THE DISPLACEMENT METHOD IN THE STUDY OF THE STABILITY SYSTEMS OF THE PRISMATIC BARS

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Abstract: In this work is about the displacement method used in the study of the stability systems of the prismatic bars. The displacements, the deflections and the rotations are unknown and the condition equation asses that the bars and joint points of the system must be in stability under the action of the external moments and forces produced by the unknown displacement. If these displacements are non-zero in the stability conditions, we obtain the determination equation of the critical flexure force.

1. INTRODUCTION

In this method the unknowns are: displacements, deflections and revolutions and the condition equations asses that the bars and joint points of the system must be in stability under the action of the external movements and forces produced by the unknown displacements.

If these displacements are non-zero in the stability conditions, we obtain the determination equation of the critical flexure force.

We use the system from fig.1.

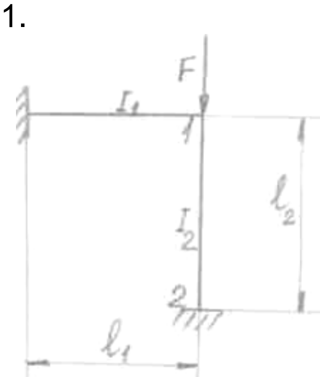

Fig.* 1 *System activated by an external force F.

In this case we have one unknown: the number 1 joint point revolution. The only one displacement is θ_1. The θ_0 and θ_2 revolutions are zero.

The condition equation for the joint point 1 is:

$$M_{10} + M_{12} = 0 \tag{1}$$

M_{10} and M_{12} are the moments from the joint point 1, caused by the 01 and 02 bars which are joining in the number 1 joint point.
The M_{10} and M_{12} are obtained with the (14), [3], relation:

$$M_1 = \frac{4EI_1}{l_1} R_1 \theta_1 \ ; \ \ M_2 = \frac{4EI_2}{l_2} R_2 \theta_1 \ ; \tag{2}$$

Because the (0-1) bar isn't compressed, we obtain:

$$\left(\frac{I_1}{l_1} + \frac{I_2}{l_2} R_2 \right) \theta_1 = 0 \tag{3}$$

For $\theta_1 \neq 0$, it is necessary that

$$\left(\frac{I_1}{l_1} + \frac{I_2}{l_2} R_2 \right) = 0 \tag{4}$$

Replacing R_2, giving by (15), [3]:

$$\mathrm{R}(\alpha l) = \frac{3\psi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)}; \ \ \mathrm{S}(\alpha l) = \frac{3\varphi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)};$$

in (4) formula, we obtain:

$$R_2 = \frac{3\psi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)}; \tag{5}$$

where φ and ψ are giving by (13), [3],formula below:

$$M_1 = \frac{3EI}{l} \left[\frac{2\psi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)} \theta_1 - \frac{\varphi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)} \theta_2 \right]$$

$$M_2 = \frac{3EI}{l} \left[\frac{2\psi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)} \theta_2 - \frac{\varphi(\alpha l)}{4\psi^2(\alpha l) - \varphi^2(\alpha l)} \theta_1 \right]$$

and they are containing the critical force, giving by (3), [3], formula: $\alpha^2 = \frac{F}{EI}$. Finally, we obtain the equation for the determination of the critical flexure force F.

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