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### Legislative Assembly Hall at Gandhinagar, Gujarat, India

Salle de l'assemblée législative à Gandhinagar, Inde

Halle der gesetzgebenden Körperschaft in Gandhinagar, Indien

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S.G. Joglekar, born 1941, obtained his Masters in Science from U.K.. At STUP Consultants Ltd., he has been actively involved in the design and construction of major bridges, hydraulic structures, industrial and nuclear projects.

#### **H.K. MEWADA**

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H.K. Mewada, born 1921, got Masters Degree in Architecture at Cornell in 1948 followed by Masters in City Planning at Illinois, USA. Starting his career with the capital city of Chandigarh, Punjab, he soon became a leading Town Planner & Architect working for the States of U.P., Assam, Rajasthan and finally for Gujarat. He had been a president of the Institute of Town Planners, India.

#### **SUMMARY**

The legislative Assembly Hall of Gujarat, India is an outstanding example of the complete synthesis of Architecture and structure. The architectural forms evolved following the function and mouldability of reinforced concrete have been used to create aesthetically beautiful yet structurally highly efficient forms bringing the Architect's daring vision into concrete reality.

#### **RÉSUMÉ**

La Salle de l'assemblée législative de Gujarat, Inde, est un modèle remarquable de synthèse totale d'architecture et de structure. Les formes architecturales se sont développées selon la fonction et l'aptitude au moulage du béton armé et ont été utilisées pour donner aux ouvrages une beauté esthétique tout en leur assurant une haute efficacité structurale. Ainsi, la vision audacieuse de l'architecte est transformée en réalité concrète.

#### **ZUSAMMENFASSUNG**

Die Halle der gesetzgebenden Körperschaft von Gujarat ist ein herausragendes Beispiel für die vollkommene Synthese von Architektur und Tragwerk. Die architektonische Form entwickelte sich aus der Funktion, die Formbarkeit von Stahlbeton schuf gleichermassen ein ästhetisch ansprechendes wie konstruktive hocheffizientes Tragwerk. So wurde die mutige Vision der Architekten in Beton gegossene Realität.



## 1. GENERAL BACKDROP

### 1.1 New capital city of Gandhinagar

After formation of a separate state in 1960, the government of Gujarat decided to construct the new city of Gandhinagar as a twin city to Ahmedabad which is the cultural and business centre of Gujarat. As a State capital it was to be planned and developed to achieve social integration of diverse groups and classes of society while creating for them a modern spacious habitat with emphasis on controlling population density and having open and green surroundings, free of environmental pollutions typical of newly growing metropolis. After 25 years of its development, Gandhinagar reflects and represents in its architectural style, the modern culture where function gets precedence over everything else and the scarce resources are deployed in cost-effective manner. The architectural style adopted for most of the government buildings exhibits structural concrete skeletal members such as columns, beams etc. with infilled panels of exposed brick or brick finish. The use of special finishing items is restricted to need-based situations. Form finished concrete is used extensively in interiors like ceiling and beams.

This basic concept was retained as a guiding principle, in planning the new Legislative Assembly Complex with the assembly hall, the offices for ministers and large number of departments. At the same time, it was recognised that the structure representing the highest seat of government has to be monumental in its conception befitting the achievements and the riches of the society governed from it. The integration of modern brutalism in architecture together with the search for beauty in forms and shapes so typical of Indian tradition and overall conception planned on spacious Mughal style has led to the creation of a masterpiece in architectural and structural engineering where one of the most beautiful and yet wholly functional monument is created.

## 2. FUNCTIONAL NEEDS AND SOME ASPECTS OF PLANNING

The entire complex is spread over 7,50,000 m<sup>2</sup> of land and comprises of 14 multi-storied office blocks providing 10,00,000 m<sup>2</sup> area for housing various governmental departments. At its centre, which is also the centre of the town, is located the Assembly Building on a raised platform, called the podium in Mughal style (Ref. fig.1).

The podium is a 120 m x 120 m x 5 m high structure separated from the surrounding by an artificial pond. This pond apart from beautifying the surrounding serves to restrict the access to the assembly building to limited locations thereby making safety controls easier to manage. From this podium, springs the assembly building which is in the form of a hollow square (Ref. fig. 2). At the centre of the hollow square is the Assembly hall which is a circular shaped structure. It is a separate and distinct structure within the assembly building and yet interconnected and integrated into one unit

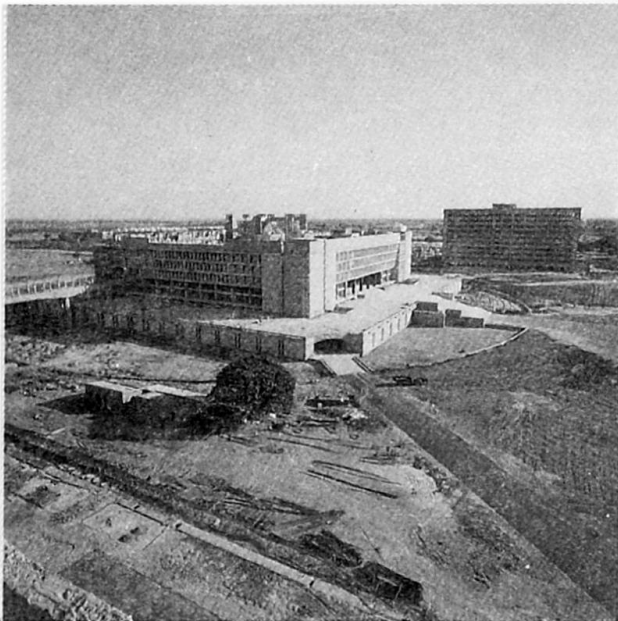
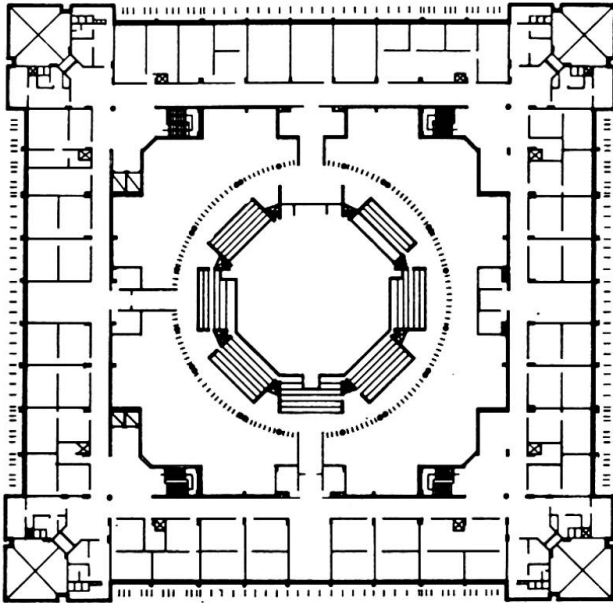


Fig.1 Assembly Building - A bird's eye-view



**Fig.2** Assembly Hall within Assembly Building

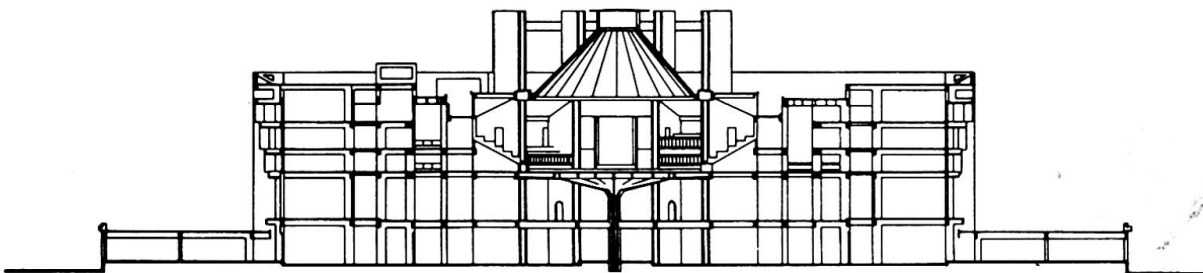


**Fig.3** View of Assembly Hall from podium level

with the wings of the surrounding hollow square by full floor at podium level and covered roof slab at 5th floor level over the gap between the assembly hall and the wings on all sides. A view of the Assembly Hall from the podium is shown in fig. 3. The assembly hall is also connected to wings at the assembly level and visitors' galleries level by walkway links.

The entire assembly block is connected to the secretarial office buildings by two 110 m long foot bridges on either side at the level of the assembly hall. One of which can be seen in fig. 1. Section taken in fig. 4 shows the Assembly Hall which is located at the 2nd floor level above the podium. The main hall provides seating for 232 legislators and is surrounded by circulating space all around which is exclusively used by the legislators. The offices of the speaker, deputy speaker, the chief minister and other ministers are located in the surrounding wings at this level.

The 3rd floor level of the hall above the podium is provided with visitors



**Fig.4** Central Section through Assembly Building

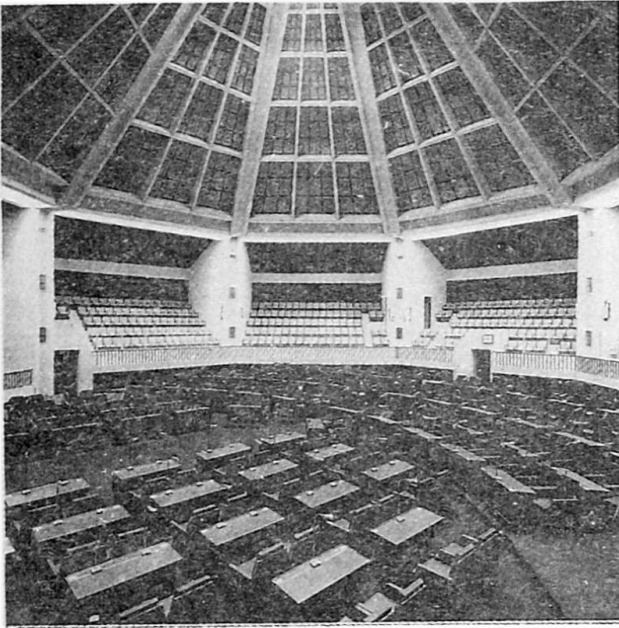


Fig.5 View of Assembly Floor and visitors galleries

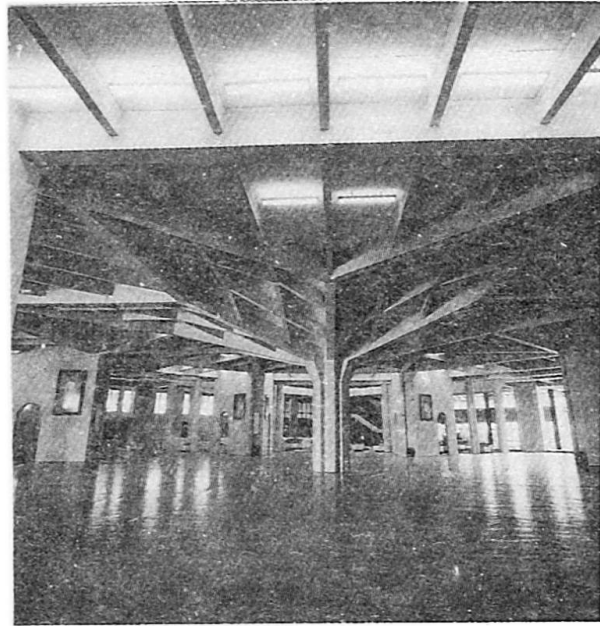


Fig.6 The stylised flower supporting Assembly Floor

galleries seating 600 visitors. The galleries for press and officials assisting the ministers during the session are also provided. These galleries are accessible from the surrounding circulating spaces at the 3rd floor level which in turn is connected to the wings on 3 sides. The direct intermixing of legislators and visitors is thus avoided. This is a functional and a security requirement.

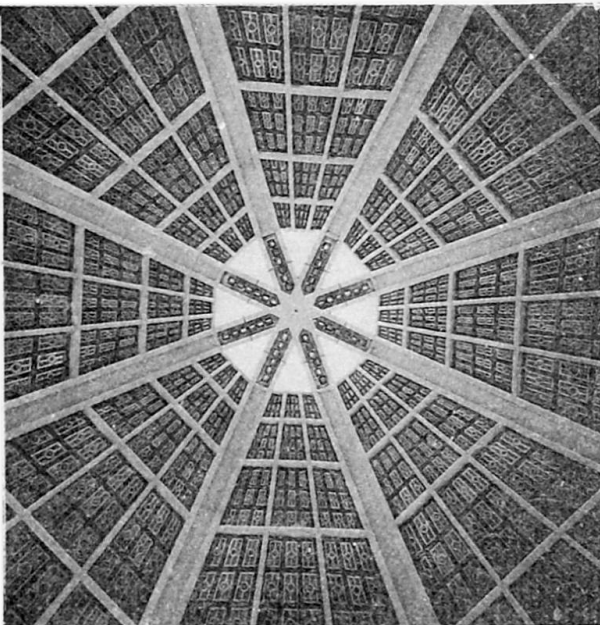


Fig.7 Structural Division, Acoustic panels and central lighting of dome

The hall is roofed over by an octagonal dome in the shape of a frustum of a cone. This dome springs from the 8 number of corbel-brackets leaving a clear gap between the roof slab and the dome on all sides of the assembly hall giving an impression of a floating dome. It has a central sky-light. The natural light taken from the eight sides and the central skylight gives uniform and adequate lighting on the assembly floor. An overall view of the assembly floor, the visitors' galleries and the roof dome is seen in fig. 5.

### 3. THE STRUCTURAL ARRANGEMENT OF THE ASSEMBLY HALL

The 42 m diameter assembly hall is structurally separated from the surrounding building and is supported on 8 main 'V' shaped columns going to the full 40 m height of the structure,



the central column going upto the 2nd floor supporting assembly floor and four other columns stopping below the podium floor. Each floor is supported on main beams spanning between the columns and cantilevers out beyond 'V' shaped columns to support the circular circulating spaces. The space between main beams is sub-divided by ribs or secondary beams which form part of the ribbed slab system spanning between the main beams. The selection of the ribbed slab system has two advantages. It subdivides the space creating strong visual-patterns for the ceiling of each floor and also led to structurally efficient slab system where stiffness and economy of reinforcing steel was achieved by providing the larger depth of ribs. The thickness of the slab portion could then be reduced to bare minimum of 80 mm which is the practical limit for construction of cast-in-situ slab and for embedding electrical conduits. The economy of the system becomes obvious by the fact that the equivalent concrete thickness of ribbed slab is under 100 mm.

The main assembly floor is supported on eight 'V' shaped columns and the central column. As seen from the podium floor (fig. 6) the central column rises from the center of the foyer into radiating, reinforced concrete beam pattern which is further sub-divided by rib-beams to form a delicate stylised flower. The floral pattern derives its significance in Indian mythology in the sense that the Goddess of wealth and prosperity 'Laxmi' has chosen "Lotus flower" as her seat. Hence this has become an apt and suggestive architectural motif. The inclined cover slab visible in photograph is a part of the structural rib-slab system which is cast in-situ and merges into the flat portion. Over this inclined portion the slab supporting assembly is made from precast panels supported between the beams. This assembly floor provided at one level retains the flexibility in arranging or rearranging the seating arrangement. The circular passage surrounding the meeting hall is provided with visual barrier on outer periphery in the form of vertical fins fixed all around which helps to define the central assembly hall as seen from the podium and also provides a visual barrier as seen in fig. 3. These fins are virtually the only non-structural RCC elements of the hall.

The visitors galleries supported on and between main 8 'V' shaped columns are classic examples of "function determining the form". The galleries are inverted folded plate units following the shape of the seating and in the form of an inverted two sides of a triangle. The location of door openings on different sides have been different thus creating a discontinuity at the lower cut-out part of the inclined plate. This portion has, therefore, been designed as a cantilever hanging portion from the folded plate, thereby giving total flexibility to the architect for selecting any suitable location of the doors. The circulating space around the galleries is supported on cantilevering rib slabs system.

The octagonal floating dome roofing over the meeting hall is supported on eight brackets cantilevering from 'V' columns. The four number of intersecting portals forming 8 corners of the dome are cast integrally with the brackets. Each of the eight 'sides' is the rib-slab system proportioned in such a way as to give a beautiful pattern as seen from below (ref. fig. 7) This rib-slab system is provided from the edge of the bracket upto the central skylight, thereby giving openings to natural light on all 8 sides at the bottom and the skylight at the top. The panels formed in between the ribs of rib-slab are used for fixing acoustic panels which also had been fixed in a matching pattern. This cladding is the only non-structural finishing item for the legislative meeting hall.

The eight 'V' columns projecting above the roof have cantilevered beams extending upto the central skylight. These beams create an impression as if



the central dome is suspended from these beams slab over the assembly hall.

#### 4. AIRCONDITIONING AND LIGHTING

The airconditioning of the assembly hall is handled in an ingenious way. Eight numbers of units are located over the roof level in triangular rooms formed by enclosing the 3rd side of 'V' columns projecting above the roof. These units take return air directly from the duct formed within the crook of the V notch of main column by providing an enclosing partition. The blower pipes are also fitted within the duct. The openings for return air and feeders in the assembly hall are provided in 'V' columns. These can be seen in fig.5. This neatly hidden air conditioning system has avoided a maze of ducts and the false ceiling. It has also led to a considerable reduction in cost.

The artificial lighting is similarly simplified. At the crown of the dome number of halogen luminaires are fitted in shape of a star (fig. 7) which is the only source of general artificial light for the assembly floor. This single source is able to light the entire hall and the galleries.

#### 5. THE FINISHING ITEMS

With the exception of the partition brick walls, perepherial fins and the accoustic treatment of dome, all other surfaces and forms are provided by structural concrete, thus achieving a total synthesis of the architecture and structure. The form-finished concrete is painted over by neat cement paint to achieve uniformity in colour shade.

#### 6. ANALYSIS & DESIGN

The analysis of this 3-D frame structure was carried out using combination of 3-D beam elements and shear wall effects provided by 'V' shaped columns. The rib slab system is analysed and designed as a system spanning between the main beam system. Structural grade of concrete used is of 20 N/Sq.mm cube strength for the entire construction. Cold twisted bars of grade 415 N/sq.mm have been used as reinforcement.

The external cladding of this assembly complex and the office buildings is provided by fine grained sand stone of light pink colour in order to achieve rich finish as well as to minimise the cleaning and maintenance costs thus combining functionality and beauty. The exposed form-finished concrete is used everywhere.

The end structure is extremely light for such spans. If total concrete used is spread uniformly over the total floor area constructed it will be of 180 mm thickness.

#### 7. CONCLUSION

As can be seen from the above description and photographs the Legislative Assembly Hall is a beautiful synthesis of architecture and structure. In the process of its planning the form has followed the function and combination of structural efficiency and aesthetically expressive forms brought an architect's daring vision into a concrete reality.