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ABOUT dominant factor DYNAMIC PROPERTIES OF A VEHICLE

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Established that a dominant influence on the dynamic properties of the car with only two of their design parameters - weight and engine power rating. An extremely simple mathematical models to approximate evaluation time Acceleration to a given speed.

Acceleration time, given the speed, nominal motor power, vehicle weight

Problem. The dynamic properties of the vehicle play a crucial role in its dispersal after parting from the point when overtaking and more. The main characteristic of dynamic properties is Acceleration time to set some speed, which is determined experimentally. Accurate and rapid determination of the index theoretical way not possible through a series of objective circumstances. For example, based on said determination must lie outside of the engine speed obtained in unstable conditions of work, but to date for most engines such features exist. In addition, the calculations required for a number of other parameters whose values can only be obtained experimentally.

Analysis of recent research. Specialists Kama Automobile Plant methods dimensional theory [1] constructed an approximate mathematical model to determine the acceleration time Kamaz Scania and to some arbitrarily set speed motion [2]. The resulting model allows them to determine the time Acceleration error of less than 6%, but it is not straightforward and requires a significant amount of input (9 units), one third of which must be accepted as a result of previous calculations.

The purpose of research. Identify the basic parameters that determine the dispersal of the car, and on this basis to build a very simple approximate mathematical model for estimating the time Acceleration to a given speed.

Results. We assume that at the time Acceleration to a certain velocity V significantly affect only the following factors:

- vehicle weight m;
- nominal motor power N;
- speed V, which accelerates the car.

The desired model looking as:

$$t = \tilde{N} \cdot f(m, N, V) = C \cdot m^a \cdot N^b \cdot V^d \quad (1)$$

Formula dimension model (1) has the form [2]:

$$\mathrm{T} = (\mathrm{M})^a (\mathrm{ML}^2\mathrm{T}^{-3})^b (\mathrm{LT}^{-1})^d = \mathrm{L}^{(2b+d)} \mathrm{M}^{(a+b)} \mathrm{T}^{(-3b-d)}.$$

It has the following performance dimensions:

- length L: $0 = 2b + d$; (2)
- mass M: $0 = a + b$; (3)
- time T: $1 = -3b - d$. (4)

Adding equations (2) and (4), we get $b = -1$Then from equation (3) we obtain $a = -b = 1$And from equation (2) $d = -2b = 2$That results in model (1) to the form:

$$t = C \cdot m^1 \cdot N^{-1} \cdot V^2 = C \cdot \frac{m}{N} \cdot V^2. \quad (5)$$

To determine the coefficient $\tilde{N}$ must have numeric values of all other variables included in the expression (5). Using the data of [2], we get a number of values of $\tilde{N}$, Which is equal to the arithmetic mean of 88.5 · 10-3 - see. Table. 1.

Thus we find that the dispersal of KamAZ, expressed in seconds, can be calculated using very simple model

$$t = 88{,}5 \cdot \frac{m \cdot V^2}{N} \cdot 10^{-3}, \quad (6)$$

where the values of the mass of the vehicle should substitute in shades of rated power output in kilowatts and speed - in km / h.

1. Background and results of calculations acceleration time KamAZ (Ed. - Car; SMS. - Dump; Ap. - Train).

Output the results of [2]					The calculation results		
Model car and his wheel formula	Type of trans-Portnoy product (TC)	Total weight TS, etc.	Power engine, KW	Acceleration time to 60 km / h, P	Value coefficient C	Acceleration time to 60 km / h,	Relative error,%
KAMAZ-5320, 6x4	Auth.	15.3	154	30.5	85.3 · 10-3	31.6	3.7
KAMAZ-5320, 6x4	Ap.	26.3	154	62.1	101 · 10-3	54.4	-12.4
KAMAZ-53215, 6x4	Auth.	19.3	176	33.6	85.1 · 10-3	34.9	3.9
KAMAZ-53215, 6x4	Ap.	33.3	176	63.9	93.8 · 10-3	60.3	-5.7
KAMAZ-54115, 6x4	p.	34.2	176	64.8	92.6 · 10-3	61.9	-4.5
KAMAZ-	Sms.	22.2	176	39.6	87.2 · 10-3	40.2	1.5

55111, 6x4							
KAMAZ-65115, 6x4	Sms.	25.2	191	38.4	80.8 · 10-3	42.0	9.4
KAMAZ-6520, 6x4	Sms.	33.1	235	42.3	83.4 · 10-3	44.9	6.1
KAMAZ-5460, 4x2	Ap.	40.0	265	49.0	90.2 · 10-3	48.1	-1.9
KAMAZ-6460, 6x4	Ap.	46.0	265	58.1	93.0 · 10-3	55.3	-4.8
KAMAZ-43114, 6x6	Ap.	15.4	191	23.5	81.0 · 10-3	25.7	9.3
	Mean module				88.5 · 10-3		5.7

Check mathematical model (6) indicates that the error does not exceed the result 12.4%, and the average is 5.7% (see. Table), which is quite acceptable for prognostic evaluation of dynamic properties. It also shows that, despite the huge number of structural parameters of the vehicle, a dominant influence over its dynamic properties result in only two structural parameters - weight and engine power rating (or, equivalently, the specific power car kW / ton).

In particular, if you want to determine the time to Acceleration 60 km / hThen the value V^2 can be combined with the coefficient Ñ As a result, equation (6) takes the form

$$t = 318{,}5 \cdot \frac{m}{N}.$$

After determining the size factor Ñ for any other more or less homogeneous set of cars can get simple and fairly accurate mathematical model since their dispersal. For example, the acceleration time to speed 100 km / h Audi A3 cars with gasoline engines [3, p. 222] describes the model:

$$t = 0{,}963 \frac{m}{N} \approx \frac{m}{N}, \qquad (7)$$

where m - Curb vehicle weight, kg;

N - Rated engine power, hp

The error model (7), taken with a coefficient of 0.963, less than 5%. With the same accuracy acceleration time to speed 100 km / h Audi A3 cars with diesel engines [3, p. 222] describes the model:

$$t = 0{,}894 \frac{m}{N} \approx 0{,}9 \frac{m}{N}, \qquad (8)$$

Calculations by model type (6) - (8) is carried out on the basis of passport data of vehicles. But the real cars based on their technical condition can be significant variations in the power, so that the results of calculations for such models should be used for indicative projections, which are used only in the absence of experimental data Acceleration time to set speed.

If you are using the model has to consider restrictions on the availability of adhesion to the road, according to which, regardless of engine power and vehicle mass during his acceleration to the desired speed V shall not be less than $V/(35{,}3\mu)$ Where μ - Coefficient of traction with the road.

Conclusion. Established that dominuyuchymy factors dynamic properties are only two cars - vehicle weight and engine power rating. This rough estimate for the Acceleration of time to any given movement speed is enough to have information only on its mass, nominal motor power and empirical numerical value of one parameter - the coefficient C Determined for several cars to the test vehicle similar in purpose, size and technical level.

References

1. H. HuntleyAnalysis razmernostey / H.Hantly. - M .: Mir, 1970. - 174 p.
2. Karabtsev VS, Valeev JHDynamic characteristics evaluation of Raschetnaya hruzovыh ATS // Automobile Industry. - 2004. - №2. - P.79.
3. Car world. - M .: Third Rome, 2006. - 240 p.

Established something domynyruyuschee Effect on Dynamic Properties Only two cars okazыvayut s konstruktyvnыh option - Massa and nomynalnaya-power engine. Poluchenы predelno matematycheskye Simple models for pryblyzhennoy otsenki TIME razhona cars to zadannoy velocity motion.

Time razhona, zadannaya velocity motion, nomynalnaya-power engine, Massa car.

Found that the dominant influence on the dynamic properties of the cars have only two of their design parameters - mass and engine power rating. Obtained very simple mathematical model to estimate the approximate time the vehicle accelerates to the desired speed.

Acceleration time given speed, engine power rating, vehicle weight.

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CLARIFICATION OF MECHANICAL MODEL elastic WHEELS

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