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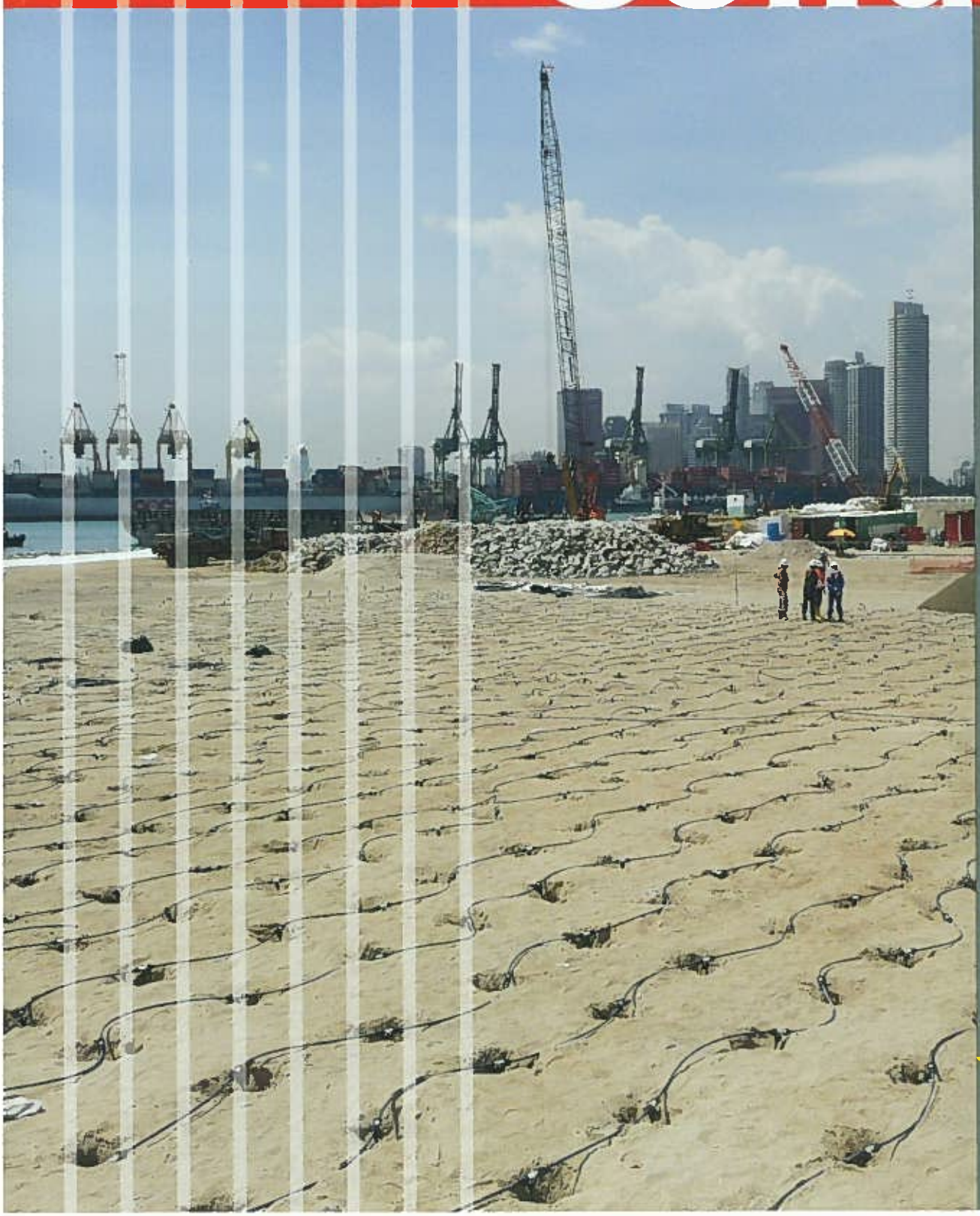

BeauDrain(-S)©

air-pressure consolidation

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Building worldwide on our strength

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Air-pressure consolidation was first introduced in 1952 by W. Kjellman, the inventor of the pre-fabricated vertical drain. Since then, air-pressure consolidation has been in frequent use in constructions which harbour a danger of instability. The BeauDrain technique was developed at the beginning of this century as an alternative to the traditional vacuum technique.

The BeauDrain technique

In the BeauDrain technique, a horizontal drain is connected to vertical drains and used to apply a pressure reduction to the vertical drains. Through the application of a pressure reduction to the drains, the use of a settlement allowance of sand can be dispensed with, thereby saving time.

Why BeauDrain?

In the preparation of a site for construction, the developer often opts for the use of normal vertical drainage with a settlement allowance. In most cases this is the best and cheapest solution. This is certainly the case if sufficient time, space and sand are available during the course of the project. If, for whatever reason, a project has to be delivered or an embankment created very quickly, it can be the case that no space is available for an extra settlement allowance or the application of extra sand is too expensive, Cofra's settlement accelerating technique BeauDrain is the solution.

The use of the BeauDrain technique with a vacuum of 50 kPa and an embankment of 2 metres exhibits the same settlement behaviour as vertical drainage installed with the same drain spacing and an embankment of 2 m + 50 kPa = 4.5 m sand. This means that when BeauDrain is used, including the application of the aforementioned 2 metres of sand, the settlement occurs more quickly. This also has advantages for stability as the subsoil adapts to a higher load than is actually present. As a result, the first embankment layers, in particular, can be considerably thicker and embankment creation can take place more quickly.

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Installation of the BeauDrain system

The installation machine uses a specially designed coulter to pull a horizontal collecting drain to a maximum depth of 2.5 m beneath the installation level (depending upon the thickness of the work floor, the course and the groundwater level). As part of the production process, this horizontal drain is automatically connected to the top of a vertical drain installed in the same work operation. Finally, a strip of membrane is installed on top of the horizontal drain to improve the sealing between the atmosphere and the drainage barrier. After the installation of a pre-determined number of drains, a blind section of the drain is led to the surface where this is connected to a vacuum pump.

BeauDrain:

> Faster preparation of residential districts for construction
> Installation of infrastructure (roads, railways and airports)
> Installation of dikes
> Faster installation of embankments
> Preparation of sites where settlement allowance is expensive or scarce

Advantages of the BeauDrain system:

> Short installation period and clean work site after installation
> No soil is excavated, thus preventing any damage as a result of horizontal deformation of the soil due to relaxation and insufficient filling
> No supply of drainage sand or removal/storage of removed soil
> A very great working depth is achievable thanks to the use of vertical drains
> The Pleistocene sand can be followed at a safe distance
> The use of vacuum pressure gives rise to an increase in effective pressure; this reduces the risks of instability in the case of ongoing embankment creation
> The existing body of soil is used as a sealing medium, thereby dispensing with the need for a surface membrane
> The work site becomes available for other activities immediately after installation and remains so
> The barrier configurations can be adapted to the soil type to be consolidated
> Horizontal effect in the event of ongoing embankment creation is considerably reduced
> The BeauDrain system also allows for a considerable reduction of secular settlements and settlement differences.

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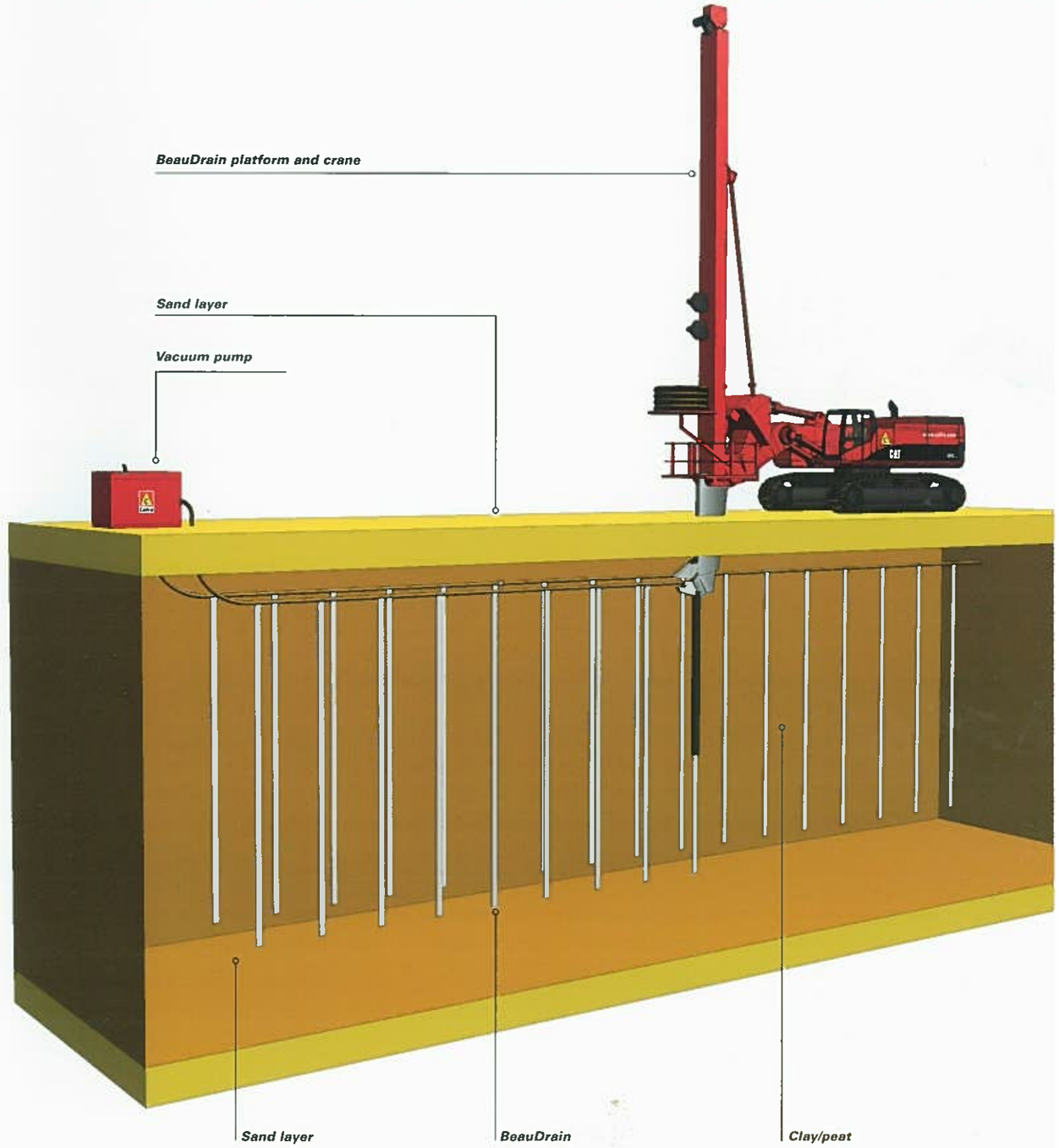

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The function of BeauDrain-S is based on the use of an air-tight hose. In this system, vertical drainage is only used in the compactable and sealing layers. The top layers of sand, where there is a risk of air or excess water inflow, are sealed off from the system with the aid of a thyleen hose. As a result, a vacuum can be applied to the drain. The vacuum in the drain translates into an equivalent (fictitious) top loading at ground level. For each project the subsoil is studied carefully in order to ensure that the system will function as desired. A slack sealing layer of clay or peat must be present just below the surface.

Why BeauDrain-S?

The BeauDrain-S system is a combination of the normal BeauDrain system and vertical drainage. It was developed in order to be able to offer customised vacuum drainage for every surface, however small. The development of a hybrid of vacuum drainage and conventional vertical drainage gives the system the advantage over BeauDrain in that it can use the normal drainage stitchers. This means that its field of application is greater, without a great deal of extra cost. It can be installed anywhere in the world on every surface and at any depth. The work floor need not consist of well-draining sand, but serves purely for the stability of the cranes.

Installation of the BeauDrain-S system

To prevent air leakage, a BeauDrain-S drain, pre-fabricated from a specially developed (MD88H) vertical drain, is coupled to a pre-determined length of thyleen hose. The thyleen hose is installed over the thickness of the work floor and, depending upon the groundwater level, pulled through into the sealing clay or peat layer by half a metre. The length of the hose is individually developed for each project or project area. After installation only the thyleen hoses protrude above the installation platform. After the cutting of the hoses to length, the BeauDrain-S drains are connected together into bundles by means of couplings. These bundles are connected to a vacuum pump at the edge of the field via a manifold and collecting hose.

BeauDrain-S:

> Faster preparation of residential districts for construction
> Installation of infrastructure (roads, railways and airports)
> Installation of dikes
> Faster installation of embankments
> Preparation of sites where settlement allowance is expensive or scarce

Advantages of the BeauDrain-S system:

> Short installation period and clean work site after installation
> No soil is excavated, thus preventing any damage as a result of horizontal deformation of the soil due to relaxation and insufficient filling
> No supply of drainage sand or removal/storage of removed soil
> The use of BeauDrain-S means that a very large working depth is achievable

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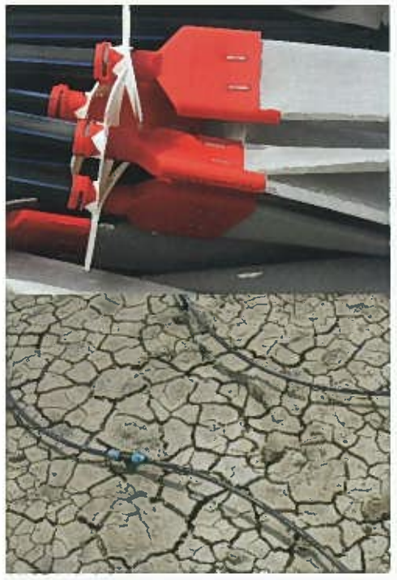

> The Pleistocene sand can be followed at a safe distance
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> The existing body of soil is used as a sealing medium, thereby dispensing with the need for a surface membrane
> The work site becomes available for other activities immediately after installation and remains so
> The barrier configurations are adapted to the soil type to be consolidated and the surface
> Horizontal effect in the event of ongoing embankment creation is considerably reduced
> The BeauDrain-S system also allows for a considerable reduction of secular settlements and settlement differences.

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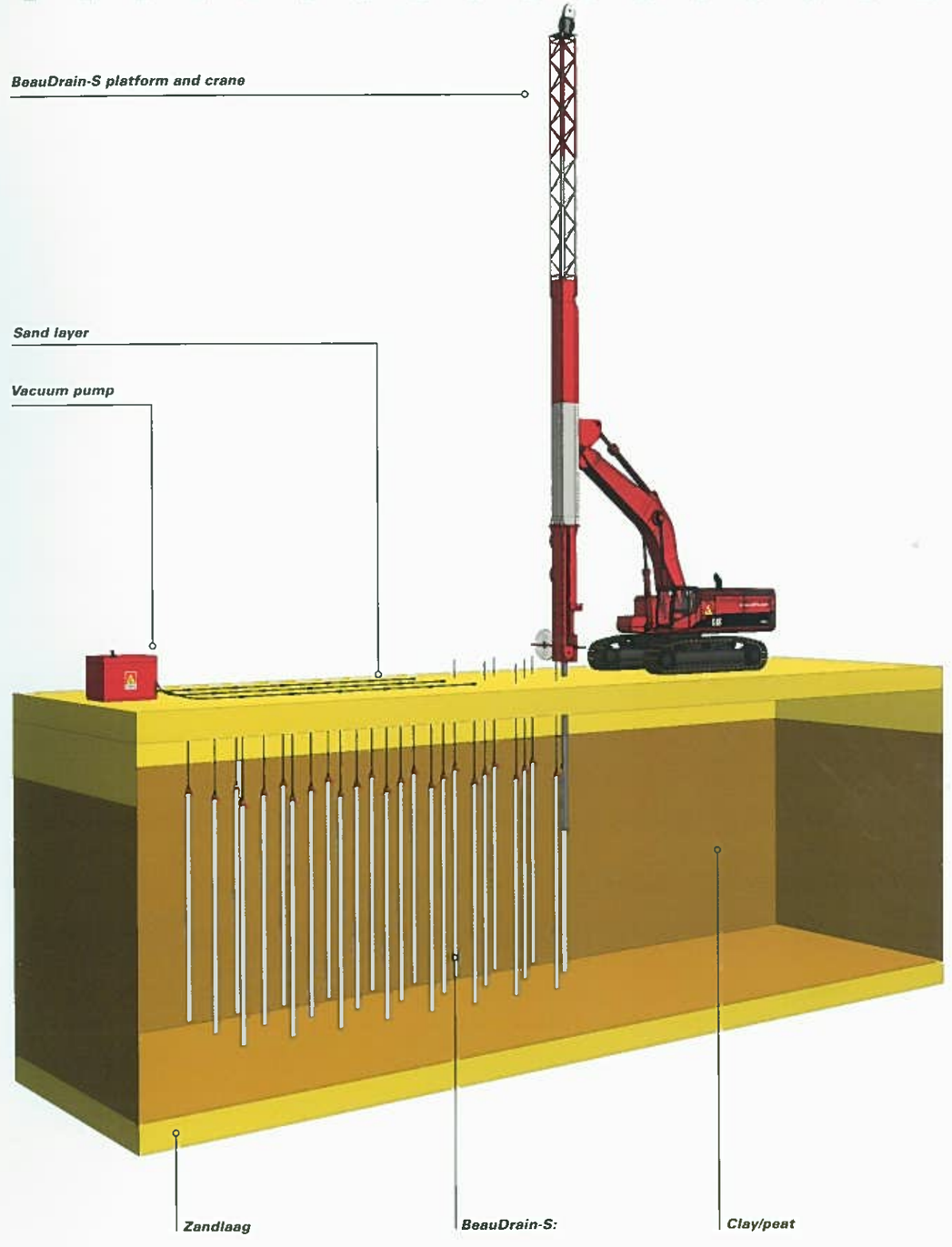
Cofra B.V. is an innovative contractor specialising in ground improvement techniques and membrane construction. Quality is everything to us and thanks to our high level of experience and expertise we can provide the entire process from design to implementation all under one roof. Cofra, and, its sister company Geotechnics, is part of the internationally operating company Royal Boskalis Westminster. Cofra is active in specific sectors of civil engineering, ground improvement techniques and geotechnical hydraulic and gas barriers. Cofra is always working on the development of new ground improvement techniques.

Other Cofra techniques:

> AuGeo
> HDPE seals
> CDC
> Vertical drainage
> Geolock

You can find further information about the BeauDrain technique and other Cofra techniques on our website www.cofra.com.



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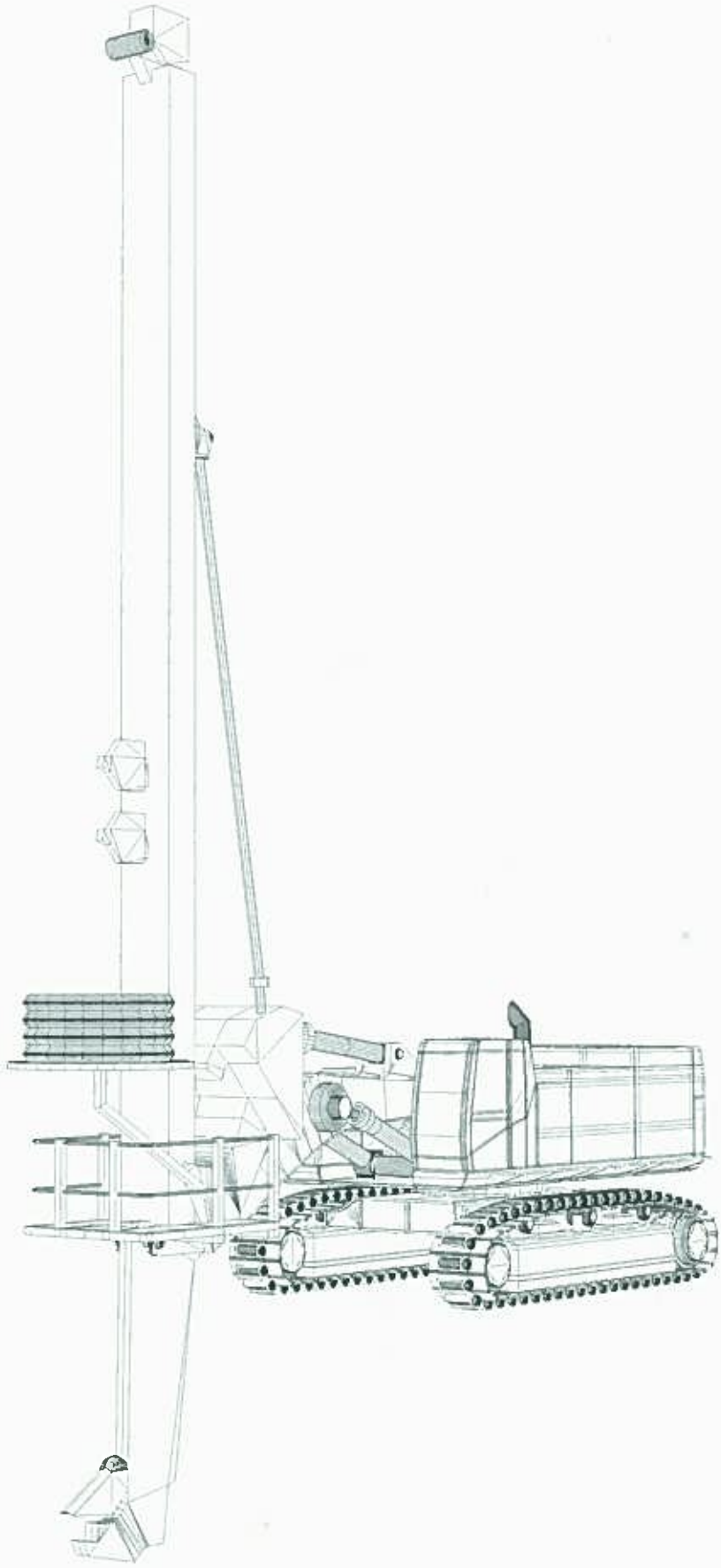

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