Pipe Jacking Method in GRP Pipe Technology & Installation

TUNNELLING AND UNDERGROUND SPACE ENGINEERING TECHNICAL DIVISION

reported by

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GRP (Glass Reinforced Plastic) pipes are widely used in Europe and the Middle East to convey fluids in industries such as Oil & Gas, Petrochemical, Water & Sewage. But these are not commonly used in Malaysia.

To raise awareness among local engineers on the use of GRP pipes, a half-day seminar on GRP Pipe Technology & Installation Using Pipe Jacking Method was held at the Chin Fung Kee Auditorium, Wisma IEM, on 19 January, 2018. It was attended by 17 participants including 1 committee member of the Tunnelling & Underground Space Technical Division (TUSTD), IEM.

The seminar was conducted in 2 sessions. The first session covered GRP pipe technology and the second was on case studies using such pipes in various industrial applications. The speakers were Dr Hassan Assaee and Ir. Neo Boon Kheng.

Dr Hassan Assaee is Assistant Professor of Mechanical Engineering at Shiraz University of Technology and the Engineering Director of Farrasan Manufacturing and Industrial Company, a major manufacturer of GRP pipes in Iran.

Ir. Neo Boon Kheng is a consultant on trenchless technology to many pipe jacking contractors in Malaysia as well as a committee member of TUSTD.

Dr Assaee began the first session with an introduction to GRP pipe technology, covering its production process, quality control, stiffness classes and load capacities. He also addressed the design criteria for flow coefficients, hydraulic and mechanical properties, with respect to other types of pipe materials and design of pipeline in a few case studies involving installation of buried pipes, above ground pipes and pipe jacking.

He explained that GRP pipes are normally designed for a lifecycle of more than 50 years, with design and testing done to ASTM, AWWA or ISO standards. The pipes are manufactured using either centrifugal casting with pipe walls built from the outside inwards on a rotating mould (around 40% of worldwide production) or filament winding with pipe walls built from inside outwards, on a rotating mandrel (60% of worldwide production) and can be either uniaxial or biaxial. GRP pipes are normally specified with the following 3 parameters:

- Diameter (DN) – designates the inside nominal diameter of the pipe.
- Pressure (PN) – indicates the long-term pressure rating (bar) the pipe is designed, to a minimum safety factor of 1.8x.
- Stiffness (SN) – higher SN values indicate the higher ability of the pipe to resist against external bending loads.

Table showing Comparison of GRP Jacking Pipes vs RC Jacking Pipes

COMPARISON		
	GRP-JP	**RC-JP**
Internal Diam. (mm)	900	900
Wall Thick. (mm)	30	147
Outside Diam. (mm)	960	1194
Weight (kg/m)	175	1249
C-Value	150	110
Corrosion Resistance	High	Low
Force Main Lining	Not required	Steel Pipe
Number of Jacking per pipe pice	Once	Twice (RCJP + Steel Pipe)
Joint Type	Flushed GRP Collar	Stainless Steel Collar + Weld
Joint Test	N/A	Radiographic
Lubrication Nozzle	Rarely required	Once every 1 pcs jacking pipe
Handling/maneuver at site	Excavator	Crane
Installation speed	**8 pcs per day**	**3 pcs per day**
Jacking Machine	Uses 750 Machine, Smaller, lower operating jacking force, lighter	Uses 1200 Machine, Bigger, Higher operating jacking force, heavier

Table showing Comparison of GRP Pipes vs MS Pipes vs DI Pipes for open trench installation

OPEN TRENCH INSTALLATION			
	GRP	DI	MS
C-Value	**150**	**120**	**110**
Internal Diam. (mm)	500	504	572
Outside Diam. (mm)	515	532	608
Weight (kg/m)	27.42	111.5	100.10
Corrosion Resistance	High	Medium	Low
Site Condition	Licit from Palm farm, high water table, pit soil	Dry, granular soil	Dry, granular soil
Joint Type	**REKA Coupling**	**Push-in, flange and welding**	**Weld**
Joint Test	N/A	N/A	Radiographic
Handling/maneuver at site	Backhoe	Crane Excavator	Crane / Excavator
Installation speed	**10-15 pcs per day**	**5-8 pcs per day**	**3-4 pcs per day**

EXCEL PIPES

Encik Ali Zareh explaining the different pipe wall thicknesses used for gravity pipe, pumping main and jacking pipe

Participants listening attentively to the speakers

In the second session, Ir. Neo presented case studies and shared his experience using GRP pipes to replace MS pipes in the original design in *Pakej D44 – Pembinaan Rangkaian Paip Pembetungan di Bunus, Setapak (Reka & Bina)*. He explained that the original design, using MS pipe of DN 1000 mm, involved jacking a larger diameter RC pipe sleeves with MS pipe installed inside the sleeves but for the DN 900 mm GRP jacking pipes, no RC pipe sleeves were required. A GRP pipe of smaller diameter was possible due to its better conveying capacity as its Hazen-William C value was 150 while that of the MS pipe with concrete lining was 110. The jacking operation for the presented stretch using GRP pipes could be speeded up as the pipe diameter was smaller, lighter and required lesser jacking force. He then highlighted some of the advantages of using GRP jacking pipes to replace the RC jacking pipes.

In addition to the case study presented by Ir. Neo, Encik Ali Zareh of Excel Pipes also presented a case study that used GRP pipes for a water supply project in Lukut, Negeri Sembilan by Jimah East Power Sdn. Bhd.; the project will be handed over to Syarikat Air Negeri Sembilan (SAINS). It involved the use of 3 different types of pipe materials, i.e. MS, DI and GRP pipes of DN 500 mm. Some of the advantages of using GRP pipes were also presented. ■

IEM DIARY OF EVENTS

Title: 2nd International Conference of Women in Science, Engineering and Technology (WiSET)

17-19 July 2018

Organised by: Women Engineers Section
Time : 8.00 a.m. - 6.00 p.m.
CPD/PDP : Applying

Title: 1-Day Course on Chemical Risk Reduction

18 July 2018

Organised by: Disaster Risk Reduction Advisory Board (DRRAB)
Time : 9.00 a.m. - 5.00 p.m.
CPD/PDP : 6.5

Title: 2-Day Course on "Plumbing - Professional Competency Examination (PCE) on the Syllabus of Hydraulic - Design Considerations"

18-19 July 2018

Organised by: Building Services Technical Division
Time : 8.30 a.m. - 5.15 p.m.
CPD/PDP : 14

Kindly note that the scheduled events are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.