Case-history

Singapore Experience in Press-in Piling

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Singapore is among the first country in Southeast Asia to adopt the press-in piling technology. Being a small heavily built-up country, the installation of sheet pile retaining walls often faces severe challenges such as close proximity to existing buildings in drainage works, low headroom under a bridge and concerns on safety, noise and vibration to nearby buildings. Picture 1 shows the installation of sheet piles right next to existing property for drainage improvement work using the Press-in Method in Singapore (2008). Picture 2 shows the installation of sheet piles very close to existing residential dwellings by the Silent Piler (2012).

Picture 1 Installation of sheet piles in 2008

Picture 2 Installation of sheet piles in 2012

In view of possible adverse impacts on adjacent buildings in terms of noise and vibration, the National Environmental Agency (NEA) of Singapore issued new guidelines on maximum permissible noise levels for construction works for Mondays to Saturdays (Figure 1) and for Sundays in 2007. It should be noted that construction works are generally not allowed on Sundays if there are residential buildings and hospitals within the vicinity of the construction. In addition, there are also vibration limits specified by the government agencies and authorities and the recorded vibration measurements must not exceed the desired value. Otherwise stop work orders may be issued till remedial measures are taken to ensure that the recorded noise and vibration limits would not be violated during construction.

CONSTRUCTION NOISE CONTROL

Maximum Permissible Noise Levels for Construction Work Commenced on or after 1st October 2007

Mondays to Saturdays

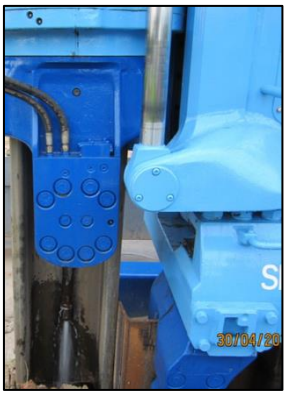
Types of affected buildings	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	65 dBA (Leq 1 hr)	-
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

Figure 1 Construction noise control

In view of the above, a number of Singapore government agencies/authorities such as Land Transport Authority (LTA) which is responsible for the construction of Singapore Mass Rapid Transit (MRT) station and tunnels, has specified that silent piling technique needs to be employed in projects with adjacent buildings nearby such that the noise and vibration levels would fall within the limits specified by the authorities. Picture 3 shows the Silent Piler being used to install sheet pile at a MRT site for an ongoing Thomson-East Coast Line construction in 2017. Public Utility Board (PUB) is another government agency that requires the press-in piling to be adopted in its works due to its many drainage improvement works (Picture 1) and infrastructure development such as cable tunnel construction.

Picture 3 Press-in piling at a MRT site

With the successful implementation of silent piling for many years in Singapore, the recent development involving press-in technique is the installation of sheet piles and steel pipe piles into harder grounds such as hard stiff soils or even weak rocks. These include the use of Water Jetting System (Picture 4) and Super Crush System (Picture 5). Another recent application of press-in technique in Singapore is to use silent piling to extract existing installed sheet piles and driven piles. It has been found that with the conventional method of extracting sheet pile, the soil would move and fill in the gap left behind after extraction resulting in movements or tilt of adjacent structures. With careful control using the Silent Piler and simultaneously back filling the gap, the movement of adjacent buildings is minimized.



Picture 4
Water Jetting System

Picture 5 Super Crush System

With the support of IPA Research Grant, field studies were carried out in the past 2 years to monitor the noise and vibration in selected sites with press-in piling and conventional piling techniques such as vibratory hammer. A sample recorded noise levels versus distance from the piling is shown in Figure 2. It is evident that the recorded noise levels due to silent piling are considerably lower than those due to conventional piling. However, the difference in noise level is less distinct when the distance exceeds 20 metres from the piling location. Two issues are worth mentioning. It is found that in some sites, the noise levels caused by the power source (Picture 6) can be as severe as or even more severe than that due to silent piling. It is thus worth investigating how to reduce the noise level of the power source. On the other hand, the traffic noise at some sites can be as severe as that of piling and this factor is beyond the control of the construction personnel.

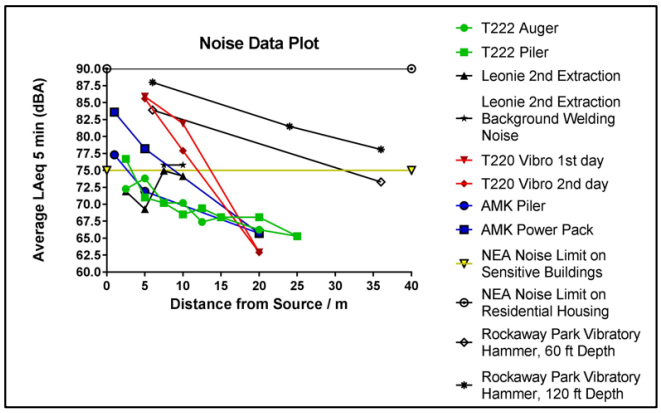


Figure 2 A sample of noise data plot

Picture 6 Power source of construction site

To ensure safety and comfort of adjacent structures, the vibration level is an important indicator. Figure 3 shows the recorded vibration measurements versus distance away from piling location for the studies. The same observation can be made at near distance to the piling location, the silent piling causes considerably less vibration than that due to conventional piling. Once the distance to 20 m and beyond, the difference in the recorded vibration levels is insignificant.

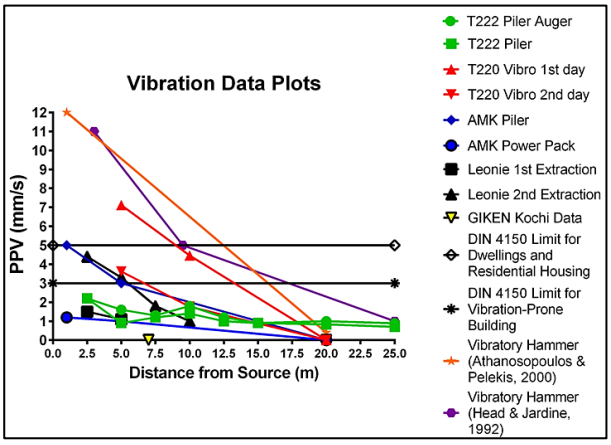


Figure 3 Vibration data plots