**1. Create a new document & structure**

* Open **FreeCAD** → File → New.
* In **Part Design** workbench:
  + Create a **Part container** (name: Piano\_ModularFrame).
  + Inside, create a **Body** (name: Master\_Body).
  + This will hold your master geometry (keyboard outline, bolt pattern, reference planes).

**2. Master sketch (parametric skeleton)**

* In Master\_Body, create a new **Sketch** on the XY plane.
* Draw:
  + A rectangle for the **keyboard footprint per octave** (about 164 mm × ~120 mm deep).
  + Add **construction lines** for note spacing (12 equal divisions along width).
  + Add 2–3 circles outside edges → bolt holes for module joining.
* Constrain dimensions with named parameters:
  + octave\_width = 164 mm
  + depth = 120 mm
  + bolt\_spacing = 80 mm  
    (Tip: put them in the **Spreadsheet workbench**, link dimensions → makes edits easy later).

**3. Derive module bodies**

* For each part (side rail, top rib, actuator bar, clamp jaws), create a **new Body**.
* Use **ShapeBinder** to pull in the master sketch references (keyboard outline, bolt holes).
* Build features relative to these, so changes propagate.

Examples:

* **Side Rail**:
  + Sketch profile (L-shaped or ribbed beam) along the side.
  + Pad to full depth.
* **Top Plate / Rib**:
  + Sketch on XY → pad 5–6 mm.
  + Add cutouts for servo bar and wiring.
* **Servo Bar**:
  + Long rectangular beam across module width.
  + Add pockets for servos (20×12 mm typical for micro SG90 class).
* **Clamps**:
  + Small pads on the side edges of the footprint rectangle.
  + Sketch → pad up → fillet corners.

**4. Assembly interfaces**

* On each side face of the module, extrude small **alignment bosses** (Ø 6 mm).
* Matching recess on the opposite side.
* Add 2× **through bolt holes (M5 clearance = 5.5 mm)** per side.
* This ensures rigid alignment when bolting modules together.

**5. Printing considerations**

* Split tall parts (side cheeks) if they exceed your 210 mm Z.
* Design ribs and cutouts so modules are **light but stiff**.
* Add nut traps for bolts:
  + M3/M5 hex pockets undersized by ~0.2 mm.
* Tolerances:
  + Sliding fit: +0.3 mm clearance.
  + Alignment pins: oversize hole by +0.1–0.2 mm, ream after printing.

**6. Parametric array & partial module**

* Use **Draft Array** or **Assembly4 workbench** to copy the module 6×.
* For the last module (44 notes total), suppress 4 keys (partial).

**7. Export for print**

* Select each Body → File → Export → STL.
* Slice in PrusaSlicer. Print test pieces at low infill (10–15%) first to confirm fits.

**✅ Suggested module contents**

Each octave module includes:

* **Frame** (side rails + top/bottom ribs + bolt interface)
* **Actuator bar** with servo pockets (12 max)
* **Clamps** to hold roll-up piano edge
* **Cable channels** at rear
* **Alignment bosses + bolt holes** for chaining