
4.4.6 In construction, the materials of old buildings that are dismantled in the construction filed or collected through other channels shall be utilized to the best of its advantage. And also the deserted materials in construction and land clearing shall be utilized as much as possible to extend their usable duration, in the purpose of saving raw materials, reducing waste, and easing the affect to the environment caused by production and transportation for renewing the needed materials.
The garbage and discarded stuff shall be sorted on the spot. This is the key point and precondition for recycling the waste. Reusable materials shall be reutilized in construction, and recyclable materials shall be recycled and processed via recycling enterprises, to avoid waste pollution and littering to the best of its advantage. The construction unit shall produce a dedicated plan of management over construction waste, including seeking for the market to dispose the stuff with discounted price; and formulating plans and methods for demolishment, waste, disposal and recycling with discounted price, including waste summary; and providing the fees on waste recycling, discounted disposal and reutilization, etc. Recycled stuff that needs to be confirmed in the plan includes paper plate, metal, concrete blocks, pitch, field garbage, drinks can, plastic, glass, plasterboard, wood-made products, etc.
Evaluation methods for this article are reviewing the planning on management over construction waste and the records of recycling of waste in the construction field.
4.4.7 Recyclable materials in construction include two parts, one is that materials uses are already recyclable materials; another is the materials that can be recycled when the building is dismantled. Recyclable materials mainly include: metals (steel, copper), glass, aluminium alloy, plaster-made product, wood materials, etc. Non-degradable construction materials, like PVC, don't belong to recyclable materials. Fully utilizing recyclable materials can reduce the energy and resource consumption and environment pollution caused by production and processing of new materials, and has very important significance to the sustainability of buildings.
Evaluation methods for this article are reviewing the amount of consumption of related materials in the list of materials for project settlement.
4.4.8 Integration of land construction and decoration requires architects to design an integrated plan for land construction and decoration, and requires the construction unit to consolidate land construction and decoration. To complete integrated land construction and decoration, holes on construction components can be reserved and fixed components for decoration can be pre-buried beforehand, to avoid chiseling and

perforation on existing construction components in the construction and decoration phase. It not only ensures the safety of the structure, but reduces noises and construction garbage; integration of land construction and decoration can also reduce the disturbance to residents, lower materials consumption and reduce decoration cost. The integration requires all-out cooperation among the land-owner, designer and construction party.

Evaluation methods for this article are reviewing the proof on integration of land construction and decoration (checking construction papers and the list of actual workload in construction when necessary) and on-site inspection.

4.4.9 Deserted stuff mainly includes deserted stuff from construction, industrial deserted stuff, and that from daily life, and it can be used for production of green construction materials as raw materials. Under the precondition that performance requirements are met, it's encouraged to use concrete blocks made of regenerated materials from deserted stuff by construction, cement-made products and regenerated concrete; it's encouraged to use the construction materials like cement, concrete, wall materials, thermal materials, that are made from industrial deserted stuff, straw of crops, construction garbage and silt; it's encouraged to use the construction materials made from treated deserted stuff from daily life.

To ensure quantitative requirement for usage of deserted stuff, this article stipulates that the weight of materials made from deserted stuff accounts for not less than 30% of the total weight of same-type construction materials. For example, when using plaster blocks for inner wall materials, if the weight of used industrial plaster blocks made from industrial plaster (like desulfurized plaster and phosphorus plaster) accounts for more than 30% of the total weight of used plaster blocks in construction, the requirements in this article are satisfied.

Evaluation methods for this article are reviewing the amount of consumption of related materials in the list of materials for project settlement.

4.4.10 Buildings of different types and features in functions, when using different structure systems and materials, have remarkable difference in terms of consumption amount of energy and resources as well as the impact on the environment. At present, in the structure system for residential buildings in our country, there are mainly brick-concrete pre-fabricated mixed structure, concrete-cast frame shear wall structure and concrete-frame structure. In recent years, there is also made some development in light-steel structure. In the whole country, brick-concrete pre-fabricated mixed structure still leads major presence, accounting for around 70% of the total building structure system. Now the proportion of steel-structure buildings in our country is less than 5%. And for green buildings, based on the requirements for resource saving and environment protection, under the precondition of safety and durability, it's the prior option to choose the building structure systems that consume less resources and generate less effect on the environment, which mainly include steel-structure system, block-structure system and wood-structure system. In brick-mixed structure system,

and steel-bar and concrete structure system, the materials will generate large amount of clay, limestone, and other non-renewable energy in the production process, and will also emit lots of pollutants like carbon dioxide. Steel and aluminium materials have good nature of recycling, and can be reutilized after recycling. Building blocks containing industrial deserted stuff are low in weight and consumes less non-renewable energy, and at the same time can form the resource recycling system of industrial deserted stuff. Wood is a kind of sustainable construction material, but it requires benign forest cycling as support. If technological and economic conditions can be satisfied, it's encouraged to import wood from the countries where forest resources are already in benign circle. Therefore, if local conditions and reality are properly considered in application of building structure systems like light-steel structure system, block-structure system and wood-structure system, the requirements of this article are satisfied.

Evaluation methods for this article are reviewing the design documents.

4.4.11 Recyclable materials refer to the materials that can be directly reutilized or that can be reutilized after re-combination and restoration in the precondition that the form of recycled materials is the same. Using recyclable materials can extend the life circle of the construction materials that still have value to use, and can reduce consumption of resources and energy for materials production as well as the impact on the environment caused by materials transportation. Recyclable materials include the materials removed from old buildings and the old building materials recycled from other places. Recyclable materials consist of blocks, brick stones, pipelines, plates, wood carpets, wood-made products (doors and windows), steel, steel-bars, part of decoration materials, etc. In evaluation, the list of materials for project settlement needs to be provided, to calculate the weight of used recyclable materials and total weight of project building materials, the ratio of two of which is the utilization rate of recyclable materials.

Evaluation methods for this article are reviewing the amount of consumption of related materials in the list of materials for project settlement.

4.5 Indoor Environment Quality

4.5.1 Sunlight is very important to human mental and psychological health. But the sunlight of residential buildings is restricted by lots of external conditions, like geographic position, heading direction, outside shield, etc. It's not easy to reach ideal state. Especially in winter, the angle of sun is relatively small so that inter-shielding between buildings is worse.

In design of green residential buildings, attention shall be paid to buildings' heading direction, distance and mutual position between buildings, graphic layout in buildings. And make sufficient sunlight for living space through elaborate calculation and adjustment.

Evaluation methods for this article are reviewing design papers and sunlight simulation calculation reports.

4.5.2 Sufficient natural sunlight and ventilation are good for livers' mental and psychological health, and also for reducing energy consumption for manmade illumination. It's relative scientific to use daylighting coefficient to evaluate whether a residential building acquires enough natural sunlight. In GB/T 50033 of Building Daylighting Design Standards, minimum value of daylighting coefficient for all sorts of rooms in residential buildings is clearly stipulated. As for green buildings, the regulation of this article must be satisfied.

Evaluation methods for this article are reviewing design papers and sunlight simulation calculation reports.

4.5.3 Residential buildings shall provide a quiet environment for livers, but in modern cities, most of residential buildings are in a noisy environment, especially those close to streets, seriously affected by traffic noise. So designers need to adopt effective sound-proof and noise lowering measures in fencing structure of residential buildings. For instance, try to place bedrooms and living rooms far away from noise sources, and place sound-proof windows for street-side windows.

The noise level allowed for bedrooms and living rooms in this article is equivalent to a high level in GBJ 118 of Regulations on Sound-proof Design for Civil Buildings. The requirements on audio performance of floor boards, household-dividing walls, outside windows and household doors are all for the required noise level for bedrooms and living rooms. As for green buildings, it shall be taken into consideration not only a benign indoor environment, but resource saving, not to partially run after high performance.

Evaluation methods for this article are reviewing design papers or test reports.

4.5.4 Natural ventilation can improve the comfort of livers and are good for their health. With good weather conditions, reinforcing natural ventilation is helpful for reducing the operation time of air-conditioners and energy consumption. So natural ventilation shall be specially emphasized for green buildings.

Whether a residential building can get sufficient natural ventilation is closely related to the area of ventilation hatch. Minimum area ratio between the ventilation hatch of living space and the floor board is stipulated in this article. Generally, when the area ratio between the ventilation hatch and the floor board is not less than 5%, the room can get good natural ventilation. Due to different climate and living habits, in southern regions, natural ventilation of rooms is more emphasized. Therefore, this article stipulates that in "hot in summer and warm in winter" and "hot in summer and cold in winter" regions, the area ratio between the ventilation hatch and the floor board is not less than 8%.

The effect of natural ventilation is not only related with the area ratio between the ventilation hatch and the floor board, but actually inter-positions of ventilation hatches.

In the design process, positions of ventilation hatches shall be considered, to generate "room-go-through wind" to the best of its advantage.
Evaluation methods for this article are reviewing ventilation simulation calculation reports, design papers and on-site verification.
4.5.5 In GB 50325 of Regulations on Control over Indoor Environment Pollution for Civil Buildings, five kinds of air pollutants harmful to human health, i.e. dissociative formaldehyde, benzene, ammonia, radon and TVOC, are listed out, and requirements and measure on controlling their vitality and density are also released. As for green buildings, regulations of this article must be satisfied.
Evaluation methods for this article are reviewing test reports.
4.5.6 Besides the functions of natural ventilation and daylighting, the windows of residential buildings can still serve as a bridge to connect inside and outside visually. Good eyeshot is good for livers' joyful mood.
Residential buildings in modern cities are usually built in rows and strips, with short distance between, so elaborate design shall be made to avoid visual interference between different households.
Bathroom is an air polluting source inside residential buildings. Opening external windows in bathrooms can help discharge stagnant air. But in graphic layout for inside space, it's usually hard to ensure a bathroom beside external walls. Therefore, this article stipulates that if a suite has multiple bathrooms, then at least one of them has external windows.
Evaluation methods for this article are reviewing design papers and on-site verification.
4.5.7 In GB 50176 of Regulations on Thermal Engineering for Civil Buildings, lots of basic requirements are released on thermal engineering of building fencing structure, and it's stipulated that dew-congealing is not allowed on inner surface of external fencing structure, which shall be abided by for green buildings. Dew-congealing on inner surface of external fencing structure will cause inconvenience for residents' lives, and if worse, will lead to breeding of mildew, affecting indoor hygiene. Green buildings shall offer a good indoor environment for livers, so dew-congealing shall not appear in the designed indoor temperature and humidity conditions. Besides from over-moist air, too low temperature on the surface is the direct reason leading to dew-congealing. Generally, it's not likely to have large-scale dew-congealing on inner surface of external fencing structure of residential buildings. Dew-congealing usually appear on metal window frames, surface of window glass, wall corner, and hot frequency bridge possibly on wall surface. In the design and construction of green buildings, it shall be figured out whether the temperature of inner surface where dew-congealing is likely to happen is higher than dew-congealing temperature, and corresponding measure shall be taken to avoid dew-congealing in designed indoor temperature and humidity conditions.

Evaluation methods for this article are reviewing design papers, computation books and on-site verification.

4.5.8 In GB 50176 of Regulations on Thermal Engineering for Civil Buildings, lots of basic requirements are released on thermal engineering of building fencing structure, and it's stipulated that in the condition of natural ventilation, the temperatures of roof, inner surfaces of east and west external walls cannot be too high. The temperatures of roof and inner surface of external walls will directly affect people's comfort inside the room. And controlling the temperatures of roof, inner surfaces of external walls at a not too high level can make livers use air-conditioners less than before and generate more ventilation, which is good for improving indoor comfort and also reducing energy consumption of air-conditioners. In Regulations on Thermal Engineering for Civil Buildings, methods of calculating the temperatures of roof, inner surfaces of east and west external walls in the condition of natural ventilation are stipulated in detail.

Evaluation methods for this article are reviewing design papers and computation books.

4.5.9 In the view of comfort, energy saving and charged service, in the residential buildings where heating equipment or air-conditioning systems are adopted, users should be able to self-adjust room temperature.

Evaluation methods for this article are reviewing design papers and on-site verification.

4.5.10 Strong sunlight in summer, going through window glass into indoor area, will cause livers' discomfort, and meanwhile largely increase workload of air-conditioners. It's quite common to mount curtains inside windows, but when shielding direct sunlight, the inside curtains also shield dispersed sunlight and affected indoor natural daylighting. And inside curtains are of little help to reduce increased air-conditioner workload caused by direct sunlight into the room. So a kind of adjustable sunlight-shied device can be installed outside the window, and its position can be adjusted as needed to avoid strong sunlight in summer directly going into indoor area though window glass, and to improve livers' comfort.

Outside adjustable sunlight-shield device is of big help to save energy in summer. In many residential buildings, in daytime from Monday to Friday, there is no person. If the window is equipped with reliable and adjustable sunlight-shield device (like movable rolled curtain), in daytime most of sun radiation can be prevented out of the room by means of the outside sunlight-shield device, and the operation time of air-conditioners can be greatly reduced at night.

Why the outside sunlight-shield device has to be adjustable is that, no matter in the view of physiology or psychology, livers' demands for sunlight into the room in winter and summer are completely opposite, while fixed outside sunlight-shield device cannot properly satisfy the two opposite demands.

Outside adjustable sunlight-shield device shall be reliable, durable and nice-looking.

Evaluation methods for this article are reviewing design papers and on-site verification.

4.5.11 Ventilation for air exchange is an effective measure to reduce indoor air pollution. Installment of fresh air exchange systems is beneficial for introduction of outdoor fresh air and discharge of indoor stagnant air, to guarantee indoor air quality and satisfy requirements for human body health. To satisfy normal physical demand of human body, the amount of fresh air for shall reach $30m^3$ each hour for each person. Indoor air quality monitoring device can automatically monitor indoor air quality, mainly measuring the density of carbon dioxide, with the alarming function. Evaluation methods for this article are reviewing related design documents and on-site verification.

4.5.12 Using functional materials that can accumulate power, adjust moisture or improve indoor air quality for bedrooms and living rooms, is good for reducing energy consumption for heating equipment and air-conditioners, and improving indoor environment. Although in current market, there are only a few such kind of functional materials that can be applied in large scale, as for green buildings, it's encouraged to develop and use this kind of functional materials. Now these materials that are relatively mature include nano complex phase coated materials with air purification function, materials with anion-generation function, rare-earth activation and antibacterial health-care materials, moisture adjustment materials, temperature adjustment materials, etc.

Evaluation methods for this article are reviewing related design documents, product test reports and on-site verification.

4.6 Operation Management

4.6.1 Property management companies shall submit the management systems regarding energy saving, water saving, materials saving and green coverage, indicating the effect of implementation. Energy saving management system mainly includes: energy saving management mode formulated by land-owner and property keeper together; measurement and charge by household and type; create energy saving management mechanisms inside the property keeper; energy saving indicator reaches the requirements of design. Water saving management system mainly includes: formulate water saving plans according to the principle of "superior quality for superior purposes, inferior quality for inferior purposes"; measurement and charge by household and type; create water saving management mechanisms inside the property keeper; water saving indicator reaches the requirements of design. Materials consumption management system mainly includes: establish maintenance systems for buildings, equipment and systems, to reduce materials consumption caused by repairs; establish property materials consumption management system and choose green materials. Green coverage management system mainly includes: measure the water used for green coverage, establish and improve water-saving irrigation systems;

regulate the usage of insecticide, weedicide, fertilizer, pesticide and other chemicals, to effectively avoid damage to soil and ground water environment.
Evaluation methods for this article are reviewing the management records and documents regarding energy saving, water saving, materials saving and green coverage, and on-site inspection and user spot check.
4.6.3 Consideration shall be first given to the proper planning of overall systems like garbage collection and transportation. If there are small garbage treatment facilities, the rationality of their arrangement shall be considered. Next is property management companies shall submit garbage management systems, indicating the effect of implementation. Garbage management system includes garbage management operation manual, management facilities, management fees, manpower allocation and institutional work allotment, supervisory mechanism, regular job training, emergency response and reaction system, etc.
Evaluation methods for this article are reviewing garbage management systems and overall planning including garbage collection and transportation as well as on-site verification.
4.6.4 Dustbins are usually placed in a hidden position near the entrance or exit of residential units. The quantity, look and color of dustbins shall be in line with the requirements for garbage collection by category. There are two types of dustbins, fixed and movable, and the specification shall be in line with related state standards. In selection of dustbins, good look and functions shall both be considered and the products shall be in harmony with surrounding scenery. They are required to be solid, durable and stable to stand. Usually dustbins can be made from stainless steel, wood, stone, concrete, GRC and ceramic materials.
Evaluation methods for this article are on-site verification.
4.6.5 The appearance of garbage stations (rooms) as well as environmental hygiene shall be emphasized, to improve the quality of the living environment. Flushing and drainage facilities shall be installed in garbage stations (rooms), and the stored garbage can be cleared and transported in time, not to pollution the environment and not to emit smelly odor.
Evaluation methods for this article are on-site inspection and user spot check.
4.6.6 Construction of safeguarding sub-system, management and equipment monitoring sub-system and information network sub-system shall be conducted, according to the basic configuration listed in CJ/T 174 of Intelligence System Configuration and Technical Requirements for Residential Areas, based on the reality of the quarters.
Evaluation methods for this article are reviewing inspection and acceptance reports on intelligence systems, on-site inspection of all systems as well as user spot check.
4.6.7 This article requires using non-environmental pollution anti-pest prevention technology to regulate usage of insecticide, weedicide, fertilizer, pesticide and other chemicals. Occurrence and proliferation of pests will directly lead to declined growth

quality of trees, destroy ecologic environment and biological diversity. Forecast on it shall be reinforced to strictly control the promotion and proliferation of pests. To carry out anti-pest prevention work more scientifically, biological prevention shall be combined with chemical prevention. Pesticide shall be used scientifically to greatly promote non-environmental pollution prevention technology, like biological pharmacy and bionic pharmacy. The proportion of Biological and non-environmental pollution prevention shall be increased to ensure human and animal safety, protect beneficial creatures, prevent environment pollution and promote sustainable development of ecology.

Evaluation methods for this article are reviewing stock lists of chemicals and records of usage as well as on-site verification.

4.6.8 Regularly trim roadside trees, flowers and shrub, green fences, and trim green lawns in time. Carry out forecast and prevention work against pest on trees in time, to guarantee no fulminant pest plague against trees, and keep lawns and lands intact to ensure high survival rate of trees, while over 98% for old trees and over 85% for newly planted ones. Trees in danger and already withered trees shall be handled in time when discovered.

Evaluation methods for this article are on-site verification and user survey.

4.6.9 ISO 14001 is the environment management standard, which includes environment management system, environment review, environment sign, complete life circle, etc. in the purpose of guiding all organizations to conduct right behaviors for the environment. It is the need of improving environment management level for property management unit to pass the environment system certification by ISO 14001. Saving energy, reducing energy consumption, reducing expenditure on environment protection and reducing cost can reduce the environment risks caused by pollution accidents or violation of laws and rules.

Evaluation methods for this article are reviewing certificates.

4.6.10 Garbage collection by category means throwing garbage by category at the beginning point and treating it by category or turning it back resource through sorted clearing, transportation and recycling. Garbage collection by category are good for resource recycling, and also can make it easier to treat noxious and harmful substance, and can reduce the amount for treatment and reduce the cost in transportation and processing. In many advance countries, garbage resource recycling industry occupies an important part in the industrial structure, even with laws to restrict people to place garbage by category. Garbage collection by category rate refers to the proportion of those households for whom garbage collection by category are implemented in the total households. This article requires more than 90% as for garbage collection by category rate.

Evaluation methods for this article are on-site verification and user spot check.

4.6.11 The lives of equipment and pipelines in buildings are commonly shorter than those of building structure, so the layout of all equipment and

pipelines shall be convenient for future repairs, renovation and replacement. Tube well can be set in public parts to reduce disturbance to residents. The equipment and pipelines for public use shall be set in public parts to facilitate daily repairs and replacement.
Evaluation methods for this article are reviewing the design documents of related equipment and pipelines and on-site verification.

4.6.12 There a lot of ways to treat daily life garbage, mainly including sanitized burial, incineration and biological treatment. Because biological treatment of organic family garbage has some features like lower quantity and good resource utilization effect, it's been promoted to use to certain extent. Biological degradation of organic family garbage is the result of interaction among various microbes. It's one of the development trends to inoculate screened effective microbes to organic family garbage and degrade daily life garbage by co-treatment technique of O_x and A_n. But the precondition is garbage sortation, to improve the percentage of organic matter in garbage for biological treatment.
Evaluation methods for this article are reviewing the design documents regarding garbage treatment rooms and on-site verification.

4. Public Buildings

1. Land Saving and Outdoor Environment

5.1.1 In the process of building, the original terrain of the land shall be maintained as well as possible, so that additional investment on flatting the land and construction workload can be reduced, and also destruction on original ecology due to land construction can be avoided. The valuable trees, pools and water systems of the land not only possess high ecologic value, but inherit historical and culture heritage of the region where the land is located, and they are also important scenery sigh of the

region. Therefore, they shall be protected according to related state regulations including Urban Green Coverage Regulations (No. 100, State Council Direction, 1992). If there is indeed a need to renovate the terrain, water system, vegetation and other environmental factors of the land because of construction and development, after the project ends, the construction party will be inspired to take corresponding measures to restore the land circumstance, reduce changes to the original surroundings and avoid damage to the overall urban environment due to excess land development. Evaluation methods for this article are reviewing land terrain maps and related documents.

5.1.2 Natural disasters like flood and mud-rock flow, can cause fatal damage to construction lands; radon is a kind of colorless and smell-less carcinogen that mainly exists in soil and stones, and it can generate huge harm to human bodies; if human bodies are exposed to certain amount of radiation that crosses the safe line for a long time, cells will be injured or killed in a large scale and it can lead to a slew of illness. There a lot of polluting sources that can produce electromagnetic wave radiation, such as TV broadcast tower, radar station, communication transmission station, transformer substation, high-voltage wires, etc. Plus, in oil depots, gas stations and toxic material workshops, there exist possibilities of fires, explosion and toxic gas leakage. Hence, in selection of sites for green buildings, related state security regulations and this article must be abided by.

Evaluation methods for this article are reviewing site-inspection reports and rationality of replying measures.

5.1.3 It is one of the basic principles for green buildings not to generate influence on surroundings in project construction. As for public construction, it shall be avoided that building layout or shape generates negative impact on the surroundings, especially light pollution to ambient environment and sunlight shield against nearby residential buildings. Recently, mirrorlike glass is used on the walls of some public buildings, and when direct sunlight and light from the sky hit it, it will generate reflective light and polarizing light, and may consequently cause potential security risks on the road; and when top buildings on both sides of a street use glass walls together, due to multi-reflection between the big glass and then reflection from multiple sources, there will be light disorder and interference which are harmful to residential buildings, passengers and vehicles passing by and shall be avoided. What's more, if there are residential buildings near public ones, too much shield shall be avoided to guarantee the public buildings satisfy the requirements on sunlight standards.

Evaluation methods for this article are reviewing papers and on-site inspection after running.

5.1.4 Near the land of a construction project, there should not exist any pollution source where pollutant discharge exceeds the standards, including kitchens where oil and smoke are not discharged as the standards require, garages, coal-burning boiler

workshops where discharge exceeds the standards, garbage stations, garbage treatment plant and other industrial projects; otherwise the atmosphere over the land will be contaminated, affecting people's indoor and outdoor work and lives, which is contrary to green building concept.

Evaluation methods for this article are reviewing environment evaluation reports and on-site verification after running.

5.1.5 In the construction design proposal submitted to the engineering unit (regulatory unit) by construction unit, technical treatment and procedures that can effectively control down the dust have to be presented and actually implemented, to reduce pollution to the air caused by construction.

To decrease damage to the soil during construction, all possible effect on soil caused by various pollution sources and destructive factors shall be recognized based on the features of the construction project and soil conditions of the construction land, and corresponding measures and actions shall be offered to avoid, eliminate, mitigate erosion and pollution against the soil.

Sewage from construction site usually contains much sand and is high in acidity and alkalinity. If not properly treated, it will generate negative impact on public drainage systems and water ecologic systems. Therefore, the requirements in GB 8978 of General Standard on Sewage Discharge must be strictly executed.

Noise from construction refers to the sound generated in the time of construction that disturbs the surroundings. Noise-lowering measures shall be established for construction sites, to make noise emission reach or better than the requirement in GB 12523 of Noise Limitation for Construction Sites.

Polarizing light generated from electric welding on construction sites and floodlight used in night work, is a main source of light pollution in construction. Construction units shall select proper lighting methods and techniques, to reduce light pollution to non-lighting area and nearby area at night as much as possible.

To set fences in construction sites, the height and materials must reach related local requirements. And safety measures shall be adopted to secure surrounding people and facilities near the construction site.

Evaluation methods for this article are reviewing related documents regarding the control in construction.

5.1.6 As for public buildings, they shall be classified by type to respectively satisfy the surrounding noise standard stipulated in GB 3096 of Surrounding Noises Standards for Urban Areas. Current noise situation around the site is required to be inspected, and surrounding noises after the plan is implemented are required to be predicted. When noise-sensitive buildings to be built cannot avoid being close to traffic trunk lines or stay far away from fixed noise sources, related measures will be taken to reduce noise disturbance. As for both sides of traffic trunk lines, though the requirement on surrounding noises is satisfied: in daytime, $L_{Aeq} \leqslant 70$dB (A), and at night, $L_{Aeq} \leqslant 55$dB (A), it doesn't mean that it's quiet inside the public buildings close

to the street, and sound-proof measures still need to be taken on fencing structures like road-side windows.
Evaluation methods for this article are reviewing environment evaluation reports and on-site inspection reports after running.
5.1.7 The coming of high buildings and super-high buildings gradually brings the issues regarding re-wind and second wind to the table. Among large quantities of high and low buildings, improper single building design and mass layout may lead to difficulties in walking or accidents like strong wind blowing off stuff breaking glass. As research result indicates, the speed of wind above 1.5m from the ground in walking area near buildings（v）is recommended to be＜5m/s, to ensure people's normal outdoor activities. Plus, bad ventilation will seriously prevent air flow, and create windless area or eddying area in some regions, which is very harmful to outdoor heat exhaust and pollution dispersion, so it shall be avoided to the best of abilities. Winter will be the season for major evaluation, since for majority of cities, most cases that wind speed is around 5m/s happen in winter.
Natural ventilation in summer and transitional seasons is very important for energy saving for buildings. And more, it's involved with comfort of outdoor environment. Not only hot and poor environment for large outdoor places in summer will affect the sense of comfort, but when the comfort of temperature exceeds ultimate limit, long-time stay will cause uncomfortableness or even sunstroke in a large proportion of people. As for large public buildings, evaluation on outdoor comfort of temperature can be conducted with consideration of ventilation.
Evaluation methods for this article are reviewing wind simulation forecast analysis reports or on-site test reports after running in the planning and design for the residential area.
5.1.8 Green coverage is an important part of urban environment construction and of improving ecologic environment and life quality. To greatly improve urban ecologic quality and green scenery environment quality, large-area pure green lawn shall be avoided on construction lands, and it's encouraged to implement green coverage on roofs and walls, since it can actually increase the area of green coverage and improve the functions on CO_2, and it can also improve the warm-keeping and heat-proof performance of roofs and walls as well as save land.
Evaluation methods for this article are reviewing building design and scenery design documents and on-site verification.
5.1.9 In setting up plants, abundance of local plant resources and featured plants shall be presented to guarantee local features of the green plants. Meanwhile, multi-green coverage including arbor and shrub shall be adopted, to form luxuriant urban green systems. It can not only provide good conditions to shelter users from sunshine and for them to relax, but attract various animals and birds to settle nestles, to improve benign ecologic environment near the buildings. While large pure green lawn will not

only cost much in maintenance fees, but its ecologic effect will not be so good as multi-green coverage, so it's recommended to use as less lawn as possible.
Evaluation methods for this article are reviewing planning and design documents or scenery design documents and on-site verification.

5.1.10 Rapid increase of motors, especially cars, brought a big problem in traffic jam and difficulty of parking. As for the buildings which feature large amount of human flow and quick assembling and scattering, to ensure convenient access of all personnel, separate traffic systems shall be organized, based on the principle of separation of human and vehicles, respectively for large amount of people and small amount of special people who use specified vehicles. At the same time, it's promoted to mainly rely on walk and bus. So in the planning and design phase for public buildings, directional setting of major accesses shall be emphasized and close to bus stations.
Evaluation methods for this article are viewing the road structure by the land and whether the walking distance between the land and bus stations reaches the standard.

5.1.11 As the development of the cities in our country accelerates, decline in land resources comes to be a definite phenomenon. Development and utilization of underground space is a major action for urban land saving, and it's one of the measures that land-saving promotes. But in utilizing underground space, the issues regarding flexible connection of underground access and over-ground, ventilation and anti-leakage shall be properly handled combined with geologic situation, and meanwhile proper measures shall be taken to save energy.
Evaluation methods for this article are reviewing the scale and functional rationality of underground space in the planning and design proposal.

5.1.12 Urban deserted lands include non-constructive land (the lands that are not used yet or not available for use due to various reasons, such as bare rocks, stone-gravel land, steep slope, subsided land, salt and alkali land, wasteland, swampland, deserted kiln cave), warehouses and factory abandoned lands, etc. These lands shall be the prior option for land-saving for cities, because the deserted can be transformed into benefits to improve city environment, and also there is basically no problems related with demolishment and removal or settlement, and it's easy to acquire these lands. Therefore, it's an important measure for land saving to first consider properly reutilization of these kinds of lands, but the original lands have to be inspected or treated. For instance, as to steep lands, they shall be divided into separate stages and reinforced; as to warehouses and factory abandoned lands, test shall be done on whether the soil contains toxic materials and related treatment shall be conducted before the lands can be used.
Evaluation methods for this article are reviewing environment evaluation reports and the rationality of replying measures in planning and design.

5.1.13 Fully utilizing still usable old buildings is not only an important measure for saving land, but a controlling condition to avoid demolishment and disordered construction. "Still usable old buildings" refer to the old buildings whose quality can

ensure safety to use; “inclusion into the planning project”, means that as for utilization of old buildings, original nature for use can be maintained or changed as the planning requires, and they can be included in the planned construction project.
Evaluation methods for this article are reviewing evaluation analysis reports on original old buildings.
5.1.14 To gradually mitigate increasing temperature in urban and residential areas and dryness in the climate, and it can alleviate heat island effect, adjust micro-climate, increase the retention of rainwater and ground water for the land, improve ecologic environment and reinforce underground permeable ability of natural rainfall, supplement ground water, diminish ground subsidence caused by decline in water table, mitigate the load of drainage systems, decrease peak radial rainwater flow and improve drainage performance, this article advances related regulations on the area of water penetration.
Definition of lands of water penetration in this article is: natural bare land, public green land, green coverage land and the hollowed and planked land whose hollowed area equals or exceeds 40% (like sod bricks); land of water penetration ratio refers to the proportion of the area of land of water penetration in total outdoor floor area.
Evaluation methods for this article are reviewing the design of land of water penetration in the site-design proposal and on-site verification.

5.2 Energy Saving and Utilization

5.2.1 Of the whole year energy consumption for public buildings (especially large shopping malls, high-class hotels, high-class office buildings), around 50% to 60% is for air-conditioning (cooling) and heating system, 20% to 30% for illumination. While of the energy consumption by air-conditioning (heating), around 20% to 50% is for heat transmission by outside fencing structure (around 20% for “hot in summer and warm in winter” regions, around 35% for “hot in summer and cold in winter” regions, around 40% for cold regions and around 50% for severely cold regions), so this standard requires energy saving as for fencing structure of green buildings.
To encourage architects’ innovation, there will be no mandatory regulations of on single parts (like figure coefficient, heat transmission coefficient on outside wall, area ratio of window and wall, curtain wall sunlight-shield coefficient, ways of sunlight-shield, etc.) of fencing structure in terms of thermal engineering performance. Only the overall thermal engineering performance will be considered, i.e. evaluation is made by using the balancing judgment method for thermal engineering performance of fencing structure in GB 50189 of Energy Saving Design Standards for Public Buildings. When the designed buildings cannot satisfy all prescribed indicators of thermal engineering performance of fencing structure designed for energy saving for public buildings, design parameters can be adjusted and energy consumption can be calculated, to finally accomplish the purpose that energy consumption in air-conditioning and heating of the designed building for the whole year is not higher than

the energy consumption of reference building. While the reference building's figure coefficient is exactly the same as the actual building, and requirements on thermal engineering performance (including thermal engineering requirements for fencing structure, establishment of area ratio of windows and walls in all heading directions, etc.), all kinds of thermal disturbance (times of ventilation for air exchange, amount of indoor heat emission, etc.) and break lists shall all be set according to the requirements in Article 4.3 of GB 50189 of Energy Saving Design Standards for Public Buildings, and also the energy consumption in air-conditioning and heating of reference building and designed building shall be computed by the same dynamic computation software.

If requirements in related articles of local energy saving standards for public buildings are higher than that of GB 50189, then evaluation on thermal engineering performance of fencing structure of buildings shall be based on the former.

Evaluation methods for this article are reviewing related design documents and on-site verification.

5.2.2 This article originates from the regulations on rated thermal efficiency of boilers in Article 5.4.3 of GB 50189-2005 of Energy Saving Design Standards for Public Buildings, and the regulations on energy-efficiency ratio of cold and thermal machinery sets in Article 5.4.5, 5.4.8 and 5.4.9. In formulating the standards, the following two state mandatory energy-efficiency standards are referred to, i.e. GB 19577 of Energy Efficiency Limitation and Energy Efficiency Class for Cool Water Machinery Sets and GB 19576 of Energy Efficiency Limitation and Energy Efficiency Class for Unit-style Air-conditioners, and also national energy-saving policies as well as the product development level in our country are taken into consideration. So the energy-efficiency standards of cold and thermal machinery sets are formulated in a scientific and reasonable way.

Evaluation methods for this article are reviewing related design documents.

5.2.3 Properly utilizing resources, improving energy utilization rate and saving energy are basic national policies of our country. If high-level electric power is directly transformed into low-level power for heating or air-conditioning, the thermal efficiency will be low, and operation cost is high, so for green buildings, this kind of "superior quality for inferior purposes" way for energy transformation and utilization shall be strictly restricted. Considering some buildings that use solar energy for heating, at night slack-hour electricity is accumulated and supplemented, and heat-accumulation electric-boiler is not used in peak or plain hours of electricity consumption, this method is beneficial for narrowing the difference between the peak and slack hours in daytime and at night, and can balance utilization of energy, so it's a method for macro energy saving. This case is a special case, beyond the limitation of this article.

Evaluation for this article requires reviewing related design documents and on-site verification.

5.2.4 In reference to the regulations from Article 6.1.2 to 6.1.4 of GB 50034 of Building Illumination Design Standards, this article adopts least perceptible difference (LPD) of ordinary illumination in rooms or places as the evaluation indicator for illumination's energy saving. Designers shall choose the light source that are high in lightening efficiency, good in color rendering, long in service life, and with proper color temperature in line with the requirements on environment protection. When the conditions of polarizing light limitation and light-match requirements are met, high-efficient lightening tools shall be adopted, and the efficiency shall satisfy the regulations in List 3.3.2 of GB 50035 of Building Illumination Design Standards. Plus, some energy saving measures like controlling by zone and by time slot shall be adopted to the best of the advantage.

Evaluation methods for this article are reviewing the design documents related to building illumination.

5.2.5 Energy consumption for public buildings is relatively complicated. Take air-conditioning system for example, it consists of freezer, freezing water pump, cooling water pump, cooling tower, air-conditioning case, fan-pan, etc. While now, in all public buildings, there is always just a general ammeter, which is not good for energy consumption distribution for all kinds of systems and equipment of the building and makes it hard to discover impropriety in energy consumption.

As for new public buildings, it has to be taken into consideration in system design that independent measurement on each energy-consuming part is available, such as cold and hot source, transportation and distribution system, illumination, office equipment, energy consumption for heating water, etc. This is good for analyzing whether energy consumption level for each part and the structure in public buildings are appropriate or not, and also helps to discover problems and propose improvement measure in order to effectively practice energy saving for buildings.

Evaluation methods for this article are reviewing related design documents and on-site verification.

5.2.6 The principle of general graphic design for buildings is that in winter, sufficient sunlight can be acquired and dominant wind direction can be avoided, and in summer, natural ventilation can be utilized and attacks from sun radiation and storms can be avoided. Although multiple factors shall be considered in general graphic design for buildings, and also restricted by lots of conditions like society, history, culture, terrain, urban planning, road, environment, etc. mutual relationships between each factor still need to be balanced at the beginning of the design. And through analysis on multiple aspects and optimization of building planning, as much effort as possible shall be made to improve the effect of natural ventilation in summer and day lighting in winter for buildings.

Evaluation methods for this article are reviewing related design documents.

5.2.7 If there is good and appropriate natural ventilation in the room, firstly, natural room temperature in summer can be significantly lowered to improve room

environment and comfort; secondly, the low-temperature outdoor air in transitional seasons can be fully utilized to reduce the operation time of air-conditioners in the room to save energy. No matter in northern or southern regions, in some time slots in spring, autumn and winter, summer, there commonly exists a habit of opening windows to reinforce room ventilation. While if the opening area of outside windows is too small, it will strongly influence the effect of room natural ventilation in the building. The regulations of this article are for the purpose of gaining comfort and good air quality for people in the room in good weather, by opening outside windows to ventilate air.

In southern regions in our country, based on field investigation and computer-aided simulation: when outdoor dry-bulb temperature is not higher than 28℃, and relative humidity is lower than 80%, and outdoor wind speed is at around 1.5m/s, then if the opening area of outside windows is not less than 8% of the room floor area, most indoor area can reach the level of thermal comfort; while when indoor ventilation is poor or outside windows are closed, and indoor dry-bulb temperature is 26℃, and relative humidity is around 80%, people in the room will still feel a little muggy. Analysis once has been conducted on meteorological data from typical "hot in summer and warm in winter" cities, which indicated that from May to October, for some regions, the number of days when average outdoor temperature was not higher than 28℃ accounted for up to 60% to 70%, and even in the hottest month, the proportion could reach around 10%, while the outdoor wind speed in corresponding time slots could mostly hit around 1.5m/s. Therefore, making good design for natural ventilation and guaranteeing certain opening area of outside windows can reduce operation time of room air-conditioners and save energy as well as improve comfort. Also, as for curtain walls of buildings, it's recommended to have openable parts or ventilation equipment for the purpose of improving indoor comfort in the building. Evaluation methods for this article are reviewing related design documents.

5.2.8 To guarantee energy saving for buildings, avoid too much outdoor air penetrated into the room in summer and winter, there hare some high requirements on airproof performance of outside windows.

This standard requires that the airproof function of outside windows is not lower than the requirement of Class 4 in current national standard, GB/T 7107 of Classification and Testing Methods of Airproof Function of Outside Windows for Buildings, i.e. under the atmospheric pressure of 10 P_a, amount of air penetration is between 0.5 to 1.5m^3 per meter per hour, and amount of air penetration is between 1.5 to 4.5m^3 per square meter per hour.

Evaluation methods for this article are reviewing testing reports on outside windows products based on the design documents.

5.2.9 Coldness and heat accumulation technology, though in the view of energy transformation and utilization, does not save energy; it has positive effect in terms of adjustment of difference between electricity consumption in peak and slack hours in

daytime and at night. It can satisfy the requirements on energy structure adjustment and environment protection, so it's encouraged by governmental policies to certain extent. Therefore, selection can made based on local resource policies, electricity price in peak and slack hours, resource shortage situation, features of equipment and systems, etc.

Evaluation methods for this article are reviewing related design documents and conducting investigation on actual system operation.

5.2.10 Recycling the energy from air-conditioner exhaust can gain very good benefits in energy saving and the environment. Therefore, it can be considered to prior recycle the energy from exhausted air, and especially when fresh air and exhausted air are delivered through dedicated and separate pipelines, it's good for setting up central heat recycling device.

Evaluation methods for this article are reviewing related design documents and conducting investigation on actual system operation.

5.2.11 In air-conditioning system design, not only construction situation, but the operation mode for the whole year shall be considered. In transitional seasons, if air-conditioning systems are running in the all-fresh-air mode or the mode that fresh air proportion is increased, then air quality in air-conditioned area will be effectively improved, and the energy consumed for air treatment can be greatly saved, so this way shall be strongly promoted. But if running in all-fresh-air mode, air access for fresh air and sectional area needed for fresh air tubes must be seriously considered in the design, and exhaust outlet must be properly arranged, to ensure proper positive pressure value in the room.

Evaluation methods for this article are reviewing related design documents and instructions of usage.

5.2.12 Air-conditioning systems of most public buildings are designed according to most disadvantageous situation (full load). While buildings are with part of load in most time, or only part of the building is in use at the same time. So it's crucial what effective measures to take to save energy, faced with these situations. System design shall ensure when the building is with part of cold and heat load and only part of the building is in use, proper energy supply is available as actually needed, and meanwhile not lowering energy transformation efficiency. To accomplish this purpose, the design of air-conditioning system shall be made based on the principle of energy saving, and customized according to segmented air-conditioning areas and different room heading directions. At the same time, adjustment measures on cold and heat sources as well as transportation and distribution systems are very necessary with part of load.

Evaluation methods for this article are reviewing related design documents and conducting investigation on actual system operation.

5.2.13 According to the regulations in Article 5.3.26 and 5.3.27 in GB 50189 – 2005 of Energy Saving Design Standards for Public Buildings, review related design documents to conduct evaluation of this article.

5.2.14 Energy consumption for daily life occupies a remarkable percentage in overall energy consumption of buildings. Self-preparing boiler workshops to provide steams or hot water for daily life, such as hot water boiler driven by natural gas, will not only generate much pollution to the environment, but is not in line with the principle of "superior quality for superior purposes" in the view of resource transformation and utilization, so it's not recommended to use this method. It's encouraged to use energy saving methods to provide hot water for daily life, such as civic thermal network, heat pump, residual heat from air-conditioners, and other residual heat. When no residual heat is available, other substitute methods (like disinfection by ultraviolet radiation) can be used in steaming clothes washing, disinfection, cooking, etc. Plus, if in the design proposal, heat from drainage is well recycled, and congealed water from air-conditioners or other residual heat is utilized as pre-heating to reduce resource consumption, they can also improve the energy utilization rate of hot water system for daily life.

Evaluation methods for this article are reviewing related design documents and conducting investigation on actual system operation.

5.2.15 Independent measurement of energy consumption in each part of public buildings, is positively significant to understand whether energy consumption level of each part and energy consumption structure are reasonable or not, and to timely discover the existing problems and provide improvement measures. But for reconstructed and expanded public buildings, due to possible limitation of original building status and actual conditions, implementation of independent measurement on each part becomes more difficult. So in this article, reconstructed and expanded public buildings are regarded as a general option, in the purpose of encouraging implementation of independent measurement on each part of energy consumption in reconstructing or expanding a building, for example, renovating original route.

Evaluation methods for this article are reviewing related design documents.

5.2.16 Total energy consumption of designed buildings refers to the total consumption of energy for fencing structure of buildings, heating equipment, ventilation, air-conditioners and illumination.

As a lot of surveys and field tests results indicate, energy consumption loss though outside windows of buildings is the major channel of energy consumption of buildings. In northern regions of our country, heat transmission coefficient and airproof function of outside windows have very big impact on energy consumption of heating for the building, while in southern regions, complex sunlight-shield coefficient of outside windows has evident impact on energy consumption of air-conditioners in the building.

Based on limitation of total energy consumption of designed buildings, this article aims at encouraging application of new-pattern construction components and other energy-saving technology, to improve the efficiency of energy utilization systems for buildings as well as the effect of energy saving.
Evaluation methods for this article are reviewing related design documents.
5.2.17 Distributional heat-electricity-coldness co-generation system can three kinds of need i.e. provide electricity, coldness and heat (including hot water), realizing the trapeziform utilization of energy, and the energy utilization rate can reach more than 80%. The system can sharply reduce discharge of solid waste, greenhouse gas, NOx, SOx and dust, and it can also react to emergency event to ensure safe power supply, and it has been widely used worldwide. This technology has been applied in a few of projects in our country, harvesting good social and economic benefits.
Developing distributional heat-electricity-coldness co-generation technology can lower the load in peak hours in summer for electric network, and supplement the usage of gas in slack hours in summer. It can balance energy utilization and realize optimized energy allocation. It's a win-win measure of scientifically and properly utilizing energy. In application of this technology, scientific argumentation must be performed, and feasibility analysis must be conducted on proposals in the view of multiple aspects, like load forecast, system configuration, operation mode, economic and environment protection benefits.
Evaluation methods for this article are reviewing related design documents.
5.2.18 One of the features of green buildings is proper utilization of renewable energy and new energy technology. As Article Two of Renewable Energy Law of the People's Republic of China stipulates: "Renewable energy stated hereof, refer to non-fossil energy, like wind energy, solar energy, water energy, biomass energy, geothermal energy, ocean energy, etc." Article Seventeen: "The country encourages units and individuals to install systems using polar energy, like heated water systems powered by solar energy, heating and cooling systems powered by solar energy, electricity generation systems powered by polar energy, etc." And according to Article Eight of Regulations on Management over Energy Saving for Civil Buildings, No. 143 of command by Construction Ministry of the People's Republic of China, the state encourages to develop the following energy-saving technology and products: (5) application technology and equipment of renewable energy like solar energy and geothermal energy. So in the design process for green buildings, utilization of renewable energy shall be considered.
China has abundant solar energy resources, and the regions where yearly sunshine duration exceeds 2200 hours with good conditions for solar energy utilization account for 2/3 of the country's territory, so development of solar energy utilization is one of the effective measures to realize China's sustainable development strategies. From 1980s, our country has made some research on the application of passive solar energy by urban multi-floor residential buildings for heating and cooling technology. It's

been approved that from proper construction and thermal engineering design, with additional finite construction investment, it's possible to improve indoor temperature comfort in winter and summer by utilization of passive solar energy.

After almost 20 years of research and development of solar energy water heater, the technology has come to be mature, and the heater is the one of the most potential products in terms of development in current new energy and renewable energy industry in our country. In recent years, yearly growth rate of solar energy water heater in the market has come up to 20% to 30%. As the improvement of urban and rural living standards, demand for hot water for daily life will greatly increase. And the coverage of solar energy water heater will gradually develop from supply of hot water for daily life to that for business and industrial and agriculture production. The development of integration technology combined of solar energy utilization and buildings has gradually lowered the cost for hot water supply by solar energy, air-conditioners, heating engineering. It's also a huge potential market for solar energy water heater.

In sunlight photoelectric transformation technology, production of solar batteries and application of electricity generation systems powered by solar energy have gradually improved. The efficiency of single crystal silicon solar batteries and amorphous silicon solar batteries that are already commercialized is respectively 12% to 13% and 4% to 6%. There is also small-amount trial production of poly silicon, with the efficiency between 10% and 12%. In 1998, the production capacity of solar batteries in our country is 4.5 MW, with actual production of 2.1 MW. State Development Reformation Committee issued multiple policies including Online Management Regulations on Renewable Energy, to encourage electricity generation by solar energy.

Currently there are two ways of utilizing geothermal energy: one is to adopt geothermal heat pump system to utilize the energy, and the other is utilizing the energy by underground wind. Work principles of geothermal heat pump systems are: working medium flows through a kind of pipe that is good at heat transmission and buried in soil or ground water and surface water (including sewage and seawater), and absorb the heat from soil or water (for heating) and discharge heat to soil or water (for cooling). Compared with air heat pump, its advantages are stable output and high efficiency, and surely without the problem of defrosting, and operation fees can be reduced considerably. If near the building there is certain area of soil where special plastic pipelines can be buried (excavate slots horizontally or drill the ground vertically for burial), geothermal heat pump sets can be adopted.

To avoid the phenomenon that utilization of renewable energy is just a matter of "seem-to-be", for instance, putting one or two solar energy lights or one or two pieces of solar energy glass as a symbol to blow the trumpet, but not emphasizing on the effect of energy saving of construction proposals and selection of high efficient products. Therefore, when using solar energy technology for heating water, the amount of hot water directly supplied by solar energy shall reach more than 10% of

total amount of hot water of the building for the whole year; if using solar energy or wind power technology for electricity generation, the volume shall reach more than 2% of total electricity volume of the building for the whole year; as for utilization of geothermal heat pump systems, no quantitative control is imposed.
Evaluation methods for this article are reviewing the design documents, test reports on product types and on-site investigation.
5.2.19 The target value of LPD stipulated in GB 50034 of Building Illumination Design Standards, so this article is regarded as a prior option. Besides minimizing LPD under the precondition that illumination quality is guaranteed, it's recommended to adopt automatic illumination control methods, such as: automatically adjust the brightness of manmade illumination according to changes in outdoor natural light; automatic light switch in office rooms by way of human body sensor or movement sensor; adopt automatic light adjustment device that can reduce brightness at night regularly in hotel lobbies, lifts and corridors outside guest rooms; in large and medium sized buildings, based on specific conditions, adopt central or decentralized, multi-functional or single-functional automatic illumination controlling systems.
Evaluation methods for this article are reviewing related design documents and on-site verification.

5.3 Water Saving and Water Resources Utilization

5.3.1 As for public buildings, they are involved with not only utilization of indoor water resources, water supply and drainage systems, but drainage of outdoor rainwater and sewage, utilization of non-traditional water resources, green coverage, water supply for scenery, and other issued related with urban macro-water environment. Therefore, when making design for green buildings, systematic planning shall be conducted on the water environment of buildings, based on the consideration of water supply and drainage, water resources, climate and other objective factors of the area. Planning proposals on water system shall be formulated, to properly increase recycling rate of water resources and reduce civic water supply and sewage drainage. Planning proposals on water system include confirmation on quota of water consumption, estimate water consumption amount and balance of water amount, design of water supply and drainage system, water-saving tools, and utilization of non-traditional water resources, etc. Based on different situations of water resources and climate features in different regions as well as different building types, planning proposals on water system may involve different content. For instance, sewage recycling doesn't have to be considered for regions with sufficient water; purposes of water for public buildings of food service are fairly onefold, with more than 90% of water is used in kitchen and little water for lavatory flushing, so utilization of regenerated water doesn't need to be considered for this kind of buildings. Therefore, specific contents of the proposal shall be based on regional reality.

Water quota for public buildings shall be scientifically and properly determined in reference with that of state standards as well as that stipulated by other related water consumption standards, while considering local economic performance, climate, habit of water consumption and dedicated plans on regional water. Generally, water quota in northern regions is lower then southern regions.

Utilization of rainwater, regenerated water, etc. is an important water-saving measure, but it shall be analyzed based on specific situation. As for rainy regions, utilization of rainwater shall be emphasized, and for seaside regions in short of water, seawater utilization shall be reinforced, and for inland regions short of water, utilization of regenerated water shall be valued, while for the regions with abundant fresh water, it's not recommended to recycle sewage. But for all regions, utilization of water-saving tools is supposed to be considered.

Evaluation methods for this article are reviewing planning proposals or reports of water (environment) systems of buildings.

5.3.2 Planning of water supply and drainage systems for public buildings shall abide by the regulations in GB 50015 of Regulations on Water Supply and Drainage Design for Buildings. And the selection and operation of water supply facilities including pipes, pipeline accessories and equipment cannot generate second pollution to water supply. And energy-saving water supply systems shall be prior chosen, such as inverter water supply, pressure superposed water supply (using civic residual pressure) systems; Proper zoning of water supply systems for high buildings. Low zones fully make use of the pressure of civic water supply, and when high zones use lowering pressure and zoning, there should not be more than one zone, and water pressure for each zone should not be more than 0.45MPa; and water-saving measures of lowering pressure and limiting water flow shall be adopted, such as lowering the water supply pressure to not more than 0.2MPa before water comes to household water meters from water supply systems; and high-efficient and low-consumption equipment, like inverter water supply equipment, high-efficient water pumps, shall be selected for water supply systems.

Complete sewage collection and drainage facilities shall be established. As for the public buildings close to or at civic drainage network, the sewage from them can be drained into civic sewage network and treated with urban sewage in a centralized way; as for the sewage far from or unable to be drained into civic drainage system, it shall be separately treated (dispersive treatment), and complete sewage treatment facilities shall be available. Then after treatment it shall be drained to nearby accepting waters, and its quality shall reach related national drainage standards. For the regions short of water, recycling shall be considered. Sewage treatment rate shall reach 100%, and qualified drainage rate must reach 100%.

Proper planning shall be conducted on rainwater drainage channels, penetration channels and recycling means based on the terrain features, to ensure unblocked drainage channels and divide rainwater and sewage, and to reduce the chance that

rainwater is polluted as well as properly make use of rainwater resources as much as possible. No matter how to collect, treat or drain water and sewage, the collection, treatment and drainage systems shall not generate any negative impact on nearby humans and environment.

Evaluation methods for this article are reviewing the design documents, and reviewing monitoring reports or operation data reports against water supply and drainage quality.

5.3.3 In the planning and design phase, when selecting water supply facilities like pipes, pipeline accessories, it shall be considered not to generate second pollution to water supply. It's recommended to choose high efficient and low-consumption equipment like inverter water supply equipment, high efficient water pumps, etc. Adopt some measures like placing pipeline liners, placing tubes inside pipes, sheathing pipelines inside pipes, selecting high-performance valves, zero-leakage valves, etc. to avoid pipeline leakage. Use water-balance test method to test the amount of leakage in pipelines of a building/a group of buildings, and the leakage rate shall be lower than 2% of self-consumed amount in peak days.

Evaluation methods for this article are reviewing the papers, design instructions and on-site verification.

5.3.4 Equipment, apparatus and tools released in the (product) index of Water-saving Equipment Currently Encouraged to Develop in China shall be chosen. According to different water consumption situations, water-saving taps, water-saving lavatories, water-saving showering settings, etc. shall be properly chosen. All equipment shall follow the requirements in CJ 164 of Water-saving Equipment and GB/T 18870 of Technical Conditions and General Management Rules on Water-saving Products.

The following water-saving equipment can be selected for office buildings and shopping malls:

1. Time-delayed automatic closure taps like photoelectricity sensor taps, and taps with the function of automatic closure when no water runs can be selected;
2. Sensor or high efficient paddling water-saving urinals and two-baffle lavatories can be selected, and non-washing urinals can for the regions lacking water;
3. Vacuum water-saving technology can be chosen for the regions in severe shortage of water.

The following water-saving equipment can be selected for public buildings like hotels:

1. For guest rooms, ceramic-valve taps with the function of automatic closure when no water runs; two-baffle water saving lavatories; water-saving showering device like water-temperature adjustor, water-saving shower can be chosen;
2. For public bathrooms, time-delayed automatic closure taps and taps with the function of automatic closure when no water runs can be selected; Sensor or high efficient paddling water-saving urinals and squat lavatories can be selected, and non-washing urinals can for the regions lacking water;

3. For kitchens, the water-saving equipment like air-compressed taps and water-saving dishwashers can be selected;
4. High-efficient water-saving washing machines can be selected for laundries.

Evaluation methods for this article are reviewing the design documents, product instructions and on-site verification.

5.3.5 Non-traditional water resources like rainwater, regenerated water, etc. in the process of storage, transportation and distribution, shall be guarded with sufficient capability of disinfection and sterilization, and water quality cannot be contaminated to guarantee the safety of water quality. Water supply systems shall be equipped with related switch facilities like back-up water resources, spilling device, etc. to guarantee the safety of water amount. Certain safeguard and monitoring and controlling measure shall be adopted in the whole process of treatment, storage, transportation and distribution for rainwater and regenerated water, in accordance with related requirements in GB 50335 of Regulations on Engineering Design of Sewage Regeneration and Utilization and GB 50336 of Regulations on Water Design for Buildings, to ensure hygiene and safety in the processes of treatment, storage, transportation, distribution and usage for rainwater and regenerated water, and not to generate negative impact on human health and the ambience. As to seawater, due to the high percentage of salt, it has to be taken into consideration anti-septic issues for pipes and equipment and then issues regarding drainage after use. When rainwater and regenerated water for scenery is used for public buildings, in the planning and design phase for water scenery, the design and safeguarding measures for water quality shall be combined into consideration.

Evaluation methods for this article are reviewing the papers, design instructions and on-site verification.

5.3.6 In the planning and design phase, the route of rainwater (including rainwater on the ground and that on building roofs) flow shall be planned and designed well based on consideration of the terrain features of the field, to reduce the chance that rainwater is contaminated. Use multi-hole materials to pave public activity ground, sidewalk and open parking lot, to make it convenient for rainwater to penetrate; replace non-permeable tubes with permeable tubes or perforated tubes for draining rainwater, with both functions of penetration and drainage; plus, the following can be adopted to increase penetration, i.e. permeable water storage pool for scenery, roof garden and atrium, permeable well, green land, etc.

Rainwater treatment proposals shall be determined after comparison of multiple proposals, based on local reality and actual conditions. In southern rainy regions that are short of water, local climate conditions as well as the building's terrain features shall be taken into consideration, to create complete rainwater collection, storage, treatment and utilization facilities. And rainwater on roofs and other non-permeable surfaces shall also be collected and utilized. In rainwater collection and utilization systems, preliminary rainwater drainage device and rainwater adjustment pools shall

be set. The collection and utilization systems can be combined with the design of water scenery of the group of buildings. Underdrain is a prior option to collect rainwater, and the quality of treated rainwater shall reach the standards for corresponding purposes. It's recommended to be used for green coverage, scenery, air-conditioners, etc.

Evaluation methods for this article are reviewing the design papers and on-site verification.

5.3.7 It's a very important part of reducing civic water supply to use non-traditional water sources including rainwater and regenerated water for green coverage. As for the regions not short of water, rainwater is recommended to be prior chosen as the water for green coverage; and for the regions short of water, rainwater or regenerated water is recommended to be prior chosen for irrigation. As to water used for scenery, water environment planning, nearby environment, features of terrain and climate shall all be taken into consideration, to advance a proper planning proposal of water scenery for buildings. Rainwater and regenerated water shall be prior considered as water used for scenery. As for other non-drinking water to use, like that for washing vehicle, firefighting, roadside irrigation, non-traditional water resources including rainwater can be properly adopted. When using rainwater and regenerated water as that for green coverage and scenery, water quality shall meet corresponding standards and shall not impose any threat to public hygiene.

Evaluation methods for this article are reviewing design instructions and on-site verification.

5.3.8 In irrigation for green coverage, it's encouraged to adopt water-saving irrigation methods, like spouting irrigation, small-amount irrigation, permeable irrigation, irrigation by low-pressure tube, etc.; it's recommended to use humidity sensor or adjustor that makes adjustment according to climate change; to increase amount of rainwater penetration and reduce amount of irrigation, for green lands, it's recommended to use permeable drainage pipes with both functions of penetration and drainage.

The commonly used irrigation methods for green coverage at present are, using special equipment (generator, water pump, pipeline) to add pressure to water, or make use of natural fall of water to distribute the pressed water to irrigation fields, and spout water via sprayer to the air which is then scattered into tiny water drops and evenly spread. It can save 30% to 50% of water than field mass irrigation. Spout irrigation shall be conducted without much wind. When using regenerated water for irrigation, since the microbe in the water is likely to prevail in the air, spout irrigation shall be avoided.

Small-amount irrigation includes dripping irrigation, micro spout irrigation, stream irrigation and underground permeable irrigation. Small-amount irrigation means feeding water to plant roots in a persistent, even and controllable way, by means of low-pressure pipeline and dripping tip or other irrigation device, which saves 50% to

70% of water than field mass irrigation and 15% to 20% than spout irrigation. The aperture of irrigation device for small-amount irrigation is very small and easy to get blocked. And the water for small-amount irrigation usually has to be purified, precipitated to eliminate big sands and mud, and then filtrated to remove tiny foreign substance. In special cases, medical treatment needs to be done.
Evaluation methods for this article are on-site verification.
5.3.9 Under the principle of "save from the beginning", for the regions short of water, in the planning and design phase, it shall be considered to properly reutilize sewage after treatment, as the water for lavatory flushing and that for outdoor green coverage, scenery, roadside irrigation and vehicle washing. Regenerated water includes regenerated civic water (the source is the water out of urban sewage treatment factories or urban sewage), regenerated water for buildings (the source is the water from daily life drainage, miscellaneous drainage, superior miscellaneous drainage). In selecting what water to use, the following shall be considered, i.e. city planning, environment of the residential area, management methods on water facilities construction in cities, balance of amount of water, etc. and decisions shall be made based on various aspects, namely economy, technology, water quality of the source, stability of water amount, etc.
If there is any central regenerated water factory near the residential area, it shall be considered firstly to use local civic regenerated water or civic regenerated water from the upper reaches; if not, follow the management methods on water facilities construction or other related regulations of the province or city where the building is located, to decide whether to create treatment facilities to treat regenerated water for buildings, while at the same time considering recycling of superior water from miscellaneous drainage, that from miscellaneous drainage and that from daily life drainage one after one. In a word, the selection of regenerated water sources and utilization of regenerated water shall be comprehensively considered in the framework of area master-plan and city planning.
As for regeneration treatment technique, it shall be determined after overall technical and economic comparison, based on treatment scale, features of water quality, utilization and recycling purpose as well as local reality and requirements. Under the precondition that utilization requirements for regeneration are satisfied and operation is stable and reliable, the general fees for infrastructure investment and operation cost shall be controlled at the most economic point. Operation management shall be simple, with convenient control and adjustment. And meanwhile, good security and hygiene conditions are also required. All regeneration treatment technique must have the treatment of disinfection, to ensure the safety of serving water quality.
Evaluation methods for this article are reviewing the planning and design papers and design instructions, etc.
5.3.10 Water meters shall be set up according to purposes of use and requirement of water balance test standards. Amount of water consumption shall be summarized

respectively for kitchen use, green scenery use, etc. to make it convenient to summarize amount of water consumption and water leakage for each purpose. Evaluation methods for this article are reviewing the design papers and on-site verification.

5.3.11&5.3.12 The feature of water consumption in office buildings and shopping malls is onefold, with most of water used for lavatory flushing and the rest for washing. According to the principle of "superior quality for superior purposes, inferior quality for inferior purposes", water supply of different quality is recommended for this kind of buildings, and use regenerated water and rainwater for lavatory flushing. Based on the regulations and standards like GB 50336 of Regulations on Water Design for Buildings, water for lavatory flushing accounts for more than 60% of that of the office building. Considering that recycling water that can be used for this kind of buildings is small in amount, if one third of water for lavatory flushing and washing is replaced by rainwater or regenerated water, then the utilization rate of rainwater or regenerated water will be more than 20%.

Since hotels usually use central air-conditioners, regenerated water and water can be used for their cooled water. As for seaside regions, seawater also can be considered. So as for this kind of public buildings, the situation of regional water resources and utilization is recommended to be taken into consideration. For water-lacking regions, non-traditional water resources like regenerated water can be used for lavatory flushing and air-conditioner cooling. According to regulations and standards like GB 50336 of Regulations on Water Design for Buildings, water for lavatory flushing for this kind of buildings account for at least 10% of total water consumption. If non-traditional water resources are also adopted for air-conditioner cooling, then utilization rate of non-traditional water resources will not be less than 15%. Utilization rate of non-traditional water resources can be calculated by the following formula:

$$R_u=W_u/W_t\times 100\%$$

$$W_u=W_R+W_r+W_s+W_o$$

In the formula, R_u---utilization rate of non-traditional water resources, %;

W_u---designed amount of water consumption from non-traditional water resources (planning and design phase) or actual amount (operation phase), m^3 /a;

W_t---designed total amount of water consumption (planning and design phase) or actual total amount of water consumption, m^3 /a;

W_R---designed amount of regenerated water consumption (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a;

W_t---designed amount of rainwater consumption (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a;
W_s---designed amount of seawater consumption (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a;
W_o---amount of consumption of other non-traditional water resources (planning and design phase) or actual amount of water consumption (operation phase), m^3 /a.

Evaluation methods for this article are reviewing design instruction book and reports on operation data (reports on amount of water consumption), etc.

5.4 Materials Saving and Materials Resources Utilization

5.4.1 Because excess decoration and poor materials may produce indoor pollution, this article, in the view of controlling indoor polluting sources, argues that in the decoration phase, the construction materials that meet the standards of harmful substance percentage shall be chosen, to avoid indoor air pollution caused by improper materials selected.

Decoration materials mainly include stone material, manmade plate and its product, construction paint, solvent paint for wood, glue, wood-made furniture, wallpaper, PVC floorboard, carpet, carpet cushion and carpet glue, etc. Harmful substance in decoration materials referrers to formaldehyde, VOC, benzene, toluene and xylene, TDI and radioactive nucleus, etc. The government issued nine standards regarding limitation of harmful substance in construction materials (GB 18580 ~ GB 18588) and the standard on limitation of radioactive nucleus in construction materials (GB 6566). The percentage of harmful substance in construction materials used in green buildings must abide by the following standards:

GB 18580 of Limitation of Formaldehyde Emission from Manmade Plate and its Products for Indoor Decoration
GB 18580 of Limitation of Harmful Substance in Solvent Paint for Wood for Indoor Decoration
GB 18582 of Limitation of Harmful Substance in Inner Wall Paint for Indoor Decoration
GB 18583 of Limitation of Harmful Substance in Glue for Indoor Decoration
GB 18584 of Limitation of Harmful Substance in Wood-made Furniture for Indoor Decoration
GB 18585 of Limitation of Harmful Substance in Wallpaper for Indoor Decoration
GB 18586 of Limitation of Harmful Substance in PVC Carpet for Indoor Decoration
GB 18587 of Limitation of Harmful Substance in Carpet, Carpet Cushion and Glue for Carpet for Indoor Decoration
GB 18588 of Limitation of Ammonia Emitted from Additions to Concrete

GB 6566 of Limitation of radioactive nucleus in decoration materials
Evaluation methods for this article are reviewing product test reports issued by qualified third-party inspection institute.

5.4.2 Construction is the combination of art and technology, but it's not in line with the basic philosophy of green buildings to partially pursue beauty with sacrifice of huge resource consumption. In design, mass application of decoration components without functional value shall be controlled. Decoration components without functional value mainly refer to: (1) plate, grid and truss that have no functions of sunlight shield, sunlight import, wind import, weight upholding and supplement to green coverage, and that are mass used as constituent element in buildings; (2) purely for the effect of symbols, set irregular parts like tower, ball and curved surface on roofs and other places; (3) the height of parapet is twice higher than the required standards.

Evaluation methods for this article are reviewing the design papers and on-site verification.

5.4.3 This article encourages using local produced construction materials, and improving the percentage of the construction products made from local materials. Localization of construction materials is one of the important means to reduce resource and energy consumption in transportation process and to ease environment pollution. Calculate the weight of construction materials produced within 500km in the construction materials for the project as well as the total weight of construction materials based on this list, and the proportion of them is required to be not less than 60%.

Evaluation methods for this article are reviewing the list of materials for project settlement (including names and addresses of materials manufacturers).

5.4.4 Green buildings promote to use pre-mixed concreted, the application technique of which is already relatively mature. Related state authorities have released a series of documents regarding prohibition on on-the-spot mixing of concrete in urban areas from the specified date, clearly stipulating "it's prohibited to mix concrete on the spot from December 31, 2003 in urban areas in 124 cities including Beijing, and it's prohibited to mix concrete on the spot from December 31, 2005 in other provinces (autonomic regions) municipalities". Compared with on-the-spot mixed concrete, pre-mixed concrete guarantee concrete quality, and the rate of guarantee on strength can be more than 95%; it can reduce noises on construction sites and dust pollution; it can reduce material damage and loss, and can reduce consumption of forest resources because of saved cement packages and hence protect biologic environment.

Evaluation methods for this article are reviewing the list of total amount of concrete used for the project offered by the construction unit as well as the amount of pre-mixed concrete consumption in the pre-mixed concrete delivery note offered by the concrete-mixing station.

5.4.5 This article encourages to properly use construction materials that are good at durability and materials saving in green buildings. High-performance concrete and high-strength steel are very superior in terms of durability and materials saving. As for construction projects, using durable materials is the biggest saving measure. High-strength steel and high-performance concrete are already strong in terms of materials saving. If the strength of main stress-bearing steel bar of steel-bar concrete is improved to 400 ~ 500 N/mm^2 , then steel amount can be saved by around 10% comparing to the status quo. And if concrete can be of strength between C30 ~ C40 and part of buildings reach C80, then the amount of concrete can be saved by around 30% compared with current level. Using high-performance concrete and high-strength steel together can solve the problems with fat girder and pillar and increase the area for buildings. Using the steel bars with strength of more than 400 N/mm^2 and high-performance concrete whose strength satisfies the design requirement in the mainbody structure of steel-bar concrete, can be seen as accomplishment of requirements of this article.

Evaluation methods for this article are reviewing the list of materials for settlement, construction records and concrete testing reports (including the durability indicator).

5.4.6 This article encourages making full use of the materials of old buildings that are dismantled in the construction filed or collected through other channels in the construction process. And also the deserted materials in construction and land clearing shall be utilized as much as possible to extend their usable duration, in the purpose of saving raw materials, reducing waste, and easing the affect to the environment caused by production and transportation for renewing the needed materials.

The garbage and discarded stuff shall be sorted on the spot. This is the key point and precondition for recycling the waste. Directly reusable materials shall be reutilized in construction, and no directly reusable materials shall be recycled and processed via recycling enterprises, to avoid waste pollution and littering to the best of its advantage.

Evaluation methods for this article are reviewing the planning on management over construction waste and the records of recycling of waste in the construction field.

5.4.7 Recyclable materials in construction include two parts, one is that materials uses are already recyclable materials; another is the materials that can be recycled when the building is dismantled, such as: metals (steel, copper), glass, aluminium alloy, plaster-made product, wood materials, etc. Non-degradable construction materials, like PVC, don't belong to recyclable materials. Fully utilizing recyclable materials can reduce the energy and resource consumption and environment pollution caused by production and processing of new materials, and has very important significance to the sustainability of buildings.

Evaluation methods for this article are reviewing the amount of consumption of related materials in the list of materials for project settlement.

5.4.8 Integration of land construction and decoration requires architects to design an integrated plan for land construction and decoration. Integrated design and

construction of land construction and decoration can completely represent the design intention of architects, and can reinforce harmony and unification of spirit and presentation of the building as well as its completeness. Meanwhile, to complete integrated land construction and decoration, holes on construction components can be reserved and fixed components for decoration can be pre-buried beforehand, to avoid chiseling and perforation on existing construction components in the construction and decoration phase. It not only ensures the safety of the structure, but reduces construction garbage; it can also ensure that in the building design phase, the architect relies on the size of final decoration materials to adjust the measurement of the building, to ensure using whole piece of material for decoration wherever possible, reduce waste of materials in corners and angles, save materials, reduce noise pollution in construction, save construction time for decoration and energy consumption, and to reduce labor intensity in decoration construction.

The integration requires all-out cooperation among the land-owner, designer and construction party.

Evaluation methods for this article are reviewing the proof on integration of land construction and decoration, and checking construction papers and the list of actual workload in construction when necessary.

5.4.9 As for office buildings and shopping malls, there is frequent turnover in the users, and office equipment and commodity layout will be changed accordingly. This presents new requirements for indoor space layout of buildings. To avoid times of decoration and generation of waste due to change in space layout, this kind of buildings, under the precondition that indoor work and business setting are not influenced, shall adopt more flexible separation structure, to save materials and reduce damage to the building components caused by repetitive decoration when the space is re-arranged.

5.4.10 Deserted stuff mainly includes deserted stuff from construction, industrial deserted stuff, and that from daily life, and it can be used for production of green construction materials as raw materials. Under the precondition that performance requirements are met, it's encouraged to use concrete blocks made of regenerated materials from deserted stuff by construction, cement-made products and regenerated concrete; it's encouraged to use the construction materials like cement, concrete, wall materials, thermal materials, that are made from industrial deserted stuff, straw of crops, construction garbage and silt; it's encouraged to use the construction materials made from treated deserted stuff from daily life.

To ensure quantitative requirement for usage of deserted stuff, this article stipulates that the weight of materials made from deserted stuff accounts for not less than 30% of the total weight of same-type construction materials. For example, when using plaster blocks for inner wall materials, if the weight of used industrial plaster blocks made from industrial plaster (like desulfurized plaster and phosphorus plaster)

accounts for more than 30% of the total weight of used plaster blocks in construction, the requirements in this article are satisfied.
Evaluation methods for this article are reviewing the amount of consumption of related materials in the list of materials for project settlement.

5.4.11 Buildings of different types and features in functions, when using different structure systems and materials, have remarkable difference in terms of consumption amount of energy and resources as well as the impact on the environment. At present, in the structure system for residential buildings in our country, there are mainly brick-concrete pre-fabricated mixed structure, concrete-cast frame shear wall structure and concrete-frame structure. In recent years, there is also made some development in light-steel structure. In the whole country, brick-concrete pre-fabricated mixed structure still leads major presence, accounting for around 70% of the total building structure system. Now the proportion of steel-structure buildings in our country is less than 5%. And for green buildings, based on the requirements for resource saving and environment protection, under the precondition of safety and durability, it's the prior option to choose the building structure systems that consume less resources and generate less effect on the environment, which mainly include light-steel-structure system, block-structure system and wood-structure system.
Evaluation methods for this article are reviewing the design documents.

5.4.12 Green buildings shall extend the life circle of the construction materials that still have value to use, use materials repeatedly and reduce consumption of resources and energy for materials production as well as the impact on the environment caused by materials transportation. Recyclable materials include the materials removed from old buildings and the old building materials recycled from other places. Recyclable materials consist of blocks, brick stones, pipelines, plates, wood carpets, wood-made products (doors and windows), steel, steel-bars, part of decoration materials, etc. Developers shall provide the list of materials for project settlement, and calculate the weight of used recyclable materials and total weight of project building materials, the ratio of two of which is the utilization rate of recyclable materials.
Evaluation methods for this article are reviewing the amount of consumption of related materials in the list of materials for project settlement.

5.5 Indoor Environment Quality

5.5.1 Indoor thermal environment refers to environmental factors that affect people's feelings on temperature. "Thermal comfort" refers to people's subjective thermal reactions on thermal environment, and it's people's subjective feeling that they are satisfied with the thermal environment. It's the result of interaction of multiple factors. Comfortable indoor environment is helpful for people's mental and physical health, then improving the efficiency of study and work; while people are in too cold or too hot environment, it will lead to illness, affect health and even endanger people's life.

Generally, indoor temperature, indoor humidity and airflow speed are the most influential factors to people's thermal comfort, and they are the easiest to be felt and recognized by human body; while the impact of environment radiation on human body's feeling on temperature is very likely to be ignored by people; besides, radiation from fencing structure can also directly influence indoor air temperature, so this standard will only quote three parameters, indoor temperature, indoor humidity and airflow speed to evaluate indoor thermal comfort for human body. Based on the requirements on calculation for design in Energy Saving Design Standards for Public Buildings, the above parameters will be respectively controlled in corresponding sectors.

Evaluation methods for this article are reviewing the testing reports on room temperature, humidity and airflow speed in the building.

5.5.2 Because the heat transmission coefficients in some parts of fencing structure are far bigger than that of mainbody part, hot frequency bridge is formed. The main purpose of requirements in this article is to prevent small temperature difference on inner and outer surface of hot frequency bridge in heating period in winter. And the temperature on inner surface is likely to be lower than dew-congealing temperature in the room, resulting in dew congealing on the inner surface of hot frequency bridge of fencing structure; also too much heat transmission on these parts in summer when using air-conditioners shall be avoided not to increase energy consumption of air-conditioners.

Dew-congealing on inner surface will make the materials on inner surface of fencing structure moist, and is likely to generate mildew in poor ventilation conditions and affect the health of indoor people. Therefore, proper thermal and heat-proof measures shall be taken to reduce loss in heat transmission on hot frequency bridge parts of fencing structure, to prevent too low temperature on inner surface of outside fencings structure like outside walls and windows.

And more, when using radiation air-conditioning terminals outdoor, close attention needs to be paid to water temperature control to avoid dew congealing on the surface.

Evaluation methods for this article are reviewing the materials about energy saving design and system design for the building as well as on-site watch.

5.5.3 The minimum amount of fresh air for public buildings shall be determined according to hygiene requirements on indoor air, people's movement and work nature, time of stay in the room, etc. As for public buildings, the major requirements are on carbon dioxide density (requirements on inhalant grains can be met by measures like filtration). Plus, to ensure the import to the room is outdoor fresh air, polluting source is not allowed in the windward of access to fresh air; it's promoted to import fresh air directly into the room, shorten the length of fresh air tubes and reduce pollution in the route.

Minimum amount of fresh air for people in major rooms of public buildings shall be determined according to building type and functional requirements, in reference with

the standards and regulations like GB 50189 of Energy Saving Design Standards for Hotel Thermal Engineering and Air-conditioning, GB 9663 ~ GB 9673 of Hygiene Standards for Public Places, GB 16153 of Restaurant Hygiene Standards, GB/T 18883 of Indoor Air Quality Standards.
Evaluation methods for this article are reviewing design instructions and on-site testing reports.

5.5.4 Health issues caused by indoor air pollution have caught people's eyes in recent years. Slight reactions include stimulus to eyes, nose and respiratory tract, headache, dizziness, and body fatigue; serious reactions may lead to respiratory organ disease, and even heart disease and cancer, etc.
Therefore, indoor pollutant density shall be strictly controlled to ensure people's health, based on regulations in GB 50325 of Regulations on Control over Indoor Pollution for Civil Buildings.
Evaluation methods for this article are reviewing testing reports.

5.5.5 Indoor background noise level is one important factor that affects indoor environment quality. Although indoor noise, compared with indoor air quality and thermal comfort, is usually not so influential to human body, it can cause multiple aspects of damage, including ear discomfort, lowering work efficiency, damaging cardiovascular, leading to disorder in nervous system, and even affecting eyesight, etc.
The factors that affect indoor noise mainly include indoor noise source and outdoor environment influence. Indoor noise mainly comes from indoor electric appliances, while outdoor environment affects indoor noise in a longer timer to a wider extent, mainly including traffic noise, construction noise, business noise, industrial noise, neighborhood noise, etc.
In GBJ 118 of Sound-proof Design Regulations for Civil Buildings, requirements on allowed indoor noise level for hotels and office buildings are released; GB 9670 of Shopping Mall and Bookstore Hygiene Standards stipulates that background noise level in shopping malls shall not exceed 60 dB(A), and background noise level for stereo counters shall not exceed 85 dB(A).
Evaluation methods for this article are reviewing on-site testing reports.

5.5.6 Indoor illumination quality is one of important factors that affect indoor environment quality. Good illumination can not only increase people's work and study efficiency, but is good for people's mental and physical health and can reduce all vocational illness.
Good and comfortable illumination first requires proper lightening level on the reference plane, and not only visual requirements have to be met, but a comfortable and healthy light environment atmosphere has to be created in the whole building space; strong polarizing light will disrupt the harmony of indoor light and make people uncomfortable, and is likely to increase body fatigue, and in serious cases, people may feel dizzy, and even with temporary blindness. Another important factor for indoor illumination quality is the color rendering of the light source. The degree of

presentation of true color by manmade light source is called color rendering of light source. To conduct quantitative evaluation on light source's color rendering, the concept of color rendering index is introduced. Rely on standard light source as baseline, and set its color rendering index at 100. And the indices of other light sources are all below 100. Manmade light and natural light have different spectrum, so their color rendering indices are different. If the light color is not in harmony with the color of the space, it will result in very inconsistent atmosphere; while too much difference in color rendering of indoor and outdoor light sources will also lead to discomfort and fatigue of eyes, and even misjudgment of object colors.

Indoor lightness, uniform polarized light value, normal color rendering index in public buildings shall satisfy the regulations in Section 5.2 of GB 50034 of Building Illumination Design Standards.

Evaluation methods for this article are reviewing on-site testing reports.

5.5.7 Natural ventilation means airflow pushed by wind pressure or heat pressure. Natural ventilation is an important means to save energy and improve indoor air quality, and it's an important way of improving indoor thermal comfort. Therefore, in building design and structure design, it's encouraged to adopt positive measures of leading airflow to promote natural ventilation, such as air-guiding wall, air-pushing well, etc. to improve the efficiency of indoor natural ventilation.

Evaluation methods for this article are reviewing design papers and ventilation simulation reports.

5.5.8 Air-conditioning terminals in public buildings are important means to ensure indoor users' comfort. The purpose of this article is to eliminate poor air-conditioning terminal design, such as radiation ceiling terminal adopted without fully considering dehumidification, un-adjustable all-air systems adopted for hotels. While as for customized air supply terminal, dry fan-pan, carpet heating terminal, users can satisfy their demand by self-adjustment or auto-adjustment, which is good for improving comfort in using them.

Evaluation methods for this article are reviewing the design papers and on-site verification.

5.5.9 To improve the construction quality of hotel-type buildings in terms of functions, common methods are providing quiet indoor environment in such buildings, avoiding sound disturbance among different rooms and protect the privacy of people's indoor activities, requiring the sound-proof performance of fencing structure satisfy certain requirements.

The fencing structure of hotel-type buildings mainly includes partition between guest rooms, partition (including door) between guest room and corridor, outside door of guest room (including window), and floor board between guest rooms and other all rooms with vibration. This standard requires that the performance of insulation against air-borne sound and insulation against solid-borne sound of related fencing structure

must respectively satisfy the requirements higher than Class One in Article 6.2.1 and 6.2.2 of GBJ 118-88 of Sound-proof Design Regulations for Civil Buildings.
Evaluation methods for this article are reviewing on-site testing reports.

5.5.10 In public buildings, indoor noise level shall be controlled according to related hygiene standards, to protect workers' health and safety. And also a work environment that can maximize employees' efficiency, including sound environment shall be created.

So this requires the-whole-way consideration of proper arrangement of graphic and space functions across the whole process of building design, construction, design and installation of equipment systems. And it also requires consideration of controlling measures on noise and vibration of equipment systems from the design and installation of them. In building design, place the rooms sensitive to noise far away from noise source, and implement controlling measures from noise sources. This is usually the most effective and economic way.

Evaluation methods for this article are reviewing the design papers and on-site examination.

5.5.11 Natural light environment is a work environment that people are used to and fond of for a long time. According to visual test results of all kinds of light sources, in the same condition of lightness, ability of recognition of natural light is superior than manmade light, so natural light is helpful for people's work, life, eyesight protection and improvement of work efficiency. Natural daylighting for public buildings can not only save energy from illumination, but provide a comfortable and health light environment for indoor visual work, and it's an indispensable and crucial part of good indoor environment quality.

The biggest disadvantage of natural daylighting is instability and difficulty in reaching required uniformity of indoor lightness. Measures like adoption of reflectors in the position of high windows in the building, can not only import more natural light into the room, but improve the uniformity and stability of natural daylighting in the room. Most regions in our country are in temperate zone, with sufficient natural light, which is a beneficial condition for utilization of natural light. In most daytime, there are sufficient natural light resources for utilization. This is very significant to energy saving for illumination.

Main functional space emphasized in this article refers to major space for use except indoor traffic, bathroom, etc. This standard requires the daylighting coefficient of 75% of major functional space satisfies the requirements in Article 3.2.2 ~ 3.2.7 of GB/T 50033 of Building Daylighting Design Standards.

Evaluation methods for this article are reviewing the design papers and related analysis or testing reports.

5.5.12 To improve the consciousness of design personnel in carrying out regulations, and to ensure convenience of access for the disabled, old folks and children, and to

represent humanity of the overall building environment, it's encouraged to set non-obstacle facilities in major movement space like building entrance, lift, rest room, etc.
Evaluation methods for this article are on-site examination.

5.5.13 The outside shape of buildings can be taken into consideration to adopt proper outside sunlight-shield measures, to form an overall effective outside sunlight-shield system. Through the system, the heat from sun radiation and that transmitted from outdoor air to fencing structure as well as that from window radiation can be efficiently reduce, which plays a very important role in improving indoor thermal comfort in summer.
Evaluation methods for this article are on-site verification.

5.5.14 To protect human health, prevent and control indoor air pollution, indoor pollution monitoring system can be designed and installed in major functional rooms, using sensors to collect and analyze the data regarding temperature, humidity, carbon dioxide, density of air pollutant, etc.; and meanwhile, the system can monitor the work status of ventilation equipment which can be connected with indoor air pollution monitoring system to auto-adjust ventilation and ensure a healthy indoor air environment all the time.
The indoor pollution monitoring system shall be able to transfer collected data to computers or a monitoring platform, to realize the functions of data collection, data storage, real-time alarm, analysis and summarization of history data, treatment and adjustment control on the air quality in public places, and to ensure good air quality in the places.
Evaluation methods for this article are reviewing the design materials and on-site verification.

5.5.15 To improve the effect of natural daylighting on the ground, besides the simple measures like using light reflectors and prism glass windows, some advanced natural daylighting technology like light pipe and optical fiber can be adopted, to import outdoor natural light into the deep of the room, and to improve indoor illumination quality and the effect of natural light utilization.
Underground natural daylighting is not only beneficial for energy saving from illumination, but can improve underground hygiene environment. Due to the isolation in underground space, natural daylighting can increase exchange of natural information from indoor and outdoor and release people's depressed mentality; meanwhile, natural daylighting can be used as a reliable light source for emergency illumination underground in daytime. There a lot of ways for natural daylighting in underground space, like simply skylight, daylighting channel, or some mature measures that are easy to maintain, like prism glass window, light pipe, etc.
Evaluation methods for this article are reviewing the design papers and on-site verification.

5.6 Operation Management

5.6.1 Property management companies shall submit the management systems regarding energy saving, water saving, materials saving and green coverage, indicating the effect of implementation. Energy saving management system mainly includes: energy saving management mode; charge mode; water saving management system mainly includes: trapeziform water utilization principle and water-saving proposal; materials consumption management system mainly includes: maintenance systems for buildings, equipment and systems, and materials consumption management system; green coverage management system mainly includes: usage and measurement of water used for green coverage, and regulation on the usage of insecticide, weedicide, fertilizer, pesticide and other chemicals.

Evaluation methods for this article are reviewing the management documents and daily management records of the property management company as well as on-site investigation.

5.6.2 In the operation process of buildings, a lot of waste water and gas will be generated, so advanced equipment and materials or other methods shall be selected, with proper technology and discharge management methods, to eliminate any discharge of waste water and gas not in line with the standard in the operation period.

Evaluation methods for this article are checking the environment evaluation reports of the project and on-site investigation.

5.6.3 In the operation process of buildings, a lot of garbage will appear, including the mud, residue and scattered mortar in the decoration and maintenance process of the building, and bricks, stones, broken concrete, scraps, packaging materials, and deserted paper generated from metal, wood and bamboo sheets, decoration. And for hotel-type buildings, there will still be kitchen garbage. So abandonment or improper treatment of so much garbage will generate huge impact on city environment. Therefore, in the operation process of buildings, the garbage shall be sorted by source, recyclability, difficulty of treatment, etc. Recycle those reusable or recyclable materials for new production.

Evaluation methods for this article are reviewing the waste management measures of the property keeper and on-site verification.

5.6.4 Investigation shall be conducted on the soil environment situation of the area where the construction land is. Land planning proposals shall be figured out, to prevent soil erosion and degeneration; as for the land needed for construction, deserted land, poor land and waste land shall be firstly considered.

When the soil dug out is piled, try to avoid loss and fill it back, balancing the amount dug out and the amount filled back; if possible, it shall be considered to borrow or lend soil resources from or to nearby construction land. Good plough soil in the construction land shall be collected and utilized.

In the planning, the continuity of the roads during construction and after completion shall be considered. And also application of temporary facilities in the operation of the building shall be considered to avoid duplicate construction.

Evaluation methods for this article are reviewing the construction reports and on-site investigation.

5.6.5 ISO 14001 is the environment management standard, which includes environment management system, environment review, environment sign, complete life circle, etc. in the purpose of guiding all organizations to conduct right behaviors for the environment. It is the need of improving environment management level for property management unit to pass the environment system certification by ISO 14001. And meanwhile the property management company has complete management measures, and conduct training for management personnel on a regular base.

Evaluation methods for this article are reviewing qualification certificates of the property management company.

5.6.6 The lives of equipment and pipelines in buildings are commonly shorter than those of building structure, so the layout of all equipment and pipelines shall be convenient for future repairs, renovation and replacement. Tube well can be set in public parts to reduce disturbance to users. The equipment and pipelines for public use shall be set in public parts to facilitate daily repairs and replacement.

Evaluation methods for this article are reviewing the design documents of related equipment and pipelines and on-site verification.

5.6.7 Before turning on air-conditioning system, the filter, cooling coil, heater, humidifler, and cooling water pan of the system shall be wholly checked, washed or replaced, to guarantee the air supply by the air-conditioner in line with the requirements of GB 17093 of Hygiene Standards on Bacteria Total in Indoor Air. As for specific methods and requirements, please refer to GB 19210 of Regulations on Air-conditioner Ventilation System Washing.

Evaluation methods for this article are reviewing the management measures and maintenance records of the property keeper.

5.6.8 To ensure the security and high efficient operation of buildings, proper and complete building information network systems shall be set up, based on GB/T 50314 of Intelligence Building Design Standards and Regulations on Check and Acceptance of Intelligence Building Engineering Quality, to successfully support the application of communications and computer network and operate in a safe and reliable way.

Evaluation methods for this article are reviewing the design documents and operation records regarding the building information network system.

5.6.9 Air-conditioners, ventilation and illumination systems of public buildings consume the majority of energy in the operation of the building. Therefore, effective monitoring shall be conducted on air-conditioning and ventilation systems, cold and hot sources, wind turbines, water pumps, etc. to collect and record key data on a real-time base; reliable and automated control shall be done on the above equipment systems according to the design requirements. As for illumination systems, besides minimizing the design of LPD under the precondition that illumination quality is

ensured, sensor or time-delayed automatic control methods can be adopted to realize energy-saving illumination for the building's operation.
Evaluation methods for this article are reviewing the design documents on equipment self-controlling systems and on-site verification.

5.6.10 In the past, fees of water, electricity, natural gas, heat, etc. were collected by area, and therefore users were likely to ignore energy saving, and it was very common to see long lasting lights on running water. This is one of the major points of energy and resource waste, so it shall be taken as one of the key targets for examination. In terms of hardware, it's required to record and measure electricity consumption and amount of heat and coldness by item and by class. Get to know and analyze the amount of energy consumption for each item of public buildings, to discover problems and provide necessary means for energy saving. And at the same time, charges shall be collected by amount of consumed resources so that land-owner and users can emphasize on energy saving.
Evaluation methods for this article are reviewing the management measures of the property keeper and spot test property management contracts.

5.6.11 Management is the key means of saving energy in operation. While in the past, management performance was usually not connected with the performance on energy and resources saving. Therefore the property keeper is required to, under the precondition that buildings' functional requirements are guaranteed and that complaint rate is lower than required, connect economic benefits of the property directly to the performance of the building's energy consumption and the usage of water and office stuff.
Evaluation methods for this article are reviewing the contract between the land-owner, tenant and property management company in the operation period.