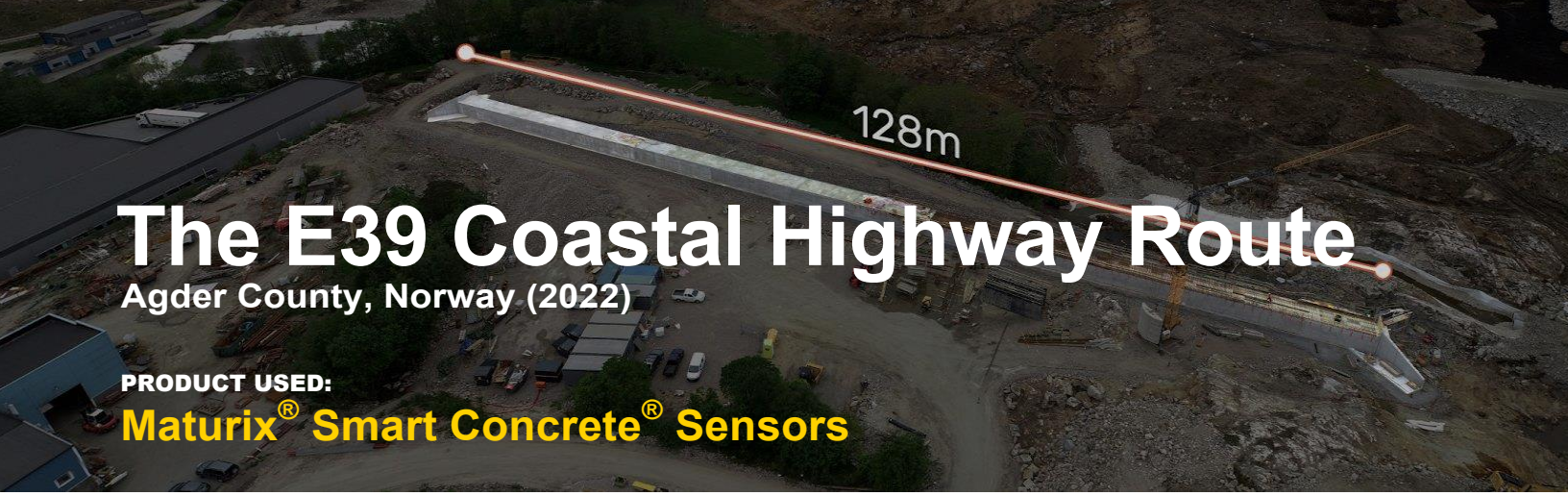

The E39 Coastal Highway Route

Agder County, Norway (2022)

PRODUCT USED:

Maturix® Smart Concrete® Sensors

CONTRACTOR:

Kruse Smith

BACKGROUND

Norway is a country with a beautiful, varied landscape full of majestic fjords, lakes, arctic tundras, and mountain tops. However, that natural beauty can cause a number of transportation difficulties. In Norway's case, this means that locals need to rely on small highways that go across numerous valleys in the country. Additionally, whenever waterways are present, they are expected to travel by ferry. In some cases, locals may find driving to a neighboring city can take around three 45-minute ferry trips. All of which can make transportation both slow and frustrating.

To counter this transportation trouble, Norway has decided to go ahead with the construction of the E39 coastal highway route. This project will likely be the largest Norway has had to undertake as it involves several massive subprojects. These include the construction of a suspension bridge at Sognefjord with 457-meter-high (1,500-foot-high) towers and a 3,688-meter-long (12,100-foot-long) span and the E39 Rogfast, which will be the world's longest and deepest subsea road tunnel according to the Norwegian Public Roads Administration. Many of these subprojects could become record-breaking engineering marvels if they are fully realized.

One of these subprojects in particular focused on the construction of a highway that would span from Kristiansand to Mandal. Part of this construction involved the development of a water and wildlife tunnel that would not only carry a stream but also allow animals to pass under the new highway.

As one of Norway's largest contractors, Kruse Smith took on this highway project. However, they decided to try something new for the project's construction. They wanted to evaluate how they could save time, so they chose to compare their normal construction schedule, which used crush tests to determine their concrete's development, against the use of Maturix Smart Concrete Sensors, which monitor concrete temperature and calculate concrete strength in real time.

SOLUTION

To start, they had the sensors silently recording the temperature and logging the strength development of each cast.

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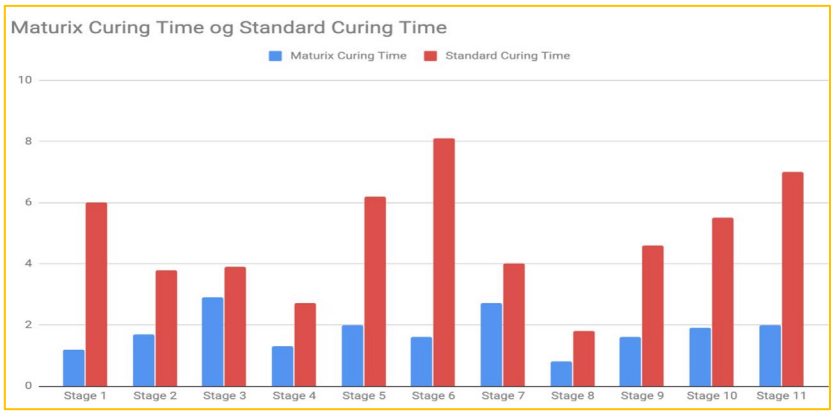
Meanwhile, Kruse Smith maintained their normal schedule over the typical 11 stages, making decisions around concrete strength using field-cured cylinders.

This approach allowed the contractor to get an understanding of the time- and cost-saving benefits that come from monitoring concrete strength in real time with Maturix® Sensors. For instance, these sensors leverage *ASTM C1074 — Standard Practice for Estimating Concrete Strength by the Maturity Method*, a non-destructive test method known for its reliability. Following the principles of this test, the Maturix Sensors convert the concrete's temperature and time data to maturity hours, which gives the sensors the ability to determine the concrete's strength.

Comparing the sensors' data against the regular construction schedule gave Kruse Smith solid evidence that solely relying on crush tests added unnecessary delays and slowed their productivity. This evaluation highlighted how field cylinders hydrate at a slower rate than concrete that's been placed en masse. In fact, Kruse Smith also saw firsthand that the placed concrete generated more heat than the cylinders. This significantly affected their understanding of when the concrete had reached target strength, which determines when they can strip forms and move to the next stage.

With that in mind, Kruse Smith noted that their normal concreting practices allowed them to complete the project in 53.6 days. However, data from the Maturix Sensors indicated that the placed concrete had achieved strength targets well in advance and that the actual curing time took only 19.8 days (as recorded in the graph below). This highlighted how the contractor had the potential to save up to 33.9 days. After reviewing this and walking through the relevant information, the teams at Kruse Smith determined they could have conservatively shaved seven days off the project if they leveraged the information provided by Maturix. As a result, the Maturix Sensors would have reduced their construction costs by over €200,000 on labor and equipment alone.

These results were so encouraging to Kruse Smith that they continue to use Maturix Sensors for a number of other construction projects for bridges, tunnels, and precast modules.



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