ARCH 2431 BUILDING TECHNOLOGY III **STUDIO ASSIGNMENT: STEEL CONNECTIONS**

Overview:

This studio assignment will introduce you to both standard steel components used for beams and columns and to the modeling of Revit parametric families. All of the semesters Studio Assignments combined, represent 30% of your final grade.

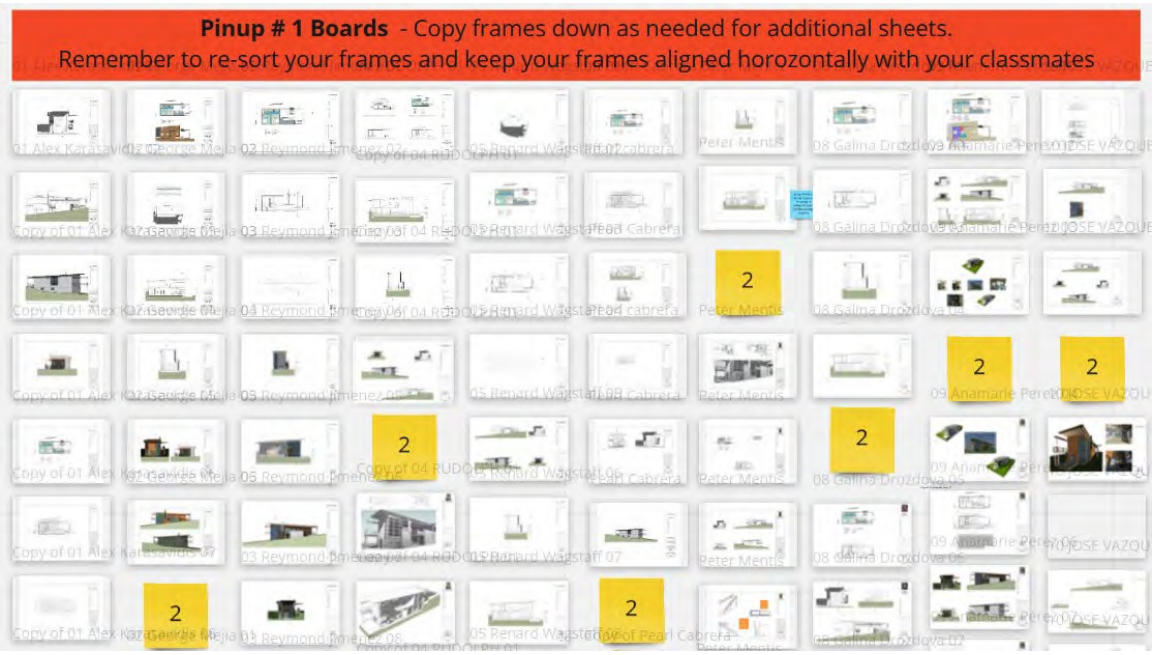
*We will review **Wide Flange Sections**, **High Strength Steel** (HSS) **Circular** and **Square Columns** as well as methods of connecting these components in construction. We will build a small assembly that includes three columns with concrete footings and beams. To this we will add column base plates, concrete footings, fins and connection splice plates and diagonal bracing. We will format **groups of 4 related views** (plan, elevation, section and isometric) at various scales to describe the different parts of the assembly and will also compose an exploded isometric sheet using the Orient to View technique in Revit.*

To this we will add descriptive annotation (notes/leaders & dimensions) as well a materials designations and cross hatchings to all views. We will start this assignment with a new Revit file.

MIRO & Pinups -

- *We will be conducting "virtual pinups", using a shared pinup board hosted on **Miro.com**. We may also conduct a live pinup in the classroom. You will not be required to create an account to work with Miro. The pinup space will be provided for you with a single frame for each of you. You will need to rename this frame to claim your pinup space and you will duplicate and place each additional sheet below, creating a vertical column of sheets for each student.*
- *To post your work in Miro - print each sheet from Revit to a separate PDF and then paste it onto the frame.*
- *MIRO Frames listing – as you add new sheets you will need to create or copy a frame.*
- *Sort you own frames, so they are always in order. It helps to name your slides sequentially. King-01, King-02, etc.*

Sample Miro.com Pinup Board



Revit Specific Tasks:

- ***Customize the titleblock****. Using a 22 x 34 titleblock – make a copy of this family and add course and individual information to the titleblock. You may have to adjust locations of lines, etc.*
- ***Add Personal Information*** *– Remove the Autodesk Logo in the top right corner of the title block and add a recognizable portrait photo of yourself to the sheet. Below this add your name. Make sure it is large enough to be legible. If your name is long, it can be on two lines. You may have to adjust lines on the titleblock for it to fit.*
- ***Add Class Information*** *– Add the Course Number & Name (ARCH 2431 Building Technology III) using the "Owner" and "Project" fields. Add the Professors Name (Prof. King, etc.) and the semester (Fall 2020) below your name.*
- ***Add Sheet information*** *– For each sheet, add a sheet number and a title. For the date drawn add the deadline date.*
- ***Duplicating views*** *– Since we have multiple pinups, you may need to include the same view on more than one sheet. To do this you will need to "duplicate" the view. Review the duplicate options. (with detailing, as a dependent)*
- ***Dimension and Text Styles*** *– Notes and dimensions text, should be 1/8" tall. Create new styles as needed.*
- ***Project Browser Cleanup*** *- When you create new views either using duplicate or creating new views as callouts, sections or elevations, be certain to rename these views appropriately.*
- ***Revit File Name*** *– Each of you must rename your Revit file in the format (Firstname.LastName BT3 Steel Connections Semester-Professor.rvt) File name for a student named Louis Sullivan in Prof. King's Fall 2023 class would be (**Louis.Sullivan BT3 Steel Connections FA23-King.rvt**)*

Grading & Rubric:

- ***Grading****: Pinups # 1 & #2 will be preliminary grades by students. Pinup #3 will receive a final grade (A/B/C/D +/-).*
- ***Rubric:*** *Assignments will be graded on the following criteria. Additional criteria may be given during discussions.*
    - *Completeness of submission & deadlines. Proper file name, sheet name/number and format of titleblock*
    - *Good sheet layout & appropriate views. Coordinated sets of four (4) views are best. (Plan, two Elevations or an Elevation & Section and an Isometric). Scales for the group of four typically match.*
    - *Annotation & appropriate scale of views. Use a scale that clearly represents the information and allows for proper annotation to be added including, hatch patterns, detail items, notes/leaders & dimensions.*
    - *Formatting and organization – Are the sheets laid out well, organized and numbered properly? Do views align, is there limited wasted (white) space? Are detail views numbered sequentially?*
    - *Level of detail – Do the studies show enough to explain the construction? This requires that drawings exist at multiple scales (½" or ¾") with a second set of callout details at larger scales. (1 ½", 3" or 6")*
    - *Demonstration of the mastery of the Revit software. Good control over views, proper organization of project browser, creation and organization of sheets with title blocks, proper printing to PDF, etc.*
    - *Oral Presentation – Students ability to describe what has been drawn.*

Archive Submission:

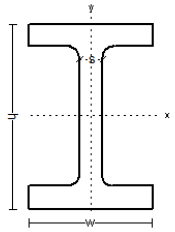
- *In addition to class Miro pinup boards, each student will need to post the completed final assignment in blackboard. For this submission, you must combine the individual PDF files into a single PDF and then upload this to the proper directory in blackboard. You must also include your Revit file. All of your Revit family files are embedded in your main project file and should not be uploaded separately as part of this submission.*
- ***Proper naming conventions*** *– For your final submissions your PDF and your Revit files must be properly named, or you will not receive full credit.*
- ***Meet all deadlines*** *– do not be late!*
- *Failure to submit the archive file on a timely basis may lower your grade.*

Sources of Information:

- https://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html

In class we will begin to use the steel manual to select steel sections of various types based on the following criteria:

1. ***Wide Flange Column:*** *(Use this for one of your columns – intersection of grid lines B & 2)*

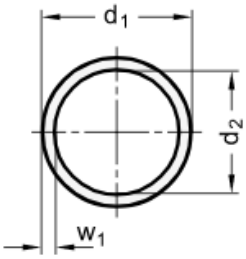


Criteria-

Cross Sectional Area 38 to 50 sq inches

Depth Range 22 to 24 inches

2. ***HSS-Round Hollow Column:*** *(Use this for one of your columns – intersection of grid lines B & 1)*

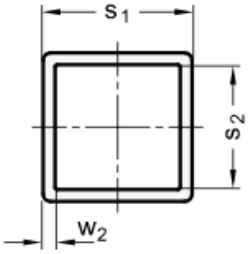


Criteria-

Cross Sectional Area 14 to 16 sq inches

Depth Range 12.5 to 14 inches

3. ***HSS-Square or Rectangular Hollow Column:*** *(Use this for one of your column s– intersection of grid lines A & 2)*

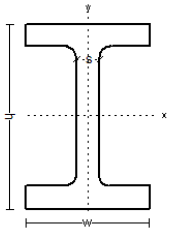


Criteria-

Cross Sectional Area 22 to 25 sq inches

Size Range 12 to 16 inches square

4. ***Wide Flange Beam:*** *(use this for all your beams)*

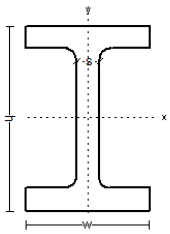


Criteria-

Cross Sectional Area 30 to 35 sq inches

Depth Range 20 to 22 inches

5. ***Wide Flange Notched Beam:*** *(use this for your notched beam)*

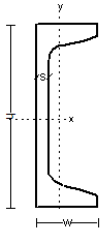


Criteria-

Cross Sectional Area 17 to 20 sq inches

Depth Range 18 to 19 inches

6. ***C-Channel:*** *(use this for your diagonal bracing – along grid line B)*



Criteria-

Cross Sectional Area 6 to 9 sq inches

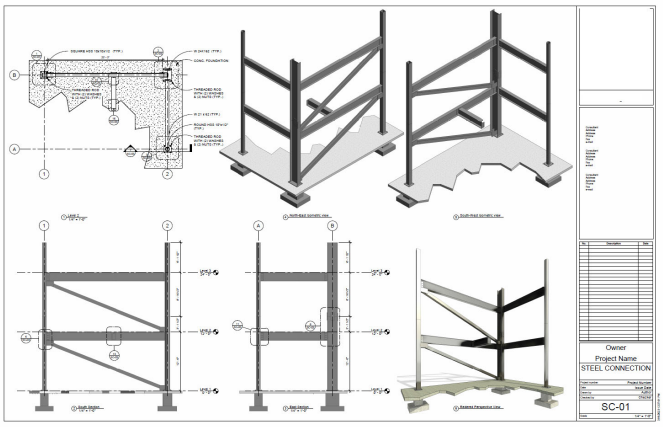
Depth Range 8 to 10 inches

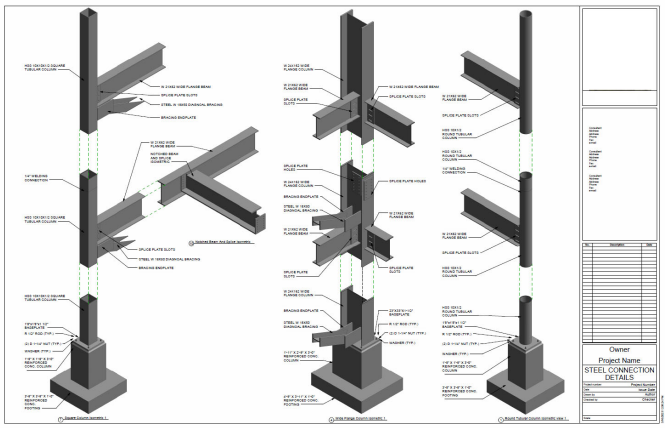
***Day 1:* In Class Work: Introduction to Steel Connections Assignment**

- *Create new Revit Project File. Grid Spacing 25' x 15'. Standard 22 x 34 titleblock.*
- *Working in teams – select column and beams based on criteria provided*
- *Model families for 3 columns (Wide Flange, HSS-Round Hollow, HSS-Square or Rectangular Hollow), Wide Flange Beam, Wide Flange Notched Beam, C-Channel diagonal Bracing, Splice plates as required.*

Day 2: Pinup #1 *–(Sheet SC-01 Steel Connection Overview) & (Sheet SC-02 Steel Connection Exploded Isometric)*

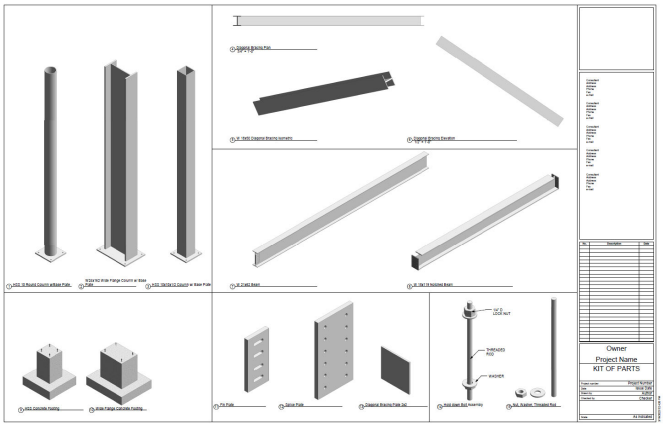
- *Basic layout sheet – plan, 2 elevations, 2 isometrics (all at **¼" scale**) , 1 perspective*
- *Exploded isometric using plan views and "Orient to View". All at **¾" scale** views aligned with annotation.*

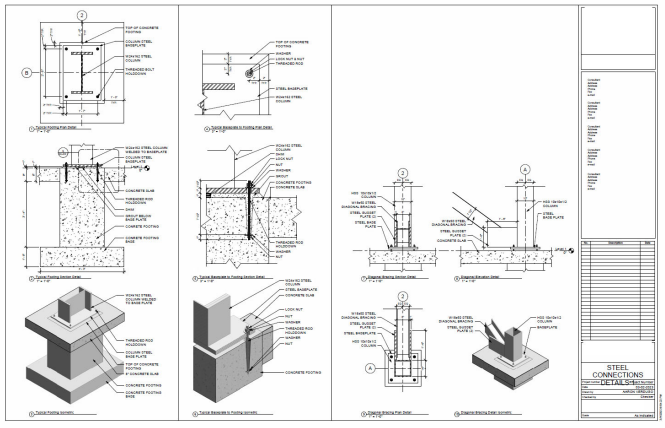




Day 3: Pinup #2 *–(Update first 2 sheets) & add (SC-03 Family Kit of Parts) & (SC-04 Footing and column base connection)*

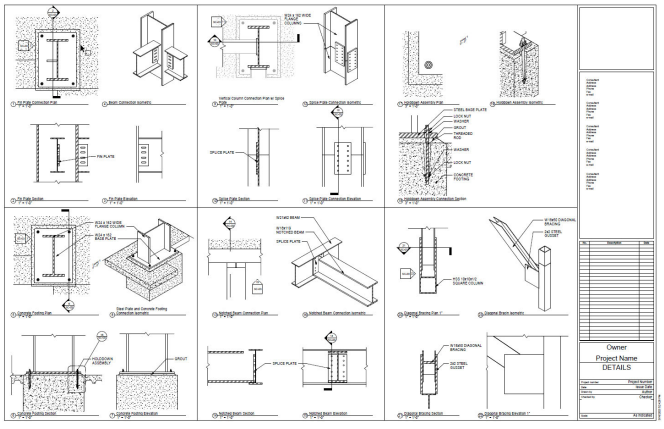
- *Kit of parts (scales vary – large to be readable) & Footing detail connections (appropriate scales 1" or 1 ½" and/or 3")*
- *Add additional families including notched beam, footing baseplate and bolt assembly.*
- *First pass at adding annotations.*

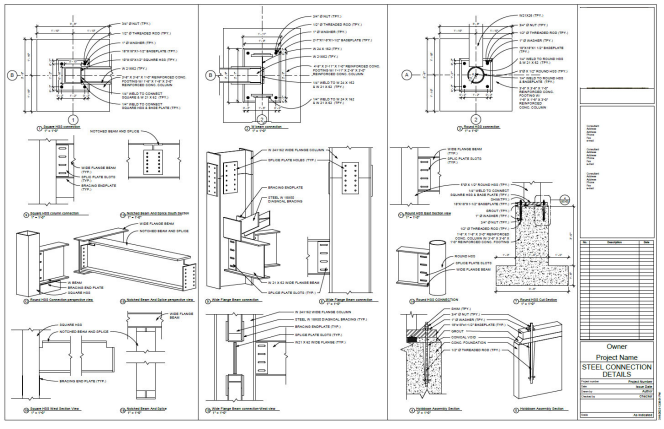




Day 4: Final Pinup #3 *–(All Sheets SC-01 to SC-04) plus (SC-05 illustrating at least 3 detail conditions using the 4 views)*

- *One or two sheets as needed for additional details (appropriate scales 1" or 1 ½" and/or 3")*
- *Add /modify final annotations as needed to all sheets.*

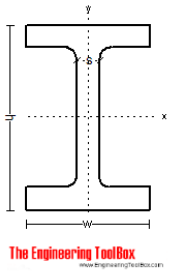




CITY TECH IS CUNY

Wide Flange Steel Beams & Columns

https://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html

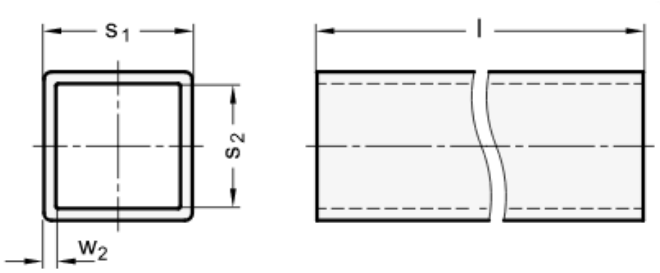


W-beams - wide flange beams - are stout, sturdy beams with wide flanges positioned perpendicularly to the web of the material giving them their characteristic shape and distinguishing them from I-beams.

Designation Imperial *(in x lb/ft)*	Depth h *(in)*	Width w *(in)*	Web Thickness t_w *(in)*	Flange Thickness t_f *(in)*	Sectional Area *(in^2)*	Weight *(lb_f/ft)*	Static Parameters			
							Moment of Inertia		Elastic Section Modulus	
							I_x *(in^4)*	I_y *(in^4)*	S_x *(in^3)*	S_y *(in^3)*
W 24 x 162	25	13	0.705	1.220	47.7	162	5170	443	414	68.4
W 24 x 146	24.7	12.9	0.650	1.090	43.0	146	4580	391	371	60.5
W 24 x 131	24.5	12.9	0.605	0.960	38.5	131	4020	340	329	53.0
W 24 x 117	24.3	12.8	0.55	0.850	34.4	117	3540	297	291	46.5
W 24 x 104	24.1	12.75	0.500	0.750	30.6	104	3100	259	258	40.7
W 24 x 94	24.1	9.07	0.515	0.875	27.7	94	2700	109	222	24.0
W 24 x 84	24.1	9.02	0.470	0.770	24.7	84	2370	94.4	196	20.9
W 24 x 76	23.9	9	0.440	0.680	22.4	76	2100	82.5	176	18.4
W 24 x 68	23.7	8.97	0.415	0.585	20.1	68	1830	70.4	154	15.7
W 24 x 62	23.7	7.04	0.430	0.590	18.2	62	1550	34.5	131	9.8
W 24 x 55	23.6	7.01	0.395	0.505	16.2	55	1350	29.1	114	8.3
W 21 x 147	22.1	12.51	0.720	1.150	43.2	147	3630	376	329	60.1
W 21 x 132	21.8	12.44	0.650	1.035	38.8	132	3220	333	295	53.5
W 21 x 122	21.7	12.39	0.600	0.960	35.9	122	2960	305	273	49.2
W 21 x 111	21.5	12.34	0.550	0.875	32.7	111	2670	274	249	44.5
W 21 x 101	21.4	12.29	0.500	0.800	29.8	101	2420	248	227	40.3
W 21 x 93	21.6	8.42	0.580	0.930	27.3	93	2070	92.9	192	22.1
W 21 x 83	21.4	8.36	0.515	0.835	24.3	83	1830	81.4	171	19.5
W 21 x 73	21.2	8.3	0.455	0.740	21.5	73	1600	70.6	151	17.0
W 21 x 68	21.1	8.27	0.430	0.685	20.0	68	1480	64.7	140	15.7
W 21 x 62	21	8.24	0.400	0.615	18.3	62	1330	57.5	127	13.9
W 21 x 57	21.1	6.56	0.405	0.650	16.7	57	1170	30.6	111	9.4
W 21 x 50	20.8	6.53	0.380	0.535	14.7	50	984	24.9	94.5	7.6
W 21 x 44	20.7	6.5	0.350	0.450	13.0	44	843	20.7	81.6	6.4
W 18 x 119	19	11.27	0.655	1.060	35.1	119	2190	253	231	44.9
W 18 x 106	18.7	11.2	0.590	0.940	31.1	106	1910	220	204	39.4
W 18 x 97	18.6	11.15	0.535	0.870	28.5	97	1750	201	188	36.1
W 18 x 86	18.4	11.09	0.480	0.770	25.3	86	1530	175	166	31.6
W 18 x 76	18.2	11.04	0.425	0.680	22.3	76	1330	152	146	27.6
W 18 x 71	18.5	7.64	0.495	0.810	20.8	71	1170	60.3	127	15.8
W 18 x 65	18.4	7.59	0.450	0.750	19.1	65	1070	54.8	117	14.4
W 18 x 60	18.2	7.56	0.415	0.695	17.6	60	984	50.1	108	13.3
W 18 x 55	18.1	7.53	0.390	0.630	16.2	55	890	44.9	98.3	11.9
W 18 x 50	18	7.5	0.355	0.570	14.7	50	800	40.1	88.9	10.7

HSS (High Strength Stee) Square Hollow Structural Sections

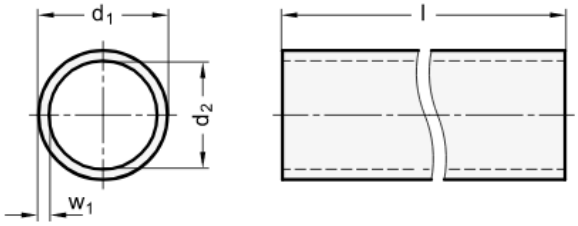
https://www.engineeringtoolbox.com/square-hollow-structural-sections-hss-d_1478.html



Square Hollow Structural Sections - HSS												
Nominal Size [3]	Weight	Wall Thickness	b/t [1]	h/t [1]	Cross Sectional Area [2]	I [1]	S [1]	r [1]	Z [1]	Torsional Stiffness Constant J	Torsional Shear Constant C	Surface Area
(in x in x in)	*(lbf/ft)*	*(in)*	-	-	*(in^2)*	*(in^4)*	*(in^3)*	*(in)*	*(in^3)*	*(in^4)*	*(in^3)*	*(ft^2/ft)*
20 x 20 x 5/8	157.75	0.625	29.0	29.0	46.4	2830	283	7.81	331	4670	465	6.34
20 x 20 x 1/2	129.06	0.500	37.0	37.0	37.9	2370	237	7.90	275	3790	379	6.45
20 x 20 x 3/8	98.12	0.375	50.3	50.3	28.8	1830	183	7.97	211	2880	288	6.51
18 x 18 x 5/8	140.73	0.625	25.8	25.8	41.4	2020	224	6.99	264	3370	373	5.68
18 x 18 x 1/2	115.45	0.500	33.0	33.0	33.9	1700	189	7.08	220	2740	305	5.79
18 x 18 x 3/8	87.91	0.375	45.0	45.0	25.8	1320	147	7.15	169	2090	232	5.84
16 x 16 x 5/8	127.37	0.581	24.5	24.5	35.0	1370	171	6.25	200	2170	276	5.17
16 x 16 x 1/2	103.30	0.465	31.4	31.4	28.3	1130	141	6.31	164	1770	224	5.20
16 x 16 x 3/8	78.52	0.349	42.8	42.8	21.5	873	109	6.37	126	1350	171	5.23
16 x 16 x 5/16	65.87	0.291	52.0	52.0	18.1	739	92.3	6.39	106	1140	144	5.25
14 x 14 x 5/8	110.36	0.581	21.1	21.1	30.3	896	128	5.44	151	1430	208	4.50
14 x 14 x 1/2	89.68	0.465	27.1	27.1	24.6	743	106	5.49	124	1170	170	4.53
14 x 14 x 3/8	68.31	0.349	37.1	37.1	18.7	577	82.5	5.55	95.4	900	130	4.57
14 x 14 x 5/16	57.36	0.291	45.1	45.1	15.7	490	69.9	5.58	80.5	759	109	4.58
12 x 12 x 5/8	93.34	0.581	17.7	17.7	25.7	548	91.3	4.62	109	885	151	3.83
12 x 12 x 1/2	76.07	0.465	22.8	22.8	20.9	457	76.2	4.68	89.6	728	123	3.87
12 x 12 x 3/8	58.10	0.349	31.4	31.4	16.0	357	59.5	4.73	69.2	561	94.6	3.90
12 x 12 x 5/16	48.86	0.291	38.2	38.2	13.4	304	50.7	4.76	58.6	474	79.7	3.92
12 x 12 x 1/4	39.43	0.233	48.5	48.5	10.8	248	41.4	4.79	47.6	384	64.5	3.93

HSS (High Strength Stee) Circular Hollow Structural Sections

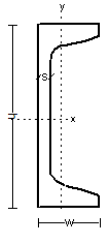
https://sketchup.engineeringtoolbox.com/circular-hollow-structural-sections-hss-c_80.html



Designation	Outside Diameter	Mass	Wall Thickness	Area of Section	Second Moment of Area - Ix
	in	lb/ft	in	in**2	in**4
20x0.5	20	104.23	0.465	28.5	1360
20x0.375	20	78.67	0.349	21.5	1040
18x0.5	18	93.54	0.465	25.6	985
18x0.375	18	70.65	0.349	19.4	754
16x0.5	16	82.85	0.465	22.7	685
16x0.438	16	72.86	0.407	19.9	606
16x0.375	16	62.64	0.349	17.2	526
16x0.312	16	52.32	0.291	14.4	443
14x0.5	14	72.16	0.465	19.8	453
14x0.375	14	54.62	0.349	15	349
14x0.312	14	45.65	0.291	12.5	295
12.75x0.5	12.75	65.48	0.465	17.9	339
12.75x0.375	12.75	49.61	0.349	13.6	262
12.75x0.25	12.75	33.41	0.233	9.16	180
12.5x0.625	12.5	79.34	0.581	21.8	387
12.5x0.5	12.5	64.14	0.465	17.6	319
12.5x0.375	12.5	48.61	0.349	13.3	246
12.5x0.312	12.5	40.65	0.291	11.2	208
12.5x0.25	12.5	32.74	0.233	8.98	169
12.5x0.188	12.5	24.74	0.174	6.74	128
12.313x0.625	12.31	78.09	0.581	21.4	369
12.313x0.5	12.31	63.14	0.465	17.3	304
12.313x0.375	12.31	47.86	0.349	13.1	235
12.313x0.312	12.31	40.03	0.291	11	199
12.313x0.25	12.31	32.24	0.233	8.84	161
12.313x0.188	12.31	24.37	0.174	6.64	122
12.25x0.625	12.25	77.67	0.581	21.3	363

C-Channels

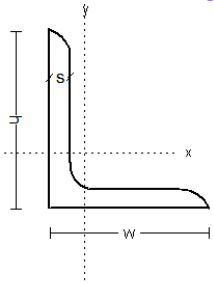
https://www.engineeringtoolbox.com/american-standard-steel-channels-d_1321.html



Designation	Dimensions					Static Parameters			
						Moment of Inertia		Elastic Section Modulus	
Imperial (in x lb/ft)	Depth - h - (in) (mm)	With - w - (in) (mm)	Web Thickness - s - (in) (mm)	Sectional Area (in^2)	Weight (lb_f/ft)	I_x (in^4)	I_y (in^4)	S_x (in^3)	S_y (in^3)
C 15 x 50	15	3.716	0.716	14.7	50	404	11.0	53.8	3.78
C 15 x 40	15	3.520	0.520	11.8	40	349	9.23	46.5	3.37
C 15 x 33.9	15	3.400	0.400	9.96	33.9	315	8.13	42.0	3.11
C 12 x 30	12	3.170	0.510	8.82	30	162	5.14	27.0	2.06
C 12 x 25	12	3.047	0.387	7.35	25	144	4.47	24.1	1.88
C 12 x 20.7	12	2.942	0.282	6.09	20.7	129	3.88	21.5	1.73
C 10 x 30	10	3.033	0.673	8.82	30	103	3.94	20.7	1.65
C 10 x 25	10	2.886	0.526	7.35	25	91.2	3.36	18.2	1.48
C 10 x 20	10	2.739	0.379	5.88	20	78.9	2.81	15.8	1.32
C 10 x 15.3	10	2.600	0.240	4.49	15.3	67.4	2.28	13.5	1.16
C 9 x 20	9	2.648	0.448	5.88	20	60.9	2.42	13.5	1.17
C 9 x 15	9	2.485	0.285	4.41	15	51.0	1.93	11.3	1.01
C 9 x 13.4	9	2.433	0.233	3.94	13.4	47.9	1.76	10.6	0.96
C 8 x 18.75	8	2.527	0.487	5.51	18.75	44.0	1.98	11.0	1.01
C 8 x 13.75	8	2.343	0.303	4.04	13.75	36.1	1.53	9.03	0.85
C 8 x 11.5	8	2.260	0.220	3.38	11.5	32.6	1.32	8.14	0.78
C 7 x 14.75	7	2.299	0.419	4.33	14.75	27.2	1.38	7.78	0.78
C 7 x 12.25	7	2.194	0.314	3.60	12.25	24.2	1.17	6.93	0.70
C 7 x 9.8	7	2.090	0.210	2.87	9.8	21.3	0.97	6.08	0.63
C 6 x 13	6	2.157	0.437	3.83	13	17.4	1.05	5.80	0.64
C 6 x 10.5	6	2.034	0.314	3.09	10.5	15.2	0.87	5.06	0.56
C 6 x 8.2	6	1.920	0.200	2.40	8.2	13.1	0.69	4.38	0.49
C 5 x 9	5	1.885	0.325	2.64	9	8.90	0.63	3.56	0.45
C 5 x 6.7	5	1.750	0.190	1.97	6.7	7.49	0.48	3.00	0.38
C 4 x 7.25	4	1.721	0.321	2.13	7.25	4.59	0.43	2.29	0.34
C 4 x 5.4	4	1.584	0.184	1.59	5.4	3.85	0.32	1.93	0.28
C 3 x 6	3	1.596	0.356	1.76	6	2.07	0.31	1.38	0.27
C 3 x 5	3	1.498	0.258	1.47	5	1.85	0.25	1.24	0.23
C 3 x 4.1	3	1.410	0.170	1.21	4.1	1.66	0.20	1.10	0.20

Steel Angles – Unequal Legs

https://www.engineeringtoolbox.com/steel-angles-unequal-legs-d_1323.html



Size (in x in)	Dimensions					Static Parameters			
						Moment of Inertia		Section Modulus	
	Depth h (in)	With w (in)	Thickness s (in)	Sectional Area (in^2)	Weight (lb_f/ft)	I_x (in^4)	I_y (in^4)	W_x (in^3)	W_y (in^3)
4 x 3 1/2	4	3 1/2	5/8	4.3	14.7	6.37	4.52	2.35	1.84
	4	3 1/2	1/2	3.5	11.9	5.32	3.79	1.94	1.52
	4	3 1/2	7/16	3.1	10.6	4.76	3.40	1.72	1.35
	4	3 1/2	3/8	2.7	9.1	4.18	2.95	1.49	1.17
	4	3 1/2	5/16	2.3	7.7	3.56	2.55	1.26	0.99
	4	3 1/2	1/4	1.8	6.2	2.91	2.09	1.03	0.81
4 x 3	4	3	5/8	4.0	13.6	6.03	2.87	2.30	1.35
	4	3	1/2	3.3	11.1	5.05	2.42	1.89	1.12
	4	3	7/16	2.9	9.8	4.52	2.18	1.68	0.99
	4	3	3/8	2.5	8.5	3.96	1.92	1.46	0.87
	4	3	5/16	2.1	7.2	3.38	1.65	1.23	0.73
	4	3	1/4	1.7	5.8	2.77	1.36	1.00	0.60
3 1/2 x 3	3 1/2	3	1/2	3.0	10.2	3.45	2.33	1.45	1.10
	3 1/2	3	7/16	2.7	9.1	3.10	2.09	1.29	0.98
	3 1/2	3	3/8	2.3	7.9	2.72	1.85	1.13	0.85
	3 1/2	3	5/16	1.9	6.6	2.33	1.58	0.95	0.72
	3 1/2	3	1/4	1.6	5.4	1.91	1.30	0.78	0.59
3 1/2 x 2 1/2	3 1/2	2 1/2	1/2	2.8	9.4	3.24	1.36	1.41	0.76
	3 1/2	2 1/2	7/16	2.4	8.3	2.91	1.23	1.26	0.68
	3 1/2	2 1/2	3/8	2.1	7.2	2.56	1.09	1.09	0.59
	3 1/2	2 1/2	5/16	1.8	6.1	2.19	0.94	0.93	0.50
	3 1/2	2 1/2	1/4	1.4	4.9	1.80	0.78	0.76	0.41
3 x 2 1/2	3	2 1/2	1/2	2.5	8.5	2.08	1.30	1.04	0.74
	3	2 1/2	7/16	2.2	7.6	1.88	1.18	0.93	0.66
	3	2 1/2	3/8	1.9	6.6	1.66	1.04	0.81	0.58
	3	2 1/2	5/16	1.6	5.6	1.42	0.90	0.69	0.49
	3	2 1/2	1/4	1.3	4.5	1.17	0.75	0.56	0.40
	3	2 1/2	3/16	1.0	3.4	0.91	0.58	0.43	0.31
3 x 2	3	2	1/2	2.3	7.7	1.92	0.67	1.00	0.47
	3	2	7/16	2.0	6.8	1.73	0.61	0.89	0.42
	3	2	3/8	1.7	5.9	1.53	0.54	0.78	0.37
	3	2	5/16	1.5	5.0	1.32	0.74	0.66	0.32
	3	2	1/4	1.2	4.1	1.09	0.39	0.54	0.26
	3	2	3/16	0.9	3.1	0.84	0.31	0.42	0.20