THE METHOD OF DESCRIBING THE INTENSITY OF DAMAGE IN COMPONENTS OF BUILDINGS

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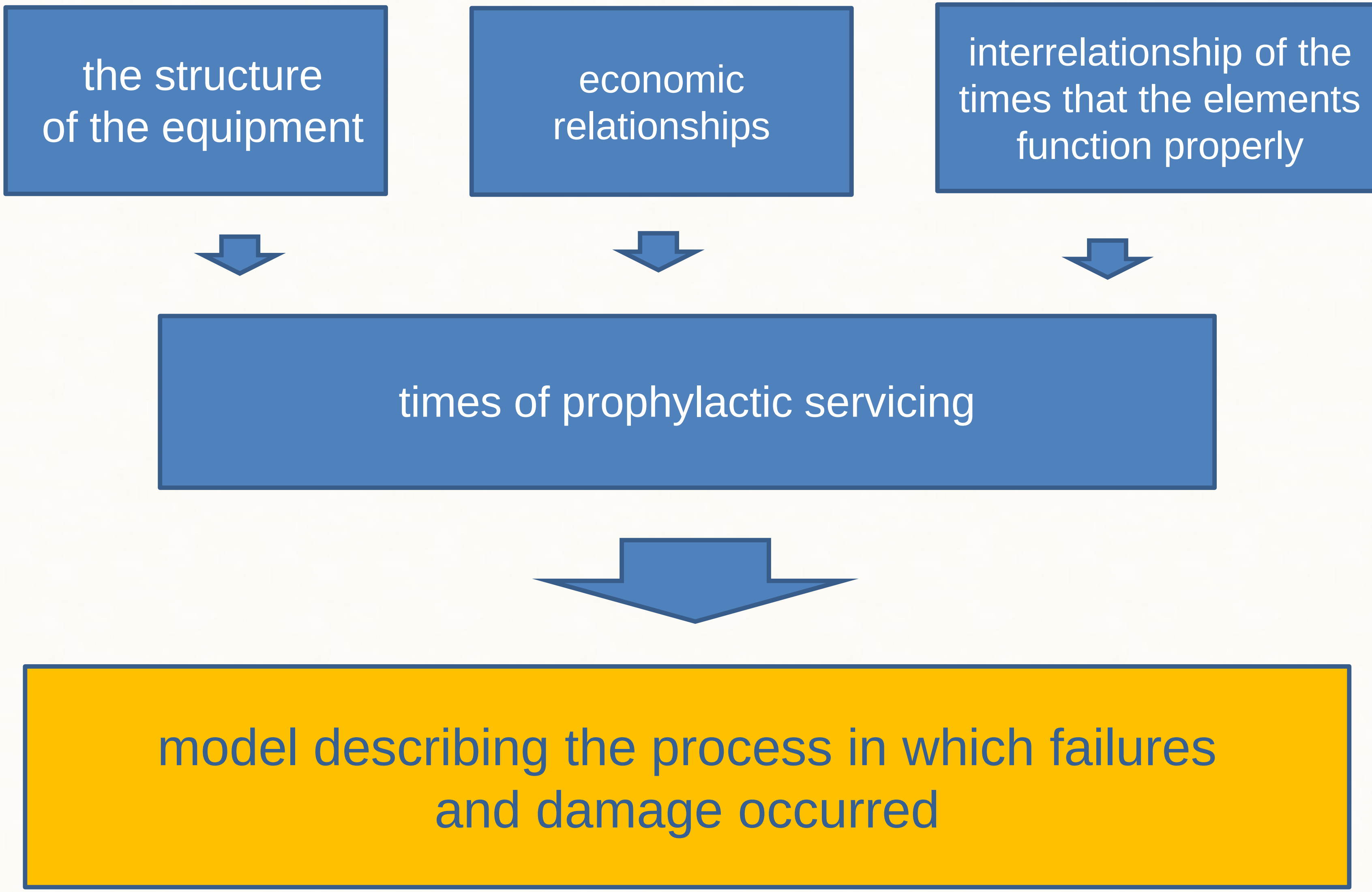

the structure of the equipment
economic relationships
interrelationship of the times that the elements function properly
times of prophylactic servicing
model describing the process in which failures and damage occurred

To model a situation in survival analysis, where the probability of a failure changes over time, the Weilbull distribution is applied as the distribution of the random variable of the time the equipment is operational.

The density of the probability of a failure is determined by the relationship:

$$f(t) = \alpha \beta^{\alpha} t^{\alpha-1} \exp[-(\beta t)^{\alpha}] \quad \text{for } t \geq 0 \qquad (1)$$

where: t - the time of using the equipment,

α - scale parameter (real number), $\alpha > 0$,

β - shape parameter (real number), $\beta > 0$.

The α parameter of the distribution determines the behavior of the probability of a failure over time:

- for $\alpha < 1$ the probability of a failure decreases over time;
  individual specimens can have manufacturing defects
  and slowly fall out of the population;
- for $\alpha = 1$ (exponential distribution) the probability is constant,
  the failures have the character of external random events;
- for $\alpha > 1$ probability increases over time,
  the wear of elements with the passing of time
  as the main reason behind failure;
- for $\alpha = 2$ (Rayleigh distribution) probability increases linearly
  with the passing of time.

β - is a coefficient characterizing the speed at which reliability is lost.

The distribution function, that is the function of the reliability of equipment for the Weibull distribution:

$$F(t) = 1 - \exp\left[-(\beta t)^{\alpha}\right] \qquad (2)$$

The reliability function - change in the probability of no damage over time:

$$R(t) = \exp\left[-(\beta t)^{\alpha}\right] \qquad (3)$$

the aging process of a building

PRRD
Prediction of Reliability according to Rayleigh Distribution

model of changes in the performance characteristics of the i-th building component based on the Rayleigh distribution:

$$R_i(t) = \exp\left(-\left(\frac{t}{T_i}\right)^2\right) \quad (4)$$

The unreliability function F(t):

$$F_i(t) = 1 - \exp(-\left(\frac{t}{T_i}\right)^2 \quad (5)$$

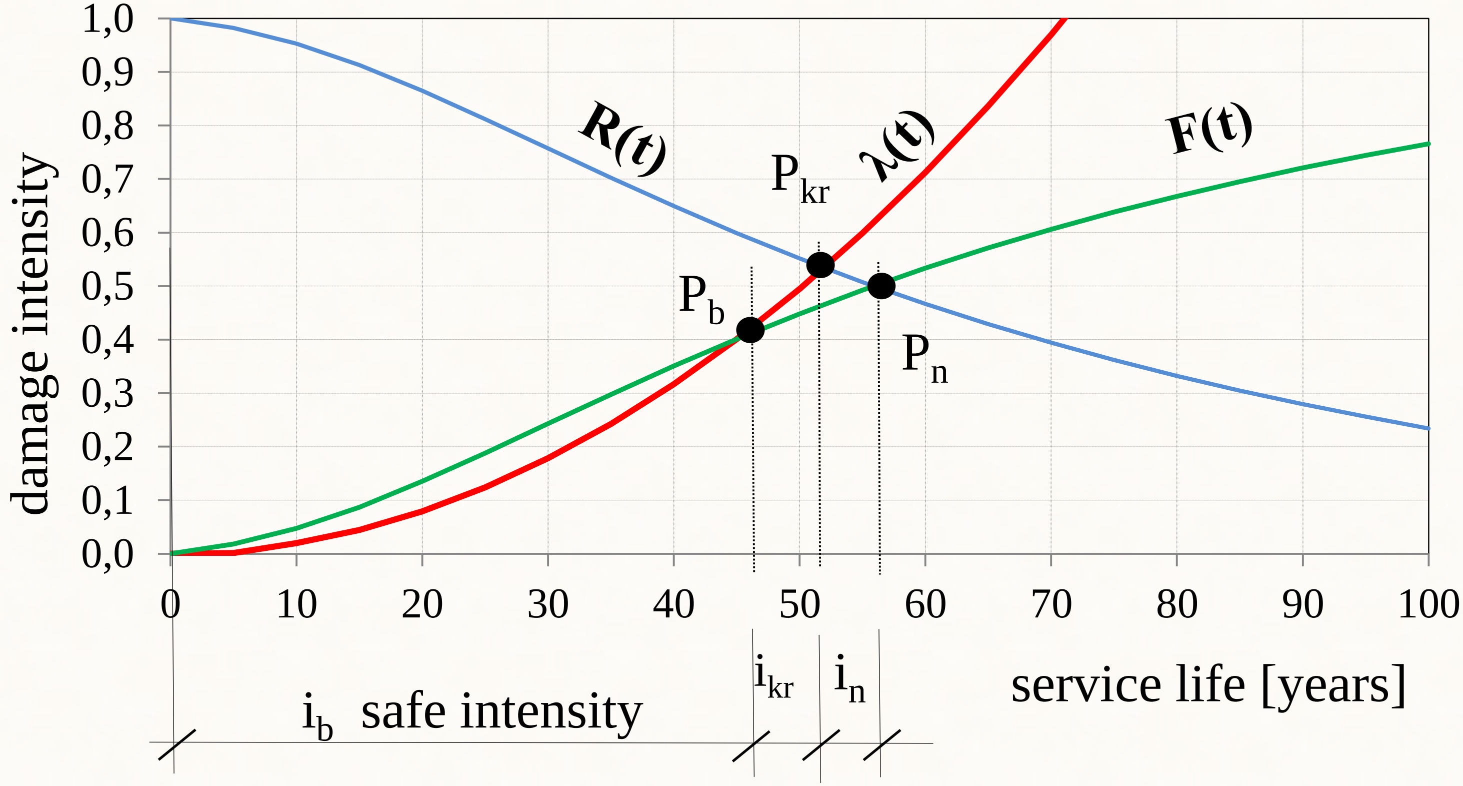
The reliability function is described by the Wiener Equation:

$$R(t) = \exp(-\int_0^t \lambda(t))dt \qquad (6)$$

the intensity of damage λ(t)

$$\lambda(t) = \frac{d\ F(t)}{dt}\frac{1}{R(t)} \qquad (7)$$

speed at which unreliability increases in relation to reliability



Changes in the intensity of damage in an unrenovated building

Safe intensity falls from the time a building is constructed to a term at point P_b. Point P_b implies the time when the intensity of damage to a building is higher than its unreliability.

From the term P_p, the intensity of damage is assumed as critical, which increases constantly and reaches the critical level at term P_{kr}.

Point P_{kr} is assumed at a term when the values of the intensities of damage are equal to the values of performance characteristics.

In the following years of use, if refurbishment works are not undertaken, the intensity of damage in a building continuously increases. It is assumed that the intensity of damage reaches an unacceptable level from term P_n.

Term P_n occurs when changes in the performance characteristics reach lower values than changes in the unreliability of a building.

The intensity of damage of a building which had not been refurbished increases continuously over subsequent years of use.

The accumulation of damage and its effects make it necessary to carry out refurbishment of the building at a term after crossing P_p.

Conclusions

The presented methodology of describing changes in the intensity of damage, unreliability and performance characteristics over the course of the service life of a building is a diagnostic process of predicting the technical condition of a residential building.

The model of the distribution of the time during which a building operates properly presented as the prognosis of changes in the technical condition can be applied to solve problems occurring in practice.

Thank you for your attention