Delhi, India Metro tunnels & shafts

Construction Follow-up Design Services for Delhi Metro Phase III Contract CC-04 (TBM, Cross-Passages & Shafts)

Delhi, India

Project

Construction Follow-up Design Services for 3.30km of TBM tunnelling, cross-passages and two (2) rescue/escape shafts for Delhi Metro Rail Corporation Package CC-04, Delhi, India

Construction Cost

Total estimated cost: ~61 million €

Project Schedule

Design (OK - INDUS scope): 2014 – 2017
Construction (estimated): 2012 – 2017

Project Description

Services included construction follow-up and field change designs for:
- 3.30 km of twin bore TBM tunnelling (2*1.15km)
- TBM tunnel cross passages
- One (1) rescue shaft for retrieval of 4 TBMs
- One (1) escape shaft

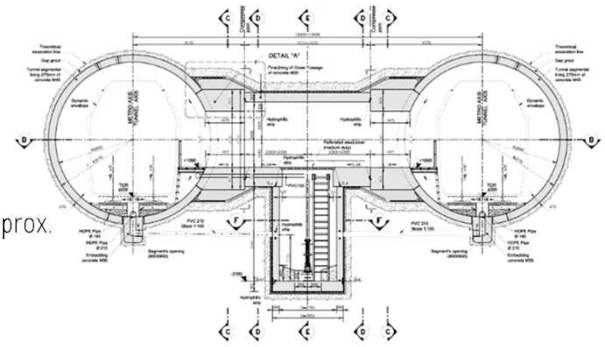
Pile construction – Rescue Shaft

<u>TBM twin bore tunnels</u>

Total length: ~3.30km (2*1.15km)
Cross section: 32m^2 Effect. cross section: 26m^2

<u>Shafts:</u>

Escape Shaft: Depth 28m, Length 8.5m, Width 5.2m
Bottom-up construction with D-walls
Rescue Shaft: Depth 27m, L-shaped, Exc. Volume approx. 7850m^3
Temporary support with contiguous and secant piles
Bottom-up construction of permanent works



Cross passage arrangement with sump

Excavation Method

- Tunnels: Mechanical excavation with EPB - TBM (Earth Pressure Balance Machine)
- Cross passages and Shafts: Conventional excavation

Geology

Normally consolidated soils, mainly silty sands to sandy silts
Water table

Our Services

- Design of cross-passages (excavation and temporary support, final lining)
- Design of TBM over-taking scheme
- Reports on prediction of settlements due to dewatering
- Design of Rescue Shaft temporary support. On-site presence and evaluation of geotechnical conditions at pre-design stage.
- Design of Escape Shaft and check of tunnel lining structural integrity due to shaft construction
- Evaluation of segmental lining steps, lips and gaps and proposals for repairs
- The designs were provided in common with INDUS CONSULTRANS Pvt. Ltd. India

Client

Continental Engineering Corporation –
CEC International Corporation India PVT LTD JV

Metro Stations

Detailed Design of one (1) UG Metro Station and of one (1) ancillary building for Contract No-CC 23 of Delhi MRTS Project of Phase-III, Delhi Metro Corporation

New Delhi, India

Project

Detailed Structural Design of one (1) Underground Metro Station and of one (1) Ancillary Building for Contract No-CC 23: Design and Construction of Tunnel between Hauz Khas Station and Kalkaji Station by Shield TBM, Tunnel near Chirag Delhi & Kalkaji Stations and Underground Ramp beyond Kalkaji Station by Cut & Cover Method, Underground Metro Stations at Panchsheel Park, Chirag Delhi, G.K.Enclave-1,Nehru Place & Kalkaji by Cut & Cover Method on Janakpuri West-Botanical Garden Corridor of Delhi MRTS Project of Phase-III, Delhi Metro Corporation, India

Construction Cost

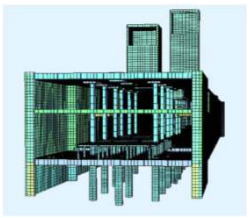
Total cost: approx. 25 m. €

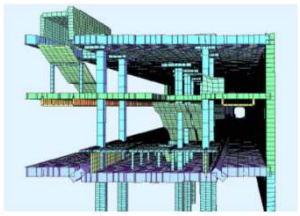
Project Schedule

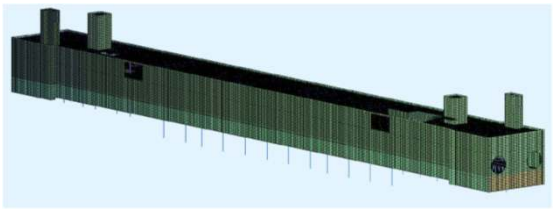
Design - Construction: 2013 ~ 2015

Project Description

Greater Kailash Enclave – 1 underground station
Length: ~ 267m, Width: 23.20m ~ 30m, Depth: 15.70 ~17.80m
Four (4) final levels: Foundation level / Platform level / Concourse level / Roof level
One ancillary building
Plan view dimensions: 27m x 23m
Height: ~13m







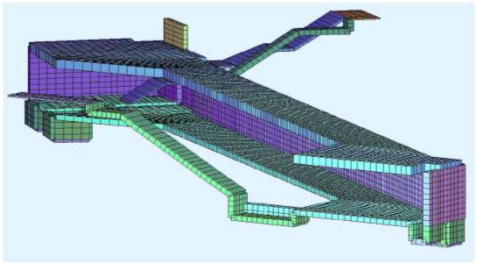
Greater Kailash Enclave – 1 Station 3D model

Construction Method

- Station: Construction by Top Down method with Diaphragm Walls
- Cross passages: Conventional tunnelling method (NATM)
- Ancillary Building – Entrances of station: Cut & Cover method

Final Lining

Concrete M40 for the station's permanent structures, Reinforcement Fe500D
Concrete M35 for ancillary building, Reinforcement Fe500D



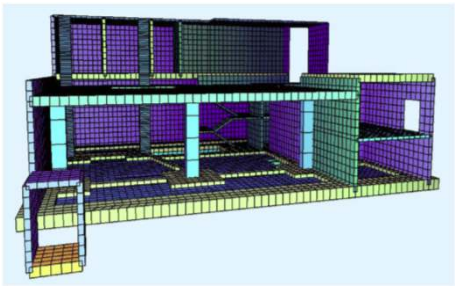
Greater Kailash Enclave – 1 Station entrance 3D model

Geology

Stiff silt & very stiff silt

Our Services

- Structural Design of the Station with 3D analysis models for the permanent situation and for each discrete part of the station according to the construction sequence
- Assessment of ground settlements within influence zone of station work
- Definitive Design of Cross passages, Sump Pit & Tunnel Drainage
- Structural design of entry & exit structures, tunnel ventilation shafts, supply & exhaust vent shafts and ancillary building at the area of the station
- Formworks (plan views and cross sections) and reinforcement drawings for the station, the entrances and the ancillary building and details for waterproofing of various structural elements
- The designs were provided in common with INDUS CONSULTRANS Pvt. Ltd. India



Ancillary Building 3D model

Client

FEMC-PRATIBHA JV

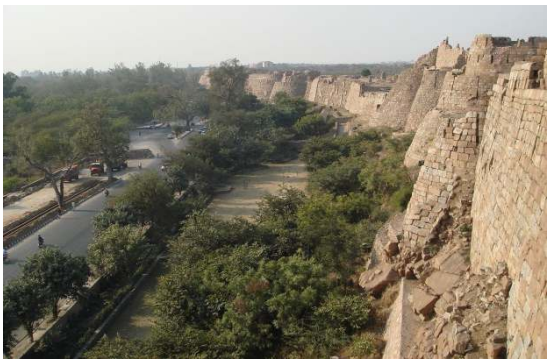
Metro tunnels & Stations

Archaeological Impact Assessment Study for ancient monuments/structures of Delhi Metro Phase IV

Delhi, India

Quila Rai Pithora ancient monument

Adilabad Fort



Tuglakabad Fort, walls in front of Mehrauli Badarpur Road

Gayasuddin Tughluk Tomb at Tughluqabad

Project

Archaeological Impact Assessment Study for ancient monuments/structures around Mehrauli Badarpur Road for Delhi Metro network expansion - Phase IV (Metro corridor from Aerocity to Tuglakabad) due to the construction of at grade and cut & cover stations and of TBM bored tunnels for metro

Construction Cost

Total cost (Aerocity to Tuglakabad Corridor): ~1,5 b. €

Project Schedule

Design: 2018

Project Description

Archaeological Impact Assessment Study for five (5) ancient monuments/structures due to Delhi Metro network expansion - Phase IV

Ancient Monuments: 1) Quila Rai Pithora, 2) Tuglakabad Fort, 3) Gayasuddin Tughluk Tomb, 4) Adilabad Fort, 5) Nai Ka Kot

Two (2) single track TBM tunnels

Length: ~ 2 x 3km Cross section: 35m^2

Construction Method

TBM tunnel: Mechanical excavation with EPB - TBM (Earth Pressure Balance – Tunnel Boring Machine)

Geology

Sandy silt, clayey silt and quarzitic rock, weathered strata man-made fill, groundwater

Overburden for TBM: 10~20m

Our Services

- Preliminary geological and geotechnical interpretative report
- Ground modification measures proposal
- Risk analysis report for avoidance of settlements and displacements
- 2-D & 3-D analytical modeling
- Initial assessment of tunnel behavior
- Analysis of stress redistribution
- TBM zone influence study
- Calculation of plastic zone formation around the tunnels
- Top tier alternative proposals
- Ground settlement contours within the influence zone of the tunnelling and stations' works
- Proposal for monitoring of ground settlements and of adjacent ancient monuments
- Assessment of TBM required support pressure
- Designs provided in common with INDUS CONSULTRANS Pvt. Ltd. India

Client

Delhi Metro Rail Corporation Limited India (DMRC)