

# Construction method of foam glass thermal insulation material in sloping roof

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**Abstract.** Foam glass thermal insulation board has the characteristics of fireproof, waterproof, corrosion resistant, noncombustible, mothproof, non-toxic, non-aging, non-radioactive, high mechanical strength and good dimensional stability. Foam glass thermal insulation material in sloping roof construction method is an effective solution to large angle sloping roof construction operation difficulties.

## 1. Introduction

Sloping roof is mainly for the slope angle greater than 30 ° of the roof, because of its beautiful appearance. In recent years, it is used on more and more buildings. Construction process of these roofs during the construction process emphasizes aesthetics, but also pays more attention to the reliability of its roof construction quality. Foam glass thermal insulation board is a new kind of inorganic thermal insulation material. It has the characteristics of fireproof, waterproof, corrosion resistant, noncombustible, mothproof, non-toxic, non-aging, non-radioactive, high mechanical strength and good dimensional stability. We in the construction of Qingdao Zhengda Haier Pharmaceutical Co., Ltd. bio-pharmaceutical R & D Center project have innovated foam glass insulation materials used in slope roof insulation construction, and explored a practical, quality assurance of construction methods.

Foam glass thermal insulation material in sloping roof construction method can fully utilize its characteristics of light weight and high strength. We can effectively solve the problems that the construction operation and the control of quality are difficult in sloping roof.

## 2. Characteristics of Construction Method

**Material innovation:** The construction method of the new thermal insulation foam glass board instead of traditional insulation materials used in sloping roof insulation works, is to promote new materials, new crafts, new technologies, new methods in the construction.

**The quality control:** We analyze the process in the new roof insulation works and find the difficulties we may meet before construction. The problems encountered in sloping roof insulation works should be timely detection, feedback and seek effectively solutions.

**Simple and efficient:** through the application of new lightweight insulation materials ,we can simplify the construction process and the complexity of the operation of workers, improve the efficiency of roof insulation works, cost savings and significantly shorten the duration.

## 3. Process Principle

The construction method is applicable to the construction of sloping roof foam glass thermal insulation material with slope between 30 ° and 60 °. The construction of sloping roof glass foam insulation material with slope range from 30 ° to 60 ° can also be carried out with reference to this construction



method.

The construction method full use of foam glass insulation board fire insulation performance, durability and good weather performance, high strength, non-toxic, non-radioactive, harmless, easy processing and deformation, long life, safety and environmental performance advantages, applied to sloping roof insulation works, in accordance with the optimization of the process of "foam glass insulation board material preparation → grass-roots cleanup → snap the line and line test(deepening layout) → laying foam glass thermal insulation board → roof special treatment → insulation layer acceptance". We can adjust the standard by deepening the insulation plate typesetting, and in a certain area of the bomb line test row before the commencement of large-scale construction.

#### 4. Operating Points

Foam glass thermal insulation board should be packed in a special box. The transport process of anti-vibration, moisture-proof measures and handling should be gently prevent mechanical and man-made damage. Foam glass thermal insulation board should accord with the requirements of the admission check and be stacked in a solid, dry room. Before foam glass thermal insulation board is used into the construction site, the acceptance should meet the appearance criteria, and do the re-examination about the density of materials, thermal conductivity and compressive strength.

Before the construction, the water and dust in the primary surface of the base course should be cleaned up. The base course must keep clean without any mortar, floating ash, debris and so on. At the same time, cleaning up the process can not use tools such as spade clean recklessly. It is strictly prohibited undermining the lower structure.

Laying foam glass thermal insulation board: Foam glass thermal insulation board should be directly attached to the grassroots by mortar full stick method (adhesive thickness  $\geq 5\text{mm}$ ). Slit should be packed between the boards and the gap of plate should be controlled within 2mm. Slit between the boards should be wedge packed by the foam glass thermal insulation. People can not trample on the boards before adhesives curing. Foam glass insulation board in the sides and the node (sink, drain, etc.) of the roof must use special adhesive (or organic binder) to bond with the base course. Adhesives should be applied to the back and the side of the insulation board, the base course. When foam glass insulation board laid, we should according to the line snapped from one side to the other (or from the center to around) to reduce the stampede during the construction process.

The adjacent foam glass insulation boards should be staggered stitched. The staggered length should satisfy  $1/2$  standard board length and  $\geq 100\text{mm}$ . Minimum non-standard insulation sheet size should be  $\geq 150\text{mm}$ , and should not be set at the edges. Layered laying boards between the upper and lower layers should be staggered with each other, the gap between the boards using the cutting foam glass thermal insulation boards matted stability and inlaid dense. The cutting processing of foam glass thermal insulation usually use portable cutting machine or hacksaw. foam glass insulation board should be promptly applied by the pressure level, to ensure that the insulation board and roof slope to keep in line. The perturbation shall not be percussed during the condensation process. Foam glass paving after 2h, the slope does not meet the requirements of the available special scrubbing plate leveling.

#### 5. Quality Control

Master project: 1 The thermal insulation properties of foam glass insulation board must meet the relevant specification requirements; 2 The laying of the insulation layer in the appearance of the quality of the construction should not have serious flaws; 3 The insulation board overlap between the staggered joints, lap length must meet the requirements, the gap between the board filled with mortar dense

General items: 1 The density of glass foam, thermal conductivity, compressive strength must comply with regulatory requirements; 2 When bonding the insulation, we should make it flatten by guiding rule to ensure the slope of the insulation board roof; 3 The appearance quality defects of the insulation layer shall be governed by the parties concerned, such as supervision (construction) units, construction units and so on according to its influence on the thermal insulation performance; 4 After the completion of construction, the supervision (construction) units and construction units shall check the appearance

quality and size deviation, make a good record, and deal with the defects in time according to the technical scheme of construction.

The key points of quality control in key parts and key process:1 Insulation layer and the grass-roots mortar with tile bonding, full compaction, shall not appear empty;2 The flatness and the sensory quality of roof should meet the general quality of plastering requirements;3 The slope and elevation of the roof should meet the design requirements and construction specifications;4 Snap the line must be fully reasonable, in accordance with the order from the middle to the surrounding to avoid cross-construction;5 Insulation board should be staggered stitching and the staggered stitch length should be 1/2 standard board length, and  $\geq 100\text{mm}$ .

## 6. Safety Measures

Everyone who enters the construction site must wear a helmet. When carrying out high-altitude construction operations, the relevant provisions of JGJ80-91, the current national standard, "Technical Code for Safe Operation of High Building Work" shall be complied with. Slope roofing operations must be tied with a safety rope, fasten seat belts. In the roof operations, to wear flat shoes, high heels and easy to slip shoes is strictly prohibited. Around the roof to be set up Weidang protective measures, protective height should be higher than 1.5m above the operating surface. Rainy weather and high winds above Grade 6 are prohibited.

## 7. Environmental Protection Measures

The use of construction waste refuse closed Road or the use of container hoisting, is strictly prohibited volley run to cause dust. Site-friendly use of directional lighting can be removed lamp cover type, should be used to prevent light pollution. Each time after the completion of the construction should be promptly clean down the hopper, you can re-use of the Treasury in a timely manner to prepare for the next use, can not be recycled back to a place, timely clean-up.

## 8. Conclusion

The whole construction process did not appear serious quality problems and overall construction quality is excellent. We achieved the expected quality and time limit objectives. Practice has proved the feasibility of this new material construction method.

Economic Benefits: At this stage, although the foam glass insulation board compared to XPS, ESP and other traditional insulation material unit price is higher, but its material performance, energy saving and environmental protection, no post-maintenance costs, worthy of promotion and popularization. The use of new materials in the construction process and deepening the layout design, construction speed, short cycle, reducing a large number of rejection, repair and clean-up work, while saving less work days, for follow-up work to provide adequate time limit. Cost savings during the construction are about 8500 yuan.

Each roof to save labor 10 days; a total of 8 roofings, labor costs 200yuan / working days. So artificial saving:  $10 \times 8 \times 200 = 16000$  yuan.

Foam glass insulation materials due to higher than the traditional price of insulation materials, construction materials for the use of new materials, the cost increase of about 1,500 yuan. So the actual cost savings:  $16000 - 1500 = 14500$  yuan

Social benefits: We originality uses this new and efficient insulation materials in sloping roof insulation works and actively promote the idea of building environmental protection and energy conservation. Foam glass insulation materials in the construction of insulation promote the project play a leading role in the demonstration. It is conducive to more environmentally friendly and efficient construction of new materials promotion.

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