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THE PRESSES RIGIDITY - QUALITY FACTOR IN THE PRODUCTS REALIZING

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ABSTRACT

The power used out of the deformation process and the precision of the realized parts defends on the presses rigidity.
The paper presents a Kind (modality) of rigidity determining of the press frame containing beside frames fixed to the hydraulics presses having big weight.

1. GENERALIZATION

The high quality and the small price to the produce realised by the plastic deformation equipments are depending on the equipments construction. To the majority plastic equipments, the frame table represented 50-70% of the table equipements itself. The power energy beside of the deformation process as well as a precision and quality of the bright work depended widely by the equipment rigidity.
The charging of the hydraulic presses and them basic components has an irregularity (prolix by the null coefficient of skew, $R_s = 0$). The speciality lecturer specified the functionality expression (considered at 30 years to the hydraulics presses pending 100 MN and 50-60 years to the bigger 100 MN ton a hydraulics presses), the 100 MN presses full timer ca (10-12) $\cdot 10^6$ cycle; again with bigger slight (7-8) $\cdot 10^6$ cycle. The special fast presses – for example for semi-finished blanking for driver – full timer (25-30)$\cdot 10^6$ cycle. [1].
The running to the plastic deformation equipments created braves stresses in the frame, appeared eccentricity what influence the quality of the elaborated pieces. Generally, the eccentricity e_x are influenced by the friction between the semi-finished and the mould (with de dimension a and b). Function to the deformation strength by semi-finished length, σ_{d_x}, the eccentricity actuated by the expression:

$$e_x = \frac{b}{2} - \frac{\int_0^b \sigma_{d_x} \cdot x \cdot dx}{\int_0^b \sigma_{d_x} \cdot dx}$$

The accession hardness perpendicularly alignment on frame plane, increment of the metal consuming getting by utilisation of the lateral frame for build up some monolith

constructions. For example, by setting the lateral frame to the bigger ton hydraulics presses at 500 MN – figure 1, position 1, 2 and 3.
For realised the lateral frame, the metal quantity used in the construction of the presses are reduce to 1,5 or. Ahead the total weights of the frame to 2420 ton, the lateral frame are approximate 200 ton, or the frame rigidity are heighten by 5,5 or to the heighten of the frame weight ascribe to the lateral frame with only 8,3 % [1].
The lateral frame is made of two pair off elements (etiers - piece to U size - 1 and 2, figure 1, trapezoidal or have another configuration), fitted to the upper and underside of the frame and special jointed among them. The pair of the element is bound by the piece 3, jointed bound by the upper element to the lateral frame 1 and situated in the seating of the underside 2. This type of joint allows the converse travelling to the pair off element by perpendicularly alignment, the extension of the etriers in the time of work to the presses (unstrained the extension of the lateral frame). The strain eccentricity to the mobile beam girder, doesn't allow the travelling in perpendicularly alignment to the frame plane, widely the frame rigidity of the presses and growing the justness and the quality of the elaborated pieces.

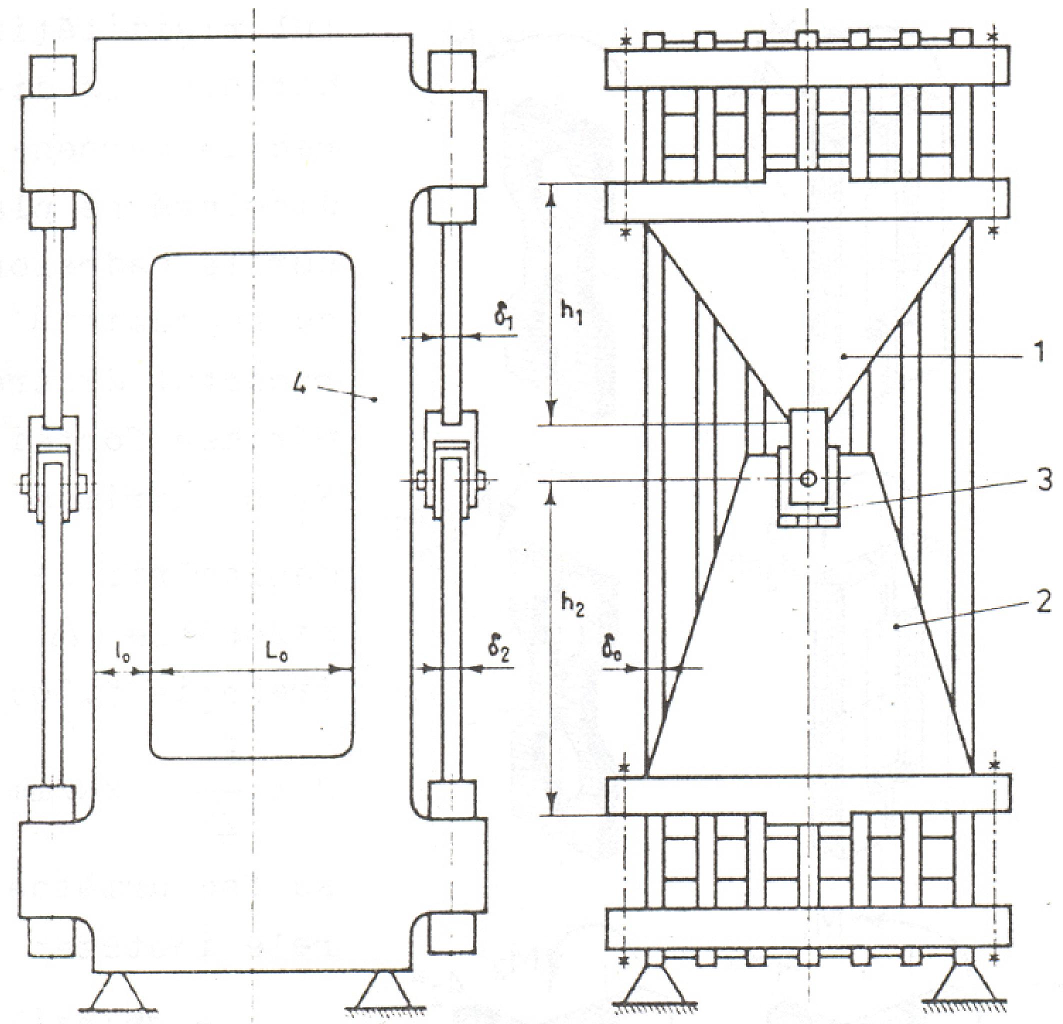

FIGURE 1. THE BIGGER TON HYDRAULICS PRESSES, OF 500 MN. THE LATERAL FRAME RIGIDITY ARE HEIGHTEN BY 5,5 OR

To the bigger 650 MN ton hydraulics presses – figure 2 the actuality of the lateral frame with the special construction, widely the frame rigidity, widely the justness of the quality of the elaborated pieces, but proportional unwieldy of the metal consuming. [3, 4].
To the eccentricity result application process charge, the mobile beam girder revolving actuated the frame by the strain F_1. The bending moment M_1 and M_2, with making the deformations Δ_1 and Δ_2 (figure 2) are take over by the assembled frame from etriers and the lateral frame, amount a rigid frame with the inessential /negligible/deformation.

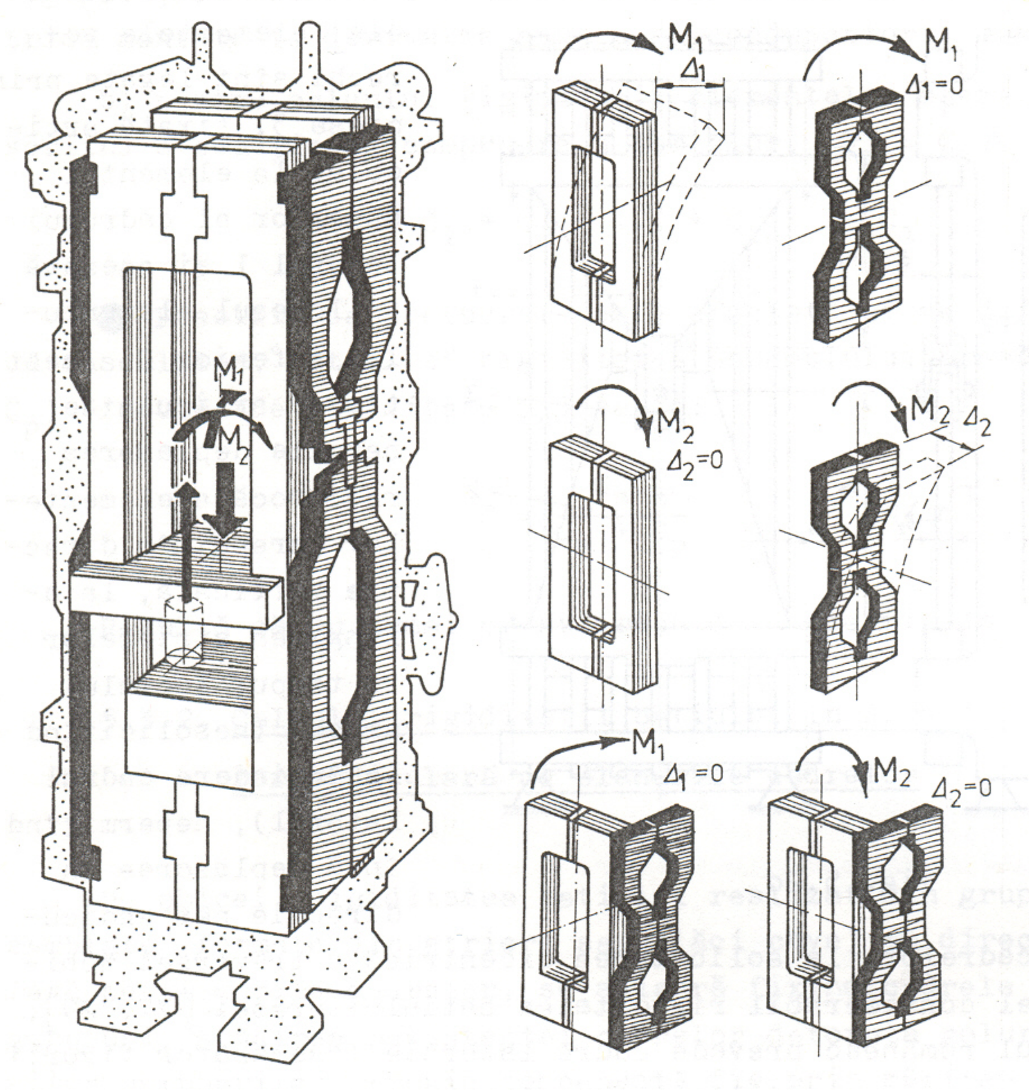

FIGURE 2. THE BIGGER 650 MN TON HYDRAULICS PRESSES. THE SETTING OF THE LATERAL LAYER FORMING THE RIGIDITY FRAME, ASSURING WIDELY RIGIDITY

2. THE RIGIDITY OF THE FRAME EQUIPEMENT

The deformation diagrams of the perpendicular alignment frame to the frame plane are illustrated in the figure 3.

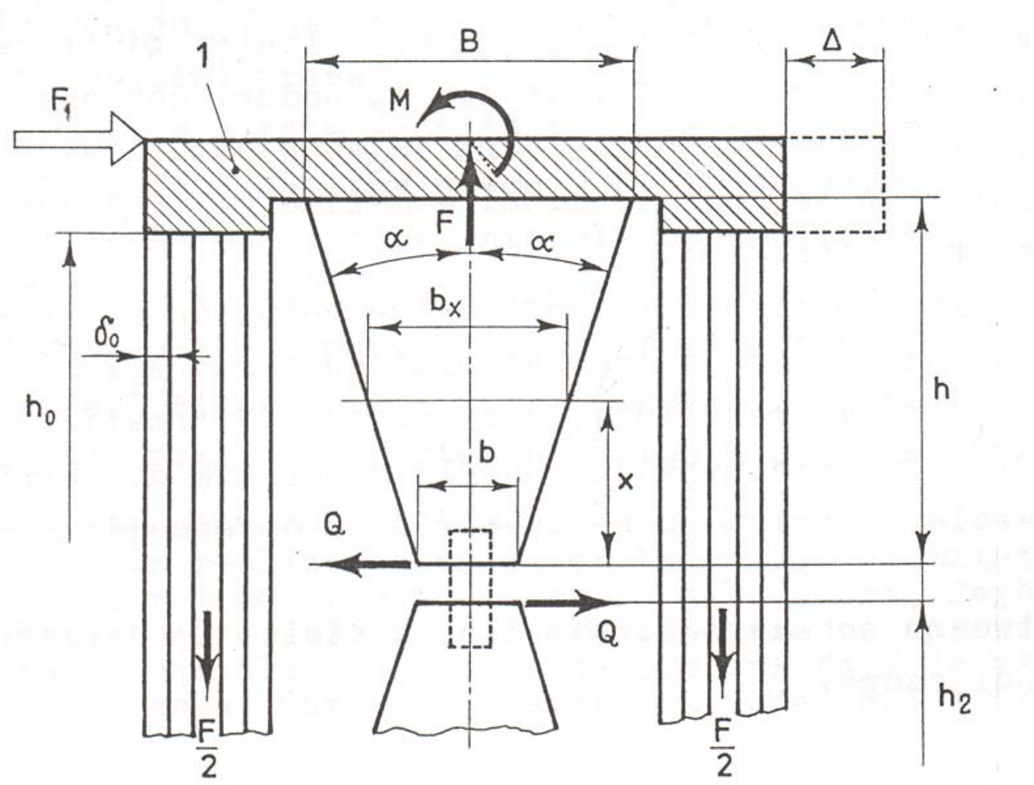

FIGURE 3. THE DIAGRAM CALCULUS OF RIGIDITY FRAME BY PERPENDICULARITY ALIGNMENT TO FRAME PLANE.

In the rigidity calculus of the frame by the perpendicular alignment to the frame plane, C_h, representative the rapport between the force size F_1 and the horizontal alignment size, Δ

$$C_h = \frac{F_1}{\Delta} \qquad [kN/mm] \tag{1}$$

allow following hypothesizes:

- the horizontal beam 1 – figure 3 – are perfect hard –set;
- pass by the little deformation to the all over of the pair off elements to the lateral frame displace itself junction with the frame;
- the normal stresses in the seating system (mullions 4 figure 1) by season of the eccentricity of the presses assign to have equal value.

Pass by the compound of frames elements and the lateral compound frames co-acting with the parallel bows.

$$C_h = n \cdot C + 2C_\ell \tag{2}$$

or the pair of the compound elements to the lateral frame acting with the serial mainspring (heaved the rigidity of the upper elements and underside C_1, respectively C_2) $\frac{Q}{C_\ell} = \frac{Q}{C_1} + \frac{Q}{C_2}$,

where:

$$C_\ell = \frac{C_1 C_2}{C_1 + C_2}, \tag{3}$$

When:

C - the bending rigidity to the corresponding cave plate (the compound elements of the frame);

N – number of the cave plate, compound of the frame;

C_ℓ - the bending rigidity to the pair of compounds elements of the lateral frame

With the balance indicator getting down the corresponding elements of the mullions, with 1 indices for the upper and 2 indices the corresponding elements underside of the frame.

By the static balance premise to the exploded slice – figure 3- inserted the Q force in the lateral frame by reason of the eccentrically load of frame.

3. THE DETERMINATION OF THE FRAME RIGIDITY BY VERTICAL ALIGNMENT OF THE FRAME PLANE

Writing down if the cave plate, compound the frame layer are bending from the F_1 force impact with the built-in beam when his both end are parallel drawing (figure 1 and 3), the bending rigidity are [2]:

$$C = \frac{F_1}{f_p} = \frac{3EI_0}{h_0^3} = \frac{3E\frac{2l_0\delta_0^3}{12}}{h_0^3} = \frac{El_0\delta_0^3}{2h_0^3} \tag{4}$$

for the calculus of the bending rigidity of the pair of compound element to the lateral frame ($C_1 = Q/f_1$ şi $C_2 = Q/f_2$), by figure 3 (for simplification waiving to the indices), can write:

$$b_x = b + 2\cdot x\cdot tg\alpha \quad ; \quad A_x = A\cdot(1 + mx) \quad ; \quad I_x = I\cdot(1 + mx)^3$$

where b_x, A_x and I_x are corresponding the breadth, area and the angular impulse to the transversal section by some section x, or

$$A = b\cdot\delta \quad ; \quad I = \delta\cdot b^3/12 \quad ; \quad m = 2\cdot tg\alpha/b$$

The beam and travelling of the pair compound elements to the lateral frame (to the force Q effects) will calculate used the energetically; method of Castigliano [2]:

$$f = \int_0^h \frac{M_x}{EI_x}\frac{\partial M_x}{\partial Q}\cdot dx + \int_0^h \frac{k\cdot Q_x}{GA_x}\frac{\partial Q_x}{\partial Q}\cdot dx$$

where

$$M_x = Q\cdot x \; ; \; k = 1{,}2 \text{ (block file rectangular section [2])} \; ; \; Q_x = Q \; ; \; \upsilon = 0{,}3 \; ; \; E = 2{,}6\cdot G \; ;$$
$$I/A = b^2/12; \; 1 + mh = B/b$$

$$f = \int_0^h \frac{Q\cdot x^2}{EI\cdot(1+mx)^3}dx + \int_0^h 1{,}2\frac{Q}{GA\cdot(1+mx)}dx = \frac{Q}{EI}\left[\frac{1}{m^3}\ln(1+mh) - \frac{h\cdot(2+3mh)}{2m^2(1+mh)^2}\right] + \frac{1{,}2\cdot Q}{mGA}\ln(1+mh) =$$

$$\frac{Q}{EI\cdot m^3}\left[\left(1+1{,}2\frac{EI\cdot m^2}{GA}\right)\cdot\ln(1+mh) + \frac{4\cdot(1+mh)-1}{2\cdot(1+mh)^2} - \frac{3}{2}\right] = \frac{1{,}5\cdot Q}{\delta E\cdot tg^3\alpha}\cdot\left[\frac{\ln\frac{B}{b}}{\cos^2\alpha} + \frac{4\frac{B}{b}-1}{2\cdot\left(\frac{B}{b}\right)^2} - 1{,}5\right]$$

because

$$1 + 1{,}2\cdot\frac{EI\cdot m^2}{GA} = 1 + 1{,}04\cdot tg^2\alpha \cong \frac{1}{\cos^2\alpha}$$

Used the substitution in the relation $C_h = n \cdot C + 2C_l$ the rigidity of the frame type layer to the vertical alignment to frame plane – fitted with lateral size frame with the trapezoidal pair elements to the eccentrically loading, become of:

$$C_h = \frac{0{,}5nEI_0\delta^3}{h_0^3} + \frac{2 \cdot E \cdot \delta_1 \cdot tg^3\alpha_1}{\left[\frac{\ln\frac{B_1}{b_1}}{\cos^2\alpha_1} + \frac{4\frac{B_1}{b_1} - 1}{2 \cdot \left(\frac{B_1}{b_1}\right)^2} - 1{,}5\right] + \frac{\delta_1}{\delta_2} \cdot \frac{tg^3\alpha_1}{tg^3\alpha_2} \cdot \left[\frac{\ln\frac{B_2}{b_2}}{\cos^2\alpha_2} + \frac{4\frac{B_2}{b_2} - 1}{2 \cdot \left(\frac{B_2}{b_2}\right)^2} - 1{,}5\right]} \quad (5)$$

4. CONCLUSIONS

In the equipments construction the plastic deformation (for example the bigger ton hydraulics presses) the frames layer assembled type from etriers or cave plate presented some advantages with the traditional frames (they can made by columns and braced frame). Used also the lateral layer are obtains the compact construction how are augment rigidity, with the positive influence about the precision and quality pieces obtained by plastic deformation.
This paper presents the calculus of the rigidity therefore to the frame in perpendicular alignment to the layer plane, provided also with the lateral layer size by trapezoidal pair elements, to eccentrically loading.

5. REFERENCES

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