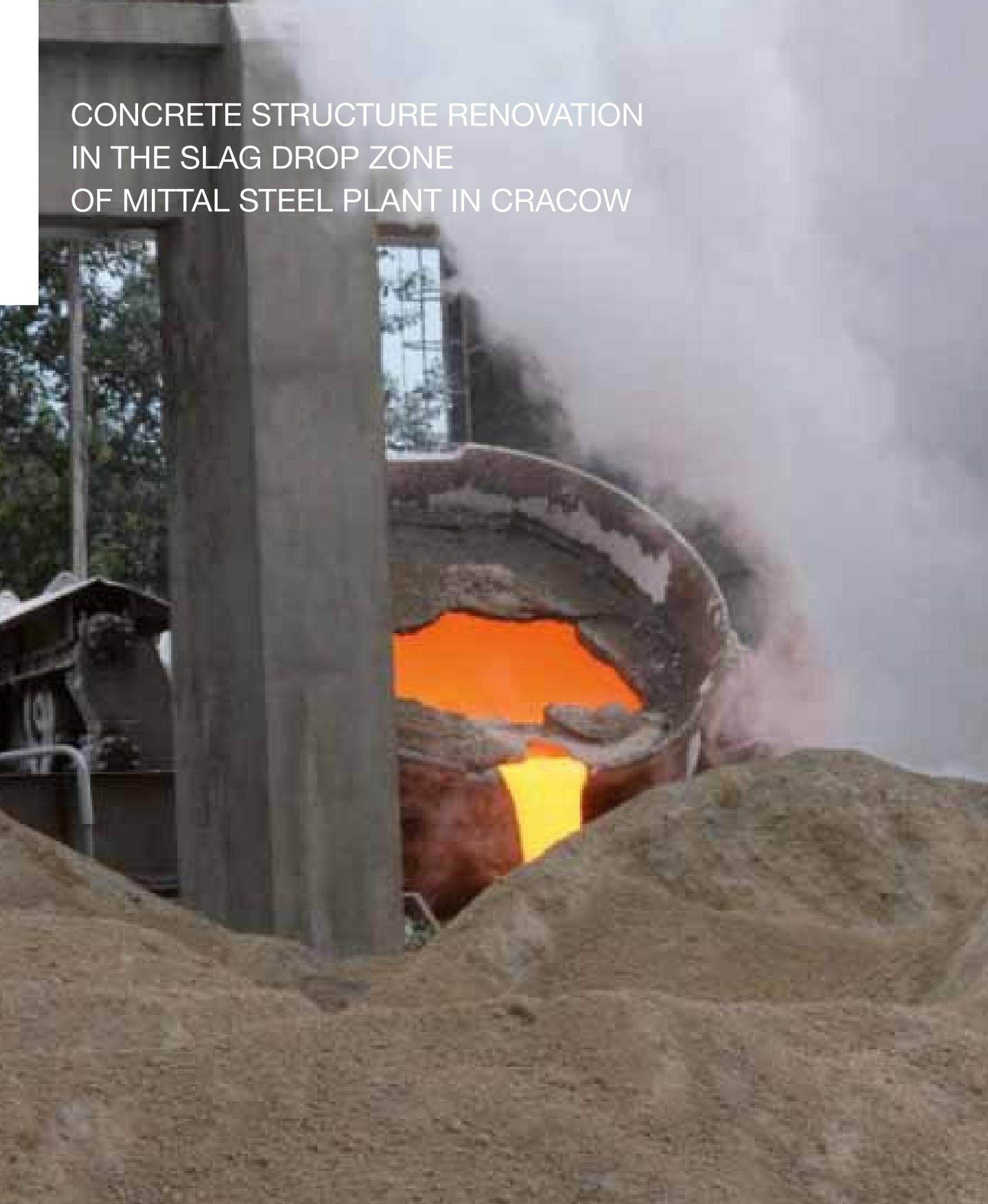


CONCRETE STRUCTURE RENOVATION  
IN THE SLAG DROP ZONE  
OF MITTAL STEEL PLANT IN CRACOW



**Durability of concrete structure, mainly working in aggressive conditions, is crucial. That is why the proper repair materials and technology selection is determined by the type of the structure, condition and other environmental characteristic. This article opens a discussion regarding the case of repair works of concrete structure in the slag drop zone of Mittal Steel in Cracow.**

The Mittal Steel Plant in Cracow was enriched by slag slaking installation in the 50s' of past century. The installation was raised to fulfill the needs of contemporary Cement Plant in Cracow. It allows to obtain blast furnace granulate slag, which is the main additive to the smelting cement. This process is based on slow pouring the liquid slag to a strong stream of water.



Slaking slag process.

Photograph above represents the slaking slag process. During the slaking we have to face huge amounts of vapor and the installation's construction is therefore exposed to huge thermal shocks. It is based on concrete structure and developed with poles and crane beams and four commanding booths. During the use only temporary repairs of the construction elements were executed. Intensive exploitation, without extensive renovation led to construction's withdrawn from use in 2009, the decision was taken by the Bureau of Technical Inspection. The same year, the construction repair, renovation and protection works concept's elaboration was commenced. In the designing phase the Mapei Technical Assistance was asked to collaborate in the concrete structure renovation technology development. The first step was to execute an adequate inventory of damages and construction's technical condition. The construction was divided to two load zones, depending on the influence of temperatures fluctuation and on conditions in which it has to operate. In the zone I, the machines with permanent contact with vapor, released during the slaking found their place. The damages in this case were major.



The concrete structure in the slag drop zone.



**Zone I.** Concrete degradation in the slaking slag construction installation.



**Zone I.** Crane beams degradation.

The zone II included beams and poles from the other side of the container. The damages were absolutely minor, because the aggressive agents influence was limited in comparison to the zone I.



The panorama of the zone II elements before renovation.

In the zone II, for repairs and filling major defects a R3 class thixotropic repairing mortar was proposed (MAPEGROUT 430), whereas for smoothing the surface a fine-grained cementitious-polymer mortar (MONOFINISH) with hydraulic shrinkage reducing admix (MAPECURE SRA) was suggested. This product was selected mainly because of the repair works conditions and mortars' protection, which was difficult to ensure on the building site. Despite the adequate composition of the offered mortars, an additional protection from shrinkage cracks was chosen, supported by the Producer and the Technical Assistance. Therefore, afterwards, an acrylic paint protective coating was executed.

Meanwhile, in zone I for larger construction cavities re-profilation, a repair mortar for spraying application (MAPEGROUT GUNITE) was suggested, whereas for local defects, similarly to zone I, a thixotropic repairing mortar (MAPEGROUT 430). Furthermore, in the direct fluctuate temperature and vapor impact zone, it was implied to create a reinforcing and protective layer from alkali-resistant fiberglass and protective mesh (MAPEGRID G220), immersed in a two-component cementitious and polymer base repair mortar (PLANITOP HDM). This technology was applied in the commanding booths and crane beams between them. This solution has for its scope raising the level of construction resistance and protection, in regards to the temperature variations during its use.

The alkali-resistant fiberglass mess immersed in the mineral mortar, thanks to its perfect adherence to the substrate, provokes the increase of resistance to brittle cracking, redistributes tensions, ensures durability and resistance to fluctuating temperatures.

In March of 2010 the contractor companies initiated the repair works according to the suggested technology. The first step was stream oriented and abrasive cleaning of the whole construction and afterwards a hydrodynamic one. Because of high temperatures and sun exposition, the contractors decided to make a good use of the hydraulic shrinkage reducing admix (MAPECURE SRA), which allowed to eliminate the post application mortars protection. The re-profilation of the heavy load zones construction was followed by the fiberglass mesh and two-component system.

In May of 2010 after required necessary technical inspections, the installation was put into operation and the construction was ready to use again.



Repair works in the slag drop zone construction.



Immerging the alkali-resistant mesh in the cementitious-polymer mortar.



The sight of the slag drop zone construction after renovation.



The detail of the slag drop zone construction after renovation.

Nowadays, after the executed repair works, the surface of construction's concrete elements is homogeneous, impermeable, crack and flaw-free.

Thanks to the proper material choice, the shape and functionality of the construction was restored, and following on from this, the necessary durability was re-ensured.

The success and effectiveness of the whole venture was accomplished, thanks to the fruitful collaboration of both the technical assistance, professional products' suppliers, the contractor's team and the architect. This operation determines the fact, that leading repair works of concrete structures requires a widely understood cooperation of different worlds, the world of science, technology and actual contractors.

## MAPEI PRODUCTS

The products mentioned in the article belong to the "Building Speciality Line" range. The technical data sheets are available at the website: [www.mapei.pl](http://www.mapei.pl). Mapei products for the protection and repair of concrete surfaces and structures have been awarded the CE mark in compliance with EN 1504. Mapei mortars for render have been awarded CE mark in compliance with EN 998 standards. More than 150 Mapei products contribute to obtain LEED (Leadership in Energy and Environmental Design) certification.

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### **EPOJET LV (CE EN 1504-5)**

Two-component very low viscosity epoxy resin for injection in micro cracks.

### **MAPECURE SRA**

Curing admixture with the property of reducing hydraulic shrinkage and the formation of micro-cracking.

### **MAPEFER 1K (CE EN 1504-7)**

One-component corrosion-inhibiting cementitious mortar for the protection of reinforcing rods.

### **MAPEGRID G220**

Primed alkali-resistant fibreglass mesh for structural reinforcement of stone, brick and tuff substrates.

### **MAPEGROUT GUNITE (CE EN 1504-3, R4)**

One-component pre-packed multi-purpose non-accelerated cementitious mortar applied using either the dry or damp spraying technique.

### **MONOFINISH (CE EN 1504-2, MC- IR; CE EN 1504-3, R2)**

One-component normal setting cementitious mortar for smoothing concrete and cementitious renders.

### **PLANITOP 430 (CE EN 1504-3, R3)**

Fine-grained thixotropic, fibre-reinforced, controlled-shrinkage, medium-strength (30 N/mm<sup>2</sup>) mortar for repairing concrete.

### **PLANITOP HDM (CE EN 1504-2, MC- IR; CE EN 1504-3, R2)**

Two-component, high-ductility mortar with a pozzolanic reaction used for reinforcing masonry structures in conjunction with Mapegrid G 120 or Mapegrid G 220 at a thickness of 6 mm and for smoothing and levelling surfaces in concrete, stone and tuff.

### **RESFOAM 1KM**

Super fluid one-component polyurethane resin to be injected for waterproofing concrete or masonry structures, grounds, and rocks subject to intense water percolation with variable adjustable setting times.

REFERENCE FILE FORM: MAPEI Polska Sp. z o.o.

DATE: 06-2011

REFERENCE NUMBER:

Checked by (initials and date): Marketing:

Technical Ass:

The Management:

NAME OF BUILDING INTERVENTION: HUTA MITTAL STEEL KRAKÓW

YEAR / PERIOD OF CONSTRUCTION: 03 – 06.2010

YEAR / PERIOD OF MAPEI INTERVENTION: 03 – 05.2010

INTERVENTION BY MAPEI: REPAIR AND STRENGTHENING WORKS OF CONCRETE STRUCTURE IN THE SLAG DROP ZONE (MITTAL STEEL)

DESIGNER: ENG. JERZY SIWEK, DR KRZYSZTOF POGAN

SITE MANAGER: WITOLD SKRZYNIARZ

MAIN CONTRACTOR: PUT OMEGA SP. Z O. O. KRAKOW POLAND

MAPEI DISTRIBUTOR: ARMA SP.J. KRAKOW POLAND

MAPEI COORDINATOR: NG. JERZY SIWEK, DR KRZYSZTOF POGAN

PHOTOS: YES

DESCRIPTION: YES

MAPEI PRODUCTS	MATERIAL INSTALLED	SUBSTRATE	QUANTITY OF PRODUCT	SURFACE	INSIDE/ OUTSIDE	NEW / RENOVATION	PRODUCT LINE
	DO NOT COMPLETE FOR BUILDING PRODUCTS						
MAPEGROUT GUNITE			54 000 KG	200 M <sup>2</sup>	OUTSIDE	RENOV.	BUILDING LINE
PLANITOP430			14750 KG	350 M <sup>2</sup>	OUTSIDE	RENOV.	BUILDING LINE
MAPECURE SRA			40 KG		OUTSIDE	RENOV.	BUILDING LINE
MONOFINISH			5500 KG		OUTSIDE	RENOV.	BUILDING LINE
MAPEFER 1K			60 KG		OUTSIDE	RENOV.	BUILDING LINE
EPOJET LV (4KG)			44 KG		OUTSIDE	RENOV.	BUILDING LINE
MAPEGRID G220			621,80 MB		OUTSIDE	RENOV.	BUILDING LINE
PLANITOP HDM			7487 KG		OUTSIDE	RENOV.	BUILDING LINE
RESFOAM 1KM			60 KG		OUTSIDE	RENOV.	BUILDING LINE

**A/ PRIVATE**  
(PRYWATNE)

- COMMERCIAL CENTRE
- BANK
- HOTEL
- RESTAURANT
- CAR SHOW ROOM
- OTHER

**B/ PUBLIC**  
(PUBLICZNE)

- CHURCH
- HOSPITAL
- SCHOOL
- MUSEUM
- LIBRARY
- OTHER

**C/ INDUSTRIAL**  
(PRZEMYSŁOWE)

- WAREHOUSE
- STORAGE
- FACTORY
- OFFICE
- OTHER

**D/ TRANSPORT**

- AIRPORT
- RAILWAY
- METRO
- ROAD
- TUNNEL
- BRIDGE
- SHIP
- OTHER

**E/ RESIDENTIAL**  
(REZYDENCJE)

- APARTMENT / FLAT
- HOUSE
- APARTMENT / BLDG
- OTHER

**F/ SPORT**

- POOL
- TRACK
- STADIUM
- GYM
- OTHER