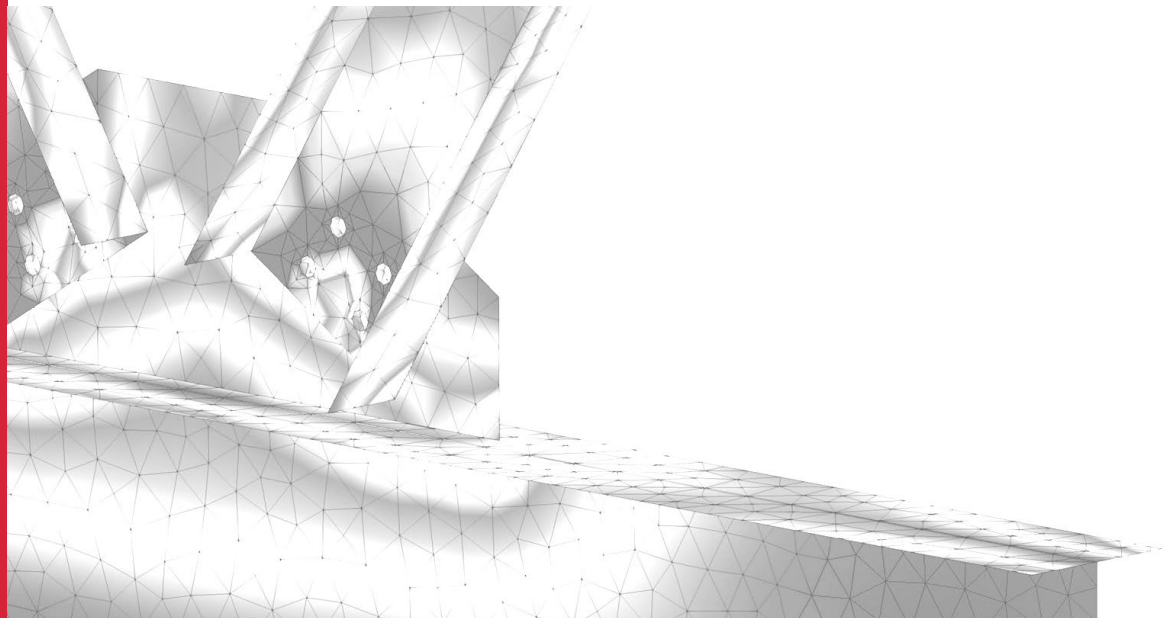
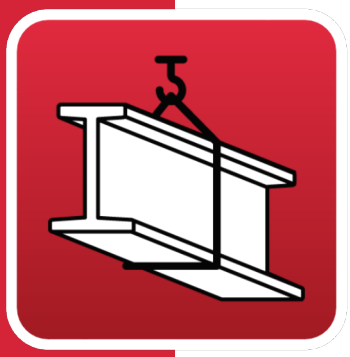
Software for Architecture,
Engineering and Construction

CYPE Connect and StruBIM Steel

JSON file specification guide





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This document describes the data structure in JSON format used to represent structural models for import into **CYPE Connect and StruBIM Steel**.

It includes the definition of the **geometric model** and the **forces**, as well as recommendations for use and a complete example.

The specification corresponds to **version 1**, defined by the field `"modelVersion": 1`

1 General structure of the model

The model consists of two separate JSON files, which, when combined, describe the geometry of the structural model and the forces on the bars:

1.1 Geometric model

Contains a complete description of the structural elements:

- nodes
- materials
- sections
- members
- relation profiles nodes
- grid
- tags

Example of general structure:

```
{
   "modelVersion": (int),
   "model": {
     "nodes": [ ... ],
     "materials": [ ... ],
     "sections": [ ... ],
     "members": [ ... ],
     "relationProfilesNodes": [ ... ],
```

```
    "grid": [ ... ],
    "tags": [ ... ]
  }
}
```

1.2 Forces

This file contains the forces analysed on the model's bars, sorted by load combinations.

Example of structure:

```
{
  “loadCombinationGroups”: [ ... ],
  “membersForces”: [ ... ]
}
```

2 Nodes

Describes the points in the 3D space where the bars connect.

Fields:

- `guid` (string): Unique identifier.
- `name` (string): Name of the node.
- `x` (number): X coordinate of the node in metres.
- `y` (number): Y coordinate of the node in metres.
- `z` (number): Z coordinate of the node in metres.

3 Materials

This section defines the materials used for the bars.

Fields:

- `id` (string): Identifier.
- `name` (string): Descriptive name.
- `type` (string): Type of material ("steel", "timber").
- `steel` (object, opcional): Steel properties.
- `timber` (object, opcional): Timber properties.

3.1 Steel properties

- `E` (number): Modulus of elasticity (N/mm^2).
- `poissonCoef` (number): Poisson's ratio.
- `thermalExpansion` (number): Thermal expansion coefficient (m/(m·°C)).
- `unitWeight` (number): Unit weight (kilonewton per metre cubed).
- `fy` (number): Elastic limit (N/mm^2).
- `fu` (number): Breaking limit (N/mm^2).
- `strengthReductionSteps` (array): Strength adjustments based on material thickness.

strengthReductionSteps

Each element of the array is an object with the following fields:

- `thickness` (number): Thickness from which the strength values are applied (m).
- `fy` (number): Elastic limit for that thickness range (N/mm^2).
- `fu` (number): Ultimate strength for that thickness range (N/mm^2).

Notas:
The array must be sorted in ascending order of thickness.
If not defined, it is assumed that `fy` and `fu` are constant for all thicknesses.

3.2 Timber properties

- `type` (string): Type of wood.
- `characteristicDensity` (number): Characteristic density, kg/m^3.
- `fc90k` (number): Compressive strength perpendicular to the fibre, N/mm^2.

4 Sections

The `sections` object defines the cross-sections of structural elements.

Common fields:

- `id` (string): Identifier.
- `type` (string): Section type (rolledChannel, rectangularTube, etc.).
- `<tipo específico de sección>` (object): Geometric properties according to type.

4.1 Types of simple sections

rolledI

- `series` (string): Series of the section.
- `name` (string): Name of the section.
- `flangeWidth` (number): Flange width (m).
- `flangeThickness` (`number`): Flange thickness (m).
- `overallDepth` (number): Overall depth of the section (m).

- `webThickness` (number): Web thickness (m).
- `flangeSlope` (number): Flange slope (radians).
- `filletRadius` (number): Fillet radius between the web and the flange (m).

rolledChannel

- `series` (string): Series of the section.
- `name` (string): Name of the section.
- `flangeWidth` (number): Flange width (m).
- `flangeThickness` (number): Flange thickness (m).
- `overallDepth` (number): Overall depth of the section (m).
- `webThickness` (number): Web thickness (m).
- `flangeSlope` (number): Flange slope (radians).
- `filletRadius` (number): Fillet radius between the web and the flange (m).
- `flangeEdgeRadius` (number): Radius of the flange edge (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

rolledT

- `series` (string): Series of the section.
- `name` (string): Name of the section.
- `flangeWidth` (number): Flange width (m).
- `flangeThickness` (number): Flange thickness (m).
- `overallDepth` (number): Overall depth of the section (m).
- `webThickness` (number): Web thickness (m).
- `filletRadius` (number): Fillet radius between the web and the flange (m).

rolledAngle

- `series` (string): Series of the section.
- `name` (string): Name of the section.
- `flangeWidth` (number): Flange thickness (m).
- `overallDepth` (number): Overall depth of the section (m).
- `thickness` (number): Thickness (m).
- `filletRadius` (number): Fillet radius between the fillet (m).
- `flangeEdgeRadius` (number): Flange edge radius (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

plate

- `series` (string): Series of the section.
- `name` (string): Name of the section.
- `width` (number): Width of the plate (m).
- `thickness` (number): Thickness of the plate (m).
- `isHorizontal` (boolean): Indicates horizontal orientation of the plate.

roundBar

- `series` (string): Section series.
- `name` (string): Name of the section.
- `diameter` (number): Bar diameter (m).

squareBar

- `series` (string): Section series.
- `name` (string): Name of the section.
- `width` (number): Bar width (m).

rectangularTube

- `series` (string): Section series.
- `name` (string): Name of the section.
- `width` (number): External width of the tube (m).
- `depth` (number): External depth of the tube (m).
- `thickness` (number): Tube thickness (m).
- `innerRadius` (number): Inner radius on the corners (m).
- `manufacturingType` (string): Manufacturing type (Rolled / cold-formed).

circularTube

- `series` (string): Section series.
- `name` (string): Name of the section.
- `diameter` (number): External diameter of the tube (m).
- `thickness` (number): Tube thickness (m).
- `manufacturingType` (string): Manufacturing type (Rolled / cold-formed).

timberRectangular

- `series` (string): Section series.
- `name` (string): Name of the section.
- `width` (number): Section width (m).
- `depth` (number): Section depth (m).

builtUpI

- `series` (string): Section series.
- `name` (string): Name of the section.
- `overallDepth` (number): Overall depth (m).

- `webThickness` (number): Web thickness (m).
- `topFlangeWidth` (number): Top flange width (m).
- `topFlangeThickness` (number): Top flange thickness (m).
- `bottomFlangeWidth` (number): Bottom flange width (m).
- `bottomFlangeThickness` (number): Bottom flange thickness (m).

builtUpITapered

- `series` (string): Section series.
- `name` (string): Name of the section.
- `webThickness` (number): Web thickness (m).
- `topFlangeWidth` (number): Top flange width (m).
- `topFlangeThickness` (number): Top flange thickness (m).
- `bottomFlangeWidth` (number): Bottom flange width (m).
- `bottomFlangeThickness` (number): Bottom flange thickness (m).
- `initialDepth` (number): Initial depth of the section (m).
- `finalDepth` (number): Final depth of the section (m).
- `depthVariationLength` (number): Depth variation length (m).

formedAngle

- `series` (string): Section series.
- `name` (string): Name of the section.
- `overallDepth` (number): Overall depth (m).
- `overallWidth` (number): Overall width (m).
- `thickness` (number): Thickness (m).
- `innerRadius` (number): Inner radius (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

formedChannelLipped

- `series` (string): Section series.
- `name` (string): Name of the section.
- `overallDepth` (number): Overall depth (m).
- `overallWidth` (number): Overall width (m).
- `flangeStiffener` (number): Flange stiffener (m).
- `thickness` (number): Thickness (m).
- `innerRadius` (number): Inner radius (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

formedZLipped

- `series` (string): Section series.
- `name` (string): Name of the section.
- `overallDepth` (number): Overall depth (m).
- `topFlangeWidth` (number): Top flange width (m).
- `bottomFlangeWidth` (number): Bottom flange width (m).
- `topFlangeStiffener` (number): Top flange stiffener (m).
- `bottomFlangeStiffener` (number): Bottom flange stiffener (m).
- `thickness` (number): Thickness (m).
- `innerRadius` (number): Inner radius (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

formedAngleLipped

- `series` (string): Section series.
- `name` (string): Name of the section.

- `overallDepth` (number): Overall depth (m).
- `overallWidth` (number): Overall width (m).
- `thickness` (number): Thickness (m).
- `innerRadius` (number): Inner radius (m).
- `verticalFlangeStiffener` (number): Vertical flange stiffener (m).
- `horizontalFlangeStiffener` (number): Horizontal flange stiffener (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

formedChannel

- `series` (string): Section series.
- `name` (string): Name of the section.
- `overallDepth` (number): Overall depth (m).
- `overallWidth` (number): Overall width (m).
- `thickness` (number): Section thickness (m).
- `innerRadius` (number): Inner radius (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

formedZ

- `series` (string): Section series.
- `name` (string): Name of the section.
- `overallDepth` (number): Overall depth (m).
- `topFlangeWidth` (number): Top flange width (m).
- `bottomFlangeWidth` (number): Bottom flange width (m).
- `thickness` (number): Section thickness (m).
- `innerRadius` (number): Inner radius (m).
- `isZAxisSymmetric` (boolean): Indicates whether the section is symmetrical with respect to the Z axis.

5 Members

The `members` object represents the linear elements of the model (bars, beams, columns, etc.).

Fields:

- `guid` (string): Unique identifier for the bar.
- `x1` (number): X coordinate of the initial node.
- `y1` (number): Y coordinate of the initial node.
- `z1` (number): Z coordinate of the initial node.
- `x2` (number): X coordinate of the end node.
- `y2` (number): Y coordinate of the end node.
- `z2` (number): Z coordinate of the end node.
- `insertionPoint` (string): Member insertion point:
  - center
  - top
  - bottom
  - left
  - right
  - topLeft
  - topRight
  - bottomLeft
  - bottomRight
- `localRotation` (number): Local rotation of the member (radians).
- `displacementY` (number): Local displacement in Y (m).
- `displacementZ` (number): Local displacement in Z (m).
- `materialId` (string): Identifier of the assigned material.
- `sectionId` (string): Identifier of the assigned section.

6 Bar connections (nodeMemberConnections)

Connections link bars to nodes. Their use is optional, allowing nodes to be created automatically during the import process.

- Fields:
  - `nodeGuid` (string): Node identifier.
  - `membersGuids` (array<string>): Elements connected to the node.

7 Grid

The `grid` object defines the reference lines of the structural model. Its use is optional; it is imported into StruBIM Steel.

Fields:

- `gridLinesX` (array): Lines in the X direction.
- `gridLinesY` (array): Lines in the Y direction.

Each grid line has this aspect:

```
{
  "coordinate": <number>,
  "label": <string>,
  "labelVisibility": "start" | "end" | "both" | "none"
}
```

8 Tags

The `tags` object groups or classifies sections by category or colour. Its use is optional; it is imported into StruBIM Steel.

- `guid` (string): Tag identifier.

- `name` (string): Name or reference.
- `color` (number): Colour value expressed as a decimal integer representing an RGB colour.
- `membersGuids` (array<string>): List of associated members.

9 Load combination groups

The `loadCombinationGroups` object describes the load combination groups used in the structural model for each material type. Within each group, the individual combinations are detailed, indicating their identifier and the conditions under which they apply.

Main object fields (`loadCombinationGroups`):

- `combinationType` (string): Indicates the type of material to which the load combinations in the group belong. The permitted options are:
  - rolledSteel
  - coldFormedSteel
  - timber
- `combinationsList` (array): List of combinations included in the group.

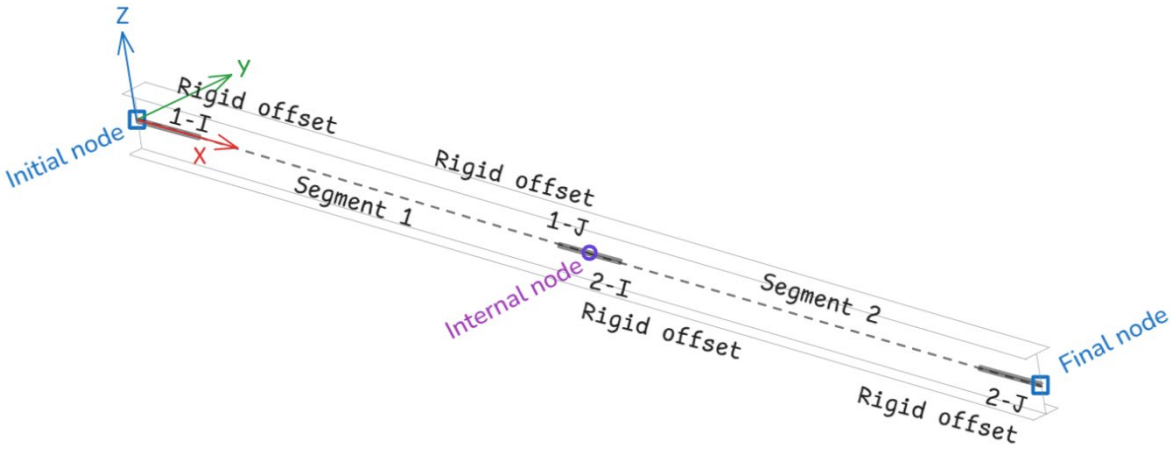
Fields for each element within `combinationsList`:

- `combinationId` (string): Unique identifier for the combination within the group.
- `loadSituation` (string): Type of load situation to which the combination belongs:
  - persistent
  - seismic
  - accidental
- `loadDuration` (string): Duration of the load associated with the combination:
  - permanent
  - longTerm
  - mediumTerm

- shortTerm
- instantaneous

10 Forces

The `membersForces` object describes the forces in the structural elements (bars) of the model. Each bar is identified by a GUID and is associated with the nodes that define it. The forces are recorded in the segments that make up the member, indicating the initial (I) and final (J) local positions, as well as the rigid offsets and force values for each load combination.



Definition of a bar (member)

Main object fields (`membersForces`)**:**

- `guid` **(string):**
  Unique global identifier for the member.
- `nodeIds` **(array of strings):**
  List of identifiers for the nodes that define the member, ordered from start to end. The first identifier always corresponds to the start node and the last to the end node. Between them, there may be one or more internal nodes.
- `segments` **(array):**
  List of segments into which the bar is divided. Each bar can consist of one or more segments, and for each segment, the forces at both the initial and final ends are recorded, along with position information and rigid lengths.

Fields for each element within `segments`:

- `localPosI` (number): Initial position of the segment along the local axis of the bar (m)..
- `rigidOffsetI` (number): Rigid offset at the initial node of the segment (m).
- `localPosJ` (number): Final position of the segment along the local axis of the bar (m).
- `rigidOffsetJ` (number): Rigid displacement at the end node of the segment (m).
- `isRigidSegment` (string / boolean): Indicates whether the segment is considered rigid along its entire length.
- `forcesAtI` (array): List of forces applied at the initial end (I) of the segment, for each type of load combination.
- `forcesAtJ` (array): List of forces applied at the final end (J) of the segment, for each type of load combination.

Fields for each element within `forcesAtI` and `forcesAtJ`:

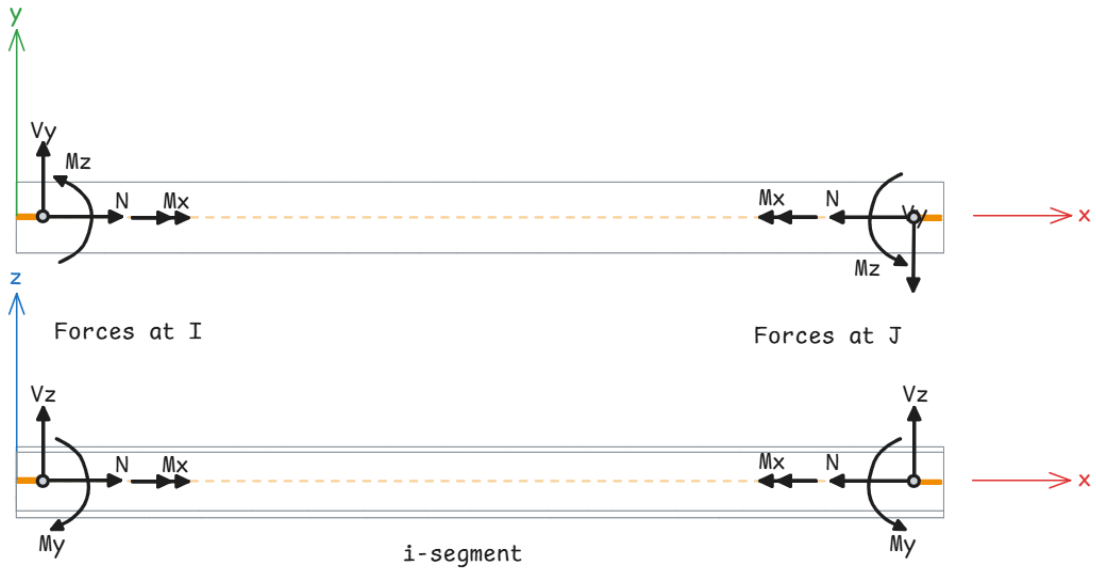
- `combinationType` (string): Type of load combination to which the forces correspond. Possible options: rolledSteel, coldformedSteel, timber.
- `forces` (array of arrays of numbers): Segment force matrix, organised by load combinations. Each subarray contains the values in the following order:

  `[Fx, Fy, Fz, Mx, My, Mz]`

  Where:

  Fx, Fy, Fz → forces in the local x, y, z directions (kN).

  Mx, My, Mz → moments relative to the local x, y, z axes (kN·m).



Sign criterion for forces at the initial and ends of a segment

11 Annex 1: Reference system

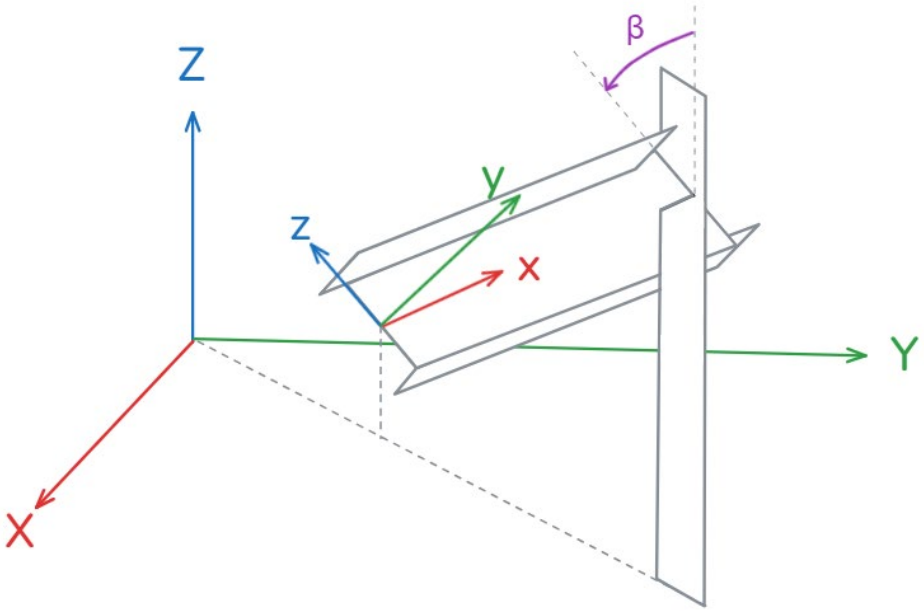
11.1 Global axes

The coordinates of the nodes are defined according to the global axis system. The global XY plane is taken as horizontal, while the global Z axis is set as the upward vertical direction.

11.2 Local axes

The local axes of a bar are defined with their origin at the initial node. The local axis **x** coincides with the direction of the element and points from the initial node to the final node. The local axis **z** is perpendicular to the axis **x** and is generally oriented in the same direction as the global axis **Z**, so that the local plane **xz** is parallel to that global axis. The local axis **y** is orthogonal to the axes **x** and **z**.

When the local axis **x** is parallel to the global axis **Z**, the above rule cannot be applied; in these cases, the local axis **z** is oriented in the same direction as the global axis **Y**. If a direction angle is specified, the element is rotated around its longitudinal axis **x** according to the specified value.



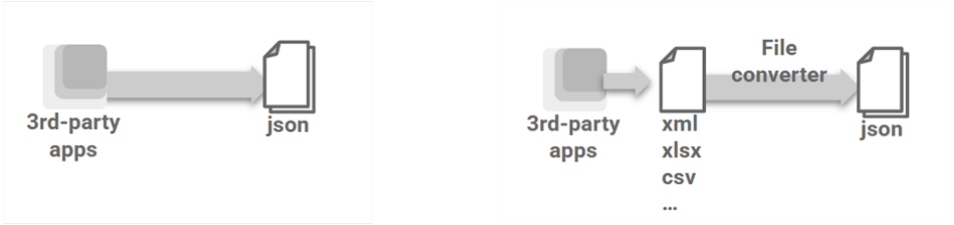
Global and local reference system

12 Annex 2: Workflow

Communication between external third-party applications and CYPE Connect or StruBIM Steel will be carried out through the BIMserver.center platform. The exchange process consists of two stages: first, generating JSON files and, second, creating the contribution to the BIMserver project from these files.

12.1 Generation of exchange files

The exchange files may be generated directly from the apps that implement this format or, alternatively, by converting the export files currently available in those apps.



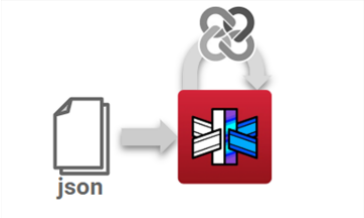
Direct generation or generation through conversion

12.2 Contribution to BIMserver.center

12.2.1 Option 1: Input from CYPE Connect or StruBIM Steel

Contributions to the BIMserver.center project must be made from CYPE Connect or StruBIM Steel, using the exchange files generated in the initial phase. To do this, use the **StruBIM Uploader** tool, located in the **File** menu.

- The model geometry file (mandatory).
- The force file (optional).

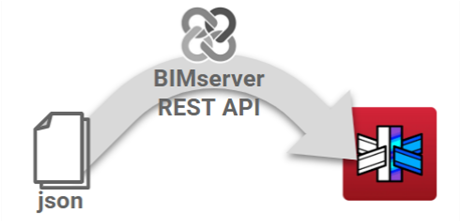


12.2.2 Option 2: Direct contribution from the source app using the BIMserver.center API

The source app of the model must send the exchange files directly to the BIMserver.center project using its API *(BIMserver.center REST API)*. This step can also be performed during the conversion of the original files. This would allow users to connect directly to BIMserver.center and export in the same way as CYPE 3D does.

The contribution generated must include:

- The model geometry file, with extension **.mgun**, labelled as `geometry_model_mef_connections_design` (mandatory).
- The force file, with extension **.mar3du**, labelled as `analytical_model_mef_connections_design` (optional).

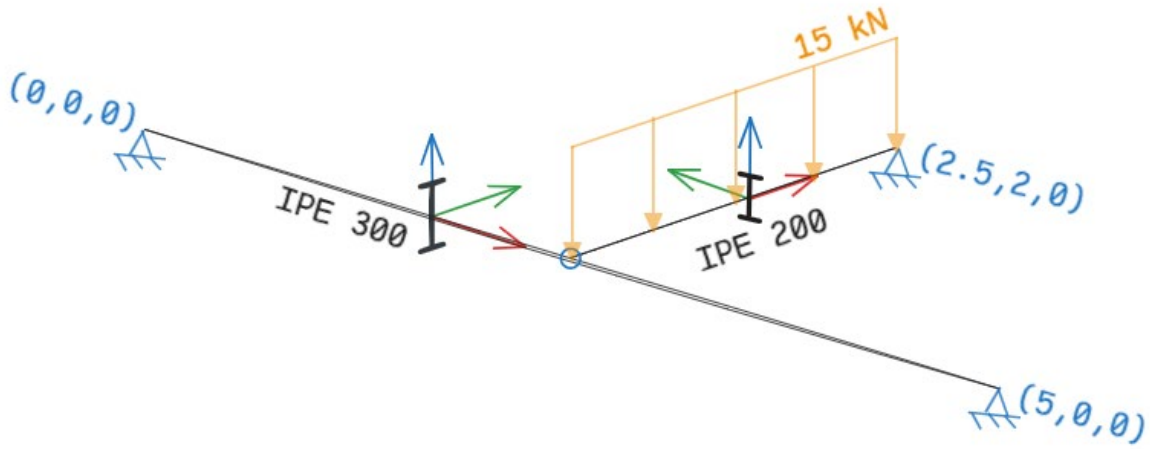


12.2.3 *Integration in CYPE Connect or StruBIM Steel*

Finally, from CYPE Connect or StruBIM Steel it will be possible to import these contributions, both when creating a new project and when updating an existing project.

13 Annex 3: Example

The following example is detailed below:



Example diagram

Geometry:

```
{
    "modelVersion" : 1,
    "model" : {
        "materials" : [
            {
```

```
            "id" : "1",
            "name" : "S275",
            "type" : "steel",
            "steel" : {
                "E" : 210000.0,
                "poissonCoef" : 0.3,
                "thermalExpansion" : 1.2E-05,
                "unitWeight" : 77.0085,
                "fy" : 275.0,
                "fu" : 430.0,
                "strengthReductionSteps" : [
                    {
                        "thickness" : 0.04,
                        "fy" : 275.0,
                        "fu" : 430.0
                    },
                    {
                        "thickness" : 0.08,
                        "fy" : 255.0,
                        "fu" : 430.0
                    }
                ]
            }
        }
    ],
    "sections" : [
        {
            "id" : "1",
            "type" : "rolledI",
            "rolledI" : {
                "series" : "IPE",
                "name" : "IPE 300",
                "flangeWidth" : 0.15,
                "flangeThickness" : 0.0107,
```

```
            "overallDepth" : 0.3,
            "webThickness" : 0.0071,
            "flangeSlope" : 0.0,
            "filletRadius" : 0.015
        }
    },
    {
        "id" : "2",
        "type" : "rolledI",
        "rolledI" : {
            "series" : "IPE",
            "name" : "IPE 200",
            "flangeWidth" : 0.1,
            "flangeThickness" : 0.0085,
            "overallDepth" : 0.2,
            "webThickness" : 0.0056,
            "flangeSlope" : 0.0,
            "filletRadius" : 0.012
        }
    }
],
"nodes" : [
    {
        "guid" : "2rmZv_nTf0lf3UPQOy$PIT",
        "name" : "1",
        "x" : 0.0,
        "y" : 0.0,
        "z" : 0.0
    },
    {
        "guid" : "3J338Q5HT6AP6VMUKsykX6",
        "name" : "2",
        "x" : 5.0,
        "y" : 0.0,
```

```
            "z" : 0.0
        },
        {
            "guid" : "1fZtxUpFj5GAxDfow$lCGP",
            "name" : "3",
            "x" : 2.5,
            "y" : 0.0,
            "z" : 0.0
        },
        {
            "guid" : "1HHendHPrFY9HUrXnSPxI8",
            "name" : "4",
            "x" : 2.5,
            "y" : 2.0,
            "z" : 0.0
        }
    ],
    "members" : [
        {
            "guid" : "3duSnHl9f8Dv5oJoVfb7XS",
            "x1" : 0.0,
            "y1" : 0.0,
            "z1" : 0.0,
            "x2" : 5.0,
            "y2" : 0.0,
            "z2" : 0.0,
            "insertionPoint" : "center",
            "localRotation" : 0.0,
            "displacementY" : 0.0,
            "displacementZ" : 0.0,
            "materialId" : "1",
            "sectionId" : "1"
        },
        {
```

```
            "guid" : "1si7PbC8bCEwc6Giu1tzXH",
            "x1" : 2.5,
            "y1" : 0.0,
            "z1" : 0.0,
            "x2" : 2.5,
            "y2" : 2.0,
            "z2" : 0.0,
            "insertionPoint" : "center",
            "localRotation" : 0.0,
            "displacementY" : 0.0,
            "displacementZ" : 0.0,
            "materialId" : "1",
            "sectionId" : "2"
        }
    ],
    "nodeMembersConnections" : [
        {
            "nodeGuid" : "2rmZv_nTf0lf3UPQOy$PIT",
            "membersGuids" : [
                "3duSnHl9f8Dv5oJoVfb7XS"
            ]
        },
        {
            "nodeGuid" : "3J338Q5HT6AP6VMUKsykX6",
            "membersGuids" : [
                "3duSnHl9f8Dv5oJoVfb7XS"
            ]
        },
        {
            "nodeGuid" : "1fZtxUpFj5GAxDfow$lCGP",
            "membersGuids" : [
                "3duSnHl9f8Dv5oJoVfb7XS",
                "1si7PbC8bCEwc6Giu1tzXH"
            ]
```

```
            },
            {
                "nodeGuid" : "1HHendHPrFY9HUrXnSPxI8",
                "membersGuids" : [
                    "1si7PbC8bCEwc6Giu1tzXH"
                ]
            }
        ],
"grid" : {
            "gridLinesX" : [
                {
                    "coordinate" : 0.0,
                    "label" : "A",
                    "labelVisibility" : "start"
                },
                {
                    "coordinate" : 2.5,
                    "label" : "B",
                    "labelVisibility" : "start"
                },
                {
                    "coordinate" : 5.0,
                    "label" : "C",
                    "labelVisibility" : "start"
                }
            ],
            "gridLinesY" : [
                {
                    "coordinate" : 0.0,
                    "label" : "1",
                    "labelVisibility" : "start"
                },
                {
                    "coordinate" : 2.0,
```

```
                    "label" : "2",
                    "labelVisibility" : "start"
                }
            ]
        },

        "tags" : [
            {
                "guid" : "3XdX_EqOv2W8o6z6ngICHr",
                "name" : "tag1",
                "color" : 14079702,
                "profilesGuids" : [
                    "3duSnHl9f8Dv5oJoVfb7XS",
                    "1si7PbC8bCEwc6Giu1tzXH"
                ]
            }
        ]
    }
}
```


Forces


```
{
    "loadCombinationGroups": [
    {
      "combinationType": "rolledSteel",
      "combinationsList": [
        {
          "combinationId": "LC1",
          "loadSituation": "persistent",
          "loadDuration": "permanent"
        }
      ]
    }
  ],
```

```
"membersForces": [
  {
    "guid": "3duSnHl9f8Dv5oJoVfb7XS",
    "nodeGuids": [
      "2rmZv_nTf0lf3UPQOy$PIT",
      "1fZtxUpFj5GAxDfow$lCGP",
      "3J338Q5HT6AP6VMUKsykX6"
    ],
    "segments": [
      {
        "localPosI": 0.0,
        "rigidOffsetI": 0.0,
        "localPosJ": 2.5,
        "rigidOffsetJ": 0.0,
        "isRigidSegment": "False",
        "forcesAtI": [
          {
            "combinationType": "rolledSteel",
            "forces": [
              [0.0, 0.0, -10.12, 0.0, 0.0, 0.0]
            ]
          }
        ],
        "forcesAtJ": [
          {
            "combinationType": "rolledSteel",
            "forces": [
              [0.0, 0.0, 10.12, 0.0, 25.31, 0.0]
            ]
          }
        ]
      },
      {
        "localPosI": 2.5,
```

```
      "rigidOffsetI": 0.0,
      "localPosJ": 5.0,
      "rigidOffsetJ": 0.0,
      "isRigidSegment": "False",
      "forcesAtI": [
        {
          "combinationType": "rolledSteel",
          "forces": [
            [0.0, 0.0, 10.12, 0.0, -25.31, 0.0]
          ]
        }
      ],
      "forcesAtJ": [
        {
          "combinationType": "rolledSteel",
          "forces": [
            [0.0, 0.0, -10.12, 0.0, 0.0, 0.0]
          ]
        }
      ]
    }
  ]
},
{
  "guid": "1si7PbC8bCEwc6Giu1tzXH",
  "nodeGuids": [
    "1fZtxUpFj5GAxDfow$lCGP",
    "1HHendHPrFY9HUrXnSPxI8"
  ],
  "segments": [
    {
      "localPosI": 0.0,
      "rigidOffsetI": 0.0,
      "localPosJ": 2.0,
```

```
          "rigidOffsetJ": 0.0,
          "isRigidSegment": "False",
          "forcesAtI": [
            {
              "combinationType": "rolledSteel",
              "forces": [
                [0.0, 0.0, -20.25, 0.0, 0.0, 0.0]
              ]
            }
          ],
          "forcesAtJ": [
            {
              "combinationType": "rolledSteel",
              "forces": [
                [0.0, 0.0, -20.25, 0.0, 0.0, 0.0]
              ]
            }
          ]
        }
      ]
    }
  ]
}
```