

NirtsCAD User Manual

Version 1.8 | WebGL-based 2D/3D CAD Application

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Overview

NirtsCAD is a browser-based 2D/3D Computer-Aided Design (CAD) application built entirely with WebGL. It provides a command-line driven interface similar to AutoCAD, supporting:

- **Vector drawing** (lines, arcs, circles, polylines, text, hatches)
- **Dimensioning** (linear, aligned, angular, leader dimensions)
- **Editing operations** (move, copy, rotate, scale, mirror, trim, extend, offset, fillet, chamfer, break, stretch, array)
- **DXF Import/Export** (AutoCAD interchange format)
- **3D Visualization** (orthographic and perspective 3D views, thickness extrusion, shaded mode)
- **Layer management**
- **Object snap (OSNAP)** and **Ortho mode**
- **Color selection** (AutoCAD Color Index or RGB)
- **Undo/Redo** with unlimited history

Key Features

- **No installation required** — runs directly in modern web browsers
- **Command-line interface** — familiar AutoCAD-style command syntax
- **Real-time rendering** — hardware-accelerated WebGL graphics
- **Cross-platform** — works on Windows, macOS, Linux
- **Offline capable** — after initial load, works without internet connection

Getting Started

System Requirements

- **Browser:** Chrome 90+, Firefox 88+, Edge 90+, Safari 14+ (with WebGL 1.0 support)
- **Display:** Minimum 1024×768 resolution
- **Input:** Mouse or trackpad (recommended: mouse with scroll wheel)

Opening the Application

1. Open `index.html` in a modern web browser
2. The application loads with an empty drawing canvas and command prompt at the bottom
3. Start drawing by typing commands or clicking menu items

First Steps

1. **Draw a line:** Type `LINE` (or `L`) and press `Enter`, then click two points on the canvas
2. **Zoom extents:** Type `ZOOM` → `E` (or press `Ctrl+E`) to fit all entities
3. **Save your work:** File menu → Save (saves as `.json` project file)

User Interface

Layout

[File] [Draw] [Dimension] [Edit] [View] [Settings]	← Menu Bar
Drawing Canvas (Click to draw)	← WebGL Canvas
Command: _	← Command Input
> Specify first point...	← Prompt/Log
[Layer Controls] [Color Picker] [Settings Panel]	← Side Panel

Command Input

- **Location:** Bottom of screen

- **Usage:** Type commands and press **Enter** or **Space**
- **Examples:** LINE, CIRCLE, TRIM, ZOOM E
- **Tips:**
 - Commands are case-insensitive
 - Most commands have short aliases (e.g., L for LINE, C for CIRCLE)
 - Press **Esc** to cancel current command

Canvas Interaction

- **Left Click:** Select points, pick entities
- **Right Click:** Confirm/Finish command (e.g., end polyline)
- **Scroll Wheel:** Zoom in/out
- **Middle Button Drag** (or **Shift+Left Drag**): Pan view
- **Mouse Move:** Preview rubber-band geometry

Drawing Commands

LINE (Aliases: L)

Draws a straight line between two points.

Usage: 1. Type LINE or L 2. Click first point (or type coordinates: x,y or x,y,z) 3. Click second point 4. Command ends automatically

Example:

Command: L

Specify start point: [click point 1]

Specify end point: [click point 2]

Tips: - Hold **F8** for Ortho mode (constrains to horizontal/vertical) - Use Object Snap to connect to existing endpoints

POLYLINE (Aliases: PL, PLINE)

Draws connected line and arc segments with optional width.

Usage: 1. Type PLINE or PL 2. Click start point 3. Click subsequent points 4.

Options during drawing: - **A** = Switch to Arc mode - **L** = Switch to Line mode - **Q** = Quadratic curve mode - **C** = Close (connects back to start point)

- **U** = Undo last segment - **W** = Set width for next segment 5. Press **Enter** or **Right-Click** to finish

Example:

Command: PL

Specify start point: [click point 1]

Specify next point (A=arc, L=line, C=close, U=undo, W=width): [click point 2]
Specify next point: [click point 3]
Specify next point: [Enter to finish]

Width Settings:

Specify next point: W
Starting width <0.000>: 0.5
Ending width <0.500>: 1.0
Specify next point: [click to draw tapered segment]

CIRCLE (Aliases: C)

Draws a circle by center point and radius.

Usage: 1. Type CIRCLE or C 2. Click center point 3. Click point on circumference (or type radius: R 5.5)

Example:

Command: C
Specify center point: [click center]
Specify point on circle (or type radius): [click perimeter point]

Radius Input:

Specify point on circle: R 10

ARC Commands

NirtsCAD supports 5 arc creation methods:

1. **ARC / 3PARC (3 Points)** Draws arc through 3 points.

Command: ARC
Specify start point: [point 1]
Specify second point: [point 2]
Specify end point: [point 3]

2. **CSEARC (Center-Start-End)** Arc by center, start point, end point.

Command: CSEARC
Specify center point: [center]
Specify start point: [start]
Specify end point: [end]

3. CSARC (Center-Start-Angle) Arc by center, start point, included angle.

Command: CSARC
Specify center point: [center]
Specify start point: [start]
Specify included angle (degrees): 90

4. SERARC (Start-End-Radius) Arc by start, end, radius.

Command: SERARC
Specify start point: [start]
Specify end point: [end]
Specify radius: 5

5. SEAARC (Start-End-Angle) Arc by start, end, included angle.

Command: SEAARC
Specify start point: [start]
Specify end point: [end]
Specify included angle (degrees): 45

TEXT (Aliases: T)

Places single-line text at a specified location.

Usage: 1. Type TEXT or T 2. Click insertion point 3. Enter text height (or press Enter for default) 4. Enter rotation angle in degrees (or press Enter for 0°) 5. Type text content 6. Press **Enter** to place text

Example:

Command: T
Specify insertion point: [click location]
Specify height <2.500>: 5
Specify rotation angle (deg) <0.000>: 0
Enter text: Hello World

HATCH (Aliases: H)

Fills a closed boundary with a pattern.

Usage: 1. Type HATCH or H 2. **Choose pattern mode:** - **U** = User-defined (specify angle and spacing) - **D** = Predefined pattern (from library) 3. **For user-defined:** - Enter angle (degrees) - Enter spacing 4. **For predefined:** - Type HATCHLIST to browse patterns - Or directly enter pattern name 5. Set

scale 6. Click points to define boundary (or type **S** to select entities) 7. Preview hatch, press **Enter** to confirm

Example (User-defined):

```
Command: H
HATCH mode: [U] user-defined (angle+spacing) or [D] defined/library pattern: U
Specify angle (degrees) <45.000>: 0
Specify spacing <1.000>: 2
Specify scale <1.000>: 1
Pick boundary points (or S=select entity): [click inside closed area]
[Preview shown]
Press Enter to confirm or pick more boundary points: [Enter]
```

Example (Predefined):

```
Command: H
HATCH mode: U or D: D
Type pattern name or HATCHLIST: HATCHLIST
[Modal opens, select pattern like "ANSI31"]
Specify scale <1.000>: 1.5
Pick boundary points: [click inside area]
```

Supported Patterns: ANSI31, ANSI32, ANSI33, ANSI34, ANSI35, ANSI36, ANSI37, ANSI38, AR-B816, AR-CONC, BRASS, BRICK, BRSTONE, CLAY, CORK, CROSS, DASH, DOTS, EARTH, ESCHER, FLEX, GRASS, GRATE, HONEY, HOUND, LINE, MUDST, NET, NET3, PLAST, PLASTI, SACNCR, SQUARE, STARS, STEEL, SWAMP, TRANS, TRIANG, ZIGZAG

Editing Commands

Selection Methods

For all editing commands, you'll be prompted to select entities: - **Click on entity** to select it (entity highlights in yellow) - **Click again** on selected entity to deselect - **Window selection:** Click-drag to create selection rectangle - **Left-to-right** (blue): Entities fully inside window - **Right-to-left** (green): Entities crossing or inside window - Press **Enter** or **Right-Click** when selection is complete

ERASE (Aliases: E)

Deletes selected entities.

Usage: 1. Type ERASE or E 2. Select entities to delete 3. Press **Enter** to confirm deletion

MOVE (Aliases: M)

Moves selected entities from base point to destination.

Usage: 1. Type MOVE or M 2. Select entities 3. Click base point (reference point)
4. Click destination point (or type displacement: @10,5 for relative offset)

Example:

Command: M

Select objects: [select entities, press Enter]

Specify base point: [click reference point]

Specify second point (displacement): [click destination]

COPY (Aliases: CO, CP)

Copies selected entities to a new location.

Usage: 1. Type COPY or CO 2. Select entities 3. Click base point 4. Click destination point (can place multiple copies, press Enter when done)

ROTATE (Aliases: RO)

Rotates selected entities around a base point.

Usage: 1. Type ROTATE or RO 2. Select entities 3. Click base point (center of rotation) 4. **Two methods:** - **Type angle:** Enter rotation angle in degrees (e.g., 90 for 90° counter-clockwise) - **Two points:** Click second point to define angle

Example:

Command: RO

Select objects: [select, press Enter]

Specify base point: [click center]

Specify rotation angle (or second point): 45

SCALE (Aliases: SC)

Scales selected entities relative to a base point.

Usage: 1. Type SCALE or SC 2. Select entities 3. Click base point (stays fixed during scaling) 4. **Two methods:** - **Type factor:** Enter scale factor (e.g., 2

= double size, 0.5 = half size) - **Reference:** Click two points to define original length, then click target length

Example:

Command: SC
Select objects: [select, press Enter]
Specify base point: [click]
Specify scale factor or [R]eference: 1.5

MIRROR (Aliases: MI)

Mirrors selected entities across a line.

Usage: 1. Type MIRROR or MI 2. Select entities 3. Click first point of mirror line 4. Click second point of mirror line 5. **Erase source?:** Type Y to delete originals, N to keep both

Example:

Command: MI
Select objects: [select, press Enter]
Specify first point of mirror line: [point 1]
Specify second point of mirror line: [point 2]
Erase source objects? [Y/N]: N

OFFSET (Aliases: O)

Creates parallel copy of line, arc, circle, or polyline at specified distance.

Usage: 1. Type OFFSET or O 2. Enter offset distance (or click two points to measure) 3. Select entity to offset 4. Click on side to offset towards 5. Repeat for more offsets, or press **Esc** to exit

Example:

Command: O
Specify offset distance: 5
Select entity to offset: [click line]
Specify point on side to offset: [click left or right of line]
Select entity to offset: [select another or Esc]

TRIM (Aliases: TR)

Trims entities to cutting edges.

Usage: 1. Type TRIM or TR 2. Select cutting edges (entities that define trim boundaries) 3. Press **Enter** to confirm cutting edges 4. Click on portions of entities to trim away 5. Press **Enter** or **Esc** to finish

Example:

Command: TR

Select cutting edges (Enter when done): [select lines, press Enter]

Select entity to trim (or shift-select to extend): [click portion to remove]

Tips: - Hold **Shift** while clicking to **Extend** instead of trim - Works on lines, arcs, circles, polylines

EXTEND (Aliases: EX)

Extends entities to boundary edges.

Usage: 1. Type EXTEND or EX 2. Select boundary edges 3. Press **Enter** 4. Click on entities to extend (click near the end to extend) 5. Press **Enter** or **Esc** to finish

FILLET (Aliases: F)

Rounds corners by creating tangent arc between two lines, arcs, or circles.

Usage: 1. Type FILLET or F 2. **Set radius:** Type R then enter radius value 3. Select first entity 4. Select second entity 5. Fillet is created automatically

Example:

Command: F

Specify fillet radius <0.000>: R

Enter radius: 2.5

Select first line or arc: [click entity 1]

Select second line or arc: [click entity 2]

Tips: - Radius 0 creates sharp corner (extends/trims to intersection) - Works with lines, arcs, circles

CHAMFER (Aliases: CH)

Bevels corners with angled line.

Usage: 1. Type CHAMFER or CH 2. **Set distances:** - Type D1 then enter first distance - Type D2 then enter second distance (or Enter to use same as D1) 3. Select first entity 4. Select second entity

Example:

```
Command: CH
Specify first chamfer distance <0.000>: D1
Enter distance: 3
Specify second chamfer distance <3.000>: D2
Enter distance: 2
Select first line: [click line 1]
Select second line: [click line 2]
```

BREAK (Aliases: BR)

Breaks a single entity into two pieces at specified points.

Usage: 1. Type **BREAK** or **BR** 2. Select entity to break 3. Click first break point on the entity 4. Click second break point 5. The segment between points is removed

STRETCH (Aliases: S)

Moves selected vertices while keeping connected segments attached.

Usage: 1. Type **STRETCH** or **S** 2. Select entities (use crossing window for best results) 3. Press **Enter** 4. Click base point 5. Click destination point (or type displacement)

Tips: - Only vertices inside/crossing selection window are moved - Connected geometry outside window stays anchored

ARRAY (Aliases: ARR)

Creates rectangular or polar (circular) pattern of entities.

Usage: 1. Type **ARRAY** or **ARR** 2. Select entities to array 3. Press **Enter** 4. **Choose type:** - **R** = Rectangular array (rows and columns) - **P** = Polar array (circular pattern)

Rectangular Array:

```
Command: ARR
Select objects: [select, press Enter]
Array type [R]ectangular or [P]olar: R
Number of rows: 3
Number of columns: 4
Distance between rows: 10
```

Distance between columns: 15

Polar Array:

Array type: P
Specify center point: [click center]
Number of items: 8
Angle to fill (360=full circle): 360
Rotate items? [Y/N]: Y

PEDIT (Aliases: PE)

Edits polylines (add/remove vertices, join separate segments).

Usage: 1. Type PEDIT or PE 2. Select polyline 3. **Choose operation:** - **J** = Join additional entities to polyline - **O** = Open (remove closing segment) - **C** = Close polyline - **X** = Exit

Example (Join):

Command: PE
Select polyline: [select existing polyline]
Enter option [J]oin [O]pen [C]lose e[X]it: J
Select entities to join: [select lines/arcs to add]
[Press Enter when done]

Dimension Commands

DIM (Aliases: D)

Creates linear or aligned dimensions.

Usage: 1. Type DIM or D 2. Click first extension line origin (point to measure from) 3. Click second extension line origin (point to measure to) 4. Click dimension line location (where dimension text appears)

Example:

Command: D
Specify first extension line origin: [click point 1]
Specify second extension line origin: [click point 2]
Specify dimension line location: [click above/below measured line]

Behavior: - If dimension line is perpendicular to measured line → **Aligned dimension** - If dimension line is horizontal/vertical → **Linear dimension** - Dimension automatically calculates distance and shows value

DIMLEA (Aliases: DIMLEADER, LEADER, MLEADER)

Creates dimension leader (arrow pointing to feature with text label).

Usage: 1. Type DIMLEA 2. Click first point (arrow location) 3. Click subsequent points for leader line 4. Click final text location 5. Enter dimension text (e.g., “#12@100”, “Ø50mm”) 6. Press **Enter** to place

Example:

```
Command: DIMLEA
Specify first point (arrow): [click feature]
Specify next point: [click to route leader]
Specify text location: [click where text goes]
Enter dimension text: Ø25 THRU HOLE
```

Angular Dimension

Creates angle measurement between two lines.

Usage: 1. Type DIM or D 2. **Instead of clicking points**, type option during prompt: - After first point prompt, if you select two lines, it switches to angular mode 3. Click vertex (angle center) 4. Click first direction line 5. Click second direction line 6. Click dimension arc location

Dimension Settings

Adjust dimension appearance with these settings commands:

DIMTXT (Aliases: DTXT) Sets dimension text height.

```
Command: DIMTXT
Enter dimension text height <2.500>: 3.5
```

DIMSCALE (Aliases: DSCALE, DS) Scales all dimension elements (text, arrows, spacing).

```
Command: DIMSCALE
Enter dimension scale factor <1.000>: 2.0
```

DIMASZ (Aliases: DASZ) Sets arrowhead size.

```
Command: DIMASZ
Enter arrowhead size <0.180>: 0.25
```

DIMDEC (Aliases: DD) Sets decimal precision (0-8 decimal places).

Command: DIMDEC

Enter decimal places (0-8) <2>: 3

View Commands

ZOOM (Aliases: Z)

Controls view magnification.

Usage: 1. Type ZOOM or Z 2. **Options:** - **E** = Extents (fit all entities) - **W** = Window (click two corners to zoom area) - **Type number** = Scale factor (e.g., 2 = 2× zoom, 0.5 = 50% zoom) - **Click two points** = Define zoom window

Examples:

Command: Z E # Zoom to fit all

Command: Z W # Window zoom (click corners)

Command: Z # Manual window (click corners)

Command: ZOOM 2 # Zoom in 2×

Shortcut: Ctrl+E = Zoom Extents

PAN (Aliases: P)

Moves the view without zooming.

Usage: 1. Type PAN or P 2. Click and drag to pan 3. Or use **Middle Mouse Button** / **Shift+Left-Drag** anytime

3D View Modes

2D Top View

Command: 3D view off (type in command or View menu → 2D Top View)

Standard orthographic top-down view.

3D Orbit View

Command: (View menu → 3D Orbit View)

Perspective 3D view. Drag canvas to orbit camera.

3D Ortho View

Command: (View menu → 3D Ortho View)

Orthographic 3D projection (parallel lines, no perspective).

3D Controls (in 3D mode): - **Left-Drag**: Orbit camera - **Scroll**: Zoom - **Middle/Shift+Left-Drag**: Pan

HIDE

Toggles hidden line removal for thick extrusions (shows depth-sorted edges).

Command: HIDE

Effect: In 3D views with thick entities (`THICKNESS > 0`), hides edges obscured by wall faces.

SHADE

Toggles shaded rendering with Blinn-Phong lighting (solid faces instead of wire-frame).

Command: SHADE

Effect: Renders entities as solid shaded surfaces. Best viewed in 3D mode.

File Operations

New Drawing

File → New (or Ctrl+N)

Clears current drawing, starts fresh document.

New Tab

File → New Tab

Opens new browser tab with blank NirtsCAD instance.

Open Project

File → Open

Opens `.json` project file (NirtsCAD native format). Preserves: - All entities - Layers - Colors - Dimension settings - Drawing elevation and thickness

Save Project

File → Save

Saves current drawing as `.json` file. This is the recommended format for working files.

Saved Data: - All entities (geometry, colors, layers) - Current layer and layer visibility states - Dimension globals (DIMTXT, DIMSCALE, DIMASZ, DIMDEC) - Elevation, thickness, hatch scale - Color picker state

Import DXF

File → Import DXF

Imports AutoCAD DXF (R12/R2000+) file. Supports:

Entities: - LINE, CIRCLE, ARC - LWPOLYLINE, POLYLINE (with VERTEX/SEQEND) - TEXT, MTEXT - DIMENSION (linear, aligned, angular) - LEADER, MULTILEADER - HATCH (via fallback parser) - INSERT (block references) - SOLID (filled triangles/quads)

Extracted Data: - Layers - Colors (ACI color index, 24-bit true color) - Dimension variables from DXF header (\$DIMTXT, \$DIMSCALE, \$DIMASZ, \$DIMDEC) - Block definitions and transformations

Notes: - Uses `dxf-parser` library for standard entities - Custom fallback parser handles HATCH entities (v1.1.2 limitation) - Automatically zooms to extents after import

Export DXF

File → Export DXF

Exports current drawing to DXF R12 format. Compatible with AutoCAD and other CAD software.

Exported Data: - All geometric entities - Layers with visibility states - Colors (ACI format) - Dimension variables in header section - Text entities with rotation

Limitations: - Hatch patterns exported as line segments (pattern definition not preserved) - Thickness extrusion exported as 2D entities (not 3D solids)

Settings & Configuration

Layer Management

Layer Panel (right side of screen): - **Create layer**: Type name in input, press **Enter** - **Set current layer**: Click on layer name - **Toggle visibility**: Click eye icon next to layer - **Layer color override**: Click color swatch to set layer color (all entities on layer use this color)

Layer “0”: Default layer, always present.

Color Selection

Color Methods:

1. **RGB Picker**: Click color swatch to open browser color picker
 2. **ACI (AutoCAD Color Index)**: Select from dropdown
 - Standard colors: 1=Red, 2=Yellow, 3=Green, 4=Cyan, 5=Blue, 6=Magenta, 7=White/Black, 8=Dark Grey
 - 256 total colors matching AutoCAD palette
 3. **ByLayer**: Select “ByLayer” in ACI dropdown (entity uses layer’s color)
-

Drawing Settings

ELEVATION (Aliases: ELEV, EL) Sets default Z-coordinate for new entities.

Command: ELEVATION

Enter elevation (Z coordinate) <0.000>: 5.0

THICKNESS (Aliases: TH) Sets extrusion thickness for new 2D entities (creates 3D solids).

Command: THICKNESS

Enter thickness <0.000>: 2.5

Example: Draw a circle with thickness = 5 → creates a cylinder.

HATCHSCALE (Aliases: HSCALE, HS) Sets global scale multiplier for hatch patterns.

Command: HATCHSCALE

Enter hatch scale <1.000>: 2.0

OSNAP (Object Snap)

Toggle: Settings menu → “OSNAP” or press **F3**

Snap Modes (when enabled): - **Endpoint:** Snaps to line/arc endpoints - **Midpoint:** Snaps to segment midpoints - **Center:** Snaps to circle/arc centers - **Intersection:** Snaps to entity intersections - **Perpendicular:** Snaps perpendicular to line/arc - **Tangent:** Snaps tangent to circle/arc

Visual Feedback: Green target circle appears at snap point.

ORTHO Mode

Toggle: Settings menu → “Ortho (F8)” or press **F8**

Effect: Constrains cursor movement to horizontal or vertical relative to last point (0°, 90°, 180°, 270°).

Use Case: Drawing perpendicular walls, grids, rectangular layouts.

Advanced Features

Hatch Pattern Library

100+ Built-in Patterns: Including ANSI standards, architectural, structural, and decorative fills.

Browse Patterns:

Command: HATCHLIST

Opens modal dialog with pattern previews. Click pattern to select.

Custom Patterns: User-defined mode allows manual angle and spacing control for any linear pattern.

Block References (INSERT)

DXF import supports block inserts with: - Translation (insertion point) - Uniform scaling (X/Y scale factors) - Rotation - Nested blocks - Color override (BYBLOCK entities inherit insert color)

Note: Block editing/creation not yet implemented in UI. Import from DXF to use blocks.

3D Thickness Visualization

Entities with `THICKNESS > 0` are rendered as 3D extrusions: - **Lines** → Vertical rectangular walls - **Circles** → Cylinders - **Arcs** → Curved wall sections - **Polylines** → Complex extruded profiles

Hidden Line Removal: Enable `HIDE` mode to depth-sort edges.

Shading: Enable `SHADE` mode for solid surface rendering with lighting.

Coordinate Input

Methods:

1. **Absolute Coordinates:** `x,y` or `x,y,z`
Specify point: `10,20`
Specify point: `10,20,5`
 2. **Relative Coordinates:** `@dx,dy` or `@dx,dy,dz` (relative to last point)
Specify next point: `@5,0` # 5 units right
Specify next point: `@0,10` # 10 units up
 3. **Polar Coordinates:** `@distance<angle`
Specify next point: `@10<45` # 10 units at 45°
 4. **Distance Only:** Type number to constrain distance, move mouse to set direction
Specify next point: `15`
[Move mouse to desired direction, click]
-

Undo/Redo

Undo: - Edit menu → Undo - **Ctrl+Z** - Type `UNDO` or `U`

Redo: - Edit menu → Redo - **Ctrl+Y** - Type `REDO`

History: Unlimited undo levels (limited by browser memory).

Keyboard Shortcuts

Shortcut	Action
Esc	Cancel current command
Enter / Space	Confirm / execute command

Shortcut	Action
Right-Click	Finish command (e.g., end polyline)
Ctrl+Z	Undo
Ctrl+Y	Redo
Ctrl+E	Zoom Extents
F3	Toggle OSNAP
F8	Toggle Ortho mode
Middle-Mouse-Drag	Pan view
Scroll Wheel	Zoom in/out
Shift+Left-Drag	Pan view (alternate)

Tips & Best Practices

General Workflow

1. **Start with layers:** Create logical layers (e.g., “Walls”, “Dimensions”, “Notes”) before drawing
2. **Use OSNAP:** Enable for precise connections (F3)
3. **Save frequently:** Save as `.json` for working files
4. **Zoom Extents often:** Press Ctrl+E to see full drawing
5. **Use command aliases:** Type L instead of LINE, C instead of CIRCLE

Performance

- **Large files:** DXF import of 10,000+ entities may take several seconds
- **Zoom limits:** Stay within reasonable world coordinates (avoid extreme zoom in/out)
- **Hatch complexity:** Dense hatches (small spacing) generate many line segments

DXF Compatibility

- **Export:** Use DXF for exchanging with AutoCAD/other CAD tools
- **Import:** Tested with AutoCAD R12-R2018 DXF files
- **Colors:** Use ACI colors for best DXF compatibility
- **Dimensions:** Dimension blocks (*D# names) are auto-generated on import

Drawing Precision

- **Coordinates:** Enter exact values via keyboard for critical points
- **Osnap tolerance:** Adjusted automatically based on zoom level
- **Grid reference:** Use coordinate display (bottom-left) to verify positions

3D Modeling Tips

- **Set elevation first:** Use ELEVATION to place entities at correct Z-height
- **Thickness for extrusion:** Set THICKNESS before drawing 2D profiles
- **3D View:** Switch to 3D Orbit to verify thickness extrusions
- **Hidden lines:** Enable HIDE mode for better visualization

Troubleshooting

Problem: Entities not visible after import - **Solution:** Try ZOOM E (Ctrl+E)
— entities may be outside view

Problem: OSNAP not working - **Solution:** Press F3 to toggle OSNAP on

Problem: Can't select entities - **Solution:** Ensure you're not in a drawing command (press Esc)

Problem: Hatch pattern not showing - **Solution:** Increase hatch scale or zoom in closer

Problem: Dimension text too small/large - **Solution:** Adjust DIMTXT and DIMSCALE settings

Command Reference (Quick List)

Drawing

- LINE (L) — Line
- PLINE (PL) — Polyline
- CIRCLE (C) — Circle
- ARC — 3-point arc
- CSEARC — Center-start-end arc
- CSARC — Center-start-angle arc
- SERARC — Start-end-radius arc
- SEAARC — Start-end-angle arc
- TEXT (T) — Text
- HATCH (H) — Hatch fill

Editing

- ERASE (E) — Delete
- MOVE (M) — Move
- COPY (CO, CP) — Copy
- ROTATE (RO) — Rotate
- SCALE (SC) — Scale
- MIRROR (MI) — Mirror
- OFFSET (O) — Offset
- TRIM (TR) — Trim

- **EXTEND (EX)** — Extend
- **FILLET (F)** — Fillet (round corner)
- **CHAMFER (CH)** — Chamfer (bevel corner)
- **BREAK (BR)** — Break
- **STRETCH (S)** — Stretch
- **ARRAY (ARR)** — Rectangular/polar array
- **PEDIT (PE)** — Polyline edit

Dimensions

- **DIM (D)** — Linear/aligned dimension
- **DIMLEA** — Dimension leader

View

- **ZOOM (Z)** — Zoom (E=extents, W=window)
- **PAN (P)** — Pan view
- **HIDE** — Toggle hidden lines
- **SHADE** — Toggle shaded mode

Settings

- **ELEVATION (ELEV, EL)** — Set Z-coordinate
- **THICKNESS (TH)** — Set extrusion thickness
- **DIMTXT (DTXT)** — Dimension text height
- **DIMSCALE (DSCALE, DS)** — Dimension scale
- **DIMASZ (DASZ)** — Arrowhead size
- **DIMDEC (DD)** — Dimension decimal places
- **HATCHSCALE (HSCALE, HS)** — Hatch scale
- **HATCHLIST** — Browse hatch patterns

Utility

- **UNDO (U)** — Undo last action
- **REDO** — Redo last undone action

Repository Architecture

Core Files

- **index.html** — Application entry point, UI layout (menu bar, canvas, command input, panels)
- **app.js** — Main application logic (~18,200 lines):
 - WebGL rendering engine
 - Command interpreter and tool handlers
 - Entity management (entities array, layers)

- View transformation (zoom, pan, 3D orbit)
- Canvas event handlers (mouse, keyboard)
- Geometry generation functions
- Editing operations (trim, extend, offset, fillet, etc.)
- Dimension and hatch logic
- OSNAP and Ortho implementation
- Undo/redo stack management
- **file-io.js** — File operations:
 - `loadJsonData()` — Parses and loads `.json` project files
 - `getEntitiesForJsonSave()` — Serializes entities for JSON export
 - `saveFileAs()` — File System Access API wrapper
 - `openFile()` — File picker wrapper
- **dxf-import.js** — DXF import pipeline:
 - `loadDxfData()` — Main entry point (uses `dxf-parser` library)
 - `convertDxfEntity()` — Maps `dxf-parser` entities to internal format
 - `parseHatchEntitiesFromRawDxf()` — Fallback HATCH parser (raw text scan)
 - `parseImportedDxfHatchPairs()` — Legacy DXF group code interpreter
 - `parseDxfDimensionPairs()` — Legacy dimension parser
 - `applyInsertTransform()` — Block transformation helper
 - `dxfColorFromParsed()` — ACI/true-color converter
- **dxf-exporter.js** — DXF export:
 - `generateDXF()` — Converts entities to DXF R12 ASCII format
 - Entity-specific DXF serializers
 - Header section with dimension variables
- **aci-colors.js** — AutoCAD Color Index definitions:
 - 256-color palette (RGB mappings)
 - `aciIntToRgbNormalized()` — ACI → WebGL color conversion
- **styles.css** — UI styling (menu bar, command input, panels, glass effects)

Dependencies

External Libraries (loaded via CDN): - **dxf-parser@1.1.2** — DXF parsing (<https://github.com/gdsestimating/dxf-parser>)

No other dependencies — Pure JavaScript + WebGL 1.0.

Development Notes

Technology Stack

- **Rendering:** WebGL 1.0 (hardware-accelerated 2D/3D graphics)

- **Projection:** Custom orthographic and perspective matrices (no Three.js/Babylon.js)
- **UI:** Vanilla JavaScript, CSS3 (no framework dependencies)
- **File I/O:** File System Access API (with fallback to download/upload)

Entity Storage

Internal Format (JavaScript objects):

```
// Line entity
{
  type: 'line',
  points: [x1, y1, z1, x2, y2, z2], // Float32Array or regular array
  thickness: 0,
  color: [r, g, b, a], // Normalized 0-1
  aci: 7, // AutoCAD Color Index (null if true color)
  layer: '0'
}

// Circle entity
{
  type: 'circle',
  points: [cx, cy, cz, px, py, pz], // Center + point on circumference
  thickness: 0,
  color: [r, g, b, a],
  aci: 256,
  layer: 'Circles'
}

// Polyline entity
{
  type: 'polyline',
  vertices: [
    { x, y, z, bulge, sw, ew }, // bulge: arc curvature, sw/ew: start/end width
    { x, y, z, bulge, sw, ew },
    ...
  ],
  closed: false,
  thickness: 0,
  color: [r, g, b, a],
  aci: 3,
  layer: '0'
}

// Dimension entity
{
```

```

    type: 'dimension',
    points: [p1x, p1y, p1z, p2x, p2y, p2z], // Measured points
    dimKind: 'ALIGNED', // or 'LINEAR', 'ANGULAR'
    dimensionMeasured: 15.234,
    segments: [...], // Generated line/text entities for rendering
    dimensionGroupId: 42,
    color: [r, g, b, a],
    layer: 'Dims'
}

// Hatch entity
{
    type: 'hatch',
    hatchBoundary: { kind: 'poly', polyx: [...], polyy: [...], z: 0 },
    hatchPatternName: 'ANSI31',
    hatchSpacing: 1.0,
    hatchAngleRad: 0.7854, // 45°
    hatchPatternScale: 1.5,
    hatchPatternLines: [...], // Pattern definition
    segments: [...], // Generated line segments for rendering
    color: [r, g, b, a],
    layer: 'Hatches'
}

```

WebGL Rendering Pipeline

1. **Entity Normalization:** Convert all entities to vertex arrays
 - Lines → 2 vertices
 - Circles → Tessellated line strips (32-64 segments)
 - Arcs → Tessellated strips
 - Polylines → Process bulge (arc segments) and width (triangles)
 - Text → Rendered as canvas 2D texture, mapped to quads
 - Hatches → Pre-computed line segments
2. **Geometry Buffering:**
 - Combine all entities into single large Float32Array
 - Upload to GPU via `gl.bufferData()`
 - No instancing — all geometry batched
3. **Shader Program:**
 - **Vertex Shader:** Applies MVP matrix (Model-View-Projection)
 - **Fragment Shader:** Flat color shading (or Blinn-Phong in SHADE mode)
4. **Rendering Pass:**
 - **2D Mode:** Orthographic projection, single draw call
 - **3D Mode:** Perspective/ortho projection, depth buffer enabled
 - **HIDE Mode:** Two-pass render (invisible fill for depth, then wire-frame)

- **SHADE Mode:** Triangle fills with lighting calculations
-

Future Enhancements (Potential)

- **Spline support** (NURBS curves)
 - **Block editor** (create/modify blocks in UI)
 - **Dimension style manager** (save/load dimension presets)
 - **Advanced hatch editor** (boundary editing, pattern customization)
 - **Measurement tools** (distance, area, angle)
 - **Snap tracking** (polar tracking, object tracking)
 - **Layer properties dialog** (freeze, lock, plot style)
 - **Print/Plot** (export to PDF, print preview)
 - **External references (XREF)**
 - **Parametric constraints** (dimensional constraints, geometric relations)
 - **Sheet sets** (multi-page layouts)
 - **3D solid modeling** (extrude, revolve, Boolean operations)
-

License

NirtsCAD — WebGL CAD Application

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- Evaluation licenses available upon request - Enterprise and multi-user licenses available

Third-Party Components: - This software uses **dxf-parser** library (MIT License) for DXF file import functionality - The use of third-party components does not affect the proprietary status of this software

Browser Compatibility: - Tested on Chrome 120+, Firefox 121+, Edge 120+
- Safari 17+ (partial support, some File API limitations)

Support & Contact

For licensing, support, or inquiries, contact NIRTS at: contact@nirts.in

End of User Manual