

Sika at work

Refurbishment and Structural Strengthening

Strengthening of the first Cooling Tower
in Germany with SikaWrap[®] Fabrics

A Case Study



The Landmark Cooling Tower

EKO Steel Works, Eisenhüttenstadt, Germany

Project

In what is probably Germany's newest town stands the first cooling tower to be reinforced using the latest carbon fibre (CFRP) strengthening technology.

The steel works near Fürstenberg (Oder) was founded in 1950 and the EKO new town (30 km south of Frankfurt/Oder) was christened "Stalinstadt". It was given its present name of "Eisenhüttenstadt" in 1961. The EKO steel works belongs to the largest steel group in the world, ARCELOR (a merger of ARBED (Luxembourg), ACERALIA (Spain) and USINOR (France)).

The energy supply is provided by VEO (Vulkan Energiewirtschaft Oderbrücke). For many years the 4 natural draught cooling towers which were built in 1961, were the landmark in the industrial town. At the time of the 1993-1996 modernisation, three of these towers were demolished and replaced by forced-draught coolers.

Problem / Challenge

A report on the proposed demolition of the last cooling tower was produced in 2002: it stated "...Refurbishment solutions with shotcrete or CFRP plates have not been further investigated on the grounds of cost or weight ..."

This was an opportunity for preservation ...

In the joint proposal (March 2003) by the engineers Leonhardt, Andrä and partners (LAP) and Sika GmbH, shotcrete was finally rejected on grounds of excessive weight. However the promising new

"feather-light" **SikaWrap**® strengthening system with bands of CFRP fabric was demonstrated to the client. "With this solution you can preserve the city's landmark ..." an important and emotive concern of the client. Naturally though, it was the technical advantages of the proposal that finally tipped the scales in its favour.

In the refurbishment proposal, the additional strengthening with bands of **SikaWrap**® CFRP fabric was detailed by LAP, and a specification for the whole shell of the tower was developed. With a height of 55 m and an average diameter of 33 m, the internal and external refurbishment area totalled some 10,000 m².

Sika Solution

Interior Refurbishment

- Blastcleaning surface preparation
- Patching damaged areas with the **Sika® MonoTop® System** (and in some places with new concrete)
- **SikaCem®-Gunit® 212 S** SPCC
- Coating in accordance with the VGB technical directive "Measures for Reinforced Concrete Cooling Towers to provide Protection against Operational and Environmental Effects"

External Refurbishment

- Blastcleaning and corrosion protection of reinforcement
 - Patching damaged areas with the **Sika® MonoTop® System**
 - **SikaCem®-Gunit® 212 S** for patching and reprofiling to obtain the required overall surface flatness.
- Structural strengthening with **SikaWrap®-200 C** (carbon fibre fabric, roll width 15 cm) at 30 or 50 cm centres (circumference - top: 80 m, bottom: 150 m) and **Sikadur®-330** impregnating resin.
- Coating and UV protection with **Sikagard®-680 S** concrete color coating

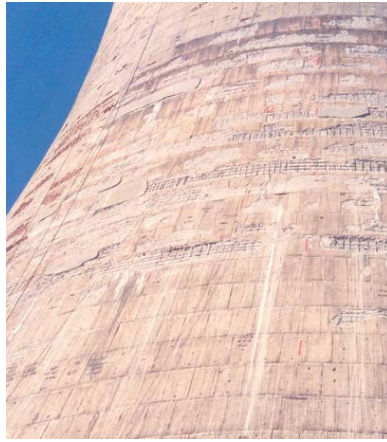
Advantages

- Low thickness and weight of repair materials
- Preservation of a landmark without spoiling its appearance
- Fast and efficient refurbishment

The cooling tower resumed operations as planned during the blast-cleaning works (external) on May 24, 2004. The strengthening project did not disrupt the production operations and the refurbishment was completed in September 2004.



Quality control of the concrete.
Core drilling on the wall.



The concrete surfaces after blastcleaning,
requiring partial concrete repair.



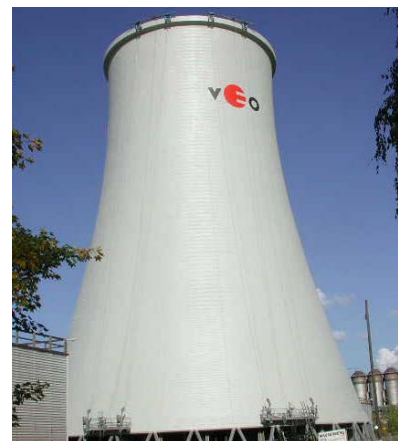
Finishing the **SikaCem®-Gunit® 212 S**
after spraying.



Winding the **SikaWrap®-200 C** carbon fibre reinforced fabric (width: 15 cm), centre-to-centre distance 30 cm.



At a circumference of 120 m (bottom) and 70 m (waist), each wrap has at least 2 lap joints
with a horizontal offset > 1.5 m.



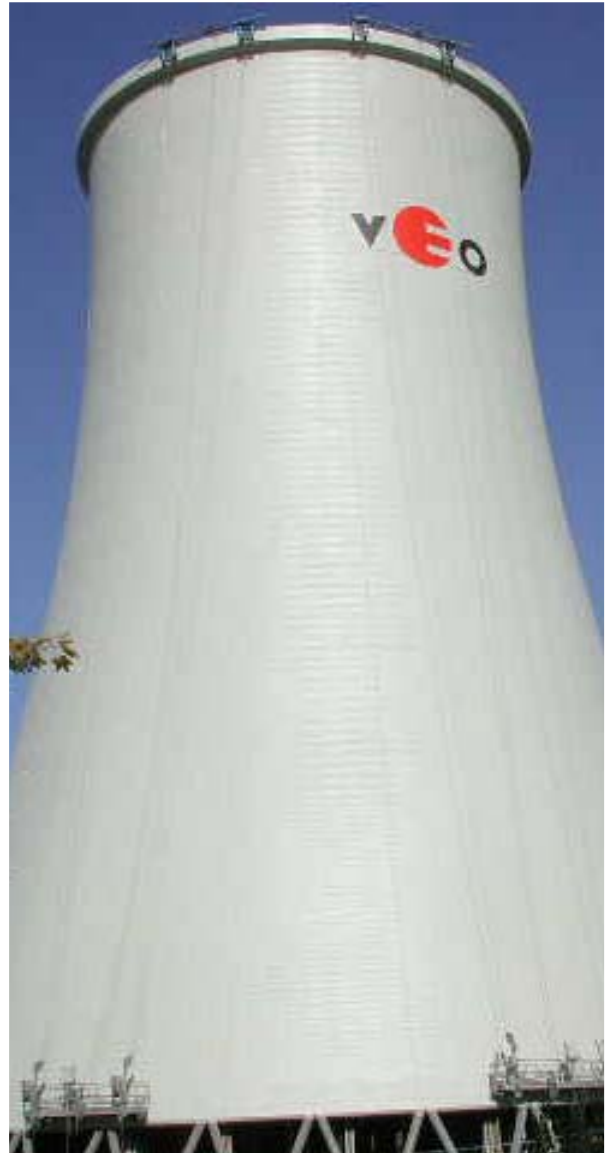
Autumn 2004, surface fully coated with
Sikagard®-680 S concrete color.

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**Before Refurbishment
(2003)**



**After Refurbishment
(September 2004)**



Literature:

- Univ.-Prof. Dr.-Ing. Konrad Zilch, Chair of Solid Structures, Munich Technical University: Expert's Report on the Installation Instructions for Strengthening of a Cooling Tower with CFRP Fabric, May 14, 2004.
- MFPA Leipzig test report: Tensile tests on lap joints at different temperatures, May 2005.



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