AUTODESK

# Advance Steel COM API Developer Training Guide

# Contents

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# Chapter 1
# Advance Steel Development possibilities

## 1.1 Introduction to the Advance Steel API

The Advance Steel API allows you to program with any .NET compliant language including Visual Basic.NET, C#, and C++. Before using the API, learn to use Advance Steel and its features so that you can better understand this API.

## 1.2 What can you do with the Advance Steel API?

- Create joints
- Create commands

## 1.3 Requirements

- Understanding Advance Steel
- Programming language like C# or VB.NET
- Microsoft Visual Studio 2019 or Visual Studio Community (if applicable) 2019 for Windows Desktop
- Advance Steel 2023

## 1.4 Installation

The Advance Steel API is installed with Advance Steel. Microsoft Visual Studio Community 2019 for Windows Desktop can be downloaded from https://visualstudio.microsoft.com/downloads/

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# Chapter 2
# Advance Steel Modeling

## 2.1 What are joints?

Joints are complex elements that consist of basic elements and dependent elements that are controlled by a construction rule.

All individual elements in the joint, including their properties and processing objects, are held together and represented as a gray box (connection object).

All connection objects and definitions are included in the gray box.

## 2.2 Joint description

A joint is created through an object which implements the *IRule* interface and uses the *IJoint* interface to create Advance Steel elements.

Joint workflow:

- Input definition (Query)
- Create objects (CreateObjects)
- Display dialog (GetUserPages)

Through a joint, the created objects depend on the selected input objects, as long as the joint object exists in the dwg. The created objects or their properties are modifiable at any time using the joint properties dialog box. Previously created objects can be updated.

The *IRule* interface *Query* method is called when a joint should be created. In this method you can select the input objects for your joint and initialize default parameters.

The *IRule* interface *CreateObjects* contains the joint functionality. It uses global variables declared in the declaration section and does the main work. The *IRule* interface *GetUserPages* is called when the “Advance Steel Joint Properties" command is invoked.

The *IJointInfo* interface properties are interrogated to get information about the developer. You need to add a record in **AstorRules.HRLDefinition** and **AstorRules.RulesDllSigned** tables after developing a joint to be able to execute it in Advance Steel.

The joint can be executed with a command like
"AstM4CrConByVB RuleName" or "AstM4CommStructAsJointVB box RuleName"

## 2.3 How joints work

*Advance Steel* creates and modifies joints by using *rules*. The *IRule* interface defines several methods/properties, each being responsible for a certain task.

The *Joint* provides the link of *IRule* with the underlying Joint object of Advance Steel. The Joint object is set by Advance Steel before calling any method of the Rule.

The *Query* method describes the input parameters of the joint. Its implementation should ask for the user for input with the help of *IAstUI* and add the necessary entities to *InputObjects* of the joint.

**Note**: *If the joint is called with "AstM4CommStructAsJointVB box RuleName" the InputObjects array contains an element (the structural box) of type IStructuralBox in the beginning of the Query Method. You can take the box parameter from the InputObjects array and use it or modify it.*

The *CreateObjects* method should create Advance Steel objects and add them to the *CreatedObjects* of the joint. Rules can be written by anybody. The Advance Steel framework is able to execute them at runtime. Thus, several services are provided - creation, list, modification, explode, deletion of a joint object:

- A joint object is created along with its driven objects. A dialog box appears displaying all the parameters which apply to that joint category.
- AutoCAD's list command lists the joint type (and parameters in later versions).
- Editing a joint object leads to the appropriate dialog box.
- Exploding an object means deleting the "logical joint unit" while maintaining the driven objects. These objects will live explicitly then and will not know anything about the joint anymore.
- Deleting an object means deleting the logical unit and the driven objects as well. This includes features at driving objects, e.g. beam notches etc.

## 2.4 Commands description

A command is created through an object which implements the *IExternalMethod* interface defined by AstSTEELAUTOMATIONLib library. The difference between joint is that, the command is a "once-only" logic type, being unable to update already created objects. The *Run* method must be implemented.
The command can be executed "AstM9CommExecuteExternalCode commandName"

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# Chapter 3
# Advance Steel Modeling API Presentation

## 3.1 Geometry API

These are the basic geometric objects. In any joint that will be developed you will have to use at least a few of these objects (IPoint3d, IVector3d, IPlane, etc.).

### 3.1.1 IPoint3d

#### 3.1.1.1 Properties

- X (property) - Gets or sets the x coordinate of the point.
- Y (property) - Gets or sets the y coordinate of the point.
- Z (property) - Gets or sets the z coordinate of the point.

#### 3.1.1.2 Methods

- Add(IVector3d VectorToAdd) - Adds the specified vector to this point.
- Create(double dfX, double dfY, double dfZ) - Creates the point with specified coordinates.
- DistanceTo(IPoint3d target) - Returns the distance between points.
- Project(IPlane targetPlane, IVector3d projDir) - Projects the point on the specified plane, along the direction given by the vector.
- Subtract(IPoint3d Subtracter) - Returns a vector, oriented from subtracter to this point: p1.Subtract(p2) – the vector is oriented from p2 to p1
- TransformBy(IMatrix3d TransformMatrix) - Applies the transformation specified by the matrix to this point.

#### 3.1.1.3 Example: Create 2 points, calculate the distance between them and create a vector from the second point to the first.

```
private void Points()
{
    //create a point with specified coordinates
    IPoint3d point = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    point.Create(10, 10, 0);

    //move point along Z axis with 100 mm
    IVector3d vector = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
    vector.Create(0, 0, 1);

    vector.Multiply(100); //vector has a new length (and new orientation if the value is negative)
    point.Add(vector);

    //print point coordinates
    Debug.WriteLine("x: " + point.x.ToString() + "y: " + point.y.ToString() + "z: " + point.z.ToString());

    //Output: x: 10 y: 10 z:100

    IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

    p1.Create(0, 0, 0);
    p2.Create(50, 0, 0);

    double distance = p1.DistanceTo(p2);
    //print distance between points
    Debug.WriteLine("Distance between points is: " + distance.ToString());

    //Output: Distance between points is: 50.0

    //return a vector oriented from p2 to p1
    vector = p1.Subtract(p2);
}
```

### *3.1.2 IVector3d*

#### 3.1.2.1 Properties

- X (property) - Gets or sets the x dimension of the vector.
- Y (property) - Gets or sets the y dimension of the vector.
- Z (property) - Gets or sets the z dimension of the vector.

#### 3.1.2.2 Methods

- Create(double dfX, double dfY, double dfZ) - Creates a vector with the specified coordinates.
- CrossProduct(IVector3d pV) - Returns a vector - the result of the cross product of this vector and specified vector. Useful when creating a CS (Coordinate system). See Figure 1.
- DotProduct(IVector3d ProductWithVect) - Returns the result of the scalar product of this vector and the specified vector.
- GetAngle(IVector3d inVect) - Returns the angle between the vectors (in radians).
- GetAngleWithReference(IVector3d inVect, IVector3d referenceVect) - Returns the angle between the vectors using a reference vector.
- IsPerpendicularTo(IVector3d inVect) - Returns true if this vector is perpendicular on the specified vector, otherwise it returns false.
- Multiply(double dfValue) - Multiplies the vector with the specified value – the vector has a new length (and a new orientation if the value is negative).
- Normalize() - Normalize the vector (length = 1). Does not change in any way the orientation.
- RotateBy(IVector3d inVect, double AngleVal) - Rotates the vector around the specified vector with the specified angle (in radians).

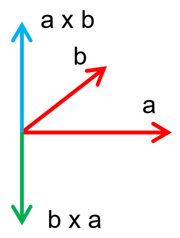


Figure 1.

#### 3.1.2.3 Example: Create 2 vectors, find the dot product, rotate the vectors and find the angles between them, check if they are perpendicular, determine their lengths.

```
private void Vectors()
{
  IVector3d xAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  IVector3d yAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());

  xAxis.Create(1, 0, 0);
  yAxis.Create(0, 1, 0);

  //cross product
  IVector3d zAxis = xAxis.CrossProduct(yAxis);

  //dot product is: 1 if angle = 0, > 0 if angle < 90, 0 if angle = 90, < 0 if angle > 90
  double dotProd = xAxis.DotProduct(yAxis);
  Debug.WriteLine("Scalar product is " + dotProd.ToString());

  //rotate vector by zAxis with 30 degrees
  xAxis.RotateBy(zAxis, Math.PI / 6);

  //Output: Scalar product is 0
```

```
   //Returns the lower angle between vectors.  Doesn't matter if we call function yAxis.GetAngle(xAxis),
   function will return same result
   double dAngle = xAxis.GetAngle(yAxis);
   Debug.WriteLine("Angle from x to y is " + ((dAngle * 180) / Math.PI).ToString() + " degrees");

   //Output: Angle from x to y is 60 degrees

   //If we want angle on other side from xAxis to yAxis we need to use GetAngleWithReference
   function
   zAxis.Multiply(-1); //Change zAxis direction

   double dAngle2 = xAxis.GetAngleWithReference(yAxis, zAxis);
   Debug.WriteLine("Angle from x to y is " + ((dAngle2 * 180) / Math.PI).ToString() + " degrees");

   //Output: Angle from x to y is 300 degrees

   //Angle from yAxis to xAxis
   dAngle2 = yAxis.GetAngleWithReference(xAxis, zAxis);
   Debug.WriteLine("Angle from y to x is " + ((dAngle2 * 180) / Math.PI).ToString() + " degrees");

   //Output: Angle from y to x is 60 degrees

   if(zAxis.IsPerpendicularTo(xAxis))
   {
     Debug.WriteLine("Vectors are perpendicular!");
   }

   //Output: Vectors are perpendicular!

   zAxis.Multiply(57);
   Debug.WriteLine("Vector length is " + zAxis.Length.ToString());

   //Output: Vector length is 57

   zAxis.Normalize(); //Normalize vector
   Debug.WriteLine("Vector length is " + zAxis.Length.ToString());

   //Output: Vector length is 1
}
```

### 3.1.3 ILine3d

3.1.3.1 Properties/Methods

- Origin - Returns the origin point of this line.
- Direction - Returns the direction vector of this line.
- CreateFromVectorAndPoint(IPoint3d inPoint, IVector3d inVect) - Creates a line with the specified origin and direction.

3.1.3.2 Example: Create a line.

```
private void Line()
{
   IPoint3d origin = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   origin.Create(0, 0, 0);

   IVector3d xAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
```

```
    xAxis.Create(1, 0, 0);

    ILine3d line = (ILine3d)(new DSCGEOMCOMLib.Line3d());
    line.CreateFromVectorAndPoint(origin, xAxis);
}
```

### 3.1.4 IPlane

#### 3.1.4.1 Properties/Methods

- PointOnPlane - Returns the origin of this plane.
- Normal - Returns the plane's normal vector.
- CreateFromPointAndNormal(IPoint3d inPoint, IVector3d inVect) - Create a plane with the specified origin and normal.
- get_DistanceTo(IPoint3d ptIn) - Returns the distance from this plane to the input point
- intersectWithLine(ILine3d inLine, out IPoint3d ptIntersection) - Calculates the intersection point of this plane with a line. Returns True or False depending on whether the objects intersect.

#### 3.1.4.2 Example: Create a plane and a line and find the intersection point where the line meets the plane.

```
private void Planes()
{
    IPoint3d origin = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    origin.Create(100, 100, 100);

    IVector3d normal = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
    normal.Create(0, 0, 1);

    //create plane from point and normal
    IPlane plane = (IPlane)(new DSCGEOMCOMLib.plane());
    plane.CreateFromPointAndNormal(origin, normal);

    IPoint3d pt = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    pt.Create(20, 30, -45);

    //get perpendicular distance from point to plane
    double distance = plane.get_DistanceTo(pt);
    Debug.WriteLine("Distance from point to plane is " + distance);

    //Output: Distance from point to plane is 145

    ILine3d line = (ILine3d)(new DSCGEOMCOMLib.Line3d());
    line.CreateFromVectorAndPoint(pt, normal);

    //intersect line with plane
    IPoint3d ptInt;

    if(plane.intersectWithLine(line, out ptInt))
    {
        Debug.WriteLine("Intersection point is " + ptInt.x + ", " + ptInt.y + ", " + ptInt.z);
    }
    //Output: Intersection point is (20, 30, 100)
}
```

### 3.1.5 ICS3d

There are two coordinate Systems: - fixed system called World Coordinate System (WCS), and a movable system called User Coordinate System (UCS). When create a beam for example you need to specify a coordinate system where beam will be created. Coordinate systems can make easier your work when create joints.
A coordinate system is defined by three axes (vectors) and origin point. The axes define three coordinate planes. The (XY) plane contains the x - axis and the y- axis. The (YZ) contains the y - axis and z - axis. The (XZ) plane contains x - axis and z- axis. Origin point is at intersection of these planes.

#### 3.1.5.1 Properties

- Origin - Gets or sets the CS origin (as a Point3d).
- XAxis - Gets or sets the CS X axis (as a Vector3d).
- YAxis - Gets or sets the CS Y axis (as a Vector3d).
- ZAxis - Gets or sets the CS Z axis (as a Vector3d).

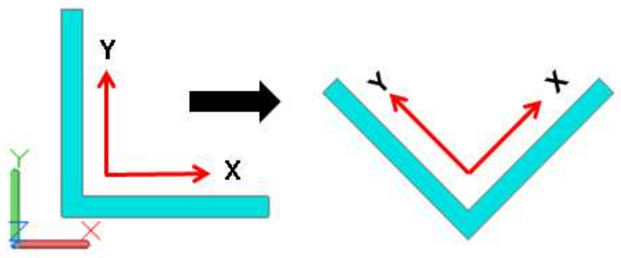
#### 3.1.5.2 Methods

- RotateCSAroundX(double AngleVal) - Rotates the CS around X axis with the specified angle value (in radians).
- RotateCSAroundY(double AngleVal) - Rotates the CS around Y axis with the specified angle value (in radians).
- RotateCSAroundZ(double AngleVal) - Rotates the CS around Z axis with the specified angle value (in radians).
- TransformBy(IMatrix3d TransforMatrix) - Applies the transformation specified by the matrix to this CS.
- TranslateCS(IVector3d TranslationVect) - Translates the CS origin with the specified vector. The vector is interpreted as being in this CS, not in WCS. For example: To translate this CS along its own X-axis the vector (1, 0, 0) multiplied by the desired value should be passed to this method.
- SetToAlignCS(ICS3d pToCS) - Returns the Matrix3d that transforms objects from this coordinate system to the “pToCS” coordinate system (the matrix can be used in an object.TransformBy(matrix) method call).

#### 3.1.5.3 Example: Create a coordinate system and rotate it by 45 degrees

```
private void CreateCS()
{
  IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  zAxis.Create(0, 1, 0);

  ICS3d inputCS = (ICS3d)(new DSCGEOMCOMLib.CS3d());
  inputCS.XAxis = startPoint.Subtract(endPoint);
  inputCS.ZAxis = zAxis;

  //rotate CS around X axis with 45 degrees
  inputCS.RotateCSAroundX(Math.PI / 4);
}
```

Output will be like image below.



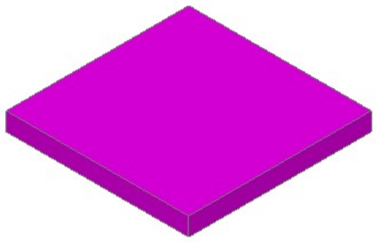
### 3.1.6 *IAugPolygon3d*

- AppendVertex(IPoint3d ptToAppend) - Adds the specified point to the polygon vertices.

3.1.6.1 Example: Create a polygon with 4 points

```
private void Polygon()
{
    IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

    p1.Create(50, 50, 0);
    p2.Create(-50, 50, 0);
    p3.Create(-50, -50, 0);
    p4.Create(50, -50, 0);

    //create polygon
    IAugPolygon3d polygon = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
    polygon.AppendVertex(p1);
    polygon.AppendVertex(p2);
    polygon.AppendVertex(p3);
    polygon.AppendVertex(p4);
}
```

Creating a plate using this polygon the output will be:



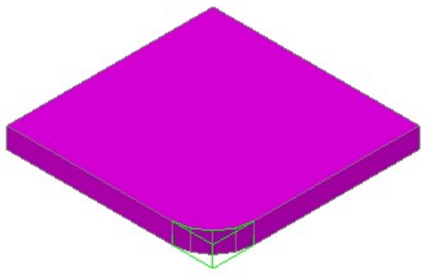
Polygon with arcs. We can do that using AppendNewVertex function.

- AppendNewVertex(IPoint3d newVertex, IVertexInfo newVertexInfo, bool bCheckValidity)- Appends a new vertex to the polygon. If bCheckValidy is set to True, then it also reinitializes the polygon.

#### 3.1.6.2 Example: Create a polygon with an arc

```
private void PolygonWithArc()
{
   IVertexInfo vertexInfo = (IVertexInfo)(new DSCGEOMCOMLib.vertexInfo());

   IPoint3d center = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   center.Create(40, 40, 0);

   IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
   zAxis.Create(0, 0, 1);

   //create vertex info
   double radius = 10;
   vertexInfo.CreateFromCenterAndNormal(radius, center, zAxis);

   IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p5 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

   p1.Create(50, 40, 0);
   p2.Create(40, 50, 0);
   p3.Create(-50, 50, 0);
   p4.Create(-50, -50, 0);
   p5.Create(50, -50, 0);

   //create polygon
   IAugPolygon3d polygon = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
   polygon.AppendNewVertex(p1, vertexInfo, true);
   polygon.AppendVertex(p2);
   polygon.AppendVertex(p3);
   polygon.AppendVertex(p4);
   polygon.AppendVertex(p5);
}
```

Creating a plate using this polygon the output will be:



## 3.2 Modeling API

In this chapter you will learn how you can create objects using Advance Steel API. The Advance Steel model is built from elements such as beams, plates, structural elements, bolts, welds, features, and joints.

### *3.2.1 Default attribute state for objects controlled by connections*

Starting with Advance Steel 2021, all attributes of objects controlled by connections are accessible by default.
Connection developers must now specify explicitly the attributes that the connection controls.
Using the COM API, this is done by setting the Attribute property for specific attributes with the value 0.

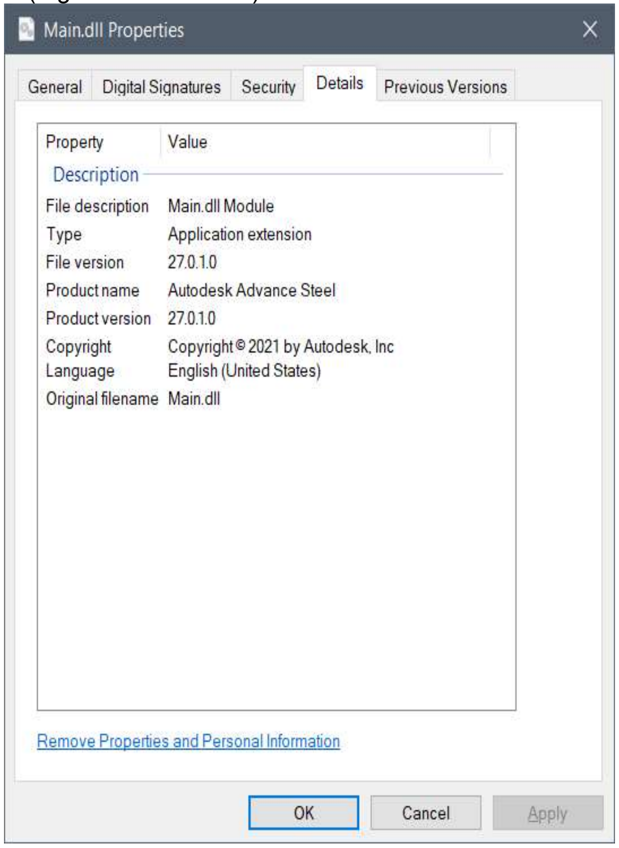
```
set_Attribute(eAttributeCodes.<kAttribute>, 0);
```

Using the .NET API, setting the Attribute property is performed simply by enumerating them as before in the Attributes member of the corresponding CreatedObjectInformation structure.
These attributes will become inaccessible from the object GUIs and will not be transferred on connection updates.

Connection developers have the possibility to switch back to the old behavior, in which the attributes of controlled objects are not accessible by default. This can be accomplished by setting the IJoint.DefaultAttributeStateAccessible property to the false value. If this is done, developers must then specify the accessible attributes from within the connections, i.e. the attributes that the connection does not control, as before.

In order to preserve the old behavior for existing connections, the Version field was introduced in the HRLDefinition table. This is set to 27 (corresponding to AS 2023) for existing connections, thus enforcing the old behavior - attributes are not accessible by default, the specified ones are accessible.

New connections should have the Version field set as the current internal AS version. This ensures that new attributes, not known prior to a certain version are correctly excepted from the above rules. The version can be found by looking at the major file version or product version of any dll from the currently installed AS binary folder (e.g. 27 for AS 2023).



| Property | Value |
|---|---|
| Description | |
| File description | Main.dll Module |
| Type | Application extension |
| File version | 27.0.1.0 |
| Product name | Autodesk Advance Steel |
| Product version | 27.0.1.0 |
| Copyright | Copyright © 2021 by Autodesk, Inc |
| Language | English (United States) |
| Original filename | Main.dll |

### 3.2.2 Beams

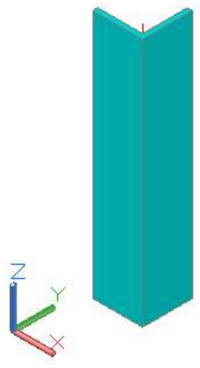
- CreateStraightBeam(string sectClass, string sectName, Role pRole, IPoint3d pt0, IPoint3d pt1, ICS3d InputCS) - Returns a straight beam object. The beam's className and sectionName are the internal names.

section.className = value from AstorProfiles.ProfileMasterTable, column TypeNameText
section.Name = from the definition table for className, value of column SectionName

#### 3.2.2.1 Example: Create a straight beam

```
private void CreateStraightBeam(ref AstObjectsArr createdObjectsArr)
{
  //get default profile
  string angleSection, angleSize;
  getDefaultProfile(0, "HyperSectionW", out angleSection, out angleSize);

  //create role object
  IRole beamRole = m_Joint.CreateRole("Beam");

  //create joint transfer
  IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Beam");

  //set some attributes
  setJointTransferForBeam(ref jointTransfer, eClassType.kBeamStraightClass);

  IPoint3d startPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d endPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

  startPoint.Create(0, 0,  0);
  endPoint.Create(0, 0,  500);

  IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  zAxis.Create(0, 1, 0);

  ICS3d inputCS = (ICS3d)(new DSCGEOMCOMLib.CS3d());
  inputCS.XAxis = startPoint.Subtract(endPoint);
  inputCS.ZAxis = zAxis;

  //create a straight beam
  //Function will use z axis from input CS and input points to create beam CS
  //xAxis = vector from input points (startPoint.Subtract(endPoint))
  //yAxis = zAxis.CrossProduct(xAxis) (zAxis from CS)
  //zAxis = xAxis.CrossProduct(yAxis)

  IStraightBeam straightBeam = m_Joint.CreateStraightBeam(angleSection, angleSize,
  (AstSTEELAUTOMATIONLib.Role)beamRole, startPoint, endPoint, inputCS);

  //Add beam to created object array
  if(straightBeam != null)
  {
    straightBeam.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;
    createdObjectsArr.Add(straightBeam);
  }
}

//Get the default profile from the database (default profiles are set in the GAM)
```

```
private void getDefaultProfile(int defaultClass, string className, out string sectionClass, out string
sectionSize)
{
  sectionClass = "";
  sectionSize = "";

  IOdbcUtils tableUtils = (IOdbcUtils)(new DSCODBCCOMLib.OdbcUtils());
  string sSectionProf = tableUtils.GetDefaultString(defaultClass, className);

  string separator = "#@" + '§' + "@#";
  string[] section = sSectionProf.Split(new string[] { separator }, StringSplitOptions.None);

  if (section.Length == 2)
  {
    sectionClass = section[0];
    sectionSize = section[1];
  }
}
//Create the JointTransfer for a beam
private void setJointTransferForBeam(ref IJointTransfer jointTrans, eClassType classType)
{
  jointTrans.ClassType = classType;

  //set here all the properties which can be modified outside the joint
  jointTrans.set_Attribute(eAttributeCodes.kBeamDenotation, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamMaterial, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamCoating, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSinglePartNumber, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamMainPartNumber, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSinglePartPrefix, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamMainPartPrefix, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamAssembly, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamItemNumber, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSinglePartDetailStyle, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamMainPartDetailStyle, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamNote, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSPUsedForCollisionCheck, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSPUsedForNumbering, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSPDisplayRestriction, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamSPExplicitQuantity, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamMPUsedForCollisionCheck, 1);
  jointTrans.set_Attribute(eAttributeCodes.kBeamMPUsedForNumbering, 1);
}
```

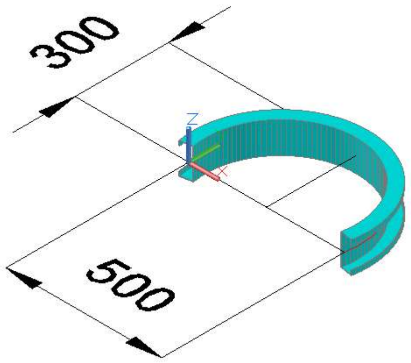


- CreateBentBeam(string sectClass, string Name, Role pRole, IPoint3d pt0, IPoint3d pt1, IPoint3d anyArcPoint, double rotAngle) - Returns a Bent Beam object. The beam's className and sectionName are the internal names for the section.

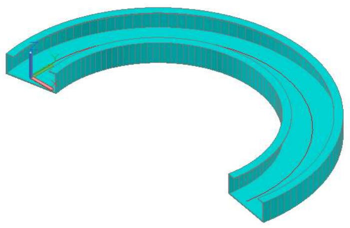
section.className = value from AstorProfiles.ProfileMasterTable, column TypeNameText
section.Name = from the definition table for className, value of column SectionName

### 3.2.2.2 Example: Create a curved beam

```
private void CreateCurvedBeam(ref AstObjectsArr createdObjectsArr)
{
  //create role object
  IRole beamRole = m_Joint.CreateRole("BentBeam");

  //create joint transfer
  IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("BentBeam");

  //set joint transfer attributes
  setJointTransferForBeam(ref jointTransfer, eClassType.kBeamBentClass);

  //get default profile
  string sectionClass, sectionSize;
  getDefaultProfile(0, "HyperSectionC", out sectionClass, out sectionSize);

  IPoint3d startPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d endPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d pointOnArc = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

  startPoint.Create(0, 0, 0);
  endPoint.Create(500, 0, 0);
  pointOnArc.Create(250, 300, 0);

  double rotAngle = 0; //rotation angle around the beam axis

  //create bent beam
  IBentBeam bentBeam = m_Joint.CreateBentBeam(sectionClass, sectionSize,
  (AstSTEELAUTOMATIONLib.Role)beamRole, startPoint, endPoint, pointOnArc, rotAngle);

  //Add beam to created object array
  if(bentBeam != null)
  {
    bentBeam.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;
    createdObjectsArr.Add(bentBeam);
  }
}
```



Rotate beam with 90 degrees: rotAngle = 90

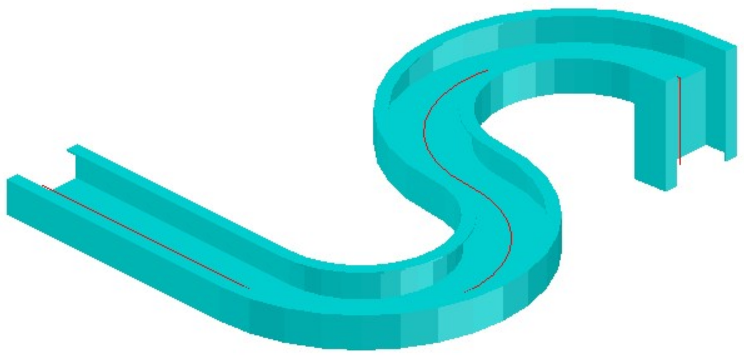


- CreatePolyBeam(string sectClass, string Name, Role pRole, IAugPolyline3d line, IVector3d vecRefOrientation, IVector3d zVec) - Creates and returns a poly beam object. The beam's className and sectionName are the internal names for the section.

section.className = value from AstorProfiles.ProfileMasterTable, column TypeNameText
section.Name = from the definition table for className, value of column SectionName
line - defines  the new poly-beam's polyline
zVec - defines the z-direction of the polyline.

### 3.2.2.3 Example

```
private void CreatePolyBeam(ref AstObjectsArr createdObjectsArr)
{
  IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d p5 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

  IPoint3d c1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d c2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

  p1.Create(0, 0, 0);
  p2.Create(300, 0, 0);
  p3.Create(300, 300, 0);
  p4.Create(300, 600, 0);
  p5.Create(300, 600, -100);

  c1.Create(300, 150, 0);
  c2.Create(300, 450, 0);

  //radius
  double radius = 150;
  IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  zAxis.Create(0, 0, 1);

  //create vertex infos
  IVertexInfo vertexInfo1 = (IVertexInfo)(new DSCGEOMCOMLib.vertexInfo());
  IVertexInfo vertexInfo2 = (IVertexInfo)(new DSCGEOMCOMLib.vertexInfo());

  vertexInfo1.CreateFromCenterAndNormal(radius, c1, zAxis);
  zAxis.Multiply(-1);
  vertexInfo2.CreateFromCenterAndNormal(radius, c2, zAxis);

  //build polyline
  IAugPolyline3d polyline = (IAugPolyline3d)(new DSCGEOMCOMLib.AugPolyline3d());
  polyline.AppendVertex(p1);
  polyline.AppendNewVertex(p2, vertexInfo1, true);
  polyline.AppendNewVertex(p3, vertexInfo2, true);
  polyline.AppendVertex(p4);
  polyline.AppendVertex(p5);

  //create role object
  IRole beamRole = m_Joint.CreateRole("Beam");

  //create joint transfer
  IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Beam");

  //set joint transfer attributes
  setJointTransferForBeam(ref jointTransfer, eClassType.kBeamPolyClass);

  //get default profile
  string sectionClass, sectionSize;
  getDefaultProfile(0, "HyperSectionC", out sectionClass, out sectionSize);

  IVector3d zVec = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  zVec.Create(0, 0, 1);

  IVector3d vecRefOrientation = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  vecRefOrientation.Create(0, 1, 0);

  IPolyBeam polyBeam = m_Joint.CreatePolyBeam(sectionClass, sectionSize,
  (AstSTEELAUTOMATIONLib.Role)beamRole, polyline, vecRefOrientation, zVec);

  //Add beam to created object array
  if (polyBeam != null)
  {
    polyBeam.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;
    createdObjectsArr.Add(polyBeam);
  }
}
```

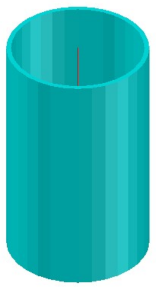


- CreateUnfoldedBeamWCS(IAugPolyline3d polyline, ICS3d polyLineCS, Role pRole, IPoint3d pt0, IPoint3d pt1, ICS3d InputCS) - Returns an unfolded beam object. The beam's cross-section is defined by the polyline together with its coordinate system and the systemline of the beam passes is defined by pt0 and pt1 points.

3.2.2.4 Example: Create an unfolded beam

```
private void CreateUnfoldedBeam(ref AstObjectsArr createdObjectsArr)
{
   //create vectors
   IVector3d xAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
   IVector3d yAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
   IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());

   xAxis.Create(1, 0, 0);
   yAxis.Create(0, 1, 0);
   zAxis.Create(0, 0, 1);

   double diameter = 300, height = 500;

   //start point of beam
   IPoint3d startPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   startPoint.Create(0, 0, 0);

   IPoint3d pt = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   pt.setFrom(startPoint);
   xAxis.Multiply(diameter / 2);
   pt.Add(xAxis);
   xAxis.Normalize();

   IVertexInfo vertexInfo = (IVertexInfo)(new DSCGEOMCOMLib.vertexInfo());
   vertexInfo.CreateFromCenterAndNormal(diameter / 2, startPoint, zAxis);

   //build polyline
   IAugPolyline3d polyline = (IAugPolyline3d)(new DSCGEOMCOMLib.AugPolyline3d());

   polyline.AppendNewVertex(pt, vertexInfo, false);
   polyline.Reinitialize();

   //end point of beam
   IPoint3d endPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   endPoint.setFrom(startPoint);
```

```
    zAxis.Multiply(height);
    endPoint.Add(zAxis);
    zAxis.Normalize();

    //polyline CS
    ICS3d polylineCS = (ICS3d)(new DSCGEOMCOMLib.CS3d());
    polylineCS.XAxis = xAxis;
    polylineCS.YAxis = yAxis;
    polylineCS.ZAxis = zAxis;
    polylineCS.Origin = startPoint;

    //create role object
    IRole beamRole = m_Joint.CreateRole("Beam");

    //create joint transfer
    IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Beam");

    //set joint transfer attributes
    setJointTransferForBeam(ref jointTransfer, eClassType.kBeamUnfoldedClass);

    IUnfoldedBeam unfoldedBeam = m_Joint.CreateUnfoldedBeamWCS(polyline, polylineCS,
    (AstSTEELAUTOMATIONLib.Role)beamRole, startPoint, endPoint, null);

    //Add beam to created object array
    if(unfoldedBeam != null)
    {
      unfoldedBeam.Thickness = 10; //thickness
      unfoldedBeam.Portioning = 1;
      createdObjectsArr.Add(unfoldedBeam);
    }
}
```



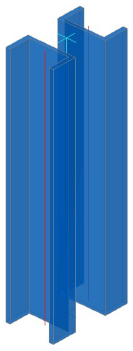
Try creating an unfolded beam with the polyline used in creating a polybeam (Example 3.2.1.3).

- CreateCompoundBeamStraight(string sectClass, string Name, Role pRole, IPoint3d pt0, IPoint3d pt1, ICS3d InputCS) - Returns a compound beam object. The beam’s className and sectionName are the internal names.

section.className = value from AstorProfiles.CompoundMasterTable, column CompoundClassName
section.Name = from the definition table for className, value of column TypeName

### 3.2.2.5 Example: Create a compound beam

```
private void CreateCompoundBeam(ref AstObjectsArr createdObjectsArr)
{
  string sectionClass = "Compound2U", sectionName = "Default";

  //create role object
  IRole role = m_Joint.CreateRole("Beam");

  //create joint transfer object
  IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Beam");
  setJointTransferForBeam(ref jointTransfer, eClassType.kBeamStraightCompoundClass);

  //section start, end point
  IPoint3d startPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  IPoint3d endPoint = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  startPoint.Create(0, 0, 0);
  endPoint.Create(0, 0, 500);

  IVector3d yAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  yAxis.Create(0, 1, 0);

  //input CS
  ICS3d inputCS = (ICS3d)(new DSCGEOMCOMLib.CS3d());
  inputCS.ZAxis = yAxis;

  //create compound beam
  ICompoundBeamStraight                              compoundBeam                              =
  m_Joint.CreateCompoundBeamStraight(sectionClass,                               sectionName,
  (AstSTEELAUTOMATIONLib.Role)role, startPoint, endPoint, inputCS);

  //Add compound beam to created object array
  if (compoundBeam != null)
  {
    compoundBeam.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer; //set joint
  transfer
    createdObjectsArr.Add(compoundBeam);
  }
}
```



For welded beams same as compound beam. Only section.className and section.Name differ.
Example: sectionClass =”WeldedIAsymmetric”, sectionName = “Default”

### 3.2.3 Plates

- CreatePlatePoly(Role pRole, IAugPolygon3d poly, double Thickness) - Returns a Plate object.

#### 3.2.3.1 Example: Create a polygonal plate

```
private void CreatePolyPlate(ref AstObjectsArr createdObjectsArr)
{
   IVertexInfo vertexInfo = (IVertexInfo)(new DSCGEOMCOMLib.vertexInfo());

   IPoint3d center = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   center.Create(40, 40, 0);

   IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
   zAxis.Create(0, 0, 1);

   //create vertex info
   double radius = 10;
   vertexInfo.CreateFromCenterAndNormal(radius, center, zAxis);

   IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p5 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

   p1.Create(50, 40, 0);
   p2.Create(40, 50, 0);
   p3.Create(-50, 50, 0);
   p4.Create(-50, -50, 0);
   p5.Create(50, -50, 0);

   //create polygon
   IAugPolygon3d polygon = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
   polygon.AppendNewVertex(p1, vertexInfo, true);
   polygon.AppendVertex(p2);
   polygon.AppendVertex(p3);
   polygon.AppendVertex(p4);
   polygon.AppendVertex(p5);

   //create plate role and joint transfer
   IRole plateRole = m_Joint.CreateRole("Plate");
   IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Plate");
   setJointTransferForPlate(ref jointTransfer);

   //plate thickness
   double plateThickness = 10;

   //create plate
   IPlate platePoly = m_Joint.CreatePlatePoly((AstSTEELAUTOMATIONLib.Role)plateRole,
   polygon, plateThickness);

   //Add plate to created object array
   if (platePoly != null)
   {
      //set joint transfer
      platePoly.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;
      platePoly.Portioning = 0;
      createdObjectsArr.Add(platePoly);
   }
}

private void setJointTransferForPlate(ref IJointTransfer jointTrans)
{
   jointTrans.ClassType = eClassType.kPlateClass;

   //set here all the properties which can be modified outside the joint
   jointTrans.set_Attribute(eAttributeCodes.kPlateDenotation, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMaterial, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateCoating, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSinglePartNumber, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMainPartNumber, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSinglePartPrefix, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMainPartPrefix, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateAssembly, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateItemNumber, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSinglePartDetailStyle, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMainPartDetailStyle, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateNote, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSPUsedForCollisionCheck, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSPUsedForNumbering, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSPDisplayRestriction, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateSPExplicitQuantity, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMPUsedForCollisionCheck, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMPUsedForNumbering, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMPDisplayRestriction, 1);
   jointTrans.set_Attribute(eAttributeCodes.kPlateMPExplicitQuantity, 1);
}
```

- CreatePlateRectangular(Role pRole, double dLength, double dWidth, double dThickness, ICS3d cs) - Returns a plate object with the specified length, width and thickness in the specified coordinate system. The center of the plate will be in the origin of the given coordinate system.

#### 3.2.3.2 Example: Create a rectangular plate

```
private void CreateRectangularPlate(ref AstObjectsArr createdObjectsArr)
{
    IPoint3d origin = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    origin.Create(0, 0, 0);

    IVector3d xAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
    IVector3d yAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
    IVector3d zAxis = (IVector3d)(new DSCGEOMCOMLib.Vector3d());

    xAxis.Create(1, 0, 0);
    yAxis.Create(0, 1, 0);
    zAxis.Create(0, 0, 1);

    ICS3d csPlate = (ICS3d)(new DSCGEOMCOMLib.CS3d());
    csPlate.Origin = origin;
    csPlate.XAxis = xAxis;
    csPlate.YAxis = yAxis;
    csPlate.ZAxis = zAxis;

    //create plate role and joint transfer
    IRole plateRole = m_Joint.CreateRole("Plate");
    IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Plate");
    setJointTransferForPlate(ref jointTransfer);
    double dPlateLength = 400, dPlateWidth = 200, dPlateThickness = 10;

    //create rectangular plate
    IPlate                                rectangularPlate                              =
    m_Joint.CreatePlateRectangular((AstSTEELAUTOMATIONLib.Role)plateRole,        dPlateLength,
    dPlateWidth, dPlateThickness, csPlate);

    //Add plate to created object array
    if (rectangularPlate != null)
    {
      //set joint transfer
      rectangularPlate.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;
      rectangularPlate.Portioning = 0;
      createdObjectsArr.Add(rectangularPlate);
    }
}
```

3.2.3.3 Example: Create a folded plate using 6 plates

```
private void CreateFoldedPlates (ref AstObjectsArr createdObjectsArr)
{
    IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

    p1.Create(50, 50, 0);
    p2.Create(-50, 50, 0);
    p3.Create(-50, -50, 0);
    p4.Create(50, -50, 0);

    //create polygon 1
    IAugPolygon3d polygon = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
    polygon.AppendVertex(p1);
    polygon.AppendVertex(p2);
    polygon.AppendVertex(p3);
    polygon.AppendVertex(p4);

    //create plate role and joint transfer
    IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("FoldedPlate");
    setJointTransferForPlate(ref jointTransfer);
    IJointTransfer jointTransfer2 = m_Joint.CreateJointTransfer("FoldedPlateRelation");

    jointTransfer.ClassType = eClassType.kPlateFoldedClass;
    jointTransfer2.ClassType = eClassType.kPlateFoldRelationClass;

    //plate thickness
    double plateThickness = 10;

    //create first plate of folded plate
    IPlateFold platePolyFold = m_Joint.CreatePolyPlateFold(polygon, plateThickness);

    IPoint3d p1b = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p2b = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p3b = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
    IPoint3d p4b = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
```

```
p1b.Create(100, -45, 75);
p2b.Create(100, 45, 75);
p3b.Create(50, 45, 0);
p4b.Create(50, -45, 0);

//create polygon 2
IAugPolygon3d polygon2 = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
polygon2.AppendVertex(p1b);
polygon2.AppendVertex(p2b);
polygon2.AppendVertex(p3b);
polygon2.AppendVertex(p4b);

//create second plate of folded plate
IPlateFold platePolyFold2 = m_Joint.CreatePolyPlateFold(polygon2, plateThickness);

IPoint3d p1c = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p2c = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p3c = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p4c = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
p1c.Create(-50, -45, 0);
p2c.Create(-50, 45, 0);
p3c.Create(-100, 45, 75);
p4c.Create(-100, -45, 75);

//create polygon 3
IAugPolygon3d polygon3 = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
polygon3.AppendVertex(p1c);
polygon3.AppendVertex(p2c);
polygon3.AppendVertex(p3c);
polygon3.AppendVertex(p4c);

IPlateFold platePolyFold3 = m_Joint.CreatePolyPlateFold(polygon3, plateThickness);

IPoint3d p1d = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p2d = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p3d = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p4d = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
p1d.Create(-45, 50, 0);
p2d.Create(45, 50, 0);
p3d.Create(45, 100, 75);
p4d.Create(-45, 100, 75);

//create polygon 4
IAugPolygon3d polygon4 = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
polygon4.AppendVertex(p1d);
polygon4.AppendVertex(p2d);
polygon4.AppendVertex(p3d);
polygon4.AppendVertex(p4d);

IPlateFold platePolyFold4 = m_Joint.CreatePolyPlateFold(polygon4, plateThickness);

IPoint3d p1e = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p2e = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p3e = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p4e = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
p1e.Create(-45, -100, 75);
p2e.Create(45, -100, 75);
p3e.Create(45, -50, 0);
p4e.Create(-45, -50, 0);
```

```
//create polygon 5
IAugPolygon3d polygon5 = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
polygon5.AppendVertex(p1e);
polygon5.AppendVertex(p2e);
polygon5.AppendVertex(p3e);
polygon5.AppendVertex(p4e);

IPlateFold platePolyFold5 = m_Joint.CreatePolyPlateFold(polygon5, plateThickness);

IPoint3d p1f = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p2f = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p3f = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
IPoint3d p4f = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
p1f.Create(100, -45, 75);
p2f.Create(100, 45, 75);
p3f.Create(200, 45, 50);
p4f.Create(200, -45, 50);

//create polygon 6
IAugPolygon3d polygon6 = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
polygon6.AppendVertex(p1f);
polygon6.AppendVertex(p2f);
polygon6.AppendVertex(p3f);
polygon6.AppendVertex(p4f);

IPlateFold platePolyFold6 = m_Joint.CreatePolyPlateFold(polygon6, plateThickness);

if ((platePolyFold != null) && (platePolyFold2 != null))
{
   IRole foldedPlateRole = m_Joint.CreateRole("FoldedPlate");
   string relationRole = "Relation";
   int stringerID;

   //create folded plate using first plate created
   IPlateFolded foldedPlate =
   m_Joint.CreateFoldedPlate((AstSTEELAUTOMATIONLib.Role)foldedPlateRole,
   (AstSTEELAUTOMATIONLib.PlateFold)platePolyFold, out stringerID);

   if (foldedPlate != null)
   {
      createdObjectsArr.Add(foldedPlate);
      int stringerID2;
      PlateFoldRelation plateFoldRelation;
      FeaturesArray plateFoldFeatures;
      bool ok;
      //extend the folded plate to the second created plate and get the Relation between the 2
       plates
      ok = foldedPlate.ExtendBy((AstSTEELAUTOMATIONLib.PlateFold)platePolyFold2, 1,
       stringerID, p1, p3b, relationRole, out stringerID2, out plateFoldRelation, out
       plateFoldFeatures);

      foldedPlate.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;

      int stringerIDFold2 = stringerID2; //remember this to connect plate #6
      if (plateFoldRelation != null)
      {
            plateFoldRelation.JointTransfer =
            (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer2;
            createdObjectsArr.Add(plateFoldRelation);
            plateFoldRelation.Radius = 10;  //set the radius
        }

        if (plateFoldFeatures != null)
        {
            int noFeats = (int)plateFoldFeatures.Count;
            IAstFeatObject currFeat;
            for (int i = 0; i < noFeats; i++)
            {
                currFeat = plateFoldFeatures[i];
                createdObjectsArr.Add(currFeat);
            }
        }

        if (platePolyFold3 != null)
        {
            ok = foldedPlate.ExtendBy((AstSTEELAUTOMATIONLib.PlateFold)platePolyFold3, 1,
            stringerID, p2, p2c, relationRole, out stringerID2, out plateFoldRelation, out
            plateFoldFeatures);
            if (plateFoldRelation != null)
            {
                plateFoldRelation.JointTransfer =
                 (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer2;
                createdObjectsArr.Add(plateFoldRelation);
                plateFoldRelation.Radius = 10;  //set the radius
            }
            if (plateFoldFeatures != null)
            {
                int noFeats = (int)plateFoldFeatures.Count;
                IAstFeatObject currFeat;
                for (int i = 0; i < noFeats; i++)
                {
                    currFeat = plateFoldFeatures[i];
                    createdObjectsArr.Add(currFeat);
                }
            }
        }

        if (platePolyFold4 != null)
        {
            ok = foldedPlate.ExtendBy((AstSTEELAUTOMATIONLib.PlateFold)platePolyFold4, 1,
            stringerID, p1, p2d, relationRole, out stringerID2, out plateFoldRelation, out
            plateFoldFeatures);
            if (plateFoldRelation != null)
            {
                plateFoldRelation.JointTransfer =
                 (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer2;
                createdObjectsArr.Add(plateFoldRelation);
                plateFoldRelation.Radius = 10;  //set the radius
            }
            if (plateFoldFeatures != null)
            {
                int noFeats = (int)plateFoldFeatures.Count;
                IAstFeatObject currFeat;
                for (int i = 0; i < noFeats; i++)
                {
```

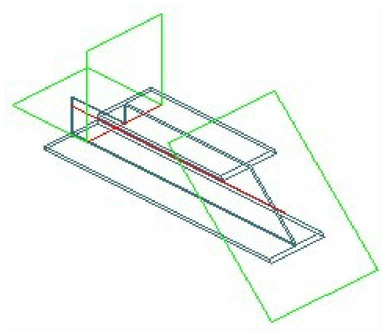
```
                currFeat = plateFoldFeatures[i];
                createdObjectsArr.Add(currFeat);
            }
        }
    }

    if (platePolyFold5 != null)
    {
        ok = foldedPlate.ExtendBy((AstSTEELAUTOMATIONLib.PlateFold)platePolyFold5, 1,
        stringerID, p3, p4e, relationRole, out stringerID2, out plateFoldRelation, out
        plateFoldFeatures);
        if (plateFoldRelation != null)
        {
            plateFoldRelation.JointTransfer =
             (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer2;
            createdObjectsArr.Add(plateFoldRelation);
            plateFoldRelation.Radius = 10;  //set the radius
        }
        if (plateFoldFeatures != null)
        {
            int noFeats = (int)plateFoldFeatures.Count;
            IAstFeatObject currFeat;
            for (int i = 0; i < noFeats; i++)
            {
                currFeat = plateFoldFeatures[i];
                createdObjectsArr.Add(currFeat);
            }
        }
    }

    if (platePolyFold6 != null)
    {
        ok = foldedPlate.ExtendBy((AstSTEELAUTOMATIONLib.PlateFold)platePolyFold6, 1,
        stringerIDFold2, p1b, p1f, relationRole, out stringerID2, out plateFoldRelation, out
        plateFoldFeatures);
        if (plateFoldRelation != null)
        {
            plateFoldRelation.JointTransfer =
             (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer2;
            createdObjectsArr.Add(plateFoldRelation);
            plateFoldRelation.Radius = 10;  //set the radius
        }
        if (plateFoldFeatures != null)
        {
            int noFeats = (int)plateFoldFeatures.Count;
            IAstFeatObject currFeat;
            for (int i = 0; i < noFeats; i++)
            {
                currFeat = plateFoldFeatures[i];
                createdObjectsArr.Add(currFeat);
            }
        }
    }
  }
 }
}
```

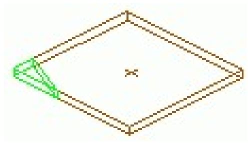
### 3.2.4 Features

The basic objects (i.e., beams and plates) have available processing features. The most important processing types are:

- Beam processing: coping, miter cuts, rectangular and circular contour cuts, or any type of contour.
- Plate processing: corner finishes, chamfers, outer plate contours and inner contours, etc.

Processing of existing basic objects (e.g., beam trimming and coping) is displayed as green processing contours within the object. The processing objects cannot exist alone and are part of a basic element (i.e., beam or plate). The object processing are edited as individual objects.





The variety of processing options in Advance Steel allows for almost any beam and plate contour.

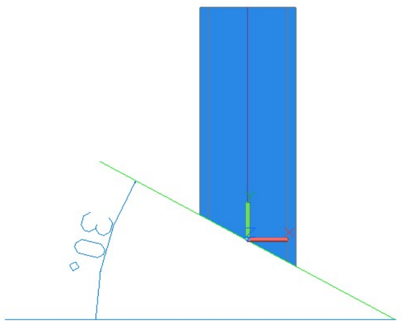
If a basic element is deleted all processing objects will also be deleted.

- addBeamShortening(eBeamEnd endOfBeam, IPlane shorteningPlane) - Shorten the beam with the specified plane at the given beam end. Returns and creates a beam shortening object. For information about possible values of eBeamEnd, see the Appendix (“Advance Steel Developer Guide”).

#### 3.2.4.1 Example: Create a shortening on a beam

```
private void AddBeamShortening (ref AstObjectsArr createdObjectsArr, IBeam inputBeam)
{
  //get beam cs at start
  ICS3d csBeam = inputBeam.get_PhysicalCSAt(eBeamEnd.kBeamStart);

  IPoint3d origin = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
  origin.setFrom(csBeam.Origin);

  IVector3d vDir = (IVector3d)(new DSCGEOMCOMLib.Vector3d());
  vDir.setFrom(csBeam.XAxis);
  vDir.RotateBy(csBeam.YAxis, Math.PI / 6);
  vDir.Normalize();
  origin.Add(vDir);

  //add beam Shortening
  IPlane plShortening = (IPlane)(new DSCGEOMCOMLib.plane());
  plShortening.CreateFromPointAndNormal(origin, vDir);

  IBeamShortening shortening = inputBeam.addBeamShortening(eBeamEnd.kBeamStart,
  plShortening);
  if (shortening != null)
```

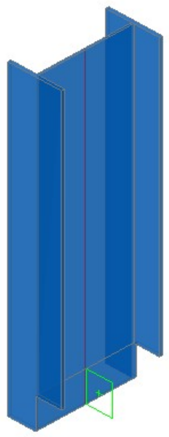
```
        createdObjectsArr.Add(shortening);
}
```



- addBeamMultiContourNotch(Role notchRole, eBeamEnd endOfBeam, IAugPolygon3d notchPts) - Creates a notch at the specified beam end with given role and contour. For information about possible values of eBeamEnd, see the Appendix (“Advance Steel Developer Guide”).

### 3.2.4.2 Example: Create a contour notch on a beam

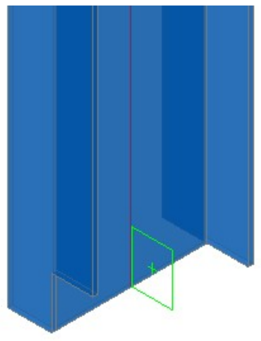
```
using JointDesignUtils;
/* … */
private void AddBeamContourNotch (ref AstObjectsArr createdObjectsArr, IBeam inputBeam)
{
   IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

   IPoint3d startPoint = inputBeam.PhysicalCSStart.Origin;
   IPoint3d endPoint = inputBeam.PhysicalCSEnd.Origin;

   IVector3d xAxis = startPoint.Subtract(endPoint);

   //retrieve beam geometrical data
   IProfType profType = inputBeam.getProfType();

   double dWidth = profType.getGeometricalData(eProfCommonData.kWidth);   //profile width
   double dHeight = profType.getGeometricalData(eProfCommonData. kProfHeight); //profile height
   double dWeb = profType.getGeometricalData(eProfCommonData.kWeb);       //profile web

   p1.setFrom(startPoint);
   Utils.movePoint(p1, inputBeam.PhysicalCSStart.ZAxis, dHeight / 2, out p1);
   Utils.movePoint(p1, inputBeam.PhysicalCSStart.YAxis, dWeb / 2, out p1);
   Utils.movePoint(p1, inputBeam.PhysicalCSStart.YAxis, (dWidth - dWeb) / 2, out p2);
   Utils.movePoint(p2, xAxis, -100, out p3);
   Utils.movePoint(p1, xAxis, -100, out p4);

   //create role object
   IRole notchRole = m_Joint.CreateRole("Feature");
   notchRole.ClassType = eClassType.kBeamMultiContourNotch;

   //compute contour
   IAugPolygon3d contourNotch = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
   contourNotch.AppendVertex(p1);
   contourNotch.AppendVertex(p2);
   contourNotch.AppendVertex(p3);
   contourNotch.AppendVertex(p4);

   //add beam notch
   IBeamMultiContourNotch multiContourNotch =
   inputBeam.addBeamMultiContourNotch((AstSTEELAUTOMATIONLib.Role)notchRole,
   eBeamEnd.kBeamStart, contourNotch);

   //Add notch to created object array
   if (multiContourNotch != null)
   {
      createdObjectsArr.Add(multiContourNotch);
   }
}
```



- addBeamMultiContourNotchClip(Role notchRole, eBeamEnd endOfBeam, IAugPolygon3d notchPts, IPoint3d pt0, IPoint3d pt1) - Creates a notch at the specified beam end with given role and points that define it. The notch has z clipping with the clipping heights defined by pt0 and pt1. Returns and creates a BeamMultiContourNotch object. For information about possible values of eBeamEnd, see the Appendix (“Advance Steel Developer Guide”).

3.2.4.3 Example: Create a clipped contour notch on a beam

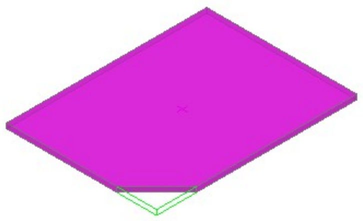
```
using JointDesignUtils;
/* … */
private void AddBeamContourNotchClip (ref AstObjectsArr createdObjectsArr, IBeam inputBeam)
{
   IPoint3d p1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p2 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p3 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d p4 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

   IPoint3d startPoint = inputBeam.PhysicalCSStart.Origin;
   IPoint3d endPoint = inputBeam.PhysicalCSEnd.Origin;

   IVector3d xAxis = startPoint.Subtract(endPoint);

   //retrieve beam geometrical data
   IProfType profType = inputBeam.getProfType();

   double dWidth = profType.getGeometricalData(eProfCommonData.kWidth);   //profile width
   double dHeight = profType.getGeometricalData(eProfCommonData.kProfHeight); //profile height
   double dWeb = profType.getGeometricalData(eProfCommonData.kWeb);       //profile web

   p1.setFrom(startPoint);
   Utils.movePoint(p1, inputBeam.PhysicalCSStart.ZAxis, dHeight / 2, out p1);
   Utils.movePoint(p1, inputBeam.PhysicalCSStart.YAxis, dWeb / 2, out p1);
   Utils.movePoint(p1, inputBeam.PhysicalCSStart.YAxis, (dWidth - dWeb) / 2, out p2);
   Utils.movePoint(p2, xAxis, -100, out p3);
   Utils.movePoint(p1, xAxis, -100, out p4);

   //create role object
   IRole notchRole = m_Joint.CreateRole("Feature");
   notchRole.ClassType = eClassType.kBeamMultiContourNotch;

   //compute contour
   IAugPolygon3d contourNotch = (IAugPolygon3d)(new DSCGEOMCOMLib.AugPolygon3d());
   contourNotch.AppendVertex(p1);
   contourNotch.AppendVertex(p2);
   contourNotch.AppendVertex(p3);
   contourNotch.AppendVertex(p4);

   IPoint3d u0 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());
   IPoint3d u1 = (IPoint3d)(new DSCGEOMCOMLib.Point3d());

   u0.setFrom(p1);
   double dFlange = profType.getGeometricalData(eProfCommonData.kFlange);
   Utils.movePoint(u0, inputBeam.PhysicalCSStart.ZAxis, -dFlange - 1e-3, out u1);

   IBeamMultiContourNotch multiContourNotch =
   inputBeam.addBeamMultiContourNotchClip((AstSTEELAUTOMATIONLib.Role)notchRole,
   eBeamEnd.kBeamStart, contourNotch, u0, u1);

   //Add notch to created object array
   if (multiContourNotch != null)
   {
     createdObjectsArr.Add(multiContourNotch);
   }
}
```



- addChamfer(double a_val, double b_val, int VertexIndex) - Returns and creates a Chamfer object. The plate corner is identified by the vertexIndex.

#### 3.2.4.4 Example: Create a chamfer on a plate

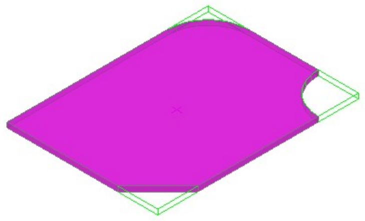
```
private void AddPlateChamfer (ref AstObjectsArr createdObjectsArr, IPlate basePlate)
{
   double dWidth = 80, dHeight = 80;

   VertexFeat chamfer = basePlate.addChamfer(dWidth, dHeight, 0);
   if (chamfer != null)
   {
      createdObjectsArr.Add(chamfer);
   }
}
```



- addFillet(double rad_val, eFilletTypes fillet_type, int VertexIndex) - Returns and creates a Fillet object. The plate corner is identified by the vertexIndex. For information about possible values of eFilletTypes, see the Appendix ("Advance Steel Developer Guide").

#### 3.2.4.5 Example: Create fillet on a plate

```
private void AddPlateChamfer (ref AstObjectsArr createdObjectsArr, IPlate basePlate)
{
   double dWidth = 80;

   VertexFeat fillet = basePlate.addFillet(dWidth, eFilletTypes.kFillet_Concav, 1);
   if(fillet != null)
   {
      createdObjectsArr.Add(fillet);
   }

   VertexFeat fillet2 = basePlate.addFillet(dWidth, eFilletTypes.kFillet_Convex, 2);
   if (fillet2 != null)
   {
      createdObjectsArr.Add(fillet2);
   }
}
```



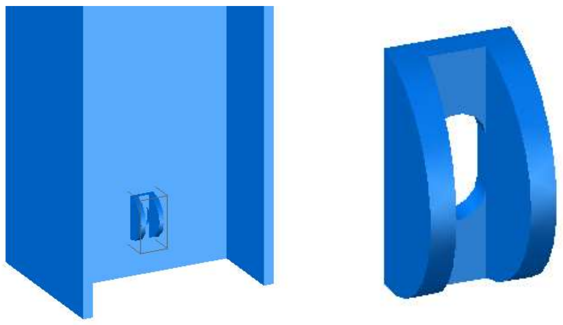
### 3.2.5 *Special parts*

Objects that are not Advance Steel standard objects can be created as special parts. When Advance Steel creates drawings and bills of material with special parts they are handled like standard objects. If these objects (special parts) are to appear in the bill of material, they must be provided with Advance Steel properties.

- CreateSpecialPart(Role pRole, double Scale, string BlockName, ICS3d pCS) - Creates and returns an SpecialPart object. For insertion point, the inputCS origin must be correctly specified.

#### 3.2.5.1 Example: Create a special part

```
private void AddSpecialPart (ref AstObjectsArr createdObjectsArr)
{
  ICS3d cs = (ICS3d)(new DSCGEOMCOMLib.CS3d());
  // set the coordinate system
  /* … */

  double dScale = 1.0;
  string blockName = "agcal12"; //C:\ProgramData\Autodesk\Advance Steel
  2023\USA\Shared\Support\Symbols\agcal12.dwg or your currently installed country folder

  //create role object
  IRole partRole = m_Joint.CreateRole("block");

  IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("block");
  jointTransfer.ClassType = eClassType.kSpecialPartWithBlock;

  //create special part
  ISpecialPart specialPart =
  m_Joint.CreateSpecialPart((AstSTEELAUTOMATIONLib.Role)partRole, dScale, blockName,
  cs);

  //Add special part to created object array
  if(specialPart != null)
  {
    specialPart.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;
    createdObjectsArr.Add(specialPart);
  }
}
```



### 3.2.6 Gratings

- CreateStandardGrating(Role pRole, string strClass, string strSize, ICS3d cs) - Returns a grating object. The grating's className and sectionName are the internal names.

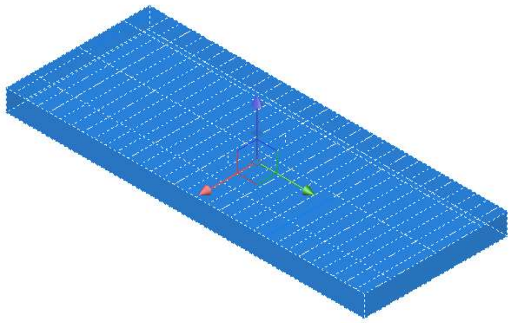
section.className = value from AstorGratings.GratingStandardMaster, column ClassName
section.size = from the definition table for className, value of column Name.

- CreateVariablePolygonalGrating(Role pRole, string strClass, string strSize, IAugPolygon3d ptsWCS) - Returns a grating object. The grating's className and sectionName are the internal names.

section.className = value from AstorGratings.GratingVariableMaster, column ClassName
section.size = from the definition table for className, value of column Name.

#### 3.2.6.1 Example: Create a grating

```
private void CreateGrating (ref AstObjectsArr createdObjectsArr)
{
   ICS3d cs = (ICS3d)(new DSCGEOMCOMLib.CS3d());
   // set the coordinate system
   /* … */

   //create role object
   IRole gratingRole = m_Joint.CreateRole("Grating");

   //create joint transfer
   IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Grating");
   jointTransfer.ClassType = eClassType.kGratingClass;

   string sectionClass = "Meiser_Standard";
   string sectionSize = "Meiser_Standard_01";

   IGrating grating =
   m_Joint.CreateStandardGrating((AstSTEELAUTOMATIONLib.Role)gratingRole, sectionClass,
   sectionSize, cs);

   //Add grating to created object array
   if(grating != null)
   {
      grating.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer; //set joint
   transfer
      createdObjectsArr.Add(grating);
   }
}
```



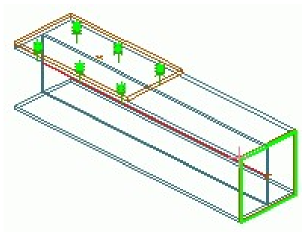
### 3.2.7 Bolts, Welds and Anchors

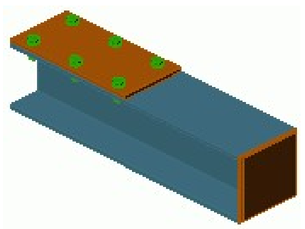
The basic objects (i.e., beams and plates) can be connected with:

- Bolt patterns (or holes only)
- Welds
- Anchors

These objects establish a connection between objects (e.g., beams and plates). This information is stored on the objects (i.e., beam or plate) including any bolt pattern (with its definition) or welds (with its relevant properties). Any individual element in the connection "knows" what holes, bolts, or welds it contains or with which element it is connected.

A bolt pattern can describe one or several bolts, which are automatically created in any plane together with the appropriate holes.





Changes in the bolt pattern automatically update the holes.

The tools for creating bolt patterns are used for bolts in addition to:

- Holes, slotted holes, countersunk holes, blind holes, threaded holes and punch marks
- Shear studs

The above are all created with their respective properties or definitions.

It is also possible to create the various hole types as part of a bolt object and a separate hole object.

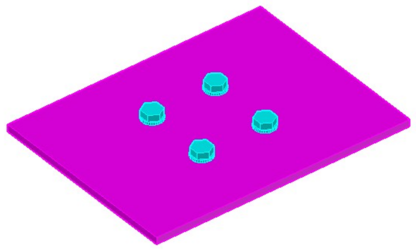
Weld points are displayed as crosses in the model.

- CreateBoltFinitRect(Role pRole, string Material, string norm, double wx_dim, double wy_dim, double dx_dim, double dy_dim, double nx_dim, double ny_dim, double diameter, ICS3d coordSys) - Returns a Bolt object. Create a bolt pattern of type finite, rectangular.

#### 3.2.7.1 Example: Add bolts to a plate

```
private void AddBolts (ref AstObjectsArr createdObjectsArr, IPlate basePlate)
{
   //read defaults from database
   IOdbcUtils tableUtils = (IOdbcUtils)(new DSCODBCCOMLib.OdbcUtils());

   string sBoltType = tableUtils.GetDefaultString(401, "Norm");
   string sBoltGrade = tableUtils.GetDefaultString(401, "Material");
   string sBoltAssembly = tableUtils.GetDefaultString(401, "Garnitur");
   double dBoltDiameter = tableUtils.GetDefaultDouble(401, "Diameter");

   //Create bolts
   IRole boltRole = m_Joint.CreateRole("Bolt"); //role object

   //create joint transfer object
   IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Bolt#1");
   setJointTransferForBolt(ref jointTransfer);
```

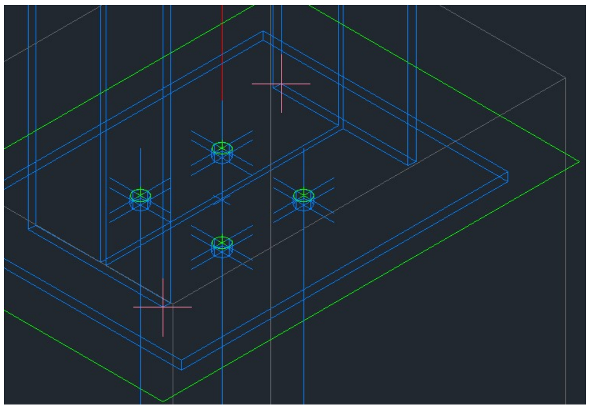
```
    ICS3d csPlate = (ICS3d)(new DSCGEOMCOMLib.CS3d());
    // set the coordinate system
    /* … */

    //create bolt pattern
    IBolt bolt = m_Joint.CreateBoltFinitRect((AstSTEELAUTOMATIONLib.Role)boltRole,
    sBoltGrade, sBoltType, 0, 0, 100, 100, 2, 2, dBoltDiameter, csPlate);

    //Add bolt to created object array
    if (bolt != null)
    {
      //set joint transfer
      bolt.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTransfer;

      bolt.SetHoleTolerance(2, true);
      bolt.BoltSet = sBoltAssembly;

      //connect objects
      AstObjectsArr conObj = m_Joint.CreateObjectsArray();
      conObj.Add(basePlate);

      bolt.Connect(conObj, eAssembleLocation.kOnSite);
      createdObjectsArr.Add(bolt);
    }
}

private void setJointTransferForBolt(ref IJointTransfer jointTrans)
{
   jointTrans.ClassType = eClassType.kFinitrectScrewBoltPattern;

   //set here all the properties which can be modified outside the joint
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonGripLengthAddition, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonHoleTolerance, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonCoating, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonDenotation, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonAssembly, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonItemNumber, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonInvertAble, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonNote, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonIgnoreMaxGap, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonSPUsedForCollisionCheck, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonSPUsedForNumbering, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonSPUsedForBillOfMaterial, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonSPExplicitQuantity, 1);
   jointTrans.set_Attribute(eAttributeCodes.kBoltPatternCommonRole, 1);
}
```



- CreateWeld(Role pRole, eWeldType Type, double Thickness, IPoint3d pLocation, ICS3d coordSys) - Returns a weld object with the specified type and thickness.

#### 3.2.7.2 Example: Add weld between a beam and a plate

```
private void AddWeld (ref AstObjectsArr createdObjectsArr, IPlate basePlate, IBeam inputBeam)
{
  //create new role object
  IRole weldRole = m_Joint.CreateRole("Weld");

  //create new joint transfer object
  IJointTransfer jointTrans = m_Joint.CreateJointTransfer("Weld#1");

  //set some attributes
  jointTrans.set_Attribute(eAttributeCodes.kWeldPatternThickness, 1);
  jointTrans.set_Attribute(eAttributeCodes.kWeldPatternAssembleLocation, 0);
  jointTrans.set_Attribute(eAttributeCodes.kWeldPatternSeamType, 1);

  IWeld       weld       =       m_Joint.CreateWeld((AstSTEELAUTOMATIONLib.Role)weldRole,
  eWeldType.kTWeld, 4, point, csAtPoint);

  //Add weld to created object array
  if (weld != null)
  {
    //set joint transfer
    weld.JointTransfer = (AstSTEELAUTOMATIONLib.JointTransfer)jointTrans;

    createdObjectsArr.Add(weld);

    //connect objects
    AstObjectsArr conObj = m_Joint.CreateObjectsArray();
    conObj.Add(inputBeam);
    conObj.Add(basePlate);

    weld.Connect(conObj, eAssembleLocation.kInShop);
  }
}
```



### 3.2.7.3 Example: Add a weld preparation on a plate

```
private void AddWeldPreparation (ref AstObjectsArr createdObjectsArr, IPlate basePlate)
{
   //create weld preparation
   IEdgeFeat weldBevel;
   //create weld role
   IRole weldRole = m_Joint.CreateRole("Feature");

   int edgeIndex = 1; //which edge of plate
   double xDist = 10; //x dist of weld prep
   double yDist = 5; // ydist of weld prep
   int plateSide = 0; // side of plate

   weldBevel = platePoly.addPlateWeldingBevel((AstSTEELAUTOMATIONLib.Role)weldRole,
   edgeIndex, xDist, yDist, plateSide);

   if (weldBevel != null)
      createdObjectsArr.Add(weldBevel);
}
```

# Chapter 4
# Joints API

## 4.1 User interface

The joint with its attributes is controlled by a property sheet dialog box. This means, that this dialog box will appear during creation and modification. It exposes the joint category, the type, and all the joint attributes. One default page appears in every property sheet dialog box.
The Type page contains a runtime list of all types of this category. It allows for switching between types.
The Update contains a check box indicating whether this joint should be updated automatically or not (which means that the user will be informed).
The rule designer has to design all other pages. This is done by implementing the GetUserPages method of the IRule.
The relationship between joint type and category is represented by a table in the database AstRules.mdf. The rule designer has to create entries there in order to create this relationship.

## 4.2 Query method

The *Query* method implementation should use the provided AstUI object and get user input regarding necessary parameters or objects. The objects must be added to the *Joint.InputObjects*. The selected objects will become “driver objects” for the joint. Modification of the “driver objects” will instigate an update of the Joint.
Also, if the rule is called using _astm4commstructasJointVB box _RuleName there is always a structural box inside the InputObjects array at the beginning of the Query method.

## 4.3 CreateObjects method

*CreateObjects* method implementation should create AS objects and add them to the *CreatedObjects* of the *Joint*. The objects can be created by using specific methods of the *Joint* object. Once the objects are created they are automatically added to the drawing. The connection between them and the Joint object is done after they are added to the *Joint.CreatedObjects*. Although it’s possible to create objects without adding them to *Joint.CreatedObjects* doing this is wrong because the connection is not created, and those objects will be “out of joint”. They will not be erased when updating the joint and other will be created.

## 4.4 InField/OutField methods

Advance Steel calls the *OutField* method every time it deems necessary to get the values and / or names of the *Rule* attributes. Similarly, the *InField* method is called every time it’s necessary for the *Rule* to change its current attribute values. For example, calls to these methods will happen when a dwg containing a joint created with this Rule is opened/saved, when the user changes the joint parameters in the joint properties dialog box, etc.

## 4.5 GetUserPages method

By implementing this method, you are able to specify the GUI of this Rule. This method should return handles to the created windows. The windows will become property pages for the Rule dialog box. Also, here you should assign the corresponding prompts for the Rule dialog box title and for the PropertyPages titles.

#### 4.5.1.1 Example

```
//Set Title(From AstCrtlDb.ErrorMessages)
pPropSheetData.SheetPrompt = 81309;

//First Page bitmap index(From AstorBitmaps)
pPropSheetData.FirstPageBitmapIndex = 60782;
pPropSheetData.ResizeOption = eGUIDimension.kStandard;

//Property Sheet 1
RulePage rulePage1 = m_Joint.CreateRulePage();
rulePage1.title = 88438; //Base plate layout
m_Page1 = new Page1(this);
rulePage1.hWnd = m_Page1.Handle.ToInt64();
pagesRet.Add(rulePage1);
```

## *4.6 GetTableName method*

Return the name of the table used by the rule to run.

## *4.7 GetExportData*

By implementing this method, the *Rule* can specify the necessary external data it needs to run. Based on this information a tool can import / export data from / to Advance Steel databases.

## *4.8 GetFeatureName*

Must return true or false depending on license feature usage for this rule.

## *4.9 FreeUserPages*

Release user pages

## *4.10 Libraries*

Advance Steel provides several libraries that are intended to be used when implementing a Rule.

- **AstSteelAutomation** library – provide access to all Advance Steel dwg objects.
- **DSCGeomCom** library – Geometry library, useful for geometric calculation (vectors, coordinates, points, parametric curves)
- **DSCProfilesAccesCom** library – Provides access to the profiles defined used by Advance Steel.
- **DSCUtilFacetCom** library - Provides access to the geometric body of an Advance Steel object.
- **DSCOdbcCom** library - Provides access to data used by Advance Steel and stored in external databases.
- **AstControls** library – Provides several controls intended to be used for the GUI of the joints.

Mainly this library has regular controls but uses database prompts (language dependent) instead of hardcoded prompts. Also this library has a Bitmap control that uses bitmaps stored in AstorBitmaps or in dll's.

## 4.11 Attributes and categories

Whenever you need to create and Advance Steel object you should define a new IRole object. This object is used to identify object from model. To create a role you need to assign a name from AstorBase database, table ModelRole corresponding to your object.

```
// create role object
IRole role = m_Joint.CreateRole("Haunch"); // name from AstorBase.ModelRole table
```

To set the user attributes of an object:

```
role.set_Attribute(eAttributeCodes.kUserAttr1, 0);
string userAttribute = beam.get_UserAttribute(0);
beam.set_UserAttribute(0, "value");
```

## 4.12 JointTransfer

This object will be passed after it is created to almost all of the methods that create Advance Steel objects. The joint transfer has mainly two “visible” applications: identify objects with identical geometry and properties and set which of the properties of joint created objects can be set by the user outside of the joint.

To define a complete joint transfer means to assign a name, the class type of the objects it will be applied to and to define which of the object’s properties will be editable outside the joint.

After setting the object class type, you have to specify which will be the editable attributes. In Visual C# syntax, this is what you have to do:

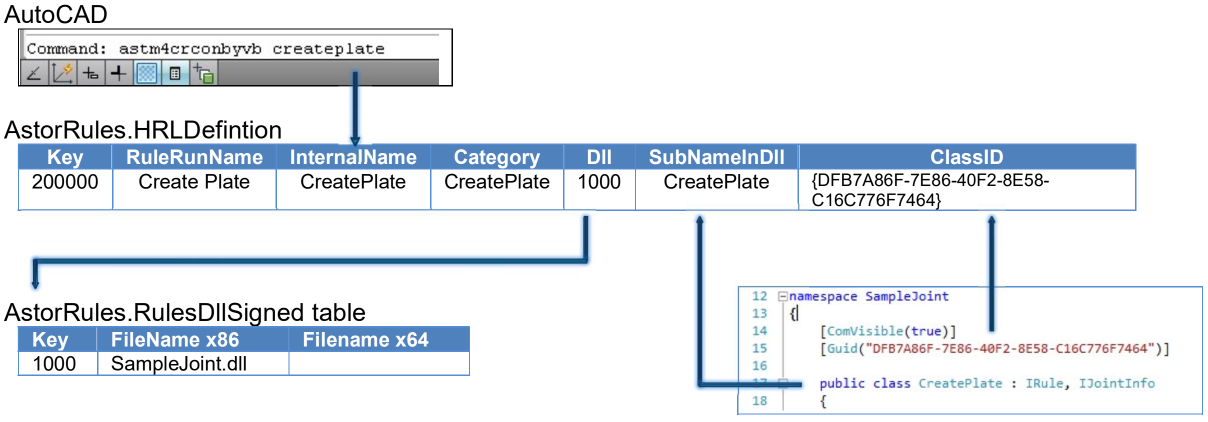
```
// create the joint transfer object
IJointTransfer jointTransfer = m_Joint.CreateJointTransfer("Beam");

// this joint transfer will be used when creating a straight beam
jointTransfer.ClassType = eClassType.kBeamStraightClass;

//set here all the properties which can be modified outside the joint
jointTransfer.set_Attribute(eAttributeCodes.kBeamMaterial, 1); //means the beam material can be
set outside the joint
jointTransfer.set_Attribute(eAttributeCodes.kBeamCoating, 1); //other editable properties of object
with this joint transfer
```

If a joint transfer attribute should not be modified outside the joint (this is the default state of attributes – read only), you could use: jointTransfer.set_Attribute(eAttributeCodes.kBeamMaterial, 0); //means the beam material cannot be set outside the joint

## 4.13 Database Structure

Usually, the following databases are used for joint development.
AstCrtlDb.mdf - used to store the localized texts the joint uses to display in AutoCAD windows or dialog box pages.
AstorRules.mdf - used to store the joint "definition" records (HRLDefintion and RulesDllSigned tables) and to store any table the joint uses.
The definition record in HRLDefinition requires the specification of the GUID on the ClassID column.

#### 4.13.1.1 Relationships



AutoCAD

```
Command: astm4crconbyvb createplate
```

AstorRules.HRLDefintion

| Key | RuleRunName | InternalName | Category | Dll | SubNameInDll | ClassID |
|---|---|---|---|---|---|---|
| 200000 | Create Plate | CreatePlate | CreatePlate | 1000 | CreatePlate | {DFB7A86F-7E86-40F2-8E58-C16C776F7464} |

AstorRules.RulesDllSigned table

| Key | FileName x86 | Filename x64 |
|---|---|---|
| 1000 | SampleJoint.dll | |

```
namespace SampleJoint
{
    [ComVisible(true)]
    [Guid("DFB7A86F-7E86-40F2-8E58-C16C776F7464")]

    public class CreatePlate : IRule, IJointInfo
    {
```

For joints created in pure .Net (without COM technology) the SubNameInDll field should contain the fully qualified name of the class. E.g.: SampleJoint.CreatePlate (where SampleJoint is the namespace and CreatePlate is the class name). Also, for joints created in pure .Net the ClassID field should be a new generated GUID.

## 4.14 Joint table

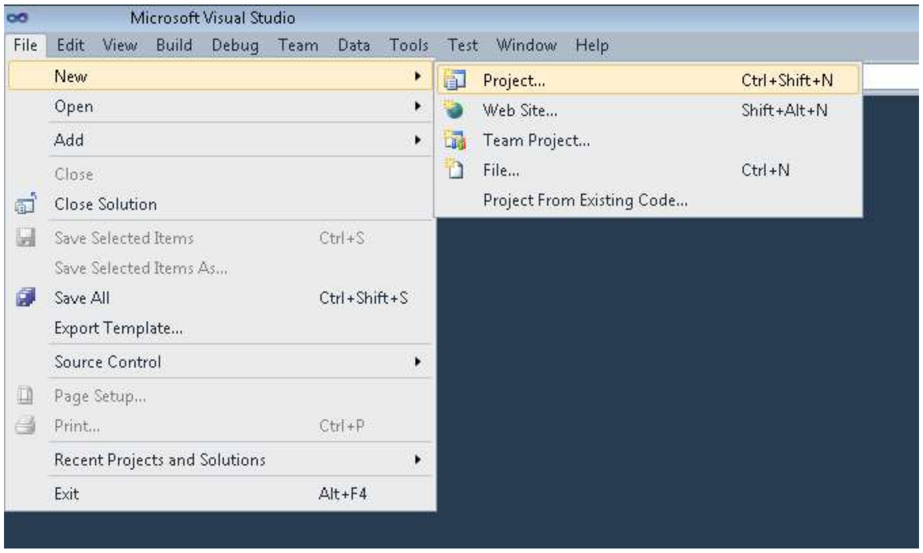
Each joint can store its parameters to database. This is useful when you need to create the joint for many times. You need to configure joint one time and then save its values to database. Then when make a new joint will be created with these values. Joint table columns must be in order and with same name as the members from (InField/OutField).
In Query method after adding the input objects you can set parameters for joint (load from joint table or initialize with some values).

```
IOdbcTable odbcTable = (IOdbcTable)(new DSCODBCCOMLib.OdbcTable());
odbcTable.SetCurrent("RULE_CreatePlate"); // table name
odbcTable.AddSearchCriteria(1, "Default");

//Search if joint table contain a record with "Default" name. If succeeded load values from that record.
int key = (int)odbcTable.Search();
if (-1 != key)
{
   int idx = 2;
  m_dPlateThickness = (double)odbcTable.GetAt(idx++);
  //…
}
else
{
  m_dPlateThickness = 10;
}
```

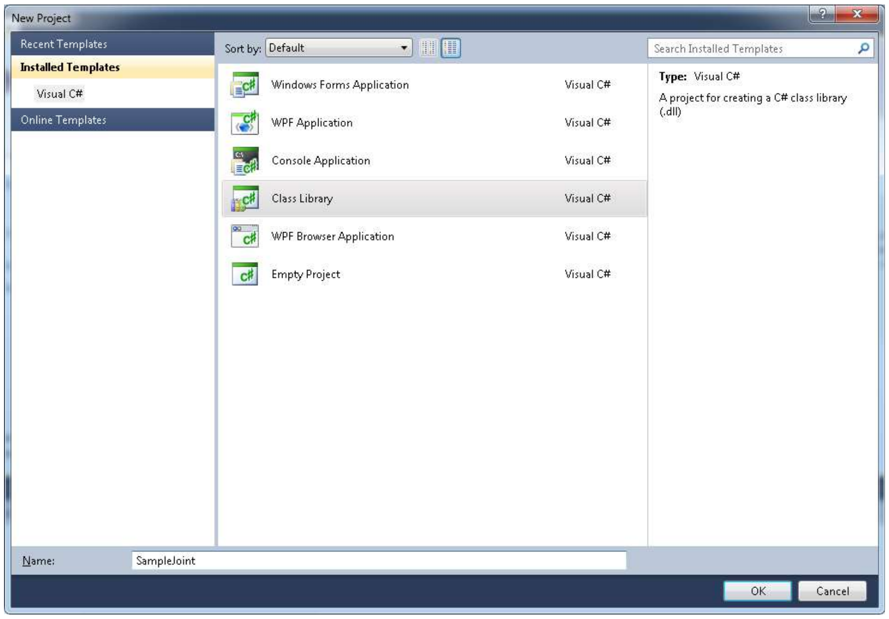
## 4.15 Developing a joint

### 4.15.1 Visual Studio solution

After starting visual studio, you need to choose new project (**File / New / Project**).



The dialog below will appear. Choose Class Library


New Project
Recent Templates
Installed Templates
Visual C#
Online Templates
Sort by: Default
Search Installed Templates
Windows Forms Application Visual C#
WPF Application Visual C#
Console Application Visual C#
Class Library Visual C#
WPF Browser Application Visual C#
Empty Project Visual C#
OK
Cancel

Type: Visual C#

A project for creating a C# class library (.dll)

Name: SampleJoint

Project configuration should target x64 platform and .NET framework 4.7.

From menu Project choose Add Reference. In the Add Reference dialog box, click the Browse tab. Locate the folder where Advance Steel is installed ("BinPath" value from the registry key HKEY_LOCAL_MACHINE\SOFTWARE\Autodesk\AutoCAD\R24.2\ACAD-6101).

Select the following files:

C:\Program Files\Autodesk\AutoCAD 2023\ADVS\

- Interop.DSCGEOMCOMLib.dll
- Interop.DSCODBCCOMLib.dll
- Interop.DSCPROFILESACCESSCOMLib.dll
- Interop.AstSTEELAUTOMATIONLib5.dll
- Interop.DSCUTILFACETCOMLib.dll

Each of these libraries has a well-defined role in the joint development process and will be described in the following brief descriptions.
**AstSteelAutomation** handles all the "core" Advance Steel functionalities. It exposes interfaces to objects that can be created with Advance Steel and also handles joint, GUI and other functionalities.

**AstControls** is used mainly for GUI development of joints. Several ActiveX objects have been provided with this library. For example the joint developer can link one static prompt to a CrtlDb message through a StaticDbTextControl.

**DSCUtilFacetCom** mainly handles the body interface. It provides access to body intersection with lines and other basic geometry interfaces.

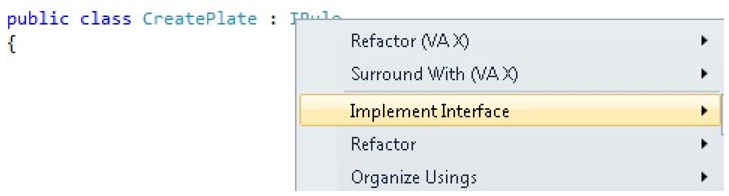
**DSCGeomCom** handles basic geometry classes. This library can be used without Advance Steel. It exposes interfaces like point, vector, plane etc.

**DSCOdbcCom** library provides useful and easy access to Advance Steel databases. One can get prompts, defaults or easily access tables through interfaces provided by this library.

**DSCProfilesAccesCom** library is used to handle Proftype objects (beam profiles, user defined and general use profiles).

At this stage the project should have only one class (default named "Class1"). This can be renamed to fit the joint's name. Your class should inherit from IRule interface and IJointInfo.

You need to implement several methods/properties. To do that, right click on IRule and select Implement Interface.



```
public class CreatePlate : IRule
{
```

## Query method

Is the function that is passed only once when the joint is run the first time. Its role is to ask the user for input objects and set defaults.

```
public void Query(AstUI pAstUI)
{
            //Filter to select only straight beam
            IClassFilter classFilter;
            classFilter = pAstUI.GetClassFilter();
            classFilter.AppendAcceptedClass(eClassType.kBeamStraightClass);

            //Declare the input objects
            AstObjectsArr inputObjectsArr = m_Joint.CreateObjectsArray();
            eUIErrorCodes errCode;
            IAstObject selectedObject = pAstUI.AcquireSingleObject(163, out errCode);

            //selection incorrect
            if (errCode == eUIErrorCodes.kUIError)
                  return;

            //user abort the selection
            if (errCode == eUIErrorCodes.kUICancel)
                  return;

            //add selected object to the input objects array
            if (selectedObject != null)
                  inputObjectsArr.Add(selectedObject);

            //add all the objects selected by the user (input objects)
            m_Joint.InputObjects = inputObjectsArr;

            //load default parameters for joint
            loadDefaultValues();
}
```

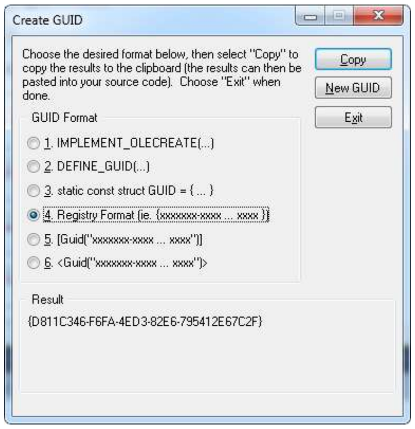
**CreateObjects** contains the joint functionality. It uses the global variables declared in the declaration section and does the main work. The normal behavior when creating a new joint is to create objects in the "CreateObjects()" method and show the property pages. Remember - when you show property pages you should not force the update of the joint.
For the correct functionality of a joint when a problem has appeared and the box should be red, the joint should implement the CreateObjects method as follows:

```
public void CreateObjects()
{
   bool bCreationStatus = true;
   AstObjectsArr createdObjectsArr = m_Joint.CreateObjectsArray();

   try
   {

      //…creation stuff…..
   }
   catch (COMException ex)
   {
      System.Diagnostics.Debug.WriteLine(ex.Message);
      bCreationStatus = false;
   }
   catch (System.Exception ex)
   {
      System.Diagnostics.Debug.WriteLine(ex.Message);
      bCreationStatus = false;
   }

   //Set it to false will result in a joint "red box" situation. The
   //objects created by the joint until the error occurred will be deleted and the old
   objects will be available.
   m_Joint.CreationStatus = bCreationStatus;
   m_Joint.CreatedObjects = createdObjectsArr;
}
```

### 4.15.2 Create GUID

From Visual Studio menu, select (**Tools/Create GUID**). Select Registry Format and click Copy. Then add the following lines to you project before class name

```
[ComVisible(true)]
[Guid("paste generated GUID here")]
```


Create GUID

Choose the desired format below, then select "Copy" to copy the results to the clipboard (the results can then be pasted into your source code). Choose "Exit" when done.

GUID Format

- 1. IMPLEMENT_OLECREATE(...)
- 2. DEFINE_GUID(...)
- 3. static const struct GUID = { ... }
- [✓ 4. Registry Format (ie. {xxxxxxx-xxxx ... xxxx })]
- 5. [Guid("xxxxxxx-xxxx ... xxxx")]
- 6. <Guid("xxxxxxx-xxxx ... xxxx")>

Result

{D811C346-F6FA-4ED3-82E6-795412E67C2F}

### 4.15.3 Build the program

After completing the code, you must build the project. From the Build menu, click Build Solution.

### 4.15.4 Add records in database

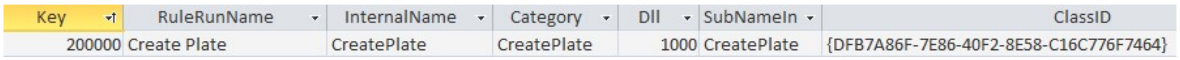
Go to **C:\ProgramData\Autodesk\Advance Steel 2023\USA\Steel\Data\ (or your currently installed country folder)** and open **AstorRules** database.

Open **HRLDefinition** table

Table structure:

- Key
- RuleRunName - The name that would appear on joint property sheet
- InternalName - Command name used to call joint
- Category - Joint category
- Dll - Key to RulesDllSigned table
- ClassID - Generated GUID

Add new record



| Key | RuleRunName | InternalName | Category | Dll | SubNameIn | ClassID |
|---|---|---|---|---|---|---|
| 200000 | Create Plate | CreatePlate | CreatePlate | 1000 | CreatePlate | {DFB7A86F-7E86-40F2-8E58-C16C776F7464} |

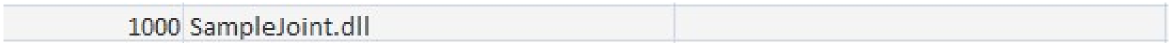
Open **RulesDllSigned** table

Table structure:

- Key - number from HRLDefinition.Dll

- FileName - DLL name.
- Tech – Possible values are: 0 – for C++ COM, 1 – for COM in .NET, 2 – for pure .NET .

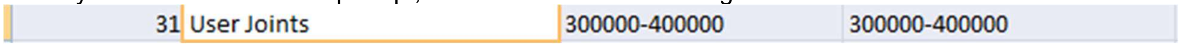
Add new record:



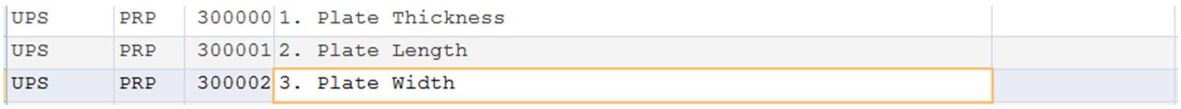
| | | |
|---|---|---|
| 1000 | SampleJoint.dll | |

Save and close database
Prompts are stored in **AstCrtlDb** database, table **ErrorMessages**.
Go to **PromptSetDefinition** and set your prompt range.

When you need to add a new prompt, use numbers from this range.



| | | | |
|---|---|---|---|
| 31 | User Joints | 300000-400000 | 300000-400000 |



| | | | | |
|---|---|---|---|---|
| UPS | PRP | 300000 | 1. Plate Thickness | |
| UPS | PRP | 300001 | 2. Plate Length | |
| UPS | PRP | 300002 | 3. Plate Width | |

### *4.15.5 User interface*

The joint with its attributes is controlled by a property sheet dialog box. This means, that this dialog box will appear during creation and modification. It exposes the joint category, the type, and all the joint attributes.

The rule designer has to design all pages. This is done by implementing the *GetUserPages* method of the *IRule*.

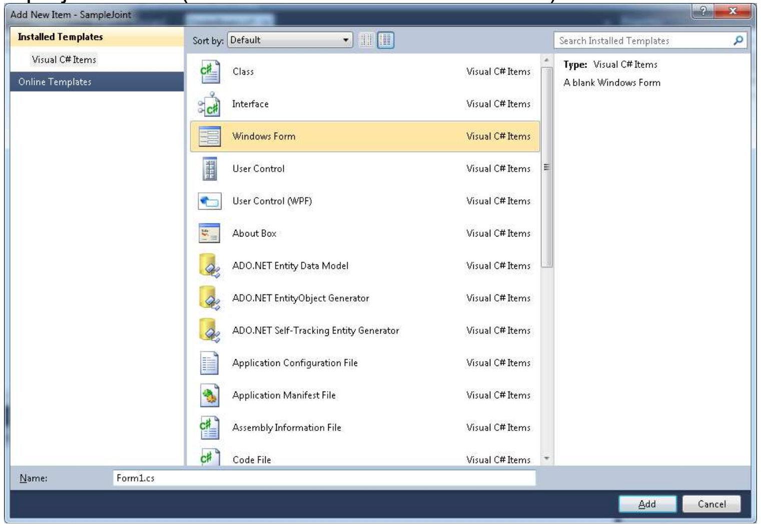
*GetUserPages* provides the link between the ActiveX class object created and forms created for the GUI. The joint developer is responsible for creating GUI forms for the joint. Each form represents one property sheet in the Joint Properties tab.

**InField** should contain persistent data reading from the dwg. In the InField function there should be calls to *pFiler.readItem* like:
m_dPlateThickness = (double) pFiler.readItem("PlateThickness");

Please note that the "**PlateThickness**" string is important and should be exactly the same in the reverse operation,
**Outfield**: pFiler.writeItem(m_dPlateThickness, "PlateThickness")

### 4.15.6 Create first page

Right click on your project select (**Add/New item/ Windows Form**)


Add New Item - SampleJoint
Installed Templates
Visual C# Items
Online Templates
Sort by: Default
Search Installed Templates
Class
Interface
Windows Form
User Control
User Control (WPF)
About Box
ADO.NET Entity Data Model
ADO.NET EntityObject Generator
ADO.NET Self-Tracking Entity Generator
Application Configuration File
Application Manifest File
Assembly Information File
Code File
Visual C# Items
Type: Visual C# Items
A blank Windows Form
Name: Form1.cs
Add
Cancel

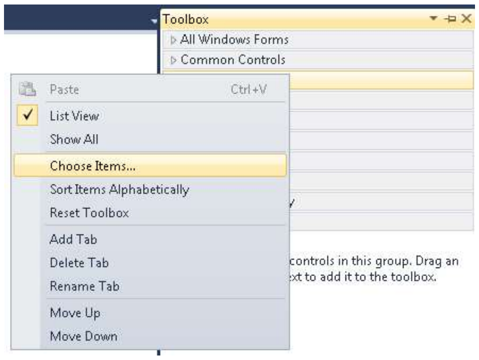
After that you need to set some properties to the form:

- ShowIcon: False
- ShowInTaskBar: False
- FormBorderStyle: None
- Override CreateParams

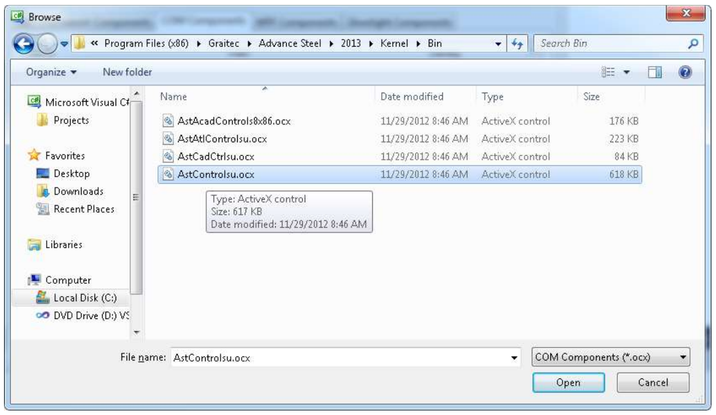
```
private const int WS_CHILD = 0x40000000;

protected override CreateParams CreateParams
{
        get
        {
                CreateParams cp = base.CreateParams;
                cp.Style = cp.Style | WS_CHILD;
                return cp;
        }
}
```

### 4.15.7 Add ActiveX control

Right click on Toolbox and select Choose Items.



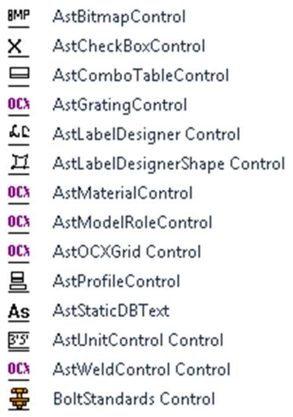
- On COM Components tab select browse (*.ocx files)
- Go to SDK\Controls subfolder from your Advance Steel SDK package
- Select AstControlsu.ocx



| Name | Date modified | Type | Size |
|---|---|---|---|
| AstAcadControls8x86.ocx | 11/29/2012 8:46 AM | ActiveX control | 176 KB |
| AstAtlControlsu.ocx | 11/29/2012 8:46 AM | ActiveX control | 223 KB |
| AstCadCtrlsu.ocx | 11/29/2012 8:46 AM | ActiveX control | 84 KB |
| AstControlsu.ocx | 11/29/2012 8:46 AM | ActiveX control | 618 KB |

Type: ActiveX control
Size: 617 KB
Date modified: 11/29/2012 8:46 AM

File name: AstControlsu.ocx



AstBitmapControl
AstCheckBoxControl
AstComboTableControl
AstGratingControl
AstLabelDesigner Control
AstLabelDesignerShape Control
AstMaterialControl
AstModelRoleControl
AstOCXGrid Control
AstProfileControl
AstStaticDBText
AstUnitControl Control
AstWeldControl Control
BoltStandards Control

AstControlsu.ocx is a custom control that allows editing of the joint pages in Visual Studio and it is compiled on 32 bits for compatibility with Visual Studio (which is a 32 bits application). Adding the OCX control in the Visual Studio toolbox requires elevated permissions (run Visual Studio as administrator) so the COM will be registered in the system. This operation automatically adds two COM references to the project (ASTCONTROLSLib and AxASTCONTROLSLib) that should be removed and replaced with AxInterop.ASTCONTROLSLib.dll instead.

### *4.15.8 Control Properties*

- **AstUnitControl**
  - **EditType**: Length, Angle, Area, Weight, Volume, Double Adimensional, Integer Adimensional and String
  - **LabelDbkey**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **LabelLength**: Control length
  - **Visible**: True/False
  - **IntegerValue**: Control value (use ONLY for integer type controls)
  - **DoubleValue**: Control value (use ONLY for double type controls)
- **AstComboTableControl**

- **LabelKey**: Prompt number from database(AstCrtlDb, table ErrorMessages)
- **LabelLength**: Control length
- **TableName**: Link to table name from AstorRules database
- **ComboIndex**: Order of runname in list, starting from 0 - not the key of the table record
- **ComboCaption**: Displayed runname
- **StringLey:** Key of record for current runname - use ONLY when table has a string key
- **LongKey:** Key of record for current runname - use ONLY when table has an integer key

- **AstBitmapControl**
  - **Key**: AstorBitmaps. BitmapIndex table

- **AstCheckBoxControl**
  - **CaptionKey:** UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **Value**: Control value
  - **Enable**: True/False

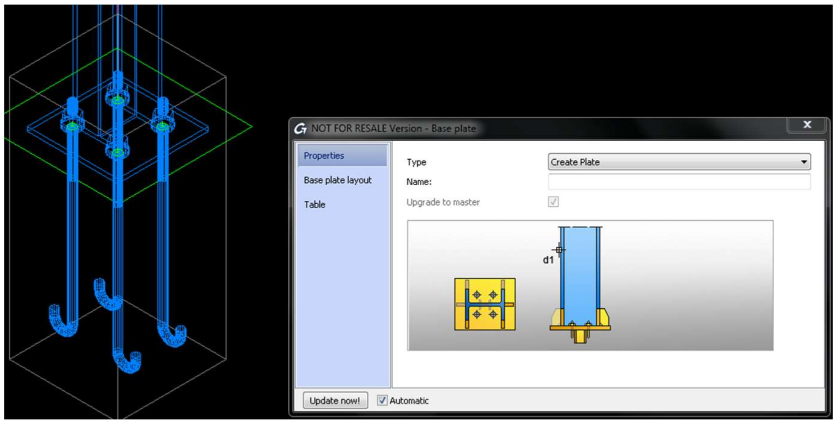
- **AstBoltStandards**
  - **BoltStandard**: Bolt type
  - **BoltMaterial**: Bolt material
  - **BoltSet**: Bolt assembly
  - **BoltDiameter**: Bolt diameter
  - **LabelStandard**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **LabelMaterial**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **LabelBoltSet**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **LabelDiameter**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **ElementType**: Bolt, Shear stud, Anchor
  - **LabelLength**: Control length

- **AstProfileControl**
  - **CaptionClass**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **CaptionShowHideAllSection**: UPS Prompt number from database (AstCrtlDb, table ErrorMessages)
  - **CaptionTyp**: UPS Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **CurrentClass**: Value from AstorProfiles.ProfileMasterTable, column TypeNameText
  - **CurrentSection**: From the definition table for className, value of column SectionName

- **AstWeldControl**
  - **LabelDbKey**: Prompt number from database(AstCrtlDb, table ErrorMessages)
  - **LabelLength**: Control length
  - **SelectItemByKey**: Control value

### *4.15.9 Run joint*

- Compile your project
- Copy output dll to **C:\Program Files\Autodesk\AutoCAD 2023\ADVS\**
- Run Advance Steel
- Call joint with **astm4crconbyvb <jointName>**



Type: Create Plate
Name:
Upgrade to master ✓
Automatic ✓

### 4.15.10 Making the joint available in Revit

Currently Advance Steel joints are available in Revit under the Steel Connections addin. The third-party Advance Steel joints binaries have to be installed in Revit in Addins\SteelConnections sub folder together with the other Advance Steel components.

After creating a joint and making it available in Advance Steel (under AutoCAD), there are some special steps required to make it available in Revit too:

- re-compile the joint project by using library references from the Revit installation (e.g. %Program Files%\Autodesk\Revit 2023\AddIns\SteelConnections).

- add info about the new joint

  - locate SteelConnectionsData.xml settings file in the Revit installation (e.g. %ProgramData%\Autodesk\Revit Steel Connections 2023).

  - there should be a folder named ThirdPartySettings. If it doesn't exist create it. Inside this folder create a new one (e.g. named by your company to avoid conflicts with other 3rd party folders) that should contain the joint settings.

  - create a new xml file with the joint settings (the contents structure should be like the SteelConnectionsData.xml).

  - make sure the typeId field from the xml has the same guid as the classId from AstorRules.HRLDefinition table.

  - fill the Images and PreviewText with the names of your corresponding resources.

  Example

```
<PaletteItem>
      <Description>Sample joint</Description>
      <Command>samplejoint</Command>
      <PreviewText>Preview text for the sample joint</PreviewText>
      <Images>
      <string>SampleJointImage.png</string>
      </Images>
      <PreviewImages>
      <string>SampleJointPreviewImage.png</string>
      </PreviewImages>
      <TypeId>DFB7A86F-7E86-40F2-8E58-C16C776F7464</TypeId>
</PaletteItem>
```

  - add the resource dll name (The one containing the image and preview image for the joint) to the ResourceDll and PreviewResourceDll fields. The resources dll names should be separated with a comma (",") from the existing dll names.

  Example:

```
ResourceDll>ASConnectionsResources.dll,SampleJointDotNetResources.dll</ResourceDll>
<PreviewResourceDll>ASConnectionsPreviews.dll,SampleJointDotNetResources.dll</PreviewResourceDll>
```

- add info about the new joint in SteelConnectionsData.xml similar to what you have for the other joints

  - make sure the typeId field from the xml has the same guid as the classId from AstorRules.HRLDefinition table.

- fill the Images and PreviewText with the names of your corresponding resources

Example:

```
<PaletteItem>
    <Description>Sample joint</Description>
    <Command>samplejoint</Command>
    <PreviewText>Preview text for the sample joint</PreviewText>
    <Images>
      <string>SampleJointImage.png</string>
    </Images>
    <PreviewImages>
      <string>SampleJointPreviewImage.png</string>
    </PreviewImages>
    <TypeId>DFB7A86F-7E86-40F2-8E58-C16C776F7464</TypeId>
 </PaletteItem>
```

- add the resource dll name (The one containing the image and preview image for the joint) to the ResourceDll and PreviewResourceDll fields. The resources dll names should be separated with a comma (“,”) from the existing dll names.

Example:

```
<ResourceDll>ASConnectionsResources.dll,SampleJointDotNetResources.dll</ResourceDll>
<PreviewResourceDll>ASConnectionsPreviews.dll,SampleJointDotNetResources.dll</PreviewResourceDll>
```

- for joints requiring additional input points (e.g. stiffener connection) you must create the InputPointsInfo field inside joint definition. Under this field you must define an *InputPointInfo* field, which will contain the necessary information for point definition like:

- *PointSelectionText* - This string is a Revit tip message shown to the user to guide her through joint creation.
- *InputPointRestriction* – in this field you can define a restriction for the input point. Currently only restrictions of type InputMemberAxis can be defined, which will restrict the movement of your input point only to the xAxis of any of your input members. You can select to which input member to restrict you point by using *InputMemberIndex* field.

Example:

```
<InputPointsInfo>
    <InputPointInfo>
        <PointSelectionText>Please choose a placement point for the connection. </PointSelectionText>
        <InputPointRestriction>
            <RestrictionType>InputMemberAxis</RestrictionType>
            <InputMemberIndex>0</InputMemberIndex>
        </InputPointRestriction>

    </InputPointInfo>
</InputPointsInfo>
```

In Revit, joints have a default symbolic representation in coarse/medium view level of detail.

- to disable a joint's symbolic representation in coarse detail level, add the following joint field in xml:

```
<HasCoarseRepresentation>false</HasCoarseRepresentation>
```

- to disable a joint's symbolic representation in medium detail level, add the following joint field in xml:

```
<HasMediumRepresentation>false</HasMediumRepresentation>
```

- update table AstorRules.AutoFilteringConfig with information about the new joint

  Example:

| | |
|---|---|
| *Key* | *999999* |
| *Category* | *SampleJoint* |
| *RunName* | *ColOrRaf Any to ColOrRaf Any* |
| *InputSet* | *Any+Any* |
| *InputSetConds* | *No Condition* |
| *RuleInternalName* | *SampleJoint* |
| *ObjectsOrderForJoints* | *2 Beams inversed* |
| *OwnerText* | |

  For more information about configuring the AstorRules.AutoFilteringConfig please check the following document: "AstorRules set up for SteelConnection Project.docx"

- installation (joint dll, .NET resources dll and all the AS databases and xml files updated for all the languages). Currently the Steel Connections addin is installed in many languages, so the databases and SteelConnectionsData.xml for each country has to be updated accordingly.

The path to the SteelConnections binaries should be composed from the Revit install location read from Registry Keys (e.g. HKEY_LOCAL_MACHINE\SOFTWARE\Autodesk\Revit\2023\REVIT-05:0409\InstallationLocation) and the relative path to the Revit addins. The result should be something like this:
"C:\Program Files\Autodesk\Revit 2023\" + "AddIns\SteelConnections".
The SteelConnections addin stores its data in a dedicated folder specified by the "DataPath" key from ASSettings_Advance.xml configuration file. This is usually C:\ProgramData\Autodesk\Revit Steel Connections 2023. The path doesn't include the language sub-folder that is dynamically appended on start up. SteelConnections data (including databases) is archived in a .zip file and it's automatically unzipped on the first usage of SteelConnections functionality in Revit.

Database modifications for the new joint could be also added automatically on Advance Steel start-up by using the third party project database patching mechanism (see DatabasePatching.docx)

**Joint input objects**
The Advance Steel joints currently work on the Revit structural families (framings, columns).
The structural steel columns and framing elements need to meet a series of requirements in order to be used in the steel fabrication workflow:
http://help.autodesk.com/view/RVT/2022/ENU/?guid=GUID-6244E741-5D14-4DAD-AE25-5069F71B69F3

**Special steps required to add a joint design module in Revit**
- there is no special requirement for adding an Advance Steel joint design module to Revit; the dll must be installed in the Steel Connections folder and the Advance Steel databases for Steel Connections have to be updated accordingly (just like for Advance Steel).

# Chapter 5
Joints Design API

### 5.1.1 *Implementation of a joint calculation module*

We will use the following terms:

- joint calculation module - the module which implements the interface for communication between Advance Steel and the program used to calculate the steel structure
- calculation engine - the external calculation program

### 5.1.2 *How it works?*

A joint calculation module must be able to perform the following operations:

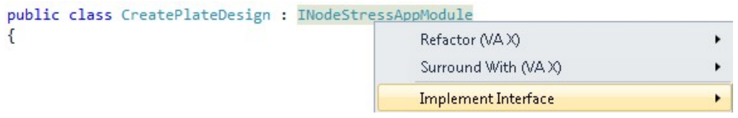
- accept input data
- process input data
- display results of input processing

Description of the above operations:

- The calculation module must be able to read joint data:
    - **Joint parameters** - values that define the configuration of the joint and are important to the calculation engine used (e.g. thickness of a plate, number of bolts, position of bolts, dimensions of a plate, etc.)
    - **Efforts** - the values should be read from  Advance Steel node object defined in the proximity of the joint, but also the efforts / loadings can be entered and stored as persistent data in the calculation module itself
- Processing the read data: The data processing (with an external calculation engine) must support the following actions:
    - **Check joint** - The external calculation engine must receive all important information's from the joint and then only check if the joint configuration is correct.
    - **Presize joint** - The external calculation engine receives required data from the joint and supplies the "best configuration" for the joint, and then the joint calculation module must set the modified parameters back into the joint.
    - **Export** - The current joint configuration in the format required by the external calculation engine.
    - **Import** - The joint configuration from a previously created file by the external calculation engine.
- Displaying the results: Ideally, the external calculation engine must be able to produce two types of reports (after a "check" or a "presize" operation):
    - **Quick report** - In TXT format (which will be displayed in the "Joint Design" sheet) and which contains general information's.
    - **Detailed report** - which should be in RTF format and should contain detailed information about the calculation results.

### 5.1.3 *Communication interface*

The joint calculation module must implement the **INodeStressAppModule** interface**.**



```
public class CreatePlateDesign : INodeStressAppModule
{
```

### 5.1.4 *Description of interface methods*

We will describe below the main methods which need to be implemented for a calculation module and the type of actions which should be performed when each of them is called by Advance Steel.

- ModuleName - You need to return from this method the internal name of the calculation module, as it was specified in the database during configuration.
- Standard - Currently, from the get method you need to return "Default".
- GetExportName() -This method is called to obtain the string required to complete the text displayed in the "Joint Design" sheet on the button "Export". Example: return "to my app" will make the "Export" button display the "Export to my app" text.
- GetImportName() -This method is called to obtain the string required to complete the text displayed in the "Joint Design" sheet on the button "Import".
- GetLastReportFilename(bool bQuickReportFilename) - On the "Joint Design" sheet, after a check or presize operation, reports should be available in order to see the results of the calculation. This method must return the full path of the last created quick report and detailed report files. Depending on the values of the input parameter "QuickReportFilename" you must return true (the quick report file path) or false (the detailed report file path).
- CheckJoint() - This method is called in two situations:
  - When you press the "Check" button from "Joint Design" sheet.
  - When the joint updates, if the checkbox "Automatic checking" is checked.
    After the check operation is finished, you need to return the joint status, depending on the results returned by the calculation engine (the joint is correctly designed, incorrectly designed or not possible to calculate).
- PresizeJoint() - This method is called when the "Presize" button is pressed. You need to pass required parameters to the calculation engine, read back the results and set the new configuration of the joint, as well as returning the new status of the joint (correctly designed, incorrectly designed or impossible to calculate).
- ImportJoint()/ExportJoint () - Each method is called when the "Export", respectively "Import" buttons are pressed. In case of export: you need to save the current joint configuration in a format which can be read by the calculation engine. In case of import: you need to set the joint parameters to the corresponding values, depending on the imported data, which has been created previously by the calculation engine. You must to display the "Save As…" or "Open…" dialogs when the methods are called.
- GetUserPages(RulePageArray pagesRet, PropertySheetData pPropSheetData) - Called when the "Torsors" button is pressed – you need to prepare the dialogs which display the efforts/loadings from the Node (if it exists) and also allow the creation of new sets of efforts/loadings.
- GetUserTorsorsPage(RulePage pageRet) - Called when the "Joint Design" sheet is displayed. You need to prepare the display of the "torsor" values on the "Joint Design" sheet.
- GetUserSettingsPages(RulePageArray pagesSettingsRet, PropertySheetData pPropSheetData) - Called when the "Settings" button is pressed. You need to prepare the dialogs which allow the setting of other data required by the calculation engine (other than efforts and joint parameters) - like detailed report format (TXT, RTF …), reports creation (only in certain conditions, like calculation failed), etc…

In addition to the implementation of the INodeStressAppModule interface, the joint calculation module requires the use of an object of IStressModuleJoint type.

Methods and properties available in IStressModuleJoint interface:

- InputObjects - obtain the array of input objects for the joint.
- CreatedObjects - obtain the array of objects created by the joint.
- CreateObjectsArray - create an array for storing objects.
- UseDetailedTorsors - check if all efforts/loadings should be used in calculation, or only the maximum torsor is to be considered.
- Units - get current Advance Steel units.
- JointName - identifies the internal name of the joint currently being calculated
- GetJointParam - obtain the specified parameter value from the joint (requires the use of a string that identifies the parameter - must be the same string used in the joint OutField/InField methods).
- SetJointParam - set the specified joint parameter value - you need to use this after a presize or import operation (requires the use of a string that identifies the parameter - must be the same string used in the joint OutField/InField methods).
- GetJointNSAModuleSpecificData - retrieve the value of a persistent parameter set by the calculation module (similar to the joint InField functionality).
- SetJointNSAModuleSpecificData - set the value of a persistent parameter for the calculation module (similar to the joint OutField functionality).
- GetNodeInputObjectIds - retrieve the IDs assigned to the specified input object (one or two IDs) - when a Node is defined.
- GetNodeEffortSetsLengthAtId - retrieve the number of efforts sets for the specified ID - when a Node is defined.
- GetNodeEffortSetAtId - retrieve, from the specified ID, the effort set with the specified index - when a Node is defined.
- GetJointNSAModuleLoadingCases - retrieve the efforts/loadings defined in the calculation module.
- SetJointNSAModuleLoadingCases - save the new set of efforts/loadings for the calculation module.
- CreateJointEffort - create a new object for storing one effort.
- CreateJointEfforts - create an object for storing efforts.
- CreateJointLoadingCase - create one loading object.
- CreateJointLoadingCases - create an array of loadings.
- GetModuleOutputFileName - get the name of the file for saving current joint data (full path, supplied by Advance Steel - contains joint name and joint ID).
- GetJointUserId - get the ID of this joint (unique in the dwg).
- CreateRulePage - create an IRulePage object (for dialogs).

### 5.1.5 Database Structure

In order to attach a joint calculation module to a joint, you need to create records for the calculation module in the AstorJointsCalculation.mdf database.

- JointInternalName - Key to AstorRules.HRLDefinition table
- NSAModuleInternalName - Key to AstorJointsCalculation.NSAModuleDefinition
- DefaultModule - 1
- ClassID - GUID from "CreatePlateDesign" class

#### 5.1.5.1 Relationships

AstorJointsCalculation.NSAModule table

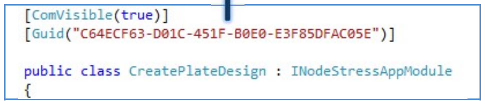
| Key | StressAnalysisCodeID | JointInternalName | NSAModuleInternalName | DefaultModule |
|---|---|---|---|---|
| 1 | 0 | CreatePlate | CreatePlateNSAModule | 1 |

AstorJointsCalculation.NSAModuleDefinition table

| Key | ModuleRunName | InternalName | NSAModuleDll | ClassID |
|---|---|---|---|---|
| 1 | My module | CreatePlateNSAModule | 12 | {C64ECF63-D01C-451F-B0E0-E3F85DFAC05E} |

AstorJointsCalculation.NSAModuleDllSigned table

| Key | FileName x86 | FileName x64 |
|---|---|---|
| 12 | SampleDesign.dll | |

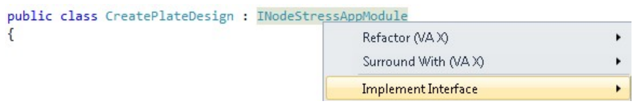


```
[ComVisible(true)]
[Guid("C64ECF63-D01C-451F-B0E0-E3F85DFAC05E")]

public class CreatePlateDesign : INodeStressAppModule
{
```

## 5.2 Developing a joint design

- Use same bat from developing joint section.
- Create new Project
- Choose Class Library
- Add References
  - Interop.AstSteelAutomationLib5
  - Interop.DSCGEOMCOMLib
  - Interop.DSCRootsCOMLib
  - DotNetRoots

- Implement **INodeStressAppModule** interface



```
public class CreatePlateDesign : INodeStressAppModule
{
```

**CheckJoint method** contains the joint design functionality.

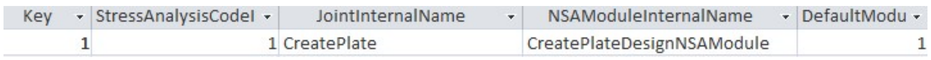
```
public eJointStatus CheckJoint()
{
        eJointStatus ret = eJointStatus.JointSupported;

        //report format
        int nReportFormat = (int)getJointNSAModuleSpecificData(m_joint, this, "ReportFormat", 0);

        //get efforts
        List<double> dM, dN, dV;
        List<string> sCaseName;
        getEfforts(m_joint, m_joint.GetJointNSAModuleLoadingCases(this),
                    m_joint.UseDetailedTorsors, out dM, out dN, out dV, out sCaseName);


        //read some values from joint
        bool bModifiable = false;
        double     dPlateThickness     =     (double)m_joint.GetJointParam("PlateThickness",     ref
bModifiable);
        double dPlateLength = (double)m_joint.GetJointParam("PlateLength", ref bModifiable);
        double dPlateWidth = (double)m_joint.GetJointParam("PlateWidth", ref bModifiable);

        return ret;
}
```

- Generate GUID

```
 [ComVisible(true)]
 [Guid("C64ECF63-D01C-451F-B0E0-E3F85DFAC05E")]
```

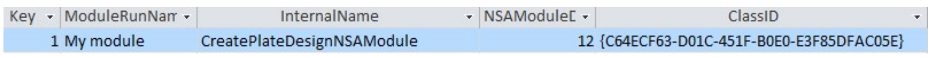
- After completing the code, you must build the project. From the Build menu, click Build Solution.
- Go to C:\ProgramData\Autodesk\Advance Steel 2022\USA\StressAnalysis\Data\ (or your currently installed country folder) and open AstorJointsCalculation database.

- Open **NSAModule** table and add new record



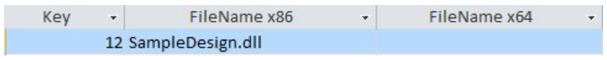
| Key | StressAnalysisCodeI | JointInternalName | NSAModuleInternalName | DefaultModu |
|---|---|---|---|---|
| 1 | 1 | CreatePlate | CreatePlateDesignNSAModule | 1 |

- Open **NSAModuleDefinition** table and add new record



| Key | ModuleRunNam | InternalName | NSAModuleD | ClassID |
|---|---|---|---|---|
| 1 | My module | CreatePlateDesignNSAModule | 12 | {C64ECF63-D01C-451F-B0E0-E3F85DFAC05E} |

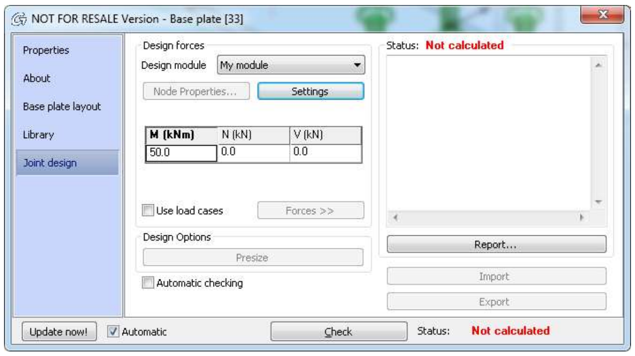
- Open NSAModuleDllSigned table and add new record



| Key | FileName x86 | FileName x64 |
|---|---|---|
| 12 | SampleDesign.dll | |

- Save and close database
- Compile your project
- Copy output dll in C:\Program Files\Autodesk\AutoCAD 2022\ADVS\
- Run Advance Steel

- Call joint. Now you should see a new Page "Joint Design"



Status: Not calculated

| M (kNm) | N (kN) | V (kN) |
|---|---|---|
| 50.0 | 0.0 | 0.0 |

AUTODESK

# Chapter 6
# Advance Steel Scripting Possibilities

## 6.1 Advance Steel Lisp API

See Advance Steel Visual Lisp Script Language manual

## 6.2 Numbering scripts

Before creating the project documentation (drawings, BOMs, etc.), the structure must be numbered. The basis for numbering is finding identical parts that should have the same mark.

Each object in Advance Steel has two part marks: a Single Part number and an Assembly part number. The basis for numbering is finding identical parts that should have the same mark.

During the numbering process, the numbering tool:

- Analyzes the model to identify equal parts and determine quantities.
- Analyzes the relationship between parts to identify assemblies and main parts.
- Assigns part and assembly numbers to objects in the structure.

Single Parts and Assemblies are automatically numbered for the entire model.
The elements are compared by geometry, material properties, coating, and commodity (and behavior). The properties name and lot/phase are not considered for numbering. The Model Role is used by the prefix tool to assign prefixes, but it is not used directly for numbering.

### 6.2.1 Workflow

- At first, all structural parts should be numbered so start with single part marks.
- The program then determines the assembly marks for parts connected in the shop. The biggest part of an assembly is the main part and will get an assembly mark and all other parts are considered attached and will have a single part mark.
- Standard parts are numbered using additional options. Any part in the current model that matches a Standard Part in the template will get the same mark (single part mark or assembly mark, according to the situation).

During the numbering process beams and then plates are the first to be numbered. In each case, the group with the most elements will get the lowest number.

### 6.2.2 Numbering standard parts

A Standard Part Template makes a particular item or group of items have assigned a fixed part mark.
Standard parts are created in a template model using normal Advance Steel functionalities and then assigned required part marks. During a numbering process objects are compared to detect identical parts. Any part of the current model that matches a Standard Part in the template will get the same mark.

The standard part templates can be linked to the current project.
The folder C:\ProgramData\Autodesk\Advance Steel 2023\USA\Shared\StandardPartTemplate\ (or your currently installed country folder) contains the standard part models. The available templates are listed on the Standard part template tab of the Numbering dialog box.

The standard part template can be reused for any other project or new standard part templates can be created if necessary.

### 6.2.3 Numbering prefix

In a steel structure, to make the difference between single parts and assemblies, prefixes can be used to have distinct part marks.

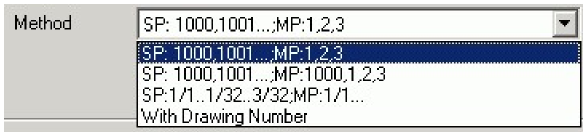
Prefixes can be manually assigned, separately for parts and assemblies, or automatically assigned during the numbering process, according to the model role of the model elements (e.g.: beam, column, rafter, plate, etc.).

### 6.2.4 Main part of an assembly

Main part assignment is either performed manually or by the numbering process using Create main part of assembly that automatically detects attached parts. Alternatively, during assembly numbering, the biggest part automatically becomes the main part.

### 6.2.5 Numbering methods

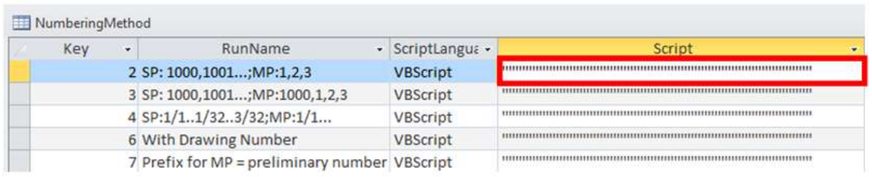
There are few methods for numbering available in **Numbering - General tab.**


Method
SP: 1000,1001...;MP:1,2,3
SP: 1000,1001...;MP:1,2,3
SP: 1000,1001...;MP:1000,1,2,3
SP:1/1..1/32..3/32;MP:1/1...
With Drawing Number

The first three numbering methods assign fixed numbers to the objects. There will be no link between the assigned element number and the drawing the piece is detailed on.

- **SP: 1000, 10001, ...; MP: 1,2,3:** The Single parts and the Main parts are numbered starting with the defined value.
- **SP: 1000, 10001, ...; MP: 1000, 1,2,3:** The Single parts and the Main parts are numbered starting with the defined value. The standalone parts are numbered using same numbering rule defined for the Single parts.
- **SP: 1/1 ..1/32..3/32;MP:1/1..:** The Single parts and the Main part mark contains the number of identical parts.
- **With drawing number:** Assigns an internal number to each object. During the detail creation, the internal number will be changed to the drawing number the element is detailed on. At drawing creation, the first part gets the prefix a001, then b001, etc.

These methods are implemented in VBScript. The code can be found in C:\ProgramData\Autodesk\Advance Steel 2023\USA\Kernel\Data\ database (or your currently installed country folder) **AstorKernelEnvironment.mdf**, **NumberingMethod** table.



NumberingMethod

| Key | RunName | ScriptLangua | Script |
|---|---|---|---|
| 2 | SP: 1000,1001...;MP:1,2,3 | VBScript | """""""""""""""""""""""""""""""""""""""" |
| 3 | SP: 1000,1001...;MP:1000,1,2,3 | VBScript | """""""""""""""""""""""""""""""""""""""" |
| 4 | SP:1/1..1/32..3/32;MP:1/1... | VBScript | """""""""""""""""""""""""""""""""""""""" |
| 6 | With Drawing Number | VBScript | """""""""""""""""""""""""""""""""""""""" |
| 7 | Prefix for MP = preliminary number | VBScript | """""""""""""""""""""""""""""""""""""""" |

The **IPositionMarkCreator** interface properties/methods are interrogated to get information about numbering options from user dialog.

Methods and properties available in **IPositionMarkCreator** interface

- MarkProcessType - Gets or sets the process type (kSinglePart, kMainPart, kPreliminaryPart)

  Single part marks: All structural parts are numbered.

  Assembly marks: The program determines the assembly marks for parts connected in the shop. The biggest part of an assembly is the main part and gets an assembly mark and all other parts are considered attached and will have a single part mark.
- UseTemplateType – Gets or sets template type.
- CurrentObject – Gets or sets the object to be numbered.
- IsUniqueInTheModel – Checks if a part number is unique in the model.
- GetAsInternalFormat – Formats a part number. (Ex: 1001 -> #internalnumber1001)
- IsInternalNumber – Checks if a part number is an internal number.
- GetStartAtForSingleParts – Returns the start number for the single parts numbering. By default, single parts marks begin with 1000 and increase by increments of 1.
- GetStartAtForMainParts – Returns the start number for main parts.
- GetDeltaForSingleParts – Returns the increment for the single parts numbering.
- GetDeltaForMainParts – Returns the increment for the main parts numbering.
- UpdateStartAtForSingleParts – Update the start number for the single parts numbering.
- UpdateStartAtForMainParts – Update the start number for the main parts numbering.
- UpdateDeltaForSingleParts – Update the increment for the main parts numbering.
- UpdateDeltaForMainParts – Update the increment for the main parts numbering.
- GetNextNumber – Returns the next number for numbering.
- GetStartAtForSinglePartsWithPrefix – Returns the current start number for the single parts numbering with prefix.
- GetStartAtForMainPartsWithPrefix – Returns the current start number for the main parts numbering with prefix.
- UpdateStartAtForSinglePartsWithPrefix – Update the current start number for the single parts numbering with prefix.
- UpdateStartAtForMainPartsWithPrefix – Update the current start number for the main parts numbering with prefix.
- UpdateNumber – Update the number for an IEqualPartObject.
- GetStartAtForPreliminaryPartsWithPrefix – Returns the current start number for the preliminary parts with prefix.
- GetDeltaForPreliminaryParts – Returns the increment for the preliminary parts numbering.
- GetStartAtForPreliminaryParts – Returns the start number for the preliminary parts numbering.
- UpdateStartAtForPreliminaryPartsWithPrefix – Update the start number for the preliminary parts numbering with prefix.

- UpdateStartAtForPreliminaryParts – Update the start number for the preliminary parts numbering.
- UpdateDeltaForPreliminaryParts – Update the increment for the preliminary parts numbering.
- AddZerosToPartMark – Adds zeros to part mark.

Your script must implement the getNumber method.

Example:

```
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
'Script used by Numbering process
''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
Function getNumber(EqualPartObject)
   Number = -1
   If PositionMarkCreator.MarkProcessType = kSinglePart Then
      'Calculate the single part number
      StartAt PositionMarkCreator.GetStartAtForSinglePartsWithPrefix(
            EqualPartObject.Type, EqualPartObject.SinglePartPrefix)
      Delta = PositionMarkCreator.getDeltaForSingleParts(EqualPartObject.Type)

      Number = StartAt
      Number = PositionMarkCreator.AddZerosToPartMark(Number)
      Do Until PositionMarkCreator.isUniqueInTheModel(kBoth,
            EqualPartObject.SinglePartPrefix & Number)
         StartAt = StartAt + Delta
         Number = StartAt
         Number = PositionMarkCreator.AddZerosToPartMark(Number)
      Loop
      PositionMarkCreator.UpdateStartAtForSinglePartsWithPrefix
      EqualPartObject.Type, EqualPartObject.SinglePartPrefix, StartAt+Delta
   End If

   getNumber = Number

End Function
```

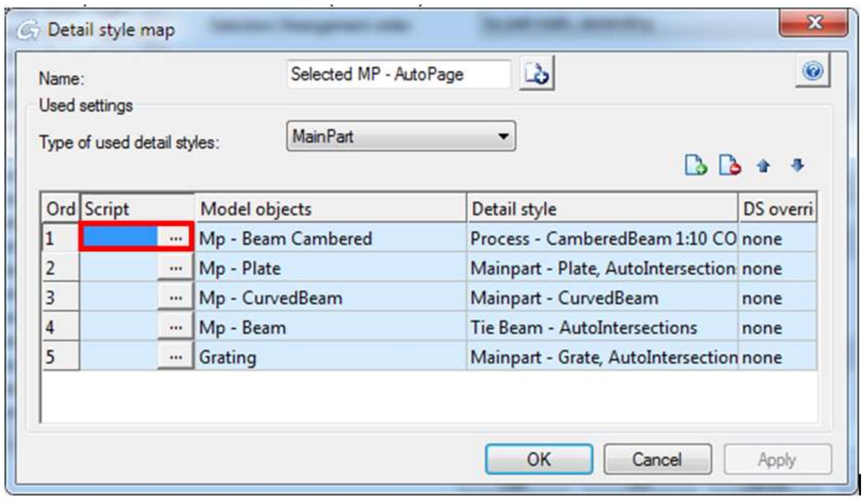
## 6.3 Drawing styles scripts

### 6.3.1 Overview

Upon building a 3D model, dimensioned and labeled 2D general arrangement and shop drawings can be automatically created. The drawings are created in separate DWG files from the model, however they are linked to track changes.
The model knows which drawings have been linked and checks if these drawings still correlate. Thus, the drawings can be updated after any model modifications. This link is 'one way' and changing a drawing will not modify the model.
A drawing may consist of several linked details, which are individual Advance objects with their own properties.

Advance offers a variety of drawing styles for general arrangement drawings, sections, and shop drawings in various designs. The drawing style is a group of instructions used to create a detail drawing and defines the selection of the elements that are to be displayed including labeling and dimensioning preferences.

The drawing styles provide the option to automatically create drawings and to modify the layout exactly to user requirements. Drawing styles are used in a similar way to standard CAD dimension styles, line styles, etc.
The styles are defined with various settings (e.g., parts to be displayed, view, dimensions, labeling, representation etc.) in MS Access tables (libraries).



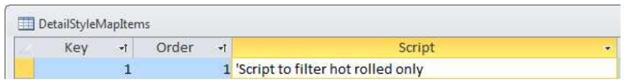
Name: Selected MP - AutoPage

Used settings

Type of used detail styles: MainPart

| Ord | Script | Model objects | Detail style | DS overri |
|---|---|---|---|---|
| 1 | ... | Mp - Beam Cambered | Process - CamberedBeam 1:10 CO | none |
| 2 | ... | Mp - Plate | Mainpart - Plate, AutoIntersection | none |
| 3 | ... | Mp - CurvedBeam | Mainpart - CurvedBeam | none |
| 4 | ... | Mp - Beam | Tie Beam - AutoIntersections | none |
| 5 | ... | Grating | Mainpart - Grate, AutoIntersection | none |

Scripts are implemented in VBScript. The code can be found C:\ProgramData\Autodesk\Advance Steel 2023\USA\Steel\Data\ (or your currently installed country folder) database **AstorDetails.mdf**, **DetailStyleMapItems** table.



DetailStyleMapItems

| Key | Order | Script |
|---|---|---|
| 1 | 1 | 'Script to filter hot rolled only |

Your script must implement the checkElement method.

Example:

```
'Script to filter " C" profiles only
Function checkElement(Obj)
    checkElement = False
    'Be sure the object is a beam.
    If Obj.Type = kBeamStraightClass OR Obj.Type = kBeamPolyClass Then
        'Get the name of the profile and convert it to upper letters.
        ProfName = Ucase(Obj.getProfType.getSectionName)
        'Check if the name contains "C".
        If InStr(ProfName, "C") Then
            checkElement = True
        End If
    End If
End Function
```

## 6.4 Drawing process scripts

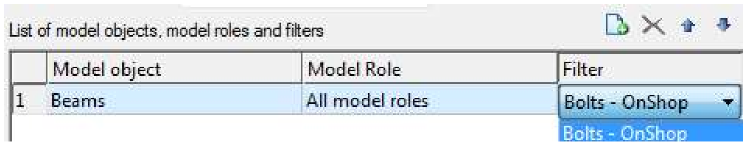
### 6.4.1 Overview

To accelerate the drawing creation by automatically assigning drawing styles and layouts for the selected parts, drawing processes are used.

Drawing processes automatically create part drawings (using appropriate drawing styles) and arrange the created details within a drawing (.dwg) or across several drawings. A drawing process will step through all the selected objects, choose a suitable Drawing Style and create a drawing of the object, then move on to the next object. In this way many drawings of many objects can be created quickly and easily.

A drawing process includes several sub-processes:

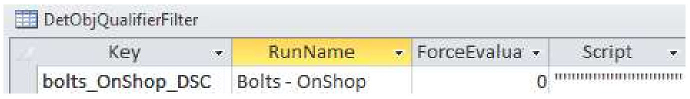
- Selection of parts
- Sorting, selection of an appropriate drawing style based on the object type and model role
- Selection of the appropriate prototype
- Rules for arranging details on the sheet: several drawing scales are tested to find the best fit on the sheet. The actual scales tried are defined within the Process. If multiple sizes are allowed all scales will be tried on the smallest sheet first then all scales on the next sheet size and so on working up. If a single sheet size is selected and none of the scales fit the border the views will be still created at the smallest scale on the given sheet.
- Rules to attach new sheets.
- Automatically naming the file


List of model objects, model roles and filters

| | Model object | Model Role | Filter |
|---|---|---|---|
| 1 | Beams | All model roles | Bolts - OnShop |

Bolts - OnShop

Scripts are implemented in VBScript. The code can be found in the C:\ProgramData\Autodesk\Advance Steel 2023\USA\Kernel\Data\ (or your currently installed country folder) database **AstorDetailsBase.mdf**, **DetObjQualifierFilter** table.


DetObjQualifierFilter

| Key | RunName | ForceEvalua | Script |
|---|---|---|---|
| bolts_OnShop_DSC | Bolts - OnShop | 0 | """""""""""""""""""""""" |

Your script must implement the checkElement method.

Example:

```
'Returns true for bolts connected On Shop
Function checkElement(Obj)
   bOnShop = False
   If Obj.IsKindOf(kScrewBoltPattern) = True Then
      'See if bolt is On shop
      If Obj.AssemblyLocation = kInShop Then
         bOnShop = True
      End If
   End If
   checkElement = bOnShop
End Function
```

## 6.5 BOM pre-processing using XSLT

From the model information an extract is created which is used to generate reports. The model extract can be pre-processed using XSL transformation. XSLT files are stored in C:\ProgramData\Autodesk\Advance Steel 2023\USA\Shared\Support\Transformations\ (or your currently installed country folder) folder.
In order to pre-process the model extract xml file user has to create the XSL file and save it in the Transformation folder assign the XSLT file to the report template in BOM Editor and save the template. When a report is generated the XSL transformation is applied to the selected model extract and the resulted extract is then used by the BOM tool.
Example: The Cladding list report template uses Cladding list.xslt in order to preprocess the cladding profiled which contain additional information (set via Cladding joint dialog) about the inside/outside coating, number of bolts needed to fix the profile.

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