

ASSEMBLED STEEL PIPE CONCRETE BI-BLOCK RAILWAY SLEEPER

TECHNICAL FIELD

[0001] The invention relates to the field of ballastless tracks, and more particularly, to a twin-block sleeper including a plurality of concrete-filled steel tubes.

BACKGROUND

[0002] A sleeper is one of the most crucial components for ballastless track system. During the construction of a ballastless track bed, the sleepers position the embedded components without fasteners, and determine the geometric shape of the track. To effectively control the width and number of cracks between the precast concrete sleepers and the new and old concrete of the cast-in-place track bed slab, and ensure that the main structure of ballastless track meets the requirements of the durability of the concrete structure, the traditional long concrete sleepers have been gradually optimized to be concrete sleepers connected and positioned by reinforced trusses.

[0003] At present, the widely used concrete sleepers in the ballastless track mainly include France's Stedf sleepers (adopting angle-iron as interconnecting piece), Germany Radar 2000 (adopting reinforced trusses as interconnecting piece), Germany's Zublin twin-block sleepers, and CRTSI twin-block sleepers widely used in China. The existing twin-block sleepers used in ballastless track are mainly an integrated structure composed of two concrete blocks disposed on both sides of the sleepers and connected by reinforced trusses or angle-iron. But this type of integrated structure has the following deficiencies in terms of manufacturing, transportation, storage, and construction.

[0004] As described in the article "Discussion on the Prefabrication of Twin-Block Sleepers for Ballastless Track" ("Construction Engineering Technology and Design", Wang CY, March 2016), to precast the above mentioned integrated twin-block sleepers, the construction process requires different complex equipment to operate in harmony with each other, such as steel models, model conveying rollers, concrete pouring

equipment, shaking tables, curing ponds, mold carriers, turn-and-release machines, etc. The construction process involves many complex installations of connectors such as embedded tubes and reinforced trusses. These connectors are required to have a sufficient rigidity and high-quality materials, which leads to a great impact on manufacturing efficiency and total production cost of the sleepers.

[0005] In the transportation process, as disclosed in Chinese Patent Publication No. CN101245578A and CN202785279, the twin-block sleepers are transported by using manual or special loading tools, or spreaders such as a beam, a left hook, a right hook, and a synchronous link mechanism, etc. The rigidity of the connectors determines whether or not geometric deformation occurs during transportation. The above settings can perform a process of moving a total of 25×5 sleepers disposed in stacked relation. In the storage process, as disclosed in Chinese Patent Publication No. CN203246881, an automatic palletizer for moving twin-block sleepers includes a fixed bracket, a first vehicle traveling on a cogged track, a second vehicle disposed on both sides of the first vehicle. The positioning, hoisting and stacking of the sleepers can be performed by a lifting arm and a manipulator of the second vehicle. It is obvious that there is a great technical limit to the process of transportation and storage, for example, a set of precast twin-block sleepers weighing about 270 kg, is time-consuming and laborious to move to the construction site. And the twin-block sleepers connected by angle-iron or reinforced trusses have a limit on the number of stacking layers when they are placed in the factory. These result in inconvenience, and high costs of storage and transportation, and cause waste of space when the sleepers are stacked in the transportation vehicles.

[0006] As disclosed in Chinese Patent Publication No. CN101289828A and CN102268851A, the construction process for twin-block ballastless track requires different complex equipment to operate in harmony with each other, such as combined track racks, self-propelled pavers, multi-functional electrical control spreaders, and mobile mechanical assembly platforms. There are many types of large matching units, but they all have the disadvantages of requiring complex construction technology and special transportation channels, which pose great challenges to the construction difficulty and efficiency. In view of the above technical problems in various aspects, there is an

urgent need in the art to provide a more comprehensive solution to better meet the growing demand for high-quality engineering.

SUMMARY

[0007] It is an object of the disclosure to provide a twin-block sleeper comprising a plurality of concrete-filled steel tubes. Considering the actual needs of manufacturing, transportation, storage and construction, the overall structure and the setting methods of the twin-block sleepers of ballastless track are studied and redesigned, and meanwhile, the structure of each key component is improved according to the requirements of transportation, storage and field assembly. Compared with the prior art, the disclosure can implement the fixing and assembly process more quickly and accurately at the construction site, which fits the manufactured components in a precise location. Moreover, the disclosure significantly reduces use of the connectors and maintains the sleepers in its original shape and position on the track bed. In particular, the disclosure has the advantages of reducing the process difficulty, improving process efficiency and reducing costs in many links such as manufacturing, storage, transportation and construction. The design of the disclosure is particularly suitable for ballastless track projects that require a high requirement of construction cycle and are limited on construction conditions.

[0008] According to one aspect of the disclosure, provided is a twin-block sleeper comprising a first concrete sleeper block and a second concrete sleeper block configured in pairs, and a plurality of concrete-filled steel tubular columns;

[0009] the first concrete sleeper block and the second sleeper block each comprise a top surface provided with at least one embedded bolt sleeve, and at least one threaded through hole connecting two ends of the first/second concrete sleeper block along the length of the first/second concrete sleeper block; the concrete-filled steel tubular columns are formed by pouring self-compacting concrete in a hollow steel tube and curing the concrete; and both ends of the concrete-filled steel tubular columns are threaded; and

[0010] the first concrete sleeper block, the second sleeper block, and the plurality of the concrete-filled steel tubular columns are separate during the process of transportation and storage, and then transported to a construction site; the distance and the geometric shape and position of the first and second concrete blocks are adjusted and fixed; both ends of the plurality of the concrete-filled steel tubular columns are separately screwed into the threaded through holes of the first concrete sleeper block and the second concrete sleeper block and fastened.

[0011] According to another aspect of the disclosure, provided is a twin-block sleeper, comprising a first concrete sleeper block and a second concrete sleeper block configured in pairs, and a plurality of concrete-filled steel tubular columns;

[0012] the first concrete sleeper block and the second sleeper block each comprise a top surface provided with at least one embedded bolt sleeve, and at least one through hole connecting two ends of the first/second concrete sleeper block along the length of the first/second concrete sleeper block; the concrete-filled steel tubular columns are formed by pouring self-compacting concrete in a hollow steel tube and curing the concrete; and the inner diameter of the through hole is matched with the outer diameter of the ends of the steel tubular columns; and

[0013] the first concrete sleeper block, the second sleeper block, and the plurality of the concrete-filled steel tubular columns are separate during the process of transportation and storage, and then transported to a construction site; the distance and the geometric shape and position of the first and second concrete blocks are adjusted and fixed; both ends of the plurality of the concrete-filled steel tubular columns are separately inserted into the through holes of the first concrete sleeper block and the second concrete sleeper block, and the through holes are sealed by mortar.

[0014] The first concrete sleeper block and the second concrete sleeper block are both integrally cast by concrete. Preferably, a reinforced mesh and a steel stirrup are provided inside the concrete sleeper blocks.

[0015] Preferably, both sides of the first concrete sleeper block and the second concrete sleeper block are provided with an inclination angle of 11: 1 to 7: 1, and the upper corners of the first and second concrete sleeper blocks are chamfered.

[0016] Preferably, the number of the plurality of concrete-filled steel tubular columns is 2 or 3. When the number of the columns is 3, the centers of the circles on the ends of the three concrete-filled steel tubular columns can be connected to form an inverted triangle in a section view of the sleepers.

[0017] Preferably, the depth of the threaded through holes or the through hole is 708 mm, and the inner diameter thereof is 45 mm.

[0018] The twin-block sleepers are not provided with reinforced trusses or angle-iron.

[0019] Compared with the prior art, the disclosure has the following technical advantages:

[0020] 1. Considering the actual needs of manufacturing, transportation, storage and construction, the entire twin-block sleeper comprising multiple components independent of each other for processing and manufacturing is transported to the construction site for installation. The integrated forming of the concrete-filled steel tubular columns and the concrete sleeper blocks can effectively maintain the sleepers in its original shape and position on the track bed, and satisfy the requirements for torsional resistance of the twin-block sleeper blocks. In particular, the overall structure and the setting methods of the twin-block sleepers of ballastless track are studied and redesigned. These optimizations avoid excessive large supporting units and special transportation channels in the construction site, thus enhancing the construction efficiency.

[0021] 2. The disclosure overcomes the inherent inconvenience of the traditional twin-block sleepers depending on the sufficient rigidity of the connectors to maintain the sleepers in its original shape and position during stacking storage, hoisting and transportation. The disclosure also improves the efficiency of manufacturing, stacking storage, and transportation to various construction sites, which has no limits on the number of stacking layers and is conducive to saving storage space.

[0022] 3. The twin-block sleepers comprising concrete-filled steel tubes can overcome various technical problems faced in various processes such as manufacturing, multi-point transportation, centralized storage, and on-site construction. And the twin-block sleepers have a good combination effect with the track bed, a good ability to maintain the sleepers in original shape and position, a good stability. In addition, the twin-block sleepers also have the advantages of simple preparation technology, low cost, reliable quality, flexible specifications, and easy maintenance, thus having high economic and social value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. 1 is a schematic diagram of a twin-block sleeper according to one embodiment of the disclosure.

[0024] FIG. 2 is a schematic diagram of a concrete-filled steel tubular column according to one embodiment of the disclosure.

[0025] FIG. 3 is a schematic diagram of placing a first concrete sleeper block and a second concrete sleeper block opposite to each other.

[0026] FIG. 4 is a schematic diagram of combining a first concrete sleeper block, a second concrete sleeper block, and a plurality of the concrete-filled steel tubular columns according to one embodiment of the disclosure.

[0027] The reference numerals in the figures: 1. First concrete sleeper block; 2. Second concrete sleeper block; 3. Concrete-filled steel tubular column; 11. First embedded bolt sleeve; 21. Second embedded bolt sleeve; 12. First threaded through hole; 22. Second threaded through hole.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0028] To further illustrate, embodiments detailing a twin-block sleeper are described below. It should be noted that the following embodiments are intended to describe and not to limit the disclosure.

[0029] The traditional twin-block sleepers for ballastless track have various technical problems faced in many processes such as manufacturing, transportation, storage, and on-site construction. And these processes also cause the different problems such as enormous human and material costs, low efficient and high cost. The disclosure optimizes and designs the overall structure and the setting methods of the twin-block sleepers of ballastless track, especially the specific structure of each key component and the requirements of transportation, storage and field assembly are improved.

Example 1

[0030] A twin-block sleeper comprises a plurality of components independent of each other, specifically, a first concrete sleeper block 1 and a second concrete sleeper block 2 configured in pairs, and a plurality of matching concrete-filled steel tubular columns 13. These components are separately placed during the process of transportation, storage, etc., and then transported to the construction site together.

[0031] The first concrete sleeper block 1 and the second sleeper block 2 respectively comprise an embedded bolt sleeve 11,21 on the top surface, and a threaded through hole 12 extending inwardly along the length of the sleeper blocks and being disposed on both sides of the sleeper blocks. Preferably, as shown in FIG. 1, the number of the embedded bolt sleeves 11 is 2, which are symmetrically disposed on the top surface of the first concrete sleeper block 1 and extend downward, thereby being used for installing other components such as fasteners. Preferably, the number of the threaded through holes 22 is 2, which are symmetrically disposed on the both sides of the threaded through holes. More preferably, the number of the threaded through holes 22 is 3, the centers of the circles on the ends of the three concrete-filled steel tubular columns can be connected to form an inverted triangle which is viewed from the longitudinal section of the sleepers.

[0032] As shown in FIG. 2, the concrete-filled steel tubular columns 3 are formed by pouring self-compacting concrete in hollow steel tubes, followed by the curing of concrete. Then the both ends of the concrete-filled steel tubular columns 3 are processed into a thread structure. The first concrete sleeper block 1, the second concrete sleeper block 2 and the plurality of the concrete-filled steel tubular columns 3 are separately

placed during the process of transportation and storage, and then transported to the construction site together for integrated assembly, thereby avoiding all inconveniences that may be caused by on-site processing and manufacturing. Then the both ends of the plurality of the concrete-filled steel tubular columns are separately screwed into the threaded through holes of the first concrete sleeper block and the second concrete sleeper block, and finally fastened, thus obtaining the required twin-block sleepers comprising concrete-filled steel tubes. Various practical tests show that the twin-block sleepers processed, manufactured, handled, stored, and constructed on-site according to the disclosure can effectively maintain its original shape and position on the ground, and satisfy the requirements for torsional resistance of the twin-block sleeper blocks. The sleepers also efficiently overcome the inherent inconvenience of the traditional twin-block sleepers that must depend on the sufficient rigidity of the connectors to maintain the sleepers in its original shape and position during stacking storage, hoisting and transportation. And the sleepers also improve the efficiency of manufacturing, stacking storage, and transportation to various construction sites, which has no limits on the number of stacking layers and is conducive to saving storage space.

[0033] The positioning and the adjustment for the sleeper blocks and the concrete-filled steel columns are performed by a thread engagement method, which further improves the construction efficiency and convenience and facilitates the later maintenance inspection.

Example 2

[0034] A twin-block sleeper comprises a plurality of components independent of each other, specifically, a first concrete sleeper block 1 and a second concrete sleeper block 2 configured in pairs, and a plurality of matching concrete-filled steel tubular columns 3. These components are separately placed during the process of transportation, storage, etc., and then transported to the construction site together. The first concrete sleeper block 1 and the second sleeper block 2 respectively comprise an embedded bolt sleeve 11, 21 on the top surface, and a through hole 12 extending inwardly along the length of the sleeper blocks and being disposed on both sides of the sleeper blocks. There are no reference

numerals for the hole in the figures, that is, the through hole replaces the threaded through hole in Example 1.

[0035] As shown in FIG. 2, the concrete-filled steel tubular columns 3 is formed by pouring self-compacting concrete in hollow steel tubes, followed by the curing of concrete. The inner diameter of the through hole is matched with the outer diameter of the ends of the steel tubes. The first concrete sleeper block 1, the second concrete sleeper block 2 and the plurality of the concrete-filled steel tubular columns 3 are separately placed during the process of transportation and storage, and then transported to the construction site together for integrated assembly, thereby avoiding all inconveniences that may be caused by on-site processing and manufacturing. As shown in FIGS. 3-4, the distance between the two concrete blocks is first adjusted and the geometry is also determined. Then the both ends of the plurality of the concrete-filled steel tubular columns are separately inserted into the through holes of the first concrete sleeper block and the second concrete sleeper block, and finally a mortar is poured into the through holes to be cured, thus obtaining the required twin-block sleepers comprising concrete-filled steel tubes.

[0036] Replacement of the thread engagement method with the curing of the mortar can help ensure the integrity and structural intensity of the twin-block sleepers that are finally obtained. The process of the construction is convenient and quick, and no special equipment for twin-block sleeper production is required, and the engineering cost is low.

[0037] The sleeper blocks integrally cast by concrete are symmetrical with the vertical axis of the steel rail, and they have smaller joint surfaces with the cast-in-situ track bed. At the same time, the flank of the concrete sleeper blocks is preferably an inclined plane with a certain slope, and the upper corners of the concrete sleeper blocks can be chamfered. This facilitates the demolding of the concrete sleeper block of the manufacturing process and reduces the stress concentration of the concrete.

[0038] The twin-block sleepers comprising concrete-filled steel tubes can effectively overcome various technical problems faced in various processes such as manufacturing, multi-point transportation, centralized storage, and on-site construction. And the twin-block sleepers have a good combination effect with the track bed, a good ability to

maintain the sleepers in original shape and position, a good stability. In addition, the twin-block sleepers also have the advantages of simple preparation technology, low cost, reliable quality, flexible specifications, and easy maintenance, thus having high economic and social value. The design of the disclosure is particularly suitable for ballastless track projects that require a high requirement of construction cycle and are limited on construction conditions.

[0039] It will be obvious to those skilled in the art that changes and modifications may be made, and therefore, the aim in the appended claims is to cover all such changes and modifications.

CLAIMS

1. A twin-block sleeper, comprising a first concrete sleeper block (1) and a second concrete sleeper block (2) configured in pairs, and a plurality of concrete-filled steel tubular columns (3); wherein

the first concrete sleeper block (1) and the second sleeper block (2) each comprise a top surface provided with at least one embedded bolt sleeve (11, 21), and at least one threaded through hole (12, 22) connecting two ends of the first/second concrete sleeper block along the length of the first/second concrete sleeper block; the concrete-filled steel tubular columns (3) are formed by pouring self-compacting concrete in a hollow steel tube and curing the concrete; and both ends of the concrete-filled steel tubular columns are threaded; and

the first concrete sleeper block (1), the second sleeper block (2), and the plurality of the concrete-filled steel tubular columns (3) are separate during the process of transportation and storage, and then transported to a construction site; the distance and the geometric shape and position of the first and second concrete blocks are adjusted and fixed; both ends of the plurality of the concrete-filled steel tubular columns (3) are separately screwed into the threaded through holes (12, 22) of the first concrete sleeper block (1) and the second concrete sleeper block (2) and fastened.
2. The twin-block sleeper, comprising a first concrete sleeper block (1) and a second concrete sleeper block (2) configured in pairs, and a plurality of concrete-filled steel tubular columns (3); wherein

the first concrete sleeper block (1) and the second sleeper block (2) each comprise a top surface provided with at least one embedded bolt sleeve (11), and at least one through hole connecting two ends of the first/second concrete sleeper block along the length of the first/second concrete sleeper block; the concrete-filled steel tubular columns (3) are formed by pouring self-compacting concrete in

a hollow steel tube and curing the concrete; and an inner diameter of the through hole is matched with an outer diameter of the ends of the steel tubular columns; and

the first concrete sleeper block (1), the second sleeper block (2), and the plurality of the concrete-filled steel tubular columns (3) are separate during the process of transportation and storage, and then transported to a construction site; the distance and the geometric shape and position of the first and second concrete blocks are adjusted and fixed; both ends of the plurality of the concrete-filled steel tubular columns (3) are separately inserted into the through holes of the first concrete sleeper block (1) and the second concrete sleeper block (2), and the through holes are sealed by mortar.

3. The twin-block sleeper of claim 1 or 2, wherein the first concrete sleeper block (1) and the second concrete sleeper block (2) are both integrally cast by concrete; and a reinforced mesh and a steel stirrup are provided inside the first and second concrete sleeper blocks.
4. The twin-block sleeper of claim 3, wherein both sides of the first concrete sleeper block (1) and the second concrete sleeper block (2) are provided with an inclination angle of 11: 1 to 7: 1, and the upper corners of the first and second concrete sleeper blocks are chamfered.
5. The twin-block sleeper of claim 1 or 2, wherein the number of the plurality of concrete-filled steel tubular columns (3) is 2 or 3; when the number of the columns is 3, the centers of the circles on the ends of the three concrete-filled steel tubular columns are connected to form an inverted triangle in a section view of the sleepers.

6. The twin-block sleeper of claim 5, wherein a depth of the threaded through hole (12) or the through hole is 708 mm, and an inner diameter thereof is 45 mm.
7. The twin-block sleeper of claim 6, wherein the number of the threaded through hole (12) or the through hole is 2 or 3, and a distance therebetween is 150-180 mm.