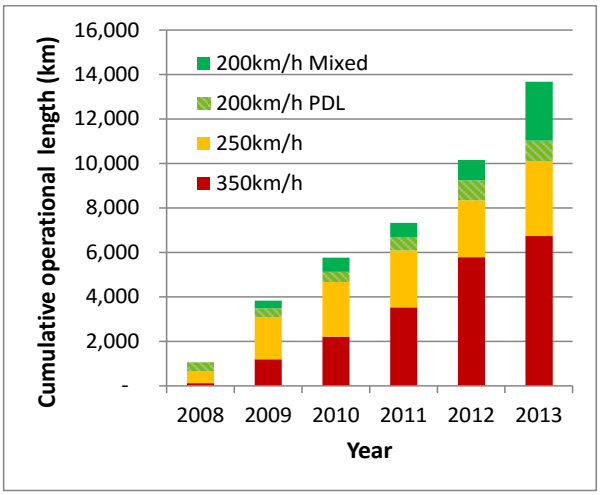
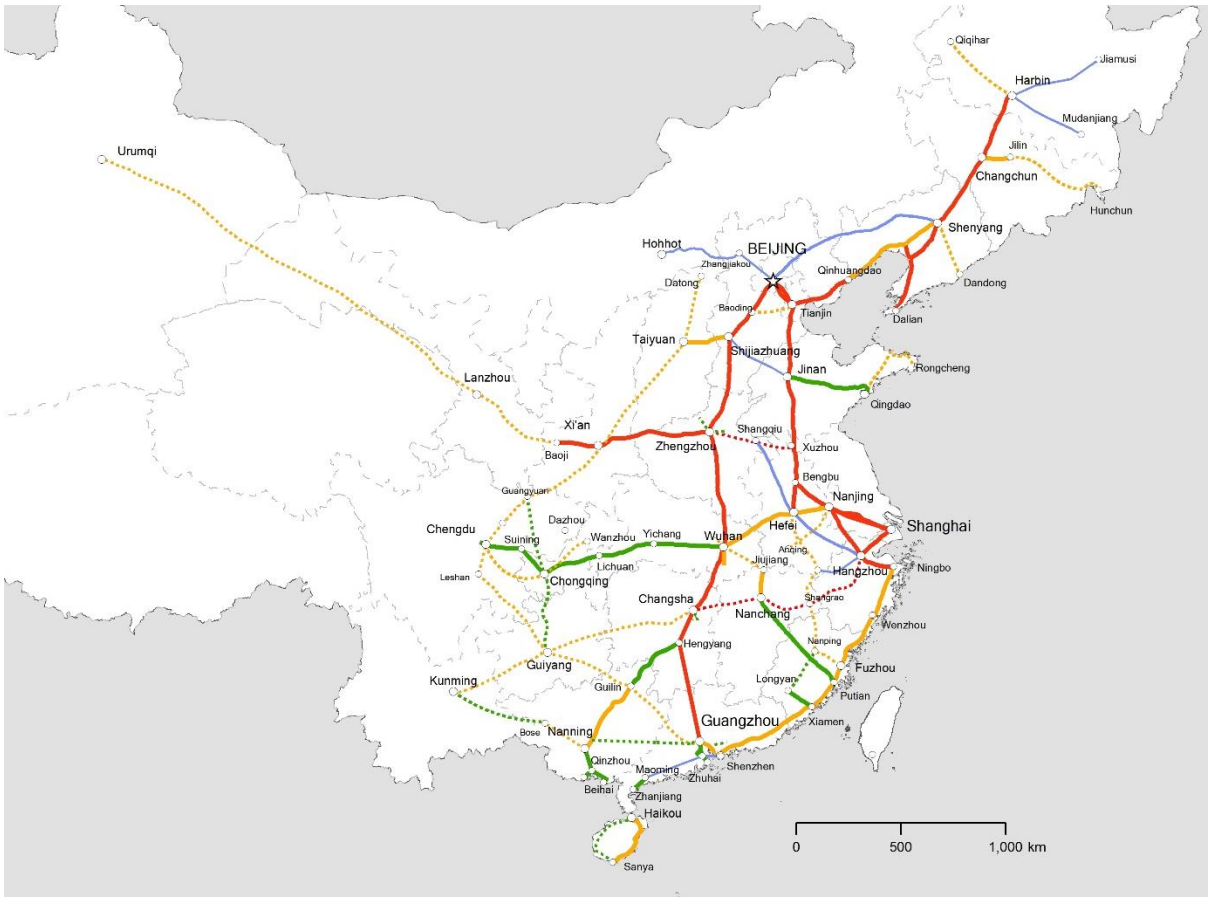
Highspeed train by Thomas (Xiaochu) Meng

China may not always be known being at the forefront of development but when it comes to the construction High Speed Rail (HSR), it has everyone beat. Now China is the world leader in HSR construction with tracks extending to 30 of its 33 provinces and spans a total of 29,000km which accounts for about two thirds of the total HRS tracks. They plan to further increase their reach by installing more rails and reaching 38,000km in 2025.





Figures from report: “High-Speed Railways in China: A Look at Construction Costs”.

What is HSR?

Though it differs, a typical definition of HSR would be a train that can travel more than 250 km/h. China has two main types of HSR trains, 250km/h and 350 km/h, with the main difference being the increase in cost of the railways. The trains can typically carry about 550 passengers with some of the larger trains being able to carry up to 1300 passengers. For reference, a Boeing 747 can carry 467 passengers on its largest model.

What is our experience with HSR?

When we were in China, we took the high-speed rail every time we had to go to another city. That includes Nanjing-Yichang, Yichang-Nanjing, and Nanjing-Shanghai. While we were on board, I think the top speed was about 300 km/h so we must have been on one of the slower high speed trains. In total, we spent about 12 hours on the high-speed rail, so we can say for certain that it was probably one of the most comfortable long-distance trips except for one crying baby.

The seating rows could turn around, so we arranged a 6-player game of cards using the deck of cards someone brought along. There was also a café with inside the train where you can go and sit when you wanted to stretch your legs. The carriages also featured hot water dispensers which is a standard in mainland China due to their culture of drinking hot water though I just used it to make instant noodles.

We were also amazed by the vastness of rail system itself. Back at home, it took 15 students an entire afternoon just to make a tiny 1m long concrete column whereas it only took the Chinese a bit over a decade to build 29,000km of rail. Another thing that caught us off guard was how the train would pass right through hill and mountains rather than going around them. The train would be going so fast that the air pressure would change when we went through a tunnel and we could feel it in our ears.

Constructability of the HSR

Nowadays China leads the world in affordable HSR construction. A typical track for a 350 km/h train would cost 94-183 million RMB per km and a 250 km/h track would cost 70-169 million RMB per km. These two figures convert to about 20-38million AUD per km and 14-35 million AUD per km. Here is a rough breakdown of the aspects of construction and their costs in millions of RMB per km:

Element	350 km/h	250 km/h	200 km/h
Land acquisition and resettlement	4	5-9	5-8
Civil Works	57	56-62	42-43
Embankment	*24*	*31-42*	*23-28*
Bridges/viaducts	*71*	*57-73*	*59-62*
Tunnels	--	*60-95*	*51-68*
Track			
Track (ballast-less)*	10	10-13	
Track (ballasted)*			5-7
Signaling and Communications	5	3	3-4
Electrification	6	4-5	4

This price is low compared to HSR networks in other regions such as Europe where it costs about 120-186 million RMB per km or in the US where it costs about 267 million RMB per km.

There are many aspects to why this cost can be kept so low:

1. Standardisation of designs/bulk construction;
2. Low cost of labor and land acquisition;
3. Localisation of the construction.

The standardisation of the designs meant that time can be taken away from the planning and design stage and moved into the construction stage as well as simplify construction and manufacturing. Since the length of railway is so large, it is better just to overdesign slightly to standardise the construction method and thus decrease mobilisation and design costs. The downside to this method is an increase in the amount of material used but the time savings easily offsets that. Another factor that decreases the cost is the large scale of the constructions. If other countries where HSR development isn't as quick, companies may have to do additional planning for each project/line whereas in China, standard designs and techniques can be reapplied to multiple lines/projects.

The low cost of viaduct construction has been a topic of interest when discussing the construction methods. The viaduct spans have been standardised as 24m and 32m with a mass of 750-800t. They along with the slabs are constructed at temporary facilities set up along the railway and are transported up to 8km by a specialised beam carrier vehicle. After completion, the slab and beam construction facilities are dismantled to be reinstalled at another site.

It is well known that things can be done cheaply in China, with labour and land acquisition. Land acquisition in California in the US is predicted to use 17% of the total budget whereas it is only 8% in China. Also, due to the massive population, there are many large construction and engineering firms located closed to the site, the project planners can feasibly hire locally and thus boost rural economies while also keeping mobilisation costs low.

Social Impacts

While the railway is designed to generate revenue, it also has a secondary benefit of boosting national cohesion. There is a large economical discrepancy between the first, second and third tier cities in China and the government wants to close the gap and promote their lower tier cities. The increase in transport speed is expected to increase the movement of people between cities and effectively distribute the wealth of the first-tier cities while benefiting all cities involved. For example, a HSR was made to directly connect Beijing with Hong Kong in order to connect the SAR with the rest administrative capital of the country.

The railway is also a source of national pride for the Chinese people, due to its extensive length and record-breaking construction speeds.

Finishing remarks

Getting the chance to use the High-Speed Rail while not super exciting has been a great opportunity for us Civil engineering students. Maybe one day in the future, Australia can have their own HSR to connect all the big cities.