

TECHNICAL UPDATE

PILED WALLS



Technical Update: Piled walls

This technical article covers the following points:

- Contiguous piled walls
- Secant piled walls
- When are they used in the formation of a basement?
- Can contiguous piles be used in all ground conditions?
- Do they provide a waterproofing solution?

Contiguous piled walls

The word contiguous was derived possibly in the 16th Century from the Latin word *Contiguus* meaning "touching" or being "in contact". However in reality a contiguous pile very rarely is in contact with an adjacent pile. A better understanding of the word contiguous is "neighbouring".

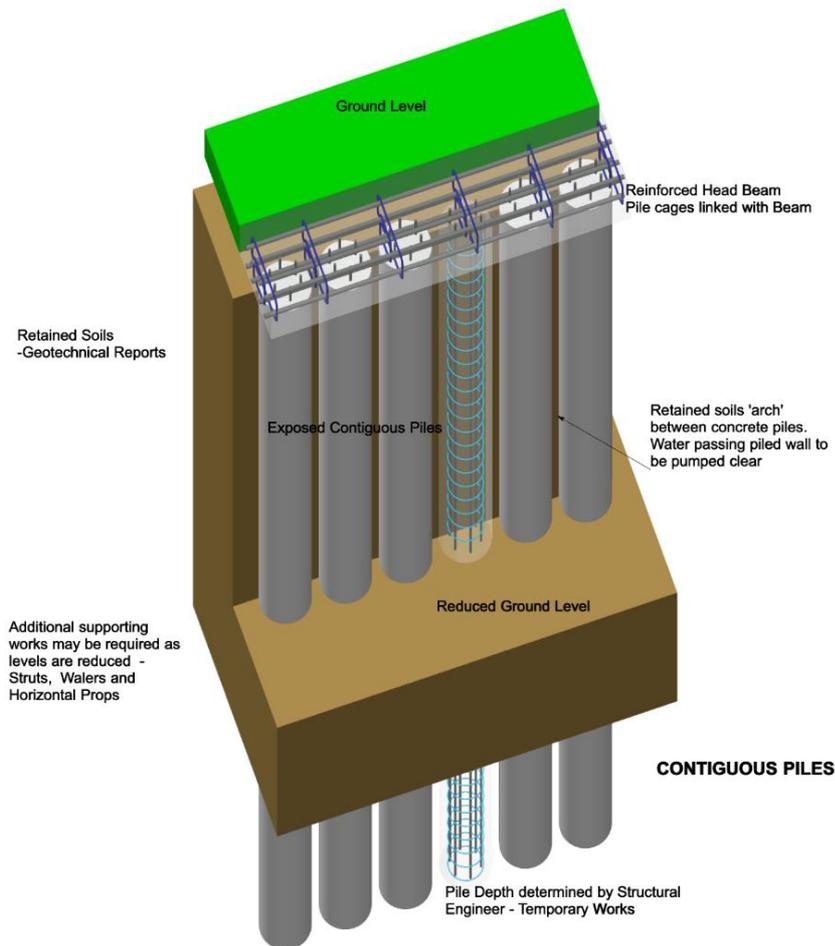
A contiguous pile will never be found in isolation but will always be a series of closely spaced piles that will initially form a below ground wall that separates two neighbouring ground profiles.

Contiguous piled walls provide an economic solution when any excavation is required, especially where the construction site has limited space along a boundary where an open excavation is not possible.

The use of a contiguous piled wall will allow the excavation face to be vertical, maximising the foundation and building construction permitted on the development site.

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On new development sites "bottom up" construction is generally used where a series of piles are augured (CFA) rotary drilled into the ground to form the foundation box. On completion, the centre is excavated to the new level. The contiguous piles are then exposed from the ground level to the reduced level as shown above.

Contiguous piled walls are generally designated as temporary works but in the majority of construction events will be included as part of the basement shell or foundation for the above ground permanent works.

Contiguous piled walls can also be used for "top down" construction. This method of basement formation is mostly used in retro-fit situations where a structure or building already exists. The method is also effective in new works especially on congested sites or access-restricted sites. The structural ground slab (podium and/or transfer slab) is first cast between the installed piled walls. This, in effect, provides a stable working platform with no loss of working

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area within the site. Above ground construction can continue whilst excavation works to form the below ground basement structure is undertaken at the same time.



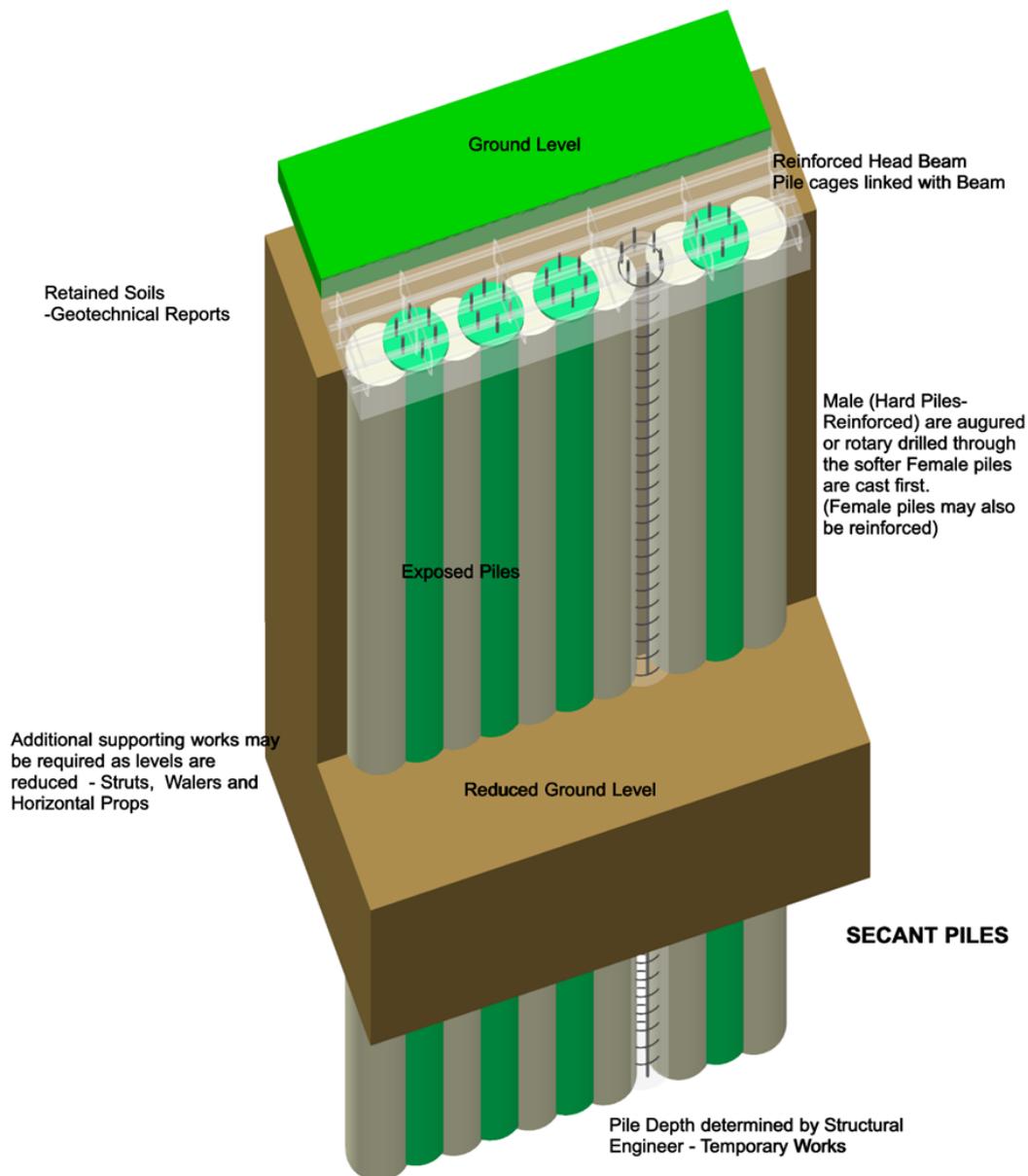
Basement formation: Note the rippling of the slab soffit which was cast on the ground prior to excavation of the basement. Contiguous piles are clearly evident at the rear (clay soils), with waterproof concrete liner walls currently being formed up to the underside of head beam to the top of the installed piles.

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Secant piled walls

In geometrical terms, a secant is a line that cuts a curve at two points. A secant piled wall is similar to the contiguous piled wall except that it introduces an additional pile which interlocks or cuts into the two adjacent piles as shown below.



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Secant piled walls will require a temporary guide wall formed in advance of the piling operation to ensure the overlap between adjacent piles is maintained over the full depth of the excavation. Depending on the height of soil retention, various pile combinations may be adopted.

Secant Pile Type	Male Pile	Female Pile	Retention Height
Hard-Hard	Structural concrete	Structural concrete	10m - 20m
Hard-Firm	Structural concrete	Low strength concrete	6m - 15m
Hard-Soft	Structural concrete	Cement grout - bentonite	6m - 10m

Female piles are augured or rotary drilled first and to make the key the male piles are augured into the softer female piles either side. The male pile is always reinforced with a steel reinforcement cage. Occasionally, the female pile is reinforced depending on the design requirements of the piled wall.

Secant piled walls are significantly less common than a contiguous piled wall due to the extent of the preparation involved and the additional piling and materials. However, they are significantly more effective where ground materials are more fluid, i.e., running sands, soft silts and where the soil layering transports significant volumes of water or where there is a water table above the reduced dig level.

Watertightness

Contiguous piled walls although not watertight are ideally suited for use in cohesive, granular soil or where water-bearing strata is evident. Retained soils will arch naturally between the piles and they will reduce water flows sufficiently to allow for the construction of the below ground basement. Pumping from sumps will be required in the presence of water and necessary for the formation of the basement slab and kickers for the wall construction.

Secant piles cannot be relied on to be completely watertight even though there is a continuity of the piled wall. Where ground and soil conditions are more fluid, a secant solution will be the preferred option. A secant piled wall will provide greater resistance to water. As for contiguous piles, pumping of ground water from the basement shell construction will be necessary.

Waterproofing

Ground-water levels above the reduced ground level, perched water from aquifers in the ground transporting water from rainfall or localised flooding should not enter into the basement void created. Piled walls will limit the flow but will not prevent it. Waterproofing should therefore be provided to any below ground structure or basement.

An understanding of the design and resolution of construction issues will ensure the correct water-tightness requirement for the internal environment of the basement or below ground

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structure. The recognised standard for waterproofing is BS 8102: 2009 *Code of Practice for the protection of below ground structures against water from the ground.*

The code of practice specifies three environmental grades

- | | | |
|------------------|----------------------------|-------------------------------|
| • Grade 1 (Wet) | Car parking plant rooms | Seepage and damp tolerable |
| • Grade 2 (Damp) | Plant rooms and workshops | Damp tolerable |
| • Grade 3 (Dry) | Residential and commercial | No water penetration accepted |

For warranty provisions only grades 2 and 3 are acceptable – no water penetration.

Basement or below ground structure waterproofing is successfully achieved using water resisting construction in the form of:

- Type A - Barrier protection
- Type B - Structural integrity
- Type C - Drained protection

The waterproofing design must be undertaken by a certificated CSSW designer.

Structural design

Contiguous and secant piled walls are effectively cantilevered or propped cantilever retaining structures and require a significant structural input before, during and following installation for the safe retention of the soils, including any surface surcharges. Piled walls are temporary support structures whilst the permanent basements are constructed, which can take many months depending on the size of the development. As the ground levels are reduced by excavation, applied loads are constantly changing and the temporary works engineer will monitor movement of the works. Additional supporting works may be applied to the piles which include horizontal propping, walers and struts as the engineer requires.

Temporary work defects

- Piles are not always vertical?
- Contiguous piled walls are not always evenly spaced?
- Piles are not always the same diameter for their full length?
- Exposed piles get knocked during excavation?

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In this top-down basement the temporary works engineer had to apply additional supports to the contiguous piles resulting in delays to the construction phases and increased costs for the additional bracing and propping.

The four-storey house above was monitored weekly for movement as well as the neighbouring semi-detached home which was occupied throughout the basement construction.

Variations in cross-sectional area piles can occur – voids or soft spots in the ground during auguring of the pile.

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Note the piles in the background forming the contiguous wall.

The temporary pile in the centre is a bearing pile supporting a portion of the steel frame upon which the four-storey house sits.

Water is penetrating the wall through an aquifer in the corner. Water is pumped daily following its exposure.

Every care was taken to ensure information in this article was correct at the time of writing (April 2021). Guidance provided does not replace the reader's professional judgement and any construction project should comply with the relevant building regulations or applicable technical standards. For the most up to date LABC Warranty technical guidance please refer to your risk management surveyor and the latest version of the [LABC Warranty Technical Manual](#).