Chapter

6.3

Rehabilitation of the Complex Reinforced Concrete Shell Roof Structure of an Industrial Building

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Brief Description of the Presented Case Including Project Aims and Challenges

This case study presents the investigation and design of the rehabilitation of a storage structure for the cement industry and in particular of its roof. The storage was designed and constructed within a two-year period between 1956 and 1958 as part of a cement plant in the northern part of Bulgaria. The storage is approximately 500 m long and is divided into seven separate structures (indicated as blocks in the following text) by expansion joints (*Figs 1 and 2*).

The main structure is a single-span frame in transverse direction and multiple-span frames in longitudinal direction. The structural span width in transverse direction is 33 m, and the span width in longitudinal direction is generally 6 m. The roof structures of three of the storage blocks are steel trusses with a cover made of trapezoidal steel sheets. The roof of the other blocks is a reinforced concrete (RC) shell structure. The RC shells span 33 m in transverse workshop direction and 6 m in the longitudinal direction. The shell structure is thin, elegant and unique for Bulgaria. It represents efficient implementation of the theoretical advantages of shell structures. The shell is divided by means of RC arch ribs supported by steel elements (two channels of 180 mm) for resisting the tension in transverse direction at each column position. The shell is additionally divided by secondary beams/ribs in the longitudinal direction in order to increase the stiffness and to minimize the shell thickness. These beams are considered as the final transverse rib of the shell. The storage has been operational for decades without need for additional maintenance during the long period of use. Material corrosion and structural damages caused mainly by crane operation have deteriorated its condition and have raised a reasonable question about the structural safety and reliable behavior of the structure. A team led by the author of the present study carried out an extensive investigation of the storage structure. It included visual observation, laboratory testing of the materials both on site and on samples, and computer modeling of the entire structure and its parts. Calculations and design checks were carried out according to the

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