

# Newly Completed and Inaugurated Routes

## Routes Completed and Inaugurated in 2014

### 1. Songshan Line

The Songshan line runs north from the Nangang line's Ximen Station along Zhonghua Rd. to Tacheng St., northeast to Tianshui Rd. then turns east along Nanjing West and East roads sections 1-5. It then turns southeast onto Bade Rd. Sec. 4 before continuing east to end at the square north of Songshan Railway Station. The 8.5-kilometer route encompasses eight underground stations, including Ximen Station, and one elevated transfer facility for the Wenhu line.



MRT service after opening of the Songshan Line between Ximen and Songshan stations

In accordance with the "Regulations for Mass Rapid Transit Systems Inspection," MRT construction and operation authorities should confirm that new routes meet operational scope and safety requirements. The local competent authority should then conduct a preliminary inspection. After Taipei City Government and the Ministry of Transportation and Communications (MOTC) conducted preliminary and final inspections of the Songshan line on October 5 and 31, 2014, respectively, Taipei Mayor Hau Lung-bin announced that the new route would begin service at 6 a.m. on November 15, 2014. To celebrate Songshan line opening, fare incentives were offered for one month from November 15 (Saturday) through December 14 (Sunday), 2014. There were two discounts: 1. No fare was charged to EasyCard holders for travel between Ximen Station and Songshan Station of the new Songshan line, 2. A 30% discount applied to passengers satisfying both of the following criteria: (1) Entering/leaving from one of the following MRT stations (Guting, Dingxi, Yongan Market, Jingan, Nanshijiao, Taipower Building, Gongguan, Wanlong, Jingmei, Dapinglin, Qizhang, Xiaobitan, Xindian District Office, and Xindian) (2) The other end of travel was at any of the following MRT

stations (NTU Hospital, Taipei Main Station, Zhongshan, Shuanglian, Minquan West Rd., Yuanshan, Jiantan, Shilin, Zhishan, Mingde, Shipai, Qilian, Qiyang, Beitou, Xinbeitou, Fuxinggang, Zhongyi, Guandu, Zhuwei, Hongshulin, and Tamsui).

An inauguration marking the opening of the Songshan line was held at Beimen Station on November 14, 2014. Presiding over the ceremony was Taipei Mayor Hau Lung-bin, and honored guests included President Ma Ying-jeou, Premier Jiang Yi-huah; central government, Taipei and New Taipei government officials; and Taipei City councilors. Travel between the terminal stations of Ximen and Songshan took only 15 minutes.



President Ma Ying-jeou joined Premier Jiang Yi-huah, Taipei Mayor Hau Lung-bin, and other honored guests in inaugurating the Songshan Line

Construction of the Songshan line was divided into three section contracts: CG590C (launched on August 15, 2006), CG590B (launched on August 27, 2006) and CG590A (launched on December 18, 2006). Built as a high-capacity system, the eight stations of the 8.5-kilometer underground route (including the existing Ximen Station) from west to east are Ximen, Beimen, Zhongshan, Songjiang Nanjing, Nanjing Fuxing, Taipei Arena, Nanjing Sanmin, and Songshan. Trains operate between the Xindian line's Xindian Station and Songshan line's Songshan Station, and transfers are available at Ximen for the Bannan line, Zhongshan for the Tamsui line, Songjiang Nanjing for the Zhonghe-Xinlu line, and Nanjing Fuxing for the Wenhua line. Songshan Station also links to the Taiwan Railways Songshan Station via a connection passageway. After the Taoyuan International Airport line opens, Beimen will serve as a transfer station between the two lines. The new line is the most convenient transportation corridor to the Songshan commercial zone.

DORTS began Songshan line construction inspections in December 2013. After system stability tests were completed, EMUs were handed over to the Taipei Rapid Transit Corporation (TRTC) on July 17, 2014, for trial runs, simulations and drills. TRTC officially took over the system, including train control rights, on August 22, 2014. In accordance with the Mass Rapid Transit Act, DORTS and TRTC jointly requested preliminary inspection by the Taipei City Government. Following preliminary and final inspections by the city and MOTC on October 5 and 31, 2014, respectively, the new route began operations on November 15, 2014. It increased the number of operational stations from 109 to 116.

## (1) Preliminary Inspection of the Songshan Line



Inspection members were briefed by DORTS Central District Project Office Director Yu Nian-zi on behalf of a civil works group during Songshan Line preliminary inspection



DORTS and TRTC conducted the preliminary inspection of the Songshan Line



Preliminary inspection members inspected Songshan Line stations



A wrap-up meeting following preliminary inspections of the Songshan Line

## (2) Final Inspection of the Songshan Line



DORTS Commissioner Tsay Huel-sheng spoke in the final inspection meeting



Inspection members were briefed by DORTS Central District Project Office Director Yu Nian-zi on behalf of a civil works group during Songshan Line preliminary inspection





Final inspection of Songshan Line stations

A wrap-up meeting following final inspections of the Songshan Line

## Completed and Inaugurated Routes (As of December 31, 2014)

Route	Terminal Stations	Total Length (km)	Notes
Wenshan Neihu Line	Taipei Zoo Station to Zhongshan Junior High School Station	10.9	Inaugurated on March 28, 1996
	Zhongshan Junior High School Station to Taipei Nangang Exhibition Center Station	14.8	Inaugurated on July 4, 2009
Tamsui Line	Tamsui Station to Chiang Kai-Shek Memorial Hall Station	23.8	Section between Tamsui and Zhongshan stations was inaugurated on March 28, 1997 Section between Zhongshan and Taipei Main stations was inaugurated on December 25, 1997 Section between Taipei Main Station and Chiang Kai-Shek Memorial Hall Station was inaugurated on December 24, 1998
Zhonghe Line	Guting Station (excluded) to Nanshijiao Station	5.4	The entire line was inaugurated on December 24, 1998
Xindian Line	Chiang Kai-Shek Memorial Hall Station (excluded) to Xindian Station	11.2	The entire line was inaugurated on November 11, 1999 (The 1.9-kilometer Xiaobitan branch line was inaugurated on September 29, 2004)
Xiaonanmen Line	Ximen Station to Chiang Kai-Shek Memorial Hall Station	1.6	Inaugurated on August 31, 2000
Nangang Line	Ximen Station to Kunyang Station	11	Section between Ximen and Taipei City Hall stations was inaugurated on December 24, 1999 The entire line was inaugurated on December 30, 2000
Banqiao Line	Ximen Station (excluded) to Fuzhong Station	7.1	Section between Ximen and Longshan Temple stations was inaugurated on December 24, 1999 Section between Longshan Temple and Xipu stations was inaugurated on August 31, 2000 Section between Xipu and Fuzhong stations was inaugurated on May 31, 2006
Tucheng Line	Fuzhong Station (excluded) to Yongling Station	5.6	The entire line was inaugurated on May 31, 2006



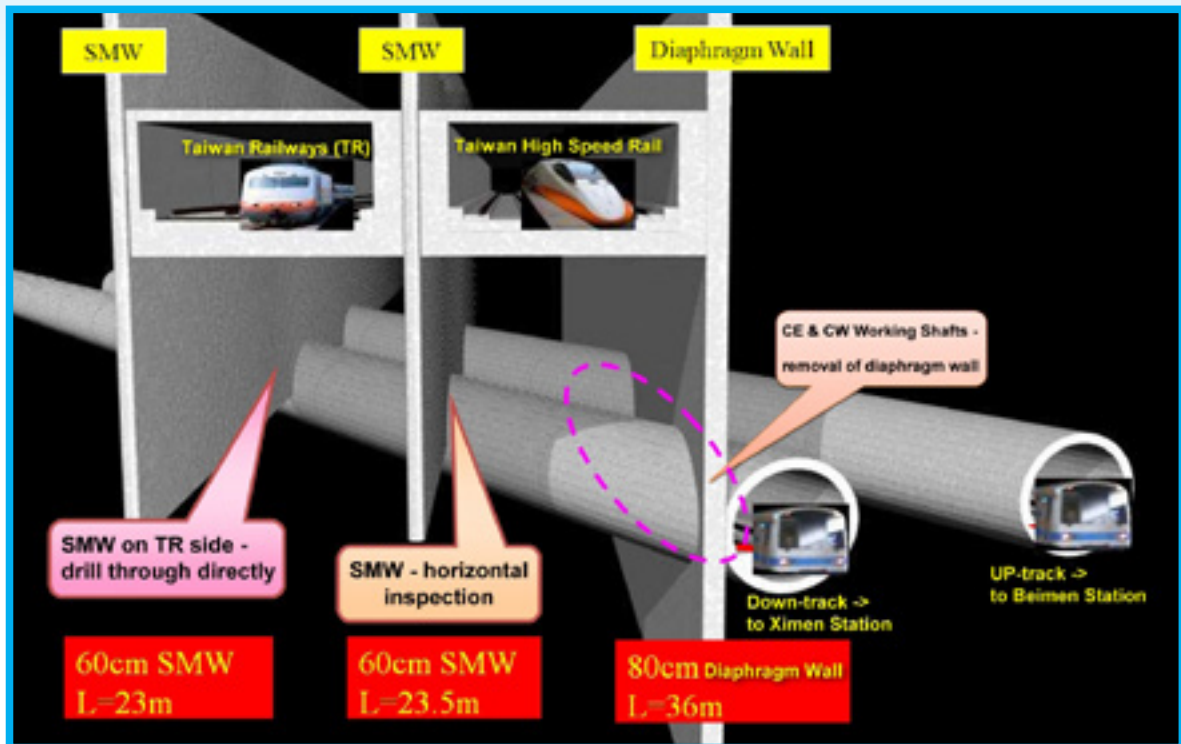
Route	Terminal Stations	Total Length (km)	Notes
Nangang Eastern Extension	Kunyang Station to Taipei Nangang Exhibition Center Station	2.5	Section between Kunyang and Nangang stations was inaugurated on December 25, 2008 Section between Nangang and Taipei Nangang Exhibition Center stations was inaugurated on February 27, 2011
Luzhou Line	Luzhou Station to Sanchong Elementary School Station	6.4	The entire line was inaugurated on November 3, 2010
Xinzhuang Line	Taipei City Section: Daqiaotou Station to Zhongxiao Xinsheng Station	6.1	Inaugurated on November 3, 2010
	Zhongxiao Xinsheng Station to Guting Station	2.3	Inaugurated on September 30, 2012
	New Taipei City Section: Daqiaotou Station to Fu Jen University Station	8.2	Inaugurated on January 5, 2012
	Fu Jen University Station to Huilong Station	2.8	Inaugurated on June 29, 2013
Xinyi Line	Chiang Kai-Shek Memorial Hall Station to Xiangshan Station	6.4	Inaugurated on November 24, 2013
Songshan Line	Ximen Station to Songshan Station	8.5	Inaugurated on November 15, 2014
Total 134.6 km			

## Challenges Encountered During Construction of the Songshan Line

The Songshan line, which runs beneath the busiest districts in Taipei – Datong, Zhongshan, and Songshan – was built in conjunction with common ducts and environmental renewal projects along Nanjing East and West roads to accommodate urban infrastructure needs. Traffic maintenance had to be adjusted section by section in accordance with station, shield tunnel, common duct and road recovery progress. Ten of the most difficult challenges are described as follows:

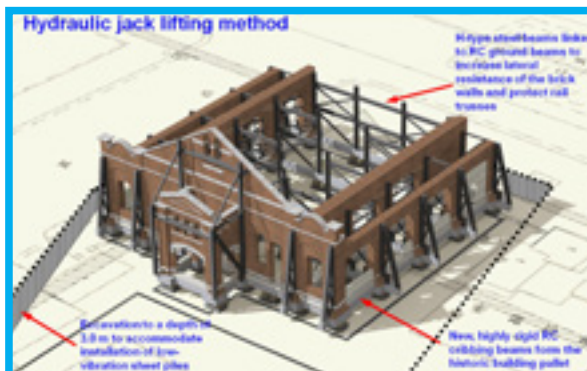
### 1. The tunnel between Ximen and Beimen stations was the first such construction built beneath an operational high speed rail

For Contract CG290, up-track and down-track tunnels passed beneath the cut-and-cover tunnel belonging to Taiwan Railways and the Taiwan High Speed Rail at 0K + 608 and 0K + 634, respectively, at an angle of 60 degree. According to completion data of the Taiwan Railways and the high speed rail, the MRT shield tunnel conflicted with a diaphragm wall and two SMW retaining walls. The down-track tunnel was only 0.5 meters away from an emergency exit structure diaphragm wall at 0K + 575. Possible uneven and protruding walls at the tunnel side raised structural safety and collision concerns during shield tunnel excavation. Precautionary measures, such as trial excavation, geophysical exploration, and follow-up ground improvement, were adopted in order to ensure safe location of the MRT tunnel and maintain safe and regular operations of the two existing systems. Challenges were immense.



The MRT Songshan Line passes through diaphragm walls belonging to Taiwan Railways and Taiwan High Speed Rail

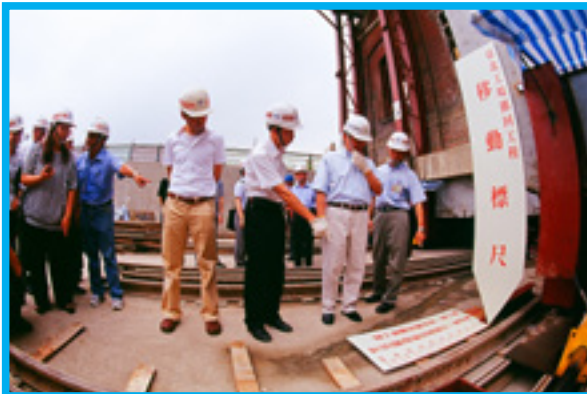
## 2. Historic preservation through the relocation of Taipei Workshop



Hydraulic jack lifting method for Taipei Workshop



Taipei Workshop before removal



DORTS Commissioner Richard C.L. Chen and DORTS Central District Project Office Director Yu Nian-zi briefed Mayor Hau Lung-bin during an inspection of the Taipei Workshop relocation site



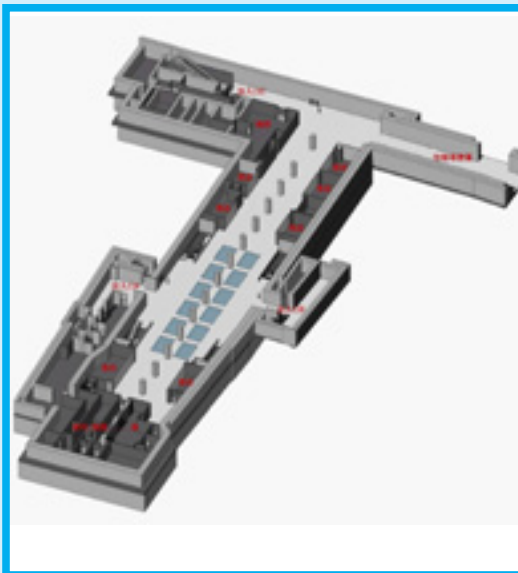
Mayor Hau Lung-bin, DORTS Commissioner Richard C.L. Chen, DORTS Central District Project Office Director Yu Nian-zi, and the construction team in front of Taipei Workshop



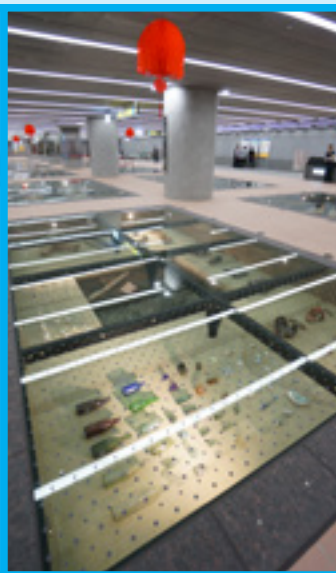


Taipei Workshop, located near the Railway Department at Beimen, was built in 1909 and is the capital's only surviving century-old railway monument. It conducted train and track maintenance for Taipei Arsenal during the Qing dynasty and for the Taiwan North-South Railway during the Japanese-colonial period. The workshop was renovated for office use in 1935 and served as a Taiwan Railways auditorium after World War II. The brick building had six arches that provided clearance for trains to enter for maintenance. Later, due to Zhengzhou Road broadening, two arches were demolished. In 2007, the 500-square-meter building that remained was lifted using hydraulic jacks. It was moved using computer-controlled oil jacks on eight steel tracks at a speed of 1 cm per minute, with a steel frame and iron sheets used for protection. The project, which served as a model of development and preservation, showed engineers how to respect and cherish cultural assets as they learned a new preservation technique. In a press conference on May 16, 2012, to mark return of the workshop to its permanent location, Mayor Hau Lung-bin, DORTS Commissioner Richard C.L. Chen, and Department of Culture Commissioner Lieu Wei-gong pressed a launching button. Mayor Hau said the project set a good example for balancing infrastructure development and historic monument preservation.

**3. To fulfill the requirements of Taipei Arsenal excavations, an exit/entrance was moved. A dozen sink glass pits were installed in an underground passage to accommodate display of the relics. The exhibit is free for the public to visit.**



Sink pits exhibited at the Beimen Station transition level



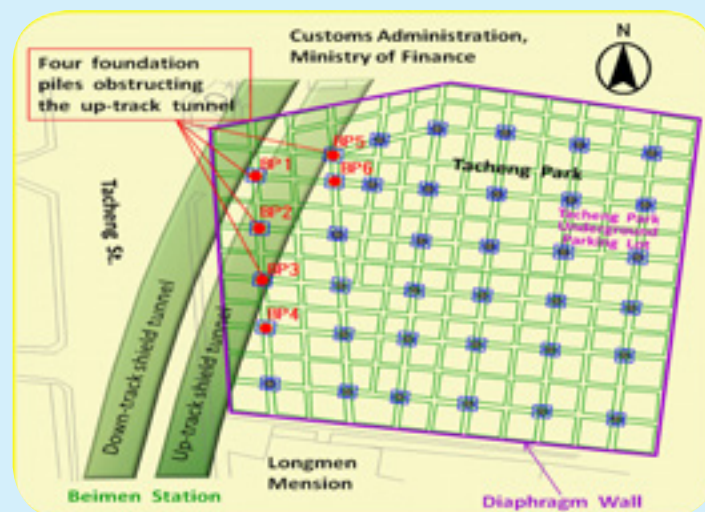
Sink pits display of Beiman historic relics

Taipei Arsenal remains, which included stone walls and slate roads found while conducting ground leveling on the southwest side of the Railway Department, were discovered at the end of 2006 following the start of construction on the Songshan line. After National Taiwan Museum submitted an appraisal report to the Taipei Department of Cultural Affairs, a year of surveys and excavations by a cultural

asset task force brought the artifacts to life. Only seen in Taipei, the Qing dynasty slate road remains bear significant historic value and were listed as a municipal historical heritage. Designated historic relics include enclosing walls on the east side of arsenal, the remains of the office of the governor, and Qing slate roads 5 meters away from the enclosing walls. DORTS was commissioned by the Department of Cultural Affairs to conduct excavation and present a complete picture of the remains. Accordingly, DORTS suspended MRT construction and re-planned the locations of Exits A, B and

C. To ensure distribution of underground remains at the Beimen Station designated site, DORTS used ancient maps and old photos as part of a special investigative study and extensive archaeological excavation. In 2010, an excavation team, consisting of members of the Academia Sinica and the Cheng Kung University Department of History, confirmed that the artifacts were from the Taipei Arsenal and the Japanese colonial period. Archaeological strata dating to the Qing dynasty, that were discovered after underground water was drained, included important items from when Liu Mingchuan was promoting the westernization movement. Responding to preservation appeals, the relics were blended into station architectural finishings via a display in 12 glass-top pits and walls on the B1 level of Beimen Station. Ancient materials were utilized to preserve the historic nature of the display.

#### 4. Management of group piles belonging to the underground Tacheng Park parking lot, located where the shield tunnel passes between Beimen and Zhongshan stations



Location of the shield tunnel between Beimen and Zhongshan stations that passes through group piles beneath the Tacheng Park underground parking lot



Treatment of group piles beneath the Tacheng Park underground parking lot to allow passage of a shield tunnel between Beimen and Zhongshan stations



To allow the shield tunnel between Beimen and Zhongshan stations on the Songshan line to pass beneath the Tacheng Park underground parking lot, six 1.5-meter diameter steel concrete foundation piles had to be cut and removed in a high-risk operation. To ensure the parking lot's operational and structural safety, the construction team conducted structural simulations and geographical safety analyses and assessment using strict monitoring values and an automatic monitoring system. Work began with stratum improvement grouting surrounding the foundation piles at the B2 parking lot. Then, using a shield machine head for water testing and supplementing grouting to ensure water stoppage, workers cut the foundation piles to allow the shield tunnel machine to safely take the planned excavation route beneath the parking lot.

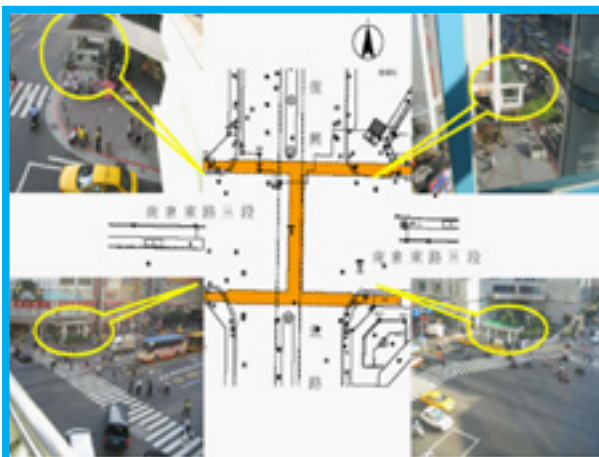
## 5. Adding ground-level and underground passage transfer facilities at Nanjing Fuxing Station for the operational Wenhua line



High traffic volume on Nanjing East and Fuxing North roads increased traffic maintenance difficulties



Due to height limitations, the diaphragm wall method was replaced by the reversed circulation pile construction method. Tangent piles, used to facilitate small machines, reduced construction efficiency



Demolition of old underground pedestrian paths posed construction water circulation challenges. Additional water sealing and supply measures were needed



Intricate underground pipeline

The intersection of Nanjing East and Fuxing North roads is a vital traffic in downtown Taipei. Due to the Wenhua line's Nanjing Fuxing Station above, construction height was constrained. Intricate pipelines, an old pedestrian underpass and heavy traffic volume added to construction difficulties, making the station's transfer floor beneath the intersection a critical path of Section Contract CG590B. To complete construction while maintaining road safety and traffic flow, these factors needed to be incorporated into a traffic maintenance plan.

**Critical Challenge Points:**

- (1) Limited by mid-column location and lane alignment on Fuxing N. Rd., work on the 2-meter-wide north and south bound lanes could not proceed at the same time.
- (2) Where construction could not proceed simultaneously, there were concerns that the road area would be occupied. Options included reducing lane width (maintaining three lanes) or shortening construction time.
- (3) Since the construction area was not located above mid-columns, temporary supports had to be built.
- (4) Pipeline rehabilitation and schedule control when coordinating with other agencies.

**6. Expedited construction allowed Songshan line bulk supply substation to be completed within two years, despite two relocations**

As electricity powers MRT facilities and EMUs, a bulk supply substation was planned for each MRT route. The Songshan line bulk supply substation was originally planned to be located inside Yucheng Park near Beimen Station and to be integrated with the scheduled Taipower Huanhe substation. Taipower commissioned DORTS to conduct design and construction. After completion of the design, resident protests obstructed approval of the construction permit. The delays posed a serious problem since work on the MRT bulk substation had to be launched by March 2009 to maintain the overall construction schedule, which included completing civil works, HVAC systems, and the power supply system within three and half years.

In order to solve the MRT bulk supply substation location problem, DORTS began planning alternative locations in January 2009. These included: 1. The basement of the office building shared by DORTS' Central District Project Office and Songshan Precinct, 2. Taiwan Railways land near Beimen Station Exit C, 3. Linsen No. 14 Park, 4. The old Zhonglun substation in Taipei Sports Park. Following assessment, on April 8, 2009, DORTS decided on the basement of the office building shared by DORTS' Central District Project Office and Songshan Precinct. Due to strong protests from neighboring Dunhua Mid-Park mansion, however, the alternative was scrapped. The substation was then moved to the site of the old Zhonglun substation. Following approval from the mayor on August 6, 2009, design, environmental impact assessment, urban planning reviews, and tendering began. After urban planning review was completed in January 2011, environmental impact assessment and preliminary design documents were finished over the following few months. The construction budget difference was approved by Taipei City Government in March 2011. A notice to proceed (NTP) was issued on October 25, 2011, after the end of tendering in September 2011.



After undergoing two planning and design relocation, placing the Songshan Station bulk substation next to the old Zhonglun substation was the most difficult alternative for the following two reasons:

- (1) Due to irregular terrain, the site had to be divided into two blocks. Since the north side site overlapped with land for Taipei Arena Station Exit B, the exit had to be integrated with the bulk substation. Due to poor land use efficiency, 30-meter-deep excavation was necessary for six underground levels and two above-ground level structures.
- (2) Since the north site was to face the protruding eaves of Taipei Arena, which were 3 meters above the ground, the space was not large enough for machinery and steel cage operation on diaphragm wall construction (typical required space is at least 8 meters high). Excavation therefore had to proceed to a depth of 5 meters, adding difficulties. To make the bulk substation power supply ready for operation of the Songshan line, the overall construction period was compressed to 912 days. During this shorter period, construction teams also had to add another integrated exit. Through a combination of strenuous effort and effective communication, civil structure finishings, HVAC systems, the power supply system, power conduits, and fire inspections were completed in two and half years. Finally, the bulk substation power supply was completed for Songshan line operations on September 4, 2014.



Old Zhonglun bulk supply substation building



Completed bulk supply substation integrated with Taipei Arena Station Exit 2

## 7. Management of anchor barriers at the shield tunnel between Nanjing Fuxing and Taipei Arena stations



Anchor impact area





Anchor blocking at the inspection mouth after 1,000 mm of pulling by the shield tunneling machine screw axes



Removal of anchors by the shield tunneling machine excavation pump

During construction, anchor barriers, left by the Asia World Department Store construction, were found on Nanjing E. Rd. (near Dunhua N. Rd.). As they hindered MRT shield tunnel construction, removal took place using three methods:

- (1) Common duct method: Using the diaphragm retaining wall construction method, clamshell scoops used for diaphragm wall construction were applied to cut off anchor tendons. This ensured safety of the original building structure.
- (2) Change of common duct width: Common duct excavation on Nanjing E. Rd. (between Nanjing E. Rd. Sec. 3, Lane 335 and Dunhua N. Rd.) was adjusted from 3.4 m to 7.5 m with a length of 100 m to accommodate the location of anchor barriers.
- (3) Cross passage construction method: Cut-and-cover construction method was applied to shield tunnels (up-and-down tracks). Due to the extent of the affected area and the need to maintain original building structure safety, strict management was needed.

## 8. Management of anchor barriers left by Zhengqi Bridge construction at the shield tunnel between Nanjing Sanmin and Songshan stations



Remaining foundation piles belonging to Zhengqi Bridge



The civil works 6<sup>th</sup> site office of DORTS Central District Project Office, detailed design consultants, and contractors jointly conducted on-site surveys and investigation



Foundation pile steel bars belonging to the Zhengqi Bridge were excavated through the P0 pump gate

The shield tunnel section between Nanjing Sanmin and Songshan stations encountered old Zhengqi Bridge ramp foundation piles that were not shown on the original design drawing. Either pile cutting or adding a work shaft for removal would have delayed scheduled completion by more than one year. DORTS' East District Project Office therefore adjusted tunnel alignment to minimize impact. It estimated pile strength based on the excavated steel and concrete. After reviewing follow-up reinforcement measures, the shield tunneling machine passed through successfully, only leading to a one month delay. This again demonstrated the experience and precise judgment of the construction team.

## 9. Maintaining traffic flow during reconstruction work on Yucheng Bridge



Traffic maintenance layout for Yucheng Bridge reconstruction and tail track construction

The shield tunnel section between Songshan Station and the tail track had to pass through the Yucheng Bridge foundation piles. Located at Bade Rd. Sec. 4 north of the Songshan Elementary School, the section was a critical path leading to Nangang. Bridge reconstruction therefore had to proceed while maintaining traffic flow. With a road width of less than 20 meters, two-way traffic could not be maintained. One-way traffic, coupled with Nangang Rd. Sec. 3, was adopted, leading to strong opposition from neighboring residents. Other construction proceeding at the same time added to difficulties. Potential variables and problems, such as the Songshan section railway underground project, scrapping of Dongxin Bridge, opening of Songxin Rd., relocation of Songshan Railway Station, and Ciyou Temple activities, led Taipei City Government to reject the traffic maintenance plan, even though it had been approved in August 2006. In 2009, DORTS' Central District Project Office began conducting another traffic maintenance plan for Yucheng Bridge reconstruction and tail track construction. Negotiations for supplementary measures after a construction fence was built followed between the office and the Railway Reconstruction Bureau, the MOTC, the Taipei Hydraulic Engineering Office, the Taipei Public Works Department, and the National Property Administration. Finally, a traffic maintenance plan, adopting one-way traffic on Bade Rd. and two-way traffic on Nangang Rd., was approved by the Taipei City Road Safety Supervisory Committee on July 14, 2010. Completion of Yucheng Bridge reconstruction allowed the shield tunneling machine to pass through, avoiding delays to the Songshan line.

## 10. Construction of Common Ducts and Supply Pipelines along Nanjing East and West Roads

In line with municipal policy, construction of common ducts and supply pipelines was conducted in conjunction with the MRT project. As common ducts were built above the MRT construction and road alignment was adjusted to coordinate with the Nanjing East and West Roads Environmental Renewal Project, excavation along the entire road and traffic flow requirements presented significant challenges.



Intricate pipeline beneath Nanjing East and West roads



New pipelines beneath Nanjing East and West roads



Sidewalk manholes along Nanjing East and West roads



Rehabilitated sidewalk along Nanjing East and West roads

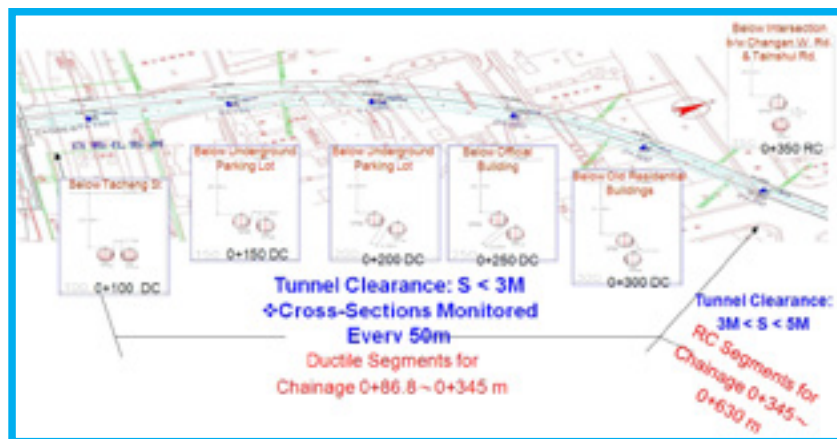
Despite the 10 challenges mentioned above, thanks to the strenuous effort of construction teams, the Songshan line was completed and opened on schedule in 2014.



## Special Construction Methods Used on the Songshan Line

Nanjing East and West roads compose a main east-west artery in downtown Taipei. With saturated traffic volume, high density of residential buildings, high-rise buildings, and frequent business activities, construction along the road caused substantial impact on quality of life. Geographical limitations posed another challenge. To reduce these impacts and allow the Songshan line to be completed on schedule, special construction methods were applied.

- 1. An 11.146-kilometer shield tunnel included pioneering use of ductile iron rings on a section with a 5.6-meter inner diameter located beneath Jiancheng Roundabout, the Customs Administration and Tacheng Park.**



Completed spheroidal graphite iron rings in the shield tunnel

## 2. Glass Fiber Reinforced Plastic (GFRP) Construction Method:

The GFRP construction method was applied to the diaphragm wall steel bar cage within the shield tunnel mirror excavation range by replacing bamboo steel with glass fiber reinforced polymer bars. Lower dynamic shear strength of GFRP allowed cutting edge disks to employ direct spins and cuts on the diaphragm wall, so automatic cut and excavation could occur simultaneously. This reduced potential risks posed by applying a traditional shield tunneling machine during launch or excavation of the diaphragm wall's mirror face. Significantly increased safety.



Glass Fiber Reinforced Plastic (GFRP) put in place

### 3. Fourth Generation Decking

The cut-and-cover method was used for construction of MRT stations that were primarily located beneath main roads. To reduce traffic impact and allow safe access for pedestrians and vehicles, a decking system was applied to areas surrounding construction sites.



Composite decking without steel rim used in the cut-and-cover area on Nanjing E. Rd.

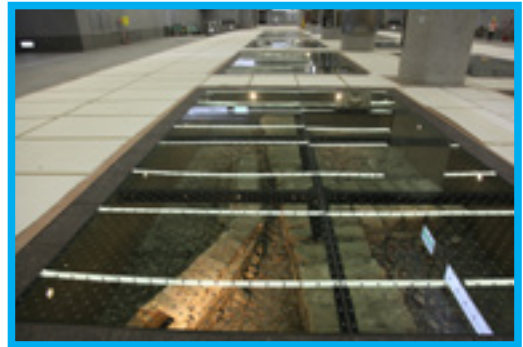
## Highlights along the Songshan Line

As a vital transportation artery, Songshan line construction was similar to other lines. However, in terms of overall characteristics, the new line put greater emphasis on architectural aesthetics. Unique features are described as follows:

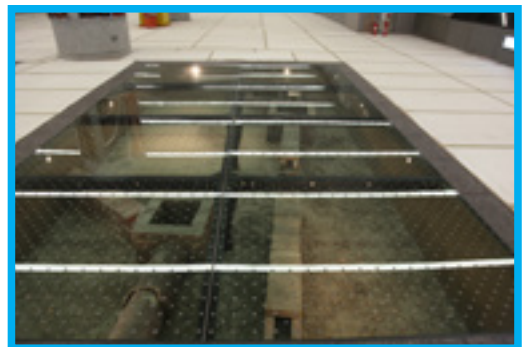
- 1. Beimen Station, the first station to integrate historic relics in the station architecture, is built where the Qing dynasty Arsenal and the Japanese colonial period Taipei Workshop are located. During construction, precious items from Qing dynasty archaeological strata, brick waterways, qili'an stone, Taipei Workshop water conduits, and kitchen aisles were excavated by hand. These are on display at the north-end ground level station walls under the title "Legend - Read the Memory of Taipei" and in a dozen glass-covered pits. The two pits on the north end introduce archaeological efforts and relics commonly found in the archaeology of late modern history while the 10 remaining pits display historic relics discovered during three excavations of the Qing dynasty Arsenal and Taipei Workshop between 2006 and 2010. The ruins include the remains of Qing brick waterways, roads within the Taipei Workshop,**



and aisles connecting the Taiwan Governor-General's Office and kitchen. The display gives the general public a deeper understanding of the rich cultural heritage Taipei has built since its establishment 130 years ago.



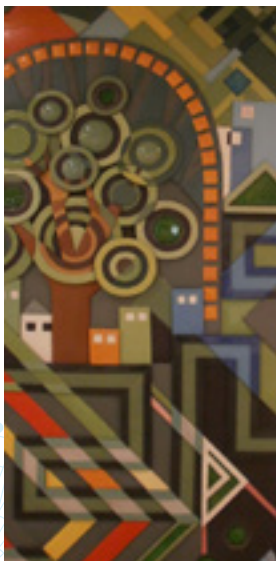
Brick waterway from the Qing dynasty (ancillary structure of the office of the governor)



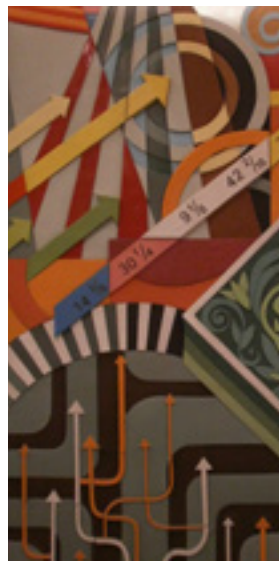
Sewer system from the Japanese colonial period

## 2. Unique Public Art at Songshan Line Stations

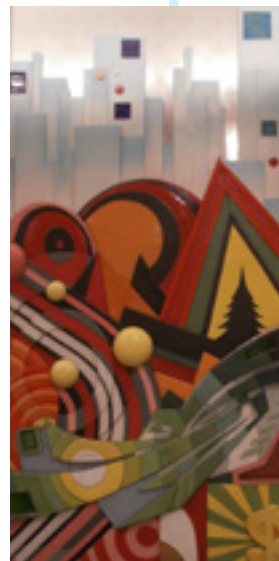
- (1) Public artworks exhibited on the end wall between the concourse and ground levels of Nanjing Sanmin Station include "Green Heart of the Urban Jungle," "Glamour and Glitz," "Web of Fashion and Delight," and "City of Future Hope."



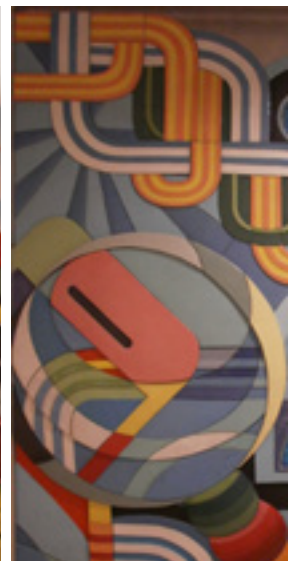
Green Heart of the Urban Jungle



Glamour and Glitz



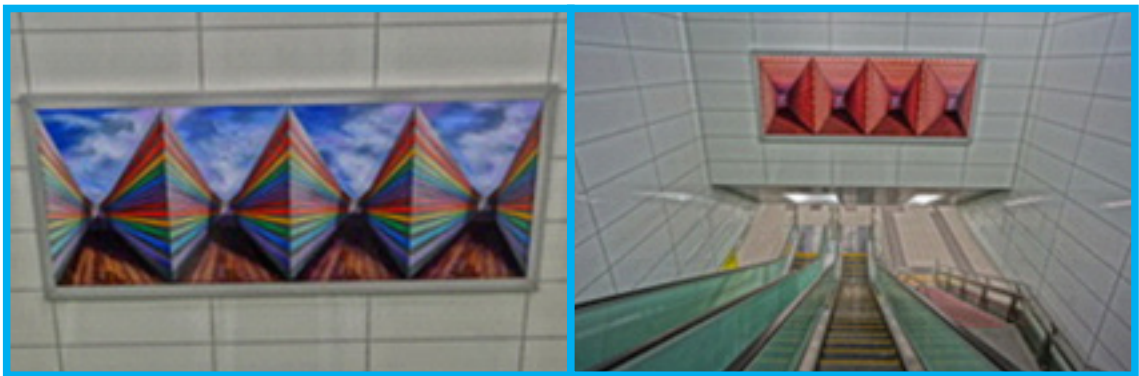
Web of Fashion and Delight



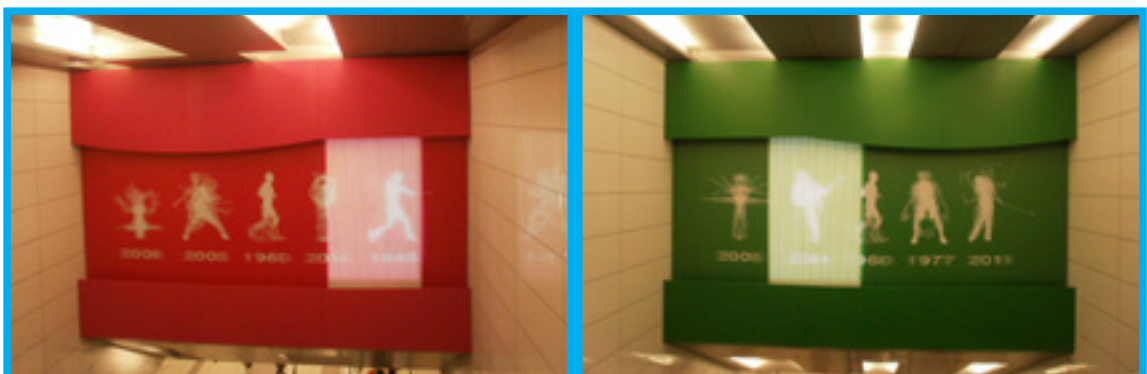
City of Future Hope



- (2) Using visual illusion and Moiré animation principles, contre-jour images were restored to vivid and lifelike moving imagery. Public artworks exhibited at Taipei Arena Station include "Moving Forward," by artist Hung Tung-Lu, and "Energy-Activating Code," by Yuan Goang-Ming. Adjacent to Taipei Arena and Taipei Track and Field Stadium, Taipei Arena Station is located in Taipei's main sports park and serves as a vital transportation link for the public to watch sports competitions and concerts. Due to the station's close connection to urban and recreational activities, its design adopted a sports track theme. A combination of underground MRT track space and aboveground activities creates an urban sports park atmosphere.



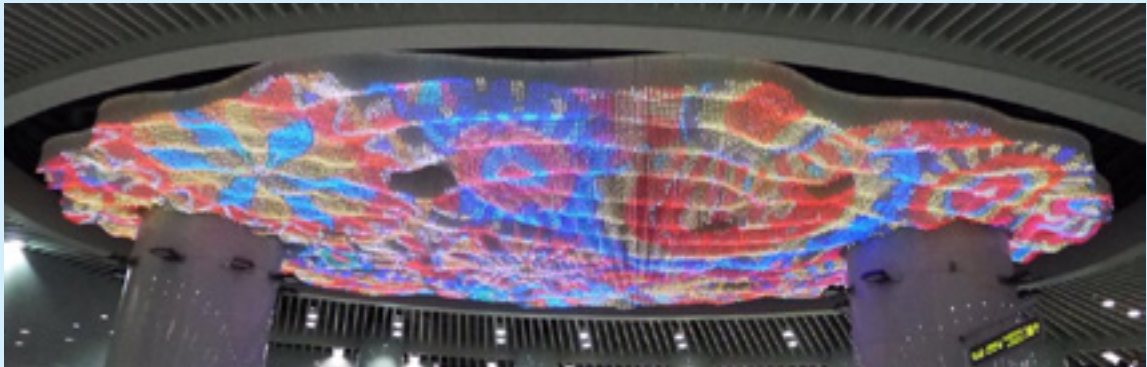
Artwork "Moving Forward" by artist Hung Tung-Lu



Artwork "Energy Activation Code" by artist Yuan Goang-Ming

- (3) At the oval concourse of Songshan Station, Chiang Yang-huei of VERY Conception Corp. used crystal and 50,250 LED lights to create the artwork "Winding River, Flourishing Flowers, Dome of Lights." In Songshan District, a bountiful culture is nurtured by a meandering river and the surrounding natural landscape. This artwork, inspired by the special poetic sense of this place, serves as a platform for an encounter that includes the geographical surroundings and people. Tens of thousands of vertical pipes of various lengths create an organic, hollowed-out shape, like flowing waves in a bay. As the structure extends freely within the high-rise space, it creates a visual experience of multiple layers and angles that reflects the abundant, bright historical origins of Songshan. The magnificent, large light sculpture becomes a Dome of Light reminiscent of a hundred flourishing flowers.

Its organic force, full of vitality, dances to produce a rich, sensory experience that pays tribute to the cultures of Songshan, both ancient and modern. It also expresses the hope we hold for the future.



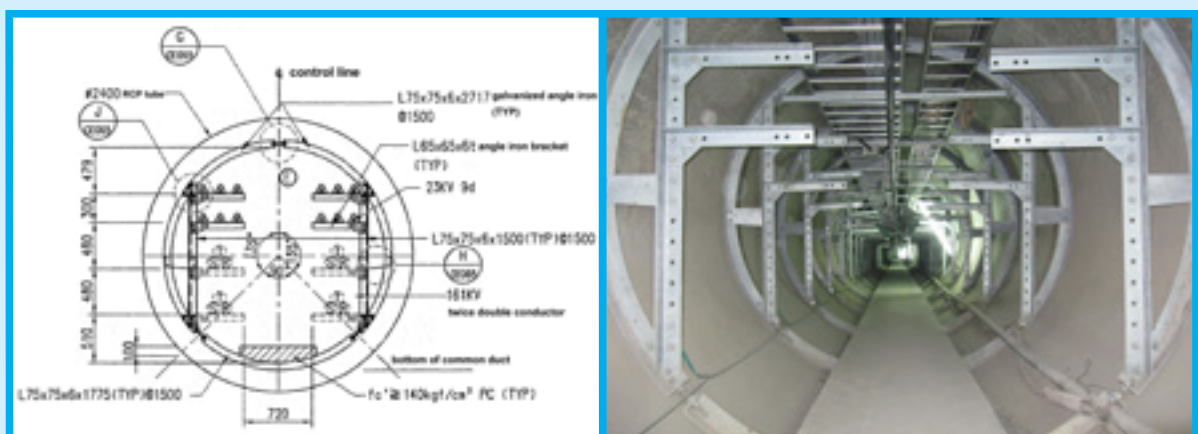
Artwork "Winding River, Flourishing Flowers, Dome of Lights" by artist Chiang Yang-Huei of VERY Conception

## Simultaneous Improvements to Nanjing East and West Roads

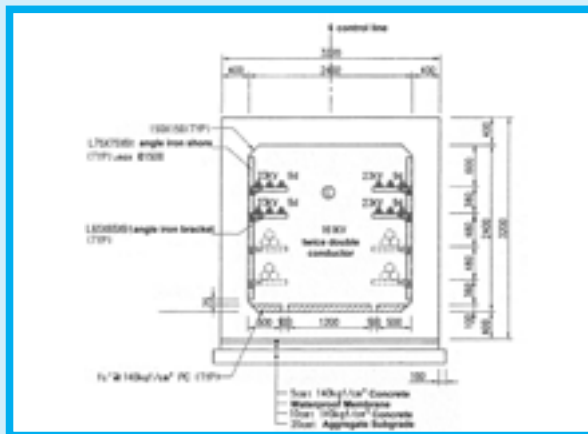
### 1. Common Duct Construction along Nanjing East and West Roads

Common duct construction, built in conjunction with the Songshan line project, was conducted in accordance with plans announced by the responsible agency, the New Construction Office of the Taipei City Public Works Department. Construction started from the intersection of Xinsheng N. Rd. and Nanjing E. Rd. Sec. 2, and ended at the intersection of Tayou St. and Nanjing E. Rd. Sec. 5. The common duct accommodates electricity (transmission and distribution), water, and telecommunication pipelines. It includes a 3,708-meter-long cut-and-cover tunnel section and a 374-meter-long jacking section.

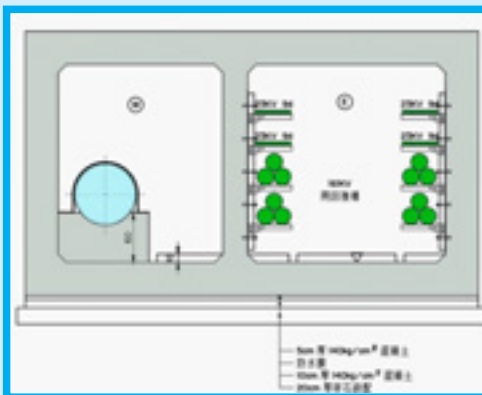
Although conducting common duct construction in conjunction with MRT development increased the overall interface and added difficulties, benefits will include reduction of road excavations, improved road quality, and enhanced disaster rescue preparations. Common ducts will also facilitate pipeline maintenance and renovation to avoid future excavations and their impact on traffic and the city.



Pipe jacking construction



Single-hole culverts



Double-hole culverts



Aboveground vent shafts belonging to common ducts on Nanjing East and West roads



A management center for common ducts along Nanjing East and West roads

## 2. Environmental Renewal Project along Nanjing East and West Roads

Expansion of sidewalk broadening scope was conducted in conjunction with the Environmental Renewal Project along Nanjing East and West roads, in accordance with plans by the Taipei City Department of Urban Development. The renewal project extended across 5.6 kilometers, starting from Chien Cheng Roundabout at the intersection of Nanjing W. Rd. and Chongqing N. Rd. then passing along Nanjing W. Rd. and Nanjing E. Rd. Sec. 1-5 after intersecting Zhongshan N. Rd. Improvements were made to sidewalks, vegetation, bike lanes, facilities, common duct supply pipelines and special sections. Renovation and addition of street lamps, traffic signals and signs were also conducted.





Median strips and common duct facilities



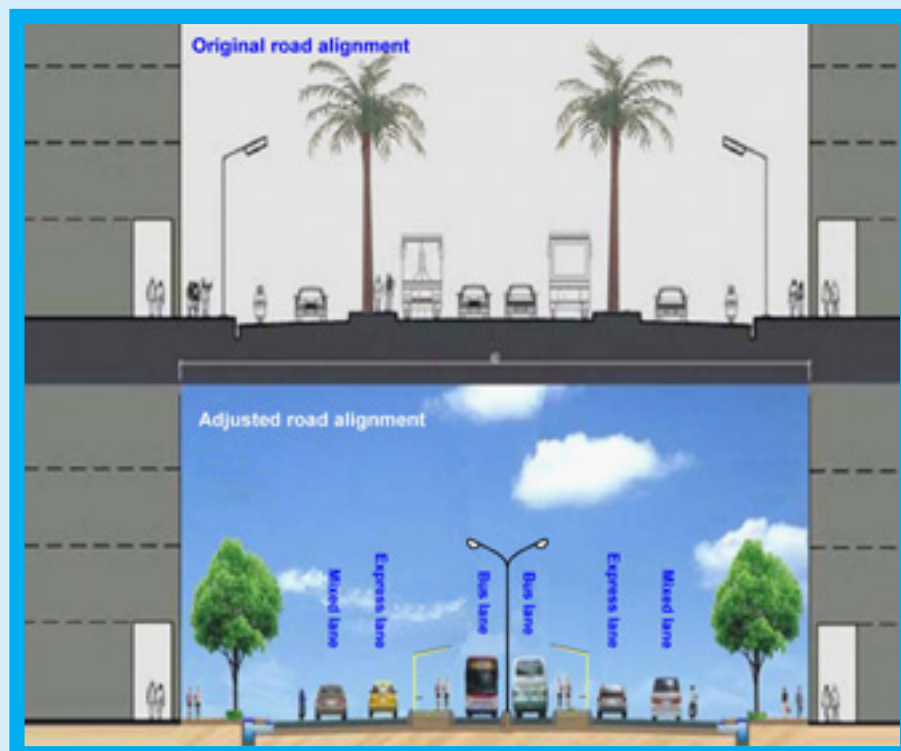
Sidewalk vegetation



Shared traffic signal pole



Integration of traffic signals and streetlight poles



Public environmental renewal project along Nanjing East and West Roads

### 3. Addition of Corridor-style Bus Shelters along the Songshan Line

DORTS' Central District Project Office (CDPO) held a meeting to discuss beautification of corridor-style bus shelters along the Songshan line with the Taipei City Department of Cultural Affairs, Public Transportation Office, and other related agencies on August 5, 2014. Conclusions included adoption of laminated and tempered glass for the bus shelter roofs. Unlike the Xinyi line, a gray-white color was used for the roofs to better block the sun. The Taipei City Public Transportation Office conducted shelter beautification and commissioned CDPO to handle construction supervision.

CDPO completed color planning of four bus shelters for both directions at the Nanjing-Fuxing intersection and Nanjing-Longjiang intersection (green for eastbound buses and blue for westbound buses) as well as the addition of signs pointing to major landmarks. The Taipei Fine Arts Museum was commissioned by the Department of Cultural Affairs to conduct bus shelter beautification.

A total of 19 corridor-style bus shelters were built along Nanjing East and West roads. Customized design includes a lightweight, earthquake-resistant steel frame and glass curtain as well as LED lamps. Coupled with the bus information system, these provide a user-friendly waiting environment for passengers.

In terms of construction characteristics, corridor-style bus shelters are lightweight. A modular design was adopted, and each shelter is conveniently composed of several units assembled to fit desired shelter length. Additional space was reserved on shelter platforms to avoid repetitive construction and facilitate future expansion based on increasing passenger volume.

#### Features of Corridor-style Bus Shelters:

- (1) Compared to traditional bus shelters that adopt a single dependent design, new shelters use a continuous rain cover design to provide additional space and shelter from wind and rain.
- (2) The 1-meter-long segmented seats used in traditional bus shelters were unable to meet demand during peak hours. The new shelters were therefore equipped with seats that are at least 12 meters long.
- (3) The unit design of new shelters accommodates demand by providing a bus stop area at least 32 meters in length.
- (4) New shelters provide better nighttime illumination and use LED lamps to increase brightness.
- (5) New shelters provide a user-friendly waiting area, traffic information and bus route guides.



Routes on corridor-style bus shelters distinguished by color



Compared to bus shelters along Xinyi Road, bus shelter glass roofs along Nanjing East and West roads better block the sun



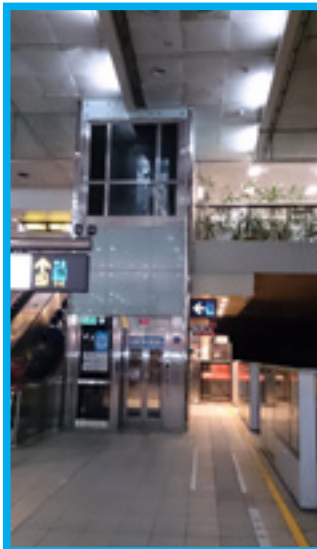
## Facility Improvements on Operational Routes

### 1. Renovations to Chiang Kai-Shek Memorial Hall Station Exit 1

In response to the needs of an aging society and transfer requirements for the future Wanda line, two elevators and an escalator were built at Chiang Kai-Shek Memorial Hall Station Exit 1.

After renovations are completed, there will be two escalators (one each heading up and down) from the ground level to the concourse level. Two elevators (one at the ground level leading to the concourse level and one for the concourse level to the platform level) will help passengers who use wheelchairs and passengers with baby carriages and luggage.

Renovations began in April 2013. Although the scale was small and station operations could continue, work items and construction interface were complex. In order to maintain regular power supply for the station and to test the Songshan line, work could only be conducted when the MRT was closed. During road recovery, obstacles such as pipeline belonging to Chunghwa Telecom and old foundation piles were encountered, leading to more challenges. Strenuous effort from the construction team over 18 months allowed renovations to be completed, providing passengers with more convenient passage.



An elevator between the concourse and platform levels



An elevator leading from the ground level to the concourse level

### 2. Improvements to Gutting Station Exits 3, 5, and 7

Improvement items proposed in 2012 included sidewalk widening along both sides of Roosevelt Rd. sections 5 and 6 as well as improvements to exits and widening of sidewalks along Roosevelt Rd. between Gutting and Jingmei stations. An assessment was then conducted on the installation of two-way escalators between Gutting and Jingmei stations to facilitate elderly passengers. At a review meeting, the Taipei City Department of Transportation concluded that only Gutting Station needed improvements. DORTS will change configuration at Exits 3, 5 and 7 from one escalator



and staircase to two-way escalators in order to meet the needs of an aging society and improve quality of service. Tendering was underway.

## Conclusions

Since the first Taipei MRT line opened in 1996, Taipei MRT has undergone a number of operational mode adjustments in conjunction with construction progress. This short-term expedient approach will end when the Songshan line, the last puzzle piece of the downtown Taipei MRT network, opens at the end of 2014. The network, which will meet the original design approved by the Executive Yuan, will be organized by color and number: Brown (Line 1), Red (Line 2), Green (Line 3), Orange (Line 4), and Blue (Line 5). This will not only facilitate easy recognition but also reduce time and cost expenditures, thereby making MRT travel more convenient.

MRT construction involved a series of tough challenges that were overcome by the hard work of construction teams. Local residents and people from all sectors of society also contributed. One engineer recalled that he was proud of working on the MRT following encouragement from a member of the general public. This kind of support allowed successful completion of the Songshan line. Convenient MRT services allow the public to enjoy added value through economic and cultural benefits and improved quality of life.

