# Speed-raising of the Existing Railway and the High-speed Railway in the Future

(Xiang Dingyuan, Deputy Board Chairman,
Shanghai Railway Society; Li Jia, Engineer,
General Office of Shanghai Railway Society)

**Abstracts**: The article expounds that the speed competition is the motive force of each transportation means. It also analyzes the current condition of the speed of Chinese railways .The developing strategy for Chinese railway is to raise the speed of the existing lines as a primary step and to construct the high-speed railway in selected sections concurrently, which proved that constructing high-speed railway in Beijing-Shanghai area is the best choice .
**Keywords**: railway speed-raising high-speed

## 1.Speed-raising is the developing trend for railway in world wide, and it is the developing direction for Chinese railway.

Speed is the goal that each transportation means pursued .The history of world transportation is the history of speed competition. In 1825, since the first train was launched from Stockton. Britain, the train taking advantage of its speed went into a period of full bloom by the beginning of the 20 century . In 60s , Japan, and in 70s ,France and Germany launched the high-speed train with speed of 200 km/h, which contained the development of highway and aviation by taking advantage of rapidity ,safety ,large traffic volume and low contamination . The railway ,which was called "sun-setting industry" shows its vitality again. Up to now, many countries' long term strategy is to develop high-speed railway. Even USA ,the "automobile kingdom", dismantled the railway in 30s and 40s, now reevaluated the railway and planned to develop the high-speed railway. Now more than 20 countries, including Sweden, Spain, Brazil , South Korea and China etc, are constructing or planning to set up high-speed railway. Members of EC made the "plan for European high-speed network in 2010", and the high-speed railway network to all the directions will be set up in European continent. Thus it can be seen , in world wide speed-raising of railway and the utilization of hi-technology are becoming the trends of the development of railway.

China is a developing country . For recent decades, great achievements have been made in railway construction . Compared with those developed countries in the

world , Chinese railway is still backward. Specially, for long time the speed of the train is in low level .The average speed of train was only 48.3km/h , and the freight train is about 27.1km/h. Taking Shanghai Railway Administration for example, for recent 30 years the speed of passenger and freight train only have increased 2.3km/h , which can' t meet the needs of the nation' s development. With the increased economy and the improvement of people' s living standard , people have the urgent need to raise the speed . With setting up the socialist market economy and being perfected, the rapid development of aviation and the highway ,the competition in transportation market is violent . While the backwardness of current Chinese railway have effected seriously railway' s market share, which is vital importance to the railway' s existence and development. From 1995, passenger and freight traffic volume have a minus increase. Chinese railway , which once was called "daughter of emperor never worries about marriage", now emerges the phenomenon that there are vacant seats in the train, while people have difficulty in buying tickets.

By analyzing the reason why the passenger and traffic volume decreased ,we found that low speed is the main factor. Therefore, speed-raising and developing Chinese high-speed railway conform to new trends of railway development, and at the same time it' s the only way for railway to survive in the fierce competition of transportation market.

## 2.The developing way for Chinese railway is to raise speed of the existing lines and to construct new high-speed railway lines concurrently.

In worldwide , there are two ways to develop high-speed railway. one is to construct n special new passenger railway line( such as Japan ,France, etc) or on the same line for the mixed operation of passengers and freight. The other is to reconstruct the existing lines and to transform the transport facility to meet the needs of operating train on high-speed or quasi-high speed railway line(such as Britain, some countries in North Europe, etc.)Since there are so much experience in developing high-speed railway, then what way should Chinese railway adopt? Developing high-speed railway is an important symbol to evaluate the science and technology level of a country' s railway .The advanced technology includes tract way of new type train , light high-speed vehicle, high-quality and stable structure of line, automatic system for controlling operation. Technology of speed-raising can push the science and technology of whole railway forward. It no doubt is way that Chinese railway should go. So the construction of high-speed railway is in the country' s overall plan of speeding up the construction of the fundamental facilities of railway in the coming five years. Now the preliminary work is being prepared , and we are trying hard to accelerate the step to build the high-speed railway line from Beijing to Shanghai before the coming of the new century .The high-speed railway has a very bright future , but its investment is huge and construction period is long . The construction

of the high-speed railway in the developed countries are all highly invested. For example in 1964, Japan set up the first high-speed railway in the world (515.4 Km), Which cost as much as 380 billion Yen, converting to US $ 1 billion at that time. Nowadays the newly-built high-speed railways in many developed counties and regions also cost as much as US $50 million per Km. The estimated investment of the planned Beijing-Shanghai high-speed railway is more than hundreds billion RMB. Apparently, it is unbearable for China to raise huge amount of money to construct several railway lines concurrently. Reconstructing the existing lines to raise the speed of the train to high-speed or quasi-high speed is a low investment ,efficient and feasible way. In the light of the actual conditions of our country , the strategy for Chinese railway' s speed-raising should take reconstructing the existing lines as the primary way, and constructing the high-speed railway as the auxiliary way. That is to accumulate most amount of funds to reconstruct the existing lines. The main trunks as Beijing-Shanghai , Beijing-Guangzhou , Lanzhou-lianyungang, Beijing-Kowlow will be reconstructed into quasi-high speed lines with speed of 160km/h by adopting new technology . The speed of other trunk lines also will be improved highly. So the general speed of Chinese railway lines will get into a higher step. At the same , high-speed railway will be built in the selected most valuable sections. And we try to set up the first high-speed railway at the beginning of the 21 century.

### 3. It' s a feasible way to raise the speed of the train in a large scale by adopting new technology

In line with the international railway developing trends and to meet the needs of development of railway . In 1995, we succeeded in testing speed-raising of passenger and freight train. After 7 months of preparation and facility reconstruction, on April 1, 1996, the "advanced train" with speed of 140km/h was firstly launched on Shanghai-Nanjing line. The experience of the success test on Shanghai-Nanjing line and the launching high-speed train becomes the policy decision for Chinese railway to improve the speed in overall. Shanghai-Nanjing line is a busy line in east coastal area of China. The profile of railway line is in well condition , and the structure of the track is heavy duty. The line is built by continues welded track with the length of 60kg/m and the pre-stressed concrete sleeper. The whole line adopted elastic rail fastener and hard crashed stone roadbed. Signal facility adopted section triple signal indication for double tracks with audio frequency shift automatic block system. All the stations have electrified.

Before the speed raising , the highest speed of the passenger train had reached 115km/h. As long as we reinforce the tracks and bridges, and change all the switches into 60kg/m and 1/12 speed-raising switches , the technology condition of the track will close to that of quasi-high speed railway. After many years maintenance and reconstruction on the main trunk lines in the nation wide , the technology level of those lines are similar to the Shanghai-Nanjing line. That is ,the speed of those lines

can be improved to 140-160km/h without reconstructing it for long time and large amount of money. Now China has ability to produce tract locomotives and vehicles for the quasi-high speed train with speed of 140-160km/h, so it is a feasible way to raise the speed in a large scale. In 60s , after reconstructing the existing railway lines , Britain and Germany improved the speed of the train to 160km/h, which gave us full illustration. After the success launching of the "advanced train" on Shanghai-Nanjing line, MOR put forward the strategy for raising the speed of the train in overall and made out the standard for reconstructing the facility of the existing lines. On April 1.1997, on main trunk lines 15 pairs of trains with speed of 140km/h and 60 pairs of speed-raising train have been launched, and also the speed of passenger and freight trains on other trunk lines were readjusted appropriately. The average speed of the passenger trains have improved 53% , which strengthened railway' s mainstay of all the means of transportation. On October .1 , we will enlarge the scale of the speed-raising of trains while readjust the operating chart of trains. Practice for three years illustrates that reconstructing the existing lines to improve the speed of the train is a feasible way to develop Chinese railway.

## 4. To choose the suitable sections to start high-speed railway construction is the key point for the development of modernization of Chinese railway in the future

While devoting major efforts to raising train speed of the existing railway lines ,we must acknowledge that , from the long-term strategies of railway , the utilization of the existing railway upgrading is limited .Compared with the high-speed railway, the scientific and technical content in the reconstruction is less, which can not represent the main trend of the development of the railway in the future. On consideration of the high-speed railway opened to traffic in Japan and European countries , it has the great advantages during the competition of various means of transportation. Moreover, high technology involved in the high-speed railway, representing the technology level of various fields of the country, highlights the comprehensive technology and comprehensive national power of the country. Therefore, it is necessary and urgent to seize the opportunity to start the national high-speed railway construction .

The construction of high-speed railway is a very complicated systems engineering due to its great investment, high scientific and technical contents and long-term construction period. Although we can use a lot of successful experience of other countries for reference, we can not swallow and copy it by whole. While China starts to construct high-speed railway, we must combine with the facts and take a full consideration of choosing an area with well-developed technology, superior geographic environment and good economic benefit for construction. According to it,

it is the best choice to construct Jinghu (Beijing ---Shanghai) high-speed railway line.

### 1) It is the area with most flourishing economy in China

Jinghu railway line connects our capital Beijing and biggest industrial city Shanghai at both ends. It transverses three municipalities and four provinces, including Beijing, Tianjin, Shanghai, Hebei, Shandong, Anhui, Jiangsu, etc. This area is densely populated and has well-developed industrial and agricultural production. Along the railway line, the three municipalities, Beijing, Tianjin and Shanghai, have a population of about 10,000,000 respectively, and 7 cities have a population of more than 1,000,000 respectively. These years, GDP in these three municipalities and four provinces has risen more than 10% every year. With the scenic spots and historic sites and tourism resources renowned at home and abroad, it is the area with well-developed economy and one of the areas firstly opening to the outside. With further deepening and widening of the reform and opening to outside world, establishment and perfecting of socialism market economy mechanism, development of Shanghai Pudong new economic zone, development of export-oriented economy and fast development of our China economy, this area comes to be not only the dragon head of the economy development in eastern area giving an impetus to the development middle and western area but also the forward position of our China meeting with the world market economy system. It will play a decisive role in the fast development of China economy.

### 2) There is a big demand of passenger and freight transportation in this area

The traffic and transportation network in this area is well-developed. However, with regard to the demand of transportation, it is the area with tightest pressure of traffic and transportation, where its volume of passenger and freight transportation and circulating volume of passenger and freight transportation amounts to 20% of national traffic departments and also has a trend of rising. In China, natural resources are distributed mainly over northwest, but industrial production, especially the processing and manufacturing industry, mainly concentrates in eastern coastal area, bringing the pattern that a large quantity of material flows in a long distance both from west to east and from north to south. Densely populated cities and tourism resources in this area are mostly dispersed from south to north like a belt, bringing a great number of passengers of middle and long distance from south to north. Thanks to the rapid increase of the volume

of passengers and freight from south to north both in this area and in transit, it becomes the focus of traffic and transportation of China. Due to the restrict of the pattern of industry and cities, the great flow of passengers and freight will remain no change. Meanwhile most of the increase of the volume of middle-and-long-distance

transportation will still concentrate on the existing Beijing-Shanghai railway line, especially the volume of passenger transportation of which can hardly distribute or transverse to other north-south railway lines. On the basis of the analysis of various major traffic and transportation methods, it is believed that railway transportation, with its characteristics of large transportation capacity, fast speed, safety and economy, is still in a key position.

### 3) The transportation capacity of existing railway lines in this area has reached saturation point

The full length of existing Jinghu railway line totals 1463 km. It has achieved automatic block, and the passenger and freight trains have almost realized diesel traction. The classification of most passenger trains have reached 18 to 20 cars. The traction weight of down freight trains ( in direction of heavy-loaded train) amounts to 3,500t to 4,000t, up freight train 3,200t to 4,000t, and the number of trains of arriving and dispatching reach 1,050. Since 1993, the freight trains of 5000t have run in part of the south area of Jinan city. Jinghu railway line is the busiest major line for passenger and freight transportation. In 1995, the average two-way conversion density of transportation reached 125,898,000 conversion ton km/km, of which the density of passenger and freight transportation between Xuzhou and Nanjing has reached 35,558,000 person km/km and 105,211,000t km/km respectively and density of passenger and freight transportation between Nanjing and Shanghai of which reached 4,429 person km/km and 72,660,000t km/km respectively. The utilization of transportation capacity of Jinghu railway, based on the available technical equipment and management standard, is saturated. However, according to the prediction of Jinghu railway transportation in the coming several years, the volume of passenger and freight transportation, especially the volume of passenger transportation, will continue to have a great increase.

| | | Beijing—Tianjin | Tianjin—Jinan | Jinan—Xuzhou | Xuzhou—Nanjing | Nanjing—Shanghai |
|---|---|---|---|---|---|---|
| Volume of Passenger Transportation | 1995 | 1503 | 1500 | 1454 | 1880 | 2290 |
| | 2000 | 2150 | 2200 | 2050 | 2500 | 3000 |
| | 2010 | 3300 | 3400 | 3500 | 3800 | 4400 |
| Volume of Freight Transportation | 1995 | 6788 | 6549 | 6686 | 8855 | 6870 |
| | 2000 | 5950 | 6030 | 6290 | 7840 | 6880 |
| | 2010 | 7600 | 7400 | 7500 | 9000 | 7600 |

(Unit: Passenger Transportation, one-way, ten thousand person km/km; Freight Transportation, direction of heavy-loaded train, ten thousand ton km/km)

As predicted above, the existing Jinghu railway can not solve the following problem between the volume of transportation and capacity of transportation so that the capacity extension of the existing railway must be enforced. The construction of high-speed railway in this area, supported by the volume of transportation, will play a great role of distribution and have an obvious economic profit superior to other areas.

**4) It has best condition of technology and environment in China**

The maximum operating speed of the Jinghu high-speed railway under designing will reach 300 km/hour and the medium operating speed will reach 160 to 200 km/hour. The railway infrastructure will be designed to meet the demand of 350 km/hour, employing new-type railway structure and trans-section continuous welded railway (CWR). The whole railway line is all-closed and adopts advanced dispatching management and natural disaster forecast system. To construct such high standard high-speed railway needs a certain foundation of science and technology. The Jinghu area, with the most developed science and technology level, is concentrated of high schools, science research institutes, large-scale enterprises for manufacturing and processing so that it has the ability of undertaking the research, development and application of the demanding technical equipment. Concerning the technical exchange with foreign countries and attraction of foreign investment, it also has the unique advanced. The Jinghu high-speed railway under designing almost parallels to the existing Jinghu railway and lies in the coastal plain area. Most topography is plain except that some parts of the railway must go through the low mountainous and hilly areas. The condition of graphical environment and railway line can almost meet the demand of large radius and low slope for the high-speed railway. The length of tunnels needed to excavate totals to 10 km. However, the railway line must go through many rivers including Haihe River, Huanghe River, Huaihe River and Yangze River so that the proportion of bridging is high. It is estimated that the whole length of the railway totals to 432 km and amounts to 33% of the total length. On consideration of big rivers which should be opened to navigation, such as Yangze River, the program of crossing the rivers is very complicated and further research should be taken into consideration.

The following methods of constructing Jinghu high-speed railway should be used: unified planning, constructing in different sections and opening to traffic step by step. Firstly, experimental section between Shanghai and Nanjing can be constructed, or Shanghai-Nanjing railway section and Beijing-Tianjin railway section at both ends can be constructed. So it can concentrate the capital and avoid to construct on too large a scale, but also can gain the profit as soon as possible through constructing the railway while opening it to traffic. The technology of constructing Jinghu high-speed railway mainly depends on our China, but we should also import advanced technology from other countries. We should strive to enable the high-speed railway to

reach international advanced standard and form the technical system of high-speed with Chinese characteristics step by step, providing the model for further development of high-speed railway. Regarding raising capital, the multi-way investment should be adopted while fully attracting the foreign investment so as to change the pattern that the construction of railway is invested by the country over a long period of time and explore a new way of multi-way investment.

Summarized as above, Chinese railway should take a road of concurrent development of raising speed of the existing railway lines in an all-round way and constructing high-speed railway between Beijing and Shanghai so as to gear to the demand of increasing development of traffic and transportation in China and to conform to the trend of international railway development.