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Design Standard for Energy Efficiency of Residential Buildings in Severe Cold and Cold Zones

严寒和寒冷地区居住建筑节能设计标准

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1 General Provisions

1.0.1 This standard was formulated with a viewing to implementing the relevant national laws, regulations and policies on energy conservation and environment protection, improving the thermal environment in residential buildings in severe cold and cold zones and improving the energy efficiency of heating.

1.0.2 This standard applies to the design for energy efficiency of those constructed, renovated and extended residential buildings in severe cold and cold zones.

1.0.3 The residential buildings in severe cold and cold zones must adopt energy saving design. On the condition of ensuring the indoor thermal environment, the thermal, heating and ventilating as well as air conditioning design shall control the energy consumption for heating within the specified range.

1.0.4 The energy efficiency design of residential buildings in severe cold and cold zones shall not only comply with those specified in this standard, but also shall comply with those specified in the relevant current national standards.

2 Terms and Symbols

2.1 Terms

2.1.1 Heating degree day based on 18 ℃ (hereinafter referred as heating degree day)

Heating degree days in a year, gotten by accumulating the difference of the mean daily temperature (in a day when the mean daily temperature outdoor is under 18 ℃) to 18 ℃, multiplied by 1d.

2.1.2 Cooling degree day based on 26 ℃ (hereinafter referred as cooling degree day)

Cooling degree days in a year, gotten by accumulating the difference of the mean daily temperature (in a day when the mean daily temperature outdoor is higher than 26℃) to 26 ℃, multiplied by 1d.

2.1.3 Heating period for calculation

Number of days that the mean daily temperature is under or equal to 5 ℃, gotten by rolling mean method. The heating period for calculation is only used for building energy efficiency design calculation, and it may not be equal to the number of local statutory heating days.

2.1.4 Mean outdoor temperature during heating period

Arithmetic mean value of outdoor mean daily temperature during heating period for calculation

2.1.5 Shape factor

The ratio of the building external surface area contacting the outdoor atmospheric air to the enclosed volume of the building. The external surface area excludes the area of floor, and non-heating staircase internal wall and doors.

2.1.6 Index of heat loss of building

Under the mean outdoor temperature during heating period, the quantity of heat supplied by the indoor heating equipment, required for keeping the interior design calculation temperature in unit time on unit building area.

2.1.7 Heat transfer coefficient of building envelope

Heat transferred through the building envelope in unit time on unit area under the steady

state condition that the air temperature difference on both sides of the building envelope is 1 ℃.

2.1.8 Mean heat transfer coefficient of external wall

The heat transfer coefficient of external wall, in consideration of thermal bridge affect in wall.

2.1.9 Modification coefficient of building envelope

Correction factor introduced in consideration of the influence of solar radiation on building envelope heat transmission.

2.1.10 Window to wall ratio

The ratio of the window hole area to the room vertical plane unit area (area enclosed by building story height and bay position line).

2.1.11 Efficiency of boiler

The efficiency of a boiler under actual operation condition during heating period.

2.1.12 Efficiency of network

the ratio of the network output total heat to the total heat supplied into the network.

2.1.13 Ratio of electricity consumption to transferred heat quantity

Under the heating calculated temperature indoor and outdoor, the ratio of the full-day theoretical pump power consumption to the full-day heating load.

2.2 Symbols

2.2.1 Weather data

$HDD18$——Heating degree day, ℃·d;

$CDD26$——Cooling degree day, ℃·d;

Z——Heating period for calculation, d;

t_e——Mean outdoor temperature during heating period, ℃.

2.2.2 Building

S——Shape factor, 1/m;

q_H——Index of heat loss of building,W/m^2;

K——Heat transfer coefficient of building envelope, W/ (m^2·K);

K_m——Mean heat transfer coefficient of external wall, W/ (m^2·K);

ε_i——Correction factor of Heat transfer coefficient of building envelope, zero dimension.

2.2.3 Heating System

η_1——Heat delivery efficiency of outdoor network, zero dimension;

η_2——Efficiency of boiler, zero dimension;

EHR——Ratio of electricity consumption to transferred heat quantity, zero dimension.

3 Climate Sub-zone and Calculation Parameter of Indoor Thermal Environment

3.0.1 According to the range of different heating degree day (HDD 18) and cooling degree day (CDD 26), the severe cold and cold zones can be divided into 5 climate sub-zones indicated in Table 3.0.1.

Table 3.0.1 -- Climate sub-zones in energy efficiency design of residential buildings in severe cold and cold zones

if arranged, shall not be larger than 400mm; the heat transfer coefficient limit of bay window shall be 15 % lower than the one of ordinary window, and the heat transfer coefficient of its nontransparent top, bottom and side shall be less than or equal to the one of the external wall. The window area of bay window and the wall area occupied by the bay window, worked out for the window to wall ratio, shall be calculated according to the window aperture opening area.

4.2.6 The external window and open balcony door shall have good leak tightness. the airtightness grade of external window and open balcony in severe cold zone shall not be lower than grade 6 specified in the national standard "Graduations and Test Methods of Air Permeability Water Tightness Wind Load Resistance Performance for Building External Windows and Doors" GB/T 7106-2008. The airtightness grade of external window and open balcony door of layer 1~6 in cold zone shall not be lower than grade 4 specified in the national standard "Graduations and Test Methods of Air Permeability Water Tightness Wind Load Resistance Performance for Building External Windows and Doors" GB/T 7106-2008, and the one of layer 7 or higher layer shall not be lower than grade 6.

4.2.7 The thermal insulation of close type balcony shall meet the following requirements:

1 Separation wall and door/ window shall be arranged between balcony and directly connected room.

2 When no separation wall or door / door is arranged between balcony and directly connected room, balcony shall be used as a part of the room. The heat transfer coefficient of the wallboard, top plate and floor contacting outdoor air must meet the requirements of Article 4.2.2 in this standard, and the balcony window to wall ratio must meet the requirements of Article 4.1.4 in this standard.

3 When separation wall and door / door are arranged between balcony and directly connected room, the heat transfer coefficient of them is not larger than the limits listed in Article 4.2.2 of this standard, and the window to wall ratio is lower than the limits listed in Table 4.1.4, special heat engineering may not be required for the balcony external surface.

4 When separation wall and door / door are arranged between balcony and directly connected room, and the heat transfer coefficient of them is larger than the limits listed in Article 4.2.2 of this standard, the heat transfer coefficient of the wallboard, top plate and floor contacting outdoor air shall not be larger 120 % than the limits listed in Article 4.2.2 in this standard; the heat transfer coefficient of balcony window in severe cold zone shall not be larger than 2.5W/ (m^2·K); The heat transfer coefficient of balcony window in cold zone shall not be larger than 3.1W/ (m^2·K); The window to wall ratio of balcony external surface shall not be larger than 60 %; and the window to wall ratio of the separation wall between balcony and directly connected room shall not exceed the limit listed in Table 4.1.4 of this standard. When the surface width of the balcony is less than the bay width of the directly connected room, the window to wall ratio of the separation wall is calculated according to the room bay.

4.2.8 The gap between external window door (frame) and wall shall be filled with high efficiency insulation materials, and must not be filled with Portland cement mortar.

4.2.9 Thermal insulation treatment shall be arranged for the sidewall surface outdoor of the external window (door) opening, and it shall be ensured that the internal surface temperature of the sidewall indoor of window (door) opening is not lower than the dewpoint temperature at indoor air design temperature and humidity condition, and the additional heat loss is reduced.

4.2.10 The thermal insulation treatment shall be arranged for the thermal bridge between

system which the heating agent supply water temperature is not higher than 60 ℃.

2 Flue gas waste heat recovery device should be arranged for Heating System with heater.

3 Condensing gas fired boiler shall be adopted if necessary; if ordinary boiler is adopted, additional flue gas waste heat recovery device shall be arranged.

5.2.9 The heat meter to meter total heating load shall be arranged on the main pipe of boiler room and heating plant. Building-before heat meter as heat settlement point of building heating heat loss, must be arranged in the thermal force access point of buildings in central heating system.

5.2.10 Household fuel gas warm heating furnace (water heater) should not be used as heat source for heating in the high-rise buildings in which central heating can be used or fuel gas hot water unit (boiler) can be arranged in centralized way. If Household fuel gas warm heating furnace must be used, special air intake and smoke emission channels shall be arranged and meet the following requirements:

1 Perfect and reliable automatic safety protection system must be arranged for gas furnace.

2 The equipments shall have the function of automatic fuel gas and combustion air regulation, and arranged with room temperature controller.

3 The operation condition parameters of water circulating pump supplied in package shall meet the requirements of the Heating System.

5.2.11 If the scale of the system is larger, the primary and secondary water systems indirectly connected should be adopted; the scale of the heating plant should not be larger than 100000 m 2; the design supply temperature of primary water should be 115 ℃ ~ 130 ℃, and the backwater temperature shall be 50 ℃ ~ 80 ℃.

5.2.12 Variable-flow water system is adopted in the Heating System, variable speed regulation mode should be adopted for water circulating pump; the set number of pumps should be 2 (one in service, and the other one standby). If the scale of the system is larger, the set number may be increased properly by technical economical analysis.

5.2.13 Strict hydraulic equilibrium calculation shall be carried out for outdoor network. If valve interception way is adopted to realize resistance equilibrium of outdoor network, the pressure loss among the paralleling loops shall not be larger than 15 %. If the hydraulic equilibrium calculation of the outdoor network cannot meet above requirements, static hydraulic equilibrium valve shall be arranged at the building thermal force access point and heating plant.

5.2.14 Water filters shall be designed and arranged for each thermal force accesses of building, and whether self-force flow control valve, self-force differential pressure control valve or other device is adopted shall be determined according to the requirements in hydraulic equilibrium of outdoor network and the regulation mode of heating system in building.

5.2.15 The arrangement and selection of hydraulic equilibrium valve shall meet the following requirements:

1 The range of pressure differential at both end of the valve shall meet the requirements of the product standard.

2 Self-force flow control valve shall not be arranged in serial connection on the outlet main of the heating plant; if several sub-loops are arranged, static hydraulic equilibrium valves may be arranged in sub-loops according to the hydraulic equilibrium requirements.

3 Static hydraulic equilibrium valve, or self-force flow control valve may be arranged for

5.3.8 In small housing district with low temperature floor radiant central heating, the boiler or heat exchange station should not directly supply the heating agent which the temperature is lower than 60 ℃. When the temperature of the heating agent supplied by external network is higher than 60 ℃, water mixing pump should be arranged before the sub-water-collector of each household to pump indoor backwater to mix in water supply, keep the temperature not higher than the setting value and increase the indoor circulation water amount; the water mixing may also be arranged at the thermal force access point of the building.

5.3.9 In the design of low temperature floor radiant heating system, the warm heating loop should be divided by main rooms, and the room temperature automatic controlling device shall be arranged. Water filter shall be arranged in the water inlet pipe of water separator each household, and the heat apportion devices shall be arranged by household.

5.3.10 In the working drawing design, the strict hydraulic equilibrium calculation for indoor warm heating pipes shall be conducted, to ensure the pressure loss difference in the paralleling loops (excluding public section) is not larger than 15 %; in the hydraulic equilibrium calculation, the supplementary pressure due to water cooling shall be worked out, and the value hereof may be 2/3 the supplementary pressure under the design water feed and back temperature conditions.

5.3.11 When the energy efficiency ratio (COP) of the air conditioning equipment for heating under design condition is lower than 1.8 in cold zone, air source heat pump unit should not be adopted for heat supply; if centralized heat source or gas supply is available, air source heat pump should not be adopted.

5.4 Ventilation and Air-conditioning System

5.4.1 In the design of ventilation and air-conditioning system, combined with architecture design, the natural ventilation measures in seasons all the year around shall be determined; the indoor air flow organization shall be arranged well to improve the natural ventilation efficiency and reduce the service time of mechanical ventilation and air conditioning. When natural ventilation cannot satisfy the cooling requirements in most of the time, mechanical ventilation or air conditioning system should be arranged, and the arranged mechanical ventilation or air conditioning system shall not disturb the natural ventilation of the building.

5.4.2 When dispersal room air conditioners are adopted for air conditioning and (or) heating, the energy efficiency products (with energy efficiency grade 2) specified in the national standards "The minimum allowable values of the energy efficiency and energy efficiency grades for room air conditioners" GB 12021.3 and "The minimum allowable values of the energy efficiency and energy efficiency grades for variable speed room air conditioners" GB 21455.

5.4.3 When the vapour compression circulating cold water (heat pump) unit with motor driven compressor or the unitary air conditioners with motor driven compressor which the nominal cooling capacity is larger than 7100 W is adopted as the cooling and heat source unit for small housing district or integral building, the energy efficiency ratio (performance factor) of the unit shall not be less than the specified value in the current national standard "Design Standard for Energy Efficiency of Public Buildings" GB 50189; When Multi-connected air conditioning (heat pump) unit is adopted as concentrated air conditioning (heating) unit for household, the cooling overall performance coefficient of the unit shall not be lower than Grade 3 specified in the national standard "The minimum allowable values of the IPLV and energy

Appendix A Climate Zone Criteria, Weather Data, Heat Loss Index Requirements of Building for Cities

A.0.1 Severe cold and cold zones may be divided into five climate sub-zones future according to heating degree days and cooling degree days. Thereinto, the weather data used for the energy efficiency calculation for buildings and index of heat loss of buildings in cities shall be determined according to the provisions specified in Table A.0.1-1 and Table A.0.1-2.

A.0.2 Zone dividing index in severe cold zone is HDD18 ≥3800 and the climate in such a zone is characterized by severe cold-winter. As a result, the severe cold zone may be divided into three sub-zones: severe cold (A) zone, severe cold (B) zone and severe cold (C) zone according to different severe cold degrees in winter.

1 The dividing index for severe cold (A) zone is 6000≤HDD18 and the climate in such a zone is characterized by an extremely severe cold-winter and a cool summer;

2 the dividing index for severe cold (B) zone is 5000≤HDD18< 6000 and the climate in such a zone is characterized by a very severe cold-winter and a cool summer;

3 The dividing index for severe cold (C) zone is 3800≤HDD18< 5000 and the climate in such a zone is characterized by a severe cold-winter and a cool summer;

A.0.3 The zone dividing index in cold zone is 2000 ≤HDD18<3800, 0< CDD and the climate in such a zone is characterized by a cold-winter. The cold zone may be divided into cold (A) zone and cold (C) once in accordance with different heat degrees in summer:

1 The zone dividing index in cold (A) zone is 2000≤HDD18< 3800, 0< CDD26≤90 and the climate is characterized by a cold-winter and a cool summer;

2 the zone dividing index in cold (B) zone is 2000≤HDD18< 3800, 90< CDD26 and the climate is characterized by a cold-winter and a hot-summer.

Explanation of Wording in This Code

1 Words used for different degrees of strictness are explained as follows in order to mark the differences in executing the requirements in this code.

1) Words denoting a very strict or mandatory requirement:

"Must" is used for affirmation; "must not" for negation.

2) Words denoting a strict requirement under normal conditions:

"Shall" is used for affirmation; "shall not" for negation.

3) Words denoting a permission of a slight choice or an indication of the most suitable choice when conditions permit:

"Should" is used for affirmation; "should not" for negation.

4) "May" is used to express the option available, sometimes with the conditional permit.

2 "Shall comply with…"or "Shall meet the requirements of…"is used in this code to indicate that it is necessary to comply with the requirements stipulated in other relative standards and codes.

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