

Press-in Piling Survey in Ukraine

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ABSTRACT

Data related to the piling construction market in Ukraine are analyzed. Areas and projects that are suitable for Press-In Method implementation are considered. At the Ukrainian construction market, both imported machines and equipment of local production are in operation. Ukrainian piling contractors try to diversify their participation in the construction market. Thus, some companies being before dedicated only to civil engineering consider their possible involvement in port, offshore and coastal projects. In this connection, needs of more universal for both civil and marine engineering and more powerful press-in equipment are increased to provide pressing-in piles of larger diameter and length than before. To date, such demands are not satisfied and press-in machines usually involved in the Ukrainian construction market have some essential limitations of application such as value of the developed press-in load; piles section sizes; piles length; ancillary equipment. Some other limitations of mentioned equipment in the Ukrainian market are: low performance, bulky and unhandiness stipulated by too large dimensions; inconvenience of use in the case of restricted areas; problems of use at the maritime construction sites and other waterfront areas. This paper will be discussing the requirements of the actual national design and construction guidelines. Furthermore, recommendations on Press-In technologies development in Ukraine are also presented.

Key words: *Press-In Method, Ukrainian piling market, Design and construction guidelines.*

1. Introduction

1.1. Some general data

Considering the construction market in Ukraine (territory of the country – about 600 000 square kilometer; approximately about 43 million population, see the map on the **Fig. 1**) we may operate by using some actual statistic data. Thus, according to the Ministry of the Regional Development of Ukraine, in 2017, the volume of produced construction works was assessed as UAH 101,1 billion or approximately USD 3,89 billion. The essential part of this volume was formed by new construction, reconstruction and renovation (73,2%); remainder (26,8%) – by different kinds of repair works. Five regions had the most sufficient increase of the construction works in 2017 in comparison with 2016: Kirovograd Region (53,4%), Zhitomyr Region (38,9%), Odessa Region (38,4%), Kherson Region (29,5%) and

Kiev-city (30,1%). In particular, the most rapid growth was demonstrated by construction of the engineering structures (26,3%), nonresidential premises (20,2%) and residential housing (11,7%).

Underground part of the building and assembly works takes up to 20%. Working efforts ratio on piling foundation engineering is assessed as 10-20% of the total expenses on structures construction in the case of serial production and up to 50% in the case of quantity-produced unit construction. For traditional construction methods fulfilled with pile installation, approximately 75-90% of the productive machine time is run to waste for different auxiliary operations.



Fig. 1 Map of Ukraine

1.2. Location of the most suitable for the Press-In Engineering construction projects

There are a lot of places and regions in Ukraine where Static Press-In Engineering is considered as the most suitable construction method regarding natural, economical and environmental conditions and limitations of the considered territories.

Taking into account a very long sea (river) shoreline of the country (Black Sea, Sea of Azov, Danube and Dnipro rivers) the problem of slope stability is very topical one. Among the most dangerous areas from the point of view of coast line stability, we may indicate Odessa-city suburbs, Chernomorsk-city and related marine health-resort zones, Izmail-city precincts. During several recent years, there were large-scale (sometimes - disastrous) landslides with heavy damages of both soil slopes and buildings. Some related illustrations are presented on **Photo 1 and 2**. Another topical aspect is

development of some large cities (with population more than a million) located in the hilly country. For example, undulating land is character for Ukrainian capital Kyiv and the City of Dnipro (both on Dnipro-River, **Photo 3 and 4**). Recent numerous landslides, development of construction projects in the dangerous areas and actual tasks of historical architectural heritage protection created very serious engineering situation. In some current and future projects, the application of the Press-In Method is the most potential approach to solve mentioned problems.

2. Press-In machines and technologies in Ukraine

At the moment, different types of press-in machines are used in Ukraine. In the Ukrainian construction market both imported machines (mainly from Chinese and Russian producers) and equipment of local production are in operation.



Photo 1. Landslide in Fontanka (near Odessa-city)



Photo 2. Landslide in the city of Chernomorsk (seaside)



Photo 3. Landslide in Kyiv



Photo 4. Landslide in Dnipro-city

2.1. Imported Press-In Equipment

Chinese machines are presented in the Ukrainian market by several producers and trademarks. Among them «Liyuan Hydraulic Machine Company Ltd», «Hunan Sunward Intelligent Machinery co. LTD», «HUNAN TITAN HEAVY INDUSTRIES CO. LTD» should be mentioned.

Hunan Changhe Machine Co., ltd offers Titan rigs of different models. For example, piler Z-428 is designed to install reinforced concrete piles of sections, 300x300, 400x400 and 500x500 mm as well as pipe piles of 300-600 mm diameter; provided pile's bearing load reaches 2100 kN. Heavy Titan rigs may develop pressing force up to 12 MN (**Photo 5**).



Photo 5. ZYB pile driver (China)

Hunan NHM Construction Machinery is presented by Sunward rigs (for instance, machine DTZ260, **Photo 6**). Besides hydraulic static pile drivers of such brands as Starke (**Photo 7**) and Changsha Tianwei Engineering Machinery Manufacturing with speed of installation 1,0-1,5 m/min are also offered by local dealers.



Photo 6. ZYB pile driver (China)



Photo 7. Starke pile driver (China)

Production of Russian company “Tayzer” via Ukrainian “UkrTayzer” is presented by static driver SVU-6 for reinforced concrete piles and sheet piles (**Photo 8**). The peculiarity of such piler is the use of pulley block mechanism. It provides the performance up to 35 piles per turn.



Photo 8. SVU-6 pile driver (Russia, Ukraine)

2.2. Machines of Ukrainian production

There are several local producers/contractors who have worked out different original rigs for piles pressing.

In 1996, the company "VIF" (Kyiv) has developed and launched the first rig to press the concrete piles by static force in Ukraine. Further modifications were widely used on different construction sites in Ukraine (**Photo 9**). Essential peculiarity of this equipment is the ability to move the pressing-in mechanism in two mutually perpendicular directions. The maximal pressing-in force may reach 3 MN with performance up to 30 piles per shift (8 hours).



Photo 9. VIF pile driver (Ukraine)

In the beginning of the 21st century, “Stikon” started to use pile pressing-in system of their own design based on winches and counterweights concepts. The system is capable to press-in reinforced concrete piles from 300x300 to 450x450 mm.

Pile pressing machine UVT 200 was invented by “SSMU-10” (Kherson-city). The machine was designed to be able to drive a reinforced concrete piles with 350x350 and 400x400 mm diameter. Force for installing or withdrawal of this machine reaches 2000 kN. Length of piles is not limited. If the rig is moved by crawler crane, its performance is up to 18 piles per day; if the piler is moved on rails, its performance is up to 20 piles per day.

Hydraulic static pile drivers of such companies as “Viant” (Kyiv) and “Transzvuk” (Odessa) may provide pressing-in force up to 2500 kN. They may drive both reinforced concrete piles and sheet piles.

“Viant” has designed and constructed hydraulic static pile driver SV-250 for moving along the rails (**Photo 10**).



Photo 10. “Viant” pile driver (Ukraine)

The main advantage of the “Transzvuk” is

application of the original Modular Aggregative Piling System. This system is implemented at the construction of piled foundations and sheet pile retaining structures. The piling system (**Fig. 2**) is equipped with the original construction press-in piling machine and a Modular Coordinating Skidding System. More detailed information about “Transzvuk” innovations is placed in another report to the 1st ICPE 2018 titled “Press-In Technologies in Ukraine: Some Recent Developments”.

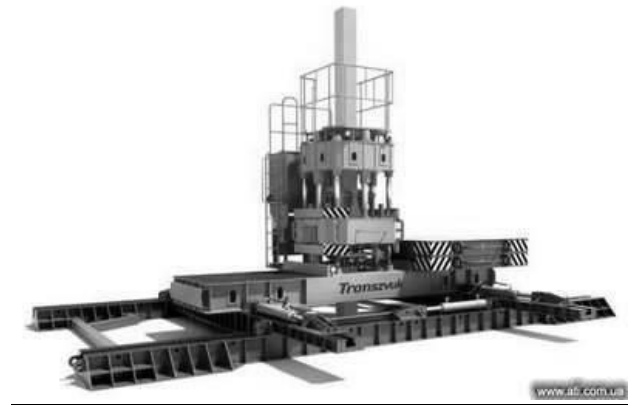


Fig. 2 “Transzvuk” pile driver (Ukraine)

2.3. Some specific features of the Ukrainian press-in piling market

After economical crises of 2008-2010, Ukrainian piling contractors try to diversify their participation in the construction market. Thus, some companies dedicated in the past only to civil engineering now consider involvement in maritime (port, offshore, coastal) projects. So needs of more universal (for both civil and marine engineering) and more powerful press-in equipment are increased to provide pressing-in piles of larger diameter and length. Till now such demands are not satisfied.

Above-mentioned press-in machines usually involved in the Ukrainian construction market have some essential limitations of application. Some of them are:

- press-in load (mainly up to 2400-3600 kN)
- piles section sizes (mainly up to 500 mm)
- piles length (mainly up to 14-16 m)
- ancillary equipment (i.e. drilling, etc.) is not available.

Some other limitations of mentioned equipment in the Ukrainian market are: unhandiness stipulated by too large dimensions and weight; inconvenience of use in the case of restricted areas; problems of use at the maritime construction sites and other waterfront areas.

3. Press-in piling guidelines

At the moment, there are no specific guidelines devoted to pile installing technologies, but related items are considered in some more general codes on foundation engineering.

Regarding the pile installing at least two design and construction guidelines are in use in Ukraine. The first (more general) document is the code “Bases and Foundations of Structures” produced in 2009 and corrected in 2012 and in 2018 (with participation of the paper’s author).

In the classification of foundation construction methods, installing of the piles is mentioned among other usually applied piling technologies. Static installation of piles is determined as one of the main methods for reconstruction and strengthening of the foundations (related additional efforts in the structure’s elements should be checked and taken into account).

In respect to environmental aspect, application of pressing machines is considered as the best due to its minimum dynamic actions and noise. The next chapter foresees fulfillment of geotechnical monitoring aiming to determine and to prevent negative influence of piling technologies on nature and existing structures. In cases of difficult soil and hydrological conditions, potential natural hazards, absence of gained experience in similar projects, it is strongly recommended to involve scientific supervising and support at stages of design, construction and during the initial period of structure’s maintenance.

The second document is the code “Engineering protection of the territories, buildings and structures against landslides and rockslides”. The static installation of piles is considered as a recommended method to provide slopes stability.

4. Concluding remarks

- Press-in technologies are variously presented in the Ukrainian construction market
- There are a lot of areas in Ukraine where only

Press-In Engineering may be in use to solve existing technical problems

- Machines of serial production are represented in Ukraine mainly by Chinese suppliers
- Equipment designed and produced in Ukraine is more effective for installation of piles of local types (reinforced concrete piles and pipe piles)
- There are prospective innovative developments related to Press-In Engineering technologies
- There are some limitations of use for both imported and domestic machines stipulated by their technical possibilities
- Press-In Engineering approaches based on Giken technologies and equipment may be successfully implemented in Ukraine, especially to provide slopes stability in coastal zones and in urban development
- Due to some recent seminars, exhibitions and presentations in Ukraine devoted to the Press-In Method, Ukrainian market is prepared to meet Press-In Engineering and related technologies.

5. Acknowledgements

Author is grateful to the International Press-In Association for the long-term support and assistance in the Press-In related issues, in particular, it is worth to note the 5th IPA Research Grant Award. Author considers fruitful cooperation with colleagues from Odessa National Maritime University (Faculty of Water Transport and Offshore Structures, Department “Sea, River Ports and Waterways”) and company “Transzvuk” as important element and a major contribution to the presented research.

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