REPORT FROM MEMBER SOCIETIES

Thai Geotechnical Society and A review of some important geotechnical works in Thailand

Background of the society

Thai Geotechnical Society, TGS, was originally formed as one of the technical committees of the Engineering Institute of Thailand, EIT, under HM The King patronage in 1993. From then on, it has played an active role in promoting technical advances and research activities in the field of geotechnical engineering in Thailand. With increasing demand in its activities, the committee decided to establish TGS in 2008 and joined the International Society for Soil Mechanics and Foundation Engineering in the same year. Currently the numbers of Thai geotechnical engineers are estimated to be around 2,000 and are working in the country and abroad.

Geotechnical engineering in Thailand

Geotechnical engineering has first been recognized as an important field in its own right in Thailand in 1960's, following the guidance of Professor Chai Mukthabhan of Chulalonkorn University, who is regarded as the Father of Soil Mechanics in Thailand (Fig. 1). Establishment of the Asian Institute of Technology (AIT) in Thailand in 1959 has also been a major impact to geotechnical engineering in Thailand. AIT has been at the forefront in introducing the subject to the country, thanks to pioneering works of such academics as Professor E.W. Brand, Professor Z.C. Moh, Professor J.D. Nelson, Professor A.S. Balasubramaniam, Professor D.T. Bergado, Professor Prinya Nutalaya, and many others. Moreover, AIT has produced many good quality researches, and has been the focal point of geotechnical education in the region. Nowadays, there are more than 30 universities in Thailand that offer graduate programs in geotechnical engineering. As part of infrastructure development in the country, geotechnical engineers have played an important role and many core members of the TGS have been actively involved in the development. Some of the major projects are described in what follows.

Fig. 1 Professor Chai Mukthabhan, Father of Soil Mechanics in Thailand

Soft Bangkok Clay and some related geotechnical problems

The city of Bangkok and surrounding area are situated over a thick deposit of soft clay. The subsoil consists of the layer of top crust underlain by the soft to very soft clay, which has the thickness of about 8 to 15 meters. The water content of the soft clay is ranged from 45 to 120 %. The liquid limit ranges from 40 to 120%. The shear strength of soft Bangkok clay is quite low, ranging from 6 to 25 kN/m^2. The soft to very soft clay layer is underlain by the medium and then stiff clay layers. Considering the difficult ground conditions, geotechnical engineering plays important roles in the construction in Bangkok and vicinity area. Many researches have been investigated in order to accurately predict the behavior of soft Bangkok clay.

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

Regarding earth retention system, conventional sheet pile with bracing system is normally used for the temporary excavation, which means the excessive lateral displacement cannot be avoided in some area. Diaphragm walls are normally used as a permanent structure for deep excavation. Barrette piles are cooperated in the diaphragm wall to increase the stability of the system and have proved to be successful. However, some failure happened and the lesson has been learnt. The collapse during construction of an inlet pumping station in 1997 brought concern to geotechnical engineers in Thailand about the design of deep excavation without adequate attention to the instrumentations and monitoring system. Due to the high demand in underground space utilization in Bangkok, there have been a relatively larger number of deep excavation projects, in the recent decades (Fig. 2).

Fig. 2 A boom in utilization of underground space in Bangkok

The post-construction excessive settlement is also the main problem of the earth structure in Bangkok area. Many highway embankments faced this problem directly which prompted numerous detailed studies to be performed to monitor and study the settlement behavior of the highway. One of the most detailed studies about consolidation behaviour of soft Bangkok clay was conducted for the Suvarnnabhumi International Airport (Fig. 3).Various methods for improvement of the soft clay have been used, such as conventional PVD preloading, soil cement columns, pile foundation, vacuum consolidation, etc. Most of the ground improvement works were successfully executed with relatively few technical obstacles. Today, prefabricated vertical drain is commonly used in highway construction. The technique has been proven to be successful in many highways. Another technique for reducing the excessive settlement is to transfer the embankment load to the firm stratum based on the pile foundation concept. In the past concrete pile has been used in highway construction but were not satisfactory due to the high construction cost. Therefore, soil-cement column technique has been studied and used in the recent highway construction because of more acceptable cost than concrete pile and shorter construction period than the vertical drain technique.

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

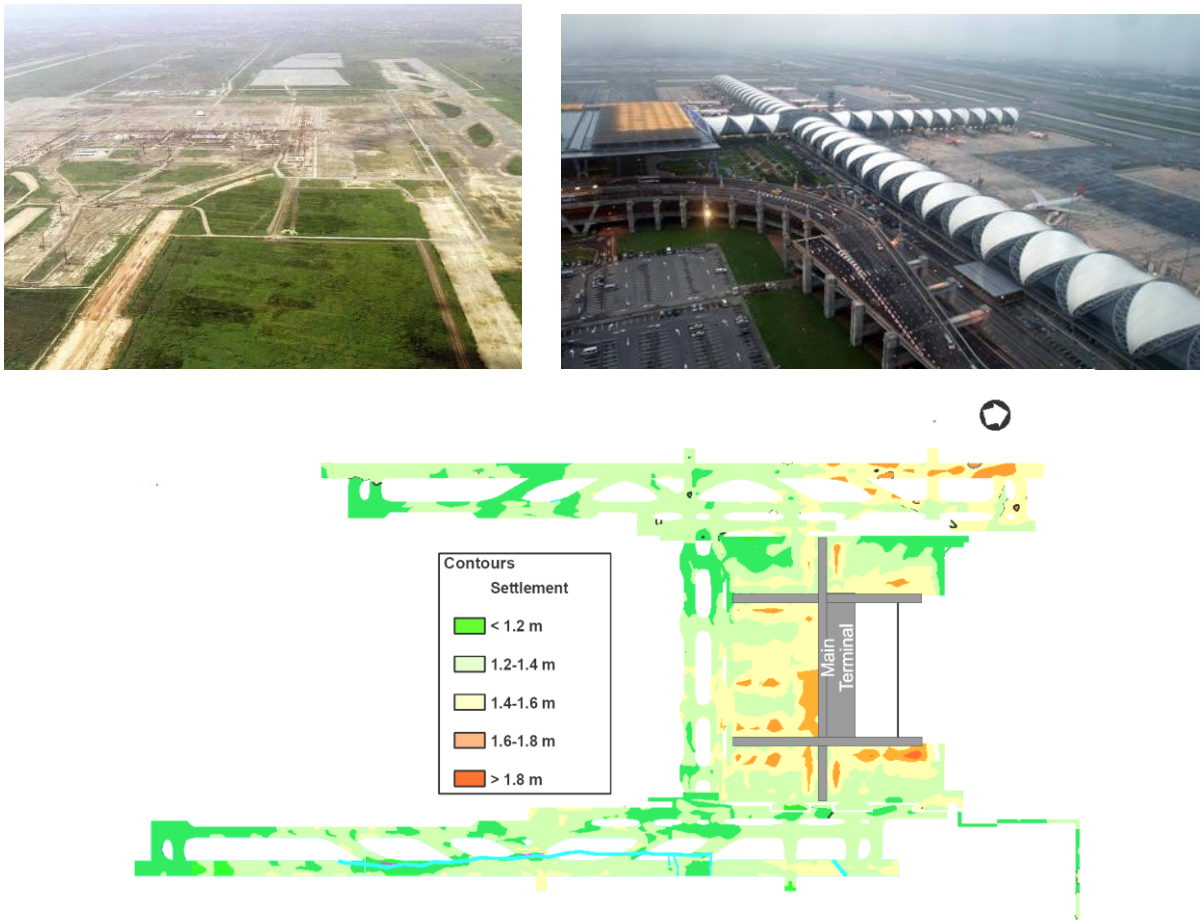

Fig 3 Suvarnabhumi International Airport and the contour of ground settlement at the end of preloading period

There are however some problems related to the use of soil-cement column as retaining structure in excavation of soft Bangkok clay and failures have been experienced in some projects (as shown in Fig. 4). These are related to two main reasons, namely 1) the variability of shear strength of the improved soils, and 2) the improved soil which is still very low in tensile strength due to presence of inherent defects. The success of the technique thus highly depends on quality control during making of cement columns. Many core members of the Thai Geotechnical Society have been active and instrumental in understanding and solving the problem (Fig. 4).

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

Fig. 4 Use of soil cement column in excavation of canal in the soft Bangkok clay, upper photo shows some related instability problem which had been solved and the lower photo shows the canal after completion

Tunneling

Tunneling activities in the soft Bangkok clay have been ongoing since 1990's. There have been numerous 3.2-m-diameter flood drain tunnels in Bangkok. In fact, the city was once the busiest place in the world in terms of the amount of pipe jacking tunneling activities. This situation has also proved very challenging in terms of tunneling-underground structure interaction (Fig. 5).

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

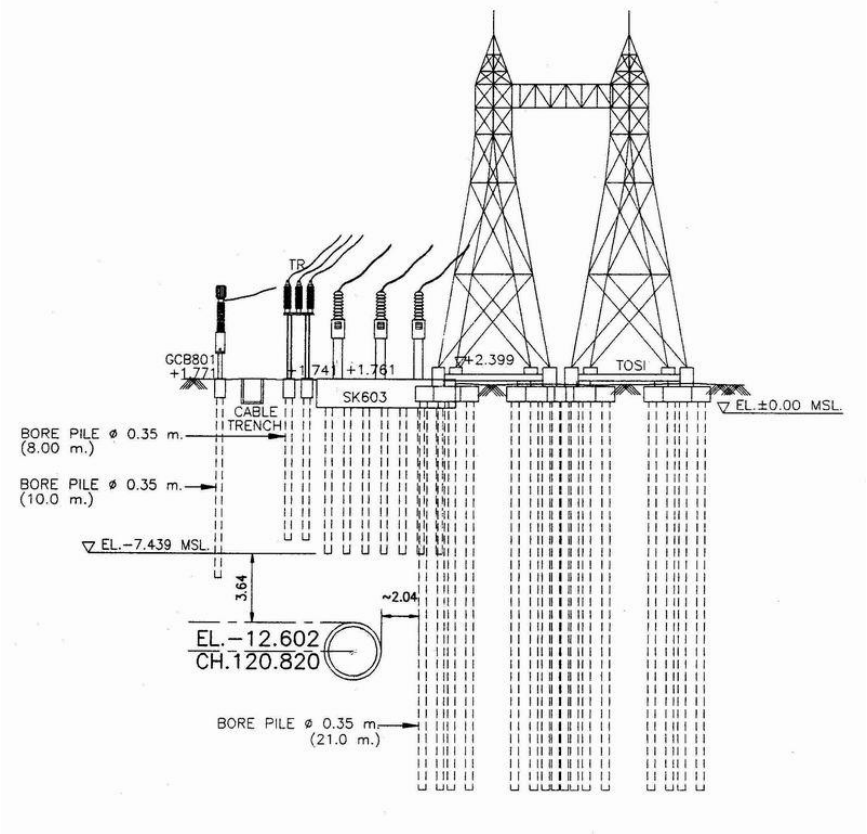

Fig. 5 Some tunneling activities and challenging situation in Bangkok

There is currently one underground railway line in Bangkok, the so-called MRTA blue line. One portion of this line is located underneath a street in the China town of Bangkok, where an underground station is also located (Fig. 6). Since this street is one of the busiest streets in Bangkok, closure of any traffic during station construction was not possible. As a result, the innovative mining method was proposed to construct the station. More underground lines are under the designing phase and are expected to operate in the coming decade (Fig. 7).

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

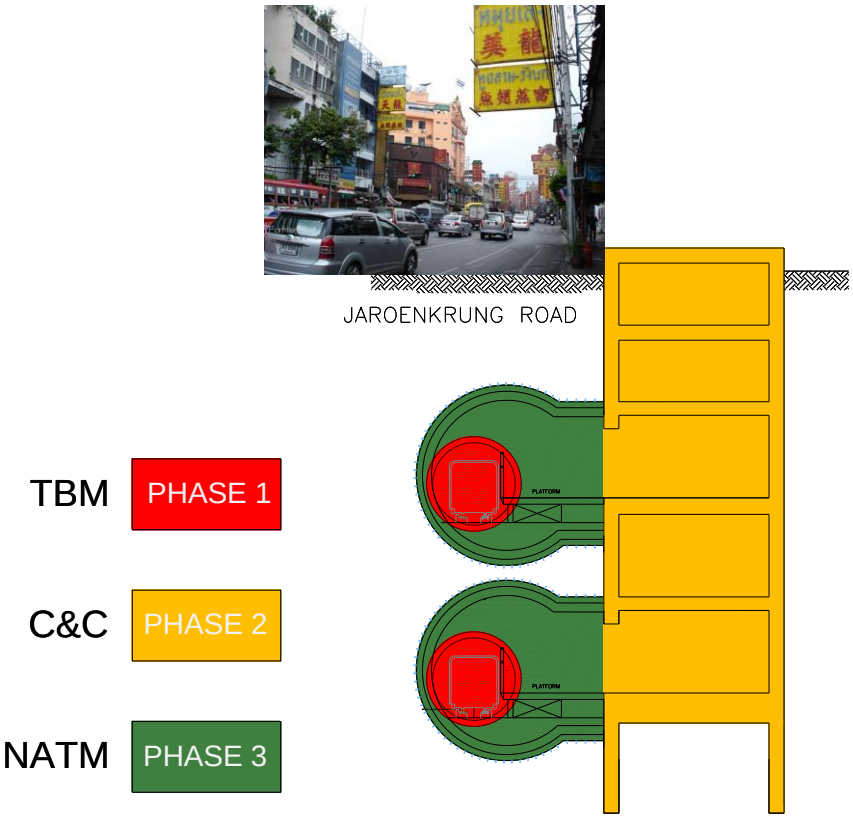

Fig. 6 Construction of a subway station in the China town of Bangkok

Fig. 7 Some tunneling activities for the MRTA system in Bangkok

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

Other tunneling projects in difficult grounds such as slaking rocks, such as siltstone & mudstones, in Thailand have been carried out successfully for the pumped storage power house project in Lamtakong as shown in Fig. 8.

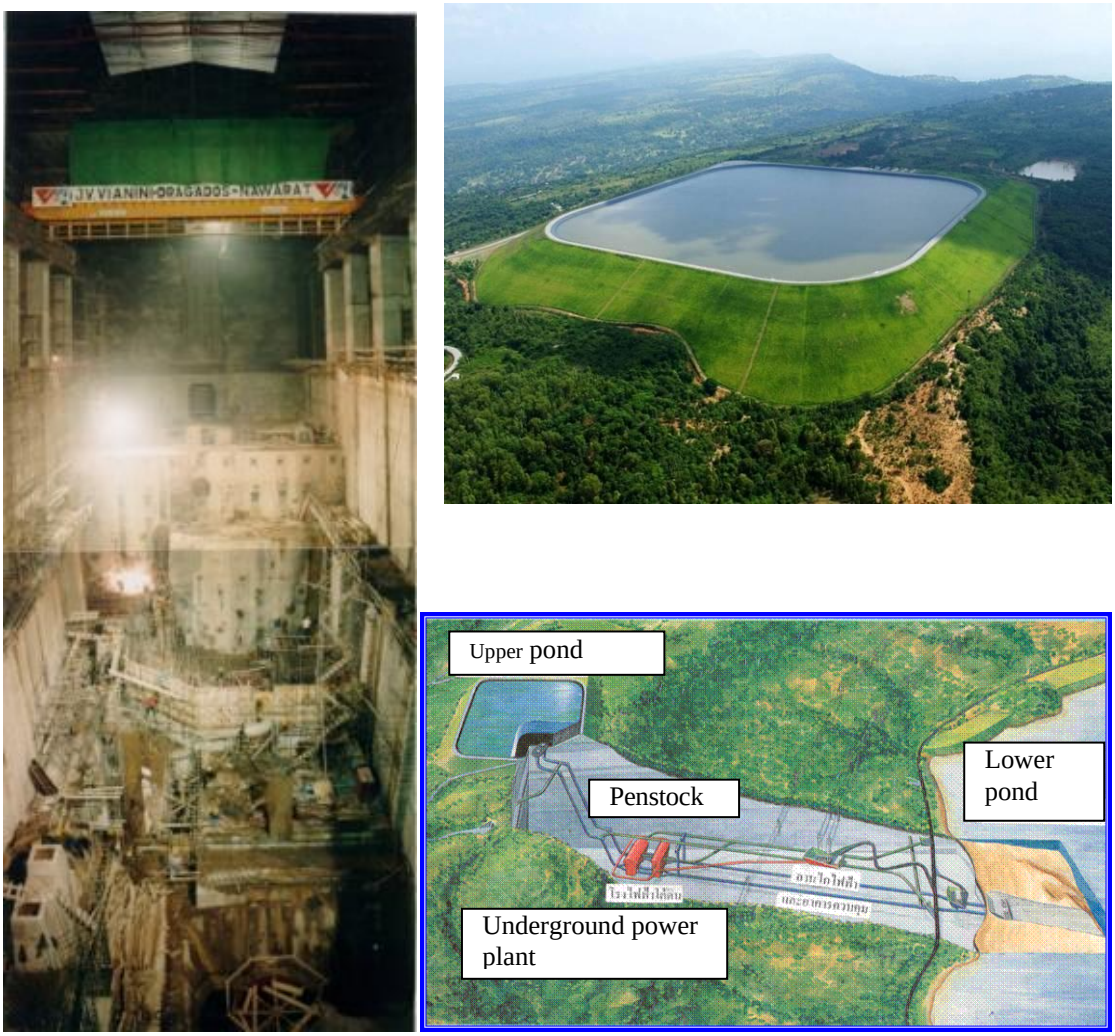

Fig. 8 Lam-ta-khong pumped storage project

Dams and the challenge

A number of large dams have been constructed in Thailand since 1960's. Thai engineers have become more confident in design, construction, evaluation and monitoring of such dams both in the country and neighboring countries such as Laos and India. For example, Thadan Dam in Nakornnayok Province, (Figs. 9 to 11) was once the largest roller-compacted concrete (RCC) dams in the world, constructed for irrigation purpose and more recently for electricity generation as well. In addition, many young Thai geotechnical engineers, researchers, and students had their opportunities to conduct various research based on real problems encountered during the construction, operation and maintenance of the dams.

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

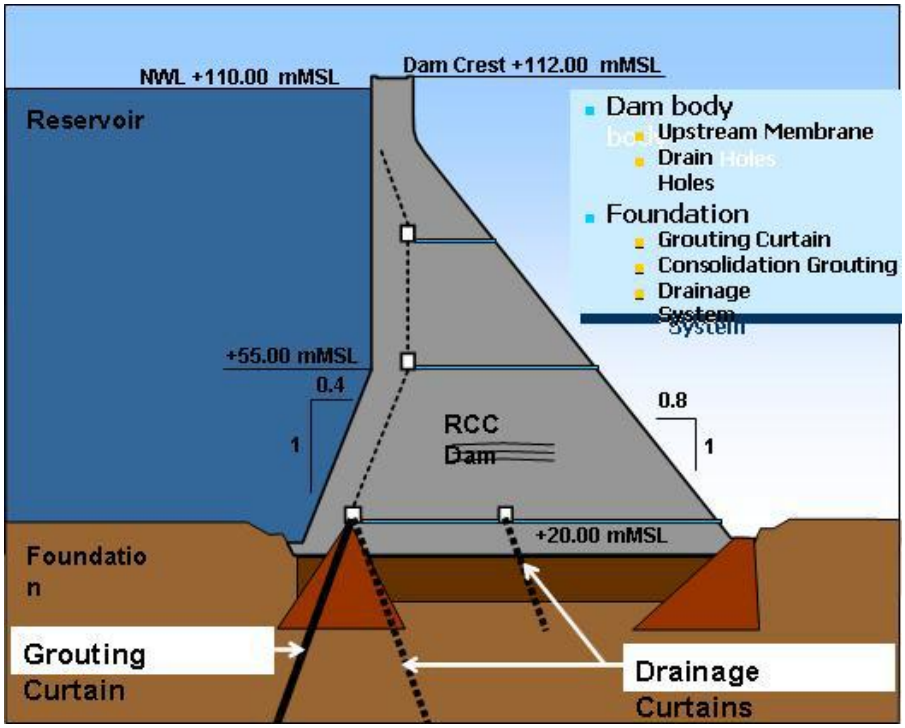

Fig. 9 Thadan dam – cross section for design

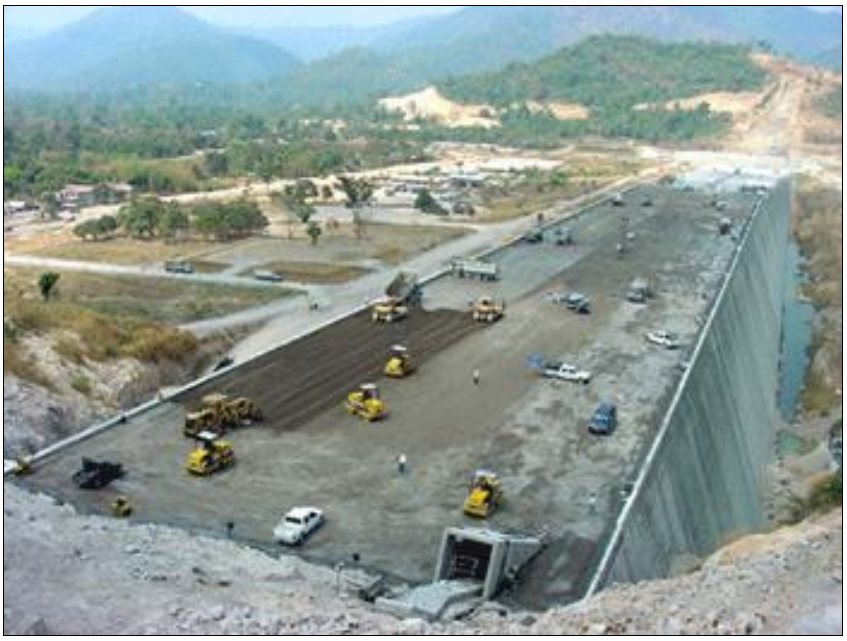

Fig. 10 Thadan dam - during construction

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

Fig. 11 Thadan dam - after completion

Landslides and other disasters

There has been a high demand of development near or on hillslopes, particularly in popular tourist resort towns such as Phuket, Samui, and Koh Chang. Thai geotechnical engineers and academics have been active in developing a safer design and construction method of foundation as well as slope stabilization method. The popular stabilization techniques include use of geosynthetics in reinforced soil slopes, soil nailing, horizontal drainage, as well as bio-stabilization such as vetiver grass utilization as well as natural geotextile (soil blanket) or limited-life geotextile (Fig. 12).

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

In addition for natural landslide such as debris flow, the geotechnical engineers are also developing the early warning as well as hazard mapping, based on geotechnical engineering method, GIS and remote sensing technique (Fig. 13).


To test the effectiveness of the soil blankets and cushions

Fig. 12 Challenging situations for slope engineering in Thailand, Construction of reinforced soil slope, vetiver grass utilization and soil blanket in slope protection

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

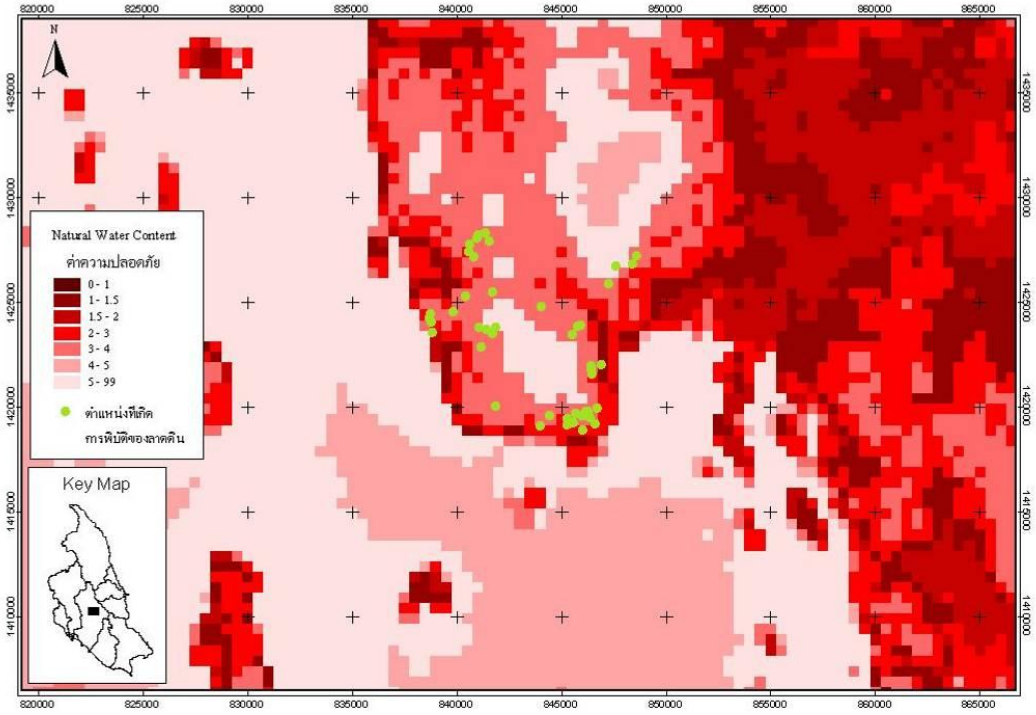

Fig. 13 Development of hazard mapping and early warning for large area landslide (contour showing Factor of Safety and its calibration with real landslide areas)

Education and international activities

TGS also encouraged a number of education and international activities such as conferences and short courses. Indeed, Research & Development has been growingly recognized as the important part of education and industry in Thailand in the recent decades. The first physical-modeling centrifuge apparatus has been manufactured in Thailand since 2005 and has been used both for research and practical work at King Mongkut's University of Technology, Thonburi (Fig. 14). Unsaturated soil mechanics has been taught in several universities in Thailand and has been gaining more practical use in analysis of soil-atmosphere interaction and landslide analysis. Several international conferences that TGS has supported include the followings.

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

Fig. 14 The first physical-modeling centrifuge apparatus manufactured in Thailand

In 2010, the Department of Highways of Thailand, with the support of TGS, organized the International Conference on Slope in Chaingmai which was very well received by many engineers from around the world.

In 2011, Geotechnical Engineering Research and Development Centre, Department of Civil Engineering at Kasetsart University, will organize the 5th Asia-Pacific Conference on Unsaturated Soils, which is supported by the Technical Committee 106 (unsaturated soils) of the ISSMGE and TGS (Fig. 15), with strong emphasis on various aspects of geotechnical practice including slopes and climate change problems. The conference will be held in Pattaya during 13-15 November 2011.

In 2012, the Thai Underground and Tunnelling Group, TUTG, of EIT will host the World Tunnel Congress, one of the most important events in the world of Tunneling, in Bangkok (Fig. 16).

Thai Geotechnical Society will continue to be proactive in collaborating with geotechnical engineers from around the world, thus contributing to the advancement of the profession both in the country and the region.

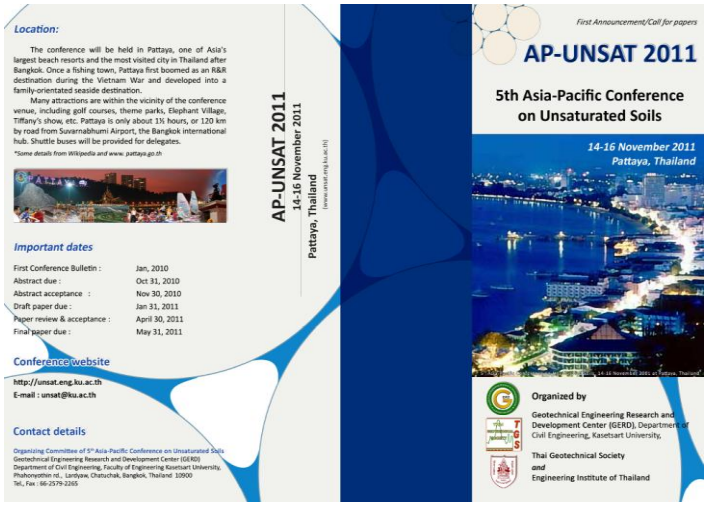

Fig. 15 AP-UNSAT 2011 conferences supported by TGS and EIT

REPORT FROM MEMBER SOCIETIES
Thai Geotechnical Society (continued)

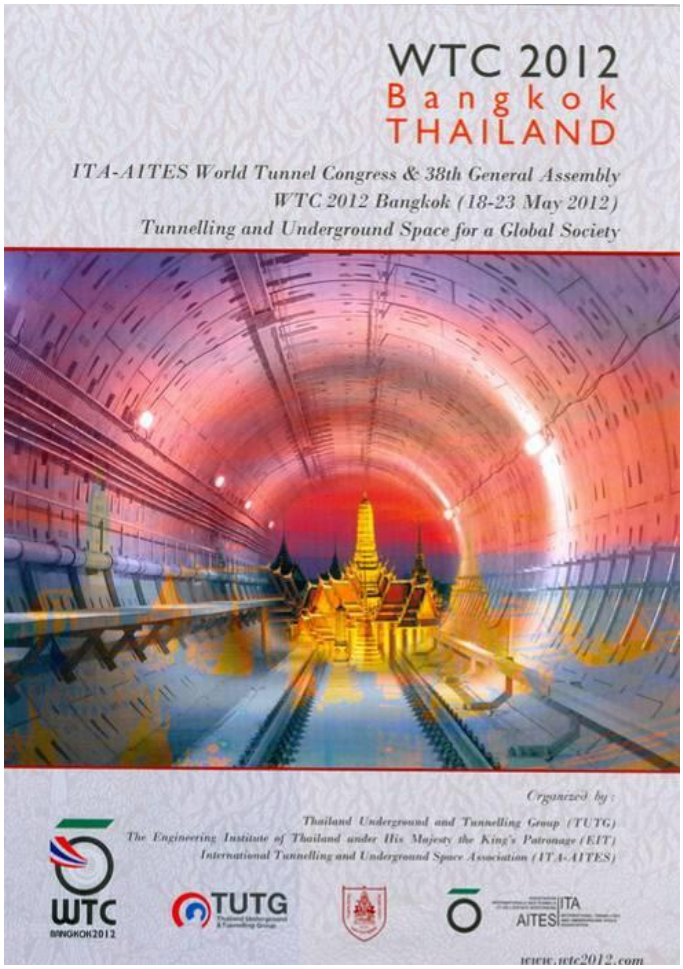

Fig. 16 WTC 2012 supported by TGS and EIT