Mati Ghar, Exhibition Gallery of Indira Gandhi National Centre for the Arts, New Delhi

Editor's remarks

Initially constructed as a temporary structure, this building has been retained for over a decade now. It is a mud construction with very low embodied energy and has an extremely effective passive system for ventilation.

Architect Sanjay Prakash

Temporary mud structure using thermal mass and innovative ventilation strategies to maintain thermal comfort

The structure was originally designed as a temporary exhibition space to last only a few years. The intent was to use it to house a special exhibition on time (*Kala*) as part of the activities of the IGNCA (Indira Gandhi National Centre for the Arts). However, the life of the structure was extended through some modifications and the structure has been retained for about a decade now till at least the main building of the IGNCA is completed.

Symbolic plan form

The conceptualization was made with the close guidance of the intellectuals at the Centre. The design encapsulates a variety of symbolisms that are related to time. There is the use of the numbers (12 [months], 24 [hours], 36 [360 parts of the year]) in the formation of the essentially circular building. There is the idea of cyclic and eternal nature of time.

A view of the IGNCA building

The building consists of a set of circumferential spaces. The spaces are kept dark and window-less in order to house the exhibition as it was designed to be seen, without daylight, to provide complete control to the exhibition designers. The outer ring has gallery spaces including entries and exits. The middle ring contains a ramp leading up to an upper level in the Centre, but is wide enough to be used as an inclined exhibition space. The inner circle that is two stories consists of a 'cave' below and a dome above. Two staircases outside the outer ring complete the connections that allow for a variety of ways of entering and exiting.

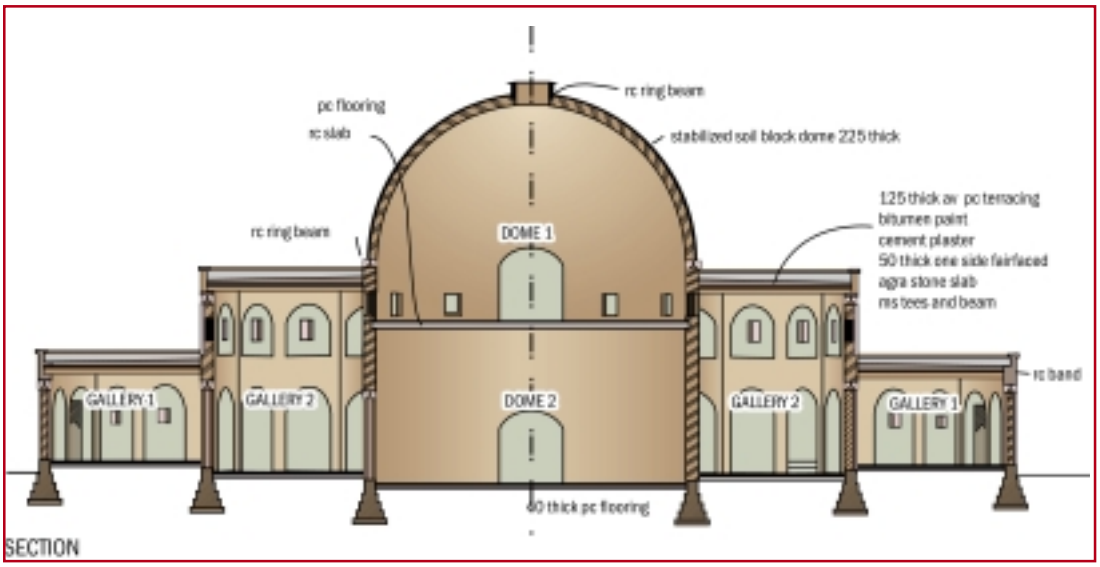
Materials, techniques, and methods

Orientation and windows

The building is not oriented to any specific direction since there were no windows and all directions had to be covered due to the nature of the subject. The small openings given are all provided with timber shutters for complete darkness.

Compressed earth block walls

The building is like an arcuated frame structure. The loads are carried within walls by arches and piers. These elements are six per cent stabilized compressed earth blocks using the Balram block press. The stabilization of the load-bearing elements is high. The in-fill walls and haunches are relatively under-stabilized at four per cent. A minimum amount of cement (four to six per cent) was added to give additional water resistance and to make it possible for the masonry to be exposed, eliminating the need for plastering. Compressed earth blocks, unlike kiln-baked bricks, could be made at site with stabilization according to different requirements, which permitted optimization of total energy input.



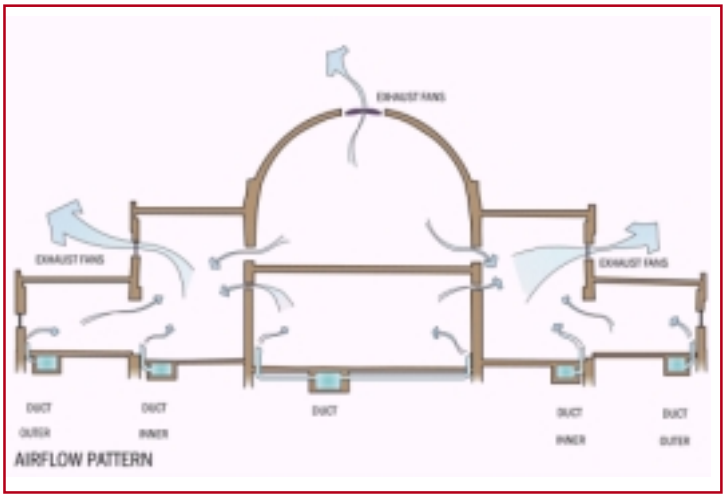
A cross-sectional diagram of IGNCA showing construction details

Stone slabs

The structure is trabeated with steel joists supporting sandstone slab roofs. This is terraced over with lean concrete and brick tiles. Along with the 'framed' nature of the walls, this system allowed the total construction time to be reduced to about 160 days. Reduction in the use of cement and structural steel helps reduce costs and energy content.

Compressed earth block dome

The central circle was roofed over with a stabilized compressed earth block dome. This is hemispherical in shape with a diameter of 9.2 m, probably one of the largest of its kind anywhere. The dome was formed without shuttering by an adaptation of Nubian techniques developed traditionally and popularized by the Egyptian architect, Hassan Fathy. This was altered later in order to extend the life of the building.



A sectional diagram showing ventilation system

Ventilation system

The volume was closed and it required ventilation to cater to the large numbers of visitors expected. Therefore, an underground system for distributing air was devised. This is similar to the ancient Roman system of hypocausts (ducts within walls and floors). A fan room in a toilet block, 30 m away from the main building, pumps air into an underground pipe of 0.9 m diameter and at a depth of 1.5 m below ground. The air is then distributed into the spaces through masonry ducts that lead to PVC pipes and mouths near the floor level of the gallery. The overall system is like an earth-air tunnel except that since the depth of the main pipe is not very large it cannot be considered too effective for heating or cooling using the thermal inertia of the earth. It is meant to provide fresh air with nominal conditioning and circulate air inside so as to not have a stuffy feeling. The system is provided with a pad that can be kept wet and thus cool the incoming air by evaporation. The system was designed for 20 air changes per hour at a maximum velocity of 6 m/s. It uses a centrifugal fan of 5 HP.

Performance

The construction elements have worked well and managed to last a decade with some maintenance every year. Ventilation system is extremely satisfactory.

Economics

The construction cost of the project was about Rs 1600 per square metre, probably about 20% lower than normal. The running cost is highly dependent on the lights and equipment used for an exhibition. The fan power works out to less that 5 W per square metre, equivalent of using ceiling fans.

At a glance

Project details

Building type Exhibition structure for a national arts centre
Climate Composite
Architects Sanjay Prakash, DAAT
Consultants Aromar Revi (construction), Umesh Dhingra (structure)
Project period 1990
Size 900 square metre covered area in a large campus
Client/Owner Indira Gandhi National Centre for the Arts
Builder/Contractor Shelter Group of the Society for Development Alternatives
Cost 1.44 million rupees

Features

- Innovative use of materials to reduce embodied energy content
  - Compressed earth blocks used for construction made at site with stabilization according to different requirements, which permitted optimization of total energy input.
  - Reduction in use of cement and structural steel reduced costs and energy content.
- Innovative ventilation system to cater to large numbers of visitors.

Temperature check for Delhi

Cold	Cool	Comfortable	Warm	Hot	
	•				January
	•				February
		•			March
			•		April
				•	May
				•	June
			•		July
			•		August
			•		September
		•			October
		•			November
	•				December

Add the checks

	3	3	4	2

Multiply by 8.33% for % of year

Heating	25
Comfortable	25
Cooling	50