KeyWild CAD Library

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Library Section Description:

This is a collection of 2 dimensional DWG files that represent Hex Head fasteners (Hex Head Cap screws, Bolts, Nuts and washers). The following nominal diameters are included: 1/4, 5/16, 3/8, 1/2 inch. The following nominal diameters are planned to be include: 9/16, 5/8, 3/4, 1 inch.

About four decades ago I worked as a toll designer for a company that made fasteners. The "official" distinction between a bolt and a screw was:

"a screw is rotated into a threaded hole"

"a bolt is retained by rotating a retainer (nut) onto the threaded end"

The manufacturing dimensions were the same for either one. Cap screws always had washer faces. Bolts sometimes had washer faces. The material designation might be different. We generally considered a bolt to be a lesser quality part (*the exception being Structural Bolts for use in structure steel construction*). In this library a bolt is defined as having less detail that a Cap Screw. Cap Screws have a washer face under the head. Bolts have plain faces. Cap screws may have detailed threads. Bolts have simple thread representation. All bolts and cap screws have a radius under the head.

No internally threaded parts (nuts) are shown to have threads. Instead they have a hole the size of the major diameter. When shown in an assembly the threads would not be seen anyway.

File/Block Naming Convention:

The following example is for a Hex Head Bolt, with a plain face (*no washer face*) that has a 1/4 inch nominal diameter and 1-1/2 inch nominal length:

IN_02500_HBLP-UNC_01500.dwg

The <u>first segment</u> indicates if the file is Inch or Metric. In the example above **IN** indicates an "INCH" based fastener.

The <u>second segment</u> for fasteners indicates the nominal diameter. In the case of INCH based fasteners this is a five digit number that corresponds to the nominal size of the fastener allowing four decimal digits. In the example above **02500** indicates a nominal diameter of "0.2500" inches (1/4 inch).

The <u>third segment</u> begins with a **four letter designator** for the particular piece of hardware. In the example above **HBLP** indicates a "Hex, Bolt, Plain Faced". For externally threaded fasteners this segment contains an additional field separated by a dash character (-) that is the thread series. In the example above **UNC** indicates "Unified National Coarse". **UNF** would indicate "Unified National Fine". **###** is used to indicate that the part has no thread feature shown (*simplified representation*).

The <u>fourth segment</u> is optional but further describes a particular part. In the case of externally threaded fasteners it is used to indicate the nominal length. In the case of INCH based fasteners this is a five digit number that corresponds to the nominal length of the fastener allowing three decimal digits. In the example above **01500** indicates a nominal length of "01.500" inches (1-1/2 inches).

An additional segment may be included to indicate the direction of the "view" such as "-Plan", "-Bottom" or "-Side".

Example File Names -

IN_03750_HHED-Plan.dwg 3/8 Inch Diameter Hex Head Cap Screw (Bolt), Plan view
IN_03750_HHCR-Side.dwg, hex-head-crown-sideinch-0375 (<i>internal block name</i>) 3/8 Inch Diameter Hex Head Crown , Side view

IN_03750_WLSL-Side.dwg
3/8 Inch Diameter Washer, Split Lock, Side view
IN_03750_WPAN-Plan.dwg,
3/8 Inch Diameter Washer, Plain, Type A, Narrow, Plan view
(IN_03750_WPAW-Plan.dwg)
(3/8 Inch Diameter Washer, Plain, Type A, Wide, Plan view)
IN_03750_WPAN-Side.dwg,
3/8 Inch Diameter Washer, Plain, Type A, Narrow, Side view
IN_03750_WPAW-Side.dwg
3/8 Inch Diameter Washer, Plain, Type A, Wide, Side view
IN_03750_WPBN-Plan.dwg
3/8 Inch Diameter Washer, Plain, Type B, Narrow, Plan view
IN_03750_WPBR-Plan.dwg
3/8 Inch Diameter Washer, Plain, Type B, Regular, Plan view
IN_03750_WPBW-Plan.dwg
3/8 Inch Diameter Washer, Plain, Type B, Wide, Plan view
IN_03750_WPBN-Side.dwg
3/8 Inch Diameter Washer, Plain, Type B, Narrow, Side view
IN_03750_WPBR-Side.dwg
3/8 Inch Diameter Washer, Plain, Type B, Regular, Side view
IN_03750_WPBW-Side.dwg
3/8 Inch Diameter Washer, Plain, Type B, Wide, Side view
IN 02750 W/PEE Plan dwg
3/8 Inch Diameter Washer Plain Fender Plan view
Systiller Dameter Washer, Hain, Fender, Han view
IN 03750 WPFF-Plan.dwg
3/8 Inch Diameter Washer, Plain, Fender, Side view

IN_03750_HCSB-Bottom.dwg
3/8 Inch Diameter Hex Head Cap Screw, Washer Face, Bottom view
IN_03750_HBLB-Bottom.dwg
3/8 Inch Diameter Hex Head Bolt, Plain Face, Bottom view
IN_03750_HBLP-###_00750.dwg
3/8 Inch Diameter Hex Head Bolt, Plain Face, No Thread Details, 3/4 Inch Long
IN_03750_HBLP-UNC_00750.dwg
3/8 Inch Diameter Hex Head Bolt, Plain Face, UNC Threads, 3/4 Inch Long
IN_03750_HBLP-UNF_00750.dwg
3/8 Inch Diameter Hex Head Bolt, Plain Face, UNF Threads, 3/4 Inch Long
IN_03750_HBLP-###_00750.dwg
3/8 Inch Diameter Hex Head Cap Screw, Washer Face, No Thread Details, 3/4 Inch Long



Insertion Points:

The insertion point of all plan (*bottom or top*) views for bolts, screws, nuts, washers is the center.

The insertion point of side views for all long fasteners (*bolts, screws*) is the bottom center of the head with the shaft pointed in the downward direction.

The insertion point of side views for all nuts and washers is the top center as if installing on a screw with the shaft pointed in the downward direction.



<u>Masks:</u>

DWG Blocks have been created with masks such that a nut can been placed over a screw and it will "mask out" (*hide*) the line work of the objects behind it.



In the first figure above the layer "Fastener-Mask" is turned off and all line work is shown. In this case the blocks would need to be exploded and the line work cleaned up. In the second figure the layer "Fastener-Mask" is turned on. The blocks for the nut and washers have had the display order set to "bring to front". This is the "correct" way to detail a fastener in a cross-section. The caveat here is that portions of the center-line are also masked-out. The third figure shows the result when the display order for the nut and washers was changed to "send to back". This is an interesting alternative but not usually considered the proper method for detailing a fastener in a cross-section.



Display of mask frames should be set off (Mask, Display Frames ? = No). Note what happens in the drawing illustration above when the Mask Frame is shown.

Layers:

Fastener files have the following layers (as applicable):

New Dele	ete Activate	al layer(s) o	displayed: 9.		Filter	expression	
Status	Name		Show	Frozen	Lock	LineColor	_
⇒	o		۲	-	1	White	Continuous
	Fastener		0	0	1	O White	Continuous
-	Fastener-Center Lines		0	0	1	🗢 Blue	Continuous
-	Gastener-Description			0	6	🔴 Red	Continuous
-	Fastener-Mask	9	0	6	😑 Magenta	Continuous	
-	Fastener-Threads	۲	0	6	O White	HIDDEN Hi	
-	KeyWild CAD Library	•	0	6	🔵 Green	Continuous 💌	
							•
科 All Used	Layers					•	Edit Filters
Reverse f	Filter					-	
Dicplay "ir	uce" ctatuc						
	raso status						
Apply curi	rent filter to Layers toolbar					_	
					🗸 🗸	X Cancel	R Help

Side views of Screws and Bolts are shown with center lines. Plan views of hex heads (HHED) and nuts (HNUT) are shown with center lines. The layer Fastener-Center Lines can be turned off the hide these.

Master Drawings:

Everything for given nominal diameter starts with a master drawing. This drawing has each particular type of part/view laid out and drawn in a grid pattern. Then a script file (7,000 lines) for that master drawing is run to export all the various blocks. After that a FIX script is run against each exported file to set the base point, zoom the drawing and a few other minor things. There is no error checking with DraftSight script files. Any small error (*an extra space, a missing drawing object, a duplicate file name, an incorrect x-y coordinate*) will cause the whole process to crash. The precise layout of the master drawing allows the process to be, for a large part, "automated". The master drawings also make a good reference for the block names.



Thread Forms:

Although dimensionally correct you are not likely to see radiused threads illustrated on an engineering drawing in this fashion very often:



A number of simpler ways to represent externally threaded fasteners on a two dimensional drawing are shown below.

3/4 Inch Diameter x 10 Threads per Inch



This illustration shows various methods of representing external threads on a two dimentional drawing. The circled numbers are my personal order of preference (depending on scale).

In this library I have used the types indicated by 1, 2 and 3 above. Turning the layer "Fastener –Threads" off will reduce types 3 to type 4. Type 2 is probably the most useful as it can be used to represent either course or fine thread fasteners. The minor diameter used for type 2 blocks is for the coarse thread series (*for this purpose there is not a significant difference between coarse and fine*). Where a type 2 thread illustration is used, the block name contains "####" as the thread pitch designation. Type 3 has the most white space. This type should be used on drawing where the scale of the fastener may reduce the clarity a drawing. Type 1 should only be used for very detailed drawings.

References:

The spreadsheet file "Fastener_Dimensions.xlsx" included in the "Reference Section" has all the dimensions used to create these blocks. Dimensions were resourced from a number of places. The primary reference work used to verify those dimensions was the twenty-fifth edition of <u>Machinery's Handbook</u> (©1996, Industrial Press Inc., New York, ISBN 0-8311-2595-0). Although that reference is somewhat dated these dimensions are by design fairly constant.

Nominal Diameter	Decimal Diameter	Across Flats (Nominal)	Across Flats (Decimal)	Head Height (Nominal)	Head Height (Decimal)	Washer Face (Diameter)	Washer Face (Thickness)	Washer Face (Radius to Shaft)
1/4	0.2500	7/16	0.4375	5/32	0.1563	0.3938	0.0160	0.03 - 0.01
5/16	0.3125	1/2	0.5000	13/64	0.2031	0.4500	0.0160	0.03 - 0.01
3/8	0.3750	9/16	0.5625	15/64	0.2344	0.5063	0.0160	0.03 - 0.01
7/16	0.4375	5/8	0.6250	9/32	0.2813	0.5625	0.0160	0.03 - 0.01
1/2	0.5000	3/4	0.7500	5/16	0.3125	0.6750	0.0160	0.03 - 0.01
9/16	0.5625	13/16	0.8125	23/64	0.3594	0.7313	0.0160	0.06 -0.02
5/8	0.6250	15/16	0.9375	25/64	0.3906	0.8438	0.0160	0.06 -0.02
3/4	0.7500	1-1/8	1.1250	15/32	0.4688	1.0125	0.0160	0.06 -0.02
7/8	0.8750	1-5/16	1.3125	35/64	0.5469	1.1813	0.0160	0.06 -0.02
1	1.0000	1-1/2	1.5000	39/64	0.6094	1.3500	0.0300	0.09 - 0.03
1-1/8	1.1250	1-11/16	1.6875	11/16	0.6875	1.5188	0.0300	0.09 - 0.03
1-1/4	1.2500	1-7/8	1.8750	25/32	0.7813	1.6875	0.0300	0.09 - 0.03
1-3/8	1.3750	2-1/16	2.0625	27/32	0.8438	1.8563	0.0300	0.09 - 0.03
1-1/2	1.5000	2-1/4	2.2500	15/16	0.9375	2.0250	0.0300	0.09 - 0.03
1-5/8	1.6250	2-7/16	2.4375	1	1.0000	2.1938	0.0300	0.12 - 0.04
1-3/4	1.7500	2-5/8	2.6250	1-3/32	1.0938	2.3625	0.0300	0.12 - 0.04
2	2.0000	3	3.0000	1-7/32	1.2188	2.7000	0.0600	0.12 - 0.04
2-1/2	2.5000	3-3/4	3.7500	1-17/32	1.5313	3.3750	0.0600	0.19 - 0.06
3	3.0000	4-1/2	4.5000	1-7/8	1.8750	4.0500	0.0900	0.19 - 0.06
3-1/2	3.5000	5-1/4	5.2500	2-5/16	2.3125	4.7250	0.0900	0.19 - 0.06
4	4.0000	6	6.0000	2-11/16	2.6875	5.4000	0.0900	0.19 - 0.06

Min. Thread (< 6 inces) Length	Min. Thread (> 6 inces) Length	Coarse (UNC) TPI	Coarse (UNC) Pitch	Fine (UNF) TPI	Fine (UNF) Pitch	UNC -2A Minor Dia Nominal	Nut Hex Thick	Nut Hex Jam Thick	Nominal Diameter
0.7500	1.0000	20	0.0500	24	0.0417	0.1890	0.2190	0.1565	1/4
0.8750	1.1250	18	0.0556	24	0.0417	0.2452	0.2655	0.1875	5/16
1.0000	1.2500	16	0.0625	24	0.0417	0.2992	0.3285	0.2185	3/8
1.1250	1.3750	14	0.0714	20	0.0500	0.3511	0.3750	0.2500	7/16
1.2500	1.5000	13	0.0769	20	0.0500	0.4069	0.4375	0.3125	1/2
1.3750	1.6250	12	0.0833	18	0.0556	0.4617	0.4845	0.3125	9/16
1.5000	1.7500	11	0.0909	18	0.0556	0.5152	0.5470	0.3750	5/8
1.7500	2.0000	10	0.1000	16	0.0625	0.6291	0.6410	0.4220	3/4
2.0000	2.2500	9	0.1111	14	0.0714	0.7408	0.7500	0.4840	7/8
2.2500	2.5000	8	0.1250	12	0.0833	0.8492	0.8590	0.5470	1
2.5000	2.7500	7	0.1429	12	0.0833	0.9527	0.9690	0.6090	1-1/8
2.7500	3.0000	7	0.1429	12	0.0833	1.0777	1.0620	0.7190	1-1/4
3.0000	3.2500	6	0.1667	12	0.0833	1.1742	1.1720	0.7810	1-3/8
3.2500	3.5000	6	0.1667	12	0.0833	1.2992	1.2810	0.8440	1-1/2
3.5000	3.7500	6	0.1667			1.4246	1.3900	0.9060	1-5/8
3.7500	4.0000	5	0.2000			1.5092	1.5000	0.9690	1-3/4
4.2500	4.5000	4.5	0.2222			1.7324	1.7190	1.0940	2
5.2500	5.5000	4	0.2500			2.1992	2.1570	1.4140	2-1/2
	6.5000	4	0.2500			2.6991	2.5940	1.6640	3
	7.5000	4	0.2500			3.1990	3.0320	1.9065	3-1/2
	8.5000	4	0.2500			3.6989	3.4690	2.1565	4