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“Reverse Ballasted Patent Application” Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique Introduction

Background of the Invention:

A **loose laid and ballasted roof system** is a common methodology in the low sloped flat roof commercial building construction with single ply rubber or plastic waterproofing membrane ballasted with smooth river washed rocks.

Loose laid and ballasted roofs consist of:

1. **A Structural Roof Deck** wood, metal, concrete, composite plank, etc.;
2. **Roof Assembly Components** Air Barrier, Fire Barrier, Rigid Roof Insulation, Cover Board etc. are loose laid over the structural roof deck;
3. **Roof Waterproofing Membrane PVC, EPDM, TPO, etc.**: is loose laid over the roof assembly components and;
4. **Ballasted in Place on Top of The Waterproofing Membrane:** With River Washed Smooth Round Gravel 1" to 2" in diameter or concrete paver blocks.

The loose laid waterproofing membrane is mechanically fastened to the building structure at perimeters and through roof penetration edges.

These mechanically fastened membrane termination areas are called angle changes. Once terminated they are properly flashed up vertical walls, curbs, vent pipes, drains, gutters, gravel stops, and other roof

*See attached ANSI/SPRI RP-4 2013 Wind Design Standard for Ballasted Single-ply Roofing Systems

Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique

appendages to roofing industry standards. On vertical walls the waterproofing membrane is flashed to a finish height for buildings geographical area expected snow and rain conditions.

The loose laid roof membrane, insulation, and roof assembly components, are commonly “ballasted in place” or weighted to the structural roof deck with smooth round stones referred to in the roofing trade as river washed gravel. 10-15 pounds per square foot per industry standards ANSI-SPRI EP20*.

Usually 10 pounds of gravel, 1” to 2” (one to two inches) in diameter are used on top of the roof waterproofing membrane with additional amounts used on corners and perimeters in geographical areas where wind uplift is severe. This gravel is used to weigh the roof waterproofing membrane and roof assembly components to the roof deck.*

In addition on some roofs in high wind zones, larger river washed stones 3” to 5” (three to five inches) in diameter are used in perimeters and corners to ballast the membrane and roof assembly components to the roof deck to hold it in gravitational pull against high wind uplift pressure differentials. Concrete pavers are also used to ballast roof membranes and they have similar weight-to-wind up lift resistance design criteria.

The ballasted roof has provided an okay resistance against winds since invented, except in high winds.

Gravel scour and paver displacement causes ballooning of the waterproofing membrane. This membrane ballooning has a moderate flutter effect that causes the loose laid insulation to shuffle under the roof membrane and bunch up on itself. To repair a damaged ballasted roof requires:

1. Removing the gravel or paver ballast from the damaged membrane area, and
2. Pealing back the membrane over the shuffled insulation and roof assembly components.

*See attached copy of NRCA Specifications & Details for Loose Laid and Ballasted Roofs

Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique

3. Reinstalling the shuffled insulation board that usually has been broken in an attempt to remove gravel ballast and roof membrane from the workmen walking over the shuffled insulation and roof assembly components.
4. Replace insulation boards
5. Reinstall roof water proofing membrane
6. Reinstall ballast gravel or pavers

Description of the Patent

This Thomas L. Kelly unique and novel roof application technique uses a heavy weighted construction wall board such as cement tile boards used for bathroom shower tile areas, to be glued to the underside of the roof waterproofing membrane, thus so named "**Reverse Ballasted.**"

The weighted construction boards take the place of the gravel ballast or concrete pavers to weighing the waterproofing membrane and the roof assembly components to the structural roof deck.

A roof waterproofing membrane is adhered to a "**Weighted Cover Board**" provides a better ballast than the present loose laid round gravel and/or concrete pavers for the following reasons:

1. When the roof waterproofing membrane is adhered to the "**Weighted Cover Board**", the waterproofing membrane cannot elongate and balloon up in itself.
2. The ballooning of a loose laid roof membrane will cause a shifting of the ballast rock and/or pavers thus allowing loose laid rigid roof insulation boards to bunch up on themselves under the gravel ballasted roof membrane.

Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique

3. Wind uplift 3-second gust pressure stresses concentrated on perimeters and corners are horizontally transferred into the center of the roof when the roof membrane is adhered to the **“Weighted Cover Boards.”**
4. The combination of membrane and “**Weighted Cover Boards**” act as a uniform mass against a specific area concentrated corner or perimeter wind load.

Like a trampoline, the concentrated perimeter or corner intense wind uplift pressure load is shared over the total roof expanse. All the weighted Cover Boards are connected to each other like an engine to a 100-car train.
5. With a paver or rock ballasted roof membrane once the gravel or one of the pavers are shifted in a concentrated wind load, the membrane can balloon causing a domino failure effect as the roof assembly continues to balloon up and blows apart.
6. Rock and paver ballasted roofs provide a rough surface to stagnate surface air flow, but once wind uplift pressures exceed the ballast weight and the membrane can balloon, the ballast can blow off the building or roll back and keep increasing the membrane in the ballooning size to where the gravel pile weight stops the ballooning membrane or collapses the structural roof deck with structural over loading of rock or paver ballast.
7. The reverse ballasted application technique never shifts or loses the ballasted weighted boards in a perimeter or corner extreme wind uplift load. It merely absorbs the concentrated load to share it with the total roof expanse like a trampoline or ice on a lake.
8. Although argued in final construction cost, the reverse ballasted roof is usually less expensive to install because all roof components can be transported by workmen and the roof is ballasted everyday as the work continues.

Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique

9. Ballast rock requires heavy equipment usage in roof installation sequence and is frequently ballasted days after the roof membrane and insulation boards are installed. The loose laid insulation and membrane are vulnerable to balloon and can blow away in light winds during the non-ballasted construction phase.
10. Finding leaks in a gravel or paver ballasted roof is a nightmare. Sometimes walking on an old ballasted roof in a freeze/thaw zone that breaks the rocks into smaller arrowhead type sharp stones that snow loads and human walk on heel pressure can causes punctures in the underlying roof waterproofing membrane.
11. In the reverse ballasted application the roof waterproofing membrane is adhered to the top of the “**Weighted Cover Boards**” and is easily examined for cuts, punctures, and deficiencies that then can be easily repaired.
12. The reverse ballasted technique adds significantly less weight to the roof structure, 2 to 3 pounds per sq. ft. where a rock or paver ballasted roof is 10 to 15 pounds per square foot.
13. Rock ballasted roof membranes when they are damaged. Water can freely flow horizontally under the loose laid membrane and loose laid insulation to enter the building.
14. Reverse Ballasted Roofs resist leaking even when damaged.
15. The reverse ballasted roof assembly the waterproofing membrane is adhered to the “**Weighted Cement Board.**” This glued membrane inhibits horizontal free flow of water under the waterproofing membrane. The water has to soak through a membrane cut or damaged and then be absorbed vertically in the “**Weighted Cover Board**”, which is very slow on concrete boards and water resistant gypsum boards.

Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique

16. Reverse ballasted roof leaks are easily detectible with infrared heat sensitive cameras at sundown.

Wet “**Weighted Cover Boards**” under the roof membrane hold heat when wet, and are easily detected.

17. Ballast rock and paver type roofs have been outlawed in many high wind costal communities because of wind blowing the rocks and pavers off the roof and into other buildings and inhabitants. This is not a concern with the Reverse Ballasted T.L. Kelly Unique Roof Application Technique. There are no stones or small paver blocks to be blown off the roof waterproofing membranes surface.

18. Conventional Totally Adhered Membrane vs. Reverse Ballasted Adhered Membranes:

Conventional totally adhered roof waterproofing membranes are adhered to mechanically attached or adhesively attached insulation boards or cover boards fastened to the structural roof deck.

19. The reverse ballasted waterproofing membrane is adhered to a loose laid “**Weighted Cover Board**” that like a trampoline or ice on a lake will transfer concentrated wind uplift pressure loads laterally out from their source for the total resistance strength of the some of their parts. This is because it is loose laid and can float like ice on a lake.

20. The conventional adhered membrane roof cannot laterally load share. The waterproofing membrane is adhered to a rigidly fixed substrate and breaks at its weakest link when a concentrated load is put on its surface. Once the membrane’s securement weakness takes place in a conventional rigidly adhered roof assembly, a domino effect of the waterproofing membrane defect continues to grow in peal and shear forces pealing off the adhered insulation or cover board surface or breaking insulation boards around fastener washers.

Reverse Ballasted Waterproofing Membrane Adhered to Weighted Cover Board Roof Application Technique

21. The reverse ballasted application has greater flexibility in structural shear, and diaphragm, for wind uplift and snow rain compression loading because it is loose laid over the roof substrate and decking, like the skin of a drum.
22. In some extreme wind uplift hurricane costal and interior tornado areas, a lesser costing Gypsum “**Weighted Cover Board**” is additionally installed under the membrane adhered cement board to hold the air permeable loose laid insulation in place when the reverse ballasted cement board and adhered membrane can rise up in extreme wind forces.
23. Conventional mechanically attached roof assemblies have tremendous energy deficiencies of up to 25% with multi-fastener heat sinks thermally conducting external temperatures to internal roof deck temperature differentials. There are no fasteners used to cause heat or cold sinks in the reverse ballasted roof assembly.
24. Optionally, spot sticking the loose laid insulation boards to the roof deck or themselves, and/or the Weighted Cover Board would make roof top installation of the roof assembly easier on windy days. Plus it improves energy performance of the roof assembly keeping the roof assembly components from shifting and enlarging joints between the layers during installation that convection air currents can infiltrate through and around once installed.