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“Иқтидорли талабалар Илмий Ахборотномаси” журнал НамДУ Илмий-техникавий Кенгашининг наватдан ташқари 10.09.2020 йилдаги кенгайтирилган йиғилишида муҳокама қилиниб, илмий тўплам сифатида чоп этишга рухсат этилган (Баённома № 9). Мақолаларнинг илмий савияси ва келтирилган маълумотлар учун муаллифлар жавобгар ҳисобланади.

METHODS FOR SIMULTANEOUS FORMATION OF MULTIGROUP TRAINS

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Annotatsiya: Ko'p guruhli poyezdlar tuzishda har bir tarmoqni mustaqil manzillarga ajratishga nisbatan vagonlarning yig'ilish jarayonida turish vaqti kamayadi. Shu bilan birga, har bir tarmoq vagonlarini alohida guruhlarga ajratish poyezdni jo'natish stansiyasida tuzish vaqtini kam miqdorda uzaytirgan holda, guruhlarni qayta biriktirish stansiyasida ishlarni ancha yengillashtiradi. Maqolada ko'p guruhli poyezdlarni tuzishning elementar sinxron, uchburchak va geometrik usullarining samaradorligi yoritilgan.

Kalit so'zlarni: bir vaqtning sinxron saralash, ko'p guruhli poyezdlar, elementar sinxron usul, uchburchak usul, geometrik usul.

Annotation: In the case of multigroup trains, the waiting time of the wagons during the assembly process is reduced compared to the division of each network into independent destinations. At the same time, the division of each network of wagons into separate groups greatly simplifies the work at the group reunification station, slightly extending the time of formation at the train station of departure. The article describes the effectiveness of elementary simultaneous method, triangular method, geometrical method of building multi-group trains.

Keywords: simultaneous formation, multigroup trains, elementary simultaneous method, triangular method, geometrical method.

Аннотация: В случае многогрупповых поездов время ожидания вагонов в процессе сборки уменьшается по сравнению с разделением каждой пути на независимые пункты назначения. В то же время разделение каждой сети вагонов на отдельные группы значительно упрощает работу на станции объединения групп, немного продлевая время формирования на железнодорожной станции. В статье рассмотрена эффективность

элементарных синхронных, треугольных и геометрических методов построения многогрупповых поездов.

Ключевые слова: одновременное формирование, многогрупповые поезда, элементарный метод одновременности, треугольный метод, геометрический метод.

Methods for simultaneous formation of multigroup trains are generally divided into methods for consecutive formation of trains, and methods for simultaneous formation of trains. According to consecutive formation methods, which are more frequently used in railways, the next train can not be formed before formation of the previous train is completed. [1]

The distinguishing feature of simultaneous methods primarily lies in the fact that vehicles are collected according to the order of appropriate intermediate stations, i.e. according to vehicle groups belonging to intermediate stations of the same number for different trains, rather than according to trains. This brings about the difference in the use of track capacities, and hence in the realization of the overall forming process. Simultaneous methods can greatly improve station operating parameters, as they enable simultaneous formation of several trains, which in turn enables their timely dispatch from marshalling yards and delivery of vehicles to their destinations. Simultaneous methods formulated so far, i.e. elementary, triangular and geometric ones. [2]

Simultaneous methods were used for the first time in French railways in 1917, when numerous trains had to be formed to ensure supply of various cargo to French army at the front toward Germany, during World War One [3]

Elementary simultaneous method

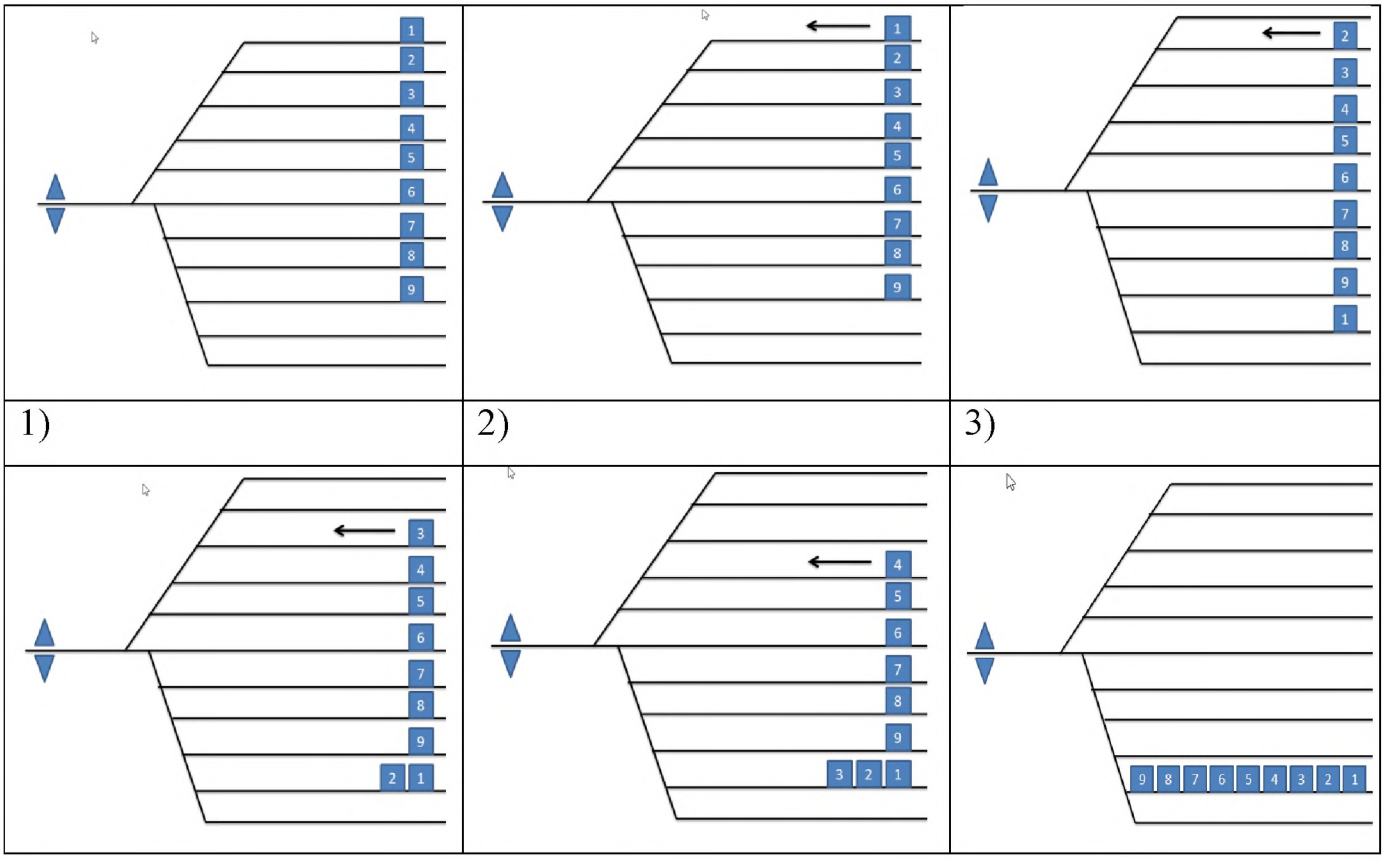
The elementary simultaneous method (Figure 1) consists of two phases. In the first phase, vehicles are collected according to intermediate stations. Vehicle collection is performed in such a way that vehicles for all first, subsequent and all other intermediate stations are brought to tracks previously determined for each intermediate station, despite the fact that vehicles belong to different trains. The

theoretical minimum number of tracks for collection (n_k) is equal to the maximum number of intermediate stations $(g_{\max})$ (1). The rule for collection of groups of vehicles g_j $(j=1,\ldots,g_{\max})$ by track is given in the expression (2), where g_k is the number of intermediate stations for trains from which vehicles are gathered at the track *k*:

$$n_k = g_{\max} \qquad (1)$$

$$g_k = g_f \quad k = j = 1,\ldots,g_{\max} \qquad (2)$$

After completion of collection phase, the second phase (formation phase) is implemented. In this phase, vehicles are moved from collection tracks, and are grouped according to the corresponding trains. The elementary simultaneous method enables formation of a great number of multigroup trains with a minimum scope of manoeuvring work (number of moves is equal for all groups and amounts to precisely one move per vehicle (*h=1*), and the number of vehicles moved, i.e. of vehicles which were used in the multigroup train forming process, corresponds to the total number of vehicles in all trains.



4)	5)	6)
Figure 1. Elementary simultaneous method		

Triangular method

Theoretical bases for triangular method are presented in full detail in paper [4] and so only basic triangular sorting indicators are given in this text. In principle, this method also consists of two phases (Figure 2). Vehicles are gathered together in the first phase, and are sorted in the second phase. In the second phase, they are partly sorted (at vehicle collection tracks) according to intermediate stations, and partly (at train forming tracks) according to trains they belong to, and according to the order of intermediate stations. The connection between the maximum number of intermediate stations in a train $(g_{\max})$ and the required number of vehicle collection tracks (n_k) is shown in the expression (3):

$$n_k = \begin{cases} \sqrt{2g_{\max}} - \frac{1}{2}, & \sqrt{2g_{\max}} - \frac{1}{2} \in N \\ \sqrt{2g_{\max}} - \frac{1}{2} & \sqrt{2g_{\max}} - \frac{1}{2} \notin N \end{cases} \qquad (3)$$

The rule for collecting vehicle groups g j (j = 1, ..., gmax) at intermediate stations and tracks k is given in the expression (4), where vehicles for intermediate stations are collected at track k at point i [5]:

$$g_{k.j.} = \frac{k(k-1)}{2} + ik + 1 + \frac{(i-1)(i-2)}{2}, k = 1,\ldots,n_k,\ i = 1,2,3,4,\ldots \qquad (4)$$

Unlike the elementary method, in case of triangular forming, vehicles for more than one intermediate station are collected at a single track. This calls for a more complex classification plan, and hence a greater scope of manoeuvring operations, such as the number of pullout operations per vehicle or the number of vehicles moved.

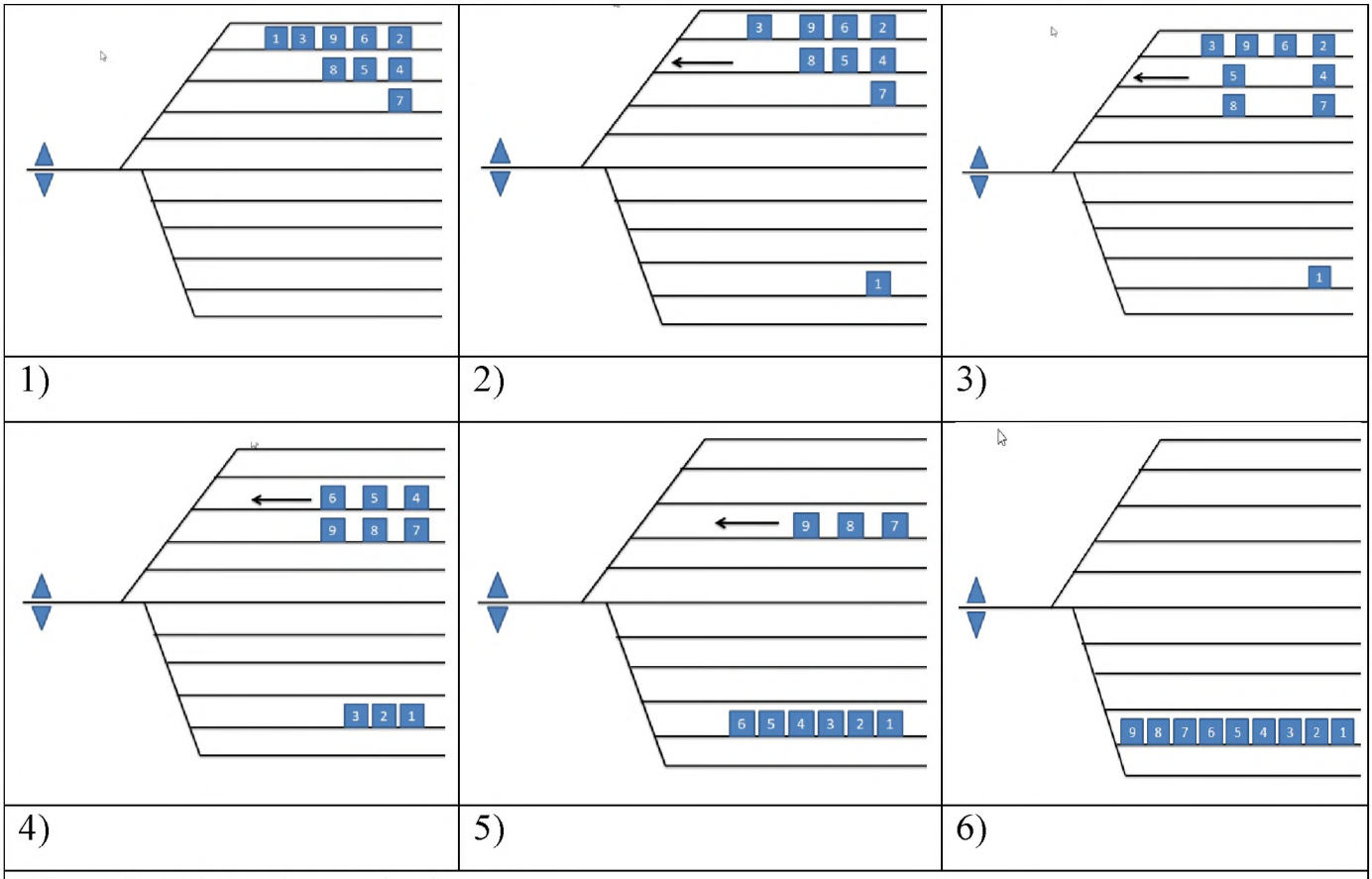


Figure 2. Triangular method

The number of pullout operations is two for all vehicles belonging to the same intermediate station, except for vehicles (4a), which represent the so called "frontal groups" at tracks k, and are pulled out once (h=1). In practice, this means that these vehicles pass through the forming process in the same way as in the elementary simultaneous method. As to the number of vehicles moved, with which the multigroup train forming process was accomplished, it is greater than the total number of vehicles in all trains, as up to two pullout operations are made with some trains.

$$g_{k.j.} = \frac{k(k-1)}{2} + 1$$

Geometrical method

The geometrical classification (Figure 3) constitutes a further advance in the development of simultaneous methods. In fact, an additional reduction in the number of tracks needed for train forming operations has been achieved by using

this method. A detailed description of geometrical method is given in papers. The connection between the maximum number of intermediate stations in a train $(g_{\max})$ and the required number of shunting tracks (n_k), where vehicles are collected and sorted according to groups belonging to the same intermediate station, is given in the relation (5), while the general principle for collecting vehicles at tracks is given in the relation (6).

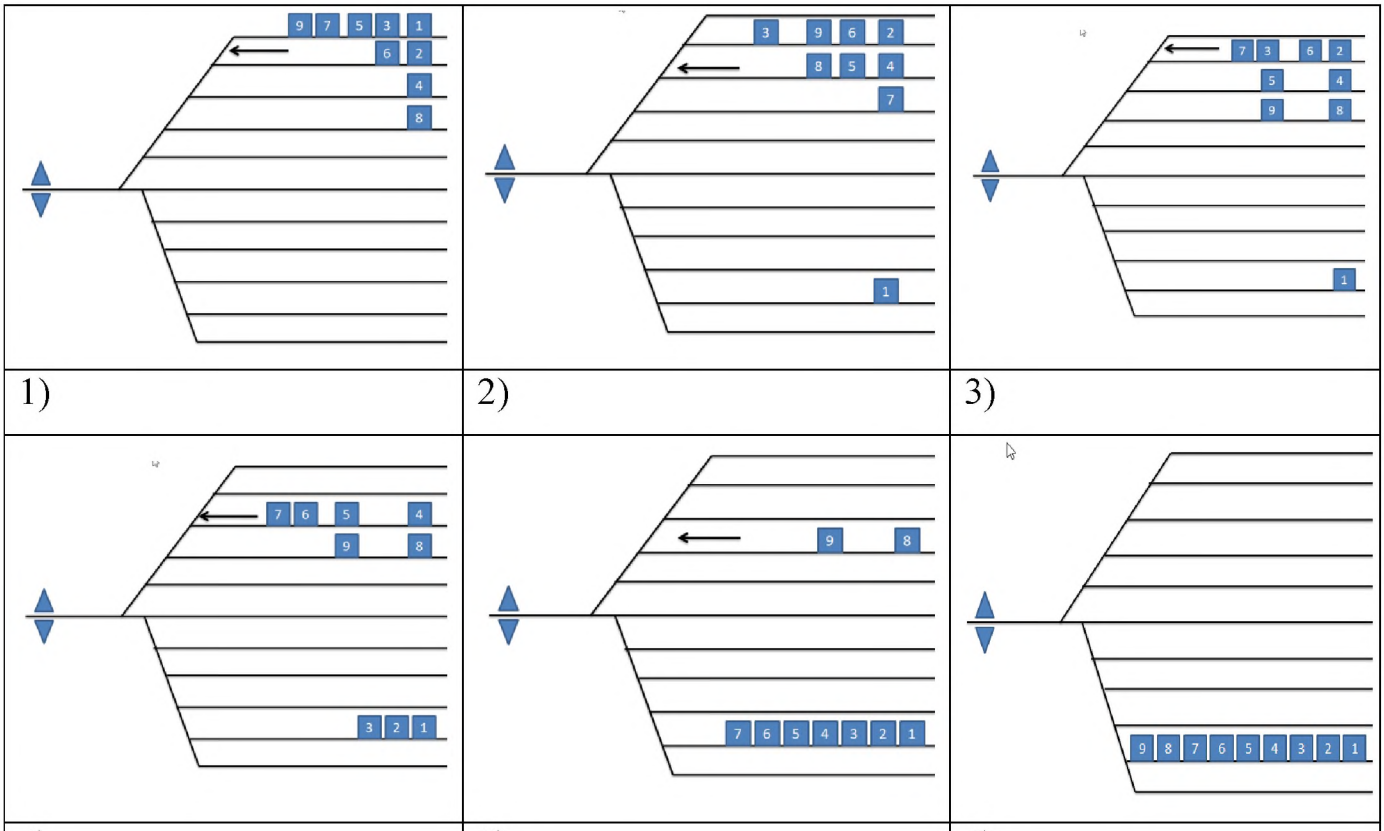


Figure 3. Geometrical method

$$n_k = \begin{cases} \log_2(g_{\max}+1) & \log_2(g_{\max}+1) \in N \\ \log_2(g_{\max}+1) & \log_2(g_{\max}+1) \notin N \end{cases} \quad (5)$$

$$g_{k,j} = 2^{k-1} + 2^k(i-1), \quad k = 1,\ldots,n_k, \quad i = 1,2,3,4,\ldots \quad (6)$$

The reduction in the number of tracks according to this method leads however to an increase in the scope of manoeuvring operations, with respect to both the pullout operations and the number of vehicles moved. The bnumber of vehicle pullout operations is dependent on the number assigned to the intermediate

station the vehicles belong to, and may amount to no more than $h=[\log_2 g]$. Just like in triangular method, the "frontal groups" have the lowest number of pullout operations, as vehicles are pulled out only once *(h=1)*. Unlike the triangular method, the number of pullout operations for other groups is not limited to a particular value, but rather varies with the change of intermediate stations for a train. In case of geometrical classification, the frontal track group k is the group $g_{k,1}=2^{k+1}$. A comparative view of the number of required tracks, as related to the number of intermediate stations.

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ТЕМИР ЙЎЛ СТАНЦИЯЛАРИДА КЎП ГУРУҲЛИ ПОЕЗДЛАРНИ ТУЗИШНИ ОРТИМАЛЛАШТИРИШ БЎЙИЧА ТАКЛИФЛАР

Хайруллоев Жаҳонгир Жасур ўғли
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Тошкент давлат транспорт университети 3-босқич талабалари

Аннотация: Охирги йилларда мамлакатимиз кон томири бўлмиш темир йўл сохасида улкан бунёдкорлик ишлари амалга ошириб келинмокда. Темир йўлларни электрлаштириш, автоматика ва телемеханикани кенг кўллаш, ишларни комплекс механизатсиялаш, хисоблаш техникаси ва микропротсессорларни кўллаш асосида техник кайта жихозлаш бўйича катта

Мундарижа