NDT in Building - Examination of a Mounting Plate Made of Concrete and the Subsoil as Part of a Failed Lifting Operation

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Abstract. As part of the installation in an industrial plant, it was necessary to lift a 300 tonne component of a mounting plate in its final position.

In the lifting process there were several difficulties which, despite corrections led to a crash of the device onto the mounting plate and destroyed both the component as well as the mounting plate. The reason of the crash could not be clarified and it was discussed whether the mounting plate or the floor plate can be seen as the cause. Thus the mounting plate and the floor plate should be systematically examined for damage.

It should be the question whether there are any voids or compression defects in the concrete slab or in the ground under the slab clarified.

As investigation procedures ultrasonic echo and rebound hammer for concrete slab and radar to study the subsoil has been applied. There linear measurement lines were performed in transverse and longitudinal directions on the concrete slab.

These extensive studies have shown that in the concrete slab (mounting plate) no defects except the cracks caused by the impact were present and the concrete compressive strength exceeded the required strength. The investigation of the subsoil with radar showed that no cavities are visible. It could be shown with the measurements that the concrete slab and the subsoil were free of damage prior to the application. Thus it was possible to document the good quality of the subsoil by means of the test methods damage free ultrasonic echo, radar and rebound hammer.

In this article the results of the tests are depicted and discussed.

1 Introduction

As part of the installation in an industrial plant, it was necessary to lift a 300 ton component from a mounting plate in its final position.

The prefabricated drum on a concrete mounting foundation should have been raised vertically, then horizontally moved and set down in the area of the bearing, two hydraulic lifting frames were used (load capacity 4 * 96 t = 384 t).
In the lifting process there were several difficulties which, despite corrections led to a crash of the device onto the mounting plate and destroyed both the component as well as the mounting plate.
Figure 3: crash of the device onto the mounting plate

Figure 4: crash of the device onto the mounting plate
The reason of the crash could not be clarified and it was discussed whether the mounting plate or the concrete slab can be seen as the cause. Thus the mounting plate and the concrete slab should be systematically examined for damage. It should be the question whether there are any voids or compression defects in the concrete slab or in the ground under the slab.

2 Solution approach

As investigation procedures ultrasonic echo and rebound hammer for concrete slab and radar to study the subsoil has been applied. There linear measurement lines were performed in transverse and longitudinal directions on the concrete slab.

2.1 Investigations with ultrasonic echo technology

Using ultrasonic echo technology sound is transmitted into the structure. If an echo signal will be received from the back side of the component, it can be assumed that the investigated area is without gravel nests or internal cracks. Thus, the homogeneity of the concrete slab can be examined and possible gravel nests can be detected.

2.2 Investigations with radar technology (GPR Ground Penetrating Radar)

Using radar technology makes it possible to examine the structure under the concrete slab. Furthermore reinforcement can be located inside the concrete slab.

3 Measurements and results

There linear measurement lines were performed in transverse and longitudinal directions on the concrete slab.
3.1 Results of ultrasonic echo measurements

Figure 6: Ultrasonic measurement on the concrete slab

Following two measurement lines are shown, their location can be found on the photo.

Figure 7: Investigated area with two illustrated ultrasonic measurement lines
The results of the ultrasonic echo measurements show:

- Very clear echoes could be detected on the back of the component in the area that was not affected by the impact, which means that gravel nests, inhomogeneities, cracks etc. and reduced thickness can be excluded in this area.
- Despite vertical cracks in the concrete the measurements show that the structure of the concrete in the adjacent region has a very high quality.
- In some fields the ultrasonic echo measurements show larger areas of reflections from the back of the component. Cores were taken and it could be shown that not a minor thickness but internal cracks of the impact occurred.

3.2 Results of radar measurements

Extensive investigations were carried out with radar measurements. The radar measurements were done as measuring line on the surface of the examined concrete slab.

The position of the measuring lines can be found on the sketch in the appendix. Following a measurement line is shown, the position can be seen on the picture.
Summary of the radar measurements:

The radar measurements showed:

- no reinforcement existing
- detected no anchor pins between the plates (for securing the panels to one another)
- no strongly inhomogeneous structure, a cavity of the plate can be excluded.
- significant reflections from the depths can be assigned to a foundation, but these foundations have no negative impact on the concrete slab.
- in the area of severe damage to the plate (slump cone, broken joints) disordered structure in the near field superimposed low signals.
3.3 Results of rebound hammer measurements

In addition measurements were made with the rebound hammer. The measurements with the rebound hammer showed that the condition of the concrete slab is very good.

4 Conclusion

These extensive studies have shown that in the concrete slab (mounting plate) no defects except the cracks caused by the impact were present and the concrete compressive strength exceeded the required strength.

The investigation of the subsoil with radar showed that no cavities are visible. It could be shown with the measurements that the concrete slab and the subsoil were free of damage prior to the application. Thus it was possible to document the good quality of the subsoil by means of the test methods damage free ultrasonic echo, radar and rebound hammer.