

## Double Sliding Isolation Pendulums protect listed Dutch farmhouse against earthquakes

**Earthquake zone Netherlands: the easy-to-handle isolation pendulums can be installed in even inaccessible places and in new buildings.**

Munich, Usquert. The large-scale extraction of gas in the area around Groningen results in frequent 'artificial' earthquakes triggered by subterranean landslips. Calculations have shown that measures must be taken to protect many existing buildings in the region against earthquake damage. This is a particular challenge with older buildings. With its SIP®-D-type Sliding Isolation Pendulum MSA®, MAURER offers an effective solution that is receiving a huge response. The bearings isolate the building from the subsurface and are at the same time so light and thus easy to handle that they can be used in even difficult locations in existing buildings, for example in a listed farmhouse in Usquert.

Two earthquakes occurred in 2018, with a particularly severe magnitude of 3.4 on 8 January. This does not sound very much, but the earthquakes are a result of natural gas extraction in the Groningen field. The epicentres are not very far from the earth's surface and the tremors are therefore felt particularly acutely. Even earthquakes of a magnitude of 3 cause damage.

Around 150,000 people live in the region to the east of Groningen and earthquakes have already damaged thousands of houses. The whole thing has become a political issue and, following public protests, politicians have ordered the annual output to be curbed. Gas extraction is set to be discontinued by 2030.

### Houses need to be made seismically safe

In addition, all 22,000 houses in the gas-extraction area will be inspected with regard to their seismic suitability. Houses deemed to be unsafe must then be retrofitted. There are two ways to do this:

1. Use more solid building methods and reinforce existing structures.
2. Isolate the building from the ground so that any seismic shocks to the structure are attenuated.

If the measures taken to strengthen a building cost more than 50% of the value of the building, it is demolished and rebuilt. However, old houses cannot simply be replaced by new ones, and reinforcing existing structures is not always possible or visually appealing. On top of that, one factor in favour of isolation is the fact that money can be saved with the foundations. "The principle is quite



The renovated Dutch farmhouse rests completely on seismic isolators.

*Image: MAURER*



One of the Typ SIP®-D-type double sliding isolation pendulums: They have an upper and lower curved sliding surface.

*Image: MAURER*

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simple”, explains project manager Oliver Benicke, a construction engineer with MAURER: “You separate the foundations from the building structure and insert the isolators there.”

### Sliding Isolation Pendulum with fourfold functionality

The first building to be isolated using MAURER isolation pendulums was a listed farmhouse in Usquert. The owner is technically savvy and came across MAURER’s expertise in earthquakes during his investigations into the subject.

SIP®-D-type sliding bearings were deployed: SIP stands for Sliding Isolation Pendulum, and D for double curved. The SIP®-D bearings are Sliding Isolation Pendulums with a curved surface at the top and bottom. They perform four tasks in the event of an earthquake:

- They isolate the house from its foundations, allowing movement of  $\pm 80$  mm.
- They dissipate the seismic energy through friction.
- They re-centre the building back to its original position following the quake thanks to the concave sliding plates.
- They transfer vertical loads of up to 681 kN.

A part of the historic farmhouse has a cellar underneath, and it rests on 45 supports, but some of the supports are difficult to access in the basement area. This is where the advantage of MAURER bearings comes in, as they are made completely from MSA®, a metal alloy that is lighter than conventional steel. An isolator with a diameter of 304 mm used in the Dutch farmhouse accordingly weighs only around 25 kg. This means that no lifting gear is required, as the parts can be carried to their final location by hand.

Furthermore, MSA® is corrosion-resistant, eliminating the need for coating in the production process and making them more economical. What is more, corrosion resistance is in itself a convincing argument in the wet Dutch climate.

A total of 45 bearings were installed underneath the farmhouse in 2017/18 and since then have isolated the house from the subsurface in the event of earthquakes.



The historic farmhouse stands on 45 supports on which the isolators rest.

*Image: MAURER*

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### Monitoring technology tracks movement

In addition, MAURER installed a sensitive monitoring system in March. Acceleration detectors were installed on one bearing: one above the bearing on the floor slab of the building and one on the support on which the bearing rests. Movement sensors were also attached. These allow all occurring earthquakes and reaction data to be recorded and stored.

### SIP®-D bearings also in demand for new buildings

News of the advantages of the bearings – affordable, easy to use and durable – has spread in the Groningen region, and they have now found use in new buildings. “Prefabricated parts can simply be placed on the isolators”, reports Benicke. “Construction firms appreciate the minimal effort together with the low price.”

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The monitoring system for earthquake-induced movements consists of acceleration sensors, displacement sensors, camera, and control cabinet with data recorder. It records accelerations and relative shifts in the event of earthquakes.

*Image: MAURER*

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**Quick facts about MAURER SE**

The MAURER Group is a leading specialist in mechanical engineering and steel construction with over 1,000 employees worldwide. The company is market leader in the area of structural protection systems (bridge bearings, expansion joints, seismic devices, tuned mass dampers, monitoring systems). It also develops and produces vibration isolation of structures and machines, roller coasters and ferris wheels as well as special structures in steel.

Maurer participates at many spectacular projects world wide, like for example the world's biggest structural bearings for the Signature Bridge in Wazirabad, Delhi, earthquake resistant expansion joints for the Bosphorus bridges in Turkey, semi-active tuned mass dampers for the Danube City tower in Vienna, or uplift bearings for the Zenit-Football-Arena in St. Petersburg. Showpieces in the field of structural engineering include BMW World and Munich Airport's Terminal 2. Spectacular amusement rides include the world's largest mobile Ferris wheel – 'Hi-Sky' in Munich – the Rip Ride Rockit roller coaster at Universal Studios in Orlando and the Fiorano GT Challenge in Abu Dhabi.

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