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# PROSPECTS OF CHINA'S HIGH-SPEED RAILROAD CONSIDERING THE DEBATE ON "MAGLEV" AND "ON-THE-TRAIL" CONTRIBUTIONS

## ABSTRACT

*Considering the fierce debate on whether "maglev" or "on-the-trail" system should be applied to China's first high-speed railroad, this paper makes prospects about China's high-speed railroads. As at the initial stage, careful considerations should be given to the framework of China's high-speed railroads. Combining China's specific national conditions, the paper demonstrates that maglev train can be well applied in the east and the regions of the middle and lower reaches of the Yangtze River where there is developed economy, large and dense population, limited land use, concentrated big cities and rail transport shortage. The maglev system is the world's most advanced technology, China should take the best to catch up with the world in this transportation field.*

## KEY WORDS

*prospect, China, maglev, high-speed trains, Transrapid*

## 1. INTRODUCTION

China began to demonstrate the feasibility of Beijing-Shanghai high-speed railroad, the country's first high-speed railroad in 1990. When the demonstration was about to draw to an end in 1998, the debate on two different contributions suddenly broke out. One is the "maglev" railroad contribution, raised by Zuo-xiu Ho, and academician and his other two colleagues, members of the Chinese Academy of Science (CAS), as representatives. The other is the "on-the-trail" contribution, which had long been favoured by the National Ministry of Communications. The "on-the-trail" high-speed railroad is relatively mature both in technology and in commercial use today in the world. As for the "maglev" railroad technology, only Germany and Japan have done research work and the technology is still at its experimental stage. Although in 1991 German government proved the maturity of application of this system technology, there have only been two experiment lines constructed in Germany and Japan with the length of 31.5 km and

18.4 km respectively. To make things worse, the planned world's first Berlin-Hamburg "maglev" line was cancelled this February 5, on various accounts. It seems to provide another reason for criticism by those who oppose it. This paper intends to present China's high-speed railroad development by viewing the debate on "maglev" and "on-the-trail" railroads as well as by combining the analyses of China's current conditions.

## 2. FOCUSES OF DEBATE

The 1998 inaugurated "maglev" or "on-the-trail" technology debate involved many scholars and professionals regarding the adoption to China's first high-speed railroad. The strong momentum of this debate can compete with the one on the "Dam the Three Gorges" project to which Chinese government also paid great attention.

### 2.1. "Economical, easy and excellent" maglev railroad

The development of "maglev" technology, represented by Transrapid system in Germany, is strongly supported by Z. Ho, Lo-guang Yan and Guanhua Xu. The three are academicians of CAS. Their points of view are expounded as following.

#### 2.1.1. Distance and speed

The Beijing-Shanghai railroad is 1300 km long, exceeding the reasonable attraction distance of 800 km for traditional train transportation. As for the "on-the-trail" train whose average speed is 200-300 km/h, it will take the train more than 5 hours to cover the whole distance so that it hardly has any attraction to the passengers who are keen on air transportation. The 500 km/h maglev train shows more advantages than the 300 km/h on-the-trail train. The much higher speed is one of the major merits.

### 2.1.2. Costs and profits

Another key focus is what-on-earth the construction and management cost of the maglev train is. Z. Ho and his followers argue that the construction cost of the maglev train is only 1.3 times as much as that one of the on-the-trail train, the speed being 1.5-1.7 times higher than the latter. In this regard, it is evident that the development of maglev railroad is the more economical way. As for the ticket price, the maglev train has the same passenger capacity as the on-the-trail train and its track and land construction costs account for 60% of the whole investment. Combined with the depreciation charge and the operation maintenance cost, the ratio of the price cost of the maglev and the on-the-trail trains is 1:2.8.

### 2.1.3. Technology feasibility

Z. Ho and his followers consider that of the two technologies, the maglev technology is easier. At present, two technology systems are applied to the maglev railroad, i.e., the superconduct system in Japan and the routine-conduct system in Germany. The latter adopts routine electromagnet and the technology has almost matured, so that there are actually few obstacles regarding utility. Furthermore, as the capable speed is 400-500 km/h, there is hardly any difficulty in construction to reach a speed of 300 km/h. What is lacking in China is merely practical experience.

The maglev train has many other advantages, such as lower energy consumption, less land occupation, little pollution, safety, more comfort, etc.

## 2.2. Disapproval: China's high-speed railroad shouldn't become testing ground

The disapproval concentrates on two points. One is that the maglev is incompatible with the existing railroads, which certainly will bring about higher construction costs. Besides, transferring trains should also affect passengers' time so that the high speed can hardly show its superiority. With the insufficient traffic added, loss may incur in the operation. Another point is the too expensive construction cost that will certainly take great risks in business operation. As a result, higher costs and lower transport quality will inevitably lead to the increase in ticket price. And the actual ticket price will be 1.8-2.4 times of the flight ticket, 3-4 times higher than of the on-the-trail high-speed train. It is the expensive construction cost that forced the cancelling of Berlin-Hamburg maglev railroad. In China, all businesses wait for flourishing. The government wants to carefully make such strategic decisions as how to effectively invest limited money into more practical projects. The matured on-the-trail technol-

ogy should certainly be applied to the budgeted 100 billion yuan project - Beijing-Shanghai high-speed railroad.

## 2.3. Voice of government

As a matter of fact, the debate took its shape from the government sponsored "Two Academy" conference in June, 1998 when Mr. Rong-ji Zhu, the Prime Minister proposed that new technology should be applied to develop the country's high-speed railroads. China Academy of Engineering organised about 30 specialists to undertake demonstration and discussion immediately. The conclusion they submitted to the State Department claimed: "Since no single maglev railroad for business use has been set up in the world, the maglev railroad system should not be applied to the whole line of Beijing-Shanghai Railroad within at least 10 years". In the meantime, they stated: "Universally speaking, the on-the-trail technology is a matured technology and still in its developing stage, so this adoption is feasible to Beijing-Shanghai Railroad." Z. Shen, the Dean of China National Ministry of Communications reckoned the views of the three academicians were of "numerous scientific illusions". And Y. Zhonu, the Vice-dean said, "I personally think it is a great waste." Nevertheless, Premier Zhou showed strong interest in the maglev technology and he specially took a ride in the maglev train during his visit to Germany this early July, 2000. He said, "The maglev technology is matured and can be well applied." Heretofore, China and Germany have signed a research agreement on Putong Airport-Lujiazui maglev train demonstration line, which gained high comments from Premier Zhu.

## 3. NATIONAL CONDITIONS IN CHINA

### 3.1. China is starving for high-speed railroads

When high-speed railroads extended about 4400 km in today's world, China just completed the feasibility demonstration of her first high-speed railroad as one of China's ten "Five-year Projects". In order to develop China's train transportation, in the previous nine "Five-year Projects", China tried to improve the speed on her major passenger railroads. The first attempt was on April 1, 1994 when the highest speed of 140 km was achieved by the passenger trains serving such large cities as Shenyang, Beijing, Shanghai, Wuhan, etc. Then in October 1998, railroads in China sped up for the second time with the highest speed of 160 km in three main stems, namely Beijing-Guangzhou, Beijing-Shanghai and Beijing-Ha'erbin railroads. This October, further acceleration will be given to Longhai, Lanxin, Jingjiu, Zhegan

railroads. However, these efforts would not fulfil the current needs of the national economy and people.

It is estimated that in about 15 years' time, the yearly increase of passenger traffic will exceed 3%-4% of freight traffic in China. At present, there is less than once a year that a person may take a train, which indicates that the domestic passenger traffic market has great potential. According to the economic development, government policies and people's living standard in China, travelling by train is favoured by about 80% of the passengers whose travelling distances exceed 500 km. Therefore, railroad transportation plays a major role in China's middle and long distance passenger traffic. Besides, in the process of China's urbanisation, more importance will be given to the passenger railroads with the expanding scales of city belts and city groups. With the factors of striding of over 5000 km east to west and 4100 km north to south on the main continent and the unbalanced distribution of resources and population in China added, rail transport longs for gigantic development.

The rapidly developed vacation economy in China also requires the construction of high-speed railroads. In addition to the traditional folk festivals, citizens in China enjoy two-day holidays each week. From 1999, holidays during Labour's Day and National Day were prolonged to seven days respectively. Touring on holidays has become the first choice for more and more Chinese. On this May 1-7 holiday, over 46 million person-times travelled. Although 79 special tour trains and 274 temporary passenger trains were added, the supply fell short of demand. Of the expensive but less time-consuming flights and the cheap but low speeded trains and coaches, Chinese tourists have to make difficult choices between the high cost while faster and the less expensive while prolonged journeys. The latter seems to be the way most Chinese may afford. However, it leads to fewer stops in each itinerary so that famous tourist attractions may be overcrowded but newly developed ones cannot attract sufficient visitors. The development of high-speed railroads may help to provide high speed and efficient transportation means, which enables travellers to travel farther during limited holidays at reasonable transportation cost.

### 3.2. Framework of high-speed railroads in China

In the whole transportation system, the high-speed maglev trains can be best applied to passenger traffic with a distance of 200 to 2000 km and to large cities that offer large quantity of passengers. It also helps to maintain the important position of railroad systems in

passenger traffic and can be developed harmoniously with flights. Currently, China's main passenger stems are listed as the following, Beijing-Guangzhou-Hongkong-Macao line 2550 km, Ha'erbin-Dalian line 940 km, Xuzhou-Byoji line 1030 km, Zhegan line 940 km, Beijing-Shenyang line 703 km, Nanjing-Shanghai-Hagzhou line 394 km, most of which are around 1000 km. Except in Taiwan, about 30 of the 36 cities whose population exceeds 1 million are hubs on these main stems. Moreover, most of them are located in the east part of the country where economy is well developed and the population of high density and city groups and city belts are concentrated. Therefore, the east of China may be the first choice of high-speed railroads development. Due to energy shortage and very limited land use in the east, maglev trains bring many good advantages. Especially, the little noise and air pollution of maglev trains can help to improve the city environmental quality.

Another important line for high-speed railroads should be along the so called "golden channel" - the middle and lower reaches of the Yangtze River, China's longest and world's third longest river. Traditionally in China, trains were constructed to communicate where there were no big water channels. As the Yangtze River flows from west to east, railroads were built in the north-south direction to transfer freight and passengers before they would be transported to either east or west by the water channel. Many cities along the Yangtze River have flourished as busy harbours and hubs of railroads extending north and south, but since no railroads were constructed along the giant river, passengers have to make detours to the east or west riverside destinations. Nowadays, areas along the middle and lower reaches of Yangtze River are becoming another important economic developed regions and at least five cities have their population over one million. Besides, people travelling on this line may enjoy great many sightseeing highlights. So high-speed railroads are urgently needed in this east-west direction along the huge river to fulfil the passenger traffic.

Considered from the angles of vast area, well-developed economy and large passenger flows among big cities, maglev trains can be first applied to the east regions and middle and lower reaches of Yangtze River of China. According to the experts in the National Ministry of Communication, population in cities and towns will account for 75% of the whole population. They suggested that special high-speed passenger traffic railroads should amount to 8000 km with 20 metropolises whose population exceeds one million as the hubs to compose the network. Since China has just begun to develop her high-speed railroads, the framework should be carefully planned prior to construction.

## 5. CONCLUSIONS

There is great potential of developing high-speed railroads in China. It is wise to apply advanced technology into China's high-speed railroads at the initial stage. The outstanding features of maglev trains, especially Transrapid developed in Germany, show that this technology would shape the future of China's high-speed railroads.

**4.1.** Large cities are rather concentrated in the east of China, especially in the Yangtze River Delta, Zhujiang River Delta and Beijing-Tienjin-Tangshan Regions. Distances between these cities usually range from 40 to 100 km. With the large passenger flow, the developed economy and the very limited land use, maglev railroads may be properly constructed to connect cities with reasonable distances and the very cities with their airports.

**4.2.** As for the regions along the middle and lower reaches of the Yangtze River, which are busy hubs of communication and economically developed while lacking train transport, maglev system can be applied. The maglev line is best to be constructed on the north bank of the river since lakes and pools widely spread in the south. The suggested line is Chongqing-Yichang-Wuhan-Jiujiang-Nanjing-Nantong-Shanghai high-speed maglev railway.

**4.3.** When certain maglev experimental or business railroads are chosen, careful co-ordination, planning and construction work should be done with the local government. The important thing is to make further technical and economic demonstrations. It is imperative to construct China's high-speed railroads in the new century. As rail communication in China needs critical improvement, even if the "on-the-trail" system is applied, the existing tracks, many of the facilities and technologies have to be changed to fulfil the need of the really high-speed railroads. Therefore, since both require great efforts, why not choose the more advanced and advantageous technology - the maglev technology.

**4.4.** Maglev railroads in China should be developed step by step. To construct maglev railroads by stages

on the basis of sufficient demonstration, it is not only beneficial to achieve the matured technology and operation experience, but also to keep with China's conditions.

**4.5.** To solve the compatible problem of the maglev and the existing trains in a reasonable way and to eliminate the possible waste and inconvenience caused by reconstruction and passenger transference are the critical points that have significant impact on the future prospect of maglev trains in China.

**4.6.** China should raise her own technological research experts while bringing in the critical technology from Germany and other countries. The infrastructure of maglev railroads should be made mainly in China so that further innovations fulfilling the national conditions will be taken to catch up with the world in high-speed railroad construction.

## LITERATURE

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## NOTE

On the background map of China in the article

### Transrapid - New Thought to China's Traffic Confusion

in: *Promet-Traffic-Traffico* Vol. 11, No. 2-3 (1999), p. 136 Taiwan is separated from the national boundary line. To the Chinese, Taiwan is an inseparable part of China's territory. Personally, I have always held this concept seriously. *Shaoying Chu*. - The map was compiled by Wolf Tietze who apologises for this mistake regarding boundary.