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## Rehabilitation of the Highest Wooden Telecommunication Tower

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### Summary

The unique telecommunication tower, over 110 m high, was built in 1933 as a spatial truss completely from larch wood. All connections were made with brass bolts. During 65 years of continuous service the tower was examined and protected several times but there were also long periods without proper maintenance. In 1998 the structure was carefully inspected, measured and checked by calculations. Imperfections in geometry of truss joints as well as damages in wooden members have been recorded. On the basis of tests of material specimens and computer analyses the range of necessary strengthening has been assumed. The tower was old enough to be treated as a monument of technology, so, the methods of repair, strengthening and protection were limited. The specific method of strengthening by means of carbon fibre polymer strips was introduced in the most endangered members of the structure. General protection works have been used for the entire tower.

**Keywords:** space structures; strengthening; towers; trusses; wooden structures.

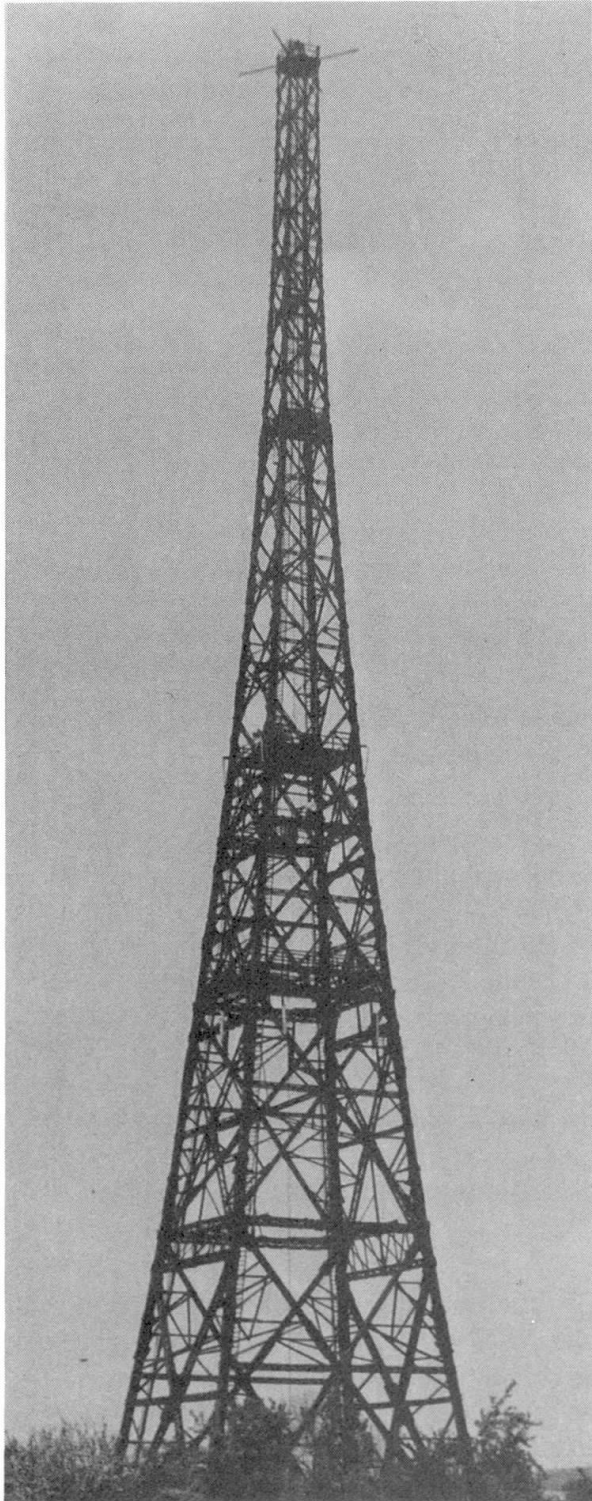
### 1. Introduction

Among a dozen or so wooden telecommunication towers over 100 m high, erected in Europe before the Second World War, the tower in Gliwice, Poland, survived as the only one to the present. With the height of 110.7 m this is the highest wooden tower in the world. In the long periods, at the time of the Second World War and just after the War, the maintenance of the structure was poor or none. Apart from the influence of natural climatic conditions typical for the middle Europe the tower has been all the time subjected to specific impact of polluted atmosphere (acid rains) due to the neighbourhood of heavy industry and chemical plants.

### 2. Description of the structure

The tower is a spatial truss structure with the size of square base  $19.8 \text{ m} \times 19.8 \text{ m}$ . The main corner members were arranged according to parabolic curves, so, the four external trusses are not flat but curved along the height (Fig. 1). The four platforms are located on levels 40.0 m, 55.3 m, 80.0 m and 109.7 m; on these levels the spandrel beams and horizontal trusses create the main bracing of the structure. The structure was built from larch wood of very good quality. Cross-sections for all

bars were precisely selected and differentiated according to design. In 1998, after 65 years of constant service the first complete and precise measurement was done. The exact initial shape of the tower was not known, so, the present results could be compared with designed shape only.



*Fig. 1 General view of the tower*

### 3. Rehabilitation program

According to inspection, measurements and calculation results the following works were recommended:

- (a) Successive reconstruction of joints and filling of all slits and openings by protective injection;
- (b) Strengthening of bars endangered with longitudinal slits – main compressed bars were indicated to be strengthened with transversal carbon fibre polymer strips;
- (c) Impregnating of all members after cleaning surfaces.

The selection of methods for reconstruction and strengthening was restricted within narrow limits because, since 1964, the tower has been announced a monument of technology under care of conservation services. Therefore, the shape and appearance of the tower should be remained, as far as possible, without changes.

### 4. Conclusions

The aim of action containing inspection, measurements, control calculations and accompanying tests was the selection of proper process for repair and rehabilitation to extend the lifespan of the 65-years-old wooden telecommunication tower.

Because the tower has to be treated as a monument, not only technological but also aesthetics aspects have been considered. It was the reason of introduction of unique method for transversal strengthening of wooden bars significantly endangered with slits. Carbon fibre polymer strip glued with selected epoxy glue has been selected.