Research on Low Carbon Multimodal Transport Network Structure and Rapid Transit Mode

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Abstract. Practice at home and abroad has proved that multimodal transport is a safe, efficient, low-carbon and environmental protection advanced transport organization. In recent years, the Chinese government has introduced a series of policy measures, to encourage broad nationwide transport and multimodal transport. This paper draws on the advanced experience of Europe, America and other developed countries, construction of a network structure model. In this paper, four typical transport modes of container unit cargo by rail are described, and the layout design of each mode loading and unloading operation area is carried out.

1. Introduction
In recent years, the chinese government attaches great importance to multimodal transport and transport work, the implementation plan of the pilot project of dumping and hanging transportation has been issued successively, circular on the Implementation of Model Multimodal Transport Projects, the Thirteen Five-Year Plan for Multimodal Transport of Railway Containers, It is proposed that the requirements to strengthen the research and development of multimodal transport rapid transfer equipment, for seamless docking of loading and transfer equipment and continuous optimization of transportation organization. In this paper, the research object is the intermodal transport of container unit cargo, a low carbon transport network structure and four rapid transit modes of intermodal transport are described. According to relevant standards and specifications, four layout schemes for different transport modes are designed, and the main technical indexes of different transport modes are comprehensively analyzed. This research result has great practical significance for optimizing regional transportation organization structure, improving logistics efficiency, reducing logistics cost and realizing energy conservation and emission reduction[2][4][5].

2. Structure of low-carbon public and rail combined transport network
The structure of the low-carbon multimodal transport operation network is shown in Figure 1, composed of the railway backbone network and the highway transportation and distribution network, both of which are organically integrated through the railway logistics center. The railway backbone network completes the long-distance transportation task, the highway transportation distribution network completes the short-distance transportation and the distribution task. Set up cargo fast transfer operation area in railway logistics center for fast transfer of container cargo. In order to improve the logistics efficiency, trailer ponds or container storage yards are set up along the railway and customers, so as to realize the hanging operation mode[3][6].
3. Operation mode and layout design of low-carbon suspension

In order to improve the logistics efficiency, the loading and unloading area should be set up in the railway logistics center to facilitate the rapid transfer of unit goods. Different transport modes are formed according to the types of loading and handling machinery used, as shown in Figure 2 - 5. Following the basic principles of standardization, applicability and advancement, the overall layout scheme is designed for different transshipment modes[1][7][8].

3.1 Crane Transfer Mode and Layout Design

The crane transfer mode and layout are shown in figure 2. With the rail gantry crane as the handling machinery, Suitable for container transshipment. According to national standards and technical specifications, the total width of loading and unloading operation area is 54.352 m.
3.2 Forklift Transfer Mode and Layout Design

The forklift transport mode and layout are shown in Figure 3. The container forklift as the handling machinery is suitable for container transfer operation. The total width of the handling area is 60.352m.

3.3 Rotation Transfer Mode and Layout Design

The rotary transport mode and layout are shown in figure 4. This mode is mainly used for the whole loading and unloading of semi-trailer, which can easily and quickly realize door-to-door transportation. When the train arrives, the rotatable flat car rotates at a certain angle and stops, the semi-trailer is moved to the flat car by the tractor and locked (loaded), or the tractor is transferred from the railway flat car to the parking area (unloading). Finally, the flat car rotates and reset to wait for transportation. According to the relevant standards, the total width of loading and unloading area should be 67 m.
3.4 Horizontal transport mode and layout design
The translation transfer mode and layout shown in Figure 5, which can meet the transport operation of container and semi-trailer. It requires bearing and translation rails on both sides of the rail tracks, used for carrying containers or semi-trailers, and automatic loading and unloading of containers through translation rails. According to relevant standards, the total width of loading and unloading area should be 40 m.

4. Comparative analysis of main technical parameters of different transport modes
Due to the different performance of loading and unloading machinery, various transfer modes have certain differences in loading and unloading efficiency and land area. When the effective length of railway special line is 1050 m, the effective length for loading and unloading is 980 m, and the train is loaded with 150 standard TEU. If calculated by two-shift system, daily operation time by 16 h, loading and unloading machinery equipped with 6 units. According to the GB 1589-2016, semitrailer length and rated load mass are equivalent to about 2 TEU length and mass. After preliminary calculation, the main technical indicators of the various modes are shown in Table 1.

To sum up, mode 4, as an automatic loading and unloading mode, occupies the smallest area and has the highest efficiency of loading and unloading. It is an ideal mode of intermodal transport, representing the future development trend. However, it is necessary to consider that this has high technical requirements and large initial investment[9].
Figure 5. Translational Transfer Mode and Layout

Table 1. Formatting sections, subsections and subsubsections.

|                        | Crane transfer mode | Forklift Transfer Mode | Rotation Transfer Mode | Translational Transfer Mode |
|------------------------|---------------------|------------------------|------------------------|-----------------------------|
| Required space, m²     | 57070               | 63370                  | 70350                  | 42000                       |
| Single machine handling efficiency, TEU/h | 30                  | 25                     | 38                     | 60                          |
| Annual loading/unloading operations, 10⁴TEU | 86.4                | 72.0                   | 109.44                 | 172.8                       |
| 1 shift handling time, Minute | 50                 | 60                     | 40                     | 15                          |

5. Conclusions

In this paper, we construct a container multimodal transport mode based on trop and pull transport, and Four rapid transport modes are studied. The layout scheme was designed according to the requirements of the relevant national and industry specifications. The results show that the translational rapid transport model is the most economical operation model, which is the future trend. The research results of this paper will provide academic guidance for further multimodal transport and it will be a good practical value.

References

[1] Zhu Wenxiao. Layout Planning of Railway Logistics Center [D]. Beijing Jiao Tong University, 2015[2]
[2] Yin Maiyun, Wang Xi, Quan Qiong. Thoughts on the Development of Public and Railway Combined Transport [J]. Railway Procurement and Logistics, 2016 (11): 50 - 52.
[3] Zhu run. A Study on Mode and Organization of Transport of Container Rail Transport [D].] and Beijing Jiaotong University ,2012.
[4] Gai Yuxian. Railway Freight Forwarding Organization[J]. China Railway Press ,2011.
[5] Wang Xu. Enlightenment and Consideration on the Development of American Container Transport [ J]. Railway Transportation and Economy, 2016, 38 (5): 91 - 94.
[6] Wang Xin. Jinan Railway Bureau Public Railway Combined Transport Model Research [D]. Southwest Jiaotong University, 2011

[7] Ye Uyen. A Study on the Configuration of Container Handling Equipment Based on Intermodal Transport [D], and Linkage Organization Beijing Jiaotong University, 2012.

[8] China Railway Corporation. Code of Railway Logistics Center [Z], 2016

[11] Wang Yongyuan. Discussion on Improving Handling Efficiency of Container Rail Transport in China [J]. Railway freight, 2015(12): 45-49.

[9] Van der Geer, J., Hanraads, J.A.J., Lupton, R.A. (2010) The art of writing a scientific article. J. Sci. Commun., 163: 51–59.