Technical Documentation: bent_bar_with_holes.scad Library

This OpenSCAD library allows modeling of bent bars in the XZ plane with customizable drill holes oriented along the Y or Z axes. It is designed to be modular, reusable, and fully configurable from the calling application.

1. Purpose

Provide a parameterized API to:

- Generate a bar composed of bent segments according to a sequence
- Add polygonal arcs at non-standard bends
- Drill each segment based on a local [x, y] reference, along the X, Y, or Z axis

2. Exported Modules

bent_bar(sequence, holes = [], bar_width=20, bar_thickness=5, arc_radius=5, arc_steps=9)

Parameters:

- sequence: a list of [length, angle] pairs, each representing a segment followed by a bend in degrees (angle in the XZ plane).
- holes: a list of drill holes defined as [segment_index, [x, y], diameter, axis] where:
    - segment_index: index of the segment to drill (0-based)
    - [x, y]: coordinates relative to the local origin (bottom front-left corner of the segment)
    - diameter: diameter of the hole
    - axis: direction of the hole ("X", "Y", "Z")
- bar_width: width of the bar (Y direction)
- bar_thickness: thickness of the bar (Z direction)
- arc_radius: radius used to simulate bends with arcs
- arc_steps: number of facets to approximate each polygonal arc

3. Internal Modules

segment(len, bar_width, bar_thickness)

Creates a straight segment of length len, centered in Y, positioned at Z = 0.

arc_bridge(angle_total, radius, width, thickness, steps)

Creates a polygonal arc joint between two segments, oriented in the XZ plane.

hole(d, pos, axis, bar_width, bar_thickness, len_seg)

Creates a cylindrical hole from a local origin:

- Axis "Y": drills transversely along Y

- Axis "Z": drills vertically along Z

holes_for_segment(holes, index)

Utility function to return all holes assigned to a given segment index.

bent_bar_internal(...)

Recursive module that builds the bent bar step-by-step.

4. Origin and Local Reference Frame

All [x, y] positions for holes are expressed:

- In the **local XY coordinate system of the segment** (before rotation)
- **From the bottom front-left corner** of the segment

5. Example Usage

```
use <bent_bar_with_holes.scad>;
bend_sequence = [
  [30, 45],
  [40, -90],
  [30, 0]
];
holes = [
  [0, [5, 5], 2, "Z"],
  [1, [10, 0], 2, "Y"]
];
bent_bar(
  bend_sequence,
  holes,
  bar_width = 25,
  bar_thickness = 4,
  arc_radius = 4,
  arc_steps = 10
);
```

6. Limitations for Future Improvements

- No drills on "X" axis
- No automatic flattening (unfolding)

- No annotation or label display
- No automatic export of hole specifications to CSV or DXF