Ground displacing Shield Foundation for Catenary, noise barrier, and signal poles

In recent years, a new system for the foundation of catenary masts, noise barriers, and signals has been developed and used in the Netherlands. This method is characterised by a short construction time and thus considerably reduces the overall construction time for catenary systems. The method is currently being validated for use in Germany.

1 Introduction

The demand to increase the share of electrified track can only be met with additional electrification of railway lines. Electrification construction is considered time consuming and expensive. One reason for this is the time-consuming foundation procedures for overhead line poles, which are either cast or set on site and/or drilled. All the usual methods require a significant amount of construction time and construction machinery.
This is where the development of the Ground displacing Shield Foundation (GSF) comes in: The main objective is to significantly shorten the construction time for the mast foundation and thus reduce the overall construction time for overhead lines.

2 Technology

The core of the GSF method is an earth displacing foundation body with an integrated top plate. This is driven into the ground directly at the mast site with a hydraulically operated vibration unit at a frequency above the natural frequency of the ground.
The foundation is made of galvanised steel, which guarantees a service of up to 80 years. The ground shields were developed for different soil classes and loads. They have low mass between 0,3 T and 0,7 Tons and a height of 3,30 m to 3,80 m (Fig. 1). The vibration unit is attached to the boom of a common two-way road/rail excavator (fig. 2)

Two steps are required for the installation of the GSF:

- **First, the inner guide pin is driven into the ground (Fig. 3). This ensures the exact alignment and positioning of the GSF.**
- **The ground displacing shield is then guided by the guide pin and vibrated into the soil to its specified depth (Fig 4).**

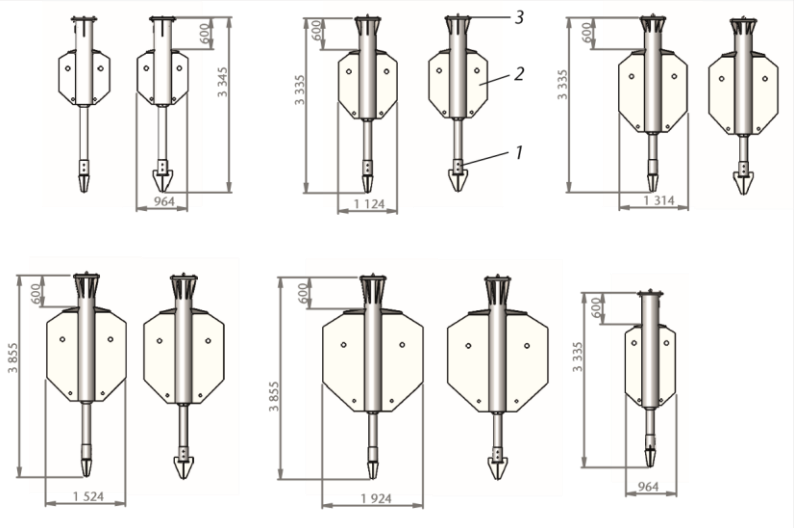

Figure 1:
GSF foundations for different soil types and load cases.
***1* – Guide pin *2* – Soil Shield *3* - Top plate**

Figure 2:
Road-rail excavator with attached vibration unit.

The frequency of the vibration unit only loosens the soil directly surrounding the ground shield. The shield is brought down into the soil and the soil is consolidated again as soon as the vibrations stop. After the installation of the GSF, which takes between 10 and 15 minutes, the process is completed. The GSF can be loaded immediately, and the catenary mast can be attached to the top plate.

With the appropriate preparation, the method allows up to 30 immediately loadable foundations to be installed with one vibration unit in an eight-hour shift. The method can be used with many types of soil, but it cannot be used with rock in the subsoil or coarse and large stones. This means that the subsoil must be examined for suitability in advance.

Figure 3:
First process step: Align and insert guide pin.

Figure 4:
Second process step: Inserting the soil shield

For the static calculations to determine the type of GSF to be used based on the limit loads, a geo-physical simulation module was developed especially for this foundation procedure. Essential parameters are the results of the cone penetration tests at the foundation side, and the forces acting on the catenary mast.

Figure 5:
GSF-foundations for noise barriers at project Theemsweg in Amsterdam

3 Use cases

The foundation was primarily developed to significantly speed up the construction of overhead contact lines. Due to the low technical requirements, it can also be used for smaller projects. For example, for the overhead line sections of charging stations for accumulator traction units. It can also be used to construct foundations for signal masts, lighting masts or the columns of noise barriers (Fig. 5). The patented process has already been approved for use on the Dutch railway network and is used there. Pilot projects are currently being prepared in Germany for local and long-distance rail lines.

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