Research on phytogenetic concrete design based on the concept of green building ecology

Feng Wu 1, Yanjun Dong 2  
1 Institute of technology, The tourism College of Changchun University, Changchun City Jilin Province 130000, China  
2 Construction and civil engineering, Changchun Institute of Technology, Changchun City Jilin Province 130000, China  
* Email: 1030205927@qq.com; djyrob@hotmail.com

Abstract. Due to the lack of vitality and material properties, traditional concrete lacks sufficient air permeability and water permeability, among which the ability to adjust temperature and humidity is poor, and "heat island phenomenon" is likely to occur due to seasonal influences. Based on the concept of green building, the concept of phytogenetic concrete design has been popularized and it is a new building material and technology. In this paper, the significance, content, key issues and technical means of the research were discussed in depth, and suggestions on the season and quality of plants were given based on the practical application, and the research methods and application effects were summarized.

1. The purpose and significance of the research

Urbanization is accelerating globally, Natural land resources are replaced by a large number of urban buildings, structures, roads, and others. The disappearance rate of natural vegetation resources is much higher than its regeneration rate. The greenhouse effect prevents heat from escaping from the air in cities, the city has lost the benign natural ecological cycle, the natural regulation ability drops extremely and cities are becoming less efficient, and urban heat island phenomenon is common in large cities. This series of modern urban problems is called "urban consolidation phenomenon", so, through simulation test and field test, fill material, fertilizer and water retaining agent are added into concrete, aiming at phytogenetic material, this architectural technology and scientific research on phytogenetic material has become a composite phytogenetic concrete that covers the facade, roof, wall and urban road of urban buildings to prevent surface erosion and is suitable for germination and growth of plant, in order to improve the noise and dust inside the city, the air in the city is polluted and good results are obtained.

2. Research content and key issues

2.1. Green building - selection of vegetation in vegetative concrete

Phytogenic concrete technology is mainly used in balconies, roof gardens, exterior walls and river embankments, due to the physical characteristics of the building, plant management and conservation should be carried out, therefore, the selection of vegetation planting must have corresponding requirements, and different plants have different growth gene characteristics, therefore, the selection...
of plants should follow the following principles as they show different adaptability to environmental conditions:

- Adapt to local climate conditions.
- Adapt to local soil conditions (water PH value, soil properties, etc).
- Strong resistance (it includes drought resistance, heat resistance, cold resistance, barren resistance, pest resistance and so on).
- The root system is developed, the aboveground part is shorter, the growth is rapid.
- Perennial or more perennial.
- Combined with the structural characteristics of phylogenetic concrete, it is easy to obtain the seeds and the price is reasonable to choose the vegetation with the characteristics of four seasons.

2.2. Selection of four seasons for planting concrete vegetation

2.2.1. Spring: white clover also known as white clover for perennial herbs, is a perennial root plant and it likes warm, cool and humid climate, poor drought resistance and strong cold resistance.

2.2.2. Summer: dog tooth root belongs to warm season type perennial herbaceous plant which has rhizomatous and creeping branches, fine tough fibrous roots and rhizomes, it has poor shade tolerance, strong cold resistance, good trampling resistance, thick grass layer and strong regeneration ability.

2.2.3. Autumn: Tall festuca belongs to cold season type perennial tufted herbaceous plant, has strong cold resistance, trample resistance, disease resistance is strong.

2.2.4. Winter: Perennial ryegrass is a non-creeping tufted lawn grass species, with thin rhizome, fibrous roots dense, soft texture, good density, it is resistant to cold, frost and heat, moisture and drought, and poverty.

Four seasons different vegetation cross-planting, create different levels of feeling, so that the building as a whole has a unique aesthetic feeling.

3. Basic conditions for research and implementation

3.1. Technical test

Three control groups were designed for the maintenance management experiment: The first group was watered once a day, and the maintenance was stopped after the emergence of seedlings; The second group was watered every day, and the seedlings were watered and maintained according to the seedling situation after emergence; The third group was similarly maintained as the second group, and dryland dragons were added to water the seedlings after they emerged.

Table 1. Materials and Equipment.

| Equipment          | Materials                                |
|--------------------|------------------------------------------|
| Test equipment     | Blender, Shotcrete machine               |
| Test materials     | Water, Cement, Medium-coarse sand        |
| Alkali reduction   | With highly active mineral admixture alkali absorption |
| measure            | FeSO₄, Silica fume (Do not affect the strength of concrete) |
| Filling material   | Rice husk, Wood chips                    |
| Fertilizer         | Compound fertilizer, Dryland dragon, Bermuda |
| Grass seed         | White clover, Perennial ryegrass, Festuca arundinacea |
3.2. Injection thickness test
First, different thickness tests were carried out on the horizontal rock surface, and the thickness was 5, 6, 8, 10 and 12 cm, respectively; Then, the same thickness test was carried out on the rock surface of different slopes. The thickness of the balcony and hanging garden surface layer was 8 cm.

Three control groups were set up in the seed treatment experiment: Do not soak, soak, and soak until the break. Application test of water retaining agent includes water retaining agent dosage test and layer distribution test. The dosage of the experiment was designed. There were 4 control groups including 60, 40, and 20 g/m2 dosage and no water retaining agent. Three control groups were designed for the hierarchical distribution experiment: 1 The surface layer and the bottom layer were added, and the dosage was 40 g/m2. 2 Only 40 g/m2 is added to the bottom layer, but not to the surface layer. 3 No water retaining agent.

3.3. Adaptability screening test of grass species
Some exotic herbs, native herbs and low woody plants were selected for adaptability test.

3.4. Construction process test
The effect of barbed wire and no barbed wire on the adhesion and stability of spray material was studied; Material mixing and adding sequence test; Layer injection thickness test; Spray height test of the shotcrete; The maximum particle size test of material is allowed in the shotcrete machine etc.

4. Study the practical efficacy of applied building engineering

4.1. Improving microclimate to control urban heat island effect
"Large area vegetation of buildings" can effectively regulate the concentration of carbon dioxide gas in urban core areas, regulate air temperature and humidity, and improve the microclimate of urban environment. There is a significant difference in temperature between the sunny side and the shady side.

4.2. Prevent soil erosion and abundant groundwater resources
Adding filling material, fertilizer and water retaining agent into the concrete to form a composite planting concrete which can not only bond with the rock slope and prevent the erosion of the surface, but also be suitable for the germination and growth of plants, has achieved good results.

4.3. Protecting roofing waterproof materials and rainwater recovery
Rainwater falls on the planting concrete roof, more than half of the rainwater will be absorbed and stored by the root system of the vegetation, through the photosynthesis of plant leaves, most of the water can be evaporated, and the rest can be discharged through the eaves and downpipes. Some of them can directly return the natural surface water to recharge groundwater, while others can be discharged to the community surface to form an urban ecological cycle chain. Meanwhile, this measure will greatly alleviate the pressure of insufficient urban drainage pipe network and save the construction investment of urban municipal pipe network.
4.4. Sound absorption and noise reduction, improve the urban sound environment

The large area planting of "building green carpet" makes use of the multi-directional distribution of leaf surface, which can reflect and diverge sound waves from one direction. The soft coverage and the mezzanine formed after the exterior surface of the building can improve the reflection of the natural building by 3dB and improve the anti-noise efficiency of 8dB anti-noise layer.

5. Expected results

Under the concept of green building, the traditional concrete is not adaptable to the new development of the environment, and the surface color of ordinary concrete is gray, lacking vitality and artistic beauty. It is of great significance to popularize new building materials and technologies -- planting concrete can be integrated with the surrounding natural ecological environment. It not only has the six practical functions described in the paper, but also can reduce the damage to the environment and meet the requirements of environmental protection. At present, although the development and application of phytogenetic concrete are in the stage of development in China, with people's attention to environmental protection, phytogenetic concrete will become an important direction for the future green building development of concrete.

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