ISSN 2663-1563 Vol. 6, Issue 1: 74-78, DOI: 10.25236/AJAGE.2024.060111

An uninterrupted cyclic automatic transportation, hoisting, and distribution system of concrete

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Abstract: *The production of prefabricated components faces a series technological problems. These include low concrete pouring efficiency, non-cyclic pouring, incapability of lifting concrete in the transportation process, incapability of moving along the direction of components and uniformly spreading concrete, and non-applicability to pouring of large-volume concrete. To solve these problems, an uninterrupted cyclic automatic transportation, hoisting, and distribution system of concrete was proposed. Its construction method and specific implementation process were studied. On this basis, key processes in uninterrupted cyclic concrete construction of prefabricated components were put forward, which can provide practical and technological reference for similar engineering.*

Keywords: *Prefabricated components, Concrete, Uninterrupted construction, Technology*

1. Introduction

Prefabricated concrete components are generally fabricated with specific molds in a workshop, which can effectively avoid occurrence of size deviation due to in-situ casting. However, prefabricated concrete components set high requirements for the pouring and curing processes. For example, it faces key technological problems that the mixing proportion of concrete during pouring and the transportation time after production of concrete both should be strictly controlled. Prefabricated concrete components are generally manufactured in the workshop, which is commonly close to the outlet of the concrete mixing station. In such a short distance, it not only wastes resources but also takes a long time if using concrete tank trucks and pump trucks to transport concrete.

At present, a concrete distribution system is generally adopted to transport and pour concrete at a position with a short distance to the workshop. Hopper cars and tracks are used to transport concrete to the designated spot and then unloaded. However, such a pouring method is less efficient, cannot realize cyclic pouring, cannot hoist concrete in the transportation process, cannot move automatically along the direction of components and realize uniform distribution, and is not applicable to pouring of large-volume concrete. In view of this, an uninterrupted cyclic automatic transportation, hoisting, and distribution system of concrete was proposed and its construction method and specific implementation processes were explored. Finally, key processes in uninterrupted cyclic concrete construction of prefabricated components were put forward, which can provide practical and technological reference for similar engineering[1-2].

2. Structure of the uninterrupted cyclic automatic transportation, hoisting, and distribution system of concrete

The uninterrupted cyclic automatic transportation, hoisting, and distribution system of concrete is shown in *Figure 1* and 2. The system consists of the first and second transfer tracks, at least two hoisting systems, at least two distribution systems, and at least two conveyer buckets. Considering the large height of prefabricated components, at least two hoisting systems were set to lift the conveyer buckets. Using at least two distribution systems can ensure the amount of concrete poured.

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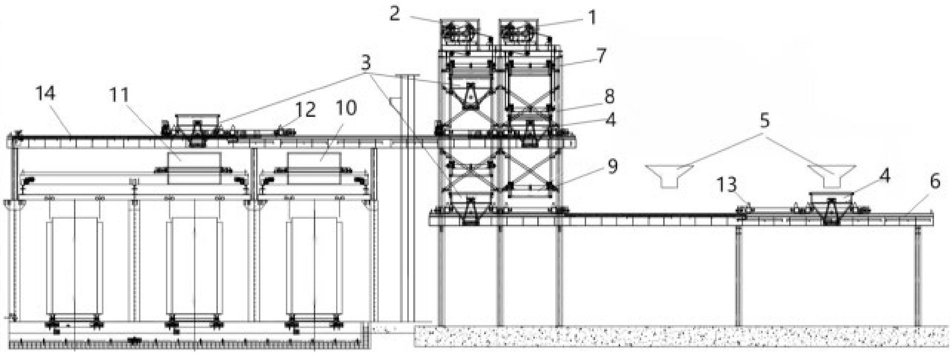
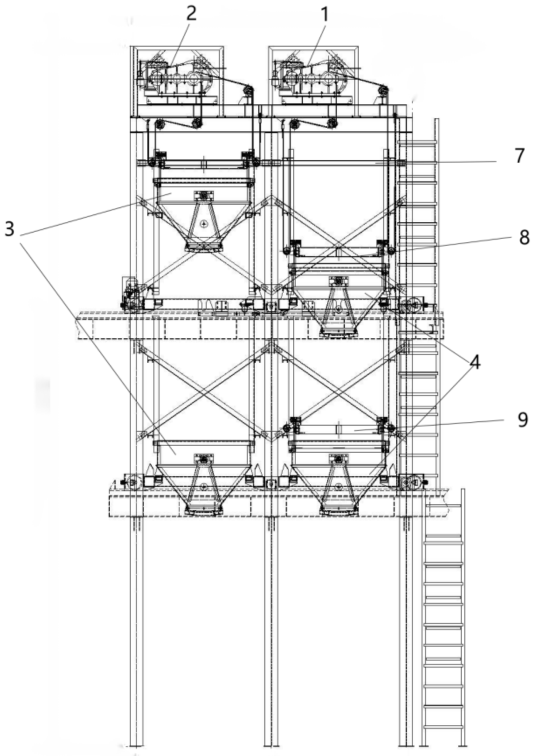


Figure 1: Front view of the system.



1-The first hoisting system; 2-The second hoisting system; 3-The first conveyer bucket; 4-The second conveyer bucket; 5-Outlet of the concrete mixing station; 6-The first transfer track; 7-The first work station; 8-The second work station; 9-The third work station; 10-Single-span concrete spreader; 11-Double-span concrete spreader; 12-The second hopper car; 13-The first hopper car; 14-The second transfer track

Figure 2: Side view of the system.

Two hoisting systems were set, namely, the first and second ones. Similarly, two conveyer buckets were also used, namely, the first and second ones. Setting the two hoisting systems can realize cross operation of the two conveyer buckets, ensure their reciprocation, and avoid interference of the two conveyer buckets on the transfer tracks.

Two distribution systems were utilized, namely, the single-span and double-span concrete spreaders. The two distribution systems both adopted single-span or double-span concrete spreaders, which could be selected according to the actual operation requirements. The concrete spreaders were equipped with an elevatable system, which was composed of fixed pulleys and cables. The concrete spreaders were allowed to move vertically by releasing or retracting the cables, which was controlled by the display terminal.

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Parameters including the hoisting height of hoisting systems, track gauge of transfer tracks, and traveling speed of hopper cars could be set according to the practical operation requirements. For example, the hoisting height of hoisting systems, track gauge of transfer tracks, and traveling speed of hopper cars can be set as 10 m, 2, 500 mm, and 0 ~ 30 m/min, respectively[3-5].

3. Key construction processes of the uninterrupted cyclic automatic transportation, hoisting, and distribution technology of concrete

The uninterrupted cyclic automatic transportation, hoisting, and distribution method of concrete involves the following steps:

Step 1: After being loaded at the outlet of the concrete mixing station, the first conveyer bucket is driven by the first hopper car to the position below the hoisting systems. The hanging bracket of the second hoisting system lifts the first hopper car to the first work station and waits there. Then, after the second hopper car arrives below the hoisting systems, the hanging bracket of the second hoisting system places the first conveyer bucket on the second hopper car, which departs from the hoisting systems and goes to the distribution systems, as shown in *Figure 3*.

Step 2: The hanging bracket of the first hoisting system descends to and waits at the third work station, and the hanging bracket of the second hoisting system descends to the second work station.

Step 3: After being loaded at the outlet of the concrete mixing station, the second conveyer bucket is driven to the position below the hoisting systems, where the awaiting hanging bracket of the first hoisting system lifts the second conveyer bucket to the first work station and then waits there.

Step 4: After transferring concrete in the first conveyer bucket to the single-span or double-span concrete spreaders through the hopper door on the bottom, the first conveyer bucket is driven to the position below the hoisting systems. The hanging bracket of the second hoisting system waiting there lifts the first conveyer bucket to the first work station and stops. Meanwhile, after the hanging bracket of the first hoisting system places the second conveyer bucket on the second hopper car, second hopper car departs from the hoisting systems and goes to the concrete distribution station. After reaching the concrete distribution station, the concrete is transferred to the single-span or double-span concrete spreaders, thus finishing concrete pouring, as shown in *Figure 4*.

Step 5: After the second hopper car safely departs form the hoisting systems, the second hoisting system descends the first conveyer bucket to the third work station and places it on the first hopper car, which departs from the hoisting systems and goes to the outlet of the concrete mixing station.

After finishing the above steps, a work cycle of the uninterrupted cyclic automatic transportation, hoisting, and distribution system of concrete is completed. The concrete distribution and loading can be conducted in parallel by the system, which greatly shortens the time of work cycles and improves the production efficiency.

Figure 3: Concrete hoisting system.

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Figure 4: Concrete spreader.

4. Effects

1) The transportation, hoisting, and distribution systems were set. The transportation system was composed of two transfer tracks with different heights, at the junction of which at least two hoisting systems were set. The uninterrupted cyclic concrete pouring was realized by cooperation of multiple conveyer buckets, hopper cars, hoisting systems, and distribution systems. Moreover, various parts of the system were compact.

2) Considering the large height of prefabricated components, two or more hoisting systems were set to lift conveyer buckets and realize cross operation of multiple conveyer buckets. This ensures reciprocation of multiple conveyer buckets and avoids interference of the conveyer buckets on transfer tracks. Multiple work stations were set on the supporting body of each hoisting system. The conveyer buckets were remained at different heights by the hanging brackets, which further ensured the continuity of various conveyer buckets and realized uninterrupted cyclic operation.

3) The transfer tracks were arranged with a certain ground clearance, so they did not influence ground cross-hauling. The action of hoisting systems was linked by connecting the two transfer tracks end to end, which shortened the total length of the system and narrowed the occupied area[6-8].

5. Conclusions

1) The concrete pouring was completed by coordination of the transportation system, hoisting systems, and distribution systems, which shows a high degree of automation and reduces the workload of concrete pouring. Two conveyer buckets worked together, which achieves the uninterrupted cyclic concrete pouring.

2) Considering the large height of prefabricated components, two hoisting systems were set to lift the conveyer buckets. This realizes the cross operation of the two conveyer buckets, ensures reciprocation of the two conveyer buckets, and avoids interference of conveyer buckets on conveyer buckets.

3) The rail-bearing beam of the concrete transportation system was erected overhead, which does not influence the ground cross-hauling and solves problems including the large occupied area and influence on cross operation.

4) The concrete distribution system was equipped with transfer tracks along the length direction of prefabricated components, as well as transverse moving devices and hoisting devices on the concrete spreaders. They can realize concrete pouring at different heights and different locations, meet uniform distribution of prefabricated components, and cut the labor cost.

5) The proposed uninterrupted cyclic automatic transportation, hoisting, and distribution equipment of concrete exhibits good economic benefit and can achieve scale production, which greatly improves the working efficiency and economic benefit.

References

[1] Luo L, Schutter G.Influence of corrosion inhibitors on concrete transport properties[J].Materials

ISSN 2663-1563 Vol. 6, Issue 1: 74-78, DOI: 10.25236/AJAGE.2024.060111

and structures, 2008, 41(9):1571-1579.
[2] Conciatori D, Grégoire É, Samson É, et al.Statistical analysis of concrete transport properties[J]. Materials and Structures, 2014, 47(1-2):89-103.
[3] Aronowitz D, Steward N, Bradley R.The design of a suspended concrete transport pipeline system[J]. Journal of the South African Institute Of Mining Metallurgy, 2008, 108(11):707-713.
[4] Zeng J W, Yang Q S.Integral Hoisting Technology of Arch Rib of Concrete Filled Steel Tube Arch Bridge [J].Applied Mechanics and Materials, 2013, 2685(405-408):3086-3089.
[5] Zhao L. The Evaluation System on Green Concrete Construction Technology of Post-Disaster Reconstruction of Underground Engineering [J].Applied Mechanics and Materials, 2014, 3309(584-586): 1718-1724.
[6] Huang X S, Sun J C, Tang N, et al.Research on Construction Technology of Self-Monitoring Asphalt Concrete[J].Applied Mechanics and Materials, 2013, 2308(303-306):2485-2489.
[7] Sun Y, Wang M Y, Cheng L, et al.Construction Technology and Benefit Analysis of Fair-Faced Concrete in High-Rise Building[J].Advanced Materials Research, 2012, 1615(446-449):3690-3693.
[8] Yin H S, Dong N Y.Construction Technology of Concrete Filled Steel Tubular in Shenyang Wanxin Building[J].Applied Mechanics and Materials, 2012, 1800(170-173):3266-3269.