

Design Analysis of Natural Lighting and Ventilation of Underground Garage

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Abstract: In the analysis of the lighting and ventilation design mode of the underground garage, it is necessary to take the natural green environmental protection standard design as the main thought and pay attention to the influence of lighting on the car. According to the data simulation method and the overall design scheme standard, the specific range of numerical simulation standard is determined. Through the analysis of airflow change, distribution mode, air volume, carbon dioxide, carbon monoxide concentration ratio level of underground garage, we can determine the actual ventilation design standards of underground garage and value more on the implementation of natural lighting and ventilation design scheme under green building mode. This paper analyzes the practical natural lighting application design method of green building underground garage, combines the development of green building and building energy saving, lays emphasis on the ventilation and sewage effect of underground garage, strengthens the reasonable allocation and application of the overall lighting and ventilation of underground garage and finally clarifies the operation standard and design effect.

Car garage is a special space, we need to pay attention to the expansion of green building mode based on the building energy saving and environmental protection development standards. According to the actual natural intensive standard of the underground garage, the design of fine lighting and ventilation in the natural condition of the underground garage model is strengthened. In this way, we can analyze air quality standard and ventilation effect. Moreover, we should pay attention to the level of ventilation proportion under the green environmental protection underground garage along with the safety protection management of underground garage, implement the digital simulation construction analysis, verify the actual implementation effect of underground garage ventilation and realize the analysis and application of digital simulation signal.

1. Natural Lighting and Ventilation Technology of Car Garage

1.1 Ventilation status and methods

There are many cars in underground garages which discharge a lot and pollute a lot. The overall air circulation of the garage is poor and the air quality is low. Underground garage ventilation mainly refers to two methods, mechanical ventilation and natural ventilation. Mechanical ventilation is a reasonable design with power coordination to improve the indoor environment level of underground garage. The overall operation of mechanical equipment is noisy, energy consumption is high and environmental protection is poor, but with high overall effect and energy efficiency. Natural ventilation needs a long time, short time effect is poor and air conversion rate of closed underground garage is low, which will be unable to adapt to the actual level of indoor environmental protection. According to the Relevant Contents of the Code for Fire Prevention in Garages and Parking Lots, strict standard control of technology should be strengthened, as shown in table 1.

Table1 Current situation of underground garage

Poor environmental protection	More cars	Row amplifier	Heavy pollution	Poor air quality
High energy consumption	Loud noise	In disrepair	Poor design	Less intelligence

1.2 Factor analysis of garage pollution emission

Garage pollution emissions mainly include carbon monoxide, hydrocarbons, nitrogen oxides, particles and so on. Carbon monoxide's damage to the human body is large, in a certain range, it will cause serious impact on the human body. According to the standard analysis of Workplace Exposure Hazard Limits in China, the reasonable concentration of carbon monoxide should be controlled within 30mg/m³.

1.3 Value standard meaning of garage ventilation

According to the actual specifications of the garage, it is necessary to adopt the methods of natural daily ventilation and mechanical ventilation cooperation, pay attention to the implementation of ventilation effect as well as the reliability analysis of sewage discharge, and strengthen the expansion of ventilation sewage energy. According to the existing garage ventilation model, we should implement reasonable allocation of energy saving ideas to enhance the garage ventilation value and significance.

2. Regulation Mode Standard of Green Building Underground Garage

Green building contains several modules that mainly refer to environmental protection, including indoor energy saving and outdoor energy saving. According to the utilization of energy saving and protection, water saving, electricity saving and material saving resources are the main ones. Through the green modular matching of indoor quality, construction management mode, design and construction standard, operation mode can be qualified. Garage design requires to optimize the construction space, define space layout and design concept to gradually improve the overall ventilation effect. According to the seasonal change, we should adjust the ventilation time and frequency to ensure the natural ventilation effect and improve the insulation effect of the garage, as shown in table 2.

Table2 Standards for construction of green underground garage

green	environmental protection	water conservation	Save electricity	Material saving
Use according to function	Ergonomic	Conform to spatial layout	Meet the equipment operation standard	Meet seasonal demand

3. Analysis of Natural Ventilation Effect of Garage

Taking the public garage construction project in a new district of Chongqing as an example, there is a park in the west, south and north side of the garage while the entrance of the garage is in the east side. Underground area of the garage is 800 square meters with regional distribution of parking space, fire area, equipment, etc in the garage.

3.1 Garage and design thinking analysis

The ventilation of the garage is handled by mechanical smoke extraction equipment, and the operation standard of the building is adjusted in the later period. According to the ventilation system mode, we should strictly follow the requirements of design standards, pay attention to the air quality allocation in the later period. We should also adjust and optimize the ventilation channel, make full use of the ventilation entrance according to the project standard. Moreover, we should adjust the window ventilation of the sunken side wall to ensure the lighting effect of the patio side window. Combined with the entrance position of the garage, we should adjust the airflow of the underground garage and pay attention to the ventilation of the green building underground garage. According to the garage interior layout, we should also strengthen the garage window position layout. It's usually set around. This example in sinking courtyard is set up four 4 m × 4 m windows with the window spacing 2 m; In day-lighting patio, it is set up 6 m × 3 m window with the window spacing 2 m. Garage entrances is set up 8 m × 3 m windows. The garage open area is 80 m², accounting for 10% of the garage indoor area.

3.2 Natural ventilation channel mode

Starting from the simulation model of air circulation, it focuses on comfort type, air circulation type and heat radiation type, and implements comprehensive natural flow ventilation to ensure the indoor air velocity effect, reduce the air residence time and carbon monoxide concentration level in order to realize effective simulation of natural ventilation effect and achieve ventilation optimization.

According to the three-dimensional flow visual dynamic distribution of the air in the garage, the gas in the garage is ideally simulated, ignoring the heat transfer effect of the surrounding structure. And the pollution emission of the car body is the source of pollution. According to the "Chinese Technical Data Standard for Building Environment Analysis", the statistical model of meteorological parameters and annotation results were judged and the average wind speed in natural seasons was determined to be 2.0m/s-2.2m/s.

In the process of natural ventilation, the air density, pressure difference and air flow are mainly analyzed by using indoor wind pressure and thermal effect, so as to build a perfect ventilation mode. According to $G = \mu F \sqrt{2\Delta p}$, G refers to ventilation with the unit of kg/s; F represents the area of the wall hole with the unit of m²; μ represents the velocity coefficient of wall hole. Δp refers to the ratio of pressure difference through the wall hole; P is the density of air with the unit of kg/m³. According to the actual ventilation calculation model standard, it is necessary to analyze the actual specific gravity standard and simplify the calculation model by combining the two action modes of hot pressure and wind pressure. Through effective role ratio analysis, the change and comprehensive effect of hot pressure and wind pressure are considered as far as possible while the ventilation effect, vehicle flow and exhaust emission of underground garage are analyzed to adjust the time and frequency of ventilation.

According to the physical model analysis, idle simulation can be conducted in the left and right of parking space. If there are 50 cars in the garage, CO emission of the garage is 350mg/s(6-7). The defining temperature of car displacement is 550°C for domestic cars and 500°C for imported cars. With 500°C as the standard, the exhaust emission of the garage is 7.56kW (7). According to the uniform distribution of pollution sources in the garage, the average emission of CO of vehicles is 21.875mg/m³.

Through simulation analysis of natural ventilation effect, we can determine the range of data simulation. According to the actual distribution of indoor velocity, air flow and CO concentration in the garage as well as the actual natural ventilation effect of the underground garage will be determined. It can be determined that the indoor wind speed and air quality are directly related to the garage entrance and exit position, window position and ventilation duration. With effective ventilation effect, the wind speed level in the garage can be adjusted to reach the ventilation target

of the garage.

Conclusion

To sum up, mentioning the natural ventilation effect of underground garage, we can fully consider the implementation process of ventilation design according to the green ventilation construction mode. We should pay attention to the optimal ventilation design of the underground garage, consider the concept of green environmental protection design, which will not only ensure the ventilation of the garage, but also meet the requirements of heat preservation in the winter, sun protection in the summer, moisture-proof in the rainy reason and wind resistance in the autumn.

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