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Research on Cast-in-situ Pumice Concrete Filler Wall Construction Technology

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Abstract: Since the existing masonry filler wall has the shortages such as: the heavy self-weight, low masonry mortar bond. we invented cast-in-situ insulation filler wall by using pumice concrete which is peculiar in Zhangjiakou region. This paper focused on construction technology for filler wall and problems that should be paid attention to on the construction. Cast-in-situ pumice concrete frame filler wall has the advantages of good entirety, simple construction, fast construction speed, it can reduce labor cost and improve the quality of engineering, thus achieves good technical and economic efficiency.

Keywords: Cast-in-situ insulation, Pumice concrete, Frame filler wall, Construction technology.

1. Introduction

Reinforced concrete frame structure is composed of beam and column connection in the form of rigid connection, horizontal and vertical load borne by the beam and column, the filler wall don't participate in force, only have the effect of retaining and separating. At present, many filler walls use the masonry structure, although you can use local materials, to a certain extent, save cement and steel, but there are also some shortages such as: the heavy self-weight,low masonry mortar bond[1].

Take the recent earthquake in Wenchuan as an example, the filler wall damaged ahead of frame structure, under horizontal earthquake action, the frame structure with filler wall, leading to the extrusion due to deformation uncoordinated filler wall crushed; Some of the filler wall and frame structure is lack of effective connection, so the filler wall is left out in whole, causing great casualties and property losses. Construction, therefore, there is an urgent need of a type of filler wall that has good entirety, convenient construction, heat insulation, and good seismic performance.

Domestic and foreign scholars have done many researches on new building walls, mainly include: Lili Zhang has developed a kind of HG lightweight insulation block filler wall[2]. Chunshan Wang using foamed concrete a foam concrete cast-in-situ just bone is developed since the insulated wall and its manufacturing process are studied[3].Stefanie Terentiuk studied the SIP (Structural insulated panel) panels under in-plane loading cycles, the structure response, studied the fastener type on the properties of the SIP plate stress influence[4].

Pumice is a volcanic eruption in the process of the formation of the rocks, with pore developed features. Using of pumice as aggregate concrete has light weight, low thermal conductivity, heat preservation, good sound insulation effect. We utilized the unique green pumice resource in Zhangjiakou region, produced the cast-in-situ filler wall insulation pumice concrete frame.

2. Construction Preparation

1. The filler wall construction belongs to the "secondary structure" construction. Before construction, technical director in the project department should therefore develop the detailed construction scheme of the secondary structure, and ask the technology department head and professional supervision engineer for approval. Before the construction, technicians should be assigned to give technical disclosure to the operation staff, when it is necessary technicians should go to the construction site for physical clarification[5].

2. The secondary structure of the the frame work structure construction should be done after the acceptance of construction quality, frame beam、column and floor should be clean and should not attached any sundries.

3. The Construction Technological Process and Operation Points

3.1. The Construction Process

Pumice concrete cast-in-situ monolithic filler wall heat preservation framework construction method of the specific steps are as follows: On-site mixing pumice concrete→locate the pay-off→planting bar→install the template→pouring of pumice concrete→dismantle the template→concrete curing.

3.2. The Preparation of Pumice Concrete

As pumice particles have many edges, have a rough surface and bare open holes, and the cement slurry has strong adsorption, the relative slip between these features increase the coarse aggregate resistance, making the concrete mix work ability poorer, and the cement dosage is bigger than ordinary concrete; At the same time due to the suction holes much cement, increased the density of concrete, reduce the thermal insulation properties[6].

First of all to wrap shell pumice aggregate, encrusting pumice. By using cement mortar and admixture for shell material, closed its surface orifice, increase the compressive strength of aggregates and improve the surface roughness, and then mixing concrete, which can well improve the work ability and reduce the dosage of cement, especially to prevent a large number of cement slurry be absorbed into holes, reducing the density of the concrete, reducing the thermal conductivity so that increases the heat preservation and sound insulation performance.

Pumice aggregate: origin of Zhangjiakou, the maximum particle size is 20 mm, the color is ash black or reddish brown. Immersing the pumice for 5~10 minites to make its absorbing water to saturate, and drying the water to make the surface dry. Second, mix the right amount of sand, cement, water and adding admixtures in forced mixer. Then, put the pre-wet pumice into the blender and continue to stir. Finally, naturally conserve for 24 hours after stirring up shell of pumice to make shell pumice. The preparation process of shell pumice is shown in figure 1.

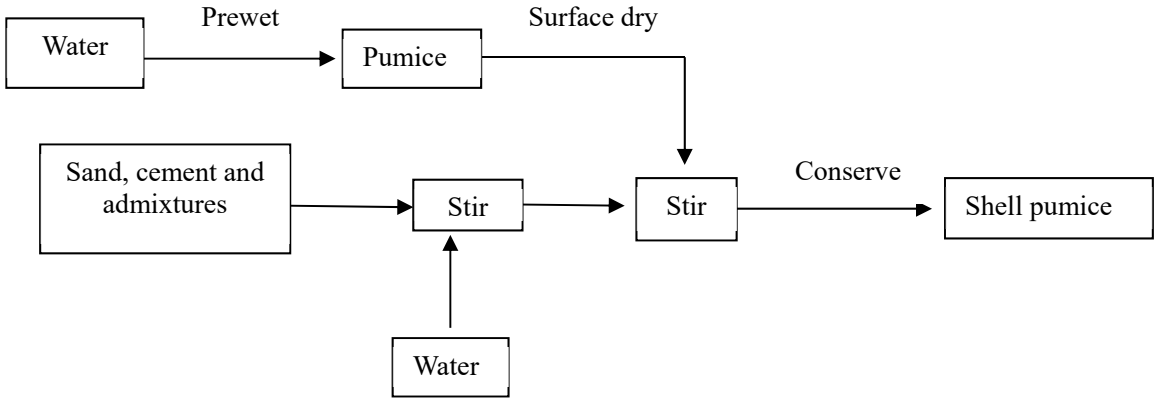

Figure 1. The preparation process of shell pumice

Design the scientific and appropriate concrete mixture ratio according to the strength grade of concrete and through the test.

3.3. Positioning and Pay-off

1. The professional construction technical personnel position the filler wall line in the process of the pay-off at the scene according to the requirements of the relevant drawings and the actual situation. Due to the positioning of pay-off is a very professional job, technicists are in strict accordance with the relevant standards in the process of construction, they should take different ways of positioning aiming at different locations in the building.

2. Construction technicists make the line of position according to the requirement for sanding and line of position for formwork.

3.4. Construction of the Tiepiece

The tiepiece is arranged obliquely along the diagonal of the frame, the arrangement is shown in figure 2.

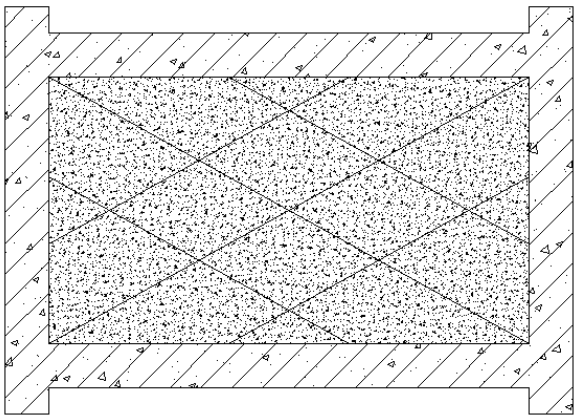

Figure 2. The layout of the tiepieces

The reinforcement along the diagonal placement have the effect of rachel, the frame structure and the filler wall can work together under the action of earthquake, avoiding the tragedy that the wall was thrown out because of the out-of-plane stress. Reinforced can use HRB300 or HRB335, etc. The tiepieces are designed along the diagonal placement which is different from the placement of ordinary masonry filler wall. The tiepieces are decorated a every 500 mm. The aim of the arrangement is to prevent the cracks of the wall under seismic action.

The tiepieces are planted on the frame, the main steps are:

1. Positioning on the frame column and frame beam where need planting bar;
2. Blank the steel;
3. Use special mechanical equipment to drill holes, ensuring the depth and the aperture of the hole in strict accordance with the relevant requirements;
4. Clean the inwall of the hole after finishing drilling the hole and keep the hole clean and dry;
5. Inject the epoxy resin adhesive into the hole;
6.Insert the reinforced into the hole along a direction of rotation, bind the planting steel bar and the original concrete securely;
7. In order to examine the effects of planting bar, no damage pull-out tests in the field are needed 7 days after the completion of planting bar. Only after pull-out tests meet the requirements for the construction can next procedure begin.

The points should be paid attention to in the process of planting bar are as follows:

1. The quality of steel bar should be strictly examined, the steel need to be grinded and descaled before planting.
2. The quality of the epoxy should be ensured before buying.
3. Use air compressor to clean the concrete powder before daubing the epoxy to avoid the impact of bonding effect.
4. The diameter of the hole should be greater than the planting steel bar of about 4 to 6 mm.

3.5. Set the Template

Template installation is an important step in the construction of cast-in-situ insulation pumice concrete filler wall. The quality of the wall and the efficiency of the construction are directly impacted by the template installation.

Count, check and number the templates before installation, the parts without repairing should not be used. Brush release agent before installation if you use the steel template. Take reliable positioning measures to fix the flat-bottom of the template, due to the template is easy to roll.

Install the template according to the numbering order.

During the installation, the template should be slowly installed to prevent the damage of the template.

3.6. Pour the Pumice Concrete

Pumice concrete is mixed in the construction field and pumped to the corresponding operation. Special mixing equipment is needed to strictly control the amount of all raw materials and strictly abide by the construction mixture ratio at the same time. Before casting the pumice concrete, clutter should be cleared out, then water the surface of the template.

Pour into the pumice concrete through the reserved hole of the upper template; In the process of pumice concrete pouring, pumice concrete should be poured from the roots, and layered casting technics should be used. Vibrate each layer of concrete separately. Insert the vibrating rod in the middle part of the template, vibrate slowly from the middle to around of the template until the end. After finishing the vibrating, pull out the vibration rod slowly, clear away the air bubbles in the pumice concrete.

3.7. Remove the Template and Maintain the Concrete

Don't dismantle the side template until the concrete strength reached the degree that can guarantee its surface and the edges is not damaged. Clean the surface of the wall. There must not have any mold release or attachments, such as oil.

Maintain the wall immediately after removing the template. Moisturizing maintenance can use water, cover, spraying methods such as curing agent. Site condition, environmental temperature and humidity, component characteristics, technical requirements and construction operation factors should be considered in choosing the curing method. The curing time is commonly a week, to guarantee the pumice concrete is in a wet state during maintenance. There is no need to do other insulated thing to meet the requirement of related specification on wall heat preservation and heat insulation performance.

4. Conclusion

Pumice is the rock formed in the process of volcanic eruption, with developed pore. Use pumice as aggregate concrete has the characteristics of light weight, low thermal conductivity, heat preservation and sound insulation. In this paper, we produced a new type of monolithic frame filler wall using natural resources pumice which is rich in the Zhangjiakou region, the wall has a good overall and seismic performance, the construction is convenient, the characteristics of the thermal insulation performance is superior.

In brief the construction of pumice concrete heat preservation framework filler wall has the characteristics of the following aspects:

(1) The construction is simple and the construction speed is fast. Due to the wall is in the form of integral cast-in-situ in the construction site, reduced the amount of building time, achieving the purpose of rapid, modular construction, speeded up the construction progress. At the same time due to the wall has a superior insulation performance, reduced the time for thermal insulation program for external wall, speeded up the progress of the whole project.

(2) The construction cost is low. Since the cost of raw material pumice concrete is low, so during the construction process it reduced the cost of human resources, reduced the cost of doing heat preservation for the wall, reducing the cost for the whole project greatly.

Pumice concrete monolithic frame filler wall has the advantages such as: good entirety, simple construction, fast construction speed. It has already been used in a residential project in Zhangjiakou district, and achieved good economic and social benefits.

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