Vehicle tracking – fully understand, what is possible

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Learning Objectives
- Learn how to create a new vehicle based on a data sheet
- Learn how to analyze and report swept path with different loads
- Learn how to animate a vehicle with a 3D load
- Discover roundabout creation capabilities

Description
Vehicle tracking is a very easy-to-use and handy tool for creating swept path analysis. You can use it from the very first moment. However, each type of software has its hidden places to be uncovered. Come to this session to learn how to create new articulated vehicles based on given data sheets and discuss other possibilities available for creating new vehicles, including rear-axle steering. You will learn how to add load to the trailer for analysis purposes and as well as for animation. Learn how to import a vehicle created in another product, and to have rich vehicle library for animation. Reporting is an important part of the product and we will go through different possibilities offered by the product. We will also discuss roundabout design possibilities

Your AU Experts

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Vehicle Tracking

Vehicle Tracking consists of several modules, which we will discuss in detail:

- Settings
- Swept Path Analysis
- Parking
- Junction
- Review

Before the start, it is important to quickly summarize the theory behind Swept Path Analysis. It is based on the Ackerman principle:

*Wikipedia says:*

**Ackermann steering geometry** is a geometric arrangement of linkages in the steering of a car or other vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radius. It was invented by the German carriage builder Georg Lankensperger in Munich in 1817, then patented by his agent in England, Rudolph Ackermann (1764–1834) in 1818 for horse-drawn carriages. Erasmus Darwin may have a prior claim as the inventor dating from 1758.
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Basic theory behind Vehicle Tracking:

- Single steering angle
- Single front axle
- Single rear axle

Vehicle parameters:

- Wheelbase
- Maximum steering angle
- Minimum turning radius

\[ R = \sqrt{L^2 + \left( \frac{L}{\tan \theta} + \frac{T}{2} \right)^2} \]

\( \Theta = \text{max steer angle of equivalent central wheel} \)

\( R = \text{min turning circle radius to outer wheel} \)

\( L = \text{effective wheel base} \)

\( T = \text{wheel track} \)

Applicable to zero thickness tyres

Assumption made by Vehicle Tracking:

- No skidding or tyre slippage occurs
- Wheels maintain contact with the surface
- Multi axle sections are reduced to single front/ rear axles
- Steered wheels on fixed axles are controlled by a perfect Ackerman linkage
- Turning capabilities are equal for left and right lock
- Clearance envelopes are calculated on the horizontal

This theory will help us to create vehicle
Create Vehicle

Before starting to create vehicle, you should check Drawing Settings -> Units, if defined units meets your requirements.

To create vehicle, you need Vehicle Data Sheet. For exercise we will use Tractor Volvo FMX 11 6x4 and TSR Semi-loader trailer

Here are few tips to create vehicle:

Lock to Lock time: time varies on driver, vehicle, road surface etc. Here are some examples
- small passenger vehicles and vans: 3 sec
- trucks: 5-6 sec
- large oversized and over-weight vehicles: 8 sec

Turning Radius:
- if both - Curb to Curb and Wall to Wall defined, Wall to Wall is more important
- Maximum Wheel angle – defined in inner wheel, rarely known

Coupling offset: not given. Varies on load driven on given day

Articulated angle: not given. Tractor and trailer are not sold in combination.
Results:
Tractor – unit no. 1:

When Vehicle created, it is part of your drawing. Can be saved as ATL file within Data directory (see System Settings -> Directories)
Rear axle steering

Rear steering parameters are available within Rear Axles tab.

- There are a number of options available in the Advanced Editor for setting up the vehicle axles.
- By default the axles will be fixed. Ackerman or Tandem Bogies tend to be the most commonly used. Bogies are also used.
- The Steering button is where the properties of the 2nd steered axles can be defined.

Steering linkage is used as a fixed value to define how the rear axles turn.
- A factor of 1 (Basis=Angles) means the rearmost axle turns 1 degree for every angle of articulation.
- Therefore the cut-in point is midway between the Theoretical Rear Axle and the kingpin/coupling point.
- EWB allows you to hard code the cut in point using distance from kingpin/coupling point.
Using AutoDrive method, you can use mouse wheel button to start Override Rear Steering. 

**Note:** Rear wheel angle – overridden must be enabled (see Steering button within Rear Axles tab)

![AutoDrive method screenshot]

**Body Outline - analysis**

Vehicle Tracking contains possibility to define load within tab Body/Outline. The outline will later appear within Report functionality.
Reporting functionality must be set the way to show Loads within analysis. You can set it in drawing level – see Drawing Settings -> Paths -> Reports, or for particular swept path – see Vehicle Tracking Properties.

**Animation**

3D blocks can be added to the vehicle in the Advanced Vehicle Editor to make the animations more realistic. Results can look like:
Vehicle Tracking allows users to define Body outline (side elevation), which can be found in Body/Outline tab.

This is for animation purposes only and not for analysis. To create trailer with load, we will create one 3D Block, containing both element – trailer and load.

The 3D body should be defined in AutoCAD as a block with the origin at the center of the front coupling (or the center of the rearmost front axle if there is no front coupling). The shape should be oriented with the spine of the vehicle running along the x-axis (increasing towards the back of the vehicle), the width on the y-axis and the height on the z-axis (increasing with height).

**Note:** Only the name of the 3D block is stored in the drawing. This means that if you send a vehicle to a third party, either in the form of a library or as a drawing, you need to send them the custom block as well. If Autodesk Vehicle Tracking cannot find a named block, it uses the Auto-Create option.

Animation can enhanced significantly, because since 2016 release we can Attach Coordination Model... from Navisworks.
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We can also use vehicle created in 3ds Max. .MAX file should be exported to DWG format and correctly measured.

**Note:** Autodesk released new 3D Presentation Vehicles as Subscription benefit for 2016 release. You can download them from Autodesk Account, Product Enhancements.

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**Roundabout Design**

Roundabout can be created based on line/polyline/arc in 2D only. Full 3D creation process has to utilize Civil 3D objects – Alignments, Profiles and Surface. In this case the result can be Corridor with all regions.

Assemblies used to create Corridor are stored in:
*C:\ProgramData\Autodesk\Vehicle Tracking 2016\Library\Assemblies\Civil3D2016*

Signs that are placed to drawing are stored in:
*C:\ProgramData\Autodesk\Vehicle Tracking 2016\Library\Signs*
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Very useful is possibility to define Roundel Slope and Elevation within Roundabout parameters

Roundel slope (including direction) can be defined directly within DWG

Roundabout consist of more elements. Not all of them has to be defined.

- Approach
- Entry
- Exit
- Level & Grades
- Splitter Island
- Crosswalk
- Rumble strips
- Speed Stripping
Roundabout analysis

Design Vehicles can be defined to automatically check swept path.

After Roundabout creation you have to run Design check.

You can also use AutoDrive option from Swept path analysis to check, if selected vehicle will be able to pass through Roundabout. The path will be automatically selected based on Fastest Path – see Junction properties.

**Note:** To see animation in 3D, you should create Civil 3D Surface from Top corridor links, use this as Final surface within Junction properties. It will bring important 2D objects to correct level – for example signage. The same Surface should be used to bring swept path to 3D.

Another possibility is to check Visibility along Roundabout
Summary
Vehicle tracking offers wide variety of functionality, from Swept path analysis to Roundabout design. Interoperability with Civil 3D objects makes this product important part of BIM Autodesk portfolio. Civil 3D Objects plays important role not only for design, but also for analysis and animation.

Input parameters for design and analysis are not “black box” and can be customized according to your needs. The same applies to output, which can be customized according to your needs.