Breaking Down of Concrete Piles

EUROPEAN FEDERATION OF FOUNDATION CONTRACTORS

Note: Although proprietary brand names are referred to in this document, the EFFC does not recommend any particular method or system in preference to another.

Introduction

Breaking down of the concrete piles has traditionally been carried out using hand-held pneumatic breakers. This method of work potentially exposes workers to significant health hazards associated with exposure to Hand Arm Vibration (HAV), dust and noise.

In accordance with EU legislation, hazards associated with this process must be suitably and sufficiently assessed and appropriate controls implemented. Otherwise workers are at risk of suffering serious ill health effects such as musculoskeletal, neurological / vascular disorders, hearing and respiratory problems

This document aims predominantly, to provide practical guidance on reducing worker ill health arising from exposure to HAV. In doing so, it also recognises that the ill health effects resulting from inhalation of dust and exposure to noise may also be considerably reduced.

Nowadays there are numerous alternative methods available for the breaking down of concrete piles that remove or significantly reduce these health hazards. These methods are discussed in more detail below and where appropriate the advantages and disadvantages of each are explored.

The guidance takes into account the European Framework Directive 89/391/EEC 'on the introduction of measures to encourage improvements in the safety and health of workers at work' and the individual Directives prepared within the meaning of Article 16(1) of the Directive.

The full title of the relevant Directive's applicable to temporary or mobile construction sites, vibration, dust and noise are listed within the annex. Furthermore applicable member state legislation must be complied with to ensure the health and safety of workers at work.

Members of the European Federation of Foundation Contractors cannot be responsible for specifying the method for breaking down concrete piles on a project. This decision must be made during the procurement process and form part of any assessment required under the EU Directives or member state legislation. The final decision as to the type of pile breaking system to adopt must also consider the potential environmental impact of the operation.

The breaking down of concrete piles is an essential part of the construction process and a subject that is often not given sufficient consideration in the planning / design stage of the piling works.

It is important that a suitable pile breaking method is established early. This can result in significant financial benefits, savings on the overall construction programme and more importantly, reduce the potential ill health effects related to this phase of the works.

Guidance

Bored cast in place concrete piles should always be cast to a level above the specified cut-off such that, after trimming, a sound concrete connection with the pile can be made. Continuous flight auger

piles and any other type concreted or grouted through the auger stem during extraction must always be concreted to the commencing surface level. Precast concrete piles should be driven such that the pile head level will provide sufficient reinforcement projection after trimming.

The pile casting level adopted should be within the tolerances as detailed in the latest ICE Specification for Piling and Embedded Retaining Walls (SPERW) and further guidance on this subject can be found in the SPERW document.

Traditional 'Mechanical' Methods

The most basic method of breaking down piles is to utilise either hand held (Light) breakers or plant mounted pneumatic (Heavy) breakers. Whilst this method is perhaps the easiest to specify and takes little initial planning. However if not carefully controlled it can produce unacceptable health and safety risk and cause unnecessary damage, particularly to small diameter piles. This type of breaking is applicable to all types of concrete piles and the key points to consider in the implementation of this method are as follows;

- A suitable and sufficient assessment has must be carried out and specific control measures implemented to reduce worker exposure to associated health hazards.
- Piles should be allowed to cure for at least 5 days before excavation and trimming. For high cement replacement mixes the curing period is likely to be extended.
- Pneumatic breakers should not be used to penetrate the pile vertically as this is likely to split the pile shaft and shear the concrete below cut-off level. The tool should be worked from the pile perimeter towards the centre.
- Heavy impact breakers should not be used on small diameter and lightly reinforced piles, or on piles in soft ground.
- This type of pile breaking can increase the risk of integrity test failures.

Typical 'Light' Breaker

Typical 'Heavy' Breaker

Hydraulic Pile Breakers

Specially designed 'Pile Breakers' are available in a range of sizes and capability. Hydraulic pile breakers are available to cater for a wide range of concrete pile shapes and sizes, both cast in place and precast, including contiguous wall piles and small secant wall piles. These systems are not appropriate for some of the larger pile diameters or for use on diaphragm walls.

Typical Pile Breakers

Plant manufacturers and suppliers should be consulted for further details of the capability and limitations of particular pile breakers.

Integrated Pile Breaking Methods - Passive

An integrated 'passive' system relies on the installation of some form of de-bonding device into the pile at or close to cut-off level. De-bonding foam is applied to the main reinforcing bars above cut-off level and in some cases a lateral de-bonding element is also included at cut-off, as in the Cordek 'Corbreak' system (www.cordek.com). The Elliot system (www.elliott-europe.com) uses oppositely acting wedges, introduced into a hole across the pile at cut-off level so that the pile is split laterally. The hole may be drilled manually or preformed by use of a lifting eye and tube, which is inserted at the same time as the pile is cast. Residual head preparation is further reduced by the use of Elliot's de-bonding sleeves which incorporate polystyrene tips. It is important that a suitably designed lifting eye is incorporated into the pile head when using either of these systems to allow easy and safe removal of the pile head.

Coredek System

Elliot System

The above systems are most commonly used in large diameter cast in place concrete piles. This method can also be used for contiguous and secant wall piles and diaphragm walls.

Integrated Pile Breaking Methods - Active

The most recent developments in pile breaking are in the form of 'integrated' active systems. In essence these rely on incorporating an active pile breaking system within the pile and once the pile has cured the system is activated remotely, breaking the pile at cut-off level. Current active breaking methods include the 'recepieux' system (www.recepieux.com) which relies on inducing a horizontal crack by introducing chemicals into the pile through carefully positioned delivery ducts to expansion chambers positioned at cut-off level. Another innovative method currently under development by Laing O'Rourke is the FAST method. This method uses water pressure to crack the pile at cut-off level using a carefully designed system of crack inducing pipes, placed in the pile at cut-off level, integral with the reinforcement cage.

Recepieux Method

FAST System

The above systems are most commonly used in large diameter cast in place concrete piles and can be used for contiguous wall piles. They are not appropriate for large secant walls and diaphragm walls.

Hydro-demolition Methods

The system uses extremely high pressure water jets capable of removing concrete without damaging the reinforcing bars. Hand held lances are typically used, but specialist remote controlled plant has been developed utilising a ring of water jets placed around the pile connected to a small tracked base unit.

Typical Hydro-demolition Pile Breaker

This method of pile breaking can in theory be adopted for all types of bearing and wall piles and diaphragm walls.

The table below shows advantages and disadvantages of each method. However it is recommended that whichever system is used the manufacturer be consulted for

Pile breaking method	Advantages	Disadvantages
Hand held breakers	Low cost. Little planning.	Exposure to HAVS, noise & dust can be high. Can split pile if penetrated vertically. Increases risk of integrity failures.
Hydraulic breakers	Variety/ range of equipment available which can be used on contiguous, secant and diaphragm walls. Reduces exposure to HAVS, noise & dust.	Not appropriate for some larger diameter piles and diaphragm walls. Can be problematic if used on small dia. piles installed in very soft / weak materials unless very carefully controlled.
Passive systems *(Cordek, Elliott)*	Common on large diameter piles Can be used on Contiguous, Secant and diaphragm walls	Requires a designed lifting eye to be incorporated into the pile head
Active systems *(Recepieux, FAST)*	Can be used on large diameter contiguous walls	Not suitable for large secant and diaphragm walls
Hydro- demolition methods		Working with extremely high pressure water Water to be managed on site Expensive / Relatively high cost

Annex

Directive 92/57/EEC on the implementation of minimum safety and health requirements at temporary or mobile constructions sites (eighth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work – the Chemical Agents Directive (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).

Directive 2002/44/EC on the minimum health and safety requirements regarding the exposure of workers' to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

Directive 2003/10/EC of the European Parliament and of the Council on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise) (seventeenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).

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