A comparison of anchor systems for wood shearwalls using the perforated and segmented approaches under various wind loads

by

Diego Sanchez

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A REPORT

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GE Johnson Department of Architectural Engineering and Construction Science
Carl R. Ice College of Engineering

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Major Professor
Kimberly Waggle Kramer

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Abstract

A comparison of anchorage systems for chord elements of wood shearwalls is presented within this report. A rectangular building plan is varied in height and the basic wind speed is varied to achieve an extensive comparison. Buildings of one-, two-, and three-stories are used with three-second gust at 33-feet, Exposure B wind speeds of 115 mph, 140 mph, and 169 mph.

Two design approaches, segmented and perforated, are used for the analysis of the shearwalls to determine the number and size of chord elements. The segmented method uses only the full height portions of a shearwall to resist the shear produced by the lateral load; each individual segment is designed to resist the shear and overturning forces induced by the lateral load. While the perforated method uses both the full height segments and segments around openings to resist shear, the wall as a whole is used to resist shear and overturning forces induced by the wind load. The chord elements within the shearwall resist the compression or tension forces produced from the overturning moment. Continuity of the tension elements is achieved by connecting/anchoring the studs, chord elements, from one level to the next. Holdowns are utilized to support the tension produced at the chord elements of the shearwall due to the overturning moment formed in the building from wind pressures. At the base of the wall where the connection to the foundation occurs, anchorage devices, holdowns, are used.

Three types of connections are examined to support the tension load in the chord elements for each level: (1) holdown with threaded anchor, (2) embedded holdown, and (3) threaded rod with bearing plate anchorage. Holdown with threaded anchor and embedded holdown are connected at each level of the buildings and threaded rod with bearing plate anchorage spans from bottom to top of the structure. Two holdowns are used in idealized perforated shearwall, while the idealized segmented shearwall uses additional holdowns based on

the number of segments. The findings of the parametric study are presented. Holdowns in the perforated approach are larger in size compared to the segmented approach due to the higher tension load produced from overturning. Additionally, the holdowns increase in size with higher wind load on the building.

Table of Contents

List of Figures

List of Tables

Acknowledgements

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Chapter 1 - Introduction

This report is a continuation of Huenefeld and Kramer (2012) report, *A Report on the Effects of Wind Speed on Timber Construction*. To vary the wind speed three locations were selected: Manhattan, Kansas; Houston, Texas; and Miami, Florida with basic three-second gust wind speeds of 115 miles per hour (mph), 140 mph, and 169 mph, respectively (ASCE/SEI 7, 2016). In general, it consisted of a typical office building in plan that varied from a one-, two-, and three-story structure (each story is twelve feet with a two-foot parapet at the roof structure). The focus of this report is on the design of wood shearwalls using the segmented and perforated methods of analysis – specifically the design of the shearwall chord elements and holdown. A shearwall is one type of lateral force resisting system (LFRS) used to resist the wind or seismic forces applied to a structure. Segmented shearwall uses the full height segments along the shearwall; this excludes portions above and below the openings. Perforated shearwall is designed by taking into account the whole wall including the sections above and below the openings. Chord elements are located at the ends of each segment of the segmented shearwall and at each end of the entire perforated shearwall. Three holdowns are examined in this report: holdown with threaded anchor, embedded holdown, and threaded rod with bearing plate. Independent calculations were reproduced using the current codes and standards, ASCE 7-16 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, 2018 National Design Specification (NDS) for Wood Construction, and 2015 Special Design Provisions for Wind and Seismic (ASCE/SEI 7, 2016) (NDS, 2018) (SDPWS, 2015). Anchorages were determined by utilizing catalogs from Simpson StrongTie and MiTek (Simpson StrongTie, 2019) (MiTek, 2017).

Objective

The goal of this report is to provide a design comparison for the perforated and segmented shearwalls, chord elements, and three types of anchorage systems. The comparison is based on three different wind loads and three different height buildings.

Scope of Report

This report covers four chapters. Chapter one provides the introduction, objective, and scope of report. Chapter two presents the differences between the segmented vs perforated shearwalls, wood material background, anchorage systems, and Huenefeld and Kramer's report. Chapter three describes the parametric study. Chapter four presents the discussion & results found from the calculations that were produced for the one-, two-, and three-story buildings at each location. Chapter five describes the findings and conclusions.

Chapter 2 - Literature Review

With the increasing concerns over environmental impacts of the building industry, more renewable and energy efficient building materials should be used. Wood is a renewable material that also absorbs and sequesters carbon which reduces greenhouse gases. Using wood for multi-story buildings is increasing. As the building increases in height, the LFRS that counteracts the wind and seismic forces imposed by the environment becomes more critical. The most common LFRS in wood construction is a shearwall.

Shearwalls: Segmented vs Perforated

A shearwall is one type of LFRS used to resist the wind or seismic forces applied to a structure. The lateral loads are transmitted into the floor and roof diaphragms then into the shearwalls. A deep beam analogy is often used to describe the idealized diaphragm behavior with the web resisting the shear and the diaphragm chords resisting the moment. The sheathing, nailing, blocking, and subpurlins resist, in-plane shear, the lateral load induced into the building. This diaphragm, a plate like structural element, spans from vertical LFRS to vertical LFRS. Loads in the diaphragm are transferred from the subpurlins through the drag struts and finally to the shearwall via top plates. The lateral load from the shearwall framing is transferred to the bottom plate by sheathing and nailing, and finally into the foundation by means of anchors. The APA- The Engineered Wood Association as conducted research on the behavior of shearwalls for over sixty years with the first technical report published in 1953. The International Building Code (IBC) and National Design Specification (NDS) Special Design Provisions for Wind and Seismic (SDPWS) recognize three methods for designing shearwalls: segmented, designed for force transfer around openings, and perforated (IBC, 2019) (SDPWS, 2015). This report focuses on the design of wood shearwalls using the segmented and perforated methods of analysis – specifically the design of the shearwall chord elements, holdowns and shear connections.

The segmented shearwall approach, adopted by the Uniform Building Code in 1955, assumes that the lateral forces, shown as 'Load, *P*' in Figure 2-1, are carried by the sections of the shearwall that contain the full height of the story; sections of the wall that contain openings will not carry lateral forces. Additionally, the segmented approach assumes the segments have the same unit shear and same deformation independent of their widths – the wall is tied together by the top plates. Furthermore, each segment resists bending through its chord elements. The perforated shearwall approach adopts that the lateral forces are carried by the shearwalls with full story height as well as the portion of the wall above and below the openings. Unlike the segment approach the entire length of the wall resists the bending and chord elements are only provided at the ends of the walls instead at each opening. A visual representation of these two methods is shown in Figure 2.1.

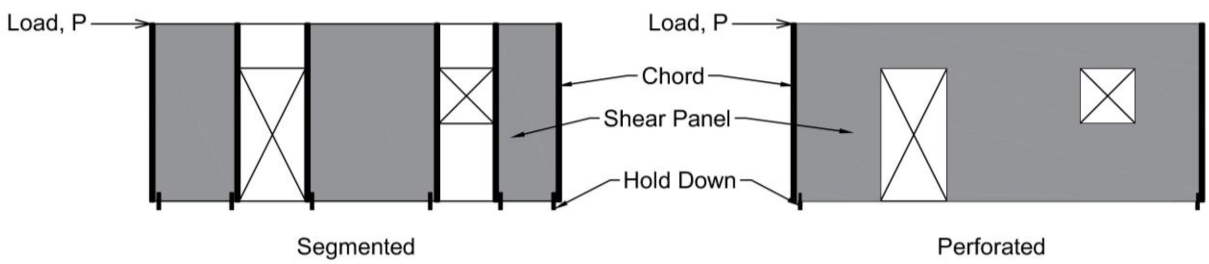


Figure 2-1 Segmented and Perforated Shearwall

Segmented Shearwall Approach

In order to use the individual full-height wall segments, SDPWS 2015 Section 4.3.5.1 requires the following limitations:

1. Openings are permitted beyond the end of the shearwalls. The length of any openings in the shearwall shall not be included in the length of the shearwall.
2. If out-of-plane offset occurs, then each wall of the offset must be considered as a separate shearwall.
3. Collectors for shear transfer to individual full-height wall segments will be provided.

The segmented shearwall approach considers only the sections of the walls that are full height. Sections above and below window openings are excluded in the stiffness and resistance of the shear. The wall segmented height for a multi-story building is based on the floor-to-floor height, since this is where the shear load is being transferred from. The segments in this approach work independently to resist bending, consequently, each segment wall must contain an anchor hold-down at the ends to resist overturning and uplift. The segmented shearwall approach must meet the aspect ratios shown in Table 2-1 modified from SDPWS 2015 Section 4.3.4. If the aspect ratio of a wood structural panel is greater than 2:1 and lower or equal to 3.5:1, then the nominal shear capacity shall be multiplied by the Aspect Ratio Factor (WSP)=1.25-0.125h/b_s (SDPWS Sec. 4.3.4.2). Segments of walls where aspect ratio exceeds 3.5:1 shall not be considered in the segmented approach (SDPWS Sec. 4.3.4.3). A study by Salenikovich and Dolan (2003) demonstrated how shearwalls with aspect ratio of 2:1 or lower are equally stiff, but walls with aspect ratio 4:1 were half as stiff. Although Salenikovich and Dolan's study does not specifically test a 3.5:1 wall, the American Wood Council (AWC) allows shearwalls with 3.5:1 aspect ratio. This will take advantage of using higher aspect ratio walls and making sure not to reach half the stiffness.

Table 2-1 Maximum Shearwall Aspect Ratio (modified from SDPWS, 2015)

Maximum Shearwall Aspect Ratio	
Shearwall Sheathing Type	**Maximum h/b_s Ratio**
Wood structural panels, unblocked	2:1
Wood structural panels, blocked	3.5:1

The sheathing, connections to the wall studs, and the wall studs resist the in-plane shear in the shearwall. This in-plane shear is typically examined as a unit shear. The unit shear is calculated by dividing the total shear by the sum of the shearwall lengths, as shown in Equation 2-1. The shearwall length is the sum of the effective panels (segments) in the shearwall, where the effective panels are selected based on the maximum aspect ratio.

$$v = \frac{V}{\Sigma L} \qquad \text{Eq. 2-1}$$

Where:

$v =$ Unit shear, plf

$V =$ Total shear force, lbs

$\Sigma L =$ Summation of shearwall lengths, ft

Once the unit shear in the shearwall is calculated, the sheathing material, minimum nominal panel thickness, fastener type & size, panel edge fastener spacing, panel field fastener spacing, and if one- or two-sided sheathing are designed. These items are selected by using Tables 4.3A, 4.3B, 4.3C, and 4.3D in the 2018 SDPWS. The wind unit shear capacity for structural I, sheathing, and plywood siding was determined from a study completed by Tissell, (1993). All the tabulated values from Tissell were multiplied by 2.8 to account for minimum performance requirement per Performance Standard for Wood-Base Structural Use Panel. After the minimum performance requirement has been considered, the tabulated seismic unit shear capacity was derived by dividing the wind units shear capacity by 1.4 (SDPWS Sec. C2.2). Shearwalls with other sheathing materials were obtained from AWC (American Wood Council) (2015). The Column B, of the Tables mentioned, tabulates the nominal unit shear capacities for wind forces. All the tabulated nominal unit shear capacity must be adjusted to Allowable Stress Design (ASD) allowable unit shear capacity or Load Resistance Factored Design (LRFD) factored unit resistance. The most common design methodology for wood design by practicing structural engineers is ASD. Therefore, this report uses ASD, consequently, all the nominal unit shear capacities must be divided by 2.0 per SDPWS Section 4.3.3, in order to change the tabulated values from ultimate strength shear capacities to allowable shear capacities. The two most common species of wood used in design are Douglas-Fir-Larch (DF-L) or Southern Pine (SP). If framing with other species of wood than DF-L or SP is used, the nominal unit shear capacity must be adjusted by multiplying it by the Specific Gravity Adjustment Factor Equation 2-2 (SDPWS 2015 Table 4.3A note 2). The SGAF considers the density of the wood studs and the corresponding connector slip and/or deformation.

$$SGAF = [1-(0.5G)] \qquad \text{Eq. 2-2}$$

Where: G = Specific Gravity of the framing lumber from the NDS Table 12.3.3A

Using beam analogy for the behavior of the shearwall, the wall studs at the ends of the segments are the chords, members that resist the bending of the wall. The forces in the tension or compression chords at each segmented shearwall and at story level must be calculated by using Equation 2-3. The chord elements are located at the ends of each segment wall; these boundary elements are parallel to the applied wind load and they resist the axial stress produced by the moment force. An illustration of the chords and unit shear is shown in Figure 2-2.

$T = C = vh$ Eq. 2-3

Where:

T = Tension force, lbs

C = Compression force, lbs

v = Unit shear, plf

h = Shearwall height

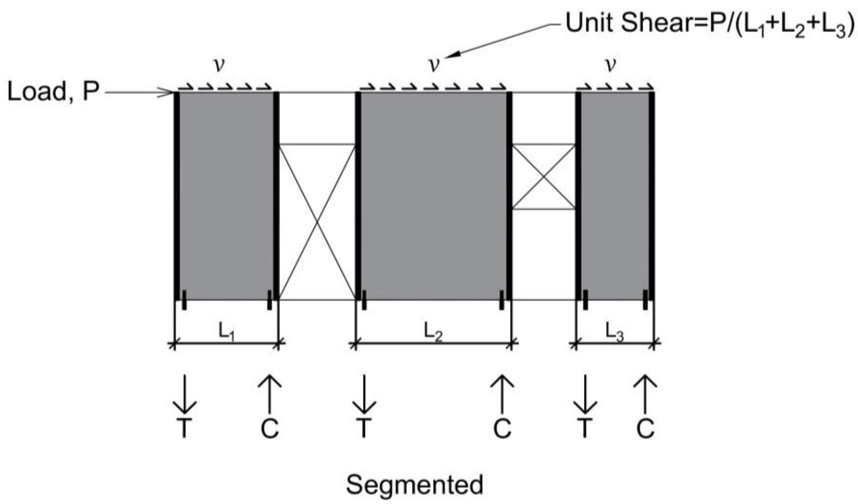


Figure 2-2 Unit Shear and Chord Forces (Tension and Compression)

The lower chord force for a multi-story building is cumulative, since the shearwalls work collectively where the bottom chord forces are the sum of the chord forces from 3rd, 2nd, and 1st floors. This is expressed in Equation 2-4. Also, shearwalls are non-bearing walls. Consequently, the self-weight of the wall is small and is not included when calculating chord forces in this report.

$$T = C = v_{roof} h_{base\ to\ roof} + v_{3^{rd}\ floor} h_{base\ to\ 3^{nd}} + v_{2^{nd}\ floor} h_{base\ to\ 2^{nd}}$$ Eq. 2-4

After the chord forces for each shear segment wall and each floor are calculated, the chords are designed. The axial capacities for the chord members are determined by using

Equations 2-5 for tension and 2-6 for compression from the 2018 NDS. Each of the reference design values shall be multiplied by the indicated adjustment factor. The reference design values are based on size classification, species, and commercial grade. This axial capacity must be larger than or equal to the chord force to be adequate. Hold-down anchors shall be designed to resist overturning, uplift, and base shear of the shearwall.

$$F_t' = F_t C_D C_M C_t C_F C_i \quad \text{Eq. 2-5}$$

$$F_c' = F_c C_D C_M C_t C_F C_i C_P \quad \text{Eq. 2-6}$$

Where:

F_t = Tension parallel to grain, psi

F_c = Compression parallel to grain, psi

C_D = Load Duration Factor

C_M = Wet Service Factor

C_t = Temperature Factor

C_F = Size Factor

C_i = Incising Factor

C_P = Column Stability Factor

Perforated Shearwall Approach

In 1981, Professor Hideo Sugiyama, University of Tokyo, proposed an empirical equation allowing designers to calculate the shear capacity and stiffness of perforated shearwall segments without intermediate overturning restraint (Sugiyama, 1981). Sugiyama's empirical equation forms the basis of the perforated shearwall design method. Douglas & Sugiyama (1994) evaluated the effects of unrestrained openings in shearwalls and full-scale tests by Dolan et al. (1996) provided further verification of Sugiyama's empirical equation. In 1996, Line and

Douglas with the American Forest & Paper Association, presented *Perforated Shearwall Design Method* at the International Wood Engineering Conference, in which a design example using the Sugiyama's Empirical Equation (Perforated Shearwall Approach) (Line & Douglas, 1996). In 2005, the American Wood Council published the first edition of the SDPWS which included both the segmented and perforated shearwall approaches.

In order to use the perforated shearwall approach, SDPWS section 4.3.5.3 requires the following limitations:

1. Perforated shearwall segment shall be located at each end of a perforated shearwall. Openings shall be permitted to occur beyond the ends of the perforated shearwall, provided the lengths of such openings are not included in the length of the perforated shearwall.
2. The perforated shearwall must follow the aspect ratio limitations (APA T2005-08).
3. The nominal unit shear capacity for a single- and double-sided wall shall not exceed 2,435 plf for wind.
4. Where out-of-plane offsets occur, portions of the wall on each side of the offset shall be considered as separate perforated shearwalls.
5. Collectors for shear transfer shall be provided through the full length of the perforated shearwall.
6. Perforated shearwall shall have uniform top-of-wall and bottom-of-wall elevations.
7. Perforated shearwall height, h, shall not exceed 20 ft.

Perforated shearwall approach accounts for the sections with openings which utilizes the entire length of wall to act as a single shearwall, as shown in Figure 2-1 perforated. The appropriate shear capacity adjustment factor, C_o, must be determined in order to calculate tension chord, compression chord, and unit shear (Line & Douglas, 1996). Appropriate shear capacity adjustment factor can be calculated two different ways. The first way is by using Equation 2-7 interpreted below (SDPWS Section 4.3.3.5). When calculating segment lengths, L_i, the perforated shearwall with aspect ratio of more than 3.5:1 shall not be considered (APA Report T2005-08, 2005). If the aspect ratio is greater that 2:1 and lower or equal to 3.5:1, then the length of each perforated shearwall segment shall be adjusted by multiplying by $2b_s/h$ (SDPWS Sec. 4.3.4.3).

$$C_O = \left(\frac{r}{3-2r}\right)\frac{L_{tot}}{\Sigma L_i} \qquad \text{Eq. 2-7}$$

Where:

C_o = Shear capacity adjustment factor

L_{tot} = Total length of the perforated shearwall including the length of sections with openings, ft

ΣL_i = Sum of the perforated shearwall segment lengths L_i, ft

$$r = \frac{1}{1+\frac{A_o}{h\Sigma L_i}} = \text{ Sheathing area ratio}$$

A_o = Total area of openings in the perforated shearwall, ft^2

h = Height of the perforated shearwall, ft

A second method to calculate the shear capacity adjustment factor is by using Table 2-2 (SDPWS Table 4.3.3.5). The wall height, maximum opening height, and percent full-height sheathing must first be identified in order to calculate the effective shear capacity ratio. Unsheathed areas above and below openings must be included in the opening height. Percent full height sheathing is equal to the sum of the perforated shearwall segment lengths, ΣL_i, divided by the total length of the perforated shearwall, L_{tot}. Where segment length must follow the same adjustment directions as mentioned previously.

Table 2-2 Shear Capacity Adjustment Factor, *C_o* (modified from Line & Douglas, 1996)

Wall Height, h	**Maximum Opening Height**				
	h/3	**h/2**	**2h/3**	**5h/6**	**h**
10’ Wall	3’-4”	5’-0”	6’-8”	8’-4”	10’-0”
Percent Full-Height Sheathing	**Effective Shear Capacity Ratio**				
10%	1.00	0.69	0.53	0.43	0.36
20%	1.00	0.71	0.56	0.45	0.38
30%	1.00	0.74	0.59	0.49	0.42
40%	1.00	0.77	0.63	0.53	0.45
50%	1.00	0.80	0.67	0.57	0.50

Once the shear capacity adjustment factor is calculated, the maximum induced unit shear, v_{max}, is calculated in accordance with Equation 2-8 (SPDWS Sec. 4.3.6.1.3). The only difference between the unit shear of the segmented and perforated approaches is that the unit shear of the perforated approach must be divided by the effective shear capacity ratio, which is what accounts for the difference in the resistance between the wall segments and the segments with openings.

$$v_{max} = \frac{V}{C_o \Sigma L_i} \qquad \text{Eq. 2-8}$$

Where:

v_{max} = Maximum induced unit shear, plf

V = Total shear force, lbs

ΣL = Summation of shearwall lengths, ft

C_o = Shear capacity adjustment factor

The perforated shearwall is designed by using the maximum induced unit shear and depending on the type of sheathing, Tables 4.3A, 4.3B, 4.3C, and 4.3D from the SDPWS 2015. The tabulated unit shear capacities must follow the same adjustments as in segmented approach, if applicable.

The unit shear is then transferred into the chord elements located at each end of the shearwalls. Each chord for the perforated shearwall must be designed to resist the tension and compression being applied due to the overturning at each story level. Tension and compression can be calculated by following Equation 2-9 per SPDWS 2015 Section 4.3.6.1.3.

$$T = C = \frac{Vh}{C_o \Sigma L_i} \qquad \text{Eq. 2-9}$$

Where:

T = Tension force, lbs

C = Compression force, lbs

v = Unit shear, plf

h = Shearwall height, ft

C_o = Shear capacity adjustment factor

Similar to the segmented shearwall, the bottom tension and compression chord forces for multi-story buildings are cumulative and Equation 2-4 is also used for the perforated approach. Once the tension and compression forces in the chord members (made from studs) are determined for the perforated shearwall, then the chord elements can be designed by using the equations in the NDS 2018.

Wood Material Background

The American Wood Council NDS Supplement *National Design Specification Design Values for Wood Construction 2018 Edition* gives design properties for forty-four different wood species or species combinations. Having stronger properties than other species, DF-L, Hem Fir, and SP are common wood species specified for shearwalls in the United States of America (USA). In addition, the majority of the shearwall tests have used DF-L or SP. The 2015 *Special Design Provisions for Wind and Seismic* (*SDPWS*) has specific criteria wood-framed shearwalls must meet. In addition, to the specific criteria, the *SDPWS* provides nominal unit shear capacities for wood-frame shearwalls in Table 4.3A that are based on Research Report 154, Wood Structural Panel Shear Walls (APA Report 154,1993). In 2005, these tables developed by the American Wood Council are based on DF-L and SP with adjustment factors given based on the specific gravity of the walls studs used in the shearwalls (SDPWS, 2015).

Wood structural panels are sheathing materials that can be used for roofs, floors, and walls. Panel materials widely used in building construction are oriented strand board (OSB), composite panels, plywood, and structural particleboard (Fridley, K. et al., 2006). Typical nominal panel thickness comes in 5/16", 3/8", 7/16", and 15/32". The correct minimum nominal panel thickness will be chosen in the shearwall calculations, more information about this is mentioned in the shearwall section. Wood structural panels come in 4'x8' standard size consequently studs must be at 12" or 16" on-center (O.C.).

DF-L is widely availability throughout the United States. Douglas Fir mainly grows in the states of Washington, Oregon, and Northern California as shown in Figure 2-3. Higher grades of SP are available compared to DF-L, causing DF-L design allowable stress capacities to be lower than SP. Conservatively designing a shearwall using DF-L over SP gives the design engineer the ability to modify the chord members and wall-stud wood species readily with little impact to the design based on the available species of wood. Design values for DF-L such as tension parallel to grain, compression parallel to grain, modulus of elasticity, etc. can be found in Table 4A of NDS Supplement.

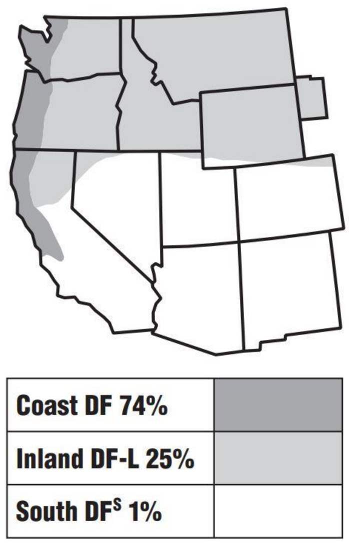


Figure 2-3 Douglas Fir growth region (Reproduced from Douglas Fir & Western Larch Pseudotsuga Menziesii & Larix Occidentalis, 2002)

Anchorage

Anchorage against overturning is used to support the tension produced in the building due to the wind load. The tension due to overturning moment is discussed in the segmented shearwall approach and perforated shearwall approach sections. Holdown anchors are located at each end of a segment on the segmented shearwall and at each end of the perforated shearwall and at each floor. Holdowns transfer the load from the shearwall chords to the foundation and/or the lower level chords. The three holdowns examined in this report are: holdown with threaded anchor, embedded holdown, and threaded rod with bearing plate, refer to Figure 2-4.

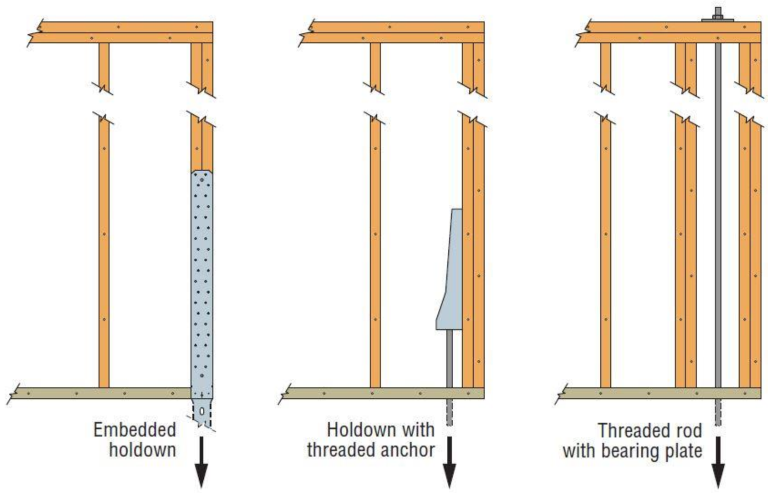
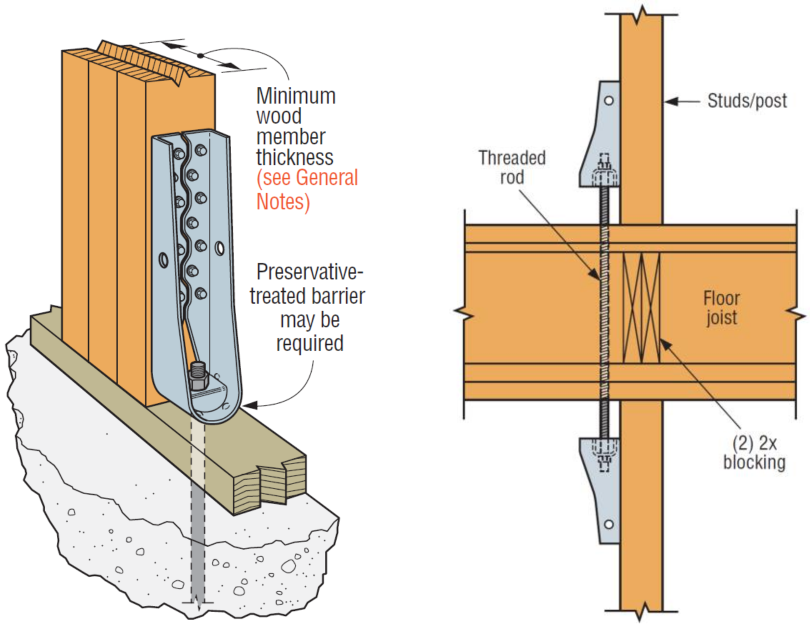


Figure 2-4 Holdown Methods (Reproduced from Simpson StrongTie, 2019)

Holdown with threaded anchor at the base are embedded in the foundation via anchor bolt and connected to the chord via nails, screws, or bolts, see Figure 2-5. Holdowns with threaded anchor between floors are connected to the chords located on top and bottom of the floor via nails, screws, or bolts, as shown in Figure 2-5. Simpson StrongTie Wood Construction Connectors 2019-2020 catalog was used in this report to select the proper holdown to support the tension force produced at the chord members. Chord forces were calculated from the overturning moment, and the holdowns were selected based on the allowable tension load for Douglas Fir Larch wood material. In order for the holdown to be adequate, the capacity from the StrongTie catalog must be higher than the chord force calculated.



Base **Between Floors**

Figure 2-5 Holdown with Threaded Anchor at Base & Between Floors (Reproduced from Simpson StrongTie, 2019)

Embedded holdowns at the base are embedded in the foundation and connected to the chord via nails, see Figure 2-6. Strap ties are used between floors and are connected to the chords on the top and bottom of the floor via nails, as shown in Figure 2-6. Simpson StrongTie Wood Construction Connectors 2019-2020 catalog is used in this report to select the proper holdown to support the tension force produced at the chord members. Uncracked mid-wall and corner installation are selected for the different buildings. Chord forces were calculated from the overturning moment, and the embedded holdowns were selected based on the allowable tension load for Douglas Fir Larch wood material. In order for the embedded holdown to be adequate, the capacity from the StrongTie catalog must be higher than the chord force calculated.

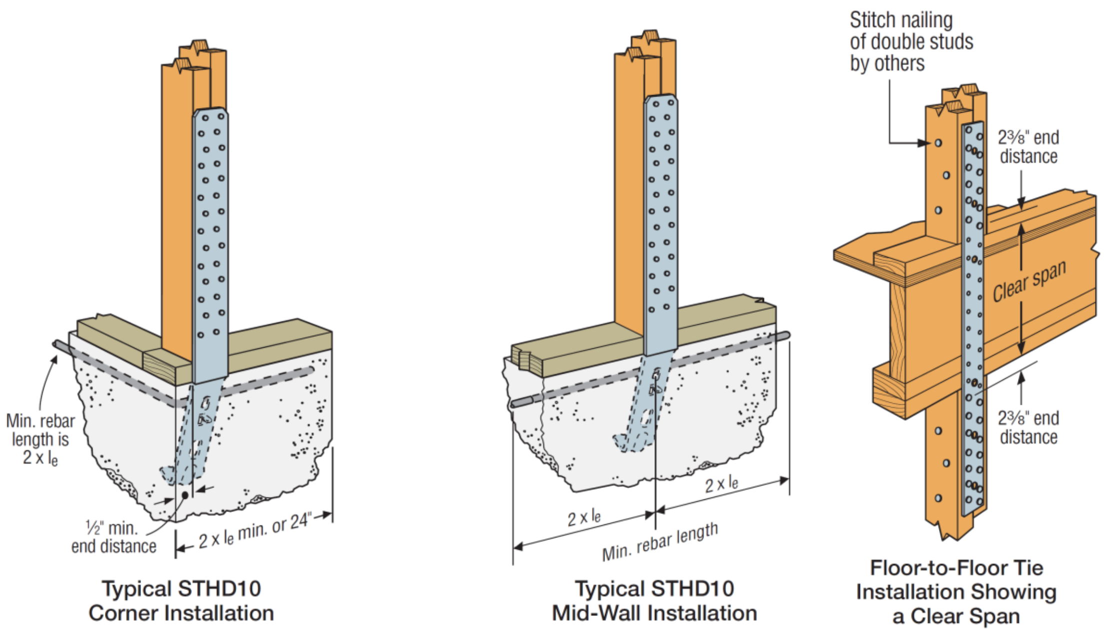


Figure 2-6 Embedded Holdown and Strap Ties (Reproduced from Simpson StrongTie, 2019)

Threaded rod with bearing plates are a tie down system mainly used in multi-story buildings. This type of anchorage consists of a cinch nut (CNX), a bearing plate washer (BPW), and a z-rod that are used at each floor. This report uses MiTek Z4 Product Catalog 2017 to design the adequate threaded rod with bearing plate. The BPW and CNX must have a higher capacity then the individual ASD design chord force. The z-rod must have a higher capacity than the cumulative (total) ASD design chord force. The rod with bearing plate anchor resists the tension produced by the wind force, see Figure 2-7 for a visual representation. The chord resists the compression force and is evenly distributed on both sides of the threaded rod with bearing plate.

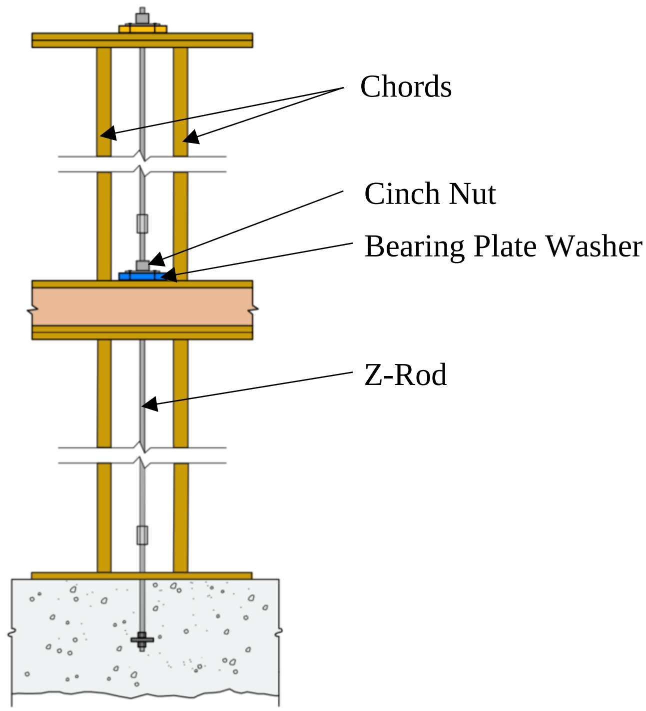


Figure 2-7 Threaded Rod with Bearing Plate for Two Floors (Adapted from MiTek, 2017)

Huenefeld and Kramer (2012)

This report is a continuation of Huenefeld and Kramer (2012) report, *A Report on the Effects of Wind Speed on Timber Construction*. In general, it consisted of a typical office building in plan that varied from a one to a three-story structure (each story is twelve feet in height with a two-foot parapet at the roof structure). Two shearwall design methodologies were studied: segmented and perforated.

To vary the wind speed, three locations were selected: Manhattan, Kansas; Houston, Texas; and Miami, Florida with basic three-second gust wind speeds of 115 miles per hour (mph), 140 mph, and 160 mph, respectively (ASCE/SEI 7, 2010).

The floor plan of all three buildings is 100 ft long by 60 ft wide. The dimensions for the base plan are shown in Figure 2-8. Base plan is the same as second and third floor plans with the exception that the second and third floor plans do not have a main entry hallway. Exterior shearwalls are at the east and west ends of the building and on each level. Interior shearwalls are 25 ft inward from the exterior walls and on each level. Windows, 2 ft wide by 4 ft high, are located in the exterior walls of the building. Also, four doors, 3 ft wide by 7 ft high, are located in each interior shearwall. Figure 2-8 is a typical building floor plans used in Huenefeld and Kramer (2012) report.

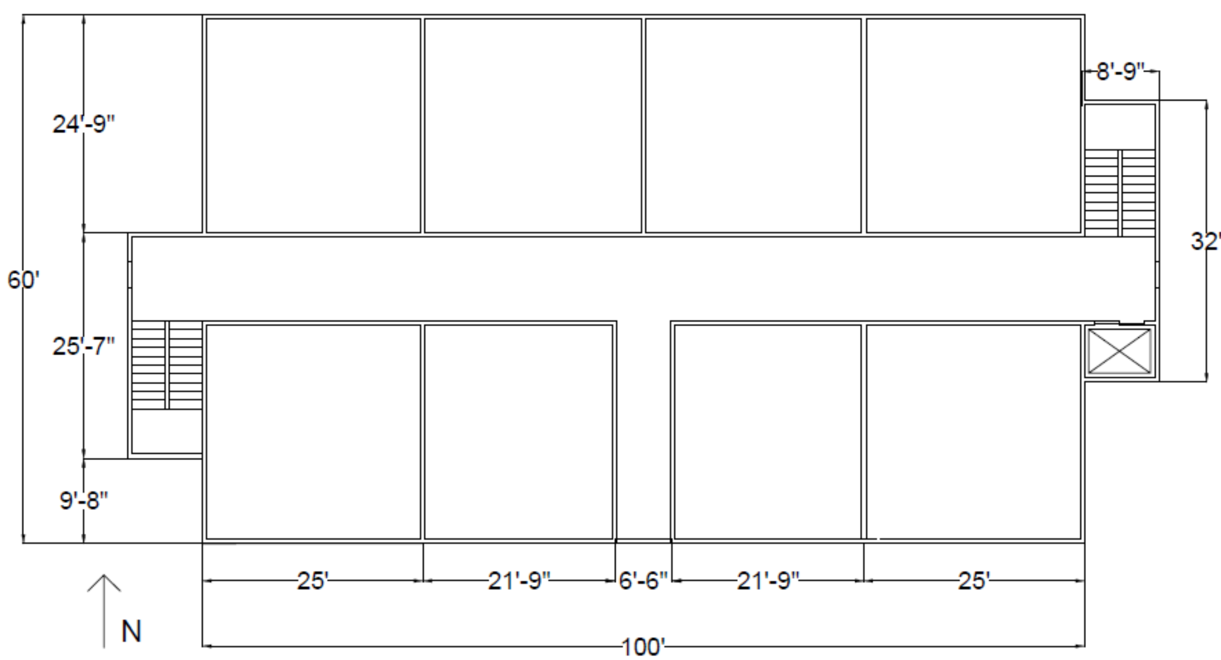


Figure 2-8 Typical Building Floor Plan (Reproduced from Huenefeld, J., & Kramer, K., 2012)

The office buildings consist of 12 ft floor-to-floor height with a 2 ft parapet. Stairwells (8'-9" wide) are located at the east and west ends of the building. An elevator is positioned in the east end of the building. Building elevations used in Huenefeld and Kramer (2012) report are presented in Figure 2-9.

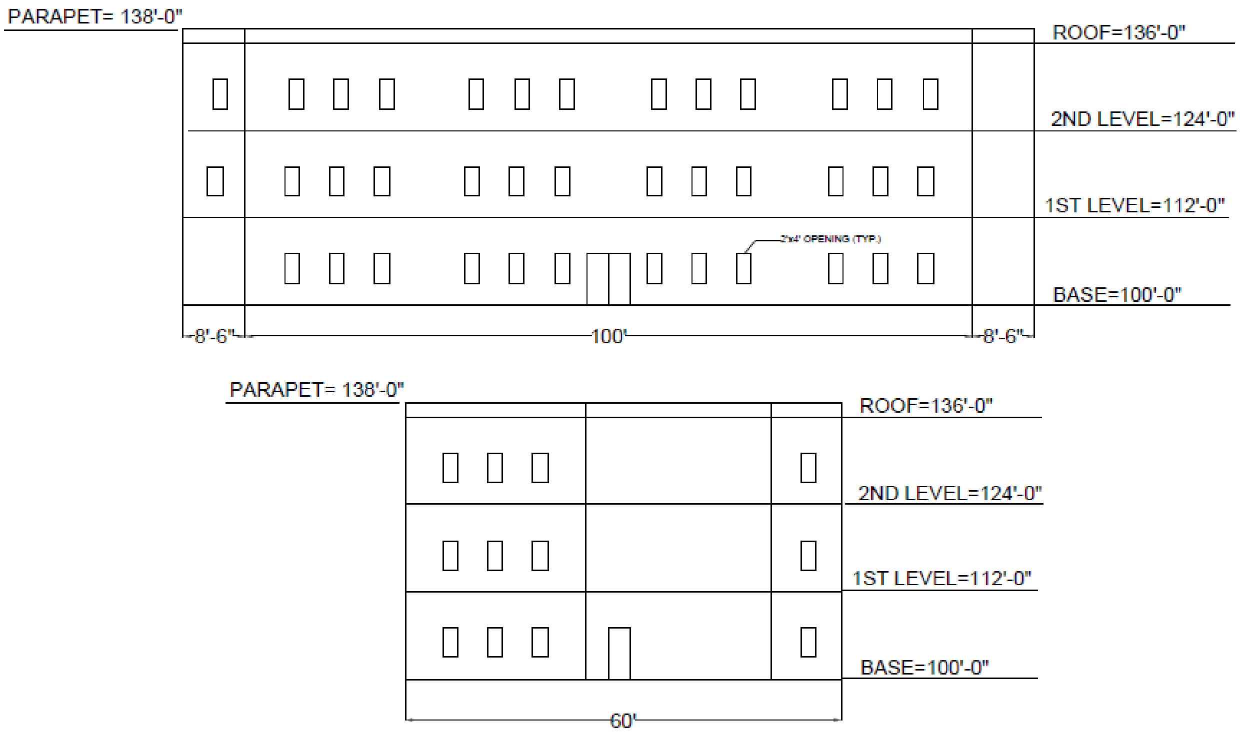


Figure 2-9 Building Elevations (Reproduced from Huenefeld, J., & Kramer, K., 2012)

Huenefeld & Kramer (2012) report concluded that the perforated shearwall approach required the following adjustments when compared to the segmented shearwall approach: closer nail spacing (more nails overall), larger nails in some cases, thicker plywood sheathing in some cases, larger, but fewer, overturning anchors, and calculations are more tedious and may require more time to complete. Additionally, for one-story buildings, the final design of the shearwalls using the segmented and perforated design approaches were nearly identical. However, the greater the wind pressure and/or the taller the building, the greater the differences in the final design when comparing the two approaches.

A design example from the previous project is discussed in the following paragraph. It is left to the reader to look at the complete design summary from the antecedent project if more information is needed.

Exterior and interior shearwall designs differ among the three different buildings and three locations for both segmented and perforated approach. The main changes were seen for sheathing thickness, minimum nail penetration, nail size, edge nailing, sheathing, stud spacing (for three-story building interior shearwall in Manhattan, KS only), chord sizes, minimum diameter of overturning anchors, and number of shear anchors. The exterior shearwall for the three-story building in Manhattan, KS is presented in Table 2-3. The interior shearwall for the same building and location is shown in Table 2-4. The interior shearwalls for the Houston and Miami sites are not applicable for the three-story building.

Table 2-3 Exterior Shearwalls Design Summary – Manhattan, KS (Reproduced from Huenefeld, J., & Kramer, K., 2012)

Exterior Shear Walls		
	Segmented	**Perforated**
Base to 1st Level Sheathing		
Sheathing Type	Wood Structural Panels	Wood Structural Panels
Sheathing Thickness	3/8" or greater	3/8" or greater
Minimum Nail Penetration	1 1/4"	1 1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
1st to 2nd Level Sheathing		
Sheathing Type	Wood Structural Panels	Wood Structural Panels
Sheathing Thickness	3/8" or greater	3/8" or greater
Minimum Nail Penetration	1 1/4"	1 1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
2nd Level to Roof Sheathing		
Sheathing Type	Wood Structural Panels	Wood Structural Panels
Sheathing Thickness	3/8" or greater	3/8" or greater
Minimum Nail Penetration	1 1/4"	1 1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	4.5
In-Plane Anchorage[2]		
Min. Dia. of Overturning Anchors (in.)	0.461	0.403
Dia, of Shear Anchor (in.)	0.5	0.5
Number of Shear Anchors	1	13
Max Spacing of Shear Anchors (in.)	#DIV/0!	60.00
Type of Holddown	Simpson Strongtie HDU4-SDS2.5 w/ 5/8" Bolt	Simpson Strongtie HDU5-SDS2.5 w/ 5/8" Bolt
Holddown Screws	10-SDS 1⁄4"x2 1⁄2"	14-SDS 1⁄4"x2 1⁄2"
Out-of--Plane Anchorage[3]		
Dia, of Shear Anchor (in.)	0.5	0.5
Number of Shear Anchors	11	11
Max Spacing of Shear Anchors (in.)	65.45	65.45

1: For segmented shear walls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shear walls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

3: For segmented and perforated shear walls, out-of-plane anchorage is for the entire wall.

Table 2-4 Interior Shearwalls Design Summary – Manhattan, KS (Reproduced from Huenefeld, J., & Kramer, K., 2012)

Interior Shear Walls		
	Segmented	**Perforated**
Base to 1st Level Sheathing		
Sheathing Type	Wood Structural Panels	Wood Structural Panels
Sheathing Thickness	3/8" or greater	19/32" or greater
Minimum Nail Penetration	1 3/8"	1 1/2"
Nail Size	8d	10d
Edge Nailing	8d at 3" O.C.	10d at 3" O.C.
Field Nailing	8d at 12" O.C.	10d at 12" O.C.
1st to 2nd Level Sheathing		
Sheathing Type	Wood Structural Panels	Wood Structural Panels
Sheathing Thickness	3/8" or greater	19/32" or greater
Minimum Nail Penetration	1 3/8"	1 1/2"
Nail Size	8d	10d
Edge Nailing	8d at 4" O.C.	10d at 4" O.C.
Field Nailing	8d at 12" O.C.	10d at 12" O.C.
2nd Level to Roof Sheathing		
Sheathing Type	Wood Structural Panels	Wood Structural Panels
Sheathing Thickness	3/8" or greater	19/32" or greater
Minimum Nail Penetration	1 3/8"	1 1/2"
Nail Size	8d	10d
Edge Nailing	8d at 6" O.C.	10d at 6" O.C.
Field Nailing	8d at 12" O.C.	10d at 12" O.C.
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	12	12
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	4.5	4.5
In-Plane Anchorage[2]		
Min. Dia. of Overturning Anchors (in.)	0.845	0.752
Dia, of Shear Anchor (in.)	0.5	0.5
Number of Shear Anchors	4	44
Max Spacing of Shear Anchors (in.)	2.11	16.74
Type of Holddown	2 Simpson Strongtie HDU8-SDS2.5 w/ 7/8" Bolt	2 Simpson Strongtie HDQ8-SDS3 w/ 7/8" Bolt
Holddown Screws	20-SDS 1⁄4"x2 1⁄2"	20-SDS 1⁄4"x3"

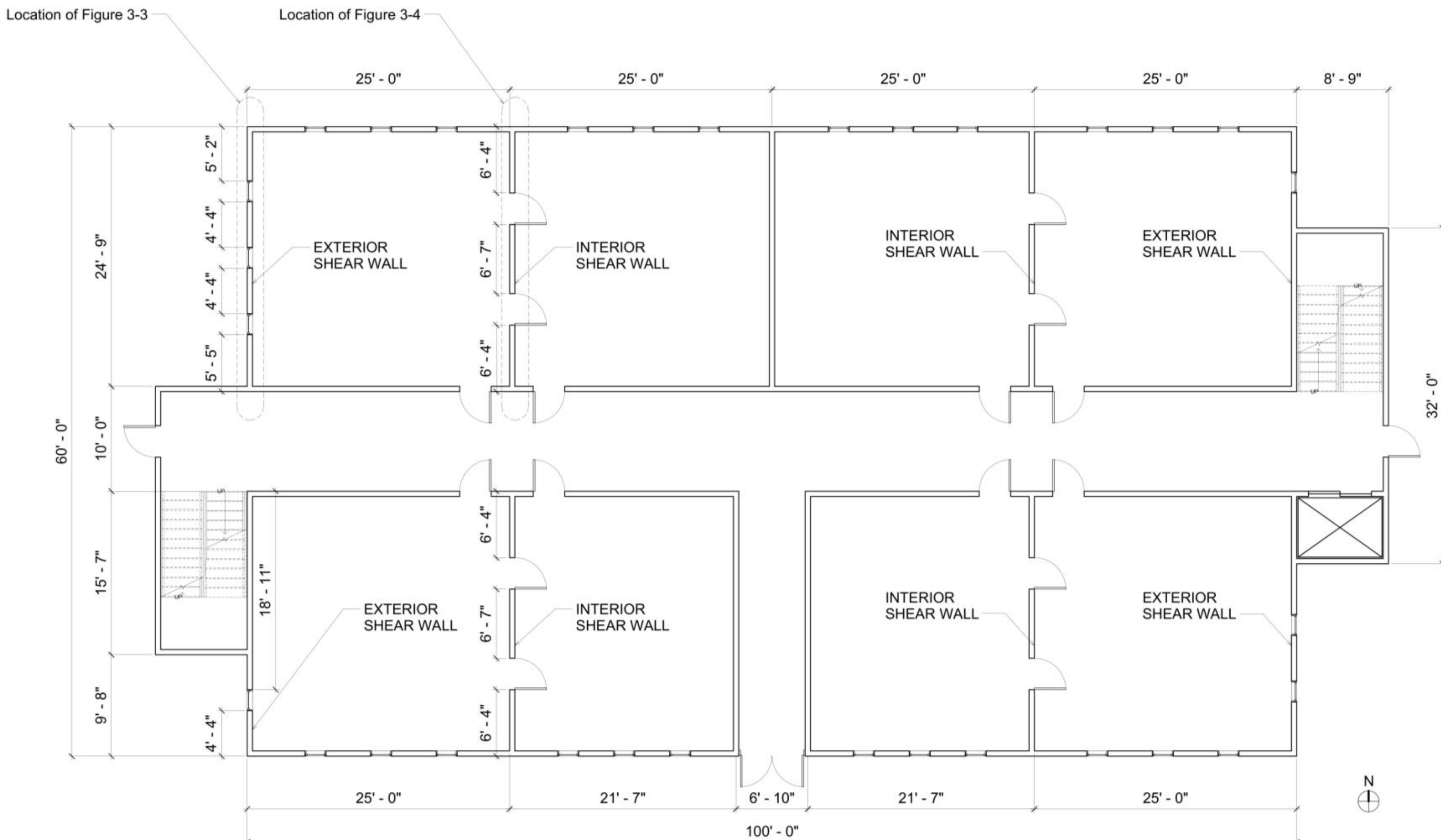
1: For segmented shear walls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shear walls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

3: For segmented and perforated shear walls, out-of-plane anchorage is for the entire wall.

Chapter 3 - Parametric Study

The wind speed in Florida is the only value that changed from the previous study; this report will use 169 mph (ASCE/SEI 7, 2016). The wind speeds were also reviewed from the ATC Hazards by Location website which provides slightly different wind speeds; however, they are all within 5 mph of the ASCE 7-16 code. Furthermore, local amendments were also researched for the three different locations and no local amendments were found for wind. For the purpose of this report, the wind speeds that will be used are according to the ASCE 7-16 and are as follows: Manhattan, KS (115 mph); Houston, TX (140 mph); and Miami, FL (169 mph). Each wind speed will be applied to the three different buildings. The stairs and elevator structures are self-supporting and have independent LFRS; therefore, these areas were not part of the calculations for the 100 ft x 60 ft building. For a more accurate comparison, exterior and interior shearwalls are used from base to roof among all buildings. Figure 3-1 and Figure 3-2 were updated from Figure 2-8 and Figure 2-9 for a better illustration of dimensions, locations of openings, and locations of interior and exterior shearwalls.


Location of Figure 3-3
Location of Figure 3-4
25' - 0"
25' - 0"
25' - 0"
25' - 0"
8' - 9"
EXTERIOR SHEAR WALL
INTERIOR SHEAR WALL
INTERIOR SHEAR WALL
EXTERIOR SHEAR WALL
EXTERIOR SHEAR WALL
INTERIOR SHEAR WALL
INTERIOR SHEAR WALL
EXTERIOR SHEAR WALL
60' - 0"
24' - 9"
10' - 0"
15' - 7"
9' - 8"
5' - 2"
4' - 4"
4' - 4"
5' - 5"
18' - 11"
4' - 4"
6' - 4"
6' - 7"
6' - 4"
6' - 4"
6' - 7"
6' - 4"
32' - 0"
25' - 0"
21' - 7"
6' - 10"
21' - 7"
25' - 0"
100' - 0"
N

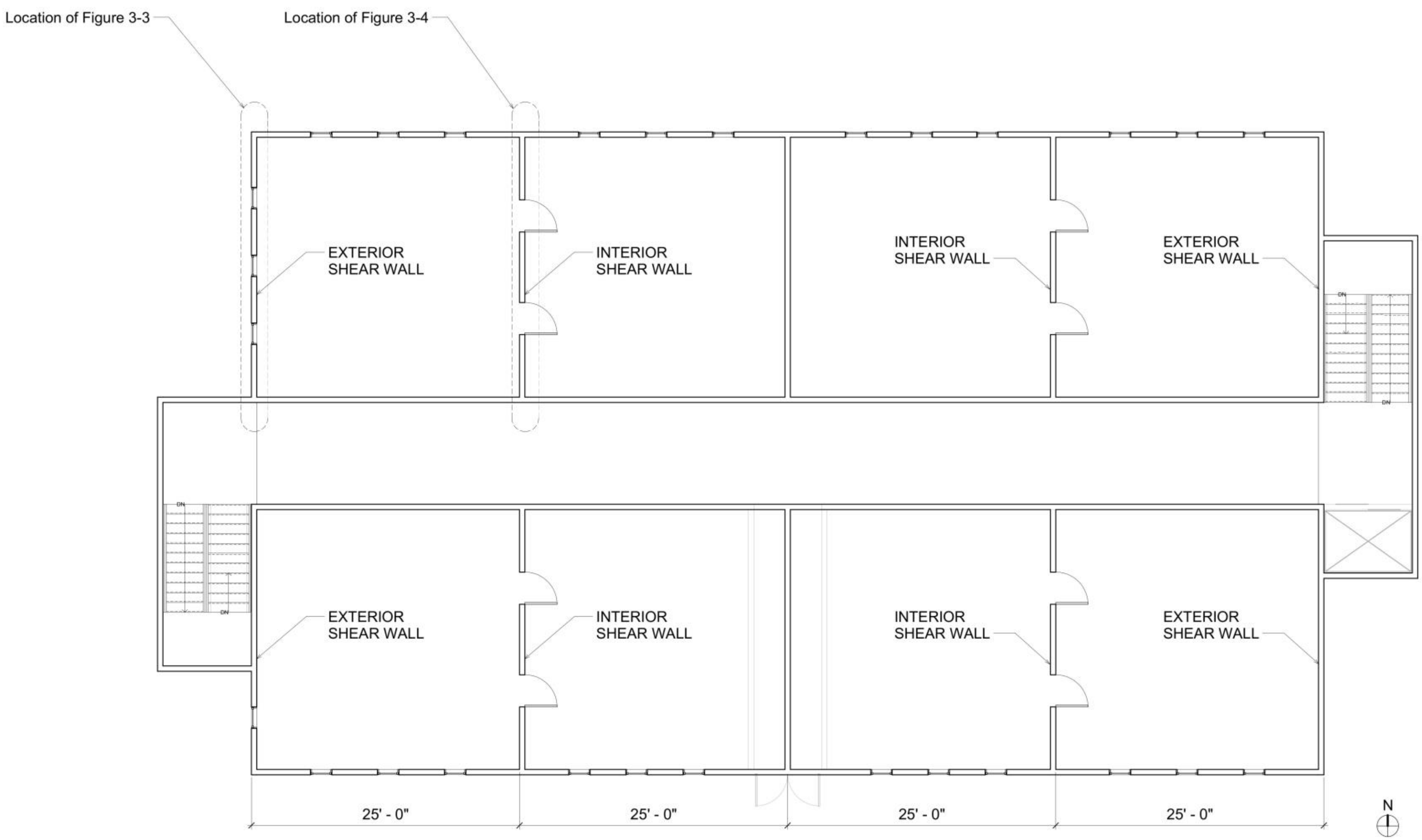


Figure 3-1 Base Plan (top) and Second Floor plan (bottom) (Adapted from Huenefeld, J., & Kramer, K., 2012)

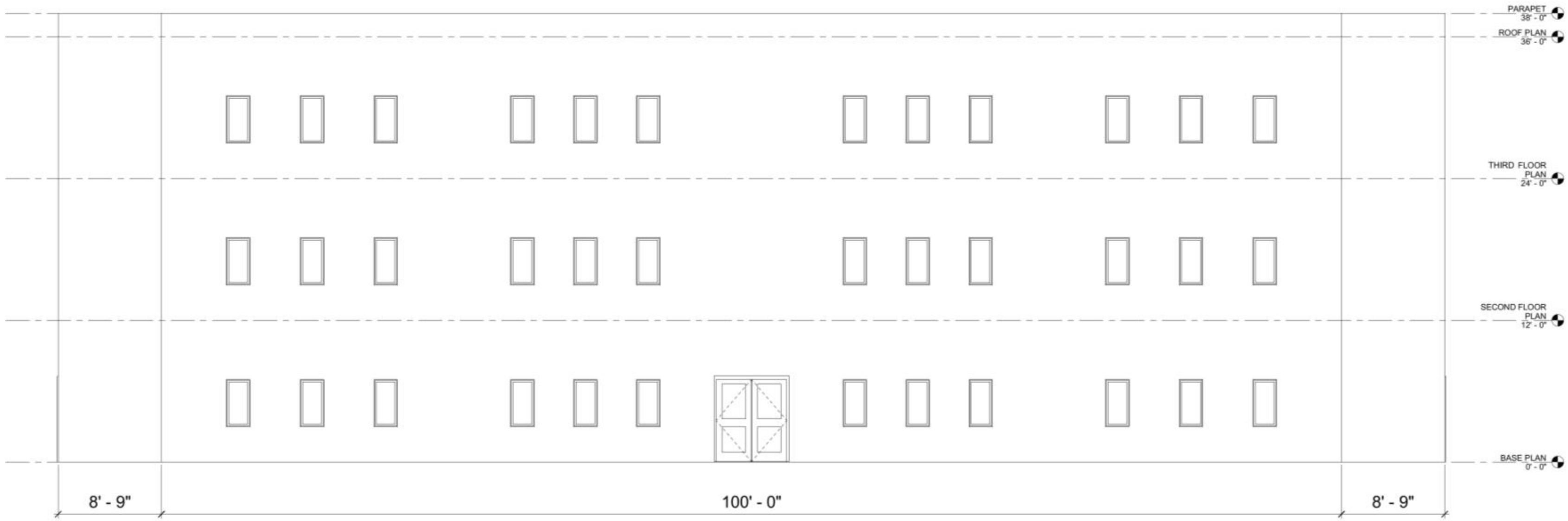

PARAPET
38' - 0"
ROOF PLAN
36' - 0"
THIRD FLOOR PLAN
24' - 0"
SECOND FLOOR PLAN
12' - 0"
BASE PLAN
0' - 0"
8' - 9"
100' - 0"
8' - 9"

Figure 3-2 South Elevation (top) and West Elevation (bottom) (Adapted from Huenefeld, J., & Kramer, K., 2012)

In order to investigate: 1) segmented and perforated shearwalls, 2) chord elements, and 3) anchorage systems, wind load calculations were performed for the transverse direction for all buildings. The transverse direction is the only one being calculated since this is the direction of the building that will experience the highest wind force. Wind loads were calculated by using the ASCE 7-16 code. Buildings of one-, two-, and three-stories are used with three-second gust at 33-feet, Exposure B, and Risk Category II. These wind forces are resisted by the interior and exterior shearwalls. The transverse exterior shearwall resists a wind load that consists of a tributary area of 12.5’ wide times the height of the building (including parapet). The transverse interior shearwall resists a wind load that consists of a tributary area of 37.5’ wide times the height of the building (including parapet). Walls are designed for sheathing, chords, and holdowns using segmented and perforated methods as discussed in chapter 2.

The exterior and interior segmented and perforated shearwalls are shown in Figure 3-3 and Figure 3-4. The exact locations of the shearwalls are noted in Figure 3-1. Only half of the segmented and perforated shearwall is shown in Figure 3-3 and Figure 3-4. The exterior segmented shearwall shows four segments, while two additional segments are not shown. Finally, interior segmented shearwalls will have the same configuration on the second half as the one shown in Figure 3-4. Location of shearwall panels, chords, and anchors are identified in the images as well.

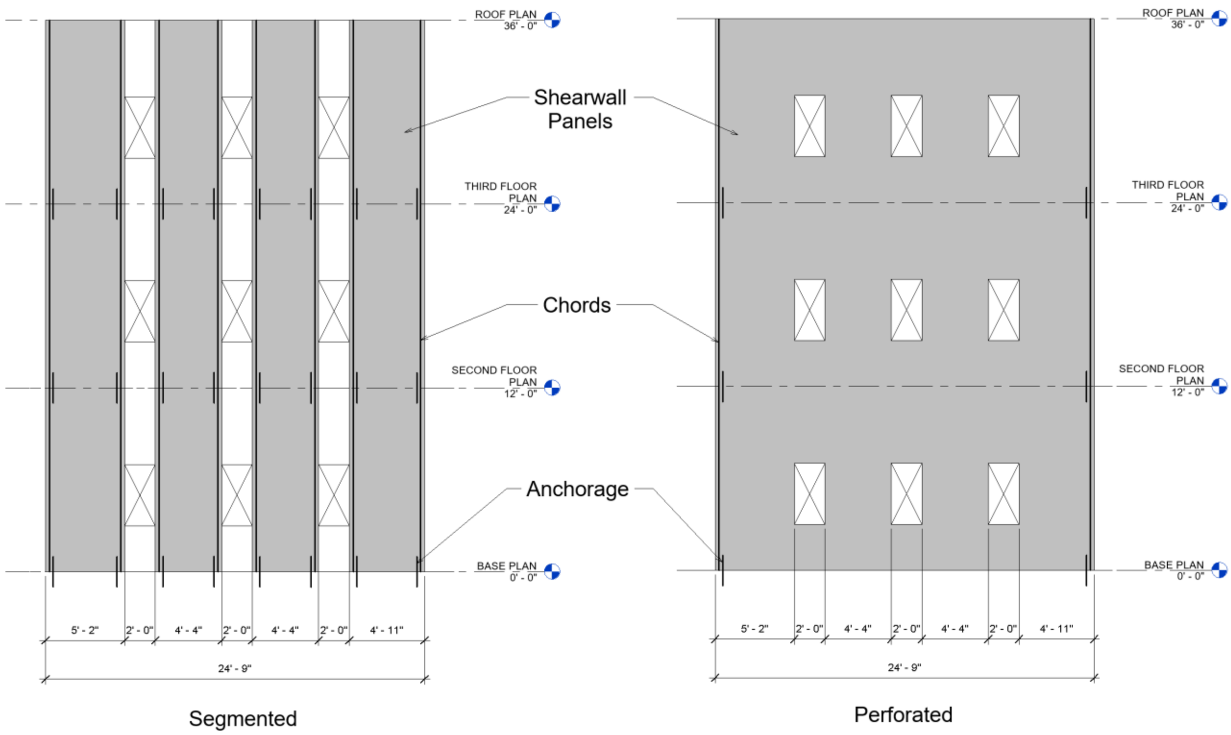


Figure 3-3 Exterior Segmented and Perforated Shearwall

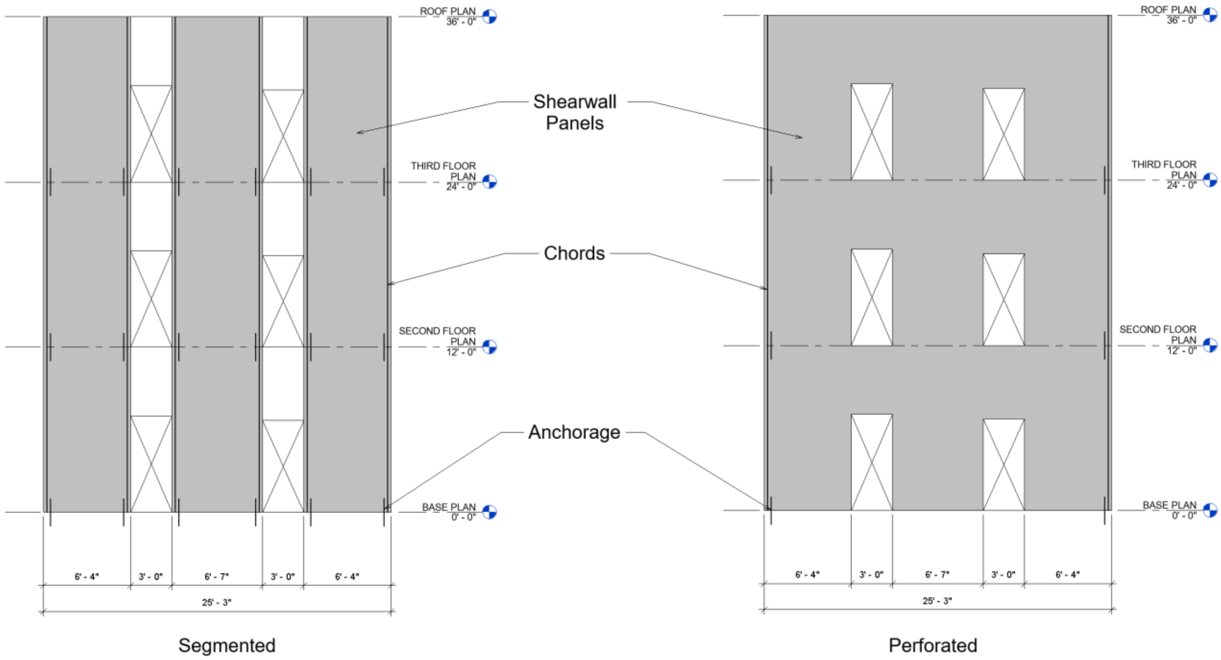


Figure 3-4 Interior Segmented and Perforated Shearwall

Chapter 4 - Discussion & Results

Three systems are being studied for this report: 1) segmented and perforated shearwalls, 2) chord elements, and 3) anchorage systems. Three different types of anchorage systems are being designed to determine which holdown works better at each building and location. These parameters are compared for one-, two-, and three- story buildings in three locations with different wind loads as described in the literature review section. First, the one-story building shows the perforated and segmented shearwall design from base plan to roof plan as well as the anchorage design at the base plan. Second, the two-story building shows the perforated and segmented shearwall design from base plan to second floor plan and second floor plan to roof plan as well as the anchorage design at the base plan and second floor plan. Third, the three-story building shows the perforated and segmented shearwall design from base plan to second floor plan, second floor plan to third floor plan, and third floor plan to roof plan as well as the anchorage design at the base plan, second floor plan, and third floor plan. **The complete calculations for a two-story building can be found in Appendix B.** The results for anchors and chords shown in Chapter 4 are for only one end of a segment for the segmented shearwall, and for only one end of the perforated shearwall.

The calculations for all buildings are for the exterior shearwall, interior shearwall, and anchorage designs at each level which support the lateral wind force in the transverse direction. The north to south wind load direction is investigated because that is where the highest wind load will occur due to the large surface area of the north/south side of the buildings. Exterior shearwalls at each level will experience a load that is calculated by multiplying wind load times the tributary area of 12.5’ wide times the height of the floor. Interior shearwalls at each level will experience a higher load due to a larger tributary area of 37.5’ wide times the height of the floor. The segmented exterior shearwall has openings as shown in Figure 3-1 along the 60’ long exterior wall. Consequently, the total full-height segments equal 42’-6” and the smallest segment is 4’-3”. Segmented interior shearwalls have openings as shown in Figure 3-1 along the 60’ long interior shearwall. Therefore, the total full-height segments equals 38’-5” and the smallest segment is 6’-4”. The studs designed to support the gravity loads are 2 x 6 Douglas Fir Larch No. 2 at 16” O.C. and are consistent across all buildings configurations for both exterior and interior walls.

One-Story Buildings

The one-story buildings for all locations have identical sheathing designs for the exterior shearwalls for both segmented and perforated method, which consist of 5/16” wood structural panels with 6d field nails at 12” O.C. and 6d edge nails at 6” O.C. However, interior shearwalls require more nails using the perforated method for the Houston and Miami locations, which is due to needing closer edge nails of 3” O.C. The chord elements for the one-story buildings are two 2” x 6” studs for both perforated and segmented methods in all locations. The one-story buildings in all three locations require one anchor for all three types of holdowns. Figures 4.1, 4.2, and 4.3 show an image representation for half of the interior shearwall showing the results for both segmented and perforated approaches in the three locations. The design for the exterior shearwalls are the same as the interior but it uses fewer edge nails. **The complete design summary for all the shearwalls and all locations are presented in Appendix C.**

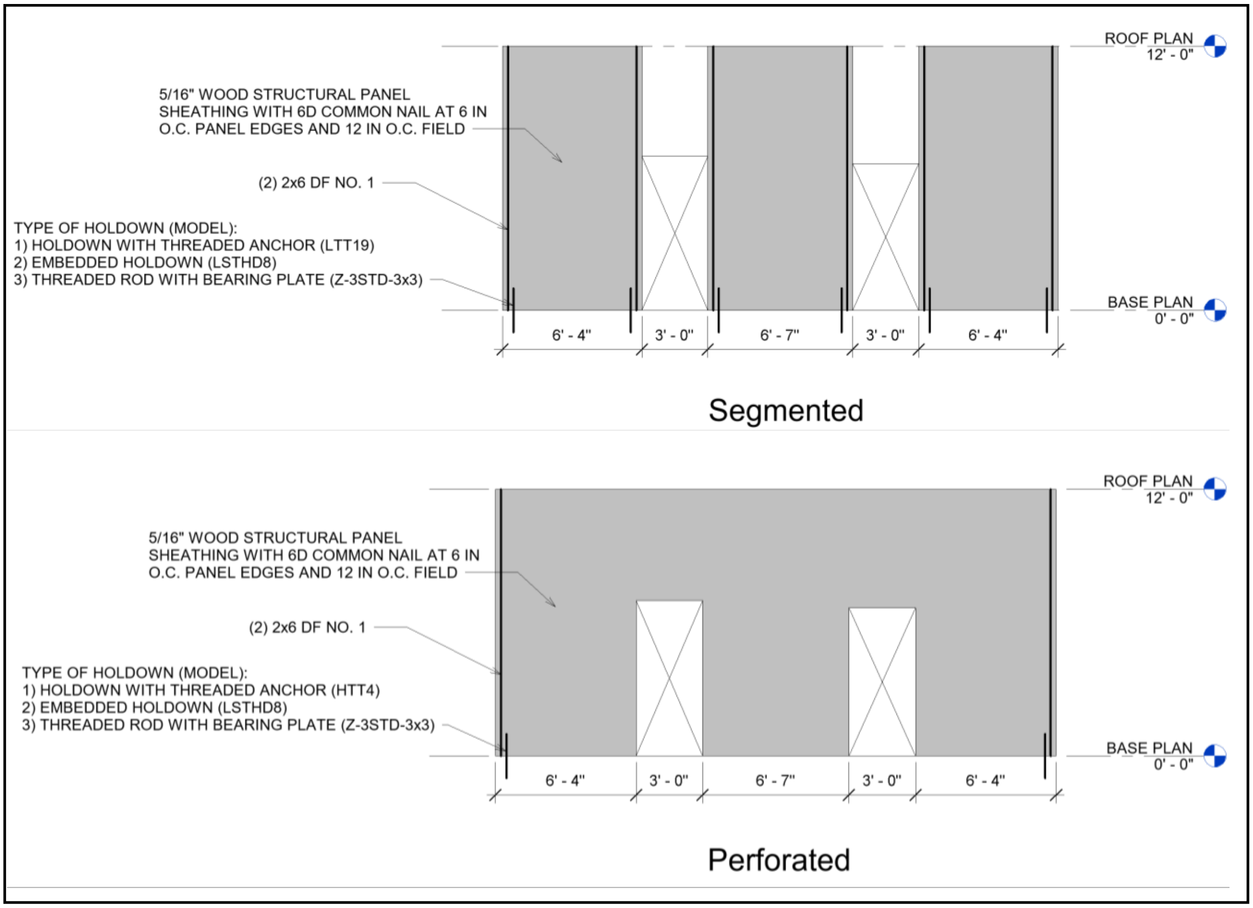


Figure 4-1 Interior Shearwall, Manhattan, KS

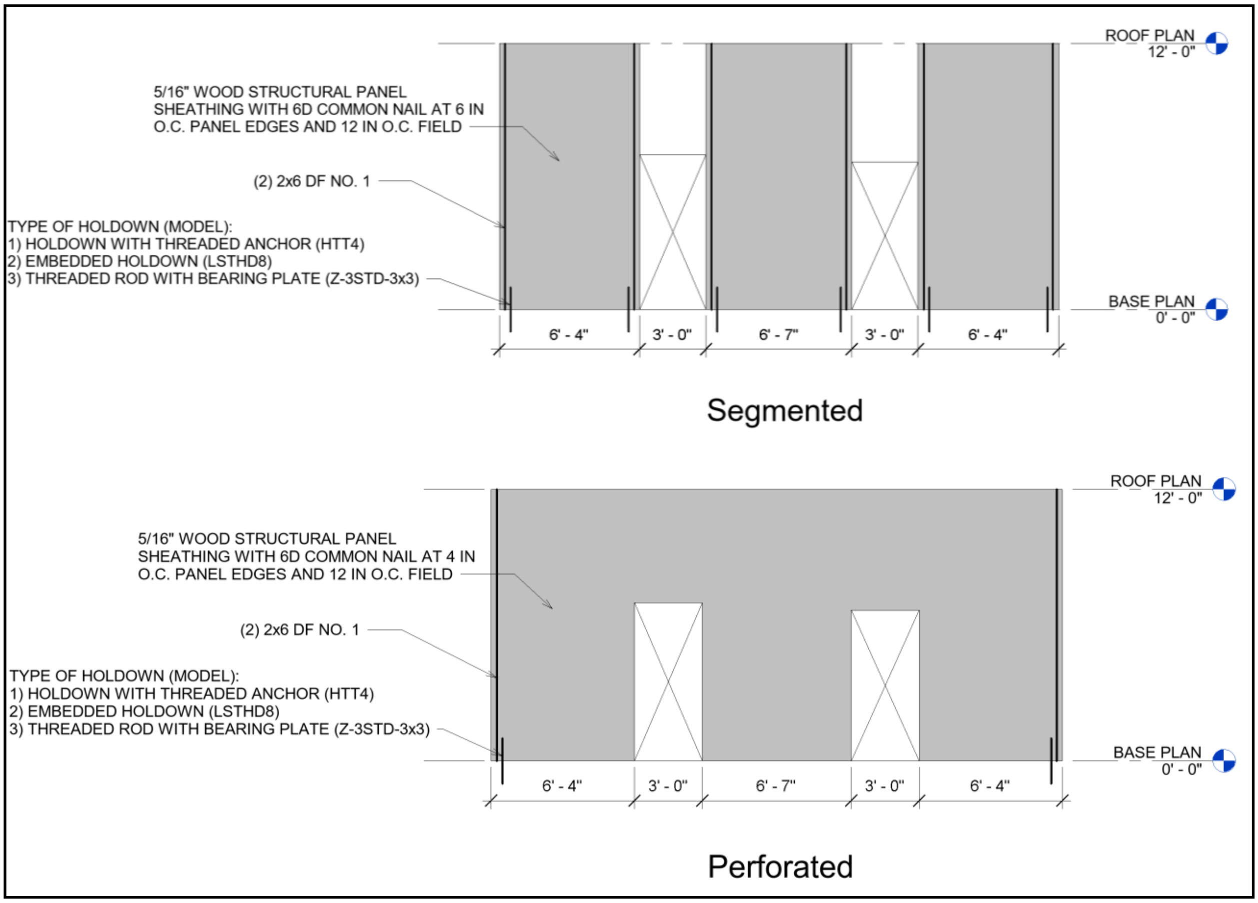


Figure 4-2 Interior Shearwall, Houston, TX

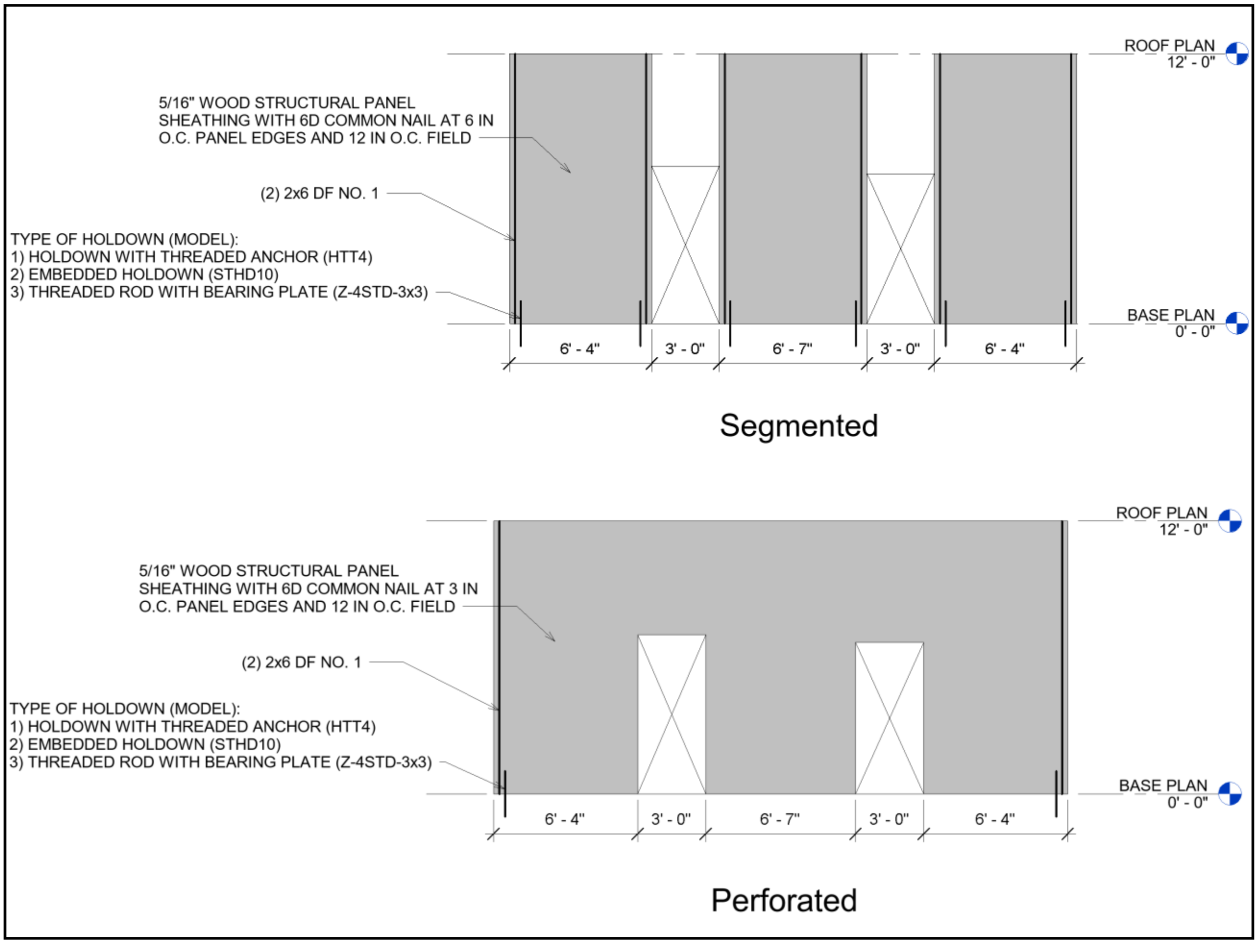


Figure 4-3 Interior Shearwall, Miami, FL

The same sheathing material is used for the three different wind loads for a better comparison of the shearwalls. The same segmented exterior and interior shearwall design is available for the three building locations. The perforated interior shearwall is the only method that requires smaller spacing of edge nailing as the wind speed increases. Although, the three anchorage systems described previously are acceptable for the three buildings, it is recommended to use holdown with threaded anchors or embedded holdowns due to having a capacity closer to what the ASD design load requires at the chords.

Two-Story Buildings

These buildings require the same sheathing design for the exterior shearwalls, which consist of 5/16" wood structural panels with 6d field nails at 12" O.C. and 6d edge nails at 6" O.C. Miami is the only exception which needs more nails for the perforated method at the base to second floor. The interior shearwall design varies from 5/16" wood structural panels with 6d field nails at 12" O.C. and 6d edge nails at 6" O.C in Manhattan to 15/32" wood structural panels with 10d field nails at 12" O.C. and 10d edge nails at 2" O.C in Miami. The chord elements are two 2" X 6" for all locations and the only chords that change are for Houston and Miami where wind forces require up to five 2" X 6" studs for the interior shearwalls at base to second floor. The two-story buildings use one anchor for all three types at exterior shearwalls as well as interior shearwalls at the base and second floor, with the exception of up to five embedded anchors needed in all three locations at the base and two holdown anchors in the perforated method in Miami at the base. Figures 4.4, 4.5, and 4.6 show a visual representation for half of the interior shearwall showing the results found for both segmented and perforated approaches in the three locations. The design for the exterior shearwalls are similar to the interior with the exception that it uses less material overall. **The complete design summary for all the shearwalls and all locations are presented in Appendix C.**

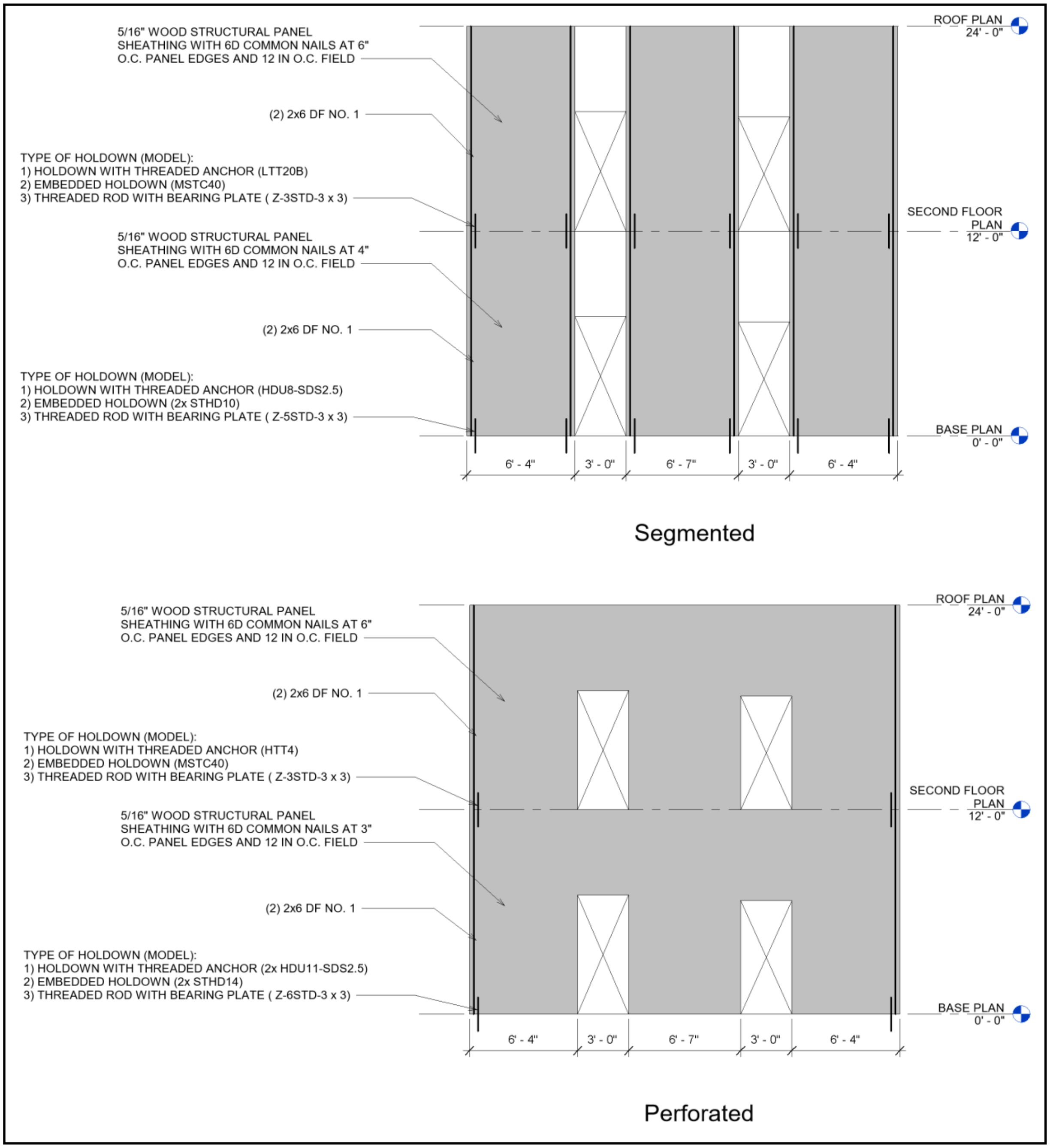


Figure 4-4 Interior Shearwall, Manhattan, KS

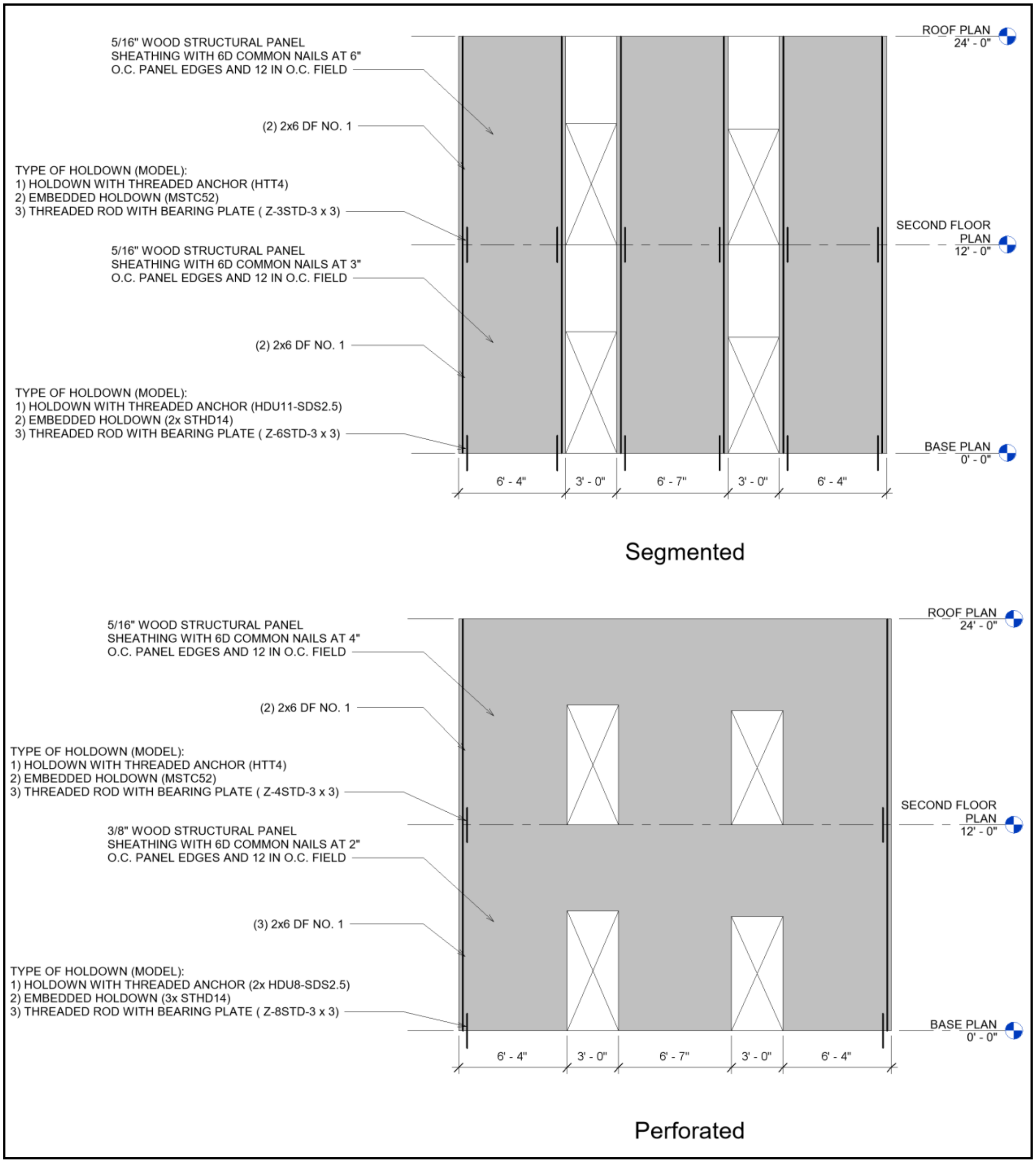


Figure 4-5 Interior Shearwall, Houston, TX

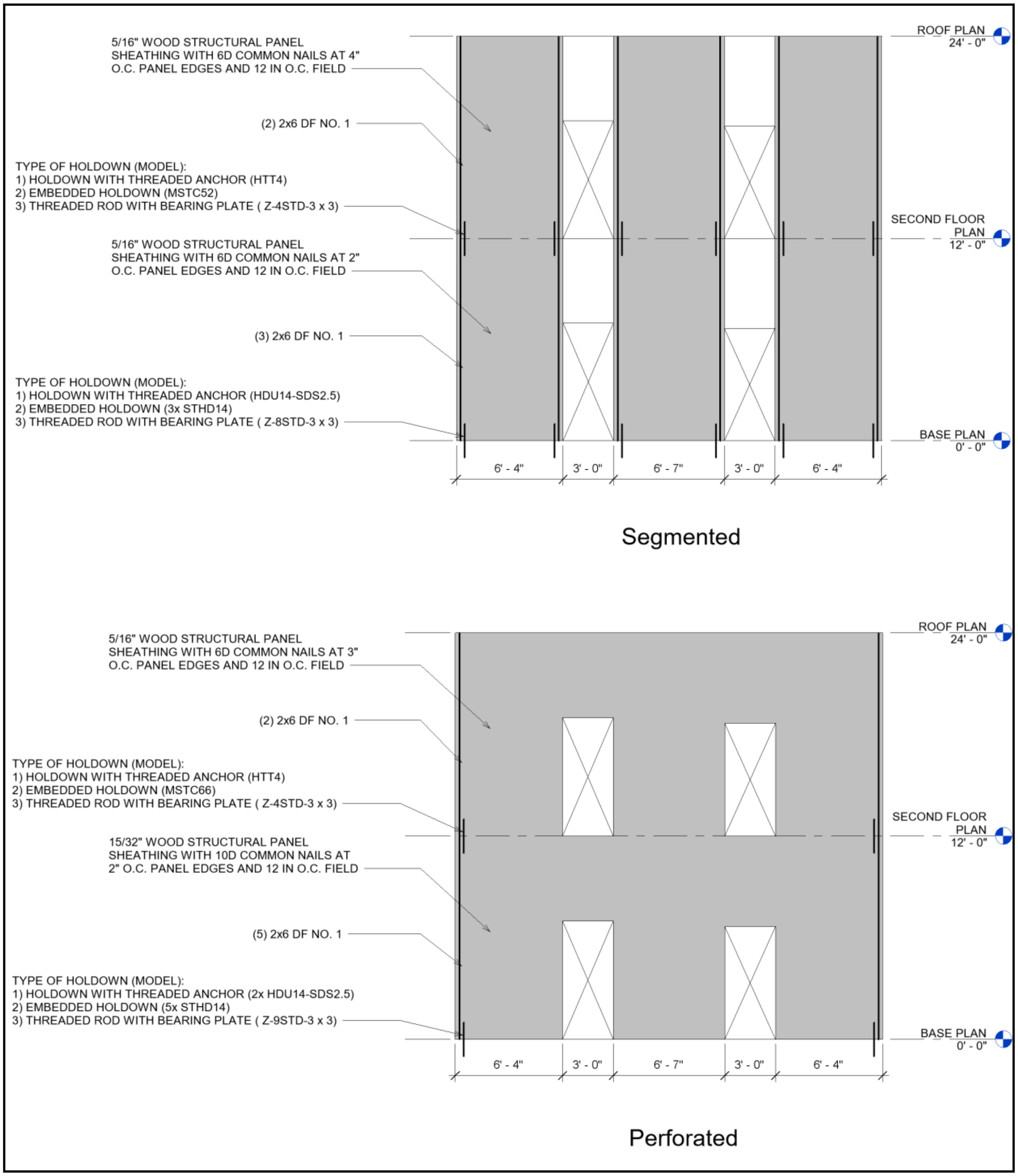


Figure 4-6 Interior Shearwall, Miami, FL

The same sheathing material is used for the three buildings for a better comparison of the shearwalls. The same segmented and perforated exterior shearwall design is available for the Manhattan and Houston locations. The two-story building located in Miami shows a smaller space on the edge nailing for the perforated exterior shearwall only. The interior shearwalls show a decrease in edge nailing space, increase in sheathing thickness, and increase in nail size as the wind speed increases on the building. As shown previously, more than one holdown with threaded anchor or embedded holdown is required on the interior segmented and perforated shearwalls. The number of holdowns required increases as wind load increases on the building. Consequently, the threaded rod with bearing plate is recommended for the two-story buildings in all locations and for both segmented and perforated shearwall approaches.

Three-Story Buildings

The three-story buildings for the exterior shearwalls use the same sheathing design, which consist of 5/16" wood structural panels with 6d field nails at 12" O.C. and 6d edge nails at 6" O.C. However, closer nails are needed at base to second floor in Houston (4" O.C.) and base to third floor in Miami (2" O.C.). The design for the interior shearwalls changes for all stories varying from 5/16" wood structural panels with 6d nails at 6" O.C. being used in Manhattan up to 19/32" wood structural panels with 10d nails at 3" O.C. being used in Miami from base to second floor. Out of all the buildings and locations, the perforated method from base to second floor in the Miami location is the only one that requires sheathing on both sides. Chord elements change across all three locations varying from two 2" x 6" studs up to ten studs needed in Miami for the perforated method at the base to second floor. Buildings at the third floor use one holdown for all three types of anchor systems at the three locations. This is for both exterior and interior shearwalls as well as segmented and perforated methods. The holdown with threaded anchor and embedded holdown use between one to ten anchors for all cases in base and second floor. Figures 4.7, 4.8, and 4.9 present an image for half of the interior shearwall showing the results found for both segmented and perforated approaches in the three locations. The design for the exterior shearwalls are similar to the interior with the exception that it uses less material overall. **The complete design summary for all the shearwalls and all locations are presented in Appendix C.**

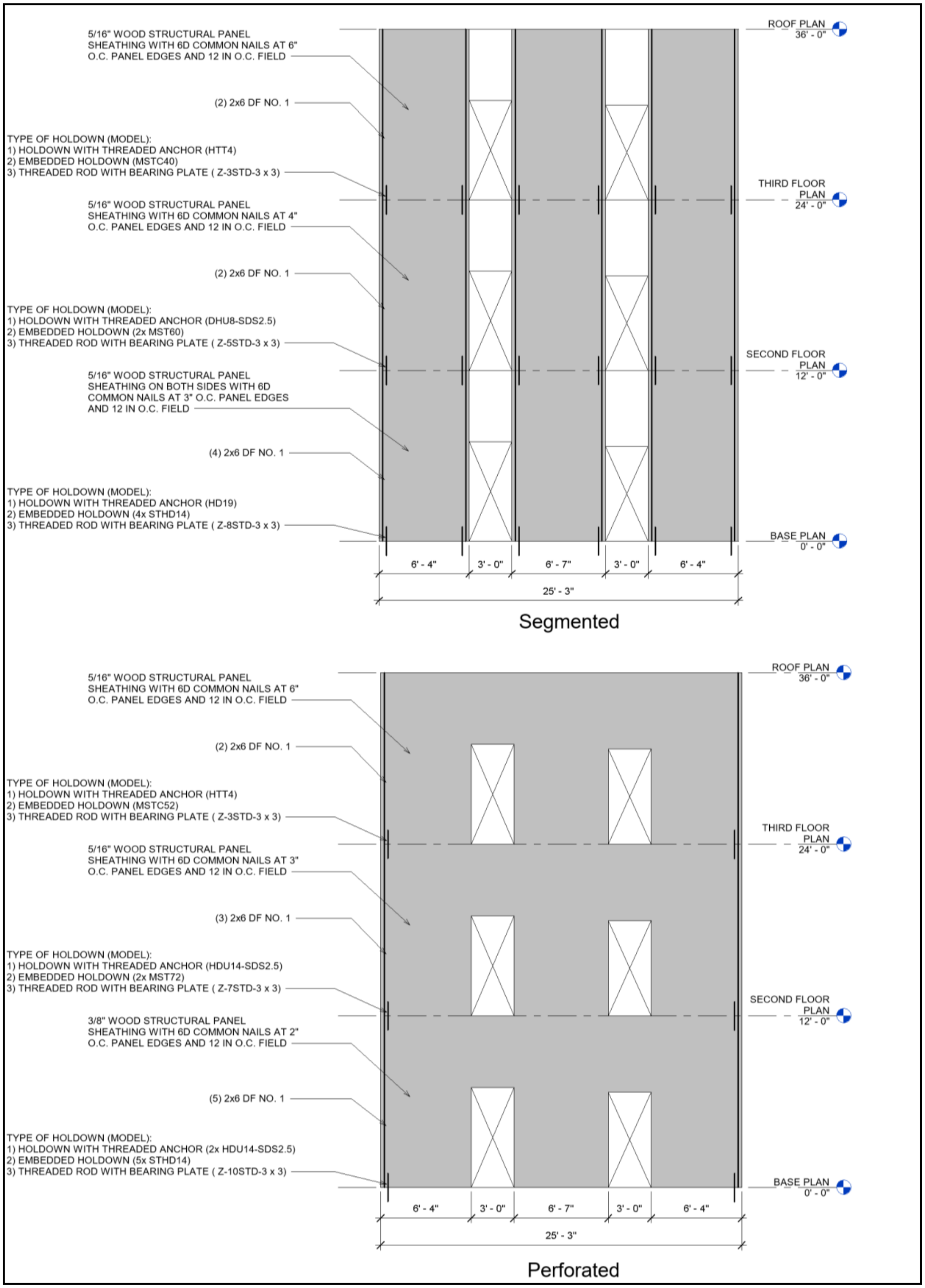


Figure 4-7 Interior Shearwall, Manhattan, KS

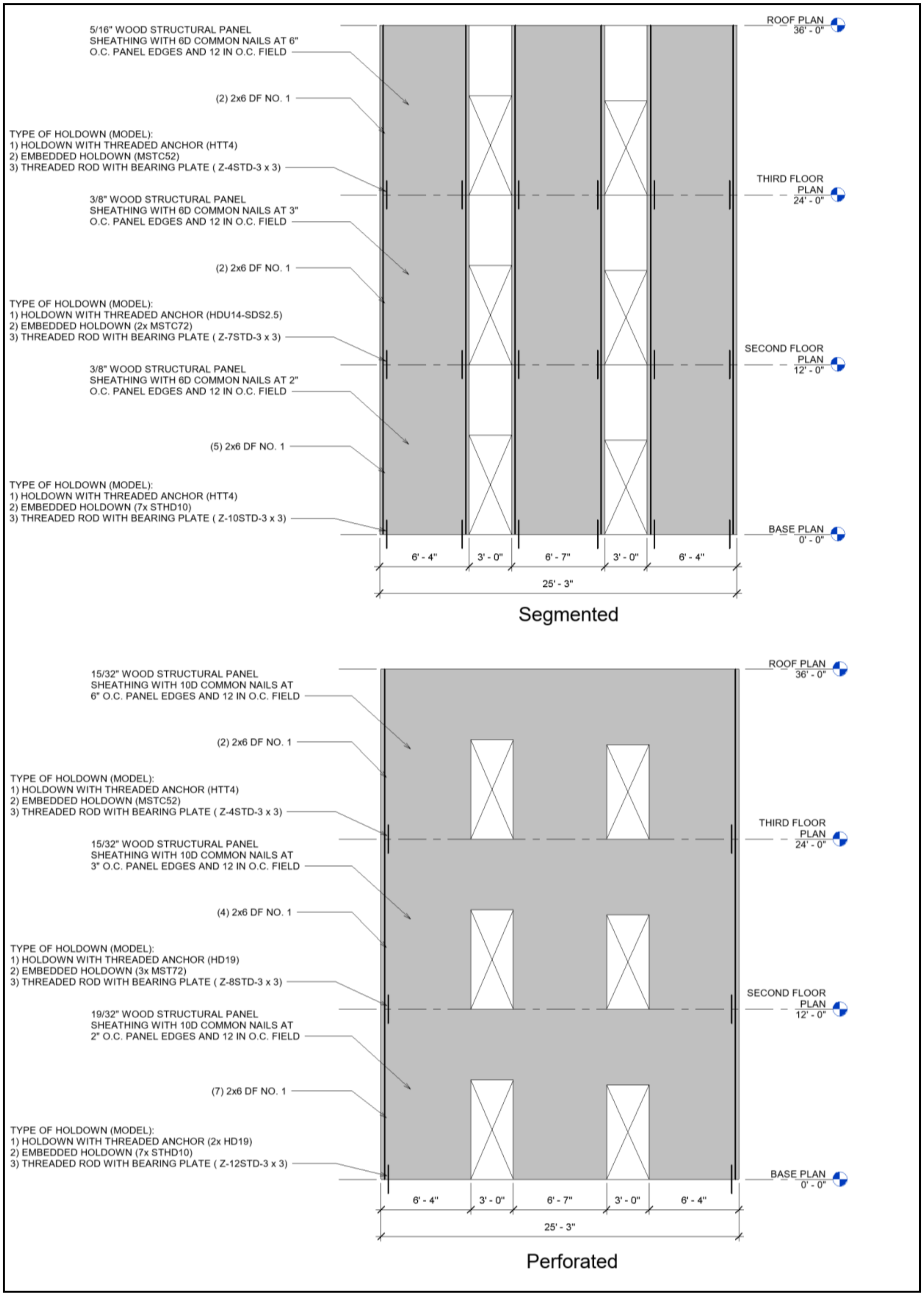


Figure 4-8 Interior Shearwall, Houston, TX

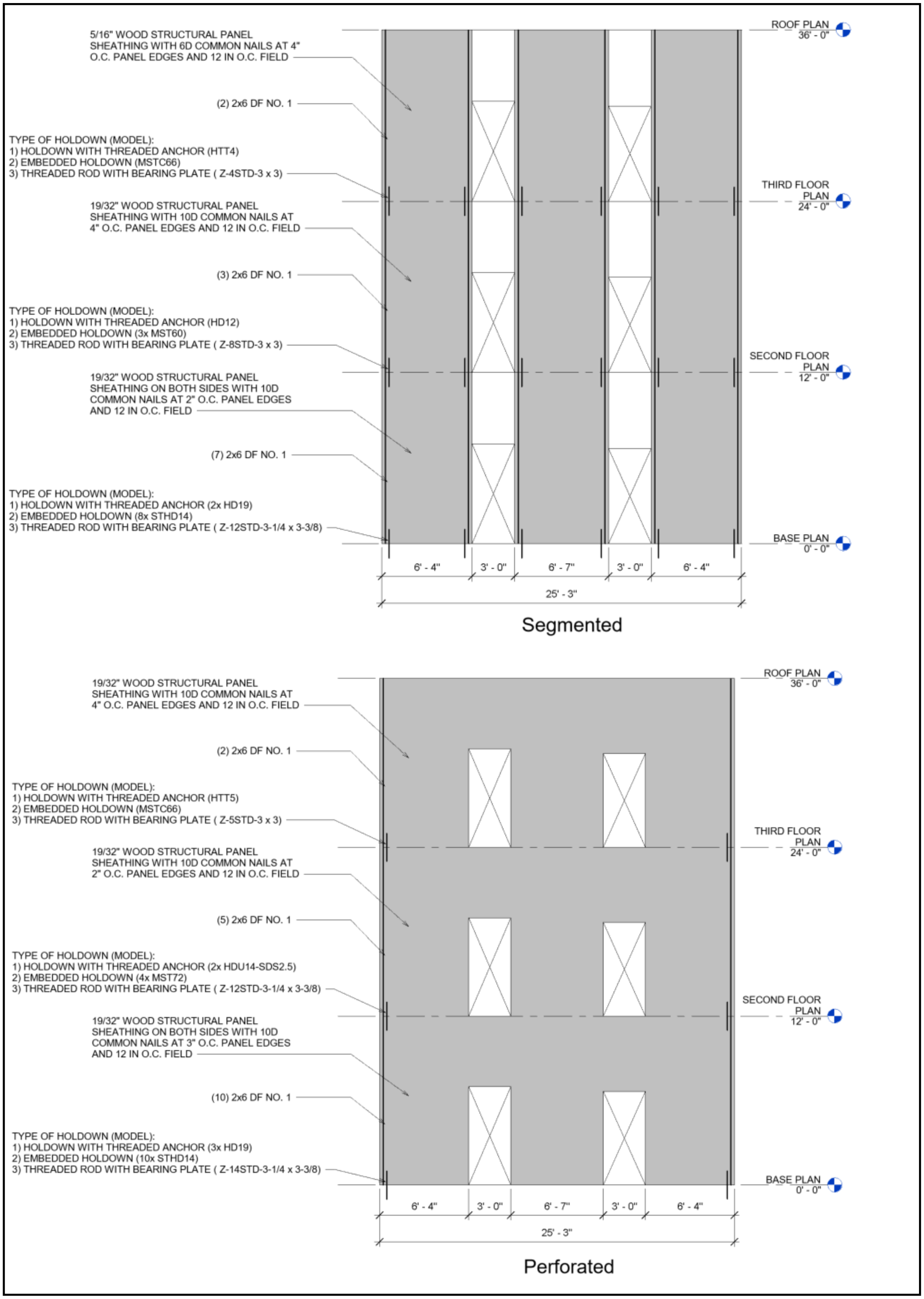


Figure 4-9 Interior Shearwall, Miami, FL

The segmented exterior shearwalls for the three floors have the same design. The segmented interior shearwalls for the Manhattan and Houston locations have the same sheathing thickness, but the edge nail spacing gets smaller for shearwalls at lower floors and as wind speed increases. The segmented interior shearwall for the Miami location has an increase in both nail size and sheathing thickness and a decrease in the edge nail spacing. The perforated exterior and interior shearwalls for all locations increase in nail size, increase in sheathing thickness, and decrease in edge nail spacing as the wind load increases. Also, the perforated interior shearwall at the base plan to second floor plan is the only one that requires sheathing on both sides. As shown previously more than one holdown with threaded anchor or embedded holdown is required on the base plan and the second floor plan among all three-story buildings. The number of holdowns varies from 1 to 3 for holdown with threaded anchor and 1 to 10 for embedded holdown. Consequently, the threaded rod with bearing plate is recommended for the three-story buildings in all locations and for both segmented and perforated shearwall approaches.

Chapter 5 - Conclusion

This report shows the comparison for shearwalls (perforated and segmented method), chord elements, and three anchorage systems among three building heights in three locations with differing wind speeds (Manhattan, KS – 115 mph; Houston, TX – 140 mph; Miami, FL – 169 mph). First, the exterior and interior shearwalls are compared based on sheathing thickness, nail size, and edge nailing. The **one-story** buildings for all locations have identical designs for the exterior shearwalls for both segmented and perforated method. However, interior shearwalls require more nails using the perforated method for the Houston and Miami locations. The **two-story** buildings require the same design for the exterior shearwalls with the exception of Miami which needs more nails for the perforated method at the base to second floor. The interior shearwall design is the same for the three locations except for the perforated method at the second to roof floor in Houston and Miami which requires more nails and base to second floor in Miami also requires thicker sheathing and larger nails. The **three-story** buildings for the exterior shearwalls use the same design, however, additional nails are needed at base to second floor in Houston and base to third floor in Miami. The design for the interior shearwalls changes for all stories varying from 5/16" sheathing thickness and 6d nails at 6" O.C. being used in Manhattan up to 19/32" sheathing thickness and 10d nails at 3" O.C. being used in Miami from base to second floor. Out of all the buildings and locations, the perforated method from base to second floor in the Miami location is the only one that requires sheathing on both sides due to the excessive wind pressure in this hurricane-prone city.

The chord elements for the **one-story** buildings are two 2" x 6" studs for both perforated and segmented methods in all locations. For the **two-story** buildings the only changes for the chord elements are for Houston and Miami where wind forces require up to five 2" X 6" studs for the interior shearwalls at base to second floor. Chord elements for the **three-story** buildings change across all three locations varying from two 2" x 6" studs up to ten studs needed in Miami for the perforated method at the base to second floor.

The three anchor systems compared are: holdowns with threaded anchor, embedded holdowns, and threaded rod with bearing plates. Calculations are for only one end of a segment for the segmented shearwall, and for only one end of the perforated shearwall. The **one-story** buildings in all three locations require one anchor for all three types of holdowns. The **two-story** buildings also use one anchor for all three types at exterior shearwalls as well as interior shearwalls at the base and second floor, with the exception of two to five embedded anchors needed in all three locations and two holdown anchors in the perforated method in Miami at the base. The **three-story** buildings at the third floor use one holdown for all three types of anchor systems at the three locations. This is for both exterior and interior shearwalls as well as segmented and perforated methods. The holdown with threaded anchor and embedded holdown use between one to ten anchors for all cases in base and second floor. Table 5-1 presents a complete foundation anchorage summary for the entire segmented and perforated shearwalls for all heights and locations. Specifically, the segmented exterior shearwalls for all locations and heights use 12 holdowns with threaded anchors, embedded holdowns, or threaded rod with bearing plates, except for the three-story buildings in Houston and Miami which require up to 36 embedded holdowns. The segmented interior shearwalls also use 12 anchors with the exception of the two- and three-story buildings for all locations which require up to 96 embedded holdowns. The perforated exterior shearwalls for all locations and heights use four holdowns with threaded anchors, embedded holdowns, or threaded rod with bearing plates apart from the three-story buildings in all locations which require up to 16 embedded holdowns. The perforated interior shearwalls also use four anchors except for the two- and three-story buildings for all locations which require up to 40 embedded holdowns and also up to 12 holdowns with threaded anchors.

Based on the findings discussed above, the recommendations are as follows. The segmented method is recommended for the shearwalls due to the fact that fewer nails are needed, thinner sheathing is used, and nail sizes tend to be smaller. Overall, the amount of anchors used in the segmented shearwall approach is considerably more than the number of anchors used in the perforated shearwall approach (refer to Table 5-1). It should be noted that the tiedown anchorage system that requires fewer anchors is the threaded rod with bearing plate which uses only one anchor at each chord location for all wind loads and building heights. This leads to the conclusion that the perforated method is a better approach due to the fewer number of anchors required in the building overall. Holdowns with threaded anchors are recommended in the one- and two-story buildings since only four anchors are required per shearwall, apart from the two-story building in Miami. Threaded rod with bearing plates are recommended for the two-story building in Miami as well as all three-story buildings since only four anchors are required in the shearwalls.

Table 5-1 Foundation Anchorage Summary

Exterior Shearwalls		
	Segmented[1]	Perforated
Manhattan, KS (115 mph)		
One-Story		
Holdown with threaded anchor	(12x) DTT1Z	(4x) DTT1Z
Embedded holdown	(12x) LSTHD8	(4x) LSTHD8
Threaded rod with bearing plate	(12x) Z-3STD-3 X 3	(4x) Z-3STD-3 X 3
Two-Story		
Holdown with threaded anchor	(12x) HTT4	(4x) HTT4
Embedded holdown	(12x) LSTHD8	(4x) STHD10
Threaded rod with bearing plate	(12x) Z-3STD-3 X 3	(2x) Z-4STD-3 X 3
Three-Story		
Holdown with threaded anchor	(12x) HDU5-SDS2.5	(4x) HDU8-SDS2.5
Embedded holdown	(12x) STHD14	(8x) STHD10
Threaded rod with bearing plate	(12x) Z-5STD-3 x 3	(4x) Z-5STD-3 x 3
Houston, TX (140 mph)		
One-Story		
Holdown with threaded anchor	(12x) DTT1Z	(4x) DTT1Z
Embedded holdown	(12x) LSTHD8	(4x) LSTHD8
Threaded rod with bearing plate	(12x) Z-3STD-3 x 3	(4x) Z-3STD-3 x 3
Two-Story		
Holdown with threaded anchor	(12x) HTT4	(4x) HTT5
Embedded holdown	(12x) STHD10	(4x) STHD10
Threaded rod with bearing plate	(12x) Z-4STD-3 x 3	(4x) Z-4STD-3 x 3
Three-Story		
Holdown with threaded anchor	(12x) HDU11-SDS2.5	(4x) HDU14-SDS2.5
Embedded holdown	(24x) STHD10	(12x) STHD10
Threaded rod with bearing plate	(12x) Z-6STD-3 x 3	(4x) Z-7STD-3 x 3
Miami, FL (169 mph)		
One-Story		
Holdown with threaded anchor	(12x) DTT1Z	(4x) LTT19
Embedded holdown	(12x) LSTHD8	(4x) LSTHD8
Threaded rod with bearing plate	(12x) Z-3STD-3 x 3	(4x) Z-3STD-3 x 3
Two-Story		
Holdown with threaded anchor	(12x) HTT4	(4x) HDU8-SDS2.5
Embedded holdown	(12x) STHD14	(8x) STHD10
Threaded rod with bearing plate	(12x) Z-4STD-3 x 3	(4x) Z-5STD-3 x 3
Three-Story		
Holdown with threaded anchor	(12x) HDU14-SDS2.5	(8x) HDU11-SDS2.5
Embedded holdown	(36x) STHD14	(16x) STHD14
Threaded rod with bearing plate	(12x) Z-7STD-3 x 3	(4x) Z-8STD-3 X 3

1: Segmented shearwalls have a total of 6 segments.

Interior Shearwalls		
	Segmented[1]	Perforated
Manhattan, KS (115 mph)		
One-Story		
Holdown with threaded anchor	(12x) LTT19	(4x) HTT4
Embedded holdown	(12x) LSTHD8	(4x) LSTHD8
Threaded rod with bearing plate	(12x) Z-3STD-3 X 3	(4x) Z-3STD-3 X 3
Two-Story		
Holdown with threaded anchor	(12x) HDU8-SDS2.5	(4x) HDU11-SDS2.5
Embedded holdown	(24x) STHD10	(8x) STHD14
Threaded rod with bearing plate	(12x) Z-5STD-3 X 3	(4x) Z-6STD-3 X 3
Three-Story		
Holdown with threaded anchor	(12x) HD19	(8x) HDU14-SDS2.5
Embedded holdown	(48x) STHD14	(20x) STHD14
Threaded rod with bearing plate	(12x) Z-8STD-3 x 3	(4x) Z-10STD-3 x 3
Houston, TX (140 mph)		
One-Story		
Holdown with threaded anchor	(12x) HTT4	(4x) HTT4
Embedded holdown	(12x) LSTHD8	(4x) LSTHD8
Threaded rod with bearing plate	(12x) Z-3STD-3 x 3	(4x) Z-3STD-3 x 3
Two-Story		
Holdown with threaded anchor	(12x) HDU11-SDS2.5	(8x) HDU8-SDS2.5
Embedded holdown	(24x) STHD14	(12x) STHD14
Threaded rod with bearing plate	(12x) Z-6STD-3 x 3	(4x) Z-8STD-3 x 3
Three-Story		
Holdown with threaded anchor	(12x) HTT4	(8x) HD19
Embedded holdown	(84x) SDTH10	(28x) STHD10
Threaded rod with bearing plate	(12x) Z-10STD-3 x 3	(4x) Z-12STD-3 x 3
Miami, FL (169 mph)		
One-Story		
Holdown with threaded anchor	(12x) HTT4	(4x) HTT4
Embedded holdown	(12x) STHD10	(4x) STHD10
Threaded rod with bearing plate	(12x) Z-4STD-3 x 3	(4x) Z-4STD-3 X 3
Two-Story		
Holdown with threaded anchor	(12x) HDU14-SDS2.5	(8x) LTT20B
Embedded holdown	(36x) STHD14	(16x) STHD14
Threaded rod with bearing plate	(12x) Z-8STD-3 x 3	(4x) Z-9STD-3 X 3
Three-Story		
Holdown with threaded anchor	(24x) HD19	(12x) HD19
Embedded holdown	(96x) STHD14	(40x) STHD14
Threaded rod with bearing plate	(12x) Z-12STD-3-1/4 X 3-3/8	(4x) Z-14STD-3-1/4 x 3-3/8

1: Segmented shearwalls have a total of 6 segments.

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Appendix A - Permission for use

RE: Permission for reuse

Josh Huenefeld <jhuenefeld@bsestructural.com>

Thu 9/24/2020 9:30 AM

To: Diego Sanchez <dsanche@ksu.edu>

Hi Diego,

I do not have any issues with you using the reference tables. Good luck with your report.

Thanks,

Joshua Huenefeld, P.E., S.E.
Associate / Senior Structural Engineer

BSE STRUCTURAL ENGINEERS

BSE Structural Engineers LLC
11320 West 79th Street
Lenexa, Kansas 66214
Office: 913.492.7400
Direct: 913.754.1190
Cell: 816.830.7796
jhuenefeld@bsestructural.com
www.BSEstructural.com

Steve McFall <smcfall@mii.com>
Thu 10/22/2020 3:13 PM
To: Diego Sanchez
Cc: David Lopp <dlopp@mii.com>

Hey Diego,
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Your projects sounds awesome and we would be very interested in learning what you are seeing through your research. Please let us know if we may be able to join a presentation you are providing to your colleagues in the coming months to review your findings.

Good luck with your research and please let us know anything else you see that we may be able to help out with.

Thanks.
STEVE MCFALL, P.E.
MiTek®
MiTek USA, Inc.
8450 E. Crescent Pkwy, Suite 300, Greenwood Village, CO 80111
Direct: 303-723-4935
MiTek-US.com | smcfall@mii.com

Adam K. Turner <akturner@stron
gtie.com>

Wed 10/21/2020 6:03 PM

To: Diego Sanchez

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Thank you Diego for offering us the chance to review the use of our catalog images in your report. It appears that they are all used in an appropriate context. Good luck on your project, and let us know if you need any literature or product samples, we'll be happy to send those to you at no charge.

Adam Turner | Technical Trainer |Simpson Strong-Tie |
972.439.3002

Appendix B - Two-Story Building Calculations

The following two-story building calculations are based on the Houston TX location. Wind loads in the transverse direction, and designs for the segmented exterior, segmented interior, perforated interior, and perforated exterior shearwalls are presented.

Table B-1 Wind Load, Transverse Direction

Wind Load Spreadsheet - Rigid Buildings (Transverse)

K_z (0-15)	0.57	(ASCE 7-16, Table 26.10-1) - Exposure B
K_z (15-20)	0.62	
K_z (20-24)	0.652	
K_z (24-26)	0.668	
K_{zt}	1	(ASCE 7-16, Section 26.8-2) - Flat Terrain
K_d	0.85	(ASCE 7-16, Table 26.6-1, For Load Combos)
K_e	1	(ASCE 7-16, Table 26.9-1) - Elevation: 105'
V	140 mph	(ASCE 7-16, Figure 26.5-1B)
q_z (0-15)	24.31 psf	(ASCE 7-16, EQ.26.10-1)
q_z (15-20)	26.44 psf	(ASCE 7-16, EQ.26.10-1)
q_z (20-24)	27.81 psf	(ASCE 7-16, EQ.26.10-1)
q_z (24-26)	28.49 psf	(ASCE 7-16, EQ.26.10-1)
C_t	0.02	(ASCE 7-16, Table 12.8-2)
x	0.75	(ASCE 7-16, Table 12.8-2)
h_n	24 ft	Structural height
T_a	0.217 s	(ASCE 7-16, EQ. 12.8-7 ($T_a=C_t h_n^x$)) - Fundamental period
n_a	4.611 Hz	Natural frequency, $n_a=1/T_o$
Is building rigid?	YES	(ASCE 7-16, Section 26.2) - Rigid Building, $n_a \geq 1$
GC_{pi}	0.55	(ASCE 7-16, Table 26.13-1) - Partially Enclosed
G	0.85	(ASCE 7-16, Section 26.11.1)
C_p		(ASCE 7-16, Table 27.3-1)
Windward Wall	0.8	
Leeward Wall	-0.5	
Side Wall	-0.7	
Roof	-0.9	(ASCE 7-16, Table 27.3-1)
	-0.18	Based on largest values
GC_{pn}		(ASCE 7-16, Section 27.3.4)
Windward	1.5	
Leeward	-1	

Area	q_z (0-15)	GC_p	q_h	GC_{pi} (+)	GC_{pi} (-)	p(+) (psf)	p(-) (psf)
W. Wall	24.31	0.68	27.81	0.55	-0.55	1.24	31.83
L. Wall	27.81	-0.425	27.81	0.55	-0.55	-27.11	3.48
S. Wall	24.31	-0.595	27.81	0.55	-0.55	-29.76	0.83

Area	q_z (15-20)	GC_p	q_h	GC_{pi} (+)	GC_{pi} (-)	p(+) (psf)	p(-) (psf)
W. Wall	26.44	0.68	27.81	0.55	-0.55	2.69	33.28
L. Wall	27.81	-0.425	27.81	0.55	-0.55	-27.11	3.48
S. Wall	26.44	-0.595	27.81	0.55	-0.55	-31.03	-0.44

Area	q_z (20-24)	GC_p	q_h	GC_{pi} (+)	GC_{pi} (-)	p(+) (psf)	p(-) (psf)
W. Wall	27.81	0.68	27.81	0.55	-0.55	3.61	34.20
L. Wall	27.81	-0.425	27.81	0.55	-0.55	-27.11	3.48
S. Wall	27.81	-0.595	27.81	0.55	-0.55	-31.84	-1.25
Roof	27.81	-0.765	27.81	0.55	-0.55	-36.57	-5.98
	27.81	-0.153	27.81	0.55	-0.55	-19.55	11.04

***Note: $p(+) = qGC_p - q_hGC_{pi}(+)$ and $p(-) = qGC_p - q_hGC_{pi}(-)$**

Per ASCE 7-16, Eq. 27.3-1, Rigid Building MWFRS

Parapet	q_z (24-26)	GC_{pn}	p (psf)
Windward	28.49	1.5	42.7349
Leeward	28.49	-1	-28.48993

***Note: $p_p=q_p(GC_{pn})$ Per ASCE 7-16, Eq. 27.3-3, Rigid Building MWFRS**

Summary										
	Windward		Leeward		Side Walls		Roof		Roof	
Height	p(+) (psf)	p(-) (psf)	p(+) (psf)	p(-) (psf)	p(+) (psf)	p(-) (psf)	p(+) (psf)	p(-) (psf)	p(+) (psf)	p(-) (psf)
0-15	1.2	31.8	-27.1	3.5	-29.8	0.8	--	--	--	--
15-20	2.7	33.3	-27.1	3.5	-31.0	-0.4	--	--	--	--
20-24	3.6	34.2	-27.1	3.5	-31.8	-1.25	-36.6	-6.0	-19.5	11.0
Parapet	42.73	--	-28.49	--	--	--	--	--	--	--

Base Shear					
	0-15	15-20	20-24	Parapet	Total
Wall Height(ft)	15	5	4	2	--
Wall Length (ft)	100	100	100	100	--
Area (SF)	1500	500	400	200	--
Forces (WW) (lbs)	47737.70	16637.61	13681.31	8546.98	86603.60
Forces (LW) (lbs)	-5213.91	-1737.97	-1390.38	5697.99	-2644.28

TOTAL 83.96 kips

*Note: This includes the bottom half of the first floor

Diapgragm Loads		
Roof	326.81	plf
2nd Floor	344.54	plf

Table B-2 Exterior Segmented Shearwall

Exterior Segmented Shearwall Design - ASD

In-Plane Loading

Exterior

Loads					
Wind Load Factor	0.6				
Length of Wall Perpendicular to Wind	100	ft			
Total Wall Length	60	ft			
Roof					
Shearwall Length	42.5	ft			
Unfactored Load	326.81	plf	Factored Load	196.09	plf
Total Unfactored Shear	4085.17	lb	Total Factored Shear	2451.10	lb
Unfactored Distr. Shear	96.12	plf	Factored Distr. Shear	57.67	plf
Second Floor					
Shearwall Length	42.5	ft			
Unfactored Load	344.54	plf	Factored Load	206.72	plf
Total Unfactored Shear	8391.9272	lb	Total Factored Shear	5035.16	lb
Unfactored Distr. Shear	197.45711	plf	Factored Distr. Shear	118.47	plf

*Note: Divide by 8 since only 12.5' of the wind goes to one exterior wall

*Note: Total shears include the accumulated shears from levels above plus the shear induced at the level

Base to 2nd Floor Sheathing			
Sheathing Type	Wood Structural Panels - Sheathing		SDPWS 2015, Table 4.3A/B/C
Aspect Ratio Acceptable?	YES		SDPWS 2015 Table 4.3.4
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		
Type of Nails	6d		
Nailing Along Edges	6d at 6" O.C.		SDPWS 2015, Table 4.3A/B/C
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	505	plf	SDPWS 2015, Table 4.3A/B/C
Sheathing on One or Both Sides?	one		*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Total Capacity	252.5	plf	
Is the sheathing and nailing adequate?	YES		
2nd Floor to Roof Sheathing			
Sheathing Type	Wood Structural Panels - Sheathing		SDPWS 2015, Table 4.3A/B/C
Aspect Ratio Acceptable?	YES		SDPWS 2015 Table 4.3.4
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		
Type of Nails	6d		
Nailing Along Edges	6d at 6" O.C.		SDPWS 2015, Table 4.3A/B/C
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	505	plf	SDPWS 2015, Table 4.3A/B/C
Sheathing on One or Both Sides?	one		*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Total Capacity	252.5	plf	
Is the sheathing and nailing adequate?	YES		

Axial Loads

Gravity Loads

Tributary Width	12.5	ft		
Roof Dead Load	20	psf x ft =	250	plf
Snow Load	0	psf x ft =	0	plf
Roof Live Load	20	psf x ft =	250	plf
Floor Dead Load	20	psf x ft =	250	plf
Floor Live Load	50	psf x ft =	625	plf
Wind Load	11.0	psf x ft =	137.994913	plf

Axial load

Second floor

Total Factored Load =	500.00	plf
Total Axial Load =	666.67	lb
Total Axial Load =	80.81	psi

Base floor

Total Factored Load =	1375.00	plf
Total Axial Load =	1833.33	lb
Total Axial Load =	222.22	psi

Wall Height	10	ft
Stud Spacing	16	in O.C.

Stud Capacity

Depth of Stud	5.5	in
Width of Stud	1.5	in
S_x	7.5625	in^3

Type of Wood	Douglas Fir Larch No. 1		
F_c	1500	psi	NDS 2018 Table 4A/B
$F_{c\perp}$	625	psi	NDS 2018 Table 4A/B

C_d	1	NDS 2018 Table 2.3.2
C_m	1	NDS 2018 Table 4A/B
C_t	1	NDS 2018 Table 2.3.3
$C_{F\ compression}$	1	NDS 2018 Table 4A/B
C_i	1	NDS 2018 Section 4.3.8
C_p	0.566055	NDS 2018 Section 4.3.10
C_b	1.25	

E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
F_c^*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c^*	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_p	0.566055		NDS 2018 Eq. 3.7-1
l_b	1.5		
C_b	1.25		NDS 2018 Eq. 3.10-2

F_c'	849.08254	psi	NDS 2018 Table 4.3.1
$F_{c\perp}'$	781.25	psi	NDS 2018 Table 4.3.1

Studs adequate in compression?	YES	
Studs adequate in compression perpendicular to grain?	YES	
Are the studs adequate?	YES	

Chord Forces - Individual Segments

Floor to Floor Height	12	ft	
Length of Segment	4.33	ft	
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Second floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Distance Between Chords	4.33	ft	
Overturning Moment	2998.9958	lb-ft	
Chord Force	692.07596	lb	
	41.943998	psi	
Base floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Distance Between Chords	4.33	ft	
Overturning Moment	12158.654	lb-ft	
Chord Force	2805.8431	lb	
	170.0511	psi	
Type of Wood	Douglas Fir Larch No. 1		
F_t	675	psi	NDS 2018 Table 4A/B
F_c	1500	psi	NDS 2018 Table 4A/B
C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ tension}$	1		NDS 2018 Table 4A/B
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.566055		NDS 2018 Section 4.3.10
E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
F_c^*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c^*	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_P	0.566055		NDS 2018 Eq. 3.7-1
F_t'	675	psi	NDS Table 4.3.1
F_c'	849.08	psi	NDS Table 4.3.1

Second floor			
Studs adequate in tension?	YES		
Studs adequate in compression?	YES		
Base floor			
Studs adequate in tension?	YES		
Studs adequate in compression?	YES		
Are the chords adequate?	YES		

Shearwall Anchorage

Shear Anchors			
Total Factored Shear	118.47	plf	
Length of Segment	4.33	ft	
Total Force	513.39	lb	
Dia. of Anchor	1/2		
$Z_{Parallel}$	650	lb/anchor	NDS 2018 Table 12E
K_f	3.32		NDS Table 11.3.1
$\Phi_{connection}$	0.65		NDS Table 11.3.1
λ	1		NDS 2018 Table N3
C_m	1		NDS 2018 Table 11.3.3
C_t	1		NDS 2018 Table 11.3.4
C_g	1		NDS 2018 Section 11.3.6
C_Δ	1		NDS 2018 Section 12.5.1
Z'	1402.7	lb/anchor	NDS Table 11.3.1
Required Number of Anchors	0.366	anchors	
Number of Anchors to Use	1	anchors	
Max Spacing	-	ft	
	-	in	

Overturning Anchors			
Second Floor			
F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	692.08	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	692.08	lb	
Required Area Per Anchor	0.017	in^2	
Required Diameter Per Anchor	0.148	in	

Holdowns with threaded anchor			
Holdown model	DTT1Z		Simpson Strong-Tie
Screwed	(6) SD #9 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	3/8	in	Simpson Strong-Tie
Minimum Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	840	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Model	DTT1Z		Simpson Strong-Tie
Nails	(6) 0.148 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	3/8	in	Simpson Strong-Tie
Min. Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	910	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Embedded holdown

Holdown model	MSTC40			Simpson Strong-Tie
Fasteners	(20) 0.148 x 3-1/4			Simpson Strong-Tie
Minimum Post thinkness	3	in		Simpson Strong-Tie
Capacity	1920	lb		Simpson Strong-Tie
Is the holdown adequate?	YES			
Threaded rod with bearing plate				
Model Number	Z-3STD-3 x 3			
Cinch Nut (CNX)	CNX-3			MiTek - Product Catalog
CNX Capacity	5175	lb		MiTek - Product Catalog
Z-Rod (ZR)	ZR-3 STD			MiTek - Product Catalog
ZR Length	12	ft		MiTek - Product Catalog
ZR Diameter	3/8	in		MiTek - Product Catalog
ZR Capacity	2485	lb		MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in		MiTek - Product Catalog
BPW Capacity	4780	lb		MiTek - Product Catalog
Is the CNX adequate?	YES			
Is the ZR adequate?	YES			
Is the BPW adequate?	YES			
Isthreaded rod adequate?	YES			
Base floor				
F_y	45000	psi		*Note: Anchor capacities based on
Individual Panel Anchor Force	729.62	lb	50351.5633	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	2805.84	lb		
Required Area Per Anchor	0.069	in^2		
Required Diameter Per Anchor	0.297	in		
Holdowns with threaded anchor				
Holdown model	HTT4			Simpson Strong-Tie
Screwed	(18) SD #10 x 1-1/2			Simpson Strong-Tie
Anchor bolt diameter	5/8	in		Simpson Strong-Tie
Minimum Post thinkness	1.5	in		Simpson Strong-Tie
Cpacity	4455	lb		Simpson Strong-Tie
Is the holdown adequate?	YES			
Model	HTT4			Simpson Strong-Tie
Nails	(18) 0.148 x 1-1/2			Simpson Strong-Tie
Anchor bolt diameter	5/8	in		Simpson Strong-Tie
Min. Post thinkness	1.5	in		Simpson Strong-Tie
Cpacity	3000	lb		Simpson Strong-Tie
Is the holdown adequate?	YES			
Embedded holdown				
Corner location				
Holdown model	STHD10			Simpson Strong-Tie
Fasteners	(28) 0.148 x 3-1/4			Simpson Strong-Tie
Capacity	4072	lb		Simpson Strong-Tie
Is the holdown adequate?	YES			
Midwall location				
Holdown model	LSTHD8			Simpson Strong-Tie
Fasteners	(20) 0.148 x 3-1/4			Simpson Strong-Tie
Capacity	2985	lb		Simpson Strong-Tie
Is the holdown adequate?	YES			

Threaded rod with bearing plate			
Model Number	Z-4STD-3 x 3		
Cinch Nut (CNX)	CNX-4		MiTek - Product Catalog
CNX Capacity	9205	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-4 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	1/2	in	MiTek - Product Catalog
ZR Capacity	4420	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		
Serviceability - Second Floor			
Bending Defelction			
Second Level Induced Unit Shear	118.47	plf	
Shear Wall Height	12	ft	
Modulus of Elasticity	1700000	psi	NDS 2018 Table 4A/B
Area of End Posts	16.5	in^2	
Shearwall Length	4.33	ft	
Bending Defelction	0.0135	in	SDPWS 2015 Section C4.3.2
Shear Deflection			
$G_v t_v$	25000	lb/in	SDPWS 2015 Table C4.2.2A/B
Shear Deflection	0.057	in	SDPWS 2015 Section C4.3.2
Nail Slip Deflection			
Nail Spacing	6	in O.C.	SDPWS 2015 Table C4.2.2D
V_n	59.237133	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Wall Anchorage Slip			
Vertical Elongation of Anchorage	0.125	in	SDPWS 2015 C4.3.3.4.1-1
Tie-Down Nail Slip Deflection	0.346	in	
Total Deflection	0.9975	in	
Allowable Deflection	2.88	in	ASCE 7-16 Sec 12.12 (Based on .02*height*12)
Is the deflection acceptable?	YES		
Serviceability - Overall Drift			
Bending Defelction			
Roof Induced Unit Shear	57.67	plf	
Second Floor Bending Deflection	0.0135	in	SDPWS 2015 Section C4.3.2
Roof Bending Deflection	0.0066	in	SDPWS 2015 Section C4.3.2
Total Bending Deflection	0.0200	in	

Shear Deflection			
Total Shear Deflection	0.1137353	in	
Nail Slip Deflection			
Second Floor Nail Slip Deflection	0.5810521	in	
Roof Nail Spacing	6	in O.C.	SDPWS 2015 Table C4.2.2D
V_n	28.836	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Second Level Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Total Nail Slip Deflection	1.162	in	
Tie-Down Nail Slip Deflection			
Total Tie-Down Nail Slip Deflection	0.692		
Total Deflection	1.9881805	in	*Based on summing the components
Allowable Deflection	5.76	in	*Based on .02*mean roof height*12
Is the deflection acceptable?	YES		

Table B-3 Interior Segmented Shearwall

Interior Segmented Shearwall Design - ASD

In-Plane Loading

Exterior

Loads

Wind Load Factor	0.6				
Length of Wall Perpendicular to Wind	100	ft			
Total Wall Length	60	ft			
Roof					
Shearwall Length	38.5	ft			
Unfactored Load	326.81	plf	Factored Load	196.09	plf
Total Unfactored Shear	12255.51	lb	Total Factored Shear	7353.31	lb
Unfactored Distr. Shear	318.32	plf	Factored Distr. Shear	190.99	plf
Second Floor					
Shearwall Length	38.5	ft			
Unfactored Load	344.54	plf	Factored Load	206.72	plf
Total Unfactored Shear	25175.782	lb	Total Factored Shear	15105.47	lb
Unfactored Distr. Shear	653.91641	plf	Factored Distr. Shear	392.35	plf

*Note: Divide by (8/3) since only 37.5' of the wind goes to one interior wall
*Note: Total shears include the accumulated shears from levels above plus the shear induced at the level

Base to 2nd Floor Sheathing

Sheathing Type	Wood Structural Panels - Sheathing		SDPWS 2015, Table 4.3A/B/C
Aspect Ratio Acceptable?	YES		SDPWS 2015 Table 4.3.4
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		
Type of Nails	6d		
Nailing Along Edges	6d at 3" O.C.		SDPWS 2015, Table 4.3A/B/C
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	980	plf	SDPWS 2015, Table 4.3A/B/C
Sheathing on One or Both Sides?	one		*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Total Capacity	490	plf	
Is the sheathing and nailing adequate?	YES		

2nd Floor to Roof Sheathing

Sheathing Type	Wood Structural Panels - Sheathing		SDPWS 2015, Table 4.3A/B/C
Aspect Ratio Acceptable?	YES		SDPWS 2015 Table 4.3.4
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		
Type of Nails	6d		
Nailing Along Edges	6d at 6" O.C.		SDPWS 2015, Table 4.3A/B/C
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	505	plf	SDPWS 2015, Table 4.3A/B/C
Sheathing on One or Both Sides?	one		*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Total Capacity	252.5	plf	
Is the sheathing and nailing adequate?	YES		

Axial Loads

Gravity Loads

Tributary Width	25	ft		
Roof Dead Load	20	psf x ft =	500	plf
Snow Load	0	psf x ft =	0	plf
Roof Live Load	20	psf x ft =	500	plf
Floor Dead Load	20	psf x ft =	500	plf
Floor Live Load	50	psf x ft =	1250	plf
Wind Load	11.0	psf x ft =	275.989827	plf

Axial load

Second floor

Total Factored Load =	1000.00	plf
Total Axial Load =	1333.33	lb
Total Axial Load =	161.61616	psi

Base floor

Total Factored Load =	2750.00	plf
Total Axial Load =	3666.67	lb
Total Axial Load =	444.44444	psi

Wall Height	10	ft
Stud Spacing	16	in O.C.

Stud Capacity

Depth of Stud	5.5	in	
Width of Stud	1.5	in	
S_x	7.5625	in^3	
Type of Wood	Douglas Fir Larch No. 1		
F_c	1500	psi	NDS 2018 Table 4A/B
$F_{c\perp}$	625	psi	NDS 2018 Table 4A/B
C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.566055		NDS 2018 Section 4.3.10
C_b	1.25		

E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
F_c*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c*	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_p	0.566055		NDS 2018 Eq. 3.7-1
l_b	1.5		
C_b	1.25		NDS 2018 Eq. 3.10-2

F_c'	849.08254	psi	NDS 2018 Table 4.3.1
$F_{c\perp}'$	781.25	psi	NDS 2018 Table 4.3.1

Studs adequate in compression?	YES	
Studs adequate in compression perpendicular to grain?	YES	
Are the studs adequate?	YES	

Chord Forces - Individual Segments

Floor to Floor Height	12	ft	
Length of Segment	6.33	ft	
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Second floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Distance Between Chords	6.33	ft	
Overturning Moment	14515.62	lb-ft	
Chord Force	2291.94	lb	
	138.91	psi	
Base floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Distance Between Chords	6.33	ft	
Overturning Moment	58849.827	lb-ft	
Chord Force	9292.0779	lb	
	563.15624	psi	
Type of Wood	Douglas Fir Larch No. 1		
F_t	675	psi	NDS 2018 Table 4A/B
F_c	1500	psi	NDS 2018 Table 4A/B
C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ tension}$	1		NDS 2018 Table 4A/B
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.566055		NDS 2018 Section 4.3.10
E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
F_c*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c*	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_p	0.566055		NDS 2018 Eq. 3.7-1
F_t'	675	psi	NDS Table 4.3.1
F_c'	849.08	psi	NDS Table 4.3.1

Second floor			
Studs adequate in tension?	YES		
Studs adequate in compression?	YES		
Base floor			
Studs adequate in tension?	YES		
Studs adequate in compression?	YES		
Are the chords adequate?	YES		

Shearwall Anchorage

Shear Anchors			
Total Factored Shear	392.35	plf	
Length of Segment	6.33	ft	
Total Force	2484.88	lb	
Dia. of Anchor	3/4		
$Z_{Parallel}$	1270	lb/anchor	NDS 2018 Table 12E
K_f	3.32		NDS Table 11.3.1
$\Phi_{connection}$	0.65		NDS Table 11.3.1
λ	1		NDS 2018 Table N3
C_m	1		NDS 2018 Table 11.3.3
C_t	1		NDS 2018 Table 11.3.4
C_g	1		NDS 2018 Section 11.3.6
C_Δ	1		NDS 2018 Section 12.5.1
Z'	2740.66	lb/anchor	NDS Table 11.3.1
Required Number of Anchors	0.907	anchors	
Number of Anchors to Use	1	anchors	
Max Spacing	-	ft	
	-	in	

Overturning Anchors			
Second Floor			
F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	2291.94	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	2291.94	lb	
Required Area Per Anchor	0.057	in^2	
Required Diameter Per Anchor	0.268	in	

Holdowns with threaded anchor			
Holdown model	HTT4		Simpson Strong-Tie
Screwed	(18) SD #10 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	5/8	in	Simpson Strong-Tie
Minimum Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	4455	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Model	HTT4		Simpson Strong-Tie
Nails	(18) 0.148 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	5/8	in	Simpson Strong-Tie
Min. Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	3000	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Embedded holdown			
Holdown model	MSTC52		Simpson Strong-Tie
Fasteners	(36) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	3455	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Threaded rod with bearing plate			
Model Number	Z-3STD-3 x 3		
Cinch Nut (CNX)	CNX-3		MiTek - Product Catalog
CNX Capacity	5175	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-3 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	3/8	in	MiTek - Product Catalog
ZR Capacity	2485	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		
Base floor			
F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	2416.26	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	9292.08	lb	
Required Area Per Anchor	0.229	in^2	
Required Diameter Per Anchor	0.540	in	
Holdowns with threaded anchor			
Holdown model	-		Simpson Strong-Tie
Screwed	-		Simpson Strong-Tie
Anchor bolt diameter	-	in	Simpson Strong-Tie
Minimum Post thinkness	-	in	Simpson Strong-Tie
Cpacity	-	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Model	HDU11-SDS2.5		Simpson Strong-Tie
Nails	(30) 1/4 x 2-1/2 SDS (Screws)		Simpson Strong-Tie
Anchor bolt diameter	1	in	Simpson Strong-Tie
Min. Post thinkness	3.5	in	Simpson Strong-Tie
Cpacity	9335	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Embedded holdown			
Corner location			
Holdown model	(2x) STHD14		Simpson Strong-Tie
Fasteners	(30) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	10570	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Midwall location			
Holdown model	(2x) STHD14		Simpson Strong-Tie
Fasteners	(30) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	10570	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Threaded rod with bearing plate			
Model Number	Z-6STD-3 x 3		
Cinch Nut (CNX)	CNX-6		MiTek - Product Catalog
CNX Capacity	16940	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-6 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	3/4	in	MiTek - Product Catalog
ZR Capacity	9940	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		
Serviceability - Second Floor			
Bending Defelction			
Second Level Induced Unit Shear	392.35	plf	
Shear Wall Height	12	ft	
Modulus of Elasticity	1700000	psi	NDS 2018 Table 4A/B
Area of End Posts	16.5	in^2	
Shearwall Length	6.33	ft	
Bending Defelction	0.0305	in	SDPWS 2015 Section C4.3.2
Shear Deflection			
G_vt_v	25000	lb/in	SDPWS 2015 Table C4.2.2A/B
Shear Deflection	0.188	in	SDPWS 2015 Section C4.3.2
Nail Slip Deflection			
Nail Spacing	3	in O.C.	SDPWS 2015 Table C4.2.2D
V_n	98.087461	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Wall Anchorage Slip			
Vertical Elongation of Anchorage	0.125	in	SDPWS 2015 C4.3.3.4.1-1
Tie-Down Nail Slip Deflection	0.237	in	
Total Deflection	1.0368	in	
Allowable Deflection	2.88	in	ASCE 7-16 Sec 12.12 (Based on .02*height*12)
Is the deflection acceptable?	YES		
Serviceability - Overall Drift			
Bending Defelction			
Roof Induced Unit Shear	190.99	plf	
Second Floor Bending Deflection	0.0305	in	SDPWS 2015 Section C4.3.2
Roof Bending Deflection	0.0149	in	SDPWS 2015 Section C4.3.2
Total Bending Deflection	0.0454	in	

Shear Deflection			
Total Shear Deflection	0.3766559	in	
Nail Slip Deflection			
Second Floor Nail Slip Deflection	0.5810521	in	
Roof Nail Spacing	6	in O.C.	SDPWS Table C4.2.2D
V_n	95.497	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Third Level Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Total Nail Slip Deflection	1.162	in	
Tie-Down Nail Slip Deflection			
Total Tie-Down Nail Slip Deflection	0.474		
Total Deflection	2.0578377	in	*Based on summing the components
Allowable Deflection	5.76	in	*Based on .02*mean roof height*12
Is the deflection acceptable?	YES		

Table B-4 Exterior Perforated Shearwall

Exterior Perforated Shearwall Design - ASD

Perforated Shearwall Checks

Full height segments at each end?	YES	SDPWS 2015 Sec. 4.3.5
Collectors provided along full length?	YES	SDPWS 2015 Sec. 4.3.5
Uniform top and bottom elevations?	YES	SDPWS 2015 Sec. 4.3.5
Shearwall height does not exceed 20ft?	YES	SDPWS 2015 Sec. 4.3.5
Nominal shear capacity of sheathing does not exceed 2435 plf (single) 2435 plf (double)?	NO	SDPWS 2015 Sec. 4.3.5
Can perforated shearwalls be used?	YES	

In-Plane Loading

Capacity					
Wind Load Factor	0.6				
Length of Wall Perpendicular to Wind	100	ft			
Roof					
Unfactored Load	326.81	plf	Factored Load	196.0881893	plf
Total Unfactored Shear	4085.171	lb	Total Factored Shear	2451.102367	lb
Second Floor					
Unfactored Load	344.54	plf	Factored Load	206.7243172	plf
Total Unfactored Shear	8391.927	lb	Total Factored Shear	5035.156332	lb

*Note: Divide by 8 since only 12.5' of the wind goes to one exterior wall
*Note: Total shears include the accumulated shears from levels above plus the shear induced at the level

Chord Forces - Overall Wall

Sum of Full Height Segment Lengths (Li)	19.25	ft	*Note: Full height segments must meet the aspect ratios of SDPWS Table 4.3.4
Total Length of the Shearwall	25.25	ft	
Percentage of Full-Height Sheathing	0.762376		
Wall Height	10	ft	
Maximum Opening Height	4	ft	
C_o	0.96		SDPWS 2015, Table 4.3.3.5
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Floor to Floor Height	12	ft	
Second floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Chord Force	795.8125	lb	Shear*Height/(Co*Li), SDPWS Eq.4.3-8
	48.23106	psi	
Base floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Chord Force	4065.394	lb	Shear*Height/(Co*Li), SDPWS Eq.4.3-8
	246.3875	psi	
Type of Wood	Douglas Fir Larch No. 1		
F_t	675	psi	NDS 2018 Table 4A/B
F_c	1500	psi	NDS 2018 Table 4A/B

C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ tension}$	1		NDS 2018 Table 4A/B
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.566055		NDS 2018 Section 4.3.10

E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
$F_c{}^*$	1500	psi	NDS 2018 Section 3.7.1
$F_{cE}/F_c{}^*$	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_P	0.566055		NDS 2018 Eq. 3.7-1

F_t'	675	psi	NDS Table 4.3.1
F_c'	849.0825	psi	NDS Table 4.3.1

Second floor	
Studs adequate in tension?	YES
Studs adequate in compression?	YES
Base floor	
Studs adequate in tension?	YES
Studs adequate in compression?	YES
Are the chords adequate?	YES

Sheathing

Base to 2nd Floor Sheathing

v_{max}	136.2326	plf	Shear/(Co*Li)
Sheathing Type	Wood Structural Panels - Sheathing		
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		SDPWS 2015, Table 4.3A/B/C
Type of Nails	6d		
Nailing Along Edges	6d at 6" O.C.		
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	505	plf	SDPWS 2015, Table 4.3A/B/C
C_o	0.96	plf	SDPWS 2015, Table 4.3.3.5
Sheathing on One or Both Sides?	one		
Total Capacity	242.4	plf	*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Is the sheathing and nailing adequate?	YES		
Is the perforated shearwall check met?	YES		

2nd Floor to Roof Sheathing

v_{max}	66.3177	plf	Shear/(Co*Li)
Sheathing Type	Wood Structural Panels - Sheathing		
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		SDPWS 2015, Table 4.3A/B/C
Type of Nails	6d		
Nailing Along Edges	6d at 6" O.C.		
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	505	plf	SDPWS 2015, Table 4.3A/B/C
C_o	0.96	plf	SDPWS 2015, Table 4.3.3.5
Sheathing on One or Both Sides?	one		
Total Capacity	242.4	plf	*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Is the sheathing and nailing adequate?	YES		
Is the perforated shearwall check met?	YES		

Out-of-Plane Loading

Gravity Loads

Tributary Width	12.5	ft		
Roof Dead Load	20	psf x ft =	250	plf
Snow Load	0	psf x ft =	0	plf
Roof Live Load	20	psf x ft =	250	plf
Floor Dead Load	20	psf x ft =	250	plf
Floor Live Load	50	psf x ft =	625	plf
Wind Load	11.04	psf x ft =	137.994913	plf

Axial load

Second floor

Total Factored Load =	500.00	plf
Total Axial Load =	666.67	lb
Total Axial Load =	80.81	psi

Base floor

Total Factored Load =	1375.00	plf
Total Axial Load =	1833.33	lb
Total Axial Load =	222.22	psi

Wall Height	10	ft
Stud Spacing	16	in O.C.

Stud Capacity

Depth of Stud	5.5	in	
Width of Stud	1.5	in	
S_x	7.5625	in^3	
Type of Wood	Douglas Fir Larch No. 1		
F_c	1500	psi	NDS 2018 Table 4A/B
$F_{c\perp}$	625	psi	NDS 2018 Table 4A/B
C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.566055		NDS 2018 Section 4.3.10
C_b	1.25		

E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
F_c^*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c^*	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_p	0.566055		NDS 2018 Eq. 3.7-1
l_b	1.5		
C_b	1.25		NDS 2018 Eq. 3.10-2

F_c'	849.0825	psi	NDS 2018 Table 4.3.1
$F_{c\perp}'$	781.25	psi	NDS 2018 Table 4.3.1

Studs adequate in compression?	YES
Studs adequate in compression perpendicular to grain?	YES
Are the studs adequate?	YES

Shearwall Anchorage

Shear Anchors

Total Factored Shear	3439.873	lb	
Dia. of Anchor	1		
$Z_{Parallel}$	2100	lb/anchor	NDS 2018 Table 12E
K_f	3.32		NDS Table 11.3.1
$\Phi_{connection}$	0.65		NDS Table 11.3.1
λ	1		NDS 2018 Table N3
C_m	1		NDS 2018 Table 11.3.3
C_t	1		NDS 2018 Table 11.3.4
C_g	1		NDS 2018 Section 11.3.6
C_Δ	1		NDS 2018 Section 12.5.1
Z'	4531.8	lb/anchor	NDS Table 11.3.1
Required Number of Anchors	0.759052	anchors	
Number of Anchors to Use	1	anchors	
Max Spacing	-	ft	
	-	in	

Overturning Anchors

Second Floor

F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	795.81	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	795.81	lb	
Required Area Per Anchor	0.020	in^2	
Required Diameter Per Anchor	0.158	in	

Holdowns with threaded anchor

Holdown model	DTT2Z		Simpson Strong-Tie
Screwed	(8) 1/4 x 1-1/2 SDS		Simpson Strong-Tie
Anchor bolt diameter	1/2	in	Simpson Strong-Tie
Minimum Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	1825	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Model	LTT19		Simpson Strong-Tie
Nails	(6) 0.148 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	3/8	in	Simpson Strong-Tie
Min. Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	910	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Embedded holdown

Holdown model	MSTC40		Simpson Strong-Tie
Fasteners	(20) 0.148 x 3-1/4		Simpson Strong-Tie
Minimum Post thinkness	3	in	Simpson Strong-Tie
Capacity	1920	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Threaded rod with bearing plate

Model Number	Z-3STD-3 x 3		
Cinch Nut (CNX)	CNX-3		MiTek - Product Catalog
CNX Capacity	5175	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-3 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	3/8	in	MiTek - Product Catalog
ZR Capacity	2485	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		

Base floor			
F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	838.98	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	4065.39	lb	
Required Area Per Anchor	0.100	in^2	
Required Diameter Per Anchor	0.358	in	
Holdowns with threaded anchor			
Holdown model	HTT4		Simpson Strong-Tie
Screwed	(18) SD #10 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	5/8	in	Simpson Strong-Tie
Minimum Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	4455	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Model	HTT5		Simpson Strong-Tie
Nails	(18) 0.162 x 2-1/2		Simpson Strong-Tie
Anchor bolt diameter	5/8	in	Simpson Strong-Tie
Min. Post thinkness	3.0	in	Simpson Strong-Tie
Cpacity	4235	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Embedded holdown			
Corner location			
Holdown model	STHD10		Simpson Strong-Tie
Fasteners	(28) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	4075	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Midwall location			
Holdown model	STHD10		Simpson Strong-Tie
Fasteners	(28) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	4755	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Threaded rod with bearing plate			
Model Number	Z-4STD-3 x 3		
Cinch Nut (CNX)	CNX-4		MiTek - Product Catalog
CNX Capacity	9205	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-4 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	1/2	in	MiTek - Product Catalog
ZR Capacity	4420	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		
Serviceability - Second Floor			
Bending Defelction			
Second Level Induced Unit Shear	136.23	plf	
Shear Wall Height	12	ft	
Modulus of Elasticity	1700000	psi	NDS 2018 Table 4A/B
Area of End Posts	16.5	in^2	
Shearwall Length	42.50	ft	
Bending Defelction	0.0016	in	SDPWS 2015 Section C4.3.2
Shear Deflection			
$G_v t_v$	25000	lb/in	SDPWS 2015 Table C4.2.2A/B
Shear Deflection	0.065	in	SDPWS 2015 Section C4.3.2
Nail Slip Deflection			
Nail Spacing	6	in O.C.	SDPWS 2015 Table C4.2.2D
V_n	68.11629	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails

Wall Anchorage Slip			
Vertical Elongation of Anchorage	0.125	in	SDPWS 2015 C4.3.3.4.1-1
Tie-Down Nail Slip Deflection	0.035	in	
Total Deflection	0.6833	in	
Allowable Deflection	2.88	in	ASCE 7-16 Sec 12.12 (Based on .02*height*12)
Is the deflection acceptable?	YES		
Serviceability - Overall Drift			
Bending Defelction			
Roof Induced Unit Shear	66.32	plf	
Second Floor Bending Deflection	0.0016	in	SDPWS 2015 Section C4.3.2
Roof Bending Deflection	0.0008	in	SDPWS 2015 Section C4.3.2
Total Bending Deflection	0.0023	in	
Shear Deflection			
Total Shear Deflection	0.130783	in	
Nail Slip Deflection			
Second Floor Nail Slip Deflection	0.581052	in	
Roof Nail Spacing	6	in O.C.	SDPWS Table C4.2.2D
V_n	33.159	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Third Level Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Total Nail Slip Deflection	1.162	in	
Tie-Down Nail Slip Deflection			
Total Tie-Down Nail Slip Deflection	0.071		
Total Deflection	1.365824	in	*Based on summing the components
Allowable Deflection	5.76	in	*Based on .02*mean roof height*12
Is the deflection acceptable?	YES		

Table B-5 Interior Perforated Shearwall

Interior Perforated Shearwall Design - ASD

Perforated Shearwall Checks

Full height segments at each end?	YES	SDPWS 2015 Sec. 4.3.5
Collectors provided along full length?	YES	SDPWS 2015 Sec. 4.3.5
Uniform top and bottom elevations?	YES	SDPWS 2015 Sec. 4.3.5
Shearwall height does not exceed 20ft?	YES	SDPWS 2015 Sec. 4.3.5
Nominal shear capacity of sheathing does not exceed 2435 plf (single) 2435 plf (double)?	NO	SDPWS 2015 Sec. 4.3.5
Can perforated shearwalls be used?	YES	

In-Plane Loading

Capacity

Wind Load Factor	0.6				
Length of Wall Perpendicular to Wind	100	ft			
Roof					
Unfactored Load	326.81	plf	Factored Load	196.0881893	plf
Total Unfactored Shear	12255.51	lb	Total Factored Shear	7353.3071	lb
Second Floor					
Unfactored Load	344.54	plf	Factored Load	206.7243172	plf
Total Unfactored Shear	25175.78	lb	Total Factored Shear	15105.46899	lb

*Note: Divide by (8/3) since only 37.5' of the wind goes to one interior wall
*Note: Total shears include the accumulated shears from levels above plus the shear induced at the level

Chord Forces - Overall Wall

Sum of Full Height Segment Lengths (Li)	19.25	ft	*Note: Full height segments must meet the aspect
Total Length of the Shearwall	25.25	ft	ratios of SDPWS Table 4.3.4
Percentage of Full-Height Sheathing	0.762376		
Wall Height	10	ft	
Maximum Opening Height	7	ft	
C_o	0.8		SDPWS 2015, Table 4.3.3.5
Depth of Chord	5.5	in	
Width of Chord	4.5	in	
Area	24.75	in^2	
Floor to Floor Height	12	ft	
Second floor			
Depth of Chord	5.5	in	
Width of Chord	3	in	
Area	16.5	in^2	
Chord Force	2864.925	lb	Shear*Height/(Co*Li), SDPWS Eq.4.3-8
	173.6318	psi	
Base floor			
Depth of Chord	5.5	in	
Width of Chord	4.5	in	
Area	24.75	in^2	
Chord Force	14635.42	lb	Shear*Height/(Co*Li), SDPWS Eq.4.3-8
	591.3301	psi	
Type of Wood	Douglas Fir Larch No. 1		
F_t	675	psi	NDS 2018 Table 4A/B
F_c	1500	psi	NDS 2018 Table 4A/B

C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ tension}$	1		NDS 2018 Table 4A/B
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.430544		NDS 2018 Section 4.3.10

E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	26.18		NDS 2018 Section 3.7.1
F_{cE}	743.47	psi	NDS 2018 Section 3.7.1
F_c*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c*	0.4956		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_P	0.430544		NDS 2018 Eq. 3.7-1

F_t'	675	psi	NDS Table 4.3.1
F_c'	645.8156	psi	NDS Table 4.3.1

Second floor	
Studs adequate in tension?	YES
Studs adequate in compression?	YES
Base floor	
Studs adequate in tension?	YES
Studs adequate in compression?	YES
Are the chords adequate?	YES

Sheathing

Base to 2nd Floor Sheathing

v_{max}	490.4373	plf	Shear/(Co*Li)
Sheathing Type	Wood Structural Panels - Sheathing		
Sheathing Thickness	3/8"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		SDPWS 2015, Table 4.3A/B/C
Type of Nails	6d		
Nailing Along Edges	6d at 2" O.C.		
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	1430	plf	SDPWS 2015, Table 4.3A/B/C
C_o	0.8	plf	SDPWS 2015, Table 4.3.3.5
Sheathing on One or Both Sides?	one		
Total Capacity	572	plf	*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Is the sheathing and nailing adequate?	YES		
Is the perforated shearwall check met?	YES		

2nd Floor to Roof Sheathing

v_{max}	238.7437	plf	Shear/(Co*Li)
Sheathing Type	Wood Structural Panels - Sheathing		
Sheathing Thickness	5/16"		SDPWS 2015, Table 4.3A/B/C
Minimum Fastener Penetration	1-1/4"		SDPWS 2015, Table 4.3A/B/C
Type of Nails	6d		
Nailing Along Edges	6d at 4" O.C.		
Nailing in Field	6d at 12" O.C.		SDPWS 2015, Table 4.3A/B/C
Table Shear Capacity	755	plf	SDPWS 2015, Table 4.3A/B/C
C_o	0.8	plf	SDPWS 2015, Table 4.3.3.5
Sheathing on One or Both Sides?	one		
Total Capacity	302	plf	*Note: Automatically divides by 2 for ASD (SDPWS 2015, Table 4.3A/B/C Note 1)
Is the sheathing and nailing adequate?	YES		
Is the perforated shearwall check met?	YES		

Out-of-Plane Loading

Gravity Loads

Tributary Width	25	ft	
Roof Dead Load	20	psf x ft =	500 plf
Snow Load	0	psf x ft =	0 plf
Roof Live Load	20	psf x ft =	500 plf
Floor Dead Load	20	psf x ft =	500 plf
Floor Live Load	50	psf x ft =	1250 plf
Wind Load	11.04	psf x ft =	275.9898 plf

Axial load

Second floor

Total Factored Load =	1000.00	plf
Total Axial Load =	1333.33	lb
Total Axial Load =	161.62	psi

Base floor

Total Factored Load =	2750.00	plf
Total Axial Load =	3666.67	lb
Total Axial Load =	444.44	psi

Wall Height	10	ft
Stud Spacing	16	in O.C.

Stud Capacity

Depth of Stud	5.5	in	
Width of Stud	1.5	in	
S_x	7.5625	in^3	
Type of Wood	Douglas Fir Larch No. 1		
F_c	1500	psi	NDS 2018 Table 4A/B
$F_{c\perp}$	625	psi	NDS 2018 Table 4A/B
C_d	1		NDS 2018 Table 2.3.2
C_m	1		NDS 2018 Table 4A/B
C_t	1		NDS 2018 Table 2.3.3
$C_{F\ compression}$	1		NDS 2018 Table 4A/B
C_i	1		NDS 2018 Section 4.3.8
C_p	0.566055		NDS 2018 Section 4.3.10
C_b	1.25		

E'_{min}	620000	psi	NDS 2018 Table 4A/B
l_e/d	21.82		NDS 2018 Section 3.7.1
F_{cE}	1070.60	psi	NDS 2018 Section 3.7.1
F_c^*	1500	psi	NDS 2018 Section 3.7.1
F_{cE}/F_c^*	0.7137		NDS 2018 Section 3.7.1
c	0.8		NDS 2018 Section 3.7.1
C_P	0.566055		NDS 2018 Eq. 3.7-1
l_b	1.5		
C_b	1.25		NDS 2018 Eq. 3.10-2

F_c'	849.0825	psi	NDS 2018 Table 4.3.1
$F_{c\perp}'$	781.25	psi	NDS 2018 Table 4.3.1

Studs adequate in compression?	YES
Studs adequate in compression perpendicular to grain?	YES
Are the studs adequate?	YES

Shearwall Anchorage

Shear Anchors

Total Factored Shear	12383.54	lb	
Dia. of Anchor	1		
$Z_{Parallel}$	2100	lb/anchor	NDS 2018 Table 12E
K_f	3.32		NDS Table 11.3.1
$\Phi_{connection}$	0.65		NDS Table 11.3.1
λ	1		NDS 2018 Table N3
C_m	1		NDS 2018 Table 11.3.3
C_t	1		NDS 2018 Table 11.3.4
C_g	1		NDS 2018 Section 11.3.6
C_Δ	1		NDS 2018 Section 12.5.1
Z'	4531.8	lb/anchor	NDS Table 11.3.1
Required Number of Anchors	2.732588	anchors	
Number of Anchors to Use	3	anchors	
Max Spacing	12.625	ft	
	151.5	in	

Overturning Anchors

Second Floor

F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	2864.92	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	2864.92	lb	
Required Area Per Anchor	0.071	in^2	
Required Diameter Per Anchor	0.300	in	

Holdowns with threaded anchor

Holdown model	HTT4		Simpson Strong-Tie
Screwed	(18) SD #10 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	5/8	in	Simpson Strong-Tie
Minimum Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	4455	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Model	HTT4		Simpson Strong-Tie
Nails	(18) 0.148 x 1-1/2		Simpson Strong-Tie
Anchor bolt diameter	5/8	in	Simpson Strong-Tie
Min. Post thinkness	1.5	in	Simpson Strong-Tie
Cpacity	3000	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Embedded holdown

Holdown model	MSTC52		Simpson Strong-Tie
Fasteners	(36) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	3455	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		

Threaded rod with bearing plate

Model Number	Z-4STD-3 x 3		
Cinch Nut (CNX)	CNX-4		MiTek - Product Catalog
CNX Capacity	9205	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-4 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	1/2	in	MiTek - Product Catalog
ZR Capacity	4420	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		

Base floor

F_y	45000	psi	*Note: Anchor capacities based on
Individual Panel Anchor Force	3020.32	lb	P=FyAg/1.67 Per AISC D2.0
Cumulative Panel Anchor Force	14635.42	lb	
Required Area Per Anchor	0.361	in^2	
Required Diameter Per Anchor	0.678	in	

Holdowns with threaded anchor			
Holdown model	-		Simpson Strong-Tie
Screwed	-		Simpson Strong-Tie
Anchor bolt diameter	-	in	Simpson Strong-Tie
Minimum Post thinkness	-	in	Simpson Strong-Tie
Cpacity	-	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Model	(2x) HDU8-SDS2.5		Simpson Strong-Tie
Nails	(20) 1/4 x 2-1/2 SDS (Screws)		Simpson Strong-Tie
Anchor bolt diameter	7/8	in	Simpson Strong-Tie
Min. Post thinkness	3.5	in	Simpson Strong-Tie
Cpacity	15740	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Embedded holdown			
Corner location			
Holdown model	(3x) STHD14		Simpson Strong-Tie
Fasteners	(30) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	15855	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Midwall location			
Holdown model	(3x) STHD14		Simpson Strong-Tie
Fasteners	(30) 0.148 x 3-1/4		Simpson Strong-Tie
Capacity	15855	lb	Simpson Strong-Tie
Is the holdown adequate?	YES		
Threaded rod with bearing plate			
Model Number	Z-8STD-3 x 3		
Cinch Nut (CNX)	CNX-8		MiTek - Product Catalog
CNX Capacity	29285	lb	MiTek - Product Catalog
Z-Rod (ZR)	ZR-8 STD		MiTek - Product Catalog
ZR Length	12	ft	MiTek - Product Catalog
ZR Diameter	1	in	MiTek - Product Catalog
ZR Capacity	17670	lb	MiTek - Product Catalog
Bearing Plate Washer (BPW)	3 x 3	in	MiTek - Product Catalog
BPW Capacity	4780	lb	MiTek - Product Catalog
Is the CNX adequate?	YES		
Is the ZR adequate?	YES		
Is the BPW adequate?	YES		
Isthreaded rod adequate?	YES		
Serviceability - Second Floor			
Bending Defelction			
Second Level Induced Unit Shear	490.44	plf	
Shear Wall Height	12	ft	
Modulus of Elasticity	1700000	psi	NDS 2018 Table 4A/B
Area of End Posts	24.75	in^2	
Shearwall Length	42.50	ft	
Bending Defelction	0.0038	in	SDPWS 2015 Section C4.3.2
Shear Deflection			
$G_v t_v$	25000	lb/in	SDPWS 2015 Table C4.2.2A/B
Shear Deflection	0.235	in	SDPWS 2015 Section C4.3.2
Nail Slip Deflection			
Nail Spacing	2	in O.C.	SDPWS 2015 Table C4.2.2D
V_n	81.73955	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Wall Anchorage Slip			
Vertical Elongation of Anchorage	0.125	in	SDPWS 2015 C4.3.3.4.1-1
Tie-Down Nail Slip Deflection	0.035	in	
Total Deflection	0.8555	in	
Allowable Deflection	2.88	in	ASCE 7-16 Sec 12.12 (Based on .02*height*12)
Is the deflection acceptable?	YES		

Serviceability - Overall Drift			
Bending Defelction			
Roof Induced Unit Shear	238.74	plf	
Second Floor Bending Deflection	0.0038	in	SDPWS 2015 Section C4.3.2
Roof Bending Deflection	0.0018	in	SDPWS 2015 Section C4.3.2
Total Bending Deflection	0.0056	in	
Shear Deflection			
Total Shear Deflection	0.70623	in	
Nail Slip Deflection			
Second Floor Nail Slip Deflection	0.581052	in	
Roof Nail Spacing	4	in O.C.	SDPWS 2015 Table C4.2.2D
V_n	79.581	lb/nail	
V_n Max	180	lb/nail	
Is spacing acceptable?	YES		
Nail slip, e_n	0.065	in	SDPWS 2015 Table C4.2.2D
Second Level Nail Slip Deflection	0.581	in	SDPWS 2015 Section C4.3.2
			*Based on plywood sheathing with 6d nails
Total Nail Slip Deflection	1.162	in	
Tie-Down Nail Slip Deflection			
Total Tie-Down Nail Slip Deflection	0.071		
Total Deflection	1.944559	in	*Based on summing the components
Allowable Deflection	5.76	in	*Based on .02*mean roof height*12
Is the deflection acceptable?	YES		

Appendix C - Design Summaries

Table C-1 One-Story Building, Manhattan, KS

Exterior Shearwalls Base to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.110	0.118
Dia, of Shear Anchor (in.)	0.5	0.75
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	-
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	DTT1Z
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(6) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	3/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-3STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.201	0.225
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	#DIV/0!
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	LTT19	HTT4
Hold Down Nails (in)	(8) 0.148 x 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	1/2	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-3STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-2 One-Story Building, Houston, TX

Exterior Shearwalls Base to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.137	0.147
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	-
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	DTT1Z
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(6) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	3/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 4" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.250	0.279
Dia, of Shear Anchor (in.)	1	1
Number of Shear Anchors	1	2
Max Spacing of Shear Anchors (in.)	-	303.00
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-3 One-Story Building, Miami, FL

Exterior Shearwalls Base to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.166	0.178
Dia, of Shear Anchor (in.)	1	1
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	-
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	LTT19
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(8) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	1/2
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	LSTHD8
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 3" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.301	0.337
Dia, of Shear Anchor (in.)	0.625	1
Number of Shear Anchors	1	2
Max Spacing of Shear Anchors (in.)	-	303.00
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	STHD10	STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	STHD10	STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 x 3	Z-4STD-3 X 3
Cinch Nut (CNX)	CNX-4	CNX-4
Z-Rod (ZR)	ZR-4 STD	ZR-4 STD
ZR Diameter (in)	1/2	1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-4 Two-Story Building, Manhattan, KS

Exterior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.239	0.288
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	-
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(18) 0.148 X 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	**Corner location**
Hold Down Model	LSTHD8	STHD10
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	STHD10
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-4STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-4
Z-Rod (ZR)	ZR-3 STD	ZR-4 STD
ZR Diameter (in)	3/8	1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Second Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.119	0.127
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	DTT1Z
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(6) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	3/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-3STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 4" O.C.	6d at 3" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.435	0.546
Dia, of Shear Anchor (in.)	0.625	1
Number of Shear Anchors	1	2
Max Spacing of Shear Anchors (in.)	-	303.00
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU8-SDS2.5	HDU11-SDS2.5
Hold Down Fasteners (in)	(20) 1/4 x 2-1/2 SDS (Screws)	(30) 1/4 x 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	7/8	1
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	**Corner location**	**Corner location**
Hold Down Model	(2x) STHD10	(2x) STHD14
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(2x) STHD10	(2x) STHD14
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-5STD-3 X 3	Z-6STD-3 X 3
Cinch Nut (CNX)	CNX-5	CNX-6
Z-Rod (ZR)	ZR-5 STD	ZR-6 STD
ZR Diameter (in)	5/8	3/4
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Second Floor to Roof Floor		
	Segmented	**Perforated**
	Sheathing	
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
	Chords[1]	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
	In-Plane Anchorage[2]	
Dia. Of Overturning Anchors (in.)	0.216	0.242
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	LTT20B	HTT4
Hold Down Nails (in)	(10) 0.148 x 3	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	1/2	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-3STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
	Studs	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-5 Two-Story Building, Houston, TX

Exterior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.297	0.358
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	-
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT5
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(18) 0.162 x 2-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	**Corner location**
Hold Down Model	STHD10	STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	LSTHD8	STHD10
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 x 3	Z-4STD-3 x 3
Cinch Nut (CNX)	CNX-4	CNX-4
Z-Rod (ZR)	ZR-4 STD	ZR-4 STD
ZR Diameter (in)	1/2	1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Second Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.148	0.158
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	LTT19
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(6) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	3/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	3/8"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 3" O.C.	6d at 2" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	4.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.540	0.678
Dia, of Shear Anchor (in.)	0.75	1
Number of Shear Anchors	1	3
Max Spacing of Shear Anchors (in.)	-	151.50
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU11-SDS2.5	(2x) HDU8-SDS2.5
Hold Down Fasteners (in)	(30) 1/4 x 2-1/2 SDS (Screws)	(20) 1/4 x 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	1	7/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	**Corner location**	**Corner location**
Hold Down Model	(2x) STHD14	(3x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(2x) STHD14	(3x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-6STD-3 x 3	Z-8STD-3 x 3
Cinch Nut (CNX)	CNX-6	CNX-8
Z-Rod (ZR)	ZR-6 STD	ZR-8 STD
ZR Diameter (in)	3/4	1
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Second Floor to Roof Floor		
	Segmented	**Perforated**
	Sheathing	
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 4" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
	Chords[1]	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
	In-Plane Anchorage[2]	
Dia. Of Overturning Anchors (in.)	0.268	0.300
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC52	MSTC52
Hold Down Nails (in)	(36) 0.148 x 3-1/4	(36) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-4STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-4
Z-Rod (ZR)	ZR-3 STD	ZR-4 STD
ZR Diameter (in)	3/8	1/2
	Studs	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-6 Two-Story Building, Miami, FL

Exterior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
	Sheathing	
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 4" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
	Chords[1]	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
	In-Plane Anchorage[2]	
Dia. Of Overturning Anchors (in.)	0.359	0.432
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	2
Max Spacing of Shear Anchors (in.)	-	303.000
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HDU8-SDS2.5
Hold Down Fasteners (in)	(18) 0.162 x 2-1/2	(20) 1/4 x 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	5/8	7/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	**Corner location**
Hold Down Model	STHD14	(2x) STHD10
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	STHD14	(2x) STHD10
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 x 3	Z-5STD-3 x 3
Cinch Nut (CNX)	CNX-4	CNX-5
Z-Rod (ZR)	ZR-4 STD	ZR-5 STD
ZR Diameter (in)	1/2	3/4
	Studs	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Second Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.178	0.191
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	LTT20B
Hold Down Nails (in)	(8) 0.148 x 1-1/2	(10) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	1/2	1/2
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	15/32"
Minimum Nail Penetration	1-1/4"	1-1/2"
Nail Size	6d	10d
Edge Nailing	6d at 2" O.C.	10d at 2" O.C.
Field Nailing	6d at 12" O.C.	10d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	4.5	7.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.652	0.819
Dia, of Shear Anchor (in.)	0.875	1
Number of Shear Anchors	1	4
Max Spacing of Shear Anchors (in.)	-	101.00
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU14-SDS2.5	(2x) HDU14-SDS2.5
Hold Down Fasteners (in)	(36) 1/4 x 2-1/2 SDS (Screws)	(36) 1/4 X 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	1	1
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	**Corner location**	**Corner location**
Hold Down Model	(3x) STHD14	(5x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(3x) STHD14	(5x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-8STD-3 x 3	Z-9STD-3 X 3
Cinch Nut (CNX)	CNX-8	CNX-9
Z-Rod (ZR)	ZR-8 STD	ZR-9 STD
ZR Diameter (in)	1	1-1/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Second Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16""
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 4" O.C.	6d at 3" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.324	0.362
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.162 x 2-1/2	(18) 0.162 x 2-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC52	MSTC66
Hold Down Nails (in)	(36) 0.148 x 3-1/4	(54) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 x 3	Z-4STD-3 X 3
Cinch Nut (CNX)	CNX-4	CNX-4
Z-Rod (ZR)	ZR-4 STD	ZR-4 STD
ZR Diameter (in)	1/2	1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-7 Three-Story Building, Manhattan, KS

Exterior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.402	0.453
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	1
Max Spacing of Shear Anchors (in.)	-	-
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU5-SDS2.5	HDU8-SDS2.5
Hold Down Fasteners (in)	(14) 1/4 x 2-1/2 SDS (Screws)	(20) 1/4 x 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	5/8	7/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	STHD14	(2x) STHD10
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	STHD14	(2x) STHD10
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-5STD-3 x 3	Z-5STD-3 x 3
Cinch Nut (CNX)	CNX-5	CNX-5
Z-Rod (ZR)	ZR-5 STD	ZR-5 STD
ZR Diameter (in)	5/8	5/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Second Floor to Third Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.254	0.453
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 X 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC52	MSTC52
Hold Down Nails (in)	(36) 0.148 x 3-1/4	(36) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-4STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-4
Z-Rod (ZR)	ZR-3 STD	ZR-4 STD
ZR Diameter (in)	3/8	1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Third Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.126	0.135
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	DTT1Z
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(6) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	3/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-3STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	3/8"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 3" O.C.	6d at 2" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	6	7.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	1	0.859
Dia, of Shear Anchor (in.)	0.75	1
Number of Shear Anchors	1	3
Max Spacing of Shear Anchors (in.)	-	151.50
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HD19	(2x) HDU14-SDS2.5
Hold Down Fasteners (in)	(5) 1" x 7" (Bolts)	(36) 1/4 x 2-1/2 SDS
Hold Down Anchor Bolt (in)	1-1/4	1
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Endwall location	Corner location
Hold Down Model	(4x) STHD14	(5x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(4x) STHD14	(5x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-8STD-3 x 3	Z-10STD-3 x 3
Cinch Nut (CNX)	CNX-8	CNX-10
Z-Rod (ZR)	ZR-8 STD	ZR-10 STD
ZR Diameter (in)	1	1-1/4
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Second Floor to Third Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 4" O.C.	6d at 3" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	4.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.462	0.581
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DHU8-SDS2.5	HDU14-SDS2.5
Hold Down Fasteners (in)	(20) 1/4 X 2-1/2 SDS (Screws)	(36) 1/4 X 2-1/2 SDS
Hold Down Anchor Bolt (in)	7/8	1
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	(2x) MST60	(2x) MST72
Hold Down Nails (in)	(40) 0.162 x 2-1/2	(54) 0.162 x 2-1/2
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-5STD-3 X 3	Z-7STD-3 X 3
Cinch Nut (CNX)	CNX-5	CNX-7
Z-Rod (ZR)	ZR-5 STD	ZR-7 STD
ZR Diameter (in)	5/8	7/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Third Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.229	0.256
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 X 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC52
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(36) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 X 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-8 Three-Story Building, Houston, TX

Exterior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1 1/4"	1 1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 4" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.500	0.563
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	2
Max Spacing of Shear Anchors (in.)	-	303.00
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU11-SDS2.5	HDU14-SDS2.5
Hold Down Fasteners (in)	(30) 1/4 x 2-1/2 SDS (Screws)	(36) 1/4 x 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	1	1
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	(2x) STHD10	(3x) STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(2x) STHD10	(3x) STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-6STD-3 x 3	Z-7STD-3 x 3
Cinch Nut (CNX)	CNX-6	CNX-7
Z-Rod (ZR)	ZR-6 STD	ZR-7 STD
ZR Diameter (in)	3/4	7/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Second Floor to Third Floor		
	Segmented	**Perforated**
	Sheathing	
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1 1/4"	1 1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
	Chords[1]	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
	In-Plane Anchorage[2]	
Dia. Of Overturning Anchors (in.)	0.316	0.563
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT5KT
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(26) SD #10 x 2-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC52	MSTC66
Hold Down Nails (in)	(36) 0.148 x 3-1/4	(54) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 x 3	Z-5STD-3 X 3
Cinch Nut (CNX)	CNX-4	CNX-5
Z-Rod (ZR)	ZR-4 STD	ZR-5 STD
ZR Diameter (in)	1/2	5/8
	Studs	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Third Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1 1/4"	1 1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.156	0.168
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	DTT1Z	LTT19
Hold Down Nails (in)	(6) 0.148 x 1-1/2	(8) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	3/8	1/2
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 x 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	3/8"	19/32"
Minimum Nail Penetration	1 1/4"	1 1/2"
Nail Size	6d	10d
Edge Nailing	6d at 2" O.C.	10d at 2" O.C.
Field Nailing	6d at 12" O.C.	10d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	7.5	10.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	1	1.068
Dia, of Shear Anchor (in.)	1	1
Number of Shear Anchors	1	5
Max Spacing of Shear Anchors (in.)	-	75.75
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	(2x) HD19
Hold Down Fasteners (in)	(36) 1/4 x 2-1/2 SDS (Screws)	(5) 1" x 7" (Bolts)
Hold Down Anchor Bolt (in)	1	1-1/4
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	(7x) SDTH10	(7x) STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(6x) SDTH10	(7x) STHD10
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(28) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-10STD-3 x 3	Z-12STD-3 x 3
Cinch Nut (CNX)	CNX-10	CNX-12
Z-Rod (ZR)	ZR-10 STD	ZR-12 STD
ZR Diameter (in)	1-1/4	1-1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Second Floor to Third Floor		
	Segmented	Perforated
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	3/8"	15/32"
Minimum Nail Penetration	1 1/4"	1 1/2"
Nail Size	6d	10d
Edge Nailing	6d at 3" O.C.	10d at 3" O.C.
Field Nailing	6d at 12" O.C.	10d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	6
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.574	0.722
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU14-SDS2.5	HD19
Hold Down Fasteners (in)	(36) 1/4 x 2-1/2 SDS (Screws)	(5) 1" x 7" (Bolts)
Hold Down Anchor Bolt (in)	1	1-1/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	(2x) MSTC72	(3x) MST72
Hold Down Nails (in)	(54) 0.162 x 2-1/2	(54) 0.162 x 2-1/2
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-7STD-3 x 3	Z-8STD-3 x 3
Cinch Nut (CNX)	CNX-7	CNX-8
Z-Rod (ZR)	ZR-7 STD	ZR-8 STD
ZR Diameter (in)	7/8	1
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Third Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	15/32"
Minimum Nail Penetration	1 1/4"	1 1/2"
Nail Size	6d	10d
Edge Nailing	6d at 6" O.C.	10d at 6" O.C.
Field Nailing	6d at 12" O.C.	10d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.285	0.318
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT4
Hold Down Nails (in)	(18) 0.148 x 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC52	MSTC52
Hold Down Nails (in)	(36) 0.148 x 3-1/4	(36) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 x 3	Z-4STD-3 x 3
Cinch Nut (CNX)	CNX-4	CNX-4
Z-Rod (ZR)	ZR-4 STD	ZR-4 STD
ZR Diameter (in)	1/2	1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Table C-9 Three-Story Building, Miami, FL

Exterior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 4" O.C.	6d at 2" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	4.5	4.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.603	0.679
Dia, of Shear Anchor (in.)	0.5	1
Number of Shear Anchors	1	2
Max Spacing of Shear Anchors (in.)	-	303.00
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HDU14-SDS2.5	HD12
Hold Down Fastener (in)	(36) 1/4 x 2-1/2 SDS (Screws)	(4) 1" x 7" (Bolts)
Hold Down Anchor Bolt (in)	1	1-1/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Corner location	Corner location
Hold Down Model	(3x) STHD14	(3x) STHD14
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(3x) STHD14	(3x) STHD14
Hold Down Nails (in)	(28) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-7STD-3 x 3	Z-8STD-3 X 3
Cinch Nut (CNX)	CNX-7	CNX-8
Z-Rod (ZR)	ZR-7 STD	ZR-8 STD
ZR Diameter (in)	7/8	1
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Second Floor to Third Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 4" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.381	0.679
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT5	HDU8-SDS2.5
Hold Down Fasteners (in)	(26) 0.148 x 3	(20) 1/4 x 2-1/2 SDS
Hold Down Anchor Bolt (in)	5/8	7/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC66	MST72
Hold Down Nails (in)	(54) 0.148 x 3-1/4	(54) 0.162 x 2-1/2
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-5STD-3 x 3	Z-5STD-3 X 3
Cinch Nut (CNX)	CNX-5	CNX-5
Z-Rod (ZR)	ZR-5 STD	ZR-5 STD
ZR Diameter (in)	5/8	5/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Exterior Shearwalls Third Floor to Roof Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	5/16"
Minimum Nail Penetration	1-1/4"	1-1/4"
Nail Size	6d	6d
Edge Nailing	6d at 6" O.C.	6d at 6" O.C.
Field Nailing	6d at 12" O.C.	6d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.189	0.203
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	LTT19	HTT4
Hold Down Nails (in)	(8) 0.148 x 1-1/2	(18) 0.148 x 1-1/2
Hold Down Anchor Bolt (in)	1/2	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC40	MSTC40
Hold Down Nails (in)	(20) 0.148 x 3-1/4	(20) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-3STD-3 x 3	Z-3STD-3 X 3
Cinch Nut (CNX)	CNX-3	CNX-3
Z-Rod (ZR)	ZR-3 STD	ZR-3 STD
ZR Diameter (in)	3/8	3/8
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Base to Second Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing (both
Sheathing Thickness	19/32"	19/32"
Minimum Nail Penetration	1-1/2"	1-1/2"
Nail Size	10d	10d
Edge Nailing	10d at 2" O.C.	10d at 3" O.C.
Field Nailing	10d at 12" O.C.	10d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	10.5	15
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	1	1.289
Dia, of Shear Anchor (in.)	1	1
Number of Shear Anchors	2	7
Max Spacing of Shear Anchors (in.)	76	50.50
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	(2x) HD19	(3x) HD19
Hold Down Fasteners (in)	(4) 1"x7" (Bolt)	(5) 1" x 7" (Bolts)
Hold Down Anchor Bolt (in)	1-1/4	1-1/4
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Location	Endwall location	Corner location
Hold Down Model	(8x) STHD14	(10x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Location	Midwall location	Midwall location
Hold Down Model	(8x) STHD14	(10x) STHD14
Hold Down Nails (in)	(30) 0.148 x 3-1/4	(30) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-12STD-3-1/4 X 3-3/8	Z-14STD-3-1/4 x 3-3/8
Cinch Nut (CNX)	CNX-12	CNX-14
Z-Rod (ZR)	ZR-12 STD	ZR-14 STD
ZR Diameter (in)	1-1/2	1-3/4
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.

Interior Shearwalls Second Floor to Third Floor		
	Segmented	**Perforated**
Sheathing		
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	19/32"	19/32
Minimum Nail Penetration	1-1/2"	1-1/2"
Nail Size	10d	10d
Edge Nailing	10d at 4" O.C.	10d at 2" O.C.
Field Nailing	10d at 12" O.C.	10d at 12" O.C.
Chords[1]		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	4.5	7.5
In-Plane Anchorage[2]		
Dia. Of Overturning Anchors (in.)	0.693	0.871
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HD12	(2x) HDU14-SDS2.5
Hold Down Fasteners (in)	(4) 1"x7" (Bolt)	(36) 1/4 x 2-1/2 SDS (Screws)
Hold Down Anchor Bolt (in)	1-1/8	1
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	(3x) MST60	(4x) MST72
Hold Down Nails (in)	(40) 0.162 x 2-1/2	(54) 0.162 x 2-1/2
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-8STD-3 X 3	Z-12STD-3-1/4 X 3-3/8
Cinch Nut (CNX)	CNX-8	CNX-12
Z-Rod (ZR)	ZR-8 STD	ZR-12 STD
ZR Diameter (in)	1	1-1/2
Studs		
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

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Interior Shearwalls Third Floor to Roof Floor		
	Segmented	**Perforated**
	Sheathing	
Sheathing Type	Wood Structural Panels - Sheathing	Wood Structural Panels - Sheathing
Sheathing Thickness	5/16"	19/32
Minimum Nail Penetration	1-1/4"	1-1/2"
Nail Size	6d	10d
Edge Nailing	6d at 4" O.C.	10d at 4" O.C.
Field Nailing	6d at 12" O.C.	10d at 12" O.C.
	Chords[1]	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Chord (in)	5.5	5.5
Width of Chord (in)	3	3
	In-Plane Anchorage[2]	
Dia. Of Overturning Anchors (in.)	0.344	0.384
Type of Hold Down	**Holdowns with threaded anchor**	**Holdowns with threaded anchor**
Hold Down Model	HTT4	HTT5
Hold Down Nails (in)	(18) 0.162 x 2-1/2	(26) 0.162 x 2.5
Hold Down Anchor Bolt (in)	5/8	5/8
Type of Hold Down	**Embedded holdown**	**Embedded holdown**
Hold Down Model	MSTC66	MSTC66
Hold Down Nails (in)	(54) 0.148 x 3-1/4	(54) 0.148 x 3-1/4
Type of Hold Down	**Threaded rod with bearing plate**	**Threaded rod with bearing plate**
Hold Down Model	Z-4STD-3 X 3	Z-5STD-3 X 3
Cinch Nut (CNX)	CNX-4	CNX-5
Z-Rod (ZR)	ZR-4 STD	ZR-5 STD
ZR Diameter (in)	1/2	5/8
	Studs	
Type of Wood	Douglas Fir Larch No. 1	Douglas Fir Larch No. 1
Depth of Stud (in)	5.5	5.5
Width of Stud (in)	1.5	1.5
Spacing (in O.C.)	16	16

1: For segmented shearwalls, chords are for each segment and for perforated chords are for the whole shearwall.

2: For segmented shearwalls, in-plane anchorage is for each individual segment and for perforated chords are for the whole shearwall.