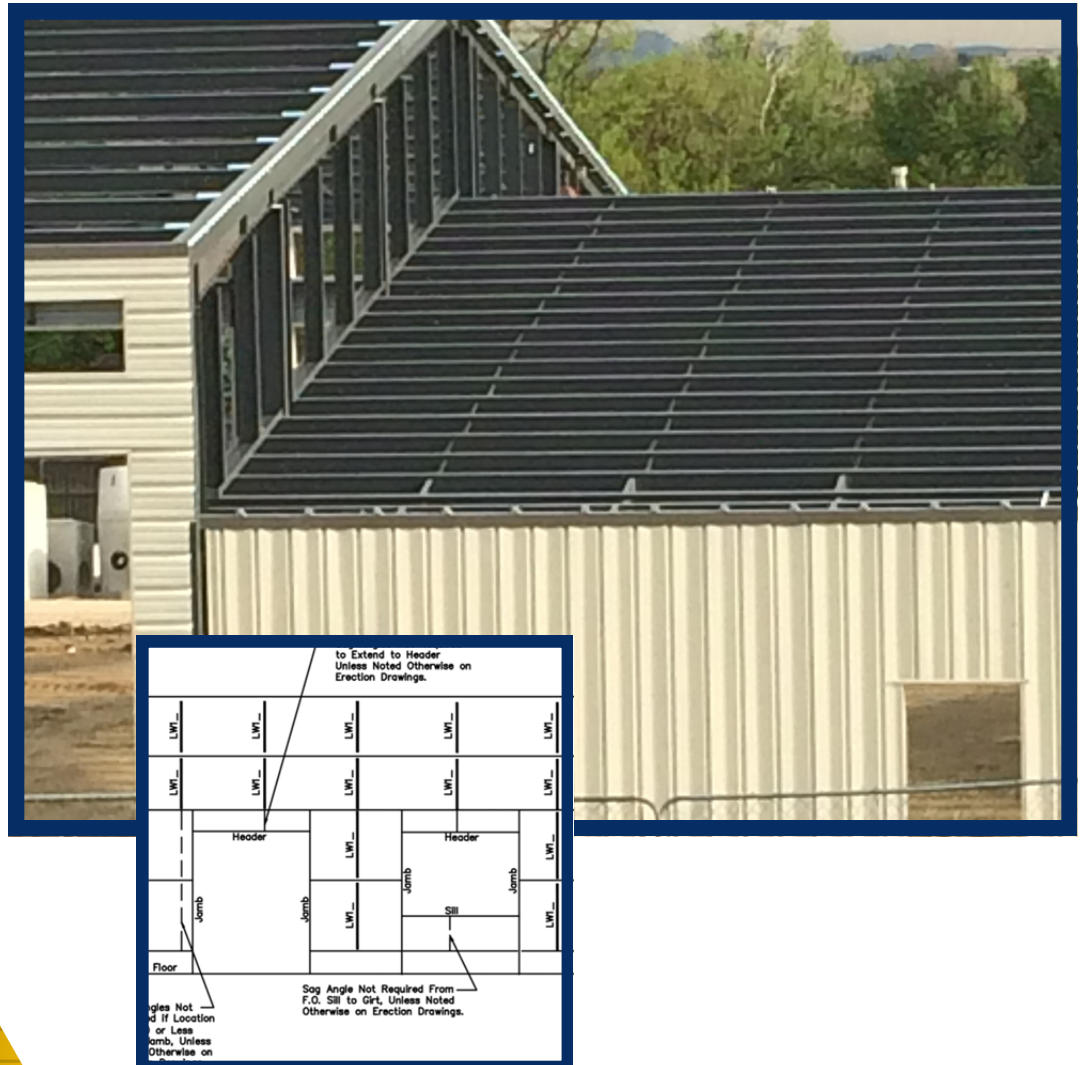


METAL BUILDINGS

2024 INTERNATIONAL ENERGY CONSERVATION CODE



In this guide you will find:

Code Requirements

Outlined and Itemized Plan Review:

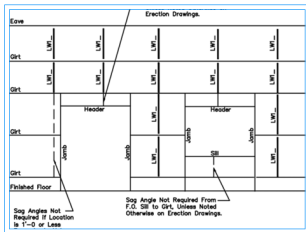
Hints, Tips and Tricks

Field Inspection: Finished Product

2024 INTERNATIONAL BUILDING CODE DEFINITION

METAL BUILDING SYSTEM:

An integrated set of fabricated components and assemblies that form a complete or partial building shell that is designed by the manufacturer. This system typically includes but is not limited to primary framing composed of built-up structural steel members, secondary members that are cold-formed steel or open-web steel joists, a metal panel roof system and exterior wall cladding. The system is manufactured in a manner that permits plant or field inspection prior to assembly or erection.



- **Metal buildings use girts and purlins, and not studs and trusses**
- **Metal buildings have a metal skin, not wood sheathing or fiberglass covered gypsum board**

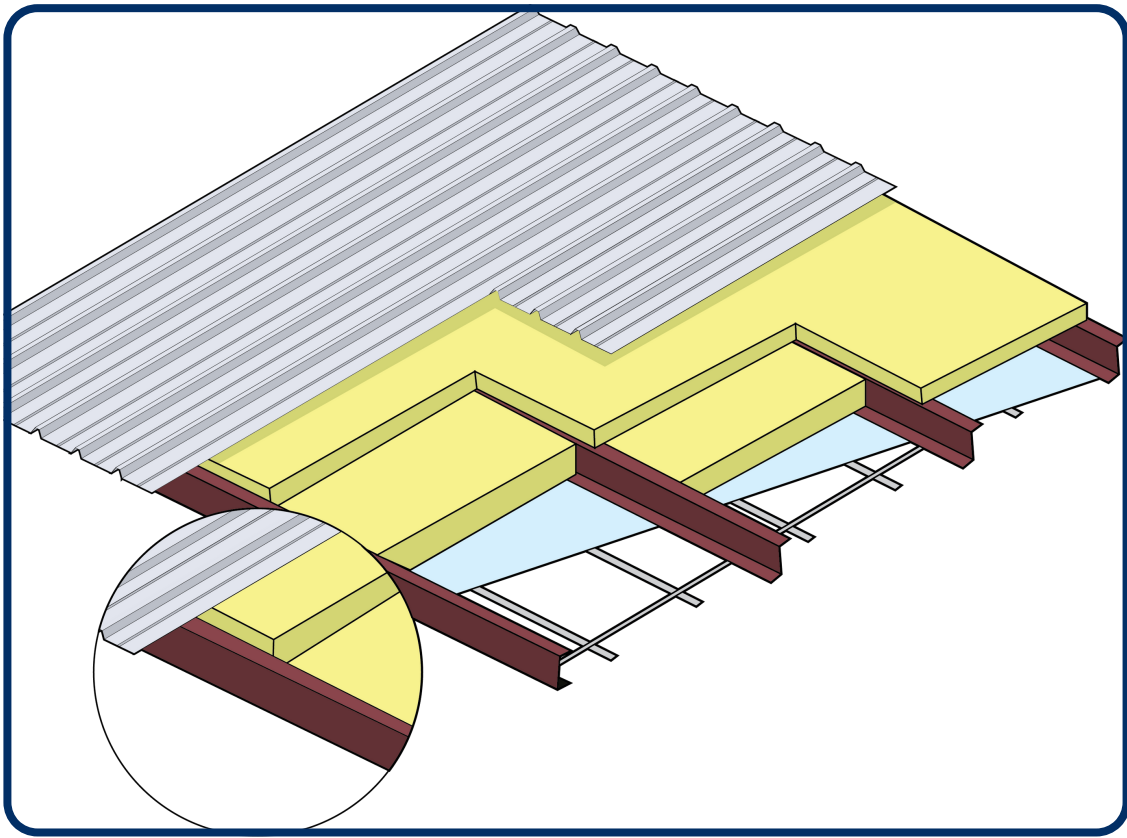
2024 INTERNATIONAL ENERGY CONSERVATION CODE DEFINITION

A system that includes the following:

1. *A continuous vapor barrier liner membrane that is installed below the purlins and that is uninterrupted by framing members.*
2. *An uncompressed, unfaced insulation resting on top of the liner membrane and located between the purlins.*

LINER SYSTEM (LS)

For multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and then compressed when the metal roof panels are attached.



Liner system design includes the following items:

- Continuous vapor barrier liner
 - Installed below the purlins and uninterrupted by any framing members
- First R-value in tables is the uncompressed and unfaced insulation installed between the purlins and rests on top of the vapor barrier liner
- Second R-value in tables is the unfaced insulation installed over the purlins
- Thermal spacer is provided between the purlins and the metal roof panels, if using the R-value option (Insulation Min. R-value column in tables)

METAL BUILDINGS USING U-FACTOR, C-FACTOR, & F-FACTOR OPTION

**TABLE C402.1.2 OPAQUE BUILDING THERMAL ENVELOPE ASSEMBLY
MAXIMUM REQUIREMENTS, U-FACTOR METHOD**

Climate Zones	4		5		6		7	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roof								
Metal Building	U - 0.035	U - 0.035	U - 0.035	U - 0.035	U - 0.031	U - 0.029	U - 0.029	U - 0.029
Wall, Above Grade								
Metal Building	U - 0.052	U - 0.050	U - 0.050	U - 0.050	U - 0.050	U - 0.050	U - 0.044	U - 0.039
Slab-on-Grade Floors								
Unheated	F - 0.52	F - 0.52	F - 0.52	F - 0.51	F - 0.51	F - 0.434	F - 0.51	F - 0.434
Heated	F - 0.62	F - 0.62	F - 0.62	F - 0.62	F - 0.62	F - 0.602	F - 0.602	F - 0.602

If a metal building uses the U-factor, C-factor, and F-factor approach and the design falls into the parameters established for standard AISI S250 Section **C402.1.2.1.6, Cold-formed steel assemblies**, may be applied to the project.

METAL BUILDINGS USING C402.1.2.1.6 COLD-FORMED STEEL ASSEMBLIES

C402.1.2.1.6 COLD-FORMED STEEL ASSEMBLIES

Cold-formed steel framed ceilings and walls are permitted to use standard AISI S250 for the U-factors of the thermal envelope. ***IT IS NOT REQUIRED TO, IT IS JUST AN OPTION.*** The U-factor can be modified as followed:

- If only using continuous insulation the spacing of the steel framing can be any spacing on-center
- If the wall framing is one of the following, then the lower framing member spacing input value can be used in the calculation from AISI S250
 - 24" on center with 23% framing factor
 - 16" on center with 25% framing factor
- If the framing factor is 22% or less no modifications required from AISI S250
- If the wall steel framing isn't C-shape then the calculation option to use from AISI S250 is "Other Than C-shaped Framing"



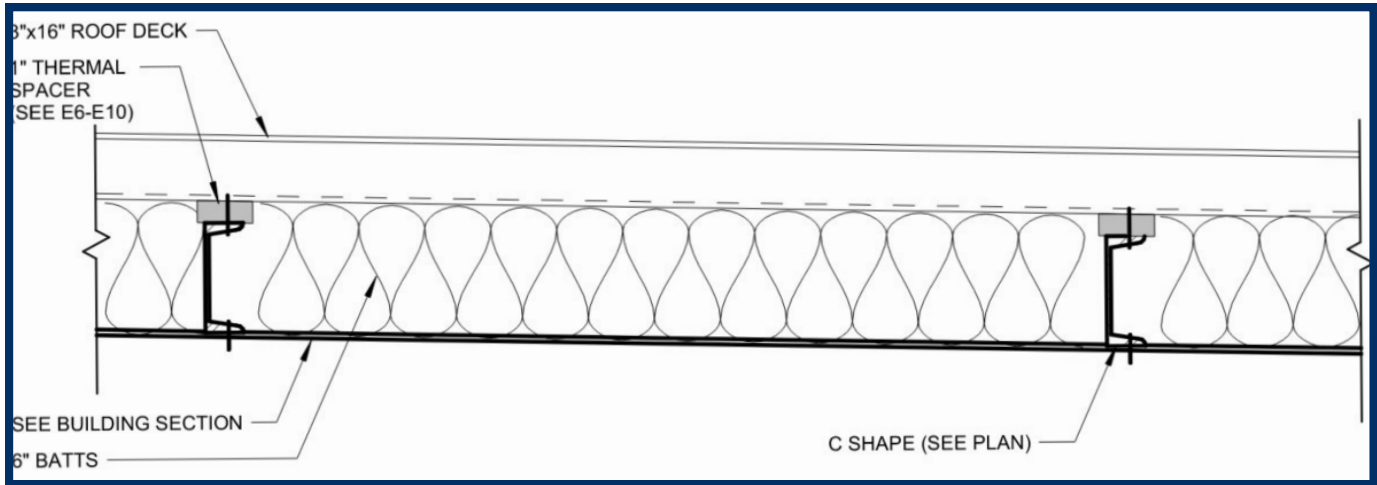
TABLE C402.1.3 OPAQUE BUILDING THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD

Climate Zones	4		5		6		7	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roof								
Metal Building^b	R-19 + R-11LS	R-19 + R-11LS	R-19 + R-11LS	R-19 + R-11LS	R-25 + R-11LS	R-30 + R-11LS	R-30 + R-11LS	R-30 + R-11LS
Wall, Above Grade								
Metal Building	R-13 + R-13ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-17ci	R-13 + R-19.5ci
Slab-on-Grade Floors								
Unheated	R-15 24" below	R-15 24" below	R-15 24" below	R-20 24" below	R-20 24" below	R-20 48" below	R-20 24" below	R-20 48" below
Heated	R-15 24" below + R-5 full slab	R-15 24" below + R-5 full slab	R-15 36" below + R-5 full slab	R-15 36" below + R-5 full slab	R-15 36" below + R-5 full slab	R-20 48" below + R-5 full slab	R-20 48" below + R-5 full slab	R-20 48" below + R-5 full slab

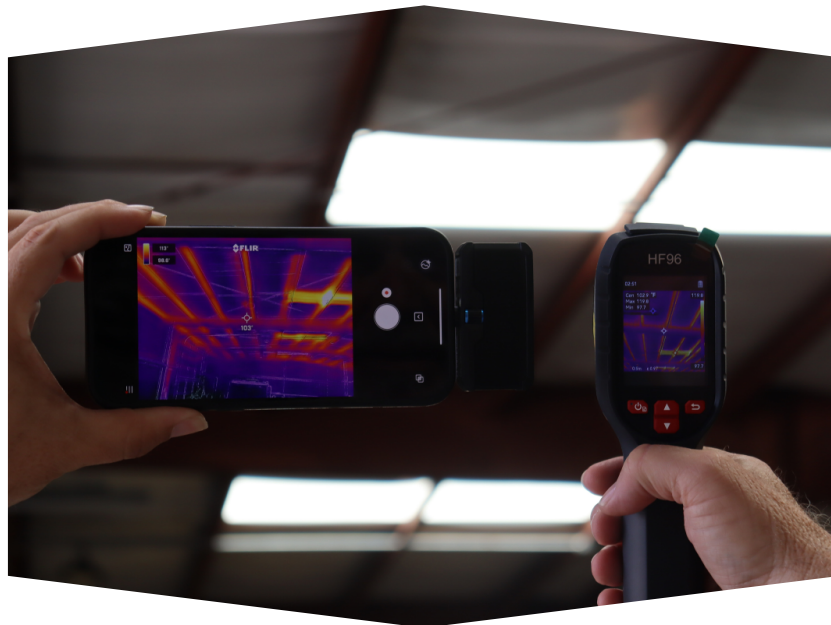
Footnote b:

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

Basically, if you do not use a thermal block then you will need to use the U-factor, C-factor-F-factor option of the prescriptive path (the assembly approach).

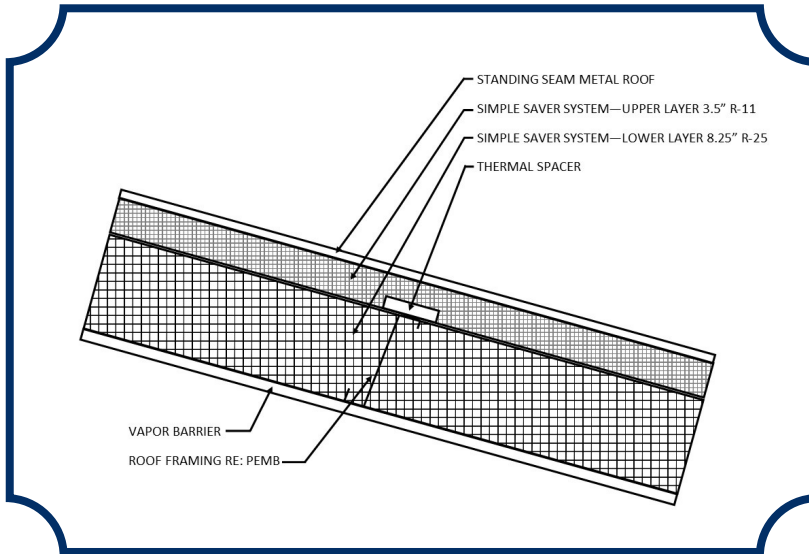


Thermal spacer is a material that is placed at the purlins to reduce the transfer of heat, also known as thermal bridging, at the connections between the outer shell or skin of the building and the interior framing of the building.



METAL BUILDING ROOF INSULATION LINER SYSTEM FOR PLAN REVIEW (PRESCRIPTIVE PATH)

With a Thermal Spacer



This design contains all of the components required for use of the R-value option.

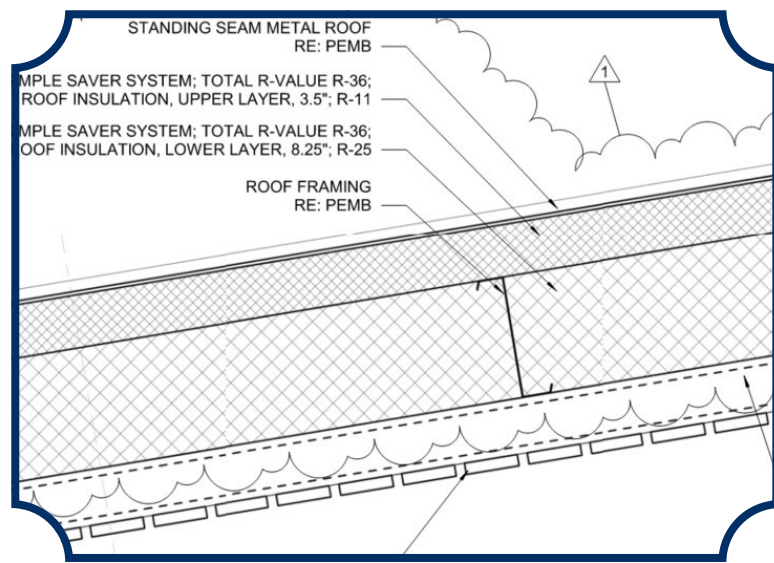
- Vapor barrier membrane below purlins
- Insulation between the purlins
- Insulation over the purlins
- Thermal spacer separating the purlins and the metal roofing

Without a Thermal Spacer

This design does not contain a thermal spacer, so it cannot use the R-value option. This project would have to comply with the assembly U-factor option.

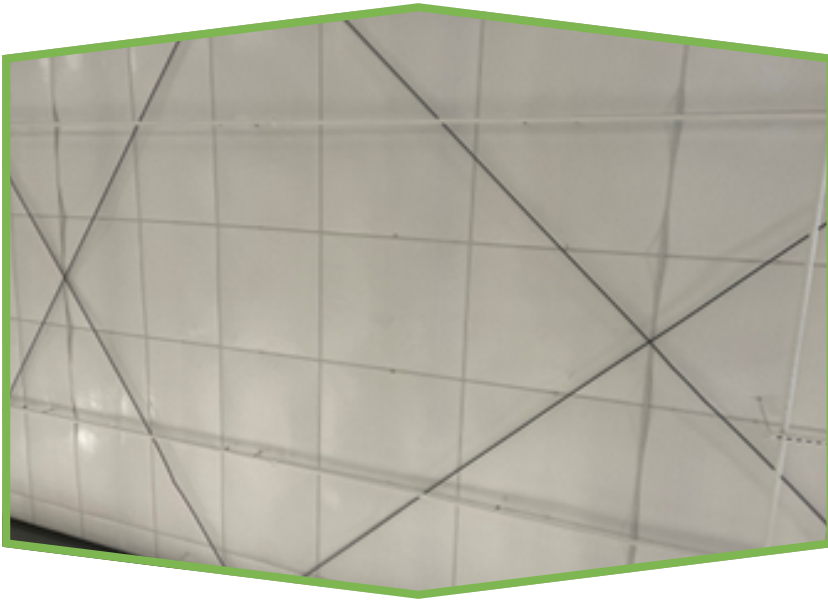
- Vapor barrier membrane below purlins
- Insulation between the purlins
- Insulation over the purlins

This design could work, but it has to use the correct prescriptive option for it, or include a thermal spacer in the design.



METAL BUILDING ROOF INSULATION LINER SYSTEM FOR INSPECTION (PRESCRIPTIVE PATH)

Metal building roofs will require multiple inspections to verify the entire system. These can be combined with other inspections. A good policy is to determine when your team wants to inspect and verify each layer and or component.



VAPOR BARRIER MEMBRANE FOR LINER SYSTEM

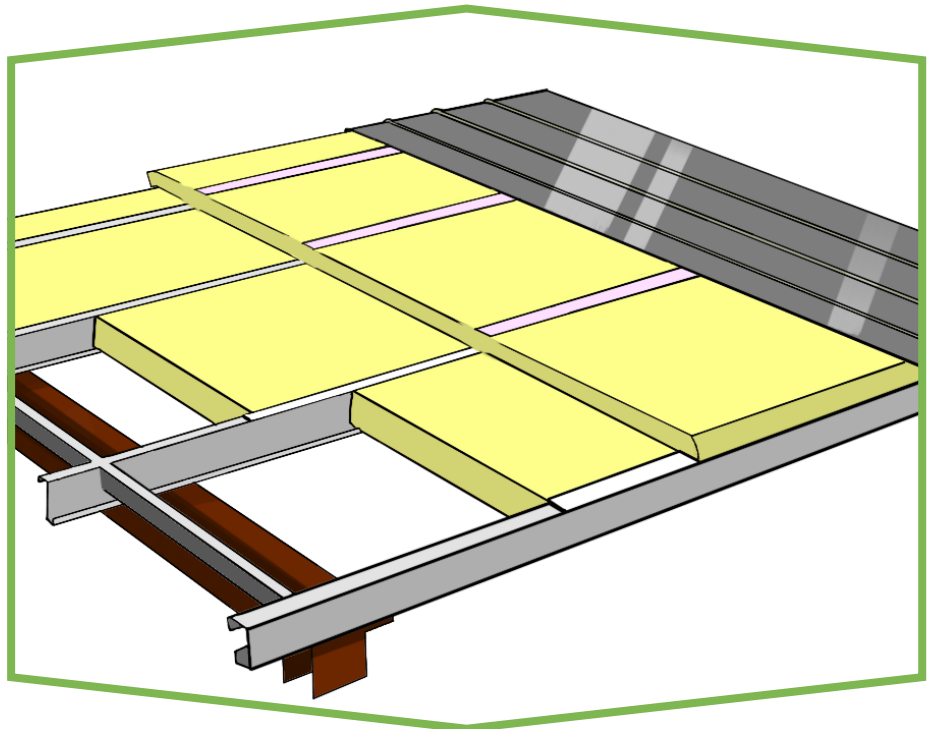
This membrane has been installed properly.

- Installed below the purlins
- Not interrupted by the purlins

THERMAL SPACER (THERMAL BLOCK)

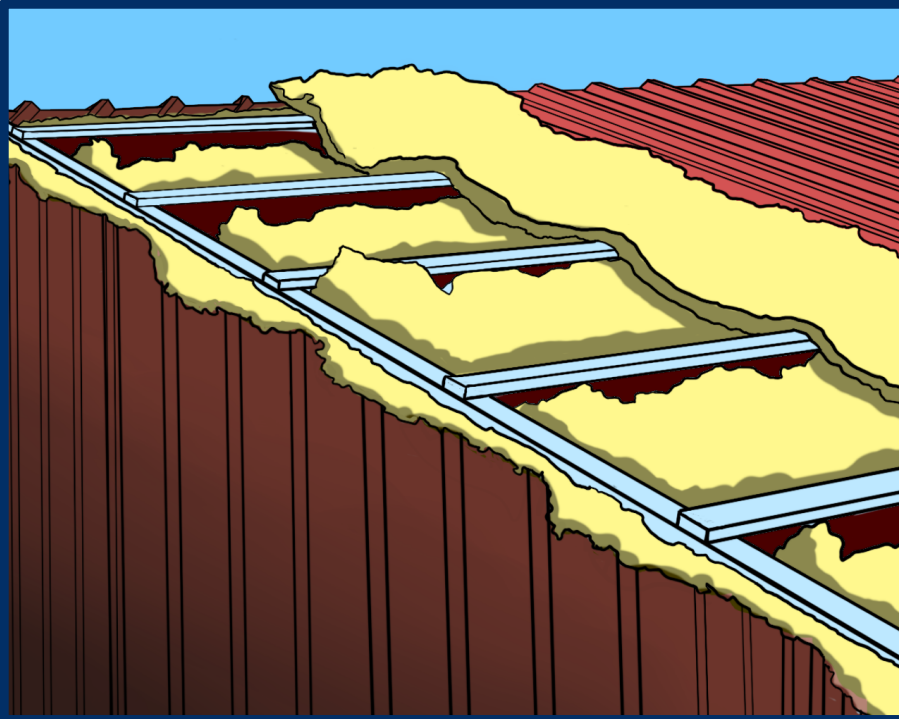
Thermal spacer has been installed properly.

- Installed above the purlins and below the metal roofing

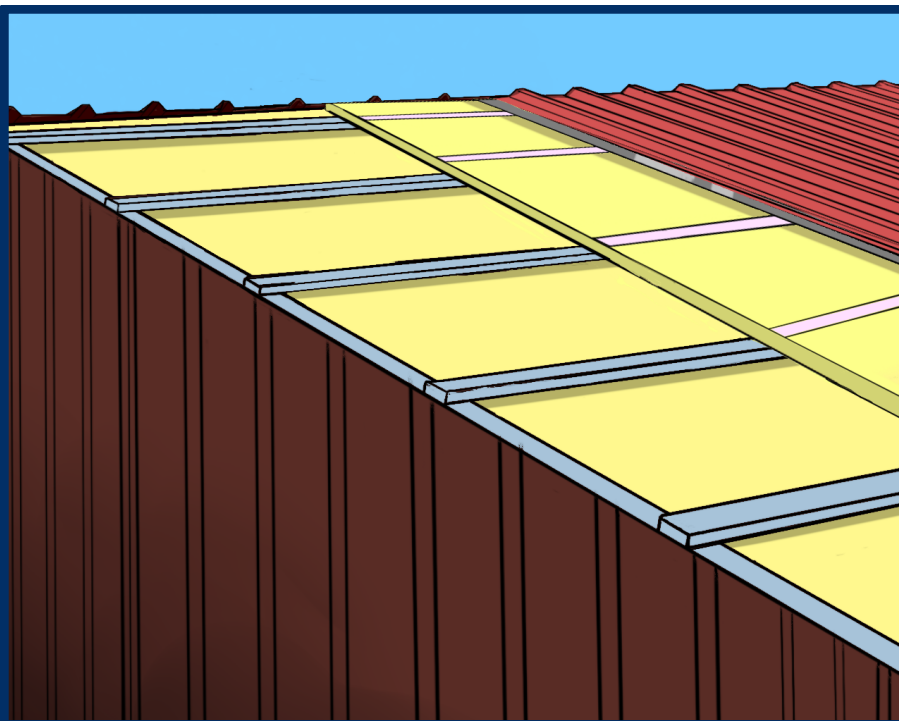


INSTALLATION MATTERS

The insulation is installed between the purlins and over the purlins.



- The installation of the insulation between the purlins is not correct.
- It doesn't extend to the edge of the roof at the roof wall junction.
- There is a gap. Building envelope is not continuous at these areas.

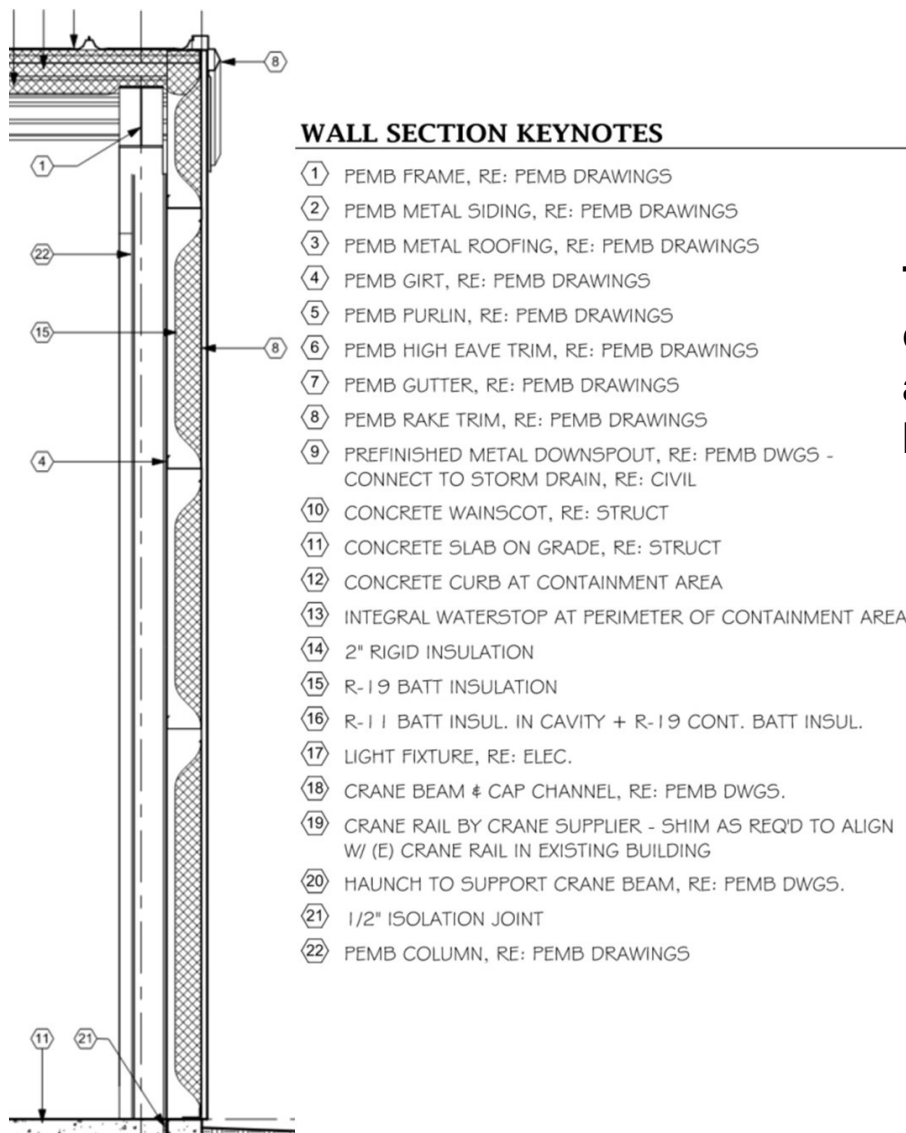


- The installation of the insulation between the purlins is installed correctly.
- The insulation fills the cavity between the purlins and uncompressed.
- The second layer is installed in the perpendicular direction over the purlins.
- Thermal spacer provided over purlins to separate the interior framing and the metal roofing.

METAL BUILDING WALL INSULATION LINER SYSTEM FOR PLAN REVIEW (PRESCRIPTIVE PATH)

Metal building walls that use the R-value option of the table require continuous insulation to be installed and cavity insulation.

- The continuous insulation can be installed on the outside or inside of the girts

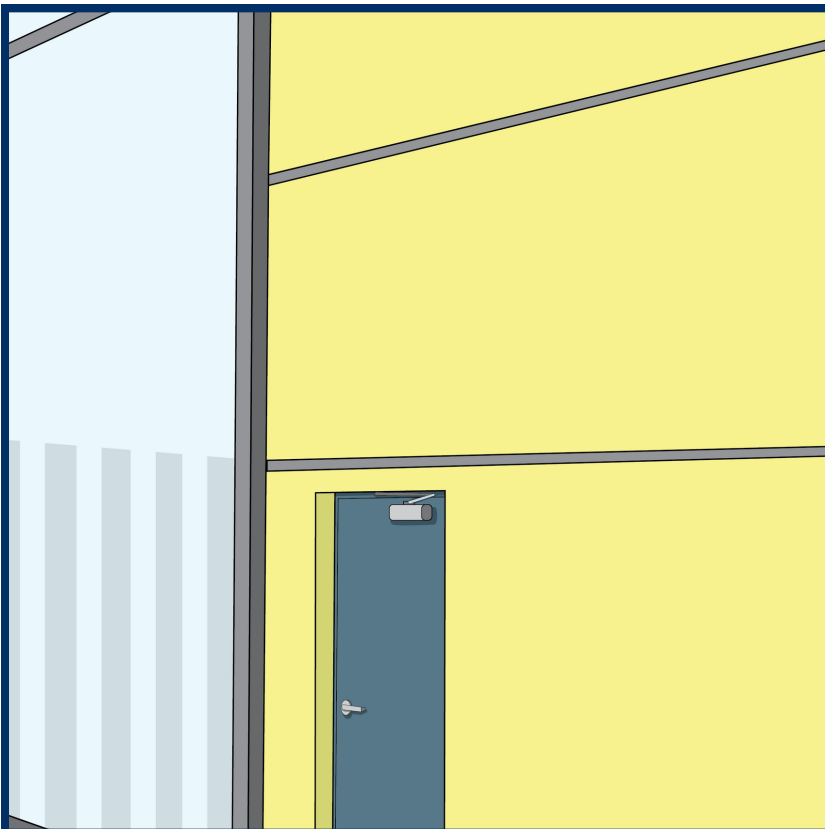


This design is showing continuous insulation, but it appears that the insulation is being compressed at the girts.

- Insulation must be continuous**

METAL BUILDING WALL INSULATION LINER SYSTEM FOR INSPECTION (PRESCRIPTIVE PATH)

CONTINUOUS INSULATION SHOWN



- The girts do not interrupt the continuous insulation
- Not compressed
- Located on the exterior side of the girts

AIR BARRIERS/AIR LEAKAGE:

- Mandatory for all energy compliance paths
- Whole-building air leakage testing required
 - Whole building test methods and reporting comply with Section C402.6.2.1
 - Dwelling and sleeping unit enclosure method and reporting comply with Section C
- Building that are not required to perform air leakage testing will be required to have building thermal envelope design and construction verification criteria in accordance with Section C402.6.2.3
- Continuous air barrier must be provided in accordance with C402.6

For a material to qualify as an air barrier it must be tested in accordance with the test method listed in Section C402.6.2.3.1 and have an air leakage rate that cannot exceed 0.004 cfm/ft². The code has 16 materials already deemed to comply.

- For metal buildings they use # 15 in the list to comply, which is sheet steel or aluminum.

