StiffWall® Shear Wall System Introduction

600C/STW250-68-1-SM-10ft-9-1/4”

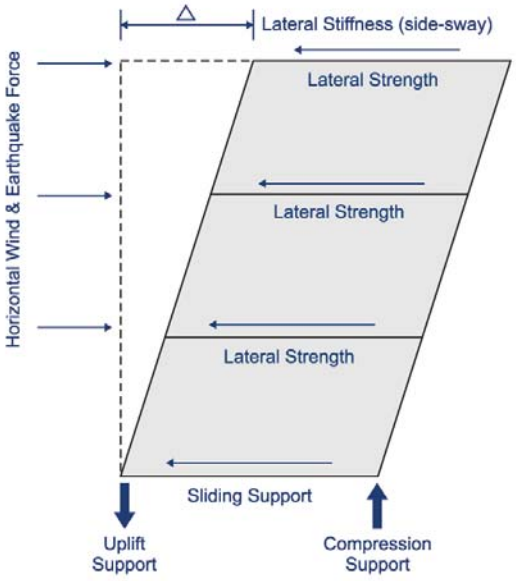
- **Overall Depth** — *Ex: 600 = 6” Wall Framing*
- **C/STW StiffWall® Column**
- **Flange Width** — *Ex: 250 = 2.5” Column Flange*
- **Material Thickness**
- **# of Column Pieces** — *(1, 2, 3P, 4P or 5P)*
- **Boot Type**
  - *LT = Light Boot*
  - *PL = Plus Boot*
  - *SM = Small Boot*
  - *ME = Medium Boot*
  - *TR = Transition Boot*
  - *LG = Large Boot*
- **Clear Span of Bearing Wall** — *Provide the height of the wall span (same as the height of the load bearing wall studs). Distance is given feet + fractions of inches.*

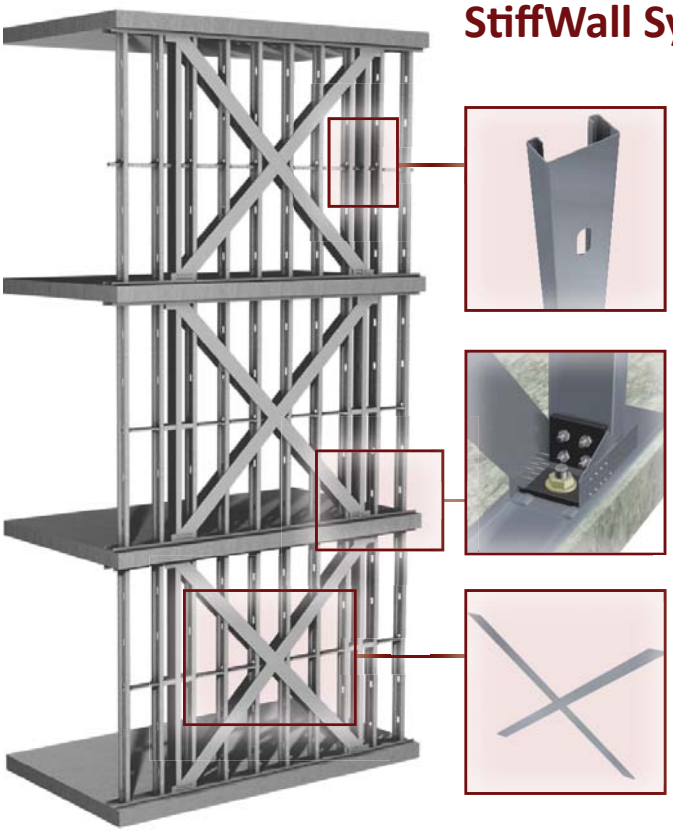
Background

StiffWall® SWS is a stick build system designed to carry loads concentrically from the point of applied loads to the foundation or other termination point, that utilizes light gage straps on both sides of the wall for shear resistance. StiffWall provides superior quality with high yield ASTM A1003 steel and hot-dipped galvanized coating for long-term durability. It is specified using simple nomenclature indicating only essential design requirements for each shear wall element. The design is ideal for job specific sizes with established load requirements. The Steel Network has optimized the design and fabrication of StiffWall through a series of both component and full scale wall assembly tests, using state of the art technology to measure performance.

StiffWall shear walls provide both lateral strength and stiffness. Lateral strength is needed to resist horizontal loads due to wind and earthquake forces. Properly designed and constructed shear walls transfer lateral forces to the next structural element in the load path below them, such as other shear walls, floors, or foundations.

Lateral stiffness is needed to prevent excessive side-sway of the structure. When shear walls are of adequate stiffness, they will maintain the lateral deflection or serviceability requirements of the building. In addition, buildings with sufficient lateral stiffness will suffer less nonstructural damage, further avoiding long-term degradation due to veneer cracking and water infiltration.





StiffWall System Components:

Columns (C/STW)

- End posts for the shear wall
- Wider flange and additional return lips provide an increased load capacity over standard steel stud sections

Boots

- Made up of a Strap Track (97 mil, 12” long track section with pre-punched screw pilot holes) and a Base Plate (“T” shaped structural steel), specified bolts for connection to column, and is designed to fit into a standard size track.
- Transfers the loads from the straps and columns through the floor system down to the foundation
- Pre-installed on top and bottom of each column by TSN
- Fits into a standard track (T) section

Flat Strap

- Runs diagonally (corner to corner) as a single piece and attaches to the strap track in an “X” pattern
- Four (4) pieces of flat strap are used in each StiffWall (2 pcs each side)
- Made to your specifications, always using 50 ksi steel

TightStrap®

- Device used to tension (tighten) flat strap in the field
- Removes “waviness” or “bowing” prior to fastening
- Ensures flat straps are as tight as possible when installed to achieve optimal system performance
- Fastens to standard track at the corners of the shear wall to provide a base for the tensioning process

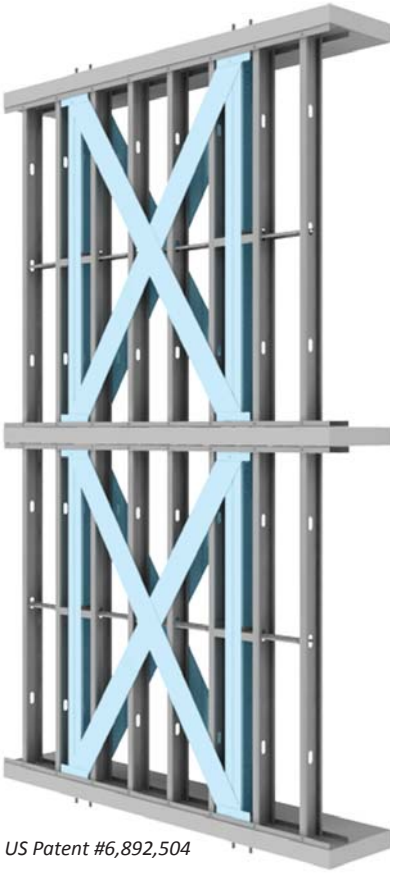
** The infill studs are not part of the StiffWall system and act independently of the shear wall. The floor slabs are part of the lateral load resisting system, but are not part of TSN StiffWall system.*

StiffWall® Shear Wall System

Planning Shear Walls

To develop an efficient shear wall layout several factors need to be considered:

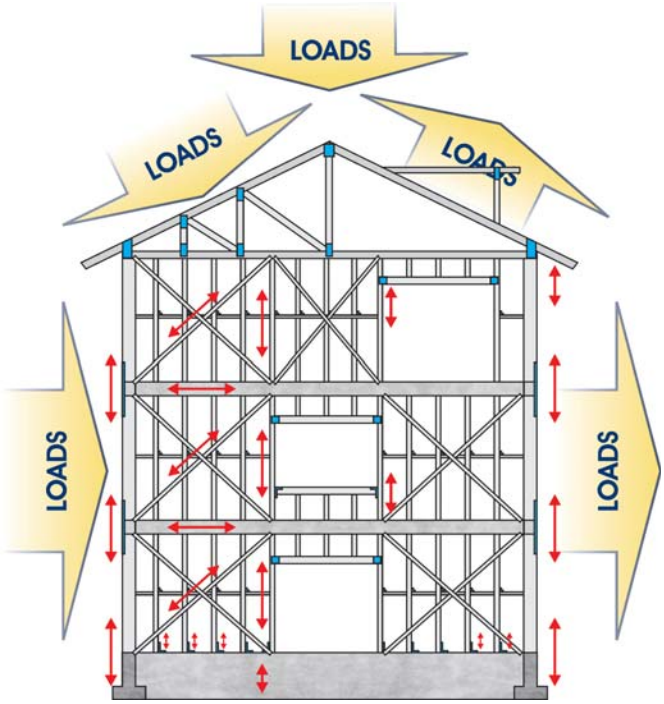
- Height to Width aspect ratio guidelines should be observed in order to maximize effectiveness
- Shear walls should be evenly distributed across the floor plan to reduce additional lateral loads resulting from torsional effects on the floor plan
- Shear Walls located in load bearing walls may use floor dead loads with the appropriate load combination to offset uplift forces in the StiffWall
- Walls must stack vertically from top floor of structure to anchorage point or foundation
- Shear walls may overlap when the available wall space has been depleted



US Patent #6,892,504

StiffWall® Benefits That Add Value

- Templates are not required for hold-downs, eliminating unrealistic field procedures.
- Designed and manufactured to meet the performance requirements of the project.
- Satisfies maximum story drift requirements per IBC.
- Only mill certified high strength steel is used.
- Plywood sheathing with fastener schedules and/or CMU shear walls are eliminated.
- Inspection is limited to simple connections at corners.
- Exceeds industry standards for sizes and loads.
- Versatile design may be incorporated into steel, concrete and wood construction
- Tested for multi-story application and capable of carrying loads present in 10 story buildings.
- No welds or controlled inspections associated with welding.
- Simplified anchoring system through floors and at roof termination.
- Each component is selected to meet or exceed both strength and stiffness requirements of the applicable building code.
- The strap system is on the outside of the wall to facilitate electrical and pipe work in the wall cavity.
- Allows 3 times the window space of plywood braced structures.



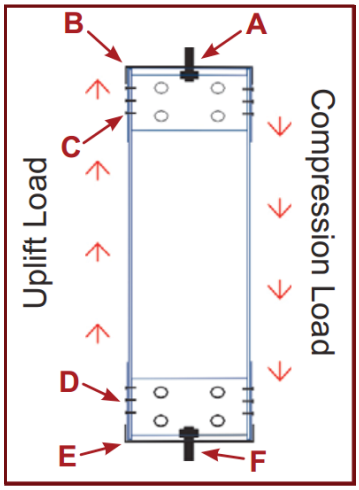
Verifying Load Paths

Tracing and verifying load paths through a structure is crucial to protect engineering liability. Loads need to migrate from the roof, through the wall and floor systems, and terminate in the foundation. Shear wall systems transfer lateral loads from the member above (i.e. floor slab) to the member below (i.e. foundation). StiffWall® provides a traceable, easily verifiable load path through the structure.

A Load transfers from the floor above through the floor connector, and to the StiffWall Boot
B From the Boot to the Strap Track*
C From the Strap Track to the flat strap*
D Through the flat strap to the Strap Track at opposite corner*
E From the Strap Track to the Boot
F From the Boot to the floor/system or foundation below

** The column section assumes the compression loads.*

** Uplift forces are transferred through the StiffWall® Boot through full bearing onto the SWS Boot Base Plate to the anchor.*

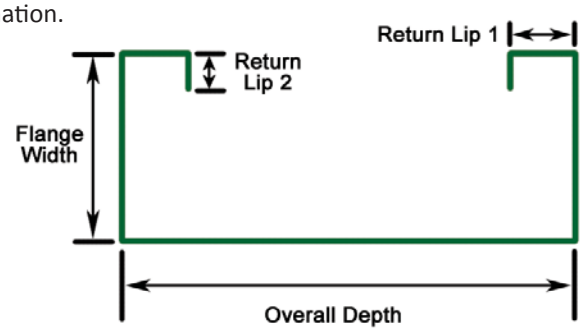


Simple Steps to Design Shear Walls

The following pages offer a guide for the design of the StiffWall® shear wall system. In addition, SteelSmart® System software is available (at www.steelsmartsystem.com) to select the optimal column, boot, strap and fasteners used in the installation of StiffWall. Contact The Steel Network for additional design information.

Step 1 - Select StiffWall® Column

This unique column contains an additional return lip to form a double lip, thus creating a stronger, more effective bearing section. The column is the main vertical load-bearing transfer element in StiffWall.



Important Note:

The StiffWall Boot must be used with the StiffWall Column. Standard stud (S) sections will not fit inside the StiffWall Boot or Strap Track.

Step 2 - Select StiffWall® Boot

The StiffWall Boot is a critical element enabling StiffWall to simultaneously resist higher loads and provide positive load transfer between elements, something conventional shear wall systems do not provide. Six different StiffWall Boots are available for accommodating changing loading requirements. Refer to the Boot Capacities table data to select the appropriate Boot to fit project conditions.

Step 3 - Determine Column-To-Boot Uplift Fastener Requirement

Attaching to the StiffWall Column with #12 screws or 0.5" A325 bolts, the boot enhances construction efficiency by reducing the number of installed fasteners used in conventional flat strap shear walls. For uplift conditions, calculate the number of screws for the Light and Plus Boots by dividing the total uplift force by the single screw shear. For Small, Medium, Transition, and Large Boots, refer to the chart below for the number of fasteners to the column.

Single Column Allowable Uplift Load (T2) (kips)

Column Thickness		Light / Plus Boot	Small Boot			Medium / Transition Boot									Large Boot		
		(1) # 12 Screw	350, 362 & 400	550 & 600	800	350, 362 & 400			550 & 600	800	550 & 600	800	550 & 600	800	350, 362 & 400	550 & 600	800
(mils)	(inch)		(2) Bolts	(4) Bolts		(3) Bolts	(4) Bolts	(5) Bolts	(6) Bolts		(8) Bolts		(10) Bolts		(7) Bolts	(14) Bolts	
33	0.0346	0.27	1.71	3.43	3.43	2.57	3.43	4.13	5.14	5.14	6.85	6.85	7.50	8.56	5.27	9.78	11.30
43	0.0451	0.41	2.30	4.59	4.59	3.45	4.59	5.38	6.89	6.89	9.19	9.19	9.77	11.48	6.87	12.74	14.72
54	0.0566	0.57	2.97	5.94	5.94	4.46	5.94	6.75	8.91	8.91	11.88	11.88	12.26	14.75	8.62	15.99	18.48
68	0.0713	0.78	3.88	7.77	7.77	5.83	7.77	8.51	11.65	11.65	15.54	15.54	15.45	18.58	10.86	20.15	23.28
97	0.1017	0.78	5.96	11.92	11.92	8.94	11.92	12.13	17.88	17.88	23.84	23.84	22.04	26.50	15.48	28.73	33.20
118	0.1242	0.78	7.66	14.64	15.32	11.49	15.32	14.82	22.98	22.98	29.36	30.64	26.91	32.36	18.91	35.09	40.55

Back-to-Back and Built-Up Column Allowable Uplift Load (T2) (kips)

Column Thickness		Light / Plus Boot	Small Boot			Medium / Transition Boot									Large Boot		
		(1) # 12 Screw	350, 362 & 400	550 & 600	800	350, 362 & 400			550 & 600	800	550 & 600	800	550 & 600	800	350, 362 & 400	550 & 600	800
(mils)	(inch)		(2) Bolts	(4) Bolts		(3) Bolts	(4) Bolts	(5) Bolts	(6) Bolts		(8) Bolts		(10) Bolts		(7) Bolts	(14) Bolts	
33	0.0346	N / A	3.43	6.85	6.85	5.14	6.85	8.26	10.28	10.28	13.70	13.70	14.99	17.13	10.54	19.55	22.59
43	0.0451	N / A	4.59	9.19	9.19	6.89	9.19	10.76	13.78	13.78	18.37	18.37	19.54	22.97	13.73	25.49	29.45
54	0.0566	N / A	5.94	11.88	11.88	8.91	11.88	13.51	17.82	17.82	23.77	23.77	24.53	29.50	17.23	31.98	36.96
68	0.0713	N / A	7.77	15.54	15.54	11.65	15.54	17.01	23.31	23.31	31.08	31.08	30.90	37.16	21.71	40.29	46.55
97	0.1017	N / A	10.60	21.21	21.21	15.90	21.21	24.27	31.81	31.81	42.41	42.41	44.07	53.00	30.97	57.47	66.40
118	0.1242	N / A	10.60	21.21	21.21	15.90	21.21	26.51	31.81	31.81	42.41	42.41	53.01	53.01	37.11	70.18	74.22

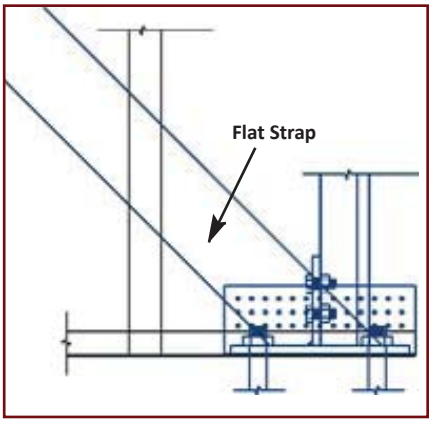
- Bolts referenced in table are ASTM F3125 Grade A325 bolts bolts.
- Refer to the Design Example for uplift requirements.
- Allowable loads for screws are based on AISI S100 Specification, Section E4.3.
- Maximum allowable load per (1) #12 screw in shear is equal to 0.849 kips, based on commercial screw data.
- Allowable loads for bolts are based on AISI S100, Section E3.3.2.
- Maximum allowable load per (1) A325 bolt in shear is equal to 4.42 kips, based on AISI S100, Section E3.4.

* Compression loads are transferred via full column bearing onto boot.

Step 4 - Select Stiffwall® Flat Strap

Flat strap is the tension element used to transfer loads between diagonally located strap tracks. Flat strap selection is simplified to 5 strap types (see chart below), with load capacity factored using standard 12ga (97mils) strap track.

Strap Width	Strap Thickness	Yield Strength	Recommended # of screws/ row	Allowable Tension in Single Strap	No. of #12 Screws for Max. Strap Tension
(in)	(mil)	(ksi)	(#)	(kips)	# (kips)
4	54	50	4	5.77	11 (6.26)
6	54		6	8.65	16 (9.10)
8	54		8	11.54	21 (11.95)
8	68		8	14.53	19 (14.76)
10	68		10	18.17	24 (18.65)



- Screw shear values are based on #12 (0.216") screw attached to 97 mil (12 ga) Strap Track.
- Minimum screw spacing = 3d
- Minimum screw edge distance = 1.5d

It is recommended to limit the use of 10" flat strap to shear wall panels that have aspect ratio > 0.72:1 (36 degrees)

Step 5 - Condition 1: Anchor Design At Foundation

Refer to Section 3.1.8 in the Hilti North American Product Technical Guide Volume 2, to design anchors at the foundation. For typical details of StiffWall at foundation, see Example Details provided in this catalog. TSN recommends the use of a washer, lock washer, double-nut washer, or tack weld at each end of the bolt.

Allowable Tension and Shear Values of Hilti HIT-RE 500 Adhesive Anchors							
Anchor Diameter	Embedment Depth	Tension			Shear (Non Seismic Design)		
		Based on Bond or Concrete		Based on Steel Strength	Based on Bond or Concrete		Based on Steel Strength
		f'c = 2000 psi	f'c = 4000 psi	ASTM A193 B7	f'c = 2000 psi	f'c = 4000 psi	ASTM A193 B7
(in)	(in)	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)
⅞"	4	3,005	5,665	24,805	7,795	11,020	12,780
	7 ⅞	12,495	15,875		17,175	24,290	
	10 ½	14,705	16,185		26,440	37,390	
1 ¼"	5 ⅝	5,760	12,815	50,620	14,760	20,870	26,080
	11 ¼	24,610	31,620		35,050	49,570	

- Bond, concrete, and steel values are referenced from Hilti North American Product Technical Guide Volume 2.
- Apply influence factors for spacing and/or edge distance to concrete/bond values, then compare to the steel strength value. The lesser value is to be used for design.
- Applied tension force shall include tension resulting from prying action produced by deformation of connected parts.
- For design of anchorage under seismic conditions, refer to ACI 318 Appendix D - Anchoring to Concrete provisions.

Step 5 - Condition 2: Through Floor Fastener Connection

Refer to Section E3.4 in the AISI S100-12 to design through floor bolt fasteners. For typical details of StiffWall at foundation, see Example Details provided in this catalog. TSN recommends the use of a washer, lock washer, double-nut washer, or tack weld at each end of the bolt. For typical details of StiffWall at top termination (roof) and through floors, see Example Details provided in this catalog.

Fastening StiffWall® Boot Through Floor		
Allowable Shear and Tension		
Shear Stress (F_v) for A325 Threads (ksi)	Tension Stress (F_t) (ksi)	Combined Shear (F_v) and Tension (F_t)
27.0	45.0	Section E3.4, AISI S100-12 Spec.

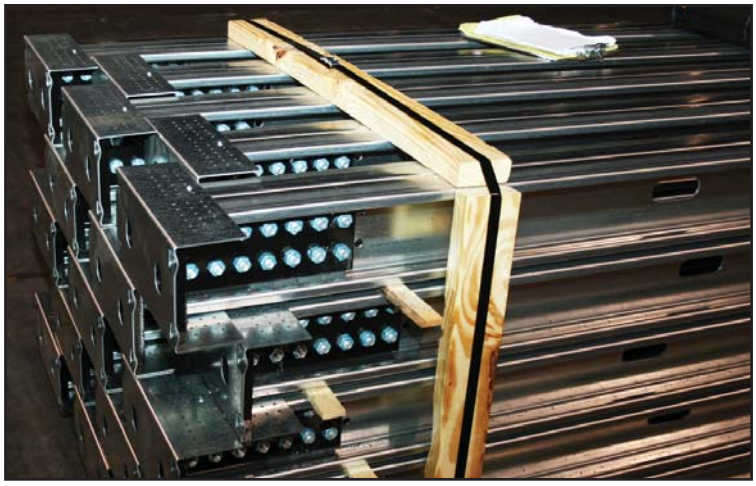
- Ensure full bearing between through-floor bolts and the floor slab. Enlarged or notched bolt holes in the slab must be filled with grout.
- Applied tension force shall include tension resulting from prying action produced by deformation of the connected parts.
- The area of a ⅞" bolt = 0.60 in^2 and area of 1 ¼" bolt = 1.23 in^2.
- Allowable Shear per one ⅞" A325 Bolt = 16.2 kips.
- Allowable Shear per one 1 ¼" A325 Bolt = 33.2 kips.
- Allowable Tension per one ⅞" A325 Bolt = 27.0 kips.
- Allowable Tension per one 1 ¼" A325 Bolt = 55.4 kips.
- ***Boot base plate guide holes for wall widths less than 5.5" accommodate ⅞" through-rods for Light, Plus, Small, Medium, and Large Boots.***
- ***Boot base plate guide holes for wall widths greater than or equal to 5.5" accommodate ⅞" through-rods for Light, Plus, Small, and Medium Boots. For Large Boots, the base plate guide holes accommodate 1 ¼" through-rods. To transition from a Large Boot with 1 ¼" through rods to any other boot type, a Transition Boot Kit is required, which will accommodate 1 ¼" through-rods on the base of wall, and ⅞" through rods at the head of the wall.***

Pre-Assembled Columns/Boots

Order Information

StiffWalls consist of two Column/Boot Assemblies (at each end post) and Flat Strap (2 sides of X-bracing). The StiffWall fits into or is embedded into the load bearing and non-load bearing walls. Do your stud take off as normal and order the Column/Boot Assembly and the Flat Strap as separate items. When ordering columns, determine the height of the bearing wall. TSN will size the StiffWall Column/Boot Assembly factoring in the dimensions of the boots at top and bottom. Each column is shipped with the boots pre-attached at the top and bottom as shown in the image to the right.

The added value of the pre-installed boots minimizes tolerance issues during erection. Simply specify the clear span of the bearing wall system and TSN will ship the Column/Boot assembly to meet the given wall height at a tolerance of +0/-⅛".



Nomenclature