

SKANSKA

Since 1971 at the service of the international tunnel construction.

ITC NEWS

- 19 - 2004

High Speed Mucking in Follafos or how to improve the loading capacity by 50%



Picture 1: The mucking machine Schaeff model ITC 312 H3 at work in Hhydro Power Plant Follafoss

INTER TECHNO COMMERCE SA

Tunnelling Equipment

122, rue de la Fusion - CH-1920 Martigny

Tf: +41-277 222 191, Fx: +41-277 222 185

<http://www.itcsa.com> - email: info@itcsa.com

A specialist company of the holding



TEREX

SCHAEFF

High speed mucking in Norway

Norway being interested in selling electricity to the neighbour countries, several Hydro Electrical Power Plants has risen. Selmer, now part of Skanska, was awarded recently the HEPP of Tyn and more recently the HEPP Follafoss.

For the project in Tyn, the plant manager of Skanska contacted ITC to see whether a suitable solution for high speed mucking in these small sections was economically viable.

After a site visit in Italy on a similar HEPP-project, the contractor decided to test one ITC 312 Tunnel-Loading Machine in the toughest Norwegian rock condition.

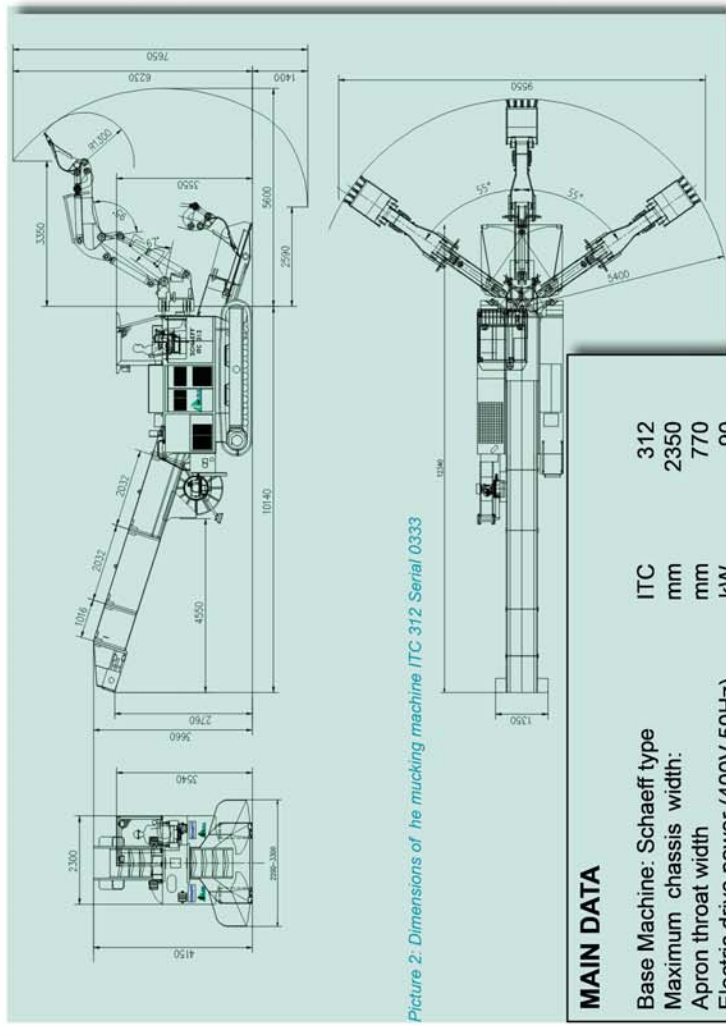
So one machine was prepared with

a so-called 'rubber plated' conveyor, developed a few years ago for very severe Chinese rock conditions and a FOPS canopy as it is required in Norway. Two and a half conveyor extensions were necessary to fill the 30 tons road trucks used in the project. For more technical data, see separate frame.

Description of the work: HEPP Tyn is the expansion of a already existing HEPP for Norsk Hydro, located close to Ardal between the high mountains of the Sognefjord region in the central Southern Norway the purpose of this plant is to supply a aluminium melting with sufficient energy. This project will include the construction of 21 km

of headrace tunnels between (12) m² and 46 m². So the capacity of the plant will be increased from 192 to 374 MW. The geology encountered on this project is rather complex, but consisting mainly of gneiss, gabbro, amphibolite and pyroxene-granulate. The major weakness zone in the project area is a regional fault zone crossing the pressure tunnel at 3,5 km from the power station, where heavy support was required.

Description of the work: HEPP Follafoss is located 140 km northwest of Trondheim, on the Tronfheim .. Ford. This was an existing HEPP with .. MW that should be expanded to .. MW.



MAIN DATA

Base Machine: Schaeff type	ITC	312
Maximum chassis width:	mm	2350
Apron throat width	mm	770
Electric drive power (400V-50Hz)	kW	90
Diesel EngineDeutz	Typ	BF6L 913
Power output according to DIN 6270 Bll	kW	112
Driving speed:	km/h	0-3,6
Conveyor chain speed:	m/s	0.5
Loading capacity	m ³ /min	3-5
Specific ground pressure:	kp/cm ²	1.0
Traction power:	kN	280
Weight	t	30

Description of the work: HEPP Bodo
 Here we consider the mucking cycle of the HEP Follafoss:

- Preparing time for drilling 10 min
- Drilling time for 56 holes Ø 48 mm 100 min
- Charging time for explosive (400kg) 30 min
- Firing and ventilation time 30 min
- Preparation time for mucking 15 min

- Mucking time 90 min
- Sealing time 20 min
- Invert cleaning time 15 min
- Support resp. anchoring time 10 min

The drilling is performed by a jumbo Atlas Copco Rocket Boomer L2C with 2 booms with 18' long slides fitted with cop 1838 hammer.

The ITC machine is considered for the Headrace tunnel 2.7 km long in Tyn and 3.5 km in Follafoss. The original cross section in the bid documents tunnel was started with conventional means, say wheel loader and road trucks. In order to allow the loading, the height of the tunnel was raised to 5.6 m and the width to 4.5 m to allow a water ditch to be used. Three truck and the wheel loader during mucking operation would require .. cubic metre of fresh air what a ventilation pipe of 1500 mm diameter requires. Wheel loaders need niches to load the 18 cubic metre capacity road truck. In order to avoid too long waiting time, the optimal distance between two niches was estimated at 150 metres. The Atlas Copco Jumbo type RB L2C with 18' feed will produce a pull of 5 metres. This being said, the normal average performance is situated at 60 metres per week composed of 11 shifts of 11 hours.

When the ITC 312 machine arrived on site in October 2002, ca 250 metres of tunnel were already completed in Tyn. In order to cope with the chain conveyor, the drilling pattern was

increased by five holes. After a certain distance, the ventilation was supposed to be improved, but due to the electric drive of the new machine, this was not anymore necessary. The contractor entered than an evaluation process to find the optimal operation for this equipment. So the distance between the niches was smoothly increased step by step until approx. 350 metres. Despite of this longer distance, the mucking time was reduced to one and a half hour and even less. In the spring and early summer 2004, a heading length of more than 100 m per week was achieved several times on the site of Follafoss. The average heading speed for this tunnel lies by 75 metres a week; this means 25% more than with conventional means, despite the large faulty zone at the beginning of the tunnel, where one week was spent to achieve 10 meter of heading. The October 2002 issue of Tunnels & Tunnelling reports a advance rate with conventional wheel loaders of 60 m per week.

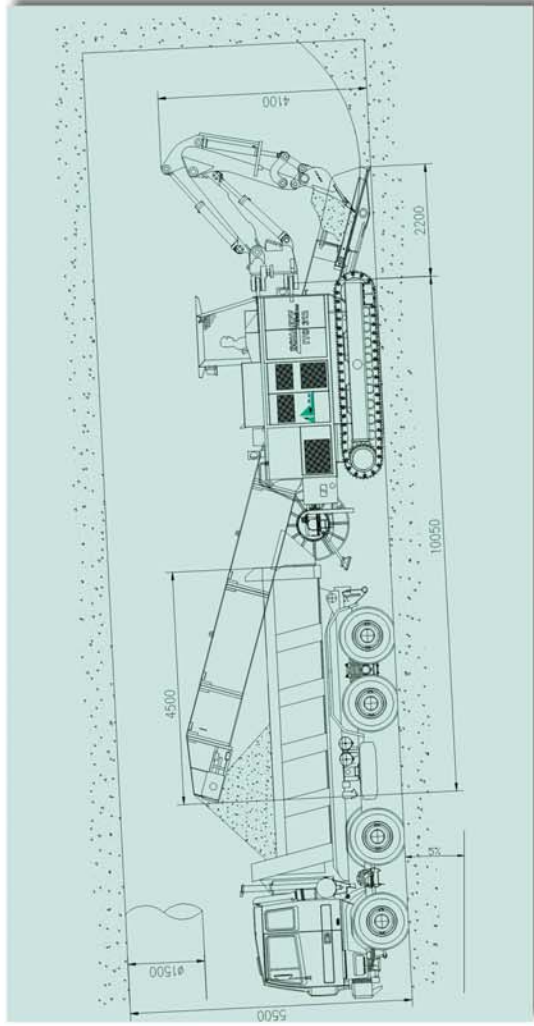
From August 2003 to December 2003 Skanska hired a second machine ITC 312 for the invert cleaning of the Tyn project. As originally the machine was designed for the invert cleaning, the performance was quite interesting.

Skanska mechanical engineer Tarald Oyen say during a site visit at tunnel face: « It is amazing to see the loading capacity of this ITC machine; many 18 cubic meter truck are loaded in three minutes, this is twice more than promised by the leaflet.. »

Despite the increased number of bored holes, the gain of performance per week, the minor need of ventilation and none-the-less longer distance between the niches, make this mucking system much more economical than the conventional.

Recent discussion with mechanical engineers of the site results that the operating cost including the wear parts of the conveyor of the machine also much lower were than originally supposed and claimed by ITC. Nils Hereid, the site responsible for the equipment say: «we practise a preventive maintenance on every shift, on this way I sleep well on the night» further he added «the availability of the ITC machine is excellent, the hydraulic system is perfectly tight, no leakage, no repair..»

Site manager Magnar Myklatun enthusiastic about the machine says «due to the good results on this site, we are now evaluating several job sites with this method and equipment..»

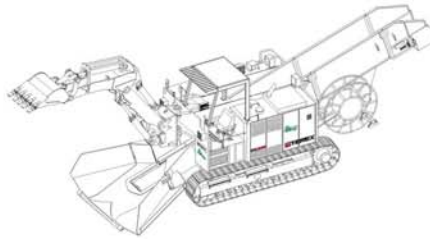




Picture 4: Rear view of the mucking machine ITC 312 H3 with cable reel for the electric drive



Picture 5: FOPS cab with grid for safe scaling



Tunnel Loading Machine Schaeff model ITC 312 H3



Pict. 6: Handling big blocks



Pict. 7: Robust boom equipment with bucket



Pict. 8: Efficient loading



Pict. 9: 4 axles mucking truck



Pict. 6: Conveyor extension to fill the truck