A CAD agent that works like a design engineer

From natural-language prompts to FreeCAD parts, assemblies with moving parts and production drawings.

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01

PURPOSE

More than a shape generator

Most AI tools for CAD produce a solid that looks right. This agent is meant to do the work of a design engineer: it designs parts and complete assemblies from prompts written in natural language, chooses joints and standard parts, checks strength, heat, tolerances, sealing and motion, and prepares documentation that a workshop can produce from.

Scope: sheet-metal parts and enclosures, solid parts, parts for 3D printing and assemblies with moving elements such as doors, flaps and drawers.

SCALE SO FAR

123
Published model versions in 10 projects

53
Engineering skills

563 / 8,467
Design rule cards / findings with quotes

444
Press brake punch and die profiles

02

WORKFLOW

From prompt to published model

The prompts come in plain language, together with sketches, photos, dimensions or STEP and DXF files from suppliers. Nobody opens the FreeCAD interface: results are reviewed in a 3D viewer in the browser.

01 Requirements and decisions

The agent records the agreed requirements and keeps a decision log: what was decided, why, which design rule or source supports it and which alternative was rejected.

02 Parametric model script

The model is a Python script for FreeCAD 1.1, the single source of truth. It runs in an isolated container without network access and without the graphical interface.

03 Publication of a version

Each version is published as FCStd, STEP, DXF flat patterns for laser cutting and a viewer model in which every face has an identifier, together with a manifest that describes the motion of moving parts.

04 3D viewer

Orbit, sections, measurement, an exploded view and sliders that move doors, flaps and drawers. Supplier STEP and DXF files of up to 200 MB can be added and viewed with the model.

05 Prompts pinned to geometry

A prompt can be pinned to a part, a specific face and a point in millimetres, with a screenshot of the view. The agent reads the geometry of that face, makes the change and answers in the viewer, or asks a question when the request is unclear.

06 Team of agents

Larger tasks are split by a lead agent between a designer, a draughtsman, a checker and a knowledge researcher, each working on its own module. Heavy checks run in the background after publication.

03

WHAT IT DESIGNS

Sheet metal, solids, assemblies and motion

- **Sheet metal:** flanges, bends, corners and reliefs, joining, welding and finishing. The flat pattern drawn for the laser is checked against the solid (area, thickness with bend allowance, number of holes), and every bent part passes a manufacturability validator before publication. Outer corners of cut contours are rounded to R2.
- **Press brake tooling:** 444 punch and die profiles of the contractor's presses, selection of the V die, minimum flange length and collisions between successive bends.
- **Solids and 3D printing:** parts for FDM and MSLA resin printing, with tolerances and fits, loaded parts and export of STL and 3MF files for the slicer.
- **Assemblies:** every element — sheet, press-in fastener, nut, hinge — is a separate part with a specification number and a catalogue designation such as `ISO 4032 M5` or `PEM FHA-M5-12`, never a vague description. Standard parts and purchased components come from a STEP library of 49 standard parts and 30 catalogue components, or from manufacturers' files.

– **Moving parts:** rotations and translations with their ranges are part of the model. A motion check sweeps the whole range and reports the first collision with the pair of parts and the free range; on a real enclosure it checked five motions in 84 seconds at a 10° step.

04

ENGINEERING

Calculations and checks

The 53 skills give the agent the working knowledge of a design engineer. A skill sets the order of decisions for a task and points to the rules and calculations it needs.

AREA	WHAT THE AGENT WORKS OUT
Strength	Strength and stiffness of panels, brackets, doors and free-standing units; wind load to EN 1991-1-4, anchoring, safety factors
FEM	Finite element analysis in FreeCAD by script: Gmsh or Netgen mesh, CalculiX solver, shells versus solids, reading the results
Joints	Bolted joints in thin sheet: threads, rivet nuts, self-tapping screws, bushes, dowel pins, spacing and load of fasteners
Tolerances	Dimension chains in bent and welded assemblies: worst case and RSS, datums, position tolerances, achievable cutting tolerances
Cost	General tolerances (ISO 2768), design for manufacture and assembly, cost of welding, grinding and assembly
Heat	Thermal estimate of an enclosure: power-loss balance, convection, filter fans, heat exchangers, air conditioning, solar gain
Sealing	Doors, hinges, locks, EPDM gaskets and their compression; IP (EN 60529) and IK (EN 62262); drainage and condensation
Vibration and EMC	Vibration and shock of electronics (IEC 60068-2-6, -27, -64), anti-vibration mounts; shielding of openings, EMC gaskets, bonding
Materials	Sheet grades (DC01, galvanised, stainless 304/316, aluminium), coatings, corrosivity classes C1–C5
Interior and service	Mounting plates, DIN rails, cable ducts and bend radii, glands, access for assembly and service

Automatic checks

– **Before publication:** valid solids with non-zero volume, the sheet-metal validator for changed parts and collisions in the closed position.

– **In the background:** collisions across the range of motion, sealing of the assembly (openings and short gaps leading into the interior), a visual review of rendered views and a parameter test that rebuilds a copy of the project with changed dimensions.

05

DOCUMENTATION

Production drawings by the standard

Every part made in the workshop gets an A3 drawing: views after bending with the dimensions the press brake operator needs, and the flat pattern with bend lines for the laser.

- Dimensions according to ISO 129-1, scales from the ISO 5455 series, a parts list according to ISO 7573 and item balloons according to ISO 6433.
- A title block with the material grade and thickness, the quantity and general tolerances such as ISO 2768-mK.
- A revision register per part: the first issue is 00, and the revision changes only when the drawing of that part changes, not with every model version.

06

KNOWLEDGE

Design rules with sources

The agent's design knowledge was prepared by the multi-agent research system, so every rule can be traced to a quoted source. The agent queries the knowledge base for rules and for values with their conditions, and cites the rule number in its decision log.

563	8,467	2,028
Rule cards for sheet-metal design	Findings with quotes	Values with conditions

Sheet-metal knowledge base, built from 1,881 sources

A separate base for 3D printing holds 264 rule cards, 850 findings, 213 values with conditions and 239 sources.