УДК 621.87(075.8)

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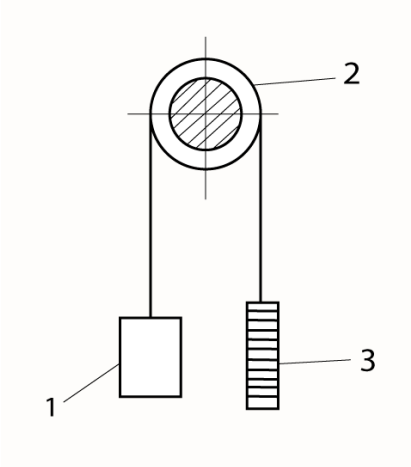
Choice and definition of elevator parameters for the logistics system of a residential building

Passenger and cargo elevators are designed to form the basis of logistic systems of residential buildings of medium and large type.The efficiency of the operation of these systems is the rational choice and placement of elevator installations at the stage of development of logistics systems. Thus one of the main criteria of type and load is the productivity of elevator plants.We performed a study of the required productivity and the number of elevator installations for the logistics system of residential buildings.The obtained results allow to make selection and placement of lifting installations of different purposes, which are produced serially.
General parameters of the proposed passenger lift with load-carrying capacity of 400 kg.

A passenger lift of 400 kg with improved parameters is offered for development.
Output data:
Passenger elevator with rope pulling pulley(drawing 1).



Drawing 1.Passenger elevator with rope pulling pulley:1 – Cabin; 2 - Rope pulling pulley; 3 –Counterweight.

Load-carrying capacitym=400 kg
Lifting heightH=45 m
In the entrance of the dwelling house

$$n_{\text{e}} = \frac{H}{h_{\text{e}}} = \frac{45}{3{,}75} = 12\text{floors},$$

lift usesΠ_f=300 people.
The task of calculation includes: the choice of a lifting vessel and the velocity of its movement; definition of elevator productivity and number of elevators; selection of lifting ropes, power calculation and engine selection; calculation of kinematic parameters of the elevator; calculation of power and power parameters of the elevator; checking of a rope-pulling pulley for hanging.

Choice of lifting vessel (cab) and speed of its movement:
Let's take an elevator in the entrance of the dwelling house, in the booth of which we pick up z=5 passengers. Vantage lift of the elevator

$$Q = m = m_1 Z = 80\ 5 = 400 \text{ kg}$$ (heremass of one passenger m_1= 80 kg)

For such a carrying capacity, the weight of the cabin may be $m_c = 710$ kg; will accept $m_c = 577$ kg.

The size of the cabin: width$B_c = 935$ mm, depth$L_c = 1075$ mm, heighth_c=2100mm.
Weight of lifting cargo:

$$G = mg = 400 \cdot 9{,}81 = 3924\ H,$$

weight of cab:

$$G_c = m_k g = 577 \cdot 9{,}81 = 5660\ H$$

For a residential building with a number of floors $n_f = 12$.We accept an ordinary lift with an average speed of the cabinV=0,9 m/s.

Determine the lift performance and the required number of elevators.
Performance of one elevator:

$$\Pi = \frac{3600Z}{\mathrm{T}}\varphi = \frac{3600 \cdot 5}{141{,}5} \cdot 0{,}7 = 89 \text{ pas/h},$$

T – time of one trip, s,

$$T = \frac{2H}{V} + t_{ex} = \frac{2 \cdot 45}{0{,}9} + 41{,}5 = 141{,}5 \text{ s},$$

t_{ex} – extra time spent on boarding and exit passengers, opening and closing of doors, launching of a lift and etc., s.

$$t_{ex} = 1{,}1[t_1(k+1) + t_2 Z\varphi] = 1{,}1[6{,}5(4+1) + 1{,}5 \cdot 5 \cdot 0{,}7] = 41{,}5 \text{ s},$$

t_1- time spent at each stop for opening and closing the door, for start and stop the elevator, s, we accept t_1=6,5s
k –number of possible lift stops on floors above the first, $k = 4$.
t_2 – time spent by the passenger on the entrance and exit from the cabin,
$t_2 = 1{,}5 \ldots 2$ s, for a two-sided door we will accept$t_2 = 1{,}5$ s;
φ –cabin fill factor; for lifts of public buildings;
$\varphi = 0{,}8 \ldots 0{,}9$;for lifts of residential buildings $\varphi = 0{,}6 \ldots 0{,}8$, we accept$\varphi = 0{,}7$.
Determine the estimated five-minute passenger traffic

$$\Pi = \mathrm{K}_0 \Pi_f = 0{,}05 \cdot 300 = 15 \text{ ppl.},$$

where inK_0 –test coefficient, for residential buildings $\mathrm{K}_0 = 0{,}04 \ldots 0{,}6$,
will accept$\mathrm{K}_0 = 0{,}05$;
Estimated hourly passenger traffic

$$\Pi_e = \frac{60}{5}\Pi_5 = \frac{60}{5} \cdot 15 = 180 \text{ pas.}$$

Required number of elevators

$$Z_e = \frac{\Pi_\mathrm{p}}{\Pi} = \frac{180}{89} = 2{,}02 \text{ elev.}$$

We accept two elevators.
Duration of waiting passengers return the cabin to the ground floor

$$t_w = \frac{T}{Z_e} = \frac{141{,}5}{2} = 70{,}75 \text{ s},$$

In residential houses interrupted traffic $t_{in} = 45 \ldots 90$ s, in hotels$t_{in} = 30 \ldots 60$s.
Selection of lifting ropes
For an elevator with a rope-pulling pulley load-carrying capacity Q = 400 kg, diameter of a rope-pulling pulley will acceptD = 870 mmin the center of a ropes, which wrapped up (outer diameter of a pulley$D_p = 885$ mm). With the plane size between the centers of the cabin weight andcounterweight at 870 mm cabin and counterweightfreely placed in the mineand do not interfere with the mutual movement. After performing the technical and operational documentation of the elevator, the distance between the center of the cab's weight and the counterweight is specified, then the diameter of the rope-pulling pulley is specified, based on the construction of the elevator. Number of lifting ropes for an elevator with load-carrying capacity 400 kg will accept$Z_{lr} = 3$.

Список використаних джерел

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