

# Taiwan High Speed Rail & Its Impact to Regional Development

T. C. Kao<sup>1</sup>, C. K. Lin<sup>2</sup>

<sup>1</sup>Taiwan High Speed Rail Vice President Ph.D., P.E.

<sup>2</sup>Taiwan High Speed Rail Project Engineer

**Abstract:** Taiwan High Speed Rail is located in the west corridor of Taiwan runs approximately 345km from Taipei to Kaohsiung (Zuoying), passing 14 major cities and counties, and 77 townships and regions, the travel time is approximately 90 minutes. Since the high-speed characteristic of the line (300 km/h) will dramatically reduce the time required for intercity travel, it can effectively resolve traffic in west corridor to promote balanced development of western region of Taiwan. In line with the operation of this rail, Taiwan's traffic development will formally enter so called "the third space revolution", following the precedents set by the conventional railway and the freeway. The formation of one-day trip between any two cities in the west corridor will vanish the demarcation line of three metropolitan zones – north, central and south.

## 1. THE HSR PROJECT

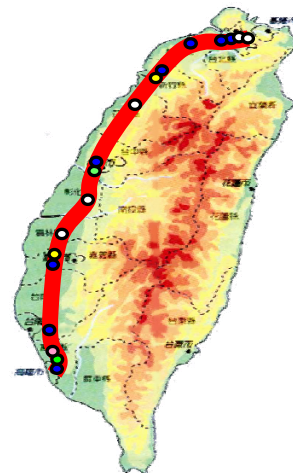
### 1.1 Project outline

The Taiwan High Speed Rail Project was constructed and is now being operated by Taiwan High Speed Rail Corporation (THSRC). As a Build-Operate-Transfer project, it will be transferred to the Government upon the expiry of the concession period. The BOT model was chosen particularly to allow private sector to participate in public work with its efficiency and entrepreneurship. The construction of the Taiwan High Speed Rail was one of the most challenging infrastructure projects in the world and also was the largest private sector invested public construction project during its construction. The total construction investment is of approximately US\$15 billion. The key elements of the project consist of the following :

- The high speed line runs approximately 345km from Taipei to Kaohsiung (Tsoying), passing 14 major cities and counties, and 77 townships and regions, supporting civil structures including tunnels, viaducts and earth works;
- 12 stations are planned in western corridor. In current phase, 8 stations are located in Taipei, Banciao, Taoyuan, Hsinchu, Taichung, Chiayi, Tainan and Zuoying. Four stations (Nangang, Miaoli, Changhua, and Yunlin Stations) will be built in later phase.
- Electric Multiple Unit ("EMU") with maximum design and operating speed of 315 and 300 kilometers per hour ("kph") respectively; and
- a system of local roads, which is constructed by the Government, to provide planned access to the HSR stations.

the Western Corridor of Taiwan and provide services to almost 92% population of Taiwan who live along the corridor.

The HSR service will be capable of journey times of less than 90 minutes between Taipei and Kaohsiung compared with travel time of some 4 to 5 hours by road or by conventional rail.



### 1.2 Why HSR

The HSR will provide a high capacity and quality railway system. This HSR project is the back bone of the Government's plans to provide a "public transport system" in the western corridor of Taiwan.

The HSR system will relieve the growing demand for inter-city travel where road traffic congestion is now widespread leading to a serious fall in the level of service.

A planned network built on Taiwan High Speed Rail as the backbone will connect all the major cities and township in



between 36 to 42 months. Trackwork commenced within 30-36 months of commencement of the civil works contracts.

Viaduct design and construction generally incorporates deck erection techniques such as Full Span Pre-cast Launching Method (FSPLM), Balanced or Fixed Cantilever Methods (BCM/FCM), Movable Scaffolding System or Advance Shoring Methods (MSS/ASM), or the more traditional Full Support Method (FSM). In addition, there are a number of steel and composite long span bridges.



## 2. THE CONSTRUCTION PLAN

### 2.1 Civil Work

To avoid complicating interfaces between the design and construction, THSR adopts the contract form of design-build at a fixed lump sum price by which contractors are allowed to exercise its design compatibility to facilitate the total construction period to select its own work methods.

The civil works infrastructure of the high speed rail includes :

- 39km Mined Tunnels of 90 m<sup>2</sup> finished cross sectional area.
- 8km of Cut and Cover Tunnels (including 2.8 km approach sections to Taoyuan Station)
- 251km of Viaducts and Bridges (plus 21km station and passing bays)
- 31km Cut and Fill Embankments.

The civil works have been constructed by 12 international Joint Ventures comprised of both national and international designers and contractors. The civil works contracts were generally awarded in March and April 2000, as Design-Build Contracts. Typically, contract periods range



The tunnels are typically constructed using the Sequential Excavate and Support (SES) method. In addition to the mined sections, a further 8 km of tunnels will be constructed using the cut and cover technique.



The earthworks consist of large-scale excavations together with the construction of substantial embankments.

## 2.2 Stations

The HSR stations are where passengers witness THSR services. Therefore, the architectural design of stations will not only contribute to the entire landscaping of the HSR system, but also serve as the showcases of the system's services. Highlighting the high-tech and safety features of the system, each passenger station will fully incorporate the characteristics of the natural environment, cultural heritage, and the industrial development of the local community in its exterior design. As a way to ensure the best service, HSR stations also feature direct and separate passenger movement design, comfortable and spacious concourse within the station, and easy transfers to local transportation systems.

After a rigorous competitive tendering process, 6 station construction contracts were awarded to international contractors or joint venture partnerships made up of Taiwanese and Japanese companies.



## 2.3 Core System

The core system procured includes rolling stock & its supporting power, control and communication systems.

Considering the fact that the HSR trains are highly integrated sophisticated vehicles, THSRC has decided to procure all E&M services including design, manufacturing, construction, and installation in a package.

In December 2000 the Taiwan Shinkansen Consortium (TSC) of Japan was awarded the Core System Contracts. TSC is a consortium comprising Kawasaki Heavy Industries Ltd., Toshiba Corporation, Mitsubishi Heavy Industries Ltd., Mitsubishi Corporation, Sumitomo Corporation, Mitsui Company Ltd., and Marubeni Corporation. All operations of the new Taiwan High Speed Rail (HSR) are controlled by TSC's Core System technology.



## 2.4 Trackwork

The engineering technologies of High Speed Rail differ from those for the conventional railroad. In general, high-speed rail demands even lower tolerance for construction deviations, stringent standards for track installation regarding safety and comfort, while endeavoring to cut down on maintenance costs and to reduce noise and vibration, on the other hand.

The majority of the Main Line trackwork comprises slab tracks (TK1+000 to TK343+103), with the final 3km ballasted track (TK343+103 to TK346+374).

The double track main line is standard gauge at 4.5m centers with the normal direction of operation using the left-hand track. At intermediate stations, crossover tracks will be provided in the vicinity of the stations.

## 2.5 Maintenance Facilities

The Maintenance bases carry four major functions: rail car overhaul at the Main workshop, coach yards, maintenance for wayside facilities at bases along the line, and rail car maintenance served by depots. Maintenance facilities were planned to accommodate the overall concerns of the project, and the sites of maintenance bases were selected along the railroad line with reference to their respective service capacities.

A main workshop and five depots were therefore planned. At the start of Revenue Service the Yencho Main Workshop, Tsoying Depot, Wujih Depot and the Liuchia Depot were operational. Hsichih Depot and Taipao Depot will be commissioned at a later date.



## 3. IMPACT OF THSR ON REGIONAL DEVELOPMENT OF TAIWAN

Taiwan High Speed Rail commenced its revenue service at the beginning of 2007.

During this period of time, passengers are becoming accustomed to this new mode of transport. Business travelers, as well as leisure travelers, are utilizing the system frequently. Rapid build up of passengers provides evidence

of the success of the High Speed Rail System. It is envisioned that the THSR system will bring in the “one day living circle” to western Taiwan and will positively impact Taiwan’s regional development. Population and job opportunities are expected to increase and be concentrated in the cities served by THSR. A number of transportation modes are now re-adjusting their roles to match the overall public transportation system, with the new THSR acting as the backbone.

Commercial activities such as chain stores, tourism and island-wide business will benefit highly, now that this system has commenced.4. CONCLUSION

The construction of the Taiwan High Speed Rail commenced in March 2000 and the system was approved for operation in December 2007. In the 82 months of construction and testing & commissioning period, the Taiwan High Speed Rail Corporation has successfully delivered the THSR project as a BOT model. The impact of the system is evident and is gradually beginning to show its full influence. It is anticipated that the THSR will play an important role in the future transportation system of western Taiwan.

