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Sports Complex

Rafsanjan, Iran

Architect
Naqsh,e,Jahan Pars: Hadi Mirmiran

Client
University of Valiasr

Design
1995

Completed
1999

Sports Complex
Rafsanjan, Iran

I. Introduction

The sports complex in Rafsanjan is part of a larger scheme aimed at providing this small town with a memorial to a native son who became the president of Iran. The design, originally intended for a library and museum, was converted for political reasons to serve a more social programme as a swimming pool and gymnasium. The building borrows some traditional features from a building type used in the past to produce ice in the winter and preserve it into the summer months. The design calls into question the practice of using historical references in modern architecture.

The building has provided a facility for the youth of the city to practise sports. Women particularly have gained an important opportunity as a result. The building provides a good example of an adequate scale for the development of such facilities; however, it also reveals some technical flaws and only average standards of construction.

II. Contextual Information

A. Historical background

Iran is a large country of some seventy million inhabitants comprising diverse territories, ethnicities and religious communities. The country's modern history is closely linked to its prominent position within the region's rich oil reserves. In the early twentieth century the country witnessed a strong move towards Western models of modernization. Under the last monarchist dynasty (the Pahlavis) the country underwent a vigorous programme of assimilation into Western institutional models, while oil revenues enabled the creation of a prosperous middle class. However, the rapid pace of modernization and the *rentier* nature of the economy left large segments of the country's population dissatisfied with the monarchy and its pro-Western attitudes. Many attempts were made to challenge Iran's direction.

Finally, in 1979, a movement led by an alliance of religious leaders and opposition groups overthrew the government. In the subsequent years, the religious leaders emerged as the main political actors in Iran. Shortly after the revolution, Iran became involved in a war with its westerly neighbour Iraq over the control of the oil-rich zone of south-western Iran, with Iraq claiming historical rights to an area mostly inhabited by ethnic Arabs. The war, which lasted from 1980 to 1988, brought devastation to both countries.

After the war, Iran embarked on a major job of reconstruction. Its religious leaders insisted on self-reliance and an avoidance of Western models of governmental institutions. Local models of governance built on certain interpretations of Islamic law were imposed. The country established an elected representative political system with a parliament and an executive branch. However, the (unelected) religious leaders retain a great deal of power in steering political decisions.

B. Local architectural character

Iran is a country with a rich architectural heritage dating back several millennia. Its most formidable examples of built heritage include monumental sites such as Persopolis in central Iran where the Achaemenid dynasty (553–330 BC) elaborated grandiose though austere buildings. Processional ways leading into hypostyle galleries and eventually into large colonnaded ceremonial spaces provided architectonic models for years to come. Later, the Sassanids (AD 224–651) developed the monumental nature of Persian buildings, using brick as the principal building material and depending on vaults and arches to cover major large spaces. This pre-Islamic architecture was particularly important as a national emblem during the last shah's rule: a modernist abstraction of monumental public buildings became a trademark of Iranian architecture from the late 1950s until the revolution in 1979.

With the advent of Islam in the seventh century, Iran became the hinterland of the Muslim Caliphate in Baghdad. Muslim institutions such as the mosque were constructed in abundance. However, the architecture of Iran was to take on a new monumental dimension starting in the sixteenth century under the rule of the Safavid dynasty (1502–1736). Isfahan, the then capital city, was progressively embellished with major urban reconstruction schemes, culminating in the large Maidan-i Shah and the many monumental mosques, bazaars, palaces, and gardens surrounding it. The architecture of the period was distinguished by subtle attention to scale and axiality. However, its most visible feature was an extensive use of polychromatic mosaics and ceramic tiles, a feature that was adopted by the religious leaders of post-revolution Iran in their search for 'Islamic models' to define the national character of post-revolution public institutions.

Iran is also home to a wide variety of vernacular architectural traditions. The country's vast territory includes regions using traditional architecture built with mud, fired bricks and wood as well as tent structures. Yet today the country is mostly dependent on steel-frame structures with brick facings as the main building materials. Concrete was used in many public buildings in very expressive and brutal forms in the architecture of the 1960s and 1970s, but today it is mostly relegated to concealed structural roles and is less emphasized on the outside of new architecture. Also, in the last few years the country has been seeing postmodern styles in commercial and residential buildings. Neoclassical façades are becoming fashionable with the emerging middle class in most large cities in the country.

The central province of Kerman is famous for its rich heritage of mud-brick construction, for which the city of Bam, which drew international attention after the devastating earthquake of 2003, is a primary example. The area is also noted for hybrid constructions of mud brick and fired brick. Construction in the city of Rafsanjan is mostly of a low-rise nature. Brick of a yellowish colour is often used as facing for steel or concrete constructions; occasionally, a darker red brick is used.

C. Climatic conditions.

The central region of Iran is generally hot and dry. In the winter sporadic rainfall is common as are occasional cold spells. Gusty winds blowing over the arid plains carry dust and sand in

the spring and autumn. The summers are hot and relatively dry. Temperature differences can reach extremes of more than 50 degrees Celsius between the coldest and hottest times.

D. Site and surroundings

The site is located in the city of Rafsanjan, some 900 kilometres to the south-east of Tehran. Rafsanjan is the fast-growing urban centre of the region with the same name, and administratively part of the province of Kerman in central Iran. Famous for its production of pistachios, the region rose to some prominence after its native son, Mr Ali Akbar Hashemi Rafsanjani, became the president of Iran in 1989. The horizontal layout of the city has started to sprawl.

On the northern edge of town a small park was to be expanded to accommodate a memorial presidential library, a commercial centre and a sports complex. Further beyond the site the land is still mostly given over to pistachio cultivation, but the northern expansion of the city is foreseen to continue beyond the site. A major plot is reserved for various academic colleges and university dormitories.

The sports complex occupies the western corner of a triangular-shaped site dedicated for the construction of the presidential memorial legacy. The site is radially planned around the presidential library and museum. The northernmost corner of the site is occupied by the tower structure of the commercial centre in white stone and glass cladding. The presidential library and museum is a square building about 12 metres high sitting on an elevated terrace overlooking the rest of the site. The building envelope consists of alternating courses of dark-pink and white stone. The building has a dome-like structure, made of interlocking diagonal ribs, topping its central court. The rest of the site comprises public gardens. A small cafeteria built in a rotunda form is located on the edge of a small artificial lake. Halfway between the main library / museum and the sports complex, a circular depression in the ground has been created to house a small stadium, which is still not completed.

E. Topography

The area around the city of Rafsanjan is flat, and the site of the project is no exception. The horizon is a very strong feature of the landscape. A rather low hilly range is barely visible on the western horizon.

III. Programme

A. What conditions gave rise to the formulation of the programme?

President Ali Akbar Hashemi Rafsanjani was the elected president of Iran from 1989 to 1997. After the end of his term, he retained considerable political influence as the chairperson of the higher council responsible for identifying state interests. A special not-for-profit group engaged in publishing the documents of the Islamic revolution chaired by Mr Mohsen Hashemi, (Ali Akbar Hashemi Rafsanjani's son) began lobbying towards the end of his term in office for the establishment of a presidential library and museum. The large amount of

funding required for such a project necessitated lobbying for public support, and the involvement of public funding entailed the launching of an architectural competition. The municipality of Tehran was persuaded to launch a project and run a competition to build such a monument, although no site was designated at that time. The entry submitted by one of Iran's leading architects, Hadi Mirmiran, won the competition.

The winning project expressed a direct reference to one of central Iran's most intriguing building types: the *yakhchal*. The *yakhchal* is a type of icehouse, comprising a wall sheltering ice ponds from the sun in winter and a massive conical room for the storage of ice into the summer months. However, the clients complained that the winning entry did not meet the standards of presidential libraries, standards for such buildings having reputedly been requested from the United States. At this stage it was also decided that the location of the building should be not in Tehran but rather in Rafsanjan, the home town of Mr Ali Akbar Hashemi Rafsanjani. A site was identified on the northern edge of town. Parts of the site were designated as charitable religious endowments (*waqf*); other parts were privately owned, but the owners were persuaded to trade this land. The clients overruled the results of the competition and went on to commission a master plan for the site and the design of the presidential library and museum, using an architect of their choice. Mr Mirmiran was offered the consolation prize of developing his winning scheme not as a library and museum but as a swimming pool, to be located on the part of the site designated as a sports complex. Mr Mohsen Hashemi argued that the winning scheme was more suitable for a pool because of the icehouse metaphor. Mr Mirmiran decided that the idea was feasible and embarked on modifying his competition entry to accommodate its new function. He had won several competitions in the past only to see the commission of these projects go to other architects who provided more standard 'Islamic references' in their work.

The tennis courts to the western part of the site were reduced in number and a triangle of land was selected to accommodate the new project. It should be noted that the western part of the site was actually the part that was under the custody of the charitable religious endowments. As construction progressed, two problems arose. One problem was the funding of the sports complex, which was not originally anticipated on this scale. This required intensified lobbying efforts. Many private individuals were persuaded to contribute, but public funds were not forthcoming as the building was legally being developed by a private society. The second problem involved the future tenure of the land, which was unalienable from public use because of its *waqf* status. To resolve this problem the site was transferred to the local University of Valiasr. The university provided the remaining funds and was given custody of the public land. Hence the project started under the commission of the not-for-profit society but ended in the hands of the public university. The parts of the site that were under private custody are now under the custody of the not-for-profit society. The commercial building is leased out to cover some of the running costs of the museum and library.

B. Objectives

The building commission was modified to fit the requirements of a sports complex. The new programme was to include a swimming pool and a gymnasium. The main objective was to provide a quality space that could be used throughout the year to accommodate training for local athletes, particularly the students in local schools and universities.

The city of Rafsanjan had one open-air pool, used only in the summer, and not accessible for female users as conditions for privacy are not met. The new complex was to provide a forum equally for male and female sports.

C. *Functional requirements*

The basic outline of the original scheme was generally respected. Dimensions of the original competition entry had to be modified to accommodate the requirements of specific sports. The sports to be included in the complex kept changing while construction was under way. The clients did not order any changes to the basic design, but interfered at various stages to redefine the programme. They also interfered with regard to materials and installations. The construction was carried out according to tight budget conditions and the design was occasionally modified to meet lower budgets or to accommodate the availability of materials.

The main brief was to include a swimming pool that could be used in both winter and summer. This was achieved by providing two adjacent parallel pools, one under the covered area, the other just outside the building envelope. The space partially enclosed by the high wall, emulating the massive walls of traditional icehouses, was ideal for the purpose; little modification to the original design was required to meet this functional purpose. The swimming pool also required mechanical and filtering spaces, as well as showers and dressing rooms.

The conical volume abstracting the form of the ice storage room of the *yakhchal* was more problematic for use as a gymnasium. After considering many possible uses, it was decided that the space under the cone would be divided into two main levels. The lower level is used for badminton and various other sports requiring a small court. The upper level is reserved for wrestling, a traditional and very popular sport in Iran. The building also required administrative rooms and entry lobbies for the athletes as well as the spectators.

In essence, the conditions of the commission meant that the building form drove the programme, rather than the other way around. The original building form was appreciated for its own sake as the historical reference appealed to the clients. Furthermore, changing the form in a drastic way would have caused the annulment of the results of the competition.

IV. Description

A. *Project data*

The sports complex uses a direct volumetric reference from a traditional building type, the *yakhchal*, or icehouse. The basic elements of the *yakhchal* comprise a long, high wall that extends from east to west, providing shade on the north side to allow ice to accumulate in the cold winter period. Along the side the wall curves towards the north to provide extra protection from the sun in the early morning or late afternoon. The wall may be supported on the outside using buttresses; occasionally on the inside its structure is reinforced using pilasters toped with arches, giving the impression of an aqueduct-like structure. The second

component is the conical storage room. This is usually made using corbelled bricks and is very massive so as to provide the required insulation to keep the icehouse cold into the hot months of the summer. The outside is usually stepped back and not purely conical in form. The cone can be placed either to one side of the wall or in the middle. Its base is typically square in shape and the circular steps of the cone will start only at a height of 2–3 metres. The inside of the room is circular in plan. The residual space making up the difference between the circular interior plan and the square exterior is occupied by small steps leading to the roof or by small rooms to store equipment.

In his abstraction of this building type, the architect has defined three components: the cone, the wall, and the shadow cast by the wall. The building sits on a platform that rises about 1 metre above street level. The cone volume is situated at the western edge; it is about 24 metres in diameter at the base and rises to a height of about 15 metres above the platform. At the top, the cone is truncated, the diameter of the top being 8 metres. An oculus brings natural light into the building. The wall rises to a height of about 11.5 metres above the platform level. It curves gently to the east and makes a sharper angle to the west, enclosing on three sides an area of about 1,300 square metres, used for the covered pool. The third element is more a poetic than an actual physical feature. In the traditional *yakhchal* the wall encloses a shaded area to its north. In this context, as the wall is actually on the north side of the pool space, it does not provide it with any shade. Instead the architect has recreated an element of shade by introducing the covered space-frame roof over the pool area. The shadow is created through the interplay of transparent and translucent panels.

The residual space around the cone separating it from the wall is occupied by the entry and circulation spaces. The entry on the street level to the north is made through stairs leading the spectators up to the public entrance and the poolside level. The southern entrance leads through stairs down to the athletes' entrance and the dressing-room levels.

The total built-up area of the project is 6,350 square metres.

B. Evolution of design concepts

1. Response to physical constraints

The concept of the building was developed independently of site conditions: accommodation to the specific site and particular context occurred afterwards. In the original site plan, the site was mostly intended for open-air tennis and basketball courts. When the function of the design was modified to become a part of the sports complex, a few courts were cancelled and a triangular portion of the site was reserved for the project.

As the project was special in the context of its construction, the design was not inhibited by any special code requirements with regard to the site. However, the architect imagined the building to interact with the horizontality of the terrain. The height of the building was carefully balanced to highlight a sense of scale, but the general gesture of the building masses is horizontal.

As the covered pool area was mostly needed in winter and required relatively high light levels, the orientation of the traditional *yakhchal* was reversed in such a way that the pool area is now to the south of the wall.

2. Response to user requirements; spatial organization

Many types of circulation had to be accommodated through the building. Separating the movement of athletes and spectators was important as well as separating the activities of the various athletes (swimmers, wrestlers, and so on). The area covered by the wall was designated for all the pool functions while the area under the cone was designated for the other sports. Spectators enter the building from the northern side through the main gate leading them to a lobby situated between the cone and the wall. The lobby leads to the spectators' area of the pool on one side and the spectators' area of the gymnasium on the other side.

The athletes enter the building from the opposite, southern side on the lower level, where they encounter a lobby of equal size. The lobby leads on one side to the dressing rooms to the side of the pool, and on the opposite side it leads to the gymnasium. The cone structure is visibly continued even inside the building. The stairways are located in the space between the inside wall of the cone and the sports courts, providing for vertical movement within the building.

3. Purely formal aspects

The volume of the building is the main formal gesture of the design. The architect's main rationale was a personal memory he had of Rafsanjan when he had first visited it years previously and had been impressed by the local construction of the *yakhchals*. When working on the competition, the *yakhchal* was one of the strongest images defining the local architecture that he carried in his mind.

In the original competition entry, the design was a more literal interpretation of the *yakhchal*; it did not have a covered roof area and the wall incorporated pilasters topped by an arched aqueduct, not unlike some of the more elaborate traditional *yakhchals*. However, as the design was modified to accommodate the new functions, the direct references to the old building type were abstracted. The pilasters were replaced with concrete columns inserted in the body of the wall, allowing for visual vertical interruptions of the horizontal brick courses.

Some direct references to the old building type were adopted in a less abstract manner, to the extent of being purely decorative. One such detail is the addition of false buttresses along the outside of the wall. These serve no structural purpose but help to break the blindness of the massive brick wall and dispel the notion that it is actually the back of the building that fronts the main street.

The use of brick was important as a reference to the local building style, but more importantly to the colour of the earth around the city. The architect was particular about the choice of colour; bricks had to be specially selected to match the colour of the rich agricultural soil. The building was perceived as emerging from the earth, an image that the site at the edge of the city reinforced. However, the site is slowly being urbanized, and already the streetscaping around it hinders such a metaphor.

Perhaps the more successful references were spatial and not directly ornamental. The type of enclosure provided by the wall and the residual spaces around the cone provide for complex architectonic spatial references without directly quoting old forms.

The two pools (covered and open) running parallel to each other were originally supposed to be connected, but technical restrictions of filtering and water temperature prevented the idea from being fully materialized. The slanted space-frame roof was actually to plunge into the pool, separating indoors and outdoors. However, owing also to technical reasons, the roof was pitched down to a height of about 3 metres and a vertical wall of similar materials separates the indoor pool from the outside one.

4. Landscaping

The building is set on a platform above the flat topography of the area. On the street side to the north, a basic metal balustrade provides for a transparent but symbolic separation of the building from the street. The blank wall ensures privacy inside the building. On the southern side, where the transparent ribs of the space-frame allow limited visibility into the pool area, a visual shield around the exterior pool area is provided by a stone-built fence. The paving has been left simple, with some planting on the perimeter. Lighting is provided through tall lighting poles that intrude visibly into the otherwise horizontal platform. A seating area is shaded using a simple metal structure with curved wooden roofs. Exterior showers and benches are also provided. The site is adjacent to the gardens of the library / museum, where a parking lot along the southern edge accommodates vehicles. The area to the west of the site was supposed to be made into gardens and playgrounds, but is not yet developed. The area immediately to the south of the platform of the complex is occupied by open tennis courts.

C. Structure, materials, technology

1. Structural systems

The structure is designed as a concrete structural frame with brick infill. The foundations were designed as a mat foundation 60 centimetres deep. The floor slabs are made of reinforced concrete. An expansion joint was provided within the pool hall but not passing through the pool itself.

The roof of the main swimming hall and the oculus of the wrestling hall are made of a steel space-frame. Because of the uniform loading direction, the space-frame was designed in the manner of continuous trusses with spherical nodes welded on particularly to anchor secondary members providing lateral support. The space-frame is anchored on the wall with fixed but not rigid joints. On the south side, the frame rests on fixed joints sitting on concrete porticos. The stresses resulting from expansion and shrinkage as well as wind loads were calculated into the allowable loads using computer software (SAP 90+).

2. Materials

All structural members are made of reinforced concrete, with the exception of the steel space-frame.

The infill material is mostly double brick cavity walls. In some parts *in-situ* concrete was poured in the cavity of the walls.

Finishing materials involved mostly stone paving and stone cladding of some of the interior spaces. The stone paving was given a slight texture in the area around the pool to prevent people from slipping. The pool and some of the dressing and shower areas are covered by ceramic tiles. Cement plaster was used in some of the administrative and functional rooms. Otherwise, the brute concrete structure and the brick infill were left exposed. The roofing material selected was lightweight Lexan plastic panels, which are mounted on the space-frame. Two varieties were used in alternating rows of translucent and transparent Lexan to form an animated shadow pattern.

3. Construction technology

The construction technology was of typical concrete frame and involved little innovation. The main difficulty involved building the cone. After casting the main structural elements, a steel armature scaffolding was constructed and the interior layer of brick was laid. Anchors were embedded in the brick courses. Concrete was poured in what would be the cavity area between the two layers of brick, using flexible metal forms and hardening additives. The exterior layer of brick was then laid. An elaborate system of masons' guide strings was stretched from top to bottom of the structure to ensure that the continuous curved surface was well laid.

The space-frame was constructed in the form of independent trusses in the factory, which were welded on site using secondary structural members. A system of pulleys was erected on site to lift the whole construction into place.

4. Building services, site utilities

Special filtering and mechanical equipment was installed in the space separating the outdoor and indoor pools on the lower level. An underground space is provided to the east of the building for heating equipment. Three metal chimneys stand at a small distance behind the wall to expel exhaust fumes from the boilers.

Water is collected in gutters around the pools, which transfer the excess water to the filtering tank. Further gutters are placed away from the pool for drainage and these are connected to the sewers.

The swimming hall is ventilated through negative suction by fans located in the upper part of the wall. The fans suck the air from the hall into the cavity between the two brick layers. Outlets are provided with dampers on the interior part of the wall just above the roof level. The intake of air into the hall is through air gaps designed as part of the flashing area where the slanted roof meets the translucent wall on the south side. Space heaters are distributed along the wall in an exposed manner, in what seems like an afterthought.

The gymnasium area was not equipped with ventilation machines because of costs involved, although a special area in one of the rooms at the side of the cone was prepared for the purpose, and their installation is planned for a next phase of funding. At the moment, some of the Lexan panels in the oculus on top of the cone are open to allow hot air to escape in the summer.

D. *Origin of technology, materials, labour force and professionals*

1. Technology

Computer software was used to calculate the mat foundation reinforcement and for the calculation of the space-frame. Most of the technology used is very typical in Iran, though not in the Rafsanjan area. The main contractors hired for the structural work are one of Iran's leading contractors, based in Tehran. Their expertise was deemed necessary to handle the type of construction involved.

2. Materials

Concrete is available in Iran and is mostly Iranian produced. Reinforcing steel is partly produced in Iran and occasionally imported. Brick was imported from a regional producer, although as the capacity of the producers was limited, extra quantities were brought from a producer near Tehran. The stone cladding and paving was bought on the local market but was quarried from an area about 500 kilometres to the north-west.

The steel of the space-frames was produced in Tehran, while the Lexan panels were imported from two sources: the United States for the transparent panels and Germany for the opaque ones.

Mechanical equipment is Iranian-made.

3. Labour force

Three principal contractors were engaged on the job. All contractors hired unskilled and semi-skilled labour from the local market but brought the skilled labour from Tehran. The bricklaying was carried out entirely using local labour.

4. Professionals

Architects

The architects Naqsh,e,Jahan-Pars are one of Iran's leading architectural firms with some one hundred employees with two main offices in Tehran and Isfahan. The general manager and principal architect, Hadi Mirmiran, is a renowned architect and educator. Most of the architects working on the project were from the Tehran area, with the exception of the site engineer, who was from Rafsanjan.

Contractors

The three main contractors were all from the Tehran area:

Kayson, who carried out the structural work, is one of the leading contractors in the country, with a permanent staff of more than four hundred. The site engineer, from Rafsanjan, was appointed by the Tehran office. Kayson hired local master masons to manage the bricklaying work but did not engage subcontractors. Kayson was engaged on work at the new international airport of Tehran at the time; its engagement in such a small-scale project as this was tied to its continued work on the larger commission in Tehran.

Rasta, the contractor that provided the finishes and the mechanical and other equipment, is also based in Tehran. It is a smaller firm. Some of the work was subcontracted to local crews.

Safira is a small contractor specializing in space-frames and is also based in Tehran. All the technical staff of the firm came from Tehran to install the space-frames.

Consultants
The main structural, mechanical and electrical consultants are all part of the architectural firm Naqsh,e,Jahan-Pars. They were all based in Tehran.

Others
The clients did not engage a general contractor, in an effort to reduce costs by reducing the margins of profit expected on the part of a general contractor. The agreement with many of the contractors sometimes involved the provision of materials by the owner. It is not clear what the nature of the contracts was with some of the contractors as some major decisions regarding materials and equipment were made during the construction to reduce costs or because of availability of less expensive alternative materials. A project accountant was provided by the clients to handle the financial management of the project.

V. Construction Schedule and Costs

A. History of project

The project proceeded at a slow pace according to available funds and was hindered at various times by its changing scope, as explained above. The main landmark dates involved in the process were:

Commission: October 1995
Design: October 1995–December 1996
Construction: December 1996–December 1999

Finishing work was delayed and occupancy did not take place till January 2001.

B. Total costs and main sources of financing

The funding was organized by the not-for-profit group Dafter Nashr Ma'aref Enghelab. The group lobbied for funds from various public and private donors. The land was acquired through the charitable religious endowments in return for a nominal compensation. Funds for construction were collected from donors. A major donor to the project was the University of Valiasr, the institution that would retain custody of the building at the end to overcome the problem of transferring religious endowment lands to private institutions. It was also the institution most capable of undertaking maintenance and operation in the future.

Initial budget: IRR 11 billion (approx. USD 1.8 million at 1995 exchange rate of IRR 6,000 to USD 1).
Cost of land: IRR 44 billion

Cost breakdown (approximation):
Infrastructure: IRR 2 billion
Labour: IRR 4.6 billion
Materials: IRR 10 billion
Landscaping: IRR 1.2 billion
Professional fees: IRR 1 billion

Actual costs: IRR 16.8 billion (USD 2.1 million at 2001 exchange rate of IRR 8,000 to USD 1). It should be noted that the numbers do not add up because many of the materials involved in the construction were provided in kind to the site by some of the donors.

C. Comparative costs

The contractor Kayson's representatives estimated that typical construction of this kind was costing about IRR 3 million per square metre at the time of construction. The construction of the sports complex was achieved at 10 per cent below standard costs.

D. Qualitative analysis of costs

The average cost of construction for the project was IRR 2.7 million per square metre (USD 336 per square metre).

E. Maintenance costs

To avoid direct involvement in the day-to-day administration of the building, the University of Valiasr outsourced the running of the place to a private not-for-profit group. The group is responsible for paying all running costs, typical maintenance work and personnel. The funds for the running expenses are collected through personal subscriptions of individuals wanting to use the facilities, as well as through a subsidy provided by the department of education in return for allowing some schoolchildren to train in the facility. It is intended that the group cover all the running costs and remit to the university the excess in the form of rent. The rents are to be added up as seed fund to carry out required long-term life-cycle maintenance and to complete the installation of the equipment and facilities in the complex as well as in the sports courts outside.

The manager of the facility estimated that the running costs of the complex average about IRR 80 million per month (approximately USD 10,000). Of this, IRR 45 million is for personnel (about forty employees). The rest is for maintenance and utilities. The following breakdown was given:

Electricity: IRR 5 million
Water: IRR 1 million
Telephone: IRR 2 million
Heating fuels: IRR 3 million
Chlorine for the pool: IRR 2 million
Maintenance contract for the mechanical equipment: IRR 5 million
Insurance: IRR 1.5 million
General maintenance: IRR 2.5 million
Miscellaneous: IRR 10 million

E. Ongoing costs

In the past two years of its operation the not-for-profit group has managed to remit to the university a net rent of about IRR 250 million (USD 31,250). This money is being saved as seed money for the next phase of funding required to install the mechanical equipment for the gymnasium and to cover long-term maintenance costs. It is assumed that this phase will take place in 2005 after accumulating enough savings.

VI. Technical Assessment

A. Functional assessment

In general, the building has carried out its swimming function in an efficient way. The place has provided a suitable sports arena for athletes and a play area for the young to practise swimming all year round. The scale of the facilities is not beyond the needs of the community of Rafsanjan. The division of entrance lobbies into two levels is effective in theory to separate the athletes from the spectators, but in practice the close proximity of the spectator platforms to the pool often leads to the spectators moving close to the pool during swimming competitions.

The pool is particularly important in that it provides the women and girls of the city with a place to practise sport. However, despite its attempt at providing a sheltered private pool, the building has had to be further protected. The main problem was in moving from the dressing areas to the gymnasium area, as the lobbies were left exposed to the eyes of passers-by. Curtains were added by the management to cover the entry lobbies, and all glass doors were covered by a translucent film, indicating that standards of privacy had not been entirely satisfactory.

The gymnasium area is less used. Training takes place there just before wrestling competitions. Badminton seems to be a hobby for only a few schoolchildren. The space under the cone traps heat and is rather difficult to bear in the summer.

B. Climatic performance

The direction of the sun ensures that the area of the pool is well lit and relatively warm in the winter. Space heaters were added to bring the temperature in the hall to rather warm levels.

However, the mechanical ventilation system is independent of the heating system and a lot of energy is wasted due to lack of coordination between heating and ventilation. The humidity levels in the pool require high ventilation standards and lead, therefore, to high heat loss. Yet as energy is relatively cheap in the country the cost of heating is not seen as a burden.

In the summer, the reverse happens: the space becomes a heat trap and the temperature rises to high levels, requiring extra ventilation. However, the limited capacity of the ventilation is not sufficient and the temperature rises to 'bearable but uncomfortable levels'. The pool guard's seat has a shade umbrella over it, indicating that sunlight pierces through the translucent Lexan. The Lexan is made of two sheets of plastic separated by a small air cavity; the distance between the two panes is kept constant by means of vertical ribs between them. It has a relatively good resistance to heat transfer but light can still travel through it.

The ventilation fans create a high level of noise in the space but without causing an echo because Lexan is a sound-absorbent material. When the fans are not open full blast, the space has agreeable acoustics, even if two dozen children are playing there.

C. Response to treatment of water and rainfall

The Lexan roof is held through special caulking into an aluminium frame. The caulking is evidently not very effective and water was leaking in a noticeable way during an average rainfall. The manager of the complex attributed the problem to local birds picking at the caulking material. Flashing around the space-frame roof seems to be operating in an effective manner. However, the roof of the lobby area separating the wall from the cone seems to have some leakage problems and certain sections of the brick are evidently moist as a result. The Lexan panels that bring light on to the perimeter of the cone wall were also noticeably leaking. The expansion joint also shows signs of leakage.

The gutters around the pool, collecting overflow water, were leaking into the lower levels. The mechanical room had a wet floor; some of the filtering machines were noticeably leaking. Some of the space heaters operated by hot water were also problematic.

Efflorescence and moisture were evident on various parts of the brick walls. In certain parts, the cap bricks under the flashing were defective.

The pool principally uses the drinking water of the city. The city receives its drinking water from a source about 100 kilometres away. The water is changed every forty-five days; the rest of the time it is filtered, but some replenishment is necessary as water is always spilling over during swimming sessions. The water from the pool is used to clean the roofs. The original system for cleaning the Lexan roofs involved pipes placed at the top of the wall, but to economize on costs, the system's nozzles were never installed. Instead the water from the pool is hosed to the top of the wall and the roof is sprayed down. The excess water from the pool is then diverted to the artificial lake at the other end of the site. No particular treatment is carried out to remove the chlorine before the water is released.

D. Environmental response

This area of central Iran is famous for its garden design. The site is no exception. The landscaping of the general site has been carefully considered. However, the garden design mostly comprises floral and fruit plants that require a high level of water. The artificial lake serves as a reservoir for such water. The chlorine content of the water does not seem to concern anyone on site at the moment.

The building also uses a larger boiler to heat the water for the pool as well as the water used in the space heaters. The fuel consumption in the winter months is about 120 litres of gasoline per hour. Chimney flues vent the smoke into the air.

E. Choice of materials and level of technology

The brick construction is very typical of the area. The local master mason assigned by Kayson to provide the labour for the brick work is an experienced builder. The brickwork is of good quality and workmanship. Problems arose with the installation of flashing after the brickwork was completed.

The technologies used were generally readily available in Iran. In general, however, the scale and scope of the project were new to the region of Rafsanjan. The mat foundation required the intervention of a specialist contractor and some of the specialist workers, especially for erecting the space-frame, were brought from Tehran.

Many of the problems discussed above with respect to water insulation are the result of poor understanding of the use of some of the materials, and the lack of adequate maintenance. However, in general, the building materials are kept simple and the building is one of the best-built structures in the city.

1. Response to and planning for emergency situations

Direct exits are provided only through the main lobbies. Fire exits are not clearly marked. In some cases, in an effort to curb the potential traffic between the spectators' areas and the dressing areas, the management has added artificial barriers, hindering movement in the event of a fire.

The building is not equipped to accommodate people with special mobility needs. Most of the construction in the country is likewise not accessible.

The area of Rafsanjan is defined according to the Iranian earthquake zone as a medium-risk area. However, the earthquake in 2003 in Bam, about 200 kilometres to the south-east, proved that even a medium-risk area can still be violently shaken by medium-strength earthquakes. The structural system of the building depends entirely on the concrete frame to withstand lateral shocks.

The area is not prone to major floods; the flat plateau of central Iran receives little rain, which is soon absorbed into the ground. However, as the area is being rapidly urbanized, it is anticipated that the covering of the green fields around the site would only increase the

potential of surface run-off. No specific data was available on flooding history to assess the point any further.

2. Ageing and maintenance problems

The main problem with ageing in the building seems to be with water insulation. Areas around flashing points and drainage are rapidly corroding. Some of the problem areas are starting to affect the brick walls, causing moisture damage and efflorescence. It remains to be seen how the building will fare over the long run. Some repairs are already needed in the building and the management seem to be inexperienced in meeting the demands of regular maintenance, although they are dedicated to the upkeep of the place as problems arise.

The Lexan is already showing signs of yellowing and the distinction between the transparent and translucent panels is slowly diminishing. The problems with caulking, as well, have led to the loosening of some of the panels. Wind seems also to affect the situation by constantly changing the exterior pressure on the roof surface. The space-frame below is rigid and does not deflect (both ends of the trusses are fixed joints), so the flexion of the roof is happening at the expense of the joinery of the Lexan panels. It is hard to imagine how the caulking of the Lexan could survive under the constant flexion caused by the wind pressure (in addition to the theory of birds picking at it).

3. Design features

The building is well placed in the complex and seems to be easily accessible. The horizontal composition seems to work well with the horizontal character of the city, while the verticality of the cone provides a distinctive landmark. Along the street side the wall provides a frontage that defines an urban edge, although this feature will lose importance once the rest of the area is developed.

The wall seems to provide a pleasant space for swimmers. The cone provides an interesting space, and the residual spaces around it used for circulation offer highly sculptured special qualities, enhanced by a generally good quality of brick workmanship. However, the circular area under the cone seems to have a logic of its own and does not really work in favour of the rectangular badminton court. A large area around the court is visually undefined and causes some confusion in orientation. The wrestling space above, by contrast, has a nice scale to it. Neither space seems to be adequately used, however.

4. Impact of the project on the site

The site in general has been recently developed to accommodate these new functions. The infrastructure is new and the streets are wide and will probably serve the traffic situation easily once the whole surrounding area is urbanized.

5. Durability and long-term viability of the project

The transfer of the project's custody to the University of Valiasr was important, as the university seems to be the only institution capable of handling its maintenance and operation over the long term. The project is already generating small revenues to enable a first cycle of major maintenance next year.

A comparison of costs and revenues, however, indicates that the building's financial sustainability is dependent on subsidies provided by the education department to cover the training of schoolchildren in the complex. This source of funding is rather tenuous and seems to be a political manoeuvre to support the building with public funds. The level of users, high as it is, reaches about seventy to eighty persons per day. At the full rate of IRR 20,000 (USD 2.50) per person, the building would generate only 60 per cent of its required running costs. This means that the subsidy required from the education department exceeds the revenue generated through entrance fees. Should the political climate change or the level of scrutiny of education funds be increased, the income of the complex could be severely reduced. An increase in tariffs would be required, or alternatively a strategy to increase the number of users. At the moment the management is not concerned with future prospects and seems to be content with the small net revenues generated.

The Lexan roof has a ten-year warranty and is already showing signs of yellowing and leakage. A major overhaul of the roof in a few years would require more than the modest savings generated by the pool so far. However, as is typical in this country, discretionary funds are sought only when needed and little maintenance budgeting is ever done.

6. Interior design and furnishing

The building has little need for furniture. In the administration rooms, the furniture is very basic and totally inappropriate to the design of the building. Curtains were added to the glazed windows in the entrance lobbies and before the doors leading to the pool as extra privacy measures for women swimmers. The colour and design of the curtains were chosen by the management and are unrelated to the building design in general.

VII. Users

A. User profile

The main users of the building are students and young people. Some adults also use the complex for practising sport. Private users are generally well-to-do as they have to buy a ticket costing about IRR 20,000. Students' entry is subsidized. Students using the building are from a variety of economic backgrounds. The pool receives a considerable number of users at night after working hours.

The complex is also a training ground for a group of local athletes who compete in local and regional competitions. The manager proudly displays in the main office trophies they have won. The complex is run as an amateur sports club. The athletes compete under the name of the complex and the complex provides them with trainers.

Half of the opening hours are dedicated to women users, although the total number of women users is slightly less than that of the men (the management holds occasional surveys to review its users' profiles and preferences).

B. *User response*

1. *How do architectural professionals and cultural intelligentsia view the project?*

The work of Mr Mirmiran is well known in Iran in general. This project has received wide acclaim. It won the second prize for the best architectural project of 2001 organized by Iran's Memar magazine. It has also been covered by many architectural publications. Many of the reviews of contemporary architecture of Iran include it, particularly some of the media produced in electronic form. The contractors of the Lexan products have added the project to its permanent brochures.

Some architects expressed concern over the direct borrowing of historical form in the creation of contemporary architecture, even though the imagery borrowed has been abstracted and de-ornamented. They see the trend of searching for historical references as a loop from which contemporary architecture does not seem to be able to escape. Whether in abstracted form or in direct recreation of historical forms, the trend is described as a symptom of a country's not being able to define its contemporary expressions and as a constraint on architects – a sort of norm or yardstick against which they have always to be compared.

By contrast, many of the people working in the cultural field, even outside architecture, seem to see a need to use past forms as a launching pad for new cultural expressions. Whether during the reign of the Pahlavis, when emphasis was on pre-Islamic monumental references, or after the Islamic revolution, when references shifted to Islamic monuments, the country has continually strived to define a national image against the imposition of Western forms under the guise of international architecture and modernity. Intellectuals interviewed found it wearisome that the past was quoted mostly on a formal level (the creation of images without substance), and that reference to the past is confined to particular forms. However, the majority insisted that some reference to the past is essential, though room should be allowed for individual creative initiatives beyond ideological reasons.

2. *What is the popular reaction to the project?*

Mr Hashemi (the chairperson of the not-for-profit group and later the person appointed by the University of Valiasr to follow the project on its behalf) was at first sceptical of the design, but the subtle reference to the local architecture of the *yakhchal* eventually won him over.

The association of the project with the figure of Mr Rafsanjani, the former president, is well received in his home town and people seem to appreciate what is perceived as a gift to the city from its native son. However, in other places of Iran, the motive of the project is questioned, in particular the problem of lack of transparency in its funding and the mixing of public funds with private contributions.

The project is particularly popular with the youth of the city. Young girls appreciate the opportunity to have a space to swim within a socially acceptable situation. Many have not had the chance to go to other cities with covered swimming pools and this building has allowed them to practise swimming for the first time.

3. *What do neighbours and those in the vicinity think about the project?*

The complex is not directly adjacent to any structures at the moment. In its first year, the garden and the empty streets around the site were used by delinquent teenagers who disturbed the other users of the space and nearby businesses. However, it seems that with a little extra policing and night lighting, the site is now accommodating many visitors and families who come to drink tea by the edge of the artificial lake. Some of the neighbours consider the fact that the building is being used even into the evening as a good opportunity to dispel petty criminal activities and feel that the increase in users has contributed to a safer environment on this site, which is rather remote from the centre of the city.

VIII. Project personnel

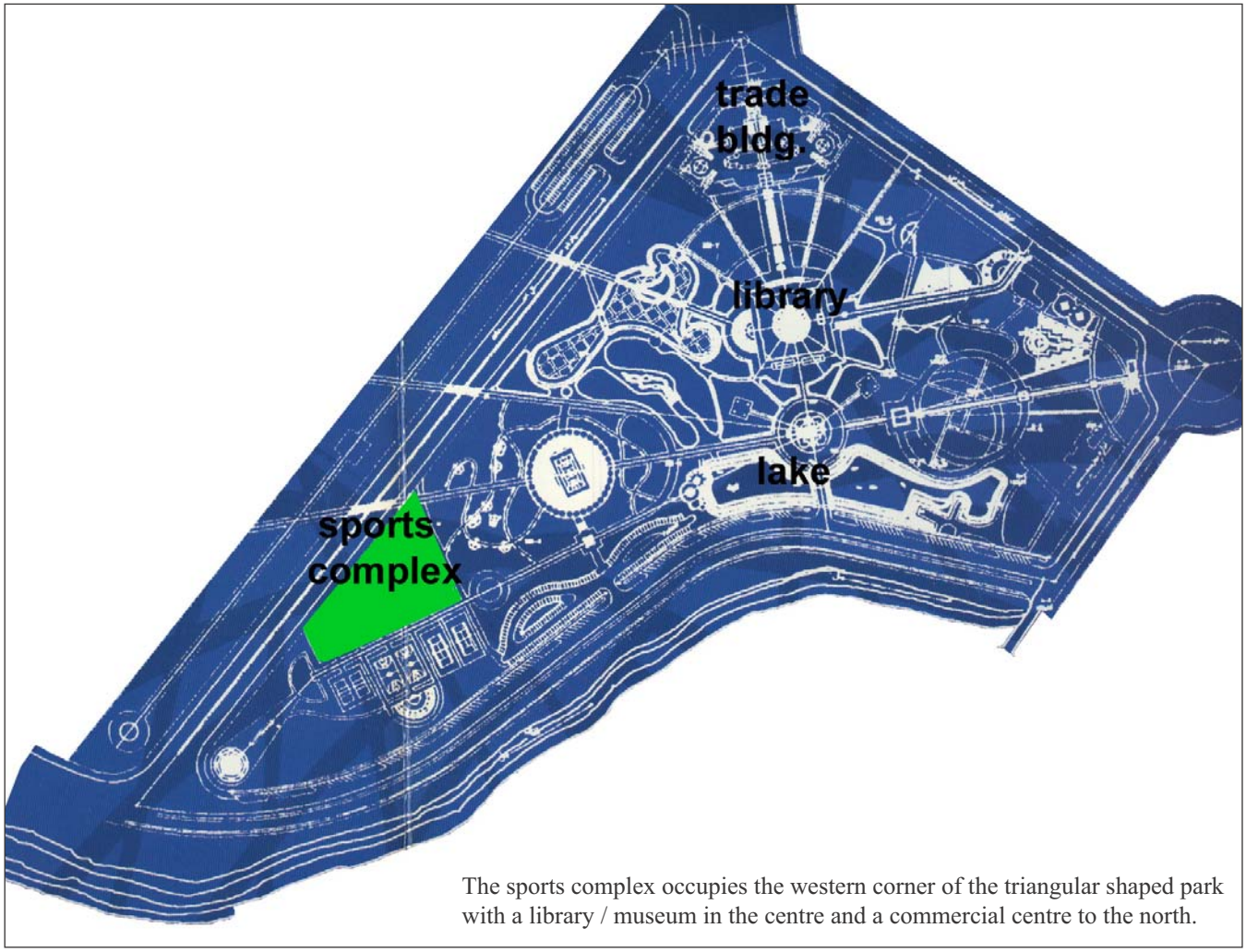
Consultants:
The firm of Naqsh,e,Jahan-Pars represented by it its general manager and principal architect, Hadi Mirmiran
Technical director: Hamid Mirmiran
Design assistant: Mojdeh Hasanvali
Design assistant: Homa Sassan
Structural consultant: Bahram Mojdehi
Construction director: Mohammad Toufigh
Construction assistant: Mousa Rezai Shoushtari
Site supervisor: Saeed Pahlevanzadeh
Mechanical and electrical engineering: Mohammad Edalatkhah

Clients:
At the beginning of the commission: Dafter Nashr Ma'aref Enghelab
At the termination of work: the University of Valiasr
In both cases the person in charge was: Mohsen Hashemi
Deputy manager: Darioush Barikani
Accountant: Nasser Musavi

Contractors:
Structural work: Kayson company. Project engineer: Alimohammad Dehghan
Finishes and equipment: Rasta Engineering Co.. Project engineer: Abdollah Razeghi
Space-frame's design and installation: Safira company. Principal: Dr Nasrollah Dianat

Master craftsman:
Master brick mason: Mohammad Jafari

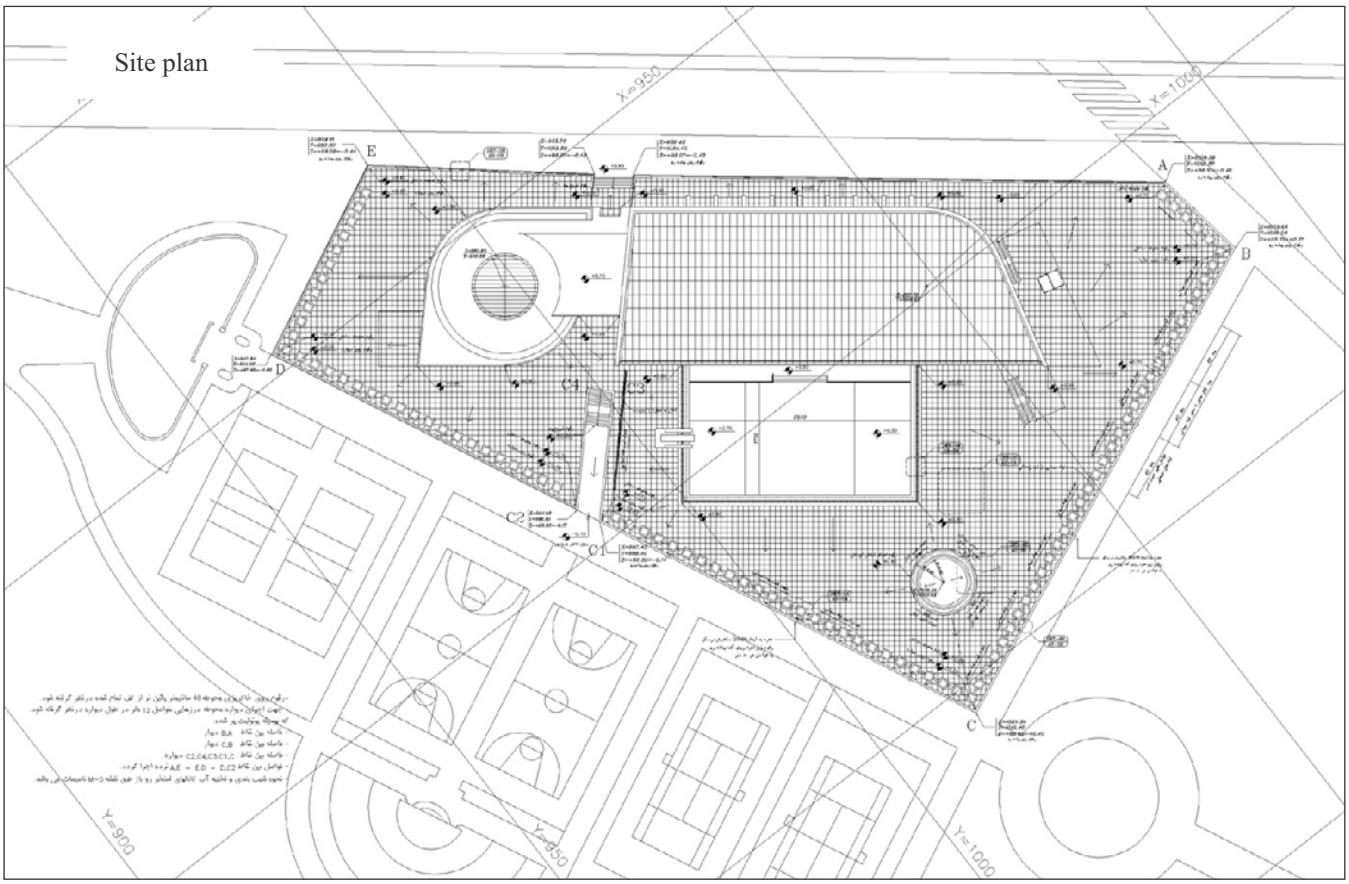
Omar Abdulaziz Hallaj
May 2004



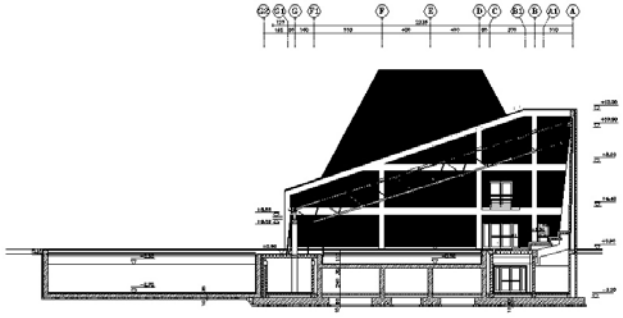
The sports complex occupies the western corner of the triangular shaped park with a library / museum in the centre and a commercial centre to the north.

Rafsanjan, some 900 kilometres south east of Tehran.

Site plan



Sections



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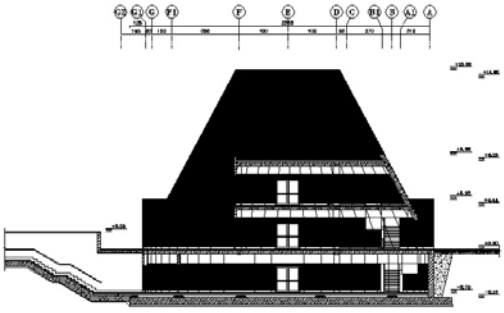

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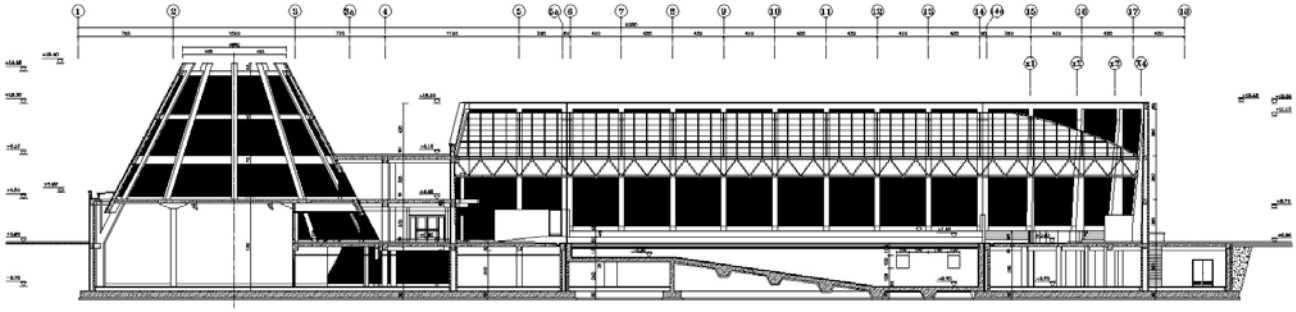

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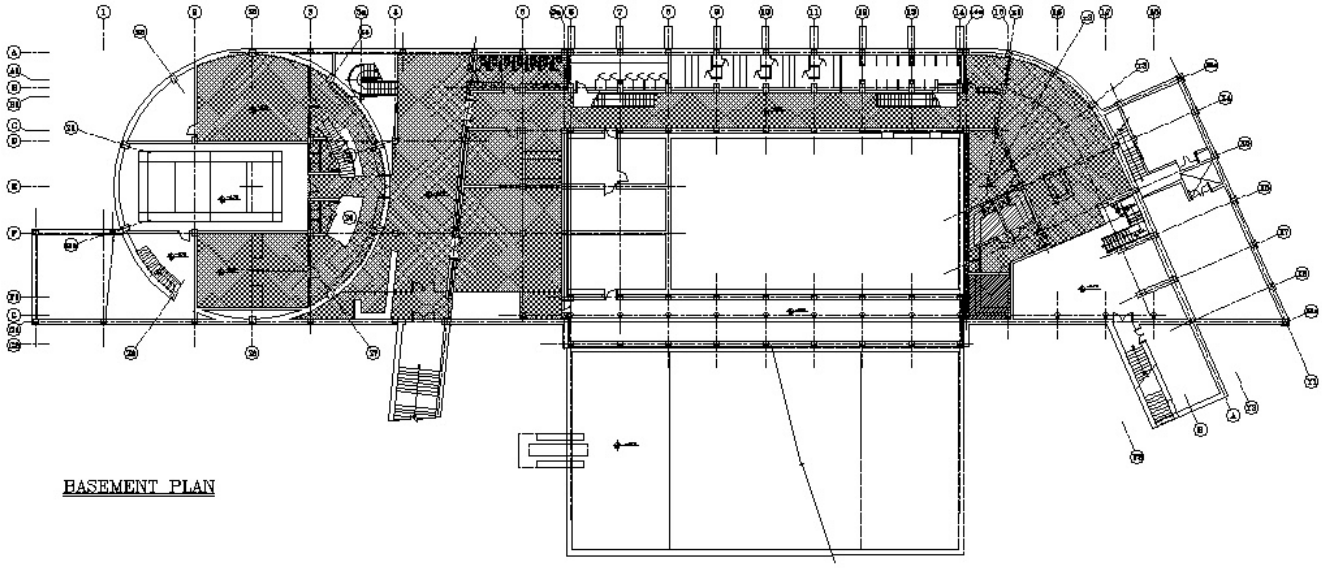
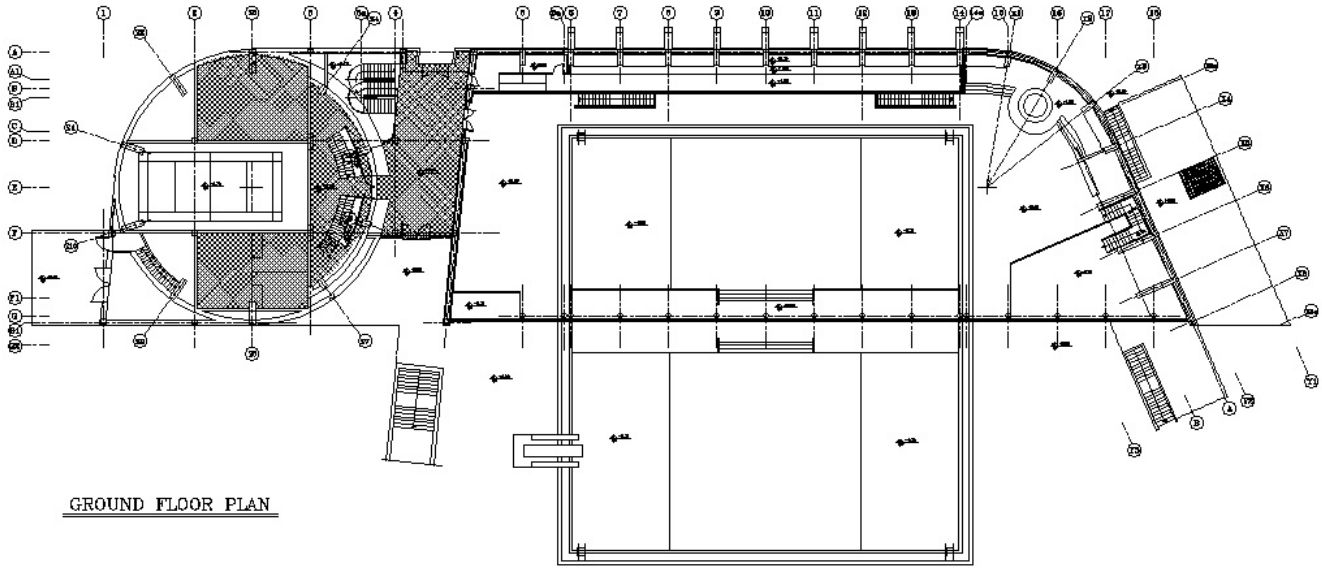
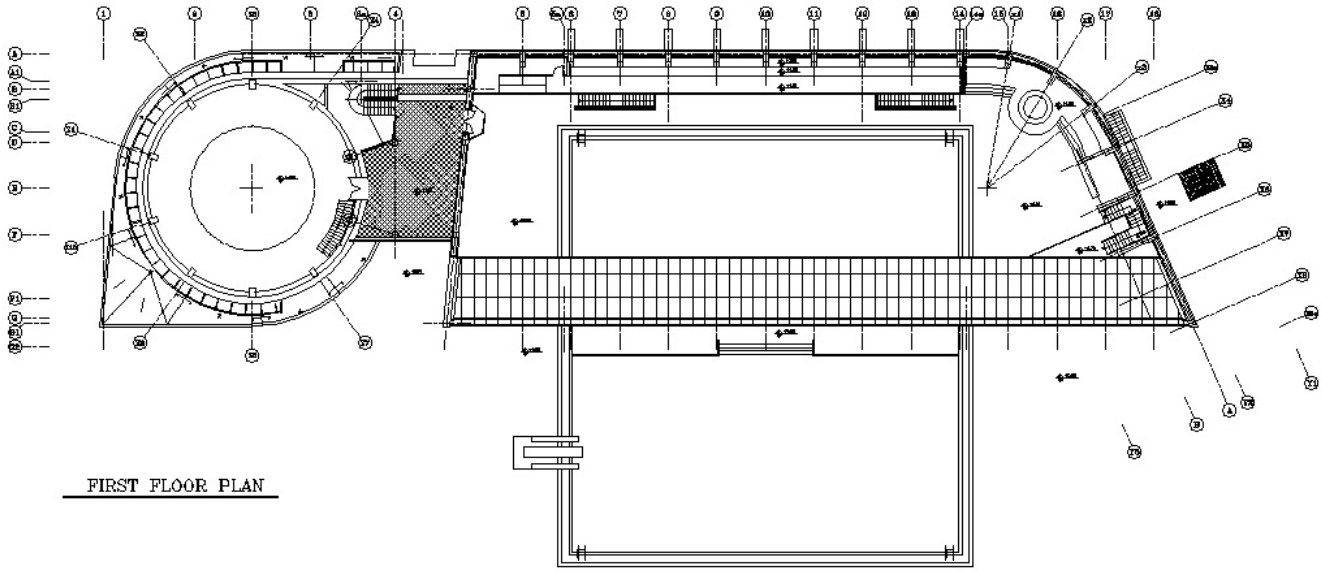


BASEMENT PLAN



GROUND FLOOR PLAN



FIRST FLOOR PLAN

Traditional *yakhchals* (icehouses) such as this one provided the inspiration for the complex. They feature a high wall to shelter ice ponds from sun during winters, and a massive conical room for storing ice in summer.

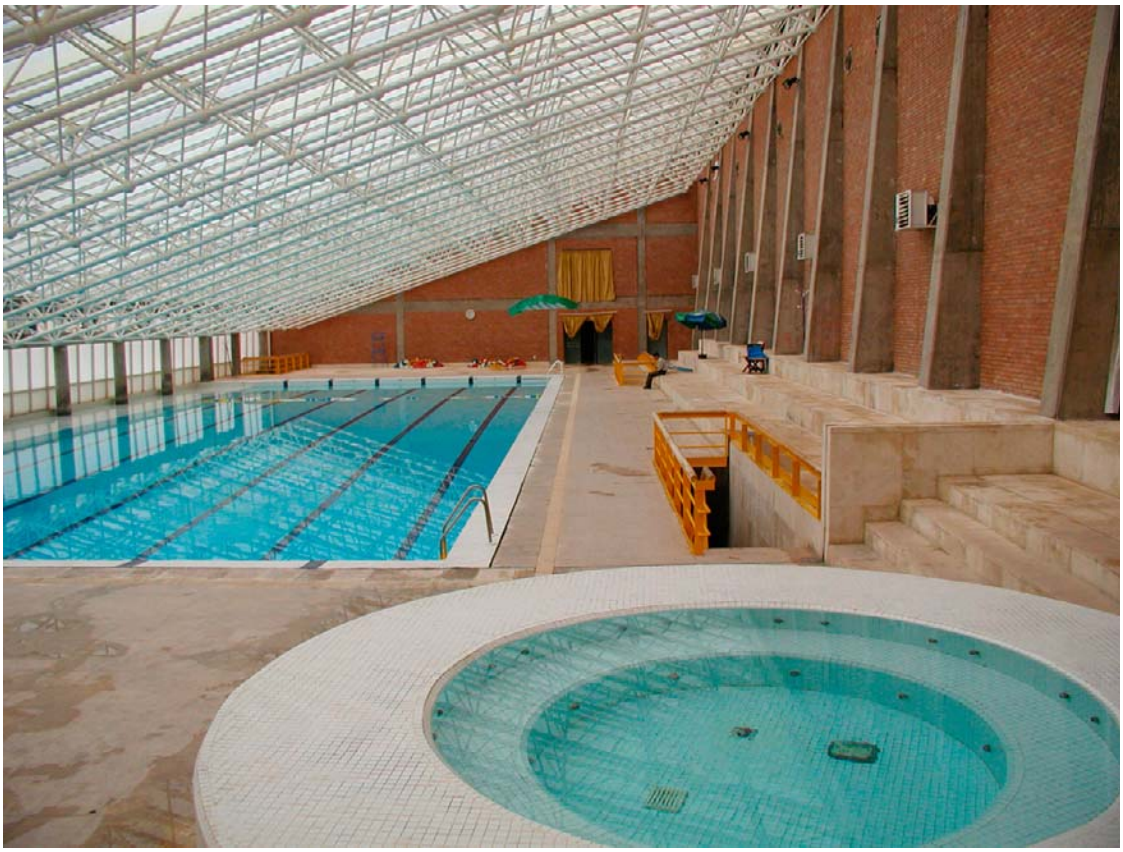
The sports complex occupies the western corner of a triangular-shaped site dedicated for the construction of the presidential memorial legacy. Halfway between the main library / museum and the sports complex, a circular depression in the ground has been created for a small stadium, still not completed.

The sports complex uses direct volumetric references to the traditional *yakhchal* building type. The basic elements of the complex comprise a long, high wall that extends from east to west. The area beyond the wall contain all the pool functions, and the area under the cone for other sports.

The conical volume is divided into two main levels. The lower level is used for badminton and other sports. The upper level is reserved for wrestling.

A covered space-frame roof is placed over the pool area, with a variety of both transparent and translucent panels.

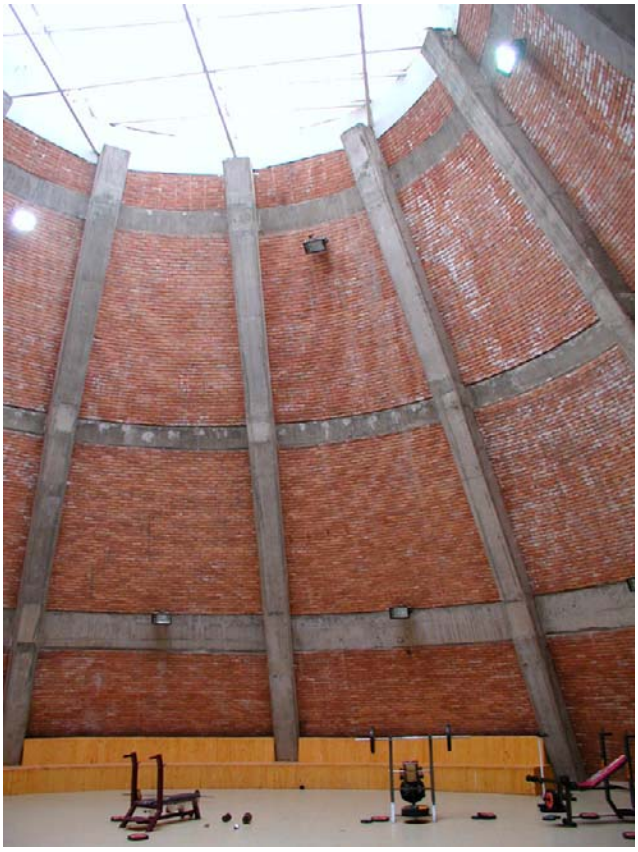
For swimming during both winter and summer, the complex contains two parallel pools, one under the covered area, the other just outside the building envelope.



Since the covered pool is used mostly in winter, the orientation of the traditional *yakhchal* was reversed so that the pool area is to the south of the wall to provide heat and sunlight.

The roof of the covered pool is a steel space-frame designed with continuous trusses.

Stairways are located in the space between the inside wall of the cone and the sports courts.



The use of brick was important as a reference to the local building style, but more importantly to the colour of the earth around the city.

Athletes enter the building from the southern side on the lower level, into a lobby that leads to dressing rooms on one side, and to the gymnasium on the opposite side.

The conical form of the structure is continued inside the building.