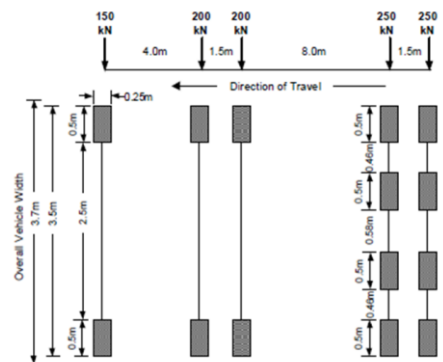# Add a User Vehicle to the Vehicle Load Optimisation facility

For LUSAS version:	19.0
For software product(s):	LUSAS *Bridge* and LUSAS *Bridge Plus*
With product option(s):	LUSAS Vehicle Load Optimisation

Description

User-defined custom vehicles may be added to the Vehicle Load Optimisation facility by copying and editing supplied files.

In this example, the assessment vehicle SV-TT (3.21) from the United Kingdom's code BD86/11, DMRB, Highways Agency 2011 will be made available for selection on the Vehicle Load Optimisation dialog. The modification is based around the currently supplied implementation for EN1991-2 UK 2009.

The method described can be applied to add a vehicle to any other design code supported by the VLO facility.

The example assumes that LUSAS has already been installed on the computer and that a licence key to run Vehicle Load Optimisation is available.

Keywords

Traffic Load Optimisation, Vehicle, BD86/11, SV-TT

Procedure

Step 1

Based on your LUSAS installation, locate the vehicle load optimisation configuration folder for the Eurocode called 'UK'.

Its location will be similar to that shown below:

`C:\Program Files(x86)\LUSAS190\Programs\scripts\vlo\config\Eurocode\UK`

Step 2

- From this folder, copy the following files:

  - ❑ **designCases.xm**l

  - ❑ **designCode.xml**

  - ❑ **LM3.xml**

  - ❑ **trafficLoads.xml**

- Paste these files into the following location (create the folder if it does not exist):

`C:\Users\<username>\AppData\Local\Lusas190\vlo\config\UK`

Note that on older versions of Windows the location will be:

`C:\Documents and Settings\<username>\Local Settings\Application Data\LUSAS190\vlo\config\UK`

Step 3

From this folder:

`C:\Program Files(x86)\LUSAS190\Programs\scripts\vlo\config\Eurocode`

- Copy and paste the whole **recValues** folder into:

`C:\Users\<username>\AppData\Local\Lusas190\vlo\config`

This step is necessary because the Combination and the Frequent design cases are defined in the files in the recValues folder.

Step 4

From this folder:

`C:\Users\<username>\AppData\Local\Lusas180\vlo\config\recValues`

- Delete the file **designCode.xml**.

This step is necessary to avoid having two design codes with the same name. No other files within the recValues folder need to be edited.

⚠️ **Caution.** **Never edit any of the files supplied as part of a LUSAS installation**. Even modifying a file and subsequently changing back to its original state would make Windows 'believe' that we want to keep this modified file, and therefore when a new version of LUSAS is installed in the future, the modified file would be kept instead of replaced by the new file, that may have been updated. This would make TLO not work correctly in the future.

Having created the vehicle load optimisation configuration folder for the UK, the files within the folder can now be edited to add the new vehicle.

Step 5

In this folder:

```
C:\Users\<username>\AppData\Local\Lusas180\vlo\config\UK
```

- Edit the file **designCode.xml**

Editing can be done in any text editor, but it is recommended to install Notepad++ text editor and set the Language as XML. See https://notepad-plus-plus.org for details.

The following section of text in the designCode.xml file needs to be modified to include ' **– USER**' to the line that starts with <GUI_NAME>

```xml
<DESIGN_CODE>
  <NAME>EN1991-2 UK National Annex</NAME>
  <GUI_CATEGORY>United Kingdom</GUI_CATEGORY>
  <GUI_NAME>EN1991-2 UK 2009</GUI_NAME>
  <UNITS>kN,m,t,s,C</UNITS>
```

- Edit the file to include the text '**– USER'** as follows:

```xml
<DESIGN_CODE>
  <NAME>EN1991-2 UK National Annex</NAME>
  <GUI_CATEGORY>United Kingdom</GUI_CATEGORY>
  <GUI_NAME>EN1991-2 UK 2009 - USER</GUI_NAME>
  <UNITS>kN,m,t,s,C</UNITS>
```

⚠️ **Caution.** The new <GUI_NAME> must be the same as the old one with the addition of ' **– USER**' to the end. No other name is valid.

When this file is saved, a new 'USER' design code entry will be added to the list of available design codes displayed on the Vehicle Load Optimisation dialog for the United Kingdom.

Step 6

In this folder:

`C:\Users\<username>\AppData\Local\Lusas190\vlo\config\UK`
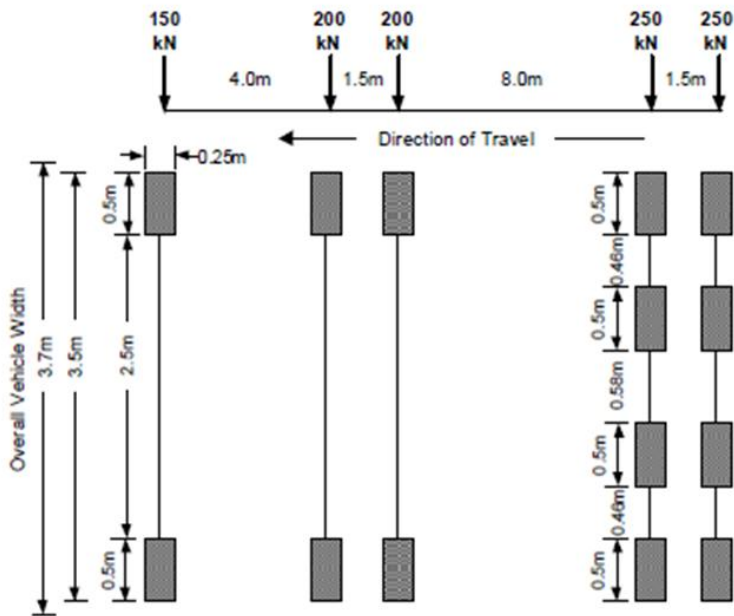
- Edit the file '**LM3.xml**' to add the additional vehicle.

The vehicle to be added is the SV-TT from the DMRB BD86/11, section 3.13, as shown on the following image:

The new lines of code will be added after the **<BOGIED_LOAD>** entry for the SOV600 vehicle and before the last **</Vehicles>** line:

```
<BOGIED_LOAD>
  <NAME>SOV600</NAME>
  <TRAFFIC_LOADS>SOV600_Bogie1, SOV600_Bogie2</TRAFFIC_LOADS>
  <SPACINGS>1.5To40</SPACINGS>
  <LOADABLE_AREA>LANE</LOADABLE_AREA>
  <STRADDLING>A</STRADDLING>
  <TRANSVERSE_LIMIT_LANE>1.5</TRANSVERSE_LIMIT_LANE>
  <TRANSVERSE_LIMIT_KERB>1.5</TRANSVERSE_LIMIT_KERB>
  <TRANSVERSE_BEHAVIOUR>ADVERSE</TRANSVERSE_BEHAVIOUR>
  <EXCLUSIONS> "EXCL_TS_UK",  "EXCL_UDL_UK"</EXCLUSIONS>
  <SYMMETRIC>NONE</SYMMETRIC>
</BOGIED_LOAD>


<! New code is to be added here>


</Vehicles>
```

In order to define the vehicle, first we need to define the wheels and the axles.

Defining Wheels

The wheels are modelled as <LOAD> objects, where the weight of the wheel is introduced in the <INTENSITY> property. For the wheels of the SV-TT vehicle, the following <LOAD> objects must be defined.

```xml
<LOAD>
  <NAME>75Wheel</NAME>
  <!-- 150kN axle gives 75kN wheels -->
  <INTENSITY>75</INTENSITY>
</LOAD>
<LOAD>
  <NAME>100Wheel</NAME>
  <!-- 200kN axle gives 100kN wheels -->
  <INTENSITY>100</INTENSITY>
</LOAD>
<LOAD>
  <NAME>62.5Wheel</NAME>
  <!-- 250kN axle gives four 62.5kN wheels -->
  <INTENSITY>62.5</INTENSITY>
</LOAD>
```

Note. Comment lines are denoted by these markers **<!-- -->** and are ignored by the software.

- Copy and paste the lines above into the stated location within the file.

Defining Axles

The axles are defined using <AXLE> objects; an axle definition comprises of the wheels (modelled as <LOAD> objects, and their position from the centreline of the vehicle. Optionally, axles can have factors applied.

For the SV-TT vehicle, the following axles will be defined:

```xml
<AXLE>
  <NAME>150Axle</NAME>
  <LOADS>75Wheel,75Wheel</LOADS>
  <!-- 3.5m wheel edge to wheel edge, less 0.5m wheel width, gives
3.0m transverse wheel centres -->
  <LOAD_POS>-1.5,1.5</LOAD_POS>
  <FACTOR>
    <NAME>daf</NAME>
    <VALUE>1.13</VALUE> <!-- The Dynamic Amplification Factor (DAF)
is defined in clause 3.25 -->
```

```
      </FACTOR>
    </AXLE>


    <AXLE>
      <NAME>200Axle</NAME>
      <LOADS>100Wheel,100Wheel</LOADS>
      <!-- 3.5m wheel edge to wheel edge, less 0.5m wheel width, gives
3.0m transverse wheel centres -->
      <LOAD_POS>-1.5,1.5</LOAD_POS>
      <FACTOR>
        <NAME>daf</NAME>
        <VALUE>1.84</VALUE> <!-- The Dynamic Amplification Factor (DAF)
is defined in clause 3.25 -->
      </FACTOR>
    </AXLE>


    <AXLE>
      <NAME>250Axle</NAME>
      <LOADS>62.5Wheel,62.5Wheel,62.5Wheel,62.5Wheel</LOADS>
      <!-- 3.5m wheel edge to wheel edge, less 0.5m wheel width, gives
3.0m transverse wheel centres -->
      <LOAD_POS>-1.5,-0.54,0.54,1.5</LOAD_POS>
      <FACTOR>
        <NAME>daf</NAME>
        <VALUE>1.05</VALUE> <!-- The Dynamic Amplification Factor (DAF)
is defined in clause 3.25 -->
      </FACTOR>
    </AXLE>
```

- Copy and paste the lines above into the stated location within the file.

Define Vehicle Load

The next step is to define the vehicle load, as shown below; note the explanatory comments for properties:

```
    <VEHICLE>
      <NAME>SV-TT</NAME>
       <AXLES>150Axle,200Axle,200Axle,250Axle,250Axle</AXLES>
      <AXLE_POS>0,4,5.5,13.5,15</AXLE_POS> <!-- Axles positions in
absolute distances -->
      <LOADABLE_AREA>LANE</LOADABLE_AREA>
      <STRADDLING>A</STRADDLING> <!-- The SV-TT vehicle can straddle two
lanes -->
```

```
    <TRANSVERSE_LIMIT_LANE>1.85</TRANSVERSE_LIMIT_LANE> <!-- This
represents how close can the centreline of the vehicle can get to the
edge of a lane -->
    <TRANSVERSE_LIMIT_KERB>1.85</TRANSVERSE_LIMIT_KERB> <!-- This
represents how close can the centreline of the vehicle can get to a
kerb -->
    <TRANSVERSE_BEHAVIOUR>ADVERSE</TRANSVERSE_BEHAVIOUR> <!-- The
vehicle is placed in adverse areas -->
    <EXCLUSIONS> "EXCL_TS_UK", "EXCL_UDL_UK"</EXCLUSIONS>  <!-- The
vehicle is using the same exclusion rules as the other SV/SOV vehicles
defined above -->
    <OVERALL_WIDTH>3.7</OVERALL_WIDTH>
    <SYMMETRIC>None</SYMMETRIC> <!-- The vehicle is not symmetric -->
  </VEHICLE>
```

- Copy and paste the lines above into the stated location within the file.

- Save the file.

Step 7

In this folder:

`C:\Users\<username>\AppData\Local\Lusas190\vlo\config\UK`

- Edit the file **designCases.xml**

This file contains the list of the load patterns (that specify which traffic loads will be tried) and design cases available for a design code. It also contains properties about the placement algorithm.

The same placement rules apply for the SV-TT vehicle as for the other SV/SOV vehicles in BS EN1991-2:2009, and therefore the load pattern that is to be created for the SV-TT vehicle will be similar to the existing ones.

The easiest way to add this new load pattern is to:

- Copy a load pattern such as **GR5B-CHAR**

- Scroll down the file and paste it before the **<DESIGN_CASE>** line.

- Rename the load pattern to be **SV-TT**

- In the <TRAFFIC_LOADS> property, replace the traffic load **SV100** with **SV-TT**

The new load pattern will look like this:

```
<LOAD_PATTERN>
  <NAME>SV-TT</NAME>
  <GROUP>GR5</GROUP>
  <UI_GROUP>GR5</UI_GROUP>
  <PLACEMENT>A</PLACEMENT>
  <TS_PSI>TS_PSI1</TS_PSI>
  <UDL_PSI>UDL_PSI1</UDL_PSI>
  <RAL_PSI>RAL_PSI1</RAL_PSI>
  <TS_TRANS>TS_TRANS_VALUE</TS_TRANS>
  <TRAFFIC_LOADS>SV-TT,LM1 udl,LM1 ts,LM1 ral</TRAFFIC_LOADS>
  <MIN_PER_LANE> 0,  0,  0,  0</MIN_PER_LANE>
  <MAX_PER_LANE> 1,  1,  1,  1</MAX_PER_LANE>
  <MIN_PER_DECK> 0,  0,  0,  0</MIN_PER_DECK>
  <MAX_PER_DECK> 1, -1,  3, -1</MAX_PER_DECK>
</LOAD_PATTERN>
```

Lastly, whilst still editing the designCases.xml file, the new SV-TT load pattern needs to be added to the **Characteristic** design case, as below:
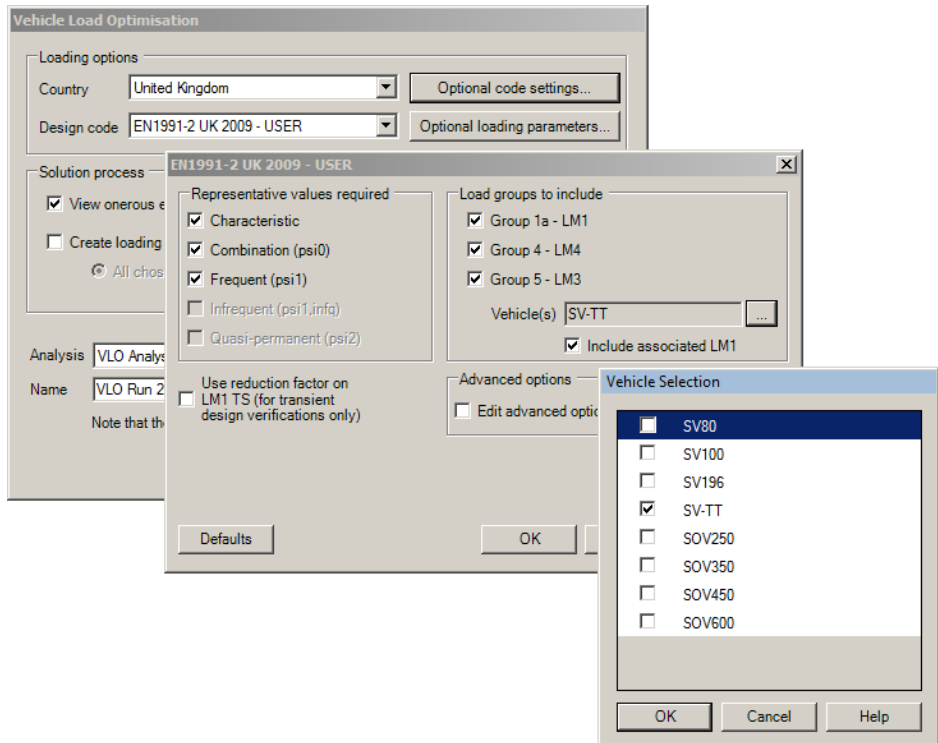
```
<DESIGN_CASE>
  <NAME>Characteristic</NAME>
  <LOAD_PATTERNS>GR1A-CHAR, GR4-CHAR, GR5A-CHAR, GR5B-CHAR, GR5C-
CHAR, GR5D-CHAR, GR5E-CHAR, GR5F-CHAR, GR5G-CHAR, SV-
TT</LOAD_PATTERNS>
</DESIGN_CASE>
```

- Once edited, save the file.

The SV-TT vehicle will now be available for selection by pressing the **Optional code settings** button in the Vehicle Load Optimisation dialog, and making the appropriate selection.

Vehicle Load Optimisation can now be carried out using this vehicle.

This completes the example.