



Code Compliance Research Report

Subject: Kelly Company-2001 Inc.
Pressure-Equalized Single-Ply Roofing Systems
Recovering Existing Roof Systems

Date: February 5, 2013

Materials: Kelly-2001 EPDM, PVC and TPO Single-Ply Membranes and Accessories

Test Standards:

1. UL 1897 Standard for Uplift for Roof Covering Systems
2. CSA A123.21-10 Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane-Roofing Systems

Building Code(s):

1. 2012 *International Building Code*
2. 2009 *International Building Code*

Summary:

The Kelly-2001 pressure-equalized single-ply roofing system meets the requirements and intent of the *International Building Code* requirements for recovering an existing roofing system, subject to the limitations provided herein, under the following conditions:

1. The existing roof system may contain wet insulation or other elements;
2. The existing roof system has one or more applications of any type of roof covering;
3. The membrane may consist of EPDM, PVC or TPO;
4. The membrane is installed in accordance with Kelly-2001 specifications using one-way pressure-equalization vents to provide wind uplift resistance and moisture ventilation;
5. Any roof components that are installed beneath the Kelly-2001 membrane must be moisture resistant (such as DensDeck, fire guard mat, cement board, extruded or expanded polystyrene insulation boards, isocyanurate (iso) insulation boards, geotextile mat, or other materials approved for this use by Kelly Company-2001, Inc.).

Limitations:

1. The existing roof deck and structural components shall be capable of supporting the combined loads of the existing and the Kelly-2001 pressure-equalized roof system including the material and equipment loads during installation. [IBC Section 1510.2]
2. Where moisture trapped between two or more layers of Class I or Class II vapor retarders within existing roof covering(s), those vapor retarders shall be vented to allow moisture transfer to the underside of the Kelly-2001 pressure-equalized membrane.

Discussion:

The *International Building Code (IBC)* provides two (2) prohibitions for roof recovers which are pertinent to this analysis:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.

and

3. Where the existing roof has two or more applications of any type of roof covering. [*IBC*, Section 1510.3]

(Prohibition # 2 does not pertain to membrane roof systems.)

However, the *IBC* provides for an exception to these prohibitions: “1. Complete and separate roofing systems, such as standing-seam metal roof systems, that are designed to transmit the roof loads directly to the building’s structural system and that do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.” [*IBC*, Section 1510.3, Exception 1]

One of the primary reasons to require the removal of existing roof coverings where two or more in place is to assure that the new roof retains adequate wind uplift resistance. If the new roof is fully adhered to or fastened through the existing roof covers, the wind uplift resistance could be compromised by either:

1. Loss of integrity of the existing roof(s) (in the case of an adhered new roof); or
2. Corrosion/deterioration of fasteners due to moisture in the existing roof(s).

The Kelly-2001 pressure-equalized membrane roof system avoids both of these pitfalls because it relies on neither adhesives nor fasteners for its wind uplift resistance. In fact, this roof system relies on wind uplift-generated-negative air pressure to remain in place during high wind events. Air pressure serves to transmit the wind loads on the roof directly to the structural elements of the roof and the building.

Therefore, Exception 1 in *IBC* Section 1510.3 applies to the Kelly-2001 roof system.

Wet roofing materials: Prohibition 1 is specifically concerned with level of moisture in the existing roof coverings. While Exception 1 applies to Prohibition 1, it is noteworthy to discuss the drying potential of the Kelly-2001 pressure-equalized roof system.

The Kelly-2001 pressure-equalized membrane roof system is unlike traditional membrane roofs in that (1) it is loose-laid over the substrate to which it is applied and (2) it is vented to the exterior. This construction technique allows communication of air between the Kelly-2001 membrane and the existing roof covering.

The 2012 *IBC Code and Commentary* provides elucidation on this Prohibition 1:

When the existing roof or roof covering is water soaked, it must be allowed to dry completely so as not to trap moisture beneath the new layer of covering. This could cause a rapid deterioration of the new covering material, as well as the existing sheathing. The existing covering is required to be removed if it cannot adequately dry out or if its physical properties have been permanently altered. [p. 15-36]

Thus, the intent of the code is to assure that wet components dry out and not deteriorate the new roof membrane and components.

The Kelly-2001 pressure-equalized roof system demonstrated its ability to dry out existing roof substrates by laboratory testing and field studies.

The Kelly-2001 pressure-equalized roof system was tested for its drying capabilities at the National Research Council Canada [NRCC Report No. B1456.4]. A fire guard mat (a porous synthetic felt) was installed as a component of the test roof assembly; to this mat was introduced 23 liters (50.8 lb) of water. The roof membrane was then subjected to 12 hours at 20°C (68°F) of dynamic wind testing in accordance with CAS A123.21-10 “Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane-Roofing Systems” (a test methodology wherein the roof test assembly is subjected to dynamic pressure cycling simulating wind gusting effects). After this 12 hour period, the fire guard mat was weighed. It was determined that 12 lb of water had evaporated, dissipated and vented from the test roof assembly. The net result was that 23.6% of the water vented from the test roof assembly within a 12 hour period.

In the field, the Kelly-2001 pressure-equalized system was installed over an existing light-weight concrete deck of known moisture content [French, 2003]. Five years after the installation of the replacement roof system, the moisture levels within the deck were re-measured. Although this particular roof represented a “worst case scenario” for drying, French observed that overall the concrete deck exhibited a gradual drying trend that dramatically reduced the water content of the wettest sections of the deck.

Based on both laboratory and field evidence, it appears that the Kelly-2001 pressure-equalized membrane roof system has the ability to dry out wet roof substrates over which it has been applied. The drying rate can be enhanced by assuring that vapor retardant membranes (Class I and II) within the existing system are appropriately penetrated to allow moisture transfer to the new, vented membrane.

Additionally, the Kelly-2001 pressure-equalized roof system avoids the use of components below the membrane, the corrosion or deterioration of which would negatively impact its wind uplift resistance.

Therefore, the prohibition against roof recovery over wet substrates would not apply to the Kelly-2001 pressure-equalized roof system. It should be noted that the drying of existing roofs can be accelerated by the venting of existing Class I and II vapor retarders (including membranes) and providing air paths between wet materials and the Kelly-2001 one-way vents.

Conclusions:

The Kelly-2001 pressure-equalized roof system meets the intent and requirements of the *IBC* Section 1510.3 for recovering over existing wet and multiple roofs when installed under the conditions and limitations provided for herein.

Respectfully submitted,
Deer Ridge Consulting, Inc.



Roger V. Morrison, PE, RRC
President

Reference Documents:

1. 2009 International Building Code: Chapter 15.
2. 2012 IBC Code and Commentary, Volume 1.
3. 2012 International Building Code: Chapter 15.
4. ESR-3184 (ICC-ES Evaluation Report).
5. ESR-3185 (ICC-ES Evaluation Report).
6. French, Warren R. 2003. "Further Evaluation of a Pressure-Equalized Single-Ply Roofing System to Determine Drying Effects on a Moist Cementitious Roof Deck." *Interface*, September 2003: 5-12. www.rci-online.org/interface/2003-09-french.pdf [accessed February 5, 2013].
7. National Research Council Canada, Report No. B1456.1.
8. National Research Council Canada, Report No. B1456.4.
9. UL Listing TGIK.R9734 Roofing Systems, Uplift Resistance.