

# Discussion on Electrical Design of Passive Residential Building

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**Abstract:** As the national buildings in each climate zone and passive low energy consumption building demonstration projects expand, there has been a wave of innovation across the construction industry. China is also becoming a hot zone for energy-efficient and high-performance passive buildings. Along with the traditional passive building structure, steel structure passive construction, assembled PC structure passive construction such as the emergence of various types of passive construction, as well as a variety of new building materials, doors and Windows, and air conditioning air equipment, put forward a new challenge for building electrical engineering design personnel and requirements.

**Keywords:** Passive; Low energy consumption; Residential building; Electrical design

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## 1. Overview of Passive Architecture

Passive House, also known as passive low-energy building, passive house, etc., is a new concept of energy saving building, which refers to the construction design of the building itself, can achieve the comfortable indoor temperature and meet the demands of winter and warm summer, a building that needs to be installed separately from the heating facility and does not require "active" energy. At the same time, it is an important way to solve the winter haze and southern winter adoption in the north.<sup>[1]</sup>

The concept of passive houses includes the use of various energy saving technologies to construct the optimal building envelope, which greatly improves the insulation performance and air tightness of the insulation, minimizing heat transfer loss; by means of technical means, the indoor and comfortable thermal environment and lighting environment can be achieved. It minimizes dependence on active heating and cooling systems, such as making full use of indoor life energy and renewable energy, to achieve a comfortable living environment, so as to greatly reduce the energy consumption at a time.

## 2. Importance of Passive Building Electrical Design

According to the definition of passive building, the key of passive architecture is "heat preservation, air tightness, thermal protection and ventilation design". The electrical system has limited role. Building electrical systems of all kinds of lighting, socket, weak current, fire pipe-

line are complex, only electrical system fits the passive buildings, air tightness and heat insulating "stays bridge" requirement, which can supplement each other with other systems and finally realize the functions of the passive construction.

In addition, with the improvement of the integration degree of the building electrical system, the passive building has the effect of achieving high efficiency and energy saving. Other than ordinary buildings, it adopts more micro photovoltaic (pv) grid technology, intelligent home control system, energy-saving doors and windows system, intelligent shading systems, photovoltaic power generation system, optical lighting system, LED energy-saving lamps and other new technology and products, and the ground source heat pump system related to the electrical control system, solar water heating system, PM2.5 air purification system, air system, the central dust collection system, drainage system, rain water collection recycling system, water purification processing system and other new technology, increasing the importance of passive building electrical system design work.

In a word, in the design of passive building, completing the relevant design work of each electrical part can realize the low-carbon energy saving of passive buildings and improve the comfort of living environment.<sup>[2]</sup>

## 3. Key Points of Passive Building Electrical Design

### 3.1 Air Tightness of Passive Construction Electrical Pipelines

The performance of building gas is very important to re-

alize ultra-low energy consumption of passive buildings. Good air tightness can reduce the amount of infiltration in winter and cooling demand caused by uncontrolled ventilation in summer, avoid moisture intrusion, the damage, mold, and condensation of building, reduce the noise and air pollution outdoor adverse factors on the influence of the indoor environment, and improve the quality of life of the residents.

The air tightness of the electrical pipeline is the most important part of the passive building electrical design work, which is an important part of the overall air tightness of the passive building.

Reference in the design of a certain community is located in Hebei province to the atlas of J16J156--Passive and Low Energy Consumption Residential Building Energy-Saving Construction, the first cold area of passive guidance atlas, is also the first "passive architecture" album.

The passive ultra-low power consumption guidelines for the green building techniques proposed the concept of air barrier, a certain community adopts double air barrier structure, surrounding the entire envelope outside air barrier, making overall realize airtight construction; the inner airtight layer is the object of a single set of residential buildings, and each house is self-formed.

When the electrical design, the basement electric casing should adopt waterproof and thermal bridge construction when wearing the outer wall; the pipeline should adopt thermal bridge and air tightness method when entering the internal distribution box and terminal box; when the inner tube is not through the airtight layer, the two ends of the pipe are blocked.

### 3.2 Electronic Control Design of High Energy New Wind System

When the passive building demands air tightness reaches the extreme, the new wind system is indispensable in passive energy saving buildings.

The new wind system can provide enough fresh air for the indoor air to breathe fresh and clean. At the same time, the new wind system also reduces the content of various harmful substances indoors, which also produces the effect of purifying the air to a great extent.

The new wind system is not available in ordinary residential buildings, and the electrical design should pay special attention to the following two points:

1) The collision of piping and electrical pipelines of the new wind system.

At present, the passive building new wind system pipe has the roof lifting and the floor of the two kinds of ways, the domestic use of the roof lifting and fitting the ceiling. The electrical design should understand the position of the air duct, especially the position of the duct through the hole of the wall, avoiding the collision between the inner pipe and the wind pipe. Avoid the internal distribution box in the bottom of the duct, so as not to cross the pipe from the distribution box to the ceiling. The problem is obvious in the loft residence.

2) New intelligent control system of the fan.

The intelligent control system of the new fan is composed of the main engine and the detection module.

The main engine is used to set indoor ideal air condition (temperature, humidity, carbon dioxide concentration, PM2.5 concentration, etc.), monitor system operation, ring failure alarm, which is commonly located in porch, sitting room and other public area convenient operation place.

Detection module is located in the independent space of bedroom, sitting room, study, kitchen, toilet, for independent detection and independent adjustment of the air state of each space. In order to ensure the accuracy of the detection, the detection module should be kept away from the air supply port and should be close to the return air port installation.

### 3.3 Design of Indoor Gas Leakage Linkage

When the passive building demands high performance air tightness, it also increases the damage caused by gas leakage, and it is easier to reach the lower limit of gas explosion. Therefore, in according with the specification for design of automatic fire alarm system design of passive building fire automatic alarm system at the same time, the passive construction shall link gas emergency shut-off valve automatically, and appropriate link open exhaust ventilation equipment. Unfortunately, "Certain Community" project fresh air ventilation devices chosen by Party A do not support the fire linkage, custom exhaust fan can't meet the requirements of air tightness, so this project can realize linkage function of ventilated take a breath.

### 3.4 Linkage Design of the Lampblack Machine

Passive building high-performance air tightness causes inside the kitchen smoke lampblack machine opens, unable to form fill enough natural wind, smoke lampblack machine operation but reach the purpose of effective smoke lampblack to outdoor. Therefore, in the passive residential building design, the hvacr will set up a special air inlet for the external wall, and the exhaust shaft shall be designed for special exhaust vents. The air inlet and outlet

are equipped with the air valve to meet the requirements of the airtight, and the air inlet and exhaust air valves are simultaneously opened and closed with the lampblack machine.

In order to achieve the above functions, it requires that a lampblack machine can output the start-stop signal, but this kind of equipment may need to be customized specially since there is no such type of lampblack machine in the market. Special customization can be realized only when Party A is responsible for the unified purchase of equipment, it is not operable for the different users.

In the design of "Certain Community", a single-link switch is adopted to control the inlet valve and the start-stop of the exhaust valve. When the smoke engine starts to stop, the air valve can be opened manually. In order to prevent the residents from forgetting to open the air valve, the switch is in the obvious position close to the lampblack machine; to prevent users from forgetting to close the air valve, the switch uses a indicator light switch. However, this method can't solve the problem of synchronous start-stop and switch wind valve.

There is also a way, it is to use switch socket by smoke lampblack machine, the power of the wind valve to connect the fastening bolt hole of the outlet of lampblack machine. The opening and stop of the wind valve and the lampblack machine are controlled by the switch in the socket. It can be perfect to realize the wind valve and the smoke and smoke machine synchronously to stop, it doesn't need to custom to smoke lampblack machine.<sup>[3]</sup> However, in order to avoid smoke lampblack machine shut down the wind valve is not closed, requirements users smoke lampblack machine to give up smoke lampblack machine used to own switch button, only use the switch on the socket and the socket installation height and wind valve connection has asked, still not perfect to solve the problem.

Therefore, "Certain Community" does not solve this problem perfectly, it merely adopted the way Party A approved of, and I welcome your better recommended ways to solve this.

### 3.5 Control of the New Wind System

As mentioned earlier, the passive residential building has a new air system. The new fan is equipped with air inlet valve, exhaust valve, return air valve and other signal points, each room and other independent space have the detection module, the ventilation valve each signal point, the public area has the control host one. A two-bedroom passive house, the signal point generally has about 12; a

three-bedroom passive house, the signal point generally has 16.

In the project of "Certain Community", according to the products selected by Party A, the new fan adopts the analog signal, which requires the new fan to use the radioactive wiring method at various signal points. When considering the partial pipeline voltage, the function is the same, and the mutual interference can be co-managed, the output line of the new fan to each signal point still has 9 to 11. These pipelines are not available in the general residential design, and new requirements are put forward for the pipeline laying in the design and construction. At the same time, the structure strength of the floor slab and the thickness of the floor are higher.

With the development of the passive construction industry, the equipment manufacturers can develop the bus control system to reduce the consumption of pipes and wires, and reduce the cost of construction and construction.

## 4. Conclusion

At present, the industrial chain of passive building is not perfect, at least the construction equipment manufacturing and the use link need to be further improved. It is believed that with the continuous development of passive construction industry in China, the emergence of new materials, equipment and technologies will be solved perfectly.

The passive residential building electrical system, as a ring of the overall effect of passive building, has a significant impact on the energy saving and residential comfort of passive buildings. As designers, therefore, we should constantly improve the level of passive building electrical design, keep learning and master the cutting-edge technologies, promoting adjustments of architectural design, making it more in line with design requirements of "safe, reliable, advanced technology, reasonable and economical, low carbon environmental protection", which is our work and responsibility.

## References

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