PRAGOPROJEKT

ROADPAC´14

PROGRAM RP43

Cross section arrangement, Widening, Superelevation

User Guide

Release 25.02.2014

Obsah

1.   Introduction

Program cross section arrangement is a part of program ROADPAC. It can be used for complex processing of road as one from first programs for design of the cross arrangement of the roadway. The program allows solve cross section arrangement and grading details of single carriageways and dual carriageways highways as well. Utilisation of program for urban roads with drainage and sidewalks is also possible.

1.1   Program functions and principles used at their solving

1)   Calculation of coordinates of the points on the paved surface and formation surface for both single and dual carriageways roads. Coordinates in cross

direction are related to the centreline of a road. Then the elevations are in relative height system, where elevation ±0.00 is supposed in the reference point. Reference point is an IP of the road centerline with cross section plane. In case of single carriageways this point is always paced in the centreline of the road. In case of dual carriageways it is placed on inner edges of roadway resp. on outer edges of central reserve without or with widening according to specified parameters. See parameters described on tab "Widening".

In paved part of roadway the grading details and superelevation is computed in three points on the left and on the right side from the centreline. On roadway there are more points that will be mainly applicable during drawing of the layout and cross sections. Next points can be deduced from these three computed points.

In this manual there is used standard numbering for following points:
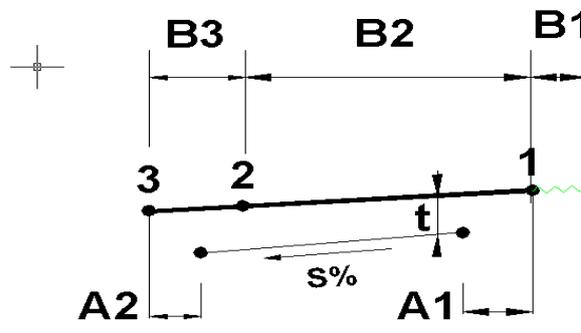
Reference Point No.1. This point either lays on centreline of the road (single carriageway) or on outer edges of central reserve. If the additional lane is inserted to middle of a single carriageway (e.g. for left turning) than the point No. 1 will be moved on common edge of this lane and the carriageway. Positions of marking up stripes are not computed.

Point No.2 This point lays on common edge of the carriageway and hardshoulder (hardstrip) respectively on edge of outer marking up stripe.

Point No.3 It is outer edge of the hardshoulder (Hardstrip)

Different explanation of these points can be given by user. Unified   crossfall (basic crossfall) is kept within points 1 and 3. In case of single carriageway road is this crossfall extended towards centreline of roadway.

On formation there are computed two points on the left and two points on the right from centreline only. Their position is related to points 1, 2 or 3 and their possible deflecting is respected. In case of single carriageway road both points No.1 are situated on the centreline, they are identical. Unified (basic) crossfall of formation is kept within points 1 and 2.

2)   Referring to road chainage there is possible to change width of cross section arrangement so the widths within points 1, 2 and 3 are changing by several methods. Generally it is called widening by jump, along line (linear taper), taper along S-shaped curves with its modifications. Methods are described in chapter widening.

3)   Dual carriageway roads can be superelevated along inner edges of road, along middle of carriageways, along outer edges of carriageways, along edges of central reserve or any reference points, generally defined by the offset distance from the centreline. Single carriageway roads can be super elevated along centreline, inner edge of roadway in curve or any generally defined reference point.

4)   Formation is superelevated in accordance with superelevation of roadway surface so a minimum gradient of formation and minimum thickness of pavement structure in cross section are kept.

Superelevation of current cross section formation is constructed automatically, following the crossfall of roadway surface.

However in program are implemented superelevation run-offs on formation in places where paved surface rotates side to side. (Crossfall of paved surface come down from positive to negative and vice-versa.) This formation run-off is processed automatically, no input is required. In this case will not be kept the terms of minimal crossfall of formation, rotation of formation will be processed in segment 2 x 10m around the theoretic point where is zero value of crossfall. At cross sections located 10m backwards and 10m forwards from this point will basic formation crossfall constructed eventually current pavement crossfall if its value is greater than basic crossfall of formation. (Such case is usually in conflict with standards.) Within those boundaries cross sections crossfall of formation changes linearly.

Example – table from protocol:

```
Overview of formation run-off (vertigo)
In those segments will not be kept minimal crossfall on formation    length 20 m
   side      chainage   crossfall%    chainage crossfall%    zero crossfall
    1         .875631    -3.50%        .895631    3.50%         .885631
    1        3.154498     3.50%       3.174498   -3.50%        3.164498
    1        4.354961    -3.50%       4.374961    3.50%        4.364961
    2         .875631     3.50%        .895631   -3.50%         .885631
    2        3.154498    -3.50%       3.174498    3.50%        3.164498
    2        4.354961     3.50%       4.374961   -3.50%        4.364961
```

5)   Each cross section on the right and on the left from centreline can be trimmed in assigned offset distance. Program disposes with so-called side limits for this purpose. Data of side limits can be defined in input data or by SIDE LIMITS file (type .SOM) or by both methods together.

6)   Each cross section on the left and on the right from centreline can be extended with 10 other points on roadway surface and by 10 other points on formation. This extension is so-called special shapes. Added special shapes points are part of roadway surface or formation surface.

7)   Superelevation is computed in cross sections stored in the list of chainage. The list can be defined either by input data or by file CHAINAGE (type .SSS) or by both methods together.

8) Results of calculation are saved in "Cross section arrangement file" (type .SKR). This file is later used for construction of corridor cross sections.

9) Protocol of calculation and results are recorded into the text output file ´road´ .L43 simultaneously.

10) In case of single carriageway roads can the width of central reserve assigned from zero to positive value. So created widening of carriageway can be used for placing of left turning lane. The vertical alignment is always in the centreline of the road considered. The carriageway and the formation too, are around the centreline continual. As superelevation method in horizontal curves segments the method 8 or 9 must be used. The formation is extended towards the centreline of road. Value A1 referring to further text has no sense.

11) In case of dual carriageway roads can be width of central reserve congestion assigned also behind centreline of road to the opposite traffic direction, but only if there is enough space for this purpose. When is in the same time widened carriageway, the turning lane to the left overlapping to opposite traffic direction. Messages about mistakes have got different meaning in context with this modification. There is tested that neither carriageway nor formation overlaps horizontally (with tolerance 1 cm).

12) The theoretical vertical alignment reference point in case of dual carriageway roads is placed in two variants with reference to assigned code of central reserve widening:

a) At offset distance B1 from centreline, where B1 is parameter assigned in tab Basic width. There is not any influence performed by congestion or by widening of central reserve.

b) Follows inner edge of carriageway including its shape

13) Allows specification of superelevation with downgrade to the lowest point in centreline of road (so - called "V-shape")

14) Main points of horizontal alignment can be taken from .SHB file to define next cross sections where superelevation is constructed.

15) Ability to specify various superelevation run-offs method, in case of dual carriageway roads, for right and left carriageway. (Different gradients of crossfall, different positions of begin and end of superelevation run-offs.) It means one half of roadway can be solved separately.

1.2 Processed files

Input files:

    .V43   - input data

    .SSS   - chainage file

    .SOM - side limits file

    .SHB   - horizontal alignment file

Output files:

    .L43   - output listing

    .SSS   - chainage file

.SKR   - Grading Details archive file

2.   Input data

The input data are processed by filling and editing of tables or to click on controls placed on forms appearing on the computer display. Display operation is described in special user guide. See chapter "Introduction". Forms usually incorporate common control part, graphical part if it is useful and input data part. A Picture box, if is placed on form, serve to display immediate results. Input data of program cross section arrangement of road are prepared in 3 blocks. Each block includes one or more tables. Some of them can be omitted (according to a type of task). Tables are placed on several tabs. Program offers immediate graphic verification of current processing. At ones are displayed grading details in plan, with run-offs position in schematics and cross sections arrangement and superelevation details.
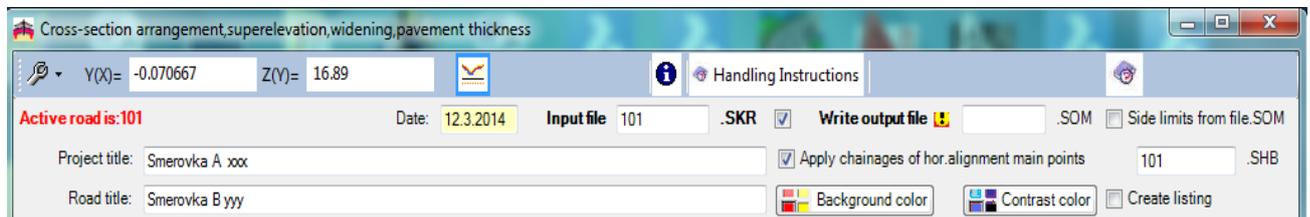
 Practice with program is next:

Specification of parameters ► calculation ► visual checking.

Alternative specification of parameters ► calculation ► visual checking.

2.1   Control data block

Is shown after pushdown button <INPUT DATA> in main menu on proper form as follows:

 Meaning of individual items is following:

Date   is date of input data assignment

Project Title and Road Title

        Those texts will be printed in the header of output files and listings.

Input/output files are not necessary to be specified. If the input files are prepared according the requirements stated bellow and name of file is not given, the program takes default name of file according set 'active road' name from main menu. If other names is specified in these textboxes then this names is preferred to 'active road' name.

Notice: In following text are files names stated as 'road' . 'type' or 'type' only. Nevertheless 'road' name it goes without saying either name specified in table or active 'road' name specified in main menu.

Save Output data to file (grading details)**:   [□/✓]**

        □   Means not to save results into cross section arrangement file (type .SKR)

    ✓   Means save results into cross section arrangement file (type .SKR). If the file already exists, it will be replaced by newly computed file. The file is named 'road' .SKR.

Create listing: ☐/✓

    ☐   Means that listing will be not create

    ✓   Listing will be created. (.L43)

Read SOM data from file: ☐/✓

    ☐   Means that Side limits file will be not used

    ✓   Means that Side limits information will be read from the Side limits file (type .SOM).

Main geometry points: [☐/✓]

    ✓ Means that list of all chainages stored in file (SKR) will be supplemented with chainages of all main alignment geometry points.

2.2   Block parameters of roadway

Block includes tables placed on ten tabs. Tabs are consequently shown on display.

Those are: **Basic Width**, **Widening_1, Widening_2, Superelevation methods, Superelevation placing**, **Side limits, Side limits by polyline, Special Shapes, Chainage and Special chainage and tapers**.

On each tab is placed the tables with limited number of rows. These limits were during development process many times changed. Present days (2014) are valid following limits:
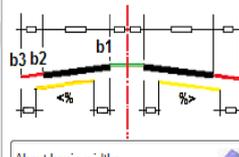
Tab	**Basic Width**	limited by 50 rows for both sides
Tab	**Widening_1**	limited by 2000 rows for both sides
Tab	**Widening_2**	limited by 2000 rows for both sides
Tab	**Superelevation method**	limited by 50 rows for both sides
Tab	**Superelevation placing**	limited by rows for both sides
Tab	**Side Limits**	limited by 200 by rows for both sides
Tab	**Side Limits by polyline**	limited by 2000 by rows for both sides
Tab	**Special Shapes**	limited by 400 by rows for both sides
Tab	**Chainage**	standard value for whole system RoadPAC 8000

2.2.1 Basic Width

On tab **Basic Width** is placed table specified for assign of basic width arrangement of roadway cross section in straight segments. On one row there are 11 values available for specification of either symmetrical arrangement (If validity of parameters on the right and on the left side is the same, the L/ /R parameter is blank.) or asymmetrical arrangement. In case of asymmetrical arrangement, must be two rows filled. On the first is defined row arrangement on the left from centreline (parameter L) and on next row arrangement on the right from centreline (parameter R). Cross section arrangement

parameters are valid from specified chainage "Valid from (km)" until chainage specified on the next possible row. The order of chainage values entered in table rows need not to be ascending, it will be sorted by program automatically. The minimal requirement is to assign one row. (Two rows in case of asymmetrical arrangement.)

Meaning of individual items is following:

Side code: [L/ /R]

Space (blank) means validity of parameters for both sides

    L   validity of parameters for the left side

    R   validity of parameters for the right side of the roadway

Validity from

    It is the chainage (km). Specified parameters are valid from.

Central Reserve (B1)

    Is offset distance in meters of outer edge of central reserve from centreline (For single carriageway roads value equal zero). In this position is the reference point No.1 of cross section arrangement defined.

Pavement Width (B2)

    Is distance in meters between points No.1 and No.2

Hard Shoulder Width (B3)

    Is distance in meters between points No.2 and No.3

Formation Offset (A1) defines the position of inner edge of formation (by distance from point No.1 of roadway related to centreline. If the value is negative the inner edge of formation will be moved towards to centreline of road. Data are given in meters. Parameter can be used only for dual carriageway roads.

Formation Offset (A2) defines outer edge of formation, depending on **code A2** see picture No.1. When code A2 = 0 the distance A2 is measured from point **3** of roadway towards centreline. When code A2 = 1 the distance of A2 is measured from point **2** of roadway towards centreline. Value A2 can be negative when method 1 (CodeA2=1) is used, outer edge of formation should not overlay point No.3 of roadway. Value A2 is set in metres.

Formation gradient (S) is assigned in % by positive value. In straight sections along alignment it is so called "roof-shaped" gradient, in curves it is used as minimal value.

Pavement Thickness (T)

    Is the minimum pavement thickness in metres. It is thickness which depends on **Pavement Thickness Code**. If code = 0, thickness is kept within full range of formation. If code = 1 thickness is kept only under carriageway (in range

between points 1 and 2 on surface and on formation too). The value need not to be kept under the hard shoulder.

Meanings of individual data are shown on picture č.1.

Picture no 1:
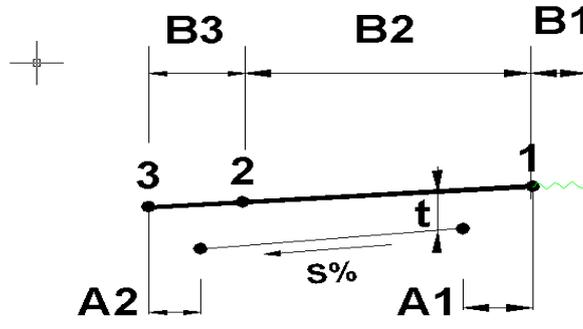
2.2.2 Widening_1

On tab **Widening_1** there is placed a table specified for assigning of data for widening one of three basic lanes of road. (The central reserve lane, the carriageway lane and the hard shoulder lane) It is assigned on one row by nine values describing one section of widening. There can be also assigned widening on two rows connected to each other, including tapers between them.
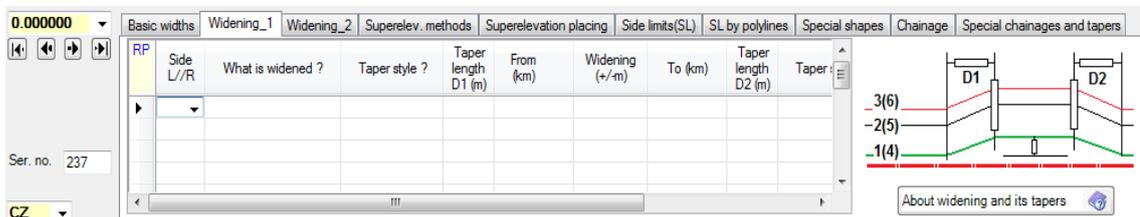
Meaning of individual items is following:

Side code: [L/ /R]

Space (blank) means that widening will be used on the left and both on the right side of the roadway.

L   validity of parameters for the left side

R   validity of parameters for the right side of the roadway

What is widened? [1/2/3/4/5/6]

1   indicates that width of central reserve will be changed (moving of point No.1 and also of point No 2 and 3 in accordance with specified parameters). While using this code the theoretic vertical alignment reference point stays in previous distance from centreline, see picture No. 1, value B1)

2   indicates that width of carriageway will be changed (moving of points No 2 and 3)

3   indicates that width of hard shoulder will be changed (moving of point No 3)

4   Indicates that width of central reserve will be changed (moving of point No1 and also of point No 2 and 3 in accordance to it). <u>While using this code the theoretic vertical alignment reference point is moved on accordance with widening.</u>

5   meaning is same as at code No 2 but it is next opportunity how the width of carriageway can be independently on method No.2 changed. Widening according to code 2 and 5 are independent on each other.

6   Meaning that, the hardshoulder will be widened in specified segment. If in this segment also a (+/- %) crossfall value is specified (last column of table) a breakpoint on pavement will be constructed. Outward part of cross-section will have different crossfall according assigned value in last column of table in this case. (If is this column blank so the basic crossfall or default value will be extended towards unpaved shoulder.) The same crossfall will have unpaved shoulder. This solution is so calling „widening for bus-stop". Program does not compare specified value with specified gradient limit values. (Min max crossfall) of pavement, not even with crossfall of contiguous carriageway. So that on the edge of widening can be created a breakline. For example ridge or range, which should be drained.

Code 1 is used e.g. for creation of turning lane to the left (congestion of central reserve together with contemporary widening of road). Code 4 is used e.g. for offset of one half of road central reserve on bridge, in tunnel etc.

Code 2 is usually used for widening of interchange branches as additional lanes. Code 5 is usually used for standard widening of road in curves. (That option is used e.g. by program SI41, automatic generation of cross section arrangement input)

Widening by option=6 is possible to specified simultaneously with widening according option = 2 (additional lines) and with widening of option =5 (standard widening of pavement in arc). All this types of widening are on each other independent.   On edge of widening according option=6 is inserted special breakpoint into pavement and on formation surface so that widened part is superelevated according sign (+/-) of specified gradient value. If is in the same alignment segment specified widening according option 2, 5 a 6, widening 2 and 5 of pavement will be added with original crossfall , afterwards the new above mentioned breakpoint is inserted and the additional lane specified by option = 6 has different crossfall only.

Widening for bus-stop can be combine with unpaved shoulder reduction by method=5, similarly to case of widening for additional lanes. Combination of all three methods in the same alignment segment is not permitted. Reduction of unpaved shoulder by method 5 is not permitted in alignment segment, where two contiguous widening methods (2 or 6) are overlapped. Reduction of unpaved

shoulder by method =5 has no influence to widening by method =5 in arc segments.

Taper style: [1/2/3/4/5/6/7] (input part)

1   Indicates that taper of widening will be done by jump (length D is equal 0)

2   Indicates that widening will be shaped by linear taper

3   Indicates that taper of widening will be done by S-shape curve created of arcs and short tangent. See picture No 2.

4   Indicates that taper of widening will be done by S-shape curve that starts from zero basic width (Suitable e.g. for enlargement of shoulder as auxiliary lane). See picture No 3.

5   Can be used only for congestion of hard shoulder together with widening of carriageway into auxiliary lane. The carriageway must be widened using method 2, 3 or 6 in the same segment. The hard shoulder must be congested. Congestion starts from point where previous extended edge of hard shoulder intersects with specified widening. See picture No 4.

6   Indicates that taper of widening by S-shape curve consists of arcs and tangent of 1/3 of taper length. See picture No 5.

7   Indicates that that taper of widening is done by S-shape curve type 6 started from zero basic width (Same method as No 4, picture No 3)

Length of taper D1;
   Input length in meters

From (km) is the chainage in kilometres in which the full widening is reached

Widening (+/-) m

   Is value in metres which defines full wide. Congestion is understood as widening with negative value. In case of dual carriageway roads can be specified bigger congestion of central reserve than is its basic width and so a left turning lane is possible to create by this way. On opposite side must stay a lane with min. width. In case of single carriageway roads the specified value of widening must be positive but widening can be specified on both sides. Total width include widening must stay positive both for carriageway and hard shoulders in any case.

To (km)   it is chainage of end of full wide

Length of taper D2 in metres is length in which required widening returns to basic width
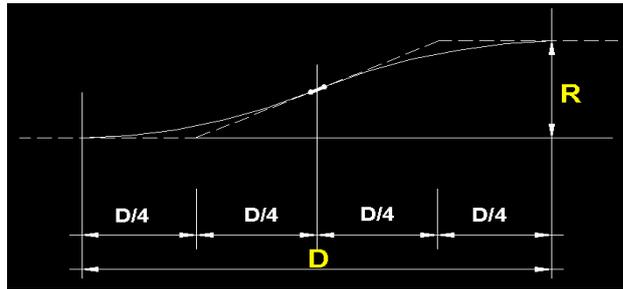
Taper style (exit part) [1/2/3/4/5/6/7] Meaning of individual codes are identical with input part.

Gradient (%) Meaning a gradient value, which come into effect if method 6 of widening is required only.

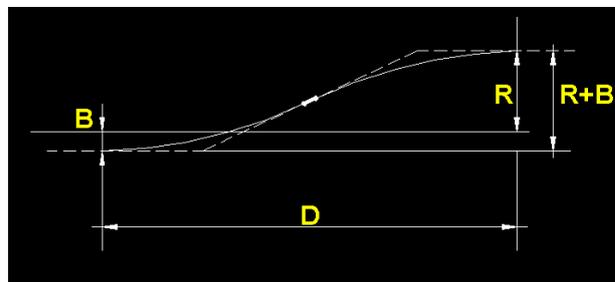**SI42 (read only)** Column used for writing of information texts of program SI42.

Picture No 2:

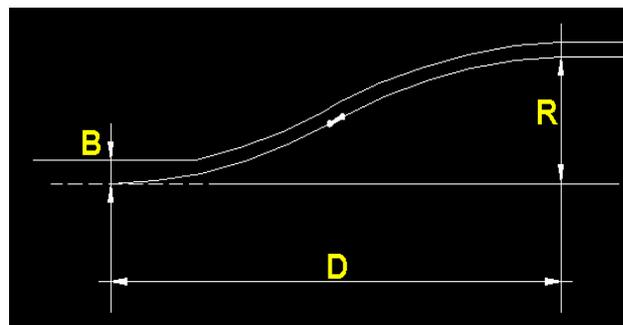Taper by S-shaped curve with short tangent (method 3)

Picture No 3:

Taper by S-shaped curve from zero width (method 4)
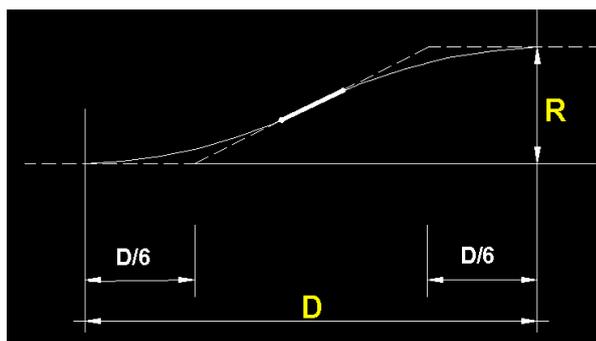

Picture No 4:

Widening of road together with contraction of shoulder (method 2,3,6 + 5):
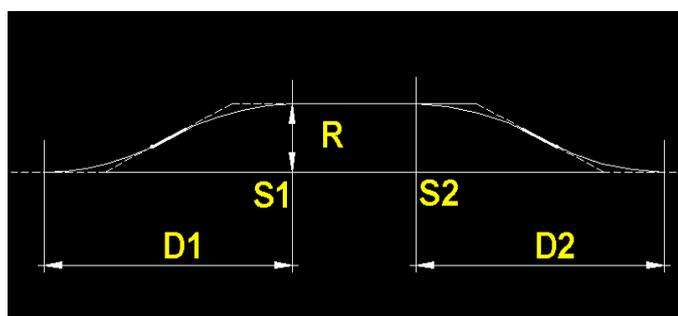

Picture No 5:

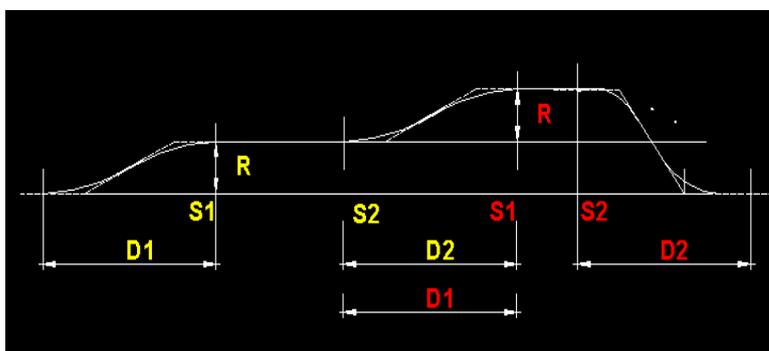Taper by S-shaped curve with 1/3 tangent (method 6):

Scheme of widening:

Picture No 6:

R......width of widening in metres

S1.....chainage of beginning of full width

S2.....chainage of end of full width

D1.....length of input taper

D2.....length of exit taper

Connecting taper can be also assigned (see picture No 7).

Picture No 7:

In that case is necessary to keep following conditions:

- Connection taper is put on two rows, on first line the first widening, on second row second one, following widening
- Length of input taper is same as length of exit taper
- Input and exit taper has same position specified by chainage
- Method of widening in common part is the same

2.2.3 Widening_2

On tab **Widening_2** there is placed a table specified for assigning data for widening of roadway lanes (carriageway or hardshoulder) according specified independent alignments. The independent alignments represent 2D/3D position of outer edge of carriageway respective outer edge of hard shoulder. It is assigned on one row by six values describing one section of widening.
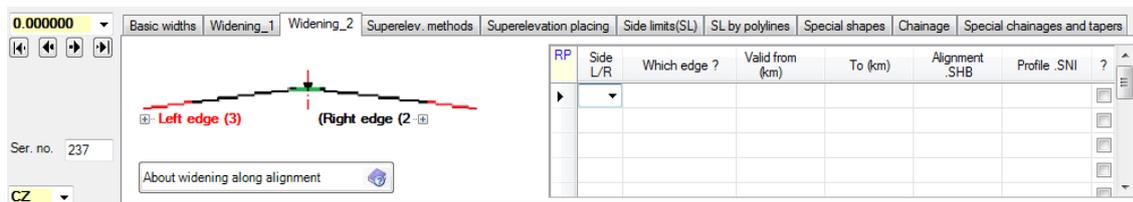
Meaning of individual items is following:

Side code: [L/R]

L   validity of parameters for the left side

R   validity of parameters for the right side of the roadway

Which edge

Carriageway outer edge or hard shoulder outer edge

Valid from (km)

Start chainage of widening segment

To (km)

End chainage of widening segment

Alignment (SHB)

Name of independent horizontal alignment SHB file (mandatory value)

Profile (SNI)

Name of independent vertical alignment SNI file (optional value)

Selected edge goes along specified alignment. Chainage of selected alignment must be ascending in the same direction as chainage of active main road alignment. If no vertical profile is specified widening is constructed in plan only (2D). As soon as is a vertical profile of selected independent alignment under consideration the widening edge will be constructed in space. (3D)

2.2.4 Superelevation method

On tab **Superelevation Methods** is placed a table specified for assigning segments with parameters defining method of superelevation run-offs and basic crossfall of roadway in straight alignment section. Definition of camber of individual curves will be performed in following table **Superelevation placing** placed on proper tab. Minimally one row must be specified. Method of camber is depended on road type. If camber is constructed for dual carriageway roads, methods 0 till 4 will be chosen. Methods 7 till 9 is valid for single carriageway road only.
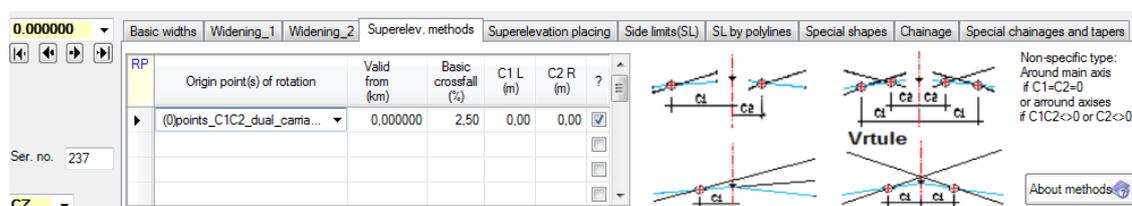
Meaning of individual items is following:

Reference points of rotation. Methods of camber: [0/1/2/3/4/7/8/9]

For each method of superelevation are available two basic options: run-off through "roof-shape" or "screw". Run-off to "screw" will be usually performed in case that adjoining run-offs touches each other and it refers to inverse turnings of adjacent horizontal alignment curves. In contact point will be zero crossfall. Camber to "roof-shape" will be done only if adjoining superelevation run-offs does not touch. Selected superelevation method schema is shown beside its description on the form.

Validity from is the chainage (km) from where are superelevation parameters assigned by this row valid.

Basic crossfall is a value in percentage that gives crossfall of roadway in straight part. It is valid from specified chainage on this row until the chainage specified on next row, or to the end of road.

C1, C2 are offset distances of reference points from centreline. Defined reference points are valid for methods 0 and 9. While edges of road respect given widening, position of reference points C1 and C2 is independent on widening.
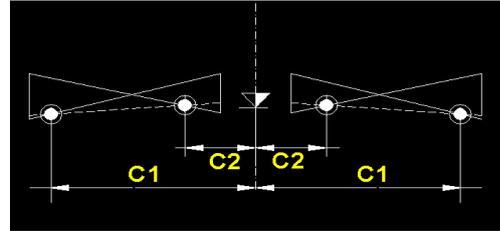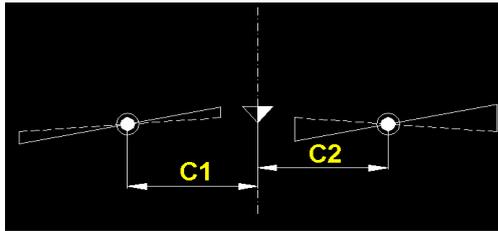
Camber for dual carriageway roads

  0 **Superelevation around reference points** whose position is defined by offset distances C1 and C2 from centre line (in metres).

    Picture No 8:

"Roof-shape" superelevation run-off   "Screw-shape" superelevation run-off
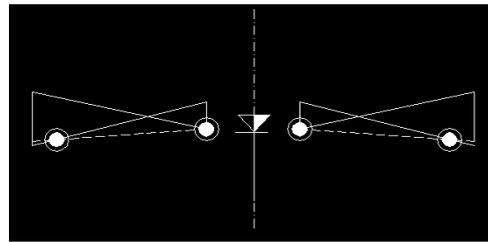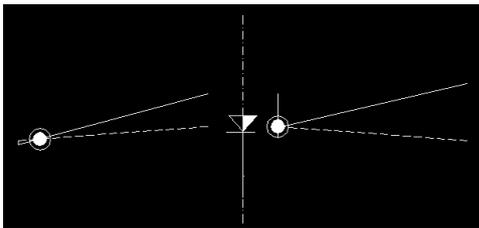
1   Superelevation around inner edges of road in curve

Picture No 9:
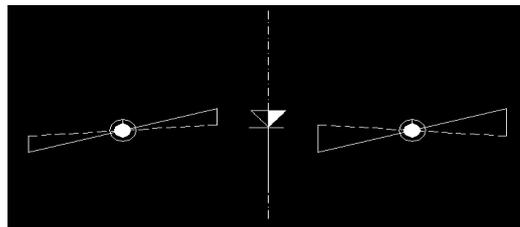
"Roof- shape" superelevation run-off   "Screw-shape" superelevation run-off

2   Superelevation around middle of carriageways.

Crossfall to screw shape and to roof shape downgrade
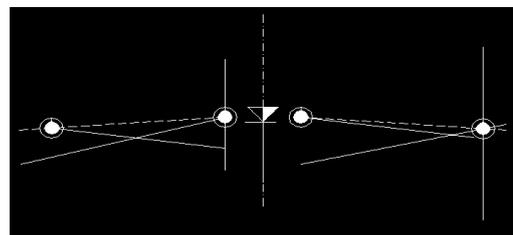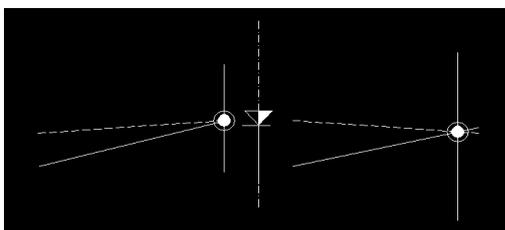
Picture No 10:

3   Superelevation around outer edges of carriageways in curve
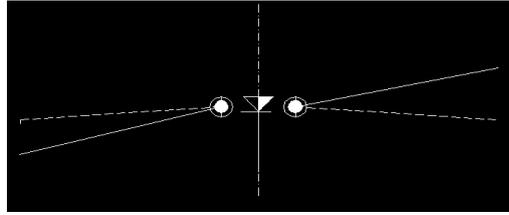
Picture No 11:

The roof shapes of crossfall   to screw

4   Superelevation around edge of central reserve (point No1 of roadway, is theoretical vertical alignment reference point). Position of the rotation point does not change and crossfall changes as screw.

Picture No 12:

(These methods can be exceptionally used for dual carriageway roads, e.g. on bridges where centre lane disappears).

Superelevation methods of single carriageway roads

**7   camber of road with gradient towards to middle of road ("V" shaped)**

Code 7 is used for a special modification of the cross section arrangement, especially is used for municipal roads. The lowest point of roadway is situated close to the centreline of the street. Both basic crossfall assigned in tables (on surface or on formation) should be specified by positive value in percentage. Close to the centreline can be placed also drains and road gullies. These drains cannot be coded in continuing program RP51 and that is why drains will be not drawn by program RP53.

In arcs can be specified the run-offs similarly as is visible on scheme No.13. At first is outer one-half of carriageway overturned to point where is reached basic crossfall in range of roadway paved part , and then are overturned whole paved part to full crossfall. Point which during overturning does not changing level (Reference Point C1 which is specified by offset distance) can be represented by centerline (C1=0) or it could be any point on inner one-half of paved part (C1 is always plus) or could be any point on outer one-half of paved part. (C1 is always minus in this case.)

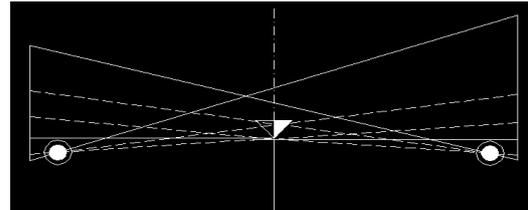**8   Superelevation run-off round inner edge of road in curve**

    Picture No 13:
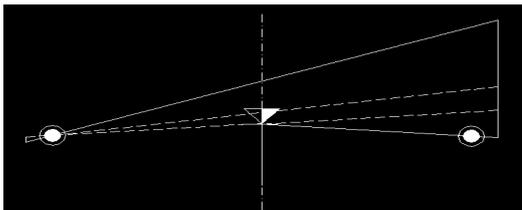
The roof-shape crossfall   to screw
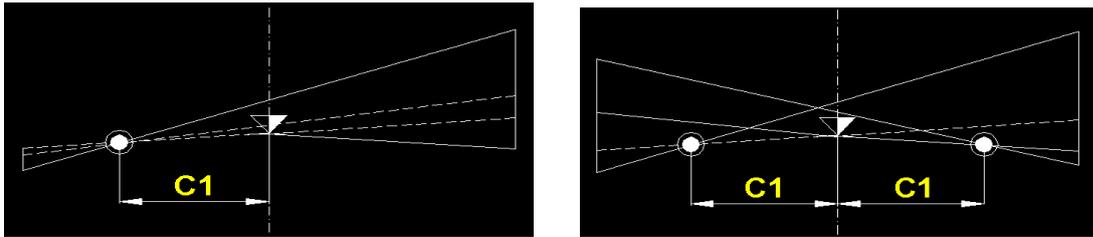

9   Superelevation run-off round point in distance C1 from centre line. If C1=0 camber along centre line is considered.

    Picture No 14:

The roof-shape crossfall   to screw

2.2.5 Superelevation placing

In table placed on tab SUPERELEVATION PLACING is specified for assign of superelevation of one curve on one row. Rarely is necessary to fill two rows for superelevation of one curve assign. (In case that for each one-half of dual carriageway road different method is valid.)

 For each curve must be specified 6 or 7 values with following meaning:

Orientation of curve: [1/2]

> 1   left turning curve
> 2   right turning curve

Carriageway Side: [L / R]

> Defines whether the method is valid for both sides or only for one-half of dual carriageway road. When different methods for left and right side are assigned on two following rows then at least a part of both curves (within given chainages) must have common segment and curve turning must be the same. If specified methods are assigned for left or right side only, without corresponding method for opposite side, the basic roof-shape crossfall will be kept on the opposite side.
>
> Curves with different rule for right and left side must not be connected with previous or next curve with "screw-shaped" superelevation run-off. The change of crossfall must be provided through the "roof-shaped" gradient. Different rules (L/R side) cannot be assigned for single carriageway road type (code of camber 7, 8 or 9).

Length of superelevation run-off in metres (V1)

Full superelevation begin chainage in kilometres (S1)

Crossfall Value. Specify crossfall in absolute value (%).

Full superelevation end chainage (S2)

Length of superelevation run-off in metres (V2)

Picture No 15:

Standard Scheme of individual curve
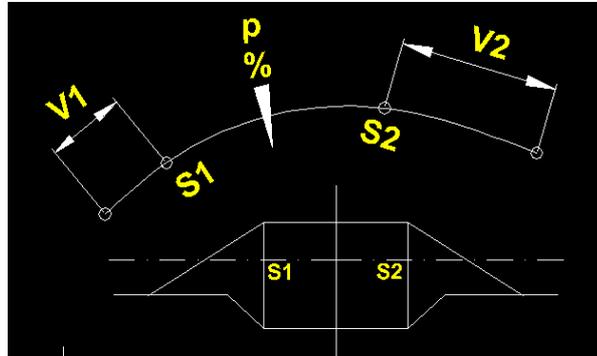
Picture No 16:

Scheme of S-shaped curve specification. Screw shape Run-off.
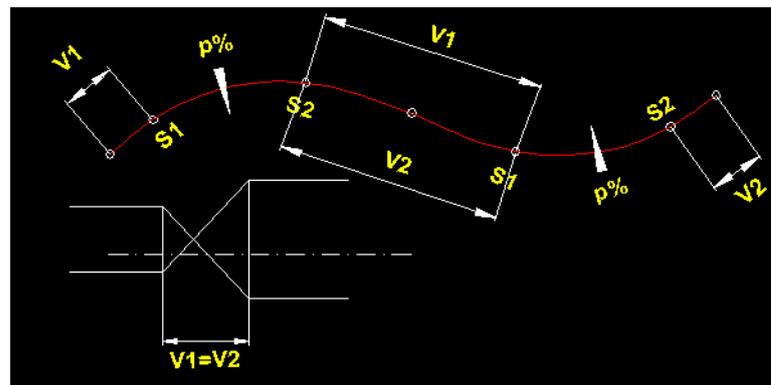
Picture No 17

Scheme of S-shaped curve specification Screw shape Run-off with given point of zero crossfall.
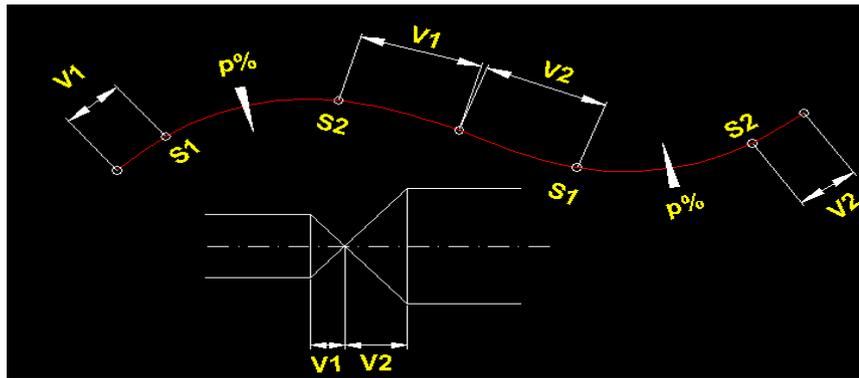
2.2.6 Side Limits

In table placed on tab **SIDE LIMITS** (SL) is specified for assign of cross section trimming in certain offset distance on the left and right side from the centreline. Side limits have no influence on calculation of superelevation and that is why e.g. the reference point of superelevation can be situated outside the side limits. Side limits can be specified in the table, read from side limits file (type .SOM) or by both options together.

In case that side limits in some cross section are defined by both options together, data specified in table are preferred. Data about side limits will be saved to cross section arrangement file (type .SKR) in both cases. Data are respected at construction of corridor cross sections, calculation of earthworks volumes even in case that side limits are situated out of roadway.

When some cross sections are placed in range of specified validity segment in which are defined side limits, side limits are add into each such cross section by linear interpolation.

Table placed on tab SIDE LIMITS (SL) enable to assign side limits borders for numerous of cross sections given in segment or for individual cross section. The assigned segments can follow each other but cannot layover. Inside of the segment an individual cross section can be assigned. In that case will be not used interpolated value from segment but the value of side limits for individual cross section is respected.

Side limits are defined by seven values:

Side code: [L/ /R]

>   Space indicates value of data on both sides
>   L   validity of parameters for the left side
>   R   validity of parameters for the right side of the road

Validity code: [1/2] Validity at single chainage or in section

> 1   assigned data are valid for one section only. Data for chainage S2 is not entered.
>
> 2   assigned data are valid within section from chainage S1 to chainage S2

Side limit type: [1/2/3] Offset distance origin.

> The code defines origin point from which are measured side limits.
>
> 1   measured from centreline (point No1)
>
> 2   measured from outer edge of carriageway (point No 2)
>
> 3   measured from outer edge of hard shoulder (point No 3)

Data valid for start cross section only.

The offset is distance from the reference point outwards from the centreline. Value is specified in meters. If reference point lays on centreline and offset distance equals zero, whole one-half of corridor is trimmed.

Last versions of program affords to specified **negative value of offset** .Such side limits is generated automatically by program "SI42 Junctions branches", when alignment of a branch is overlapping dividing line of earthworks volumes.

Offset at begin S1 is distance from reference point to the border of the cross section. It is assigned in metres and is always positive.

Chainage at begin S1 in kilometres means the chainage of the beginning of the segment where side limits are defined (data for 2nd section will follow) or chainage of a separate cross section (data for 2nd section are not given).

Data valid for end of segment.

Offset at end S2 and chainage S2 at end are specified if the side limitation is assigned for segment from (km) to (km) only. Both values have the same meaning as above mentioned..

2.2.7 Side Limits by polyline

In table placed on tab **SL by polylines** is defined trimming of cross sections by 3D or 2D polyline. Side limits have no influence on calculation of crossfall and that is why e.g. the reference point of crossfall can be situated outside the side limits.
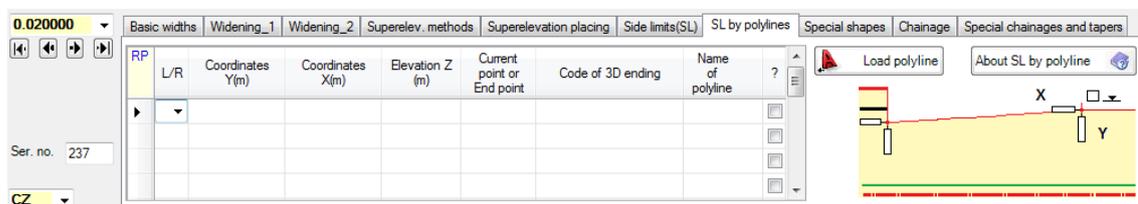
 In table placed on tab **SL by polylines** is specified boundary polylines by vertexes coordinates. One vertex of polyline is specified on one row of table. Polyline coordinates can be also loaded from file. Numerous polylines can be specified one by one.

Side limits by polylines are defined by seven values:

Side code: **[L/R]**

> L   validity of parameters for the left side
>
> R   validity of parameters for the right side of the road

Coordinate [Y m]

Coordinate [X m]

Coordinate [Z m] is omitted or is equal to zero in case of 2D polyline

Current point or End [0 /1] Value indicates either end of polyline or current vertex is on the row.

Code of 3D ending

There are three available method of ending of cross section on side limit border when renge of roadway crossing border plane.

See next picture.
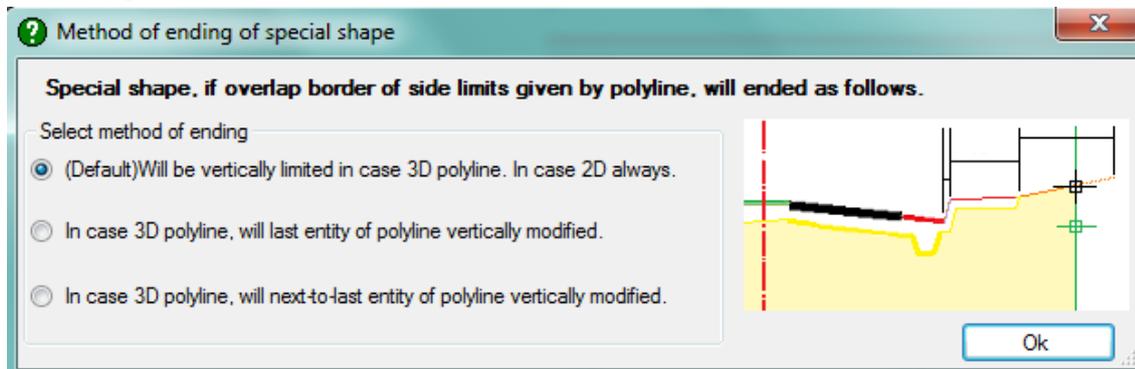
Name of polyline

Polyline name (text). Value is filled automatically in case of loading of polyline from file.

2.2.8 Special Shapes

Table placed on tab **SPECIAL SHAPES** is used for assignment so-called special shapes which can be used for crosswise extending of roadway. Maximally 10 other points on the carriageway surface and 10 other points on formation can be added. Definition of points is performed by relative increments from previous point from left to right.
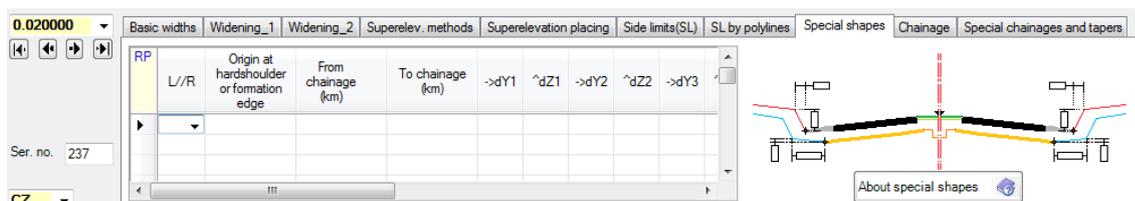
On one row of the table is placed parameters of one segment, where are specified values of extended cross section arrangement valid. Each segment is defined by 24 parameters with following meaning:

Side code: [L/ /R]

> Blank means both side validity of following particulars

> L   validity of parameters for the left side

> R   validity of parameters for the right side of the road

Code of placing: [K/P]

> K   defined points on the row are relative to the road carriageway surface.

> P   defined points on the road are relative to formation

>   On the continuing row must be this cell left blank

Segment Validity: there must be given two particulars that define segment in that are valid further mentioned points. First one is **chainage of beginning** of segment (from), second one is **chainage of end** of segment (to). Both data are given in kilometres. On the continuing row must be these two cells left blank

dY, dZ: For each point of road surface or formation surface are defined increment coordinates from previous point. Increments are given in metres. So many pairs of increments will be filled as required points, maximally 10 points. If there is more than 5 points then next continuing row will be used with blank space in column **Code of placing and Segment Validity.** Segment validity is specified according lower mentioned rule.

Specification of special shapes – interpolation and tapers

Until now, for each group of special shapes should be specified 10 values of Dy and 10 values of Dz, start chainage (s1) and end chainage (S2) of validity.

If chainage S1 was omitted by user or if it is specified by zero, the start of alignment was consider. If chainage S2 was omitted, the end of alignment range is under consideration.

New version of program has new ability to specify two consecutive rows in the proper table, which has equal values of side-code L/R, carriageway-code and formation-code and the same total number of pairs Dy, Dz. In the first row none zero S1X and S2=0 is specified, in the second one S1=0 and S2 > S1X is specified. In such a case program in section within S1X -> S2 will construct taper by the linear interpolation within Dy, DZ values for all cross-section in specified range.

The next picture includes sample of so completed form, on last two rows 436 is applied linear interpolation. There are interpolated 4 pairs of distances dy and dz in sector between km 0.150 and km 0.220, till it fades away in km 0.220.

Corresponding V43 file looks as follows:

```
436   K    100000    150000  250  100  100   30  250     0   10   30
```

```
436   P     50000      80000  550   100
436   K    150000          0  350   100   100   30   150    0   10   30
436   K         0     220000    1     0     1    0     1    0    1    0
999
001           0     220000   2000
999
/*
```

Differences are displayed with precision of 3 decimal places.

As there applies convention that the first pair of values dy = 0 and dy = 0 terminates list of special-shape points and that there the same number of distances in both rows must be preserved, it is necessary to enter zero distance (fading to zero) as 0.0, 0.01 or 0.01, 0.0 on the row.

We have abolished convention that chainage S1 = 0.0 means beginning of road and S2 = 0.0 means end of road. We have introduced a new test to check, whether S2 > S1 and besides that we test overlaps of special shapes. At the first row is chainage S1 = 0.0 permitted with signification of km 0.0 (Regular beginning of road).   If end of road is not known in advance, it is possible to enter it at current row as any chainage greater than end of road, e.g. km 999.0.

Attention: We have introduced another validation to ensure that specified sectors of special shapes do not overlap. Left - right sectors and carriageway crown - formation sectors may arbitrarily overlap. Nevertheless, formations of the same type must neither overlap nor to be in touch. In the event of chainage with overlap the program could not decide, which row is valid. It is identified as severe error and must be always corrected. Difference must be less than 1 mm.

2.3   Chainage Block

2.3.1   Chainage

Read chainage from file: [□/✓]

    □   Indicates that table of chainage will not be read from file type .SSS but will be defined in this table. Block settings of chainage.

    ✓   Indicates that table of chainage will be read from file type .SSS.

     List of chainage is assigned in two tables placed on tab CHAINAGE.
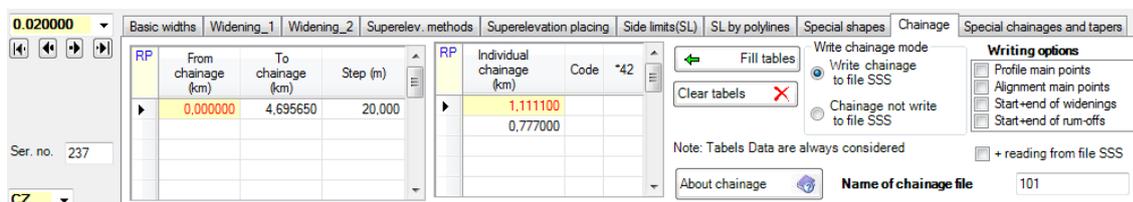
The table CHAINAGE GIVEN BY STEP may have any number of rows. One row defines one section with a regular step. The first item means the beginning of chainage

in km, the second the end of chainage in km, the third the chainage step in meters which the individual chainage between the beginning and end will be generated with.

The table INDIVIDUAL CHAINAGE may have any number of rows. Each row defines one chainage in km x.xxxxx. The computer generates a chainage file which unifies both above mentioned tables. Duplicity of chainages is eliminated. **Maximum of stored chainages number is 8000.**

Use chainage of Main point of alignments: [0/1/2/3/4/5/6/7]

0	only specified chainages in tables will be under consideration
1	indicate that list of chainage will be added by chainage of all main points of vertical alignment SNI file.
2	indicate that list of chainage will be added by chainage of all main points of horizontal alignment SHB file.
3	1 + 2

4   all sections of chainage table + beginnings and ends of widening + chainage of beginnings and ends of sectors of special shapes will be added. Chainages of such points are collected from completed "Widening" and "Special formations" tabs.

If SSS file included points at ends of widening from former runs and Chainage file is read, then they will be deleted and replaced by points from the last run of program SI43

5	like 4 + 1
6	like 4 + 2
7	like 4 + 3, i.e. all points that can be considered

All sections will be identically recorded in SSS and SKR files including WB and WP code, which describes their origin. SSS file may be used for generation of terrain cross-sections from DTM or for interpolation of terrain cross sections by program SI27, if we have available input data V27 (from survey). WP codes will be also transferred into SPR file, where they can be used for optional selection of cross sections during drawing by program RP53.

Output report of program RP43 (full listing) was extended by description of cross section origin, similarly also the large journal of program RP51.

Rounding while to Writing to file SSS

We modified system subprogram STAN, which creates SSS file (chainage). All data about chainage in this file, no matter where they come from, will be saved as rounded to mm. The reason is to be always able to align chainage, when its value is specified as numeric figure with mm precision. Saving in SSS file concerns following programs: SI12, SI14, SI15, SI27, SI31, SI43. In program SI00, function "Listing of SSS file" (option Info in RoadPAC control window), was listing of chainage from SSS file up to 9 decimal places expanded. Therefore you can check recording of chainage here. The listing was also expanded by description of all WP codes (including a new code for end of widening)

All chainages are stored in both SSS and SKR files including WP and WB code which describe its origin. File SSS could be used for terrain existing profile generation, or for terrain cross section generation over DTM. Codes WP are also transfer to SPR file for eventually selection during creation of DWG cross section drawing files.

Save system of chainages to file: [□/✔]

        □   Indicate that list of chainage will not be saved.

        ✔   Indicate that list of chainage will be saved to file type .SSS.

2.3.2 Chainage of subsidiary cross-section

**Add subsidiary cross-section and its characteristic.**

Now is introduced a new type of cross-sections - so called special cross sections. They behave just like cross sections specified by standard way. They participate in corridor generation in RoadCad part of system RoadPAC. In so constructed sections are generated e. g. terrain sections from DTM, interpolated sections in program SI27 and earth work volumes are calculated. Nevertheless, their new feature is that they are not drawn as cross-section drawings neither in section scheme in vertical profile. They are stored in SSS, STR, SKR, SPR, SHM files with a special code. (WP) In file listings they are indicated as "special sections" condition.

Such sections may be specified in table input data "chainage block" as for all programs which process chainage data. Rows in block of data "chainage" have code 004 and a form is identical to row 001 - i.e. chainage of start of sector, chainage of end of sector and step value sized in meters. See next table.

2.4   Graphic controls of pavement

On central part of form are immediately displayed current results of current data processing of particular sections. In upper picture is widening and superelevation scheme in plan displayed. In lower picture is displayed cross section arrangement of roadway. By mouse down user can move drawing and observe influence of any specified data change to current shape of pavement along alignment. Shifts and changes are controlled by standard controls placed of form. See next picture.
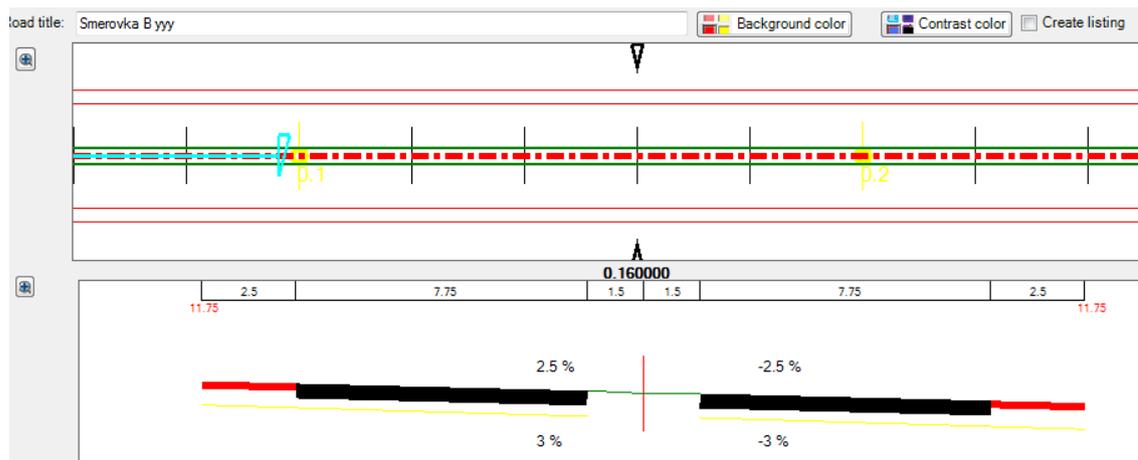
2.5   Course of pavement edges

After click on this button the new form with longitudinal course of pavement edges is displayed. This function is available if vertical alignment file SNI exists only.
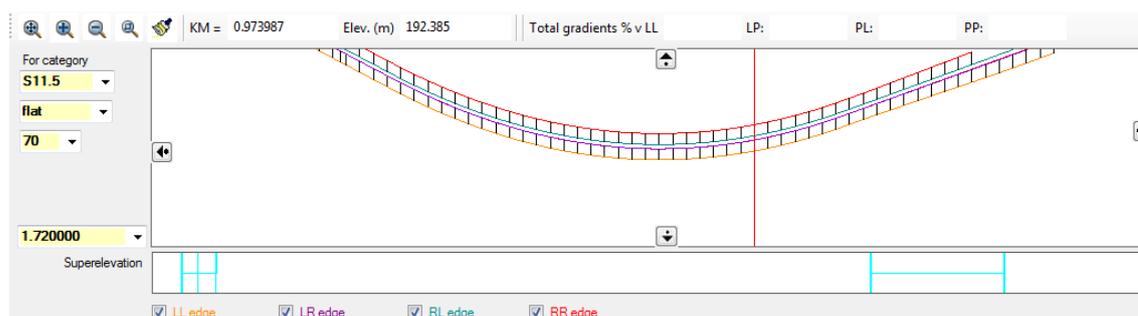
While right mouse button is permanently pressed coordinates of cursor are fluently displayed. User can choose or freeze edges to display. Standard controls are placed on the form. By click on button < Display total gradient > is switched on function which markup sections (BOLD) where gradient of edges exceeds CSN standards values.

3.   Description of output listings

The output listing is generated in the course of computation in the file "road".L43. Those listings can be controlled from the common menu for RoadPAC programs which has no graphical output.

Listing includes following information:
1)   Protocol about used files 'road' .SSS, 'road '.SOM, 'road' .SKR.
2)   Commented protocol of input data after sorting with warning messages.
3)   Protocol of road surface and formation in individual cross sections.

For each point of surface is printed axial distance in metres and relative height to vertical alignment in metres, then also crossfall of roadway on the left side and crossfall of the roadway on the right side in percentage. For each point of formation is level printed similar information as for points of surfacing. Asterisks indicates position of centreline in cross section. On the left from centreline are points situated on left one-half of cross section, on the right from centreline are points situated on right one-half of cross section.

4.   *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 * 43	
*** Inaccessible type of leading line: aaa	
** First line is ignored	
*** Between leading data read no marked line *	
*** Early data end	
*** Inaccessible function code number x = nn	
** Ending line 999 is missing	
** Unavailable type of line nnn ignored	
** More than nnn detailed points, ignored	
** Formal mistake, line ignored: (copy of line)	
** More than nnn detailed points, ignored from km n.nnnnnn	
*** Line read with error, ignored (copy of line)	
*** False code of line (first 3 symbols)	
*** False code for side in assignment of widths	
*** Exceeded possible number of lines of width arrangement	
*** Given negative width or downgrade	
*** Code of side in data of widening is missing	
*** False code of lane in data of widening	
*** False code of method in data of widening	
*** Chainage descends in data of widening	
*** Negative length of taper in data of widening	
*** Exceeded allowed number of lines in data of widening	
** False code of camber method modified	
** Given negative basic downgrade, is thought in positive	

*** Increased allowed number of lines method of camber	
*** False code of rotation in assignment of curve	
*** Chainage descends in assignment of curve	
*** Negative length of superelevation ramp	
** Negative downgrade in curve, is thought in positive	
*** Exceeded allowed number assigned curves	
*** False code of side in assignment of side limits	
*** False code of validity in assignment of side limits	
*** Chainage descends in assignment of side limits	
** Negative value of limits is thought in positive	
*** Exceeded allowed number of sections side limits	
** False code refers to point in assignment of side limits	
*** Exceeded allowed number of assigned widening	
*** Negative value dy in assignment of especial forms	
*** Chainage descends in assignment especial forms	
*** False code of side (placing) in assignment especial forms	
*** Given sections of widening layover in basic part	
** Given sections of widening layover in tapers	
** Different methods in assignment of connecting widening	
*** Given curves layover in curve	
** Given curves layover in superelevation	
*** Assignment of widening arrangement is missing	
*** In screw is assigned different method of camber (p,l)	
*** In screw is assigned different method of camber (road)	
*** Change of basic width in place of widening	
** Descending ordinates y at construction of section	
** In crown is not place for central separated lane	
** Inside ending points of formation layover	
** Descending ordinates y at construction of section	
** Descending ordinates y at construction of section	
*** Mistake in file Side limits	
** Code method of widening 5 is used out of shoulder	
** Code method of widening 5 has no connection on widening of road	
** Unavailable method of widening in taper	
** Unavailable method of widening in connection	
** Unavailable method for contraction (negative widening)	