

**Mendel University in Brno
Czech Society of Landscape Engineers – ČSSI, z.s.**

**Public recreation and landscape protection
– with environment hand in hand?**



Proceedings of the 14th Conference

Editor: Jitka Fialová

9th–11th May 2023, Křtiny

MENDEL UNIVERSITY IN BRNO

Czech Society of Landscape Engineers – ČSSI, z. s.,



and

**Department of Landscape Management
Faculty of Forestry and Wood Technology
Mendel University in Brno**



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Editor: associate Professor Ing. Jitka Fialová, MSc., Ph.D.

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Under the auspices
of prof. Dr. Ing. Jan Mareš, the Rector of Mendel University in Brno,
of prof. Dr. Ing. Libor Jankovský, the Dean of the Faculty of Forestry and Wood Technology,
Mendel University in Brno,
of doc. Ing. Tomáš Vrška, Dr., the Director of Training Forest Enterprise Masaryk Forest
Křtiny, Mendel University in Brno,
of Ing. Dalibor Šafařík, Ph.D., the Chief Executive Office, Forests of the Czech Republic,



of JUDr. Markéta Vaňková, the Mayor of the City of Brno,



and of Mgr. Jan Grolich, the Governor of South Moravia,

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LANDSCAPE-FRIENDLY METHOD OF FOUNDING WOODEN BUILDINGS FOR RECREATIONAL USE

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Abstract

When structures in the landscape based on concrete foundations are removed, the foundations are usually left in the ground, but the environment is degraded. The article focuses on the possibilities of foundations in the natural environment nowadays, when we can found buildings on earth screws. This is a way of founding buildings that will be more environmentally friendly. Using earth screws instead of concrete is a modern and eco-friendly option for founding a building or structure. They can also be used in terrain that is difficult to access. With the help of screws we can anchor an information board, a playground, a shelter, a fence, noise barriers, as well as footbridges and bridges or other wooden structures, e.g. even a modular wooden toilet building. If we decide to demolish or move the building, the screws can be unscrewed and the environment can remain intact. Another advantage is the speed of construction, compared to concrete foundations.

Key words: buildings in the landscape, foundations, ground screws, wooden buildings

Introduction

Under normal foundation conditions, we establish wooden buildings and wooden structures for recreational use in the landscape on flat foundations. These are most often strip foundations, footings or slab foundations made of concrete or reinforced concrete. Slab foundations are structures that distribute all loads into the soil at the level of the foundation joint. They are monolithic concrete structures, often combined with the pouring of concrete mix both directly into the excavation and into the lost formwork. The dimensions of the foundations depend not only on the load but also on the foundation conditions at the site. For unblocked buildings, the depth of the foundations is usually up to a non-freezing depth, i.e. a minimum of 800 mm. These foundations are sufficiently load-bearing and are also used for anchoring columns of simple wooden structures (gazebos, benches, information boards, signposts, etc.). Anchoring footings can be then fixed into the foundation directly into the fresh concrete using a spike or using a footing with a plate designed for additional fixing to a solid base, see Figure 1. However, wooden elements do not have a long service life in the natural environment. If the wood degrades, it can be replaced with new elements. But quite often the exchange does not happen, and an unsightly block of concrete remains in the natural environment.

In some recreationally attractive locations, visitor information centres, small restaurants or toilet facilities are built for visitors. These facilities can be designed as modular structures so that the environment is not burdened by the construction in the long term. However, even these buildings require foundations. If they are founded on conventional concrete slab foundations, topsoil must be removed, excavations made, and then it is possible to pour the concrete. The upper structure is then built on top of the storage slab. Pre-finished modular houses can be brought in and fitted, so that the natural environment is not affected by the construction. However, once these structures have reached the end of their useful life, the site is usually left with an unusable concrete area, even after the entire structure has been removed. A modern alternative to concrete foundations is ground drilling. Especially timber buildings, which are lightweight structures, can be founded on ground screws.

Materials and methods

In forests today, we often encounter unsightly anchoring of wooden posts directly into concrete footings or using various metal footings or profiles, see Figs. 2 and 3, where the structural protection of the wood is not even ensured and the wood degrades quite quickly. A modern variant is anchoring with ground screws. Earth screws are conical steel screws of various lengths that can be placed in the ground by hand with a mounting rod, by a special hand-held electric drill, or by a belt machine.

Thanks to many years of development and technologically demanding testing, earth screws for larger buildings are installed with the highest demands on precision, tensile and compressive strength and stability. Installation is carried out using professional equipment developed specifically for the application of ground screws. (www.zemnivruty-krinner.cz)

The screws actually work in a similar way to concrete piles, but it is a dry process. The screws are made of steel, treated with the highest quality hot-dip galvanizing, so they do not rust.

The dimensions of the screws correspond to the load and bearing capacity of the soil. The properties of the soil are determined by tensile testing. The screws can be used in any geological conditions. With experience in this method of foundation, installation can be carried out even in winter in freezing conditions. They can also be drilled into rock but need to be pre-drilled with a diamond crown drill bit. The bearing capacity of the soil is tested using a test frame. According to this test and the calculation of the structural engineer, the type, number and positioning of the drill holes are designed. It is also possible to build on a steep slope in this way.

The only limitation in the use of ground screws is swampy soil or soil with high groundwater levels. In such a situation, the screws would not provide sufficient stability (www.drevostavitel.cz).

They are manufactured in lengths from 450 to 4000 mm as standard. Timber buildings are lightweight structures, therefore the optimal lengths of the screws are approximately 2100 mm. They can be founded on one-piece or adjustable ground screws. The adjustable ones consist of a screw, an extension and a foot. The feet have different terminations, see Figure 4. The tip of the screw is specially shaped for better ground penetration.

In the case of timber framing, timber prisms - sawn timber or BSH prisms - are attached to the foot (top of the ground screws). Larch wood is suitable. The upper structure, usually a timber building, is mounted on the grid prepared in this way, see Fig. 5. It is possible to use any type of timber construction - log, timber frame, wall panel or modular construction. This creates a free space between the ground and the massive frame on which the timber building is mounted. The building is "on legs". It is a ventilated crawl space. This ventilated space is a perfect protection against ground moisture and water penetration, but also against radon penetration. Instead of the floor of the 1st floor, we are building a ceiling structure supported in several places by a grid. It is important to slope the ground so that water does not accumulate under the building.



Fig. 1: Stud feet and plate feet for anchoring wooden elements to concrete (Patky a profily, 2023)



Fig. 2: Unsightly concrete footings for anchoring the educational board (Kotásková)



Fig. 3: Inappropriate anchoring of the wooden posts of the information board, structural protection is not ensured (Kotásková)



Fig. 4: Termination of ground screw feet (DIY vruty nastavitelné, 2023)



Fig. 5: Example of a timber building based on earth screws (Chytré základy)

Results

Modular (modular) houses can be advantageously used for buildings in the countryside for recreational purposes. These are container-type houses, which are always manufactured in a production hall in a dry environment. They are constructed including the wiring and interior fittings. The

modules are then transported to the building site and stored using a crane. In this way, e.g. sanitary facilities, ticket office buildings or information centres in attractive natural locations, as well as restaurant facilities or shelters for holidaymakers can be realised in the open air. Larger objects can also consist of several modules connected to each other. This type of building can be also mounted on ground screws. This method of construction will have minimal impact on the natural environment. The ground screw can therefore be used for simple wooden structures, but also for large buildings, especially wooden buildings.

When screwed into the ground, the conical shape of the body compacts and compresses the soil in its surroundings, thus creating a very solid foundation that can be immediately loaded thanks to the regular threaded surface of the screw body. The main advantage of this technology is that it eliminates the need for concrete foundations, as well as excavation work, including the removal of topsoil. This eliminates the cost of soil removal and other field work. In addition, it is possible to flatten minor terrain irregularities with individual drills. The speed of construction and the reduced impact on nature are therefore positive. Ground screws have the undeniable advantage that they can be used even on difficult terrain where we would not be able to reach with concrete foundation equipment. Disassembly at the end of the life of the structure is possible. The screw is easily dismantled by simply unscrewing it and there is the possibility of reusing it. A service life of up to 150 years is expected (<https://www.strefa.cz>).

The disadvantages may be the inexperience of the contractors and the varying quality of the earth screws.

Conclusion

We should try to put as little strain as possible on the natural environment through construction activity. The construction of simple buildings can be carried out with modular houses, which are prepared in the factory and delivered ready to the site. In this way, the environment will not be burdened by construction traffic in the long term. For the foundation of such buildings, ground screws are sufficient. It is necessary to accurately measure the position and drill them into the ground. Without excavation and concreting, the ground screws can be used to fix a bench, anchor simple structures such as signposts, information boards for nature trails, a footbridge or fences, but they can also be used for a larger wooden recreational building, an information centre, a smaller lookout tower, toilet construction, etc. This method of foundation is land friendly, there is no damage to vegetation by traffic and installation compared to conventional concrete foundations. Primarily, temporary structures, i.e. structures for which their duration is obvious in advance, should be founded on ground screws. Once the structure is removed, there is no degradation of the site by concrete. The screw is easily dismantled by simply unscrewing it and there is the possibility of reusing it. The advantage is that the screws can be used in almost all geological conditions.

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Souhrn

Přírodní prostředí se máme snažit co nejméně zatěžovat stavební činností. Výstavba jednoduchých objektů může být realizována modulovými domy, které se připraví ve výrobě a hotové přivezou na místo. Tím nebude prostředí dlouhodobě zatíženo stavebním ruchem. K založení takových staveb stačí zemní vruty. Je třeba přesně zaměřit polohu a zavrtat je do země. Bez výkopů a betonování tak lze pomocí zemních vrutů upevnit lavičku, kotvit jednoduché konstrukce jako je rozcestník, informační tabule naučné stezky, lávku nebo ploty, ale můžeme je využít i pro větší dřevostavbu rekreačního objektu, informačního centra, stavbu toalet apod. Tento způsob zakládání je šetrný k pozemku. Odpadá nutnost betonování základů, ale i náklady na odvoz zeminy a další terénní práce.

Jednotlivými vruty je navíc možné srovnat drobné terénní nerovnosti. Pozitivní je proto rychlost výstavby a menší dopad na přírodu. Zemní vruty mají tu nespornou výhodu, že se dají použít i na špatně dostupném terénu, kam bychom se s technikou pro betonové základy nedostali.

Primárně by na zemních vrutech měly být zakládány dočasné stavby, tedy stavby, u kterých je předem zřejmé jejich trvání. Po odstranění stavby nedochází ke znehodnocení pozemku betonem. Vrut se snadno demontuje pouhým vyšroubováním a je zde možnost jej opakovaně použít. Výhodou je, že lze vruty využít téměř ve všech geologických podmínkách.

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