

## **3D Intersection Design**

Novapoint 21FP4 + 3D Intersection Tool Release 19.3-00 of 3D Intersection

**Note**: for earlier versions of Novapoint 21 you must use version 18.4-00 of 3D Intersection



Quick guide:



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### Step 1 - Introduction.

In this Quick Guide explains the 3D Intersection Task in Novapoint Base. The 3D Intersection Design function supports Roundabouts, X Intersections and T Intersection.

The function needs to be installed separately. The latest version is 19.3-00 and runs with Novapoint21.XXFP4 or newer.



If you use the default path it will match the **Options** in Novapoint Base.

If you use a different path then you need to change the path under **Novapoint Options**. See where to find the path below.

Novapoint Options		?	×
Environment	Environment		
Trimble Quadri	1		-
Spatial reference system			
Windows	Coordinate Operation Libraries		
Network	List of available coordinate operations libraries:		
Raster File Cache	ETRSS9_LAMBERT_UTM         Finland         GTRANS         HTRANS         TrLib_v110         Proj4         SKT2LAN1_EU89		
	raus		_
	Name Folder		_
	Intersection C:\Program Files\lekia\Civil\Bin\Intersection.exe		
			*
Reset	ок	Canc	el





### Left/Right Traffic Direction

The direction of traffic for 3D Intersection design is by default Right lane. Under **Novapoint Options** it can be changed to Left-hand traffic:

Novapoint Options				?	×
Environment	Environment				
Trimble Quadri	General				ł
Windows	Novapoint language:	en-GB			Ĩ
Raster File Cache	Default selection window:	PlanWindow			
	<ul> <li>☐ Automatically open new</li> <li>☑ Show status bar</li> <li>☑ Show ToolTips in Mode</li> <li>☑ Show attributes without</li> </ul>	w plan window after import el Explorer (require restart) it values in property view			
	Left-hand traffic     Allow editing in Proper     Purge Quadri models w	ty View vhen loading binder			
	Present attributes with code	e and description (enum) as			
	Description [Code]				
Reset			ОК	Cance	el



## Step 2 - Input to the Intersection task

In Novapoint Base create the road centrelines for the various legs in the intersection. Make sure that the alignments are close to one another in both horizontally and vertically at the intersection point.

In Novapoint Base under Modelling create an Intersection task:



Select the relevant Alignment tasks (Tasks must be used not objects) and select the Calculation Basis.

Note: the Calculation Basis must be a Ground surface. The function will not calculate against sub surface layers at present.

The task is created.

+ Intersection 1000

Right click on the task and select Open

+ 📲 Intersection 1000 🗆	_	
		Open
Intersection IA 00	77	Edit task
Shoulder_1-2		
table 1		Rename
		Delete
	Ж	Cut
		Save as Template
	۲	Select Input
		Copy Conversion Files
		Make Dependency Graph
		Make Features Associations Graph
		Save as Process Template
ime		Check For Outdated Tasks
		Properties



## Step 3 - Designing an Intersection

When you select **Open**, or double-click the task wait a moment....

The function starts up opening two windows:

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Home	Insett Madelling Construction	View Output	l lick	2015 - 201				0
175 -13 Copy 3	X Delete 🗿 🖾 🙆 🕤	Q V	¥ 🔨 🚟 🗠 🔹	Select Result				
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8	🗭 Create parametric intersection.			- d X	a la	Pakis Ciril Interaction Tool Inte	methon 1 (29 3-00 X64 WORK (20 05 2019 12-43-54))	- 0 X
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	OX ⊡Secondary road				S1 1"		13	
	- CV			Handles	K B A		$\backslash \sim$	
				Snapping interval 5	- X		J 11	
	Attribute	Attribute value	Description		Contraction of the second		1-1-1	
(B) (B)	4 Interaction				5 4000 -			
	Interpolation method	Paulid	Method is used to compute helping lin	es to the surface model. These interpolation is	and the second s			
E	Main road method	Scurve	Method to compute main road edge. S	curve' fits a S curve between legs, whereas 'C				
	x	98406.703	×		1 0		-111	
	Č.	1212922.872	Y					
	2	27,108	L		and the second			
	Main marilen	Vec	Main mad lan		11 11		VIII I	
	Minimize road leg	Ver.	The method used to define if a road let	in minimized externationly			TIM	
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	Lane slope right	-0.030	Lone slope right (e.g0.03)		and the second se			
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	Lane slope left	-0.030	Lane slope left (e.g0.03)			0		
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d Alexandre De	Shoulder stepe right	0.250	Shoulder slope right (e.g. 1003)		A to be	1		
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Description	Remotive calculation basis							
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Last Erecula	OK Undate Clase H	in .				X=121261.003 Y=98166.	759 7=31.507 Ground surface	
Subtack of	and aparts there is	1000						1 new
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93600						1 Start and 20 Prints 5	324 E.6292 C.Default - 153 C. 41592	S8 Sign in 🎥 Rest Actor 40

The window shown on the left contains all the Intersection parameters a user can edit. For example:

- > Type of Intersection
- Carriageway width and slope for each leg
- Shoulder width and slope for each leg
- Range of Traffic Islands
- ➢ Kerb stone heights

*Tip:* Right clip on the first parameter for arm 1 and *Copy,* right click on the first parameter for arm 2 and *Paste*.

The window shown on the right shows the intersection layout which changes as the parameters are changed.



The view can be edited using the following choices:

- Surface highlights the traffic area
- Contour draws contours at selected interval
- Triangle model shows the surface represented by triangles
- Handles allows the user to drag each leg along the alignment or widen each leg by giving a value

F Create parametric intersection		- 🗆 X
Type		Show
C.T. C.Turning hammar		C Surface
s i s runnig nammer		- Sunace
C Circular cul-de-sac		Contour lines 0.05
C X 🗖 Secondary road		Triangle model
CY		🖾 Handles
Attribute	Attribute value	Description
<ul> <li>Intersection</li> </ul>		
Style	Circular	The shape of the roundabout
Radius	8.000	The radius of the roundabout
The width of the lane	7.000	The width of the lane
The slope of the lane (e.g. 0.03)	-0.030	The slope of the lane
The width of the inner area	0.500	The width of the inner area
The width of the outer area	0.000	The width of the outer area
Curb height	0.120	Height of island curb. Note that ze
Tilting	Automatic	Method to compute angle of tilt fo
X	98406.703	x
Y	1212922.872	Y
Z	27.103	Z
Island's area structure		Double click to select structure typ
🔺 Leg 1		
Main road leg	No	Main road leg
Trimming method	Tangent curve	The method used to modify the ve
Trimming length	30.000	The station distance from the main
Minimize road leg	No	The method used to define if a roa
Length from center	139.265	The length from the center point c
Lane width right	4.000	Lane width right
Lane slope right	-0.030	Lane slope right (e.g0.03)
Lane width left	4.000	Lane width left
Lane slope left	-0.030	Lane slope left (e.g0.03)
Shoulder width right	0.750	Shoulder width right
Shoulder slope right	-0.050	Shoulder slope right (e.g0.03)

*Tip:* By activating handles the intersection arms can be dragged along the alignment or the carriageway width can be edited.





In the parameter window select the type of intersection:



#### Set the general parameters:

-	Create parametric intersection			-		×
Тур	e C T C Turning hammer C O C Circular cul-de-sac C X ∏ Secondary road C Y			Show Surface Surface Contour Triangle Handles	lines model	0.050
	Attribute	Attribute value	Description			^
а.	Intersection					
	Style	Circular	The shape of the roundabout			
	Radius	8.000	The radius of the roundabout			
	The width of the lane	7.000	The width of the lane			
	The slope of the lane (e.g. 0.03)	-0.030	The slope of the lane			
	The width of the inner area	0.500	The width of the inner area			
	The width of the outer area	0.000	The width of the outer area			
	Curb height	0.120	Height of island curb. Note that zero and negative values are also	possible.		
	Tilting	Automatic	Method to compute angle of tilt for the roundabout			
	х	98406.703	X			
	Υ	1212922.872	Υ			
	Z	27.103	Z			
	Island's area structure		Double click to select structure type			

Note: The Islands area structure is not available in this version

For each Leg select the required parameters. For example, select type of island:



Note: The Islands area structure is not available in this version



#### Example of some other parameters:

F Create parametric intersection		- 0	$\times$	Tekla Civil Intersection Tool: Intersection 100 [18.4-00 X64 WORK (24.11.2018 1
Type		Show		
C.T. C.Turning hammer		Surface		
• O C Circular cul-de-sac		Contour lines	0.050	
C X 🔲 Secondary road		Triangle model		
CY		✓ Handles		
Attribute /	Attribute value	Description	^	
Island's area structure		Double click to select structure type		
4 Leg 3				
Main road leg	No	Main road leg		
Trimming method	Tangent curve	The method used to modify the vertical geometry of this leg when the leg joins to a main ro	ad or	
Trimming length	30.000	The station distance from the main road or roundabout by which the trimming method cor	tribut	
Minimize road leg	No	The method used to define if a road leg is minimized automatically		
Length from center	67.424	The length from the center point of intersection to the end of the leg		
Lane width right	4.000	Lane width right		
Lane slope right	-0.030	Lane slope right (e.g0.03)		
Lane width left	4.000	Lane width left		
Lane slope left	-0.030	Lane slope left (e.g0.03)		
Shoulder width right	0.750	Shoulder width right		
Shoulder slope right	0.050	Shoulder slope right (e.g. 0.03)		
Shoulder width left	0.750	Shoulder width left		
Shoulder slope left	-0.050	Shoulder slope left (e.g0.03)		
Widen right lane	No	Enable widening of incoming direction		
Widen left lane	No	Enable widening of outgoing direction		
Island type	Roundabout isla	The island type used for this leg		
Continuous channeling	No	The channeling object (island) continues all the way out to the end of leg		
Slope reference	Crown to left	This property has an effect on the elevation of the island. Choose "Crown to left" to match t	he slop	
Shoulder left	0.250	The width of the shoulder		
Shoulder right	0.250	The width of the shoulder		
Walking path distance	4.000	Distance from front of island to the beginning point of pedestrian walking path.		
Walking path width	2.000	width of waiking path of the island.		
Curb height	0.150	Height of island curb. Note that zero and negative values are also possible.		
Length expansion	20.000	The length from the rear of the island to the point where expansion begins		
Length channeling	20.000	Length channeling		
Length parallel	0.000	The length of the island part with even width		
Radius front	0.500	Radius front		
Radius rear	0.500	Radius rear		
The distance from the inner island (rig	. 7.000	Radius of the reference circle contered at roundabout center point. This is used when fitting	the fre	
The distance from the inner island (lef.,	7.000	Radius of the reference circle centered at roundabout center point. This is used when fitting	the fre	
Distance front	0.100	The distance from the outer circle to the front of the island		
Parallel offset right	0.750	Parallel offset right		
Darallal official lafe	0.750	Davallal official laft		

#### Right click on the first line and you can **Copy/Paste** Leg parameters from one leg to another:

isiana sarca su accare	Double circle to select structure	- 178-
Lea 3		
Main road leg	NI- NA-in-section	
Trimming method	Export leg parameters to file	I geometry of this leg when the leg joins to a main road or
Trimming length	Export island parameters to file	d or roundabout by which the trimming method contribut
Minimize road leg	Get leg parameters from file	is minimized automatically
Length from center	Copy leg parameters	ersection to the end of the leg
Lane width right	Convisiand parameters	
Lane slope right	Darte parameters	
Lane width left	Paste parameters	
Lane slope left	Save as .vce file	
Shoulder width right	Export table	
Shoulder slope right	Copy all rows to clipboard	
Shoulder width left	Convall route to slipboard (with desired some a)	
Shoulder slope left	Copy all rows to clipboard (with decimal comma)	
Widen right lane	Copy selected rows to clipboard C	trl+C
Widen left lane	Copy selected rows to clipboard (with decimal comma)	
Island type	(Rows 173 selected 1)	
Continuous channeling		commutes all the way out to the end of leg
Class (	Communities This account, have a stress of	and an



#### When finished with the legs you can adjust the connections:

E.	Trimming length	30.000	The station distance from the main road or roun
	Minimize road leg	Yes	The method used to define if a road leg is minim
	Lane width right	4,000	Lane width right
	Lane slope right	-0.030	Lane slope right (e.g0.03)
	Lane width left	4.000	Lane width left
	Lane slope left	-0.030	Lane slope left (e.g0.03)
	Shoulder width right	0.750	Shoulder width right
-	Shoulder slope right	-0.050	Shoulder slope right (e.g0.03)
	Shoulder width left	0.750	Shoulder width left
	Shoulder slope left	-0.050	Shoulder slope left (e.g0.03)
	Widen right lane	No	Enable widening of incoming direction
-	Widen left lane	No	Enable widening of outgoing direction
	Type	None	The island type used for this len-
	Connection 1-2		
	Main horizontal turning method	R	The horizontal method used to compute the cor
	Main vertical turning method	Copy	The vertical method used to compute the conne
	Turning lane method	None	Method for separate turning lane
	Slope structure		Double click to select structure type
4	Connection 2-3		
	Main horizontal turning method	R	The horizontal method used to compute the cor
	Main vertical turning method	Сору	The vertical method used to compute the conne
	Turning lane method	None	Method for separate turning lane
	Slope structure		Double click to select structure type
	Connection 3-4		
	Main horizontal turning method	R	The horizontal method used to compute the cor
	Main vertical turning method	Сору	The vertical method used to compute the conne
	Turning lane method	None	Method for separate turning lane
	Slope structure		Double click to select structure type
4	Connection 4-1		
	Main horizontal turning method	R	The horizontal method used to compute the cor
	Main vertical turning method	Сору	The vertical method used to compute the conne
	Turning lane method	None	Method for separate turning lane
	Slone structure		Double click to select structure type



## Step 4 - Intersection superstructure.

Select Structure:

<	>
Rotate Import Export	
✓ Create alignments	
Reinitialize calculation basis	
	Structure properties Select structure
OK Update Close Help	

There are two templates to select from.

For early design/planning we recommend using the **Intersection Traffic Areas with Side Areas**. For construction modelling, we recommend using **Intersection Traffic Areas without Side Areas** 

Structure template selection		(4 <u>—</u>		×
Intersection Traffic Area with Side Area	Next type Previous ty	pes		
Intersection Traffic Area without Side Area	7			
Cancel Help			1	Vext >

#### Intersection Traffic Areas with Side Areas

This gives access to some few parameters to set the connection between the terrain and the intersection traffic area. The parameters allow you to control:

- > The intersection pavement layers same as in Novapoint Road
- > Cut slope
- Ditch bottom width (slope 0)
- > Ditch depth
- > Ditch slope (combination of slope and depth defines ditch width)
- ➢ Fill slope
- Inner slope
- Side course slop (cross section slope for each leg



Structure parameters			_	2
Parameter	Туре	Value		
1-1) Wearing course	Delta z	0.05000		
2-1) Binder 1	Delta z	0.05000		
2-2) Binder 2	Delta z	0.05000		
3-1) Base 1	Delta z	0.10000		
3-2) Base 2	Delta z	0.10000		
3-3) Base 3	Delta z	0.10000		
4-1) Sub-base 1	Delta z	0.20000		
4-2) Sub-base 2	Delta z	0.20000		
4-3) Sub-base 3	Delta z	0.20000		
5-1) Filter	Delta z	0.00100		
Cut slope	Gradient	1.00000		
Ditch bottom width	Distance	0.50000		
Ditch depth	Delta z	0.50000		
Ditch slope	Gradient	-0.50000		
Fill slope	Gradient	-0.50000		
Inner slope	Gradient	-0.66700		
Side course slope	Gradient	-0.03000		

When you press OK the Intersection is calculated and can now be displayed in Novapoint Base by selecting the task and View in 3D:





After closing the intersection dialogues you can edit the result by selecting the task again and selecting Open.

Edit the structure properties by selecting Structure properties...

After making a change select **Update** to update the view in NP Base without closing the Intersection tool.

<					1
Rotate	Impo	rt Expor	t		
🔽 Create ali	gnments				
Reinitialize o	alculation ba	isis			
					Structure properties Select stru
ок	Update	Close	Help	1	

*Note* that the alignment tasks for all the intersection edge lines are created when the *Create alignments* is selected.





#### Intersection Traffic Areas without Side Areas

F Structure template selection		8 <b>—</b> 8		×
C Intersection Traffic Area with Side Area	Next types Previous type:			
Intersection Traffic Area without Side Area				
Cancel Help			N	lext >

Select **Next** and set up the required pavement layer thicknesses:

Parameter	Туре	Value		
1-1) Wearing course	Delta z	0.05000		
2-1) Binder 1	Delta z	0.05000		
2-2) Binder 2	Delta z	0.05000		
3-1) Base 1	Delta z	0.10000		
3-2) Base 2	Delta z	0.10000		
3-3) Base 3	Delta z	0.10000		
4-1) Sub-base 1	Delta z	0.20000		
4-2) Sub-base 2	Delta z	0.20000		
4-3) Sub-base 3	Delta z	0.20000		
5-1) Filter	Delta z	0.00100		

These pavement layers correspond to the layers in Novapoint Road.





Select OK and the Traffic area is calculated. View the task in 3D:

To complete the construction model create road models for each the edge lines. This allows detailed description for each leg including the possibility to add footpaths, kerbstones and cycle ways.

The **Shoulder** and **TrafficLanEdge** alignments created by the intersection tool as alignment tasks can be used as centrelines for Novapoint Road models. The alignments now contain the Intersection task name.

```
    Intersection 100
    Intersection 100_Shoulder_1-2
    Intersection 100_Shoulder_2-3
    Intersection 100_Shoulder_3-4
    Intersection 100_Shoulder_4-1
    Intersection 100_TrafficLaneEdge_1-2
    Intersection 100_TrafficLaneEdge_2-3
    Intersection 100_TrafficLaneEdge_3-4
    Intersection 100_TrafficLaneEdge_4-1
```





The pavement layers in Novapoint road can be made to match the pavement layers in the traffic area, see over.

Create one road for each leg:



Note if you rebuild the intersection after creating road models using the edge lines. The road model centre lines from edge lines will not be deleted but new one will be created with the same name but with number (2) added with number (2) added



The final result:





# Step 5 - Quantities – Template Traffic Area without side areas

From 21.XX FP4 the 3D Intersection Traffic area supports solid geometry.

In the previous version the layers were defined without solid geometry



Previous

From 21.XX FP4

Now the pavement layers are created as solids. We can then easily create a Table View that shows the quantities for the Intersection traffic area:





A table view for the four edge models can be defined that gives the complete volume for the side areas. Create a Table task with the four models, select the features you want and customise the results as shown below. Preview the result and export to **EXCEL.** 



				Area 3D	440.258	m²				
							layerDescription.designation:	1	Area 2D	355.039
		laverDescription designation Base		Volume	515.242	m³				
			0	Area 3D	6 874.222	m²				
		course	9	Area 2D	6 415.164	m²				
	32	laverDescription.designation:Binder		Volume	124.979	m <sup>3</sup>				
StructureLayer				Area 3D	3 431.015	m²				
		course	5	Area 2D	3 260.742	m²				
		layerDescription.designation:Separation layer		Volume	3.161	m³				
				Area 3D	2 840.898	m²				
			4	Area 2D	2 739.277	m²				
		layerDescription.designation:Sub-Base	Q	Volume	1 911.486	m³				
		course	5	Area 3D	5 335.262	m²				



				Area 2D	4 451.774	m²
				Volume	102.402	m³
				Area 3D	2 564.437	m²
		layerDescription.designation:Wearing course	4	Area 2D	2 445.396	m²
TrafficLane		1	1	Area 3D Area 2D	3.491	m²
	1		1		3.489	m²

To calculate the cut and fill for the traffic area for the intersection use the **Create Volume** tool.

Home Insert Modelling Construction View	Create volumes					
Name: Create Volume 2 - I Joles Subtask of: /50 ROADS/501 ROAD MODELS/501 - Docu	mentation Type: Surfaces	Type: Surfaces v Elevation: 0 v m	Cuter Boundaries (0) +	Settings	o ble Preview	Finish C
Task	Base Input	Comparison Input	Boundary	Method Prev	iew	Finis
👌 Intersection 100 🛛 🔗 3D Window 🔠 Preview 🖉 P	review #2 ×	~		a 12		
Task	Feature Type Name	Count Attri	bute	Value	Unit	
	Cut	1 Volume		5,195.585	m <sup>3</sup>	
Create Volume 2	EXID access	1 Volume		1,262,840	m <sup>3</sup>	1

View the Volume task in 3D:

A Intersection 100 A 3D Window Create Volume 2 X	Presentation Setup [Create Volume 2 - CorridorSolid]
	Search Drawing Rules
N	Rules Show/Hide
	🕅 🗁 🖂 CorridorSolid
	⊖ ⊡ Cut
	Soil-1
	Solid Solid
	A landscape 148
	Line Line
	• Point in section
	Surface
	Solid



## Step 6 - Test project

A test project can be downloaded from our support ftp:

ftp://Support:7050support@ftp.novapoint.com/Demo\_3D\_Intersection

The link must be copied into Windows Explorer (Not Internet Explorer)



# Tips – Use the conversion rule for FP4 on an earlier intersection task.

To use the conversion rule form NP21.XXFP4 on an intersection task created in an earlier version.

- 1. Create a new Intersection task.
- 2. Right click on the task and select Copy Conversion Files.





3. On the existing task right click on the task and select **Paste Conversion Files**. Note if the existing task has sub tasks (like alignments) it is not possible to paste. Move the sub tasks to a temporary task first, then select **Paste Conversion Files** and then move back the alignments.



Patrick Mc Gloin June 2019