Advance Design Steel Connections

Tutorial
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About this tutorial

The goal of this document is to help you achieve the first connection calculations according to Eurocode 3 using the new module “Advance Design - Steel Connection”. This tutorial contains step-by-step instructions for calculating two connections: Knee of frame bolted, with haunch and Apex haunch.

Note: In this document, the ADSC abbreviation refers to Advance Design Steel Connection.
Connection design

In this chapter

- Knee of frame bolted, with haunch
- Apex haunch
Knee of frame bolted, with haunch

In this example you will create and define the properties of the following connection.

Data

The loads are:

<table>
<thead>
<tr>
<th>Case</th>
<th>Name</th>
<th>Nx (kN)</th>
<th>Vz (kN)</th>
<th>Mz (kN.m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Dead Loads</td>
<td>-11.9</td>
<td>-15.7</td>
<td>51.3</td>
</tr>
<tr>
<td>SNOW</td>
<td>Snow</td>
<td>-12.6</td>
<td>-16.3</td>
<td>54.4</td>
</tr>
</tbody>
</table>

They correspond to the following forces:

<table>
<thead>
<tr>
<th>Maximum forces in the end plate plane</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Max</td>
</tr>
<tr>
<td>D2</td>
</tr>
<tr>
<td>G8</td>
</tr>
</tbody>
</table>
Creating the project
From the Windows Start menu, select Programs > Graitec > Advance Design > Advance Design - Steel Connection.
1. On the Project tab, click New project.

2. In the “New project” dialog box enter Tutorial for the project name.
3. In the created project, create the desired connection:

Step 1: Define the connection members properties
1. On the Tools tab, click Support Beams.

   The “Support Beams” dialog box appears.
2. Define the main member properties:
3. Define the secondary member properties, also the angle around the axis (5.71°):

Step 1: Define the loads


2. Define the load cases and the loads:

   Beware the sign convention, which is not the same as in MELODY (in ADSC, a positive moment affects the upper bolts).
3. Click **Combinations**.

   ![Combinations dialog box](image1.png)

   The combinations dialog box appears.

4. On the **Combinations options** tab, click **Generate** to obtain the ULS combinations:

   ![ULS combinations](image2.png)

**Step 2: Define the connection properties**

1. On the **Tools** tab, click **Joint** to display the properties dialog box.

   ![Properties dialog box](image3.png)
The “Knee of frame bolted, with haunch” dialog box appears.

2. Define the haunch properties (length and height).

3. Define the end plate thickness.

4. Define the cap plate thickness.
5. Define the bolt properties. Select the **NF E 27-701** bolt type.

![Bolt Properties Diagram](image1)

6. Define the distances between the bolts within the groups.

![Distance Between Bolts Diagram](image2)

7. Create a sloped stiffener and the bottom stiffener.

![Stiffener Diagram](image3)
8. Define the thickness of the bottom stiffener:

![Diagram showing bottom stiffener](image)

9. Define the sloped stiffener orientation and thickness.

![Diagram showing sloped stiffener](image)

**Step 3: Checking the connection**

1. Click **Check**.

   The checking failed because of several errors with the weld thickness at the haunch flange and the rafter top flange.

![Check failed status](image)
2. To fix the connection, increase the thickness of the welds at the haunch and rafter.

3. Return to the Joint design tab and click Check. The connection is correct:

Step 4: Generate the calculation report
The detailed calculations can be verified. Click Report to generate the calculation report:
Step 5: Print the connection drawing

1. On the **Output** tab, click **Print Settings** to access the print options.

2. Click **Modify** to access the page setup options:

3. Select the printer and the paper size. Make sure to select a suitable print scale and drawing orientation.

The drawing is ready for print.
Note: ADSC creates a .dwg file. Therefore, it is possible to open and edit it using Advance Steel.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee of frame bolted, with haunch1</td>
<td>File Folder</td>
<td></td>
</tr>
<tr>
<td>Knee of frame bolted, with haunch1.bak</td>
<td>DAK File</td>
<td>65 KB</td>
</tr>
<tr>
<td>Knee of frame bolted, with haunch1.dwg</td>
<td>AutoCAD Drawing</td>
<td>65 KB</td>
</tr>
<tr>
<td>Knee of frame bolted, with haunch1.db</td>
<td>Microsoft Office Access Record-Locking Information</td>
<td>0 KB</td>
</tr>
<tr>
<td>Knee of frame bolted, with haunch1.mdb</td>
<td>Microsoft Office Access Application</td>
<td>376 KB</td>
</tr>
</tbody>
</table>
Apex haunch

Data

In this example you will design the following connection.

The loads are:

<table>
<thead>
<tr>
<th>Case</th>
<th>Name</th>
<th>Nx (kN)</th>
<th>Vz (kN)</th>
<th>My (kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Dead Loads</td>
<td>-13.2</td>
<td>-1.3</td>
<td>27.2</td>
</tr>
<tr>
<td>SNOW</td>
<td>Snow</td>
<td>-23.1</td>
<td>-2.3</td>
<td>48.0</td>
</tr>
</tbody>
</table>

They correspond to the following forces:

<table>
<thead>
<tr>
<th>NuMax</th>
<th>Fx</th>
<th>Ty</th>
<th>Mz</th>
<th>Maximum types</th>
<th>Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kN</td>
<td>kN</td>
<td>kN.m</td>
<td>MinFx</td>
<td>1.33<em>G+1.5</em>SNO</td>
</tr>
<tr>
<td>1</td>
<td>-52.26</td>
<td>5.22</td>
<td>108.18</td>
<td>MaxMz MaxFy MinEz</td>
<td></td>
</tr>
</tbody>
</table>
Creating the project
From the Windows Start menu, select Programs > Graitec > Advance Design > Advance Design - Steel Connection.

1. On the Project tab, click New project.

2. In the “New project” dialog box enter Tutorial for the project name.

3. In the created project, create the desired connection:

Step 1: Define the properties of the connection members
1. Click Support Beams.

The “Support Beams” dialog box appears.

2. Define the main member section and the slope. Select the same options for both members.
Step 2: Define the loads

1. On the **Tools** tab, click **Loads**.

2. Define the load cases and the loads:

   ![Combination dialog box](image)

   **Beware** the sign convention, which is different from MELODY (in ADSC, a positive moment affects the upper bolts).

3. Click **Combinations** to display the combinations dialog box.
4. In the **Combinations options** tab, click **Generate** to obtain the ULS combinations:

![Combination options tab](image)

**Step 3: Define the connection properties**

1. On the **Tools** tab, click **Joint** to display the properties dialog box.

![Joint properties dialog box](image)

The “Apex bolted with haunch” dialog box appears.

2. Define the end plate thickness.

![End plate thickness dialog box](image)
3. Define the haunch plate properties.

4. Define the bolt properties. Select the **NF E 27-701** bolt type.

5. Define the distances between the bolts within the groups.
6. Remove the stiffeners:

**Step 4: Checking the connection**

1. Click **Check**.
   
The checking failed because of several errors with the weld thickness connecting the top flange and the end plate.

2. Increase the thickness of the end plate – top flange weld.

3. Return to the **Joint design** tab and click **Check**. The connection is correct:
Additional remarks

In this chapter

- A Project explorer to manage the project
- Connection description the same as in Advance Steel
- Two modes for displaying a connection
- The possibility to use the drawing in Advance Steel
- The project connections are grouped in a folder
A Project explorer to manage the project files

An ADSC project may contain several connections. The project explorer (on the left side) provides an overview of the project content:

- All the project connections are displayed in the project explorer.
- You can easily switch from a connection to another by double clicking a connection.

Connection description the same as in Advance Steel

If you or your designers are using Advance Steel, you will notice that the connection properties dialog boxes in ADSC are identical to Advance Steel. This allows the transfer of the connections information from the calculation environment to the drawing environment and vice versa without any loss of information.
Two modes for displaying a connection
ADSC provides two connection display options:

- A 3D realistic rendering, completely customizable (view angles, shadows, etc.)
- 2D drawing display (adjustable scale, automatic dimensions and labels)

The possibility to use the drawing in Advance Steel

The DWG drawing created by ADSC (located in the “Detail” subfolder of the current project) can be opened in Advance Steel, where all advanced detailing tools allow adding dimensions and annotations, changing the label position, etc.

The project connections are grouped in a folder

All the project files are grouped in a folder having the project name.

This folder contains the DWG file of the 3D model. It also contains several subfolders, including:

- “Detail”, that contains the DWG drawing
- “Document”, that contains the calculation report
<table>
<thead>
<tr>
<th>Country</th>
<th>Office Name</th>
<th>Address</th>
<th>Phone</th>
<th>Fax</th>
<th>Hotline</th>
<th>Website</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>GRAITEC Inc.</td>
<td>183, St. Charles St. W. Suite 300</td>
<td>(450)</td>
<td>674-0665</td>
<td>1-800-724-5678</td>
<td><a href="http://www.graitec.com/en">www.graitec.com/en</a></td>
<td><a href="mailto:info.canada@graitec.com">info.canada@graitec.com</a></td>
</tr>
<tr>
<td>France</td>
<td>GRAITEC France Sarl</td>
<td>17 Burospace 91573 Bièvres Cedex</td>
<td>33(0)</td>
<td>1 69 85 56 22</td>
<td>33(0) 69 85 33 70</td>
<td><a href="http://www.graitec.com/Fr/">http://www.graitec.com/Fr/</a></td>
<td><a href="mailto:info.france@graitec.com">info.france@graitec.com</a></td>
</tr>
<tr>
<td>Germany, Switzerland, Austria</td>
<td>GRAITEC GmbH</td>
<td>Centroallee 263a D-46047 Oberhausen Germany</td>
<td>+49-(0) 208 / 62188-0</td>
<td>+49-(0) 208 / 62188-29</td>
<td>+420/244 016 055</td>
<td><a href="http://www.graitec.com/Ge/">http://www.graitec.com/Ge/</a></td>
<td><a href="mailto:info@graitec.de">info@graitec.de</a></td>
</tr>
<tr>
<td>Czech Republic and Slovakia</td>
<td>AB Studio spol. s r.o.</td>
<td>Jeremenkova 90a 140 00 PRAHA 4</td>
<td>+420/244 016 055</td>
<td>+420/244 016 088</td>
<td>+420/244 016 050</td>
<td><a href="http://www.abstudio.cz/">http://www.abstudio.cz/</a></td>
<td><a href="mailto:abstudio@abstudio.cz">abstudio@abstudio.cz</a></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>GRAITEC UK Ltd.</td>
<td>The Old Forge Suth Road Weybridge</td>
<td>+44 (0) 1932 858516</td>
<td>+44 (0) 1932 859099</td>
<td><a href="mailto:info@graitec.co.uk">info@graitec.co.uk</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td>GRAITEC Roumanie SRL</td>
<td>Str. Samuil Vulcan, Nr. 10 Sector 5</td>
<td>+40 (21) 410.01.19</td>
<td>+40 (21) 410.01.24</td>
<td>0729 002 107</td>
<td><a href="http://www.graitec.com/Ro/">http://www.graitec.com/Ro/</a></td>
<td><a href="mailto:sales@graitec.ro">sales@graitec.ro</a></td>
</tr>
<tr>
<td>Russia</td>
<td>GRAITEC CJSC</td>
<td>Dmitrovskoe shosse 60A Moscow, 127474, Russia</td>
<td>+7(495) 225-13-65</td>
<td>+7(495) 225-13-65</td>
<td>+7(495) 225-13-65</td>
<td></td>
<td><a href="mailto:info@graitec.ru">info@graitec.ru</a></td>
</tr>
</tbody>
</table>