

It has been observed that in an average building envelope 23% of the heat is transferred through the roof, which is the highest percentage when compared to walls, windows, etc. It is often a challenge while contemplating a change from the traditional black roof system to an energy efficient one, or determining the savings when considering alternatives for a new building or the retrofitting of an existing building. While considering the energy efficiency of waterproofing performances, the latest low energy consumption roofing system, popularly known as the LEC system, has gained momentum in various metros in India. Basically, the system consists of a mixture of multiple materials that are blended together. Though they bear different physical or chemical properties, when combined together they produce a system which is capable of delivering durable, energy-efficient, high-performance and sustainable roofing. However, the following criteria need to be considered for calculating the energy efficient performance of vegetative roofs/roof gardens/green roof systems or energy efficient roofs:

- Climate and geographical location
- Building's intended use and design life expectancy
- Exterior and interior temperature, humidity and use conditions
- Type and condition of substrate
- Structural system
- Slope and drainage
- Roof waterproofing membrane
- Type of vegetative roof system including overburden, if any
- Type and amount of insulation, protection and drainage needed
- Type of reflecting material

As per the International Energy Conservation Code (IECC) 2012 and ASHRAE 90.1, "Energy standard for buildings except low-rise residential buildings", the minimum thermal insulation requirement for roof assemblies may need significantly more insulation than previously required. Along with waterproofing and thermal insulation, this latest LEC system can be applied to virtually any existing roof, so there is no tearing off the roof, rather it involves retrofitting it to green and satisfying the norms of the Green Building Council and Cool Roof Rating Council (CRRC). Studies show that they lower roof temperatures by up to 40%, which decreases the amount of heat transferred into a building interior to dramatically reduce the cooling cost. So far a roof has been considered as nothing more than a blanket of protection for a building. This is true in most cases, but a commercial roof can also have a huge impact on the

amount of energy that a building consumes. Usually commercial roofing systems are white which reflect the heat. In fact, a commercial roofing system can lower the temperature of a roof by as much as 30°C. The system reflects as much as 85% of the sun's solar energy away from the building.

An often debated topic in the LEC system, whether the insulation will be kept over the waterproofing membrane, or vice-versa. But it is desirable to keep the waterproofing membrane over the insulation layer while retrofitting an old building with an LEC roofing system. Both the systems have their own advantages and disadvantages. As such, no particular system is ideal and the system has to be tailor-made based on the client's requirement in a particular environment.

It is very disheartening to find that most of our codes and specifications in the government sectors are still following 50 year old, traditional practices of tar felting for waterproofing, which is brittle in nature and get damaged after just 2-3 years. Sometimes, layers of brickbat coba are laid on the existing surface, thus adding distress to already distressed structural members. With the technology-driven approach, following a 50 year old practice may cause huge loss to the state coffers. So adopting the latest LEC system would save a substantial amount and would also help the energy crisis being faced by the country today, to some extent.

The collective approach of all the technocrats, builders, developers, architects, engineers and bureaucrats involves adopting this latest LEC system, which provides a guaranteed service life for 20-25 years, and energy efficient and sustainable roofing systems. In fact, the dilemma of balancing between waterproofing and thermal performance for roof assemblies has led to the need for further scientific research with the available materials and systems in the country, before finalizing the correct specification for the country.

Though the issue is being dedicated to waterproofing only, a combo system which deals with both waterproofing and thermal insulation of the roof is most ideal in the present energy crisis era, for which we have given importance to the LEC system. We have covered various aspects of the system and tried to solve the dilemma of waterproofing and thermal performances with their advantages and disadvantages through some selected articles in this issue. We will conclude our ongoing series of publications with the waterproofing of an external facade in the next issue of ReBuild.