



RESEARCH AND EVALUATION OF THE EFFECT OF TAKING THE LAND FOR PUBLIC NEEDS AT THE COST OF GRAVEL ROAD RECONSTRUCTION

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Abstract. The article studies the problems of making the design solutions in the projects of gravel road reconstruction due to the taking of land for the right-of-way. The research was carried out during which the volume of taking the land due to the correction of the road plan and the costs of special planning related to taking land were forecasted for the gravel road sections under the supervision of the SE Telšių regiono keliai. The article gives recommendations on the necessity to correct the road plan and on the reduction of the related costs.

Keywords: road plan, right-of-way, special planning, taking of land for the right-of-way, digital ortophotographical map, vectorial map of the road network.

1. Introduction

One of the component parts of the Lithuanian State Road Maintenance and Development Programme is the Gravel Roads Paving Programme (hereinafter Programme) [1]. The main objective of the Programme – to reconstruct the lower category roads of national significance and, thus to reduce the socio-economic differences among the regions [2].

The gravel road sections under the supervision of the State Enterprise (hereinafter SE) Telšių regiono keliai (Roads of Telšiai Region) were selected for the research. With the help of a digital ortophotographical map and a vectorial map of the road network supervised by the mentioned enterprise, one of the alternative route alignments was designed for the selected sections and the volume of land to be taken for public needs for the planned right-of-way was determined. Besides, in the process of research an attempt was made to find out if the common practice of trying to use the least possible deviation from the existing axis when designing the road plan for the sections to be reconstructed is sufficiently reasonable [2–4], since it is

motivated by high additional costs related to the procedures of taking the land for the planned right-of-way.

Recommendations are given on the necessity to correct the road plan and on the reduction of the related costs.

2. The law on territorial planning and its effect on the projects of roads reconstruction

Territorial planning is a process and procedures for regulating the land management for defining the intended purpose of the territories and the land use, the priorities, the environmental and monument protection and other conditions, for developing a system of land, waters, residential areas, industry and infrastructure, for regulating the population employment, and for determining the rights of natural and legal entities engaged in the territory development.

Territorial planning consists of general planning, special planning and detailed planning.

Special planning is aimed at formulating programmes, conditions and solutions of development and management of one or several types of activities and land areas. The objects of it can be the systems of infrastructure and their parts, including motor roads.

In the process of road reconstruction the following situations may occur: correction of the road plan (position of the road axis is changed) and increase in the width of the right-of-way. The width of the right-of-way can increase due to the widening of the roadbed, correction of the longitudinal section – the height of embankments or the depth of cuts are increased and repair of the water discharge system is performed.

In all the above-mentioned cases, pursuant to the Law on Territorial Planning, it is necessary to prepare a special plan.

The process of special planning comprises: studies, analysis, inventory if necessary, formulation of objectives of the activities and their approval; drafting, co-ordination, approval of public discussion on the solutions of the document of special planning, assessment of the social-economic consequences, the impact on the environment.

3. Procedure of taking the land for public needs

The taking of land for public needs – purchase of land from the land owners or cancellation of the right to use the state land and of the agreement for the rent of the state land by the decision of the Government of the Republic of Lithuania or the county governor, made by the established order, that the land is necessary for public needs.

The land can be taken from the private land owners if the land is necessary for: state aerodromes, ports and their facilities, state railways, state roads and main pipelines, high-voltage electric lines and important construction projects of national significance, development of city, town and village infrastructure, general needs of population, public construction or recreation.

Taking land for public needs includes determination of the limits of the land plot by cadastral surveys, preparation of the plan for the land plot in a graphical and digital form, calculation of the total area of the land plot, preparation of the explication of landed property, calculation of the value of the land plot and the average market value, preparation of the form for cadastral data of the land plot, the content and the filling order of which is approved by the Ministry of Agriculture of the Republic of Lithuania, compilation of the file of cadastral surveys, decision and drawing-up the agreement for taking a private land for public needs and payment to the land owner.

Having determined the limits of the land plot and having made the plans the total area of the land plot to be taken is calculated, the average market value of the land plot is estimated, the code of the value zone and the adjustment factor for the market value are defined. The consideration is taken of the purchase (market) price of the land plot, set by the sales or barter agreements, and of the date of agreement.

When taking a private land plot for public needs, the land owner has to be properly reimbursed by paying a real

cost of the land plot in monetary terms or by giving an equivalent land plot in the same locality, also by making amends for the other losses related to the taking of land plot by the established order of the laws and the Government of the Republic of Lithuania.

4. Selection of road sections, scope of research and methodology for determining the volume of a possible taking of land for the right-of-way

For the research purposes the gravel road sections under the supervision of the SE Telšių regiono keliai were selected, included into the list of the State Road Maintenance and Development Programme for 2002–2015.

The list comprises 51 road section, 18 of which have already overcome major repairs or the projects for the asphalt concrete pavement have been prepared. The road plan of 11 sections satisfies the requirements of the Regulation of Motor Roads STR 2.06.03:2001 (thereinafter Regulation of Motor Roads) [5] for the road category IV. Therefore the research was carried out on the remaining 22 gravel road sections.

During the research a vectorial road network map of the SE Telšių regiono keliai was used prepared by the technical-economical office the enterprise in 2001–2005 when making the inventory of the road network supervised and maintained by the enterprise. The inventory was performed by using data of a digital ortophotographical map ORT10. A vectorial map of the road network was made by the AutoCAD Map software. In this map the road axes are represented by the AutoCAD polylines, consisting of a certain number of connected straight-line segments and arcs. The errors of polyline positioning are not higher than 0,5–1,5 m, ie correspond to the accuracy of a digital map ORT10.

Based on a vectorial map of the road network prepared by the technical-economical office of the SE Telšių regiono keliai, it was determined that the horizontal curves of the selected sections, the radii of which are less than the allowable radii at a design speed of $V_p = 60$ km/h according to the Regulation of Motor Roads, make on average 13,9 % of all horizontal curves or 4,1 % of the total length of the sections. In order to meet the requirements of Regulation of Motor Roads for the design of the road plan, the volume of correction to the planned route alternative would be of a similar size.

It was also noticed during the research that on the selected sections, besides the horizontal curves of a too small radius, there is a rather large amount of irregular horizontal curves: compound curves of asymmetric or incompatible radii, compound or inverse curves consisting of more than 3 arcs and curves of the same direction where a straight insertion between them is less than 25 m.

To get more reliable results it was decided to design one of the alternative route alignments for the study gravel road sections.

Design works were carried out by the automated road design system Vestra CAD.

The volume of a possible taking of land for the right-of-way was determined on the basis of the deviation of the planned road axis in respect of the existing gravel road axis, making the assumption that the areas of the taken land approximately correspond to the areas of figures, restricted by the planned and the existing road axes.

When calculating the mentioned areas, the accuracy of the orthophotographical map ORT10 was also taken into consideration, which is 0,5–1,5 m. Therefore, when determining the volume of a possible taking of land for the right-of-way, it was assumed that additional taking of land would be necessary in the following cases:

- 1) $dL > 1,50$ m (dL – deviation of the planned road axis in respect to the existing road axis) and
- 2) $A > 100$ m² (A – area of a figure, restricted by the planned and the existing axis).

The number of land plots, the limits of which have to

be corrected due to the deviation of the road axis, was determined by graphically connecting the pictures of the limits of land plots, stored in the database of the SE Registry centras (Centre of Registers), with the figures (areas) restricted by the planned and the existing road axis (Fig 1).

5. Predicted volume of correction to the road plan and of taking the land for the right-of-way

The research showed that from 22 road sections the two sections would have only slight deviation from the existing road axis; therefore no additional land would be necessary to be taken for the right-of-way. In the remaining 20 sections the total length of the road plan to be corrected (deviation of the road axis and the right-of-way) would make 8,16 km, the total area of land taken for the right-of-way – 3,45 ha, the number of land plots the limits of which would have to be corrected due to the taking of land – 79 pieces.

The research showed that there is a linear relationship between the volume of the correction to the road plan and



Fig 1. Illustration of the methodology for determining the volume of a possible taking of land for the right-of-way land

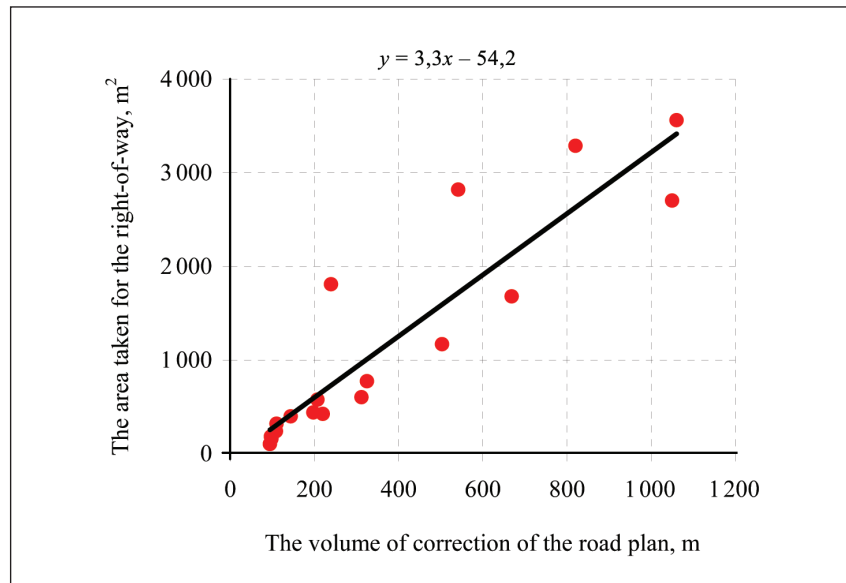


Fig 2. Relationship between the land plots to be taken for the right-of-way and the volume of correction of the road plan

the total area of land to be taken for the right-of-way. The relationship could be described by the following equation (Fig 2):

$$A = k_1 \cdot L_K + k_2, \quad (1)$$

where A – the total area of land to be taken for the right-of-way, m^2 ; k_1, k_2 – coefficients of the linear equation; L_K – length of the section where the planned road axis deviates in respect of the existing axis, m .

During the research the following coefficient values were obtained: $k_1 = 3,3$; $k_2 = -54,2$.

6. Costs related to the procedures of preparing the special planning documents and taking the land for public needs

The costs of taking the land for public needs consist of costs for the preparation of a special plan, costs of the SE Registrų centras, costs of the repurchase of land plots and compensations to the land owners for the temporary rent of land (up to 3 years).

The costs of the SE Registrų centras for the validation of the real estate consist of costs for the cadastral surveys of the real estate and costs for the registration of the real estate and the rights to it.

Payment for the cadastral surveys depends on the size of the object (total area of the structure, configuration, volume, works necessary for the cadastral surveys, quantity etc). The payment also depends on the term of execution, ie if the cadastral works are executed within the set terms or earlier. Implementation of works in a shorter period, ie with all speed, the additional payment of 50 % and 100 % is charged. Payment for the cadastral works of the real estate is set on a contractual basis.

The experience shows that the major part of the costs is taken by the preparation of a special plan, documentation, geodetical measurements, drawing-up of cadastral plans and other expenses, whereas the compensation itself for the taken land makes an insignificant part of total costs.

7. Experience of implementing the Gravel Roads Paving Programme and taking the land for right-of-way

When analysing the experience of the SE Telšių regiono keliai in implementing the Programme within the limits of its supervision, the research was carried out concerning the gravel road sections for which the procedures of taking the land for public needs were applied. It was noticed that until the year 2005 the total costs related to taking land for the reconstruction of gravel roads of category V made on average nearly 3,9 % of the calculated cost for installing the asphalt concrete pavement. Compensations to the owners for the taken land made on average only about 2,2 % of the total costs related to taking land.

During the research no clear relationship was noticed between the total costs of taking the land and the total area of the land taken for public use. However, it could be stated that there is a linear relationship between the total costs of taking the land for the right-of-way and the number of plots, the limits of which shall be corrected because of taking the land for the right-of-way. This relationship could be described by the equation:

$$B = k_3 \cdot N + k_4, \quad (2)$$

where B – total costs of taking the land for the right-of-way, thousand Lt.; k_3, k_4 – coefficients of the linear equation.

tion; N – the number of land plots the limits of which shall be corrected because of taking the land for the right-of-way, plots.

During the research the following coefficient values were obtained: $k_3 = 1,6$ and $k_4 = 52,6$.

8. Forecast of costs related to the taking of land for the right-of-way when reconstructing gravel roads under the supervision of the SE Telšių regiono keliai

This forecast was produced on the basis of the Eq (2) with the coefficient values obtained during the research. In order the forecast has a certain reserve the formula was supplemented with the member which reflects the compensation to the land owners. Thus the forecast was produced by the following formula:

$$B = (1,6 \cdot N + 52,6) + K \cdot A, \quad (3)$$

where B – total costs of taking the land for the right-of-way, thousand Lt; N – the number of land plots the limits of which shall be corrected due to the taking of land for the right-of-way, plots; K – compensations, Lt/ha, set on the basis of the map on the land values developed by the SE Registrų centras; A – the total area of land taken for the right-of-way, ha.

During the research it was determined that (Fig 3):

- the average total costs due to the taking land for the right-of-way would make 58,96 thousand Lt/km or about 2,7 % of the calculated cost for installing the asphalt concrete pavement;
- the higher is the length of the road section to be

reconstructed, the less is the part of additional costs related to taking land.

It was determined during the research that the total costs of taking the land for the right-of-way per 1 km of the gravel road to be reconstructed are related to the length of the road section to be reconstructed by the relationship which could be described by the exponential function [Fig 4]:

$$B_s = k_5 \cdot L^{k_6}, \quad (4)$$

where B_s – the total costs due to taking land for the right-of-way per 1 km, thousand Lt; k_5, k_6 – coefficients of the exponential function; L – length of the road section to be reconstructed, km.

During the research the following coefficient values were obtained: $k_5 = 51,0$ and $k_6 = -0,9$.

Besides, it was determined that the ratio between the costs of taking the land for the right-of-way and the calculated cost of installing the asphalt concrete pavement is also related to the length of the road section to be reconstructed by the relationship which could be described by analogical exponential function (Fig 5):

$$S = k_7 \cdot L^{k_8}, \quad (5)$$

where S – ratio between the total costs of taking the land for the right-of-way and the calculated cost of installing the asphalt concrete pavement; %; k_7, k_8 – coefficients of the exponential function; L – length of the road section to be reconstructed, km.

During the research the following coefficient values were obtained: $k_7 = 10,1$ and $k_8 = -0,9$.

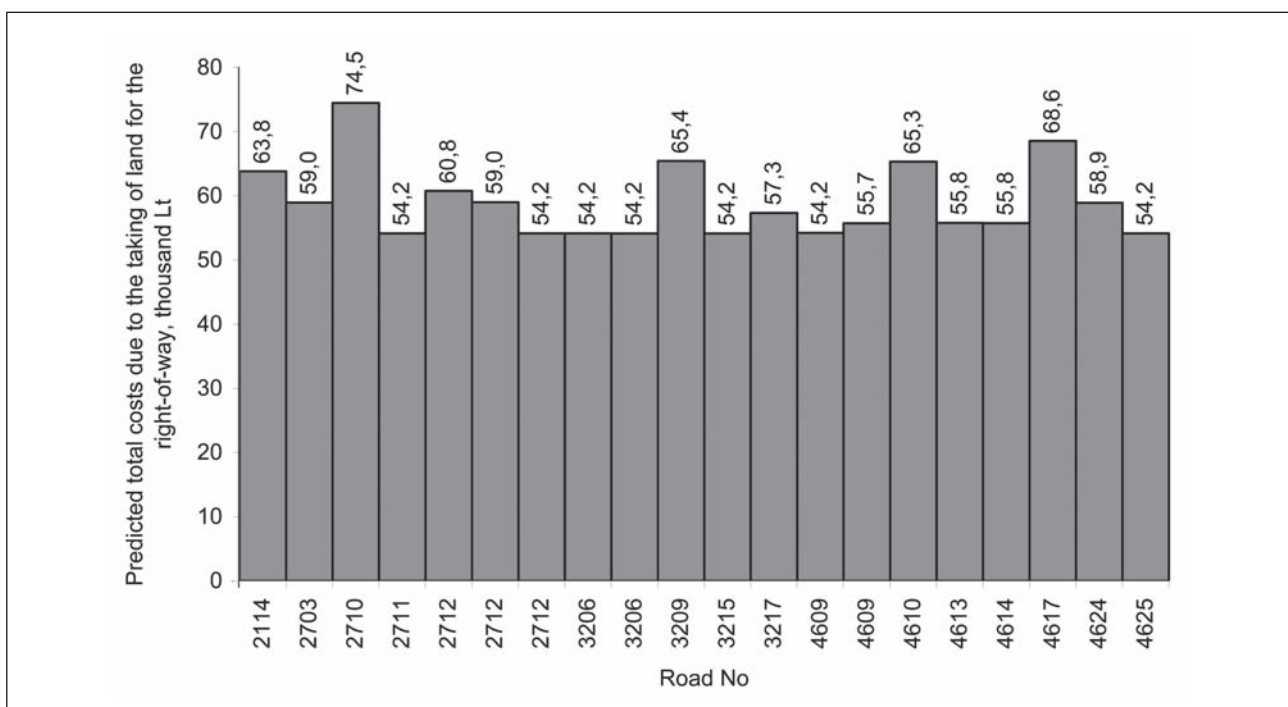


Fig 3. Distribution of the predicted total costs for gravel roads due to the taking of land for the right-of-way

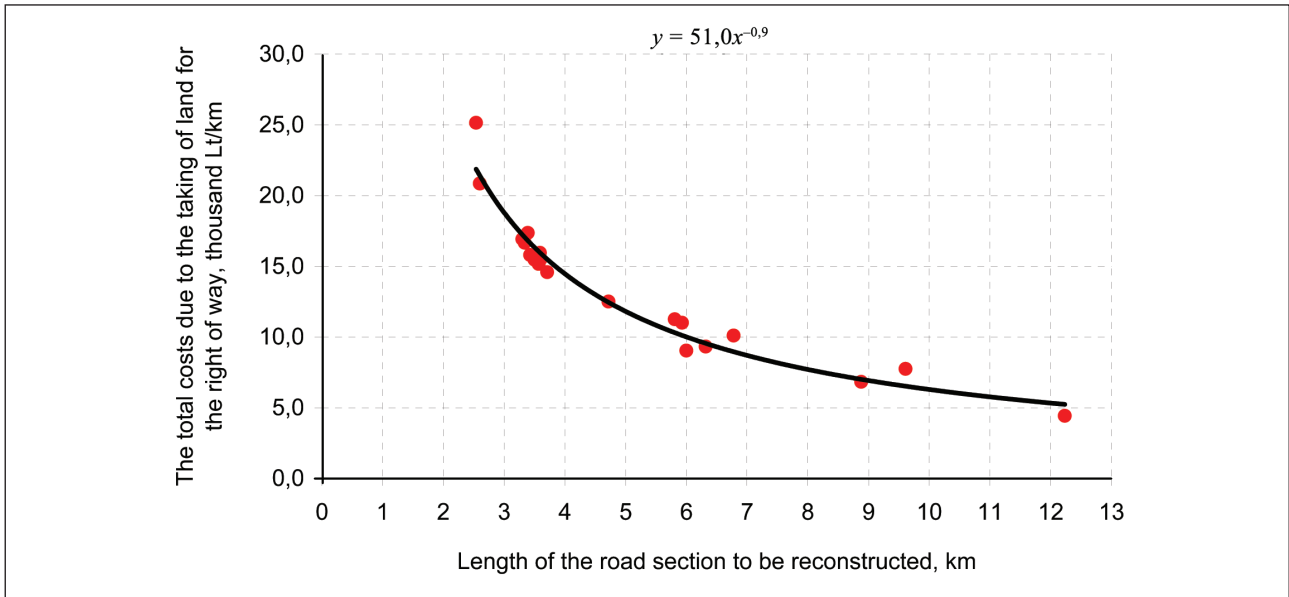


Fig 4. Relationship between the total costs due to the taking of land for the right-of-way per 1 km of the gravel road to be reconstructed and the length of the road section to be reconstructed

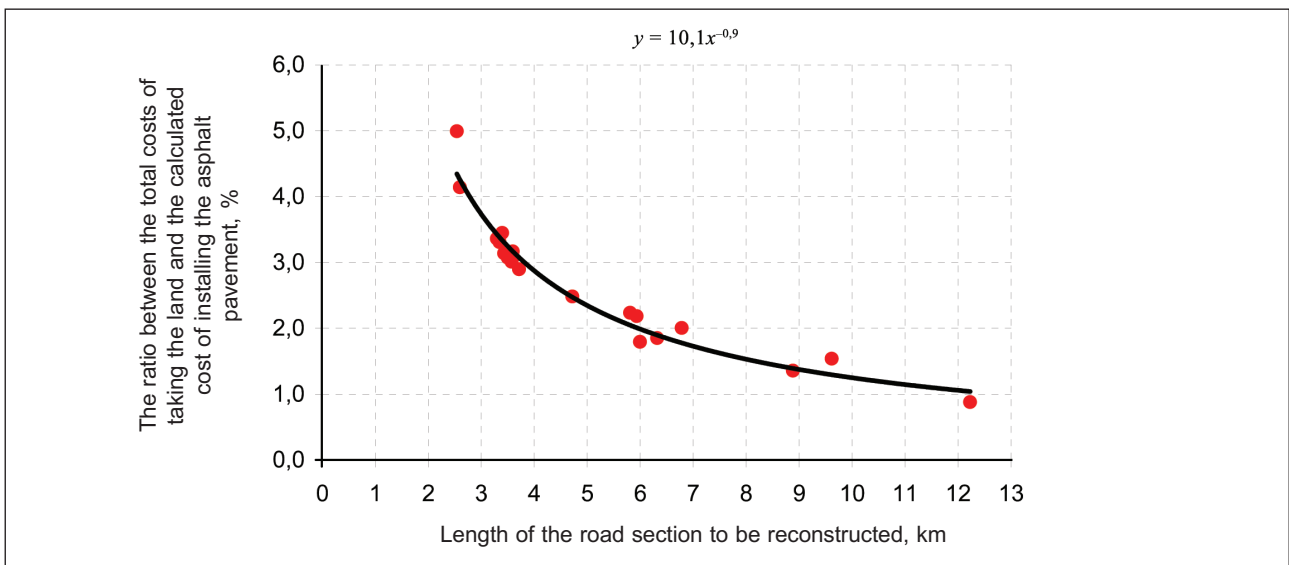


Fig 5. Relationship between the ratio of the total costs of taking the land for the right-of-way and the calculated cost of installing the asphalt concrete pavement and the length of the road section to be reconstructed

It could be summarised that when taking land for the right-of-way the additional costs are not large, especially if the gravel roads are reconstructed in longer sections.

9. Conclusions and recommendations

1. The land areas taken for the right-of-way due to the correction of the road plan are directly proportional to the volume of correction of the road plan (of the length of sections where the planned axis deviates in respect to the existing axis).

2. The total costs of implementing the procedure of

taking the land for the right-of-way are directly proportional to the number of land plots, the limits of which shall be corrected due to the deviation of the road axis (right-of-way).

3. The total costs of implementing the procedure of taking the land for the right-of-way make only a small part of the calculated cost for installing the asphalt concrete pavement (excluding the expenditures for the restoration of the damaged drainage systems, reconstruction of electric lines, cable communication lines and other works). Until the year 2005 these costs when reconstructing the gravel roads of

category V under the supervision of the SE Telšių regiono keliai came to only about 2,7 % of the calculated cost for installing the asphalt concrete pavement.

4. Compensations to the owners (natural or legal entities) for the land taken from them make a very insignificant part of costs related to the implementation of the procedure for taking the land for the right-of-way. The research showed that until the year 2005 compensations to the land owners when reconstructing the gravel road sections under the supervision of the SE Telšių regiono keliai came to only about 2,2 % of the total costs of taking the land.

5. The total costs due to the taking of land for the right-of-way make only a small percent age of the cost of installing asphalt concrete pavement and this percent age noticeably decreases with the increase in the length of the section to be reconstructed.

6. The results of the research allows us to affirm that the common practice of trying to use the least possible deviation from the existing axis, when designing the road plan for the sections to be reconstructed, motivating by high additional costs related to the procedures of taking the land for the planned right-of-way, is not sufficiently reasonable.

7. Based on the above conclusions, it is recommended for the objects of the Programme to design the road plan in accordance with the requirements of the design specifications and, if necessary, to implement the procedure of taking the land for the right-of-way. The insignificant additional costs of taking the land should be compensated by the savings in vehicle operating costs (VOC) and in travel time – to finally substantiate this proposition an additional investigation is necessary.

8. It is also recommended to reconstruct the gravel roads in the longest possible sections. If the road is to be reconstructed in stages, it is recommended to decrease the number of stages.

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