6. Naučno-stručni skup sa sa međunarodnim učešćem
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FORMULATION OF DIFFERENTIAL EQUATION MOVING OF CRANE BRIDG, FOR SYSTEM WITH TWO FLAX STAIRS

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SUMMARY
In this transaction analysis the moving of bridge crane by the mathematical model.This analyse is quite exact and acheaves the conjugate of differential and linear homogen equations with the second hand coeficient.
In this case surveys the maximal dynamic force which must be in the box determines for a normal work of the crane.

Key words: Bridge crane,increase mechanism, rope, construction convey, cargo etc.

1. INTRODUCTION

Bridge crane is appeared as a equipment with some mechanical movements, these parts of crane makes different movements which check up of applying laws of mechanic.
So we have to do with swing then are applied the laws of dynamic and swing theories. Pattern logarithm is applied by forming equivalent schemes from the base scheme of the bridge crane. Swings are annalysed by taking two measures, one measure is the measure of the cargo weight m_Q and the other is the measure of convey construction.

$$m_b=m_k+m_{red}$$

m_k- measure of carriage which holds the increase mechanic and m_{red}- the measure of decrease of the main crane carriage.
Also in the equivalent scheme except measures are taken two buttons with a specific solid; c_b- specific solid of the cargo consruction and c_l- the solid rope of steel.

During the calculation is not taken into account the influence rotation measure of the mechanic increase, because their influence is to low, whereas differential equation will be a lot complicated.

2. SPECIFIC SOLIDS

Specific solid of steel rope in the beginning of work is constant but during the interval time changing it will be changed.Theorically this is calculated by the formula:
Stiffness of rope is,

$$c_l = \frac{mg}{f_l} \tag{1}$$

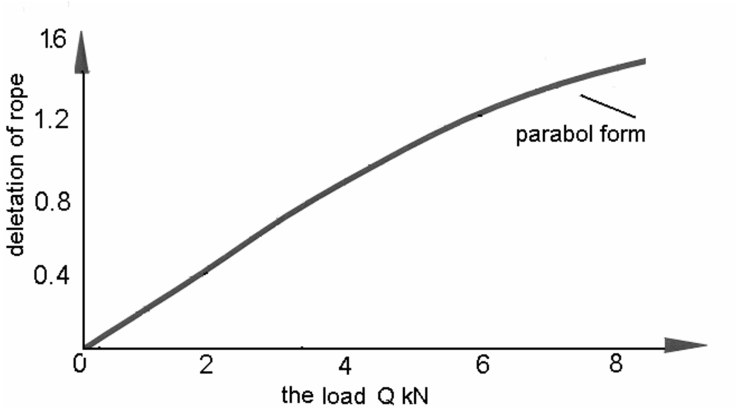

Figure 1. The won diagram in experimental way of difference of stiffness rope C_l according to load Q of.rope with c_l no const.

Stiffness of spring carrier constraction is:

$$c_b = \frac{m_Q + m_k + m_b}{f_b} g \, ,$$

Experimentation

$$c_b = \frac{800Q}{L} \tag{2}$$

Where are:
$Q=m_{Qg}$-weight of load,
$Gk=m_kg$ -weight of trolley,
$Gb=m_bg$ -weight of load of carrier construction,
fl – extension staties of rope from load action,
fb -displacement of carrier construction,

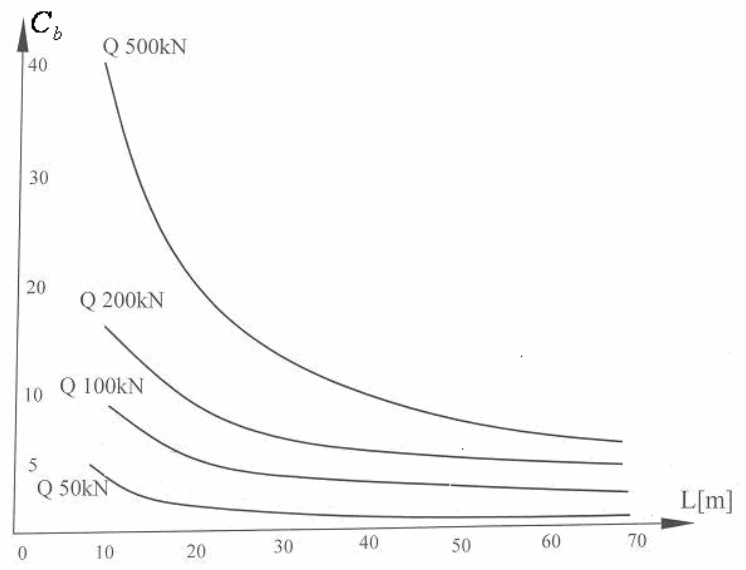

Figure 2. Sifftiness of hold construction for different weight and distance

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Practically the sold is verified by the experiment for 4 ropes parallel as the fig2.

Table 1. Values of stiffness of carrier construction

L/Q	50	80	100	200	500
10	4.00	6.40	8.00	16.00	40.00
20	2.00	3.20	4.00	8.00	20.00
30	1.33	2.13	2.66	5.33	13.33
40	1.00	1.60	2.00	4.00	10.00
50	0.80	1.28	1.60	3.20	8.00
60	0.66	1.06	1.33	2.66	6.66

3. DIFFERENTIAL EQUACIONS OF MOVEMENT.

From the equivalent scheme which came from the movement scheme logarithm comes the dynamc conditions of the equilibrium from the static and the elastic preview force.

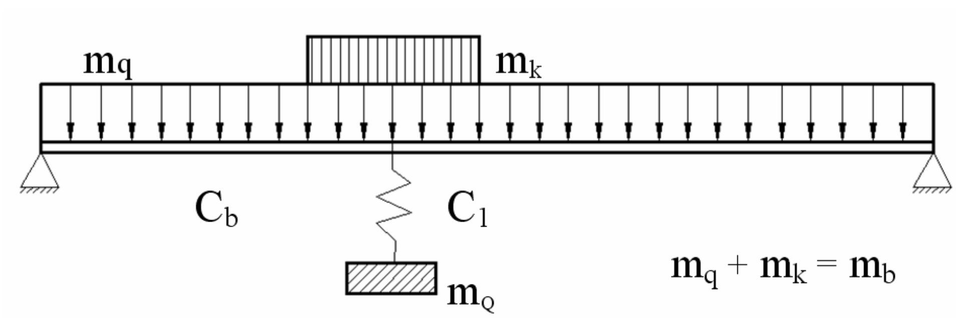

Figure 3. Equivalent system of erance bridge

The solution of the differential homogeneous equations of the second turn is:

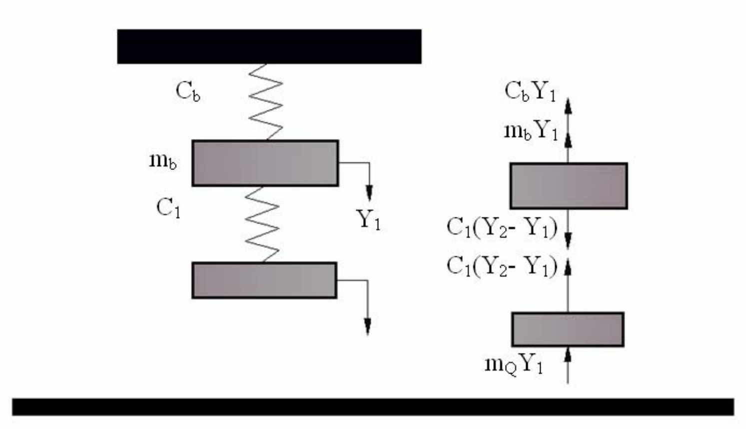

Figure 4. Equivalent system of crane bridge with two flax stairs

Logarithm system is a system of two freedom degree of movement..

$$\begin{aligned} & m_b \ddot{y}_1 + c_b y_1 - c_l(y_2 - y_1) = 0 \\ & m_Q \ddot{y}_2 + c_l(y_2 - y_1) = 0 \end{aligned} \tag{3}$$

After the regulation

$$\begin{aligned} & m_b \ddot{y}_1 + (c_b - c_l) y_1 - c_l y_2 = 0 \\ & m_Q \ddot{y}_2 + c_l y_2 - c_l y_1 = 0 \end{aligned} \tag{4}$$

We derive the expression two times and we win:

$$\begin{aligned} y_1 &= A\cos(\infty t - \alpha) \\ y_2 &= B\cos(\infty t - \alpha) \\ \ddot{y}_1 &= -\infty^2 y_1 \\ \ddot{y}_2 &= -\infty^2 y_2 \end{aligned} \tag{5}$$

after replacing are created equations
From these equations is formed the determinante:

$$\begin{matrix} c_b + c_l - m_b\infty^2 & -c_l \\ -c_l & c_l - m_Q\infty^2 \end{matrix} = 0 \tag{6}$$

$$\infty^2 m_b m_Q - \infty^2\left[m_b c_l - m_Q(c_b + c_l)\right] + c_l(c_l + c_b) - c_l^2 = 0 \tag{7}$$

After multiplication of the determiner and replacements:

$$a_1 = \frac{c_b}{m_b}, a_2 = \frac{c_l}{m_Q}\ ,\ a_3 = \frac{c_l}{m_b} \tag{8}$$

We win the expression:

$$\infty^4 - \infty^2 (a_1 + a_2 + a_3) + a_1 a_2 = 0 \quad (9)$$

Squares root of equation are:

$$\infty_{1,2}^2 = \frac{a_1 + a_2 + a_3}{2} \pm \sqrt{\left(\frac{a_1 + a_2 + a_3}{2}\right)^2 - a_1 a_2} \quad (10)$$

The roots of equation (10) expresses the circular frequents: ω_1 or ω_2

4. THE REPORT OF AMPLITUDS.

Amplitudes have their special importance because they characterize the size swings of cargo and the constructions that are very harmful. The report of amplitude is calculated by the expression(8)..

$$(-m_Q \omega^2 + c_l) y_2 - c_l y_1 = 0$$
$$(-m_Q \omega^2 + c_l) B \cos(\omega t - \alpha) - c_l A \cos(\omega t - \alpha) = 0$$

$$-c_l A + (c_l - m_Q \infty^2) B = 0$$
$$B = A \frac{c_l}{c_l - m_Q \infty^2} = A \frac{a_2}{a_2 - \infty^2} = A\beta \quad (11)$$
$$\beta_1 = \frac{a_2}{a_2 - \infty_1^2}, \beta_2 = \frac{a_2}{a_2 - \infty_2^2}$$

The final solution linear, homogenous and differential equation is:

$$y_1 = A_1 \sin\omega_1 t + C_1 \cos\omega_1 t + A_2 \sin\omega_2 t + C_2 \cos\omega_2 t$$
$$y_2 = \beta(A_1 \sin\omega_1 t + C_1 \cos\omega_1 t) + \beta(A_2 \sin\omega_2 t + C_2 \cos\omega_2 t) \quad (12)$$

And t=0, y1=0, y2=0, $y_1' = 0, y_2' = v = \alpha V$

0=C1+C2, 0=$\beta_1 C_1 + \beta_2 C_2$, C1=0 and C2=0 (13)

After derivation of (12) and applying the base conditions we win the constants:

$$0 = A_1 \omega_1 + A_2 \omega_2$$
$$v = \beta_1 A_1 \omega_1 + \beta_2 A_2 \omega_2 \quad (14)$$
$$A_1 = \frac{v}{\omega_1 (\beta_1 - \beta_2)}$$
$$A_2 = -\frac{v}{\omega_2 (\beta_1 - \beta_2)} \quad (15)$$

Equations takes the form:

$$y_1 = \frac{v}{\beta_1 - \beta_2}\left(\frac{\sin\omega_1 t}{\omega_1} + \frac{\cos\omega_2 t}{\omega_2}\right) \quad (16)$$

$$y_2 = \frac{\beta v}{\beta_1 - \beta_2}\left(\frac{\sin\omega_1 t}{\omega_1} + \frac{\sin\omega_2 t}{\omega_2}\right)$$

5. MAXIMAL DYNAMIC FORCS.

Maximal dynamic force which operates as cargo construction will cause maximal displacement Ymax, which we have to avoid because it can cause a disruption.This force is calculated:
Maximal force shifting which operate in carrier construction during maximal deformation ymax.

$$F_{\max} = c_b y_{\max} = c_b aV \frac{\infty_1 + \infty_2}{\infty_1 \infty_2 (\beta_1 - \beta_2)} \quad (17)$$

This force is called dynamic force of swings.

6. RESUME

Logarithm of the crane swings are required because it must be known the dynamic factor, not to cause any tiredness in the more critical cases to come to the the resonance. When the swings and the dynamic force are under control is able to:

- Stabilization of crane work.
- Longer term of use
- Economic and rentabil
- Secure in the work etc.

7. REFERENCES

[1] K.F.Pajer. G.Ustetingforderer,VEB Verlag Teehnik, Berlin 1978
[2] R.Mijajlovic: Dinamičko ponašanje mostnih dizalnih sistema pri dizanju tereta, Beograd 1979
[3] DIN,Normenuber Kranen und Hebezuge,Funden tecnichikDIN-Tuchembuch44,Berlin1995.
[4] J.Sedar.Prenosila e dizala.Zagreb 1975
[5] T.Pejovci, Diferencialne jednačine, Knjiga 1l Beograd 1948
[6] IMP Knjiga 3, Zavoda za udžbenike i nastavna sredstva, Beograd 1987
[7] Luteroth.A.Dinamich Krafte an Kranen bein i leben and Senken ales Last,Hebezeuge und Fondermitel Teill und