

ObjWeaver 3D & OBJStroke Manual

3D OBJ to 2.5D Cel Shaded Vector Rigging & Dynamic Hatching Engine

Introduction

This document serves as the official operational manual for **ObjWeaver 3D** and **OBJStroke**, high-performance 3D geometric projection and 2.5D vector rigging engines tailored for Moho Pro 12.5 and above (Moho 12 / 13 / 14+ Fully Supported).

While verified primarily in Windows environments, their clean architecture (pure Lua scripts, mathematical geometry calculation, and Moho native vector pipelines) ensures full compatibility across macOS and cross-platform Moho installations.

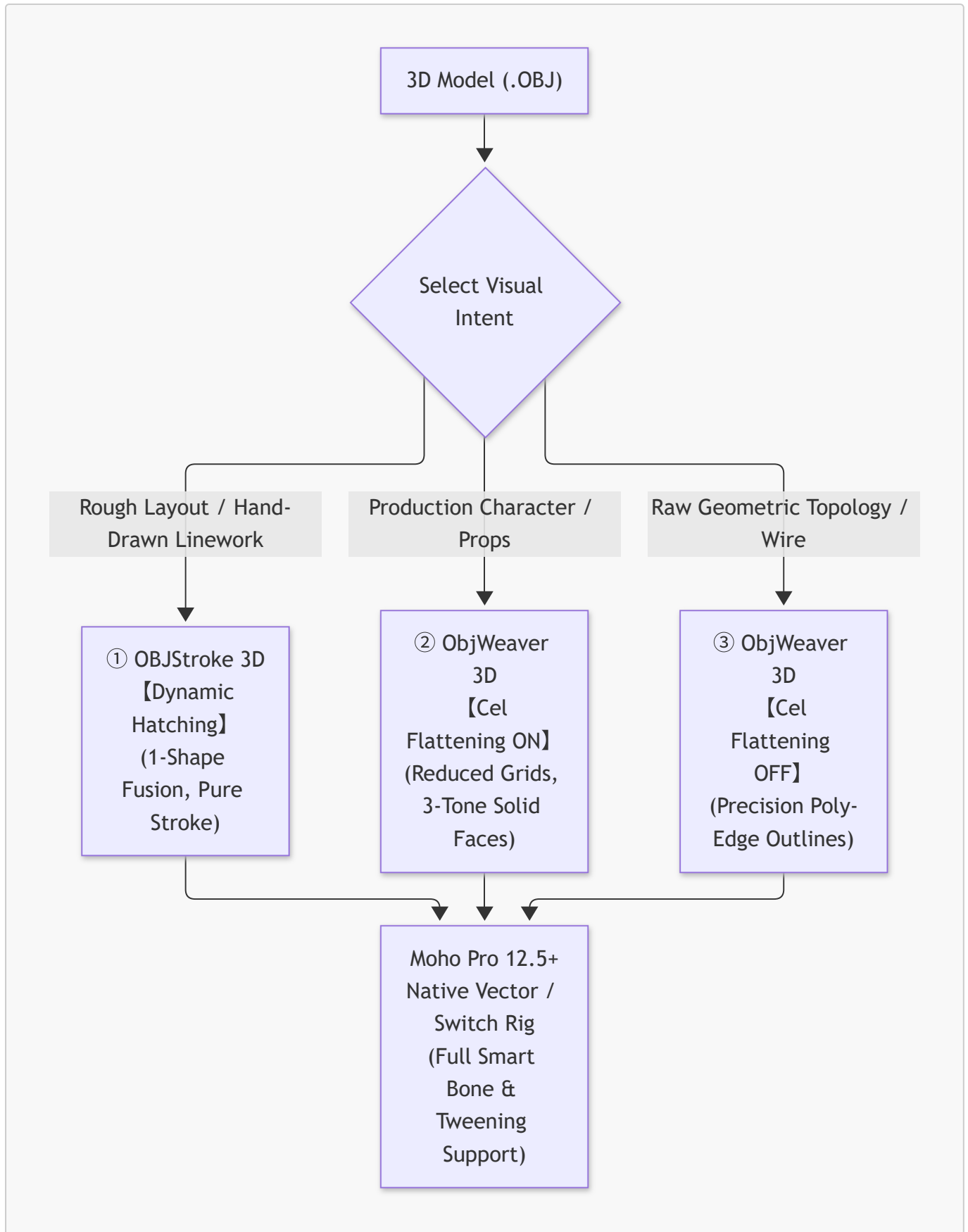
Part 1: What are ObjWeaver 3D & OBJStroke? (Philosophy & 3 Visual Approaches)

1.1 Purpose: Why Two Dedicated Tools and Three Visual Approaches?

In standard 2D vector animation pipelines, incorporating 3D assets has traditionally encountered severe bottlenecks:

1. **Raw Wireframes:** Lacking occlusion and depth, creating visual clutter where background lines bleed through.
2. **Dense Point Counts:** Heavy 3D meshes freeze Moho's viewport and make curve editing impossible.
3. **Loss of Native 2D Soul:** Rendered bitmap sequences lose vector scalability, stroke manipulation, and organic hand-drawn warmth.

ObjWeaver 3D & OBJStroke solve these challenges by projecting 3D OBJ vertices directly into Moho Pro's native **2.5D Vector Mesh with Switch Layer Interpolation (Tweening)** in a single click:



1.2 The Three Visual Approaches Comparison Matrix

Feature	① OBJStroke 3D (Dynamic Hatching)	② ObjWeaver 3D [Cel Flatten: ON]	③ ObjWeaver 3D [Cel Flatten: OFF]
Output Type	Pure 1-Shape Stroke (Consolidated Outline)	Cel-Shaded Filled Polygons (Back-to-Front)	Vector Wireframe Geometry (Transparent Faces)
Surface Treatment	Dynamic Hatching Linework (Organic pen pressure)	Flat 2.5D Anime Fill (G- pen outlines + cel fills)	Crisp Poly Mesh (Technical line drawings)
Shape Count	Exactly 1 Shape per Layer (Consolidated)	1 Shape per Polygon (Solid Painter's Order)	1 Outline Shape per Face
Generation Speed	0.2 ~ 0.5s (Ultra-lightweight)	1.5 ~ 3.0s (Full Painter's sorting)	1.0 ~ 2.0s (Standard vectorization)
Optimal Use Cases	Storyboards, Animatic Guides, Manga Linework	Main Characters, Turntable Props, Vehicles	Mechanical Blueprints, Sci- Fi HUD Wireframes

1.3 Why Does Sub-Layer Interpolation (Tweening) Work Flawlessly?

Moho's native Switch Layer interpolation requires that **all child sub-layers have 100% identical point counts, curve IDs, and topology order**.

- Standard 3D culling deletes back-facing polygons, which breaks vertex ordering and causes violent morphing glitch explosions during interpolation.
- **ObjWeaver 3D & OBJStroke guarantee identical topology:** A single unified face scan calculates the superset of valid faces across all rotation angles. Sub-layers preserve the exact same curve count; hidden backfaces simply have their opacity set to 0.0 or are scaled to zero, achieving **perfect, silky-smooth 2.5D morphing transitions**.

1.4 Centroid & Bounding Box Offset Correction (Zero-Drift Centering)

When 3D models have off-center pivot origins (e.g., origin placed at ground level or far off-mesh), converting into Moho vector layers normally causes the model to fly off-screen during turntable rotations.

- **ObjWeaver 3D & OBJStroke solve this with mathematical centroid centering:** The 3D bounding box is scanned in real-time, computing the true geometric centroid (cx, cy, cz).
- The rotation pivot is pinned precisely to the model's visual center. Turntable and multi-angle rigs stay firmly grounded at the viewport center without any wandering or rotational drift.

Part 2: Installation & Setup

2.1 File Architecture

Place the scripts into your Moho Custom Content folder:

```

Moho Custom Content/
├── Scripts/
│   ├── Menu/
│   │   └── 3D/
│   │       ├── we_objweaver_menu.lua    <-- ObjWeaver 3D Menu Script
│   │       └── we_objstroke_menu.lua    <-- OBJStroke Menu Script

```

2.2 Installation Steps

1. Copy `we_objweaver_menu.lua` and `we_objstroke_menu.lua` into `Scripts/Menu/3D/`.
2. Launch Moho Pro (12.5+ / 14+). If Moho is already running, press **Ctrl + Shift + Alt + L** (Windows) or **Cmd + Shift + Opt + L** (macOS) to reload all scripts.
3. Access the tools via the top menu bar: **Scripts ▾ 3D ▾ ObjWeaver 3D** and **OBJStroke**.

2.3 Preparation (Loading & Selecting 3D OBJ Models in Moho)

1. Import an OBJ file into Moho via **File ▾ Import ▾ OBJ 3D Model...**
2. Select the imported 3D layer in the Layers palette.
3. Launch **ObjWeaver 3D** or **OBJStroke** from the **Scripts -> 3D** menu. The tool auto-detects model properties, base angles, and keyframes.

Part 3: ObjWeaver 3D Operational Guide

3.1 4 Visual Style Selection

ObjWeaver 3D provides 4 distinct rendering styles in its dialog:

1. **Solid (Cel Flat)**: Filled vector faces with G-pen stroke outlines, sorted strictly from back to front using Painter's Algorithm.
2. **Outlines**: Transparent fills with visible polygon contour edges.
3. **Line Art**: Pure contour edges with optimized backface suppression.
4. **Flat (No Outline)**: Smooth vector color blocks without outlines for graphic illustration.

3.2 Cel Flatten (3-Tone Planar Cel Integration) ON / OFF Guide

- **Cel Flattening ON (Default)**:
 - Reduces coplanar polygon grids via planar dissolve passes and synchronizes edge stroke colors with polygon fills, visually subduing internal wireframes into clean 3-tone anime cel blocks (*Note: Essential structural lines along curved boundaries and shadow creases are preserved, not deleted into a single unified shape*).
 - Polygons are sorted from furthest to closest relative to the camera via Painter's Algorithm.
 - Generates production-ready 2.5D cel animation assets with clear front-facing silhouettes, making it effortless to draw character eyes, mouths, and details directly onto the mesh.
- **Cel Flattening OFF**:
 - Detailed 3D geometric facets mode with continuous tone shading.
 - Preserves every internal polygon edge and individual facet shading, ideal for technical HUDs, normal/contour drawing references, and continuous PNG image sequence rendering.

3.3 Color Palettes (8 Theme Presets) & Metallic Presets

The dialog features 8 curated color themes arranged in two rows:

- **Row 1 (Standard & Monochromatic):**
 - *Cel Blue*: Signature animation production blue.
 - *Classic Black*: Technical ink line style.
 - *Steel Gray*: Clean neutral shading.
 - *Crimson Red*: Dynamic high-energy action tint.
- **Row 2 (Metallic & Specialized Presets):**
 - *Gold / Brass*: Rich warm metallic gradients.
 - *Chrome / Silver*: High-contrast cool metallic reflections.
 - *Copper / Bronze*: Earthy burnished tone.
 - *Deep Navy*: Cinematic night-light aesthetic.

3.4 Point Reduction (3 Adaptive Reduction Passes) & Seam-Sealing Base Stroke

1. **Three Point Reduction Modes:**
 - **None (Standard)**: Retains 100% of the original OBJ topology.
 - **Smooth (Subtle)**: Merges nearly coplanar micro-facets (approx. 20~30% reduction).
 - **Mesh - Mid / Low**: Aggressive decimation for ultra-heavy meshes (up to 60~70% point savings).
2. **Seam-Sealing Base Stroke**: To prevent micro-gaps (light leaks) between converted vector polygons, an automatic seam-sealing outline is applied:
 - **Smooth**: 2.0px
 - **Mesh - Mid**: 3.5px
 - **Mesh - Low**: 5.0px
3. **Grazing-Angle Dynamic Stroke Boosting (Up to 2.5x)**: Polygons viewed at steep grazing angles naturally undergo perspective foreshortening. The engine dynamically boosts stroke width up to **2.5x** on grazing edges to ensure completely airtight silhouette seals.

Part 4: OBJStroke Operational Guide (Dynamic Hatching)

Running **OBJStroke** opens a streamlined dialog designed specifically for fast, organic manga/anime pen linework.

4.1 Dynamic Hatching Mechanics

OBJStroke calculates the dot product (*dot*) between each 3D vertex normal and the key light vector, applying a **non-linear gamma 2.2 power curve** to dynamically control vertex line width:

$$\text{LightFactor} = \text{clamp} \left(\frac{\text{dot} + 1.0}{2.0}, 0.0, 1.0 \right)$$

$$\text{ShadowIntensity} = (1.0 - \text{LightFactor})^{2.2}$$

4.1.1 Hatching Contrast (Dynamic Range 2.5x to 70.0x / Default: 5.0x)

The dialog allows direct control over the shading contrast ratio (C), determining how dramatically lines taper between highlights and deep shadows:

Max Width (Shadow) = 1.50,

Min Width (Highlight) = $\frac{1.50}{C}$

Contrast Ratio	Highlight Width (at 4.0px Base)	Shadow Width	Recommended Use Cases
2.5x (Soft)	0.60x (~2.4px)	1.50x (~6.0px)	Cityscapes, Buildings, Cubes, Hard-Surface Props Surfaces with 90° planar angles stay uniform, clean, and architecturally solid.
5.0x (Standard)	0.30x (~1.2px)	1.50x (~6.0px)	Standard Anime / Manga Production (Default) Natural G-pen ink pressure. Highlights taper gracefully while shadows remain bold.
10.0x (Dense)	0.15x (~0.6px)	1.50x (~6.0px)	Dense Curvature Meshes (Anvil, Organic Sculptures) Tapers highlight lines to fine hairlines, preventing dense polygon grids from clogging into solid blobs.
25.0x ~ 70.0x (Sharp)	0.06x ~ 0.02x	1.50x (~6.0px)	Dramatic Graphic Novel Shading Completely bleaches out highlight strokes to pure white, concentrating dense ink shading strictly on shadow planes.

4.1.2 Automatic Layer Scale Normalization (Mode 1 & Mode 2 Line Width Match)

In previous versions, child vector layers inside Switch rigs (Modes 2~5) multiplied their stroke width by the parent layer's scale factor (S), causing lines in Mode 2 to appear bloated and thick compared to Mode 1.

- In the current architecture, **layerScale inverse normalization** automatically divides the shape line width by the parent scale factor:

EffectiveLineWidth = $\frac{\text{StrokeWidthPx}/S}{\text{docHeight}}$

- As a result, **Mode 1 (1:1 Still) and Modes 2~5 (Switch Rigs) render with 100% identical line thickness on screen**, regardless of layer scale.

4.2 Dynamic Culling & Mesh Architecture Across Angles (Switch Tweening & Point Count)

OBJStroke performs geometric normal evaluation in real-time, producing clean, legible, and three-dimensional line drawings without background fills.

Please note the critical distinction in mesh generation between **Single Angle** and **Multiple Angles (Switch Layer)**:

[Important: Angle Count vs. Point Count (Union Mesh Architecture)]

OBJStroke 3D pre-scans all requested angles (Switch Layers) and **generates a single unified mesh containing the "union" of all front-facing edges that appear in at least one angle:**

- **Mode 1 (Single Angle):** Only extracts front-facing edges visible from that specific view (~30-40% of the model), resulting in the **minimal (lightest) point count**.
- **Modes 2~5 (Multiple Angles / Switch Layer):** Edges required to display the rear and profile angles are added to the shared base mesh. As angle coverage expands (e.g., 360° turntable), the **base point count increases proportionally** to cover all visible surfaces.

[Why Keep Back-Facing Edges in Vector Data?]

On each layer, back-facing edges are dynamically hidden by setting **line width and opacity to 0.0 (invisible)** rather than physically deleting them.

This preserves **100% identical topology (point count and curve ordering) across all layers**, which is strictly required for Moho's sub-layer Switch Tweening (smooth vector morphing).

[!TIP] Mitigating Point Growth:

For full 360° turntables with high face counts, use the built-in **[Merge & Optimize]** safety intercept to automatically decimate micro-facets down to a lightweight, responsive point count.

4.3 Why is OBJStroke Ultra-Fast (0.2s) with Zero Tweening Artifacts?

- **Consolidated 1-Shape Stroke:** All front-facing vector curves are bound into **exactly 1 Shape per layer**.
- Curve point counts stay minimal, generating complex multi-angle rigs in under 1 second.
- During Switch Layer interpolation, Moho only has to interpolate a single unified shape style, completely avoiding style conflicts and visual pop.

4.4 High-Density Mesh Safety Intercept (OBJStroke Specific)

OBJStroke incorporates the same **High-Density Mesh Safety Intercept & 2-Stage Perimeter Optimizer** found in ObjWeaver 3D:

- **High-Density Threshold (5,000+ faces):** To protect Moho's single-stroke shape generation engine from buffer overflow freezes, an automatic warning is triggered if the imported model exceeds **5,000 faces**.
- **Freeze Prevention Optimizer (Target: ~3,500 pts/faces):** Selecting **[Merge & Optimize]** automatically condenses micro-facets into a verified safe zone (~3,500 pts/faces) that executes in seconds, ensuring crisp, stable Dynamic Hatching without crashing Moho.

4.5 Match 3D Size (1:1) & Mode 1 Exact Camera Overlay (100% Scale Sync with ObjWeaver)

The geometric projection and scale synchronization engines from ObjWeaver 3D are fully shared by OBJStroke:

1. Mode 1 (Current Frame) Exact Camera Overlay (1:1 Perspective Overlay):

- Evaluates camera FOV, focal distance, zoom, and layer position in physical 3D camera space.

- Sets `SetImmuneToCamera(true)` on the output vector layer, locking it **1:1 pixel-for-pixel to the active 3D model in the viewport**.
 - Acts as an instant, perfectly aligned linework guide for layout and animatics.
2. **Global [x] Match 3D Size (1:1) Support Across All Modes:**
- Preserves the parent 3D layer's exact scaling factor (e.g., `Scale: 335.3%`) across turntable and multi-angle rigs. Automatic screen-fit normalization (`1.2 / maxDim`) is bypassed.
3. **100% Dimensional Alignment with ObjWeaver (Hybrid Cel Shading + Hatching):**
- When layering an OBJStroke linework layer over an ObjWeaver solid cel-fill layer, **their scale, angles, and camera perspective align perfectly with zero pixel drift**.
 - Enables a production-ready "3-Tone Cel Flat + Dynamic G-Pen Linework" hybrid workflow without any manual realignment.

4.6 Depth Tiers: Z-Depth Multi-Stage Grouping & Named Shapes

Both **ObjWeaver 3D** and **OBJStroke** include a **Depth Tiers** feature that automatically categorizes generated curves and faces into distinct depth tiers based on their camera-space Z distance:

Depth Tiers Selection in Dialog:

(*) 5 Tiers (Default) () 3 Tiers () 2 Tiers () Off (1 Shape)

4.6.1 Tier Configurations & Naming Conventions

- **5 Tiers (Default):**
 - `Depth_1_Back`: Furthest background elements.
 - `Depth_2_MidBack`: Mid-rear geometry.
 - `Depth_3_Mid`: Central depth plane.
 - `Depth_4_MidFront`: Mid-foreground geometry.
 - `Depth_5_Front`: Closest foreground contours.
- **3 Tiers:** `Depth_1_Back`, `Depth_2_Mid`, `Depth_3_Front`.
- **2 Tiers:** `Depth_1_Back`, `Depth_2_Front`.
- **Off (1 Shape):** Unifies all curves into a single consolidated shape for absolute maximum lightweight speed.

4.6.2 Intuitive Access in Moho Pro (OBJStroke vs. ObjWeaver Optimal Separation)

1. **OBJStroke (Linework): 1 Depth Tier = 1 Consolidated Shape (Q Key Instant Select):**
 - Each tier is created as exactly one consolidated vector shape tagged with the corresponding depth name (e.g., `<LayerName>_Depth_1_Back`), yielding only 5 shapes total in 5-tier mode.
 - Using Moho's **Select Shape Tool (Q key)**, clicking any line of that tier instantly selects the entire citywide linework on that depth plane.
 - Artists can immediately adjust line width, color tint, or opacity on the Style panel in a single click.
2. **ObjWeaver (Solid Fills): Up to 15 Native "Shared Styles" Auto-Linked & Clear Depth Shape Naming:**
 - Because Moho assigns arbitrary default shape names (such as `s1`, `s2`...) when left unassigned, each polygon shape is tagged with its corresponding depth tier name (e.g.,

<LayerName>_Depth_1_Back to Depth_5_Front). Clicking any polygon face in the viewport with the **Select Shape Tool (Q key)** instantly identifies which depth plane it belongs to.

- For styling, rather than maintaining isolated colors per face, **5 Tiers x 3 Tones (High/Mid/Shad) = Up to 15 Native Moho Shared Styles** (e.g., <LayerName>_Depth_5_Front_Shad) are automatically created and inherited across all polygon faces.
- Artists can effortlessly batch-edit colors, tints, or opacity for thousands of building surfaces simply by selecting any of the 15 styles in the Style panel.

3. Native Point Groups (M_Mesh:AddGroup / G Key):

- Points belonging to each tier are also registered into Moho's native Point Groups.
- Artists can select all points of a specific tier at once via the Groups palette or **Select Points (G key)** for batch point manipulation.

4.6.3 Coexistence with Dynamic Hatching & Shading

The Depth Tiers architecture operates orthogonally to the Dynamic Hatching and Cel Shading engines:

- Hatching line width variation (highlight tapering to shadow boldness) and cel shading tone alpha remain completely intact.
- Depth Tiers simply partition the resulting vector geometry into depth-sorted shape buckets, giving animators full creative freedom over aerial perspective, atmospheric fading, and depth-of-field effects without flattening surface shading detail.

Part 5: The 6 Vector Generation Modes (Workflow Guide)

Both tools share a standardized 6-mode workflow selection in their dialogs:

Workflow Mode Selection:

- (*) 1. Current Frame (1 Still Vector Layer) [Top / Default]
- () 2. Single Angle Turn Rig (Custom Angle to Single Layer)
- () 3. 180 deg Turntable Rig (Sweep Animation)
- () 4. Face Multi-Angle Rig (Top / Bottom / Left / Right / Diagonal Grid)
- () 5. Timeline Keyframes Rig (Bake All 3D Keys)
- () 6. Step Bake (F by F Switch: Stepped Frame-by-Frame)

5.0 Geometric Projection Engines: Why Modes [1 & 6] Differ from Modes [2 to 5]

The Weaver architecture deliberately separates its geometry engine into **Perspective Projection** and **Orthographic Projection** based on production intent:

Role Distribution Matrix across All Modes (Modes 1 to 6)

Mode Number & Name	Projection Engine	Primary Production Role	Mathematical & Architectural Rationale
Mode 1 Current Frame	Perspective (Camera 1:1 Match)	Layout Guides, Animatics, Layout Underlays	Must align 100% pixel-for-pixel with the 3D model through the active camera lens (zero tweening risk as it is a single still frame).
Mode 2 Single Angle Turn	Orthographic (Rigging Projection)	Single-Turn Smart Bone Rig	Prevents perspective morph distortion (ballooning artifacts) during Switch tweening, maintaining rigid body rotation.
Mode 3 180° Turntable	Orthographic (Rigging Projection)	180° Horizontal/Vertical Sweep Rig	Same as above. Parts must not warp or distort in size when sweeping across angles.
Mode 4 Face Multi-Angle	Orthographic (Rigging Projection)	All-Direction Multi-Angle Facial Rig	Same as above. Preserves facial component proportions across all 13 diagonal and orthogonal interpolation targets.
Mode 5 Timeline Keyframes	Orthographic (Transform Synchronized)	2.5D Morphing across 3D Keyframe Poses	Orthographic base topology ensures smooth tweening, while Moho layer transform (fTranslation , fRotation , fScale) synchronizes in 3D space.
Mode 6 Step Bake	Perspective (Camera Dynamic Occlusion)	Dynamic Camera Work / Action Sequences	Frame-by-frame stepped playback (no tweening). 100% accurate camera perspective is mandatory for dynamic cinematic shots.

Why Modes [1 & 6] Must Use Perspective while [2 to 5] Must NOT Bake Camera Perspective

1. Why Modes 1 & 6 MUST use Perspective:

- In layout drawings (Mode 1) and fast-cut action scenes (Mode 6), the animator's goal is **exact spatial replication of what the camera sees**. If a telephoto or wide-angle lens is used, foreshortening must be faithfully captured on the vector layer.

2. Three Core Reasons Why Modes 2 to 5 MUST NOT Bake Camera Perspective into Rig Geometry:

- **Reason 1: Prevention of "Balloon Morphing"**: In Moho Switch interpolation, points travel along linear vectors between sub-layers. If perspective foreshortening is baked directly into the point coordinates, rotating from front to 3/4 causes the nose and ears to balloon outward unrealistically during the in-between frames.
- **Reason 2: Rig Reusability**: A character head rig generated in Mode 4 must be freely movable anywhere on screen (left stage, right stage, background). If camera perspective is baked into the mesh, moving the character across the stage causes the perspective distortion to clash with its new screen position.

- **Reason 3: Separation of Orthographic Rigging and Moho 3D Space:** In Moho, the correct way to animate a 2.5D rig is to let the **rig maintain clean orthographic geometry**, while Moho's 3D layer space (`fTranslation.z` and camera lens) handles the optical perspective naturally.
-

5.1 Mode 1: Current Frame (Still Vector Layer, 0.3s)

- Outputs a single vector layer capturing the 3D model's exact pose at the active timeline frame.
- Applies `SetImmuneToCamera(true)` to lock 1:1 alignment with the viewport camera.

5.2 Mode 2: Single Angle Turn Rig (Custom Angle Smart Bone Ready)

- Generates a 2-pose Switch layer (`Angle_000_Center` o `Angle_Custom`).
- Bakes keyframes at Frame 1 and Frame 25, ready to be controlled by a single Smart Bone dial.

5.3 Mode 3: 180 deg Turntable Rig (Horizontal / Vertical Sweep)

- Bakes a complete 180° turnaround in 30° or 45° steps (e.g., `-90°` to `+90°`).
- Supports both Horizontal (Yaw) and Vertical (Pitch) sweeps.

5.4 Mode 4: Face Multi-Angle Rig (13-Angle Multi-Direction Grid)

- Generates 13 angle sub-layers covering Center, Left/Right/Up/Down (30°, 60°, 80°), and 4 diagonal vectors.
- Creates the ultimate base rig for full 2.5D multi-angle facial turns.

5.5 Mode 5: Timeline Keyframes Rig (Auto-Bakes Existing 3D Keyframe Poses & Point Keys)

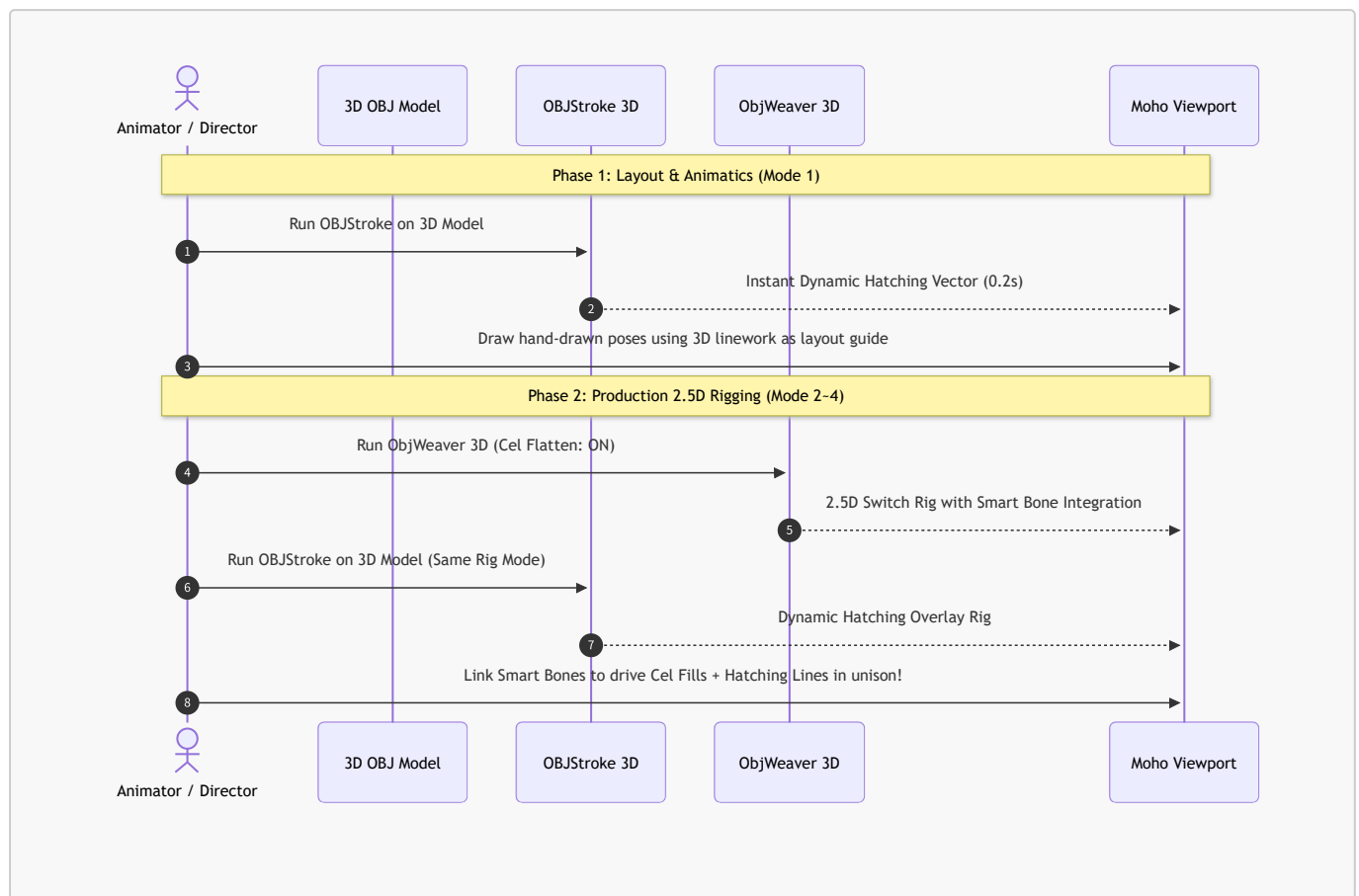
- **Automatic Keyframe Scan:** Automatically scans all translation, rotation, and scale keyframes (`fTranslation`, `fRotation`, `fScale`) on the 3D model layer (e.g., Frames 0, 12, 36).
- **1:1 Strict Scale Preservation (No Enlargement):** Bypasses screen-fitting scaling (`scaleFactor = 1.0`), ensuring the vector geometry matches the 3D model size with 100% precision without double-scaling issues.
- **Two Major Output Formats (Point Keys vs Switch Layer):**
 - **Point Keys (1-Layer Vector) [Recommended / Default]:** Does NOT use a SwitchLayer. Generates a **single VectorLayer** and directly bakes keyframes onto the native point position channel (`fAnimPos`) and stroke width channel (`fWidth`).
 - **Ultra Lightweight:** Zero sub-layer clutter; minimal file size and viewport rendering overhead.
 - **Native Moho Easing & Graph Editor:** Full access to Bezier curves, Ease-in/out, Bounce, and custom interpolation directly on the timeline.
 - **Sculpt & Direct Retouching:** Modify individual keyframe poses using Moho's Point and Magnet tools.
 - **Smart Bone Direct Binding:** Perfect for rigging custom head/body turns directly inside Smart Bone actions.
 - **Switch (Multi-Layer Rig):** Traditional SwitchLayer architecture. Generates individual sub-layers for each keyframe pose and switches/interpolates between them.

5.6 Mode 6: Step Bake (F by F Switch: Stepped Frame-by-Frame Occlusion-Free)

- **Overview:** Bakes a specified timeline range (**Start** to **End**) at custom intervals (**Step**: 1s, 2s, 3s) into individual vector frames with full camera perspective and dynamic occlusion culling. Sub-layer interpolation is explicitly disabled (**SetInterpMode(false)**), providing pure stepped anime playback.
- **Parameters:**
 - **Step:** Frame interval (e.g., **1** = full animation, **2** = on 2s, **3** = on 3s).
 - **Start / End:** Timeline frame range to bake.
- **[Latest Update: 1:1 Camera Perspective Synchronization] :**
 - Calculates true camera-to-layer distance (**layerDist**) frame-by-frame and applies optical **scaleCorrection**, ensuring **100% 1:1 overlay precision for standard-scale, non-rotated 3D models (e.g., Anvil)** without ballooning magnification or inverted backface artifacts.
- **[Latest Update: 3-Tier Toon Cel Shading (Highlight / Mid / Shadow)] :**
 - Dynamically samples surface light angles across all visible front faces, sorting them into **Shadow (bottom 35%), Highlight (top 20%),** and **Mid (balanced center)**. Delivers crisp, anime-style three-tone cel shading across every frame.
- **[Latest Update: 4 Native Shared Styles with 1-Click Universal Sync] :**
 - Automatically creates and links four shared styles in Moho's Style palette:
 - **<LayerName>_StepBake_High** (Highlight faces)
 - **<LayerName>_StepBake_Mid** (Mid-tone faces)
 - **<LayerName>_StepBake_Shad** (Shadow faces)
 - **<LayerName>_StepBake_Edges** (Crease & Silhouette line strokes)
 - **Adjust shadow colors, highlights, or stroke widths across all baked frames in a single click from Moho's Style palette!**
- **[Latest Update: Edge-Only Safe Point Grouping] :**
 - Prevents solid occlusion mask points from interfering with linework editing. Only visible outline/crease strokes (Pass B) are assigned to point groups (**Edges / Edges_Depth_X**), allowing immediate selection and manipulation via the **G** key.
- **[TIPS: Sharp Line Edges & Hand-Drawn "Pen-Break" Aesthetics] :**
 - To maximize mechanical crispness and sharp silhouette angles, default line widths are calibrated finely. Slight grazing-angle seams may occasionally appear; in commercial anime production, this functions as an organic **hand-drawn pen-line break (stylistic breathing space)**.
 - If airtight sealing is required, simply increase the stroke width of **<LayerName>_StepBake_Edges** in Moho's Style palette (e.g., to **2.5px ~ 3.0px**) to seal all seams across every frame instantly.
- **⚠ [Crucial Production Premise: Clean-Up Base Material, Not Final Artwork]:**
 - Step Bake is not intended to produce finished line art in a single click. Because it projects raw geometric 3D edges, internal intersecting lines and background fills remain.
 - **Recommended Production Workflow:**
 1. Run Step Bake to produce stepped vector sequences that track fast-action 3D camera moves with 100% mathematical perspective fidelity.
 2. Open each baked frame and use the Eraser or Hide Edge tool to delete unwanted strokes and trim fills (clean-up phase).
 3. Add hand-drawn character details, wrinkles, and secondary animation over the clean-up base.
 - Step Bake serves as an **invaluable foundation tool that saves dozens of hours of perspective construction**, giving animators a rock-solid anatomical underlay to clean up and polish.

Part 6: Production Pipeline & Hybrid Workflow

6.1 Production Flowchart



6.2 Smart Bone Integration (Dial-Driven Turn Rigs)

1. After generating a Switch Rig (Modes 2~4), create a Bone Layer parent.
2. Add a Smart Bone dial (e.g., **Head_Turn**).
3. In the Smart Bone action window, scrub through the Switch Layer sub-layers.
4. Because all sub-layers share identical topology with `SetInterpMode(true)` active, rotating the Smart Bone dial drives a **seamless, organic 2.5D vector turn** in real-time.

6.3 Organic Synergy across the Entire Weaver Pipeline

- **MeshWeaver:** Use **Switch To Mesh (Shift+W)** to generate auto-triangulated deformation meshes across all generated vector sub-layers.
- **FoldWeaver:** Align 2D vector parts to 3D surfaces with camera projection markers.
- **LayerWeaver:** Rapidly import layered PSD character designs and bind them with 3D-generated turnaround guides.

6.4 Advanced Techniques: Blending 3D Meshes (Patterns & Textures) and Moho Native Retouching

The true superpower of this pipeline is that output assets are not static 3D renders, but **fully native Moho vector layers**. This unlocks two production-grade workflows:

1. 3D OBJ Blending (Automated 3D Vector Textures, Decals & Typography)

- **Technique:**

In addition to the main model, model interior patterns, mechanical panel lines, signboards, logos, or text as polygonal geometry (thin flat planes or line meshes) and export them blended into the OBJ file.

- **Benefits:**

Eliminates the tedious process of drawing decals frame-by-frame in perspective. Patterns and typography automatically follow 3D rotation and Switch Tweening with 100% geometric accuracy.

- **Granular Control:**

Using Depth Tiers or Moho's Select Shape Tool (**Q** key), animators can isolate typography or pattern shapes in a single click to assign custom styles, colors, or line widths independently.

2. Moho Native Vector Retouching (Direct Control over Shading Density & Dynamic Silhouette)

- **Intuitive Shading & Hatching Contrast:**

After generation, use Moho's native **Line Width Tool (W key)** to click-drag shading points, thickening shadow edges or thinning out highlight contours with the nuance of an animation director's pen.

- **Stylized Perspective Distortion & Silhouette Tweaks:**

To break mechanical 3D rigidity, use the Transform Points tool to dynamically exaggerate foreground limbs or tweak silhouette contours, infusing stylized animation charm directly inside Moho.

Part 7: Troubleshooting & FAQ

Q1. Why does the vector layer align 100% with the 3D model without unwanted keys?

- **A:** The engine initializes vector curves directly at the 3D model's world position, avoiding unnecessary keyframe clutter on Frame 0 and preserving absolute transform integrity.

Q2. What if unfinished residue layers remain from cancelled runs?

- **A:** If a script run is interrupted, delete any loose vector layers outside the switch group using Moho's Layers palette trash icon.

Q3. How do I adjust line width and hatching contrast for different model types?

- **A:**
 - **Before Running:** Adjust **Stroke Width (px)** (Default: 4.0px) and **Hatching Contrast (x)** (Default: 5.0x) in the dialog:
 - *Boxy models (Cityscapes, Buildings):* Set Contrast to **2.5x** for uniform, solid outlines.
 - *Standard characters & props:* Set Contrast to **5.0x** for natural G-pen line variation.
 - *Dense curved meshes (Anvil, sculptures):* Set Contrast to **10.0x ~ 15.0x** so highlight lines taper down to fine hairlines, preventing crowded polygon grids from merging into blobs.
 - **After Running:** Select the vector layer and use Moho's native **Line Width Tool (W key)** or the Style Panel.

Q4. Why are there no seam gaps or holes at sharp grazing edges with Cel Flattening?

- **A:** The combination of Back-to-Front Painter's algorithm, Seam-Sealing base strokes, and Grazing-Angle dynamic stroke boosting (up to 2.5x) guarantees completely airtight vector silhouettes.

Q5. Can I add hand-drawn vector artwork without mixing up 3D shapes?

- **A:** Yes! Every shape generated is automatically tagged with the 3D layer's name as its **Shape Name (Group Name)**. You can easily isolate or batch-edit them via Moho's Select Shape Tool (Q key).

Q6. Does Point Reduction cause gaps between polygons?

- **A:** No. Point Reduction applies adaptive spatial snap and coplanar clustering, and Seam-Sealing Base Strokes ensure all polygon boundaries remain firmly closed.

Q7. Why do Modes 1 & 6 use Perspective while Modes 2 to 5 use Orthographic projection?

- **A:** Modes 1 and 6 capture single-frame layouts and cinematic action where camera optical distortion must be matched 1:1. Modes 2 to 5 build reusable, interpolatable rigging assets where baked camera perspective would cause balloon-like warping artifacts during Switch tweening.

Q8. Why does the model shrink or rotate in the wrong direction during rotation animations?

- **A:** This occurs because Moho's vertex tweening calculates linear (shortest-distance) interpolation in 2D space. Adding intermediate in-between keyframes completely resolves this.
 - **Cause of the Phenomenon:**
 - Moho's Switch Layer interpolation and vector point animation move vertices along **straight 2D linear vectors** between starting and ending poses.
 - When rotating across large angles (e.g., 0° to 90° or 180°), points travel straight through the model's center rather than along an arc in 3D space, causing the model to **shrink/flatten in the middle** or appear to flip in the wrong rotation direction.
 - **Solution (Adding In-Between Keys):**
 - 1. Add Intermediate Keyframes on Timeline:**
Avoid tweening large rotation angles in a single span. **Add 1 or 2 in-between keyframe poses** at midpoints (e.g., at 45°). Approximating the circular trajectory with segmented linear moves prevents shrinking and maintains consistent volume and rotation direction.
 - 2. Recommended Generation Settings (Use 30° Step):**
When generating Turntable (Mode 3) or Facial Multi-Angle (Mode 4) rigs in ObjWeaver / OBJStroke, choose **30° Step (Recommended)** rather than 45°. Finer angular steps ensure natural, smooth tweening without shrinkage or flip artifacts.

Q9. Why does increasing the number of Switch angles in OBJStroke result in more points than Mode 1?

- **A:** To maintain 100% identical topology across all Switch Layers for smooth Switch Tweening, the engine generates the "union" of all visible edges across all requested angles.
 - **Mode 1 (Single Angle):** Only generates visible front edges from a single angle (~30-40% of the model), which is the most lightweight.
 - **Multiple Angles (Switch Layer):** Edges required for profile and rear angles are added to the shared base mesh. Back-facing edges on each layer are hidden via zero line width and opacity (0.0), but the vertices remain in the data structure to preserve interpolation compatibility.

- *Tip:* If point counts grow on full 360° turntables, use **[Merge & Optimize]** in the dialog to decimate the base mesh safely.

Q10. Can I blend decals, interior patterns, and text into the 3D model, and adjust shading/scale in Moho afterward?

- **A: Yes, absolutely! That is the core advantage of outputting native Moho vector meshes rather than raster renders.**
 - **3D Decals & Typography:** Model patterns, logos, or typography as polygonal geometry in your OBJ. They convert into vector strokes that rotate and tween in perfect 3D perspective. Use Select Shape Tool (**Q** key) to isolate and recolor text independently.
 - **Native Retouching:** After generation, use the Line Width Tool (**W** key) to intuitively sculpt shading density and contour thickness, or use Transform Points to add animated perspective exaggeration.
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Part 8: Credits & Software License

Credits

- **Product:** Weaver Series — ObjWeaver 3D & OBJStroke
- **Developer:** Sentaku Clip
- **Contact:** info@sentakuclip.net
- **Target Software:** Moho Pro 12.5 and higher (Moho 12 / 13 / 14+ Fully Supported)

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