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SUPER WELL POINT TECHNOLOGY WITH ADVANCEMENTS IN SOIL IMPROVEMENTS FOR LAND RECLAMATIONS

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The present technologies in ground improvements are limited to vertical drains with some using vacuum created with plastic sheets on the ground surface. The rate of improvements resulting from such vertical drains rely also very much on earth surcharges to more than 10 m high. This total method is time consuming and costly.

The Super Well Point (SWP) technology has further advanced with compressed air setup called SukKaraKan (SKK) in further accelerating the ground improvements applied to dredged and soft soils. Less surcharge, or if required, for achieving much better what other present methods could perform in time and degree of consolidation.

This paper also shares some achievements more superior than other presently available methods in soil improvements and ground consolidation of soft soils.

The use of SWP-SKK advances land reclamations in accelerating consolidation settlement and degree of consolidation thereby creating "newland" for land scarce Singapore with less sand imports hence costs and time efficiencies.

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Keywords: Ground improvements; dredged and soft soils; consolidation settlement, super well technology; advancements; newland; reclamations

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1. Introduction

Ground improvements of soft soils have been undertaken massively in Singapore for least four decades notably for Changi Airport and many foreshore land reclamations. Since then, the technology adopted involved vertical drains and variations of vacuum applied at the ground surface to improve the drainage of ground water. This is called vacuum consolidation that is a form of pre-loading equivalent to about 4.5 m thick of sand surcharge. Surcharge using sand embankments of 10 m are commonly placed over vertical drains for consolidation settlements to take place. Such methods are slow and costly to stabilize and improve very soft and thick soils like marine clay very common in Singapore. Dredged soils too are soft and are increasingly being used as land reclamation materials due to sand shortage.

Super well point technology specially creates vacuum within a steel tube inserted into any grounds at any depths required so as to dewater the ground water. Instead of many closely packed vertical drains, one super well point has influence zone of up to almost one hectare in drawing down the ground water table. This patented technology of dewatering was used for many years in Japan to keep deep localized excavations dry for construction purposes more efficient than that of using the normal well point. It was around late nineties that the idea of using SWP for ground improvements was conceived and motivated for large-scale soil consolidation and stabilization by the authors. By extracting large amounts of ground water in especially soft grounds, consolidation settlement with improvement of strength occur much readily. Many projects were undertaken successfully using SWP.

The idea of using SWP for ground improvements in Singapore was further augmented contiuously by the authors about 17 years ago. Subsequently, with new trials in overcoming more challenging thicker and very soft soils such a marine clay and peats, new patented advancements and techniques were developed to further overcome challenges in land reclamations. Amongst various patented techniques, one of the central advancements is the use of compressed air set up, also called Qin Tako together with SWP. The patented system of hardware, techniques and procedures together is called the SukKaraKan (SKK) and how these all act together with SWP would vary with the ground conditions and extent of ground improvements needed. Comparing with vertical drain techniques, with much less surcharge if required and in less time can be achieved to the same standard of settlement and degree of consolidation without appreciable increase in costs.

SWP-SKK can be employed for Singapore's needs to create more sustainable land improvements in the reclamations of untapped land with less reliance on sand as a land fill as well as for surcharge embankments. With dredged materials as sustainable landfill, SWP-SKK can provide a sustainable creation of "newland" in Singapore's development.

2. Super Well Point

2.1 SWP configuration

SWP is a patented well pumping system as shown in Fig. 1 consisting of these basic hard wares:

- Tubular steel casing perforated at the bottom section and wrapped with special well screen.
- Vacuum system within the casing with submersible pump inside and a vacuum pump outside.

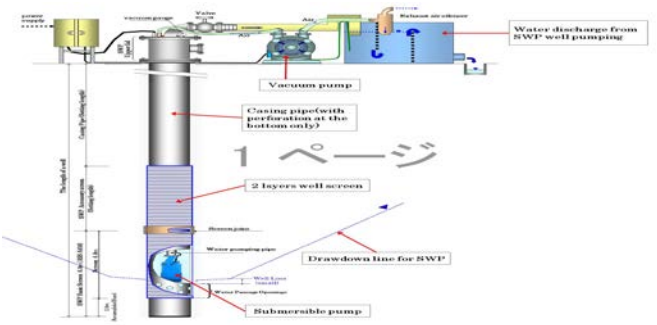

Fig1: Super Well Point

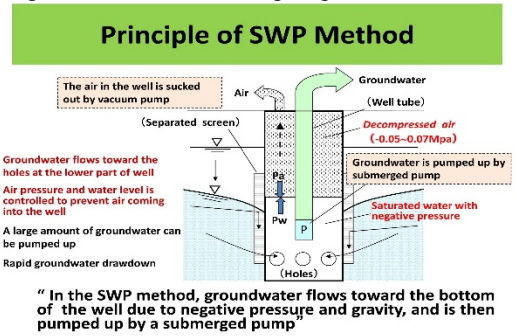

Fig 2: Principle of SWP Method

The specially patented features of the SWP ensure superior pumping efficiency. The bottom section of the pipe is perforated to allow ground water while surrounded by specially designed SWP screens to prevent debris to enter the casing. There were two layers of screens – one inner screen and one outer screen.