

# Train Controller (Railroad System) v3.2

## User Manual



**WSM GAME STUDIO**

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# Intro

Thank you for purchasing “Train Controller (Railroad System)”!

This package contains all that you need to build a simple and functional railroad (models, scripts and SFX).

More models may be included in the future and/or sold separately as extensions ([Addons Available](#)).

It's really simple to use and customize.

Follow this tutorial or watch it on youtube if you like: [Youtube Tutorial](#)

# Update Guidelines v3.2

Version 3.2 has some structural changes on train wheels suspension and rails physics. These changes were made to increase train max speed and movement stability at high speed.

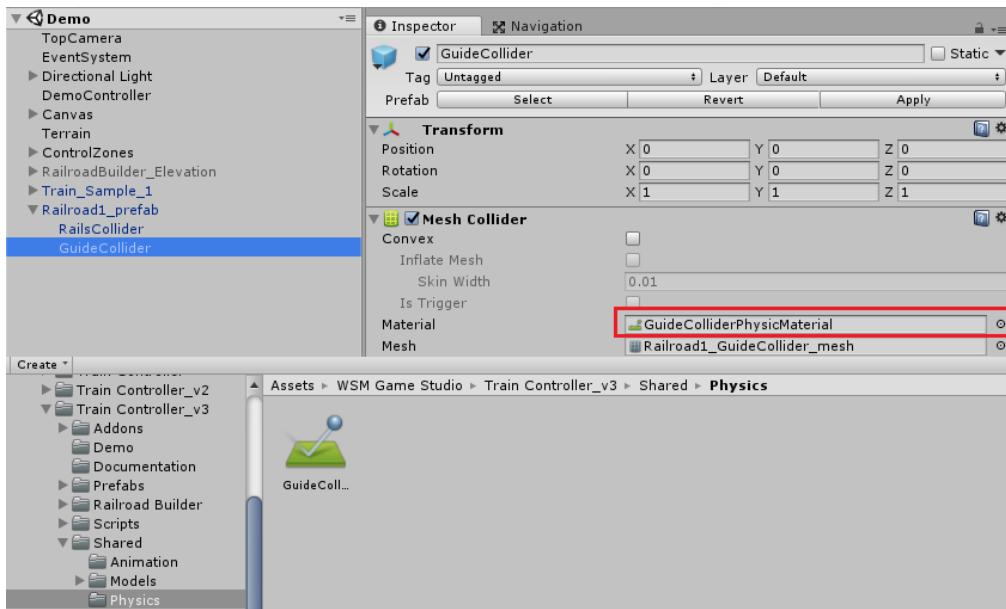
If you haven't downloaded any previous versions of this package on your project, or have completely removed any previous versions, then you don't need to worry about this section.

But, if you have already downloaded any previous versions on your project and downloaded version 3.2 as an **update** inside the Unity Editor. Then, you may need to check your **custom prefabs**, since the Unity Editor will not update custom prefabs automatically.

For custom Train prefabs created on previous versions, it's recommended to replace the locomotive and all wagons to make sure the new wheels suspensions will apply correctly.

If you have downloaded any [Additional Wagons](#), download the updated version of those wagons before replacing them on your custom train prefabs.

For custom baked railroads and/or rail segments created on previous versions, you need to apply the "GuideColliderPhysicMaterial" to your custom rails "GuideCollider" child object.

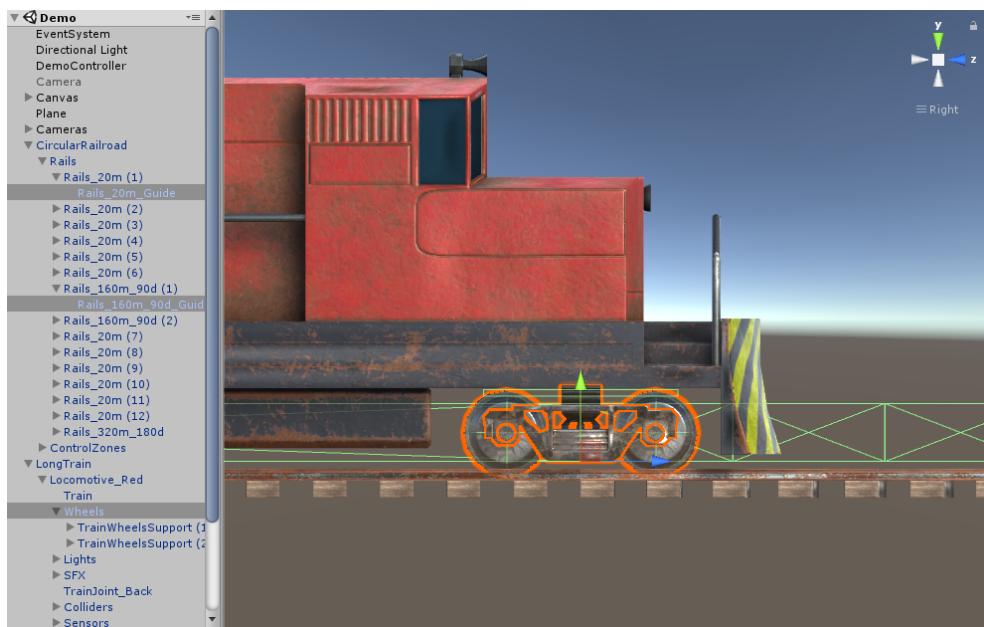


# How to Use This Asset

In this section you will learn how this asset works and how to use it based on the sample prefabs.

## How it Works

The Train Controller works by using guide colliders to keep the train on rails.



The rails are composed by colliders tagged as “Rails” and guide colliders that composes the path that the train will follow.

The TrainController script is attached to the locomotive and also controls acceleration, brakes and SFX.

The wagons are connected by Hinge Joints and moves by being pulled by the locomotive.

## Recommended Layers (Optional)

The package is ready to use as it is. Although, to avoid unwanted collisions with the rails guide colliders, it is recommended to customize the Unity Collision Matrix.

Go to “Edit > Project Settings > Tags and Layers”, add new layers for the rail guides and train wheels (Ex: RailGuide and TrainWheels). Change the layers of the train wheels and rail guides of the prefabs.

Go to “Edit > Project Settings > Physics” and change the collision matrix so the “RailGuide” layer will collide **only** with the ‘TrainWheels’ layer.

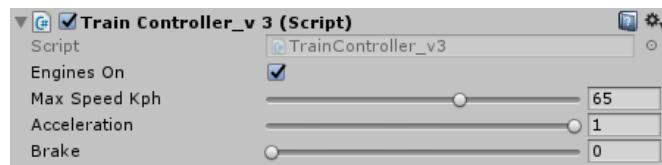
	Default	TransparentFX	Ignore Raycast	Water	UI	RailGuide	TrainWheels
Default	<input checked="" type="checkbox"/>						
TransparentFX	<input checked="" type="checkbox"/>						
Ignore Raycast	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
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RailGuide	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
TrainWheels	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

For more info about the collision matrix, check the [layer-based collision](#) official documentation.

## Sample Prefabs

This package includes a ready to use railroad and three ready to use train sample prefabs. These prefabs can be seen in action at the demo scene included in the project.

If you wish to use these prefabs on your game, all you need to do to is drag and drop a railroad and a train to your scene. You can also customize speed and acceleration in the TrainController script attached to the locomotive.



The train sample prefabs already have the “Engines On” property checked by default. You can also adjust the train max speed by changing the “Max Speed kph” parameter.

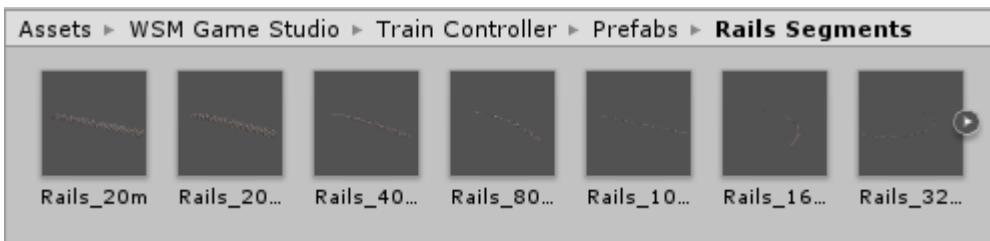
Acceleration also is set to 1 by default (1 move forwards; 0 don't move; -1 move backwards)

## Legacy Rails Segments Prefabs & Railroad Builder

Up to version 2.0, the railroads were composed by joined rail segments prefabs.

Starting with version 3.0, the railroads are now build using with the “Railroad Builder”, which is much more easier to use and give much more control over the railroad.

Although, the rail segments prefabs were kept at the “Rails Segments” folder for those whom bought any previous version of the package and wish to keep using them for any reason.



The “RailroadBuilder” prefab is now the official method for building railroads. See the [Building a Railroad](#) section for more info on how to use the “Railroad Builder”.



## Locomotive & Wagons Prefabs

A train is composed by a locomotive and wagons. There is a locomotive and a set of wagons prefabs at the “Prefabs” folder.

More locomotives and wagons may be included in this package in the future and/or sold separately as extensions ([Addons Available Here](#))

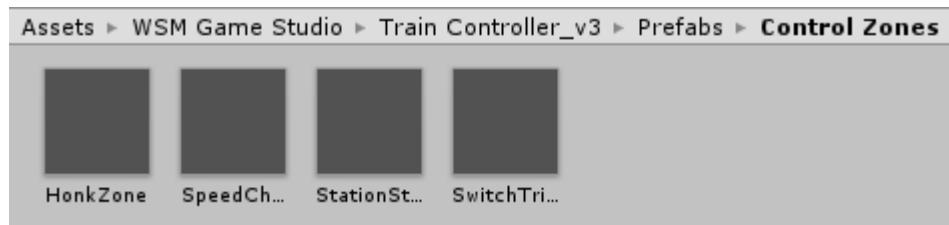
See the [Building a Train](#) section for more info on how to use these prefabs.



## Control Zones

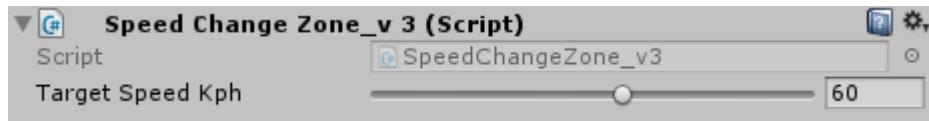
The Control Zones are used to control the train behaviour on the railroad. Currently there are four control zones in the base version of this package (More may be included in the future).

These zones are simple colliders that triggers events on the TrainController script once the train pass through them.



The “HonkZone”, triggers the “TrainController” “Honk” method once reached. This zone may be useful to add more realism at rail crossings for example.

The “SpeedChangeZone”, adjusts the train max speed to the configured target speed value.



This zone is used to reduce speed before railroad curves and increase speed on straight segments on the sample railroads. Although, you may use then to control the train speed as you wish.

For more details about the “StationStopZone”, see the [Stopping at the Station](#) section.

For more details about the “SwitchTriggerZone”, see the [Railroad Traffic Control](#) section.

# Building a Railroad

In this section you will learn how to build your custom railroad, using the Railroad Builder prefab.

You can also learn this by watching this [Video Tutorial](#) instead.

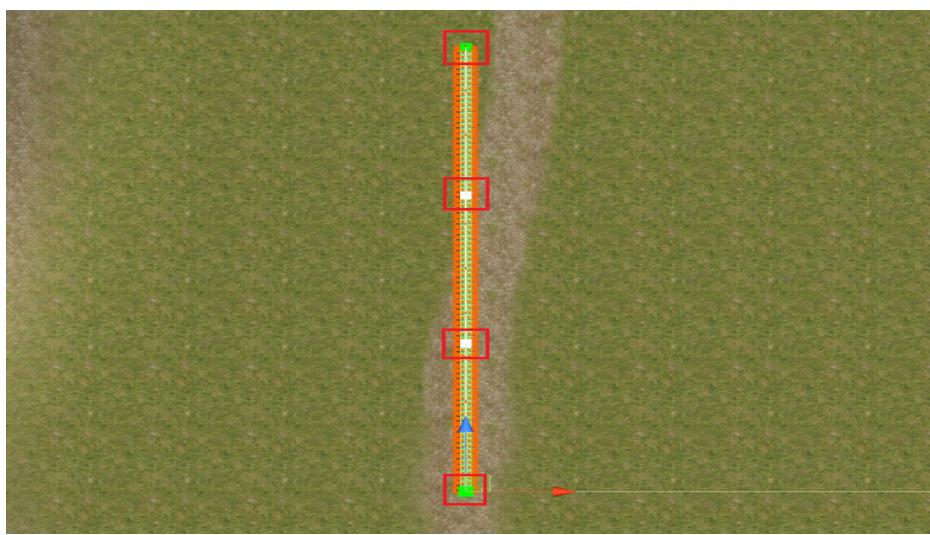
## Railroad Builder

The “Railroad Builder” prefab, allows you to build a railroad using by adjusting bezier curves on the Unity Editor.



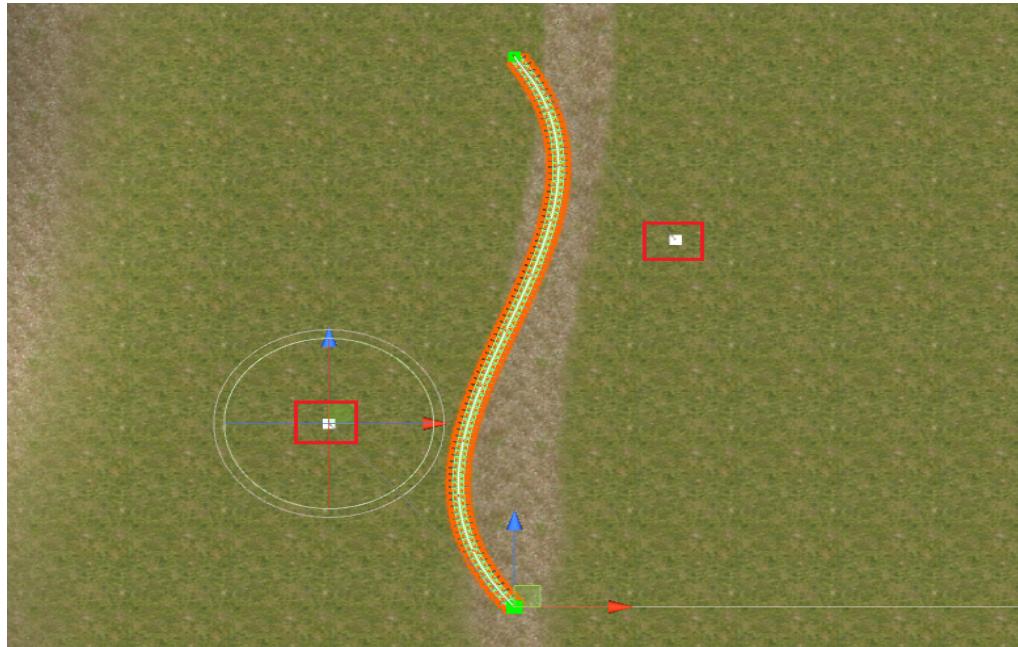
**IMPORTANT:** Do not apply modifications to the “Railroad Builder” prefab. This prefab is intended to be used as an starting point. If you wish to save your edited Railroad, you can save it on a new prefab or you can use the “Mesh Baker” to export a static and performance friendly railroad prefab.

Drag & Drop the “Railroad Builder” prefab into your scene to start building your railroad.



It will spawn a straight railroad segment along a [spline](#) with four control points. The green control points, marks the start and end of each railroad segment, the white ones are auxiliar control points.

By clicking on a control point, its position and rotation handles will appear on the editor. Change the position of the control points to curve the rail segment.



The control points are controlled by the “Spline” script. In the inspector, you can edit the selected control point position and rotation manually instead of using the handles. The curves are created by changing the control points positions, the rotation is used to deform the rails, but, for functional railroads it is not advised to change the control points rotations.

If you accidentally changed the rotation of a control point, you can reset it manually by setting the Rotation property to 0,0,0 or you can click the “Reset Rotations” button to reset all the rotations at once.

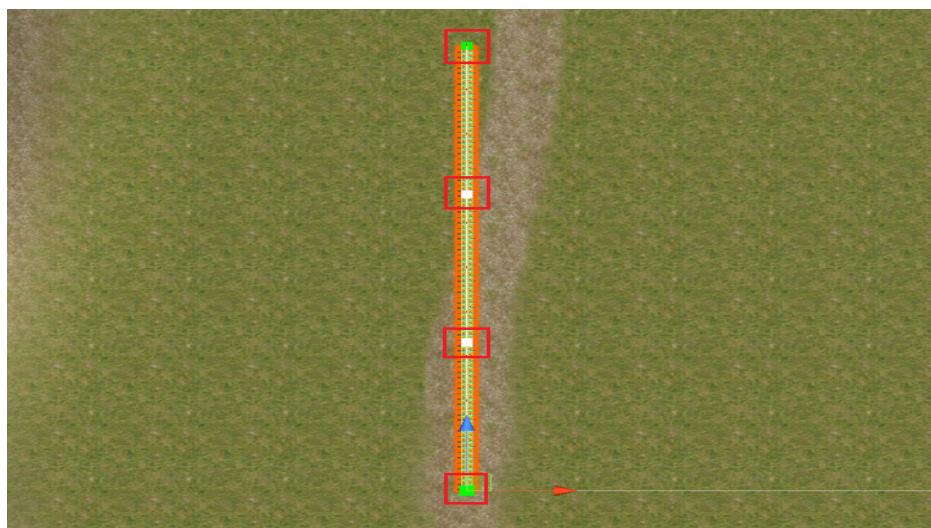
You can use the “Reset” button to reset the position and rotation of all control points. It will also set the railroad to its initial straight shape.



The “Add Curve” button, adds a new railroad segment controlled by a set of four control points. The new segment’s length will be the same as the “New Curve Length” property and its direction will follow the last control point direction. The “Remove Curve” button, removes the last curve added by the “Add Curve” button.



**IMPORTANT:** The “Reset Spline” button will remove all additional curves and set the railroad to its initial shape and length.

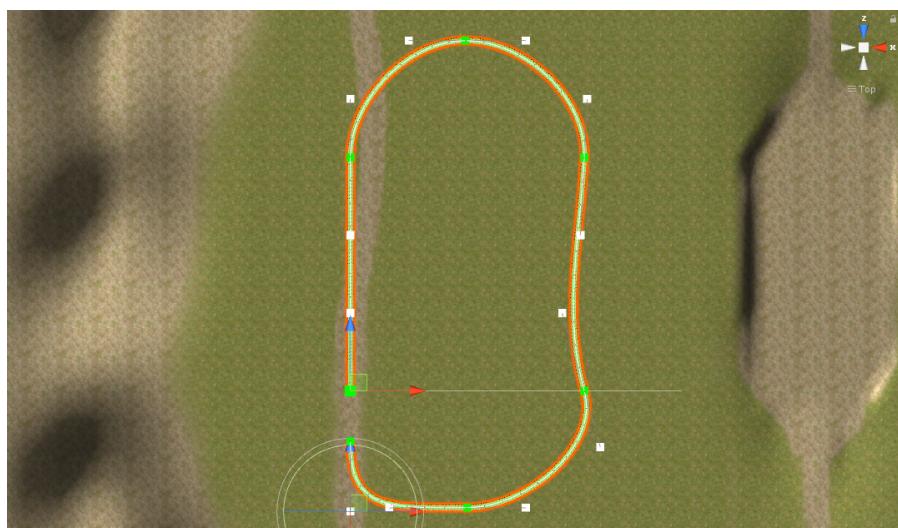


To create your railroad, its recommended to start with a straight segment long enough for your train.

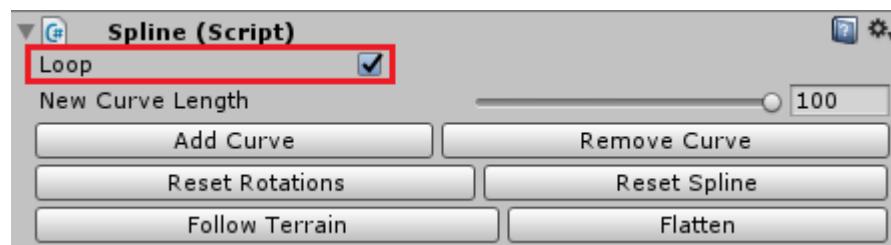
Use the “Add Curve” button to add new rails segments and adjust the control points positions to shape the railroad curves.



Repeat this process to of adding new curves and adjusting the control points to build your railroad.



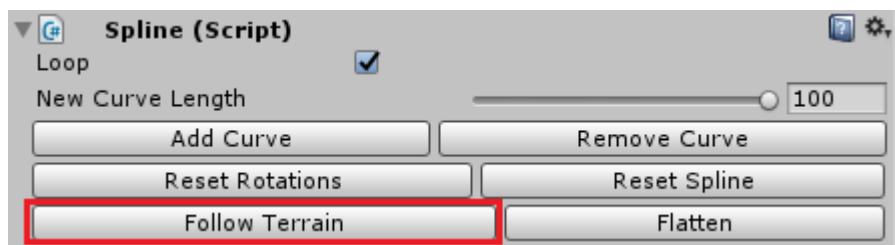
To create a closed railroad, bring the last control point as close as possible of the first control point and check the “Loop” property of the “Spline” script.



It will merge the first and last control points and close the railroad loop.



To adjust your railroad to your terrain elevations, just click the “Follow Terrain” button.



**IMPORTANT:** The “Follow Terrain” feature accuracy is affected by the “New Curve Length” property. Higher curve length values work fine with soft elevations, but for harsh terrains, lower curve length values will adjust much better to your terrain elevations. Although, like in real life, railroads are not supposed to be built on harsh terrains. So, for better results plan your terrain elevations accordingly to your railroad needs or vice-versa.

The “Flatten” button, resets the railroad elevations to default.

If you wish, you can also adjust the rails above terrain elevations manually, by selecting a control point and raising its position.

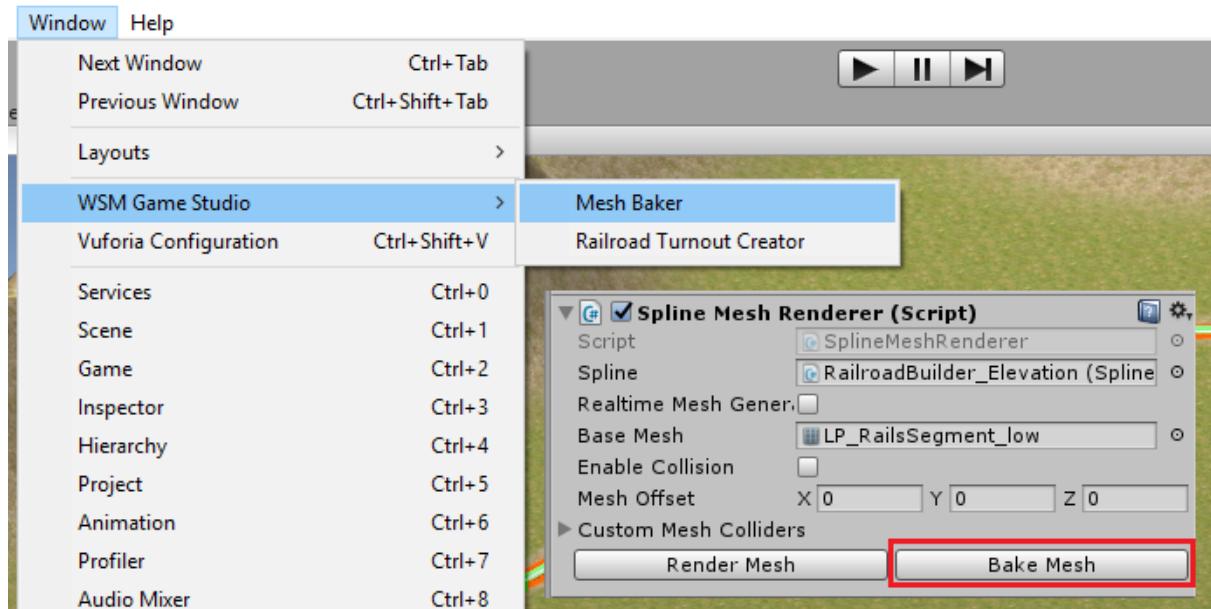


Adjust the railroad as you like. After finishing the railroad creation, you can keep it as a dynamic railroad (keep Railroad Builder on scene) or you can bake the railroad as a prefab.

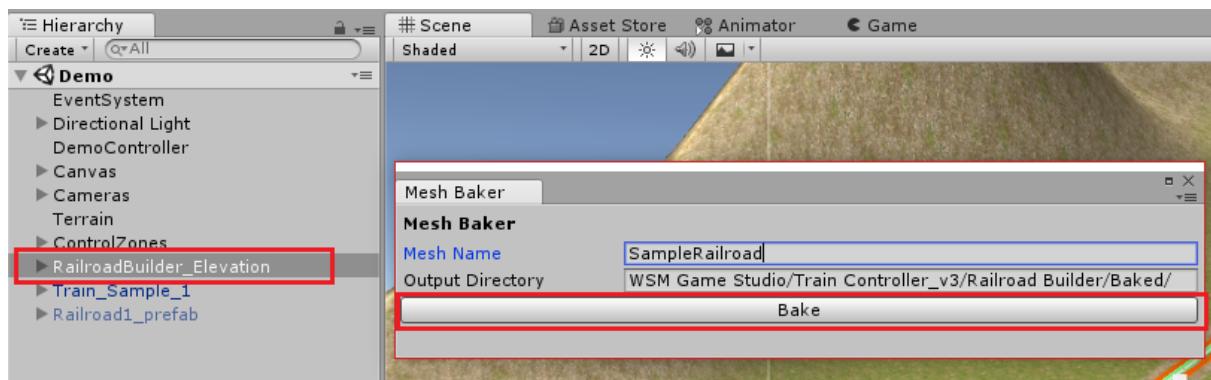
## Railroad Prefab Export (Mesh Baker)

Railroads or rail segments created using the [Railroad Builder](#) can be exported as prefabs to increase performance.

Select the Railroad Builder object in your scene and click the “Bake Mesh” button or the “Mesh Baker” menu to open the “Mesh Baker Window”.

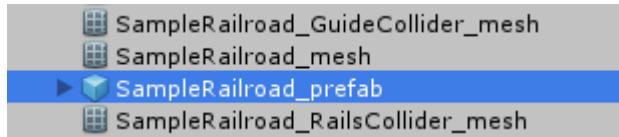


Choose a name and output directory for the prefab and with the “Railroad Builder” object still selected on your scene, click the “Bake” button.



If done correctly, four files should be created on the selected output folder.

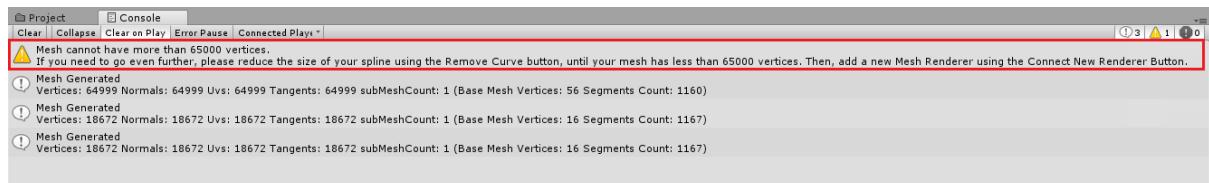
The prefab object is ready to use, just drag & drop it on your scene and disable Railroad Builder object used it to create it.



After replacing Railroad Builder by the prefab on your scene, it is recommended to keep the Railroad Builder as a disabled object on your scene, instead of deleting, in case you may want to make any adjustments later.

## Building Super Long Railroads

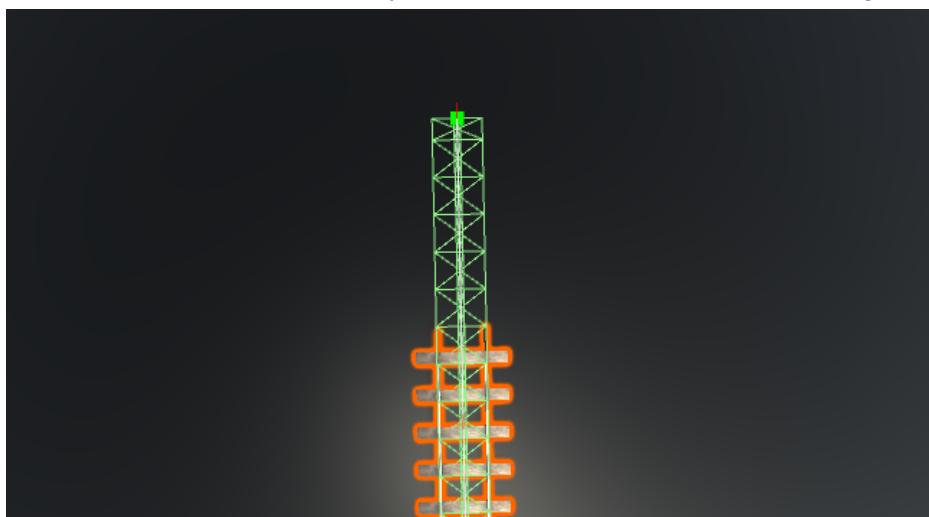
The railroad builder works by rendering the rails as a single mesh deformed along a spline. This technique allows custom rails with any curvature angle. Although, if you intend to build super long railroads, for open world games for example, eventually you may see a warning like this:



Don't worry, this is normal and **will not** ruin your plans of building a super long railroad. Unity has a limit of 65000 vertices per mesh. This limit exists to avoid performance issues when rendering large meshes. This limit is also, very useful to apply [Occlusion Culling](#) on your railroad and increase your game performance.

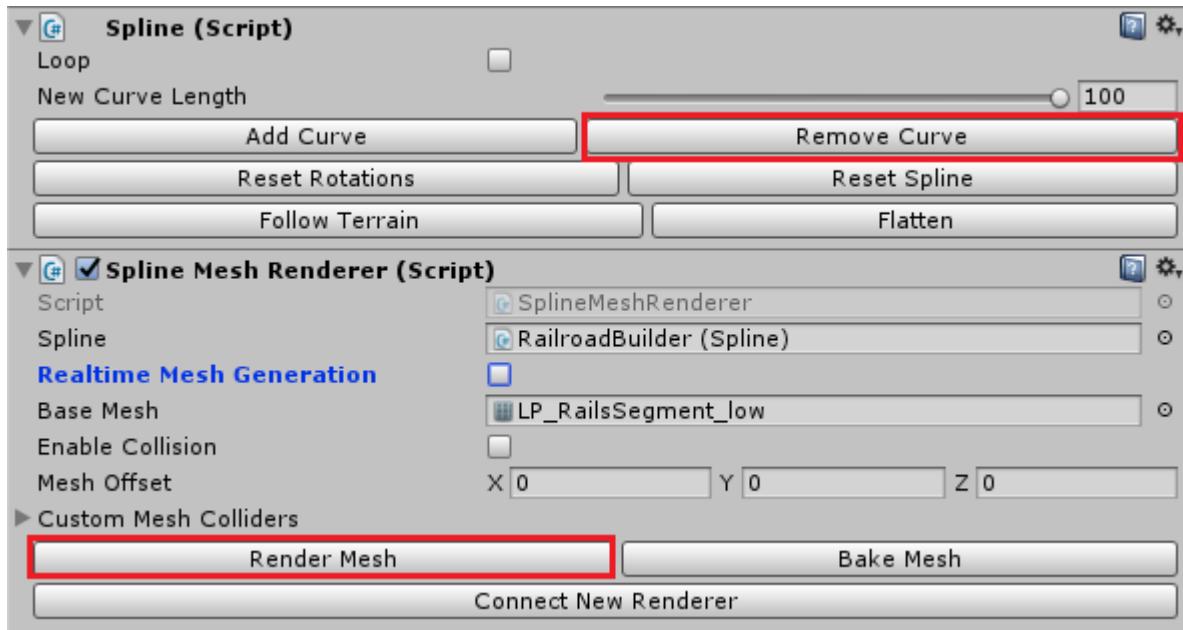
If you see that warning, just follow the instructions below to keep building your super long railroad.

With the Railroad Builder object selected, go to end of your railroad and check if the rails matches the last control point. It probably don't match, like in the sample image below.



To fix that, you need to use the “Remove Curve” button to reduce your Railroad Until the rails mesh perfectly matches the last Control point position.

Click the “Remove Curve” button, then click the “Render Mesh” button and check the console window, to see if a new warning was created.

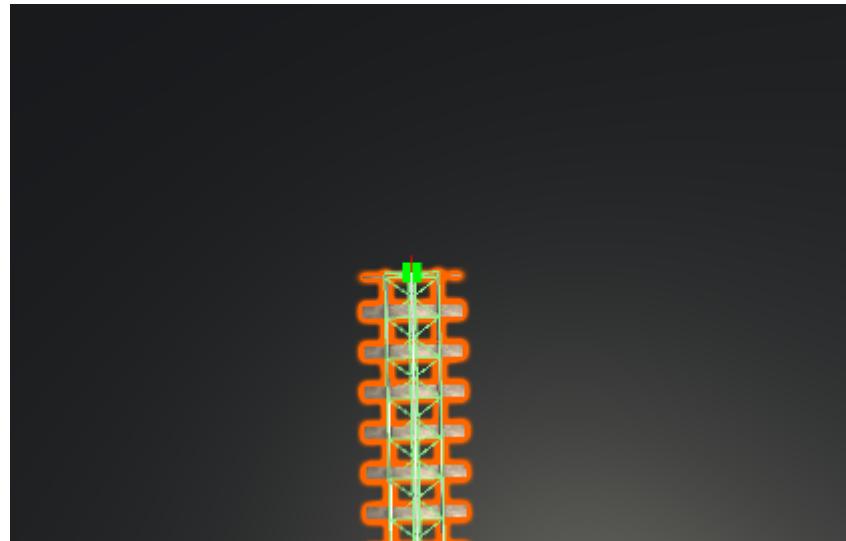


**IMPORTANT:** The “Realtime Mesh Generation” Property is disabled automatically when max number of vertices is greater the 65000. This is the default behaviour to increase the editor performance while building your railroad, since processing large mesh data in realtime is costly. You can enable the “Realtime Mesh Generation” property manually after reducing the rails, but, for very long railroads it’s recommended to use the “Render Mesh” button to update the mesh after adjusting your splines curves.

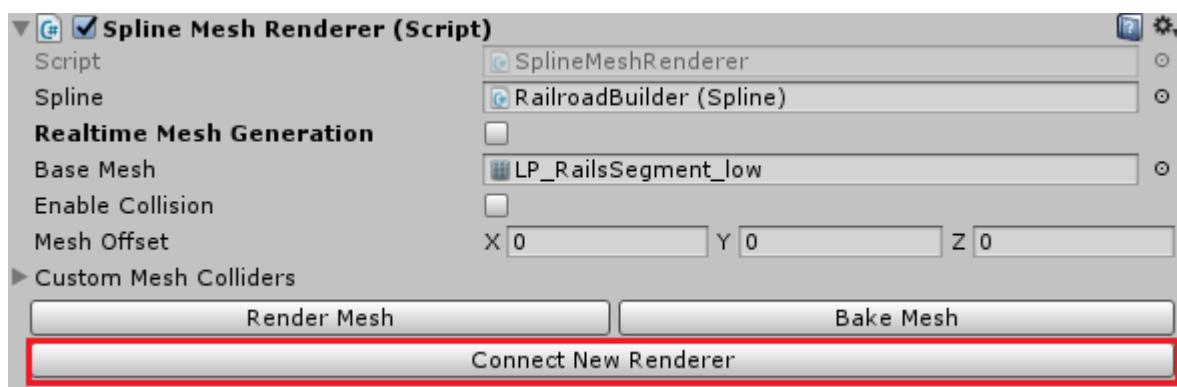
If no new warning was printed on the console after clicking on the “Render Mesh” button, you will have 3 new “Mesh Generated” outputs, like below. The first one, is relative to the rails mesh, and will be below 65000 vertices (The other two are relative to the mesh colliders)

```
! Mesh Generated
Vertices: 60704 Normals: 60704 Uvs: 60704 Tangents: 60704 subMeshCount: 1 (Base Mesh Vertices: 56 Segments Count: 1084)
! Mesh Generated
Vertices: 17344 Normals: 17344 Uvs: 17344 Tangents: 17344 subMeshCount: 1 (Base Mesh Vertices: 16 Segments Count: 1084)
! Mesh Generated
Vertices: 17344 Normals: 17344 Uvs: 17344 Tangents: 17344 subMeshCount: 1 (Base Mesh Vertices: 16 Segments Count: 1084)
```

Check the end of the railroad again. If no warning was generated, then the mesh will match the last control point perfectly. If not, then repeat the process of removing the last curve until it matches.

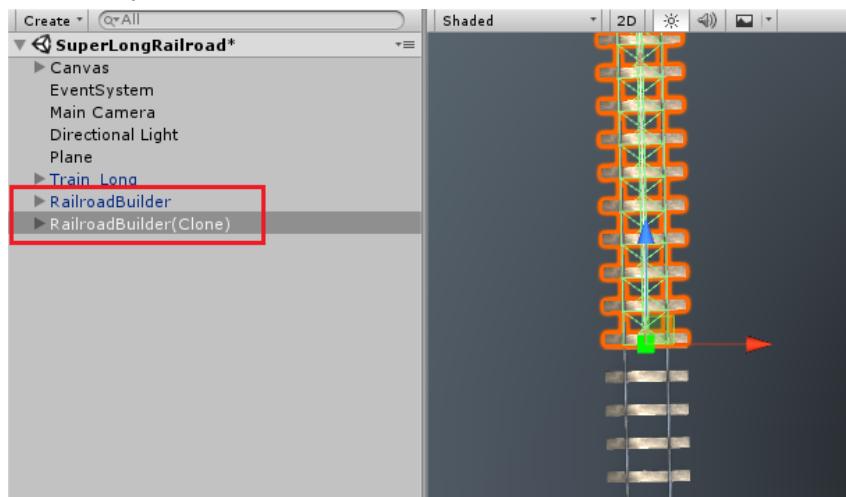


Now, that the warning is gone and the rails mesh matches the last control point. To keep building your super long railroad, just click the “Connect New Renderer” button.

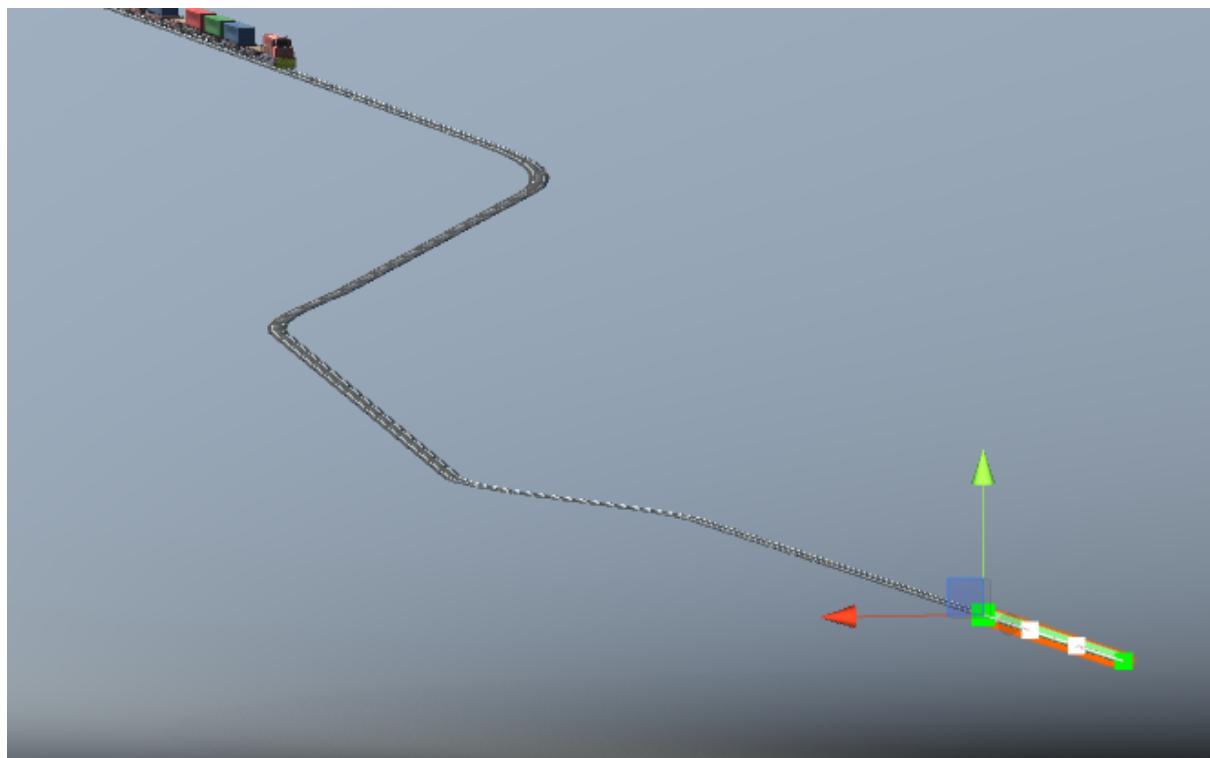


It will create a new Railroad Builder object on your scene aligned at the of the previous one. Use this new Railroad Builder to continue building your railroad.

By default, the “Realtime Mesh Generation” of the new Railroad Builder will also be disabled, but you can enable it if you wish.



Repeat this process as many time as you need. Each Railroad Builder will compose a very long segment of your railroad.

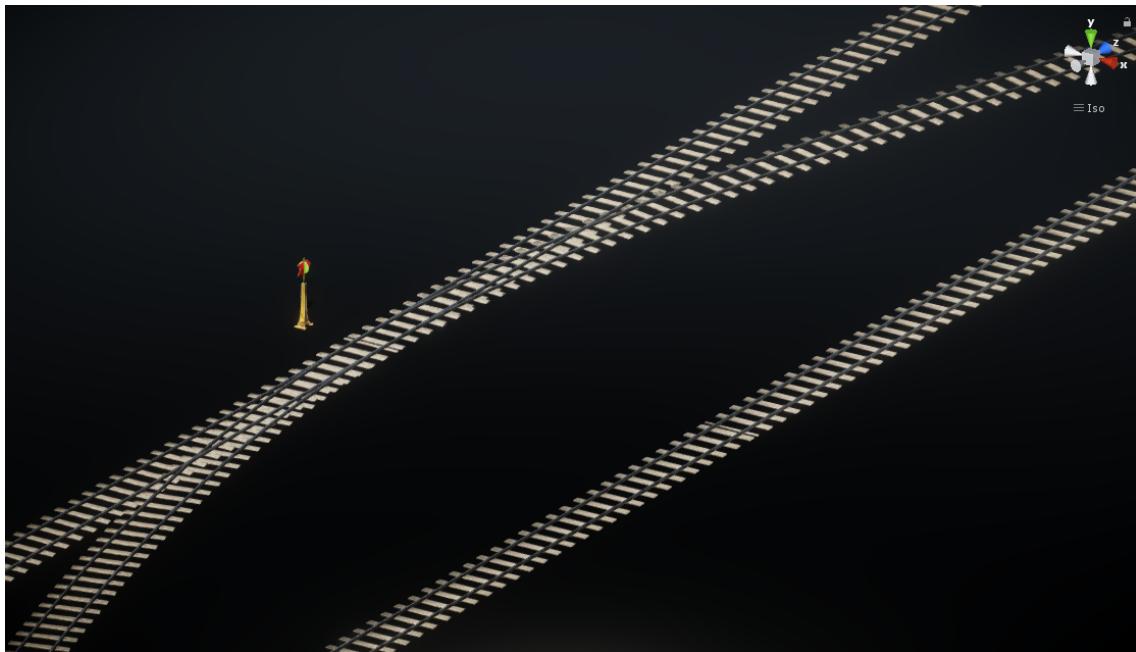


After finishing your railroad, is recommended to export all segments as prefabs using the Mesh Baker and replace all Railroad Builders with baked rails prefabs to improve scene performance. (See the [Railroad Prefab Export](#) section for more details)

# Railroad Switches (Turnouts)

In this section you will learn how to use, signalize and create custom Railroad Switches using the “Railroad Turnout Creator”.

You can also learn this by watching this [Video Tutorial](#) instead.



You will find sample turnouts at “Prefabs/Turnouts” folder. There is also, several track switching demo scenes at “Demo” folder.

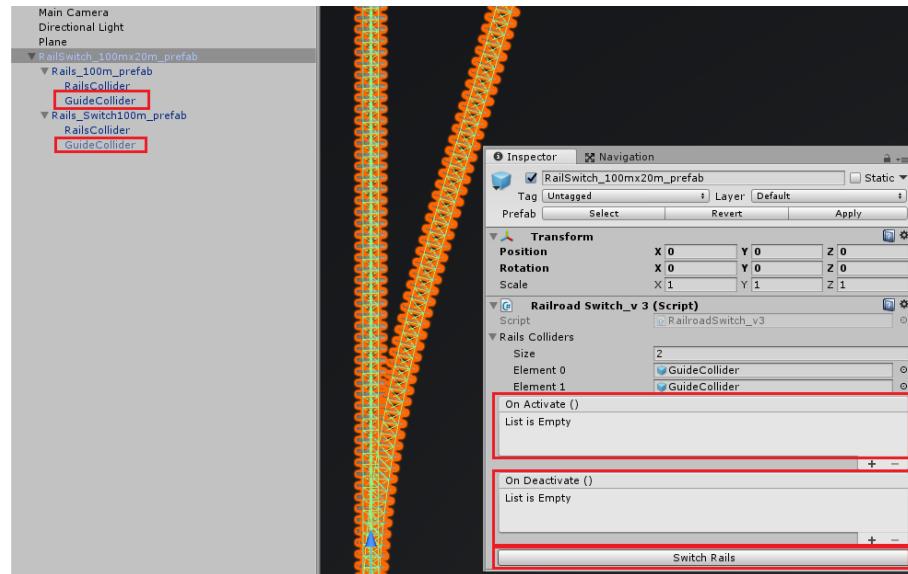


## How it works

Railroad switches works by enabling/disabling the rails “Guide Colliders” to redirect the trains on the desired direction. This behaviour is controlled by the “RailroadSwitch\_v3” script.

You can also change the initial direction of the rails at the Unity Editor by using the “Switch Rails” button on the inspector.

The “OnActivate” and “OnDeactivate” event stacks can be used to trigger custom events on your game as you wish. They are also used to sinalization (see [Railroad Turnout Sinalization](#) section for more details)

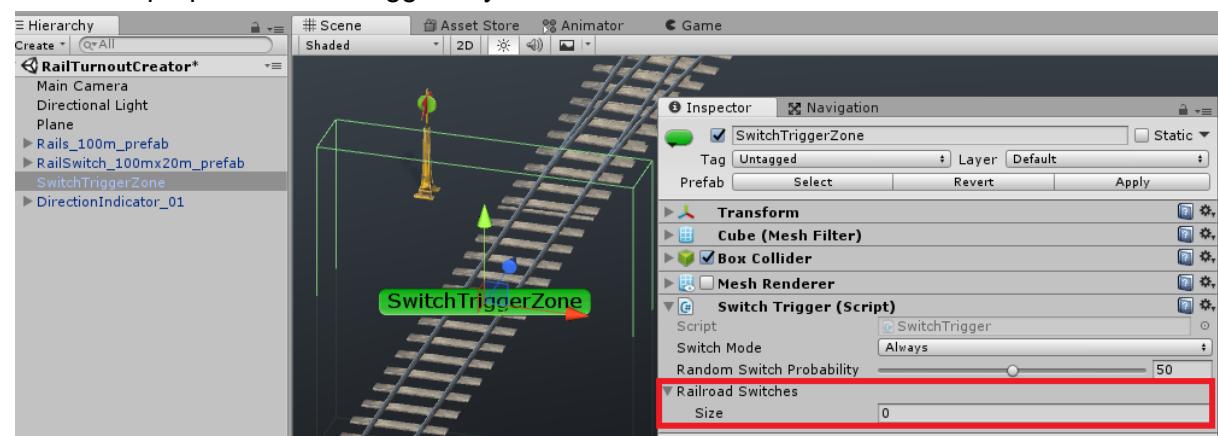


Switches are activated automatically when a train enters a “SwitchTriggerZone”. But, can also be activated manually by calling the “SwitchRails” method of the “RailroadSwitch\_v3” script.

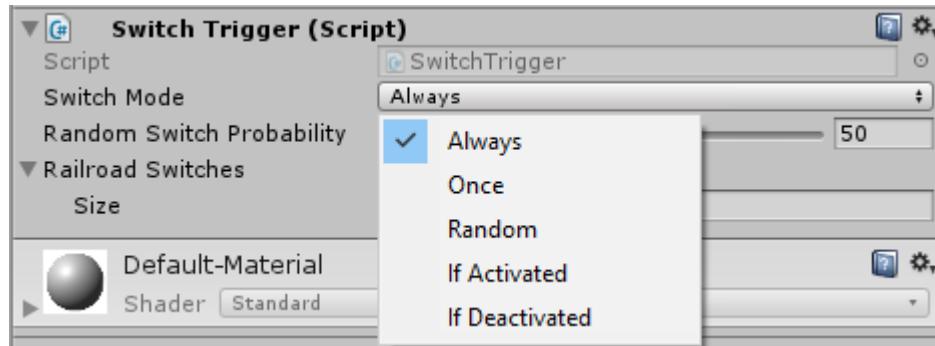
## Railroad Traffic Control

The “SwitchTriggerZone” prefab can be found on “Prefabs/Control Zones” folder. It is controlled by the “Switch Trigger” script and can activate one or more Railroad Switches at the same time.

You just need to drag & drop the railroad switches you want to control to the “Railroad Switches” propertie of the Trigger in your scene.



Switch Trigger Zones are a powerful way to automate your railroad. It allows to create custom complex railroad traffic control within minutes, just by selecting the desired switching mode.



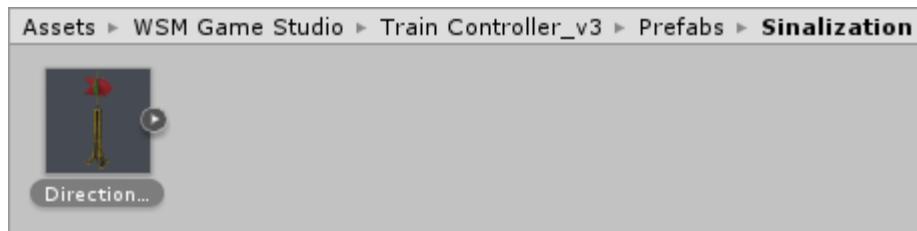
You can choose to switch the direction of the rails every time a train hit the trigger (always), only once, randomly or only if the turnout is activated or deactivated.

Random activation is controlled by the “Random Switch Probability” propertie, so you can fine tune the switch to activate more or less often.

“If Activated” and “If Deactivated” are useful to avoid derailing by creating safety check triggers before each railroad turnout.

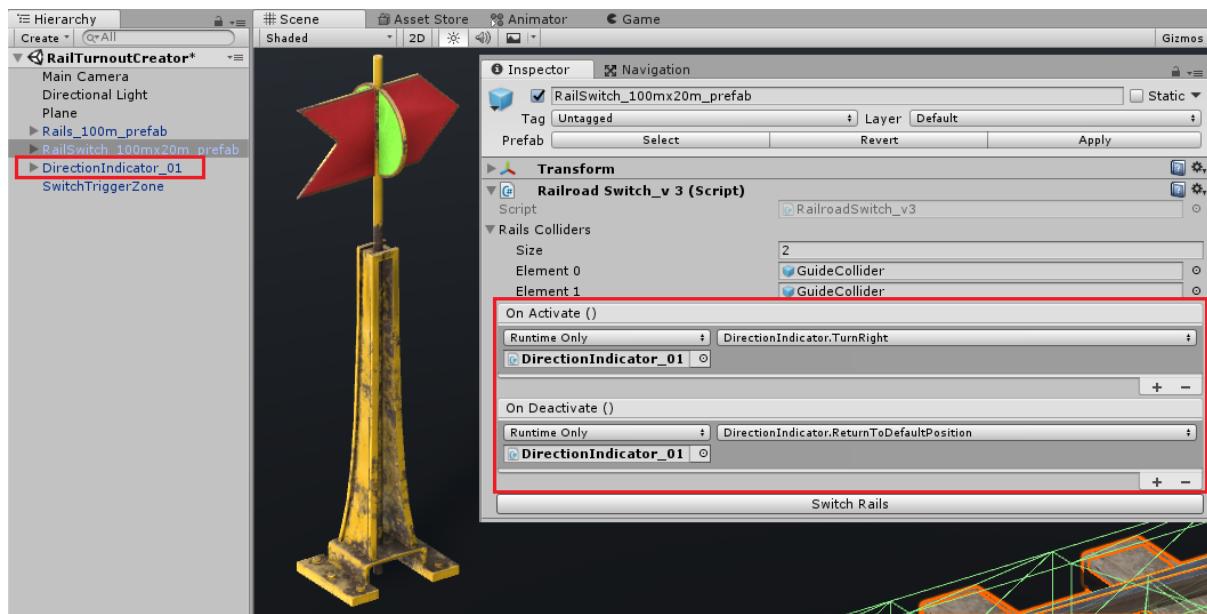
## Railroad Turnout Sinalization

At the “Prefabs/Sinalization” folder you will find the “DirectionIndicator\_01” prefab.



It is a ready to use animated direction indicator based on old real world direction indicators. It can point right, left or forward (default position)

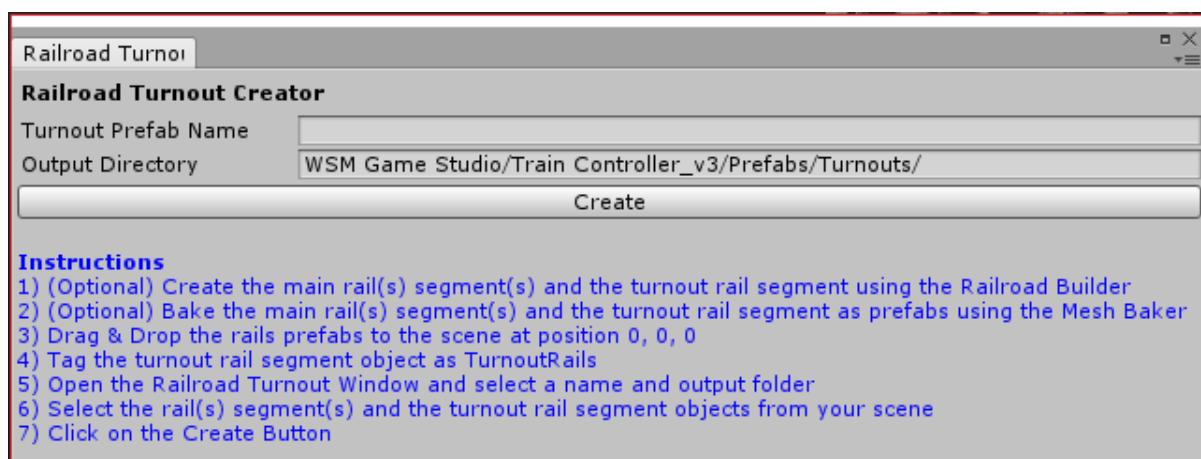
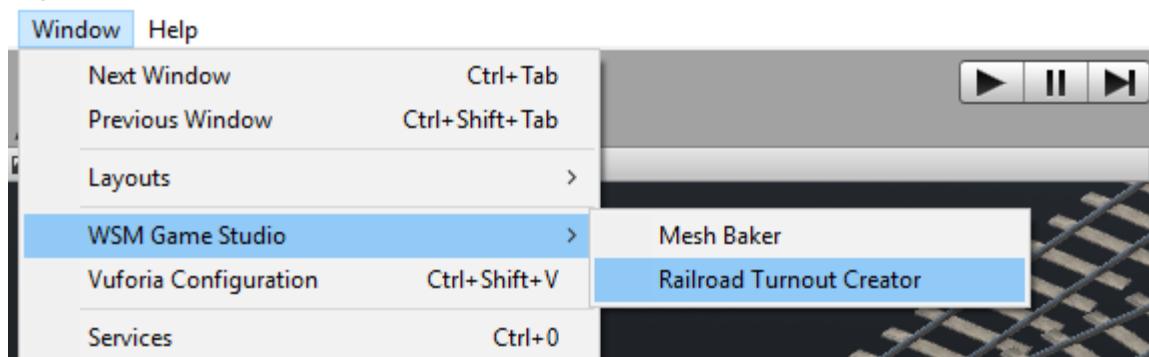
Drag & Drop it to your scene and place it next to the railroad switch you want to sinalize. Select the railroad switch object on your scene and use the “OnActivate” and “OnDeactivate” event stacks to call the “TurnRight”, “TurnLeft” or “ReturnToDefaultPosition” methods like in the sample image below.



## Custom Railroad Turnout Creator

You can create custom railroad switch prefabs by using the built-in Railroad Turnout Creator.

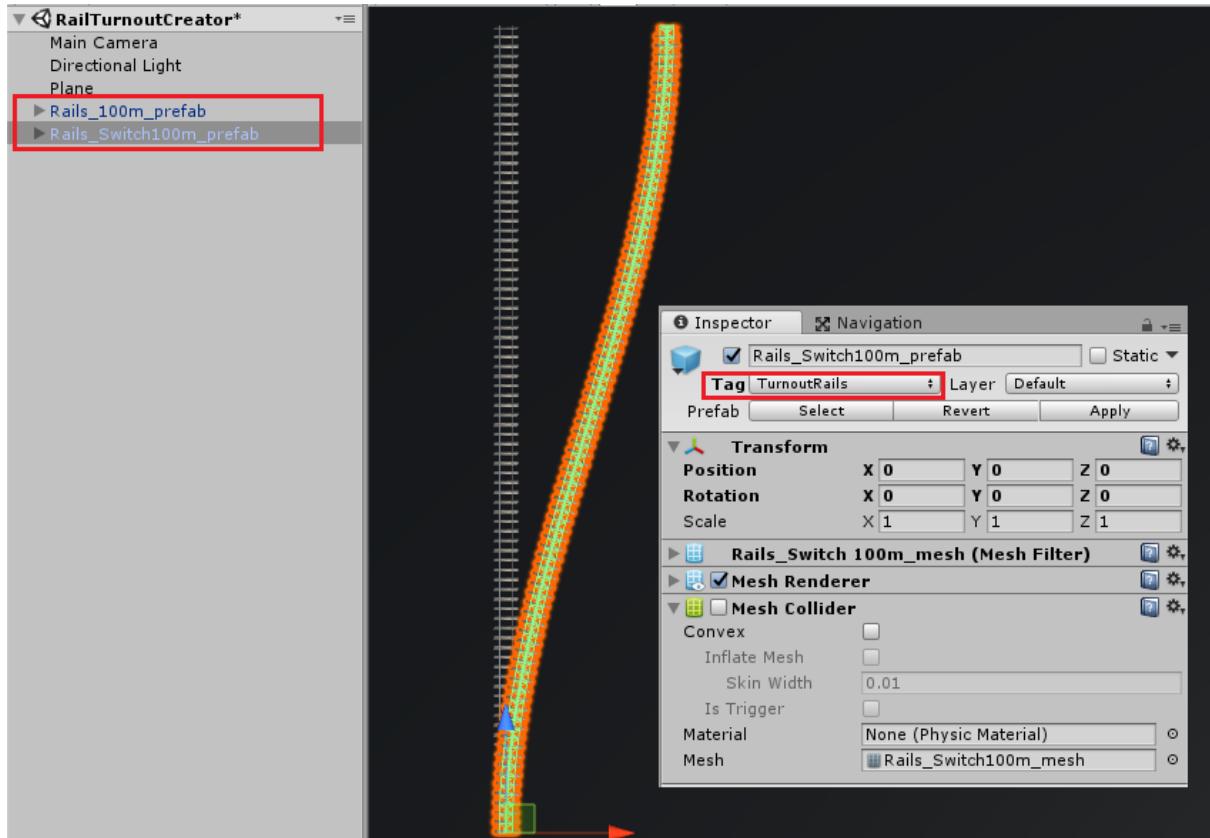
You can also learn this by watching this [Video Tutorial](#) instead.



To create a custom turnout, you just the rail segments that will be used to build the turnout. Custom rail segments with any length or curvature can be created by using the [Railroad Builder](#) and [Mesh Baker](#) (See [Building a Railroad](#) section for more details)

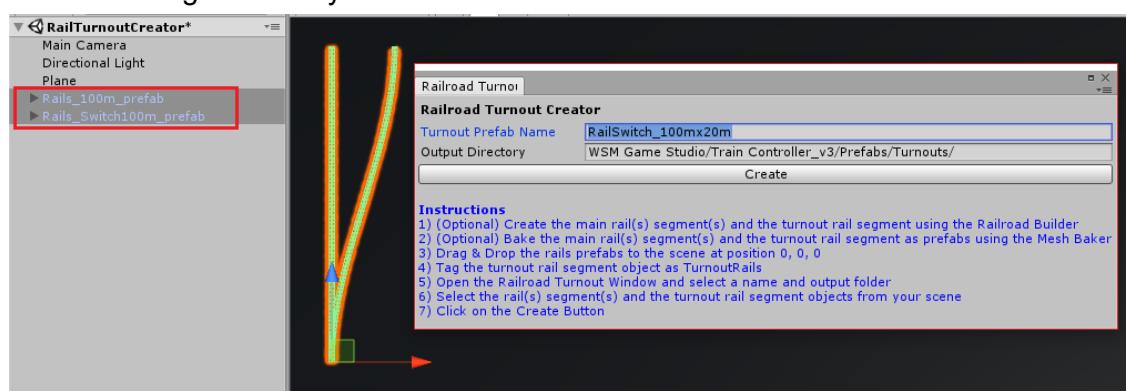
Drag & Drop the rail segments prefabs to your scene and set their positions to 0,0,0.

Then, select one of the segments (preferable the curved one) and set its Tag to "TurnoutRails". Only one segment must be tagged as "TurnoutRails". The tagged rail will be disabled by default.

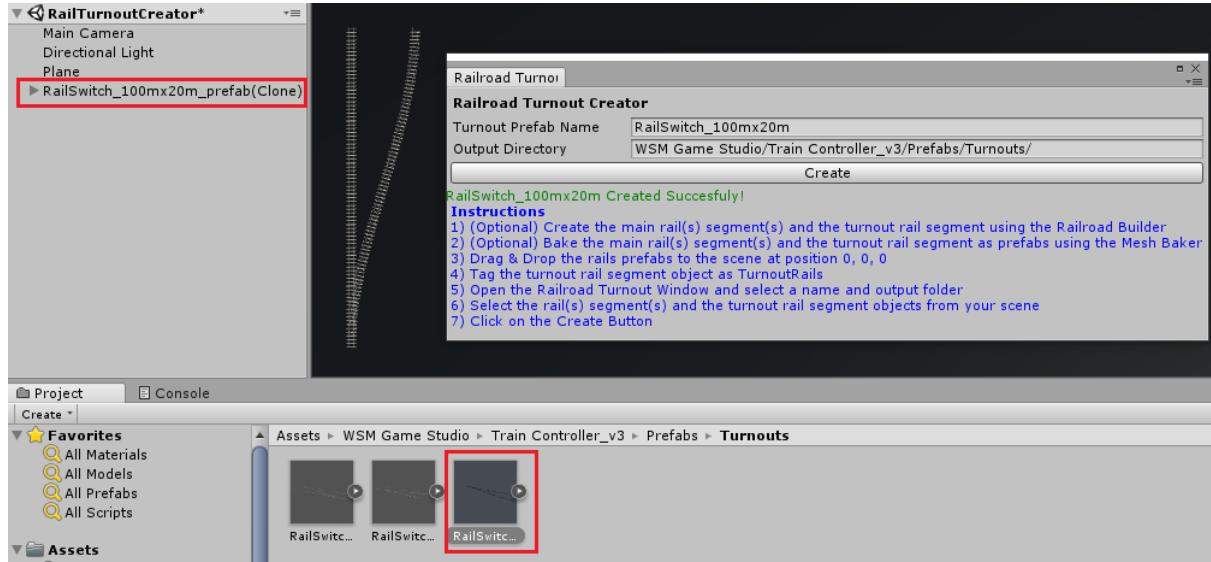


Open the Railroad Turnout Creator Window (Window > WSM Game Studio > Railroad Turnout Creator) and choose a prefab name and output directory.

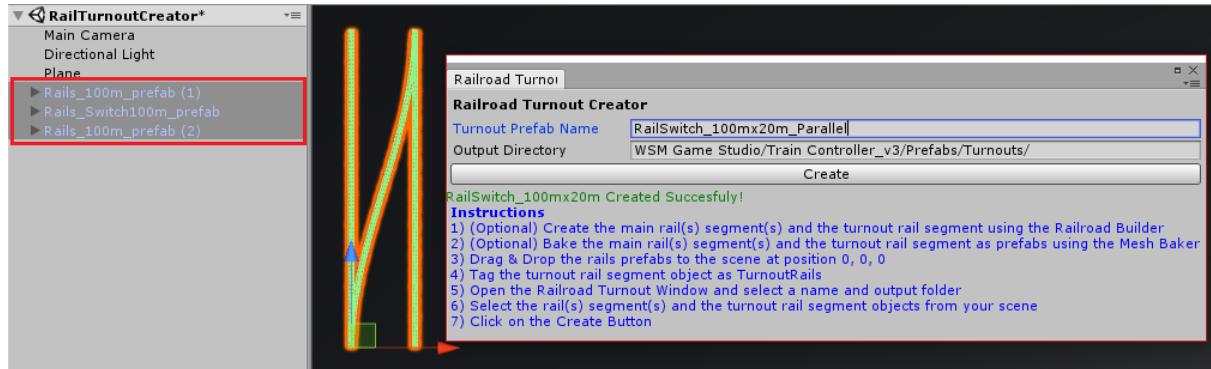
Select the rail segments on your scene and click on "Create".



If done correctly, the prefab will be saved on the selected output folder and a clone will be instantiated on the scene.



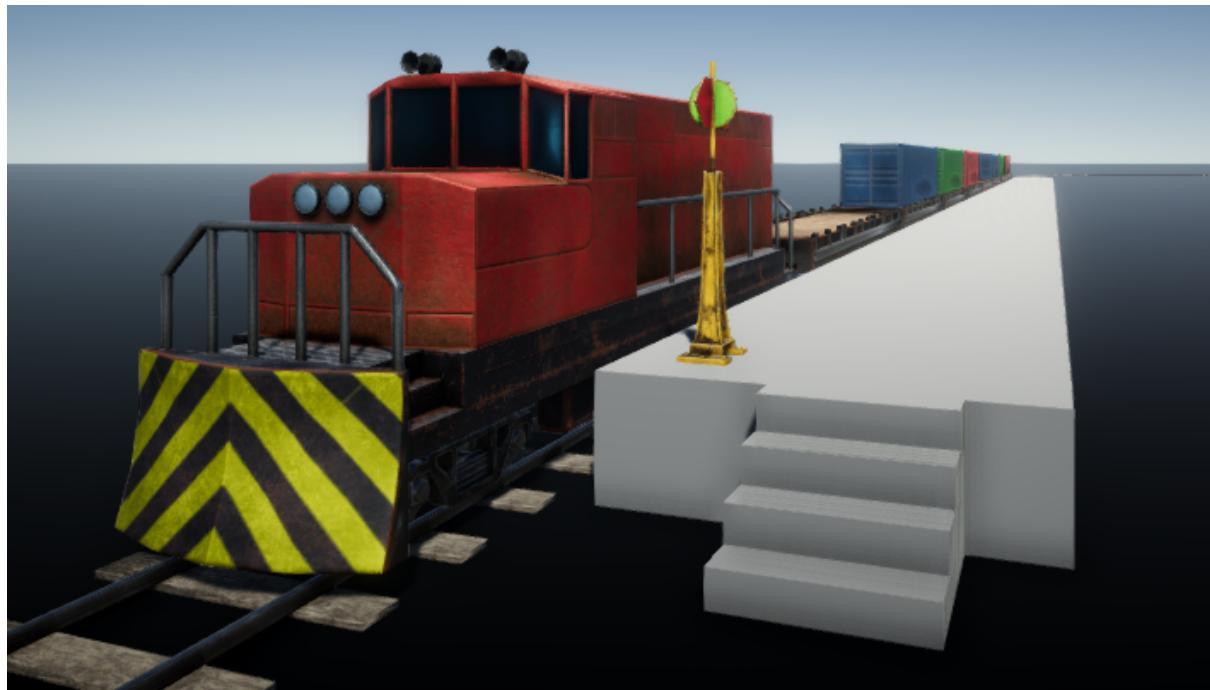
To create parallel rails connected by a turnout, you just need to add another rail segment, adjust its position and select all three rail segments before clicking on create (In this case, only the middle segment should be tagged as "TurnoutRails").



# Train Stations

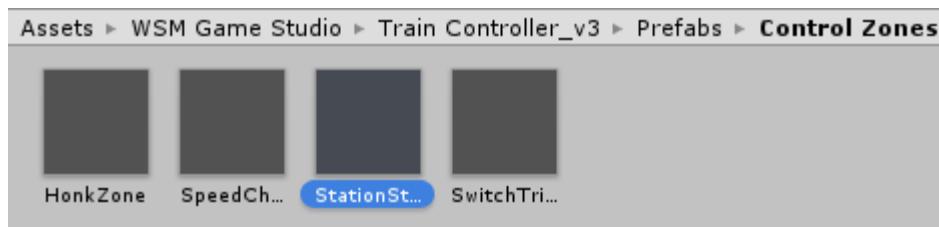
In this section you will learn how to simulate train stations

You can also learn this by watching this [Video Tutorial](#) instead.

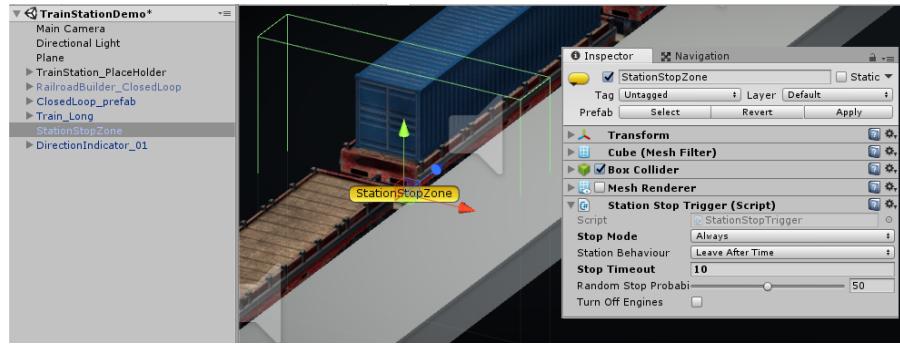


## Stopping at the Station

In the “Prefabs/Control Zones” folder you will find the “StationStopZone” prefab.



It can be used to simulate train station stops. Once a train hit a “StationStopZone” trigger, it will start braking until it stops.

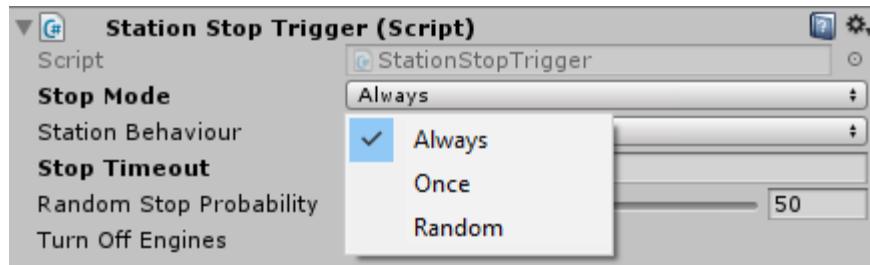


You can configure when the train should stop and how it behaves at the station after stopping.

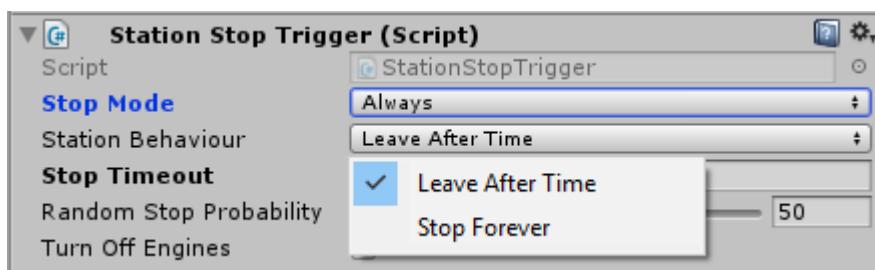


You can choose to always stop, stops only once or randomly stops at the station.

Random activation is controlled by the “Random Stop Probability” propertie, so you can fine tune if the train will stops more or less often.



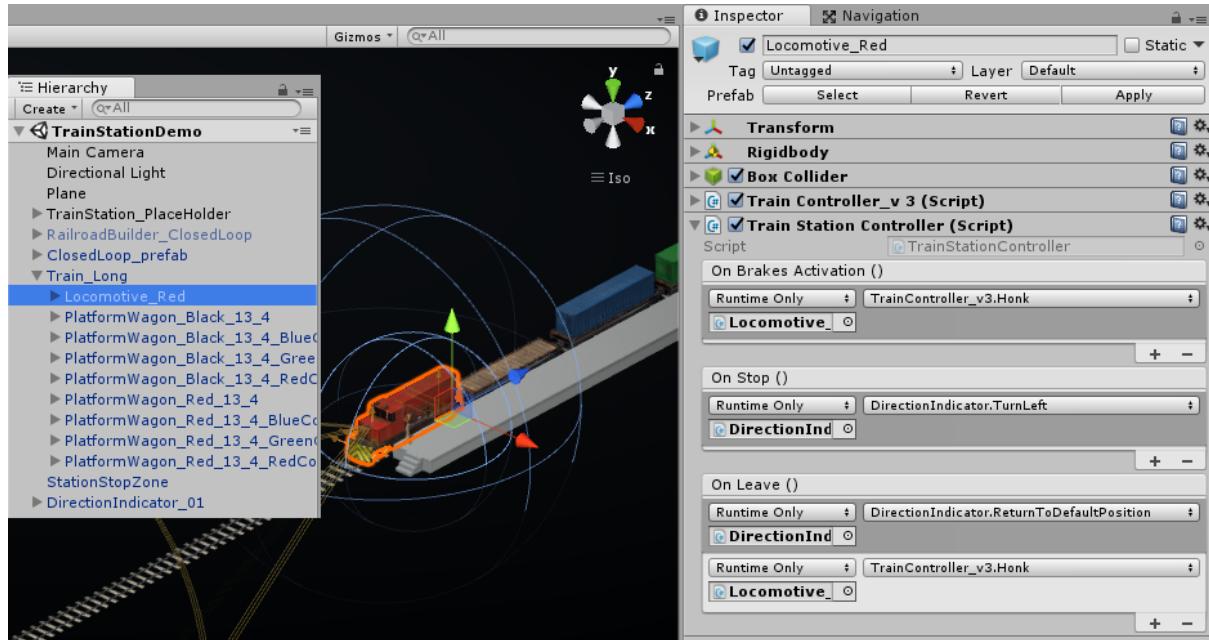
You can also choose to leave the station after some time or stay forever. The “Stop Timeout” property defines how many seconds the train will remain on station before leaving.



## Station Custom Events

You can call a custom event stack whenever the train starts breaking, stops moving or leaves the train station.

Custom events should be set at the “Train Station Controller” script of each train. This allows each train to trigger different events at the scene if needed.



# Building a Train

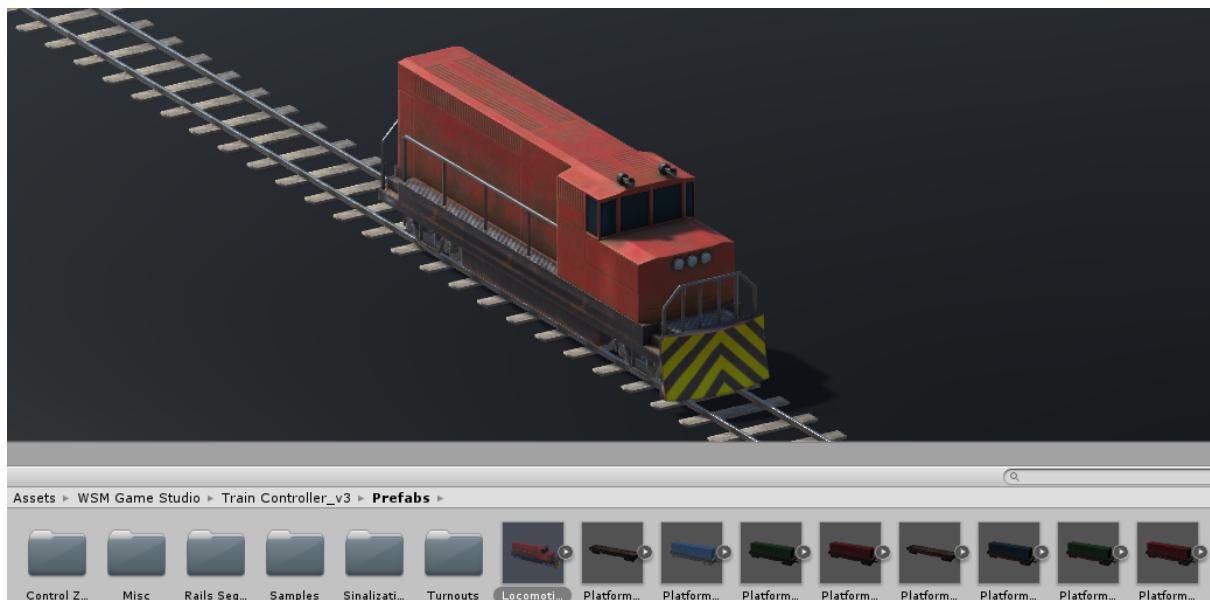
In this section you will learn how to build your custom train using the locomotive and wagons prefabs.

You can also learn this by watching this [Video Tutorial](#) instead.

## Connecting Wagons (Automatically)

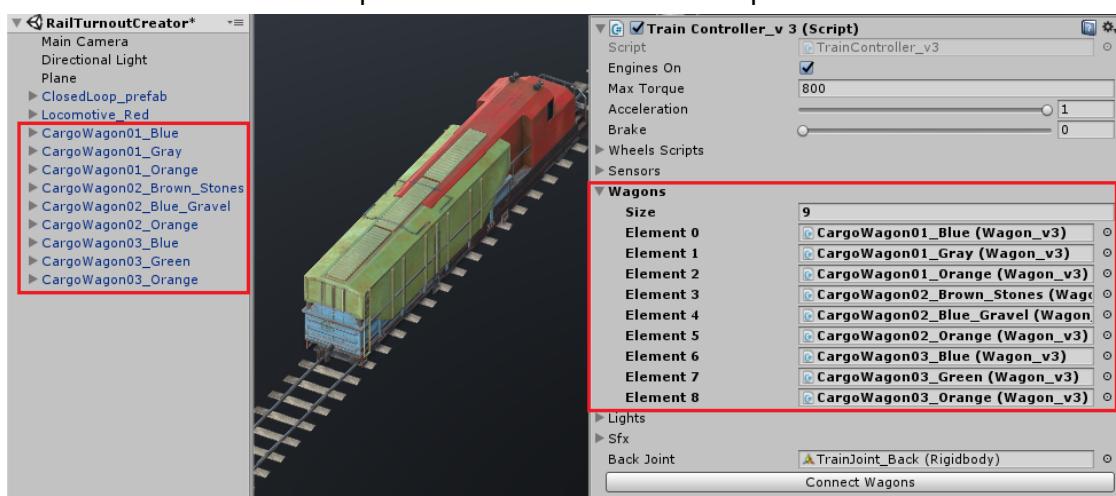
Additional wagons were used in this sample ([Available Here](#))

To start building your train, simple drag and drop the locomotive prefab on top of a straight rail segment.



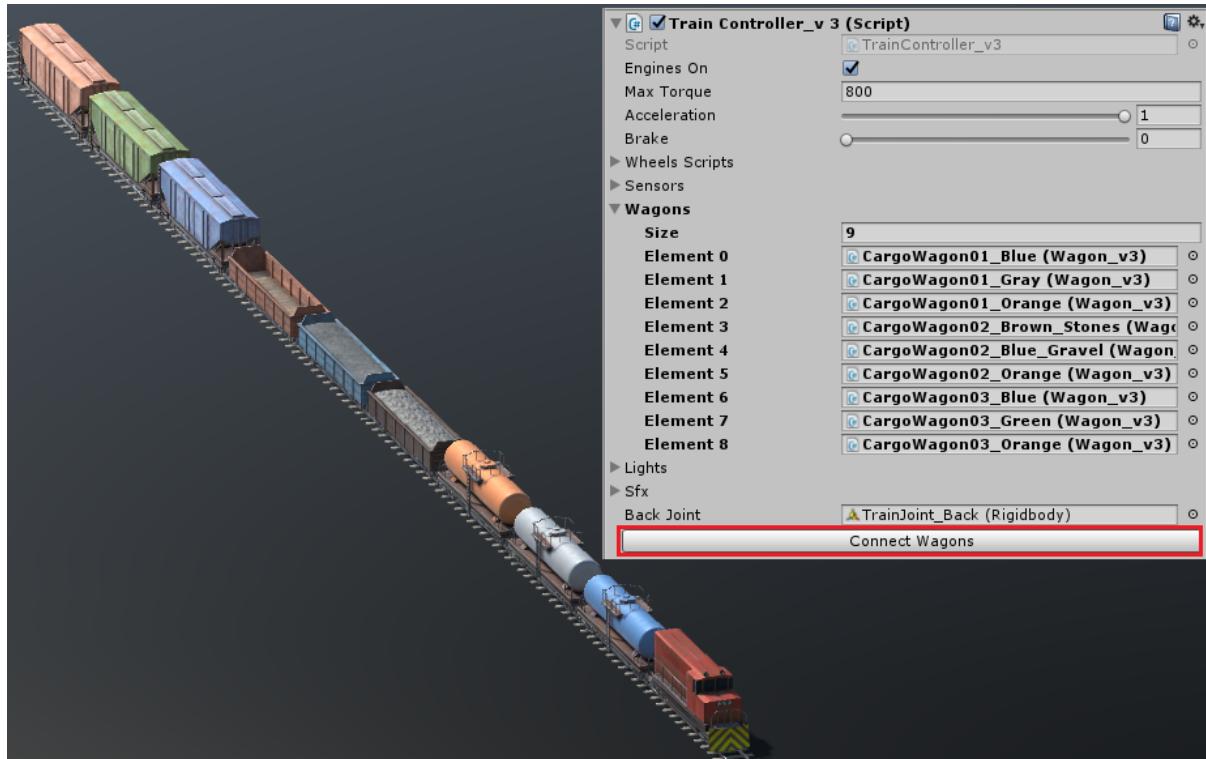
Drag & Drop wagons prefabs on your scene.

Then, select the wagons on your scene and drag & drop them on the “Wagons” list property of the “Train Controller” script attached on the locomotive prefab.



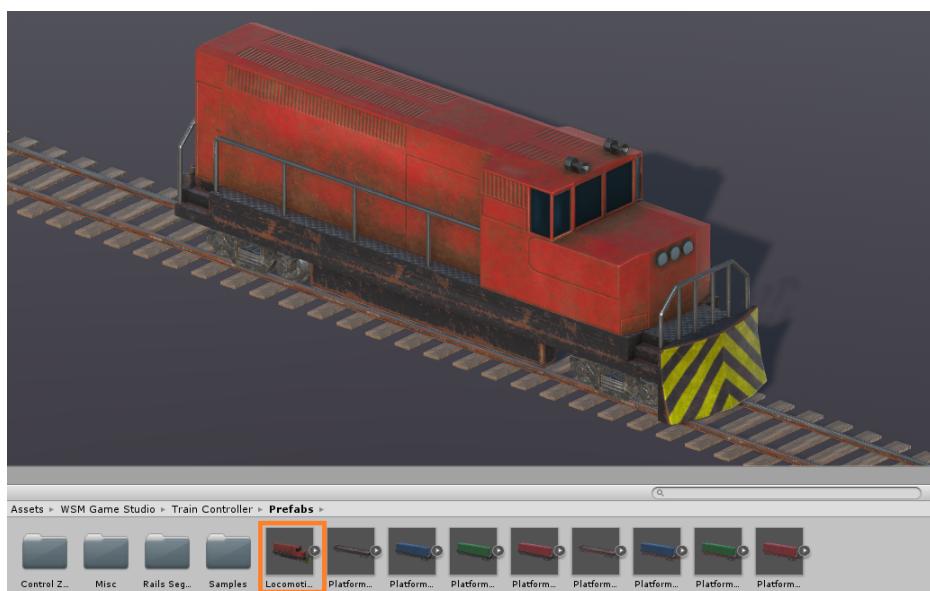
Now, click the “Connect Wagons” button.

All the wagons will be repositioned automatically behind the locomotive, following the wagons list order.



## Connecting Wagons (Manually)

To start building your train, simple drag and drop the locomotive prefab on top of a straight rail segment.



Select your first wagon on the prefabs folder and drag and drop it to your scene.



Adjust the position of the wagon until its joint is perfectly aligned with the locomotive joint.

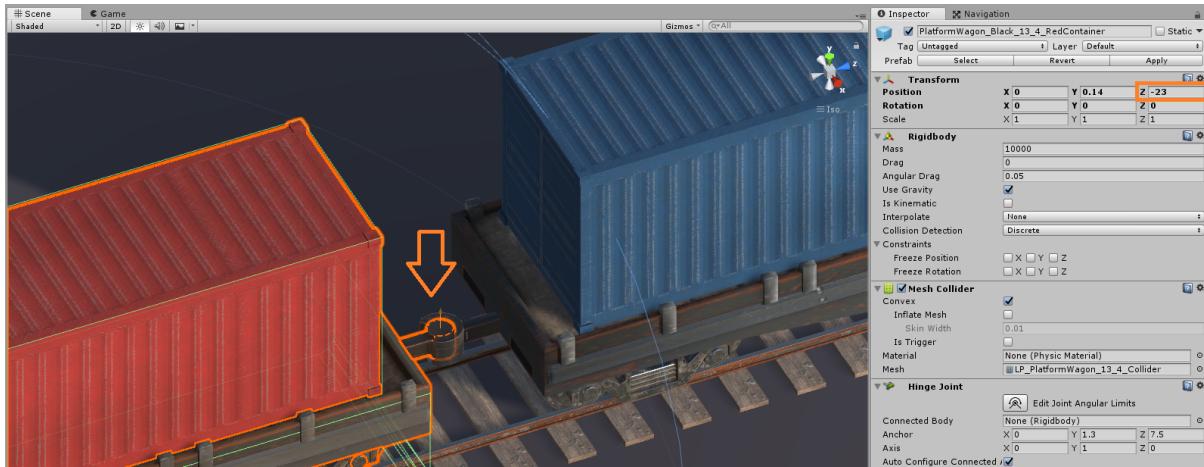
For the first wagon, the perfect alignment can be achieved by using the locomotive z position value -8.

So, if your locomotive is at  $z = 0$ , the first wagon must be at  $z = -8$ .



Repeat the process to add more wagons, but this time, use a position offset of -15 instead of -8 to get a perfect alignment.

So, if your first wagon is at  $z = -8$ , the second must be at  $z = -23$ .

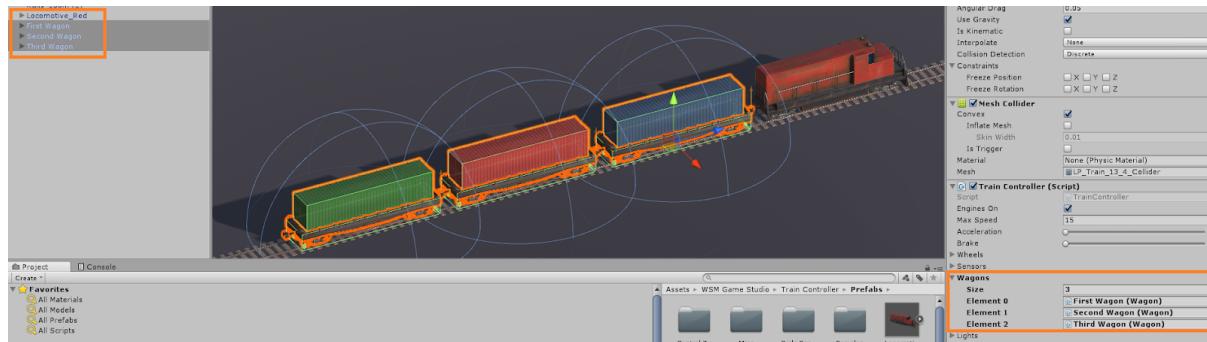


Repeat the process to add as many wagons as you wish.

After adding all the wagons to your scene, you need fill the TrainController script wagons list. The TrainController script is attached to the locomotive prefab. Simple drag and drop the wagons to the list in order.

The Wagons list is used to create the joints connections at runtime, so there is NO need for you to connect the wagons hinge joints manually. It is also used to control the wagons behaviour (wheels, sfx, etc).

The wagons MUST be added to the list in order. In the example image below, the wagons were renamed to “First Wagon”, “Second Wagon” and “Third Wagon” and then added to the list.

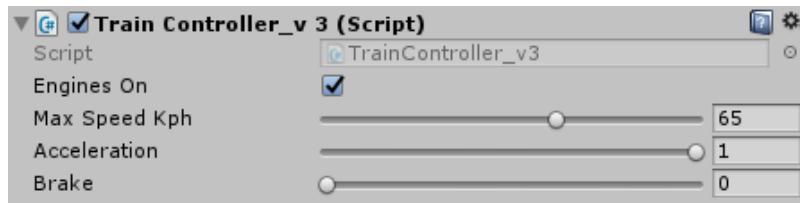


# Train Speed

In this section you will learn how to control and monitor the train speed.

## Controlling Train Speed

The train speed is controlled by the “Max Speed Kph” and “Acceleration” properties of the Train Controller script.



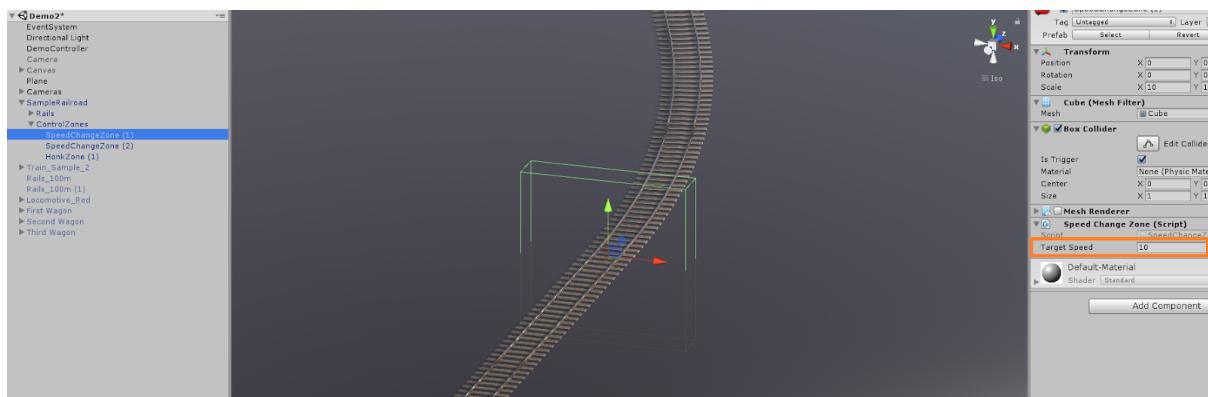
The Max speed is a range between 0 kph and 105 kph, based on real world trains average max speed values.

The acceleration property, defines train movement direction:

- **Acceleration 1:** Foward
- **Acceleration 0:** Stop
- **Acceleration -1:** Reverse

To adjust the train Max Speed at runtime, you can add SpeedChangeZones at the railroad and adjust the target speed value (See the [Control Zones](#) section for more info).

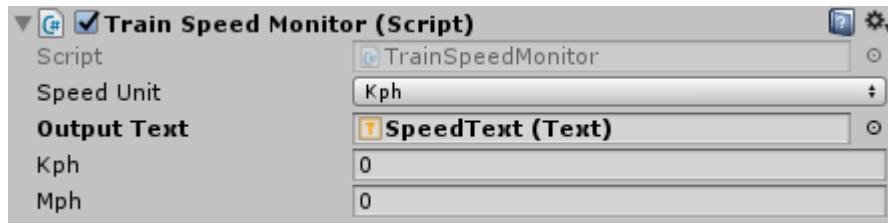
It is recommended to use SpeedChangeZones before and after every railroad curve.



You can also use the Brake property to reduce train speed and stop the train.

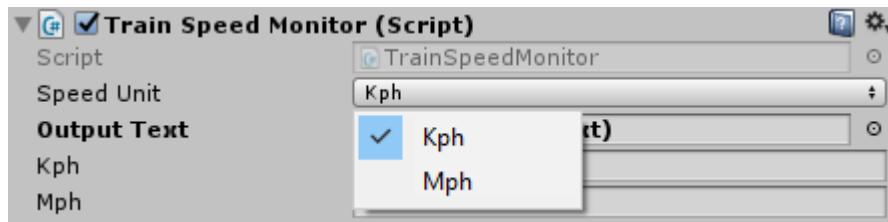
## Train Speed Monitor

You can monitor train current speed, by using the “Train Speed Monitor” attached to the locomotive prefab.

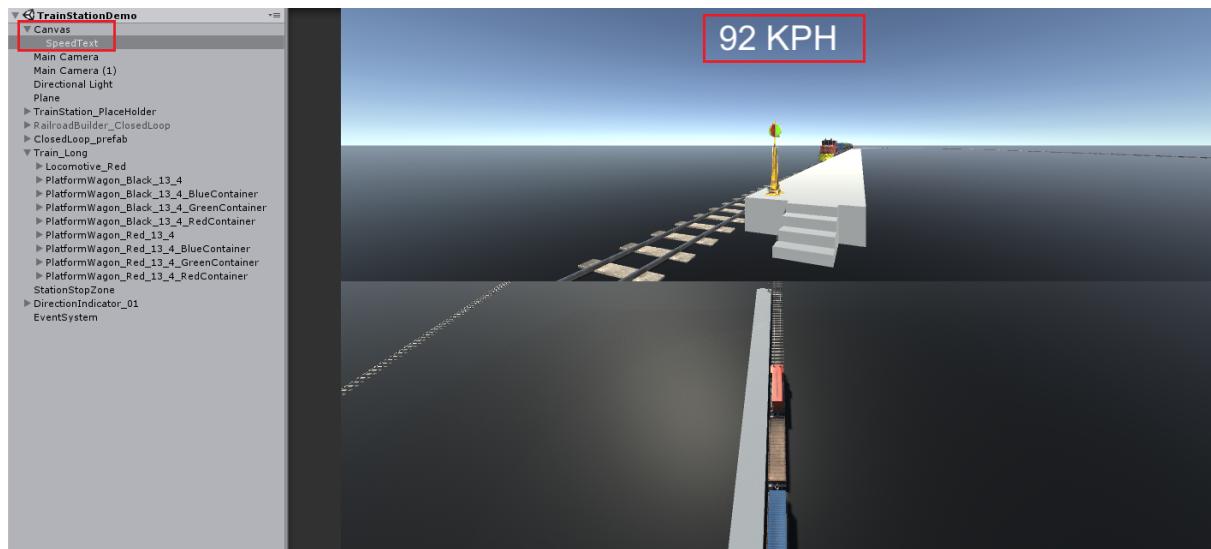


The “Kph” and “Mph” properties are updated on real time, to monitor speed by selecting the locomotive on the editor.

You can also print the current speed value to a Text field, just Drag & Drop your text to the “Output Text” property and select the speed unit you wish to print (Kph or Mph)



In all the Demo scenes included in the project, the speed is printed to the “SpeedText”, as you can see below.



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