

DIAPHRAGM WALLS & BARRETES



Pr017

Process

BUILD ON US



SOLETANCHE BACHY

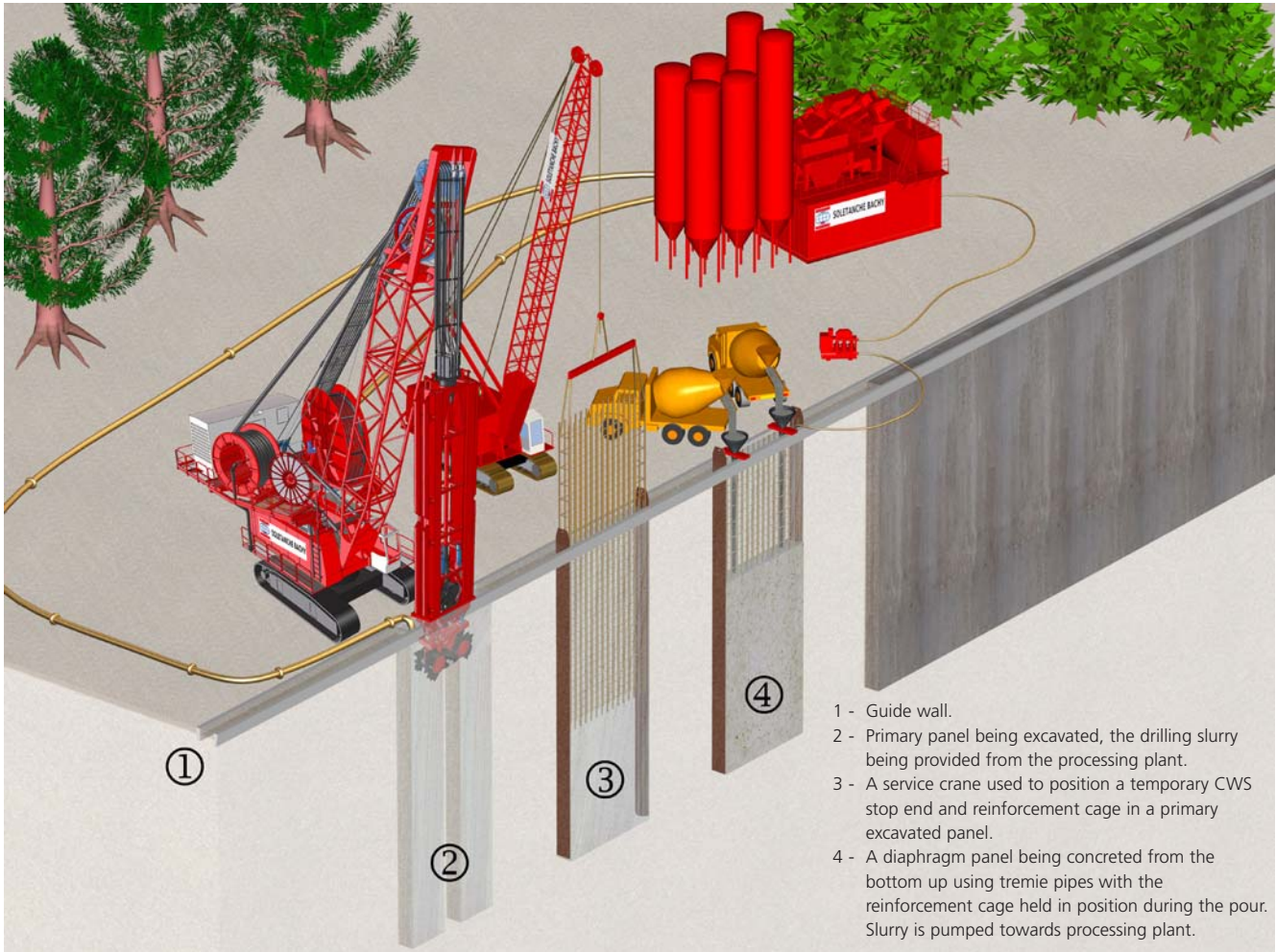
GEOTECHNICAL AND CIVIL ENGINEERING CONTRATORS

DIAPHRAGM WALLS & BARRETTES

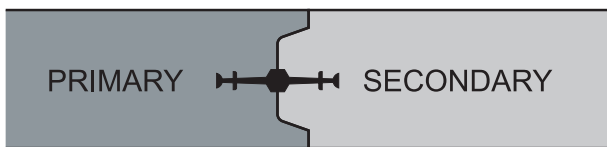
HISTORIC BENCHMARKS

- 1913:** first publications on the stabilising effects of slurry in bore holes.
- 1920:** use of slurry reverse circulation in mine boreholes.
- 1927:** the Peterfi and Freundlich definition of thixotropy in colloid suspensions.
- 1929:** the use of bentonite in drilling slurry.
- 1931:** the Marsh invention of the viscosimeter called the "Marsh cone" used to check the state of slurry.
- 1938:** Veder, the Italian engineer, designed the principle of a diaphragm wall in a slurry trench.
- 1948:** the first "slurry trench" cut-off excavated on Terminal Island, in Long Beach, California.
- 1949:** industrialisation of slurry drilling by Solétanche for constructing a 1m diameter and 65m deep pile for the Bone (Annaba) electricity power plant in Algeria.
- 1953:** Marconi, the Italian engineer invented a machine which travels on rails and which constructs panels by percussion excavation through mud, removing spoil by reverse circulation.
- 1955:** first slurry trench cut-off constructed in France.
- 1956:** construction in France of the C.I.S. machine using the Marconi process; where the ground is excavated using percussion in horizontal layers of increasing depth.
- 1957:** a 9,000m² diaphragm wall watertight box constructed by Solétanche using a C.I.S machine, as part of the construction of the Marckolsheim hydroelectric power station on the River Rhine.
- 1959:** first applications in Japan.
- 1961:** first diaphragm wall constructed in France, in Paris 8th district, impasse d'Antin, by Solétanche.
- 1962:** first applications in the USA.
- 1963:** Veder analysed the behaviour of bentonite slurry and revealed the existence of and the role played by the "slurry cake".
- 1963:** construction by Solétanche of a grab attached to a Kelly bar.
- 1964:** development of pre-stressed anchor block used for the first time by Solétanche, on the Peugeot building, avenue de la Grande Armée in the 8th District of Paris.
- 1968:** patents covering prefabricated walls lodged by Solétanche and by Bachy.
- 1970:** development by Bachy of a cable grab bucket where pulley bearings and hinges are sealed and pressurized, replacing the bronze bushes that were subject to rapid abrasion and which had to be replaced after each panel/section.
- 1970:** birth of the elasto-plastic calculation procedure for designing retaining structures and which replace ultimate state calculations.
- 1971:** Solétanche patent covering the Hydrofraise, a new generation of drilling equipment with a cutting tool arrangement at the bottom of the rig and spoil extracted by reverse circulation.
- 1984:** innovation prize awarded to Bachy by the Fédération Nationale des Travaux Publics for the CWS joint, a patented process used to overcome the need for immediate removal of formwork and the installation of a waterstop between adjacent wall panels.
- 1985:** innovation prize awarded to Solétanche by the Fédération Nationale des Travaux Publics for the Hydrofraise system.
- 1985:** the first onboard system Enpafraise, designed by Solétanche, to measure the depth and inclination at any point in time of the Hydrofraise drilling rig.
- 1988:** construction by Solétanche on the Mud Mountain (Washington, USA) dam of a 1m wide, 124.5m deep diaphragm wall through extremely hard blocks of andesite rock.
- 1990:** development by Solétanche and Kronsa of the KS 3000 hydraulic grab, first patents.
- 1991:** first Sakso integrated system used by Solétanche to measure hydraulic grab alignment.
- 1992:** the second generation Enpafraise integrated system used by Solétanche to measure pressure parameters and the tool trajectory on the Hydrofraise.
- 1993:** the construction by Solétanche and Bachy in Kuala Lumpur (Malaysia) of 125m deep barrettes for the foundations of the Petronas towers.
- 1995:** innovation prize awarded to Solétanche by the Fédération Nationale des Travaux Publics for the KS 3000 controlled hydraulic grab.
- 1996:** the Target grab developed by Bachy, the ultimate mechanical grab in terms of performance and incorporating an integrated alignment correction mechanism.
- 2001:** the steerable KS2 hydraulic grab, developed by Solétanche Bachy.
- 2005:** Delivery by Solétanche Bachy to the port of Le Havre (France) of a 1,602m long quay wall comprising a 1.20m wide diaphragm wall to depths of 42m.
- 2006:** construction by Solétanche Bachy, using a Hydrofraise rig with alignment correction, of the Carrousel circular shaft in Versailles (France) which, at a depth of 65m, achieved a verticality tolerance of less than 0.1 %.

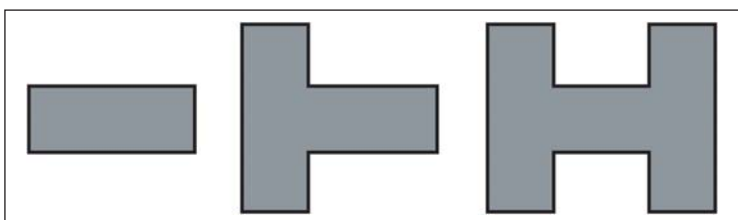
DIAPHRAGM WALLS & BARRETTES



Construction of a diaphragm wall



CWS process: a construction joint between a primary and secondary section that can be equipped with a water-stop.



Different forms of barrettes.

A barrette is an isolated and monolithic section of a diaphragm wall.



CWS process: temporary metal formwork supporting the water-stop sealing strip. This formwork is positioned at each end of the primary panels. The formwork is removed laterally after excavating the adjacent secondary panels.

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Hydrofraise mounted on its crane. The spoil is dislodged by the rotating drum cutters and pumped to the surface with the drilling slurry. The drilling slurry is used to stabilise the excavation and to facilitate the transportation of the spoil to the surface. The drilling tool descends in a continuous operation as it excavates the trench.



The KS2 hydraulic grab. The spoil contained in the grab buckets as they close is removed to the surface by the grab. Drilling slurry is only used to stabilize the trench. Excavation proceeds sequentially during which the grab is alternately raised and lowered.



Self-guided cable grab. Sequential operation identical to that of the hydraulic grab.



Drilling slurry production and processing plant comprising mixers, pumps, vibrating screens, centrifuges, bentonite powder storage silos, new and spent slurry storage silos.

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The installation of a reinforcement cage using a service crane. Special case of a reinforcement cage for a 'T' shaped panel section.



Positioning and setting a reinforcement cage on guide walls. Reservation tubes attached to the cage are clearly visible and can be used for non-destructive testing of the concrete, to carry out drilling and grout injection at the base of the wall.

Two truck mixers used to pour concrete for a panel through two tremie pipes whose vertical position is controlled by the service crane. The tremie pipes are gradually withdrawn and shortened. On the left, we can see the CWS formwork protruding. The number of concrete tremie pipes used will depend on the length and width of the panel section.



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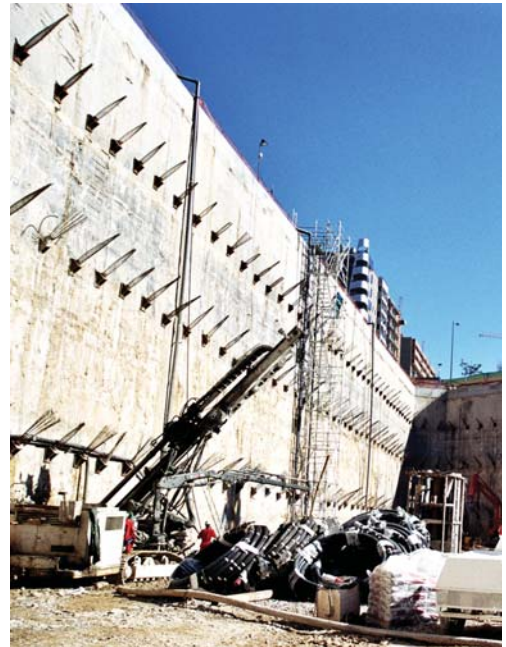
Case of passive ground anchor blocks positioned at the back of a quay diaphragm wall. They are anchored at the other end to a sheet pile wall.



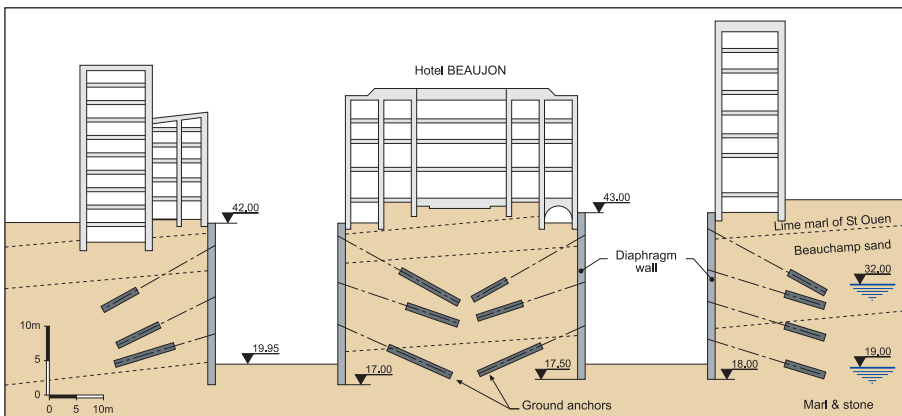
Support wholly provided by props. As in the case of passive anchors, the props will only take load if the wall moves.



Ground anchors can consist of single bars or a number of strands. They are pre-stressed using a hydraulic jack. The photo shows a strand anchor as it is being pre-stressed.



Installation of anchors through a diaphragm wall. Each level of ground anchors is constructed by interrupting earth moving works at the level concerned. The photo shows a drilling rig boring holes for the 4th level of ground anchors.



Schematic cross section of a project comprising diaphragm walls supported by several levels of pre-stressed ground anchors secured in the ground below existing buildings.

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Self-stabilising circular wall for an underground reservoir.



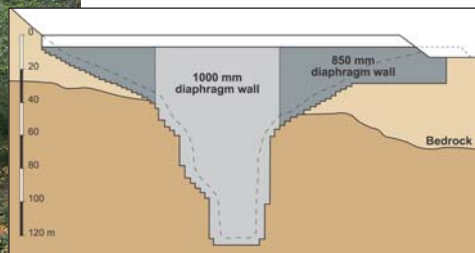
Multi-cell wall with self-stabilising circular segments with props at the intersections only.



Example of a diaphragm wall supported by 5 levels of ground anchors used for constructing basements as part of a refurbishment project undertaken inside an historic building where only the facades were retained.



Example of a deep trench adjacent to a historic building, below the water table level, protected by a wall combining pre-stressed ground anchors and corner struts.



Example of a non-retaining cut-off wall forming a watertight core as a repair to an existing earth dam. In the example shown, a record depth of 124.5m was achieved.

1 - **RUSSIA** - Moscow

Sakharova 30

2 - **SINGAPORE**

Marina Bay Sands

3 - **UNITED ARAB EMIRATES**

Al Raha Beach

4 - **UNITED STATES** - Baltimore

Hotel Four Seasons car park

5 - **FRANCE** - Le Havre

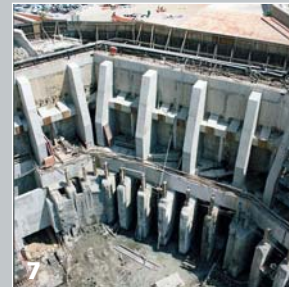
Port 2000

6 - **SPAIN**

Palacio Municipal del Hielo

7 - **MONACO**

Cultural and Exhibition Centre



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