

# Safer and faster: The new E134 route between Gvammen and Århus

## Project overview >

Relocation of the E134 through a tunnel between Gvammen to Århus will successfully shorten the E134 route by approximately 11km. In addition, the new road, with very little gradient, reduces driving time for heavy vehicles by about 18 minutes, making the journey both safer and faster.

**Project title:** Drill and Blast tunnel, E134 Gvammen-Århus

**Client:** Ferdigbetong A/S

**Contractor:** NCC Norway A/S

**Location:** Telemark Fylke, Norway

**Developer:** Statens Vegvesen, Norwegian Road Administration

**Length:** Approximately 11.7km. Approximately 9.4km of which is tunnel

**Speed limit:** 80km/h

**Road width:** 10 metres

**Tunnel category:** C (tunnel cross section T10.5)

**Total cost:** Approximately NOK 2.0 billion

**Financing:** State funds (100%)

**Duration:** 2014 – 2018

**ArcelorMittal Fibres used:** 1,250 tonnes to include:

- 650 tonnes of standard HE 55/35, 1200 N/mm<sup>2</sup>
- 600 tonnes of new premium HE+ 55/35GL, 1800 N/mm<sup>2</sup>

**Dosage:** Between 23kg/m<sup>3</sup> and 28kg/m<sup>3</sup>

“In addition to what the ArcelorMittal higher performance HE+ 55/35 fibre is bringing to the concrete, the lower dosage rate has had a big influence on the daily work at the concrete ready mix plant. With 30% less fibres, we found the process of mixing and dosing the fibres considerably easier. The reduced dosage rate also positively affected the whole supply chain with less deliveries and less stock required at our mobile concrete plant in the remote Notodden location.”

## The challenge >

The Gvammen-Århus tunnel runs predominantly through quartzite. The thickness of the overburden in many sections of the tunnel is more than 1000 metres, resulting in high rock stress and a real danger of rock burst. The tunnel is constructed using a Drill and Blast method and reinforced with ArcelorMittal steel fibre reinforced shotcrete.



## The solution >

In unstable subterranean environments, where there are rough, undulating rock surfaces with deep cracks and fissures, ArcelorMittal steel fibres not only proved their efficiency by quickly re-stabilising the environment, but they also demonstrated how the hooked end design, with its tensile strength, enabled contractors to use fewer fibres, with no compromise to performance and strength.

Successful tests at SINTEF Certification Institute in Oslo demonstrated that the ArcelorMittal high performance shotcrete steel fibre, the HE+ 55/35GL, with 1800 N/mm<sup>2</sup>, allowed for a reduction in the steel fibre dosage by around 30%.

By using a higher performing steel fibre, our client achieved considerably savings in the quantity of steel fibres used and greater workability when spraying.

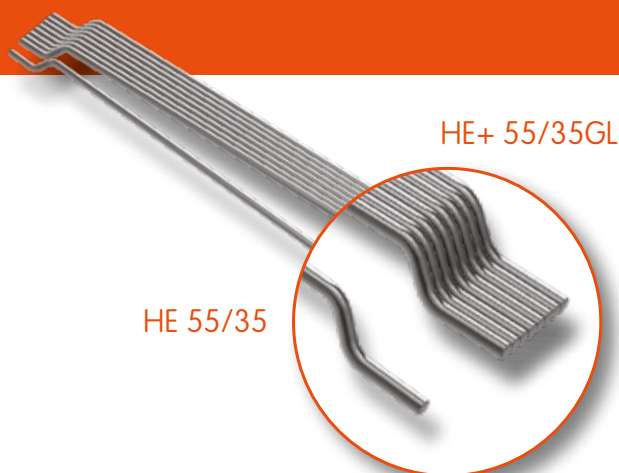
## We constantly strive to improve our products.

The project began with the use of the very popular HE 55/35 (1200 N/mm<sup>2</sup>). This fibre already has a long history of delivering highly efficient reinforced shotcrete solutions in very similar environments to the E134 tunnel in the whole Nordic area, but also in other important projects such as London's Crossrail, and multiple high speed railway lines throughout Spain and many other European countries. Although ground conditions in the Nordic area are quite different to many other areas where the HE 55/35 has been used, the performance specifications of the HE 55/35 exceeded the Gvammen – Århus project's stringent quality requirements.

During the course of the project, ArcelorMittal's ongoing development of a new breed of steel fibre resulted in the launch of the HE+ 55/35GL. This new generation of fibre means that the same performance levels can be achieved as the HE 35/55 but the volume of fibres used can be reduced.

We supplied the HE+ 55/35GL as a glued fibre which provides greater workability and delivers an even distribution of the fibres throughout the concrete mix.

Switching from the HE 55/35 to the HE+ 55/35GL represented a reduction in dosage rates. Independent test results proved the performance of the new HE+ grade and the client was able to see the very beneficial efficiency savings.



"It was interesting to see how the new HE+ 55/35GL, 1800 N/mm<sup>2</sup>, performed compared with the standard HE 55/35 fibre, 1200 N/mm<sup>2</sup>. From panel tests according to NB07, 2011 at SINTEF in Oslo, we could also see that we could dose 23kg/m<sup>3</sup> to achieve 700 joules, and 28kg/m<sup>3</sup> for 1000 joules. This led to around 30% material savings, not to mention the reduced impact on the environment."

Mats Pettersson

Head of Steel Fibre Sales Nordic and Baltic, ArcelorMittal.

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