Stakeholders

1. China State Construction Engineering Corporation
2. China Construction South Investment Co., Ltd
3. Shenzhen Metro Group Co., Ltd
4. China Construction First Building (Group) Co., Ltd
5. China Construction Third Engineering Bureau Co., Ltd
6. China Construction Fourth Engineering Division Corp., Ltd
7. China Construction Fifth Engineering Division Corp., Ltd
Stakeholders

- China Construction Eighth Engineering Division. Corp. Ltd
- China Construction Communications Engineering. Group Corp. Ltd
- China Construction Installation Engineering Co., Ltd
- China State Decoration Group Co., Ltd
- Guangzhou Metro Design & Research Institute Co., Ltd
- Engineering Supervision Consulting Co. Ltd., 4th China Railway Reconnaissance & Design Institute (Hubei)
Map for cities of available subway operation in China
Shenzhen

China’s 1st special economic zone
GDP of 2015 is 262.8 billions US dollars.

City Of Maker

City Of Piano

City Of Design

Urban Rail Transit Line 9 in Shenzhen – Zhou Zhe
Sketch map of No.9 urban rail transit line in Shenzhen
Design parameters

1. Duration 37 months
2. Include 22 stations, 21 sections
3. Length of shield TBM tunnel is 29,707m
4. Length of mining method tunnel is 4,482m
5. Number of construction methods is 8
6. Excavation diameter of the TBM tunnel is 6.28m, while mining method tunnel is 6.1~14.85m
The project passes through four kinds of landform of coastal beaches, plains, plateaus, hills.

The project passes through 22 kinds of Stratum such as coastal rock, hard rock, sand stratum etc.

The project underneath pass 46 buildings.

There are 7 locations underneath passing subway or railway tracks closely.

The project underneath passes through 5 rivers or lakes.

Surrounding Environment
Challenges

Management
The whole project is managed by only one contractor.

Schedule
The project need to be completed from start to operate within 50 months.

Surrounding
Surrounding environment is very complicated.

Geological conditions
The geological condition is very complicated.
Surrounding environment of metro stations is very complicated.
Dense buildings around metro stations
Number of removal

Utilities removal
387km

Urban house removal
16,000 m²

Trees removal
34,000
Bedrock uplift in deep foundation pits

Geologic structure is much varied.
Measures
The diversity of excavating ways

Drill + blast method

Composition of D&B method and shield TBM

Shield TBM method

Cut-and-cover method

In order to adapt to the varied characteristics of strata, the diversification of enclosure structure forms is utilized.
The diversification of enclosure structure forms

- Diaphragm wall
- Wall-pile
- Upper-wall-lower-pile
- Bored pile
Reinforcement of ground near shield TBM’s launching/arriving shafts

1. Jet grouting pile
   Jet grouting pile strengthening has been used for soil and sand strata

2. Grouting
   grouting strengthening for gravel strata

3. Steel sleeve
   steel sleeve for strata which is plenty of water
25 shield TBM's were put into use in this project
‘1123’ management model

The 1st ‘1’ means the schedule management is regarded as the core.

The 2nd ‘1’ means the milestones are regarded as the main line.

‘2’ means the two basic documents (Project Plan and Liability Form).

‘3’ means the three reports (Daily/Weekly/Monthly Report of Project Schedule).
Green construction

1. Water recycle
   Solar energy

2. The first-time use of radial slot embedded in tunnel segments in China.

3. Noise & dust isolation shed
Other innovation

- Lift the whole shield TBM assembly
- Shield TBM thru prior station excavation
- Automatic monitoring
- Cut 137 piles in one shield TBM tunneling
In order to adapt to the varied characteristics of strata, the diversification of enclosure structure forms, construction methods and equipment types is utilized. Compared with traditional methods, it can save 23% of the time, 16% of the cost, reduce 28% carbon emissions.
Significance
The significance of the Project

Environmental protection

Adjust measures to local conditions

People-oriented

During construction of the project, correct principle is upheld all the time. Faced with complicated geological conditions and complex surrounding environment, the constructors adhere to "people-oriented, adjust measures to local conditions, environmental protection", the principle of the project management.
The significance of the Project

CSCEC has expanded its subway markets to 5 cities on the basis of this project. The idea of selection in complex strata for enclosure structure forms, construction methods and equipment types are spread to use in other cities which have similar geological conditions, such as Guangzhou, Dongguan, Huizhou, Nanjing, etc.
We have successively invited 15 China well-known academicians and other national experts to the project to solve the problem, to carry out seminars, invited major Chinese metro operators, such as Beijing Metro, Guangzhou Metro, Shanghai Subway to the project to visit and exchange experiences.
External evaluation

High quality project 1
All the tunnels have been named “high quality project” by Shenzhen Municipal Government.

National patents 3
18 China national patents are obtained.

China national “AAA” 2
The tunnel working sites are named China national “AAA” for recognized safety and civilization.

The owner’s appraisal 4
The owner has given a high appraisal to the project.
Adhering to the people-oriented, constructors of the project invited the residents of their nearby communities to visit working site to better know the meaning of the project and took a variety of measures to reduce dust, noise and light pollution to minimize disturbances to the residents’ daily lives that has won much support and cooperation.
THANKS