Chapter 4
Vulnerability-Based Assessment and Retrofit of Crawlspace Dwellings

4.1 General

This chapter contains provisions for vulnerability-based assessment and retrofit of wood light-frame *crawlspace dwellings* supported on a raised *cripple wall* and foundation systems (Figure 4.1-1, Configuration A) or supported directly on a foundation system (Figure 4.1-2, Configuration B). Where both occur in a single dwelling, dwellings shall be assessed for both Configuration A and Configuration B. Vulnerabilities addressed by this chapter are:

- At cripple walls and foundation systems (Configuration A)
  - Connection to the framing above (A)
  - Cripple wall sheathing (B)
  - *Foundation sill plate* anchorage to the foundation (C)
- At foundation *stem walls* or foundations without cripple walls (Configuration B)
  - Connection to the dwelling above (A)
  - Foundation sill plate anchorage to foundation (B)

The primary purpose of this chapter is the reduction of earthquake-induced damage to wood light-frame crawlspace dwellings.

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.0 Seismic) ONE-STORY																				
Weight Category	Total Area in Square Feet	☒ Mark row that applies	Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length								
			Wood Structural Panels									Foundation Sill Anchors					Floor to Cripple Wall or Floor to Foundation Sill		
			Cripple Wall Height								Panel Edge Nailing								
			up to 1'	1'-1" to 2'	2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"										
			Without Tie-downs	Without Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs		Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
1-Story Light Construction	up to 800		5.3'	5.3'	8.0'	5.3'	9.3'	5.3'	9.3'	6.7'	4"	4	7	7	7	5	11	10	14
	801 to 1000		6.7'	6.7'	8.0'	6.7'	10.7'	6.7'	10.7'	8.0'	4"	5	8	8	8	6	13	12	16
	1001 to 1200		6.7'	6.7'	9.3'	6.7'	10.7'	8.0'	12.0'	8.0'	4"	6	9	10	10	7	15	14	19
	1201 to 1500		8.0'	8.0'	10.7'	8.0'	13.3'	9.3'	13.3'	9.3'	4"	7	11	12	12	8	18	17	22
	1501 to 2000		9.3'	10.7'	13.3'	10.7'	14.7'	10.7'	16.0'	12.0'	4"	9	14	15	15	10	23	22	29
	2001 to 2500		12.0'	12.0'	14.7'	12.0'	17.3'	12.0'	18.7'	13.3'	4"	10	16	18	18	12	27	26	35
	2501 to 3000		14.7'	14.7'	16.0'	14.7'	18.7'	14.7'	20.0'	16.0'	4"	12	19	21	21	14	32	31	40
1-Story Medium Construction	up to 800		5.3'	6.7'	8.0'	5.3'	9.3'	6.7'	10.7'	6.7'	3"	5	8	8	8	6	13	12	16
	801 to 1000		5.3'	6.7'	9.3'	6.7'	10.7'	8.0'	12.0'	8.0'	3"	6	9	10	10	7	15	14	19
	1001 to 1200		6.7'	8.0'	9.3'	6.7'	12.0'	8.0'	12.0'	9.3'	3"	7	10	11	11	8	17	17	22
	1201 to 1500		8.0'	8.0'	10.7'	8.0'	13.3'	9.3'	14.7'	10.7'	3"	8	12	13	13	9	20	20	26
	1501 to 2000		9.3'	10.7'	13.3'	9.3'	14.7'	10.7'	16.0'	12.0'	3"	10	15	17	17	11	25	24	32
	2001 to 2500		10.7'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	13.3'	3"	12	18	20	20	14	30	29	38
	2501 to 3000		12.0'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	3"	13	21	23	23	16	35	34	45
1-Story Heavy Construction	up to 800		5.3'	6.7'	8.0'	5.3'	10.7'	6.7'	10.7'	8.0'	2"	6	9	10	10	7	15	14	18
	801 to 1000		6.7'	8.0'	9.3'	6.7'	12.0'	8.0'	12.0'	9.3'	2"	7	10	11	11	8	17	17	22
	1001 to 1200		6.7'	8.0'	10.7'	8.0'	12.0'	9.3'	13.3'	10.7'	2"	8	12	13	13	9	20	19	25
	1201 to 1500		8.0'	9.3'	12.0'	9.3'	14.7'	10.7'	14.7'	12.0'	2"	9	14	15	15	11	24	23	30
	1501 to 2000		9.3'	10.7'	14.7'	10.7'	16.0'	12.0'	17.3'	13.3'	2"	11	18	19	19	13	30	29	38
	2001 to 2500		10.7'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	2"	13	21	23	23	16	36	34	45
	2501 to 3000		12.0'	14.7'	17.3'	13.3'	20.0'	16.0'	21.3'	17.3'	2"	16	25	27	27	18	41	40	53

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on sheet S3 may be used for strengthening the particular condition.
5. This plan set was developed using the lowest listed manufacturer's capacity within a particular group. Cells marked "NG" on the applicable Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be made by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

Figure 4.4-6 Earthquake retrofit schedule, S_{DS} = 1.0, one story. Sheet S3.1-1.

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.2 High Seismic) ONE-STORY																				
Weight Category	Total Area in Square Feet	☒ Mark row that applies	Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length								
			Wood Structural Panels									Foundation Sill Anchors					Floor to Cripple Wall or Floor to Foundation Sill		
			Cripple Wall Height								Panel Edge Nailing								
			up to 1'		1'-1" to 2'		2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"									
			Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs		Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
1-Story Light Construction	up to 800		6.7'	6.7'	8.0'	6.7'	10.7'	6.7'	10.7'	8.0'	4"	5	8	8	8	6	13	12	16
	801 to 1000		6.7'	8.0'	9.3'	6.7'	12.0'	8.0'	12.0'	8.0'	4"	6	9	10	10	7	15	15	19
	1001 to 1200		8.0'	8.0'	10.7'	8.0'	13.3'	9.3'	13.3'	9.3'	4"	7	11	12	12	8	18	17	22
	1201 to 1500		9.3'	9.3'	12.0'	9.3'	14.7'	10.7'	16.0'	10.7'	4"	8	13	14	14	10	21	20	27
	1501 to 2000		12.0'	12.0'	14.7'	12.0'	17.3'	12.0'	18.7'	13.3'	4"	10	16	18	18	12	27	26	34
	2001 to 2500		14.7'	14.7'	17.3'	14.7'	20.0'	14.7'	21.3'	16.0'	4"	12	19	21	21	15	33	31	41
	2501 to 3000		17.3'	17.3'	18.7'	17.3'	21.3'	17.3'	22.7'	17.3'	4"	14	23	25	25	17	38	37	48
1-Story Medium Construction	up to 800		5.3'	6.7'	9.3'	6.7'	10.7'	8.0'	12.0'	8.0'	3"	6	9	10	10	7	15	15	19
	801 to 1000		6.7'	8.0'	10.7'	6.7'	12.0'	8.0'	13.3'	9.3'	3"	7	11	12	12	8	18	17	23
	1001 to 1200		8.0'	8.0'	10.7'	8.0'	13.3'	9.3'	14.7'	10.7'	3"	8	12	13	13	9	21	20	26
	1201 to 1500		9.3'	9.3'	12.0'	9.3'	14.7'	10.7'	16.0'	12.0'	3"	9	15	16	16	11	24	23	31
	1501 to 2000		10.7'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	14.7'	3"	12	18	20	20	14	30	29	39
	2001 to 2500		13.3'	13.3'	17.3'	13.3'	20.0'	14.7'	21.3'	16.0'	3"	14	22	24	24	16	36	35	46
	2501 to 3000		14.7'	14.7'	18.7'	14.7'	21.3'	17.3'	22.7'	18.7'	3"	16	25	27	27	19	42	40	53
1-Story Heavy Construction	up to 800		6.7'	8.0'	9.3'	6.7'	12.0'	8.0'	12.0'	9.3'	2"	7	10	11	11	8	17	17	22
	801 to 1000		6.7'	8.0'	10.7'	8.0'	13.3'	9.3'	14.7'	10.7'	2"	8	12	14	13	9	21	20	26
	1001 to 1200		8.0'	9.3'	12.0'	9.3'	14.7'	10.7'	16.0'	12.0'	2"	9	14	16	15	11	24	23	30
	1201 to 1500		9.3'	10.7'	13.3'	10.7'	16.0'	12.0'	17.3'	13.3'	2"	11	17	18	18	13	28	27	36
	1501 to 2000		10.7'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	2"	13	21	23	23	16	36	34	45
	2001 to 2500		13.3'	14.7'	18.7'	13.3'	21.3'	16.0'	22.7'	17.3'	2"	16	25	28	28	19	43	41	54
	2501 to 3000		14.7'	16.0'	20.0'	16.0'	22.7'	18.7'	25.3'	20.0'	2"	19	29	32	32	22	50	48	63

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on sheet S3 may be used for strengthening the particular condition.
5. This plan set was developed using the lowest listed manufacturer's capacity within a particular group. Cells marked "NG" on the applicable Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be made by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

Figure 4.4-7 Earthquake retrofit schedule, S_{DS} = 1.2, one story. Sheet S3.1-2.

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.5 Very High Seismic) ONE-STORY																				
Weight Category	Total Area in Square Feet	Mark row that applies ☒	Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length								
			Wood Structural Panels									Foundation Sill Anchors					Floor to Cripple Wall or Floor to Foundation Sill		
			Cripple Wall Height								Panel Edge Nailing								
			up to 1'		1'-1" to 2'		2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"									
			Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
1-Story Light Construction	up to 800		8.0'	8.0'	10.7'	8.0'	12.0'	8.0'	13.3'	9.3'	4"	6	10	10	10	7	16	15	20	
	801 to 1000		9.3'	9.3'	12.0'	9.3'	13.3'	9.3'	14.7'	10.7'	4"	7	11	12	12	9	19	18	24	
	1001 to 1200		10.7'	10.7'	13.3'	10.7'	16.0'	10.7'	16.0'	12.0'	4"	8	13	14	14	10	22	21	28	
	1201 to 1500		12.0'	12.0'	14.7'	12.0'	17.3'	12.0'	18.7'	13.3'	4"	10	16	17	17	12	26	25	33	
	1501 to 2000		14.7'	14.7'	17.3'	14.7'	21.3'	16.0'	22.7'	16.0'	4"	13	20	22	22	15	34	32	43	
	2001 to 2500		18.7'	18.7'	20.0'	18.7'	24.0'	18.7'	25.3'	18.7'	4"	15	24	27	27	18	41	39	52	
	2501 to 3000		21.3'	21.3'	22.7'	21.3'	26.7'	21.3'	28.0'	21.3'	4"	18	28	31	31	21	48	46	60	
1-Story Medium Construction	up to 800		6.7'	8.0'	10.7'	6.7'	13.3'	9.3'	13.3'	9.3'	3"	7	11	12	12	9	19	18	24	
	801 to 1000		8.0'	9.3'	12.0'	8.0'	14.7'	10.7'	16.0'	10.7'	3"	9	13	15	15	10	22	21	28	
	1001 to 1200		9.3'	10.7'	13.3'	9.3'	16.0'	12.0'	17.3'	12.0'	3"	10	15	17	17	11	26	25	32	
	1201 to 1500		10.7'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	14.7'	3"	12	18	20	20	14	30	29	38	
	1501 to 2000		13.3'	13.3'	17.3'	13.3'	21.3'	16.0'	22.7'	17.3'	3"	14	23	25	25	17	38	36	48	
	2001 to 2500		16.0'	16.0'	20.0'	16.0'	22.7'	17.3'	25.3'	20.0'	3"	17	27	29	29	20	45	43	57	
	2501 to 3000		18.7'	18.7'	21.3'	18.7'	25.3'	20.0'	26.7'	21.3'	3"	20	31	34	34	23	53	50	67	
1-Story Heavy Construction	up to 800		8.0'	9.3'	12.0'	8.0'	13.3	10.7'	14.7'	10.7'	2"	8	13	14	14	10	22	21	27	
	801 to 1000		8.0'	10.7'	13.3'	9.3'	16.0'	12.0'	17.3'	12.0'	2"	10	15	17	17	11	26	25	33	
	1001 to 1200		9.3'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	13.3'	2"	11	18	19	19	13	30	28	37	
	1201 to 1500		10.7'	13.3	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	2"	13	21	23	23	16	35	34	45	
	1501 to 2000		13.3	16.0'	18.7'	14.7'	22.7'	17.3'	24.0'	18.7'	2"	17	26	29	29	20	44	43	56	
	2001 to 2500		14.7'	17.3'	21.3'	16.0'	25.3'	20.0'	26.7'	21.3'	2"	20	32	35	34	24	53	51	67	
	2501 to 3000		17.3'	20.0'	24.0'	18.7'	28.0'	22.7'	29.3'	24.0'	2"	23	37	40	40	27	62	59	79	

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on sheet S3 may be used for strengthening the particular condition.
5. This plan set was developed using the lowest listed manufacturer's capacity within a particular group. Cells marked "NG" on the applicable Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be made by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

Figure 4.4-8 Earthquake retrofit schedule, S_{DS} = 1.5, one story. Sheet S3.1-3.

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.0 Seismic) TWO-STORY

Weight Category	Total Area in Square Feet	☒ Mark row that applies	Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length							
			Wood Structural Panels									Foundation Sill Anchors					Floor to Cripple Wall or Floor to Foundation Sill		
			Cripple Wall Height																
			up to 1'	1'-1" to 2'	2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"										
			Without Tie-downs	Without Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Panel Edge Nailing	Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
2-Story Light Construction	up to 1600		8.0'	8.0'	10.7'	8.0'	12.0'	9.3'	13.3'	9.3'	4"	7	10	11	11	8	17	17	22
	1601 to 2000		9.3'	9.3'	12.0'	9.3'	13.3'	10.7'	14.7'	10.7'	4"	8	12	13	13	9	20	19	26
	2001 to 2400		10.7'	10.7'	13.3'	10.7'	14.7'	10.7'	16.0'	12.0'	4"	9	14	15	15	10	23	22	29
	2401 to 3000		12.0'	12.0'	14.7'	12.0'	17.3'	13.3'	18.7'	13.3'	4"	10	16	18	18	12	27	26	34
	3001 to 4000		14.7'	14.7'	17.3'	16.0'	20.0'	16.0'	21.3'	16.0'	4"	13	20	22	22	15	34	32	43
2-Story Medium Construction	up to 1600		8.0'	9.3'	10.7'	8.0'	13.3'	9.3'	13.3'	10.7'	3"	7	11	12	12	9	19	18	24
	1601 to 2000		9.3'	10.7'	12.0'	9.3'	14.7'	10.7'	14.7'	12.0'	3"	9	13	15	15	10	22	22	28
	2001 to 2400		9.3'	10.7'	13.3'	10.7'	16.0'	12.0'	16.0'	13.3'	3"	10	15	17	17	11	26	25	32
	2401 to 3000		10.7'	12.0'	14.7'	12.0'	17.3'	13.3'	18.7'	14.7'	3"	12	18	20	20	14	30	29	39
	3001 to 4000		13.3'	14.7'	17.3'	13.3'	20.0'	16.0'	21.3'	17.3'	3"	14	23	25	25	17	38	36	48
2-Story Heavy Construction	up to 1600		9.3'	9.3'	12.0'	9.3'	13.3'	10.7'	14.7'	12.0'	2"	9	14	16	16	11	24	23	30
	1601 to 2000		9.3'	10.7'	13.3'	10.7'	14.7'	12.0'	16.0'	13.3'	2"	11	17	18	18	13	28	27	35
	2001 to 2400		10.7'	12.0'	14.7'	10.7'	16.0'	13.3'	17.3'	14.7'	2"	12	19	21	21	14	32	31	41
	2401 to 3000		12.0'	13.3'	16.0'	13.3'	18.7'	14.7'	18.7'	16.0'	2"	14	23	25	25	17	38	37	48
	3001 to 4000		13.3'	16.0'	18.7'	14.7'	21.3'	17.3'	22.7'	18.7'	2"	18	28	31	31	21	48	46	60

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on sheet S3 may be used for strengthening the particular condition.
5. This plan set was developed using the lowest listed manufacturer's capacity within a particular group. Cells marked "NG" on the applicable Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be made by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

Figure 4.4-9 Earthquake retrofit schedule, S_{DS} = 1.0, two story. Sheet S3.1-4.

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.2 High Seismic) TWO-STORY

Weight Category	Total Area in Square Feet	☒ Mark row that applies	Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length							
			Wood Structural Panels									Foundation Sill Anchors					Floor to Cripple Wall or Floor to Foundation Sill		
			Cripple Wall Height																
			up to 1'	1'-1" to 2'	2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"										
			Without Tie-downs	Without Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Panel Edge Nailing	Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
2-Story Light Construction	up to 1600		9.3'	9.3'	12.0'	9.3'	14.7'	10.7'	16.0'	12.0'	4"	8	12	13	13	9	21	20	26
	1601 to 2000		10.7'	10.7'	13.3'	10.7'	16.0'	12.0'	17.3'	13.3'	4"	9	14	16	16	11	24	23	31
	2001 to 2400		12.0'	12.0'	14.7'	13.3'	17.3'	13.3'	18.7'	14.7'	4"	10	16	18	18	12	28	26	35
	2401 to 3000		14.7'	14.7'	16.0'	14.7'	20.0'	14.7'	20.0'	16.0'	4"	12	19	21	21	14	33	31	41
	3001 to 4000		17.3'	18.7'	18.7'	18.7'	22.7'	18.7'	24.0'	18.7'	4"	15	24	26	26	18	40	39	51
2-Story Medium Construction	up to 1600		9.3'	10.7'	12.0'	9.3'	14.7'	10.7'	16.0'	12.0'	3"	9	14	15	15	10	23	22	29
	1601 to 2000		10.7'	12.0'	13.3'	10.7'	16.0'	12.0'	17.3'	13.3'	3"	10	16	18	17	12	27	26	34
	2001 to 2400		10.7'	12.0'	14.7'	12.0'	17.3'	13.3'	18.7'	14.7'	3"	12	18	20	20	14	31	29	39
	2401 to 3000		13.3'	14.7'	17.3'	13.3'	20.0'	16.0'	21.3'	16.0'	3"	14	22	24	24	16	36	35	46
	3001 to 4000		16.0'	16.0'	20.0'	16.0'	22.7'	18.7'	24.0'	20.0'	3"	17	27	30	29	20	46	44	58
2-Story Heavy Construction	up to 1600		9.3'	10.7'	13.3'	10.7'	16.0'	12.0'	16.0'	13.3'	2"	11	17	19	18	13	28	27	36
	1601 to 2000		10.7'	12.0'	14.7'	12.0'	17.3'	13.3'	18.7'	14.7'	2"	13	20	22	22	15	34	32	42
	2001 to 2400		12.0'	13.3'	16.0'	13.3'	18.7'	14.7'	20.0'	16.0'	2"	15	23	25	25	17	38	37	49
	2401 to 3000		13.3'	14.7'	18.7'	14.7'	21.3'	17.3'	21.3'	18.7'	2"	17	27	30	29	20	46	44	58
	3001 to 4000		16.0'	17.3'	21.3'	17.3'	24.0'	20.0'	25.3'	21.3'	2"	21	34	37	37	25	57	55	72

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on sheet S3 may be used for strengthening the particular condition.
5. This plan set was developed using the lowest listed manufacturer's capacity within a particular group. Cells marked "NG" on the applicable Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be made by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

Figure 4.4-10 Earthquake retrofit schedule, S_{DS} = 1.2, two story. Sheet S3.1-5.

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.5 Very High Seismic) TWO-STORY

Weight Category	Total Area in Square Feet	☒ Mark row that applies	Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length							
			Wood Structural Panels									Foundation Sill Anchors					Floor to Cripple Wall or Floor to Foundation Sill		
			Cripple Wall Height																
			up to 1'	1'-1" to 2'	2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"										
			Without Tie-downs	Without Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Panel Edge Nailing	Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
2-Story Light Construction	up to 1600		12.0'	12.0'	14.7'	12.0'	17.3'	12.0'	18.7'	13.3'	4"	10	15	17	17	11	26	25	32
	1601 to 2000		13.3'	13.3'	16.0'	13.3'	18.7'	14.7'	20.0'	16.0'	4"	11	18	20	19	13	30	29	38
	2001 to 2400		14.7'	16.0'	17.3'	16.0'	21.3'	16.0'	22.7'	17.3'	4"	13	20	22	22	15	34	33	43
	2401 to 3000		18.7'	18.7'	20.0'	18.7'	22.7'	18.7'	24.0'	18.7'	4"	15	24	26	26	18	41	39	51
	3001 to 4000		22.7'	22.7'	22.7'	22.7'	26.7'	24.0'	28.0'	24.0'	4"	19	30	33	33	22	50	48	64
2-Story Medium Construction	up to 1600		10.7'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	14.7'	3"	11	17	18	18	13	28	27	36
	1601 to 2000		12.0'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	3"	13	20	22	22	15	33	32	42
	2001 to 2400		13.3'	14.7'	18.7'	13.3'	21.3'	16.0'	22.7'	17.3'	3"	14	23	25	25	17	38	37	48
	2401 to 3000		16.0'	17.3'	20.0'	16.0'	22.7'	18.7'	24.0'	20.0'	3"	17	27	29	29	20	45	43	58
	3001 to 4000		20.0'	20.0'	22.7'	20.0'	26.7'	21.3'	28.0'	22.7'	3"	21	34	37	37	25	57	54	72
2-Story Heavy Construction	up to 1600		12.0'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	2"	13	21	23	23	16	35	34	45
	1601 to 2000		13.3'	14.7'	17.3'	14.7'	20.0'	16.0'	21.3'	17.3'	2"	16	25	27	27	19	42	40	53
	2001 to 2400		14.7'	16.0'	20.0'	16.0'	22.7'	18.7'	24.0'	18.7'	2"	18	28	31	31	21	48	46	61
	2401 to 3000		16.0'	18.7'	21.3'	17.3'	24.0'	20.0'	25.3'	21.3'	2"	21	34	37	37	25	57	55	72
	3001 to 4000		18.7'	21.3'	25.3'	20.0'	28.0'	24.0'	29.3'	25.3'	2"	27	42	46	46	31	71	68	90

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on sheet S3 may be used for strengthening the particular condition.
5. This plan set was developed using the lowest listed manufacturer's capacity within a particular group. Cells marked "NG" on the applicable Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be made by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

Figure 4.4-11 Earthquake retrofit schedule, S_{DS} = 1.5, two story. Sheet S3.1-6.

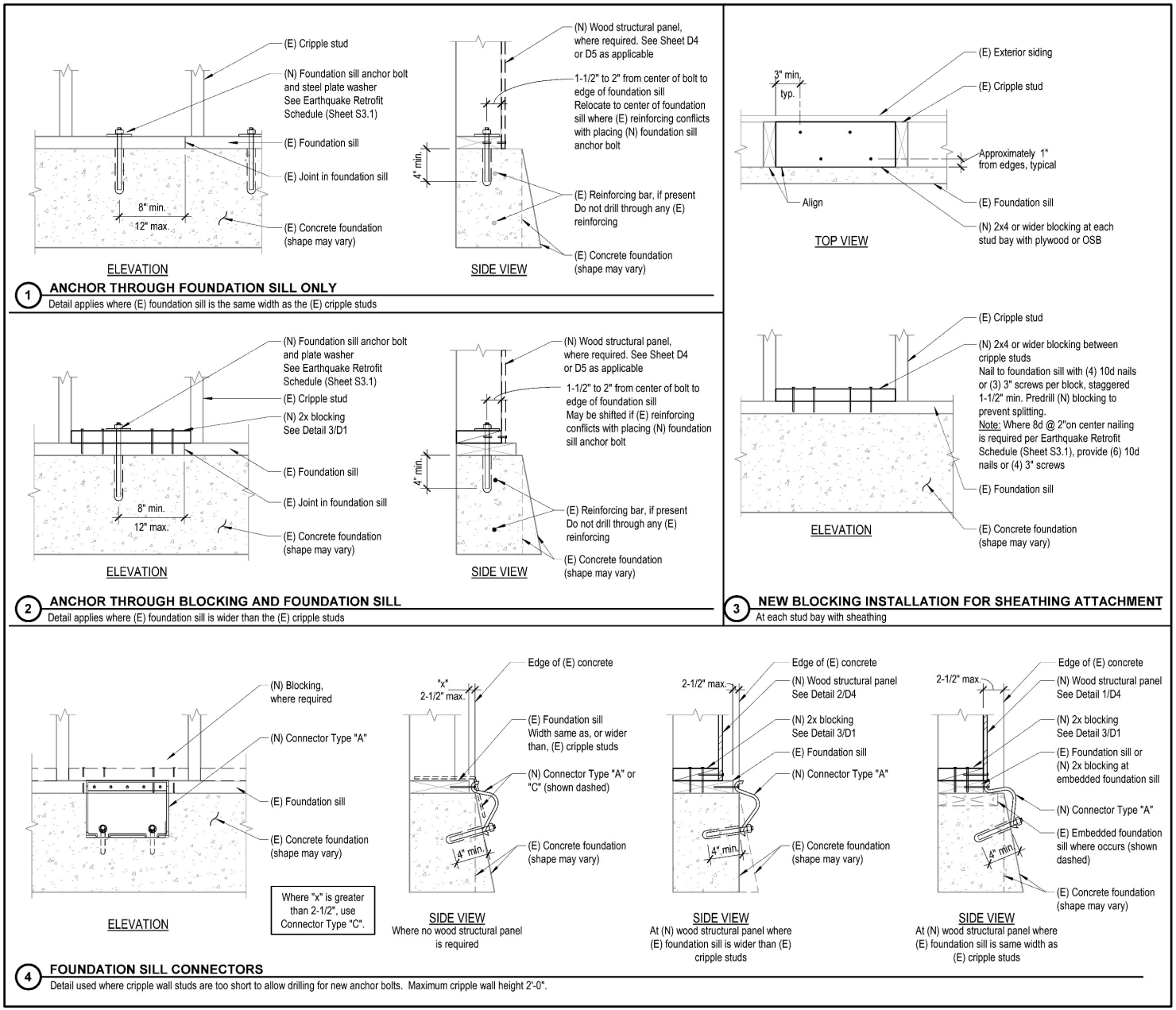

Figure 4.4-12 Foundation sill to concrete foundation connection details. Sheet D1.

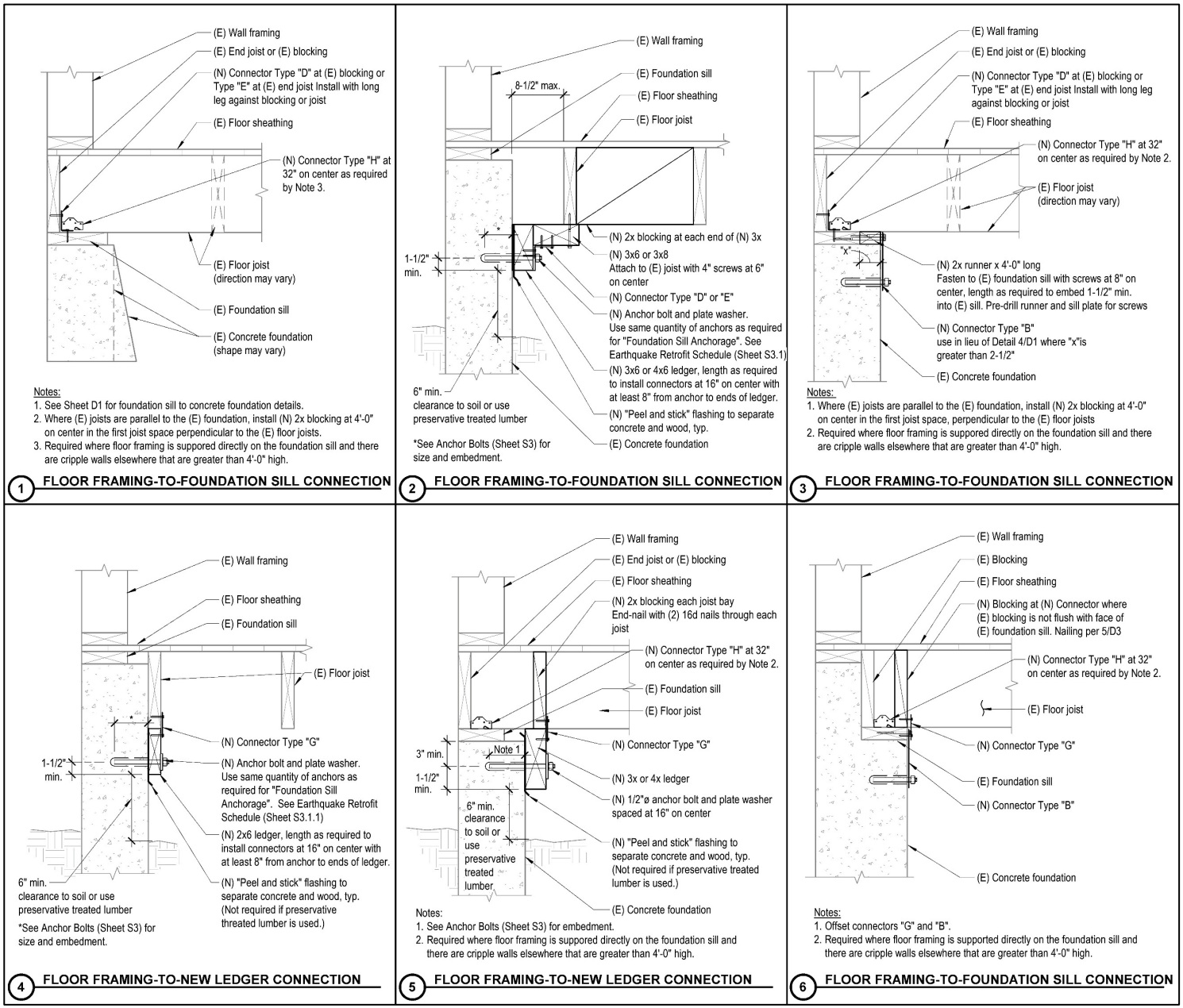

Figure 4.4-13 Floor framing to foundation sill connection details. Sheet D2.

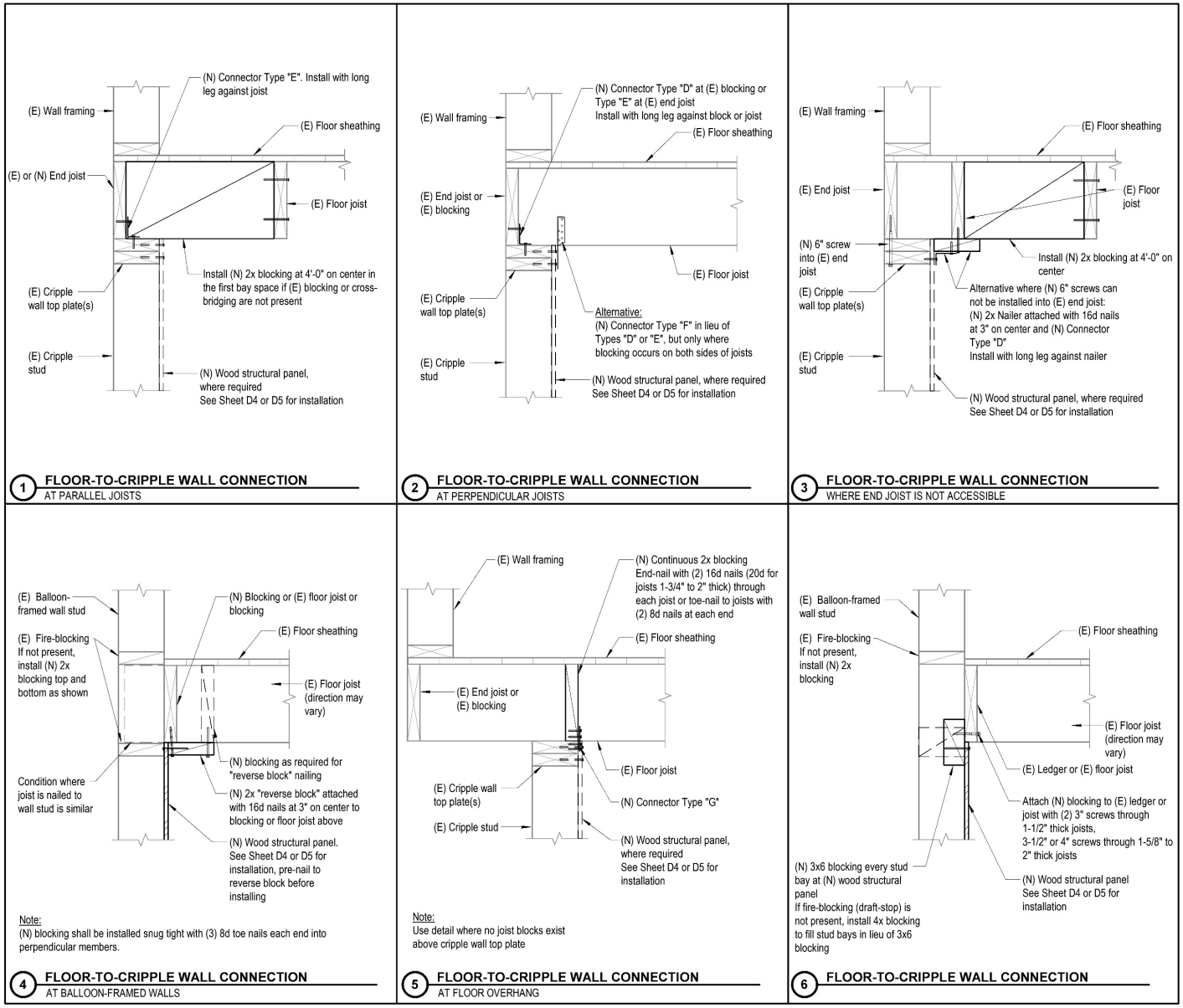

Figure 4.4-14 Floor framing to cripple wall connection details. Sheet D3.

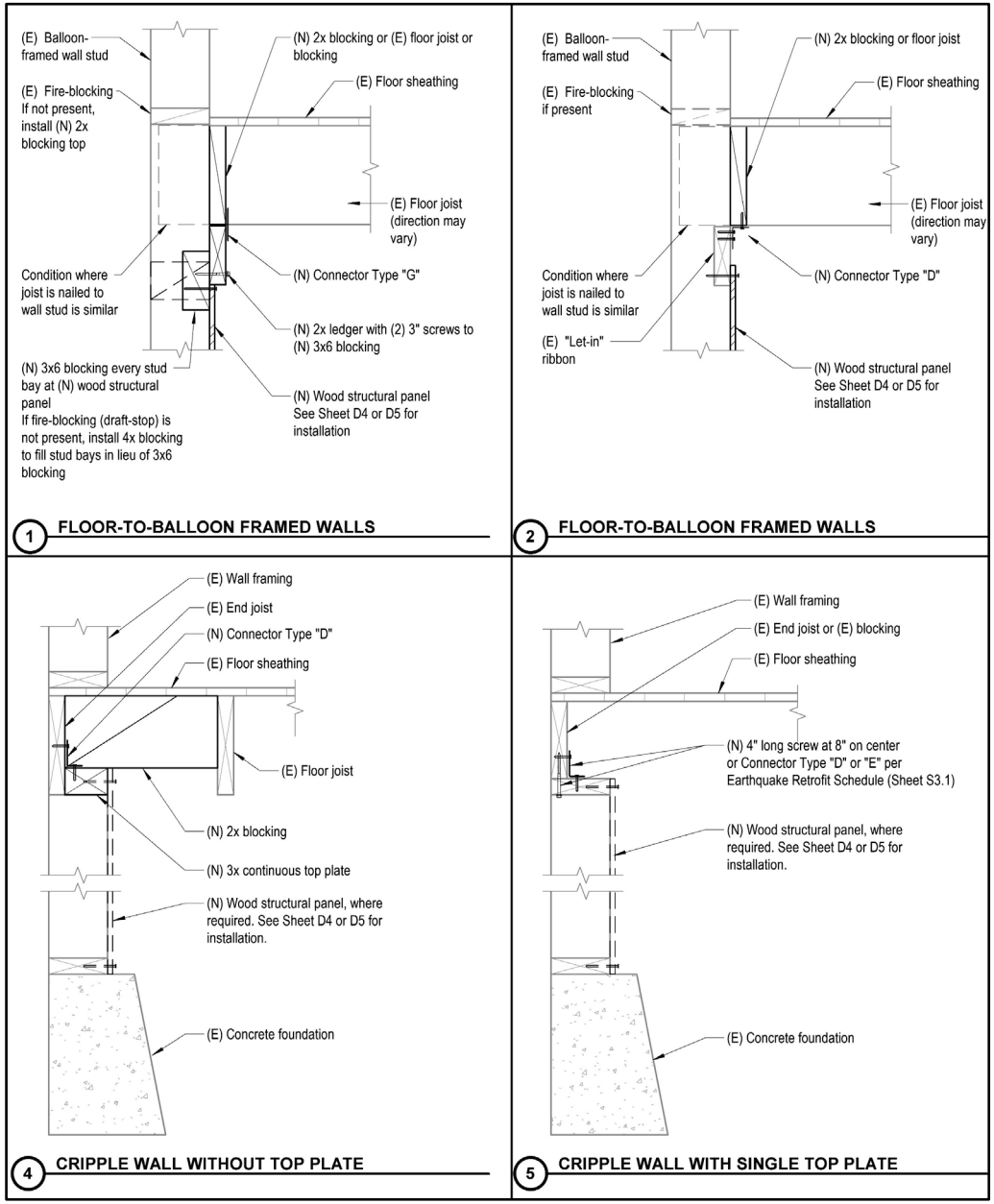

Figure 4.4-15 Floor framing to cripple wall connection details. Sheet D3.1.

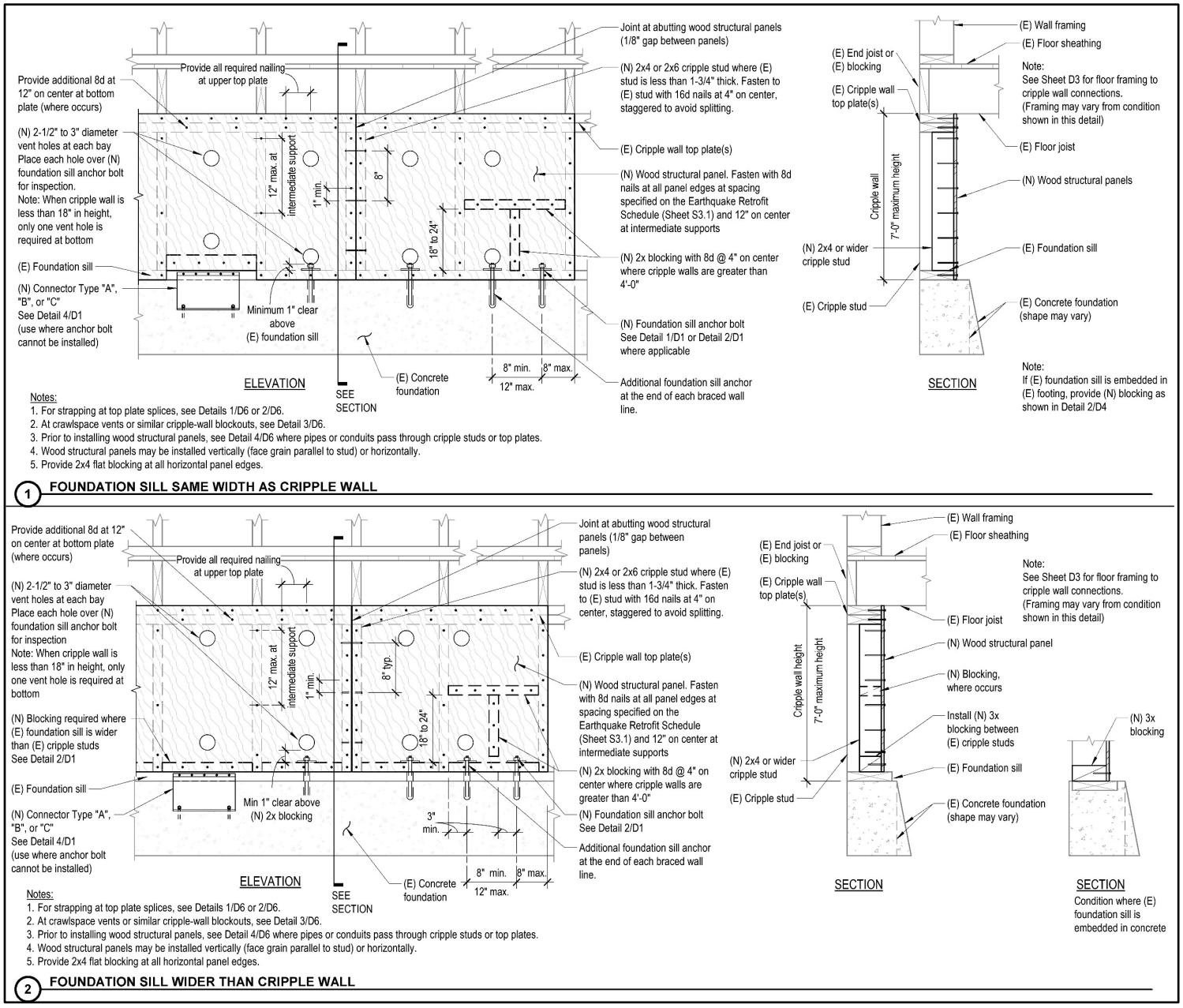

Figure 4.4-16 Wood structural panel installation without tie-downs. Sheet D4.

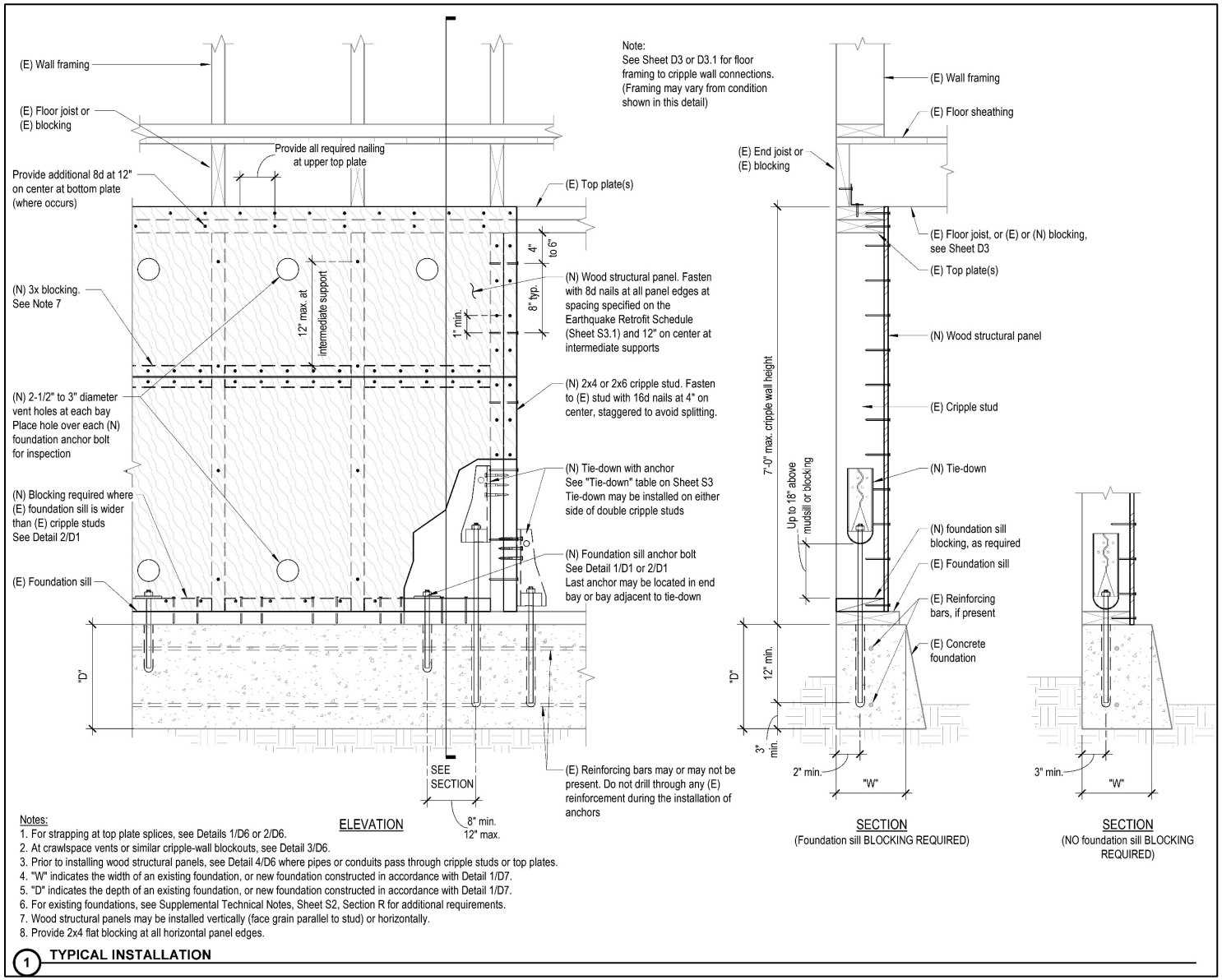

Figure 4.4-17 Wood structural panel installation with tie-downs. Sheet D5.

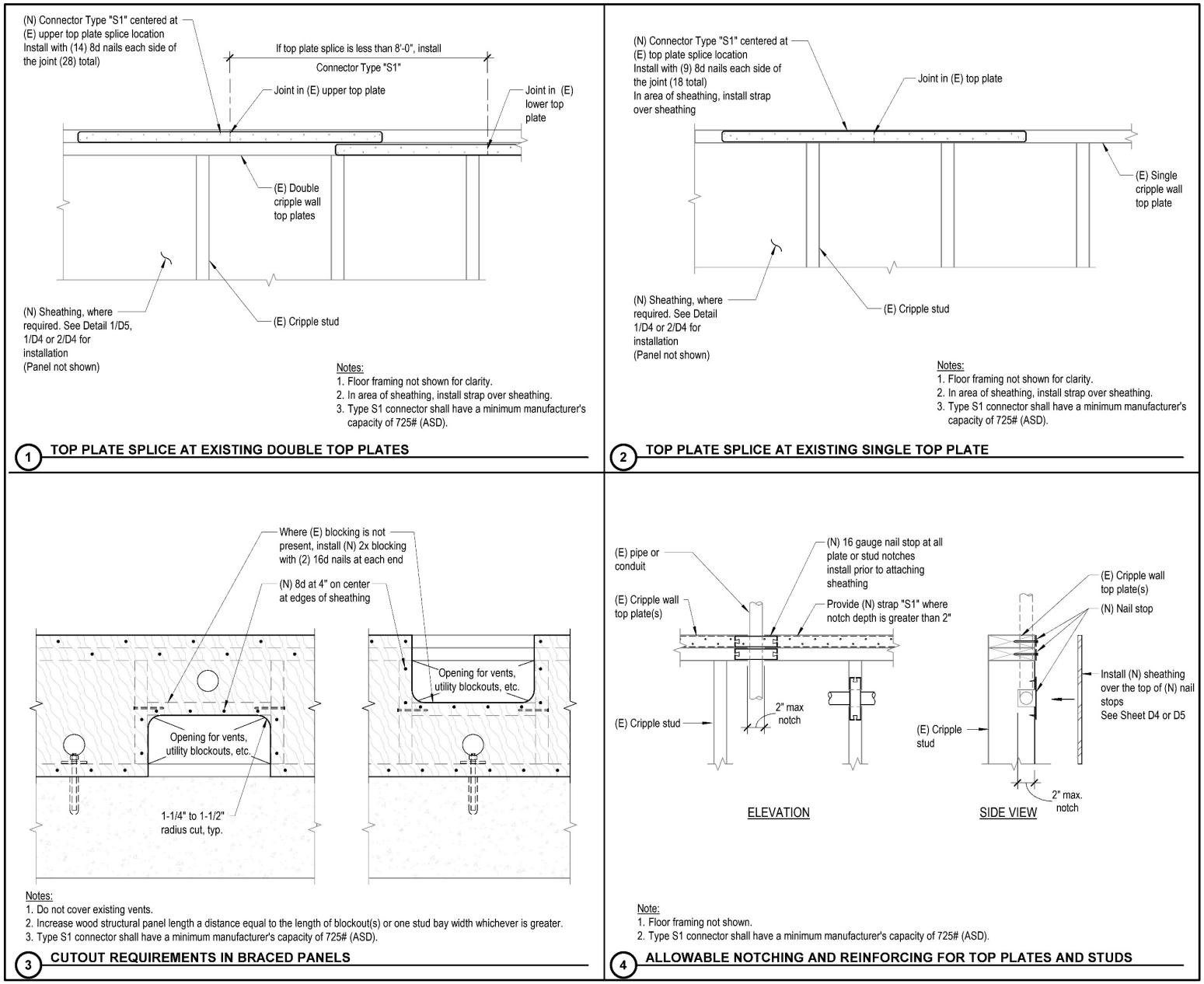

Figure 4.4-18 Vent openings and top plate details. Sheet D6.

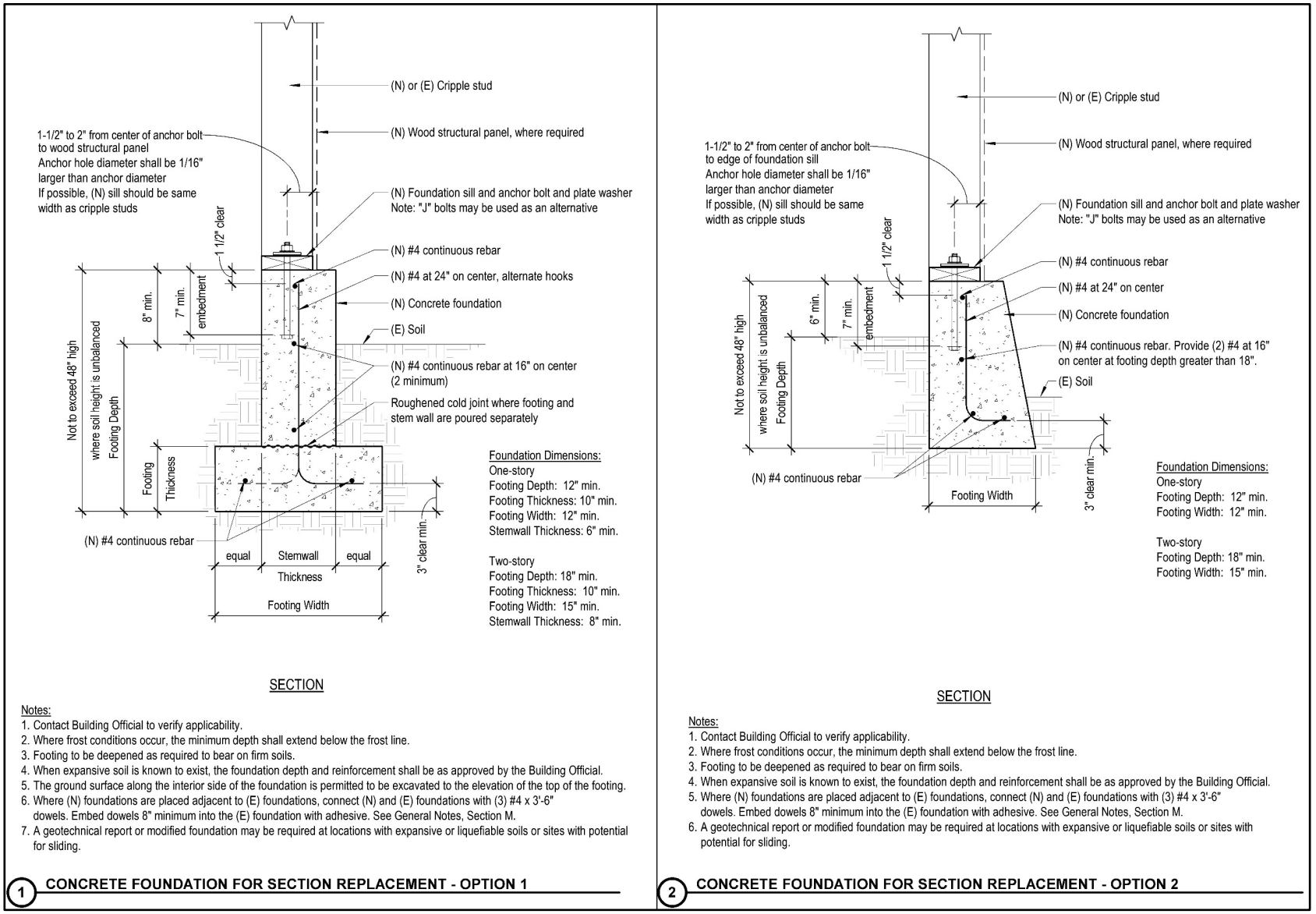

Figure 4.4-19 Foundation replacement details. Sheet D7.