BFTEC

Practice Report No. 2

STEELROOTS®

FOR STEEL HALL FOUNDATIONS

The first commercial hall in the world to be erected on steel root foundations without concrete now stands in the Haunecker district of Unterhaun in the administrative district of Hersfeld-Rotenburg. The Hersfeld-based construction company Räuber erected the building on the basis of SteelRoots® by BFtec, a company from Nentershausen-Süß.

Initially, it appeared as though the construction project for the erection of a steel construction commercial hall could not be implemented: over the course of the preliminary planning, it became clear that foundations on bored piles, as intended in the original plans and as had also been implemented by several adjoining commercial properties due to the low load-bearing capacity of the inhomogeneous ground quality, would not be economically viable.
The project was destined to fail due to the high foundation costs, until the Site Manager responsible, Mathias Wagner, received a decisive tip from a colleague during a site manager meeting regarding foundations created without concrete by BFtec from Nentershausen. However, right up until the actual construction work began, the BFtec company founder and developer of SteelRoots®, Peter Kellner, still had to do a lot of work to convince his clients and to resolve the prevailing scepticism regarding this new type of foundations.
Would it really be possible to found a self-supporting steel construction hall 65 metres in length and 25 metres wide in such difficult ground conditions on SteelRoots®, and thus also to substantially reduce the costs?
The years of development work, the positive experiences with antenna masts and small wind power plants, the short construction period, the capacity for recycling and not least the cost efficiency are all good arguments in themselves, which however also required appropriate verifications of stability.
From a statics point of view, SteelRoots® is a kind of counterbalance foundations in which the earth surrounding the SteelRoots® is used to dissipate the load. The structural engineering was performed by Diplom-Ingenieur (Certified Engineer) Ditmar Halm from Paderborn, Consultant Engineer at the IK-Bau Nordrhein-Westfalen (North Rhine-Westphalia), in accordance with the acknowledged rules of technology. The adherence to the standards EC3 and

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EC7 is fulfilled, meaning that the construction method requires no approvals or types. One important basis for his calculations were the soil parameters determined by the IGBW/ Ingenieurbüro für Geotechnik und Bodengrunduntersuchung aus Wildeck (Engineering Office for Geotechnics and Substrate Investigations from Wildeck). These static calculations were able to clear up any remaining doubts, and fulfil the prerequisites for implementation of the construction project.

In order to ultimately counteract any residual concerns and reservations regarding the new foundations technology prior to the commencement of construction, the static calculations created by Dipl.-Ing. Halm were also submitted for examination to the external engineering Ingenieurgemeinschaft für Bauwesen (Engineering Company for Construction) in Bad Soden (IGBS). After a few day's deliberation, the IGBS announced that they had no concerns whatsoever regarding foundations using SteelRoots®.
The 65-metre-long and 5-metre-high steel hall was built by Wolf System GmbH on a total of 38 SteelRoots® with basic dimensions of 1.60 m x 1.60 m. These were each incorporated 1.40 m deep into the ground at the standard truss spacing of six metres conventional for hall construction. For each of these foundations, an approximately 2 m x 2m large excavation pit was dug, and a stabilisation layer made from recycled gravel was added and compacted. The SteelRoots® were then positioned and aligned on this even surface with the aid of a mobile digger. After this, the excavation pit was backfilled and compacted layer by layer using the earth previously removed. Only the uppermost segment of the SteelRoots® projects out of the ground.

A major advantage of SteelRoots®, which predestines them also for application on ground with low load-bearing capacity, for example in the Haunetal district or close to the coast, is its low dead weight. One single SteelRoots® product of the dimensions used in Unterhaun weighs approximately 180 kilogrammes. Concrete foundations of the same dimensions weigh 9 tonnes. This is 50 times the weight. From the comparison of these figures alone, it becomes clear how much pressure is them placed on the ground. A further positive aspect of the SteelRoots® in comparison to concrete foundations is the substantially shorter building times: the curing time for concrete is rendered unnecessary. This curing time otherwise totals between 21 and 28 days, depending on the size of the foundations and the outside temperature. Once 3 to 4 SteelRoots® respectively are positioned on opposite sides of the hall, the hall constructors can immediately begin to set up the trusses made from steel elements. Various trades can be conducted in parallel due to this type of foundations. Another advantage is that it is possible to build independent of weather conditions – only very rarely does the ground frost extend to depths of 1.50 metres in our latitudes. The hall in Unterhaun was erected in the winter half of the year.

The friction-locked connection between the SteelRoots® and the base points of the steel frame is produced through a base plate with a connection shoe embedded into the standpipe at the tip

of the steel root foundations. Using a laser, the position and height of the plates are aligned to the millimetre in order to adhere to the accuracies and tolerances demanded in steel hall construction. They are then fixed using a few litres of concrete, for which the curing time is reached after only a few hours.
The SteelRoots® themselves had already been delivered to the construction site in individual pieces. In this way, the steel struts can be transported substantially more easily and compactly then preinstalled building structures. Assembly is easy and quick, because the individual elements only permit assembly in one direction. Once completely assembled and set up, the form of the SteelRoots® is reminiscent of tree roots, which is how the product got its name.
In order to protect against soil moisture or high groundwater levels, only galvanised steel profiles are used, which are also manufactured with thicker walls than actually stipulated. The dimensioning of the individual SteelRoots® products is directly dependent on its later use and the ground quality. This is individually statically verified for each construction project.
SteelRoots® (and the steel construction hall) are 100 percent recyclable: they can for example be dismantled when a company relocates, and set up elsewhere. Should no new construction be required elsewhere, they still retain their value as raw materials. SteelRoots® can be recycled. The fact that no soil excavation is incurred, which might also have to be transported away and disposed of, also saves resources.

And the hall construction in Unterhaun revealed another positive secondary effect: the earth for the lightning protection was executed completely via the SteelRoots®. No further lightning protection measures were required.
Site Manager Mathias Wagner has estimated that, through the SteelRoots® foundations, the cost of the foundations was reduced by more than half. The building owner EPOLOG Exportverpackung und Logistik GmbH had their new steel construction hall with its innovative, inexpensive and efficient foundations handed over to them on the due date.
Summary: It doesn't matter how good or poor the ground conditions are: SteelRoots® represent an exceptionally economical and ecological alternative to conventional concrete foundations.

STEELROOTS®

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