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MOBILE WORKING MACHINES SIZE SEQUENCE DETERMINATION ON THE BASIS OF MARKETING RESEARCH

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Abstract:
The contribution deals with the methodology of determination of a size sequence of mobile working machines – track excavators. Methodology is applied on statistical data – basic technological machine parameters – gained from the existing producers of mobile working machines. The aim of the methodology is the objective proposal of size classes of machines on the basis of chosen technical parameters.
Key words:
track excavators, modularity, size sequence

1. STRUCTURE DEVELOPMENT OF MOBILE WORKING MACHINES

The newest knowledge in the area of design, technology and materials, mechatronics and similar is presently applied in the development of new structures of mobile working machines. In the design praxis flexible machine assemblies are applied consisting of unified modular building parts figure 1, (1), (4), (5).

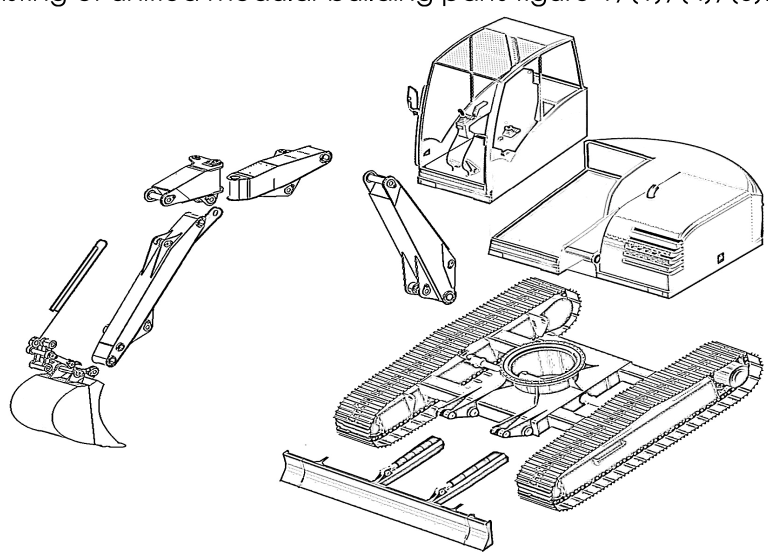

Figure1. Modular structure of track excavators

A modular structure solution for a given building machine sequence uses modular parts, which, in a purposeful design assure required variability of products, high number of variants and possibility of configuration. An important aim of a producer in an effort of improvement of company economy indices and competitiveness of products is the creation of a platform, including as many as possible basic building modules common for all products creating a size building sequence.

An objective design of a building sequence, which is quantified according to previously chosen technical parameter usual for given machine type (overall machine mass, installed engine power, tool's volume, load ability and similar) has for a producer substantial importance, because it brings him closer to requirements of user market

2. DETERMINATION OF A SIZE SEQUENCE OF TRACK EXCAVATORS

Methodology of an objective determination of a size sequence of mobile working machines comes out from evaluation of the set of all track excavators produced presently on the world market. This set represents the data of 121 products of various sizes from 25 producers. This set was consequently processed by suitable statistical methods. On the figure 2 all the excavators are depicted as dots in the mass-power system It is seen that the system exerts strong line dependency depicted by the regression line with the correlation coefficient close to 1.

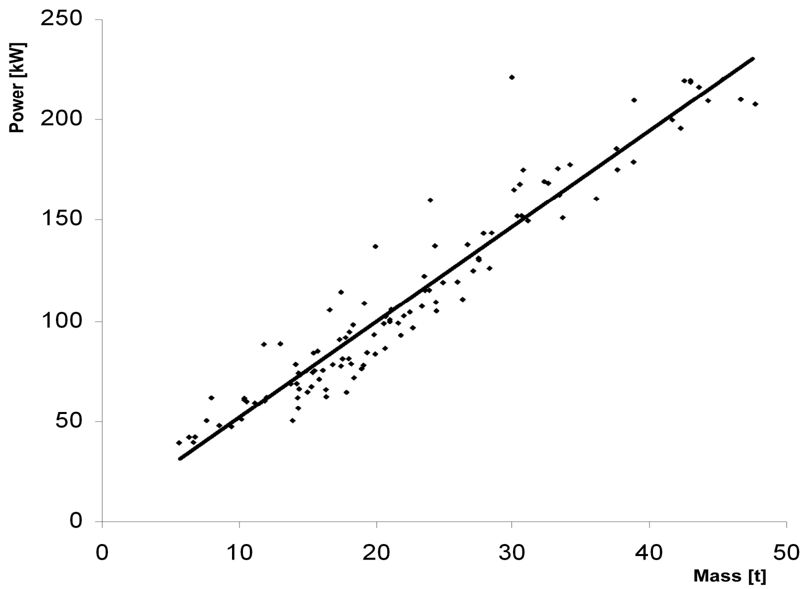

Figure 2. The set of track excavators and its regression line

Let us apriori define number N classes, which will be defined for the existing system of track excavators. Let us denote these size classes by CL_1, CL_2, ., .,. ., CL_N (Class 1, ., . , Class N). In these power classes, there will be consequently defined representants R_1, R_2, ., ., ., R_N, as „hypotetic excavators" of particular power and mass based on some reasonably chosen criterion. Definition of mass and power classes was performed in the following several steps. In the first step all the excavators of the above described group were projected on their regression line. Then certain weighing of all the excavators was considered. It is very important to say that the best weighing coefficient would be the number of produced excavators of every particular excavator type. But this information in this stage of the solution is not at our disposal and so the substitute weighing coefficients based on the histogram of existing types of particular mass and power were used.

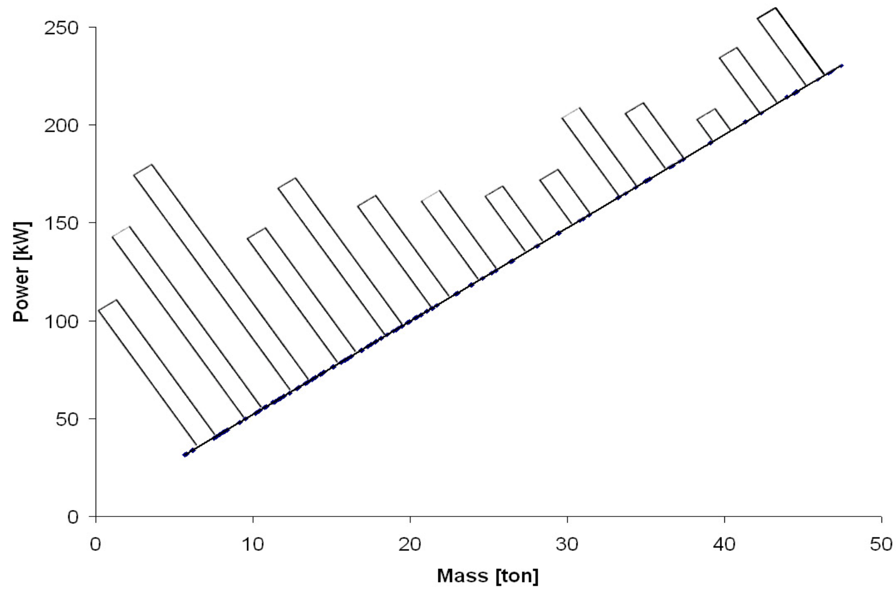

Figure 3. Histogram of excavator's types

In the figure 3 we see projections of particular types from the figure 2 (depicted as dots on the regression line) and histogram of excavator types, which will be used as weighing values for particular excavator types. The histogram is spread over the regression line of the excavator's system in the limits of „minimal" and „maximal" projection of the whole system. (2), (3). This „minimal" projection has the coordinates 5,66 t, 31,33 kW, the „maximal" projection has the coordinates 47,42 t, 230,54 kW.

This idea is based on the concept that number of produced machines of particular type coincides to some extent with the density of various types close to particular mass and power values. All the projections onto the regression line were multiplied each by its weighing coefficient defined by the particular histogram value and consequently summed together. The result of this summation will be denoted as OMRL (Overall Massiveness alongside Regression Line). From this value will be derived the value RRL (Repletness of particular CL_i Alongside Regression Line), by the relation:

$$RRL = OMRL/N \ [-] \qquad (1)$$

where: N – is the apriori chosen number of classes (-)

The limits of particular size classes were then defined by consecutively filling in so that every class has the equal repletness defined by the value RRL. This procedure enables defininition of the overlay of the whole system of products by apriori defined number N of classes by respecting the substitute weighing coefficients defined by the histogram. But it would be of no problem to perform the described procedure with the more relevant weighing values (numbers of produced pieces of particular types) in case we could gain access to this data.

In every class CL_i we can consequently define a representing R_i of that particular class, using some reasonable criterion. One such criterion could be the centre of particular size class. Another, maybe even more suitable criterion would be the choice of a representing on the „upper" limit of particular class

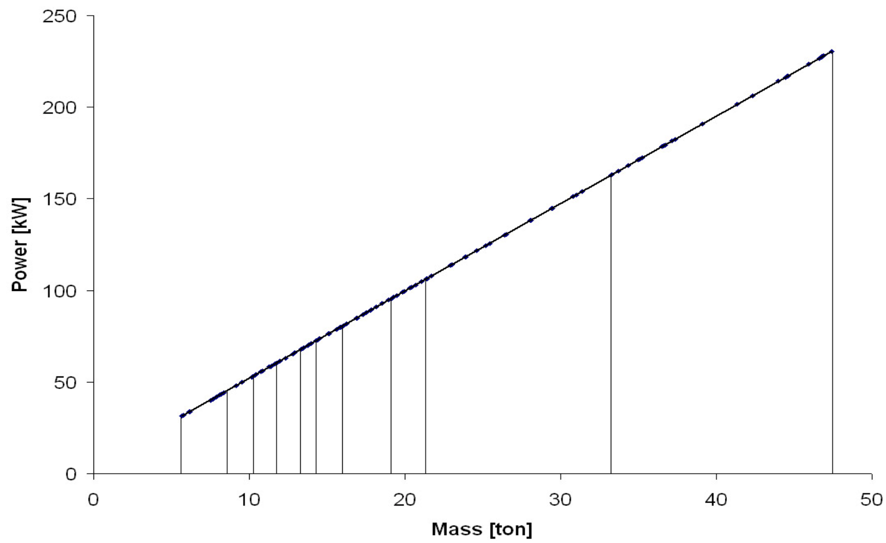

Figure 4. Definition of power classes and their

3. CONCLUSION

In the figure 4 it can be seen that the proposed methodology seems to be relevant for the lower half of the mass-power range.

For the upper half of more robust machines which are often produced on separate orders for specific customers (mines, quarries) the „only two" broad classes should be adjusted to smaller classes according to some different criterion.

For N=10 the following CL_1, CL_2, ..., CL_{10} and R_1, R_2,..., R_{10} of particular size classes were determined with the use of the described methodology.

- mass classes:

CL_1 - (5.66-8.34) t,
CL_2 - (8.34-10.76) t,
CL_3 - (10.76-11.74) t,
CL_4 - (11.74-13.35) t,
CL_5 - (13.35-14.29) t,
CL_6 - (14.29-16.02) t,
CL_7 - (16.02-19.10) t,
CL_8 - (19.10-21.43) t,
CL_9 - (21.43-33.28) t,
CL_{10} - (33.28-47.42 t,

- to this mass classes correspond the following representants defined as upper limits of particular classes):

R_1 – 8.34 t,
R_2 – 10.76 t,
R_3 – 11.74 t,
R_4 – 13.35 t,
R_5 – 14.29 t,
R_6 – 16.02 t,
R_7 – 19.10 t,
R_8 – 21.43 t,
R_9 – 33.28 t,
R_{10} – 47.42 t,

- power classes:

CL_1 - (31.33 - 44.10) kW,

CL_2 - (44.10 - 55.64) kW,
CL_3 - (55.64 - 66.33) kW,
CL_4 - (66.33 - 68.01) kW,
CL_5 - (68.01 - 72.48) kW,
CL_6 - (72.48 - 80.74) kW,
CL_7 - (80.74 – 95.42) kW,
CL_8 -(95.42 - 106.56) kW,
CL_9 -(106.56 – 163.01) kW,
CL_{10} -(163.01 – 230.54) kW

- to this power classes correspond representants defined as upper limits of particular classes:

R_1 – 44.10 kW,
R_2 – 55.64 kW,
R_3 – 66.34 kW,
R_4 – 68.01 kW,
R_5 – 72.48 kW,
R_6 – 80.74 kW,
R_7 – 95.42 kW,
R_8 – 106.56 kW,
R_9 – 163.01 kW,
R_{10} – 230.54 kW.

From the comparison with chosen world producers it can be stated that in this way defined classes of track excavators in some cases gives a true picture of reality. Proposed methodology enables a producer of particular mobile working machine to define beforehand objectively size classes according to specified technical parameters. This method can be considered as an effective contribution in the process of mobile working machines design.

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