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Structural Rehabilitation of an Industrial Steel Building

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Summary

The industrial steel building analyzed in the paper was constructed in 1967 and has been exploited in an aggressive atmosphere for about 25 years. The electrochemical corrosion occurred at the surface of the steel elements which together with design, construction and maintenance faults have significantly decreased the loadbearing capabilities of each structural member. The technical state of the structural system has been evaluated using visual inspection and nondestructive testing. Suitable strengthening and rehabilitation solutions have been proposed in order to restore the functional and structural performances of the industrial steel building.

1. The anatomy of the industrial building

The industrial building designated to shelter a zinc coated, cold-formed light gauge sections workshop has been designed and constructed between 1965 and 1967.

The framing system consists of ten main transverse steel frames, each of 3x24 m span (fig.1). The spacing between frames is 12 m. Seven overhead traveling cranes with handling loads of 125 kN to 500 kN are operating inside the building and transmit their load effects to the main structural system. Continuous tapered solid web welded sections have been selected for the main girders of the transverse frames. The main girders are supported on steel stepped built-up welded columns. The roof decking is made of prefabricated concrete elements which support thermal insulation and waterproofing. The roof decking is sustained by solid web welded purlins rigidly connected to the main transverse girders. The painting system applied on the steel members surfaces consisted of two main components: two layers of red-lead primer and two coats of chlor-rubber based paint.

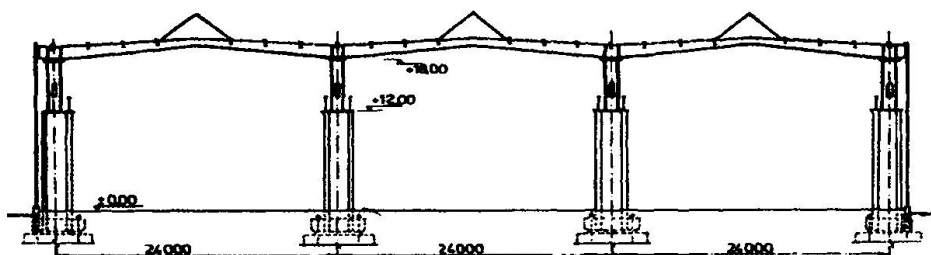


Fig.1 The transverse frame of the industrial steel building

2. The corrosive effects on the structural steel members

The structural steel members were exploited in a very aggressive environment (involving the use of sulfuric acid, chlorine hydride and hot water) between 1967 and 1980 and in a less corrosive atmosphere until 1992. All structural steel members have been severely affected by the corrosion process. Depending on the type of the element, the stress level and the local corrosive factors, extensive damages of the protective coatings, from 7% to 100% have been identified and corrosion penetrations up to 1.5 mm have been determined.

Fig.3 Cross-section strengthening of the main steel columns