

**Секція 3. Виробництво, технології, інженерія: міцність, надійність, ресурс
конструкцій, матеріалів, інженерних систем**

UDC 624.07:620.19

Hasenko A.V., Ph.D.

Rozhko V.N., Ph.D.

Poltava National Technical Yuri Kondratyuk University

Typical damages of the polyhedral void reinforced concrete poles for yard overhead transmission lines

***Abstract.** Typical damages of polyhedral void reinforced concrete poles described in the article. The damages found during the inspection of yard overhead transmission lines. Recommendations to minimize the impact of the identified damage the safe operation of concrete poles are the conclusions of the article.*

***Keywords:** reinforced-concrete poles, defects, damages.*

УДК 624.07:620.19

Гасенко А.В., к.т.н., доцент

Рожко В.Н., к.т.н., доцент

Полтавський національний технічний університет імені Юрія Кондратюка

Типові пошкодження багатограних пустотілих залізобетонних стовпів дворової лінії електропередач

***Анотація.** У статті описано типові пошкодження багатограних пустотілих залізобетонних стовпів, які виявлено під час обстеження дворової лінії електропередач. Наведено рекомендації щодо мінімізації впливу виявлених пошкоджень на безпечну експлуатацію залізобетонних опор.*

***Ключові слова:** залізобетонні стовпи, дефекти, пошкодження.*

Introduction. Formulation of the problem. The need for grouping damages of building structures on the causes and extent of influence on the technical condition of structures arises from the need to develop generalized recommendations on required activities to be performed during routine inspections and repairs. Today the average life of the pylons in Ukraine is 40 ... 50 years [2], which only increases the urgency of planned repairs.

Analysis of recent research. Damages of structures that arise and develop during their operation - this is usually a result of gross violations of the rules of technical operation. Their causes can also be design errors and defects in manufacturing, transportation and installation [4]. In the work [3] presents the results of the survey of technical state operated warehouses and industrial buildings of manufacturing base construction and assembly management, are given the typical damages of supporting structures of buildings and ways to prevent their formation.

According to many researchers [1, 4; 5] the main types of physical deterioration of structures is corrosion, which occurs mainly as a result of becoming soaked.

The goal of work is to describe the typical damages of reinforced concrete poles of supporting power lines collected as a result of field surveys.

Achieving the specified goal conducted in the following stages:

- conducting of natural inspection of constructions poles based on which executed drawings and fixed damages;
- analysis of detected damages, determining the degree of their impact on the overall technical condition of structures;
- typification of detected damages and development the measures of preventing their formation and development during the next operation.

Test results. Surveyed concrete poles have the the following design solution [5]. Rack made conical with a total length 8500 mm. The height of the reinforced concrete poles from the ground level is around 7000 mm. The lower part of the rack at height of 1000 mm from ground level has a local increase in diameter. The cross section of poles has a form of proper octagon with an outer diameter at the lower bulge 335 mm; diameter at mark 1.000 m equal to 270 mm; diameter at mark. + 7,000 meters - 150 mm. Inside the poles are void. Thus the column wall thickness equal to 70-80 mm. Reinforcement of reinforced concrete poles made of eight rods $\varnothing 14$ mm class A400C. Transverse reinforcement - $\varnothing 4$ mm class A240C (step 150 ... 200 mm). General view of the reinforced concrete poles shown in figure 1.

Surveyed concrete poles serve several functions (see. fig. 2):

1. The suspension of four wires of 0.38 kV overhead lines;
2. Suspension of telegraphic cable;
3. Arrangement of street lighting: installation of distribution switchgears and street lighting lantern.

At the time of the survey the lines operated only electricity and telegraph communication, street lighting elements were in a state of repair. The approximate age of the yard power lines poles - about 50 years.

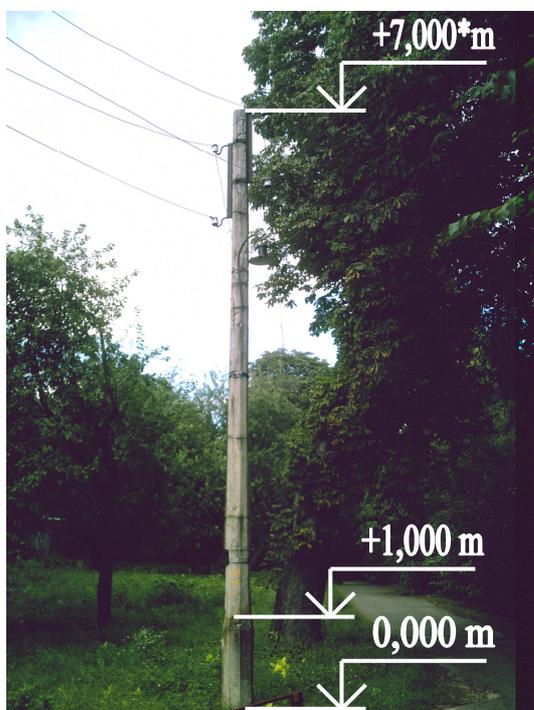


Figure 1 - General view of the reinforced concrete poles

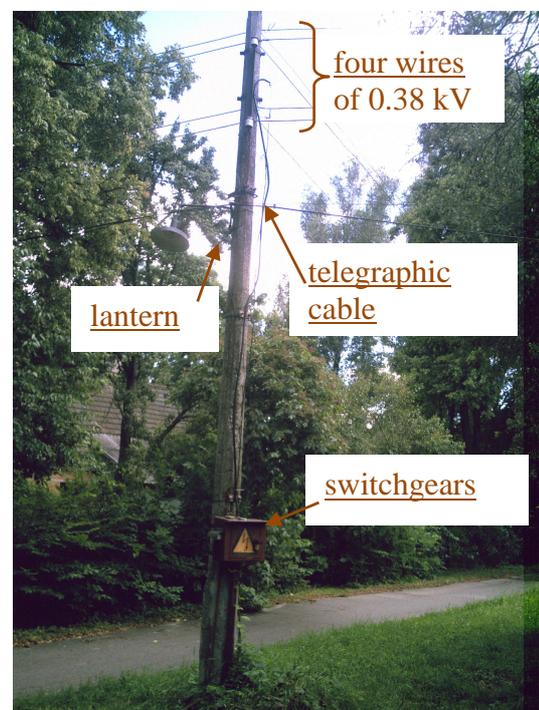


Figure 2 - The functions that perform concrete poles

During the survey of constructions poles were used the following methods: visual method of direct linear measurements, theodolite planned an altitude survey, non-destructive testing of mechanical properties of materials, testing bearing capacity calculations, technical evaluation of structures and the development of appropriate schemes of strengthening.

As a result of the visual inspection have been analyzed the collected materials with definition the overall picture of defects and accumulated during operation damages and expected trends of their development and influence on the technical condition the surveyed designs. Among the accumulated during operation damages should note the following.

1) The formation of vertical cracks with opening width from 0,5 mm to 4 mm along the reinforcing rods of reinforced concrete poles (fig. 3), arising, probably as a result of penetration of moisture into the hollow of poles and its periodic freezing-thawing. The length of the fixed vertical cracks varies for different poles of reinforced concrete from 0.5 m to 4.5 m, ie almost the entire height of poles.

2) As a result of the formation of vertical cracks and mechanical damages of the protective layer of concrete occurs the outcrop of reinforcing rods in reinforced poles (fig. 4). In some places there is complete debonding between reinforced concrete and reinforcing rods, causing the loss of local resistance of these rods.

3) After outcrop of reinforcing rods in reinforced concrete poles occurs development of corrosion on these rods (fig. 4). Corrosion of individual rods of working reinforcement $\text{Ø}14$ mm class A400C reaches 35%. Also fixed gap of transverse reinforcement, made with wire $\text{Ø}4$ mm class A240C reinforced concrete poles.

4) As a result of penetration of moisture into emptiness inside reinforced concrete poles and repeating cycles of freezing-thawing occurs cracking, local destruction and loss of individual parts of the concrete poles at a height of 3000 mm (fig. 5). For some concrete poles fixed the destruction of more than half the cross-section of these poles.

5) As a result of geodetic measurements (height and planned displacement points of poles), fixed the presence heel of pillars. The largest deviation from the vertical fixed for combined poles – 203 mm, in relative value f / H is $1/26$. This deviation arose, probably, as a result of incorrect placement or installation of power cables (location poles outside power lines).



Figure 3 - Vertical cracks along the reinforcing rods of reinforced concrete poles



Figure 4 - Outcrop and corrosion of reinforcing rods of reinforced concrete poles. The gap of transverse reinforcement wire of concrete poles

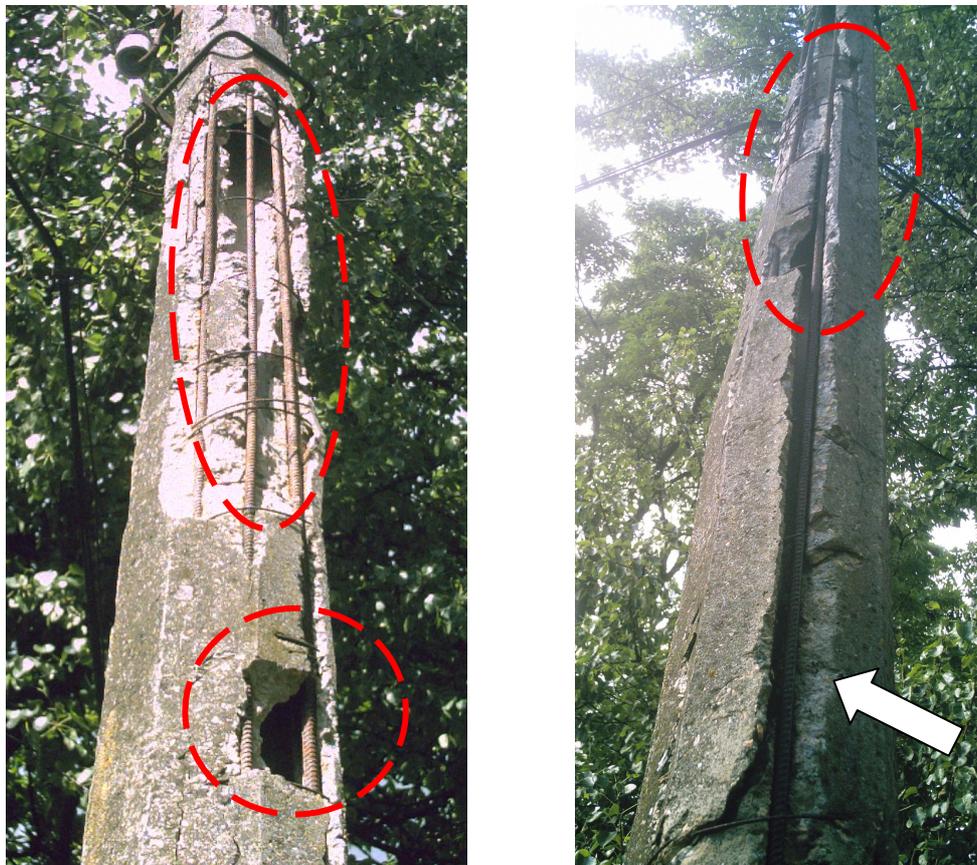


Figure 5 - Complete destruction and loss of concrete poles of reinforced concrete parts

On some concrete poles seen partial periodic repairs of poles (see. fig. 6). During these repairs was carried out filling in damaged areas poles at mark. 0,000 of 1,000 m cement-sand mortar. Previous anticorrosive processing reinforcing rods poles was not fulfilled, which did not provide long-term adhesion of reinforcing rods with the recovered parts of the concrete.

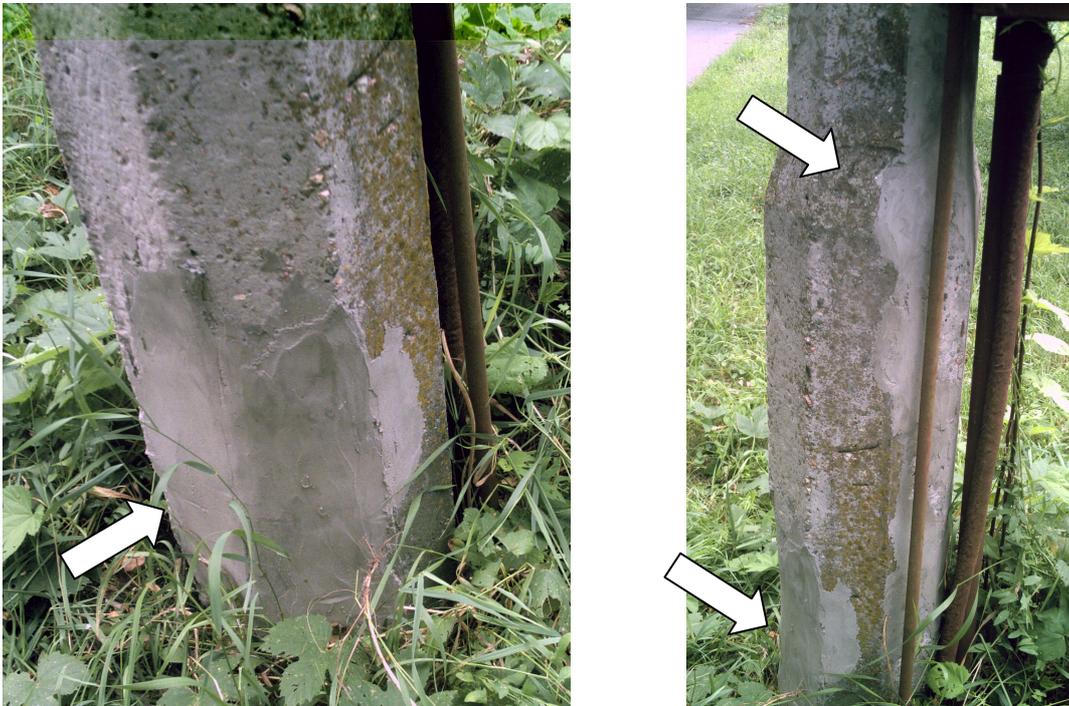


Figure 6 - Partial periodic repairs of some reinforced concrete poles

On the basis of a number of surveys of reinforced concrete poles of yard power line and the analysis of identified damages can be done the next **conclusions**. The destruction of void reinforced concrete poles occurs due to regular atmospheric moisture, especially at internal closed space and the subsequent freezing-thawing cycles. First, the formation of vertical cracks, then outcrop of working reinforcing rods, local destruction and loss of certain parts of the concrete poles.

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