

ANTI-SEPARATION DESIGN FOR CONCRETE-FILLED STEEL TUBE MEMBER AND SLEEPER BLOCK OF BALLASTLESS TRACK

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims priority of Chinese Patent Application No. 201910672719.2, filed on July 24, 2019, the contents of which are herein incorporated by reference in their entirety.

TECHNICAL FIELD

[0002] The present application belongs to the technical field of a concrete sleeper of a ballastless track, and more specifically to a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track, and a concrete-filled steel tube sleeper of a ballastless track including the separation-prevention structure.

BACKGROUND

[0003] In the railway ballastless track system, a prefabricated sleeper is provided. The sleeper is installed in the track bed or integrated with the track bed by means of concrete pouring, for installing clips, so as to further fix rails above the sleeper. There is a requirement that a good connection between the sleeper and the track bed is needed to be maintained. However, the prefabricated sleeper still has several defects as follows.

[0004] 1. The surface of current concrete-filled steel tube is a relatively smooth steel surface. After the concrete-filled steel tube is directly buried in the material, such as concrete, etc., the bond stress between the concrete-filled steel tube and the material is limited. The connection between the concrete-filled steel tube and the sleeper block is not strong enough. Therefore, the concrete-filled steel tube is easy to be loosed and detached from the sleeper block.

[0005] 2. Since the diameter of the hollow steel tube is relatively small, it is very difficult to pour concrete into the steel tube. The compactness inside the steel tube is insufficient, and the compactness between the outlet of the steel tube and the sleeper block is also insufficient, which brings hidden hazards to the overall structure of the sleeper, and increases the later-period maintaining cost.

SUMMARY

[0006] In view of at least one of the above defects or improvement requirements in the related art, the present application provides a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track. An end part of the formed concrete-filled steel tube is enlarged by flaring treatment. After the concrete-filled steel tube member is inserted in the sleeper block by pouring, the periphery of the steel tube is tightly wrapped by the concrete. Since the outer diameter of the end part of the steel tube is larger than other parts of the steel tube, under the external load effect, the concrete-filled steel tube member cannot be pulled out and separated from the sleeper block. Furthermore, an enlarged part at one end part of the steel tube is quite beneficial to the spraying operation of spray heads with larger dimension, and an enlarged part at another end part of the steel tube is also beneficial to the spread of sprayed slurry. Therefore, the steel tube can be rapidly and efficiently filled, the compactness inside the steel tube and the compactness at the junction between the steel tube and the sleeper block are ensured, the hazards are prevented, the life expectancy of the overall structure of the sleeper is improved, and the later-period maintaining cost is reduced.

[0007] In order to achieve the above objective, according to one aspect of the present application, a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track is provided. The separation-prevention structure is used in a concrete-filled steel tube sleeper of the ballastless track. The concrete-filled steel tube sleeper includes two or more sleeper blocks and a plurality of concrete-filled steel tubes for connecting the sleeper blocks. The sleeper blocks are formed by means of concrete pouring. Each of the concrete-filled steel tubes is formed by filling a hollow steel tube with concrete and arranged in a mold for manufacturing two sleeper blocks

adjacent to each other, and integrated with the two sleeper blocks by means of concrete pouring during a pouring process of the sleeper blocks.

[0008] Herein, an outer end part of the hollow steel tube, which is buried in the sleeper block, is provided with a part with an enlarged radial width. The part with the enlarged radial width has a length range smaller than 50 mm. The part with the enlarged radial width is filled with concrete during a filling process of the hollow steel tube, and then the part with the enlarged radial width is integrated with the sleeper block by means of concrete pouring during the pouring process of the sleeper block.

[0009] Preferably, a cross section of the part with the enlarged radial width may be of a circular, elliptic or elongated shape.

[0010] Preferably, the number of the hollow steel tubes may be two, and one of the two hollow steel tubes may be arranged at one side of a buried member of the sleeper block and the other one of the two hollow steel tubes may be arranged at another side of the buried member of the sleeper block.

[0011] Alternatively, the number of the hollow steel tubes may be three, and the three hollow steel tubes may be arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.

[0012] In order to achieve the above objective, according to another aspect of the present application, a concrete-filled steel tube sleeper of a ballastless track is provided. The concrete-filled steel tube sleeper of the ballastless track includes two or more sleeper blocks and a plurality of concrete-filled steel tubes for connecting the sleeper blocks. The concrete-filled steel tube sleeper of the ballastless track further includes the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track described above.

[0013] In order to achieve the above objective, according to another aspect of the present application, a construction method for the concrete-filled steel tube sleeper of the ballastless track described above is provided. The construction method includes the following steps.

- [0014] In Step 1, a hollow steel tube with a length of 2000 mm and an outer diameter of 40 mm is selected.
- [0015] In Step 2, an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm is enlarged to 45-48mm by using a flaring tool.
- [0016] In Step 3, high-pressure concrete filling materials is sprayed and filled from one end part of the hollow steel tube to another end part of the hollow steel tube, and the part with the enlarged radial width is densely filled with concrete.
- [0017] In Step 4, the concrete-filled steel tube member is maintained to form a plurality of prefabricated concrete-filled steel tubes.
- [0018] In Step 5, the concrete-filled steel tubes and a steel reinforcement cage are placed into a mold for producing the sleeper, and concrete materials are poured, so that the concrete-filled steel tubes are inserted in the sleep blocks by pouring.
- [0019] In order to achieve the above objective, according to another aspect of the present application, a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track is provided. The separation-prevention structure is used in a concrete-filled steel tube sleeper of the ballastless track. The concrete-filled steel tube sleeper includes two or more sleeper blocks and a plurality of concrete-filled steel tubes for connecting the sleeper blocks. The sleeper blocks are formed by means of concrete pouring. The concrete-filled steel tubes are configured as follows: hollow steel tubes are arranged in a mold for manufacturing two sleeper blocks adjacent to each other, and then, by means of concrete pouring during a pouring process of the sleeper blocks, the hollow steel tubes are integrated with the sleeper blocks and filled with concrete at the same time.
- [0020] Herein, an outer end part of the hollow steel tube, which is buried in the sleeper block, is provided with a part with an enlarged radial width. The part with the enlarged radial width has a length range smaller than 50 mm. During the pouring process of the sleeper blocks, the part with the enlarged radial width is filled with concrete, and integrated with the sleeper block by means of concrete pouring.

- [0021] Preferably, a cross section of the part with the enlarged radial width may be of a circular, elliptic or elongated shape.
- [0022] Preferably, the number of the hollow steel tubes may be two, and one of the two hollow steel tubes may be arranged at one side of a buried member of the sleeper block and the other one of the two hollow steel tubes may be arranged at another side of the buried member of the sleeper block.
- [0023] Alternatively, the number of the hollow steel tubes may be three, and the three hollow steel tubes may be arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.
- [0024] In order to achieve the above objective, according to another aspect of the present application, a concrete-filled steel tube sleeper of a ballastless track is provided. The concrete-filled steel tube sleeper includes two or more sleeper blocks and a plurality of concrete-filled steel tubes for connecting the sleeper blocks. The concrete-filled steel tube sleeper further includes the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track described above.
- [0025] In order to achieve the above objective, according to another aspect of the present application, a construction method for the concrete-filled steel tube sleeper of the ballastless track described above is further provided. The construction method includes the following steps.
- [0026] In Step 1, a hollow steel tube with a length of 2000 mm and an outer diameter of 40 mm is selected.
- [0027] In Step 2, an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm is enlarged to 45-48 mm by using a flaring tool.
- [0028] In Step 3, a plurality of prefabricated hollow steel tubes are formed.
- [0029] In Step 4, the hollow steel tubes and a steel reinforcement cage are placed into a mold for producing the sleeper, high-pressure concrete filling materials are sprayed from one end part of the hollow steel tube to another end part of the hollow steel tube

until a sleeper block cavity and the part with the enlarged radial width, which are located at the another end part of the hollow steel tube, are filled with the high-pressure concrete filling materials. And then a sleeper block cavity and the part with the enlarged radial width which are located at the one end part of the hollow steel tube are continually filled with the high-pressure concrete filling materials, so that concrete-filled steel tubes are inserted in sleep blocks by pouring.

[0030] In Step 5, the concrete-filled steel tube sleeper is maintained.

[0031] The above preferred technical features may be combined with each other as long as not causing conflicts with each other.

[0032] In general, the above technical solutions conceived by the present application have the following beneficial effects compared with the related art.

[0033] 1. In the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of the present application, an end part of the formed concrete-filled steel tube is enlarged by flaring treatment. After the concrete-filled steel tube member is inserted in the sleeper block by pouring, the periphery of the steel tube is tightly wrapped by the concrete. Since the outer diameter of the end part of the steel tube is larger than other parts of the steel tube, under the external load effect, the concrete-filled steel tube member cannot be pulled out and separated from the sleeper block.

[0034] 2. In the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of the present application, an enlarged part at one end part of the steel tube is quite beneficial to the spraying operation of spray heads with larger dimension, and an enlarged part at another end part is also beneficial to the spread of sprayed slurry. Therefore, the steel tube can be rapidly and efficiently filled, the compactness inside the steel tube and the compactness at the junction between the steel tube and the sleeper block are ensured, the hazards are prevented, the life expectancy of the overall structure of the sleeper is improved, and the later-period maintaining cost is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0035] FIG. 1 is a schematic diagram of a hollow steel tube of a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track of embodiments of the present application;
- [0036] FIG. 2 is a schematic cross-sectional view of a section A-A in FIG. 1;
- [0037] FIG. 3 is a schematic cross-sectional view of a section B-B in FIG. 1;
- [0038] FIG. 4 is a schematic diagram of a concrete-filled steel tube sleeper of a ballastless track of embodiments of the present application.
- [0039] In the above accompanying drawings, the unit of the size indicia is millimeter (mm).

DETAILED DESCRIPTION

- [0040] In order to make the purpose, technical solutions and advantages of the present application more clear and obvious, the present application will be further illustrated in detail in combination with accompanying drawings and embodiments hereinafter. It should be understood that the specific implementations described here are used only to explain the present application, rather than limit it. Furthermore, the technical features involved in the various implementations of the present application described below may be combined with each other as long as not causing conflicts with each other. The present application will be further described in detail in combination with specific implementations.
- [0041] As the first preferred embodiment of the present application, as shown in FIGS. 1-4, the present application provides a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track. The separation-prevention structure is used in a concrete-filled steel tube sleeper of the ballastless track. The concrete-filled steel tube sleeper includes two or more sleeper blocks 1 and a plurality of concrete-filled steel tubes 2 for connecting the sleeper blocks 1. The sleeper blocks 1 are

formed by means of concrete pouring. Each of the concrete-filled steel tubes 2 is formed by filling a hollow steel tube with concrete and arranged in a mold for manufacturing two sleeper blocks 1 adjacent to each other, and integrated with the two sleeper blocks 1 by means of concrete pouring during a pouring process of the sleeper blocks 1.

[0042] Herein, an outer end part of the hollow steel tube, which is buried in the sleeper block 1, is provided with a part 3 with an enlarged radial width. The part with the enlarged radial width has a length range smaller than 50 mm. The part with the enlarged radial width is wider than a body part of the hollow steel tube in the radial direction by 4-8 mm. The part 3 with the enlarged radial width is filled with concrete during a filling process of the hollow steel tube, and then the part 3 with the enlarged radial width is integrated with the sleeper block 1 by means of concrete pouring during the pouring process of the sleeper block 1.

[0043] Preferably, a cross section of the part 3 with the enlarged radial width is of a circular, elliptic or elongated shape, etc. When the hollow steel tube is of a circular cross section, the outer diameter of the body part of the hollow steel tube is preferably 40 mm, and an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm is enlarged to 45-48 mm. Since the surface of the steel tube is circular and relatively smooth, after the steel tube is directly buried in concrete, the bond stress between the steel tube and concrete is limited. After the end parts of the steel tube is enlarged before the steel tube is filled with filling materials, and then the steel tube is filled with filling materials, such as mortar, the end parts of the concrete-filled steel tube member is thicker than other parts of the concrete-filled steel tube member. Therefore, under the external load effect, the steel tube cannot be pulled out from concrete.

[0044] Preferably, the number of the hollow steel tubes is two, and one of the two hollow steel tubes is arranged at one side of a buried member of the sleeper block and the other one of the two hollow steel tubes is arranged at another side of the buried member of the sleeper block. Alternatively, the number of the hollow steel tubes is three, and the three hollow steel tubes are arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.

[0045] In order to achieve the above objective, according to another aspect of the

present application, a concrete-filled steel tube sleeper of a ballastless track is also provided. The concrete-filled steel tube sleeper includes two or more sleeper blocks 1 and a plurality of concrete-filled steel tubes 2 for connecting the sleeper blocks 1. The concrete-filled steel tube sleeper further includes the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track described above.

[0046] In order to achieve the above objective, according to another aspect of the present application, a construction method for the concrete-filled steel tube sleeper of the ballastless track is also provided. The construction method includes the following steps.

[0047] In Step 1, a hollow steel tube with a length of 2000 mm and an outer diameter of 40 mm is selected.

[0048] In Step 2, an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm is enlarged to 45-48mm by using a flaring tool.

[0049] In Step 3, high-pressure concrete filling materials are sprayed and filled from one end part of the hollow steel tube to another end part of the hollow steel tube, and the part 3 with the enlarged radial width is densely filled with concrete.

[0050] In Step 4, the concrete-filled steel tube member is maintained to form a plurality of prefabricated concrete-filled steel tubes 2.

[0051] In Step 5, the concrete-filled steel tubes 2 and a steel reinforcement cage are placed into a mold for producing the sleeper, and concrete materials are poured, so that the concrete-filled steel tubes 2 are inserted in the sleep blocks 1 by pouring.

[0052] In the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of a ballastless track of the present application, an end part of the formed concrete-filled steel tube is enlarged by flaring treatment. After the concrete-filled steel tube member is inserted in the sleeper block by pouring, the periphery of the steel tube is tightly wrapped by the concrete. Since the outer diameter of the end part of the steel tube is larger than other parts of the steel tube, under the external load effect, the concrete-filled steel tube member cannot be pulled out and separated from the sleeper

block.

[0053] In the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of the present application, an enlarged part at one end part of the steel tube is quite beneficial to the spraying operation of spray heads with larger dimension, and an enlarged part at another end part is also beneficial to the spread of sprayed slurry. Therefore, the steel tube can be rapidly and efficiently filled, the compactness inside the steel tube and the compactness at the junction between the steel tube and the sleeper block are ensured, the hazards are prevented, the life expectancy of the overall structure of the sleeper is improved, and the later-period maintaining cost is reduced.

[0054] As the second preferred embodiment of the present application, as shown in FIGS. 1-4, the present application also provides a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track. The separation-prevention structure is used in a concrete-filled steel tube sleeper of the ballastless track. The concrete-filled steel tube sleeper includes two or more sleeper blocks 1 and a plurality of concrete-filled steel tubes 2 for connecting the sleeper blocks 1. The sleeper blocks 1 are formed by means of concrete pouring. The concrete-filled steel tubes 2 are configured as follows: hollow steel tubes are arranged in a mold for manufacturing two sleeper blocks 1 adjacent to each other, and then, by means of concrete pouring during a pouring process of the sleeper blocks 1, the hollow steel tubes are integrated with the sleeper blocks 1 and filled with concrete at the same time.

[0055] Herein, an outer end part of the hollow steel tube, which is buried in the sleeper block 1, is provided with a part 3 with an enlarged radial width. The part with the enlarged radial width has a length range smaller than 50 mm. During the pouring process of the sleeper blocks 1, the part 3 with the enlarged radial width is filled with concrete, and integrated with the sleeper block 1 by means of concrete pouring.

[0056] Preferably, a cross section of the part 3 with the enlarged radial width is of a circular, elliptic or elongated shape. When the hollow steel tube is of a circular cross section, the outer diameter of the body part of the hollow steel tube is preferably 40 mm, and an outer diameter of two end parts of the hollow steel tube having a length range of

0-50 mm is enlarged to 45-48 mm. Since the surface of the steel tube is circular and relatively smooth, after the steel tube is directly buried in concrete, the bond stress between the steel tube and concrete is limited. After the end parts of the steel tube is enlarged before the steel tube is filled with filling materials, and then the steel tube is filled with filling materials, such as mortar, the end parts of the concrete-filled steel tube member is thicker than other parts of the concrete-filled steel tube member. Therefore, under the external load effect, the steel tube cannot be pulled out from concrete.

[0057] Preferably, the number of the hollow steel tubes is two, and one of the two hollow steel tubes is arranged at one side of a buried member of the sleeper block and the other one of the two hollow steel tubes is arranged at another side of the buried member of the sleeper block. Alternatively, the number of the hollow steel tubes is three, and the three hollow steel tubes are arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.

[0058] In order to achieve the above objective, according to another aspect of the present application, a concrete-filled steel tube sleeper of a ballastless track is also provided. The concrete-filled steel tube sleeper includes two or more sleeper blocks 1 and a plurality of concrete-filled steel tubes 2 for connecting the sleeper blocks 1. The concrete-filled steel tube sleeper further includes the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track described above.

[0059] In order to achieve the above objective, according to another aspect of the present application, a construction method for the concrete-filled steel tube sleeper of the ballastless track is also provided. The construction method includes the following steps.

[0060] In Step 1, a hollow steel tube with a length of 2000 mm and an outer diameter of 40 mm is selected.

[0061] In Step 2, an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm is enlarged to 45-48 mm by using a flaring tool.

[0062] In Step 3, a plurality of prefabricated hollow steel tubes are formed.

[0063] In Step 4, the hollow steel tubes and a steel reinforcement cage are placed into a mold for producing the sleeper, high-pressure concrete filling materials are sprayed from one end part of the hollow steel tube to another end part of the hollow steel tube until a sleeper block cavity and the part 3 with the enlarged radial width, which are located at the another end part of the hollow steel tube, are filled with the high-pressure concrete filling materials. And then a sleeper block cavity and the part 3 with the enlarged radial width, which are located at the one end part of the hollow steel tube, are continually filled with the high-pressure concrete filling materials, so that concrete-filled steel tubes 2 are inserted in sleep blocks 1 by pouring.

[0064] In Step 5, the concrete-filled steel tube sleeper is maintained.

[0065] In the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of a ballastless track of the present application, an end part of the formed concrete-filled steel tube is enlarged by flaring treatment. After the concrete-filled steel tube member is inserted in the sleeper block by pouring, the periphery of the steel tube is tightly wrapped by the concrete. Since the outer diameter of the end part of the steel tube is larger than other parts of the steel tube, under the external load effect, the concrete-filled steel tube member cannot be pulled out and separated from the sleeper block.

[0066] In the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of the present application, an enlarged part at one end part of the steel tube is quite beneficial to the spraying operation of spray heads with larger dimension, and an enlarged part at another end part of the steel tube is also beneficial to the spread of sprayed slurry. Therefore, the steel tube and the sleeper block cavity at another end part can be rapidly and efficiently filled. At the same time, the compactness inside the steel tube and the compactness at the junction between the steel tube and the sleeper block are ensured, the hazards are prevented, the life expectancy of the overall structure of the sleeper is improved, and the later-period maintaining cost is reduced.

[0067] In one aspect of the embodiments of the present application, a separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a

ballastless track is provided. The separation-prevention structure is used in a concrete-filled steel tube sleeper of the ballastless track. The concrete-filled steel tube sleeper includes at least two sleeper blocks 1 and a plurality of concrete-filled steel tubes 2 for connecting two sleeper blocks 1 adjacent to each other. Each of the concrete-filled steel tubes 2 is formed by filling a hollow steel tube with concrete. The separation-prevention structure includes a part 3 with an enlarged radial width and concrete with which the part 3 with the enlarged radial width is filled. An end part of the hollow steel tube is enlarged in a radial direction to form the part 3 with the enlarged radial width. The part 3 with the enlarged radial width is buried into the sleeper block 1.

[0068] The part 3 with the enlarged radial width is buried into the sleeper block 1, so that the periphery of the part 3 with the enlarged radial width is tightly wrapped by the concrete of the sleeper block. The outer diameter of the part 3 with the enlarged radial width is larger than that of the concrete-filled steel tube in the related art, and the contact area between the part 3 with the enlarged radial width and the concrete of the sleeper block 1 is larger than the contact area between the concrete-filled steel tube and the concrete of the sleeper block in the related art. Under the the external load effect, the separation-prevention structure cannot be pulled out and separated from the sleeper block 1. The concrete with which the part 3 with the enlarged radial width is filled is configured to increase the structural strength of the separation-prevention structure.

[0069] It should be noted that the concrete-filled steel tube sleeper includes at least two sleeper blocks 1. The concrete-filled steel tube sleeper may include two sleeper blocks 1, and it may also include more sleeper blocks 1, for example, three, four, five or ten, etc.

[0070] In one embodiment, the part 3 with the enlarged radial width has a length smaller than 50 mm.

[0071] In one embodiment, the part 3 with the enlarged radial width is filled with concrete during a filling process of the hollow steel tube, and then the part 3 with the enlarged radial width is integrated with the sleeper block 1 by means of concrete pouring during a pouring process of the sleeper block 1.

- [0072] In another embodiment, during the pouring process of the sleeper block 1, the part 3 with the enlarged radial width is filled with concrete, and integrated with the sleeper block 1 by means of concrete pouring.
- [0073] In one embodiment, a cross section of the part 3 with the enlarged radial width is of a circular, elliptic or elongated shape.
- [0074] In one embodiment, the number of the hollow steel tubes is two, and one of the two hollow steel tubes is arranged at one side of a buried member of the sleeper block 1 and the other one of the two hollow steel tubes is arranged at another side of the buried member of the sleeper block 1.
- [0075] In another embodiment, the number of the hollow steel tubes is three, and the three hollow steel tubes are arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.
- [0076] In one embodiment, the part 3 with the enlarged radial width is wider than a body part of the hollow steel tube in the radial direction by 4-8 mm. For example, the outer diameter of the body part of the hollow steel tube is 40 mm, and the outer diameter of the part 3 with the enlarged radial width is 44 mm. Alternatively, the outer diameter of the body part of the hollow steel tube may be 40 mm, and the outer diameter of the part 3 with the enlarged radial width may be 45 mm. Furthermore, the outer diameter of the body part of the hollow steel tube may be 40 mm, while the outer diameter of the part 3 with the enlarged radial width may be 48 mm.
- [0077] In another aspect of the embodiments of the present application, a concrete-filled steel tube sleeper of a ballastless track is provided. The concrete-filled steel tube sleeper of the ballastless track includes at least two sleeper blocks 1, a plurality of concrete-filled steel tubes 2 for connecting two sleeper blocks 1 adjacent to each other, and the separation-prevention structure provided by any one embodiment described above.
- [0078] In another aspect of the embodiments of the present application, a construction method for the concrete-filled steel tube sleeper of the ballastless track provided by any one embodiment described above is provided. The construction method includes the

following steps.

[0079] In Step 1, two end parts of a hollow steel tube are enlarged in a radial direction by using a flaring tool, to form a part 3 with an enlarged radial width.

[0080] In Step 2, the hollow steel tube is arranged between molds for two sleeper blocks 1 adjacent to each other, wherein the part 3 with the enlarged radial width is arranged in the molds for the sleeper blocks 1; and a steel reinforcement cage is arranged in the molds for the sleeper blocks 1.

[0081] In Step 3, high-pressure concrete is sprayed from one end part of the hollow steel tube to another end part of the hollow steel tube, to fill the hollow steel tube, the part 3 with the enlarged radial width and the molds for the sleeper blocks 1 with concrete to form the concrete-filled steel tube 2, the separation-prevention structure and the sleeper blocks 1 respectively.

[0082] By enlarging end parts of the hollow steel tube in the radial direction by using a flaring tool to form the part 3 with the enlarged radial width, it is quite beneficial to the spraying operation of spray heads with larger dimension, and also beneficial to the spread of sprayed slurry. Therefore, the body part of the hollow steel tube and the part 3 with the enlarged radial width can be rapidly and efficiently filled, the compactness inside the hollow steel tube and the compactness at the junction between the hollow steel tube and the sleeper block 1 are ensured, the hazards are prevented, the life expectancy of the overall structure of the sleeper is improved, and the later-period maintaining cost is reduced.

[0083] In another aspect of the embodiments of the present application, another construction method for the concrete-filled steel tube sleeper of the ballastless track provided by any one embodiment described above is provided. The construction method includes the following steps.

[0084] In Step 1, two end parts of a hollow steel tube are enlarged in a radial direction by using a flaring tool, to form a part 3 with an enlarged radial width.

[0085] In Step 2, high-pressure concrete is sprayed from one end part of the hollow

steel tube to another end part of the hollow steel tube, to fill the hollow steel tube and the part 3 with the enlarged radial width with concrete to form the concrete-filled steel tube 2 and the separation-prevention structure respectively.

[0086] In Step 3, the concrete-filled steel tube 2 is arranged between molds for two sleeper blocks 1 adjacent to each other, wherein the separation-prevention structure is arranged in the molds for the sleeper blocks 1; and a steel reinforcement cage is arranged in the molds for the sleeper blocks 1.

[0087] In Step 4, the concrete is poured into the molds for the sleeper blocks 1 to form the sleeper blocks 1.

[0088] By enlarging end parts of the hollow steel tube in the radial direction by using a flaring tool to form the part 3 with the enlarged radial width, it is quite beneficial to the spraying operation of spray heads with larger dimension, and also beneficial to the spread of sprayed slurry. Therefore, the body part of the hollow steel tube and the part 3 with the enlarged radial width can be rapidly and efficiently filled, the compactness inside the hollow steel tube and the compactness at the junction between the hollow steel tube and the sleeper block are ensured, the hazards are prevented, the life expectancy of the overall structure of the sleeper is improved, and the later-period maintaining cost is reduced.

[0089] Those skilled in the art can easily appreciate that, what are described above are merely preferred embodiments of the present application, and are not to limit the present application. And any modification, equivalent and improvement within the spirit and principles of the present application shall be covered in the protective scope of the present application.

CLAIMS

1. A separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track, the separation-prevention structure being used in a concrete-filled steel tube sleeper of the ballastless track, the concrete-filled steel tube sleeper comprising two or more sleeper blocks (1) and a plurality of concrete-filled steel tubes (2) for connecting the sleeper blocks (1), the sleeper blocks (1) being formed by means of concrete pouring, each of the concrete-filled steel tubes (2) being formed by filling a hollow steel tube with concrete and arranged in a mold for manufacturing two sleeper blocks (1) adjacent to each other, and integrated with the two sleeper blocks (1) by means of concrete pouring during a pouring process of the sleeper blocks (1);

wherein an outer end part of the hollow steel tube, which is buried in the sleeper block (1), is enlarged in a radial direction to form a part (3) with an enlarged radial width, the part (3) with the enlarged radial width having a length range smaller than 50 mm, the part (3) with the enlarged radial width is filled with concrete during a filling process of the hollow steel tube, and then the part (3) with the enlarged radial width is integrated with the sleeper block (1) by means of concrete pouring during the pouring process of the sleeper block (1).

2. The separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of claim 1, wherein a cross section of the part (3) with the enlarged radial width is of a circular, elliptic or elongated shape.

3. The separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of claim 1, wherein the number of the hollow steel tubes is two, and one of the two hollow steel tubes is arranged at one side of a buried member of the sleeper block and the other one of the two hollow steel tubes is arranged at another side of the buried member of the sleeper block;

or the number of the hollow steel tubes is three, and the three hollow steel tubes are arranged in a manner that connection lines between center points of cross sections of the three

hollow steel tubes constitute a triangle.

4. A concrete-filled steel tube sleeper of a ballastless track, comprising two or more sleeper blocks (1) and a plurality of concrete-filled steel tubes (2) for connecting the sleeper blocks (1), and further comprising the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of any one of claims 1 to 3.

5. A construction method for the concrete-filled steel tube sleeper of the ballastless track of claim 4, comprising the following steps:

Step 1: selecting a hollow steel tube with a length of 2000 mm and an outer diameter of 40 mm;

Step 2: enlarging an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm to 45-48 mm by using a flaring tool;

Step 3: spraying and filling high-pressure concrete filling materials from one end part of the hollow steel tube to another end part of the hollow steel tube, and densely filling the part (3) with the enlarged radial width with concrete;

Step 4: maintaining the concrete-filled steel tube member to form a plurality of prefabricated concrete-filled steel tubes (2);

Step 5: placing the concrete-filled steel tubes (2) and a steel reinforcement cage into a mold for producing the sleeper, and pouring concrete materials, so that the concrete-filled steel tubes (2) are inserted in the sleep blocks (1) by pouring.

6. A separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track, the separation-prevention structure being used in a concrete-filled steel tube sleeper of the ballastless track, the concrete-filled steel tube sleeper comprising two or more sleeper blocks (1) and a plurality of concrete-filled steel tubes (2) for connecting the sleeper blocks (1), the sleeper blocks (1) being formed by means of concrete pouring, the

concrete-filled steel tubes (2) being configured as follows: hollow steel tubes are arranged in a mold for manufacturing two sleeper blocks (1) adjacent to each other, and then, by means of concrete pouring during a pouring process of the sleeper blocks (1), the hollow steel tubes are integrated with the sleeper blocks (1) and filled with concrete at the same time;

wherein an outer end part of the hollow steel tube, which is buried in the sleeper block (1), is enlarged in a radial direction to form a part (3) with an enlarged radial width, the part (3) with the enlarged radial width having a length range smaller than 50 mm, during the pouring process of the sleeper blocks (1), the part (3) with the enlarged radial width is filled with concrete, and integrated with the sleeper block (1) by means of concrete pouring.

7. The separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of claim 6, wherein a cross section of the part (3) with the enlarged radial width is of a circular, elliptic or elongated shape.

8. The separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of claim 6, wherein the number of the hollow steel tubes is two, and one of the two hollow steel tubes is arranged at one side of a buried member of the sleeper block and the other one of the two hollow steel tubes is arranged at another side of the buried member of the sleeper block;

or the number of the hollow steel tubes is three, and the three hollow steel tubes are arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.

9. A concrete-filled steel tube sleeper of a ballastless track, comprising two or more sleeper blocks (1) and a plurality of concrete-filled steel tubes (2) for connecting the sleeper blocks (1), and further comprising the separation-prevention structure of the concrete-filled steel tube member and the sleeper block of the ballastless track of any one of claims 6 to 8.

10. A construction method for the concrete-filled steel tube sleeper of the ballastless track of claim 9, comprising the following steps:

Step 1: selecting a hollow steel tube with a length of 2000 mm and an outer diameter of 40 mm;

Step 2: enlarging an outer diameter of two end parts of the hollow steel tube having a length range of 0-50 mm to 45-48mm by using a flaring tool;

Step 3: forming a plurality of prefabricated hollow steel tubes;

Step 4: placing the hollow steel tubes and a steel reinforcement cage into a mold for producing the sleeper, spraying high-pressure concrete filling materials from one end part of the hollow steel tube to another end part of the hollow steel tube until a sleeper block cavity and the part (3) with the enlarged radial width, which are located at the another end part of the hollow steel tube, are filled with the high-pressure concrete filling materials, and then continually filling, a sleeper block cavity and the part (3) with the enlarged radial width which are located at the one end part of the hollow steel tube, with the high-pressure concrete filling materials, so that concrete-filled steel tubes (2) are inserted in sleep blocks (1) by pouring;

Step 5: maintaining the concrete-filled steel tube sleeper.

11. A separation-prevention structure of a concrete-filled steel tube member and a sleeper block of a ballastless track, the separation-prevention structure being used in a concrete-filled steel tube sleeper of the ballastless track, the concrete-filled steel tube sleeper comprising at least two sleeper blocks (1) and a plurality of concrete-filled steel tubes (2) for connecting two sleeper blocks (1) adjacent to each other, each of the concrete-filled steel tubes (2) being formed by filling a hollow steel tube with concrete, the separation-prevention structure comprising a part (3) with an enlarged radial width and concrete with which the part (3) with the enlarged radial width is filled, an end part of the hollow steel tube being enlarged in a radial direction to form the part (3) with the enlarged radial width, the part (3) with the enlarged radial width being buried into the sleeper block (1), the part (3) with the enlarged radial width having a length smaller than 50 mm.

12. The separation-prevention structure of claim 11, wherein the part (3) with the enlarged radial width is filled with concrete during a filling process of the hollow steel tube, and then the part (3) with the enlarged radial width is integrated with the sleeper block (1) by means of concrete pouring during a pouring process of the sleeper block (1);

or during the pouring process of the sleeper block (1), the part (3) with the enlarged radial width is filled with concrete, and integrated with the sleeper block (1) by means of concrete pouring.

13. The separation-prevention structure of claim 11, wherein a cross section of the part (3) with the enlarged radial width is of a circular, elliptic or elongated shape.

14. The separation-prevention structure of claim 11, wherein the number of the hollow steel tubes is two, and one of the two hollow steel tubes is arranged at one side of a buried member of the sleeper block (1) and the other one of the two hollow steel tubes is arranged at another side of the buried member of the sleeper block (1);

or the number of the hollow steel tubes is three, and the three hollow steel tubes are arranged in a manner that connection lines between center points of cross sections of the three hollow steel tubes constitute a triangle.

15. The separation-prevention structure of claim 11, wherein the hollow steel tube has a circular cross section, and the part (3) with the enlarged radial width is wider than a body part of the hollow steel tube in the radial direction by 4-8 mm.

16. A concrete-filled steel tube sleeper of a ballastless track, comprising at least two sleeper blocks (1), a plurality of concrete-filled steel tubes (2) for connecting two sleeper blocks (1) adjacent to each other, and the separation-prevention structure of any one of claims 11 to 15.

17. A construction method for the concrete-filled steel tube sleeper of the ballastless track of claim 16, comprising the following steps:

enlarging two end parts of a hollow steel tube in a radial direction by using a flaring tool, to form a part (3) with an enlarged radial width;

arranging the hollow steel tube between molds for two sleeper blocks (1) adjacent to each other, wherein the part (3) with the enlarged radial width is arranged in the molds for the sleeper blocks (1); and arranging a steel reinforcement cage in the molds for the sleeper blocks (1);

spraying high-pressure concrete from one end part of the hollow steel tube to another end part of the hollow steel tube, to fill the hollow steel tube, the part (3) with the enlarged radial width and the molds for the sleeper blocks (1) with concrete to form the concrete-filled steel tube (2), the separation-prevention structure and the sleeper blocks (1) respectively.

18. A construction method for the concrete-filled steel tube sleeper of the ballastless track of claim 16, comprising the following steps:

enlarging two end parts of a hollow steel tube in a radial direction by using a flaring tool, to form a part (3) with an enlarged radial width;

spraying high-pressure concrete from one end part of the hollow steel tube to another end part of the hollow steel tube, to fill the hollow steel tube and the part (3) with the enlarged radial width with concrete to form the concrete-filled steel tube (2) and the separation-prevention structure respectively;

arranging the concrete-filled steel tube (2) between molds for two sleeper blocks (1) adjacent to each other, wherein the separation-prevention structure is arranged in the molds for the sleeper blocks (1); and arranging a steel reinforcement cage in the molds for the sleeper blocks (1);

pouring concrete into the molds for the sleeper blocks (1) to form the sleeper blocks (1).