

Natural Cooling of Amphitheater Using Indian Heritage Techniques

Panasia Engineers has developed 'ThermOdrain'. It drains the solar heat out of the structure to keep it cool. It is a 'passive' system because the heat always travels from high to low temperature, never from low to high.

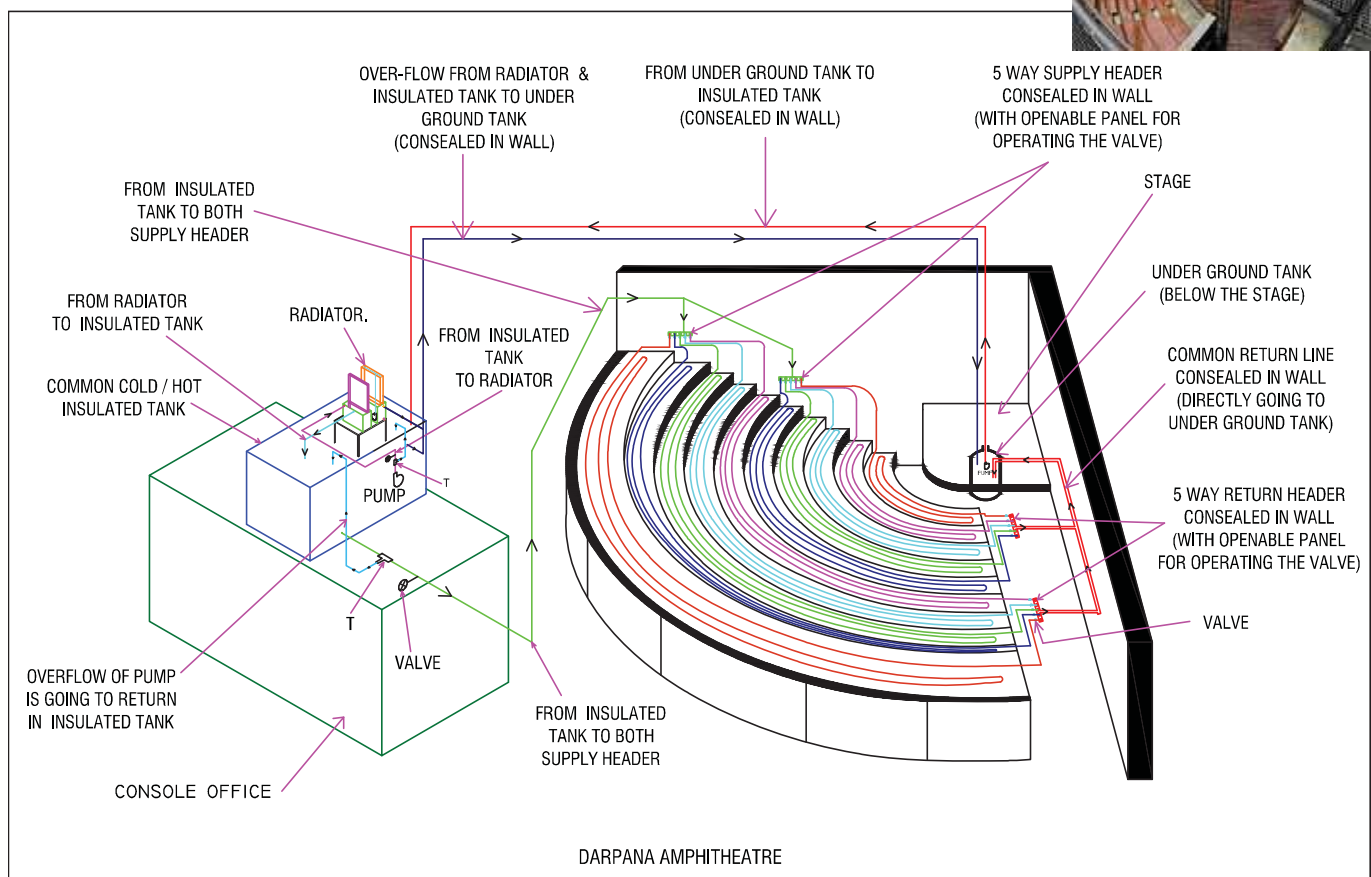


Diagram 1: Layout of structure cooling

Like so many people and organisations working for solutions to global warming, we at Panasia Engineers are also active in the thermal comfort area. We have developed 'ThermOdrain'. As the name suggests, it drains the solar heat out of the structure to keep it cool, just as a roof drains out the rain to keep the interior dry. It is a 'passive' system because the heat always travels from high to low temperature, never from

low to high. Thus, it does not need any energy.

The Natrani project, it is a 385-seat open air Amphitheatre owned by Darpana Dance Academy of Mallika Sarabhai. It is located on the riverfront at Ahmedabad

The problem was – how to provide thermal comfort and cool fresh air in an affordable eco- friendly manner.

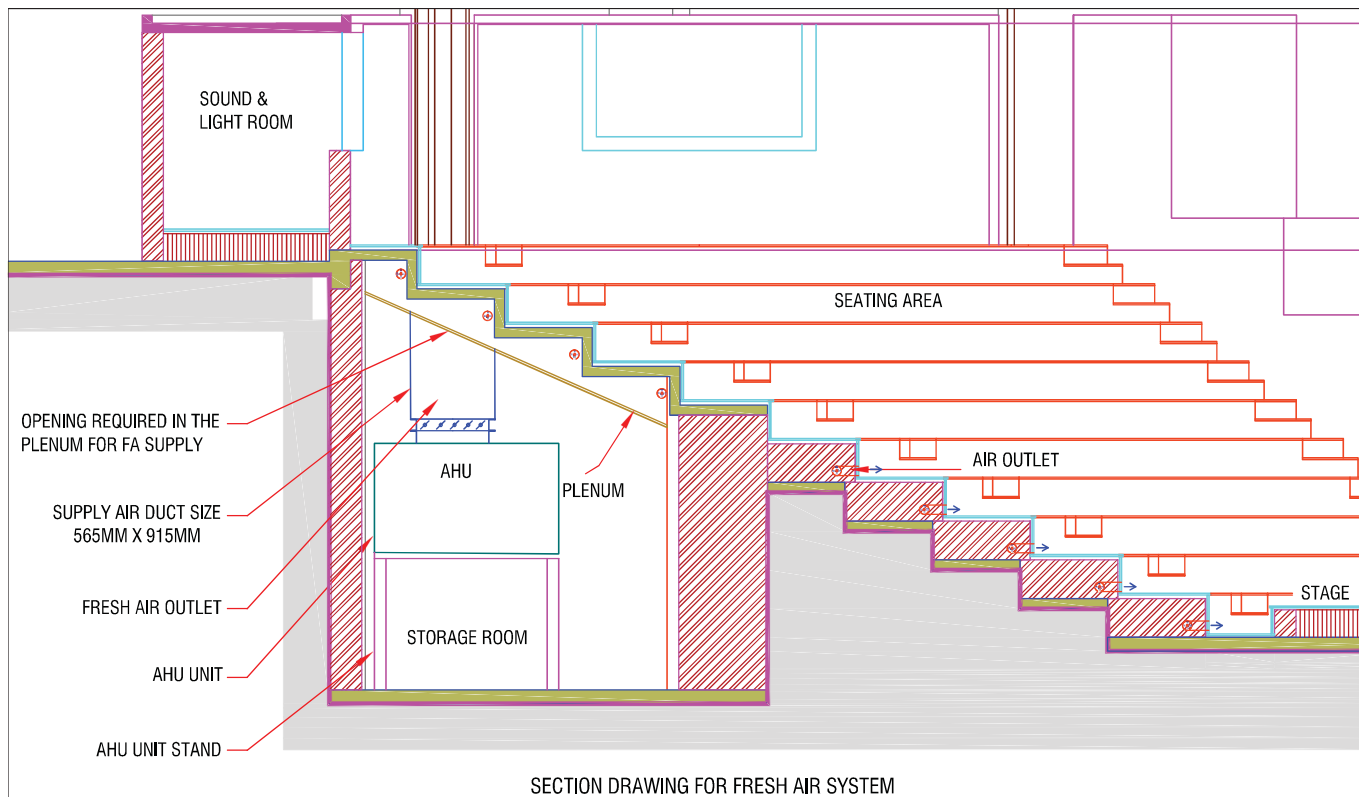
Since air conditioning, evaporative cooling or high-volume ventilation options

were not feasible, natural cooling was chosen. There are two parts – structure cooling and gentle displacement ventilation.

Structure Cooling

Structure Cooling starts with a 1.6 lakh liter rainwater harvesting tank under the stage. Water from here is pumped up to a high-level tank and a radiator unit.

After getting cooled by the radiator, the



SECTION DRAWING FOR FRESH AIR SYSTEM
Diagram 2: Working of structure cooling.

water drains by gravity back to the underground tank through plastic pipes laid under the tiers in a serpentine loop. The pipes are then covered by screed.

In operation, the water in the pipes absorbs the heat from the structure and keeps it below the body temperature, thus providing comfortable seating.

The layout of structure cooling is shown in diagram 1.

Displacement Ventilation System

An AHU with a fan and filter draws air from outside and pumps it into a plenum under the steps. From there, it enters gently into the arena through a number of 70 mm holes, covered by grilles, through the steps.

The air is cooled by contact with the

cool structure, as per our Hawa Mahal tradition, and lightly displaces stale humid air, thus freshening the surroundings.

Diagram 2 shows the working of structure cooling.

Proof of the Pudding

Temperature readings were taken on the day of the opening. Refer Table 1.

The ambient temperature was 45Deg.C Max.

Thus, the green room and the seats were below human skin temperature and therefore, comfortable.

- Electrical power figures are as under
1. Cooling system- Total one kilowatt including pumps and radiator fan.
 2. Ventilation AHU – Two Kilowatts for 6000 CFM

Comment from a Spectator Present at the first Show

It was indeed a great experience. September 21, was a hot day, but even then, the seat at Natrani was a very good comfortable feel. Always, since years we, all members on Natrani, have been sitting on the burning hot to really cold polished kotah stone seats and enjoying performances at the beautiful amphitheatre, but this time at the unveiling and reopening of Natrani, we were seated on controlled temperature red mosaic seats and it was a wonderful feel.

Engineering used at it is the best for the maximum comfort of the user. The vents on risers of the steps at regular intervals, gave cool thrust of air and added

Table 1: Temperature readings were taken on the day of the opening at Natarani Amphitheater - September 2018

Date	Time	Ambient temperature in Green Room	Surphase temperature below seating	External temperature at location 1 (shaded area only)	External temperature at location 2 (shaded area only)	External temperature at location 3 (shaded area only)
16 - 9 - 2018	11:00	30.2	31.6	36.2	35.2	33.8
	5:00	31.2	31	37.8	38.6	34.2
17 - 9 - 2018	11:00	30.2	31.6	37.2	37.6	35
	5:00	31.2	31	34.8	35.4	35.2
18 - 9 - 2018	10:00					

The Radiator



- The radiator is the key element in the ThermOdrain System
- It has two sections.
- The main section comprises a passive cooling coil (No refrigeration) and a fan.
- The other section has an evaporative cooling pad, used when the ambient temperatures are high, to cool the air going through the radiator.
- Together they dump the heat out.

to the cooling.

Way Ahead

From very humble beginnings, the HVAC industry has grown into a Behemoth that is gobbling away at our energy resources while degrading our environment. While the industrial segment justifies itself, the domestic and commercial thermal comfort division drains away the energy, only for a few degrees of cooling. So far, almost every proposed alternative solution is either complex or costly or both.

A simple solution has been staring at us all the while. Taj Mahal and heritage

buildings that remain cool without using any machinery or energy.

Their technique of using massive structures to absorb heat is no longer practical. So, we have modified it to use water instead. That is the method used here and the results are here for all.

ThermOdrain can be the slingshot because

- It is a very simple technology that even

marginally trained persons can understand and apply to provide 'Adaptive' thermal comfort.

- It is universally applicable in any country between the two tropics, regardless of the weather.
- Two Masters' and one PhD Theses confirm that it meets "Adaptive Cooling" Criteria.
- It is quite affordable to own and the running and maintenance cost is negligible.
- It can be retrofitted in most cases, particularly, the roofs.
- While the name "ThermOdrain" is a Trademark, the technology itself is not patented or copyright protected.
- We shall gladly share it with anyone that can qualify for it without any charge.

We hope ThermOdrain will be universally adopted, provide jobs to millions of low tech persons and reverse global warming. ■

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