Study on Construction Technology of Latex Cement Mortar Pouring Composite Pavilion

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Abstract: Pouring composite pavement is one ideal type of pavement structure, but research on the pouring composite pavement is still in its infancy, especially in the construction technology. The normal pavement construction machinery is not compatible with this kind of pavement structure, while the construction efficiency is relatively low, which is not conducive to large-scale construction and affects its popularization and application. Based on the latex cement mortar pouring composite pavement developed by the authors, the pouring composite pavement construction methods of macroporous open-graded asphalt pavement and latex cement mortar are mainly introduced in this paper. According to the characteristics of macroporous open-graded asphalt mixture, the mixing temperature, dry/wet mixing time, paving speed, rolling combination mode and temperature of the mixture were studied, and the key construction process was put forward; For the construction of latex cement mortar, the construction technology of cement mortar production, pouring method and pouring time are mainly studied, and the construction process of cement mortar pouring is put forward.

1. Introduction
Pouring composite pavement is one new type of pavement structure, which is formed by pouring special slurry with cement as the main component into the base asphalt mixture (void ratio 20\%–35\%) pavement. The strength of the material is formed by the mutual extrusion between aggregates and the pouring cement mortar, which improves the ability of the structural layer to resist the load, and has the characteristics of "combination of rigidity and flexibility" and so on. Firstly, it has the characteristics of high strength and high temperature deformation resistance similar to cement concrete pavement, which can solve the high temperature deformation diseases of asphalt pavement. At the same time, asphalt concrete and latex cement mortar have great crack resistance performance, so this structure has good crack resistance. Secondly, because cement mortar is directly poured into open-graded asphalt pavement, it has the advantages of continuous driving on asphalt pavement, and there are no complex structures such as expansion joint and force transfer rod in cement concrete pavement. Finally, compared with cement concrete pavement, it has the advantages of lower cost and convenient construction [1].

At present, highway toll stations, parking areas of large service areas and other sections with serious channelized traffic, as well as mining areas, ports and other heavy-duty vehicles, have serious ruts and slippage on long longitudinal slope pavement. The pouring composite pavement structure is
an ideal solution. The application research of the pouring composite pavement material was first carried out in France as early as 1954. The construction method of open graded asphalt concrete pavement with grouting cement was successfully developed and tested on the runway of jet aircraft at Konek (Cognac) Airport as a heat-resistant pavement. On this basis, "Salviacim" construction method was applied as a patent [2]. This kind of pavement was introduced to Japan in 1961. In February of the following year, 1000m² experimental pavement was paved on the junction section of Hakone New Road by the Japan Road Corporation. After France, Japan applied for a patent under the name of "Semi-flexible Pavement and Semi-flexible Pavement Construction Method"[3]. At present, the research on the pouring composite pavement is still in its infancy. Although the construction technology, mechanical equipment, construction plane dimensions of the pouring composite pavement have been explored, the feasibility and superiority of this technology are also preliminarily demonstrated by the master's degree thesis of Wuhan University of Technology [4], there are no relevant construction specifications and technical and economic indicators. Therefore, based on the latex cement mortar pouring composite pavement developed in this paper, the research on the construction technology of pouring composite pavement is studied which has great practical significance for improving the performance and service life of pavement.

2. Research Programs and Specific Measures
According to the characteristics of macroporous open-graded asphalt mixture, the mixing temperature, dry/wet mixing time, paving speed, rolling combination mode and temperature of the mixture were studied, and the key construction process was put forward. For the construction of latex cement mortar, the construction technology of cement mortar production, pouring method and pouring time are mainly studied, and the construction process of cement mortar pouring is put forward.

2.1 Construction of Matrix Asphalt Mixture

2.1.1 Production of Matrix Asphalt Mixture
In this paper, relying on the Suizi highway construction project, the physical experiment road is paved. In the production process of base asphalt mixture, the mixing building is according to the proportion of heat storage bin in the production mix ratio and the temperature of mixture according to the requirement of Table 1. The production records of asphalt mixture are automatically controlled by computer and printed one by one. Through on-site inspection, the aggregate, asphalt and mineral powder of heat storage are accurately measured, the requirements of production of base asphalt mixture are arrived.

| Mixture Type      | Asphalt Heating Temperature | Mineral Heating Temperature | Discharge Temperature | Waste temperature of mixtures |
|-------------------|-----------------------------|-----------------------------|-----------------------|------------------------------|
| SBS Modified Asphalt | 160±5                      | 190±5                      | 180±5                | 195                          |

The production cycle of the mixing plant is about 52 seconds, including 5 seconds for dry mixing and 35 seconds for wet mixing. From the appearance of the produced asphalt mixture, the asphalt is coated more evenly, with no white, agglomeration and segregation phenomena.
2.1.2 Transporting of Matrix Asphalt Mixture

The base asphalt mixture is transported to the paving site by dump truck. Because the fine aggregate of the base asphalt mixture is less, the base asphalt mixture has a certain amount of free asphalt. In order to prevent the free asphalt from adhering to the carriage board, a thin layer of separator or anti-adhesives is required to be coated on the carriage board. At the same time, when loading from mixer to truck, it is necessary to move the position of truck several times before-after-in the middle to balance the loading so as to reduce the segregation of mixture; Considering the large void of the base asphalt mixture, it is easy to produce ventilation and heat dissipation, and it’s transport vehicle is strengthened to avoids excessive temperature drop of the mixture in the process of transportation.

2.1.3 Paving of Matrix Asphalt Mixture

The paving of base asphalt mixture is basically the same as that of conventional asphalt mixture. In the field of the experimental road, a paver is used to pave the pavement. The ultrasonic balance beam is used to control the elevation and the paving speed is controlled at about 2.0m/min. Because the matrix asphalt mixture belongs to skeleton-void mixtures, its coarse aggregate accounts for more than 60% of the proportion of the mixture, which makes the slack paving coefficient of the mixture smaller. Through field debugging, the slack paving coefficient of the matrix asphalt mixture is 1.05-1.10.

2.1.4 Rolling of Matrix Asphalt Mixture

In the paving of the experimental road, BOMAG double-wheel roller is used for rolling. The rolling is mainly static. The rolling scheme is shown in Table 2.

Considering the actual situation of the test road, attention should be paid to the following aspects in rolling:

- Rubber wheel roller is not used in rolling to prevent rubbing of rubber wheel and to ensure void ratio of base asphalt mixture pavement;
- All rolling of base asphalt mixture pavement should be completed before 80°C, so as to prevent the damage of base structure caused by rolling of double-wheel roller when the temperature is too low and to affect the quality of pavement.
- The adjacent rolling strips should overlap 1/3-1/2 wheel width, not less than 1/4 wheel width, so as to prevent excessive rolling of some pavement.
- Roller driving wheels face the paver direction, and the starting and stopping of the roller must slow down to prevent the mixture from moving.

| Rolling stage | Roller type             | Rolling speed (km/h) | Rolling times  |
|---------------|-------------------------|----------------------|---------------|
| Initial Pressure | 1 Double Steel Wheel     | 2~4                  | Static Pressure 1 Time |
| Repression    | 1 Double Steel Wheel     | 3~4                  | Static Pressure 1 Time |
| Final Pressure | 1 Double Steel Wheel     | 3~6                  | Static Pressure 1 Time |
2.1.5 Appearance of Matrix Asphalt Pavement

Seen from the pavement condition after compaction, the surface of asphalt film is evenly coated, no stone exposed, asphalt sticking away, the overall uniformity of the pavement is good, and there is no obvious segregation of the whole pavement (see Figure 2).

![Figure 2. Construction of Matrix Asphalt Mixture](image)

2.2 Production of Pouring Materials

As pouring material, latex cement mortar can be produced in two ways, one is construction site, the other is plant mixing by mixing station, which is transported to construction site by concrete mixer. Considering the small scale of application of the experimental road, more flexible and convenient on-site production is adopted by latex cement mortar.

Before the production, it is necessary to carry out trial matching according to the proportion of latex cement mortar in the production mix ratio, and carry out the fluidity experiment. After the test is passed, the latex cement mortar is produced. The production of latex cement mortar was carried out by using cement self-falling mortar mixer (Fig. 2.3). The order of latex cement mortar production is as follows: first mix mineral powder, sand and cement in proportion for 1-2 minutes, mix evenly, add water and mix for 2-3 minutes, then mix until the material is uniform.

The following points should be paid attention to in the mixing process of latex cement mortar by paving the experimental road and combining with the site construction situation:

- On-site mixing should be sufficient to ensure uniformity of all kinds of materials;
- It is necessary to strengthen the linking of various mixing processes in order to improve the construction efficiency.
- The fluidity of latex cement mortar should be tested at any time.

![Figure 3. Pictures of Pouring Materials Construction](image)
2.3 Infusion of Pouring Material

As pouring material, after mixing latex cement mortar, the pouring operation should be carried out immediately. In the pouring operation, the combined construction technology of manual pouring and small machines is adopted. The technological process is shown in Figure 4.

Figure 4. Pouring process of latex cement mortar

When it is confirmed that the paved base asphalt mixture has cooled below 50℃, mortar can be poured into it. The plastic conduit depends on the flow of the mortar itself to the surface area of the asphalt mixture pavement that needs to be constructed, the rubber rake is repeatedly dragged to make it soak naturally, and the excess mortar is dragged to the lack of mortar by the rubber rake. Because the pouring mechanism of latex cement mortar in the void of base asphalt mixture is the replacement of air in the void of asphalt mixture with latex cement mortar. In order to make the latex cement mortar pour into the base asphalt mixture better, vibration equipment should be used to assist the pouring of the latex cement mortar. In this project, the vibration-assisted pouring of small steel wheel roller is used in the necessary area. If necessary, construction should be done in the way of pouring, vibration and pouring repeatedly until the latex cement mortar on the surface of the section is not permeated (see Figure 2.5).

In the process of pouring latex cement mortar, the following points should be paid attention to:

- Matrix asphalt mixture should be cooled below 50℃ to prevent the rapid hardening of latex cement mortar caused by excessive matrix asphalt temperature, which makes it impossible to complete pouring;
- To prevent excessive vibration amplitude from damaging base asphalt mixture pavement, high frequency and low amplitude vibration equipment should be used as auxiliary grouting equipment.

Figure 5. Pictures of Pouring Construction on Site for Pouring Composite Pavement
2.4 Surface Treatment and Maintenance of Pouring Composite Pavement

2.4.1 Surface Treatment of Pouring Composite Pavement
Because the residual latex cement mortar on the pavement will reduce the anti-skid performance of the pouring composite pavement and affect the appearance of the pavement, therefore, it is necessary to clean the residual mortar on the asphalt pavement surface with a broom or sprinkler until the surface is uneven.

2.4.2 Maintenance of Pouring Composite Pavement
Generally speaking, latex cement mortar needs to be cured for a certain time because the strength of the pouring material takes a certain time to form. But in this experimental road, because there is a layer of conventional asphalt mixture surface, high temperature asphalt mixture and enclosed environment can effectively improve the hydration reaction speed of latex cement mortar and form early strength. Therefore, one day after the completion of the pouring construction, the paving of the upper layer is carried out, and the quality of the pouring composite pavement can be effectively guaranteed by this construction technology.

3. Conclusion
The following conclusions can be drawn by paving the experimental road and testing the coring on site:
- The construction method of pouring composite pavement can be roughly divided into two steps: construction of base asphalt mixture and pouring of latex cement mortar. The construction technology of base mixture pavement is generally similar to that of drainage asphalt mixture pavement, but the difference is that tyre roller should be prohibited from rolling, and the rolling temperature should be strictly controlled during construction to avoid crushing of surface aggregate when the temperature of mixture is too low. In addition, excessive rolling should be avoided to reduce the void fraction and affect the pouring of latex cement mortar.
- The construction of latex cement mortar can be divided into mixing, pouring, vibration, removal of floating slurry and sprinkler covering. Each step should be carried out in strict accordance with the construction requirements. When pouring, attention should be paid to manual leveling where construction machinery can’t be poured or the effect of pouring is not satisfactory. Rubber scrapers are used for leveling to ensure the same amount of pouring at each place. The pouring methods in special areas should be adjusted according to the specific conditions to ensure the pouring effect.

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