

In January 2017, Craig Moore reports from Beijing:

*As for Line 16* - The stations are very impressive. High ceilings with traditional Chinese decorative styles and colours, interesting lighting (chandeliers/wall lights etc) and all lovely and clean as you would expect from a 48 hour old line. All have island platforms and full screens and the usual platform trimmings. There is lots of staff around to guide people down the long wide connector corridor between L4/16 and to help on platforms and ticket halls, moreover, across the entire network, all station maps, ticket machines, and hand out maps are up to date with the new line, although there is no specific information on the line itself. There must have been an army of people working on this leading to the opening.

But it is also disappointing in some regards. The headhouses are pretty bland, and the new stock is quite plain (as one of the four HK MTR managed lines this basic-ness seems to be a trend!). The 8 car stock is branded with the new CRRC logo (CNR and CSR merged in 2015 but this is the first CRRC labelling I've seen) but there really is nothing stylish or different about it, unlike some of the new stock on other lines in China – that is the 'uniformity policy' of the Beijing strategy influencing things. There is side seating with some banks of seats missing to allow more standing space for the planned heavy crush loads once the southern extension is completed. The interior is bright and shiny but oh so very cold – in fact there were teams of staff checking for draughts around the doors – I suppose one can expect teething problems. The journey is slow and the dwell times are ridiculously long.

So good and bad in equal measure.

### **Beijing Subway**

The Beijing Subway has 19 lines stretching 569.8km, with 409.6km (72%) of the system underground. In global ranking it is exceeded in length only by the Shanghai Metro, which is a mere 15km longer, yet it is the busiest in terms of passengers carried (9.7mil passengers per day (2015) and one of the best organised and effective Metros in the world.

## Line Summary

Line	Km	Km-UG	Stations (UG)	Transfer Stations	Avg. St spacing (km)	Base Headway	Journey time (mins)	Power supply	Rolling stock
1	30.3	28.9	23 (21)	10	1.3	4	56	Third Rail	CSR
2	23.1	23.1	18 (18)	10	1.3	4	43	Third Rail	CNR
4	28.2	28.0	24 (23)	9	1.2	4	48	Third Rail	CSR
5	27.6	16.9	23 (16)	10	1.2	6	49	Third Rail	CNR
6	42.8	42.8	27 (27)	9	1.6	6	1.08	Overhead	CNR
7	23.7	23.7	19 (19)	4	1.2	6	43	Third Rail	CNR
8	26.6	25.5	18 (17)	6	1.5	6	44	Third Rail	CSR
9	16.5	16.5	13 (13)	7	1.3	6	30	Third Rail	CNR
10	57.1	57.1	45 (45)	15	1.3	4	1.24	Third Rail	CNR
13	40.5	2.5	16 (15)	8	2.5	6	52	Third Rail	CNR
14	43.8	43.8	26 (26)	9	1.7	6	1.13	Overhead	CNR
15	41.4	27.9	19 (15)	4	2.2	8	59	Third Rail	CNR
16	19.6	19.6	9 (9)	1	2.2	10	32	Overhead	CRRC*
AE	28.1	8.5	4 (4)	2	7.0	10	30	Third Rail	Bomb.
BT	18.9	1.4	13 (0)	2	1.5	8	32	Third Rail	CSR
CP	31.9	14.0	12 (6)	2	2.7	10	39	Third Rail	CSR
DX	21.7	17.8	12 (11)	1	1.8	8	31	Third Rail	CSR
FS	24.8	2.7	11 (2)	1	2.3	8	31	Third Rail	CNR
YZ	23.2	8.9	13 (5)	1	1.8	10	32	Third Rail	CNR
<b>19</b>	<b>569.8</b>	<b>409.6</b>							

The statistics for the Beijing Subway are evidence enough to acknowledge that this is one of the world's great Metro systems. Carrying 9.5mil passengers per day over 570km of route from 0500-2300, the system is highly organised and well run. The Subway system follows the grid structure of Beijing's road network with its rigid north-south and east-west trajectories, together with 'ring roads'. This structure creates many perpendicular interchange possibilities between lines, with over 30% of stations providing transfer to other lines. Operated in the main by BMTRO, 4 lines (4/10/16/DX) are controlled by a consortium led by Hong Kong MTR with separate management structures, unique design features and distinct regulations and service standards. However both operators defer to the Beijing Municipal Government, which sets policies and procedures to ensure that uniformity is deployed in much infrastructure development and operations. As such, most of the lines follow quite similar station and operational formats. However, the scale of the system, and the speed of expansion means there are plentiful variances to create a real appeal.

Most of this stems from the original two lines. Lines 1 and 2 run through the main commercial areas of the city and are quite utilitarian in appearance and seem to flaunt their differences with the rest of the system, despite attempts to make them conform. Quite aged and unkempt with mainly island platforms, lower standards of navigational signage, some characterful older stock and few platform barriers (and many of these are inoperable), the lines ooze character and team with activity from high frequencies and high passenger numbers. Line 13 likewise has a different style to other suburban lines, with large, side platformed station structures, and long station distances. These three lines, by their nature, have much longer transfer requirements at interchange stations, often involving lengthy walkways and high levels of passenger flow management. The nature of the environment changes as you move from one of these 'heritage' lines to the newer Beijing Subway offer.

Although more standardised, the newer lines have a mix of side and island platforms and also display distinct characteristics, whether it be in terms of ownership, design, alignment, and rolling stock. The MRT lines have a different feel, as do the suburban lines with long station distances and elevated running. But the overriding feature is of order, uniformity and capacity - this 'control' ethos is very much infused throughout the entire system.

Despite its scale and passenger volume, the Beijing Subway is one of the cleanest, safest and straightforward systems to use. Station plans are sensible, security screening, ticket purchase and platform access is simple to follow and passenger flow management\* is impressive, if sometimes overbearing. Stations are well lit, clean and plentifully staffed with helpful individuals. The trains are likewise immaculately clean, punctual, headways are impressive (halved at peak periods) and interchange is well signed and effortless to follow. Indeed, the system has one of the most impressive approaches to wayfinding I have witnessed. Signs are in appropriate places, ticket machines are straightforward, directional guides are easy to understand and there is plentiful route and network information in station foyers, platforms and on trains, all of which is in Mandarin and English – electronic and audio. Electronic information on trains is located by the sides of doors and shows news, entertainment, and metro information/usage information. On the newer lines advertising is also screened on the walls of tunnels, although not to the same degree as in Seoul.

This simplicity of use is no doubt made easier by the politeness, calmness and tolerance of passengers. If the escalator doesn't work then climb the stairs; if the walk between platforms is long and crowded this is expected; if queues are long for information or tickets, so be it; queue at appropriate places on the platform and if the train is crammed tight, no matter, just wait for the next service! Even at peak times when passenger numbers entering the station are controlled, the queues outside just stand quiet, calm, orderly and patient – in a genuinely egalitarian zone within a city with high levels of inequality. To witness this side of Beijing only adds to the satisfaction of riding the system. The ease of use, the distances available, the constancy of service and the attitude of fellow passengers make the Beijing Subway a truly wonderful experience.

In terms of hard copy information, in 2012/13 Beijing Subway introduced 'Service+ Centres' at several main stations. These centres were in addition to the Passenger Service/Fare Adjustment Offices that are present at all stations and had multi-lingual staff and open shelves with maps and other information. The shelves are now quite bare and the growing range of diffuse information available (Line 4 used to have its own illustrated map) has now been reversed with the current offer being a simple three fold map. This is approx 11x24cm and is too small for 550km of route and hundreds of bi-lingual station names to fit– it is far from legible and the suburban lines are crammed at the edges. Nonetheless, it is a map, and it is widely available. Moreover, it retains many of the design attributes that make the map so simple and stylish (when compared to other large Asian urban rail systems such as Seoul, Tokyo and Shanghai).

Despite patronage rates and service densities that would give most Metro operators a nose bleed, Beijing Subway requires a growing subsidy. Its fare box recovery ratio is higher than many systems but does not cover costs. A number of reasons for this seem to be obvious. Firstly, the system has high operating costs and low fares. It visibly employs lots of people – watching over entrance halls, security screening, those helping at ticket machines and ticket barriers, platform staff – let alone the drivers and signal attendants in the cab (often three people), and the many thousands behind the scenes in the control centres, administration, maintenance and management etc. Second, the Subway has long chosen the most expensive construction option of tunnels, at a time when it has deliberately kept fares low. This isn't a political problem as such, nor really a financial problem as it would be perceived in Europe or North America, but it is nonetheless something that, according to local media, the Beijing Subway management is 'aware' of. The decision to move from a flat 2 Yuan fare (2007-2014) to a distance based/time-sensitive structures (3 Yuan to 10 Yuan/4 hours maximum) was designed to address the subsidy issues, with research suggesting fares should be trebled to balance finances. The increases caused some consternation and in 2015 ridership fell by 4% - illustrating frustration with the decision. However, passenger numbers have returned and continue to grow as the system expands, and the commitment to Metro expansion remains politically and financially strong.

Of course, a system of this size is bound to have imperfections. For me three things emerge, although two are the result of its success. Firstly, the system is not very stylish. Older stations are a little shabby and only a handful can boast decorative touches. Rapid

expansion and the need to move mass numbers have created a system where function creates a quite basic form. Some of the newer lines have occasional distinctive design features but the founding principles of the Beijing Subway have been steadfastly adhered to - a utilitarian system that is solid and practical. Secondly, the high patronage rates - For metrophiles, this is one of the real experiences of riding the system, but occasionally the queues for security, for tickets, for the walkways and the mass on the platform and train can get overpowering. The system is already exceeding capacity on several lines and upgraded signalling to lessen headways has already reached safe minimums. It is hard, though, to be critical of the design deficiencies of the system when we are talking about such volumes of passenger and train movements.

Finally, and this is the one thing that I cannot really defend - the flaws in the Airport Express Line. These are numerous. Whilst the line connects with the two ring lines (Line 4/10) the train does not go into the city centre and is not ideally located or convenient for travellers with luggage. The Airport Express stations themselves are at a smaller scale than other stations and are busy because new journey specific tickets are required by all passengers (at a surcharge of 25 Yuan). Likewise, the platforms are quite small and claustrophobic as are the trains which have only 4 carriages (paired seating). With services operating only 4 times per hour the stations and journey can be hectic. At the airport, the dwell time at T3 (first stop) is about 5mins and then a slow crawl passing the stabling facilities and into tunnel to T2 takes a further few minutes before another long dwell period occurs at T2 station. The train is in the airport area for about 15mins! Finally, and an easy one to fix - the Airport Express line sits uncomfortably on the Subway map in my opinion with the pale lilac swoosh at odds with the other line representations and their regulated form.

But if that is all there is to be critical of then Beijing Subway does well – a phenomenal system which is well organised, functional, efficient and expansive, reflecting the very ethos of the city. A magical experience!

\*Passenger flow management consists of snaking paths, narrowing path widths to funnel passengers into narrower spaces, limiting the number of people entering the ticket hall or the actual station entrance via human/metal chains at security posts.

The Subway opened in 1969 with an initial stretch of Line 1, the opening coinciding with the 20<sup>th</sup> anniversary of the founding of the Peoples Republic of China. The primary rationale for the early Subway was strategic – for civil defence and to provide access to the workplace for military and government officials - but the emphasis changed toward civilian use with the completion of Line 2 in the mid 1980s and the sporadic extensions of the early 2000s. Subsequently, the system has had two surges in expansion: the first as a result of hosting the 2008 Olympics, for which the original phases of Lines 5, 8, 10 and the Airport Express were opened; the second phase reflecting the growing economic and demographic changes in Beijing, where, between 2009 and 2016, 13 lines began operations.

## Individual Line information

**Line 1 (30.3km-23 stations):** This was the first line to be constructed, and is one of the busiest on the Beijing Subway as it runs through the main commercial, business and tourist/cultural areas of the city. The cut and cover line is shallow and raised controversy when first built due to the resultant destruction of much of the 15<sup>th</sup>/16<sup>th</sup> century city wall. The line is mainly underground except for grade running around Sihui, where two street-level stations are located, providing interchange to the parallel Batong Line. To the west of Pingguoyuan there is a continuation of the line which includes three additional stations: Fushouling (Metro Drivers' Vocational School); Gaojing and Heishitou – both located within the Beijing Military zone. This section of the line is closed to public use. Platforms on Line 1 are being retrofitted with half screens.

**Line 2 (23.1km-18 stations):** Line 2 was partly reconfigured from the original path of Line 1 and is now a loop line following the route of the Ming Dynasty City Walls and 2<sup>nd</sup> ring road. The line is fully underground and over half of its stations allow transfer to other lines on the Beijing Subway. It is also the only line to connect with Beijing Main Railway Station and one of the most widely used lines on the network. As a 'loop line', services are identified as 'clockwise'/'anti-clockwise'. Half screens are being introduced on Line 2 platforms.

**Line 4 (28.2km-24 stations):** Line 4 is part-owned and operated by Hong Kong MTR and has separate management structures, unique design features and distinct regulations and service standards. Its route follows major trip generating areas such as Beijing South Railway Station; the Universities area and the Summer Palace. The line is fully underground with the exception of a short section at the northern terminus at Anheqiao North. Line 4 operates as a through-route on the suburban Daxing Line with trains running a continuous service from Anheqiao North to the southern terminus of the Daxing Line at Tiangongyuan; although every second Line 4 train from Anheqiao terminates at Xingong, thereby halving the headway on the Daxing Line section.

**Line 5 (27.6km-23 stations):** The line runs north-south and unlike most of the core city lines, has a significant amount of elevated running to the north of Datunlu. Opened in 2007, the line was the first in Beijing to have platform screens and runs in long sections of tubing around Tiantongyuan. Transfer to Line 13 at Lishuiqiao involves a change of station building, although without the need to exit the system. Here also there is a short rail spur between the Lines 5 and 13 which is used for shedding movements. At the southern terminal there is cross-platform transfer with Line 10, and barrier free access to the Yizhuang Line.

**Line 6 (42.8km-27 stations):** Running parallel to Line 1/Batong Line, this fully underground line functions as a mechanism to relieve pressure on Line 1, but also as a high capacity line in its own right, running, as it does, through high density residential areas and important commercial districts. The line is unique in several ways - it uses the highest capacity rolling stock on the system (8 car, large profile sets); it utilises overhead power supply and has the highest average speed of all core city lines, mainly due to long station

spacing in the east. Outside peak periods, every third eastbound train short stops at Caofang, lessening the headways further east. The line has cross-platform transfer with Line 8 at Nanluoguxiang.

**Line 7 (23.7km-19 stations):** Line 7 is the only core city line to be fully located in the south of Beijing. As with Line 6, this line was designed as a principal east-west route to relieve pressure from Line 1, with which it runs parallel. The line uses 8-car CNR stock and (although originally designed to use overhead power) operates utilising third rail supply. The line has cross platform transfer with Line 9 at Beijing West Station.

**Line 8 (26.6km-18 stations):** The line was planned and opened to serve the main Beijing Olympics sites in 2008 and has been extended since it began operations as a branch from Line 10. Its track alignment was designed for higher speeds and it runs underground except for 1km of grade running on the extension to the Changping Line transfer station in the north. This line has cross-platform interchange at both terminus stations and has some unique station designs in the Olympic area.

**Line 9 (16.5km-13 stations):** This fully underground line runs in the west of Beijing city, connecting the main network to the suburban services of the Fangshan Line. Despite being the shortest line of the Beijing Subway system, it provides essential links to Beijing West Railway Station and over half of the stations along the route have interchange with other lines. As a newer line it has been designed for speedy interchange, with connection to Lines 4, 7 and Fangshan Line via cross-platform transfer.

**Line 10 (57.1km-45 stations):** Following the route of the 3<sup>rd</sup> Ring Road/Yuan city walls, Line 10 is the second loop on the system. Built in stages between 2008 and 2013, the line is the longest loop line in the world, taking almost one and a half hours to complete the circle. It is also the busiest line on the Beijing system. Most services operate as a full loop, although certain trains operate a 'partial loop' service, running from Chedaogou to Songjiazhuang via the northern portion of the line.

**Line 13 (40.5km-16 stations):** Line 13 was built prior to the rapid expansion of the Beijing Subway. The line runs mainly at grade on a former heavy rail alignment and has one of the fastest line speeds on the network and lengthy distances between stations. The semi-circular route connects Xizimen/Beijing North Railway Station (Beijing Suburban Rail S1/Line 2/Line 4) to Dongzhimen (Airport Express/Line 2) via the northern residential areas of the city and during peak hours, this line is one of the busiest on the entire system. At Xi'erqi, there is bi-level transfer to the Changping Line – one of the busiest stations on the network.

**Line 14 (43.8km-26 stations):** Akin to Line 4, this line is part owned and operated by Hong Kong MTR and uses high capacity trains. It currently operates as two discrete underground segments. The first section is located in the south west of the city and runs for 12.4km with 7 stations. To the east of Beijing South Railway Station the line continues as a half loop located both within and outside of Line 2 and Line 10. It runs for 31.4km with 19 stations toward Shan'gezhuang in the north east of the city. The line uses its own station personal, and its station design is often different from the norm.

**Line 15 (41.4km-19 stations):** Although a numbered line, Line 15 is a fully suburban line running in the north east of the city around the airport area. It has a mixture of underground and elevated line and uses modern CNR 6-car sets. The line operates quite low frequencies within the context of the Beijing Subway system (8mins), and passes through less densely populated areas of the city. Line 15 will shortly have barrier free transfer provision to Line 13 at Qinghuadongluxikou in the west, whilst transfer between the two lines in the east at Wanjing West involves a lengthy transfer corridor and pedestrian footbridge.

**Line 16 (19.7km-9 stations):** This is the latest of the HK MTR lines to operate in Beijing and currently runs fully underground as a suburban line in the more sparsely populated far north-west of the city from (Xiyuan Line 4), although this will change once southern extensions are completed. The line uses modern CRRC 8 car sets with lower seating capacity to support more overall train capacity. It operates 10min frequencies with overhead power supply. The stations on the line have similarities, all are spacious with high ceilings, traditional Chinese decorative styles and colours, and interesting lighting (chandeliers/wall lights etc) features.

**Airport Express line (28.1km-4 stations):** Although part of the Beijing Subway, the Airport Express Line (also known as **ABC - Airport Beijing City Line**) has a different rail format from other routes. The line is connected to the Subway at Dongzhimen and Sanyuanqiao where the Airport Express stations are accessed through long interconnector corridors. The line attracts a premium fare requiring special ticket purchases and separate branding is used in stations and on the trains. The rolling stock is medium capacity 4 car Bombardier Innova trains with paired seating. These trains have staff in the front cabin but can be adapted to automated, driverless operations if required. Running underground in the city and at the airport, the line is linked by a high speed elevated section. At both Terminal 3 and Terminal 2 the train enters a dead end station then reverses via a 4km tunnel (T2).

**Batong Line (18.9km-13 stations):** The Batong Line opened in 2003 as an extension to Line 1, from which transfer is available at Sihui and Sihui East. The line is above ground and runs parallel to Line 1 on its western section. Headways are lower than Line 1 and there is no through running due to different signalling infrastructure.

**Changping Line (31.9km-12 stations):** The Changping line is located in the north-west of the city, running on a mix of elevated, tubed and underground alignments. It connects with the main network at Zhuxinzhuang (Line 8) with cross-platform interchange and at Xi'erqi (Line 13) via a large bi-level station. At its southern end, the Changping line is one of the busiest lines on the system; it also has the highest station spacing (2.7km) and highest average speeds of any line.

**Daxing Line (21.7km-12 stations):** Like Line 4 and 14, the Daxing Line is jointly owned-operated by Hong Kong MRT. Although classified as a discrete line, it is operated as part of a Line 4 through-service, with alternate southbound Line 4 trains continuing beyond Gongyixiqiao to the southern Daxing Line terminus at Tiangongyuan. Unlike most suburban

lines, the Daxing Line runs mainly underground with Xihongmen being the only surface station. Here is found the Subway Culture Park, an open air Metro Museum.

**Fangshan Line (24.8km-11 stations):** Connected to Line 9 at Guogongzhuang via cross platform transfer, this suburban line runs for 2.7km underground and then on a long elevated section to the peripheral south-west of Beijing around Suzhuang. The line has 8min headways.

**Yizhuang Line (23.2km-13 stations):** Connected to Line 5 and Line 10 at Songjiazhuang via a 150m walkway, the Yizhuang Line is a suburban metro line operating a mix of underground (8.9km) and elevated sections. The line serves industrial areas and satellite towns, using smart CNR stock.