

Exam Study Guide

Prepared By RRC Examination
Development Subcommittee



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STUDY GUIDE FOR REGISTERED ROOF CONSULTANT (RRC®) EXAM

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STUDY GUIDE FOR RRC® EXAM

INTRODUCTION

The Registered Roof Consultant (RRC®) Program has been in existence since 1987. The demand for the RRC® title by private clients and public agencies continues to grow rapidly as the industry recognizes the value of the RRC's quantified skill-set. The primary beneficiaries of this program are the public, the roofing industry, and those individuals who become registered.

Registration is a two-part program. The comprehensive application allows IIBEC to verify certain aspects of education, ethics and roofing experience. The online examination confirms these qualifications by testing one's knowledge of roofing and the ability to use this knowledge in practical applications.

This study guide outlines subjects that are addressed in the computer-based examination; however, it is not intended to be an inclusive listing of every topic addressed on the test. This document is strictly a guide. A sample of references used in the development of this exam is provided.

The examination is not tailored to any one particular area of roof consulting or to the design and construction practices unique to any geographic area. It deals with roof consulting in general as indicated by the references listed on the next page. It may include all phases of roof consulting (evaluation, design, testing and construction), both steep- and low-slope roofing, and all systems (e.g., shingle, tile, slate, built-up, single-ply, metal and spray-applied systems).

In order to receive a passing score on the examination, the candidate must be thoroughly familiar with a broad spectrum of principles related to roof system design, testing and construction. Education and experience in these areas are extremely important. However, practical application under the guidance of a qualified mentor may be even more important because it reinforces formal education and training and provides a sound foundation over a broad spectrum. It pulls everything together. The weakness most often identified with exam failure is a narrow focus in the industry.

The RRC® exam is offered by Meazure Learning, a computer-based testing company, which has

over 1,000 conveniently located testing centers. Consult www.assessments.meazurelearning.com/test-site-cities/ for testing center locations. Approved applicants will be sent exam registration forms. Upon receipt, candidate information will be conveyed to Meazure and they will then contact the candidate to schedule a testing session.

The examination is up to four hours in length and consists of 60 multiple-choice questions that will test knowledge in the following roofing areas: codes and standards, materials and properties, assemblies, analysis and design, and evaluation and testing. Some problems may involve mathematical computations that require familiarity with basic algebra, geometry, and trigonometry. Reference materials, charts, and/or tables needed for the solution of problems will be provided online within the exam.

To earn the RRC® designation, both the General Knowledge Consultant (GCK) and Registered Roof Consultant exams must be taken and passed. There is no separate application for the general exam; approval of the RRC® application will qualify the candidate to take the GCK Exam. If only one of these two exams is passed, the candidate is required to retake only the exam he or she failed. The exam that has been passed will be valid until the candidate passes the other exam and the designation is earned. Candidates who do not initially pass an exam will have the option to retry every four months. Once an applicant has passed the GCK Exam, it will not need to be retaken for other IIBEC consultant designations (Registered Waterproofing Consultant and Registered Exterior Wall Consultant).

Approved applications have a two-year shelf life; and once the application has expired, reapplication will be required.

Although not required, IIBEC offers education programs that may be useful for anyone pursuing this designation: [Recommended Courses for the RRC](#). These courses are available through the IIBEC storefront, [LearnUpon](#).

A sample of documents/references that were used to develop the RRC Exam is as follows.

STUDY GUIDE FOR RRC® EXAM

REFERENCES

	Title	Author	Pub. Date
1	ANSI/SPRI FX-1: Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners	ANSI/SPRI	August 11, 2011
2	ASCE 7-10: Minimum Design Loads for Buildings and Other Structures	ASCE	2010
3	FM Global Property Loss Prevention Data Sheets	Factory Mutual Insurance Company	2012
4	International Building Code 2009	International Code Council	February 2009
5	<i>The NRCA Roofing Manual: "Metal Panel and SPF Roof Systems"</i>	NRCA	2012
6	<i>The NRCA Roofing Manual: "Membrane Roof Systems"</i>	NRCA	2011
7	RCIF Publication No. 02.03, <i>Roof Drainage</i>	Patterson/Mehta/Wagner	2003
8	<i>Roof Systems Thermal & Moisture</i>	RCI (now IIBEC)	2011
9	<i>Roof Technology & Science I</i>	RCI (now IIBEC)	2014
10	<i>Roof Technology & Science II</i>	RCI (now IIBEC)	2014
11	<i>Architectural Sheet Metal Manual</i>	SMACNA	January 2012
12	<i>Wind Uplift Pressures on Low-slope Roofs</i>	Stephen Patterson and Madan Mehta	2013

*The references listed above are only some of the many that were used in the development of this exam. This is meant to serve as a guide to illustrate the types of references used; this is not a recommendation or suggestion to purchase all of the publications listed. The most useful tool in preparation for the exam is the following list of skills, knowledge and responsibilities identified by the task force as those associated with acceptable performance within the roof consulting profession. It is recommended that the applicant review this list as it relates to one's experience/skill set and then prepare accordingly with the courses and/or publications that may be helpful to the individual.

STUDY GUIDE FOR RRC® EXAM

As part of the exam revision process, the committee of subject matter experts systematically compiled a list of domains that relate to the responsibilities, knowledge, and skills associated with acceptable performance within the roof consulting profession. This list provided the organizational framework for the exam and is included below. The percentage of questions on the exam from each section is indicated.

Sections	Section/Domain Title	Percentage of questions from section on exam
SECTION 1	CODES AND STANDARDS	8.5%
Objective 1.1	Identify application of fire codes for roof design.	
Objective 1.2	Identify industry standards that apply to roof design.	
Objective 1.3	Describe application of building codes and standards that apply to roof design.	
SECTION 2	MATERIALS AND PROPERTIES	16.5%
Objective 2.1	Describe roofing component characteristics.	
SECTION 3	ASSEMBLIES	20%
Objective 3.1	Describe characteristics of steep-slope assemblies.	
Objective 3.2	Describe characteristics of low-slope assemblies.	
Objective 3.3	Describe characteristics of flashings and details.	
SECTION 4	ANALYSIS AND DESIGN	30%
Objective 4.1	Demonstrate knowledge of wind design.	
Objective 4.2	Demonstrate knowledge of drainage design.	
Objective 4.3	Demonstrate knowledge of moisture control systems.	
Objective 4.4	Demonstrate knowledge of thermal system design.	
SECTION 5	EVALUATION AND TESTING	25%
Objective 5.1	Describe quality-assurance practices.	
Objective 5.2	Describe field and laboratory testing practices.	
Objective 5.3	Demonstrate knowledge of moisture surveys.	
Objective 5.4	Demonstrate knowledge of visual roof condition assessments.	
Objective 5.5	Describe roof failure modes and mechanisms.	
	TOTAL PERCENTAGE	100%

RRC® SAMPLE EXAM QUESTIONS

Sample questions are provided from each section of the exam and are indicative of the types of questions you will encounter. Exhibits and answers have been provided at the end of the study guide. Partial credit is not given for one correct answer where two are required.

CODES AND STANDARDS

1. You are asked to prepare specifications for a new 100,000-square foot [9,290-square-meters] warehouse in Kansas City, Missouri. The building will have a structural steel frame and a corrugated metal roof deck. The client has indicated they plan to be insured by FM Global and will need a Class 1-rated roof assembly. The client has also requested that the roof assembly consist of a modified bitumen roof covering with a minimum *R*-value of 20 [*RSI* = 3.52] installed over the roof deck.

Which two standards should be referenced in the performance standards of the roof specification to address the fire rating of the assembly? (Choose two.)

- A. FM 1-28
 - B. FM 1-52
 - C. FM 4450
 - D. FM 4470
2. You are calculating the uplift for an edge metal attachment.
- Which standards organization would you use for your design?
- A. SMACNA
 - B. ASTM
 - C. ANSI/SPRI
 - D. NRCA
3. Which two components of a roof assembly are administered by requirements in ASHRAE Standard 90.1? (Choose two.)
- A. Insulation
 - B. Ballast
 - C. Air barrier
 - D. Metal deck

MATERIALS AND PROPERTIES

4. For a gravel-surfaced built-up roof membrane, the aggregate surfacing provides which two primary functions? (Choose two.)
- A. Splitting resistance
 - B. Impact resistance
 - C. UV resistance
 - D. Water resistance
5. A tile roof is to be installed on a building located in a hot/humid climate with a plywood roof deck installed at a slope of 3 units vertical in 12 units horizontal, and the dimension of the S-shaped tile is 18 inches [450 mm] long and 18 inches [450 mm] wide with an installed weight of 10 psf [479 Pa].

According to the Tile Roof Institute, what is the recommended attachment method?

- A. One steel nail with $\frac{5}{16}$ -inch [8-mm] diameter head of length to penetrate $\frac{1}{2}$ inch [13mm] into the deck or batten.
 - B. Two copper nails with $\frac{3}{8}$ -inch [9-mm] diameter head of length to penetrate $\frac{3}{4}$ inch [19 mm] into or through the thickness of the deck or batten.
 - C. One hot-dipped galvanized screw with $\frac{5}{16}$ -inch [8-mm] diameter head of length to penetrate $\frac{3}{4}$ inch [19 mm] into or through the thickness of the deck or batten.
 - D. Medium-sized patty of mortar composed of Type I Portland cement, cleaned/sieved sand, and potable water.
6. What are two purposes of gypsum cover boards? (Choose two.)
- A. To prevent crushing of roof insulation
 - B. To improve water resistance
 - C. To improve fire resistance
 - D. To reduce the number of fasteners required for attachment

RRC® SAMPLE EXAM QUESTIONS

7. The coating for a spray-applied polyurethane foam roof contains 69 percent solids at the time of application.

For average 15-mil [0.38-mm] dry film thickness, what is the wet mil thickness required for a single-coat application measured to the nearest mil [0.03 mm]?

- A. 10 mils [0.25 mm]
- B. 18 mils [0.46 mm]
- C. 22 mils [0.56 mm]
- D. 25 mils [0.64 mm]

ASSEMBLIES

8. A standing-seam metal roof has thermal movement caused by changes in temperature. When designing for expansion and contraction, the consultant elects to affix the panels at the ridge.

At which location should the panels be affixed?

- A. At the eave
- B. At the hip
- C. At the lap joints
- D. At the valley

9. What are two ways that ANSI/SPRI/FM 4435/ES-1 is used in the design of perimeter edge systems? (Choose two.)

- A. To determine vertical and horizontal loads on sheet metal and wood nailers
- B. To determine the type of fasteners used to attach metal edge systems
- C. To prescribe the field test procedures for metal edge systems
- D. To prescribe the laboratory testing procedure for metal edge systems

10. A client asks you to investigate a SPF roof system that has developed numerous blisters. Core samples reveal larger, elongated cells between two of the lifts.

What caused the blisters?

- A. Tree-bark foam texture on the lower lift
- B. Off-ratio foam on the upper lift
- C. Ultraviolet degraded foam of the lower lift
- D. Popcorn foam texture on the upper lift

11. As part of a factory expansion, additional plumbing vents are being provided in the existing conventional built-up roofing system.

Which two features should be included in the flashing detail at these penetrations? (Choose two.)

- A. Cant strip
- B. Metal flashing
- C. Wood curb
- D. Membrane stripping sheet

12. You are designing a sump for a roof drain on a low-sloped roof.

According to NRCA guidelines, how wide should the sump be?

- A. Ten times the thickness of the insulation
- B. The drain bowl size plus 24 inches [610 mm]
- C. 36 inches [914 mm] minimum
- D. 48 inches [1219 mm] minimum

RRC® SAMPLE EXAM QUESTIONS

ANALYSIS AND DESIGN

13. Refer to Exhibit #1

A building is located on open terrain with scattered obstructions. The distance from the ground surface adjacent to the building to the roof eave varies from 54 feet [16.5 m] to 58 feet [17.7 m].

In accordance with ASCE 7-10, what is the Velocity Pressure Exposure Coefficient for this roof as shown in the exhibit?

- A. 1.106
- B. 1.114
- C. 0.834
- D. 0.842

14. A client asks you to calculate the design wind pressure for a roof on a building that meets enclosure classification requirements for both an open and partially enclosed building.

According to ASCE 7-10, which statement is true?

- A. The building should be classified as an open building.
- B. The building should be classified as an enclosed building.
- C. The building should be classified as a partially enclosed building.
- D. The building classification is not required when calculating design wind pressures.

15. Refer to Exhibit #2

You are designing the drainage for a new house, and the owner wants to have half-round gutters that are to be installed level with two downspouts. The roof has a slope of 6:12 and is located in an area where the rainfall intensity is 5.7 inches [146 mm] per hour.

Referring to the exhibit, what is the minimum diameter gutter size to be used assuming the downspouts are adequate to drain the roof?

- A. 5 inches [127 mm]
- B. 6 inches [152 mm]
- C. 7 inches [178 mm]
- D. 8 inches [203 mm]

16. Refer to Exhibit #3

You are designing the replacement for the upper roof section on a commercial building. The existing scuppers are only 4 inches [102 mm] wide and often become clogged with debris. For the building shown on the exhibit, the head of water at the scupper is 1 inch [25.4 mm] and a rainfall intensity of 2.75 inches [69.9 mm] per hour.

What is the minimum scupper length for the scupper on roof section C?

- A. 7 inches [178 mm]
- B. 8 inches [203 mm]
- C. 9 inches [229 mm]
- D. 10 inches [254 mm]

17. You are asked to perform a peer review on a low-slope roof system for a new indoor pool facility.

The roof assembly contains the following:

- metal deck
- ½ inch [13 mm] gypsum
- 6 mil polyethylene vapor retarder
- 2 inches [50 mm] polyisocyanurate (two layers, staggered)
- ½ inch [13 mm] wood fiber cover board
- 4-ply BUR

The system is to be mechanically fastened to the deck through the polyisocyanurate.

Which two concerns should you bring to the attention of the architect? (Choose two.)

- A. A hygrothermal analysis should be completed of the roof assembly.
- B. No vapor barrier should be installed.
- C. Consider using a different vapor barrier type.
- D. A mechanically fastened membrane would be less prone to thermal bridging.

RRC® SAMPLE EXAM QUESTIONS

18. Refer to Exhibit #4

Referring to the exhibit, what is the temperature between the layers of polyisocyanurate insulation to the nearest whole degree?

- A. 49 degrees F [9.4 degrees C]
- B. 51 degrees F [10.6 degrees C]
- C. 53 degrees F [11.7 degrees C]
- D. 55 degrees F [12.8 degrees C]

19. Your client owns a 20,000 square foot [1,860 square meters] light-industrial warehouse near San Jose, California, which was constructed five years ago. The client is planning to re-coat the existing roof and is concerned about whether this project will need to meet the state's coolroof requirements in regard to solar reflectance.

Which consideration will affect the design of this project?

- A. The color of the existing roof
- B. The U-value of the existing roof assembly
- C. The coating rating by the Cool Roof Rating Council
- D. The height of the existing building

EVALUATION AND TESTING

20. According to RCI (now IIBEC)'s Rooftop Quality Assurance manual, during the installation of a multi-ply asphalt built-up roof.

Which two statements describe quality control guidelines? (Choose two.)

- A. Bitumen is within the recommended equiviscous temperature (EVT) range at the point of felt application.
- B. Roofing plies are installed so sidelaps and endlaps are not bucking water.
- C. Insulation is loosely attached to the substrate or underlying insulation with specified securement.
- D. Substrate is 90 percent dry, clean, reasonably smooth, and suitably prepared to receive insulation and/or membrane.

21. When testing for withdrawal resistance of fasteners, which two conditions would suggest the need for additional pull tests to be performed? (Choose two.)

- A. Steel decking has multiple changes in orientation
- B. Pullout values vary significantly
- C. Water infiltration has occurred
- D. Roof slope changes direction

22. You are asked to investigate possible moisture damage in an existing roofing system; however, the building owner is concerned about cutting or damaging the roof during the fieldtest procedure.

Which two nondestructive techniques should be used? (Choose two.)

- A. Capacitance meter
- B. Core sampling
- C. Electrical resistance probe
- D. Infrared thermography

23. Your client has a series of warehouses at a single facility. You are asked to recommend a single, noninvasive, moisture survey technique to be used on all the roofs. All buildings are single-story, high-bay structures with metal decking. Some buildings feature through-fastened metal panel roofs with fiberglass batt insulation; some feature PVC roofs with foil-faced isocyanurate board insulation. The survey will be conducted during a planned week-long vacation shutdown when you will have complete access to the facility.

Which moisture survey technique should you recommend?

- A. Electrical impedance
- B. Infrared
- C. Capacitance
- D. Electric field vector mapping

RRC® SAMPLE EXAM QUESTIONS

- 24.** During a visual assessment survey of a conventional built-up roofing membrane with peagravel surfacing, the asphalt flood coat of the roofing membrane has areas of displaced gravel.

What does this mean?

- A.** The roofing membrane is nearing the end of its service life.
- B.** The roofing membrane is experiencing differential movement.
- C.** The roofing membrane is experiencing creep.
- D.** The roofing membrane is experiencing wind scour.

- 25.** The construction of an existing, original roof on a 12-year-old warehouse located in Duluth, MN, consists of:

- Modified bitumen cap sheet, torch-applied
- Modified bitumen base sheet adhered with asphalt bitumen
- ½-inch [12.5-mm] wood fiberboard adhered with asphalt bitumen
- 2 inches [75 mm] polyisocyanurate insulation mechanically fastened to the roof deck
- Sloped steel deck

The building was originally used for heated dry goods handling and storage but was converted a year ago to a facility for temporary storage of finished pulp products, which is a high humidity activity. Dripping from the roof deck at the interior roof drain openings was observed during the late winter and spring. The roof has not leaked during the summer. Visual examination of the roof did not reveal any apparent damage or excessive deterioration of the roof membrane or the membrane flashings at the rooftop penetrations.

What is the probable cause of the reported dripping at the roof drain openings?

- A.** Water penetrating at undetected flaws in the membrane seams
- B.** Snow blowing in at the mechanical units during the winter
- C.** Condensation accumulation within the roof assembly
- D.** Water seeping through the aging membrane

EXHIBIT #1

Velocity Pressure Exposure Coefficients, K_h and K_z

Table 28.3-1

Height above ground level, z		Exposure		
		B	C	D
ft	(m)			
0-15	(0-4.6)	0.70	0.85	1.03
20	(6.1)	0.70	0.90	1.08
25	(7.6)	0.70	0.94	1.12
30	(9.1)	0.70	0.98	1.16
40	(12.2)	0.76	1.04	1.22
50	(15.2)	0.81	1.09	1.27
60	(18)	0.85	1.13	1.31

Notes:

- 1 The velocity pressure exposure coefficient K_z may be determined from the following formula:

For $15 \text{ ft.} \leq z \leq z_g$

$$K_z = 2.01 (z/z_g)^{2/\alpha}$$

For $z < 15 \text{ ft.}$

$$K_z = 2.01 (15/z_g)^{2/\alpha}$$

Note: z shall not be taken less than 30 feet in exposure B.

2. α and z_g are tabulated in Table 26.9-1.
3. Linear interpolation for intermediate values of height z is acceptable.
4. Exposure categories are defined in Section 26.7.

EXHIBIT #2 (Page 1 of 2)

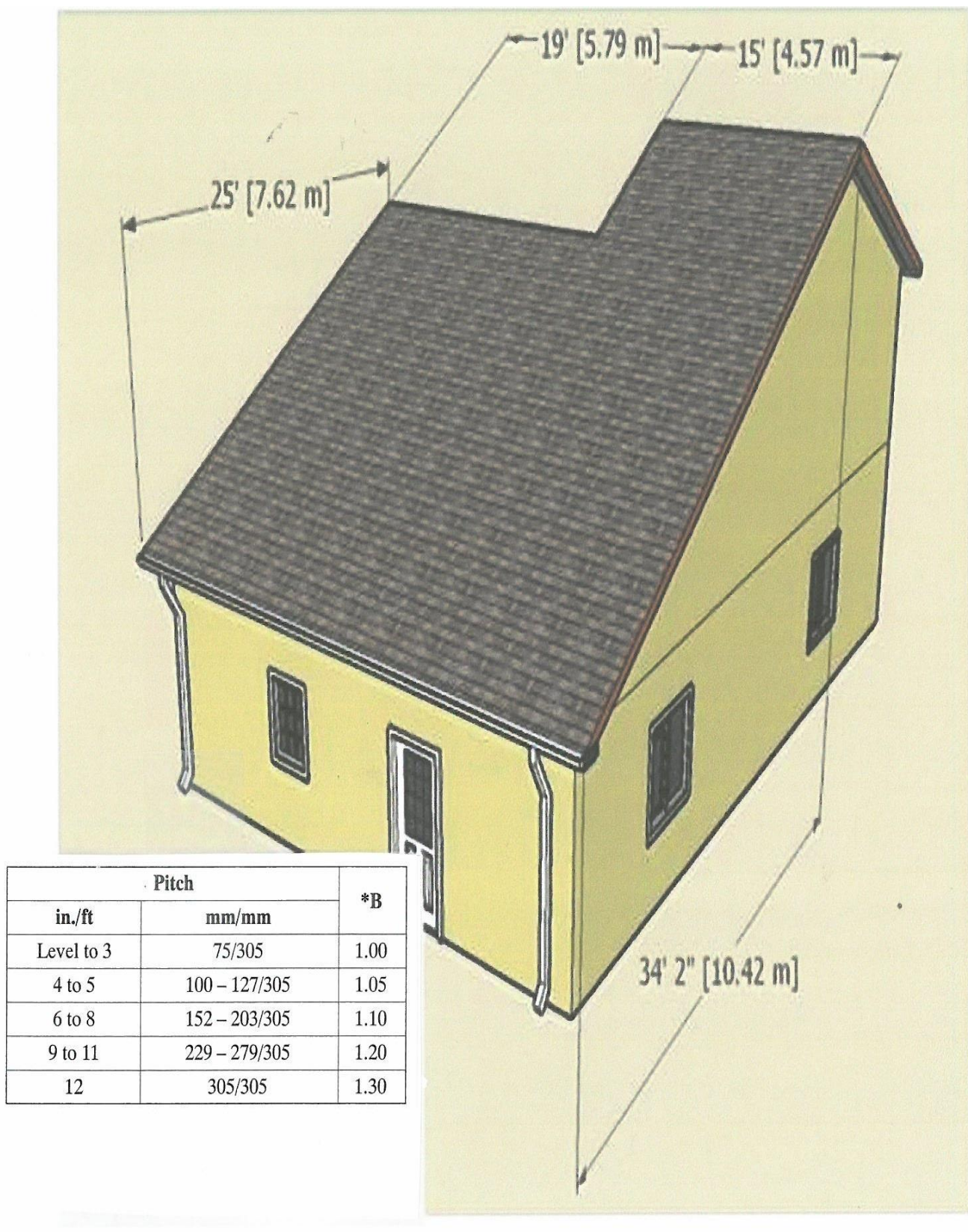


EXHIBIT #2 (Page 2 of 2)

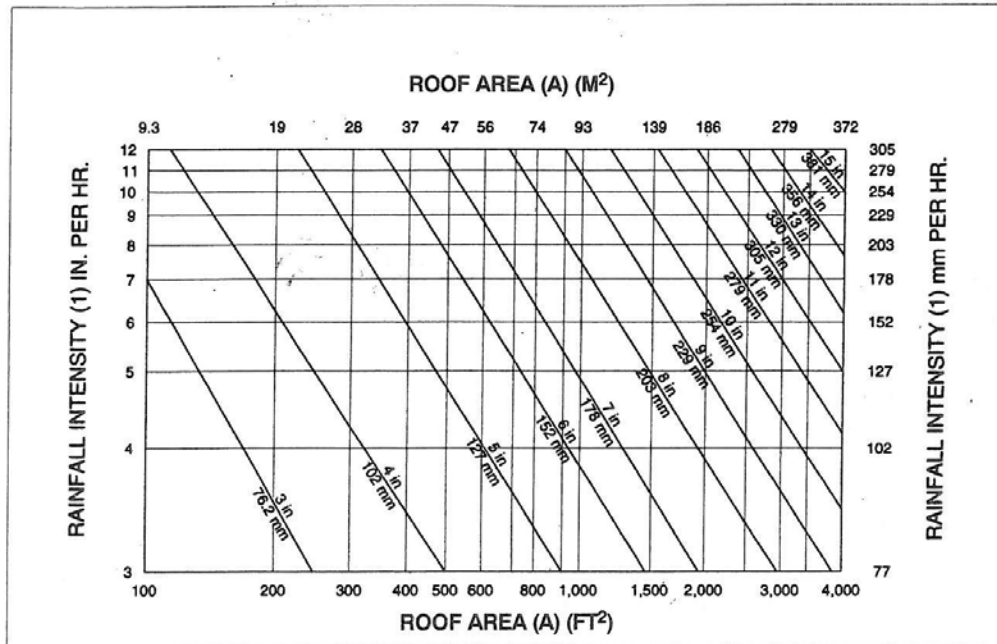


CHART 1-2 HALF ROUND GUTTER SELECTION WIDTH REQUIRED FOR GIVEN ROOF AREAS AND RAINFALL INTENSITIES

Diameters of Gutter in. mm	C.S. Area		Level		Level		½ in. per ft. Slope (3.2 mm/0.3 m)				¼ in. per ft. Slope (6.4 mm/0.3 m)			
	in. ²	mm ²	ft. ²	m ²	gpm	l/s	ft ²	m ²	gpm	l/s	ft ²	m ²	gpm	l/s
3 75	3.5	2258	680	63	7	0.44	960	89	10	0.63	1360	126	14	0.88
4 100	6.3	4064	1440	134	15	0.95	2040	190	21	1.33	2880	268	30	2.08
5 127	9.8	6321	2500	232	26	1.64	3520	327	37	2.33	5000	465	52	3.28
6 152	14.1	9095	3840	357	40	2.52	5440	505	57	3.60	7680	713	80	5.05
7 178	19.2	12390	5520	513	57	3.60	7800	725	81	5.11	11040	1030	115	7.26
8 203	25.1	16190	7960	739	83	5.24	11200	1040	116	7.32	14400	1338	165	10.4
10 254	39.1	25220	14400	1338	150	9.47	20400	1895	212	13.4	28800	2676	299	18.9

**Table 1-4 Sloped Roof Gutters
Maximum Roof Area for Gutters**

EXHIBIT #3

$$Q = 3.0(L - 0.2H)(H)^{1.5}$$

where:

Q = drainage capacity of scupper (gpm)
 L = length of scupper (in.)
 H = head of water in the scupper (in.)

$$q = 0.01039(A)I$$

where:

q = amount of water entering the scupper
 A = roof area drained by the scupper (ft²)
 I = rainfall intensity (in./h)

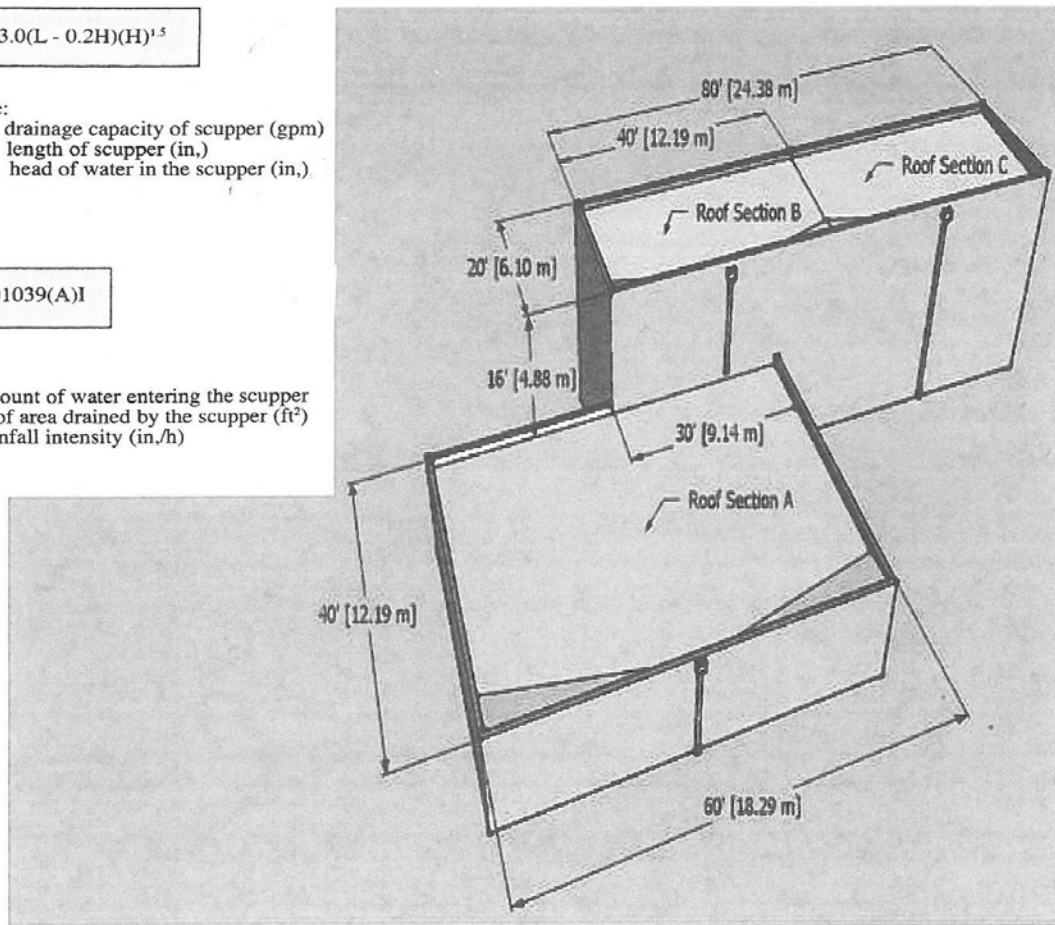
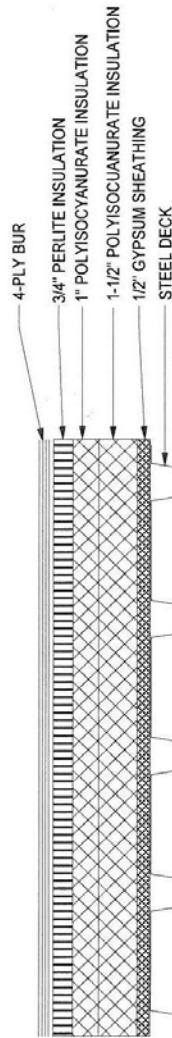


EXHIBIT #4

WINTER CONDITIONS

OUTSIDE TEMPERATURE = 31 DEG. F

R-VALUES	
OUTSIDE AIR	0.17
BUR	0.33
3/4" PERLITE	2.08
1" ISO	5.6
1.5" ISO	8.4
1/2" GYPSUM	0.56
STEEL DECK	-
INSIDE AIR FILM	0.61



$$T_x = T_i - \left(\frac{\sum R_i}{\sum R} \right) (T_i - T_o)$$

T_x = Temperature at location x

T_i = Design inside (interior side) temperature (F)

T_o = Design outside (exterior side) temperature (F)

ΣR_i = R-value (F•ft.2-h/Btu) of construction below (to the interior side) of location "x"

ΣR = R-value (F•ft.2-h/Btu) of the overall roof construction

AIR PLENUM

SUSPENDED CEILING

INSIDE TEMPERATURE = 70 DEG. F

RRC® SAMPLE EXAM ANSWERS

Note your answers. Review the appropriate document(s) in those areas to better understand the rationale behind the indicated correct answer. Take advantage of the programs provided by IIBEC, including courses on the national and regional levels. IIBEC provides [Recommended Courses](#) for pursuing the RRC designation. These courses are available through the IIBEC education storefront, [LearnUpon](#).

1. C and D
2. C
3. A and C
4. B and C
5. B
6. A and C
7. C
8. B
9. A and D
10. B
11. B and D
12. B
13. B
14. A
15. B
16. B
17. A and C
18. A
19. C
20. A and B
21. B and C
22. A and D
23. B
24. D
25. C



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