Evaluating Wind Resistance of Single Ply Membrane Roof Covers on Commercial Buildings with Steel Decks

About the Roof Cover:

Single Ply Membrane (SPM) Roof Covers

White membrane roofs are typically made using **T**hermoplastic **P**oly**O**lefin (TPO) or **P**oly**V**inyl **C**hloride (PVC) membranes, while black membrane roofs are typically made using a synthetic rubber **E**thylene **P**ropylene **D**iene **M**onomer (EPDM) membrane. Damage to SPM roof covers can be reduced by following enhanced standards for anchorage of the membrane and edge flashing. SPM covers can be mechanically attached, fully adhered or ballasted. This guide does not address ballasted covers.

Mechanically Attached SPM roof covers have their membranes anchored to the steel deck using metal or plastic plates, like large washers, and long screws. The plates are located along overlapping membrane seams and installed using screws that penetrate through insulation boards and engage the deck below. This type of membrane installation can be identified by checking seams for signs of anchorage plates, as shown in Figure 1. Typical high wind failures include the SPM tearing over the seam plates, if the sheets are too wide and/or if the seam plates are spaced too far apart. TPO and PVC membranes have seams where the two overlapping sheets are heat welded together to form a mechanical bond. Batten bars are narrow plastic or metal bars that can also be used to fasten the SPM to the deck, and they will be covered with a membrane. Newer mechanically attached EPDMs use double-faced tape to attach seams, while older installations use adhesives or single-face tape, and therefore, are more prone to failure.

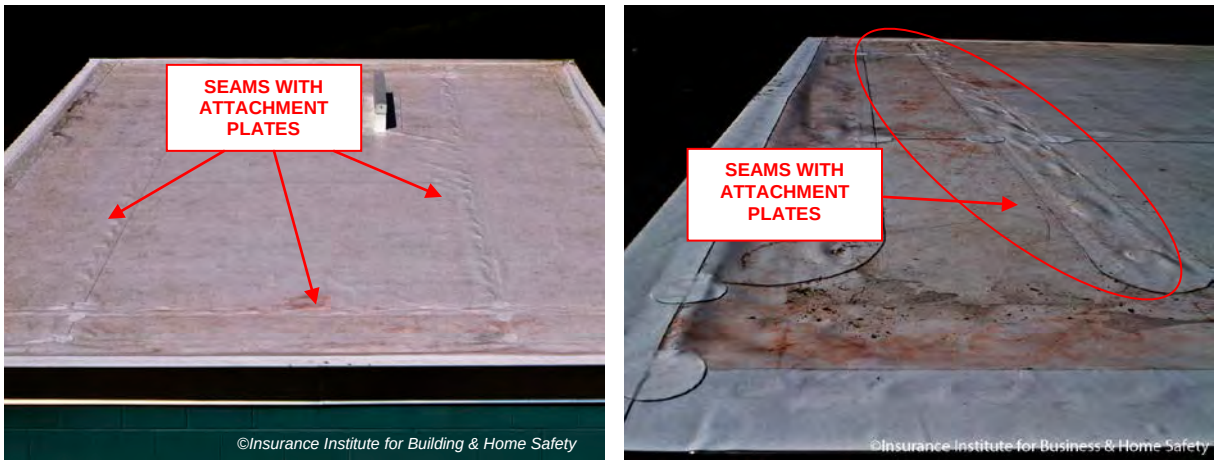

Figure 1. Mechanically attached TPO roof membranes with indications of seam attachment plates.

Adhered SPM roof covers include a contact adhesive that attaches the membrane to a substrate, typically insulation boards. The boards are attached with plates and long screws, which engage the steel deck below. This type of membrane installation can be identified by looking for indentations in areas away from laps, where the membrane is pulled down over anchor plates used to attach the insulation, as shown in Figure 2 (next page). Typical high wind failures include SPM delaminating from insulation board; delamination of insulation board facer; or an inadequate number and spacing of plates and screws anchoring insulation to the deck.

Figure 2. Adhered EPDM with insulation plates (left) and TPO cover removed exposing insulation plates (right).

INSPECTION PROCESS:

From the Ground:
Perform Quick Evaluation: While it is not practical to evaluate the roof cover system from outside while standing on the ground, it is possible to perform a quick evaluation of flashing. To ensure the best inspections of the membrane, gain access to the roof, including the edge of the roof, and to an area where the bottom surface of the roof deck near a corner of the roof is visible. It may be possible to use a service such as "Eagle View" to provide some level of inspection without walking the roof. Use the IBHS Guide: *How to Evaluate Wind Resistance of Roof Edge Flashing* (http://disastersafety.org/hurricane/evaluating-flashing-and-coping) to inspect and evaluate roof edge flashing.

From the Roof, Using Appropriate Safety Precautions and Personal Protective Equipment:
Walk several sections of the roof, including locations where you can observe the perimeter and corners of the roof.

Use the following checklist to identify key areas of inspection:

Yes	No	
		1a. Are plates present along the seams of the roof membrane sheets? If so, the roof cover is mechanically attached. If it is difficult to see the plates, gently rub your foot along the seam to identify the plate locations. Next, to determine wind resistance, measure the spacing of the seam plates in the interior/field sections and note the sheet width. Then, compare the sheet width and plate spacing with that of seam plates in the perimeter areas to answer the following questions: Does the perimeter area have more plates along the seams? Were reduced-sized membrane sheets used in the perimeter areas? Are there intermediate rows of plates or batten bars covered with strips of membrane?
		1b. Using the notations made above, determine whether, in comparison to the perimeter areas, there are additional rows of plates or batten bars in the corners to provide additional anchor plates and screws?
		2. No plates will be present along membrane seams if the roof cover is a fully adhered SPM. However, insulation plates may be visible. If it is difficult to see the plates, gently rub your foot over the membrane to identify the plate locations. If the roof deck below is exposed, it may be easier to count the fasteners from inside. Either way, the goal is to determine if the insulation is anchored to the deck with a higher density of plates and screws in the perimeter and corners than in the interior. To determine this choose a corner area of approximately 3 ft. x 3 ft. and count plates. Do this for a perimeter area away from the corner, and also for a 9 ft. x 9 ft. area in the interior of the roof. Divide the number of interior fasteners by 9. For wind resistance, the greatest number of fasteners should be located in the corners, followed by the perimeter and the fewest plates in the interior. Is this the case?
		3. If SPM is fully adhered, is there a line of stripped-in plates around the entire perimeter, about 1 ft. in from the edge? This is possible, but less common on mechanically attached membranes.
		4. Is the membrane that covers the top flange of the perimeter flashing well adhered to the flashing?
		5. Does the membrane show any signs of tenting / shrinkage; does it pull away from the edges around parapet walls or roof mounted equipment?
		6. Does the membrane show any signs of distress such as tears, cracks, cuts or punctures?

		7. Are the seams worn or are there signs that the membrane has become brittle or patches that are separating or showing distress?
		8. Are there one or more sections of the membrane that are loose, or are there indications of long-term standing water such as extensive mold or vegetative growth?

Assessing the Roof*:* In the checklist above, the first three questions address whether the roof was installed using superior techniques. These techniques should, provided the materials are in good condition, indicate a more wind-resistant roof. The last four questions below are intended to help assess the condition of the roof membrane.

If the answer is "Yes" to questions 1a and 1b or, 2 and 3 (depending upon the appropriate type of membrane installation), then it is likely the roof membrane installation is more wind-resistant than typical installations. For example, there are 50% more anchor points along the roof perimeter than at the interior and 100% more anchor points in the corner than in the interior.

If the answer is "Yes" to any of questions 5-8, the roof is likely to need repairs and possibly replacement.

From the Inside of the Building:
Find an access point to visually inspect the bottom surface of the steel deck, preferably in a corner where the perimeter is also visible. This may be in a corner where there is storage or a warehouse area, or may be accessible by moving a drop ceiling panel in a corner room on the top floor. Mechanical rooms also typically have exposed roof decks.

Use the following checklist to identify key areas of inspection.

Yes	No	
		1a. Identify fastener locations. If the membrane is mechanically attached to the steel deck, there will be straight lines of fasteners protruding through the steel deck. Are there indications of more fasteners around the roof perimeter than in areas closer to the center of the building?
		1b. Are the fasteners spaced more closely in the corners than the perimeter of the roof?
		2. If the membrane is fully adhered, there will be insulation board fasteners protruding through the deck in a scattered manner. If you could not determine the number of fasteners from the roof, use this opportunity to find out if there are indications that the insulation is anchored to the deck with a higher density of plates and screws in the perimeter and corners. To do this, look for screws through the roof deck. Are these screws more closely spaced along the perimeter and in the corner of the roof? Count screws as described above in "From the Roof, Question 2." Be careful not to include steel deck lap screws, which are smaller than the insulation screws, in this count.
		3. If it is fully adhered, are there screws around the entire perimeter, about 1 ft. in from the edge?
		4. Are there water stains on the ceilings?
		5. Are there rust marks or discoloration on the underside of the steel deck?
		6. Are there water stains on perimeter walls?

Assessing the Roof: If fasteners are more closely spaced in the corners, this is an indication the roofer was providing greater uplift capacity in the areas where wind uplift is greatest.

1. If the answer is "Yes" to questions 1a and 1b or, 2 and 3 (depending upon the appropriate type of membrane installation), then it is likely that the roof membrane installation is more wind-resistant than typical installations.
2. If the answer is "Yes" to questions 4-6, there are signs of leaks and the roof cover needs to be repaired or replaced.

Upgrading to Stronger More Wind-Resistant Construction through Repair, Recovering or Replacement
Significant roof cover securement improvements will be most cost effective at the time of a major roof repair, recover, or replacement. For more guidance and information, use the IBHS Guide, *Commercial Roofs: Repair, Recover or Replace* (http://disastersafety.org/hurricane/repair-recover-or-replace-the-roof).