Introduction

0

TimberCAD Toolbelt

The TimberCAD™ Toolbelt™ is a collection of abbreviated AutoCAD™ commands and macros. While some commands perform functions that could only be carried out by several AutoCAD commands, others simply shorten the number of keystrokes required to submit a command to AutoCAD. Herein lies the debate: keystrokes vs. menu picks. In brief, those who make the effort to learn keyboard commands do not then returned to relying on menus. In some cases, the sidescreen menu has been disabled, adding as much as 10% more available drawing area on the monitor. This is valuable space due to both increased production and economy of hardware.

There are hundreds of commands included in this collection. While it is not expected that you will memorize all of them, we do encourage you to visit and revisit this document. Each time you look it over, you will likely discover a handful of commands that you will find useful. The more of these you employ in your daily work, the quicker you will become. As with most skills, continued practice improves efficiency.

Since the collection is large, we have classified the commands by type. At the end of the manual, you will find appendices that include descriptions of related commands, such as layer management, and an alphabetical glossary of commands.

0.1 Toolbelt Command Categories

1. Assist
2. Construct
3. Dim
4. Draw
5. File
6. Inquiry
7. Layer
8. Modify
9. Select
10. View

Appendices

A: Toolbelt Variables
B: Compound Angles
C: AutoCAD Settings
D: Programming Tools
E: Command Glossary

The veteran AutoCAD user may notice we have added a few categories! We did this to simplify the classification of command functions. For example, Toolbelt relies heavily on AutoCAD's internal programming language, AutoLISP. There are a number of settings that control how Toolbelt AutoLISP functions handle certain conditions; the functions that control these settings are listed in Appendix D, while Appendix C contains the functions that control AutoCAD settings.

0.2 Organization of This Manual

The manual is composed of sections for each of the command categories listed above. Each category contains an alphabetical list of all the functions grouped in that particular category and a description of each command. The descriptions are not intended to replace your AutoCAD references; a simple keystroke command like ML, for example, contains no description other than the two words "Move Last" since its use is self-evident. More complex functions such as OCL have a detailed description of their operation. In other cases, command descriptions contain references to other similar commands or to sections of the manual that offer related information.

The Appendices contain more detailed explanations of the use of both TimberCAD and AutoCAD. Appendix A covers the use of AutoLISP variables in TimberCAD, and Appendix B describes the use of compound angles when designing a timber frame with TimberCAD. We strongly recommend a thorough review of the many useful functions used to control AutoCAD settings found in Appendix C. Most end-users will never need to consult Appendix D, which contains descriptions of some basic developer functions. Finally, Appendix E contains an alphabetical list of all of the Toolbelt functions.

1.0 ASSIST COMMANDS

The ASSIST category is a set of functions related to error recovery.

OP OOPS

RE REDO

U UNDO

UB UNDO BACK

UM UNDO MARK

2.0 CONSTRUCT COMMANDS

The CONSTRUCT category is a set of functions that use existing drawing entities to create new drawing entities. They consist of the following three subgroups:

2.1 COPY Commands

2.2 MIRROR Commands

2.3 OFFSET Commands

2.1 COPY Command Descriptions

A ARRAY

C COPY

CLO Clone: Creates a duplicate set of parts with no displacement. The originals can be selected by AutoCAD's Previous option at the next Select Objects: prompt.

CM Construct Midline: Creates a line between 2 user-selected lines. New line is on CL (CONSTRUCTION LINE) layer.

CP COPY Previous

CX Copy along the X-axis: User is prompted for a displacement, followed by the `Select Objects:` prompt. Entering a positive displacement copies the objects the specified distance along the X-axis in a positive direction, while a negative displacement copies the selected objects in a negative direction along the X-axis. The default displacement value is the current value of global variable **L**; the user-entered displacement becomes the new value for **L.** (See Section A.2: Common Toolbelt Variables; see also CY, CZ, and L-.)

CY Copy along the Y-axis: CY functions the same as CX except it copies along the Y-axis.

CZ Copy along the Z-axis: CZ functions the same as CX except it copies along the Z-axis.

2.2 MIRROR Command Descriptions

ALLDFIX Properly aligns all dimension text in the drawing after it has been mirrored.

DFIX Properly aligns selected dimension text after it has been mirrored.

MI MIRROR

MIL MIRROR Last

MIP MIRROR Previous

2.3 OFFSET Command Descriptions

OC Offsets to current layer: Functions very much like the standard AutoCAD OFFSET command, except the newly created entities are drawn on the current layer.

OCL Offsets to CONSTRUCTION LINE layer, CL. Functions much the same as the standard AutoCAD OFFSET command, except the newly created entities are drawn on layer CL. Refer to the ECL and LL commands in Appendix E: Command Glossary.

OF OFFSET

3.0 DIM COMMANDS

The Dimension commands are broken into three subgroups:

3.1 Dimension Draw Commands

3.2 Dimension Edit Commands

3.3 Dimension Settings Commands

3.1 Dimension Draw Command Descriptions

DAN Dimension Angular: Creates an angular dimension between two lines with coincident endpoints. First select the vertex (intersection), then pick the two lines. The dimension arc will be drawn to the point that you select on the second line, and the smaller angle (the angle less than 180 degrees) will be the angle that is dimensioned. See Appendix B: Compound Geometry for more on compound geometric measurements.

DB Dimension Baseline: Continues the last dimension from its base point.

DC Dimension Continue

DD Dimension Down: User selects a series of points for horizontal dimensioning; when finished, pressing enter causes the command to create a chained dimension string distance **H** below the selected points, as well as an overall dimension string, 2 times **H** below the first selected point. Dimension variable **H** is set by HSET (currently only available through the Frame Module). See Appendix E: TimberCAD Variables in the TimberCAD *Frame Manual.*

DDD DDIM: Dimension Dialogue Box

DH Dimension Horizontal

DL Dimension Left: Same as DD but on the left and reference is made to global variable **V** instead of **H**. Variable **V** is set by VSET (currently only available through the Frame Module). See Appendix E: TimberCAD Variables in the TimberCAD *Frame Manual.*

DR Dimension Right: Same as DD but on the right and reference is made to global variable **V** instead of h. Variable **V** is set by VSET (currently only available through the Frame Module). See Appendix E: TimberCAD Variables in the TimberCAD *Frame Manual.*

DU Dimension Up: Same as DD but dimensions are created above the selected points. Reference is made to the global variable **H**, which is set by HSET (currently only available through the Frame Module). See Appendix E: Variables in the TimberCAD *Frame Manual.*

DV Dimension Vertical

3.2 Dimension Edit Command Descriptions

DHO Dimension Hometext

DRO Dimension Rotate

DUP Dimension Update

3.3 Dimension Settings Command Descriptions

DOA Toggles value of global variable **DOA** between 1 and 0. When **DOA** is one, overall dimensions are added to DD, DU, DL, and DR. When **DOA** is 0, no overall dimension string is drawn. See Appendix E: TimberCAD Variables in the TimberCAD *Frame Manual.*

DS Dimscale

4.0 DRAW COMMANDS

The DRAW category covers functions used to create new drawing entities from scratch, as contrasted to those used to create new entities from existing ones as in the CONSTRUCT category.

4.1 DRAW Command Descriptions

ARO Draws a leader and arrow. Pick two points and enter twice for a straight arrow, or pick 2-3 points for a curved leader and arrowhead. Global variable **ASCALE** controls arrowhead size.

BH BHATCH: Boundary Hatch

CCL Creates a circle on layer CL (CONSTRUCTION LINE layer).

CI CIRCLE

DDI DDINSERT: Inserts dialog box.

DO DONUT

EDGE EDGESURF

FA 3DFACE

H HATCH

I INSERT

IN Inserts a file at 0,0, exploded. User must enter file name at keyboard.

L LINE

LC Draws a line on layer LC (LINE CENTER).

LD Draws a line on layer LD (LINE DASHED).

LH Draws a line on layer LH (LINE HIDDEN).

LL Turns on ortho and draws a line on layer CL (CONSTRUCTION LINE layer) if it exists. This layer is intended for temporary lines that can be conveniently eliminated (with caution) with the ECL command. See also OCL and CCL commands.

MIDL Draws an angle bisector on Layer CL between two user-selected lines.

PL PLINE

PO POINT

POL POLYGON

REV REVSURF

RULE RULESURF

SO SOLID

T DTEXT

TAB TABSURF

TC TEXT CENTERED

TF TEXT FIT

TM TEXT MIDDLE

5.0 FILE COMMANDS

The FILE commands consist of macros that save the current drawing. Both simple AutoCAD SAVE macros and WBLOCK macros are included.

5.1 FILE Command Descriptions

RS REDRAW and SAVE: No prompts or second chances.

SA SAVE: No prompts or second chances.

WB WBLOCK

6.0 INQUIRY COMMANDS

The INQUIRY category primarily consists of geometric measurement utilities and a handful of entity inquiries based on the AutoCAD LIST function.

The INQUIRY commands are subdivided into three major areas:

6.1 Geometric Measurements

6.2 Entity Listing

6.3 Hawkindale Angles

6.1 Geometric Measurements Command Descriptions

AN Angle command: User is prompted for 2 points. AutoCAD evaluates the angle to the coordinate system and returns an angle in decimal degrees. See also ANG.

ANG Similar to AN, except the angle is reported as projected onto the current UCS.

AR AREA

D Distance command, overall is stored in **L.**

DE Distance command between two endpoints, overall is stored in **L**.

DEN Distance along a line entity. Selecting a line returns the line's overall length. Result is stored in variable **L**.

DEP Distance from endpoint to a perpendicular, overall is stored in **L**.

DI Distance command between two intersections, overall is stored in **L**.

DIN Distance command between two insertions, overall is stored in **L**.

DIP Distance command, insertion point to perpendicular, overall is stored in **L**.

DIV DIVIDE

DNP Distance command, near to perpendicular, overall is stored in **L**.

DP Distance command, node to node, overall is stored in **L**.

DT Distance command, whereby the user provides two letters describing the point snaps, overall is stored in **L**.

ME MEASURE

ST STATUS

6.2 Entity Listing Command Descriptions

LI LIST

LIL LIST LAST

LIP LIST PREVIOUS

6.3 Hawkindale Angles

See Appendix B: Compound Geometry for a description of these angles.

7.0 LAYER COMMANDS

Layer management is one of the most important techniques you need to master in your pursuit of the highest productivity. With creativity and thoughtfulness, proper layer control can simplify editing and drawing tasks and allows for the generation of working drawings that use the original 3D model.

With so many different functions to manage layers, they need to be broken down further into subcategories, as follows:

7.1 Layer Creation Commands

7.2 Layer Freeze/Thaw Commands

7.3 Layer On/Off Commands

7.4 Viewport Layer Freeze/Thaw Commands

7.5 Set Variable **LYR** Commands

7.6 Miscellaneous Layer Commands

Also, be sure to review Appendix A: Toolbelt Variables, paying close attention to the discussion of **LYR**. In brief, **LYR** is a variable that contains a user-maintained list of layers.

7.1 LAYER Creation Commands

LAM LAYER MAKE

LAN LAYER NEW

MLA Make Layer by entering name in BxD format, MLA automatically builds the color. See the discussions of layering and the BxD convention in the TimberCAD *Frame Manual.*

NLA New Layer by entering name in BxD format, NLA automatically builds the color. See the discussions of layering and the BxD convention in the TimberCAD *Frame Manual.*

7.2 LAYER Freeze/Thaw Commands

LAF LAYER FREEZE: Operator types name of layer to freeze.

LAT LAYER THAW: Operator types name of layer to thaw.

7.3 LAYER On/Off Commands

AB All But: Turns on all layers except those in the variable **LYR.** AB is the opposite of LO.

ALL Turns on all layers.

CF Turns current layer off.

CN Turns current layer on only, all others off.

LO Turns **LYR** on only. Turns off all layers except those in **LYR.** LO is the opposite of AB.

LOF LYR is set off. Turns off all layers in variable **LYR**.

NON No layers on, but remains in the layer command.

OFF Operator enters layer(s) to be turned off at the keyboard.

OFN Off/On: User enters layers to turn off, and then enters layer(s) to turn on.

ON Operator enters layers to be turned on.

ONLY Turns off all layers and turns on only those layers requested from keyboard input.

XR Turns off all annotation layers except those for Roof, and sets **LYR** and **L2** with LXR.

XY Turns off all annotation layers except those for XY plane, and sets **LYR** and **L2** with LXY.

XYZ Turns off all annotation layers and sets **LYR** and **L2.**

XZ Turns off all annotation layers except those for XZ plane, and sets **LYR** and **L2** with LXZ.

YZ Turns off all annotation layers except those for YZ plane, and sets **LYR** and **L2** with LYZ.

7.4 Viewport Layer Freeze/Thaw Commands

FV Vplayer freezes the **LYR** set in the current viewport.

7.5 Setting Variable LYR Commands

See Appendix A: Toolbelt Variables for more information.

AL Adds a layer to variable **LYR** by keyboard entry.

ANL Adds new layers to the variable **LYR** by selection.

ENL Creates new layer variable **LYR** by selection. Create a new layer set by selecting entities on the screen; the layer of the selected entity is added to **LYR**.

LXR Roof: Sets **LYR** variable = "*XY*,*YX*,*YZ*,*ZY*,*XZ*,*ZX*" and **L2** variable = "*XR*,*RX*".

LXY XY: Sets **LYR** variable = "*XZ*,*ZX*,*YZ*,*ZY*,*XR*,*RX*" and **L2** variable = "*XY*,*YX*".

LXYZ XYZ: Sets **LYR** variable = "*XY*,*YX*,*XZ*,*ZX*,*YZ*,*ZY*,*XR*,*RX*".

and **L2** variable = "*X*–*".

LXZ XZ: Sets **LYR** variable = "*XY*,*YX*,*YZ*,*ZY*,*XR*,*RX*" and **L2** variable = "*XZ*,*ZX*".

LYZ YZ: Sets **LYR** variable = *XY*,*YX*,*XZ*,*ZX*,*XR*,*RX* and **L2** variable = "*YZ*,*ZY*".

NENL Creates new layer variable **LYR** by selection. Command is like ENL except selection of entities nested within blocks results in the entity's original layer being added to **LYR** instead of the layer the block is inserted on.

RL Resets **LYR** variable to previous setting.

SL Creates new **LYR** variable through keyboard input.

SNL Removes layers from the **LYR** variable through selection.

SUL Remove a layer from the **LYR** variable through keyboard input.

TILDE Adds a tilde as a prefix to each string in the **LYR** variable. (Tilde is a "not," so if you turn off all layers named ~*X*-*, you will turn off all layers except your timbers.

7.6 General Layer Commands

CHR Views chroma slide (256 color table).

DDL DDLMODES: Layer dialog box.

LA DDLMODES: Layer dialog box.

LA? Prints list of layers and their status to the text screen.

LAC LAYER COLOR

LAL LAYER LINETYPE

LEN Sets current layer by selection.

LN Queries layer name by selection.

LS Sets current layer by keyboard entry.

LT? Lists loaded line types.

VPL VPLAYER: Viewport Layer command.

8.0 MODIFY COMMANDS

MODIFY commands are those that change existing entities, as opposed to CONSTRUCT commands that create new entities from existing entities. One of the greatest benefits of CAD is the ability to make changes, so it should not be surprising that MODIFY commands are the single largest group of Toolbelt commands.

To make it easier to find and learn these functions, we have subdivided them into smaller groups:

8.1 3D EXTRUDE
8.2 BLOCK
8.3 BREAK
8.4 CHANGE
8.5 Conversion
8.6 ERASE
8.7 EXPLODE
8.8 EXTEND
8.9 FILLET/CHAMFER
8.10 Flatten
8.11 MOVE
8.12 Poly-Edit
8.13 ROTATE
8.14 SCALE
8.15 STRETCH
8.16 TEXT
8.17 TRIM

Notice there are different types of subcategories. Commands can be grouped by entity as in BLOCK and TEXT. Other commands are grouped by the type of function they perform, such as MOVE and ERASE. Finally, a collection of more sophisticated commands is broken out: commands that create 3D objects, convert lines to plines, and flatten out entities.

8.1 3D EXTRUDE Commands

PLP Converts user-picked pline into a six-sided 3Dface object (surface model) and creates a line on one of the corners. This line extends along the full length of the extrusion and is required for the TimberCAD Frame Module labeling routines.

PUP Converts user-picked pline into a six-sided 3Dface object, similar to PLP, except no label line is created.

8.2 BLOCK Commands

BL BLOCK

DDA DDATTE: Attribute Edit Dialog Box.

DDX DDATTEXT: Attribute Extract Dialog Box.

RES Prompts for a new scale factor, user selects blocks, and they are scaled up by specified factor, in all 3 dimensions, and from their individual base points.

REX Revises X scale of selected blocks.

REY Revises Y scale of selected blocks.

REZ Revises Z scale of selected blocks.

8.3 BREAK Commands

B BREAK

BB Breaks at selected point (break @). User selects object to break; when prompted for first point, select a point on the line where the break should occur and press Enter. The line is broken at this point.

BF Breaks with F option. User selects object to break, and then is prompted for a First Point and a Second Point. The portion of the line between these two points is deleted.

8.4 CHANGE Commands

CH CHANGE

CHL CHANGE LAST

CLA Change Layers. Select object and enter existing layer name. The selected objects are now on this layer.

CLL Change Layer of Last. Enter existing layer name and the last object drawn is moved to that layer.

CLP Change Layer of Previous. Enter existing layer name and the objects in the last selection set are moved to that layer.

CP CHPROP

CPL CHPROP LAST

CPP CHPROP PREVIOUS

DDC DDCHPROP: Properties Dialog Box.

DDM DDMODIFY: Modify Dialog Box.

SWAP Reverses start and end points on selected lines.

8.5 Conversion Commands

DEFACE Converts selected faces to lines.

Also see IM and IMP of Section 8.12 Poly-Edit Commands.

8.6 ERASE Commands

E ERASE

EA Erase All: Turns on all layers, current space only.

ECL Erase all entities on layer CL (see also OCL and LL).

EL ERASE LAST

EP ERASE PREVIOUS

ER ERASE AND REDRAW

8.7 EXPLODE Commands

EXP EXPLODE

LEX Explode a BLOCK, POLYLINE, or DIMENSION and copy the entities that replace it to the layer that the original entity was on.

8.8 Commands EXTEND

EX EXTEND

EX3 Projects (extends) lines to current UCS or user defined UCS. User is prompted for 3 points to define user coordinate system or press enter for current UCS, select lines to extend, and press Enter. Lines are extended to specified UCS.

8.9 FILLET/CHAMFER Commands

CHM CHAMFER

CLE Corner Cleanup (fillet intersection). Works especially well on intersecting corners, but projected corners work with extra picks.

COR Fillet 2 lines with a crossing window.

F FILLET

JN Join two lines, fillet radius 0.

8.10 Flatten Commands

This collection of flattening commands can be especially useful if objects have been placed with the wrong Z coordinate, for example, placing a block or snapping a line with an object snap in a 3D drawing. The following functions allow you to return those objects to the current UCS without changing their XY location. Another application might be to trace an outline of some 3D object with CL and then flatten it with FLC to the current UCS, effectively performing a selective projection on an object.

ALLFLAT Selects all lines and edits their Z values to be 0 of current UCS. Flattens all lines onto the current UCS.

FD Flatten Dimensions: Z values of defpoint nodes of selected dims changed to 0 of current UCS.

FL Flatten Lines: Z value of selected lines changed to 0 of current UCS.

FLC Flatten Construction Lines: Z value of all lines on layer CL changed to 0.

FLATIP Flatten Blocks: Z values of selected block changed to 0 of current UCS.

FLL Flatten Last: Z values of Last (must be a line) changed to 0 of current UCS.

FLP Flatten Previous: Z values of Previous (must be a line) changed to 0 of current UCS.

8.11 MOVE Commands

M MOVE

ML MOVE LAST

MP MOVE PREVIOUS

MX Move a user-specified distance, **I**, along the X-axis. User is prompted for the distance to move. Positive values move objects in a positive direction along the X-axis, and negative numbers go in the negative direction along the X-axis. After entering the distance, the operator selects the objects to move and they are moved. (See Section A.2: Common Toolbelt Variables. See also MY, MZ, and L-.)

MY Move a user-specified distance, **I**, along the Y-axis. See MX above but apply to the Y-axis.

MZ Move a user-specified distance, **I,** along the Z-axis. See MX above but apply to the Z-axis.

8.12 Poly-Edit Commands

PE PEDIT

IM Implode converts selected lines, arcs to a polyline.

IMP Implode Previous: Same as IM above, but applied to previous selection set.

8.13 ROTATE Commands

AROT Rotates selected entities around their insertion point, typically used for rotation of blocks around their insertion points. Rotation angle is stored in variable **A**. (See Section A.2: Common Toolbelt Variables.)

RO ROTATE

ROL ROTATE LAST

ROP ROTATE PREVIOUS

SPIN Spin entities 180 degrees around their insertion points.

8.14 SCALE Commands

SC SCALE

8.15 STRETCH Commands

S Stretch with crossing, one window only.

S0 Stretch from 0: Allows input of displacement. For example, to move an entity up a 10/12 pitch, S0 will allow a stretch that includes a displacement of 12,10.

SX Stretch in X direction, sets and defaults to **L**. User specifies displacement. Positive numbers stretch in a positive X direction, while negative numbers stretch the other way. After entering

the displacement, pick a crossing window around the objects to stretch. (See Section A2: Common Toolbelt Variables. See also SY, SZ, and L–.)

SY Stretch in Y direction, sets and defaults to **L**. See SX, but apply to Y-axis.

SZ Stretch in Z direction, sets and defaults to **L**. See SX, but apply to Z-axis.

8.16 TEXT Commands

ALLTFIX Aligns text following a mirror command, specifically a paragraph of text when mirrored can change from left justification to right. So ALLTFIX left-justifies all the text to the top line of the selected text.

CT Change Text: Swaps new string for old string.

DDT DDEDIT

MUNT Multiple text replacement, enter new text, select old text, and it is replaced with the new.

NT New Text, then select string to swap in new text.

SPIN Rotates text 180 degrees around insertion point.

TFIX See ALLTFIX above, except TFIX allows you to select text to rejustify.

TRO Text Rotation: Allows for selection of multiple text entities.

TSI Changes text height, allows for the selection of multiple text entities.

TST Changes text style, allows for the selection of multiple text entities.

8.17 TRIM Commands

TR TRIM

TRL Trim using Last object as cutting edge.

TRP Trim using Previous selection set as cutting edge.

9.0 SELECT COMMANDS

The SELECT commands provide quick macros that collect groups of entities into a selection set. Whenever you pick a group of AutoCAD entities at a `Select objects:` prompt, you are building a selection set, and this selection set can be retrieved at the next `Select objects:` prompt by responding with a “P” for Previous. This is all that these commands do; they give us quick access in a subsequent function by creating a selection set that can be “selected” by entering “P” at the next `Select Objects` prompt.

For example, if you wanted to erase all entities on layers currently stored in **LYR** (see Appendix C: AutoCAD Settings), you would run SLL, followed by EP (Erase Previous).

9.1 SELECT Commands

SE SELECT

SL? Select all entities on a given layer as specified by the user.

SLA SELECT ALL

SLC Select all on current layer.

SLE Select all entities of type as specified by user, for example, circles or lines.

SLEL Select all entities of a specific type as expressed by operator via keyboard input, and that happen to lie on a specific layer, also specified by user through keyboard input.

SLF Select all faces.

SLL Select all entities on layers stored in **LYR** variable (See Section A2: Common Toolbelt Variables.)

SLN Select all blocks of user-specified name.

SLV Select all entities within AutoCAD's virtual memory.

10.0 VIEW COMMANDS

Viewing functions contain zoom, pan, slide, viewport, and other commands that affect what we see when we're using AutoCAD.

There are enough individual VIEW commands to justify breaking them down into the following groups:

- **10.1** **General VIEW Commands:** Redraw, Regen, Hide, Shade, etc.
- **10.2** **DVIEW:** Commands for storing, restoring, and manipulating clipped views
- **10.3** **PSPACE:** Commands involved in moving to and from paper space, and managing paper space
- **10.4** **Slides:** Creation and viewing of AutoCAD slides
- **10.5** **VIEW:** AutoCAD View commands
- **10.6** **Viewpoint:** 3D viewpoints
- **10.7** **Zoom:** Panning and Zooming

10.1 General VIEW Commands

HI HIDE

R REDRAW

RA REDRAWALL

RG REGEN

RGA REGENALL

SH SHADE

10.2 DVIEW Commands

CPR Construction Plane Restore: Restores a saved clipping plane (saved by CPS), including clipping and UCS. Also when automode is on, it automatically sets **BPW** variable and controls appropriate annotation layer visibility. For more information, see Section D2 in the TimberCAD Frame Manual.

CPS Construction Plane Save: Prompts for front and back clipping planes, a view name, and then saves view and UCS with this view name. For more information, see Section D2 in the TimberCAD Frame Manual.

DVO DVIEW command that turns off clipping, while maintaining current viewpoint.

DVW DVIEW

10.3 Paper Space Commands

Also see ZS in 10.6 for viewport scaling and MVSETUP in your AutoCAD documentation for alignment of viewport contents.

MS MSPACE

MV MVIEW

PS PSPACE

TI Sets tilemode, toggles from pspace to model space.

10.4 Slide Commands

MSL MSLIDE

SLIDE Multiple slide viewer with user-controlled delay; need an ASCII file containing a list of the slide files.

VSL VSLIDE

10.5 VIEW Commands

DDV DDVIEW: View Dialog Box.

V VIEW

V? View list (?): Lists all named views.

VR View Restore: User enters name of view.

VS View Save, user enters name of view.

VW View Window, user selects window and enters view name to save.

10.6 Viewpoint Commands

DDVP DDVPOINT: Viewpoint Dialog Box.

GL VPOINT Globe (compass)

VP VPOINT Rotate

10.7 Zoom Commands

P PAN

PX Pan using variable **L**. Positive values slide the drawing along the X-axis in a positive direction. See variable **L** in Appendix A.

PY Pan using variable **L**. Positive values slide the drawing along the Y-axis in a positive direction. See variable **L** in Appendix A.

PZ Pan using variable **L**. Positive values slide the drawing along the Z-axis in a positive direction. See variable **L** in Appendix A.

Z ZOOM

Z+ Zooms out 5%.

Z– Zooms in 5%.

ZA Zooms All.

ZCZ Zooms 0, 0 to center and zooms out 5%.

ZD Zoom Dynamic.

ZE Zoom Extents.

ZP Zoom Previous.

ZS Zoom Scale: Zoom viewport to xp = current dimscale.

ZV Zoom Vmax: Zoom out to largest non-regenerating zoom level.

ZZ Zooms to 1/100th greater than extents.

Appendix A: TOOLBELT VARIABLES

A.1 Toolbelt Variable Control

This collection of commands has been created to simplify the control of a group of AutoLISP variables employed by Toolbelt functions. The following list consists primarily of functions that assist the operator in the assignment of value to a particular variable name used in the program.

To enter the contents of a variable to a command's request for input, you enter an exclamation point followed by the variable name. For example, if you want to rotate an object by the angle contained in variable **A,** you would do the following:

Command: RO
Select objects: *(user selects objects and presses Enter)*
Base point*:* *(user selects point)*
Rotation angle: **!A**

Following is a description of the most commonly used Toolbelt variables **L, A,** and **LYR.** Section A.3 contains a list of variable commands that are used to establish and/or assign values to these and other TimberCAD variables.

A.2 Common Toolbelt Variables

TimberCAD makes repeated use of the following standard variables:

L Length: Many Toolbelt distance measuring routines (including D, DE, DEN, DEP, DI, DIN, DIP, DNP, DP, and DT) store their results as variable **L**. **L** is used as the operating value in a variety of other Toolbelt operations when a distance is required (including all the editorial routines that MOVE/COPY/STRETCH by a specified distance in the X, Y, or Z directions). To reverse direction in a sequence of such commands, type **L–**. This will reverse the sign of variable **L** and repeat the last editing operation calling for **L**.

A Angle: Similar to L, variable **A** is saved by a number of Toolbelt angular measurement routines (like AN, ANG, and MAN) and is used by others (including MA, CMP, and SUP). **CMP** sets the variable **CP** equal to the complement of A (90°–A). **SUP** sets the variable **SP** equal to the supplement of A (180°–A).

LYR Layer: **LYR** is a user-definable string variable that can be set manually using the Toolbelt command SET. **LYR** is used by a variety of Toolbelt layer commands. Examples: Use SL to type a list of layers to be stored in **LYR**. Or use ANL to pick entities and add their layers to the layer list in **LYR**.

When AUTOLAY is in effect, the **LYR** variable is automatically set to the list of layers to be turned off during a current TimberCAD operation. For instance, if you use CPR to recall a View/UCS in the YZ plane, the program will set **LYR** equal to

"*XY*, *YX*, *XZ*, *ZX*, *XR*, *RX*"

Simultaneously, the secondary layer variable, **L2**, will be set to a list of layers that display information on the current UCS. In this case, **L2** will be set to

"*YZ*, *ZY*"

See Sections 7.3 and 7.5 in Layer On/Off Commands for more information regarding the implementation of variable **LYR**.

A.3 Toolbelt Variable Command Descriptions

A– Sets variable **A** = –**A.**

CMP Sets variable **CP** = complement of **A.**

DEN Sets variable **L**= length of selected line.

DSL Sets variable **L** = dimscale.

DZ Sets variable **L** to the distance between two user-selected points.

GD Sets variable **L** = value of system variable DISTANCE.

HT Toggles the value of variable **HT** between 1 and 0.

L– Sets **L** to negative **L**, and runs last quick edit command. For example, if you just used CX to copy a Post 96" to the right (positive X direction), by entering **L–,** you can now select objects you want to copy 96" to the left (negative X direction). This function also works with the MOVE and STRETCH quick-edit commands such as MX, MY, SX, and the like.

LAV Sets variable **L**= average length of 2 user-selected lines.

LDIF Sets variable **L** = difference in length of 2 user-selected lines.

LINELAY Sets variable **LYR** to all layers in selection set.

LP Sets variable **LP** = last point

LSUM Sets variable **L** = sum of the length of 2 user-selected lines.

PERI Sets variable **L** = sum of user-selected lines.

SET SETs or views value of user-specified variable: SET prompts the operator for a variable name, default name is the last used by SET. After the user enters the name, its value is returned as the default and the user can enter a new value. Note: Strings must be entered inside single quotes. For example, to set a variable equal to the text string "MYFILE", the operator would enter 'MYFILE' at the Value: prompt.

STEP Prompts operator for value to assign to **STEP**. See Section B.2 Steel Square Angular Measurement.

SUFFIX Changes the suffix in HAWKTAB: It doesn't work if global variable **X** is nil.

SUP Set **SUP** = to the supplemental angle of **A.**

TOL Prompts user to enter tolerance, **TOL**, old tolerance stored in **OTOL**.

Appendix B: COMPOUND GEOMETRY

This appendix is included to assist you in the generation of complex three-dimensional geometry, such as that occurs in hip and valley roof framing. For an explanation of how to incorporate AutoLISP variables in AutoCAD input, see Section A.1: Toolbelt Variable Control.

B.1 Cutting Compound Angles

When cutting compound angles with power tools, for every miter and bevel, you must derive a saw bevel. This can be done graphically or trigonometrically. **BEVEL.LSP** contains routines to find the saw bevel (SB) on right-angle stock for a given miter (M) and bevel (B), plus additional routines for use when the corner of the stock being sawn is not 90° (such as to top corners of hips and valleys).

For right-angled stock:

SB Calculates saw bevel (SB) given miter (M) and bevel (B).

BS Calculates bevel (B) given miter (M) and saw bevel (SB).

For non-right-angled stock:

SBE Calculates saw bevel (SB) given miter (M), bevel (B) and edge bevel (EB).

BSE Calculates bevel (B) given miter (M), saw bevel (SB) and edge bevel (EB).

In addition to its application in sawing compound angles, **BEVEL.LSP** can also be used to determine angles in compound/complex framing. Indeed, the formulas on which the code is based, were used by Rees Acheson and Ed Levin in the process of compiling the Hawkindale angles.

B.2 Steel Square Angular Measurement

The process of layout and cutting hip and valley roofs generates many angles needed by the framer. Typically, these are tabulated in decimal degrees, a form not directly useful to the carpenter. So the **HAWKTAB.LSP** routine presents Hawkindale angles both in decimal degrees and also in typical carpenter's measure for use with the steel square (36.8699° = 9:12).

The routine **TANGENT.LSP** also converts angles in decimal degrees into carpenter's measure. The program works by stepping through a series of approximations to the given angle, saving those that fall within specified tolerances in a file called ANGLES (in the working ACAD directory) and returning the best match (saved as variable **BEST**) to the command line. Default step is 1/16" (stored in the variable **STEP**), default tolerance is 0.009° (stored as variable **ATOL**). To use, type (Lay Angle). Angle can be a number in decimal degrees or a variable name representing same.

B.3 Hawkindale Angles

The Hawkindales are a series of angles used in the framing of hip and valley roofs. The following functions assist in calculating and labeling the Hawkindale Angles. For information on using the Hawkindales, see "Hip and Valley Framing II" and "Hip and Valley Framing III" in *Timber Framing*, Nos. 19 & 21 or the *Timber Frame Joinery Design Workbook*, pp. 87-95, both available at the Web site of the Timber Framers Guild of North America (TFGNA) at http://www.tfguild.org.

HAWK HAWK.LSP calculates the Hawkindale angles for a given set of conditions, storing them both in the text file HAWK (in the working ACAD folder, typically c:\r13\win or c:\r14) and as variables in the current drawing available through the AutoCAD CAL function. The easiest way to use Hawk is to first establish basic roof conditions by running SSDD, SSS, or SSW (see below).

HAWKTAB Creates a file, HAWKTAB, containing a table of Hawkindales expressed both as angles in decimal degrees (36.8699°) and in carpenter's measure (9:12). The routine first queries the user for a base (default = 12), then writes the file to disk using the data produced earlier by HAWK.LSP.

MA Match Hawkindale Angle: A lisp routine that checks whether the angle (in decimal degrees) stored as variable **A** matches any in the current Hawkindale set. Syntax: MA checks the current value of variable **A**. Or you can specify a particular angle by typing (ma angle).

MAN Match Hawkindale Angle: After running Hawkindales, use MAN to pick 2 lines and find a matching Hawkindale angle between them. Any matches are returned to the command line. The first pick must be near the end of a line terminating at the vertex to be measured.

DANG Match and Dimension Hawkindale Angle: Checks for Hawkindale equivalencies and dimensions the angle in decimal degrees (if no match) or with Hawkindale ID. If there is a choice of a number of equal Hawkindales, the system will use the last one. The operator can edit the label as necessary.

HANG Dimension Hawkindale Angle: Dimensions angle, labeling it with the last Hawkindale equivalent measured by the prior use of MA or MAN (HANG does not recheck the angle for a match). The operator can edit the label as necessary.

TANG Label Hawkindale Saw Bevel or Chase Angle: Like HANG, TANG does not run a check, but labels a line with a Hawkindale identifier chosen by prior usage of MA or MAN. User must choose line to be labeled and supply prefix (examples: SB = or CA =). TANG must be run under the World Coordinate System.

HAWKNIL Sets angles DD, D, SS, S, and W to nil in preparation to defining a new set of Hawkindales.

SSDD Hawkindale input routine calling for main pitch (SS), and deck angle (DD). Assumes default wall angle (W) of 90°. Used for regular pitch, regular plan and for regular plan, irregular pitch roofs.

SSS Hawkindale input routine calling for main and adjacent pitches (SS and S). Assumes default wall angle (W) of 90°.

SSW Hawkindale input routine calling for main pitch (SS) and wall angle (W), deck angles (DD=D) are presumed to be equal to one-half of the wall angle. Used for irregular plan, regular pitch roofs. This is the preferred option for defining polygonal roof structures.

SUFFIX A function that sets the variable suffix. If suffix equals " " (nil string), the HAWKTAB function will store a list of main Hawkindales angles with no suffix identifier (C5). This is the default condition. If suffix is set equal to “m“, HAWKTAB will store a table of main Hawkindales with suffix “m“ (C5m). If suffix is set equal to “a“, HAWKTAB will store a table of adjacent Hawkindales with suffix “a“ (C5a).

TOL A variable that controls the tolerances when testing angles for a Hawkindale match when using commands MA or MAN. See also Section B.2: Steel Square Angular Measurement, above.

Appendix C: AUTOCAD SETTINGS

AutoCAD maintains its tremendous flexibility by providing numerous options regarding drawing methods and entity appearance. This flexibility is managed through individual settings. These settings are controlled by AutoCAD and TimberCAD commands, and by AutoCAD dialog boxes. Following is a comprehensive list and description of these techniques broken down as follows:

C.1 Dialog Box Commands

Most AutoCAD system settings can be controlled through dialog boxes. Following is a list of the keystrokes for all of the R12 dialog boxes. Note that many dialog boxes control much more than system settings. We recommend that you become familiar with all of the following dialog commands, since this can be a very efficient way of manipulating several AutoCAD commands and settings at once:

DDA DDATTE: Attribute Edit

DDC DDCHPROP: Change Properties

DDD DDIM: Dimensioning

DDE DDEMODES: Object Creation Modes

DDG DDGRIPS: Grips Settings

DDI DDINSERT: Insert

DDL DDLMODES: Layers

DDM DDMODIFY: Modify

DDN DDRENAME: Rename

DDO DDOSNAP: Running Object Snap

DDP DDPTYPE: Node (point), Display

DDR DDRMODES: Drawing Aids

DDS DDSELECT: Object Selection Settings

DDT DDEDIT: Edit Text

DDU DDUCS: UCS List

DDUN DDUNITS: Units Control

DDUP DDUCSP: UCS Control

DDV DDVIEW: View Control

DDVP DDVPOINT: Viewpoint Control

DDX DDATTEXT: Extract Attribute Information

C.2 AutoCAD Settings Commands

The following commands are used to quickly set general AutoCAD settings.

C.2.1 General Settings

ECHO Toggles CMDECHO on and off. Should command prompts disappear or become erratic, ECHO can sometimes restore them.

G GRID

LIM Sets Limits to 5% greater than extents and ZA.

LT LTSCALE

MN MENU

OS OSNAP

OSN OSNAP None: Turns off a "Running Object Snap".

SN SNAP

SV SETVAR

STY STYLE

SURF Sets SURFTAB1 and SURFTAB2.

TS Sets Text Style.

C.2.2 UCS Control Commands

3 Specifies new UCS by selection of 3 points.

IC Cycles value of Ucsicon between off, on, and origin.

O Prompts for new UCS origin.

U–45 Rotates UCS –45 degrees.

U–90 Rotates UCS –90 degrees.

U? UCS List: Lists named UCSs.

U45 Rotate UCS 45 degrees.

U90 Rotate UCS 90 degrees.

UE Align UCS with Entity.

UP Restore previous UCS.

UR UCS RESTORE: User enters name of UCS to restore.

US UCS SAVE: User enters name of UCS to save.

UV UCS VIEW: Aligns UCS to current view, makes construction plane orthogonal to viewpoint.

UX UCS X: Prompts user for angle to rotate UCS around X, + is clockwise looking down the X-axis at 0,0,0.

UY UCS Y: Prompts user for angle to rotate UCS around Y, + is clockwise looking down the Y-axis at 0,0,0.

UZ UCS Z: Prompts user for angle to rotate UCS around Z, + is clockwise looking down the Z-axis at 0,0,0.

W World coordinate system: Sets UCS to world.

X Aligns UCS on "left side".

XX Aligns UCS on "right side".

Y Aligns UCS on "front side".

YY Aligns UCS on "back side".

C.2.3 Units Control Commands

U16 Sets current units to a 1/16" precision; won't work with decimal or engineering units.

U2 Sets decimal units with ten-thousandths precision.

U3 Sets engineering units with ten-thousandths precision.

U4 Sets architectural units with 1/32" precision.

U5 Sets fractional units with 1/32" precision.

U64 Sets current units to 1/64" precision; won't work with decimal or engineering units.

UN UNITS

Appendix D: PROGRAMMING TOOLS

TimberCAD Toolbelt is written primarily in AutoLISP. AutoCAD's internal programming language and a subset of Common Lisp. In many situations, individual user preferences may vary and therefore a certain amount of flexibility must be available. In order to assist you in the personal customization of your software, we provide the following commands. However, be forewarned, we are unable to effectively support individual customized versions of our software. Ideally, you will use the following commands only under the close supervision of a TimberCAD developer.

D.1 Programming and Debugging Commands

ERROR	Disables error checking; to re-enable error checking, reload error.lsp.
EN	Sets variable **EN** = entity name of user selected entity, and **EL** = entity dxf codes, returns value of **EL** and returns entlist.
FRAME	Loads LISP file from tcadpath\frame.
LISP	Loads LISP file from tcadpath\lisp\.
NEN	Sets {en} to selected entity, and returns {el} entity list.
SHOP	Loads a LISP file from \tcadpath\shop.

APPENDIX E: COMMAND GLOSSARY

Command	Category	File	Description	Class
ERROR	Program	Error.lsp	Disables error checking; to re-enable error checking, reload error.lsp	
3	Settings	Command.lsp	UCS 3 point command	UCS
A	Construct	Acad.pgp	ARRAY	
A-	Variable	Command.lsp	Sets variable A = –A	Variable
AB	Layer	Layer.lsp	Turns on all layers but those in the variable LYR.	Off/On
AL	Layer	Layer.lsp	Adds a layer to variable LYR by keyboard entry	Variable LYR
ALL	Layer	Layer.lsp	Turns on all layers	Off/On
ALLFLAT	Modify	Flat.lsp	Selects all lines and edits their Z values to be 0 of current UCS	Flat
ALLTFIX	Modify	Mi.lsp	Aligns text following a mirror command, specifically a paragraph of text when mirrored can change from left justification to right. So ALLTFIX left-justifies all the text to the top line of the selected text.	Text
AN	Inquiry	Command.lsp	Angle, 2 point, 3 dimensional angle.	
ANG	Inquiry	Command.lsp	Angle, 2 point, projected onto current UCS.	
ANL	Layer	Layer.lsp	Adds new layers to the variable LYR by selection	Variable LYR
AR	Inquiry	Acad.pgp	AREA	
ARO	Draw	Aro.lsp	Draws a leader and arrow. Pick two points and enter twice for a straight arrow, or pick 2-3 points for a curved leader and arrowhead. Global variable **ASCALE** controls arrowhead size.	
AROT	Modify	Mi.lsp	Rotates selected entities around their dxf 10 code, typically used for rotation of blocks, globally around their insertion point. Rotation angle is variable A.	Rotate
B	Modify	Acad.pgp	BREAK	Break
BB	Modify	Command.lsp	Break at selected point (break @)	Break
BF	Modify	Command.lsp	Break select and pick two points	Break
BH	Draw	Acad.pgp	BHATCH	
BL	Modify	Acad.pgp	BLOCK	Block
C	Construct	Acad.pgp	COPY	
CCL	Draw	Command.lsp	Circle on CL layer	
CF	Layer	Layer.lsp	Current layer off	Off/On
CH	Modify	Acad.pgp	CHANGE	Change
CHL	Modify	Command.lsp	Change Last	Change
CHM	Modify	Acad.pgp	CHAMFER	Fillet/Chamfer
CHP	Modify	Acad.pgp	CHPROP	Change
CHR	Layer	Layer.lsp	View chroma slide (256 color table)	General
CI	Draw	Acad.pgp	CIRCLE	
CL	Construct	Command.lsp	Copy Last	
CLA	Modify	Command.lsp	Change Layers	Change
CLE	Modify	Command.lsp	Corner Cleanup (fillet intersection)	Fillet/Chamfer
CLL	Modify	Command.lsp	Change Layer of Last	Change
CLO	Construct	Command.lsp	Copy onto self (clone)	
CLP	Modify	Command.lsp	Change Layer of Previous	Change
CM	Construct	Command.lsp	Create Midline on Layer CL	
CMP	Variable	Command.lsp	Set variable CP = compound of variable A	Variable

CN	Layer	Layer.lsp	Current layer on only	Off/On
COR	Modify	Command.lsp	Fillet 2 lines with a crossing window	Fillet/Chamfer
CP	Construct	Command.lsp	Copy Previous	
CPL	Modify	Command.lsp	Chprop Last	Change
CPP	Modify	Command.lsp	Chprop Previous	Change
CPR	View	Plane.lsp	Construction Plane Restore: Restores a saved clipping plane (saved by CPS), including clipping and UCS. Also when automode is on, it automatically sets BPW variable and controls appropriate annotation layer visibility	Clip
CPS	View	Plane.lsp	Construction Plane Save: Prompts for front and back clipping planes, a view name, and then saves view and UCS with this view name.	Clip
CT	Modify	Command.lsp	Change Text, swap new string for old string	Text
CX	Construct	Command.lsp	Copy along X-axis	
CY	Construct	Command.lsp	Copy along Y-axis	
CZ	Construct	Command.lsp	Copy along Z-axis	
D	Inquiry	Command.lsp	Distance command sets variable L= to result	
DAN	Dim	Command.lsp	Dimension Angle	
DB	Dim	Command.lsp	Dimension Baseline	
DC	Dim	Command.lsp	Dimension Continue	
DD	Dim	Dim.Isp	Dimension down, overall is added when DOA = 1	
DDA	Modify	Acad.pgp	DDATTE (dialog)	Block
DDC	Modify	Acad.pgp	DDCHPROP (dialog)	Change
DDD	Dim	Acad.pgp	DDIM (dialogue)	
DDE	Settings	Acad.pgp	DDEMODES (dialog)	Dialog
DDG	Settings	Acad.pgp	DDGRIPS (dialog)	Dialog
DDI	Draw	Acad.pgp	DDINSERT (dialog)	
DDL	Layer	Acad.pgp	DDLMODES (dialog)	General
DDM	Modify	Acad.pgp	DDMODIFY (dialog)	Change
DDN	Settings	Acad.pgp	DDRENAME (dialog)	Dialog
DDO	Settings	Acad.pgp	DDOSNAP (dialog)	Dialog
DDP	Settings	Acad.pgp	DDPTYPE (dialog)	Dialog
DDR	Settings	Acad.pgp	DDRMODES (dialog)	Dialog
DDS	Settings	Acad.pgp	DDSELECT (dialog)	Dialog
DDT	Modify	Acad.pgp	DDEDIT (dialog)	Text
DDU	Settings	Acad.pgp	DDUCS (dialog)	Dialog
DDUN	Settings	Acad.pgp	DDUNITS (dialog)	Dialog
DDUP	Settings	Acad.pgp	DDUCSP (dialog)	Dialog
DDV	View	Acad.pgp	DDVIEW (dialog)	View
DDVP	View	Acad.pgp	DDVPOINT (dialog)	Vpoint
DDX	Modify	Acad.pgp	DDATTEXT (dialog)	Block
DE	Inquiry	Command.lsp	Distance between two endpoints.	
DEFACE	Modify	Convert.lsp	Converts selected faces to lines.	Convert
DEN	Inquiry	Command.lsp	Distance, Length of Line, sets L.	
DEP	Inquiry	Command.lsp	Distance, endpoint to perpendicular.	
DH	Dim	Command.lsp	Dim1, horizontal dimension, once.	
DHO	Dim	Command.lsp	Dim1 Hometext	
DI	Inquiry	Command.lsp	Diatance, intersection to intersection.	
DIN	Inquiry	Command.lsp	Distance, insert to insert.	
DIP	Inquiry	Command.lsp	Distance, insert to perpend.	
DIV	Inquiry	Acad.pgp	DIVIDE	
DL	Dim	Dim.Isp	Dimension left, overall is added when DOA = 1	

DNP	Inquiry	Command.lsp	Distance, near to perpend	
DO	Draw	Acad.pgp	Donut	
DOA	Dim	Dim.lsp	Toggles value of DOA (dim overall) between 1 and 0	
DP	Inquiry	Command.lsp	Distance, node to node.	
DR	Dim	Dim.lsp	Dimension right, overall is added when DOA = 1	
DRO	Dim	Command.lsp	Dim1, Rotate	
DS	Dim	Command.lsp	Set Dimscale	
DSL	Variable	Command.lsp	Set variable L = Dimscale	Variable
DT	Inquiry	Command.lsp	Distance with prompt for osnaps	
DU	Dim	Dim.lsp	Dimension up, overall is added when DOA = 1	
DUP	Dim	Command.lsp	Dim, Update	
DV	Dim	Command.lsp	Dim, Vertical	
DVO	View	Plane.lsp	DVIEW command that turns off clipping	Clip
DVW	View	Acad.pgp	DVIEW	General
DZ	Variable	Command.lsp	Sets variable l to distance between 2 user selected points on current UCS, ignores Z coordinates.	Variable
E	Modify	Acad.pgp	ERASE	Erase
EA	Modify	Command.lsp	Erase All: Turns on all layers, current space only	Erase
ECHO	Settings	Command.lsp	Toggles CMDECHO on and off	General
ECL	Modify	Command.lsp	Erases all entities on layer CL	Erase
EDGE	Draw	Acad.pgp	EDGESURF	
EL	Modify	Command.lsp	Erase Last	Erase
EN	Program	Command.lsp	Sets variable EN = ename, and EL = elist, returns contents of EL	
ENL	Layer	Layer.lsp	Creates new layer variable LYR, by selection.	Variable LYR
EP	Modify	Command.lsp	Erases Previous	Erase
ER	Modify	Command.lsp	Erases and Redraw	Erase
EX	Modify	Acad.pgp	EXTEND	Extend
EX3	Modify	Ex3.lsp	Extends lines to current UCS or user-defined UCS.	Extend
EXP	Modify	Acad.pgp	EXPLODE	Explode
F	Modify	Acad.pgp	FILLET	Fillet/Chamfer
FA	Draw	Acad.pgp	3DFACE	
FD	Modify	Flat.lsp	Z values of defpoint nodes of selected dims changed to Z = 0 of current UCS.	Flat
FL	Modify	Flat.lsp	Z value of selected lines changed to Z = 0 of current UCS.	Flat
FLATIP	Modify	Flat.lsp	Z values of selected block changed to Z = 0 of current UCS.	Flat
FLL	Modify	Flat.lsp	Z values of Last (must be a line) changed to Z = 0 of current UCS.	Flat
FLP	Modify	Flat.lsp	Z values of Previous (must be a line) changed to Z = 0 of current UCS.	Flat
FRAME	Program	Command.lsp	Loads LISP file from /tcadpath/frame	
FV	Layer	Layer.lsp	Vplayer freezes the LYR set in the current viewport.	VPLayer
G	Settings	Acad.pgp	GRID	General
GD	Variable	Command.lsp	Sets L = value of system variable distance.	Variable
GL	View	Command.lsp	Vpoint Globe (compass)	Vpoint
H	Draw	Acad.pgp	HATCH	
HANG	Dim	Hawk.lsp	Dimensions angle with results of last MA or MAN	

HAWK	Hawk	Hawk.lsp	Loads Hawk.lsp, which defines the rest of the Hawkindale functions and runs the Hawkindale calculator. Some global variables must be set up first by C:SSW, C:SSDD, or C:SSS.	
HAWKNIL	Variable	Hawk.lsp	Sets variables SS, S, DD, D, and W to nil. These variables supply the current roof conditions to C:HAWK.	Hawk
HAWKTAB	Hawk	Hawktab.lsp	Creates a new hawk file using the values stored in the Hawkindale variables. Note that it does not create an entirely new set of data.	
HI	View	Acad.pgp	HIDE	General
HT	Variable	Hawk.lsp	Toggles value of variable ht between 1 and 0.	Hawk
I	Draw	Acad.pgp	INSERT	
IC	Settings	Command.lsp	Cycles value of UcsIcon between off, on, and origin.	UCS
IM	Modify	Command.lsp	IMplode converts selected lines, arcs to pline.	Convert
IMP	Modify	Command.lsp	Implodes Previous	Convert
IN	Draw	Command.lsp	INSET inserts a file at 0,0 exploded.	
JN	Modify	Command.lsp	Joins two lines, fillet radius 0.	Fillet/Chamfer
L	Draw	Acad.pgp	LINE	
L-	Variable	Command.lsp	sets L to negative L, and runs last quick edit command.	Variable
LA	Layer	Acad.pgp	ddlmodes (layer dialogue box)	General
LA?	Layer	Layer.lsp	Keystrokes: Layer <Enter> ? <Enter> (list layers)	General
LAC	Layer	Layer.lsp	Keystrokes: Layer <Enter> Color <Enter>	General
LAF	Layer	Layer.lsp	Keystrokes: Layer <Enter> Freeze <Enter>	Frz/Thaw
LAL	Layer	Layer.lsp	Keystrokes: Layer <Enter> Linetype <Enter>	General
LAM	Layer	Layer.lsp	Keystrokes: Layer <Enter> Make <Enter>	Create
LAN	Layer	Layer.lsp	Keystrokes: Layer <Enter> New <Enter>	Create
LAT	Layer	Layer.lsp	Keystrokes: Layer <Enter> Thaw <Enter>	Frz/Thaw
LAV	Variable	Den.lsp	Sets variable L = avg. length of 2 sel. lines	Variable
LD	Draw	Command.lsp	Line on layer LD (dashed)	
LDIF	Variable	Den.lsp	Sets variable L = difference in length of 2 lines	Variable
LEN	Layer	Layer.lsp	Set current layer by selection	General
LEX	Modify	Lex.lsp	Explodes a BLOCK, POLYLINE, or DIMENSION and copies the entities that replace it to the layer that the original entity was on.	Explode
LI	Inquiry	Acad.pgp	LIST	
LIL	Inquiry	Command.lsp	List Last	
LIM	Settings	Command.lsp	Sets Limits to 5% greater than extents and performs a Zoom All	General
LINELAY	Variable	Depth.lsp	Sets variable LYR to all layers containing lines	Variable
LIP	Inquiry	Command.lsp	List Previous	
LISP	Program	Command.lsp	Load lisp file from c:\tcad\lisp\	
LL	Draw	Command.lsp	Line, orthogonal, on layer CL, construction line	
LN	Layer	Layer.lsp	Layer name by selection	General
LO	Layer	Layer.lsp	Layer set on only (all layers off except those in LYR)	Off/On

LOF	Layer	Layer.lsp	Layer set off (all layers in variable LYR are turned off)	Off/On
LP	Variable	Command.lsp	Sets variable LP = lastpoint	Variable
LS	Layer	Layer.lsp	Layer set by keyboard entry.	General
LSUM	Variable	Den.lsp	Sets variable L = sum of the length of 2 lines.	Variable
LT	Settings	Acad.pgp	LTSCALE	General
LT?	Inquiry	Command.lsp	Lists loaded linetypes.	
LXR	Layer	Layer.lsp	Sets LYR = "*XY*,*YX*,*YZ*,*ZY*,*XZ*,*ZX*" and L2 = "*XR*,*RX*"	Variable LYR
LXY	Layer	Layer.lsp	Sets LYR variable = "*XZ*,*ZX*,*YZ*,*ZY*,*XR*,*RX*" and L2 variable = "*XY*,*YX*"	Variable LYR
LXYZ	Layer	Layer.lsp	sets LYR = "*XY*,*YX*,*XZ*,*ZX*,*YZ*,*ZY*,*XR*,*RX* "and L2 = "*X*-*"	Variable LYR
LXZ	Layer	Layer.lsp	sets LYR = "*XY*,*YX*,*YZ*,*ZY*,*XR*,*RX*" and L2 = "*XZ*,*ZX*"	Variable LYR
LYZ	Layer	Layer.lsp	sets LYR = *XY*,*YX*,*XZ*,*ZX*,*XR*,*RX* and L2 "*YZ*,*ZY*"	Variable LYR
M	Modify	Acad.pgp	MOVE	Move
MA	Hawk	Hawk.lsp	Match Angle. After running Hawkindales and an angle measurement, MA searches the current Hawkindales for a match to variable A; it returns the names of any matching Hawkindales.	
MAN	Hawk	Hawk.lsp	Match Angle. After running Hawkindales, use MAN to pick 2 lines and match angle between them to Hawkindales; any matches are returned to the command line. Pick lines near their intersection (runs AN, then MA).	
ME	Inquiry	Acad.pgp	MEASURE	
MI	Construct	Acad.pgp	MIRROR	
MIDL	Draw	Command.lsp	Creates angle bisector between two lines.	
MIL	Construct	Command.lsp	Mirror Last with ortho.	
MIP	Construct	Command.lsp	Mirror Previous with ortho on.	
ML	Modify	Command.lsp	Move Last	Move
MLA	Layer	Layer.lsp	Make Layer by entering name in BxD format, MLA automatically builds the color.	Create
MN	Settings	Acad.pgp	MENU	General
MP	Modify	Command.lsp	Move Previous	Move
MS	View	Acad.pgp	MSPACE	Pspace
MSL	View	Acad.pgp	MSLIDE	Slide
MUNT	Modify	Munt.lsp	Text replacement, enter new text, select old text, and it is replaced with the new.	Text
MV	View	Acad.pgp	MVIEW	Pspace
MX	Modify	Command.lsp	Move a user-specified distance {L} along X-xis.	Move
MY	Modify	Command.lsp	Move a user-specified distance {L} along Y-axis.	Move
MZ	Modify	Command.lsp	Move a user-specified distance {L} along Z-axis.	Move
NEN	Program	Command.lsp	Set {EN} to selected entity, and return {EL} entity list.	
NENL	Layer	Layer.lsp	Creates new layer variable LYR by selection. Just like ENL, but uses nentsel in-	Variable LYR

			stead of entsel to select layers inside blocks.	
NLA	Layer	Layer.lsp	New Layer by entering name in bxd format, nla automatically builds the color.	Create
NON	Layer	Layer.lsp	No layers on, but remains in the layer command.	Off/On
NS	Variable	Hawk.lsp	Toggles value of variable ns between 1 and nil	Variable
NT	Modify	Command.lsp	New Text, then select string to swap in new text	Text
O	Settings	Command.lsp	Prompts for new UCS origin.	UCS
OC	Construct	Command.lsp	Offset to Current {LYR}.	
OCL	Construct	Command.lsp	Offset to Construction Line layer: CL	
OF	Construct	Acad.pgp	OFFSET	
OFF	Layer	Layer.lsp	User-entered layer is turned off.	Off/On
OFN	Layer	Layer.lsp	User-entered layers are turned off, and the second set of user-entered layers is turned on.	Off/On
ON	Layer	Layer.lsp	Turns on layers entered by user.	Off/On
ONLY	Layer	Layer.lsp	Turns off all layers and only turns on layers entered at the keyboard in response to the prompt.	Off/On
OP	Assist	Acad.pgp	OOPS	
OS	Settings	Acad.pgp	OSNAP	General
OSN	Settings	Command.lsp	OSnap None, Turns off a "Running Object Snap"	General
P	View	Acad.pgp	PAN	Zoom
PE	Modify	Acad.pgp	PEDIT	Pedit
PERI	Variable	Den.lsp	Sets variable L = sum of selected lines	Variable
PL	Draw	Acad.pgp	PLINE	
PLP	Modify	Depth.lsp	Extrudes user picked pline into 3dface object and creates a Z line from pline origin in Z direction, with length of thickness.	3D
PO	Draw	Acad.pgp	POINT	
POL	Draw	Acad.pgp	POLYGON	
PS	View	Acad.pgp	PSPACE	Pspace
PUP	Modify	Depth.lsp	Extrudes user-picked pline into 3Dface object.	3D
PX	View	Command.lsp	Pan with {l} in X-axis + to right, - to left	Zoom
PY	View	Command.lsp	Pan with {l} in Y-axis + up, - down	Zoom
PZ	View	Command.lsp	Pan with {l} in Z-axis + up, - down	Zoom
R	View	Acad.pgp	REDRAW	General
RA	View	Acad.pgp	REDRAWALL	General
RE	Assist	Acad.pgp	REDO	
RES	Modify	Command.lsp	Prompts for a new scale factor, user selects blocks, and they are scaled up by specified factor.	Block
REV	Draw	Acad.pgp	REVSURF	
REX	Modify	Command.lsp	Revise X-scale of selected blocks	Block
REY	Modify	Command.lsp	Revise Y-scale of selected blocks	Block
REZ	Modify	Command.lsp	Revise Z-scale of selected blocks	Block
RG	View	Acad.pgp	REGEN	General
RGA	View	Acad.pgp	REGENALL	General
RL	Layer	Layer.lsp	Sets tl = LYR, LYR to ol, and ol = tl. Used to reset the original LYR variable before an ANL, ENL, NENL, SL, and RL.	Variable LYR
RO	Modify	Acad.pgp	ROTATE	Rotate
ROL	Modify	Command.lsp	Rotate Last	Rotate

ROP	Modify	Command.lsp	Rotate Previous	Rotate
RS	File	Command.lsp	Redraw and Save	
RULE	Draw	Acad.pgp	RULESURF	
S	Modify	Command.lsp	Stretch with crossing, one window only.	Strectch
S0	Modify	Command.lsp	Stretch from 0, allows input of displacement	Strectch
SA	File	Command.lsp	SAve	
SC	Modify	Acad.pgp	SCALE	Scale
SE	Select	Acad.pgp	SELECT	
SET	Variable	Command.lsp	Prompts for an AutoLISP variable name that you want to assign a value to. The previous variable you set with this command is the default, only works with strings.	Variable
SFP	Variable	Command.lsp	Set File Prefix, adds current drawing directory to {file} as prefix.	Variable
SH	View	Acad.pgp	SHADE	General
SHOP	Program	Command.lsp	Load a lisp file from //tcadpath//shop	
SL	Layer	Layer.lsp	Create new LYR variable through keyboard input	Variable LYR
SL?	Select	Select.lsp	Select all entities on a given layer as specified by the user.	
SLA	Select	Select.lsp	SELECT ALL	
SLC	Select	Select.lsp	Select all on current layer.	
SLE	Select	Select.lsp	Select all entities of type as specified by user, for example circles or lines.	
SLEL	Select	Select.lsp	Select all entities of a specific type as expressed by operator via keyboard input, and that happen to lie on a specific layer, also specified by user-provided keyboard input.	
SLF	Select	Select.lsp	Select all faces.	
SLIDE	View	Slide.lsp	Multiple slide viewer with user-controlled delay, need an ASCII file containing a list of the slide files	Slide
SLL	Select	Select.lsp	Selects all entities on layers stored in LYR variable (see Appendix C: AutoCAD Settings).	
SLN	Select	Select.lsp	Selects all blocks of user-specified name.	
SLV	Select	Select.lsp	Selects all entities within AutoCAD 's virtual memory.	
SN	Settings	Acad.pgp	SNAP	Snap
SNL	Layer	Layer.lsp	Removes layers from the LYR variable through selection.	Variable LYR
SO	Draw	Acad.pgp	SOLID	
SPIN	Modify	Command.lsp	Spins entities 180 degrees around their insertion points.	Rotate
SPINTEXT	Modify	Command.lsp	Rotates text 180 degrees around {0,0}.	Text
SSDD	Hawk	Command.lsp	Hawkindale, input main pitch, and deck angle, wall angle = 90.	
SSS	Hawk	Command.lsp	Hawkindale, input main and adjacent pitches, standard wall and deck angles, wall angle = 90.	
SSW	Hawk	Command.lsp	Hawkindale, input main pitch and wall angle, deck angle = 1/2 wall angle.	
ST	Inquiry	Acad.pgp	STATUS	
STEP	Variable	Tangent.lsp	Prompts operator for value to assign to Step.	Hawk

STY	Settings	Acad.pgp	STYLE	General
SUFFIX	Variable	Hawktab.lsp	Changes the suffix in Hawktab; it doesn't work if global variable x is nil.	Hawk
SUL	Layer	Layer.lsp	Removes a layer from the LYR variable through keyboard input	Variable LYR
SUP	Variable	Command.lsp	Sets SUP = to the supplemental angle of {a}.	Variable
SURF	Settings	Command.lsp	Sets SURFTAB1 and SURFTAB2.	General
SV	Settings	Acad.pgp	SETVAR	General
SWAP	Modify	Endswap.lsp	Reverses start and end points on selected lines.	Change
SX	Modify	Command.lsp	Stretch in X direction, sets and defaults to {l}.	Stretch
SY	Modify	Command.lsp	Stretch in Y direction, sets and defaults to {l}.	Stretch
SZ	Modify	Command.lsp	Stretch in Z direction, sets and defaults to {l}.	Stretch
T	Draw	Acad.pgp	DTEXT	
TAB	Draw	Acad.pgp	TABSURF	
TC	Draw	Command.lsp	Text Centered	
TF	Draw	Command.lsp	Text Fit	
TFIX	Modify	Mi.lsp	Aligns selected text following a mirror command.	Text
TI	View	Command.lsp	Sets tilemode, toggles from pspace to model space.	Pspace
TILDE	Layer	Layer.lsp	Adds a tilde as a prefix to each string in the LYR variable.	Variable LYR
	Draw	Command.lsp	Text Middle	
TOL	Variable	Hawk.lsp & Tangent.lsp	Prompts user to enter tolerance (tol), old tolerance stored in otol.	Hawk
TR	Modify	Acad.pgp	TRIM	Trim
TRL	Modify	Command.lsp	Trim using last object as cutting edge.	Trim
TRO	Modify	Command.lsp	Text Rotation, allows for selection of multiple text entities.	Text
TRP	Modify	Command.lsp	Trim using Previous selection set as cutting edge.	Trim
TS	Settings	Command.lsp	Sets Text Style, and begins dtext command	General
TSI	Modify	Command.lsp	Changes text height, allows for the selection of multiple text entities.	Text
TST	Modify	Command.lsp	Changes text style, allows for the selection of multiple text entities.	Text
U	Assist	Acad.exe	Undo	
U?	Settings	Command.lsp	UCS List, list of named UCSs.	UCS
U16	Settings	Command.lsp	Sets current units to a 1/16" precision, won't work with decimal or engineering units.	Units
U2	Settings	Command.lsp	Sets decimal units with ten-thousandths precision.	Units
U3	Settings	Command.lsp	Sets engineering units with ten-thousandths precision.	Units
U4	Settings	Command.lsp	Sets architectural units with 1/32" precision.	Units
U45	Settings	Command.lsp	Rotates UCS 45 degrees.	UCS
U-45	Settings	Command.lsp	Rotates UCS -45 degrees.	UCS
U5	Settings	Command.lsp	Sets fractional units with 1/32" precision.	Units
U64	Settings	Command.lsp	Sets current units to 1/64" precision, won't work with decimal or engineering units	Units
U90	Settings	Command.lsp	Rotate UCS 90 degrees	UCS

U-90	Settings	Command.lsp	Rotate UCS -90 degrees	UCS
UB	Assist	Command.lsp	Set Undo Back.	
UE	Settings	Command.lsp	Align UCS with Entity.	UCS
UM	Assist	Command.lsp	Set Undo Mark.	
UN	Settings	Acad.pgp	UNITS	Units
UP	Settings	Command.lsp	Restore previous UCS.	UCS
UR	Settings	Command.lsp	UCS RESTORE: User enters name of UCS to restore.	UCS
US	Settings	Command.lsp	UCS SAVE: User enters name of UCS to save.	UCS
UV	Settings	Command.lsp	UCS VIEW: Aligns UCS to current view, makes construction plane orthogonol to viewpoint.	UCS
UX	Settings	Command.lsp	UCS X, prompts user for angle to rotate UCS around X, + is clockwise looking down X-axis at 0,0,0.	UCS
UY	Settings	Command.lsp	UCS Y, prompts user for angle to rotate UCS around Y, + is clockwise looking looking down Y-axis at 0,0,0.	UCS
UZ	Settings	Command.lsp	UCS Z, prompts user for angle to rotate UCS around Z, + is clockwise looking looking down Z-axis at 0,0,0.	UCS
V	View	Acad.pgp	VIEW	View
V?	View	Command.lsp	View list (?), lists all named views.	View
VP	View	Acad.pgp	VPOINT Rotate	Vpoint
VPL	Layer	Acad.pgp	VPLAYER	General
VR	View	Command.lsp	View Restore: User enters name of view.	View
VS	View	Command.lsp	View Save: User enters name of view.	View
VSL	View	Acad.pgp	VSLIDE	Slide
VW	View	Command.lsp	View Window.	View
W	Settings	Command.lsp	World coordinate system, sets UCS to world.	UCS
WB	File	Acad.pgp	WBLOCK	
X	Settings	Command.lsp	Align UCS on "left sidel"	UCS
XR	Layer	Layer.lsp	Sets LYR variable = "*XY*,*YX*,*YZ*,*ZY*,*XZ*,*ZX*" and L2 = "*XR*,*RX*" and runs C:AB.	Variable LYR
XX	Settings	Command.lsp	Align UCS on "right side"	UCS
XY	Layer	Layer.lsp	Sets LYR variable = "*XZ*,*ZX*,*YZ*,*ZY*,*XR*,*RX*" and L2 variable = "*XY*,*YX*" and runs C:AB.	Variable LYR
XYZ	Layer	Layer.lsp	Sets LYR variable = "*XY*,*YX*,*XZ*,*ZX*,*YZ*,*ZY*,*XR*,*RX* "and L2 = "*X*–*" and runs C:AB.	Variable LYR
XZ	Layer	Layer.lsp	Sets LYR variable = "*XY*,*YX*,*YZ*,*ZY*,*XR*,*RX*" and L2 = "*XZ*,*ZX*" and runs C:AB.	Variable LYR
Y	Settings	Command.lsp	Align UCS on "front "	UCS
YY	Settings	Command.lsp	Align UCS on "back "	UCS
YZ	Layer	Layer.lsp	Sets LYR variable = *XY*,*YX*,*XZ*,*ZX*,*XR*,*RX* and L2 "*YZ*,*ZY*" and runs C:AB and runs C:AB.	Variable LYR
Z	View	Acad.exe	Zoom.	Zoom
Z-	View	Command.lsp	Zooms in 5%.	Zoom
Z+	View	Command.lsp	Zooms out 5%.	Zoom
ZA	View	Command.lsp	Zoom All	Zoom
ZCZ	View	Command.lsp	Zoom 0, 0 to center and zoom out 5%.	Zoom
ZD	View	Command.lsp	Zoom Dynamic	Zoom

ZE	View	Command.lsp	Zoom Extents	Zoom
ZP	View	Command.lsp	Zoom Previous	Zoom
ZS	View	Command.lsp	Zoom Scale, zoom viewport to xp = current dimscale.	Zoom
ZV	View	Command.lsp	Zoom Vmax, zoom out to largest non-re-generating zoom level.	Zoom
ZZ	View	Command.lsp	Zooms to 1/100th greater than extents.	Zoom