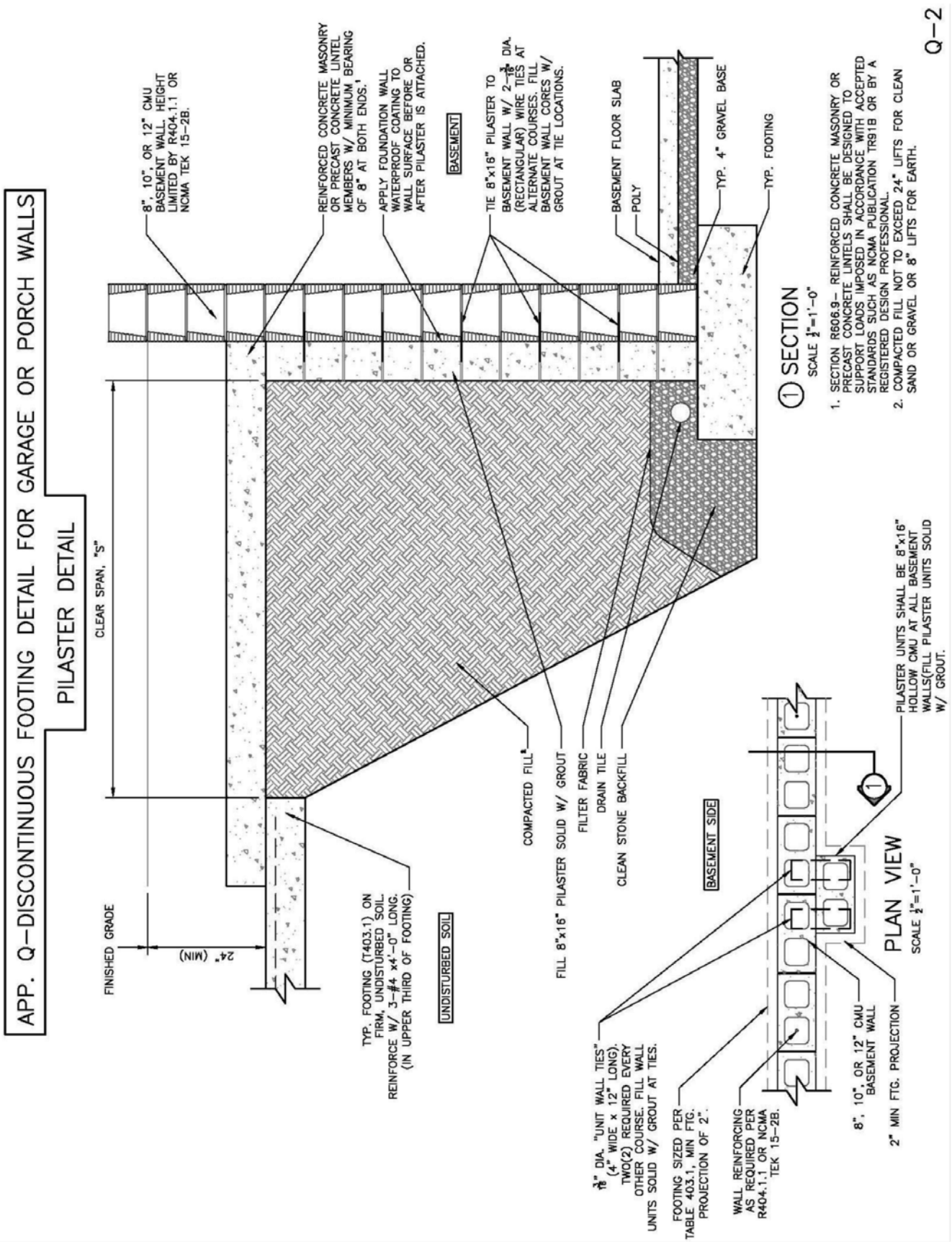
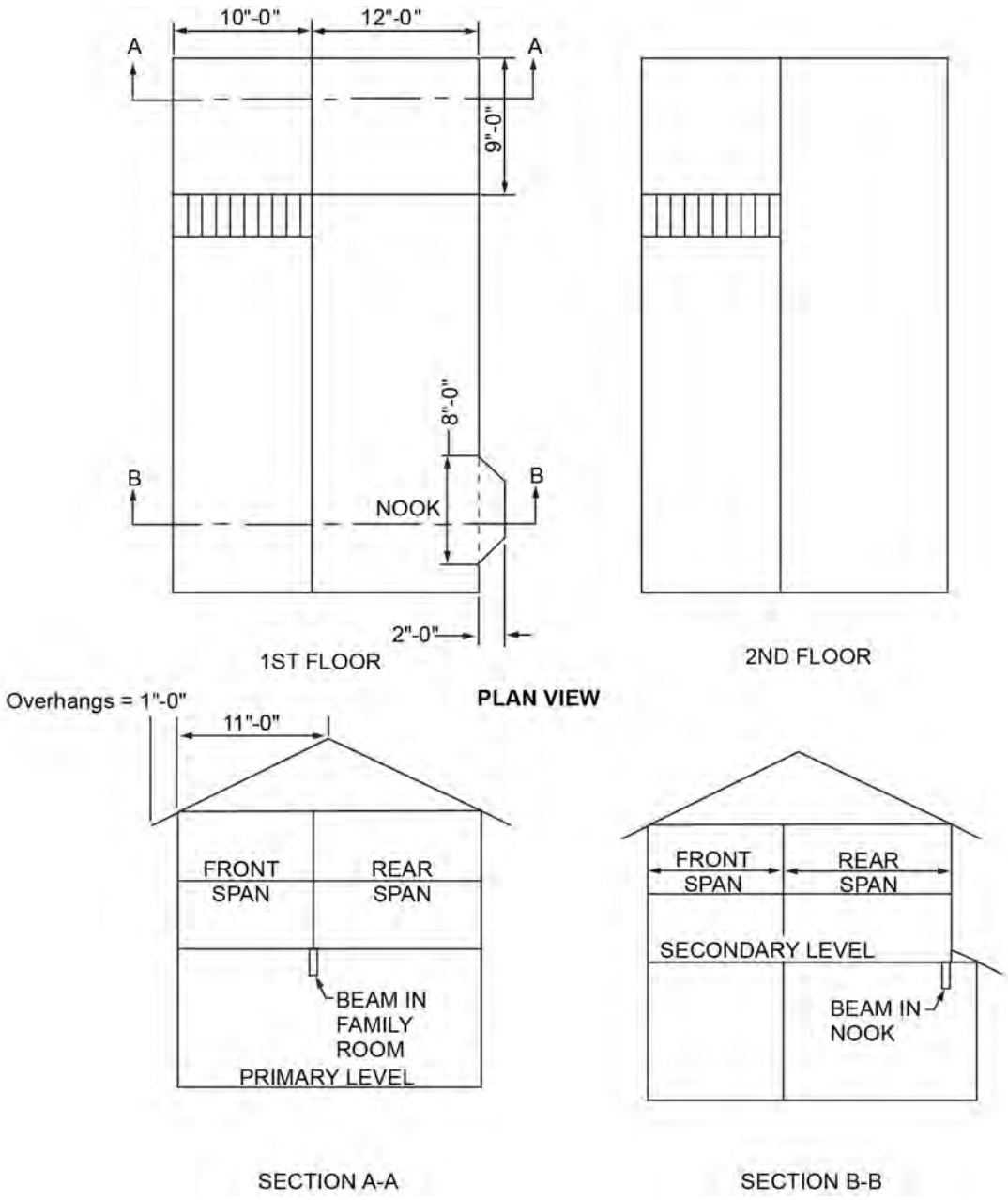
APPENDIX NCB—DISCONTINUOUS FOOTING DETAILS FOR GARAGE OR PORCH WALLS



APPENDIX NCC
BASIC LOAD ESTIMATING

This appendix is a North Carolina addition and not part of the 2021 International Residential Code. *There will be no marginal markings added.*

The provisions contained in this appendix are adopted as part of this code.



For SI: 1 inch = 25.4, 1 foot = 304.8 mm, 1 square foot = 0.0929m^2.

ASSUMPTIONS (sleeping area live load; roof or stick frame rafters with no interior bearing):

Loads

Secondary floor level is 30# L.L. + 10# D.L.= 40#/sq. ft.

Attic level is 20# live load + 10# dead load = 30#/sq. ft.

Nook ceiling is 10# dead load (No attic storage)= 10#/sq. ft.

Wall load

Studs @ 16", $^1/_2$" gypsum = 8#/sq. ft.

Roof load

20# live load + 10# dead load = 30#/sq. ft.

EXAMPLE OF LOAD ESTIMATING
LOAD ON BEAM IN FAMILY ROOM

Loads in Section A - A as follows: **Total Loads** (in pounds/linear foot)

$$2nd \text{ floor load} = \frac{(front \text{ joist span} + \text{rear joist span})}{2} \times 2nd \text{ floor (dead load + live load)} = \text{LOAD/linear ft} = \frac{(10+12)}{2} \times (10+30) = \frac{(22)}{2} \times (40) = 11 \times 40 = 440 \text{ pounds/linear ft}$$

Interior wall load = Wall Weight per Square foot × Wall Height = LOAD/linear foot = 8 pounds/sq. ft. × 8ft. = 64 pounds/linear ft
(Wall weight can vary. Verify actual weight of materials used)

$$Attic \text{ load} = \frac{(front \text{ joist span} + \text{rear joist span})}{2} \times attic \text{ (dead load + live load)} = \text{LOAD/linear ft} = \frac{(10+12)}{2} \times (10+20) = \frac{(22)}{2} \times (30) = 11 \times 30 = 330 \text{ pounds/linear ft}$$

Roof load: No roof load is transmitted to the beam in the family room. Roof Load = 0
Total Load on Beam in Family Room = 834 pounds/1ft.
Beam span in family room is 9 feet and total estimated load is 834#/linear foot:
By using Table NCC-1, the required beam is 4 @ 2 × 12 SPF
OR
By using Table NCC-2, the required minimum flitch beam is 2@2 × 8 with $^{5}/_{8}$″×7″ steel plate bolted with $^{1}/_{2}$″ bolts spaced at 2′ o.c.

EXAMPLE OF LOAD ESTIMATING
LOAD ON BEAM IN NOOK AREA

Loads in Section B - B as follows: **Total Loads** (in pounds/linear foot)

$$2nd \text{ floor load} = \frac{(front \text{ joist span} + \text{rear joist span})}{2} \times 2nd \text{ floor (dead load + live load)} = \text{LOAD/linear ft} = \frac{(0+12)}{2} \times (10+30) = \frac{(12)}{2} \times (40) = 6 \times 40 = 240 \text{ pounds/linear ft}$$

Exterior wall load = Wall Weight per Square foot × Wall Height = LOAD/linear foot = 8 pounds/sq. ft. × 8ft. = 64 pounds/linear ft
(Wall weight can vary. Verify actual weight of materials used)

$$Attic \text{ load} = \frac{(front \text{ joist span} + \text{rear joist span})}{2} \times attic \text{ (dead load + live load)} = \text{LOAD/linear ft} = \frac{(0+12)}{2} \times (10+20) = \frac{(12)}{2} \times (30) = 6 \times 30 = 180 \text{ pounds/linear ft}$$

$$Roof \text{ load} = \frac{(front\ rafter \text{ span} + \text{rear rafter span})}{2} \times overhang \times roof \text{ (dead load + live load)} = \text{LOAD/linear ft} = \left(\frac{(11+11)}{2}+1\right) \times (10+20) = \left(\frac{(22)}{2}+1\right) \times (30) = 12 \times 30 = 360 \text{ pounds/linear ft}$$

$$Nook\ Ceiling \text{ load} = \frac{(\text{joist span} + \text{joist span})}{2} \times ceiling \text{ (dead load + live load)} = \text{LOAD/linear ft} = \frac{(0+2)}{2} \times (10+0) = \frac{(2)}{2} \times (10) = 11 \times 40 = 10 \text{ pounds/linear ft}$$

$$Nook\ Roof \text{ load} = \frac{(rafter \text{ span} + \text{rafter span})}{2} \times roof \text{ (dead load + live load)} = \text{LOAD/linear ft} = \frac{(0+2)}{2} \times (10+20) = \frac{(2)}{2} \times (30) = 1 \times 30 = 30 \text{ pounds/linear ft}$$

Beam span in nook is 8 feet and total estimated load is 884#/linear foot:
By using Table NCC-1, the required beam is 4 @ 2 × 12 Southern pine or 4 @ 2 × 12 Spruce-pine-fir
OR
By using Table NCC-2, the required minimum flitch beam is 2@2 × 8 with $^{1}/_{2}$″×7″ steel plate bolted with $^{1}/_{2}$″ bolts spaced at 2′ o.c.

TABLE NCC-1
WOOD BEAMS AND GIRDERS ALLOWABLE LOADS
IN POUNDS PER LINEAR FOOT [a, b, c, d]

2 × 8 ($1^1/_2$″ × 7 $^1/_4$″)						
Span L[f] (feet)	Spruce-Pine-Fir[e]			Southern Pine		
	2 ply	3 ply	4 ply	2 ply	3 ply	4 ply
3	1,305	1,956	2,610	1,692	2,538	3,383
4	979	1,468	1,958	1,013	1,519	2,026
5	736	1,104	1,472	648	972	1,296
6	511	767	1,022	450	675	900
7	375	563	751	331	496	661
8	287	431	575	253	380	506
9	227	341	454	200	300	400
10	184	276	368	162	243	324
12	114	170	228	113	169	225
14	72	108	144	72	108	144
2 × 10 ($1^1/_2$″ × $9^1/_4$″)						
Span L[f] (feet)	Spruce-Pine-Fir[e]			Southern Pine		
	2 ply	3 ply	4 ply	2 ply	3 ply	4 ply
3	1,665	2,498	3,330	2,158	3,238	5,250
4	1,249	1,873	2,498	1,426	2,139	2,852
5	999	1,499	1,998	913	1,369	1,825
6	763	1,144	1,525	634	951	1,268
7	560	840	1,120	466	698	931
8	429	643	858	357	535	713
9	339	508	678	282	423	563
10	275	412	549	228	342	456
12	191	286	381	158	238	317
14	140	210	280	116	175	233
2 × 12 ($1^1/_2$″ × $11^1/_4$″)						
Span L[f] (feet)	Spruce-Pine-Fir[e]			Southern Pine		
	2 ply	3 ply	4 ply	2 ply	3 ply	4 ply
3	2,025	3,038	4,050	2,625	3,938	4,317
4	1,519	2,278	3,038	1,969	2,953	3,938
5	1,215	1,823	2,430	1,266	1,898	2,531
6	1,013	1,519	2,025	879	1,318	1,756
7	753	1,130	1,507	646	969	1,291
8	577	856	1,154	494	742	989
9	456	684	911	391	586	781
10	369	554	738	316	475	633
12	256	385	513	220	330	439
14	188	283	377	161	242	323

For SI: 1 inch = 25.4 mm., 1 foot = 304.8 mm.

a. Lumber grade is #2 intended for an in-service moisture content of 19% or less.

b. Deflection is limited to L/360.

c. Load duration factor used in calculations is 1.0.

d. Adequate bearing and lateral support for the member must be provided. Support for the member ends must provide a continuous load path from the bearing to the foundation.

e. Values tabulated are for Spruce-Pine-Fir, not Spruce-Pine-Fir (South). Values tabulated for Southern Pine are based on design values published by the American Wood Council in an addendum to NDS dated March 2013.

f. Span, L, is clear span. Effective span for bending and deflection is clear span plus 3 inches.

TABLE NCC-2
FLITCH PLATE BEAM ALLOWABLE LOADS
IN POUNDS PER LINEAR FOOT [a, b, c, d]

(2) 2 × 6 WITH PLATE INDICATED					
Span L[f] (feet)	Plate size/(Beam weight per foot)				
	1/4″ × 5″ Plate (8 lb./ft.)	3/8″ × 5″ Plate (10 lb./ft.)	1/2″ × 5″ Plate (13 lb./ft.)	5/8″ × 5″ Plate (15 lb./ft.)	3/4″ × 5″ Plate (17 lb./ft.)
6′-0″	643	825	1,006	1,188	1,370
7′-0″	473	606	739	873	1,006
8′-0″	362	464	566	668	771
9′-0″	272	348	425	502	579
10′-0″	198	254	310	366	422
11′-0″	149	191	233	275	317
12′-0″	115	147	179	212	244
(2) 2 × 8 WITH PLATE INDICATED					
Span L[f] (feet)	Plate size/(Beam weight per foot)				
	1/4″ × 7″ Plate (11 lb./ft.)	3/8″ × 7″ Plate (14 lb./ft.)	1/2″ × 7″ Plate (17 lb./ft.)	5/8″ × 7″ Plate (20 lb./ft.)	3/4″ × 7″ Plate (23 lb./ft.)
6′-0″	1,150	1,499	1,849	2,199	2,549
7′-0″	845	1,102	1,359	1,615	1,872
8′-0″	647	843	1,040	1,237	1,434
9′-0″	511	666	822	977	1,133
10′-0″	414	540	666	792	917
11′-0″	342	446	550	654	758
12′-0″	287	375	462	550	637
13′-0″	230	300	369	439	509
14′-0″	184	240	296	352	408
15′-0″	150	195	240	286	331
16′-0″	123	161	198	236	273
(2) 2 × 10 WITH PLATE INDICATED					
Span L[f] (feet)	Plate size/(Beam weight per foot)				
	1/4″ × 9″ Plate (14 lb./ft.)	3/8″ × 9″ Plate (18 lb./ft.)	1/2″ × 9″ Plate (22 lb./ft.)	5/8″ × 9″ Plate (26 lb./ft.)	3/4″ × 9″ Plate (30 lb./ft.)
6′-0″	1,642	2,145	2,649	3,153	3,657
7′-0″	1,206	1,576	1,946	2,317	2,687
8′-0″	923	1,207	1,490	1,774	2,057
9′-0″	730	954	1,177	1,401	1,625
10′-0″	591	772	954	1,135	1,317
11′-0″	488	638	788	938	1,088
12′-0″	410	536	662	788	914
13′-0″	350	457	564	672	779
14′-0″	302	394	487	579	672
15′-0″	263	343	424	504	585
16′-0″	231	302	373	443	514
17′-0″	204	267	330	393	456
18′-0″	182	238	294	350	406

(*continued*)

TABLE NCC-2—continued
FLITCH PLATE BEAM ALLOWABLE LOADS
IN POUNDS PER LINEAR FOOT [a, b, c, d]

(2) 2 × 10 WITH PLATE INDICATED					
Span L[f] (feet)	Plate size/(Beam weight per foot)				
	1/4″ × 9″ Plate (14 lb./ft.)	3/8″ × 9″ Plate (18 lb./ft.)	1/2″ × 9″ Plate (22 lb./ft.)	5/8″ × 9″ Plate (26 lb./ft.)	3/4″ × 9″ Plate (30 lb./ft.)
19′-0″	155	203	250	298	345
20′-0″	133	174	214	255	296
(2) 2 × 12 with Plate Indicated					
Span L[f] (feet)	Plate Size / (Beam Weight per Foot)				
	1/4″ × 11″ Plate (18 lb./ft.)	3/8″ × 11″ Plate (22 lb./ft.)	1/2″ × 11″ Plate (27 lb./ft.)	5/8″ × 11″ Plate (32 lb./ft.)	3/4″ × 11″ Plate (36 lb./ft.)
6′-0″	2,297	3,006	3,715	4,425	5,134
7′-0″	1,688	2,209	2,730	3,251	3,772
8′-0″	1,292	1,691	2,090	2,489	2,888
9′-0″	1,021	1,336	1,651	1,966	2,282
10′-0″	827	1,082	1,338	1,593	1,848
11′-0″	683	894	1,105	1,316	1,527
12′-0″	574	752	929	1,106	1,283
13′-0″	489	640	791	943	1,094
14′-0″	422	552	682	813	943
15′-0″	367	481	594	708	821
16′-0″	323	423	522	622	722
17′-0″	286	374	463	551	639
18′-0″	255	334	413	492	570
19′-0″	229	300	371	441	512
20′-0″	207	271	334	398	462
21′-0″	188	245	303	361	419
22′-0″	171	224	276	329	382
23′-0″	156	205	253	301	349
24′-0″	140	183	226	269	312

For SI: 1 inch = 25.4 mm., 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa.

a. Lumber species and grade is #2 Southern Pine intended for an in-service moisture content of 19% or less. Design values used were published by the American Wood Council in an addendum to NDS dated March 2013. For Spruce-Pine-Fir lumber using the tabulated flitch plate allowable loads will be slightly conservative.

b. Tabulated values are based on ASTM A36 structural steel plate.

c. Deflection is limited to L/360.

d. Load duration factor used in calculations is 1.0.

e. Adequate bearing and lateral support for the member must be provided. Support for the member ends must provide a continuous load path from the bearing to the foundation.

f. Span, L, is center to center of supports. Wood side plates and steel flitch plates shall be continuous throughout the span.

APPENDIX NCD
FOAM PLASTIC DIAGRAMS

This appendix is a North Carolina addition to the 2021 International Residential Code*. There will be no marginal markings added.*

(The provisions contained in this appendix are adopted as part of this code.)

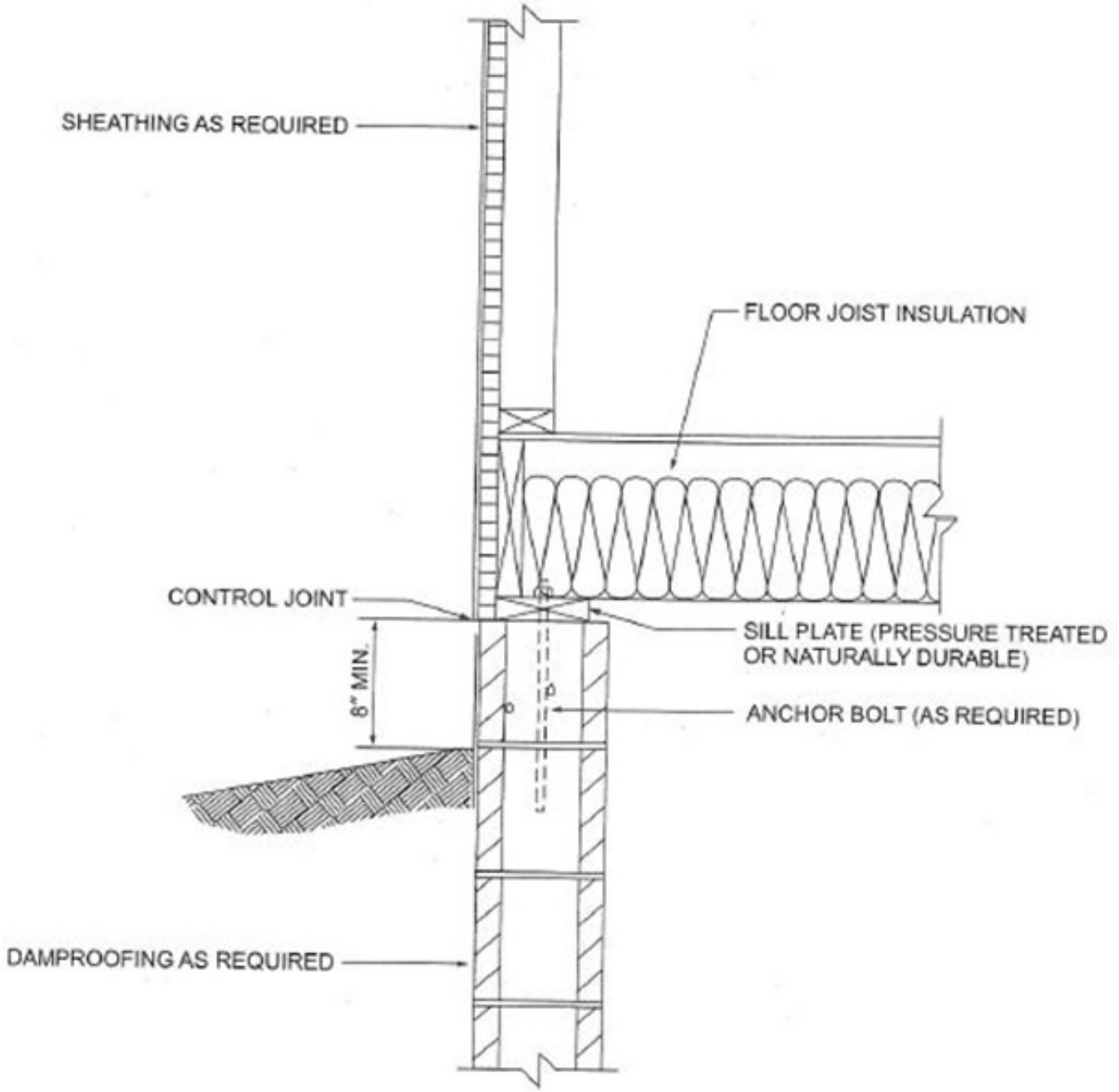


FIGURE NCD-1
FOUNDATION WALL

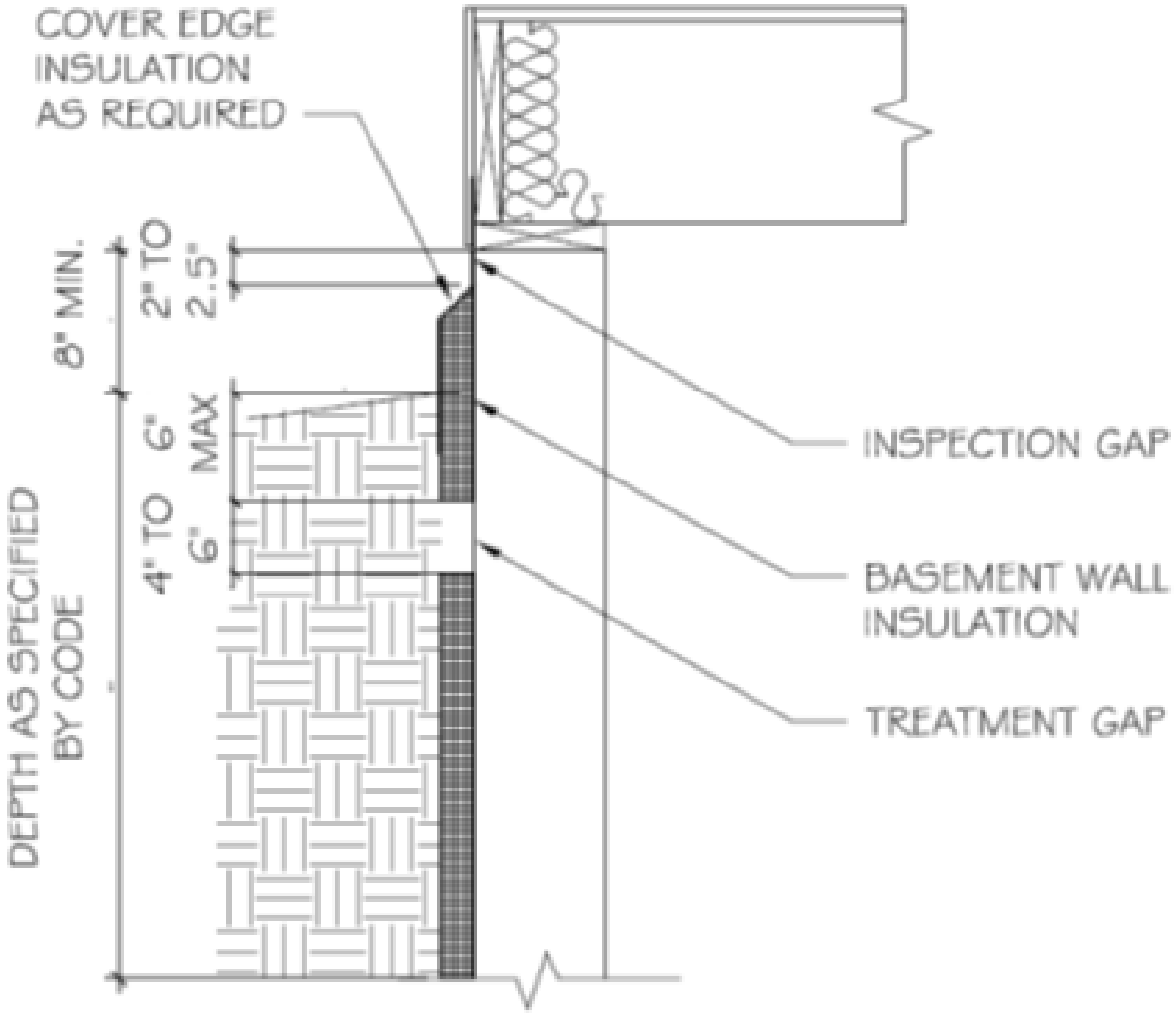


FIGURE NCD-2
BASEMENT WALL

N1102.2.9 Basement walls with exterior foam insulation. Insulation illustrations – Section view of exterior foam insulation location for basement walls. (Includes detailing from N1102.2.11.)

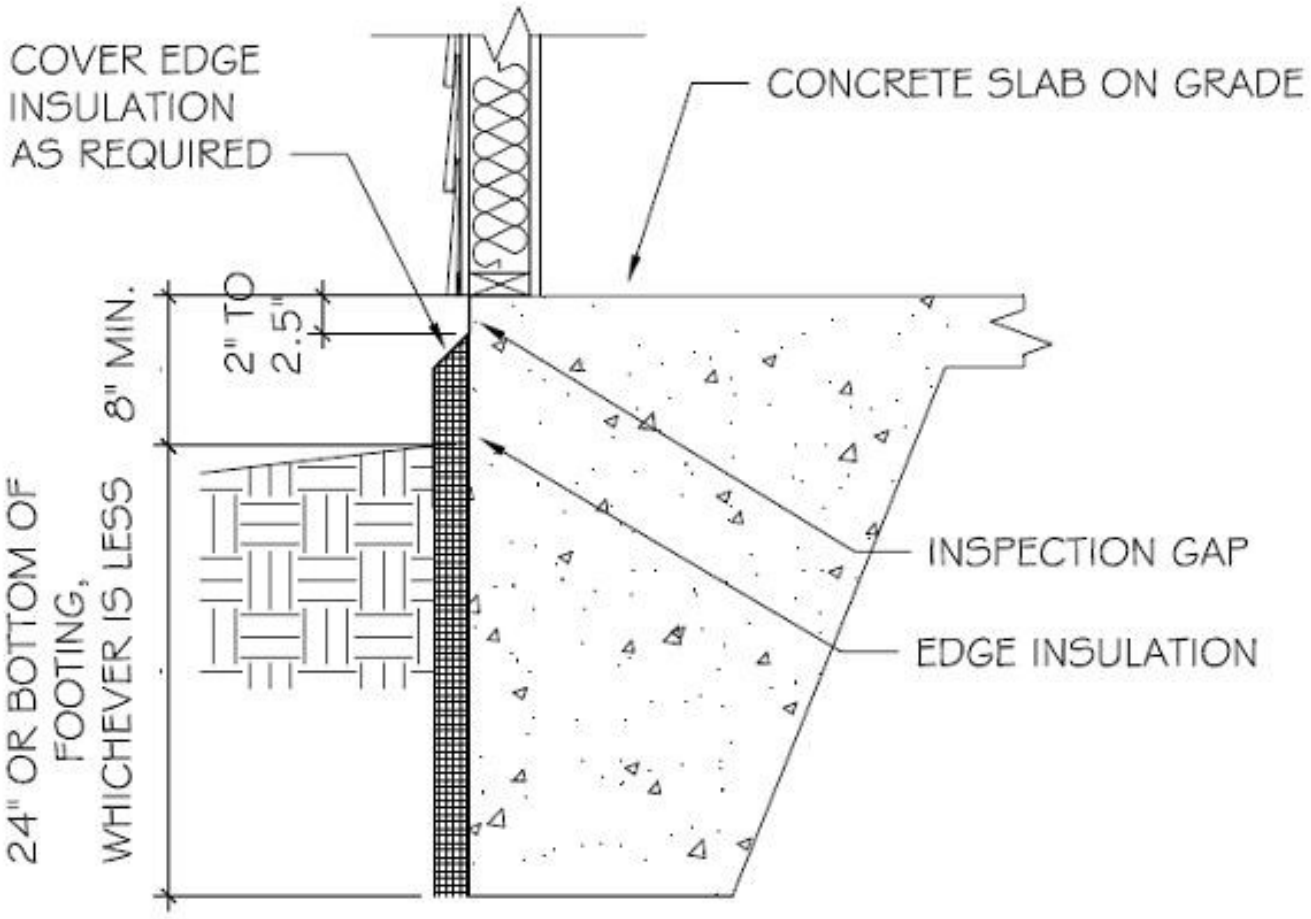


FIGURE NCD-3
FRAME WALL

N1102.2.10 Slab insulation details. Insulation illustrations.

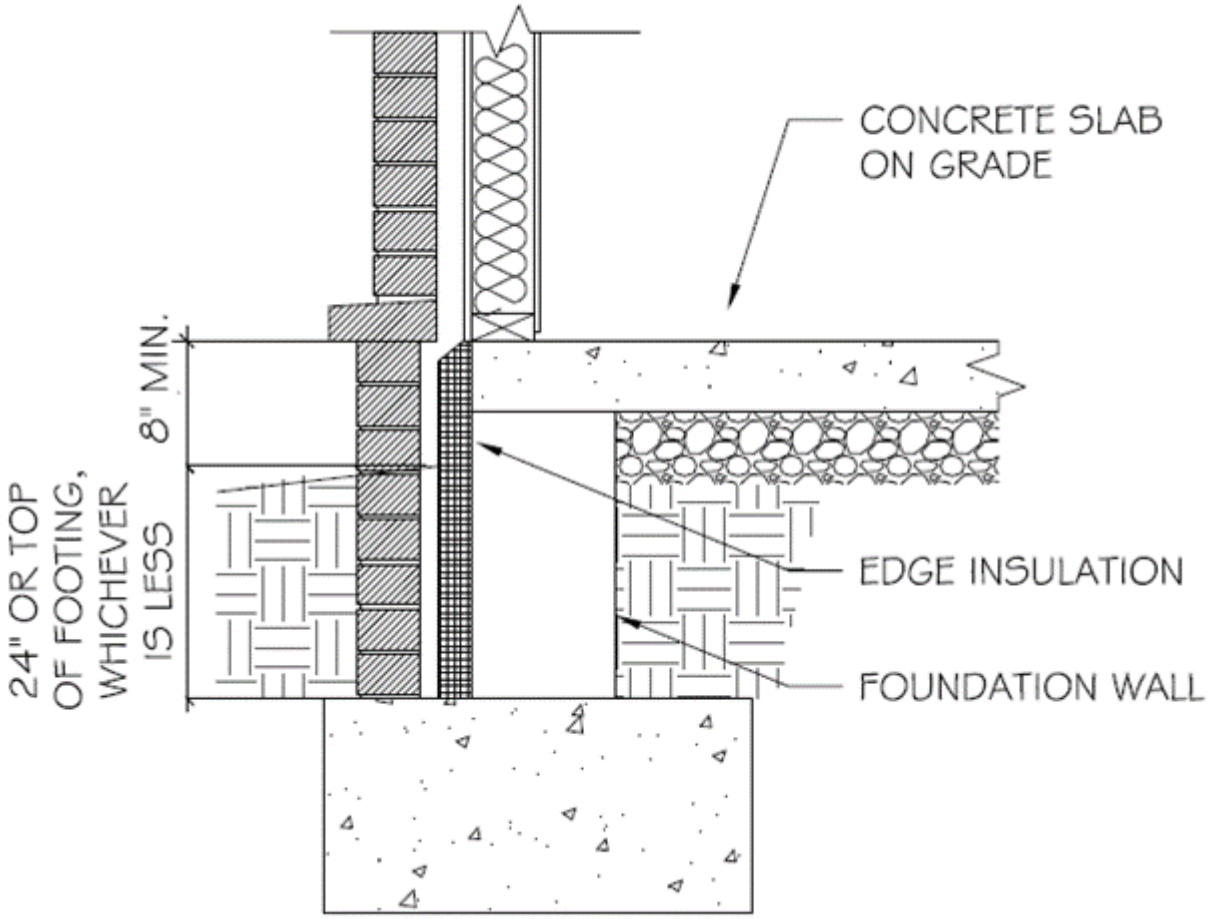


FIGURE NCD-4
FRAME WALL

N1102.2.10 Slab insulation details. Insulation illustrations - Example for slab edge insulation location behind brick, stone, or masonry facing. (Other options may also compliant.)

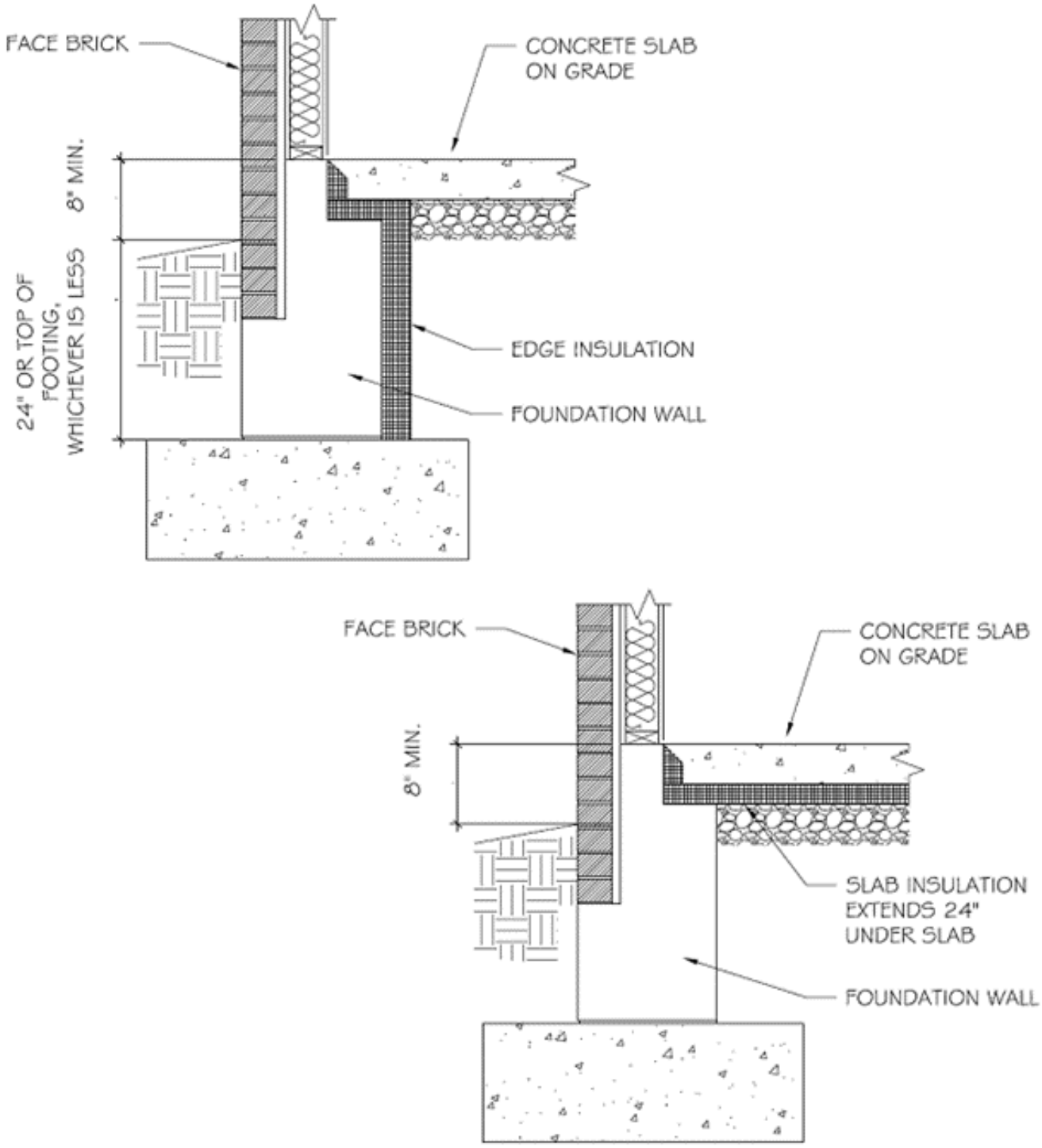


FIGURE NCD-5
FRAME WALL

N1102.2.10 Slab insulation details. Insulation illustrations – Examples for slab insulation location for floating slab with stem wall.

APPENDIX NCE

(NCE-1 THROUGH NCE-4)
RESIDENTIAL REQUIREMENTS FOR ENERGY CONSERVATION

This appendix is a North Carolina addition and not part of the 2015 *International Residential Code*. There will be no marginal markings added.

(The provisions contained in this appendix are adopted as part of this code.)

APPENDIX NCE-1 Energy Efficiency Certificate (Section N1101.14)

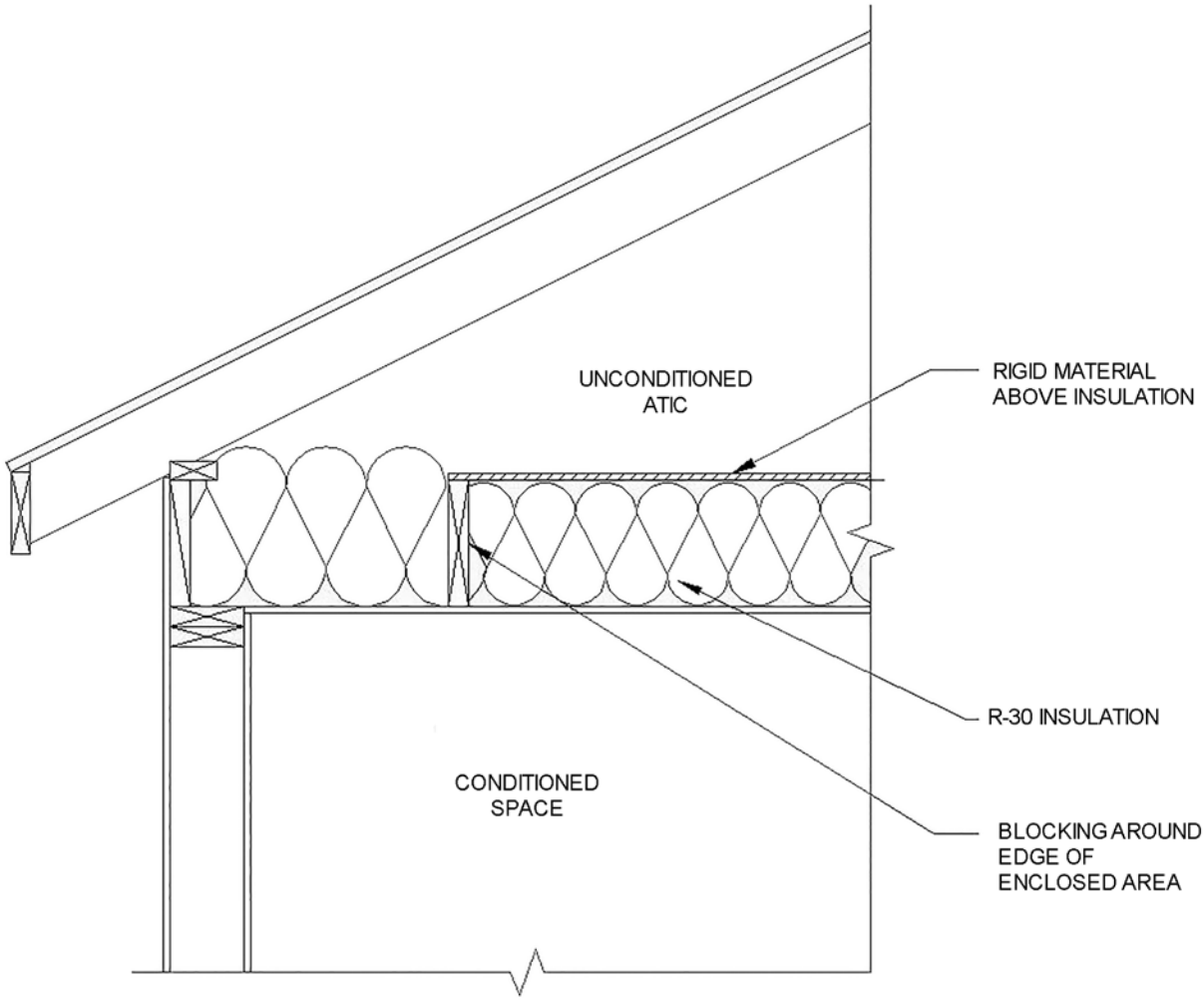
ENERGY EFFICIENCY CERTIFICATE (N1101.14)

Builder, Permit Holder or Registered Design Professional Print Name: Signature:	
Property Address:	
Date:	
Insulation Rating – List the value covering largest area to all that apply	***R*-Value**
Ceiling/roof:	R-
Wall:	R-
Floor:	R-
Closed crawl space wall:	R-
Closed crawl space floor:	R-
Slab:	R-
Basement wall:	R-
Fenestration:	
U-Factor	
Solar Heat Gain Coefficient (SHGC)	
Building Air Leakage	
Visually inspected according to N1102.4.2.1 OR	
Building air leakage test results (Sec. N1102.4.2.2) ACH50 [Target: 5.0] or CFM50/SFSA [Target: 0.30]	
Name of Tester/Company: Date: Phone:	
Ducts:	
Insulation	R-
Total duct leakage test result (Sect. N1103.3.3) Circle one: Total duct leakage test (CFM25 Total/100SF) [Target: 5] or Duct leakage to the outside test (CFM25 Total/100SF) [Target: 4]	
Name of Tester or Company: Date: Phone:	
Certificate to be displayed permanently	

APPENDIX NCE-2
INSULATION AND AIR SEALING DETAILS

APPENDIX NCE-2.1

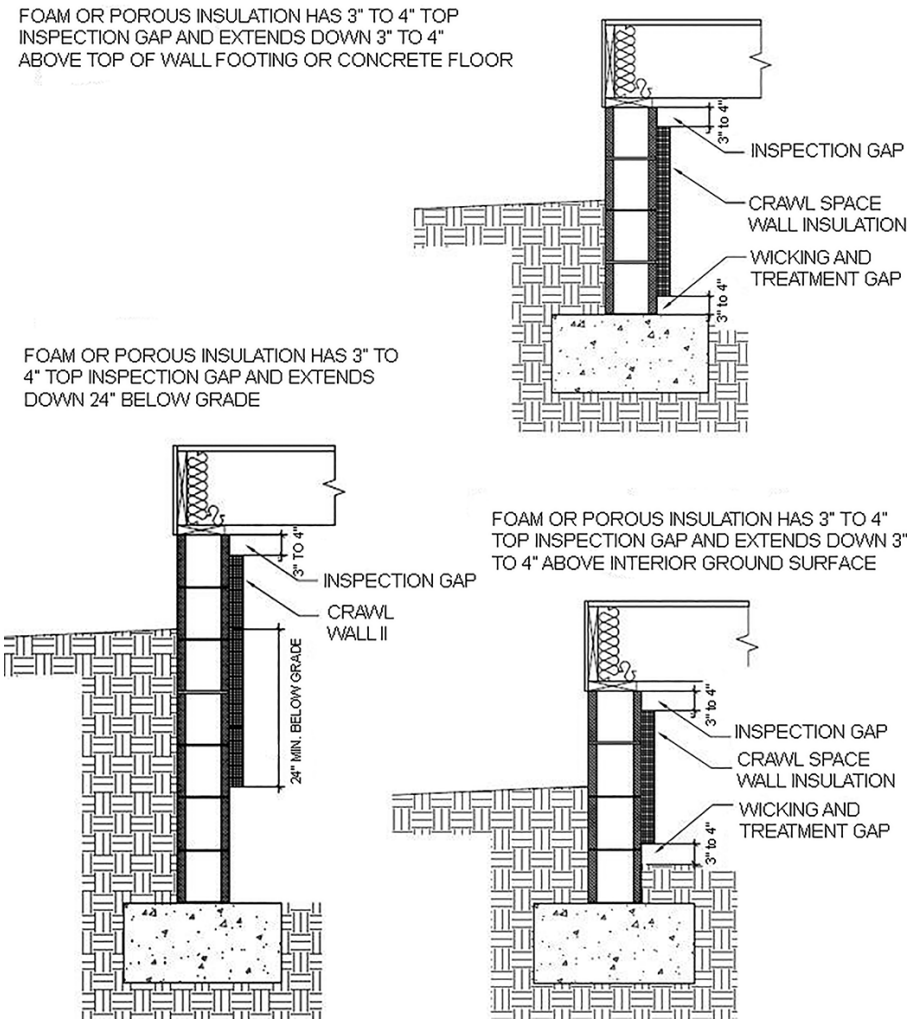
N1102.2.1 Ceilings with attic spaces: Exception for fully enclosed attic floor systems



SECTION VIEW OF CEILING WITH ATTIC SPACE

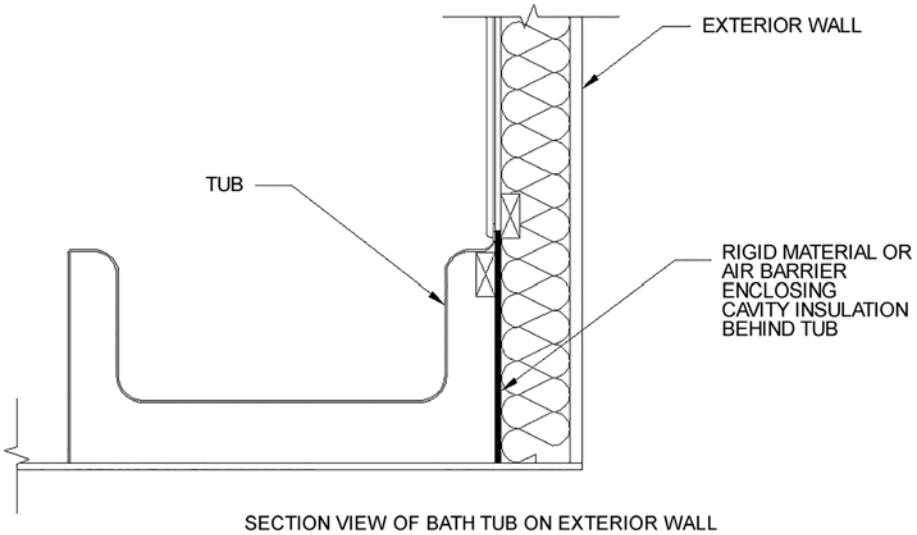
APPENDIX NCE-2.2

N1102.2.11 Closed crawl space walls. Insulation illustrations



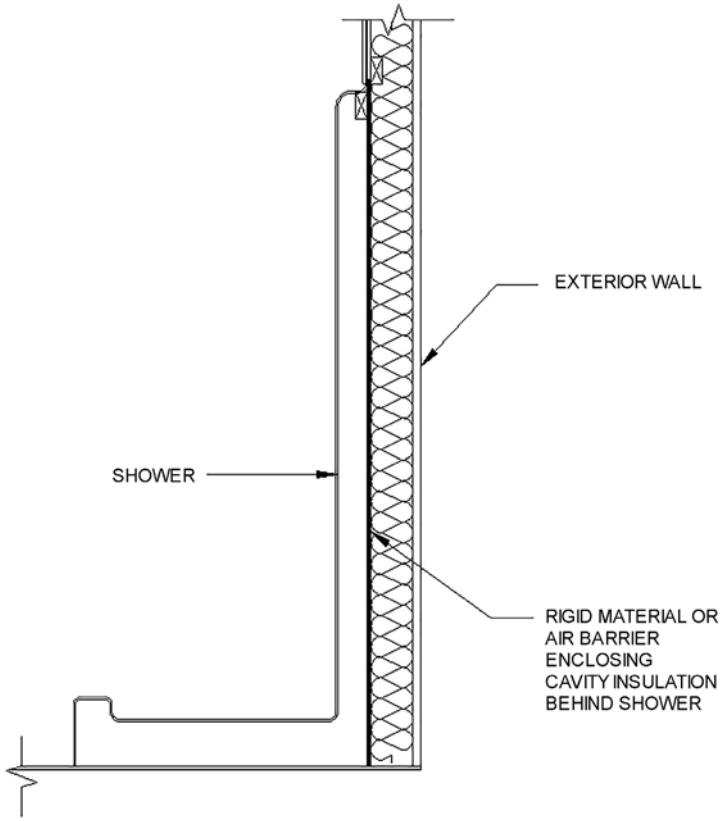
APPENDIX NCE-2.3

N1102.2.14 Framed cavity walls. Insulation enclosure—1. Tubs



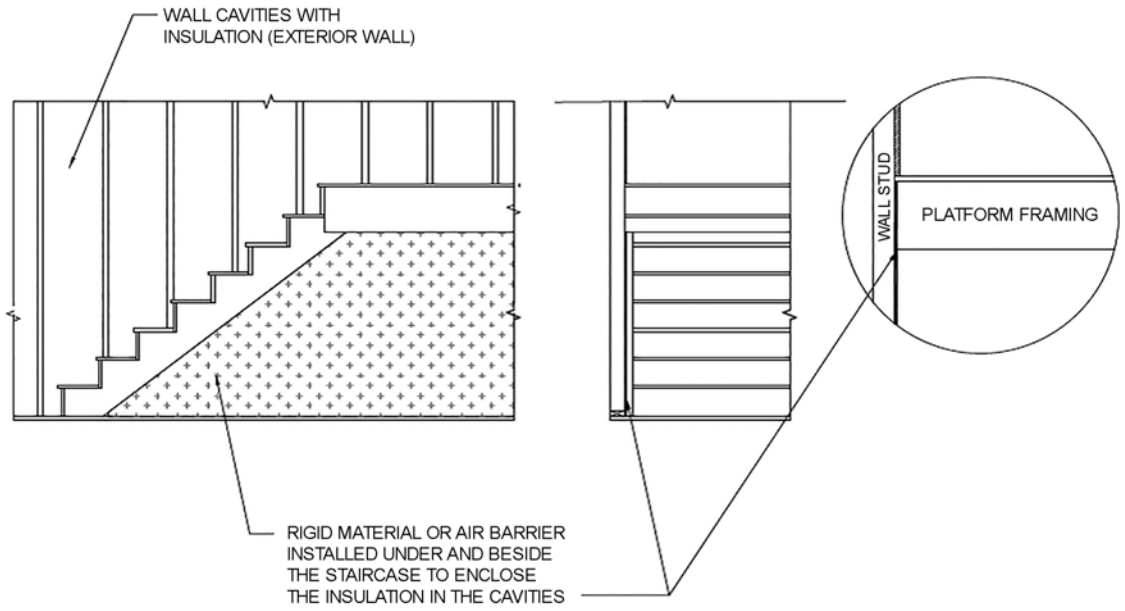
SECTION VIEW OF BATH TUB ON EXTERIOR WALL

N1102.2.14 Framed cavity walls. Insulation enclosure—2. Showers



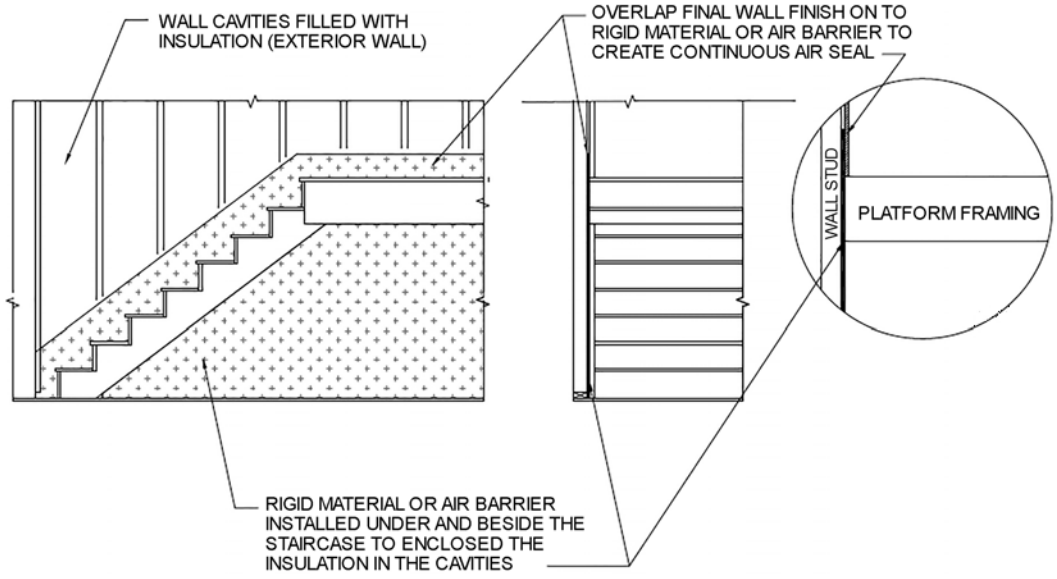
SECTION VIEW OF SHOWER ON EXTERIOR WALL

N1102.2.14 Framed cavity walls. Insulation enclosure—3. Stairs



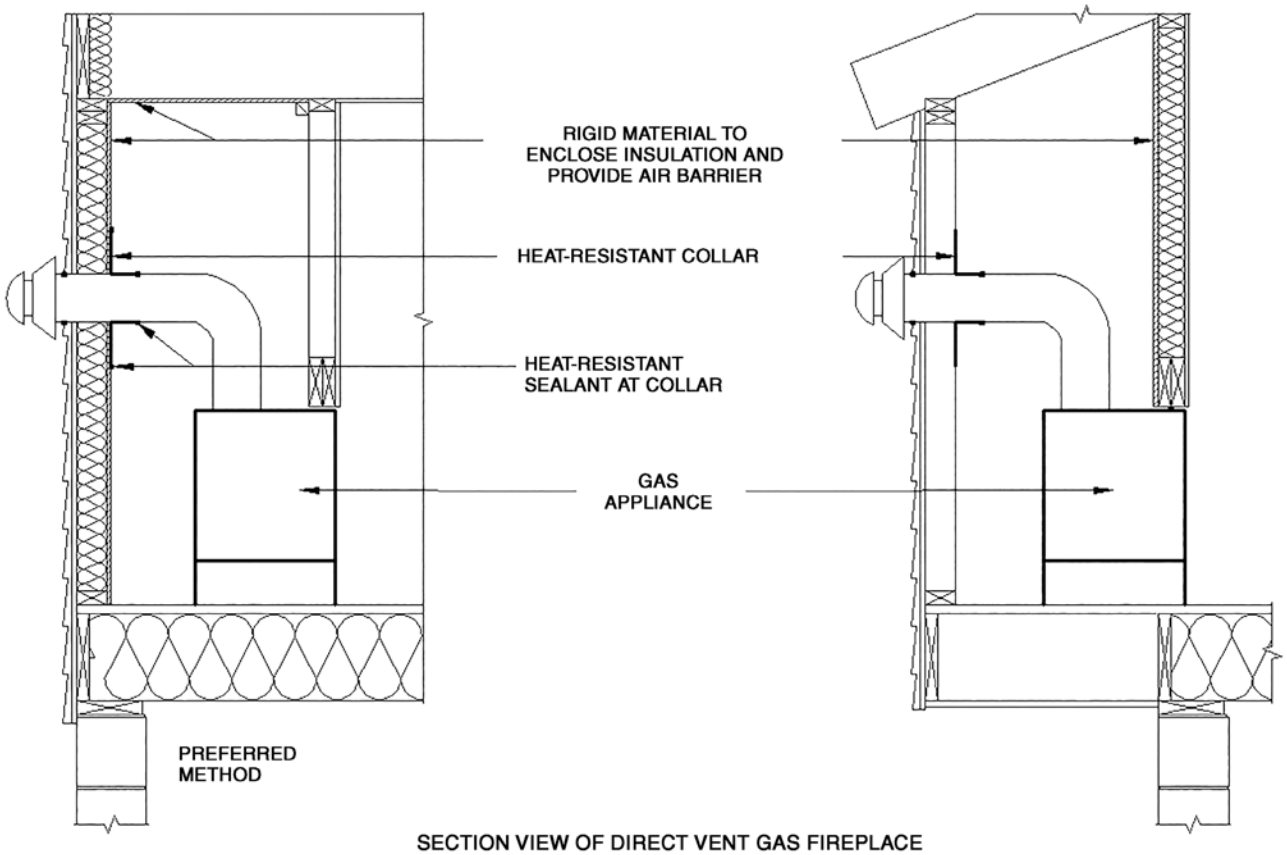
SECTION VIEW OF INTERIOR STAIRCASE ON EXTERIOR WALL (OPTION 1)

N1102.2.14 Framed cavity walls. Insulation enclosure—3. Stairs



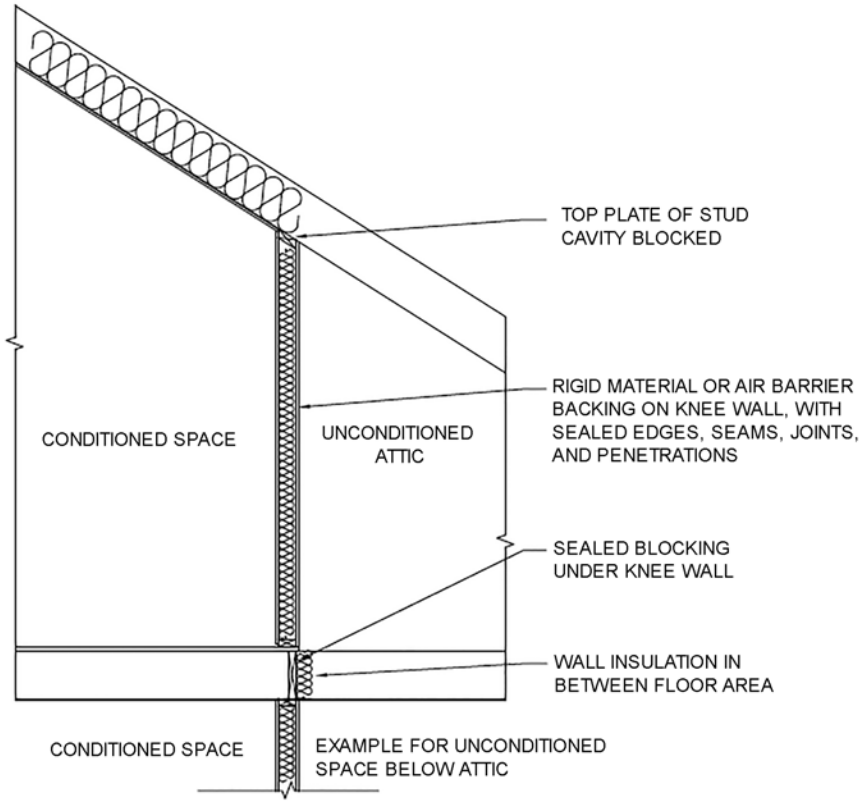
SECTION VIEW OF INTERIOR STAIRCASE ON EXTERIOR WALL (OPTION 2)

N1102.2.14 Framed cavity wall. Insulation enclosure—4. Direct vent gas fireplace



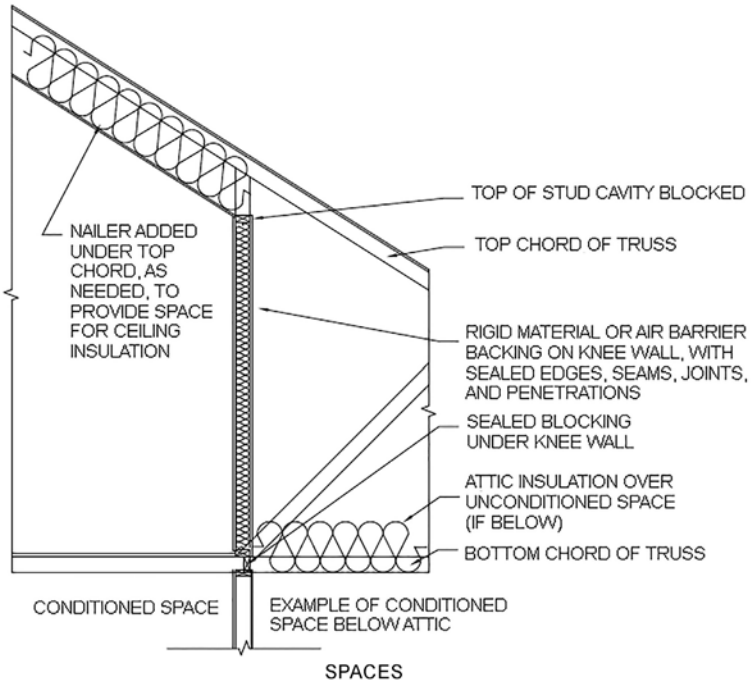
SECTION VIEW OF DIRECT VENT GAS FIREPLACE

N1102.2.15 Framed cavity walls. Insulation enclosure—5. Walls that adjoin attic spaces



SECTION VIEW OF WALL ADJOINING ATTIC SPACE WITH STICK FRAMED ROOF

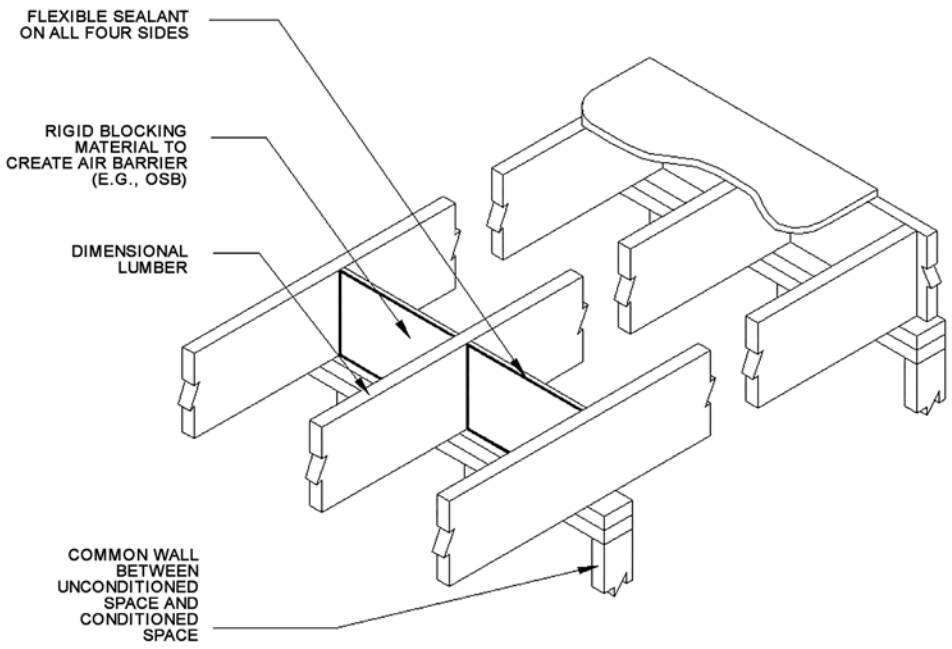
N1102.2.15 Framed cavity walls. Insulation enclosure—5. Walls that adjoin attic spaces



SECTION VIEW OF WALL ADJOINING ATTIC SPACE WITH TRUSS ROOF

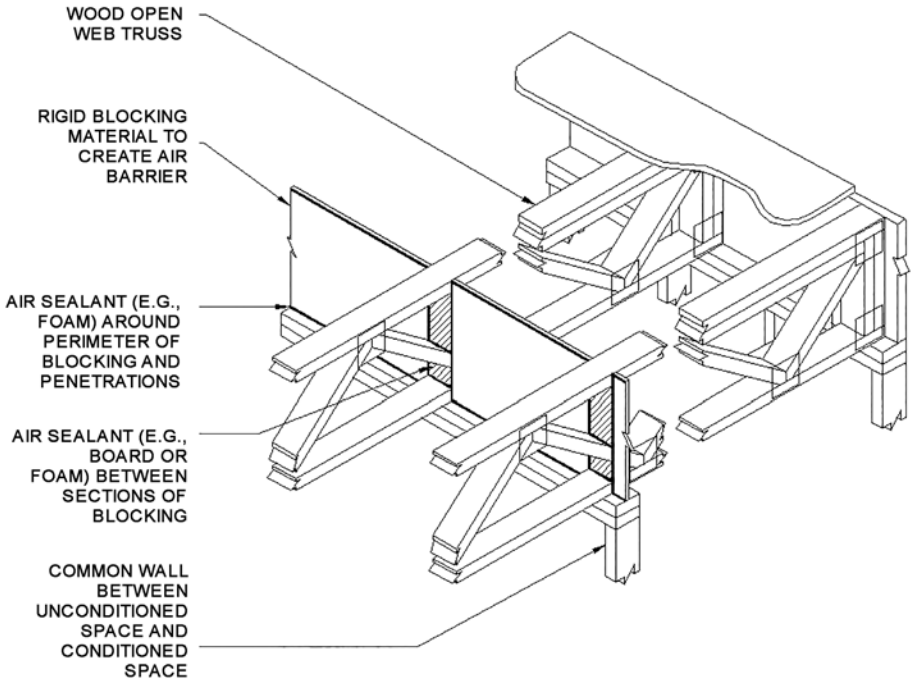
APPENDIX NCE-2.4

N1102.4.1 Building thermal envelope.—1. Block and seal floor/ceiling systems



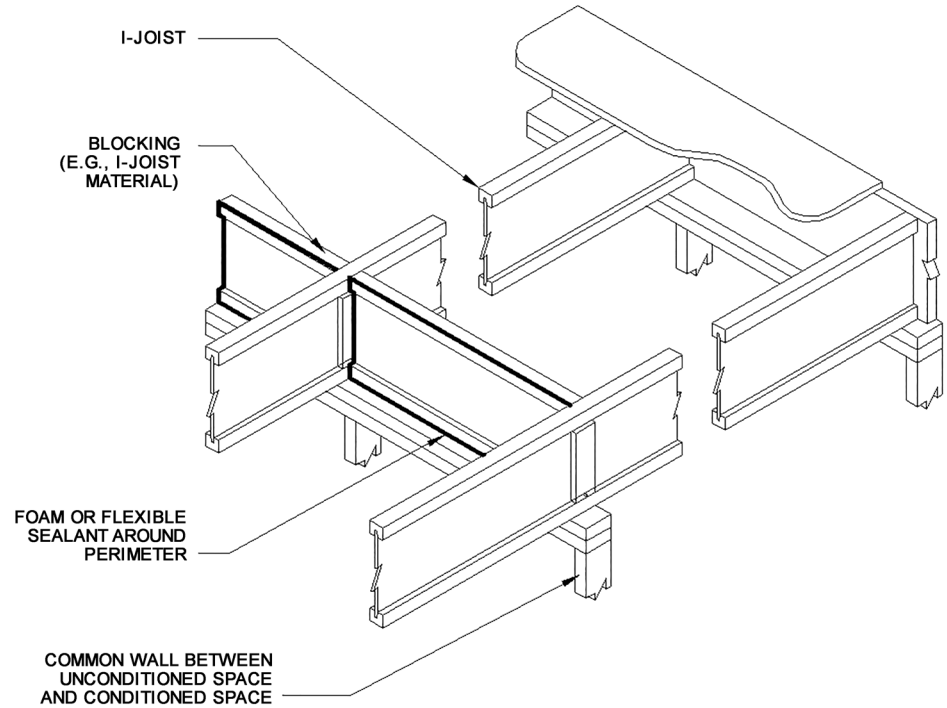
ISOMETRIC VIEW OF DIMENSIONAL LUMBER FLOOR/CEILING SYSTEM ABOVE COMMON WALL BETWEEN UNCONDITIONED AND CONDITIONED SPACE

N1102.4.1 Building thermal envelope.—1. Block and seal floor/ceiling systems



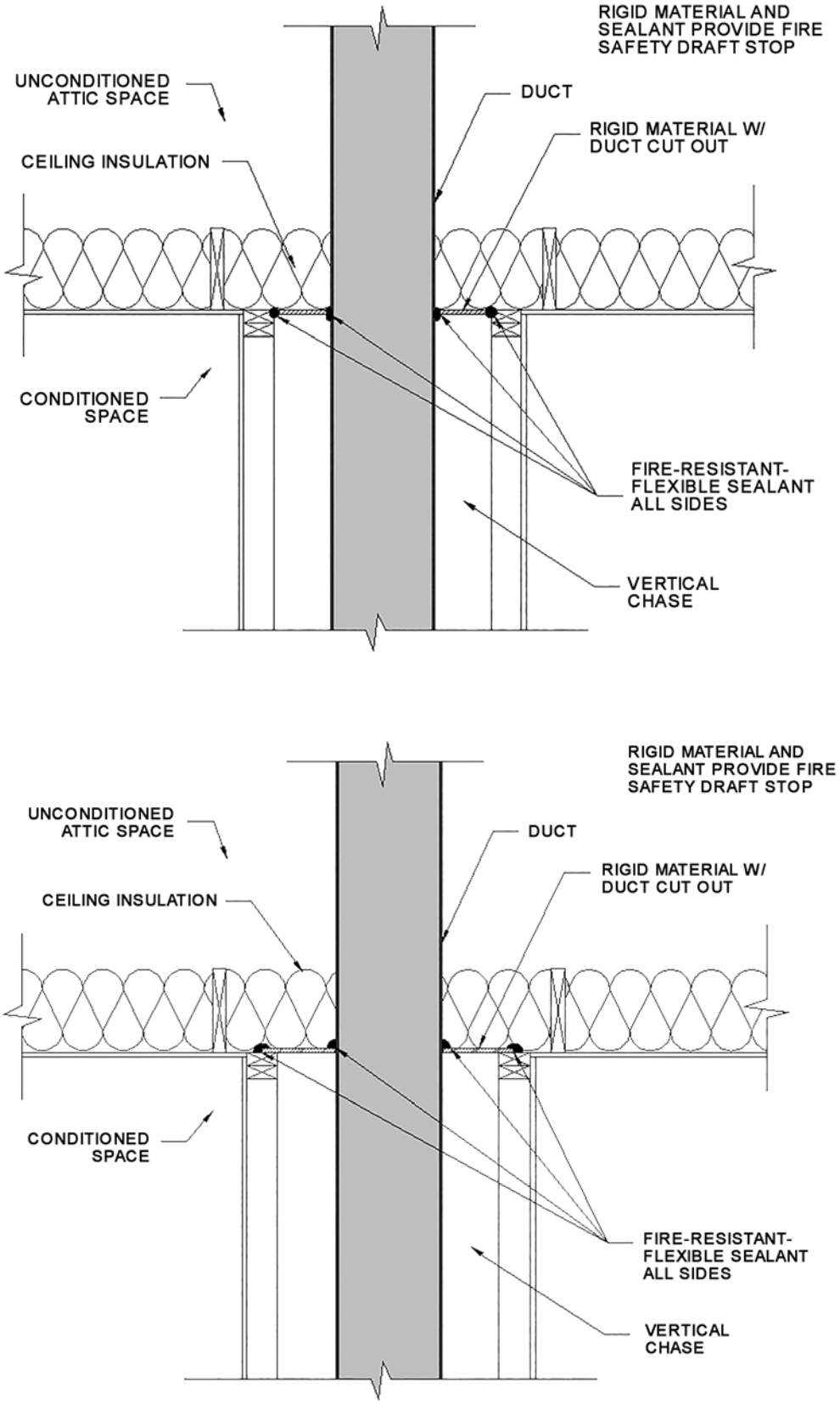
ISOMETRIC VIEW OF WOOD TRUSS FLOOR/CEILING SYSTEM ABOVE COMMON WALL BETWEEN UNCONDITIONED AND CONDITIONED SPACE

N1102.4.1 Building thermal envelope. —1. Block and seal floor/ceiling systems



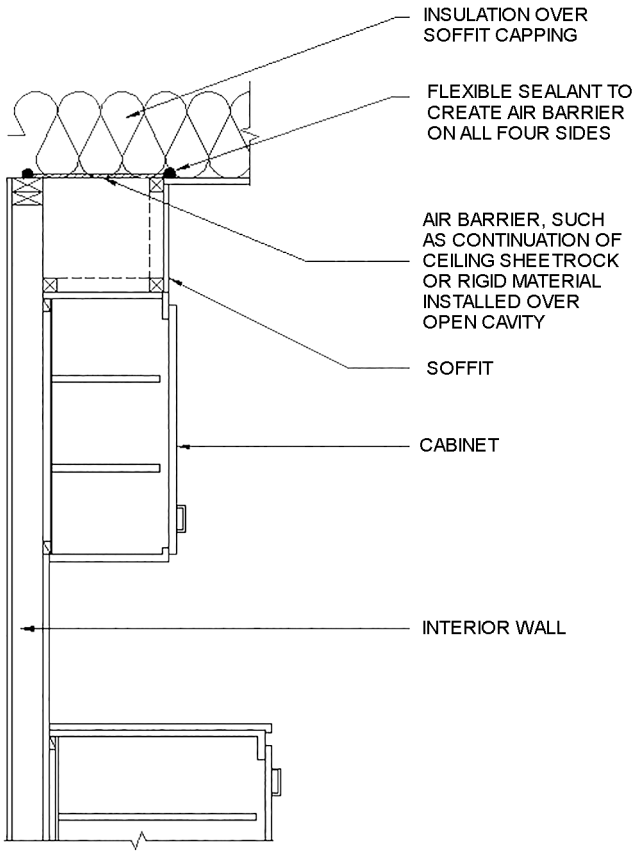
ISOMETRIC VIEW OF I-JOIST FLOOR/CEILING SYSTEM ABOVE COMMON WALL BETWEEN UNCONDITIONED AND CONDITIONED SPACE

N1102.4.1 Building thermal envelope—2. Cap and seal shafts and chases



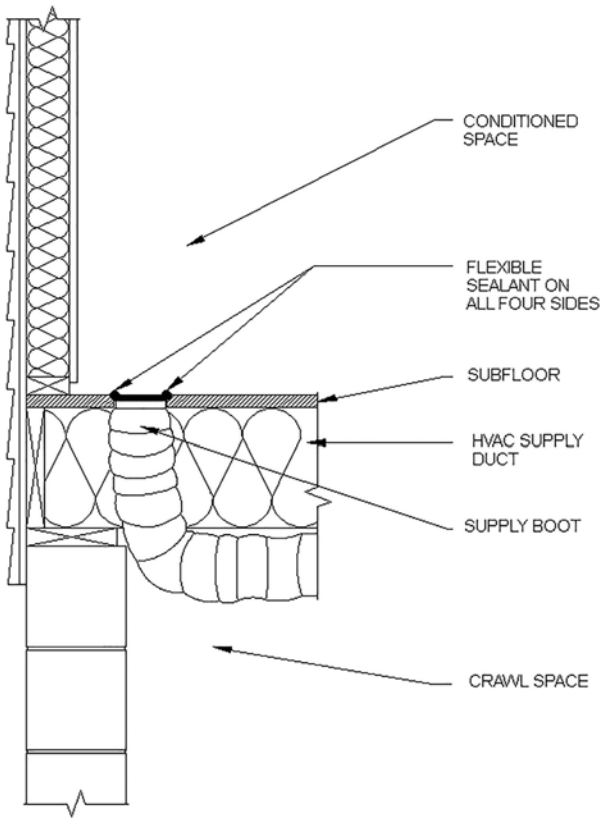
SECTION VIEWS OF DUCT PENETRATING INTO ATTIC

N1102.4.1 Building thermal envelope. —3. Cap and seal soffit or dropped ceiling



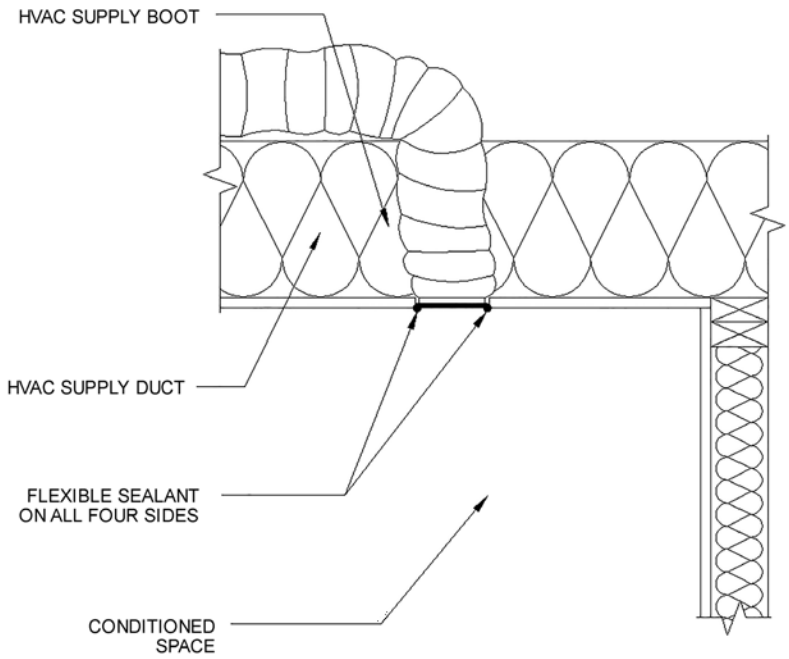
SECTION VIEW OF SOFFIT OVER CABINET

N1102.4.1 Building thermal envelope.—4. Seal HVAC boot penetration—floor



SECTION VIEW OF FLOOR HVAC BOOT PENETRATION

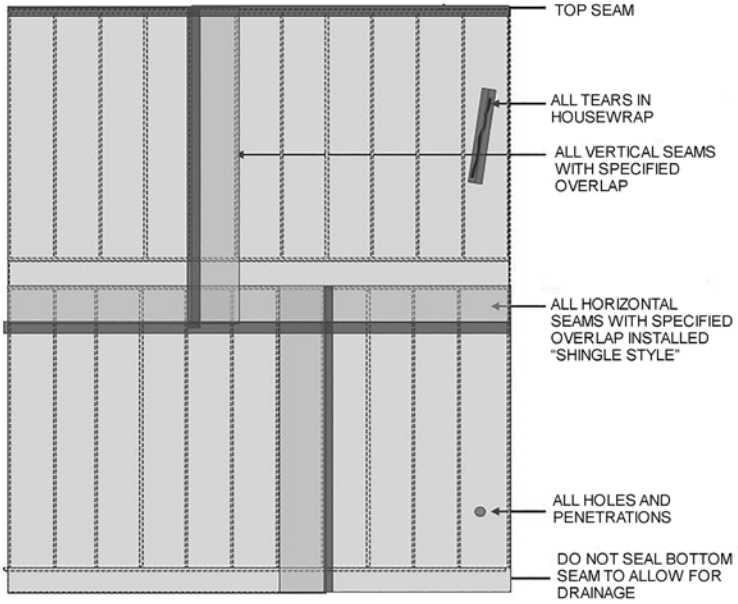
N1102.4.1 Building thermal envelope.—4. Seal HVAC boot penetration—ceiling



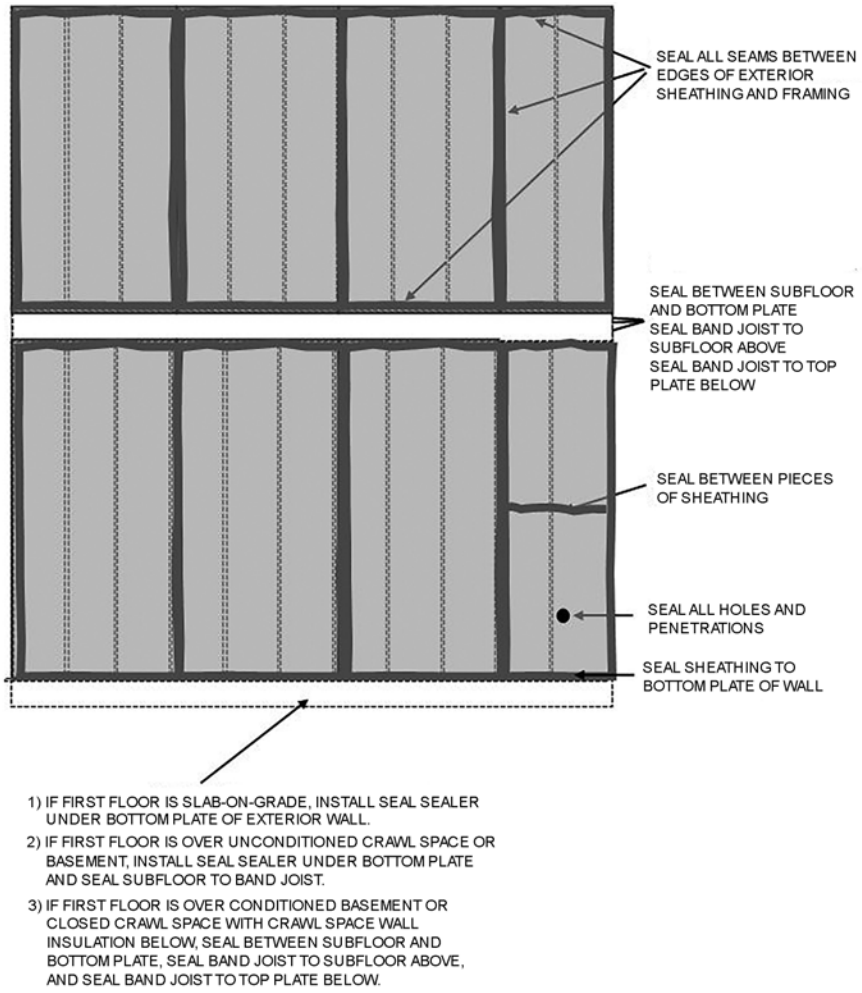
SECTION VIEW OF CEILING HVAC BOOT PENETRATION

N1102.4.1 Building thermal envelope.—5. Sealed exterior air barrier with housewrap

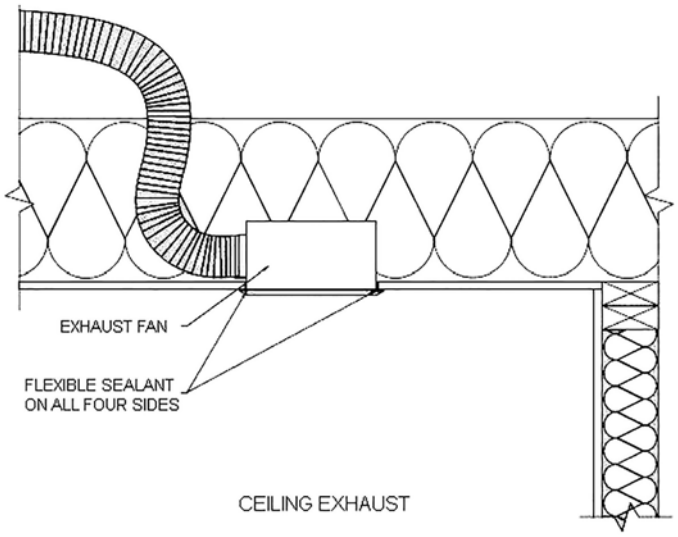
Follow manufacturer's instructions for sealing air barrier-rated housewrap, including choice of materials, to provide an exterior air barrier at the following locations:



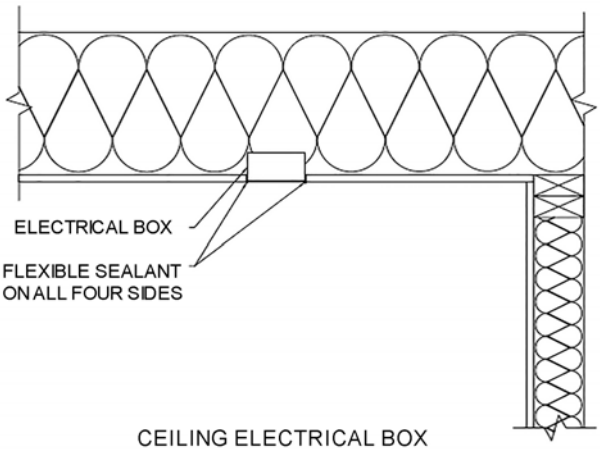
N1102.4.1 Building thermal envelope.—5. Sealed exterior air barrier with sheathing



N1102.4.2.1 Visual inspection option. —Table N1102.4.2 Seal ceiling mechanical box penetrations



N1102.4.2.1 Visual inspection option. — Table N1102.4.2 Seal ceiling electrical box penetrations



APPENDIX NCE-3:
SAMPLE WORKSHEETS FOR RESIDENTIAL AIR AND DUCT LEAKAGE TESTING

APPENDIX NCE-3A
AIR SEALING: VISUAL INSPECTION OPTION (Section N1102.4.2.1)

SAMPLE WORKSHEET

N1102.4.2 Air sealing. Building envelope air tightness shall be demonstrated by Section N1102.4.2.1 or N1102.4.2.2.

N1102.4.2.1 Visual inspection option. Building envelope tightness shall be considered acceptable when items providing insulation enclosure in Section N1102.2.14 and enclosure and air sealing in Section N1102.2.15 and air sealing in Section N1102.4.1 are addressed and when the items listed in Table N1102.4.2, applicable to the method of construction, are certified by the builder, permit holder or *registered design professional* via the certificate in Appendix E-1.

TABLE N1102.4.2
AIR BARRIER INSPECTION

COMPONENT	CRITERIA
Ceiling/attic	Sealants or gaskets provide a continuous air barrier system joining the top plate of framed walls with either the ceiling drywall or the top edge of wall drywall to prevent air leakage. Top plate penetrations are sealed. For ceiling finishes that are not air barrier systems such as tongue-and-groove planks, air barrier systems (for example, taped house wrap), shall be used above the finish. **Note:** It is acceptable that sealants or gaskets applied as part of the application of the drywall will not be observable by the code official.
Walls	Sill plate is gasketed or sealed to subfloor or slab.
Windows and doors	Space between window and exterior door jambs and framing is sealed.
Floors (including above-garage and cantilevered floors)	Air barrier system is installed at any exposed edge of insulation.
Penetrations	Utility penetrations through the building thermal envelope, including those for plumbing, electrical wiring, ductwork, security and fire alarm wiring, and control wiring, shall be sealed.
Garage separation	Air sealing is provided between the garage and conditioned spaces. An air barrier system shall be installed between the ceiling system above the garage and the ceiling system of interior spaces.
Ceiling penetrations	Ceiling electrical box penetrations and ceiling mechanical box penetrations shall be caulked, gasketed, or sealed at the penetration of the ceiling finish. See Appendix E-2.4. **Exception:** Ceiling electrical boxes and ceiling mechanical boxes not penetrating the building thermal envelope
Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. **Exception:** Fixtures in conditioned space.

Property Address:

_____

N1102.4.2.1 Visual Inspection Option. The inspection information including tester name, date, and contact shall be included on the certificate described in Section N1101.14.

_____ _____

Signature Date

APPENDIX NCE-3B
Air sealing: Testing option (Section N1102.4.2.2)

Sample Worksheet

N1102.4.2 Air sealing. Building envelope air tightness shall be demonstrated by Section N1102.4.2.1 or N1102.4.2.2:

N1102.4.2.2 Testing option. Building envelope tightness shall be considered acceptable when items providing insulation enclosure in Section N1102.2.14 and enclosure and air sealing in Section N1102.2.15 and air sealing in Section N1102.4.1 are addressed and when tested air leakage is less than or equal to one of the two following performance measurements:

1. 0.30 CFM50/Square Foot of Surface Area (SFSA) or
2. Five (5) air changes per hour (ACH50)

When tested with a blower door fan assembly, at a pressure of 33.5 psf (50 Pa). A single point depressurization, not temperature corrected, test is sufficient to comply with this provision, provided that the blower door fan assembly has been certified by the manufacturer to be capable of conducting tests in accordance with ASTM E779—03. Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances. Testing shall be reported by the permit holder, a North Carolina licensed general contractor, a North Carolina licensed HVAC contractor, a North Carolina licensed Home Inspector, a *registered design professional*, a certified *BPI Envelope Professional* or a certified *HERS rater*.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed, including exhaust, backdraft, and flue dampers;
3. Interior doors shall be open;
4. Exterior openings for continuous ventilation systems, air intake ducted to the return side of the conditioning system, and energy or heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off; and
6. Supply and return registers shall not be sealed.

The air leakage information, including building air leakage result, tester name, date, and contact information, shall be included on the certificate described in Section N1101.14.

For Test Criteria 1 in this section, the report shall be produced in the following manner: Perform the blower door test and record the *CFM50* _____. Calculate the total square feet of surface area for the building thermal envelope, all floors, ceilings, and walls (this includes windows and doors) and record the area_____. Divide *CFM50* by the total square feet and record the result below. If the result is less than or equal to **[0.30 CFM50/SFSA]** the envelope tightness is acceptable; or

For Test Criteria 2, the report shall be produced in the following manner: Perform a blower door test and record the *CFM50* _____. Multiply the *CFM50* by 60 minutes to create CFHour50 and record _____. Then calculate the total conditioned volume of the home and record_____. Divide the CFH50 by the total volume and record the result below. If the result is less than or equal to **[5 ACH50]** the envelope tightness is acceptable.

Property Address: _____

Fan attachment location _____ Company Name _____

Contact Information: _____

_____

Signature of Tester _____ Date _____

Permit Holder, NC Licensed General Contractor, NC Licensed HVAC Contractor,
NC Licensed Home Inspector, *Registered Design Professional*,
Certified *BPI Envelope Professional*, or Certified *HERS Rater*
(circle one).

APPENDIX NCE-3C
Duct sealing. Duct air leakage test (Section N1103.2.2 & Section N1103.3.3)

Sample Worksheet

N1103.3.2 Sealing (Mandatory Requirements). Ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with either the *International Mechanical Code* or *International Residential Code*, as applicable.

N1103.3.3 Duct leakage (Prescriptive) and duct testing (Mandatory). Duct testing and duct leakage shall be verified by compliance with either Section N1103.3.3.1 or N1103.3.3.2. Duct testing shall be verified using one of the two following methods:

N1103.3.3.1 Total duct leakage. Total duct leakage shall be less than or equal to 5 CFM (12 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area served by that system when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure.

During testing:

1. Block, if present, ventilation air duct(s) connected to the conditioning system.
2. The duct air leakage testing equipment shall be attached to the largest return in the system or to the air handler.
3. The filter shall be removed and the air handler power shall be turned off.
4. Supply boots or registers and return boxes or grilles shall be taped, plugged, or otherwise sealed air tight.
5. The hose for measuring the 25 Pascals of pressure differential shall be inserted into the boot of the supply that is nominally closest to the air handler.
6. Specific instructions from the duct testing equipment manufacturer shall be followed to reach duct test pressure and measure duct air leakage.

N1103.3.3.2 Duct leakage to the outside. Conduct the test using fan pressurization of distribution system and building at a fixed reference pressure for combined supply and return leaks. Duct leakage to the outside shall be less than or equal to 4 CFM (12 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area served by that system when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, relative to the outside, including the manufacturer's air handler enclosure.

During testing:

1. Block, if present, the ventilation air duct(s) connected to the conditioning system.
2. The duct air leakage testing equipment shall be attached to the largest return in the system or to the air handler.
3. The filter shall be removed and the air handler power shall be turned off.
4. Supply boots or registers and return boxes or grilles shall be taped, plugged, or otherwise sealed air tight or as tight as possible.
5. The hose for measuring the 25 Pascals of pressure differential shall be inserted into the boot of the supply that is nominally closest to the air handler.
6. Open all interconnecting doors in the building, close dampers for fireplaces and other operable dampers.
7. Set up an envelope air moving/flow-regulating/flow measurement assembly, such as a blower door, following the manufacturer's prescribed procedure.
8. Specific instructions from the duct testing equipment manufacturer shall be followed to reach duct test pressure and measure duct air leakage used in combination with a blower door. Typical steps are as follows:
    a. Depressurize the ductwork system to 25 Pa using the measurement hose in Step 5 above.
    b. Depressurize the house to 25 Pa using an envelope air moving/flow-regulating/flow measurement assembly, such as a blower door.
    c. Correct the duct pressure to measure 0 Pa of pressure differential between the house and the ductwork system.
    d. Read the CFM of duct leakage using the procedures for the specific equipment being used. (Note that most automatically calculating pressure gauges cannot compute the CFM25 automatically with a duct-to-house difference in pressure of 0 Pa, so the gauge setting should be set to read CFM instead of CFM25).

Testing shall be performed and reported by the permit holder, a North Carolina licensed general contractor, a North Carolina licensed HVAC contractor, a North Carolina licensed Home Inspector, a registered design professional, a certified BPI Envelope Professional or a certified HERS rater. A single point depressurization, not temperature corrected, test is sufficient to comply with this provision, provided that the duct testing fan assembly(s) has been certified by the manufacturer to be capable of conducting tests in accordance with ASTM E1554-07.

The duct leakage information, including duct leakage test selected and result, tester name, date, and contact information, shall be included on the certificate described in Section N1101.14.

For the Test Criteria, the report shall be produced in the following manner: perform the HVAC system air leakage test and record the CFM25. Calculate the total square feet of Conditioned Floor Area (CFA) served by that system. Multiply CFM25 by 100, divide the result by the CFA and

record the result. If the result is less than or equal to 5 CFM25/100SF for the "Total duct leakage test" or less than or equal to 4 CFM25/100SF for the "Duct leakage to the outside" test, then the HVAC system air tightness is acceptable.

Complete one duct leakage report for each HVAC system serving the home:

Property Address: _____

Test Performed: Total duct leakage or Duct leakage to the outside (circle one)

HVAC System Number: _____ Describe area of home served: _____

CFM25 Total _____. Conditioned Floor Area (CFA) served by system: _____ s.f.

CFM25 × 100 divided by CFA = ____ CFM25/100SF (e.g. 100 CFM25 × 100/2,000 CFA = 5 CFM25/100SF)

Fan attachment location _____

Company Name _____

Contact Information: _____

_____

_____ _____

Signature of Tester Date

Permit Holder, NC Licensed General Contractor, NC Licensed HVAC Contractor,
NC Licensed Home Inspector, *Registered Design Professional*,
Certified *BPI Envelope Professional*, or Certified *HERS Rater*
(circle one)

APPENDIX NCE-4

ADDITIONAL VOLUNTARY CRITERIA FOR INCREASING ENERGY EFFICIENCY (High Efficiency Residential Option)

1. **Introduction.** The increased energy efficiency measures identified in this appendix are strictly voluntary at the option of the permit holder and have been evaluated to be the most cost effective measures for achieving an additional 10 to 15-percent energy efficiency beyond the code minimums.

2. **Requirements.** Follow all sections of Chapter 11 of the *North Carolina Residential Code*, Chapter 11, except the following.

   a. Instead of using Table N1102.1.2 in Section N1102.1.2, use Table E-4A shown below.

   b. Instead of using Table N1102.1.4 in Section N1102.1.4, use Table E-4B to find the maximum *U*-factors for building components.

   c. For compliance with Section N1102.4 Air leakage control (Mandatory Requirements), Sections N1102.4.1 (Building thermal envelope) and

TABLE NCE-4A
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b, j]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, k]	CEILING *R*-VALUE[m]	WOOD FRAME WALL *R*-VALUE	MASS WALL R-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c, o] WALL *R*-VALUE	SLAB[d] *R*-VALUE	CRAWL SPACE[c] WALL *R*-VALUE
3	0.32	0.55	0.25	38 or 30 ci[l]	19[n], 13+5, or 15 + 3[h]	5/13 or 5/10ci	19	5/13[f]	5	5/13
4	0.32	0.55	0.25	38 or 30 ci[l]	19[n], 13+5, or 15 + 3[h]	5/13 or 5/10ci	19	10/15	10	10/15
5	0.32	0.55	(NR)	38 or 30 ci[l]	19[n], 13+5, or 15 + 3[h]	13/17 or 13/12.5ci	30[g]	10/15	10	10/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. "10/15" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-15 cavity insulation at the interior of the basement wall or crawl space wall.
d. For monolithic slabs, insulation shall be applied from the inspection gap downward to the bottom of the footing or a maximum of 24 inches below grade, whichever is less. For floating slabs, insulation shall extend to the bottom of the foundation wall or 24 inches, whichever is less. (See Appendix O) R-5 shall be added to the required slab edge *R*-values for heated slabs.
e. Deleted.
f. Basement wall insulation is not required in warm-humid locations as defined by Figure N1101.7 and Table N1101.7.
g. Or insulation sufficient to fill the framing cavity, R-19 minimum.
h. The first value is cavity insulation, the second value is continuous insulation, so "13 + 5" means R-13 cavity insulation plus R-5 continuous insulation. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.
j. In addition to the exemption in Section N1102.3.3, a maximum of two glazed fenestration product assemblies having a *U*-factor no greater than 0.55 shall be permitted to be substituted for minimum code compliant fenestration product assemblies without penalty.
k. In addition to the exemption in Section N1102.3.3, a maximum of two glazed fenestration product assemblies having a SHGC no greater than 0.70 shall be permitted to be substituted for minimum code compliant fenestration product assemblies without penalty.
l. R-30 shall be deemed to satisfy the ceiling insulation requirement wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Otherwise R-38 insulation is required where adequate clearance exists or insulation must extend to either the insulation baffle or within 1 inch of the attic roof deck.
m. Table value required except for roof edge where the space is limited by the pitch of the roof, there the insulation must fill the space up to the air baffle.
n. R -19 fiberglass batts compressed and installed in a nominal 2 × 6 framing cavity is deemed to comply. Fiberglass batts rated R-19 or higher compressed and installed in a 2 × 4 wall is not deemed to comply.
o. Basement wall meeting the minimum mass wall specific heat content requirement may use the mass wall *R*-value as the minimum requirement.

TABLE NCE-4B
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[d]	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR[c]	CRAWL SPACE WALL *U*-FACTOR
3	0.32	0.55	0.030	0.061	0.141	0.047	0.091	0.136
4	0.32	0.55	0.030	0.061	0.141	0.047	0.059	0.065
5	0.32	0.55	0.030	0.061	0.082	0.033	0.059	0.065

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.07 in Climate Zone 3, 0.07 in Climate Zone 4, and 0.054 in Climate Zone 5.
c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure N1101.10 (R301.1) and Table N1101.10 (R301.1).
d. A maximum of two glazed fenestration product assemblies having a *U*-factor no greater than 0.55 and a SHGC no greater than 0.70 shall be permitted to be substituted for minimum code compliant fenestration product assemblies without penalty.

N1102.4.2.2 (Testing option) must be followed, with the maximum leakage rate shown below. Section N1102.4.2.1 (Visual inspection option) cannot be used to show compliance.

i. 0.24 CFM50/Square Foot of Surface Area (SFSA) or

ii. Four (4) air changes per hour (ACH50)

d. Instead of using the duct leakage value for maximum leakage shown in Section N1103.3.3 use the following:

1. **N1103.3.3.1 Total duct leakage.** Total duct leakage shall be less than or equal to 4 CFM (113 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area served by that system when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure.

2. **N1103.3.3.2 Duct leakage to the outside.** Conduct the test using fan pressurization of distribution system and building at a fixed reference pressure for combined supply and return leak. Duct leakage to the outside shall be less than or equal to 3 CFM (85 L/min) per 100 ft2 (9.29 m2) of conditioned floor area served by that system when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, relative to the outside, including the manufacturer's air handler enclosure.

e. For compliance with Section N1104.1 (Lighting equipment), the home must comply with the following:

Not less than 90 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

Table NCE-4C:
Sample Confirmation Form for ADDITIONAL VOLUNTARY CRITERIA FOR INCREASING ENERGY EFFICIENCY
(High Efficiency Residential Option)

***North Carolina Energy Conservation Code*:** **HIGH EFFICIENCY RESIDENTIAL OPTION INSULATION AND FENESTRATION VALUES (Notes correlate to Table N1102.1.2)**				**PROPOSED PROJECT VALUES**
Climate Zone	**3**	**4**	**5**	
Fenestration *U*-Factor[b, j]	0.32	0.32	0.32	
Skylight *U*-Factor[b]	0.55	0.55	0.55	
Glazed fenestration SHGC[b, k]	0.25	0.25	(NR)	
Ceiling *R*-value[m]	38 or 30 ci[l]	38 or 30 ci[l]	38 or 30 ci[l]	
Wood frame wall *R*-value[h]	19[n], 13 + 5, or 15 + 3	19[n], 13 + 5, or 15 + 3	19[n], 13 + 5, or 15 + 3	
Mass wall *R*-value[i]	5/13 or 5/10 ci	5/13 or 5/10 ci	13/17 or 13/12.5 ci	
Floor *R*-value	19	19	30[g]	
Basement wall *R*-value[c, o]	5 /13[f]	10/15	10/15	
Slab *R*-value and depth[d]	5	10	10	
Crawl space wall *R*-value[c]	5/13	10/15	10/19	
	** Note: ci = continuous insulation*			
High Efficacy Lighting				
% of lighting that is high efficacy according to N1104.1. (90% required)				
Building Air Leakage				
Building Air Leakage Test according to N1102.4.2.2 (check box). Show test value:				
ACH_{50} [Target: 4.0], or				
CFM_{50}/SFSA [Target: 0.24]				
Name of Tester / Company:				
Date: Phone:				
Duct Insulation and Sealing				
Insulation value	*R*-			
Duct Leakage Test Result (Sect. N1103.3.3)	Total duct leakage or		Duct leakage to the exterior	
(CFM25 Total/100SF) [Target: 4 Total/ 3 To exterior]				
Name of Tester or Company:				
Date: Phone:				

NCE-4D:

SAMPLE WORKSHEETS FOR RESIDENTIAL AIR AND DUCT LEAKAGE TESTING

NCE-4D.1
AIR SEALING: TESTING
(Section N1102.4.2.2)
Sample Worksheet for Alternative Residential Energy Code for Higher Efficiency

Air sealing. Building envelope air tightness shall be demonstrated by Section N1102.4.2.2:

Air sealing: Testing option (Section N1102.4.2.2) Sample Worksheet for Alternative Residential Energy Code for Higher Efficiency

N1102.4.2.2 Testing. Building envelope tightness shall be considered acceptable when items providing insulation enclosure in Section N1102.2.14 and enclosure air sealing in Section N1102.2.15 and air sealing in Section N1102.4.1 are addressed and when tested air leakage is less than or equal to one of the two following performance measurements:

1. 0.24 CFM50 (6.8 L/min)/square foot of surface area (SFSA) or
2. Four (4) air changes per hour (ACH50)

When tested with a blower door fan assembly, at a pressure of 0.2 inches water gauge (50 Pa), a single point depressurization, not temperature corrected, test is sufficient to comply with this provision, provided that the blower door fan assembly has been certified by the manufacturer to be capable of conducting tests in accordance with ASTM E779—03. Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances. Testing shall be reported by the permit holder, a North Carolina licensed general contractor, a North Carolina licensed HVAC contractor, a North Carolina licensed Home Inspector, a r*egistered design professional*, a certified *BPI Envelope Professional* or a certified *HERS rater*.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed, including exhaust, backdraft, and flue dampers;
3. Interior doors shall be open;
4. Exterior openings for continuous ventilation systems, air intake ducted to the return side of the conditioning system, and energy or heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off; and
6. Supply and return registers shall not be sealed.

The air leakage information, including building air leakage result, tester name, date, and contact information, shall be included on the certificate described in Section N1101.14.

F**or Test Criteria 1** in this section, the report shall be produced in the following manner: Perform the blower door test and record the *CFM50*_____. Calculate the total square feet of surface area for the building thermal envelope, all floors, ceilings, and walls (this includes windows and doors) and record the area_____. Divide *CFM50* by the total square feet and record the result below. If the result is less than or equal to **[0.24 CFM50/SFSA]** the envelope tightness is acceptable; or

For Test Criteria 2, the report shall be produced in the following manner: Perform a blower door test and record the *CFM50* = _____. Multiply the *CFM50* by 60 minutes to create CF/Hour50 and record = _____. Then calculate the total conditioned volume of the home and record = _____cubic feet. Divide the CF/Hour50 by the total volume and record the result = _____ ACH50. If the result is less than or equal to **[4 ACH50]** the envelope tightness is acceptable.

Property Address: _____

Fan attachment location _____ Company Name _____

Contact Information: _____

_____

_____ _____

Signature of Tester Date

Permit Holder, NC Licensed General Contractor, NC Licensed HVAC Contractor,
NC Licensed Home Inspector, *Registered Design Professional*,
Certified *BPI Envelope Professional,* or Certified *HERS Rater*
(circle one)

NCE-4D.2
DUCT SEALING. Duct air leakage test (Section N1103.3.3)
Sample Worksheet for Alternative Residential Energy Code for Higher Efficiency

N1103.3.3 Duct leakage (Prescriptive) and duct testing (Mandatory). Duct testing and duct leakage shall be verified by compliance with either Section N1103.3.3.1 or N1103.3.3.2. Duct testing shall be performed and reported by the permit holder, a NC licensed general contractor, a NC licensed HVAC contractor, a NC licensed Home Inspector, a *registered design professional*, a certified *BPI Envelope Professional* or a certified *HERS rater*. A single point depressurization, not temperature corrected, test is sufficient to comply with this provision, provided that the duct testing fan assembly(s) has been certified by the manufacturer to be capable of conducting tests in accordance with ASTM E1554—07.

The duct leakage information, including duct leakage test selected and result, tester name, date, and contact information, shall be included on the certificate described in Section N1101.3.

For the Test Criteria, the report shall be produced in the following manner: perform the HVAC system air leakage test and record the CFM25. Calculate the total square feet of Conditioned Floor Area (CFA) served by that system. Multiply CFM25 by 100, divide the result by the CFA and record the result. If the result is less than or equal to 4 CFM25/100SF for the "Total duct leakage test or less than or equal to 3 CFM25/100SF for the Duct leakage to the outside" test, then the HVAC system air tightness is acceptable.

Exceptions to testing requirements:

1. Duct systems or portions thereof inside the building thermal envelope shall not be required to be leak tested.
2. Installation of a partial system as part of replacement, renovation or addition does not require a duct leakage test.

1103.3.3.1 Total duct leakage. Total duct leakage less than or equal to 4 CFM (113 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area served by that system when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. During testing:

1. Block, if present, ventilation air duct(s) connected to the conditioning system.
2. The duct air leakage testing equipment shall be attached to the largest return in the system or to the air handler.
3. The filter shall be removed and the air handler power shall be turned off.
4. Supply boots or registers and return boxes or grilles shall be taped, plugged, or otherwise sealed air tight.
5. The hose for measuring the 25 Pascals of pressure differential shall be inserted into the boot of the supply that is nominally closest to the air handler.
6. Specific instructions from the duct testing equipment manufacturer shall be followed to reach duct test pressure and measure duct air leakage.

1103.3.3.2 Duct leakage to the outside. Conduct the test using fan pressurization of distribution system and building at a fixed reference pressure for combined supply and return leak. Duct leakage to the outside shall be less than or equal to 3 CFM (85 L/min) per 100 ft^2 (9.29 m^2) of conditioned floor area served by that system when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, relative to the outside, including the manufacturer's air handler enclosure.

During testing:

1. Block, if present, the ventilation air duct(s) connected to the conditioning system.
2. The duct air leakage testing equipment shall be attached to the largest return in the system or to the air handler.
3. The filter shall be removed and the air handler power shall be turned off.
4. Supply boots or registers and return boxes or grilles shall be taped, plugged, or otherwise sealed air tight or as tight as possible.
5. The hose for measuring the 25 Pascals of pressure differential shall be inserted into the boot of the supply that is nominally closest to the air handler.
6. Open all interconnecting doors in the building, close dampers for fireplaces and other operable dampers.
7. Set up an envelope air moving/flow-regulating/flow measurement assembly, such as a blower door, following the manufacturer's prescribed procedure.
8. Specific instructions from the duct testing equipment manufacturer shall be followed to reach duct test pressure and measure duct air leakage used in combination with a blower door. Typical steps are as follows:
    a. Depressurize the ductwork system to 25 Pa using the measurement hose in Step 5 above.
    b. Depressurize the house to 25 Pa using an envelope air moving/flow-regulating/flow measurement assembly, such as a blower door.
    c. Correct the duct pressure to measure 0 Pa of pressure differential between the house and the ductwork system.
    d. Read the CFM of duct leakage using the procedures for the specific equipment being used. (Note that most automatically calculating pressure gauges cannot compute the CFM25 automatically with a duct-to-house difference in pressure of 0 Pa, so the gauge setting should be set to read CFM instead of CFM25).

Complete one duct leakage report for each HVAC system serving the home:

Property Address: _____

HVAC System Number: _____ Describe area of home served: _____

CFM25 Total _____. Conditioned Floor Area (CFA) served by system: _____ s.f.

CFM25 × 100 divided by CFA = _____ CFM25/100 SF

(e.g. 50 CFM25 × 100/ 2,000 CFA = 2.5 CFM25/100SF)

Fan attachment location _____

Company Name _____

Contact Information: _____

_____

_____ _____

Signature of Tester Date

Permit Holder, NC Licensed General Contractor, NC Licensed HVAC Contractor,
NC Licensed Home Inspector, *Registered Design Professional*,
Certified *BPI Envelope Professional*, or Certified *HERS Rater*
(circle one)

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