VENTILATED FLAT ROOFS

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РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ПОЛЕЗНУЮ МОДЕЛЬ

№ 43018

ВЕНТИЛИРУЕМАЯ КРОВЛЯ

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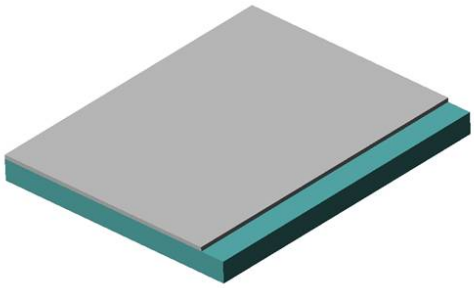
One of the main tasks to be solved during flat roofs' construction is the conduction of steam from the multi-layered thermo-insulation and hydro-isolation systems. These systems usually consist of the following elements:

- roof plate (concrete or corrugated tin sheet)
- steam-isolation with or without the steam conduction system
- thermo-insulation
- leveling layer
- base layer for hydro-isolation
- hydro-isolation
- hydro-isolation protection layer (for transient roofs)

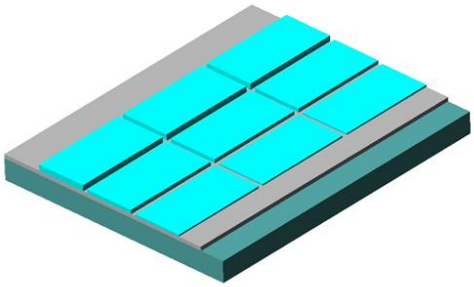
The general remark concerning such systems is related to the arrangement of layers, especially to the position of the leveling layer. An experienced designer will always place the leveling layer under the hydro-isolation, even under the thermo-insulation, so that the water could be drained from the lowest point in case of hydro-isolation damage or leaking. Otherwise, if the water gets through the hydro-isolation it will certainly lead to deterioration of the isolation and even to the degradation of the whole roof structure, especially after several freeze-thaw cycles.

However, there is the climate factor (more precisely air humidity and precipitation) that can not be influenced or predicted during the design stage of the project. Namely, the vapor barrier, designed with or without the steam conduction system and placed directly over the roof plate, serves as protection from the steam coming from beneath. Hydro-isolation as the final layer on the flat roofs, on the other hand, protects the roof structure from the atmospheric water, but also serves as the vapor barrier over the thermo-insulation layers stopping the steam coming from above.

However, the problem of the moisture trapped between the vapor barrier and the hydro-isolation (inside the thermo-insulation layer) remains unsolved. This moisture usually appears as a result of the rainfall during the construction of the flat roof. The chance that such situation will occur rises with the increment of the roof's surface and the prolongation of the construction works.



1. Simprolit monolith layer t=40 mm



2. Slope formation
using styrofoam plates 500mm x 1000mm,
at 50mm distance

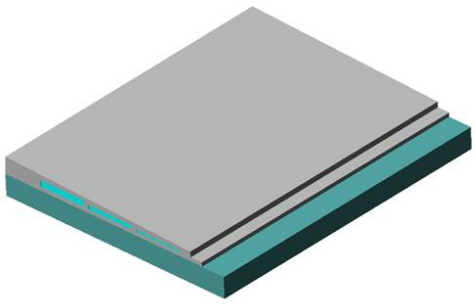
The measures taken by the contractor in order to avoid such problems usually don't give satisfactory results. This happens because of the fact that such construction technology requires division of the roof's surface into smaller sections, which can be finished within one working day making all the necessary layers, from the steam-isolation, leveling layer, thermo-insulation and finally hydro-isolation, including the obligatory lateral hydro-isolation protection of each section.
However, this is the procedure that almost none of the contractors follow, because of the frequent work interruptions and the difficulties in the construction of the leveling layer. It also drastically increases the price of the flat roof structure, to the extent that almost no investor is willing to pay, especially because of the fact that this type of work is usually paid per m^2 of the finished flat roof.

On the other hand, even when the layers of the flat roof are made using the correct technology, the problem of the free moisture from the leveling layer still remains unsolved. Although it is possible to eliminate such moisture using special technological methods, it also means the prolongation of the construction deadlines and higher total price of the flat roof structure.

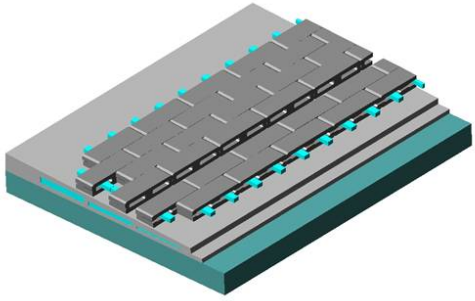
However, the factor that can not be influenced is the air humidity during execution of the works. Although it doesn't initially seem very significant, this factor often has a lot of influence on the final thermo-insulation properties, as well as on the durability of the flat roof.

As an example, let us assume that the thermo-insulation layer consists of the hard-pressed mineral wool and that it should be installed on the flat roof with dimensions 25.00 m x 40.00 m, i.e. upon the surface of app.1000,00 m^2. If the contractor daily finishes 200m^2 of this layer, and if there are just 5 layers, he needs 25 working days, i.e. 30 calendar days to finish the whole structure. On condition that he was lucky - that there was no rainfall during the whole month and that the excess water from the leveling layer had also completely dried out, the problem of the captured moisture inside the flat roof structure will still be present just if the air moisture was above the minimum in this period.

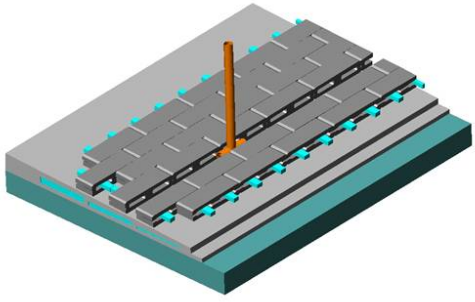
It is a known fact that just 1% of humidity inside the mineral wool decreases its thermo-technical properties for more then 20%. If there is approximately 80% of entrapped air inside the mineral wool and if the air humidity is, for instance, also 80% (and it is very often even higher, due to summer rains, which are usual in most of the climate regions), it means that between the steam isolation and hydro isolation layers we have entrapped air with 64% humidity. Over the years, after multiple cycles of high summer and low winter temperatures the final result is always the same - degradation of the thermo-insulation and often also the hydro isolation layer, no matter how carefully they were installed.



3. Casting of the Simprolit monolith upper layer with minimal thickness of 40 mm



4. Laying «sideways» the 120 mm thick Simprolit SPB60 blocks, with 100mm - 120mm wide styrofoam pads



5. Installation of the steam conductor made of PVC pipes - ∅50 pipe put inside the ∅100 pipe, with Simprolit in between

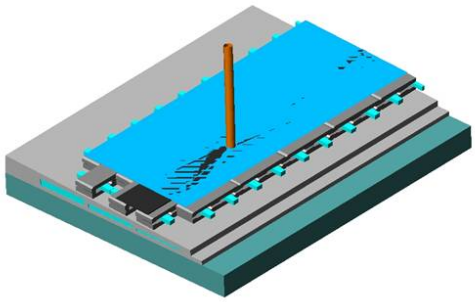
Theoretically, one of the possible solutions for this problem could be the fitting of a steam permeable hydro isolation, which lets through the steam coming from beneath, but doesn't let through the water coming from above. Although the quality steam permeable hydro isolation is relatively rare, usually expensive and requires the additional protection layer (because of its poor resistance to mechanical influence and direct sun rays), this type of solution is safer regarding the aspects of functionality and durability.

However, even with this solution we have to be careful and pay attention that the next two conditions are fulfilled:

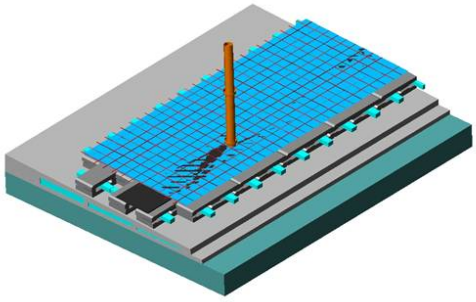
- the steam permeability of such isolation should be sufficient to let through all the steam accumulated inside the layers before the pressure builds up and detach the isolation from the lower base-layer (which happens quite often in case when the atmospheric water penetrates into lower layers during the roof construction) and
- the protective layer, which should be put over the steam permeable isolation, must also possess good steam permeability; on the other hand, it has to be resistant to destructive influence of water that could penetrate through this layer and freeze during the night.

Another and more often applied solution is the installation of steam conductors along the whole surface of the roof. However, a practical problem may arise during calculation of the exact distance between steam conductors. Namely, the following basic condition must be obeyed: the resistance to the horizontal motion of the steam through the thermo-insulation layer (at the length measured in meters) must be smaller then the resistance to the vertical motion of the steam through the thermo-insulation layer (at the length measured in centimeters) increased by the adhesion value between the hydro isolation and the base layer, all these factors being in relation to the air temperature, exposure of the roof's surface to the sun, atmospheric pressure, air humidity, etc. The most frequent damages of this type of protection system occur because of one of the next two problems:

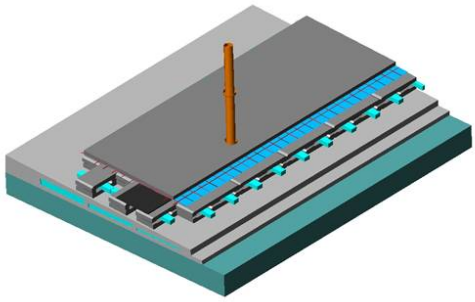
- either the steam conductors are placed to far away one from another, so that the steam expands and detaches the hydro isolation layer before it is evacuated through the conductors,
- or the steam conductors are placed to close, making a «sieve» from the roof surface, which results as a logical consequence in damaging and leaking of the hydro isolation, especially in the area near the conductors; this happens either because of the freeze-heat cycles' influence on the hydro isolation, or because of the snow sliding down the roof, wind effect, mechanical damages, etc.



6. Covering the 120 mm wide «channel», made by exclusion of one row of the blocks, first with salonit, orgalit or some other 250mm-300mm wide similar material, and than putting the PVC sheet over the whole surface, as the vapor barrier



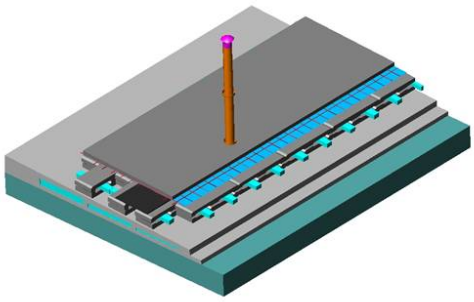
7. Installation of the thinnest possible reinforcement mesh over the PVC sheet



8. Casting of the concrete or Simprolit monolith layer, depending on the climate conditions

Simprolit system for ventilated flat roofs makes it possible to completely remove steam from the hydro isolation layer, improving at the same time its durability as well as the durability of other layers.

It is very effective, especially in cases when other systems reach their limits or become totally inapplicable, for instance at flat roofs' construction in power plants, heating plants, indoor swimming pools and all other places with high temperature (over 50^0C) and high air humidity (even over 90%) in the area directly under the roof structure.



9. Installation of the steam conductor's «cap», in order to stop the eventual rainfall penetration

10. Front view of the «steam conductor» without outer pipe at the lower section, in order to show the Simprolit monolith filling

11. Cross-section of the PVC steam conductor pipe:
- inner PVC pipe Ø50
- outer PVC pipe Ø100

12. The space between PVC pipes Ø 50 and Ø 100 is filled with Simprolit monolith