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STATICAL ESTIMATE OF SAFETY AT VARIABLE LOADING, THROUGH ASYMMETRICAL CYCLES, USING A PARABOLISED APPROACH

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ABSTRACT:
The paper revolves around rendering the manner of evaluation, what the safety coefficient is concerned, namely in the case of variable stress through asymmetric cycles, by using the parabolic method.
KEY WORDS:
variable stress, schematizations, safety coefficients

Compared to the classical approximation methods of the Haigh type diagram [1], the subsequent paper aims at establishing an improved ratio for the calculus of the safety coefficient at variable loadings, through asymmetrical cycles.

Soderberg [1] borders on the Haigh type diagram by means of the AC straight line, Serensen [2] and Gh. Buzdugan [3], in terms of the ABC broken line, moreover to the quarter of ellipse having the OC and OA semiaxis. Consequently, these methods regard the diagram of resistances at weariness, whilst *neglecting* a part of the real field, (case [1] and [2]) or *increasing* this field ([3]).In this respect, the expressions of the safety coefficients deduced by Soderberg and Gh. Buzdugan, using the classical notations, are the following:

$$\psi = \sigma_v / \sigma_{-1}; \quad \theta = \sigma_m / \sigma_c,$$

are

$$c_d = \frac{1}{\psi + \theta}; \tag{1}$$

$$c_c = \frac{1}{\sqrt{\psi^2 + \theta^2}} \tag{2}$$

$M(\sigma_m, \sigma_v)$ representing the coordinates of a current point on the homothetic curve.

The continuation revolves around an emphatic purpose, namely the estimation of the Haigh type diagram through a parabola; *the condition*, according to which it passes through points A and C, nonetheless verging on the $M_1(x_i, y_i)$, i = 1 ..., n points obtained experimentally in the most efficient manner possible, *is allotted and imposed on the parabolic design.*

Coefficient b of the parabola

$$y = -\frac{1}{\sigma_c^2}(b\sigma_c + \sigma_{-1})x^2 bx + \sigma_{-1} \tag{3}$$

that undergoes points A and C, is exhibited through the method of the smallest squares from the condition,

$$\sum_{i=1}^{n}\left[b\left(x_i-\frac{x_i^2}{\sigma_c}\right)^2-\frac{\sigma_{-1}}{\sigma_c^2}x_i^2+\sigma_{-1}-y_i\right]^2=\text{minimum} \qquad (4)$$

resulting in the determination

$$b=-S/\left(\frac{1}{\sigma_c^2}\sum_{i=1}^{n}x_i^4-\frac{2}{\sigma_c}\sum_{i=1}^{n}x_i^3+\sum_{i=1}^{n}x_i^2\right) \qquad (5)$$

where

$$S=\frac{\sigma_{-1}}{\sigma_c^3}x_i^3-\frac{\sigma_{-1}}{\sigma_c^2}\sum_{i=1}^{n}x_i^3-\frac{\sigma_{-1}}{\sigma_c}\sum_{i=1}^{n}x_i^2+\frac{1}{\sigma_c}\sum_{i=1}^{n}x_i^2y_i+\sigma_{-1}\sum_{i=1}^{n}x_i-\sum_{i=1}^{n}x_iy_i \qquad (6)$$

Parabola (3) as a limit cycle (safety coefficient equals to the unit) and its homothetic parabola to the origin are considered, the points of which represent loading cycles with the same safety coefficient c > 1. Based on that assumption, for the same type of efforts concentrator, the parabola has the equation

$$y=-\frac{1}{\sigma_c^2}(b\sigma_c+\sigma_{-1})cx^2+bx+\frac{\sigma_{-1}}{c} \qquad (7)$$

b illustrated by relation (5).

Taking into account, that in this ratio, (x, y) epitomize the coordinates of a current point M(σm, σv) in the homothetic parabola, the relation is assigned the from:

$$\sigma_v=-\frac{1}{\sigma_c^2}(b\sigma_c+\sigma_{-1})c\sigma_m^2+b\sigma_m+\frac{\sigma_{-1}}{c} \qquad (8)$$

Henceforth, noting:

$$B=b\sigma_m/\sigma_{-1} \qquad (9)$$

The expression:

$$c=\frac{1}{\sqrt{\frac{1}{4}(\psi-B)^2+\theta^2\left(1+b\frac{\sigma_c}{\sigma_{-1}}\right)}+\frac{1}{2}(\psi-B)} \qquad (10)$$

results from the safety coefficient at variable loadings through asymmetrical cycles.

In the particular case in which n = 1, point M_1 immediately attains the coordinates $\sigma_{0/2}$, $\sigma_{0/2}$ (the positive pulsatory cycle is to be checked); thus, the statistical estimate is no longer necessary. Additionally, the passing through this point, and the value of b is:

$$b=-\frac{\frac{\sigma_{-1}}{\sigma_0^2}\left(\frac{\sigma_2^2}{2}\right)-\sigma_{-1}+\frac{\sigma_0}{2}}{\frac{1}{\sigma_c}\left(\frac{\sigma_0}{2}\right)^2-\frac{\sigma_0}{2}} \qquad (11)$$

The modelling through relation (3), with the value of coefficient b provided by (5), situates the approximation curve in the immediate vicinity of the Haigh type diagram, leading therefore to values close to the real situation.

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