Tubbing manipulator Snekkestad, Norway

A tubbing manipulator for the Snekkestad Tunnel

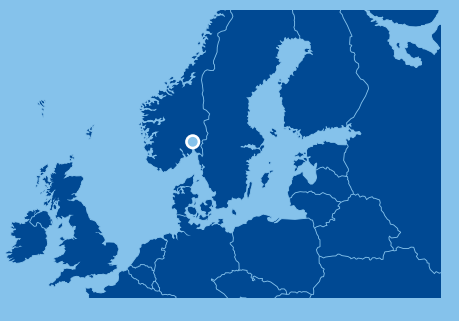
The Snekkestad Tunnel in Norway is to be expanded with single skin tubbing. The length of our lot is 2080 m and a suitable manipulator is required. The 7.2 t tubbing will be placed on the parament and ridge. Owing to the tunnel conditions, Marti Technik AG has developed a specific manipulator based on a hydraulic excavator equipped with a special jib and a vacuum manipulator on the end. This sucks up the tubbing, turns and moves horizontally and vertically into the right place. Despite the limited space, the elements must be placed efficiently, within a max. of 30 minutes per element. The stability, hydraulics and remote control posed the greatest challenges.

Overview

Customer: Renesco a.s.
Built: 3rd & 4th quarter of 2013

Tubbing manipulator

Base excavator: Liebherr R 954 C Litronic
Operating weight with manipulator: 65 t
Uptake of the precast concrete element: vacuum with suction plate
Degrees of freedom: 5 axes
Control of the excavator: Conventional cab control or external remote control
Stability: load bearing limit



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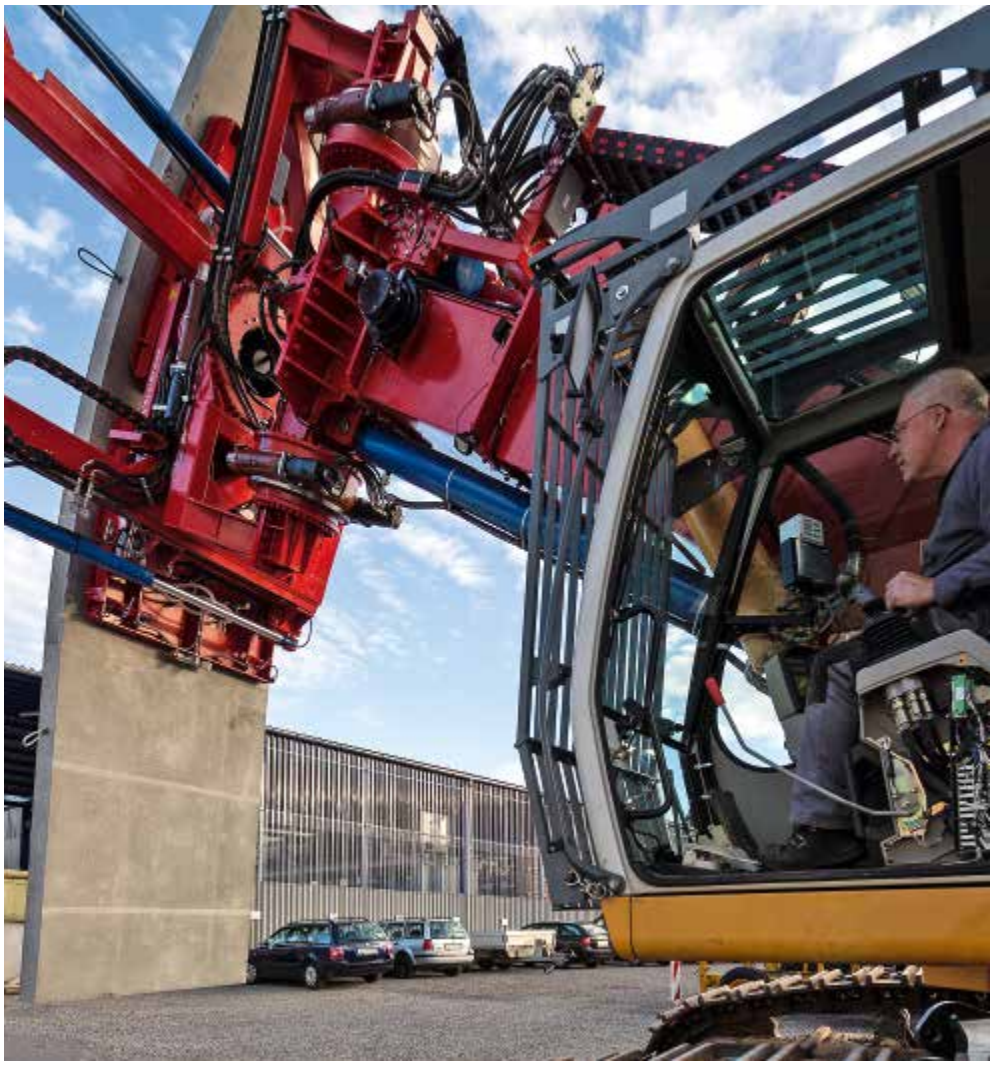

Tunnel excavation
Cross-sectional area: 135 m²
Tunnel length: 2080 m
Inner diameter: 13.3 m to 16.2 m
Elements in the cross-section: 4 pieces
Weight of precast concrete element: 7.2 t
Width of element: 2.0 m

A hydraulic excavator becomes a tubbing manipulator

A Liebherr R 954 C Litronic excavator form the basis of the manipulator. This model has been selected because of its size, the width of its chassis and its net weight of 55 t. We dismantled the excavator up to the upper structure and rebuilt it with a special jib. We installed a vacuum plate right at the front of the head, which sucks the 7.2 t of tubbing, i.e. the precast concrete segments. To ensure the stability of the excavator, it was weighed down with an additional counter weight of 6 t at the rear. A load bearing limit measures when the excavator has reached its maximum jib radius. If this is exceeded it shuts off automatically, resp. only functions that lessen the load can be initiated.

Guiding the excavator by remote control

In addition to the controls in the cab, the excavator can also be operated by remote control. This involved working with the existing hydraulic system of the excavator. The operator in the cab of the excavator can now place the elements exactly where necessary to within up to 20 cm, then they switch over to the remote control and a second engineer, who is not in the excavator, places the elements precisely in the right place by remote control.

A challenge for the hydraulics

The hydraulic system of the excavator was oversized for the advanced features of the tubbing manipulators with its pump capacity of 700 litres per minute at 360 bar. Only 50 litres throughput per minute at 150 bar are required to place and position the elements to the nearest millimetre. Two additional built-in pumps that are continuously controlled by proportional valve blocks create the necessary balance.

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