Sturdi-Wall Plus Design Manual

for

SWP46, SWP66, SWP63, SWP64, SWP83, and SWP84 Models

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by
Brent Leatherman, P.E.
Timber Tech Engineering, Inc
E-Mail: bl@timbertecheng.com

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East: 22 Denver Road, Suite B Denver, PA 17517
717.335.2750 Fax: 717.335.2753

West: 206 S. Main St, P.O. Box 509 Kouts, IN 46347
219.766.2499 Fax: 219.766.2394

www.timbertecheng.com

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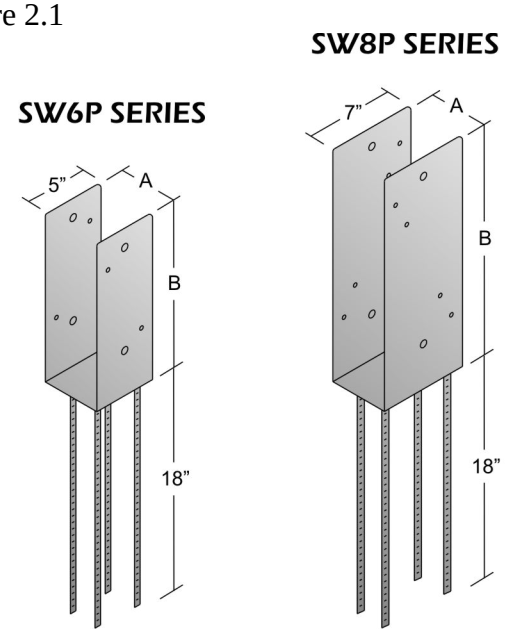
1. Design Overview

The Sturdi-Wall Plus base brackets are designed to connect wood columns to a concrete foundation in a typical post frame building application. This manual contains drawings and descriptions for each of the Sturdi-Wall Plus models, a chart showing allowable shear, uplift, and bending moment for Sturdi-Wall Plus base brackets, description of method for attachment to concrete, and discussion of design assumptions.

2. Sturdi-Wall Plus Descriptions

Dimensions for the SWP46, SWP66, SWP63, SWP64, SWP83 and SWP84 are given in Figure 2.1. The brackets are constructed with ¼" ASTM A36 steel and ¼" fillet welds of E70XX electrodes. Each assembled bracket has a powder coat finish. The SWP46 is to be used with a 4x6 wood post, SWP66 with a 6x6 wood post, SWP63 with a 3-ply 2x6 mechanically laminated column, SWP64 with a 4-ply 2x6 laminated column, SWP83 with a 3-ply 2x8 laminated column, and SWP84 with a 4-ply 2x8 laminated column. The Sturdi-Wall Plus Bracket dimensions are suitable for 3 and 4 ply 2x6 and 2x8 mechanically laminated columns.

Figure 2.1



	TYPE	DIM A	DIM B
SWP46	4" X 6" POST	3-5/8"	13"
SWP66	6" X 6" POST	5-5/8"	13"
SWP63	3 PLY 6" LAM COL	4-5/8"	13"
SWP64	4 PLY 6" LAM COL	6-1/8"	18"
SWP83	3 PLY 8" LAM COL	4-5/8"	18"
SWP84	4 PLY 8" LAM COL	6-1/8"	18"

3. Steel Bracket Design

The forces applied from the building columns to Sturdi-Wall Plus brackets are a vertical uplift force, a downward gravity force, a horizontal shear force, and a moment about the strong axis of the column. The wood columns should have direct bearing on the bottom to transfer axial loads directly into the concrete wall or foundation. Unlike the Sturdi-Wall brackets the Sturdi-Wall Plus brackets do have moment capacity and an allowable bending moment has been developed for each model. The building must be designed to resist lateral loads through diaphragm action or other bracing means which are assumed to be adequate to take up weak axis bending. All mechanical fasteners are to be installed as per the manufacturer's recommendations and this design manual. The brackets consist of ¼" ASTM A36 steel with A706 weldable reinforcing bars welded to the base of the bracket, #4 (1/2") for the SWP 4 and 6 Series brackets and #5 (5/8") for the SWP 8 Series brackets and 5/8" diameter holes for

the ½" diameter bolts in the vertical legs. The brackets also have 5/16" diameter holes for ¼" diameter Simpson SDS screws near the bolts in the vertical legs.

4. Concrete Reinforcing Bar Design

This manual includes recommendations for the use of concrete reinforcing bar (rebar) to provide a moment connection between the steel to concrete interface.

4.1 #4 (1/2" diameter) Rebar

The #4 rebar anchors are to be weldable ASTM A706 grade 60 straight rebar, 18" long. Four of the #4 rebar are welded to the bottom of the SWP 4 and 6 Series Base with a minimum of ¼" continuous fillet weld. One layer of the double ¼" steel base has a hole thru it to accept the rebar and provide superior weld penetration. The rebar is then cast in place by being set in wet concrete shortly after a wall or foundation pour. The rebar must be placed within the recommended cover noted in the design chart. The cast in place rebar allows for bending moments to transfer from the column to the steel bracket and into the concrete wall or foundation.

4.2 #5 (5/8" diameter) Rebar

The #5 rebar anchors are to be weldable ASTM A706 grade 60 straight rebar, 18" long. Four of the #5 rebar are welded to the bottom of the SWP 8 Series Base with a minimum of ¼" continuous fillet weld. One layer of the double ¼" steel base has a hole thru it to accept the rebar and provide superior weld penetration. The rebar is then cast in place by being set in wet concrete shortly after a wall or foundation pour. The rebar must be placed within the recommended cover noted in the design chart. The cast in place rebar allows for bending moments to transfer from the column to the steel bracket and into the concrete wall or foundation.

5. Wood Connection

The wood to steel connection is made with (2) ½ " diameter A325 (grade 5) bolts in double shear and ¼" x 3" strong drive screws (SDS) by Simpson Strong Tie or equal in single shear installed from each side. Typically, one screw is installed from each side of the bracket at each bolt except the SWP8 series has 2 screws on each side at each bolt. Screws help prevent stress concentrations around the bolt which would cause splitting of the wood members. The wood to steel connection was analyzed as per the National Design Specification for Wood Construction 2001 edition by the American Forest and Paper Association using Southern Yellow Pine wood columns.

No wet service reductions have been made since the wood portion is not in contact with the soil or concrete and it is assumed to be used in an enclosed building. If the SWP brackets are to be used in an environment where the moisture content of the wood in service will exceed 19% for an extended period of time, pressure treated wood and galvanized or stainless steel bolts should be used, and a wet service factor of 0.7 applied to the allowable shear, uplift, and moment values in Table 6.1. In addition, a barrier membrane should be applied between the pressure treated wood post and the Sturdi-Wall Plus bracket to provide corrosion protection. Consult your local supplier for a suitable barrier. The design of the wood post above and the concrete foundation below the Sturdi-Wall Plus bracket, as well as, lateral bracing of the supporting structure are the responsibility of others.

6. Sturdi-Wall Plus Bracket Design Chart

Table 6.1 shows the allowable shear, uplift, and bending moment for the wood to steel connection and the steel to concrete connection using the fasteners described above. The allowable loads for the wood to steel connection have been increased by 60% for wind or seismic loading, reduce where other loads govern. The allowable loads for the concrete connection have been reduced by a factor of 1.6 to convert from LRFD. The steel to concrete design numbers are based on a minimum concrete compressive strength (f'c) of 4000 psi.

The rebar design capacities are the calculated development length of the rebar according to the American Concrete Institute Building Code ACI 318-99. The length of rebar required for the rebar to reach its full load capacity is 19" for #4 rebar and 23.7" for #5 rebar. A reduction factor was then applied to the calculated development lengths to obtain the charted required rebar lengths. The reduction factor is a ratio of the actual tension developed in the rebar based on the capacity of the wood to steel connection to the fully developed tension capacity of the rebar. In all cases except for the SWP64 the wood to steel connection governed the design; in the SWP64 the rebar capacity governed the design. When the Sturdi-Wall Plus brackets are placed in wet concrete, care shall be taken to ensure that the concrete is not too wet that the brackets sink below the base plate and not too dry that the concrete will not flow around and adhere to the rebar. Ideally, the consistency of the concrete should be such that the rebar can be easily inserted in the concrete and the base of the steel bracket will float on the surface of the concrete. The entire length of rebar shall be embedded in the concrete such that the bottom of the steel base plate bears on the surface of the concrete. The suggested minimum concrete cover requirements shall be followed, 3" when cast against or permanently exposed to earth and 2" when exposed only to weather.

Although design of the concrete wall or foundation that the Sturdi-Wall Plus brackets are cast into is the responsibility of others it is important that the concrete wall or foundation is designed to resist the shear, uplift, and moment that are transferred from the column to the concrete wall or foundation. To resist uplift a greater than or equal to weight of concrete should be provided in the foundation. The concrete foundation must also be capable of supporting the gravity loads from the columns and transferring the loads without exceeding the allowable bearing pressure of the soil at the specific site location.

Table 6.1: Allowable Shear, Uplift, and Bending Moment for Sturdi-Wall Plus Base Brackets

	Sturdi-Wall Plus Bracket Components			Sturdi-Wall Plus Bracket Capacities			Required Development Length for Rebar
Model	Post Size	Perma-Column Bracket Spec.	Rebar Size	Shear (lbs)	Uplift (lbs)	Moment (in-lbs)	
SWP46	4x6	PC4600	(# 4) 1/2"	6561	9019	28000	18"
SWP66	6x6	PC6600	(# 4) 1/2"	6638	9019	28000	18"
SWP63	3 ply 2x6	PC6300	(# 4) 1/2"	6638	9019	28000	18"
SWP64	4 ply 2x6	PC6400	(# 4) 1/2"	6638	9019	30000	18"
SWP83	3 ply 2x8	PC8300	(# 5) 5/8"	9138	11519	59000	18"
SWP84	4 ply 2x8	PC8400	(# 5) 5/8"	9138	11519	59000	18"

Notes:

1. This chart is for Sturdi-Wall Plus Brackets for use in Post Frame Building Applications to connect wood columns to a concrete wall or foundation.
2. Loads applied to the brackets from the columns are a vertical uplift force, horizontal shear force, and a moment about the strong axis of the column.
3. Column weak axis loads are assumed to be taken by adequate diaphragm action of roof and shearwalls.
4. Wood to steel connections were calculated as per the NDS 2001 for Wood Construction, using Southern Yellow Pine columns and a dry use condition.
5. The bolted connection of the Perma-Column Bracket to the post governed all allowable bending moments except for the SWP64 in which the rebar development length governed.
6. The allowable loads in wood have been increased by 60% for wind or seismic loading.
7. The allowable loads in concrete have been decreased by a factor of 1.6 to convert from LRFD.
8. Concrete design numbers are based on a minimum concrete compressive strength of 4000 psi.
9. All rebar is weldable A706, Grade 60, #4 for 4 and 6 series brackets and #5 for 8 series brackets.
10. Bolts are to be 0.5" diameter ASTM A325 with hex nuts.
11. Screws are to be 1/4" diameter x 3" Strong Drive Screws (SDS) by Simpson Strong Tie, or approved equal.
12. The calculated full development length of deformed bars in tension according to the ACI 318-99 is 19" for #4 rebar and 23.7" for #5 rebar, development length reflects straight rebar, no standard hooks are used.
13. The required development length was obtained by multiplying the calculated full development length by a reduction factor that was developed from a ratio of the actual tension in the rebar due to the allowable bending moment to the fully developed rebar tension.
14. Minimum development length for any rebar shall not be less than 12" as per ACI 318-99, Section 12.2.1.
15. Minimum concrete cover for rebar shall be 3" when permanently exposed to earth or 2" when exposed to weather.
16. Wood column above the bracket and concrete foundation below the bracket to be designed by others.
17. Gravity loads shall be supported on an adequate foundation, in order to use the charted allowable uplift values an equal or greater than weight of concrete must be provided below the bracket.
18. Install all fasteners as per the manufacturers recommendations and these notes.
19. Final bracket design should include a complete building analysis performed by a design professional.

The Sturdi-Wall Plus design manual can be downloaded via our website: www.sturdiwall.com

7. Summary and Conclusion

Sturdi-Wall Plus base brackets are designed to be used in a post frame building application to connect wood columns to a concrete wall or foundation. This can be done only in a wet set application in order for the rebar to concrete bond to develop correctly and create a connection that allows for bending moment transfer from the column to the steel bracket and into the concrete wall or foundation. Since the bracket capacities are based on strong axis bending of the column it is important that the supported structure be designed to resist lateral loads through diaphragm action of roof and shear walls or other bracing means. It is also important that the concrete wall or foundation, which the Sturdi-Wall brackets are cast into, are designed to resist the uplift, shear, and moment that is transferred thru the Sturdi-Wall Plus bracket into the concrete wall or foundation. Complete design calculations for the Sturdi-Wall Plus Brackets are available upon request.