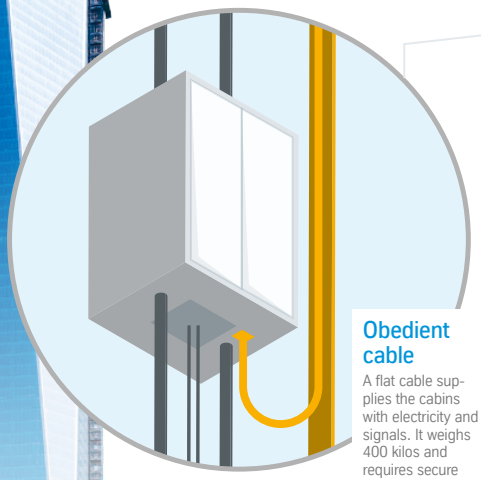
Together

The power of magnets

Why the fast elevators in the new **One World Trade Center** in New York City required experts from Transrapid and Magnet Technology at Materials Services in Essen, Germany.

One World Trade Center

Eight of the 74 elevators in New York's 1 WTC ride from the lobby up to the 104th floor, over 406 meters aboveground. The very tip of the tower is 541.3 meters high.



Obedient cable

A flat cable supplies the cabins with electricity and signals. It weighs 400 kilos and requires secure guidance – with magnets.

It doesn't even take a minute to ride up from the lobby to the very top. The 104th floor of the new One World Trade Center in New York City is 406.6 meters above the ground. thyssenkrupp elevators glide up to this floor at a record speed of 10.16 meters per second. That's a new high, even for the thyssenkrupp Elevator specialists. "These are the first elevators to manage this kind of height at this speed," says Markus Jetter, Head of Product Development for Systems and Components in Neuhausen, near Stuttgart, Germany. "Inevitably, that gives rise to new challenges."

One of these is the cable required to supply the cabins with power and ensure that signals are transmitted to the sensors. It is over 200 meters long, weighs about 400 kilos, and is secured at the rear end of the cabin floor and halfway up the elevator shaft, which means it moves during every ride. If the elevator is halfway up the shaft, it forms a large loop. During a maintenance check shortly after the building handover in summer 2015, the presiding technical expert and engineer from Elevator Memphis, Scott Lahmers, discovered an issue. The flat cable, which is nine centimeters wide, 1.4 centimeters thick, and has a natural tendency to twist, kept slipping out of the metal rail that had been specially attached to the shaft wall whenever the cabins were on the lower floors. "At these dimensions, this could lead to the cable getting caught on components, getting damaged, or even tearing," says Jetter. In the worst-case scenario, this would take the elevators out of service for several days, damaging our corporate image. As a result, a quick solution was needed.

Lahmers turned to the team in Neuhausen for assistance. They had developed a solution for projects in China and Russia using magnetic rubber bands to guide cables with steel reinforcements on the right- and left-hand sides onto the rail. However, the elevators in New York are higher and test results showed that the magnetic power of attraction of the caoutchouc/hard ferrite composite material used would not suffice. The cables still went off course.

In-house magnet specialists

The search for a solution continued. First came the Munich-based thyssenkrupp Transrapid team. Olaf Huber, a magnetic technology specialist, made calculations for the required magnetic field and its orientation. To receive a concrete solution with improved magnetic material, Jetter contacted his colleagues at thyssenkrupp Magnet Technology in Essen, who also supplied the permanent magnets for the MULTI. Jetter reasoned that the team that had the right material for a cable-free elevator with a linear drive would also have an idea for the One World Trade Center. That's how physicist Wilhelm Cassing from Materials Services (MX) came on board. He's familiar with the magnet business as well as with the materials available at MX. After all, according to Huber, "High-quality permanent magnets based on rare earths are difficult to come by. At the present time, rare earths are mainly being mined in China."

Cassing suggested using a neodymium/iron/boron alloy to solve the issue at hand. "Not every magnet is suitable for every application," he says. "Based on many years of experience, we know which material can best generate given magnetic forces." For example, Cassing and his team tested the values of magnets for the ISS space station prior to supplying them. "On the ISS, those magnets are used in the magnetic bearings on the satellites, among other applications," says Cassing. "We need to ensure that every single one of them can bear the load in space, and we also need to document this precisely."

New York's tallest building is now equipped with a permanent magnet based on the rare earth neodymium. At a magnetic flux density of 1,100 millitesla, it is four times as powerful as the caoutchouc/hard ferrite magnet that employees previously experimented with, which has a field strength of 280 millitesla. These good magnetic properties compensate for the greater effort required to install the magnet; since neodymium/iron/boron magnets are smaller due to the manufacturing process by which they are produced, more of them need to be attached to either side of the rails. "But the important thing was to deliver quickly and effectively, and we achieved that together," says Cassing.

The solution is a success. The magnets are easy to retrofit and keep the cable within the rails, where it moves back and forth as planned. The magnets were installed onto the lower portion of five out of the eight elevators that go from the lobby to the top floor. High-rise experts from Elevator are now testing various options in the Rottweil testing tower – then the elevators can go even higher, even faster.

> "The magnets from MX exceeded our expectations and solved our problem in the One World Trade Center."
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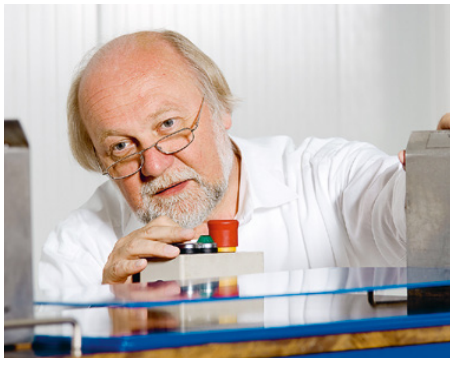
> Scott Lahmers, engineer at Elevator Americas (left), with Markus Jetter, Head of Research & Innovation Center Rottweil and Product Development Center MULTI.



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> Wilhelm Cassing, Physicist, Magnet Technology at Materials Services

Spectacular: Scott Lahmers documented the installation of an escalator in 1WTC from the roof on camera. His video is available on we.online.

Photos: shutterstock, Frederik Laux, thyssenkrupp Illustration: G3 Visual Lab