INTERNATIONAL MOLYBDENUM ASSOCIATION
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Mobile cranes reach higher

Today's global demand to build infrastructure larger, faster and higher challenges crane manufacturers to keep pace by developing more powerful, versatile and cost-effective equipment. Molybdenum-containing high- and ultra-high-strength steels allow them to push performance boundaries to new heights.

Spectators from near and far gathered to watch as three enormous parts of a scaffold that took two years to install were removed in four hours. The Cologne Cathedral, a World Heritage site, attracts approximately 20,000 people a day, making it the most visited landmark in Germany. Its two towers reach 158 meters into the sky, making it the fourth tallest church building in the world.

Weathering, acid rain and other industrial pollutants eroded this gothic masterpiece over its lifetime. Bird droppings also damaged its delicate sandstone façade, though nesting falcons given an aerie in the cathedral have solved this problem. Even so, the cathedral needs constant maintenance and repair, and employs 60 permanent craftsmen for this purpose.

In 1984, a three-meter chunk of stone plummeted 100 meters from the cathedral's north tower during a heavy storm. The ensuing incident investigation found that brass and iron stone anchors had failed. The iron anchors corroded and the resulting rust (occupying a greater volume than iron) put pressure on the stone, cracking and loosening it in places. To avoid similar incidents, stainless steel stone anchors were to be installed in place of the old iron and brass components.

For the stonemasons to access the lofty areas without damaging the façade in the process, intricate scaffolding had to be hand-assembled over the course of two years. It took years to restore the stonework, and then months to disassemble much of the scaffolding. However, the three largest sections of scaffolding remained at a height of 100 meters. Project managers estimated another six months would be needed to extract these last massive sections manually, so a more efficient approach was sought. To do the job quickly and economically, German logistics experts from Wasel GmbH were engaged. Armed with a highly detailed and complex plan, they brought in one of the biggest mobile cranes available, the Liebherr LTM1750-9.1, to perform this delicate operation.

The wonderful world of mobile cranes

Mobile cranes are compact, lightweight and fuel-efficient and can be rapidly set up and taken down. They perform tasks as disparate as unloading the heaviest of shipping containers at an expansive seaport and deftly extracting a large tree from the confines of a residential property. They must be able to travel on highways or over rugged terrain. They must be both light enough to cross highway bridges and small enough to clear underpasses and tight spaces.

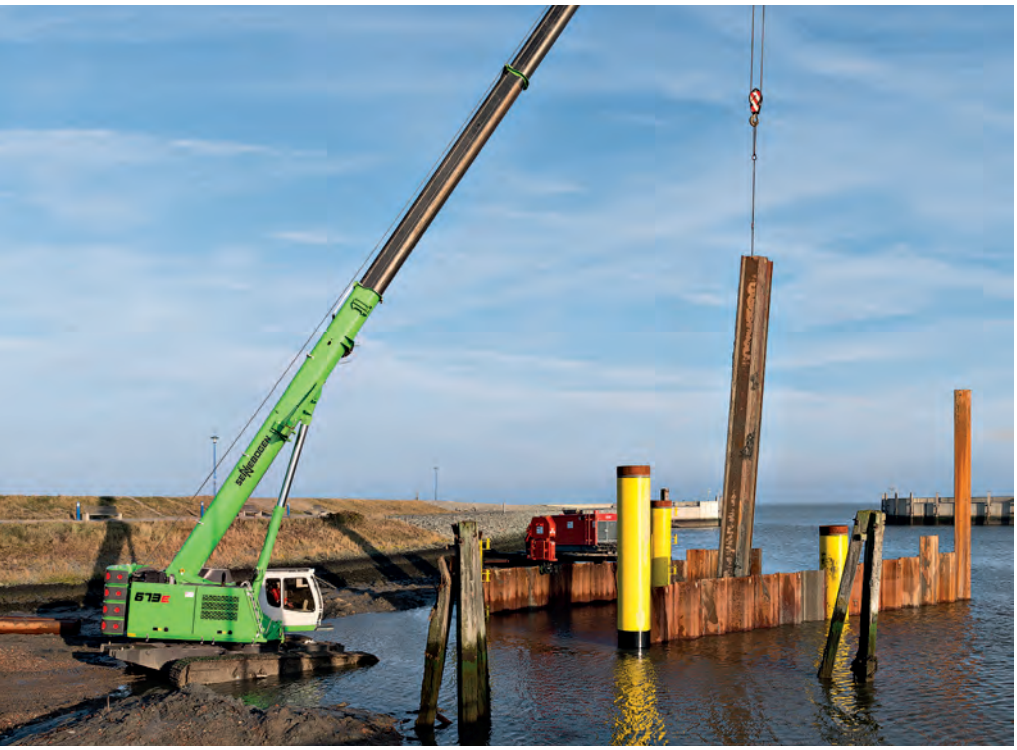
Once the crane is at a job site, its boom either unfolds or telescopes to reach the necessary height. Thinner and stronger structural members confer great advantages on mobile cranes. They allow the cranes to be more compact, extend to greater height, and lift larger loads. Crane manufacturers require high- and ultra-high-strength steels to make these thinner and lighter sections. The very high strengths required, combined with the good toughness needed for safe operation, are only achievable by adding molybdenum to the steel. Typically, these molybdenum additions range from as little as 0.1% up to 0.7% for the highest-strength steels. ›

Mobile cranes must be able to navigate standard highways and roads, even in the most demanding circumstances. © Liebherr-International Deutschland GmbH

Mobile crane classification

Mobile cranes are appearing more and more at worksites. They come in varying types, sizes and lifting capacities, and can be categorized as crawler, truck, all-terrain, and rough-terrain cranes.

Crawler cranes have an undercarriage with a set of tracks or crawlers to provide stability and mobility. Manufacturers use high-strength structural steel containing up to 0.7% molybdenum in their designs to reduce weight and increase efficiency.



Crawler cranes are the “heavy lifters” of the crane family, and are widely used for construction projects.© SENNEBOGEN Maschinenfabrik GmbH

These cranes can lift upwards of 6,800 tonnes and maneuver the load with precision. They are ideal for modular construction where large, heavy, pre-fabricated modules need to be positioned. The only disadvantage of the crawler crane is that it moves slowly, so it must be transported to the worksite by truck.

Truck cranes are self-propelled loading and unloading machines mounted on a truck body. They are equipped with rubber tires that allow them to travel on public roads. The crane’s working section comprises a rotating turntable and a cantilevered boom. High-strength steels are used in many of the components that make up truck cranes, including the hydraulics that power the boom.

One of the world’s largest truck cranes has a lift capacity of 30 tonnes when the boom is extended to nearly five meters, and nine tonnes when extended to 15 meters. Extension booms employ a high-strength structural steel with 0.7% molybdenum.

Some truck cranes are used for lighter-duty work, for instance bridge inspection. These cranes feature a large operating range that allows inspectors access to all parts of the bridge deck. They can also be used for performing light repair work or for taking material samples. Despite the lower loads, they also employ high-strength steels. One leading manufacturer uses steels with up to 960 MPa tensile strength, containing up to 0.7% molybdenum, in their components.

Truck cranes are highly versatile, and are seen in a wide variety of lighter lifting applications such as this tree extraction. © Robert Bukk

All-terrain cranes are a more versatile version of truck cranes. Typically, all-terrain cranes have four to eight large rubber tires, four-wheel drive and all-wheel steering. A single engine powers both the vehicle and the telescoping crane. Their increased mobility makes them ideal for on- and off-road as well as confined work sites and rough terrain. They can travel at speed on public roads and highways. All-terrain cranes use molybdenum-containing steels in their lifting components; these cranes have lifting ranges from 40 tonnes with a maximum boom extension of 35 meters to 400 tonnes with a maximum boom extension to 60 meters. Some all-terrain cranes can hoist loads as large as 1,200 tonnes.

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Rough-terrain cranes are compact cranes with a single cab for both driving and lifting operation and a telescoping boom. All-wheel drive and steering and large rubber tires provide the rough-terrain crane with maneuverability and versatility to work not only on slick, uneven and rough terrain but also in narrow spaces.

Rough-terrain cranes can be used in bridge building, operations in power and chemical plants, refineries, and for large construction projects such as wind farms. Lifting capacities can range from 30 to 135 tonnes. Boom extensions range from 29 to 60 meters for smaller models and higher for larger models.

"Ideal for the job"

Back in Cologne, in July 2013 the 9-axle Liebherr all-terrain mobile crane rolled onto the forecourt of adjacent Cologne Central Station, one of the busiest railway stations in Germany, to remove the remaining scaffolding from the Cologne Cathedral. The best location for the crane to reach the scaffolding would have been the cathedral square. However, the drawings of the parking garage underneath the square were lost when the city archives collapsed in 2009. It was therefore not possible to check whether the ground would hold or to calculate the exact placement of the crane.

Because of the crane's location in front of the busy train station, crews had very little time to assemble the lattice boom, and the constricted space required it to be put together while suspended. The crane's crew worked through the night with the assistance of a smaller mobile crane. By morning the larger crane with its impressive 160-meter boom, built from steels with up to 1300 MPa tensile strength containing around 0.5% molybdenum, was ready to begin the intricate task of removing the scaffolding.

A large number of spectators from all over Germany and the Netherlands gathered to watch as crews detached the seven-meter wide, 33-meter high scaffolds and very slowly lowered them to the ground. To help the crane operator, a crew of guides was secured to the cathedral spires by ropes and climbing harnesses. In some places a mere 15 centimeters separated the scaffold from the cathedral. With delicate coordination between the crane operator and the guides, the scaffold was slowly and precisely moved and deftly deposited in front of the cathedral's main entrance without incident in a little over four hours. Molybdenum-containing high-strength steels played a crucial role in this timesaving drama. (Robert Bukk)

The Cologne Cathedral's scaffolding is carefully lowered to the ground during its removal following restoration work. © Raimond Spekking/ CC BY-SA 3.0 (via Wikimedia Commons)