ISSN (Print) 2616-7263
ISSN (Online) 2663-1261

Л.Н. Гумилев атындағы Еуразия ұлттық университетінің

ХАБАРШЫСЫ

BULLETIN
of L.N. Gumilyov
Eurasian National University

ВЕСТНИК
Евразийского национального
университета имени Л.Н. Гумилева

ТЕХНИКАЛЫҚ ҒЫЛЫМДАР ЖӘНЕ ТЕХНОЛОГИЯЛАР сериясы

TECHNICAL SCIENCES AND TECHNOLOGY Series

Серия **ТЕХНИЧЕСКИЕ НАУКИ И ТЕХНОЛОГИИ**

№ 3(132)/2020

1995 жылдан бастап шығады

Founded in 1995

Издается с 1995 года

Жылына 4 рет шығады

Published 4 times a year

Выходит 4 раза в год

Нұр-Сұлтан, 2020

Nur-Sultan, 2020

Нур-Султан, 2020

Editorial address: 2, Satpayev str., of. 402, L.N. Gumilyov Eurasian National University,
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Responsible secretary, computer layout: Aizhan Nurbolat

Bulletin of L.N. Gumilyov Eurasian National University.
TECHNICAL SCIENCS and TECHNOLOGY Series
Owner: Republican State Enterprise in the capacity of economic conduct «L.N. Gumilyov Eurasian National University» Ministry of Education and Science of the Republic of Kazakhstan
Periodicity: 4 times a year
Registered by the Ministry of Information and Communication of the Republic of Kazakhstan
Registration certificate №16991-ж from 27.03.2018. Signed in print 30.03.2020.
Circulation: 30 copies
Address of Printing Office: 12/1 Kazhimukan str., L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan 010008
Tel: +7 (7172) 709-500 (ext.31-428). Website: http://bultech.enu.kz

Л.Н. ГУМИЛЕВ АТЫНДАҒЫ ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІНІҢ ХАБАРШЫСЫ.
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ВЕСТНИК ЕВРАЗИЙСКОГО НАЦИОНАЛЬНОГО УНИВЕРСИТЕТА
ИМЕНИ Л.Н.ГУМИЛЕВА. СЕРИЯ ТЕХНИЧЕСКИЕ НАУКИ И ТЕХНОЛОГИИ
BULLETIN OF L.N. GUMILYOV EURASIAN NATIONAL UNIVERSITY.
TECHNICAL SCIENCE AND TECHNOLOGY SERIES
№3(132)/2020

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IRSTI 67.11.29

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Press-in Piling Method for Road/ Railway Retaining Walls

Abstract. *The "Press-in Piling Method", installs preformed piles using static loading generated by a hydraulic press-in machine called "Silent Piler", which eliminates disturbance from noise and vibration. With regard to applicable piles, the Silent Piler can install most of the major steel piles available on the global market. Also, there are four penetration modes of the Silent Piler available depending on ground conditions and working conditions. Therefore, piling works can be carried out without difficulties even on extremely soft/ hard ground conditions or restricted working conditions.*

The Press-in Piling Method requires only minimum working space and can also carry out piling works even though the commencing surface for the piling works is uneven i.e. piling works on sloping embankment or working above water, which conventional piling methods are not considered without extensive temporary working platform.

Keywords: *vibration, piles, ground, friction, excavation.*

DOI: https://doi.org/10.32523/2616-68-36-2020-132-3-120-126

Mechanism of the Press-in Piling Method. The basis of the Press-in Method is simple. The Silent Piler presses a pre-formed displacement pile into the ground by static jacking force. The reaction for the Press-in Force is generated by gripping previously installed piles. As a pile is pressed into the ground, "A Pressure Bulb" is formed around the pile toe. Accordingly, higher bearing capacity can be generated compared to driven piles without disturbing the ground and producing any vibration. (Figure 1).

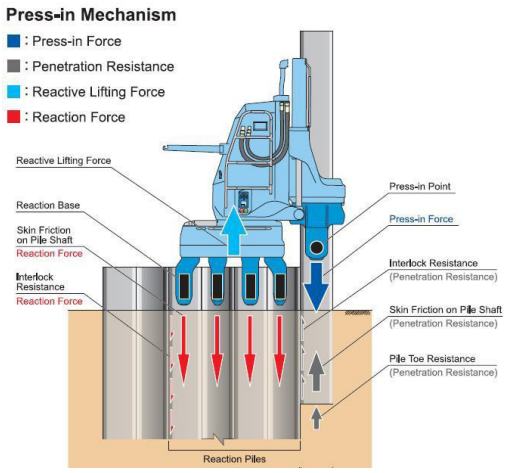
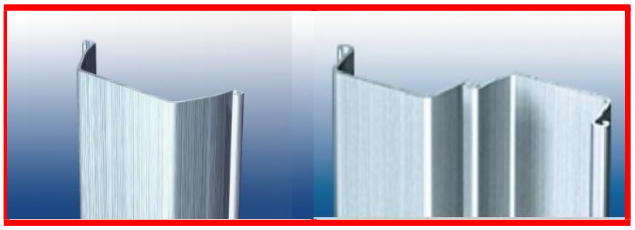


Figure 1: Press-in Mechanism

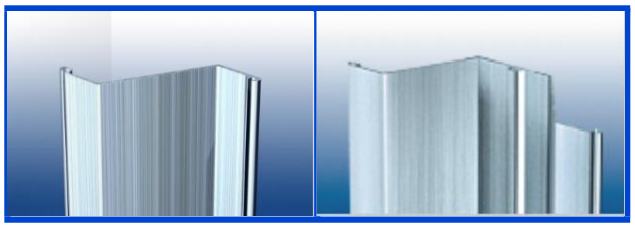
Background. The Press-in Method is applicable to most of the steel piles available on the global market i.e. U sheet pile in single form and pair, Z sheet pile, also in single and pair and Tubular Pile

as described in Figure 2. Wall thickness of those piles can be 0.3m to 2.5m and moment of inertia of the wall ranges up to about nine million biquadratic cm per meter, which can deliver similar elastic modulus EI (kNm2/m) to 2.0m thick diaphragm walls and can be utilized for extremely deep excavations required in today's construction industry.

U Sheet Pile



Z Sheet Pile



Steel Tubular Pile

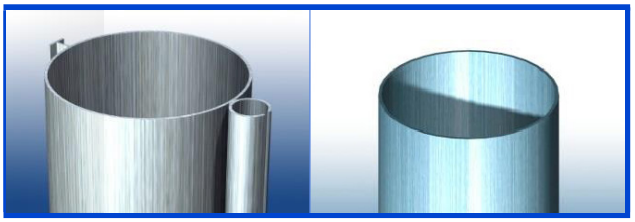


Figure 2: Applicable Pile Profile for Press-in Method

Applicable Pile Depth and Ground Conditions. There are four penetration modes available for the Press-in Method depending on pile depth and ground conditions, which enables piles to be installed into a range of ground conditions, from very loose/ soft ground to very hard ground such as peat in a bog and less weathered rock.(Figure 3).

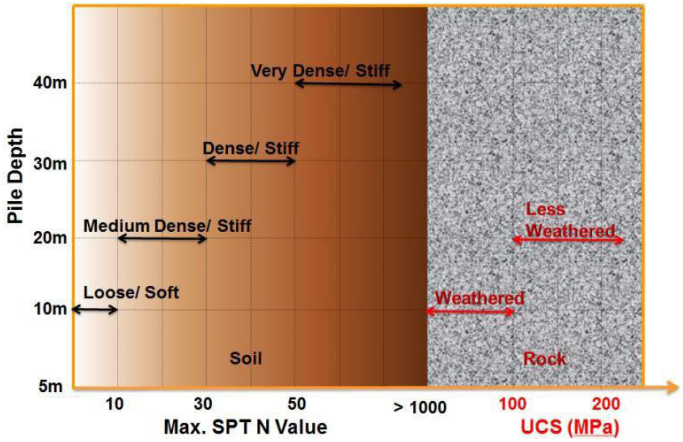


Figure 3 Applicable Pile Depth and Ground Conditions (Steel Tubular Pile)

Various Pile Penetration Modes.

- Standard Mode installs a pile vertically by static jacking force alone and is applicable to loose/ soft ground conditions.

- Press-in with Water Jetting Mode uses auxiliary water jetting system in addition to the Standard Mode and is applicable to from medium to very dense/ stiff ground conditions.

During the operation, high pressure water jetting prevents generation of the pressure bulb by temporarily and locally loosening granular soil and/or softening cohesive soil. Simultaneously, the returning water lubricates the pile surface and the interior of the interlocks, reducing their friction. Both the water pressure and the water flow can be regulated in accordance with the density/ stiffness of the ground to minimize ground movement. Typical water flow rates are shown in the table below:-

Table 1

Typical Flow Rate of Water Jetting

Ground Conditions	Water Pressure	Water Volume
Medium Dense/Stiff	2.5-5MPa	50-100L per minute
Dense/Stiff	5-10MPa	100-200L per minute
Very Dense/Stiff	10-15MPa	200-350L per minute

- Press-in with Integral Augering Mode installs a pile with simultaneous augering and can be applied to significantly hard ground such as cobble or boulder mixed ground, and rock. Gripping the auger casing along with a set of press-in piles, hard soil just below the pile toe is loosened by the auger. Effective reduction of toe resistance allows the pile to be installed with minimum ground disturbance and spoil from the augering.

- Rotary Cutting Press-in Moderotary jacking is a newly-developed approach that is a combination of axial penetration and twisting of the pile. This mode is only applicable to a steel tubular pile. The tubular pile with drilling bits on its toe can be installed by Gyro Piler into significantly harder ground such as less weathered rock.(Figure 4).

Figure 4: Various Penetration Methods

Application of the Press-in Piling Method for Retaining Walls. Due to the applicability of the Press-in Piling Method to wide variety pile profiles, a wide retained height range of retaining walls can be achieved by the Press-in Piling Method. It can be from a couple of meters to 10m or greater depending on project requirements. Typical bending moment capacities of the applicable retaining wall systems are shown in Figure 5 below, which can cover from low to high retained height.

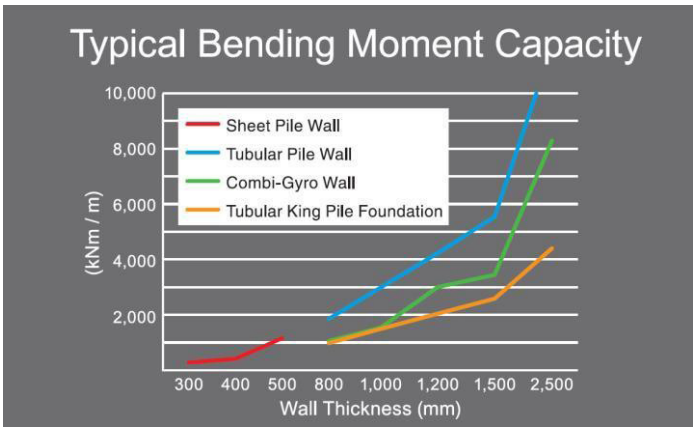


Figure 5: Bending Moment Capacity of Various Retaining Wall Systems

Retaining walls are normally constructed by either "Installation and Excavation Method" or "Installation and Filling Method" depending on the nature of project. The Press-in Piling Method can be adapted to both methods. In addition, the Press-in Piling Method can be carried out even though commencing surface is not available at the top of the proposed retaining wall. The Silent Piler self-travels along the top of the retaining wall as it installs piles. Therefore, both "Installation and Excavation" and "Installation and Filling" types of retaining walls can easily be constructed by the Press-in Piling Method without the need of a temporary working platform.(Figure 6,7,8,9).

Figure 6: Installation & Filling Retaining Wall (in operation at the foot of sloping embankment)

Figure 7: Installation & Filling Retaining Wall (Completion)

Figure 8: Installation & Excavation Retaining Wall (in operation on sloping embankment))

Figure 9: Installation & Excavation Retaining Wall (Completion)

GRB System for «Minimum Temporary Work» Construction. In conventional construction projects, great deal of cost, time and energy has been spent on temporary works, such as temporary platforms and berms. It is said that core construction work generally accounts for around 30% of the costs with the remaining 70% spent on temporary work.

The GRB System (Giken Reaction Base System) is one of the most advanced forms of the Hydraulic Press-in Piling Method. Basically, the Press-in Method is applied to a continuous foundation wall i.e. retaining wall and cofferdam, which comprises prefabricated piles and enables to carry out piling works to be carried out on top of previously installed piles by utilizing reaction force from the piles.

The GRB System is led to the front by the Silent Piler, followed by the Power Unit as in the standard Press-in Method, Clamp Crane, and Pile Runner. All of this equipment combines to grip the previously installed piles which are integrated with the earth and the work is simply carried out on top of the piles.

The process is simple. The Pile Runner transports the piles from the work base. The Clamp Crane raises the piles and delivers them to the Silent Piler. And the Silent Piler presses the piles into the ground. The machines move themselves forward as they carry out the work.

The GRB System, therefore, can be used to build structures above water, in locations adjacent to roads and buildings, besides operational railway lines on slopes and uneven ground. Under bridges and elevations, keeping transport functions are kept operational during piling work.

Hence, the GRB System enables substantial temporary work to be eliminated and allows structures to be built efficiently. This technology is especially effective in dealing with disaster prevention/ restoration works, in which rapid construction is always needed as the first priority.(Figure 10).

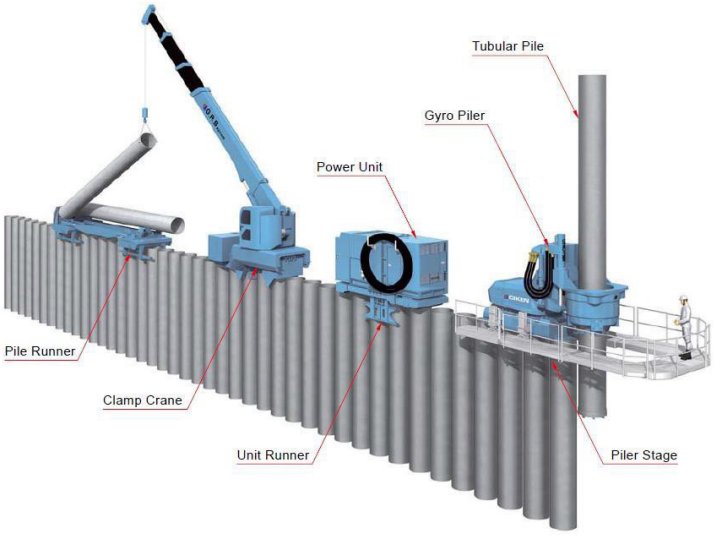


Figure 10: Typical Layout of GRB System

Summary and Conclusions. Retaining walls are one of the most basic structures of construction work and are used for most types of infrastructure globally. Also, they have become diversified to meet the transition of infrastructure status and the working environment. This diversity of retaining wall is seen especially in dense urban areas where infrastructures are complicated and congested. In addition, the construction process in dense urban areas tends to be complicated and sensitive, taking into account surrounding environment.

In case of renovation or upgrading work of public transport infrastructure, such as road and rail, it is effectively unfeasible to suspend traffic, therefore, the "scrap & build" construction method is not practical. Under these circumstances, construction work needs to be carried out in restricted working conditions to maintain existing traffic flow.

In general, there is only a narrow working space available along the road and railway in dense urban areas. If the working space is not sufficiently wide, reduction of road lanes or closure of railways is inevitable. This normally involves working at night within limited working hours and results in lengthy construction periods.

In addition, limitation of working space is not the only major issue. Many roads and railways are constructed above or below ground level i.e. depressed roads/railways or roads/railways on embankments. In order to renovate/ upgrade these kinds of roads or railways by conventional piling methods, temporary working platforms will be essential to provide working space for piling rigs and storage yards. However, as previously mentioned, the available working space itself is normally narrow and additional land acquisition will most likely be inevitable for the construction of a temporary working platform with conventional piling methods. This leads to soaring construction costs and extended construction periods. In the worst cases, a lot of infrastructures are left untreated.

The Press-in Piling Method is effective to overcome abovementioned issues and is widely used in dense urban areas. Because of the advantages of the Press-in Piling Method in difficult working space i.e. minimal machine size and self-travel function, the Press-in Piling Method enables the piling work, without need of a temporary working platform, reduced traffic flow or night work. As a result, both construction costs and duration can be minimized without disturbing existing traffic.

References

1. Bowles, J.E. Foundation Analysis and Design. 5th edition, McGraw-Hill, Singapore. 1996.
2. Baguelin. Correlation between PMT and CPT after dynamic compaction in reclaimed calcareous sand. 1978.
3. Wilson. NCSU Research Site. 1988.
4. Gambin and Rousseau. Range of Epmt and PI for several soil types. 1988.

References

1. Bowles, J.E. Foundation Analysis and Design. 5yh edition, McGraw-Hill, Singapore, 1996.
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Жол теміржол тіреу қабырғаларына қадаларды сығымдау әдісі

Аңдатпа. «Қадаларды престеу әдісі» - Шу мен дірілдің кедергісін жоятын» үнсіз жинағыш « деп аталатын гидравликалық престеу машинасы жасаған статикалық жүктемені қолдана отырып, алдын ала жасалған қадаларды орнату. Қолданылатын қадаларға келетін болсақ, үнсіз жинағыш әлемдік нарықта қолжетімді негізгі болат қадалардың көпшілігін орната алады. Сонымен қатар, жер асты жағдайлары мен жұмыс жағдайларына байланысты дыбыссыз жинағыштың енуінің төрт режимі бар. Осылайша, қадалар өте жұмсақ/ қатты топырақ жағдайында немесе шектеулі жұмыс жағдайында да қиындықсыз жасалуы мүмкін.

Қадаларды басу әдісі тек минималды жұмыс кеңістігін қажет етеді, сонымен қатар, қадалардың бастапқы беті тегіс емес болса да, қадалар жұмыстарын орындай алады, яғни көлбеу үйіндідегі қадалар немесе су жұмыстары, бұл қадалардың әдеттегі әдістері үлкен уақытша жұмыс платформасынсыз қарастырылмайды.

Түйін сөздер: діріл, қадалар, топырақ, үйкеліс, Жер жұмыстары.

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Способ прессования свай для дорожных/ железнодорожных подпорных стенок

Аннотация. «Метод прессования свай» - это установка предварительно сформированных свай с использованием статической нагрузки, создаваемой гидравлической прессующей машиной, называемой «бесшумным штабелером», которая устраняет помехи от шума и вибрации. Что касается применимых свай, то бесшумный штабелер может установить большинство основных стальных свай, доступных на мировом рынке. Кроме того, существует четыре режима бесшумного проникновения штабелера в зависимости от грунтовых условий и условий работы. Таким образом, свайные работы могут выполняться без каких-либо трудностей даже в очень мягких/ твердых грунтовых условиях или ограниченных условиях работы.

Метод прессования свай требует лишь минимального рабочего пространства и посредством его могут выполняться свайные работы, даже если исходная поверхность для свайных работ неровная, то есть свайные работы проводятся на наклонной насыпи или над водой, в то время как при обычных методах проведение свайных работ не рассматривается без обширной временной рабочей платформы.

Ключевые слова: вибрация, сваи, грунт, трение, земляные работы.

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