Roofing:
What You May Not Know….

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Topics

- ✓ RCABC vs. The Designer – Responsibility
- ✓ Project Specification - Standard Language
- ✓ Wind Uplift Performance of Roof Flashings
- ✓ Air Barriers in Roofs
- ✓ A Quick note about Green Roofs

The RCABC Inspector vs. The Designer

- ✓ Many people don't understand where the line of the Designer starts and the RCABC Inspector Ends.
- ✓ Generally the RCABC Inspector should be viewed as a testing agency or a third party to the project.
- ✓ Over the years I have been asked do complete several tasks that were not in my responsibility to complete.
- ✓ Several specifications state that the Roofer is to provide shop drawings to conform with RCABC. This may not always mean the roof will perform.

The RCABC Inspector vs. The Designer

- ✓ The RCABC inspector is not involved with the design of the project or take any responsibility with the design of the project.
- ✓ The designer is responsible for the design of the roofing system and to ensure that the design conforms to the RPM, the code, and the manufacturers instructions.
- ✓ The RCABC inspector is not involved with any part of contract administration and reviews submittals only to become familiar with the approved systems.
- ✓ The designer must review all submittals and changes to ensure the overall roof design still works and that any proposed changes conform to the required standards.

The RCABC Inspector vs. The Designer

- ✓ The RCABC inspector does not review the roof for air barrier continuity or even the presence of a vapour barrier, the RCABC does not require these items and therefore does not provide direction on the proper use or installation techniques.
- ✓ The designer is responsible for the design and review of air / moisture / vapour barriers as well as the integration with the adjacent BE components.
- ✓ The RCABC inspector is responsible to ensure the roofing application at minimum conforms to the RPM, the manufacturers written instructions, and the project specifications.
- ✓ The designer must review all roofing components and any integrations to ensure that they are comfortable issuing professional schedules for all of these components.

The RCABC Inspector vs. The Designer

✓ So what is the reason in highlighting these responsibilities?

- Without clear expectations problems may arise.
- BE components can be completed without them being reviewed properly.
- Additional costs may be incurred due to corrections.
- Both parties may end up wasting time and resources.
- Just because the RCABC or the RCABC inspector approves something doesn't necessarily mean that the roof will perform for the expected life.

Specification - Standard Language

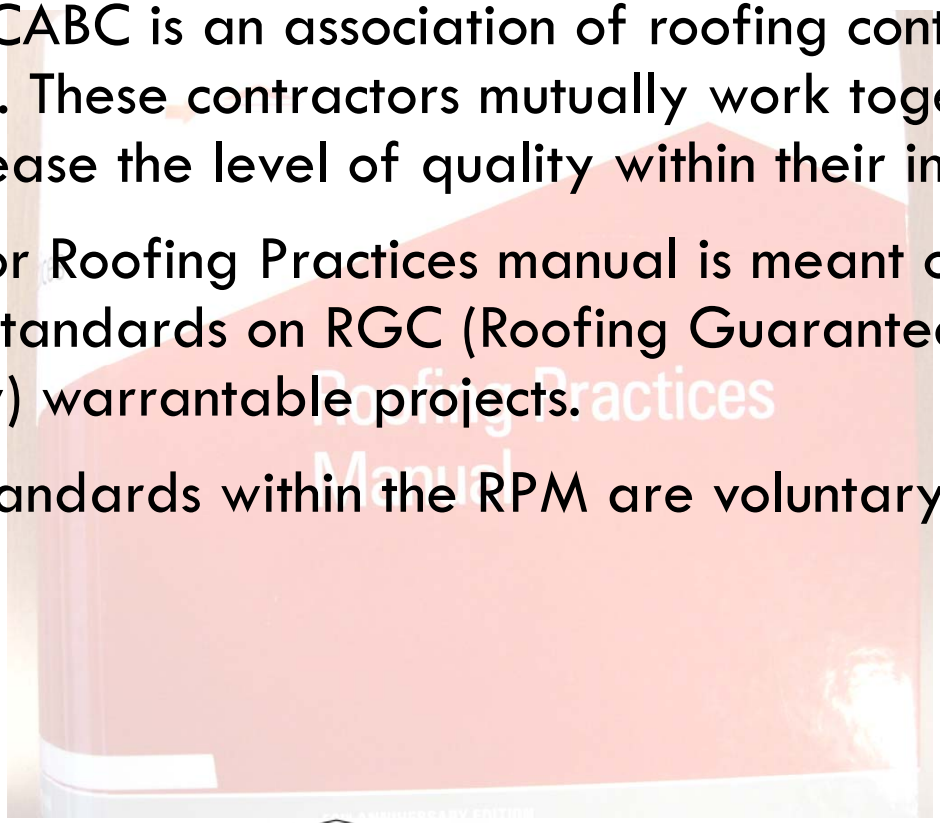
✓ Specifications reference standards to ensure a level of quality, these standards typically are:

- "Must meet RCABC minimum standards"
- "Roof to meet minimum FM 1-90"

✓ However many people don't know what referencing these standards mean to the overall project delivery.

So what is the RCABC?

- ✓ The RCABC is an association of roofing contractors within BC. These contractors mutually work together to help increase the level of quality within their industry.
- ✓ RPM or Roofing Practices manual is meant only to provide standards on RGC (Roofing Guarantee Company) warrantable projects.
- ✓ The standards within the RPM are voluntary and not codified.



RCABC Standards

✓ These standards only apply to the systems that are covered within the RPM

- For example a liquid urethane membrane is not covered within these standards.

✓ By referencing these standards as a whole every component within the assembly needs to be reviewed and compared to the standard and ensure conformance.

✓ In many cases the designed system isn't fully reviewed and the specification may not meet these standards.

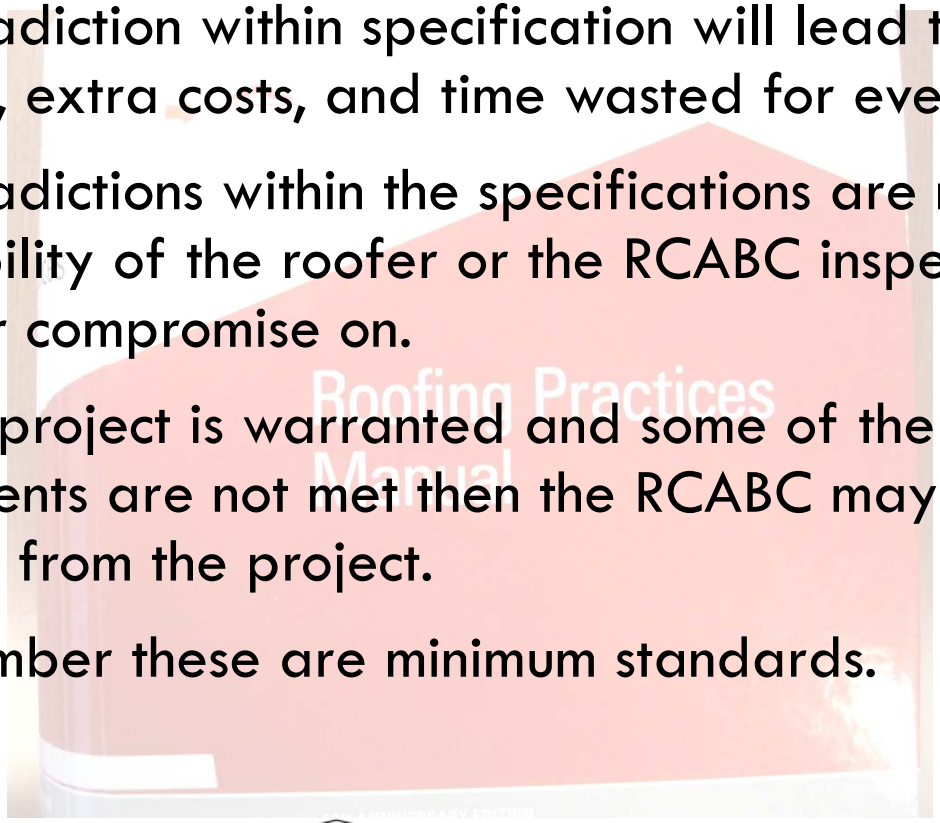
RCABC Standards

✓ RCABC standards typically contradicted within the specifications or during construction would include:

- Minimum slopes
- Penetration locations
- Use of gumlip flashings
- Doorsill requirements
- Drain requirements
- etc.

RCABC Conclusion

- ✓ Contradiction within specification will lead to confusion, extra costs, and time wasted for everyone.
- ✓ Contradictions within the specifications are not the responsibility of the roofer or the RCABC inspector to correct or compromise on.
- ✓ If the project is warranted and some of the requirements are not met then the RCABC may just withdraw from the project.
- ✓ Remember these are minimum standards.



FM, What is FM?

- ✓ FM Global, formally Factory Mutual, is an international full building insurance company.
- ✓ Due to a number of insurable claims, FM took it upon themselves to develop standards that must be met for them to be able to insure a building. These standards are based on claims made as well as testing of actual assemblies.
- ✓ This is a voluntary standard and is not codified.

FM 1-90 or 1-60 Standards

✓ So what does it mean when you spec a roof to meet FM 1-90?

- The prefix 1 means that the roof system has passed the FM requirement for Calorimeter Testing. (Fire Resistance Testing)
- The second number is the field uplift pressure.
- The Canadian method of determining uplift pressures is different and cannot be used to determine the design pressure for use with FM systems.

FM 1-90 or 1-60 Standards

✓ A Roof System that has a FM 1-90 rating means that the roof membrane assembly is rated at 90 psf.

✓ Assembly includes:

- Membrane
- Insulation
- Air / Vapour barrier
- Overlay boards
- Substrate

FMG Standards

✓ To determine what FM rating is required for a particular project a calculation must be performed.

- https://roofnav.fmglobal.com

✓ By referencing the FM 1-90 standard you may unintentionally specify something else like:

- Steel Deck Gauge
- Nailer Attachment
- Steel Weld Sizes and Patterns

FMG Standards

✓ What does the Designer, Roofer, General Contractor, or Inspector need to know?

- By specifying these standards you may unintentionally contradict another part of the project documents
- There is more to the standard then just membrane selections and uplift ratings
- Something that is "buried" in the roofing specification may impact the forming contractor or steel welders
- Possible extra costs during construction?

CSA Standards for Wind Uplift?

- ✓ CSA standards are currently being developed to encompass all aspects of roofing.
- ✓ The CSA A123.21 Wind Uplift Standard is being completed in phases.
- ✓ This standard is different than American standards as in is based on dynamic pressure differential rather than static pressure.
- ✓ Currently the only completed phase is the mechanically attached roofing systems, however the adhesively applied roofing systems is close to completion.

Use of standards

- ✓ Ensure the use of standard reference is appropriate and that all aspects of the design are reviewed to ensure conformance with those standards.
- ✓ Follow through during construction to ensure you get what is in the specifications.
- ✓ Remember: all inspections are meant to support the project specifications and drawings not change it.

Wind Uplift Performance

- ✓ Proper construction to withstand wind uplift forces is still not fully understood within the industry
- ✓ A roof can fail through the forces of the wind acting on the roof membrane surface.
- ✓ Many of the roof membranes we use today can withstand the forces of wind within BC fairly easily if designed properly.
- ✓ A typical detail that is overlooked when designing a roof is the perimeter flashing attachment.

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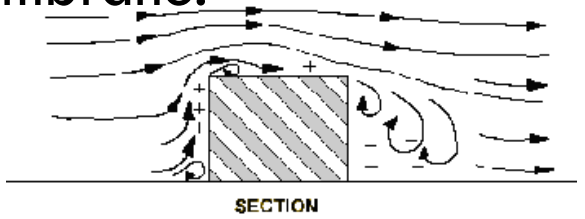
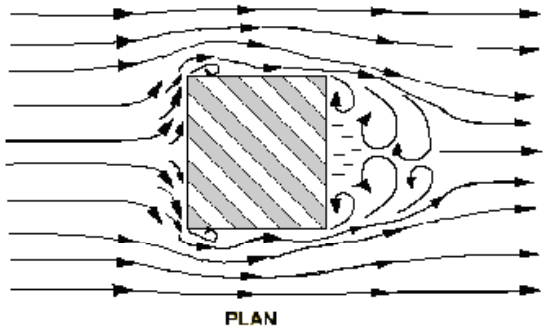
Wind Uplift Performance

✓ Improperly secured perimeter flashing is the leading cause of roof failures through wind uplift.

✓ Once the flashings are bent or torn off the wind can act directly on the edge of the membrane.





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Wind Uplift Performance

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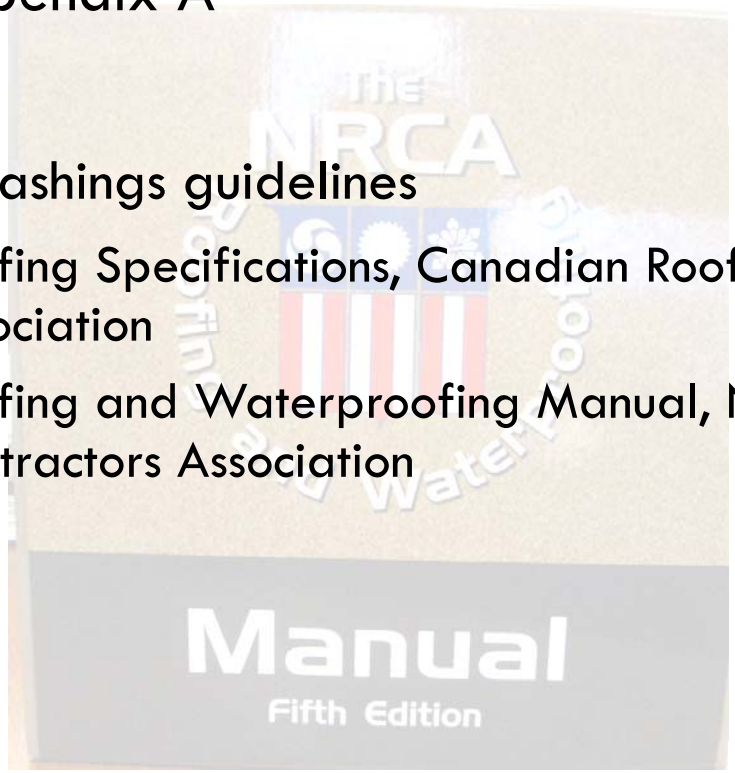
Wind Uplift Performance

- ✓ So how do the codes deal with this?
  - Part 5 – Environmental Separation
    - Construction conforming to a design that resists the loads of wind up-lift imposed on roofing and associated components.
  - Schedule B-2
    - 1.18 Roofing and Flashings
    - 1.22 Integration of BE components
    - 1.06 Structural Capacity of Architectural Components?

Wind Uplift Performance

- ✓ BCBC Appendix A
- ✓ A-5.6.2.1
  - Roof Flashings guidelines
    - Roofing Specifications, Canadian Roofing Contractors Association
    - Roofing and Waterproofing Manual, National Roofing Contractors Association



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Wind Uplift Performance

✓ There is currently no standard for the design of flashings for wind uplift in Canada.

✓ What Standards are in-place to aid with designing flashing components?

- ANSI/SPRI ES-1 - http://www.spri.org/
- FMG Data Sheet 1-49 - http://www.fmglobal.com/default.aspx

✓ Both standards are based on tested flashing assemblies

✓ The FM standard is intended to only be used on FM insured buildings. It is not referenced in any building codes or industry standards and therefore is a voluntary standard.

ANSI / SPRI ES-1 Calculation

PROJECT DATA

Project Name	Plaza 500
Building Height (feet)	190
Exposure (A, B, C or D)	B
Importance Classification	2
Basic Wind Speed (MPH)	90

RESULTS

Design pressure is the pressure that a product must be tested to withstand (using test method RE-2 or RE-3), measured in pounds per square foot.

Design Pressure Horizontal 22 psf
(outward pressure)

Design Pressure Vertical 57 psf
(upward pressure)

- SPRI releases final report on Thermal Performance of Ballast Study

The calculations are based upon an American Society of Civil Engineers standard. To do these calculations, you need building height, local terrain exposure, importance classification, basic wind speed, roof edge face height or coping height and width.

The calculator includes Help Sections to explain these terms.

WIND DESIGN CALCULATOR

Project Name: Plaza 500
Building Height (feet):
Exposure (B, C or D): B Help!
Importance Classification: 1 Help!
Basic Wind Speed (MPH): Help!
Do the Calculation

EXPOSURE

Exposure B
Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Use of this exposure category shall be limited to those areas for which terrain representative of exposure B prevails in the upwind direction for a distance of at least 1,500 feet (460 m) or 10 times the height of the building or structure, whichever is greater.

Exposure C
Open Terrain with scattered obstructions having heights generally less than 30 feet (9.1 m). This category includes flat open country and grasslands.

SPRI
SINGLE PLY ROOFING INDUSTRY

ANSI
American National Standards Institute

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ANSI / SPRI ES-1 Calculation

✓ Why can't I use the calculation in the Canadian Code?

- The Canadian code provides a calculation of surfaces of the building. On roofs it will provide an uplift pressure in the field, perimeter, and corners.
- This doesn't accurately depict the pressures on flashings as the forces are dynamically acting on the flashing from two different surfaces.

ANSI / SPRI ES-1

- ✓ So what do these numbers mean?
  - Well these are un-factored design loads.
- ✓ What is the next step?
  - Have the project flashings tested.
- ✓ NRCA has several tested details which their accredited members can use for projects.

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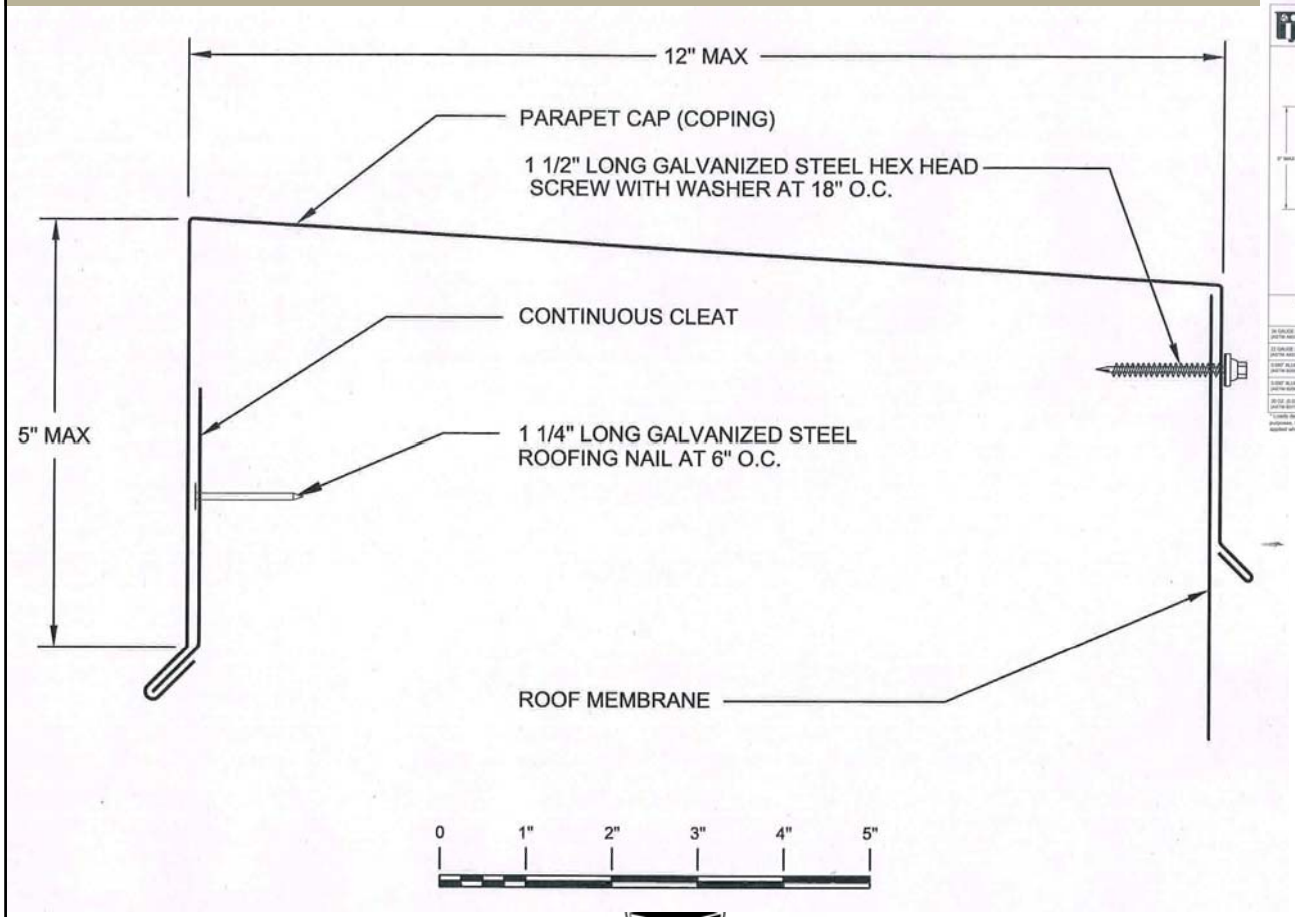
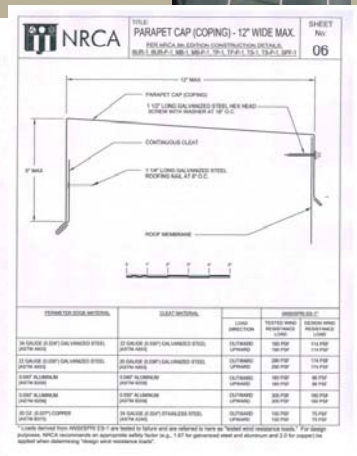
ANSI / SPRI ES-1 – NRCA Details





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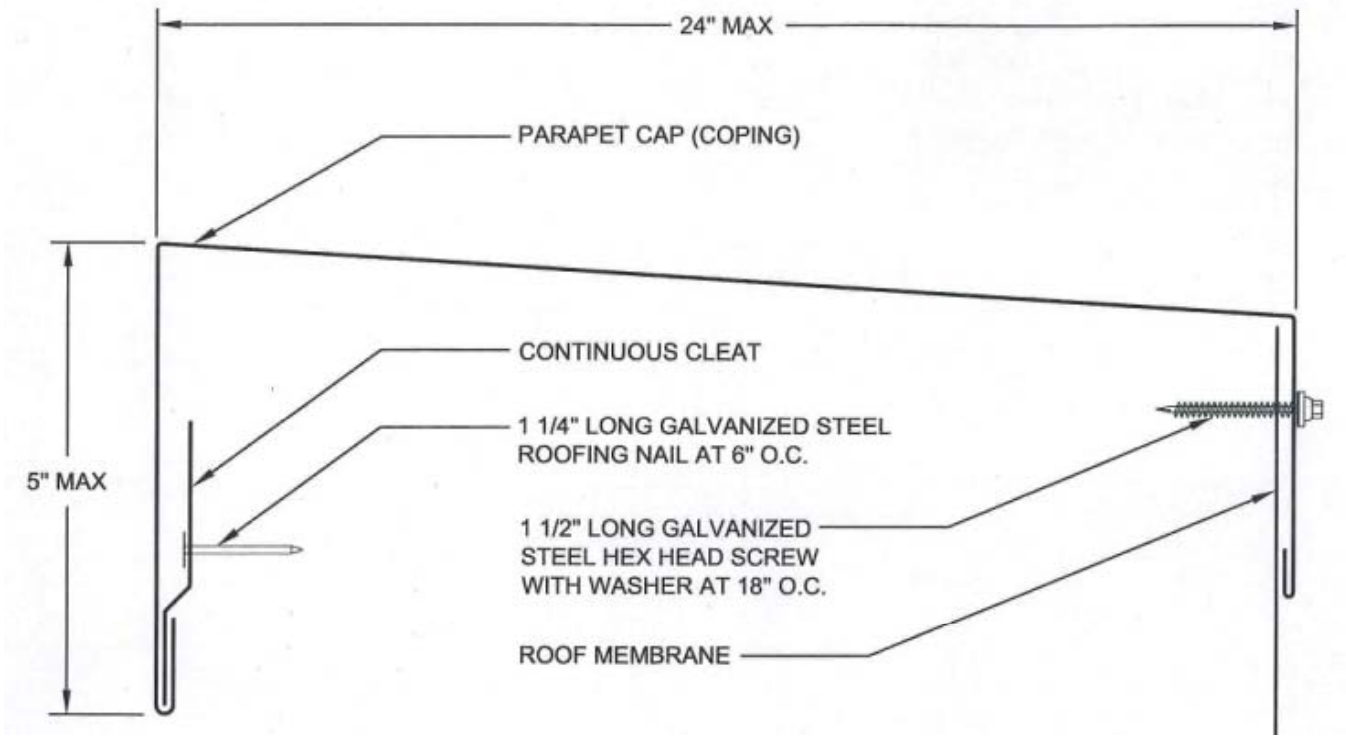
ANSI / SPRI ES-1 – NRCA Details

PERIMETER EDGE MATERIAL	CLEAT MATERIAL		ANSI/SPRI ES-1*	
		LOAD DIRECTION	TESTED WIND RESISTANCE LOAD	DESIGN WIND RESISTANCE LOAD
24 GAUGE (0.024") GALVANIZED STEEL [ASTM A653]	22 GAUGE (0.030") GALVANIZED STEEL [ASTM A653]	OUTWARD UPWARD	190 PSF 190 PSF	114 PSF 114 PSF
22 GAUGE (0.030") GALVANIZED STEEL [ASTM A653]	20 GAUGE (0.036") GALVANIZED STEEL [ASTM A653]	OUTWARD UPWARD	290 PSF 290 PSF	174 PSF 174 PSF
0.040" ALUMINUM [ASTM B209]	0.040" ALUMINUM [ASTM B209]	OUTWARD UPWARD	160 PSF 160 PSF	96 PSF 96 PSF
0.050" ALUMINUM [ASTM B209]	0.050" ALUMINUM [ASTM B209]	OUTWARD UPWARD	300 PSF 300 PSF	180 PSF 180 PSF
20 OZ. (0.027") COPPER [ASTM B370]	24 GAUGE (0.024") STAINLESS STEEL [ASTM A240]	OUTWARD UPWARD	150 PSF 150 PSF	75 PSF 75 PSF

* Loads derived from ANSI/SPRI ES-1 are tested to failure and are referred to here as "tested wind resistance loads." For design purposes, NRCA recommends an appropriate safety factor (e.g., 1.67 for galvanized steel and aluminum and 2.0 for copper) be applied when determining "design wind resistance loads".

ANSI / SPRI ES-1 – NRCA Details



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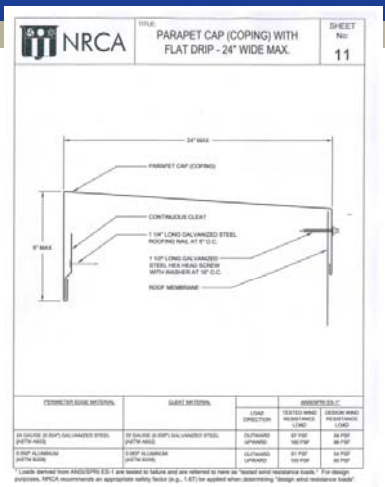

PERIMETER EDGE MATERIAL	CLEAT MATERIAL		ANSI/SPRI ES-1*	
		LOAD DIRECTION	TESTED WIND RESISTANCE LOAD	DESIGN WIND RESISTANCE LOAD
24 GAUGE (0.024") GALVANIZED STEEL [ASTM A653]	22 GAUGE (0.030") GALVANIZED STEEL [ASTM A653]	OUTWARD UPWARD	97 PSF 160 PSF	58 PSF 96 PSF
0.050" ALUMINUM [ASTM B209]	0.063" ALUMINUM [ASTM B209]	OUTWARD UPWARD	91 PSF 150 PSF	54 PSF 90 PSF

* Loads derived from ANSI/SPRI ES-1 are tested to failure and are referred to here as "tested wind resistance loads." For design purposes, NRCA recommends an appropriate safety factor (e.g., 1.67) be applied when determining "design wind resistance loads".

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Flashing Clips

RCABC Flashing Standards

- ✓ RCABC has developed flashing attachment standards for use by RCABC members.
- ✓ These standards are based on SMACNA (Sheet Metal and Air Conditioning Contractors` National Association) details with some changes to meet BC's specific requirements.
- ✓ SMACNA details are also tested to meet the ANSI/SPRI ES-1Standard
- ✓ These flashing attachment details are meant for typical details and thus cannot be used for unique or custom flashing profiles.
- ✓ Wind ratings for RCABC details are not provided

Future Changes to the NBC

✓ RCABC with SIGDERS (Special Interest Group For Dynamic Evaluation of Roofing Systems) and NRC are developing the CSA A123.21 Wind Uplift Standard

- Mechanically Attached Roofing Systems (MARS)
- Adhesively Applied Roofing Systems (AARS)
- Metal Edge Flashing Attachment

SIGDERS
Special Interest Group for Dynamic Evaluation of Roofing Systems

Wind Performance

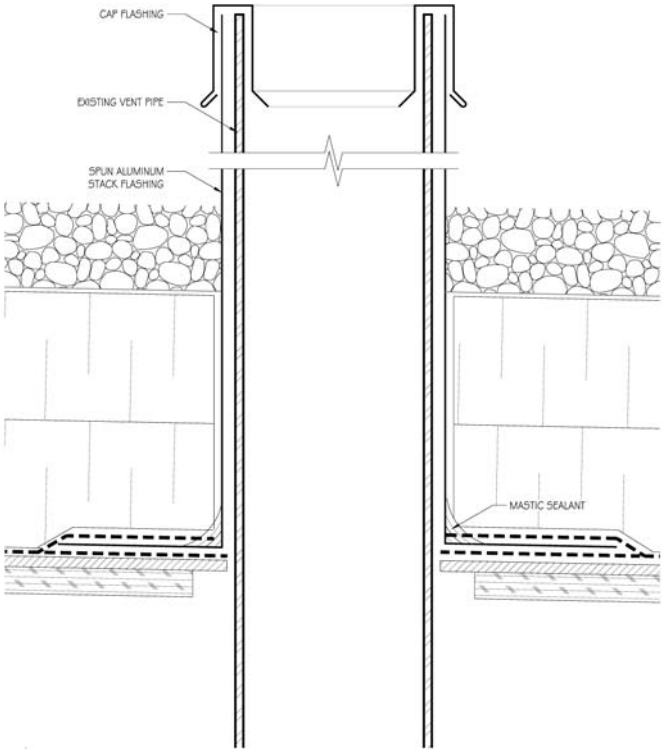
✓ Remember, when it comes to wind design, just because it has worked for hundreds of years doesn't mean it can't fail in a second.

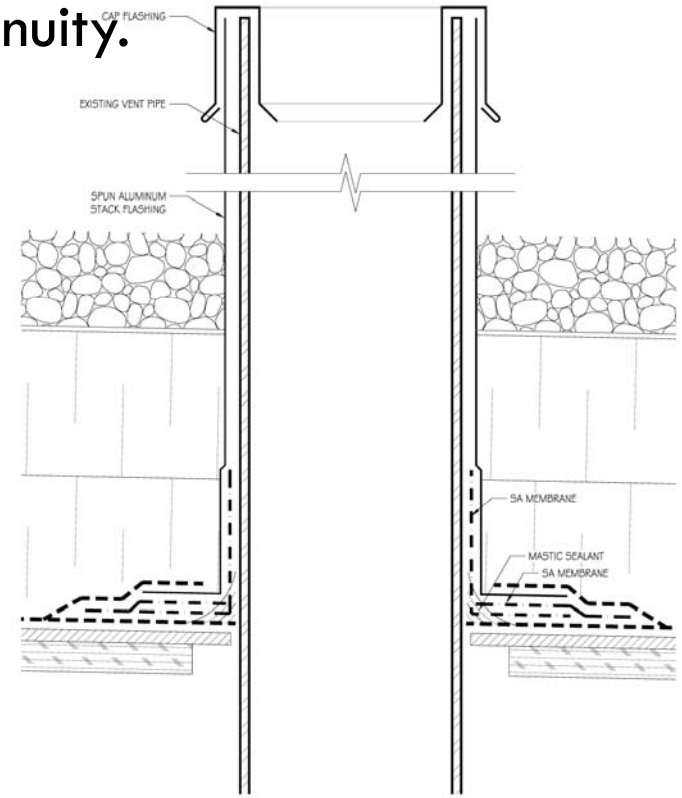
Air Barriers in Roofs

- ✓ Still misunderstood within the roofing industry
- ✓ RCABC does not provide any direction on air barriers
- ✓ Improper Air barrier installation still lead to premature failures of roofs
- ✓ Several typical details where installation problems still occur are:
  - Penetration flashings
  - Perimeter parapets
  - Mechanical units

Air Barriers in Roofs

✓ Plumbing stacks, B-vents, etc. are often not properly detailed for air barrier continuity.





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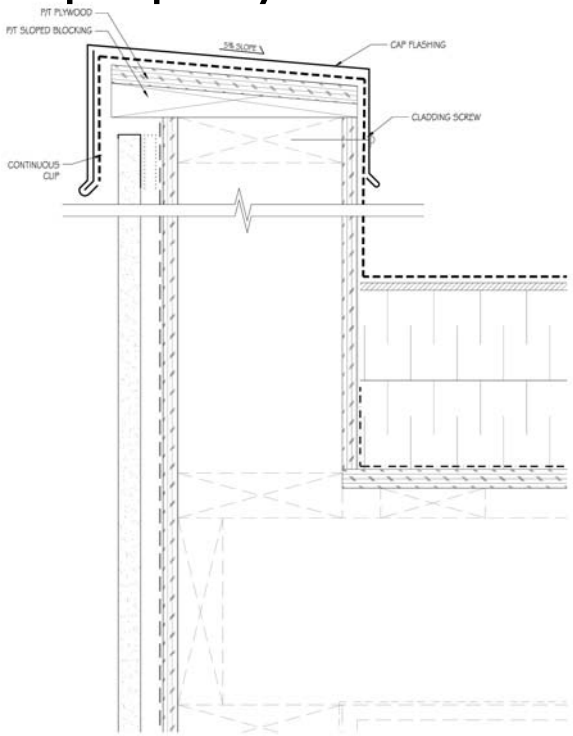
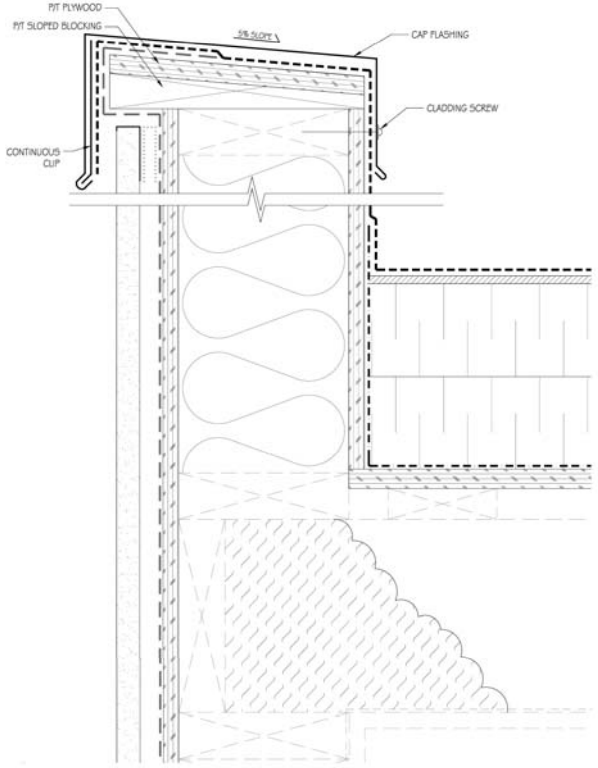
Air Barriers in Roofs

✓ Air Barriers at parapet walls are typically not properly tied in with the exterior walls





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Air Barriers in Roofs

- ✓ Ensure that the air barrier planes within roofing systems are thought-out, detailed properly and constructed as designed.
- ✓ Discuss these details during the pre-roofing meeting to ensure the roofer understands that these are not "standard" details.
- ✓ Don't simply rely on caulking to withstand the forces on the air barrier.
- ✓ Remember that the RCABC inspector will not review to ensure the air barrier is completed properly but will confirm that the project documents are followed.

Some Points About Green Roofs

- ✓ Typical green roof assemblies if designed and constructed properly should last 50 years with proper maintenance
- ✓ Green roofs have been building in popularity over the last few years do to a push to be “greener”
- ✓ Many landscapers / designers / inspectors are now moving to the roof of the building without properly understanding the differences with the systems.

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Some Points About Green Roofs

- ✓ The industry standard for plumbing stacks is Spun Aluminum
- ✓ Aluminum Corrosion is affected by the pH level of the water that comes into contact with the plumbing stacks. Typically a thin oxide forms on the aluminum protecting it from corrosion but when the pH is outside of its normal range the oxide will breakdown exposing the raw aluminum.
- ✓ Fertilizers used on many Garden roofs affect the pH level of the soil and the water runoff
- ✓ Aluminum used for flashings is fairly stable at a pH of between 4 and 9

Some Points About Green Roofs

- ✓ Although you may design a Green Roof to be within a specific pH range fertilizers and plants can be easily changed after construction
- ✓ A study of green roofs after construction showed the average pH of the water runoff is unintentionally above 8 and in many cases is above 9
- ✓ Several documented cases in Ontario of aluminum plumbing stack corrosion leading to roof failures within 5 years of construction.

Some Points About Green Roofs

- ✓ Plumbing Stack Flashings
  - Aluminum Stacks - $30 – Possibility of Problems
  - Copper Stacks - $60 – No Problems
  - Stainless Steel - $200 – No Problems
- ✓ What about barrier coatings?

Some Points About Green Roofs

✓ The fire ratings on green roofs have not yet been determined (Class A, B, C)

✓ SPRI has developed a standard that has just been sent to ANSI for inclusion in the IBC.

- VF-1 External Fire Design Standard for Vegetative Roofing Systems
- RP-14 Wind Design Standard for Vegetative Roofing Systems

Some Points About Green Roofs

✓ There are several details that are typically overlooked on green roof projects.

✓ These details, although simple to do correctly, can cause major problems with the roof system and are typically related to coordination

- Plumbing Stack Heights
- Membrane Heights
- Drain Sumps

Some Points About Green Roofs

✓ Plumbing stacks should terminate a minimum of 8" above the mature height of the plants.

Some Points About Green Roofs

- ✓ Membrane termination heights
  - Many green roofs are being installed without the roof membrane extending up the surrounding walls 8" above the soil.
  - Many times the roofer doesn't know how deep the soil is as this is by others.
  - Prior to the membrane installation a start-up meeting with the landscaper, roofer, and designer is a must to ensure extra costs for additional stripping is not incurred.

Some Points About Green Roofs

✓ Ensure that the drains used on green roofs have provisions that allows for cleaning as well as a gravel separation Zone.

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Some Points About Green Roofs

- ✓ So what about irrigation…….
  - Ensure a proper flashings are used for irrigation or

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Conclusion

- ✓ The RCABC Inspector vs. the Designer
  - Know the responsibilities of each and where things may overlap to ensure consistency and high overall project delivery.
  - Be aware that the role of the RCABC and the RCABC inspector is often misunderstood.
- ✓ Specification References
  - Ensure that language within specifications are appropriate for the system and the construction being used otherwise what you may have expected won't be provided.
  - Make sure you understand what you are referencing and what it means.

Conclusion

- ✓ Perimeter Edge Flashing Attachment
  - Ensure that the perimeter edge flashing is designed to meet all applicable forces exerted on it and that this is provided during construction.
- ✓ Air Barriers in Roofs
  - Design an air barrier assembly to meet the applicable loads and will last the life of the roof.
  - Make continuous at penetrations and at roof wall intersections
- ✓ Green Roofs
  - Specify accessories that will last the life of the roof and provide ease of maintenance.

QUESTIONS?

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