Unlimited work preparation of beams & bars

- Bolted connections
- Welded connections
Unlimited work preparation of beams & bars

Why limit yourself when everything is possible? Traditionally the design and detailing of a structure was restricted by the limitations of the fabrication process or availability of macros. With our 3D profiling machine we set a new standard and welcome you to our world of 100% freedom. This document shows a variety of parts with commonly used cuts prepared for welding and/or fastening. It provides a clear insight into unlimited possibilities.

Programming of parts
HGG offers 3D profiling of parts based on 100% freedom to design. The cuts represented in this document are supported by the following HGG modules:

- Manual Data Input (MDI)
- CAD-CAM Interface for model-based design software such as Tekla Structures.
- CAD-CAM Interface for solid modelling software such as SolidWorks.

What is a cut?
A cut is shown as an outlined box representing a commonly used shape with weld preparation functions which are used in all industries using beams and bars. Three types of cuts can be distinguished:

- A flange end cut (top view)
- A web end cut (side view)
- An intermediate cut

A practical example
The example shown below will help to understand the structure of this document. Cuts are available for end shapes, holes and cut-outs. Four cuts are needed to define a beam end shape. Top flange, top web, bottom web and bottom flange. The weld preparation is shown on the right side of the cut. Holes can be added where required.
Example 1
Left: a bolted beam to beam connection, sloped shear tab connection with notches and an intermediate.

Middle: an intersection.

Right: a bolted beam to beam connection, sloped with web end plate and notches.
Example 2
A welded beam to beam connection, fully fixed for high performance steel structures.
Example 3
A welded beam to beam connection, pinned with snipe for supporting members in high performance steel structures.
Example 4
Left: a bolted and welded column to beam connection, slotted web (SSDA) moment connection for seismic structural design.

Right: a bolted column to beam connection, extended end-plate moment connection.
Example 5
Bolted beam to beam connection, Bolted Flange Plate (BFP) moment connection with and without Reduced Beam Section (RBS) for seismic structural design.
Example 6
Left: a bolted column to beam connection, shear tab connection without notches.

Right: a bolted beam to beam connection, shear tab connection with notches.
Example 7
A bolted and welded column to beam connection, Welded Un-reinforced Flange-welded Web (WUF-W) moment connection with and without Reduced Beam Section (RBS).
Cuts

This is an overview of all available cuts for flange and web.

Cuts for end shapes

Flange cuts for part ends
These six flange cuts can be applied to define the flange of a part. Half of the cut displayed in the top view is working for channel and angle bar.

Legend

- Cut
- Rathole possible.
- Joint face supporting bevel cutting for weld preparation.
- Weld preparation detail.
Web cuts for part ends
These four side viewed flange cuts can be applied to define half of the web of a part. So one for the top flange and one for the bottom flange is needed for channels or beams.

Legend
- **Cut**
- **Rathole possible.**
- **Joint face supporting bevel cutting for weld preparation.**
- **Weld preparation detail.**
**Cuts for intermediate shapes**

**Web cuts**
This cut actually covers both the flange and web.

- **IC001**

**Flange cuts**
These cuts are mostly used for reduction of the flange.

- **Cut-out**
- **RBS**
  - CAD/CAM only

**Universal cuts**
These cuts can be applied to both the flange and web.

- **Hole**
- **Slotted Hole**

**Included shapes**

**Legend**
- Cut
- Rathole possible.
- Joint face supporting bevel cutting for weld preparation.
- Weld preparation detail.
Cuts for length shapes

Web cuts
Cuts for shapes in longitudinal direction.

Legend
- Cut
- Rathole possible.
- Joint face supporting bevel cutting for weld preparation.
- Weld preparation detail.
**End shape configuration**

A group of four cuts is needed to define the end shape of a part. This group represents flange cuts and half web cuts for the top flange, top web, bottom web and bottom flange. A group of only two cuts is needed for T-bars and angle bars. Intermediate cuts like holes can be applied additionally. HGG supplies a selection of grouped cuts for manual programming of common end shapes. Contact HGG sales to enquire whether this selection fits your requirements.
Guide to weld preparation

*HGG develops machines to cut copes and weld preparation with a wide variety of bevel types.*

**Bevel cutting**

**None**
Preferred in case of bolted connections or to apply fillet welds.

**Single groove**
Bevel cut for groove weld. Weld preparation on top side or bottom side.

**Single groove with nose**
Bevel cut for groove weld with broad root face. Weld preparation on top side or bottom side.

**Double groove**
X-bevel cut for X or K groove welds. Small root face can be applied after cutting.

**Double groove with nose**
X-bevel cut for X or K groove welds with broad root face.

**Ratholes**
This open hole in the web right up against the flange allows continuous weld passes on flange joints across the web with complete joint penetration. The necessary reduction in the web brings avoidance of defects like discontinuities, inclusions and incomplete penetration of the passes. Ratholes enable nondestructive testing of the full joint. Depending on the contract documents and included welding regulations a fabricator can choose not to apply ratholes. This avoids reduction of the web but possible defects that cannot be tested need to be taken into account during strength calculation.

**None**
No reduction in web section for full strength. Nondestructive tests of welds located across the web are not possible.

**Type 1**
Traditional rathole. The required torch to flange distance for web cuts requires a minimum of grinding.

**Type 6**
HGG optimised rathole. No grinding required.

**AWS 6.2**
Weld inspection hole for seismic moment connections (CAD-CAM only).
HGG’s Terminology

This page contains a list of commonly used terminology.

Intersection geometry

Skew
Acute angle between member axes in the horizontal plane.

Slope
Acute angle between member axes in a vertical plane. Also called ‘inclination’.

Shape
Actual geometry to create the end cut, cut-out or hole for a proper fit.

Weld preparation

Groove angle \( \phi \)
The angle between opposing faces of the connected parts which create a groove to be filled up with weld materials. Can be an inside or outside groove angle for weld preparation.

Bevel angle \( \beta \)
The angle formed between a centreline perpendicular to the wall and the cut face of the wall. Equal to cutting angle and can be negative or positive.

- A perpendicular cut has \( \beta=0^\circ \);
- Largest \( \beta \) plasma 45° (- or +).

Dihedral angle \( \psi \)
Angle between the outer faces of the connected walls. Calculations for optimal weld preparation are based on \( \psi \).

Root opening (R)
The separation at the joint between the walls after fitting. Technique to increase the joint penetration for stronger connections.

Rathole
An opening in the web right under the flange to achieve complete flange joint penetration and allow nondestructive tests.

Weld types

- Fillet weld
- Groove weld
- Butt weld