



ROADPAC'14

PROGRAM RP71

Earthworks volumes and mass-haul diagram

User Guide

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1. **Introduction**

Program EARTHWORKS VOLUMES and mass-haul diagram writing is part of RoadPAC program system. It is designed for end-to-end processing of a road design as one of the last-programs of the system for determination cut and embankment volumes and other items areas. The program can be used after SPR file (Corridor Cross sections) is created by program RP51 only.

1.1 **Program features**

1) **Calculation of earthworks areas and volumes**

SPR file (CORRIDOR CROSS SECTIONS) contains all necessary data of embankment and cut parts of cross sections for further processing by program RP71. Volumes of cut and fill are calculated between adjacent corridor cross sections. Cut volumes can be classified by soil classification. Besides that the program computes volume of transverse cut to fill haul, volume of active zone and improving subbase and also ordinates of mass-haul diagram in the course of road.

2) **Calculation of topsoil stripping/spread out and finishing of slopes.**

Program also calculate volumes of topsoil stripping, topsoil spreading, areas of embankment slopes finishing, cut slopes finishing, removing of unsuitable materials, formation finishing, volumes of unsuitable soil to fill, areas of consolidated subgrade under embankment, improving of subbase layers and total area of road bed. Beside that are calculated areas of land acquisition in range of construction limits.

3) **Addition of cut-fills, totals and changes of cut-fill totals**

The program allows add cut, fill volumes, finishing areas etc. totals into task calculation either at start chainage or in any chainage of task range. Additional items could be processed by different process. The program also allows omission of cut-fill calculations in specified segments. Besides that it is possible to specify subtotals and changes cut-fill totals in summaries (e.g. due to consequent engineering structure) in selected cross section.

1.2 **Processed Files**

Input files:

- .V71 - input data
- .SPR - corridor cross sections file

Output files:

- .L71 - listing
- .L71a - listing – topsoil spreading volumes and areas and next
- .L71b - full protocol (listing for EXCEL)
- .SHM - mass-haul file (linkage with program RP76 – drawing of mass-haul chart)

2. Input data

Input data are collected by direct entering in tables or by clicking on individual controls which are situated on form tabs displayed on computer screen. Forms handling is described in detail in chapter "Introduction".

Input data of program EARTHWORKS VOLUMES is prepared in three blocks. Depending on calculation type, some tables may be omitted.

2.1 Control data Block

Is displayed after selection of button "INPUT DATA" in previous menu in a following manner:

RP	Range from (km)	to (km)
▶	0.000000	4.695650

Meaning of individual items is as follows:

Date of input data entry

Project title and road title arbitrary text that is displayed in headings of protocols and listings.

Name of Input file (Corridor Cross section file .SPR)

Names are not required. If the name is not specified, the program will use standard name 'active road' from main menu. In case that the name is defined in proper textbox, then this name has preference to the standard name of "Active Road".

Name of Input file (geometry points of horizontal alignment .SHB)

It may not be specified. In this case no name of file is specified, program takes over active name of input file from main menu. File is used in case of computation mode with respect to curvature of alignment is under consideration only.

Notice: Below are files marked 'align' and 'extension', whereas as 'align' specified name on program form or 'align' specified in main menu is meaning.

Computation with influence of alignment curvature...

Check in checking box „**Make calculation more precise**“. If this option is checked, option is validate for all items and all output values. Distances of items are during calculation considered in its center of gravity.

2.2 Block of parameters

This block consists of two tables, which are situated on two tabs directly on a form sheet. (See next picture.) In table RANGE OF TASK there is a request for specification of calculation range. In table SELECTION OF OBJECTS can be specified location of engineering structures or other anomalies. In table “Totals with potential addition and subtraction” can be specified requests for subtotals and changes of cut-fill summary.

Active road is 101

RP	Range from (km)	to (km)
	0.000000	4.695650

Objects and sub-totals Initial values of totals

Bridges (objects) with code			Totals with potential additions and subtractions						
RP	From (km)	to (km)	Summation reset ?	Chainage(km)	Cut (m3)	Fill (m3)	Topsoil stripping (m3)	Topsoil spreading (m3)	Unsuitable soil (m3)

Explanatory notes:

In the table “**Range of task**” must be specified range of task by road chainage of beginning and end in kilometers. Existence of the chainage in SPR file is required. (The program cannot create cross section in given chainage by interpolation of two adjacent cross sections). Such data will ensure calculation only in certain section of a road.

Table **Bridges (objects) with code** is used to specify position of engineering structures along a road. In such segment range, cut-fills calculation will be ignored. In case of larger engineering structures, which limiting the haul of soil (e.g. river), can be specified request for summary reset. One row can hold just one engineering (bridge) structure. Maximum of submitted engineering structures is 20.

Chainage of beginning and end in kilometers in this table; they define a segment, where an omission of cu-fill calculation is requested. In this case the program will perform interpolation of data based on two adjacent cross sections both for data concerning soil and data concerning topsoil.

Code for summary reset: [0/1]

- 0 resetting of summaries is not required
- 1 resetting of summaries is required. In this case, all summaries in chainage will be sets to zero in the end of engineering structure.

It is possible to request listing of summaries (subtotals) in table “**Totals with potential addition and subtraction**” in proper cross section, which is included in SPR file and possibly perform changes of totals in below stated items. This can be used for adjustment of earthworks and topsoil balance with effect of engineering structures constructed in relation with currently calculated road. One row can hold just one requirement. Maximum of submitted rows is 20.

Meaning of individual items is as follows:

Chainage Where listing of cut-fills with possible cut-fill changes of summaries is required. Changes of subtotals are specified by following figures:

Cut volume of cut in m3

Fill volume of fill in m3. It is necessary to specify always a negative value.

Topsoil stripping volume of topsoil stripping in m3.

Topsoil spreading volume of topsoil spreading in m3. It is a sum of topsoil for arrangement of slopes and a central reserve

Unsuitable soil volume of unsuitable soil in m3

2.3 Block of initial volumes and totals

On the tab “**Initial volumes of totals**” of a form you can specify individual values that enable set values in summaries at the task segment beginning. Values are not specified if all summaries start with zero. Summaries consist of following items:

Cut (m3)	<input type="text" value="0.0"/>	Fill (m3)	<input type="text" value="0.0"/>	Mass haul diag. ordinate (m3)	<input type="text" value="0.0"/>	Subbase improvement layer	<input type="text" value="0.0"/>	(m3)	
Categ.2 soil (m3)	<input type="text" value="0.0"/>	Categ.3 soil (m3)	<input type="text" value="0.0"/>	Categ.3 soil (m3)	<input type="text" value="0.0"/>	Categ.5 soil (m3)	<input type="text" value="0.0"/>	6 and 7 soil categ. <input type="text" value="0.0"/>	(m3)
Stripping of topsoil total (m3)	<input type="text" value="0.0"/>								
Fill slope finishing (m2)	<input type="text" value="0.0"/>	Topsoil spreading on slopes (m2)	<input type="text" value="0.0"/>	Formation arrangement (m2)	<input type="text" value="0.0"/>				
Topsoil spreading on planes (m3)	<input type="text" value="0.0"/>	Unsuitable soil (m3)	<input type="text" value="0.0"/>	Topsoil stripping(m3)	<input type="text" value="0.0"/>				
Subsoil compaction (m2)	<input type="text" value="0.0"/>	Cut slope finishing (m2)	<input type="text" value="0.0"/>	Claimed area (ha)	<input type="text" value="0.0"/>				

Earthworks volumes at beginning of road:

Cut is volume of cut in v m3

Fill is volume of embankment in m3 and is always specified as a negative value

Ordinate of Mass-haul diagram is a figure about mass-haul diagram in m3 (positive - overage, negative - deficiency)

Subbase improvement layer volume

Next items at beginning of road:

Categ2. cut volume in 2nd class of soil classification in m3

Categ3. cut volume in 3rd class of soil classification in m3

Categ4. cut volume in 4th class of soil classification in m3

Categ5. cut volume in 5th class of soil classification in m3

Categ67. cut volume in 6th and 7th class of soil classification in m3

Topsoil stripping	volume of stripped topsoil in m3
Total volume of Topsoil	total volume of topsoil in m3
Topsoil spreading on slopes	area of topsoil spreading in m2
Topsoil in central reserve	area of central reserve and unpaved shoulder topsoil spreading in m2
Embankment slope	area of finishing of embankment slope in m2
Sloping of a cut	area of a cut of slope finishing in m2
Modification of formation	area of modified formation in m2
Unsuitable soil	volume of unsuitable soil in m3
Subsoil compaction	of consolidated subgrade under embankment in m2
Area of land acquisition	area of a land occupied by road bed in ha
Thickness of active zone	in meters; is specified uniformly for entire road. If zero, active zone is not considered.

Computation with influence of alignment curvature

While proper option is checked program reads active horizontal alignment and volumes are then enumerated with respect to curvature of alignment: in range of all arcs are distances within items enumerated at average gravity centers of each item. If gravity center lay near center of current arc the distances will be shorter and vice-versa. Mostly is those distortion insignificant, but where are used small radiuses (junction branches) and where often left half of pavement is missing or is limited (side limits) are differences significant, indeed.

3. DESCRIPTION OF OUTPUT LISTINGS

The output listing is generated in the course of the computation in the 'road' .L71 file. Program create 3 separated protocols now, marked as „align.L71", "align.L71a" and "align.L71b".

First two files are displayed and printed by program WORDPAD. Third file is modified as easy input to EXCEL.

Its printing can be controlled from the main menu:

The Listing comprises the following information:

- 1) Protocol about used 'road' .SPR file
- 2) **Earthworks area and volumes** includes data about areas of soils in cross sections (odd rows) and about earth volumes between adjacent cross sections (even rows).

Odd row items	Even row items
chainage in km	distance between adjacent cross sections in km

Cut area in m ²	cut volume in m ³
Fill area in m ²	fill volume in m ³
Area of active zone in m ²	volume of active zone in m ³
	transverse cut-fill haul in m ³
mass-haul diagram in m ³ ordinate	
	active zone in m ³
cut areas by soil classification class in m ²	cut volumes by soil classification class in m ³

The above mentioned fill volumes are active zone inclusive.

- 3) **Topsoil and slope arrangement** includes data about areas of topsoil in cross sections (odd lines) and about topsoil volumes between adjacent cross sections (even lines).

Odd row items	Even row items
chainage in km	distance between adjacent cross sections in m
topsoil stripping on slope in m	topsoil stripping on slope in m ³
topsoil spreading on slope in m	topsoil spreading on slope in m ²
topsoil spreading in central reserve and shoulder in m	topsoil spreading in central reserve and shoulder in m ²
finishing of embankment slope in m	finishing of embankment in m ²
finishing of cut slope in m	finishing of cut in m ²
finishing of embankment slope in m	finishing of embankment slope in m ²
unsuitable soil in m ²	unsuitable soil in m ³
consolidation of subgrade under embankment in m	consolidation of subgrade under embankment in m ²
width of roadway on the left in m	land acquisition of land in ha
width of roadway on the right in m	

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4. **Mass-haul diagram file .SHM**

File transmits information from program SI71 to program SI76 (drawing and processing of mass-haul diagram).

In this file are stored all cross sections processed by program SI71 and possible objects (Gaps in mass-haul diagram.) and possible subtotals and amongst. It is a ASCII file generated in free format. It is making up by rows with following meaning:

- Chainage (km)
- Cut item (m², +)
- Fill item (m², -)
- Mass-haul ordinate (m3)
- Cut item for category (class) 1 and 2 (m², +)
- Cut item for category (class) 3 (m², positive)
- Cut item for category (class) 4(m², positive)
- Cut item for category (class) 5 (m², positive)
- Cut item for category (class) 6 and more than (m², +)

5. **Warning messages**

The program differentiates between fatal errors, which usually cause program termination with unusable results and formal errors that are handled by alternate solution. Fatal errors are marked by *** in reports and formal errors are marked by **. The following table contains list of warning messages and comments to alternate solution:

Error message text	Alternate solution
*** Leading line is missing * 71	
*** Inaccessible type of leading line: aaa	
** First line ignored	
*** Between leading data read no marked line *	
*** Premature end of data	
** End line 999 is missing	
*** Line 711 is missing	
** Inaccessible type of line nnn ignored	
** Number of chainage, where subtotal is entered, is greater than 20, other ignored	
*** The line read with error (description of line)	
** Incorrect layers depths	
** Incomplete terrain on the left in chainage km: nn.nnnnnn	

** Incomplete terrain on the right in chainage km: nn.nnnnnn	
*** Program error - PI of filleting not found	