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Excavator and Vehicle Operation System

Kamoliddin Joraboyevich Rustamov,
PhD, Associate Professor, Tashkent State Transport University

Samandar Iskandarovich Komilov,
Acting Associate Professor, Tashkent State Transport University

Nafisa Baxodirovna Muxamedova,
Senior Lecturer, Tashkent State Transport University

Panji Sodiqovich Egamshukurov,
Student, Tashkent State Transport University

Said Solijon-ogli Yusubjonov,
Assistant-teacher, Tashkent State Transport University

Abstract: The article discusses the “excavator - vehicle - unloading point” system is the simplest option for the operation of an excavator and a vehicle.

Keywords: excavator, machine, operation system, vehicle.

The “excavator - vehicle - unloading point” system is the simplest option for the operation of an excavator and a vehicle. The transition of such a system from state to state occurs “in a jump” under the influence of the next cycle of delivery of “cargo” to the consumer, and since each cycle can be numbered, then according to [11] it is of a discrete type and this property should be considered when identifying patterns of functioning and developing a description model. In terms of the amount of cargo developed, shipped and delivered to the consumer, the productivity of the excavator is equal to the productivity of the system.

2) - a system consisting of a loading point (excavator), several vehicles, an unloading point (consumer) and transport communications. In terms of configuration, it completely coincides with the scheme of the “excavator - vehicle - unloading point” system (see Fig. 1) and includes all the elements of this system, which is typical of hierarchical systems [9]. The difference is that several cars work in the system (A>1). This necessitates the development of schedules for the arrival of vehicles for the first loading (development of schedules for the entry of service vehicles into the system), and therefore the duration of operation of each vehicle is different and is reduced for each subsequent one by the amount of time spent on the first loading of the previous vehicle by an excavator.

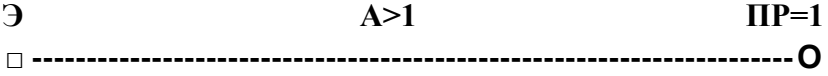

Figure 1. System diagram - “excavator - transport vehicles - unloading point”

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Such systems can be unsaturated (according to the number of cars involved), saturated or oversaturated.

A system in which the interval of movement of vehicles (1d) is equal to the rhythm of cargo work (R) should be considered saturated. From the theory of road freight transportation [10, 11] it is known that adding another vehicle to the system will inevitably cause a queue of vehicles to form during repeated loading or unloading, which cannot have a positive impact on the operation of the excavator and the system as a whole. In addition, vehicles of a certain carrying capacity must work with the excavator, since if you use vehicles of light loading capacity, then you can use the excavator as much as possible in time, but the performance of the excavator on the ground may decrease.

If in the system “excavator - transport vehicles - unloading point” there is an insufficient number of vehicles (1d > R), then the process of functioning of the excavator will be accompanied by downtime. This is a property of unsaturated systems. And, conversely, when 1D < R the system will be oversaturated and cars will be idle [8, 9]. The productivity of the excavator does not increase.

As follows from the description, all the properties of the “excavator - vehicle - unloading point” system find their place in the “excavator - motor vehicles - unloading point” system, where, as a result of the use of a larger number of vehicles, new properties arise that are not in the “excavator - vehicle” system - unloading point." Consequently, according to theoretical principles [7], the system “excavator - motor vehicles - unloading point”, in terms of complexity and complexity of behavior [2], corresponds to a higher level in the hierarchy of systems in which the leading link is the excavator, and therefore for such a system there must be A model has been developed that considers the peculiarities of its functioning.

Logical analysis allows us to conclude that the performance of the system is equal to the performance of a group of cars, and it also corresponds to the performance of an excavator on the “ground”.

3) - a system in which an excavator works together with a number of vehicles when delivering soil to several consumers. Such a subsystem consists of a loading point (excavator), vehicles, several unloading points (consumers) and transport connections (Fig. 2). The number of A_e cars is significantly more than one.

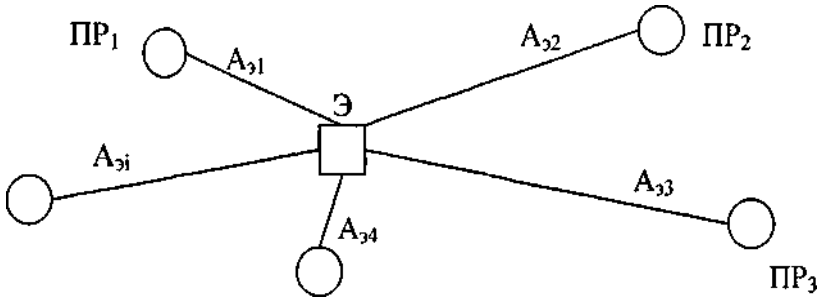

Figure 2. Scheme of the system “excavator - motor vehicles - unloading points”

□ - excavator (loading point);

_____ - transport connections (transport branch);

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O - destinations (unloading).

According to the discrete theory of the transport process [2, 3, 4, 5, 6], in their configuration the systems “excavator - motor transport vehicles - unloading points” (Fig. 2.) are similar to radial motor transport systems. Each branch of the general transport scheme exactly corresponds to the transport connection of systems No. 1 and No. 2. Therefore, system No. 3 includes all elements of systems No. 1 and No. 2 and additionally - the number of consumers, the number of which is greater than one, and they are located at different distances in relation to to the driving element (excavator). For this system, it is necessary to develop not only a schedule for the entry of vehicles into the system, but also schedules for the operation of vehicles in order to eliminate possible downtime of the excavator and the formation of a queue of vehicles during repeated loadings. In such a system, the vehicle does not necessarily deliver the “soil” to only one consumer. Having all the properties of systems No. 1 and No. 2 and its own additional ones, the system “excavator - motor vehicles - unloading points” is more complex and occupies the next place in the hierarchy of systems, where the leading link is the excavator.

Such systems can also be unsaturated, saturated and supersaturated.

Common to all second-level systems is that the leading link of all systems is represented by one excavator. Considering all second-level systems from the perspective of general systems theory [2], we can once again state that an excavator is an integral element of systems and its functioning depends on the operation of vehicles, and its productivity, on the one hand, determines the load on the systems , and on the other hand, it is equal to the performance of cars. According to the provisions of systems theory, these systems are closed or closed, i.e. have a limited number of demand sources (dump trucks).

In the system, the work of the excavator sets the loading time for each vehicle during each cycle of delivering a portion of “soil” to consumers. Thus, the performance of the system as a whole is determined by the amount of “soil” delivered to its destinations, i.e. performance of vehicles in a connected (closed) system “excavator - vehicles - consumers”.

This property of second-level systems should be used when developing models for describing the functioning of the above systems. In addition, it is necessary to take into account the discrete nature of the operation of systems for delivering “soil” to consumers.

In all systems, the performance of the excavator is determined by the performance of the system, and not by the potential capabilities of the excavator itself.

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