13th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2009, Hammamet, Tunisia, 16-21 October 2009

FACTORS THAT IMPACT IN DETERMINATION OF DYNAMIC FORCEDURING THE LIFTING UP OF LOAD

Ismet Ibishi
Faculty of Mine and Metallurgy
Rr Tjegullorja S1 nr 14, Mitrovicë
Republic of Kosova

Fehmi Krasniqi
Faculty of Engineering Mechanics
Prishtina,
Republic of Kosova

Melihate Shala,
Faculty of Technical Science
Mitrovicë,
Republic of Kosova

ABSTRACT
In this work are described some details about vibrations of the Crane-Bridge. During the lifting up of weight and the analysis of dynamic force in the rope of lever mechanism .The formulation of mathematics models is done by using the differential equations of movement.
Maximal dynamic force is fixed in this method to certify security and stability of the steel-rope, which is used at the Crane-Bridge.
In dynamic force also can impact the stiffness of the rope and carrier construction.
Key words: Crane-bridge, dynamic force, carrier construction, load, steel-rope, etc.

1. INTRODUCTION
With purpose of realization of normal work of crane-bridge is done the calculation of dynamic force, which certify a certain work.
Dynamic force cause swings which if they are large will cause consequences that appears with destabilization of lever mechanism and with defects of cranes.
The problem is analyzed for system with one flax-stairs of movement.
Which is not so exact but is recognized for certain work of crane-bridge during the lifting up of loads with a fixed speed.

2. FACTORS THAT IMPACT IN DYNAMIC FORCE
The value of maximal force having elastic force which can e notify during the lifting up of load and other parts for the case when crane bridge for the system with one flax stairs of movement which can be allocated according the formula:

$$F'_{\max} = 0.053 Q \frac{\alpha V}{\sqrt{f}} \tag{1}$$

This force can be expressed through dynamic factor Ψ:

$$F_{max} = \psi Q \quad (2)$$

From this expression factor dynamic is:

$$\psi = \frac{F_{max}}{Q} \quad (3)$$

Lever of weight of crane usually can be taken from standard value:
Q [k N] : 20 40 50 80 100 200 300 500
The speed of cranes can be taken from standard table:
V [m/min]: 10 20 32 40 50 60
α - Factor of lever where the maximal value is 1
f- Total displacement
f_l [mm] - Represent the sum of displacement of rope
f_b - Displacement of carrier construction f_b

$$f = f_l + f_b$$

During the calculation of displacement of carrier construction have to take consideration of masses reduction.
Displacement of rope is:

$$f_l = \frac{Q}{C_l} \quad (4)$$

Factor that impact in dynamic force during the lifting up of weight is stiffness, too.
Stiffness of rope corresponding static of all ropes allocates according to expression.

$$C_l = \frac{EA}{l} \left[\frac{kN}{mm}\right] \quad (5)$$

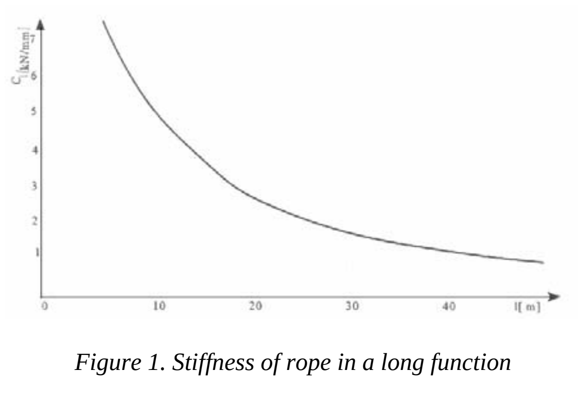

Figure 1. Stiffness of rope in a long function

The crane bridge usually improve the steel-rope according to DIN655

6 x 37 = 222 + 1

Diameter of rope d_l = 27 mm

- Section of indirect rope A = 251.1 mm^2
- Module of elasticity E = 2.1 10^5 N/mm^2

The length of rope can have different values and that 10m, 14m, 18m, 20m, 25m, 30m, 40m, 50m, etc.

In figure 1 with calculation is won the diagram of difference of specific stiffness of rope in function of length.
From the diagram can be seen that the value of stiffness of rope C_1 changes according to hyperbolic law in function of length of rope 1, in which depend the load. We can say that the elastic force, which is caused in rope and will be conducted in carrier construction and that, is in proportion with the length of rope.
Elastic force is only in proportion with load. For our optimal realizations is attempted that the high of lifting up of load to be smaller. For example for the length of rope 1=14m, it's stiffness would be C_1=3.7 [k N/mm], whereas for 1=10[m], C_1=5.27 [k N/mm].
So specific stiffness of rope is in proportion with the length of rope.
If the length of rope increase the specific stiffness decrease.
In dynamic force impact the stiffness of carrier construction, which can be expressed with formula: (5).
Maximal displacement of counting system according to formula:

$$f = \frac{mg}{c} \tag{6}$$

Preliminary have to calculate amount of constant system for lifting up weight Q= 100[k N]:

- Mass of load, m_Q=Q/g=100/9.81=10.19 x 10^3[kg]
- Mass of dispersion in continual way in carrier, m_q=q L/g=(6.309 10^3 [kg]
- Mass of carriage m_k=(0.3 + 0.4) m_q ± 10%=3.21 x 10^3 [kg]
- Mass reduction can be calculated according to m_r=0.493m_q=3.09 x 10^3 [kg]
- Mass of carrier construction is m_b=m_k + m_r=6.30 x 10^3 [kg]
- Mass of all system shake m=m_b + m_q = 16.49 x 10^3 [kg]

Maximal dynamic force is given according to formula:

$$F_{\max} = 0.053Q\frac{\alpha v}{\sqrt{f}} \tag{7}$$

$$F_{\max} = 0.053Q\frac{\alpha v}{\sqrt{f}}\sqrt{c} = 0.053Q\frac{\alpha v}{\sqrt{mg}}\sqrt{\frac{c_1 c_b}{c_1 + c_b}} \tag{8}$$

$$F = 0.053\frac{\alpha v}{\sqrt{f}}\sqrt{\frac{\frac{AE}{e}\frac{800Q}{L}}{\frac{AE}{e}+800\frac{Q}{L}}} \tag{9}$$

After replacing takes this functional form:

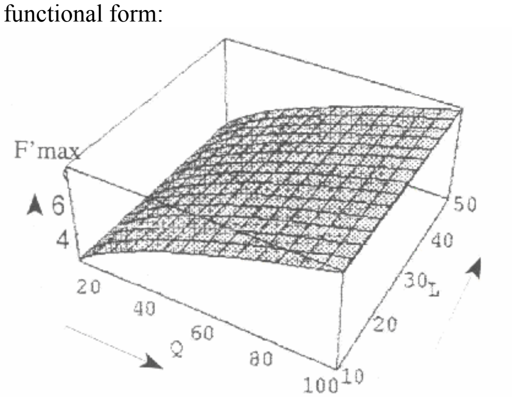

Figure: 2. Maximal dynamic force in function of lifting up of weight Q and space of work L.

In figure 2 is represented maximal dynamic force in function of two parameters (of lifting up weight Q and space of work L). We gain some hyperbolas, which lay in plane, definite and selected in exact way these parameters gained.

3. RESUME

In analysis are given mathematics models for calculation of carrier construction for crane-bridge. Differential equations system of movement with one flax stair is showed exactly for use practice here is given the possibility of representation of dynamic process through dynamic force.
In base of results that are gained of dynamic force and other characteristics dynamic and constructive can be observed that cranes with these characteristics make sure a stabile process in movement what can be notice that dynamic force for small speed is about 3% of load, whereas for a great speed is about 20% of load.
Can be advised gradual increase of speed of lifting up of load.

4. REFERENCES

[1] Pajer K. F., G.Ustetingforderer: VEB Verlag Teehnik, Berlin, 1978.
[2] Mihajlović R.: Dinamička ponašanje mostnih dizalnih sistema pri dizanju tereta, Beograd, 1979.
[3] Bajraktari M.: Mjete transportuese, Prishtinë, 1988.
[4] Sedar J.: Prenosila i dizala, Zagreb, 1975.
[5] Ibishi I.: The dynamic analysis of moving crane brige, Prishtinë,1988.
[6] Pejović T.: Diferencijalne jednačine, Naučna knjiga, Beogarad, 1978.
[7] IMP: Knjiga 3, Zavod za udžbenike i nastavna sredstva, Beograd, 1987.
[8] Luteroth A.: Dynamische Krafte an Drehkranauzologern, Fordermittell, Teill I und II, 8 und 9, Sttutgart,1962