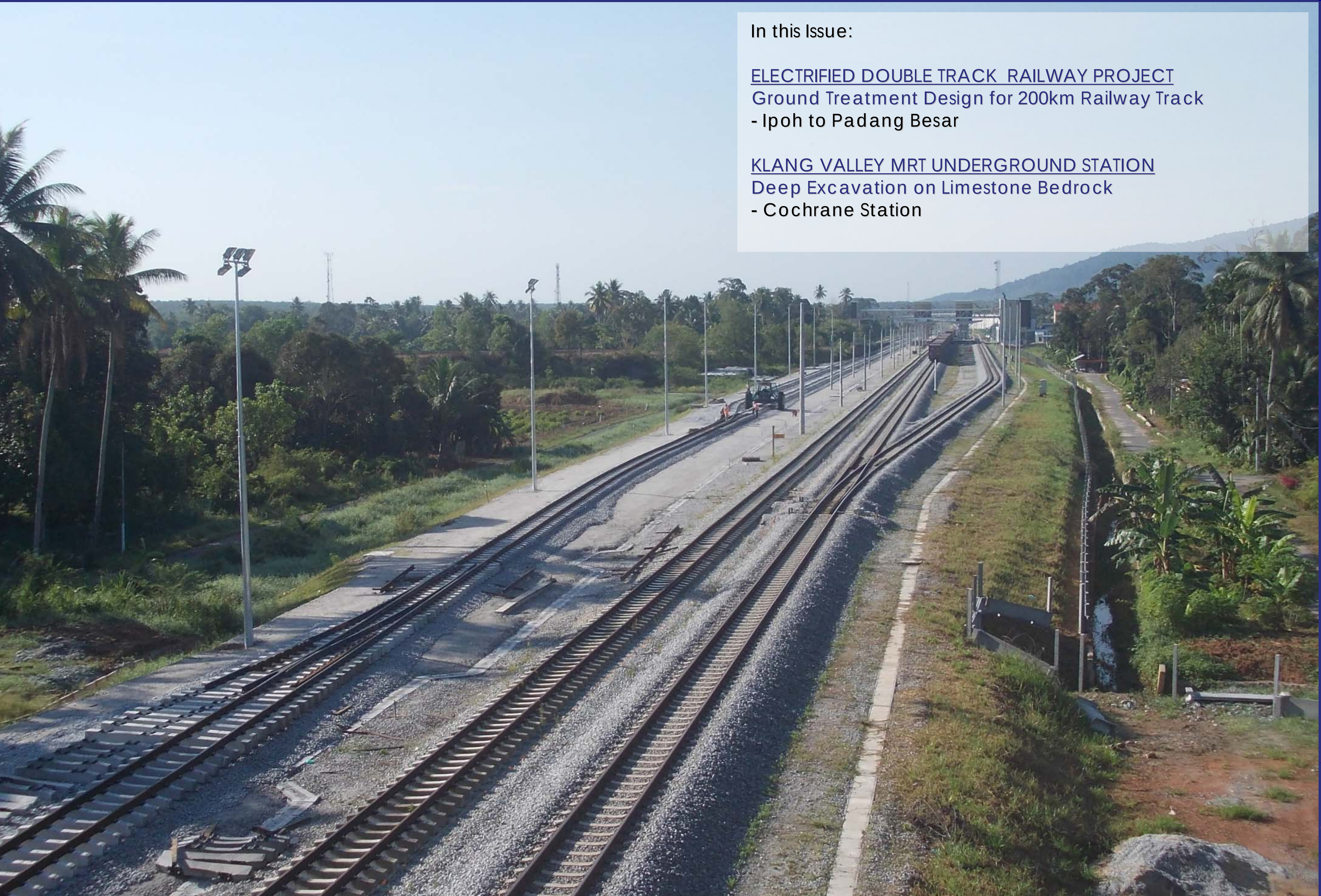
Newsletter of G&P Professionals Group

G&P DIGEST

Issue 6 : July – December 2013



In this Issue:

Ground Treatment Design for 200km Electrified Double Track Railway Project in Northern Peninsular Malaysia

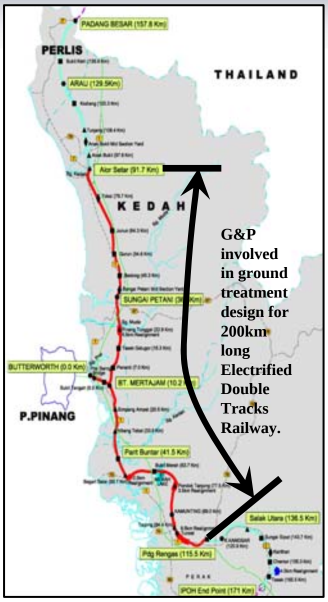


Figure 1: Location of Electrified Double Tracks Railway

Introduction

The Malaysian Government has decided to extend the electrified double track railway from Ipoh to Padang Besar in Peninsular Malaysia. The electrified double track railway generally follows the alignment of the old railway line from Ipoh to Padang Besar with a total distance of 350km as shown in Figure 1. G&P is the consultant engaged by MMC-Gamuda Joint Venture Sdn Bhd to design the ground treatment for about a 200km stretch of the electrified double tracks from Padang Rengas to Alor Setar. The design speeds for passenger train and freight train are 180km/hour and 90km/hour respectively. The designed axle loads are 20 tonnes and 16 tonnes for passenger and freight trains respectively.

The Challenges

As the railway tracks transverse a distance of 200km from north to south going through various geological formations, (Figures 2 and 3), the subsoils vary from soft alluvium deposits to dense residual soils.

In addition, the geometrical tolerance of railway tracks is very stringent, especially for trains with high a design speeds of 180km/hour. The design performance requirements include differential settlement of not more than 10 mm over a chord length of 10m and settlement of not more than 25mm within 6 months after completion.

Hence, various ground treatment designs are required to meet the performance requirements and construction schedules are required, especially when long stretches of the embankment supporting the tracks are traversing very soft to soft alluvium deposits with thickness of 15m to 20m.

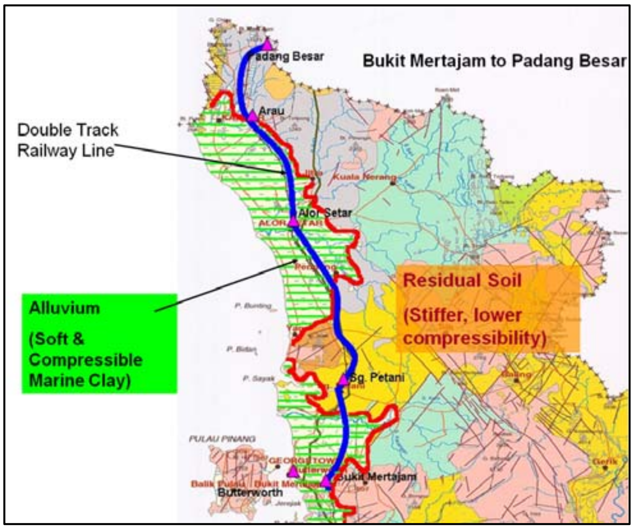


Figure 2: General Geology for Electrified Double Tracks Railway from Bukit Mertajam to Alor Setar

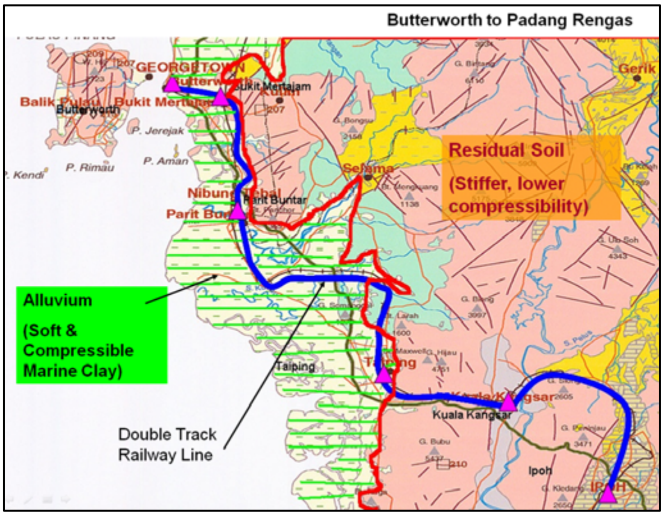
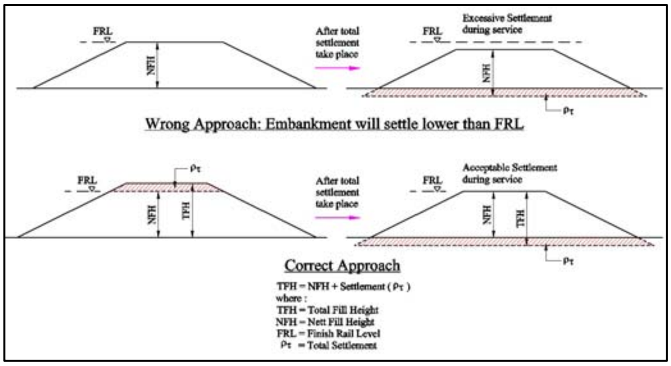


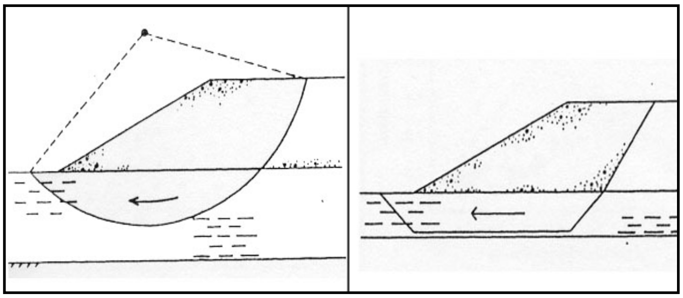
Figure 3: General Geology for Electrified Double Tracks Railway from Butterworth to Padang Rengas

Design for Embankments

Settlement Analyses

Construction of embankments will cause settlement to take place in the subsoil during and after filling especially for soft clay. Therefore, it is necessary to evaluate the magnitude and rate of settlement of the subsoil supporting the embankments. The design concept is shown in the adjacent figure. It is of utmost importance to ensure long term settlement is within the acceptable tolerance.





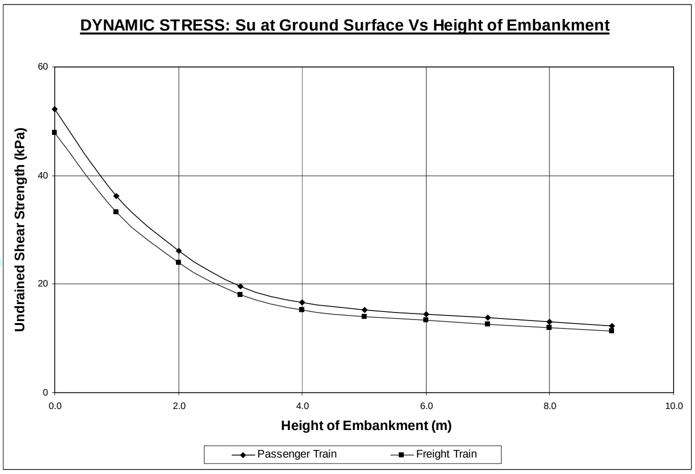
Stability Analyses

The stability of the embankment is assessed with consideration for different potential failure mechanisms namely circular (Modified Bishop Method) and non-circular (Modified Janbu Method). The Factor of Safety (FOS) during construction is 1.2 and the FOS for long term is 1.4.

Dynamic Analyses

Other than stability analyses (static effect), dynamic effect analyses were also carried out to determine the safe configuration of the railway embankment in order to prevent excessive subgrade deformation and failures due to repetitive axle loads.

Empirical formulae based on speed, probability factors and track conditions are adopted for the computation of the Dynamic Amplification Factor (DAF)

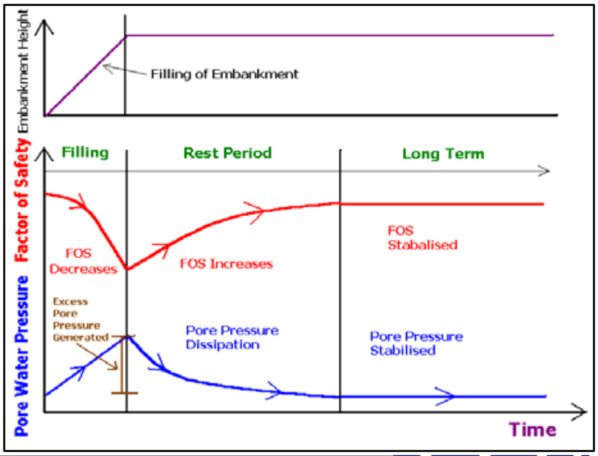


Undrained Shear Strength Required for Dynamic Stress Effect

Embankment Behaviour on Soft Ground

The behaviour of an embankment's Factor of Safety and pore water pressure changes on soft ground are most critical (highest risk of failure) during filling and least critical (lowest risk of failure) in the long term during the operation of the embankment track.

The Factor of Safety of embankment over soft ground against excess pore water pressure is shown in the adjacent figure, which shows highest risk of failure at the end of filling.



Use of Ground Treatment

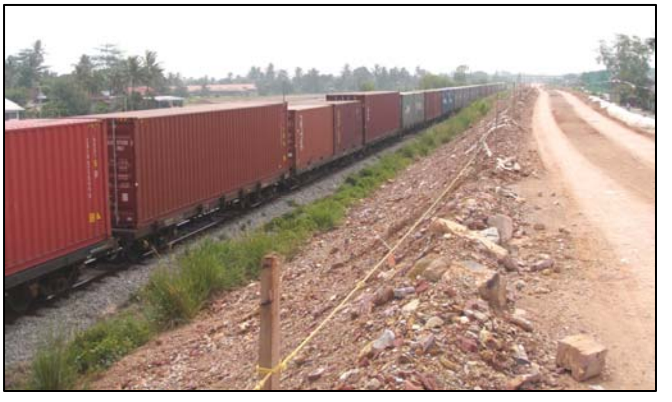
Ground treatments are used to fulfill the specified settlement criteria and to ensure adequate stability of embankment and prevent collapse. Generally, some ground treatments are required in soft ground areas due to its high compressibility and low bearing capacity.

Adopted Ground Treatment Techniques

a) Excavation & Replacement of Soft Soil

Typical Cross Section and Photo showing Temporary Sheet Pile for E&R.

b) Surcharging



Embankment fill with surcharge beside existing live tracks

c) Prefabricated Vertical Drain (PVD)

Typical PVD Machine working beside the Live Track

d) Stone Columns

Installation of Stone Columns adjacent to Existing Live Track.

Conclusions

The basic key ingredients for a successful ground treatment to achieve the performance requirements (stability and settlement) for design and construction of high speed railway embankment area as follows:-

(a) Awareness of project requirements and specifications
(b) Knowledge of the site and subsoil conditions
(c) Proper geotechnical design
(d) Full time proper supervision and care as well as proper monitoring of the performance of the embankment.

Klang Valley Mass Rapid Transit
Underground Station @ Cochrane, Kuala Lumpur

Introduction

The Klang Valley Mass Rapid Transit (KVMRT) from Sg.Buloh to Kajang is one of the major infrastructure projects launched in 2011. It is the first MRT project in Malaysia. The project involved a 9.8km long tunnel from Semantan to Maluri with 7 underground stations and associated structures such as portals, ventilation shafts, escape shafts and crossovers to be constructed over the Klang Valley and Kuala Lumpur city areas.

Cochrane station is one of the underground stations located in the city area (Figure 1) with a maximum excavation depth of 32m below ground level. This station also serves as a launching shaft for the tunnel boring machine from both ends of the station. This is also the first underground station of the KVMRT project to have reached its final excavation level.

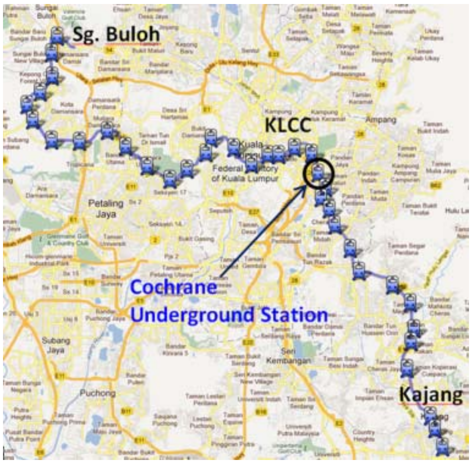


Figure 1: Location of the construction site

Geological Conditions

Cochrane station is located within the Kuala Lumpur Limestone formation (Figure 2) which is well known for its highly erratic karstic features with irregular depths of soil above bedrock.

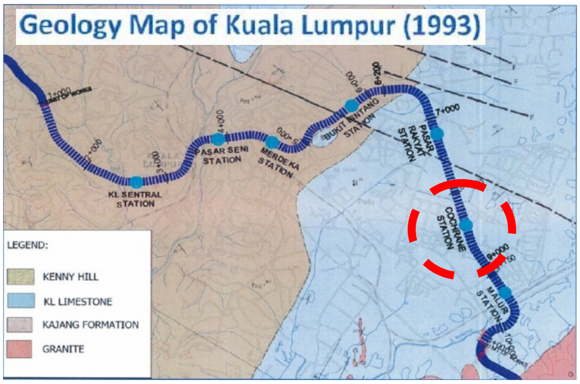


Figure 2: Geological map of Kuala Lumpur

Design for Excavation Works

Photo (a) Looking south

Photo (b) Looking north

Excavation works for the Cochrane station consist of overburdened soil and rock excavation to the required depth for TBM launching, preparation and also permanent structure construction. A rectangular cofferdam measuring about 37m x 176m was constructed to facilitate soil excavation to the bedrock level. Continuous vertical rock slope excavation with face support to the final excavation level was carried out with just 1m offset from the retaining wall alignment. Photo (a), shows the north face of station box. Photo (b) shows the TBM launching face upon reaching the final excavation depth.

Figure 3 shown schematic of excavation works at Cochrane station. The selection of the retaining structure has to consider the workability and suitability of subsoil and rock conditions. A secant pile wall was selected as the earth retaining wall tied back with a temporary ground anchor (Figure 4). The advantages of the selected wall type are (i) water-tightness to prevent groundwater draw-down on the retained side; and (ii) the ability to vary the pile lengths to suit the irregular limestone bedrock profiles. Secant piles of 880mm and 1000mm in diameter were designed with an overlap of 130mm and 200mm respectively representing 15-20% of pile diameter. The extent of overlapping of the secant piles are governed by pile installation verticality, pile deviation and pile depth.

The rock excavation was carried out using controlled blasting with adequate protection. The blasting works were carried out in 2 to 3m benches. After blasting, geological mapping was carried out by qualified geologists to collect field data on the exposed rock face including details of discontinuities, rock face weathering conditions, etc. to determine suitable rock strengthening works.

Grouting work was also carried out for limestone to reduce the rate of groundwater inflow into excavation and reduce water pathways around excavation areas.

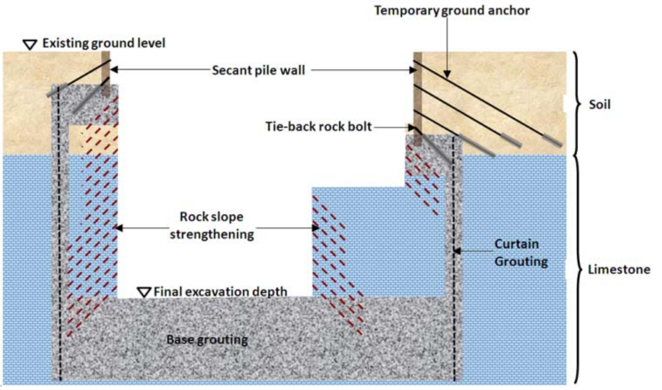


Figure 3: Schematic of excavation works (Note: Actual locations and length of rock slope strengthening are determined after geological mapping works and kinematic analysis).

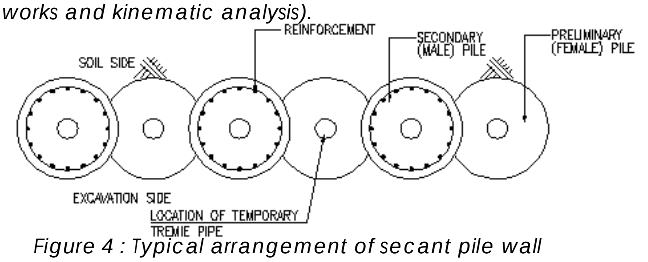


Figure 4 : Typical arrangement of secant pile wall

Fissure grouting involves a single packer in ascending or descending stages in order to inject grout suspension into existing pathways, fissures, cavities and discontinuities within the rock formation. Rock fissure grouting is also adopted for base grouting at larger grout hole spacing. If any cavities are detected during drilling / grouting, compaction grouting with cement mortar will be used as cavity treatment.

Achievement

With proper geotechnical input, costly failure and delay associated with underground works in limestone formation such as excessive groundwater lowering, occurrences of sinkholes, excessive ground settlement, etc. can be prevented. It is important to have continuous feedback from the construction team to anticipate such problems and such model of cooperation between the construction team and G&P geotechnical engineers has proven to be successful for the excavation works at Cochrane station.

(front) Ir. Dr. Gue S.S (Managing Director) and Ir. Tan Y.C. (Project Director)

Design Team : (from left) Ir. Koo K.S. , Lee Y.C , Chee F.W. and Tong H.S.

Christmas Party 2012

Christmas Party being a G&P annual event was held on 20th December 2013. Some of the highlights were Caroling, mini games as well as a memorable gift exchange session. The event was full of joy fun and exciting moments.




Site Visit @Damansara Uptown Phase 2

G&P Professionals being a company emphasizing continuous learning and knowledge sharing has continuously provided various types of training to its engineers for their personal and professional development. The G&P training committee has organized a site visit to an on-going project site known as Damansara Uptown Phase 2.

The site visit was a very beneficial experience to all engineers as it was undergoing various geotechnical works. Many site activities can be witnessed, such as construction of secant pile wall, installation and stressing of ground anchor on the secant pile wall as well as bored piles construction. The site visit was also accompanied by a few of our experienced engineers Ir. Darryl Fong and Ir. Loh Yee Eng for on-the-spot explanation and clarification.







CORPORATE PROFILE

G&P Professionals Group consists of the following specialist engineering consulting firms that provide a wide range of quality engineering services:

- G&P Geotechnics Sdn. Bhd.
- G&P Structures Sdn. Bhd.
- G&P Infra Sdn. Bhd.
- G&P Maritime Sdn. Bhd.
- G&P Claims & Contracts Sdn. Bhd.
- G&P Project Management Sdn. Bhd.
- G&P Water Sdn. Bhd.
- G&P R International (Cambodia) Co. Ltd.
- G&P Highways & Transportation Sdn. Bhd.
- G&P Dams & Water Services Sdn. Bhd.
- G&P Professionals (Sarawak) Sdn. Bhd.
- NGI - G&P Sdn. Bhd.
- G&P Water (Singapore) Pte. Ltd.
- G&P - AA International Consultant Joint Stock Company, Vietnam
- G&P Professional (Sabah) Sdn. Bhd.
- G&P R&D Sdn. Bhd.
- G&P M&E Sdn. Bhd.
- G&P Special Structures Sdn. Bhd.

The Group has a fast expanding pool of highly qualified and experienced Geotechnical, Civil & Structural, Mechanical & Electrical, Infrastructure, Maritime, Water, Highways, Railways & Transportation and Dams Engineers, Engineering Geologists and technical support staff.

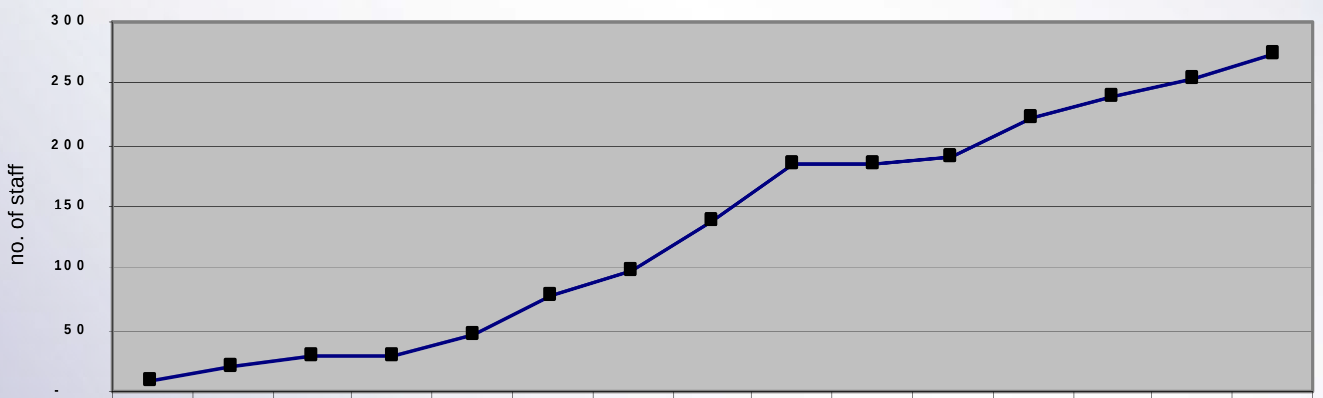
The Group has several associated organisations overseas where value added is further enhanced. The project activities are handled by the specialists within the Group who explore innovative and economical solutions tailored to the needs of the projects. Our research and development culture has ensured that our services are always at the forefront of world trends.

Associated Organisation

NGI Norwegian Geotechnical Institute Norway

G&P PROFESSIONALS GROUP OF COMPANIES

Staff Strength From September 1999 to April 2013



	Sept 1999	Sept 2000	Sept 2001	Sept 2002	Sept 2003	Sept 2004	Sept 2005	Sept 2006	Sept 2007	Sept 2008	Sept 2009	Sept 2010	Sept 2011	Sept 2012	Apr 2013
No. of Employees	10	21	28	30	45	79	99	139	184	186	191	221	239	255	273

Year

G&P Professionals Sdn Bhd
Wisma G&P
39-5, Jalan Tasik Selatan 3,
Bandar Tasik Selatan, 57000 Kuala Lumpur, Malaysia.
Tel : 60(3) – 9054 1612 /9059 5396 Fax : 60(3) – 9059 5869
Email: gnp@gnpgroup.com.my www.gnpgroup.com.my