ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2018 SESSION

Toute documentation permise
Calculatrices : modèles autorisés seulement
Durée de l'examen : 3 heures

14-BA-A7 BUILDING ENVELOPE DESIGN

QUESTION #1 **(10 points)**

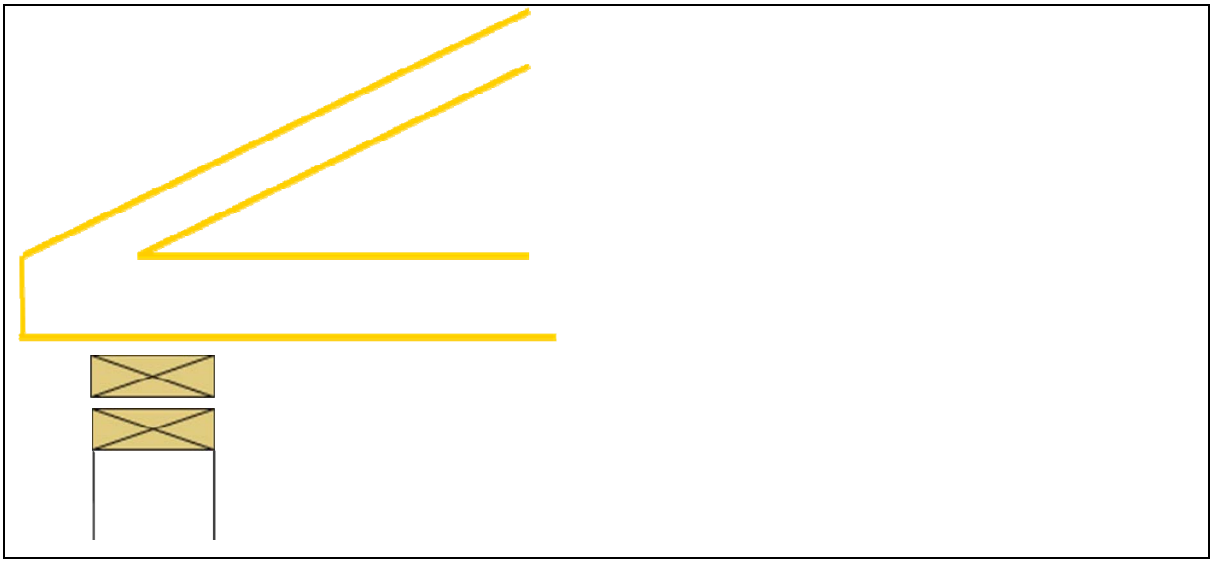
Name 2 principal requirements for an **air *barrier system.***

1) _____

2) _____

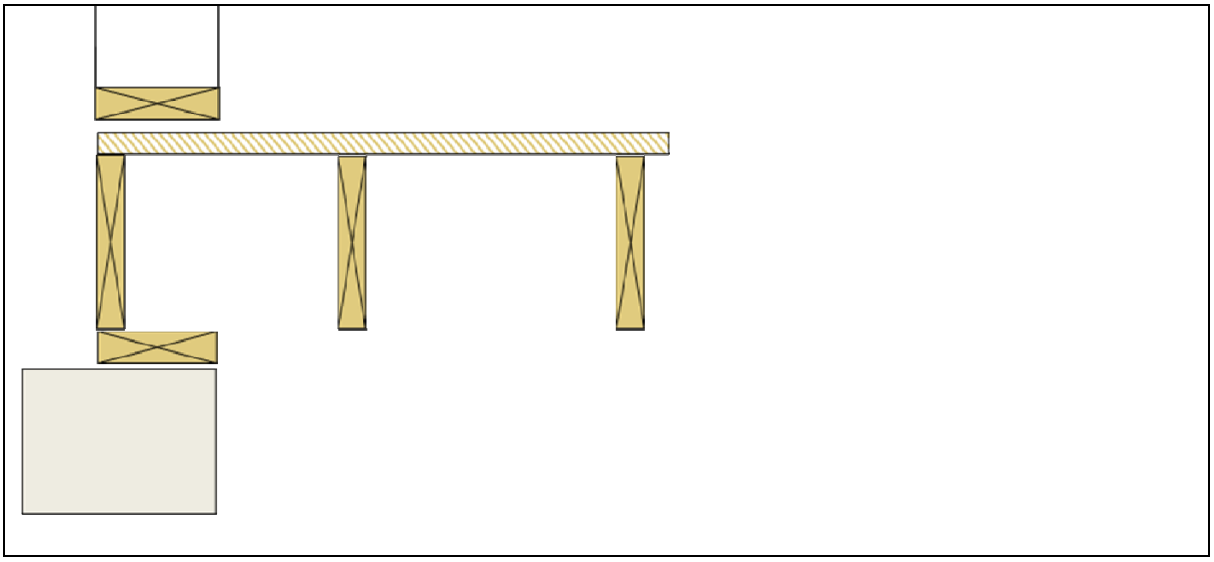
QUESTION #2 **(10 points)**

Illustrate the continuity of an **exterior air barrier system** on the wall connecting to the interior air barrier system along the horizontal roof trusses. Name ***BOTH*** air barrier materials and sealing component(s) to ensure continuity across the wall to ceiling junction.



QUESTION #3 **(10 points)**

Illustrate the continuity of an **interior air barrier system** to air seal the header joist area that ties into the interior air barrier system of the exterior wall and to the concrete foundation wall. Name all air barrier materials and sealing component(s) to ensure continuity of the interior air barrier system across the floor header.



QUESTION #4 **(5 points)**

Which type of insulation can be used in a protected membrane roof assembly?
Circle the best answer.

A) Expanded polystyrene rigid insulation
B) Extruded polystyrene rigid insulation
C) Polyisocyanurate rigid insulation
D) Mineral wool board insulation

QUESTION #5 **(5 points)**

Which type of insulation can be used in a conventional roof assembly?
Circle the best answer.

A) Expanded polystyrene rigid insulation
B) Extruded po,lystyrene rigid insulation
C) Polysiocyanurate rigid insulation
D) All of the above

QUESTION #6 **(20 points)**

Exterior wood stud wall assembly made up of 2x4 wood studs spaced 24''o.c.

- Project is in Montreal, Quebec (4600 Heating Degree Days)
  Wall Components (from exterior to interior):

a) Exterior air film; R-0.17
b) Vinyl siding; R-0.62
c) Vertical wood strapping (3/4-inch air space); R-1.02
d) 2''expanded polystyrene rigid insulating sheathing; R-8
e) Exterior weather barrier membrane; R-0
f) 2"x4" wood studs @24" o.c.; R-4.29
g) 3.5" Mineral fiber batt insulation in the stud cavity; R-14.0
h) 6 Mil Polyethylene vapor barrier; (R-0)
i) ½ "Gypsum board; R-0.45
j) Interior air film; R-0.68

1) Calculate the **Nominal** thermal resistance for the wall assembly: (R)_____

2) Calculate the **Effective** thermal resistance for the wall assembly using the Parallel Planes Method formula provided on last page: (R)_____

Calculations:

QUESTION #7 **(10 points)**

Name the 2 methods in which water vapor moves through an exterior wall assembly

1)_____

2)_____

QUESTION #8 **(10 points)**

Name 2 environmental conditions in a building that can affect occupant comfort

1)_____

2)_____

QUESTION #9 **(8 points)**

Which of the following 2 factors will influence the type of window that can be used in a building? Circle the 2 best answers.

A) Building shape
B) Building height
C) Surrounding landscape
D) Occupants

QUESTION #10 **(8 points)**

Name the 2 main factors that cause ice dams to form along the eaves of pitched roofs with attics in single family homes.

1)_____

2)_____

QUESTION #11 **(4 points)**

What is the definition of a Net Zero Energy Home?

_____
_____
_____

Formulas:

RSI_{eff} = 100/ [(% area framing/$RSI_{tot\ framing}$) + (% area cavity/$RSI_{tot\ cavity}$)]

Table A-9.36.2.4.(1)A.
Framing and Cavity Percentages for Typical Wood-frame Assemblies(1)

Wood-frame Assemblies		Frame Spacing, mm o.c.									
		304		406		488		610		1220	
		% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity
Floors	lumber joists	–	–	13	87	11.5	88.5	10	90	–	–
	I-joists and truss	–	–	9	91	7.5	92.5	6	94	–	–
Roofs/ Ceilings	ceilings with typical trusses	–	–	14	86	12.5	87.5	11	89	–	–
	ceilings with raised heel trusses	–	–	10	90	8.5	91.5	7	93	–	–
	roofs with lumber rafters and ceilings with lumber joists	–	–	13	87	11.5	88.5	10	90	–	–
	roofs with I-joist rafters and ceilings with I-joists	–	–	9	91	7.5	92.5	6	94	–	–
	roofs with structural insulated panels (SIPs)	–	–	–	–	–	–	–	–	9	91
Walls	typical wood-frame	24.5	75.5	23	77	21.5	78.5	20	80	–	–
	advanced wood-frame with double top plate(2)	–	–	19	81	17.5	82.5	16	84	–	–
	SIPs	–	–	–	–	–	–	–	–	14	86
	basement wood-frame inside concrete foundation wall	–	–	16	84	14.5	85.5	13	87	–	–

Wall Assembly	Thermal Resistance (R)	
	Through Stud	Through Cavity
Interior air film	0,68	0,68
1/2" gypsum board sheathing	0,45	0,45
Polyethylene vapour barrier	0,00	0,00
Mineral wool		14,00
2" x 4" wood studs	4,29	
Total Nominal Thermal Resistance for Inboard Part of Wall (R)		**15,13**
EPS insulation	8,00	8,00
Sheathing membrane	0,00	0,00
1"x4" vertical wood furring strips (3/4" air space)	1,02	1,02
Vinyl siding	0,62	0,62
Exterior air film	0,17	0,17
Total Nominal Thermal Resistance for Outboard Part of Wall (R)		**9,81**
THERMAL RESISTANCE INDIVIDUAL AREAS (R)	**15,23**	**24,94**
Wall Area Factor (%)	**20,00**	**80,00**
TOTAL NOMINAL THERMAL RESISTANCE OF WALL ASSEMBLY (R)		**24,94**
TOTAL EFFECTIVE THERMAL RESISTANCE OF WALL ASSEMBLY (R)		***22,12***