JA

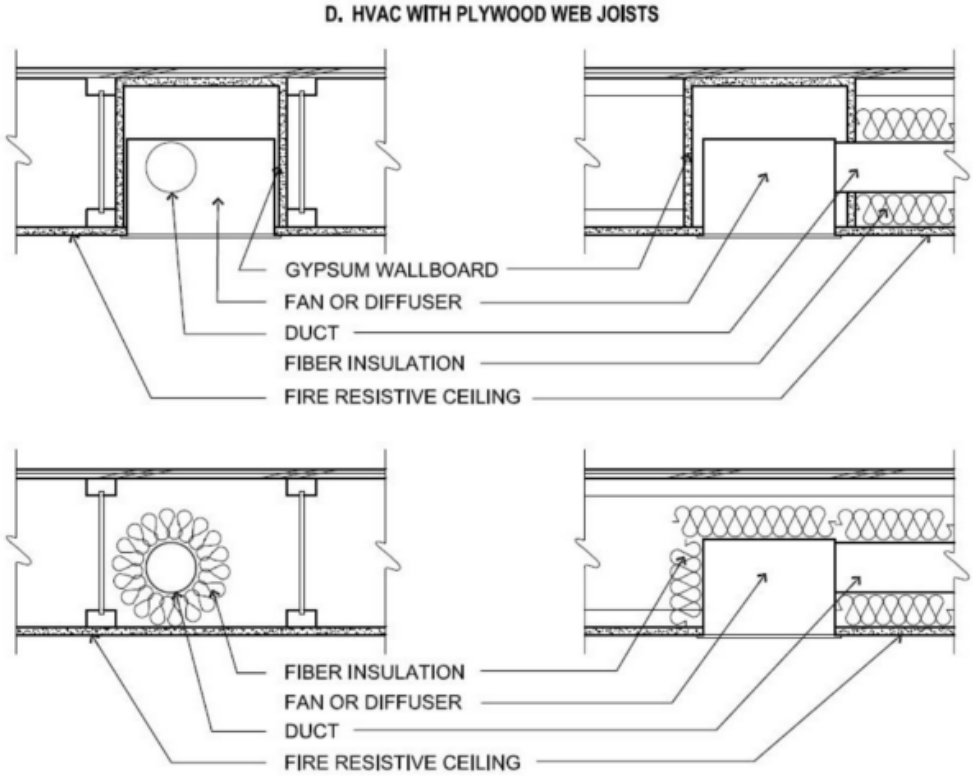
BUILDING CODE ALTERNATE REQUEST

January 22, 2021

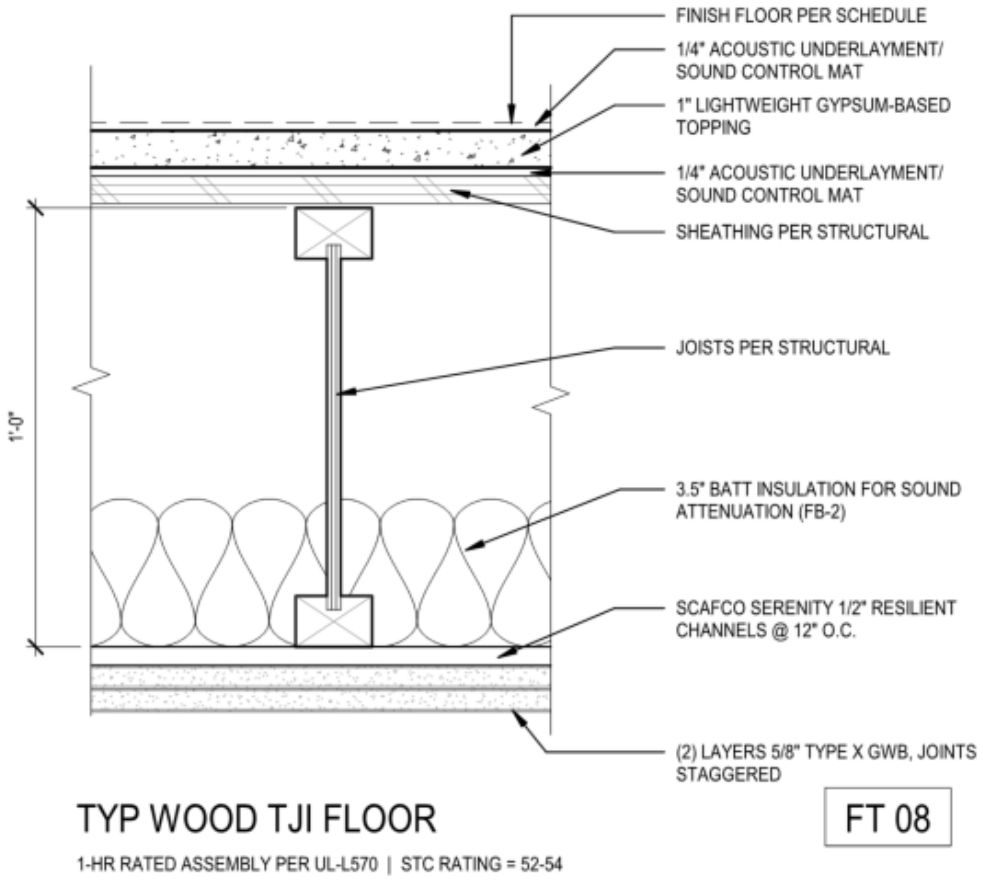
To: Don Cole, City of Mercer Island
Project: Xing Hua Mixed Use; 2885 78th Ave SE
RE: Ductwork within 1 HR Rated Horizontal Assembly

Code Section for which alternate is being proposed:
WSBC Section 714.4.2: Where floor/ceiling assemblies are required to have a fire-resistance rating, recessed fixtures shall be installed such that the required fire resistance will not be reduced

Proposed alternative to the minimum code requirement:
In all 1 HR plywood web joist horizontal rated assemblies, the ventilation fan housing will be boxed completely (all 4 sides and top) with 5/8-inch Type X gypsum wallboard and all ductwork completely wrapped in 1-1/2 inches of high density mineral fiber insulation; as shown below:



Justification:
The proposed 1 HR Horizontal Assembly between dwelling units is per diagram below and UL L570:



However, the UL assembly test report does not address ductwork or membrane penetrations.

VENTILATION FAN HOUSING:
IBC Section 722.6 offers fire-resistance rating of wood assemblies by calculation.

IBC 722.6.2(1) assigns minutes of fire resistance of membranes:

- 19/32-inch wood structural panel bonded w/ exterior glue = **15 mins**
- 5/8-inch Type X gypsum wallboard = **40 mins**

➔ Contribution of the gypsum topping floor underlayment is not included in the IBC table. Generic 5/8-inch gypsum wallboard is indicated at 30 mins, the closest equivalent shown. Therefore it is reasonable to assume the 1 inch gypsum topping will contribute at least **5 mins** to the rating, bringing total membrane contributions to the rated assembly of **60 mins**, meeting with 1HR minimum, without contribution of the wood frame rating in 722.6.2(2), which is not contributing at the boxed fan housing.

At the area of the 5/8 inch Type-X boxed fan housing, the assembly between floors is as follows: 1 inch gypsum underlayment (assume **5 mins**) + 19/32-inch wood structural panel bonded w/ exterior glue (**15 mins**) + 5/8-inch Type X gypsum wallboard (**40 mins**), maintaining the required **60 mins**/1 HR separation at the fan housing.

Secondly, and less conservative than the IBC calculation above, the Gypsum Association and ASTM C1396 defines Type X gypsum wallboard as gypsum board that "provides not less than one-hour fire resistance for boards 5/8-inch thick" (p 15, GA-600-2018). Under this definition, the 5/8-inch Type X gypsum board box of the fan housing provides the required continuous 1 HR protection on its own.

METAL DUCTWORK:
The non-combustible metal duct running from the fan housing directly to the building exterior is wholly contained both within the 1 HR horizontal assembly and remains within a single fire area. The residential unit ductwork never passes outside of the single dwelling unit from which it originates, which is protected horizontally by 1 HR fire barriers and vertically by 1 HR horizontal assmeblies. The duct is proposed to be wrapped completely in 1-1/2 inches of high density mineral fiber insulation, which is both an approved firestop and approved draftstop material per WSBC 718.2.1 and IBC 718.3.1, respectively. Therefore, the annular space of the horizontal assembly is protected, with the mineral wool insulation forming a continuous "shaft" around the duct. In this way, the penetration of the ceiling membrane created by the duct is completely protected from fan housing to building exterior.

Additionally, the entire building is protected by an automatic sprinkler system.

Lastly, the proposed method is approved for use and commonly deployed in nearby jurisdiction of Seattle. Seattle clarifies that the specified materials [boxing fan with 5/8-inch gypsum wallboard and wrapping duct completely with 1-1/2 inches high-density mineral fiber insulation] provide draftstopping for penetrations less than 100 square inches each and less than 100 inches in any 100 square feet or maintain the fire-resistance-rating of the assembly for membrane penetrations greater than 100 square inches. A copy of the code interpretation is included for reference with this letter.

By: Megan McKay, Partner, Johnston Architects LLC

Sources:

1. GA-600-2018 Gypsum Association Fire Resistance and Sound Control Design Manual
2. 2015 International Building Code, Third Printing Oct 2015; accessed online at https://codes.iccsafe.org/content/IBC2015/chapter-7-fire-and-smoke-protection-features

3. Seattle Department of Construction and Inspections, 2015 SBC Code Interpretation: Section 714.4 Membrane Penetrations of Horizontal Assemblies; Release Date: July 31, 2018, pgs 1-8
4. 2015 Washington State Building Code, July 2016 printing; accessed online at < https://www.sbcc.wa.gov/sites/default/files/2019-12/ga_2015_IBC2ed_070119r.pdf>

2015 SBC Code Interpretation

Section 714.4
Membrane Penetrations of Horizontal Assemblies
Release Date: July 31, 2018

The following interpretation, policy or code alternate is intended to provide guidance to staff for consistency of review and is subject to change without notice. Application of this interpretation, policy or code alternate to specific projects may vary.

Code Issue:

Under the Seattle Building Code penetrations of horizontal fire-resistance-rated floor/ceiling or roof/ceiling assemblies, not requiring shaft enclosure by Section 712.1 (Vertical Openings), need the protection required in Sections 714.4 through 714.4.3. These sections identify how to protect horizontal membranes penetrated by steel, ferrous or copper conduits, pipes, tubes, vents, electrical boxes, fire sprinklers or something similar. **However, the code is not clear about how to protect membrane penetrations by recessed lighting, ceiling exhaust fans or diffusers, and associated duct work.**

Code Interpretation: When approved by the building official, the assemblies shown in Tables I and 2 below satisfy the requirements of Section 714.4.2.

Table 1- Protection for membrane penetration (less than 100 square inches)

Use this table when **aggregate area of penetrations** is: 100 square inches or less **and**
100 square inches or less in any 100 square feet.

The specified materials provide draftstopping.

Opening Type	Framing Type: Solid Sawn	Framing Type: Plywood Web joists	Framing Type: Metal Plate Connected Wood Trusses
Recessed Light[b]	**Floor joists:** *Select method # 1 or #2 below:* **1. Box the light**. Protect 4 sides and top with (choose one)**:** o 3½ inch fiberglass o 1½ inch high-density mineral fiber insulation. **2. Solid block** each side of light with (choose 1): o 2-inch framing o 5/8-inch gypsum wallboard **Dropped soffits:** Pre-rock bottom of floor joists above with 5/8-inch gypsum wallboard. **Note: See figure A.**	**Box the light**. Protect 4 sides and top with (choose one)**:** o 3½ inch fiberglass o 1½ inch high-density mineral fiber insulation o 5/8-inch gypsum wallboard **Dropped soffits:** Pre-rock bottom of floor joists above with (2) layers of 5/8-inch gypsum wallboard. **Note: See figure C.**	**Box the light.** Protect 4 sides and top with (choose one)**:** o 3½ inch fiberglass o 1½ inch high-density mineral fiber insulation o 5/8-inch gypsum wallboard **Dropped soffits:** Pre-rock bottom of floor joists above with (2) layers of 5/8-inch gypsum wallboard. **Note: See figure E.**
HVAC[a,b]	*Select method #1 or #2 below:* **1. Box the fan or diffuser.** Protect 4 sides and top**)** *pick one:* o 3-inch (0.75 PCF) fiberglass duct wrap o 1 ½ inch high-density mineral fiber. **2. Solid block each side** of fan or diffuser *pick one*: o with 2-inch framing or o 5/8-inch gypsum wallboard **~and~** **3. Wrap duct completely** *(choose one)* o with 3-inch (0.75 PCF) fiberglass duct wrap o 1 ½ inch high-density mineral fiber insulation o line joist cavity with 5/8-inch fire-taped gypsum wallboard **Note: See figure B.**	**Box the fan or diffuser.** Protect 4 sides and top (choose one): o 5/8-inch gypsum wallboard o 3-inch (0.75 PCF) fiberglass duct wrap o 1 ½ inch high-density mineral fiber **~and~** **Wrap duct completely** *(choose one)* o 3-inch (0.75 PCF) fiberglass duct wrap o 1 ½ inch high-density mineral fiber insulation o line joist cavity with 5/8-inch fire-taped gypsum wallboard **Note: See figure D**.	**Box the fan or diffuser.** Protect 4 sides and top (choose one): o 5/8-inch gypsum wallboard, o 3-inch (0.75 PCF) fiberglass duct wrap o 1 ½ inch high-density mineral fiber **~and~** **Wrap duct completely** *(choose one)* o with 3-inch (0.75 PCF) fiberglass duct wrap or o 1 ½ inch high-density mineral fiber insulation o line cavity with 5/8-inch fire-taped gypsum wallboard **Note: See figure F.**

Table 2- Protection for membrane penetration (more than 100 square inches)

Use this table when **aggregate area of penetrations** is: more than 100 square inches, or the aggregate area of openings exceeds 100 square inches in any 100 square feet.

Note: The specified materials maintain the fire-resistance-rating of the assembly.

	Framing Type		
Opening Type	**Solid Sawn**	**Plywood Web joists**	**Metal Plate Connected Wood Trusses**
Recessed Light[b,c]	**Floor joists:** *Select method # 1 or #2 below:* **Box the light**. Protect 4 sides and top. o For floor joists, box the light with 5/8 gypsum wall board o In dropped soffits, pre-rock bottom of floor joists above with 5/8-inch gypsum wallboard. **Note: See figure A.**	**Box the light**. Protect 4 sides and top with 5/8-inch gypsum wallboard **Note: See figure C.**	**Box the light.** Protect 4 sides and top with 5/8-inch gypsum wallboard **Note: See figure E.**
HVAC[a,b,c]	*Select method #1 or #2 below:* **Box the fan or diffuser.** o Protect 4 sides and top with 5/8-inch gypsum wallboard, **and** o Wrap duct completely with 1 ½ inch high-density duct fire wrap**, or** **Line joist cavity.** Line joist cavity with 5/8-inch fire-taped gypsum wallboard **Note: See figure B**	**Box the fan or diffuser.** o Protect 4 sides and top with 5/8-inch gypsum wallboard, **and** o Wrap duct completely with 1 ½ inch high-density duct fire wrap**, or** **Line joist cavity.** Line joist cavity with 5/8-inch fire-taped gypsum wallboard **Note: See figure D**.	**Box the fan or diffuser.** o Protect 4 sides and top with 5/8-inch gypsum wallboard, **and** o Wrap duct completely with 1 ½ inch (6 PCF) high-density duct fire wrap, **or** **Line joist cavity.** Line joist cavity with 5/8-inch fire-taped gypsum wallboard **Note: See figure F.**

Footnotes

a. Ventilation fan box or diffuser grill and associated metal duct.
b. See additional requirements for recessed light and HVAC penetrations.
c. Opening protection shall match the type, and number of layers of gypsum wallboard as the ceiling.

Additional Considerations for Recessed Light and HVAC Penetrations

Installation, listings, and manufacturer's specifications

1. Install fixtures and equipment according to their listing
2. Install HVAC systems under permit and according to plan (if plans are required).
3. Fixtures protected with insulation are required to be steel and IC rated.

Size of openings

4. Openings for ducts through framing members or blocking are limited to the diameter of the duct plus 2 inches, to a maximum opening diameter of 8 inches. Maximum size and location of openings through engineered wood products must also comply with the product listing.

Blocking and Boxing

5. Where there are penetrations of both the floor and ceiling membranes within the same joist cavity, solid block between the openings with 2-inch framing or 5/8-inch gypsum wallboard.
6. Energy code complying fiberglass insulation may be used to box recessed lights, fans, or diffusers at roof/ceiling penetrations.

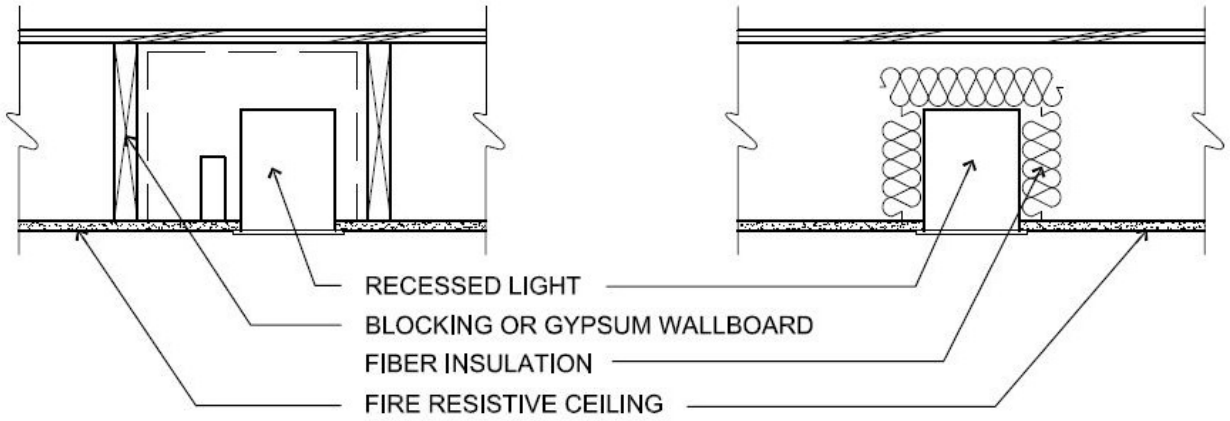
Wrapping ducting

7. Where dryer exhausts enter directly into ceilings, completely wrap the duct in the same manner as HVAC penetrations.
8. Ventilation ducts in attics shall be wrapped completely with 1 ½ inch high-density mineral fiber insulation.
9.In buildings equipped with fire sprinkler systems, protect ducts a minimum of 10 feet from the opening.

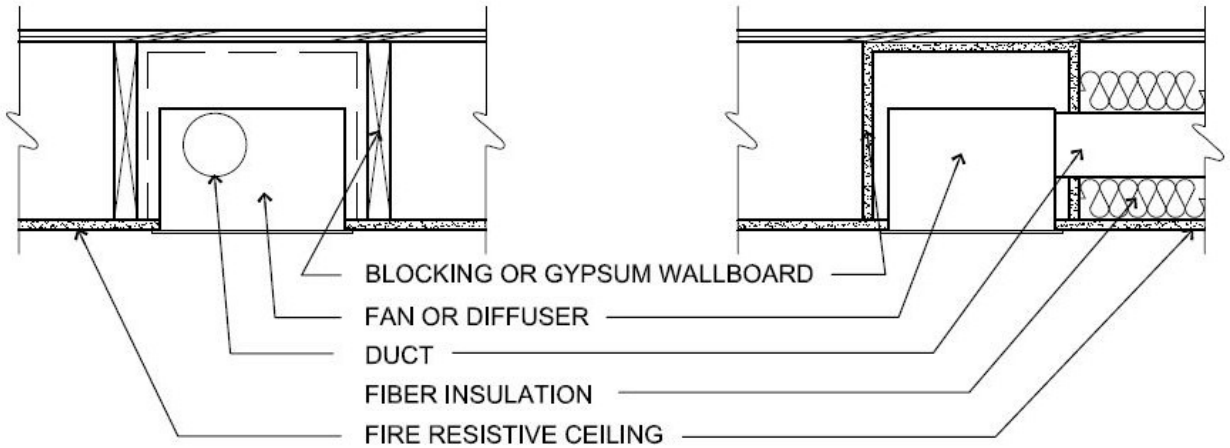
Tight fit

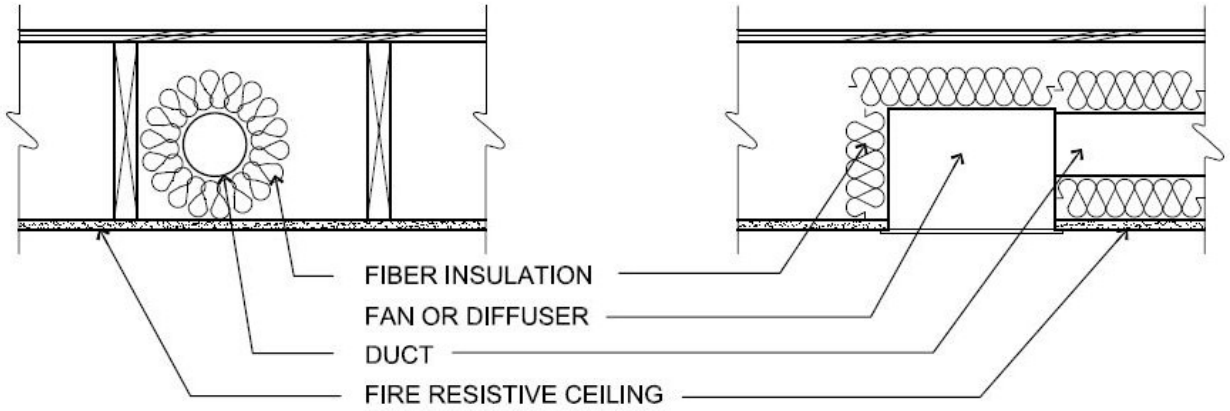
10. Fit duct insulation tight against the framing members or blocking at duct penetrations through framing.
11. Securely fit and fasten all materials in place. No adhesive.

A. RECESSED LIGHT WITH SOLID SAWN

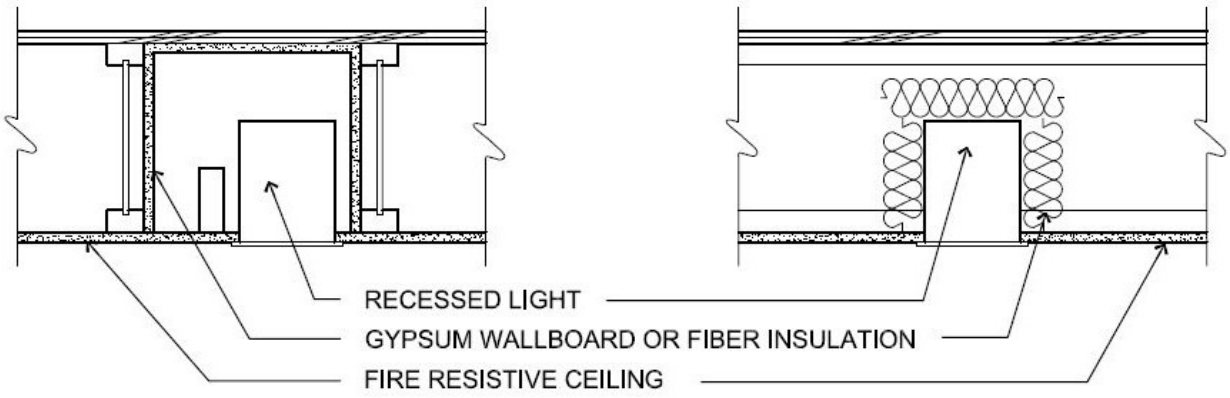


B. HVAC WITH SOLID SAWN

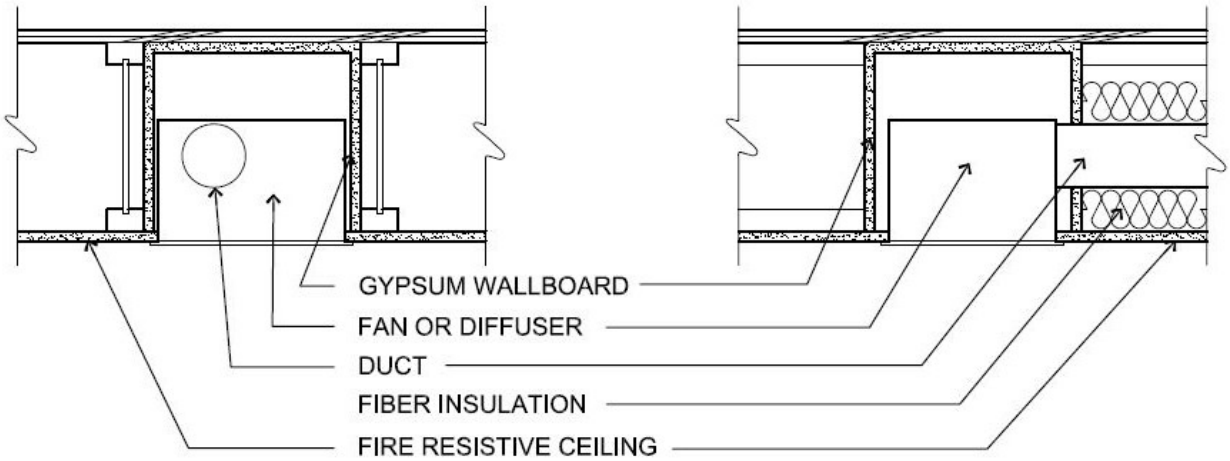


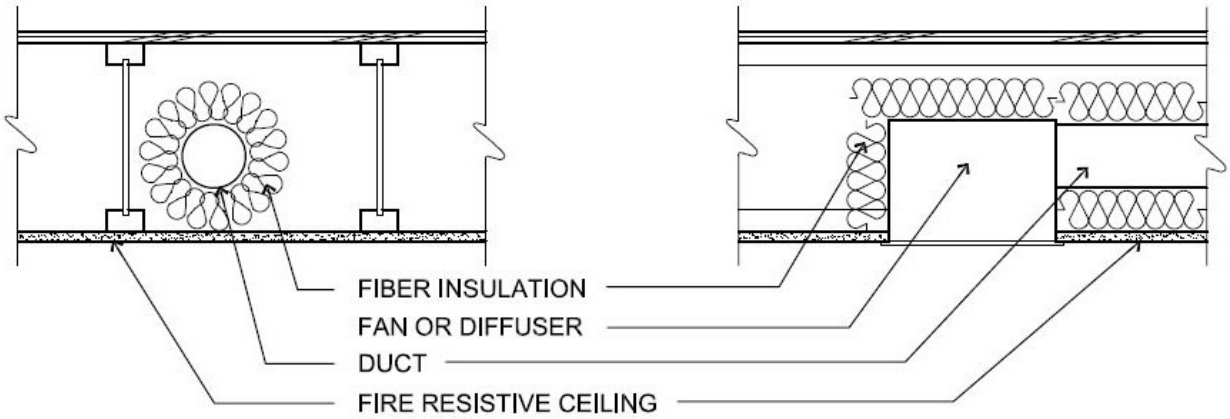


C. RECESSED LIGHT WITH PLYWOOD WEB JOISTS

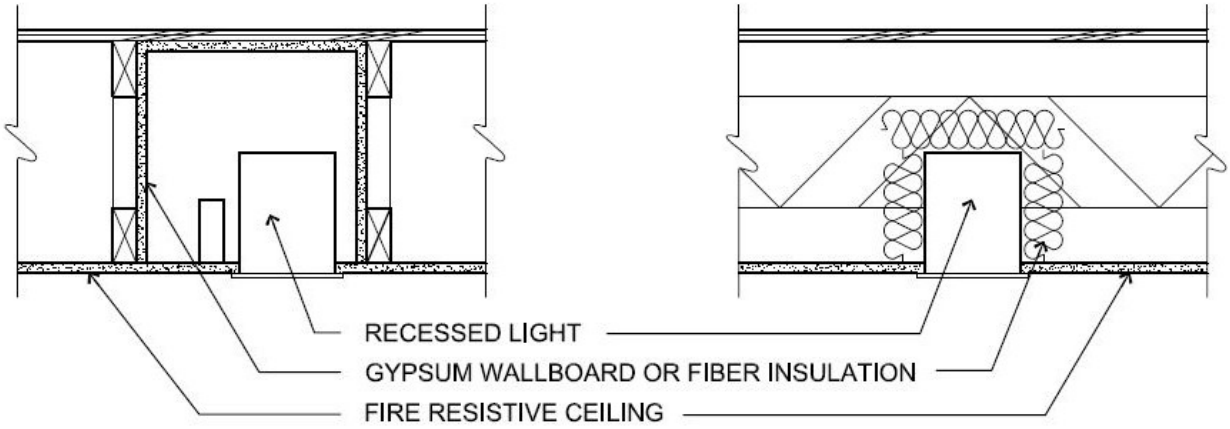


D. HVAC WITH PLYWOOD WEB JOISTS

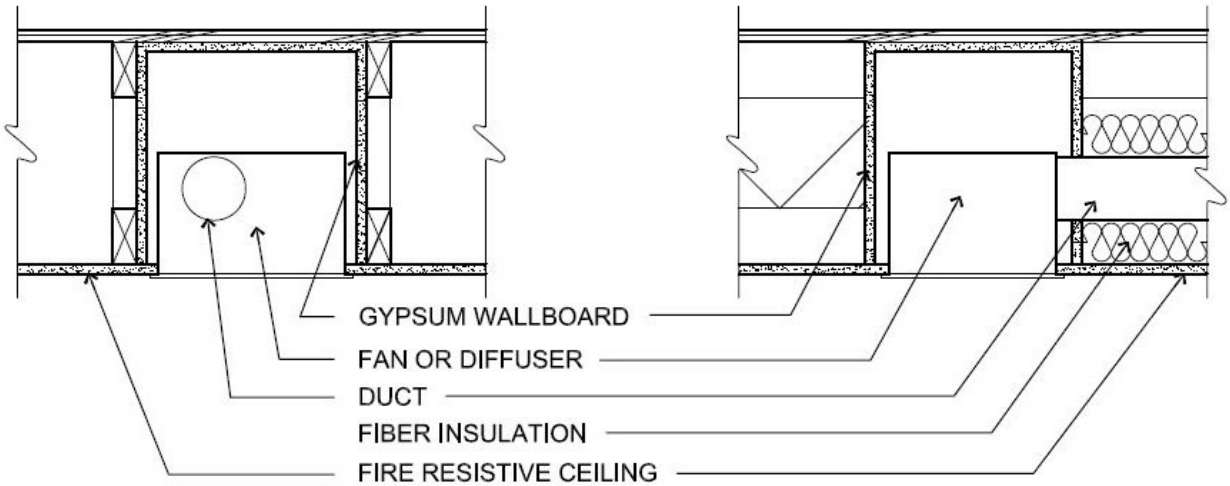


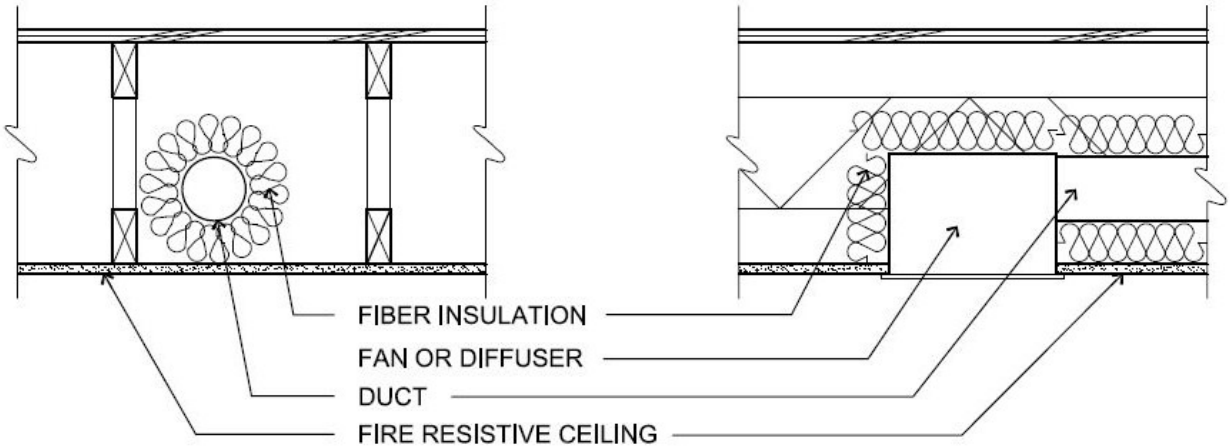


E. RECESSED LIGHT WITH METAL PLATE CONNECTED TRUSSES



F. HVAC WITH METAL PLATE CONNECTED TRUSSES





For questions about whether this code solution applies to your project:

- *If you have submitted a permit application, contact the Building Code plan reviewer assigned to your application*
- *If you have not submitted an application, send us a question through the SDCI website http://www.seattle.gov/dpd/toolsresources/sendusaquestion/default.htm or in person at the Applicant Services Center. Visit the Applicant Services Center website for more information about hours and location*
  http://www.seattle.gov/dpd/aboutus/whoweare/applicantservicescenter/default.htm