SARDAR VALLABHBHAI PATEL STADIUM

AHMEDABAD, INDIA

Comprehensive Conservation Management Plan

World Monuments Fund
Amdavad Municipal Corporation
2020 Keeping It Modern Grant, Getty Foundation

The report is published with the assistance of the Getty Foundation through its Keeping It Modern initiative.


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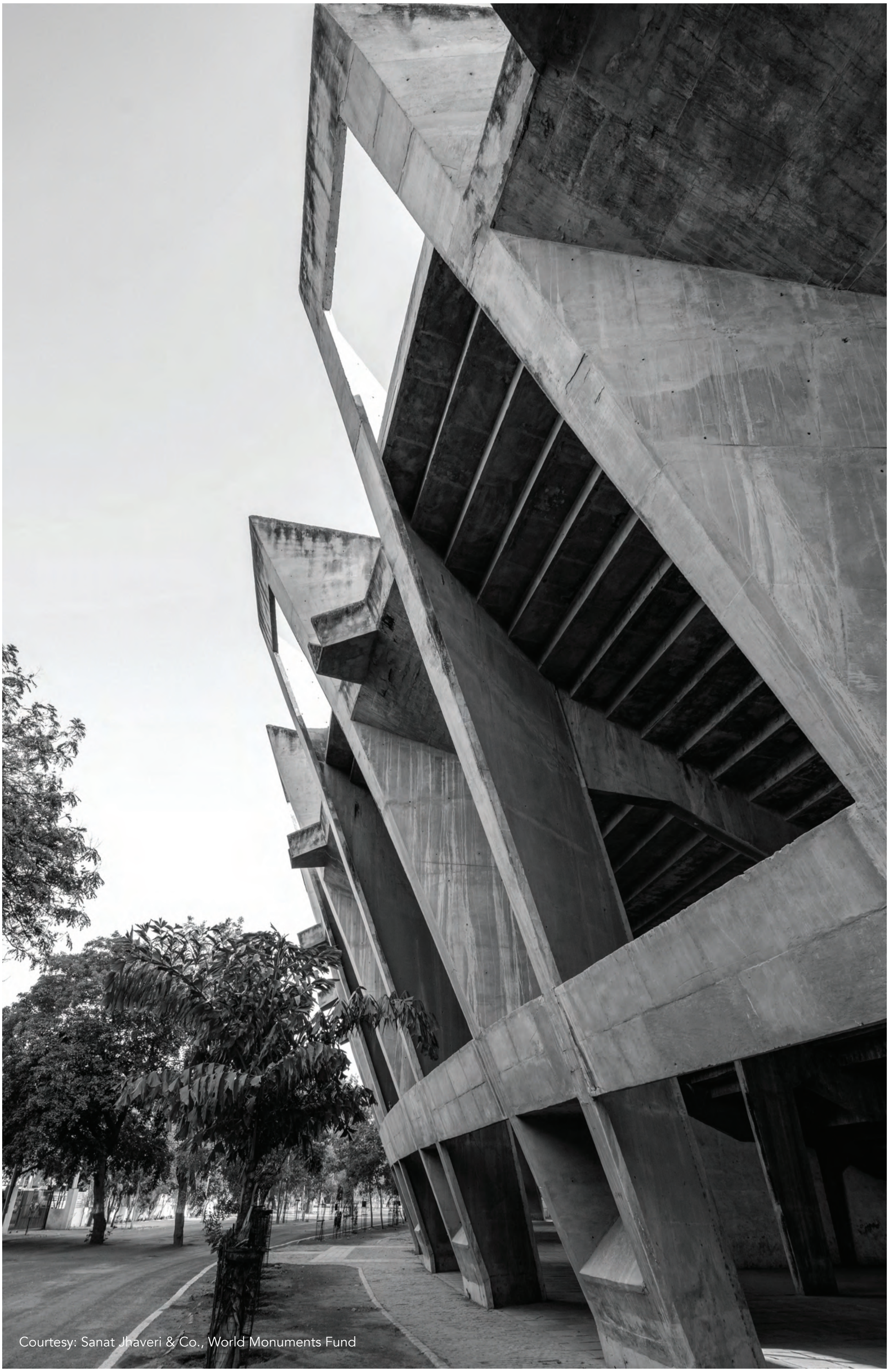
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COMPREHENSIVE CONSERVATION MANAGEMENT PLAN

VOLUME I

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Comprehensive Conservation Management Plan - Sardar Vallabhbhai Patel Stadium

Comprehensive Conservation Management Plan by World Monuments Fund in collaboration with Amdavad Municipal Corporation, with a 'Keeping It Modern' grant from the Getty Foundation, following the stadium's inclusion on the 2020 World Monuments Watch.

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Courtesy: Sanat Jhaveri & Co., World Monuments Fund

COMPREHENSIVE CONSERVATION MANAGEMENT PLAN

Sardar Vallabhbhai Patel Stadium

The Comprehensive Conservation Management Plan (CCMP) is organised in the following four volumes:

VOL I. Comprehensive Conservation Management Plan

VOL II. Architectural Drawings- As Built and Condition Mapping

VOL III. Conservation Recommendations

VOL IV. Master Plan

The CCMP is supplemented by four annexures:

- Assessing Significance of a 20C icon
- Conservation of 20C Concrete - A Discussion
- Conversations with Architects & Engineers on a 20C Icon
- Stakeholder and Community Engagement

CONTENTS

MESSAGE FROM WORLD MONUMENTS FUND

The Sardar Vallabhbhai Patel Stadium was included on the 2020 World Monuments Watch to draw attention to the complex challenges of preserving not only an iconic twentieth-century modern structure, but an emblematic public space for the people of Ahmedabad. Inclusion on the watch also sought to encourage a conservation management plan that includes the communities who support and benefit from the building. In July 2020, the Getty Foundation acknowledged Sardar Vallabhbhai Patel Stadium as one of the 13 significant twentieth-century buildings in the world, which would receive the 'Keeping It Modern Grant'.

World Monuments Fund is delighted to have stewarded the Comprehensive Conservation Management Plan for the Stadium in Ahmadabad, India.

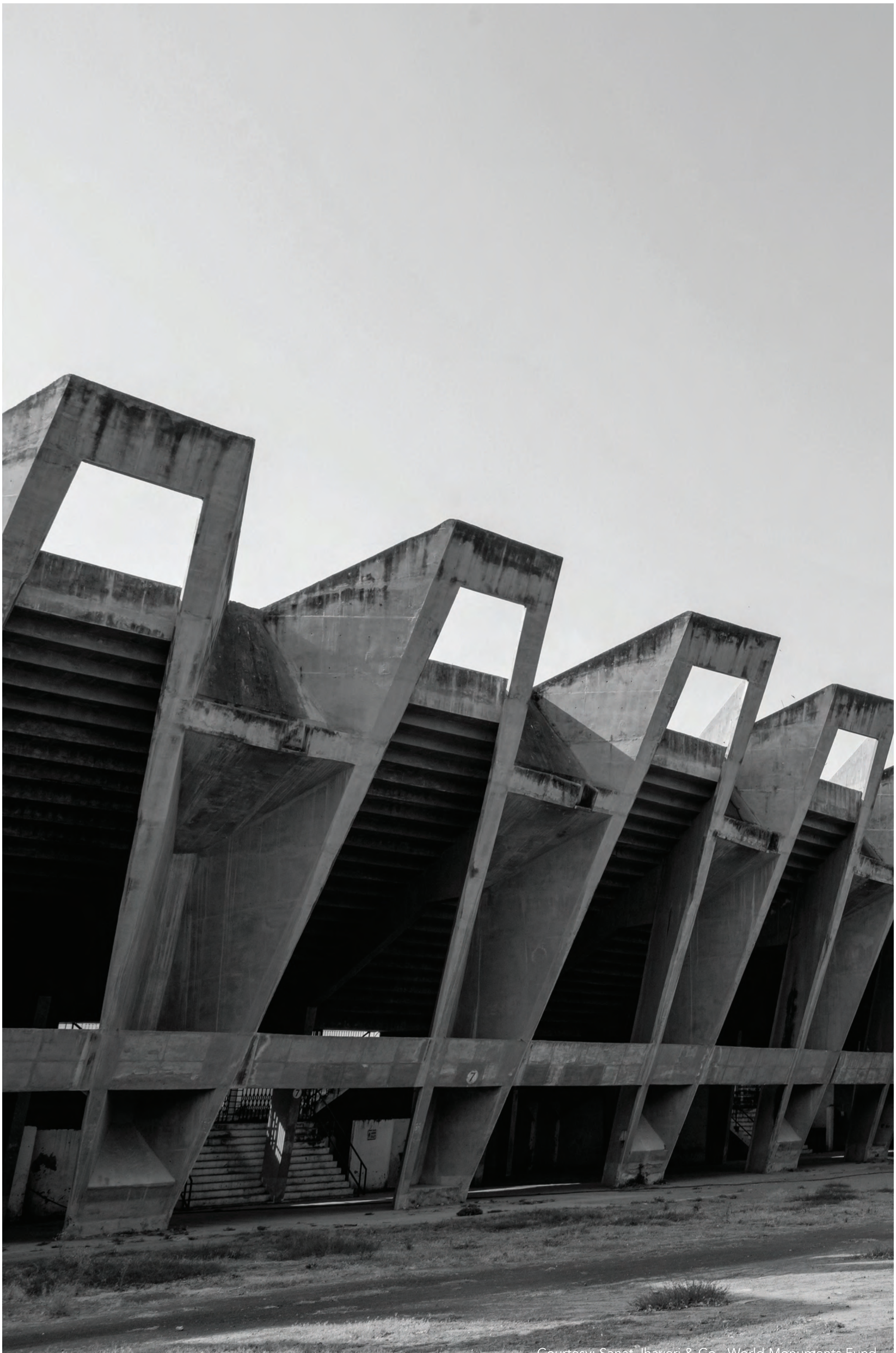
The Sardar Vallabhbhai Patel Stadium represents the progressive ideals and experimental spirit that characterized India's post-independence period. Designed in the 1960s by renowned architect Charles Correa and engineer Mahendra Raj, the stadium is part of a larger constellation of structures built in Ahmedabad by a generation of architects who helped create a new architectural language in the country. This collection of buildings illustrates the cultural and economic importance of Ahmedabad in India. The stadium was aspirational, modern and yet firmly rooted in the emerging Indian context. At the cutting edge of design as well as engineering technology, the project reflects a complete synergy of architect and engineer; where both pushed the boundaries of what was possible. Built over a period of almost ten years the overall vision is still clearly visible, even though elements of the overall design were truncated over time.

It was the premier cricketing destination in the sixties and seventies, hosting some of India's major matches and was also the training ground for fledgling cricketers. It therefore, has played a major role in the history of Indian cricket. Even though there is a much larger sports Stadium recently built in the city, it remains a much-treasured community space with multiple uses, for school sports as well as morning walkers. At the centre of a bustling metropolis, the stadium when restored, will reflect the vision of 21st century India, its facilities and sports venues upgraded to contemporary standards.

We remain indebted to the citizens of Ahmedabad who have guided our thoughts and shared both their memories and their dreams with us. Most of all we are deeply grateful to the Ahmedabad Municipal Corporation who have been our most robust partners and were generous with both their time and their ideas through multiple presentations and workshops.

The Comprehensive Management Plan was undertaken over a period of twenty months and included multi-disciplinary experts from within India and abroad. We have brought these knowledge strengths together in a single integrated document and we hope this will become the guiding manual for not only the conservation of the structure but also to upgrade the existing facilities, so that the Stadium once again becomes the centre of the city's sporting and civic life.

1.0
INTRODUCTION


Courtesy: Sanat Jhaveri & Co., World Monuments Fund

Introduction

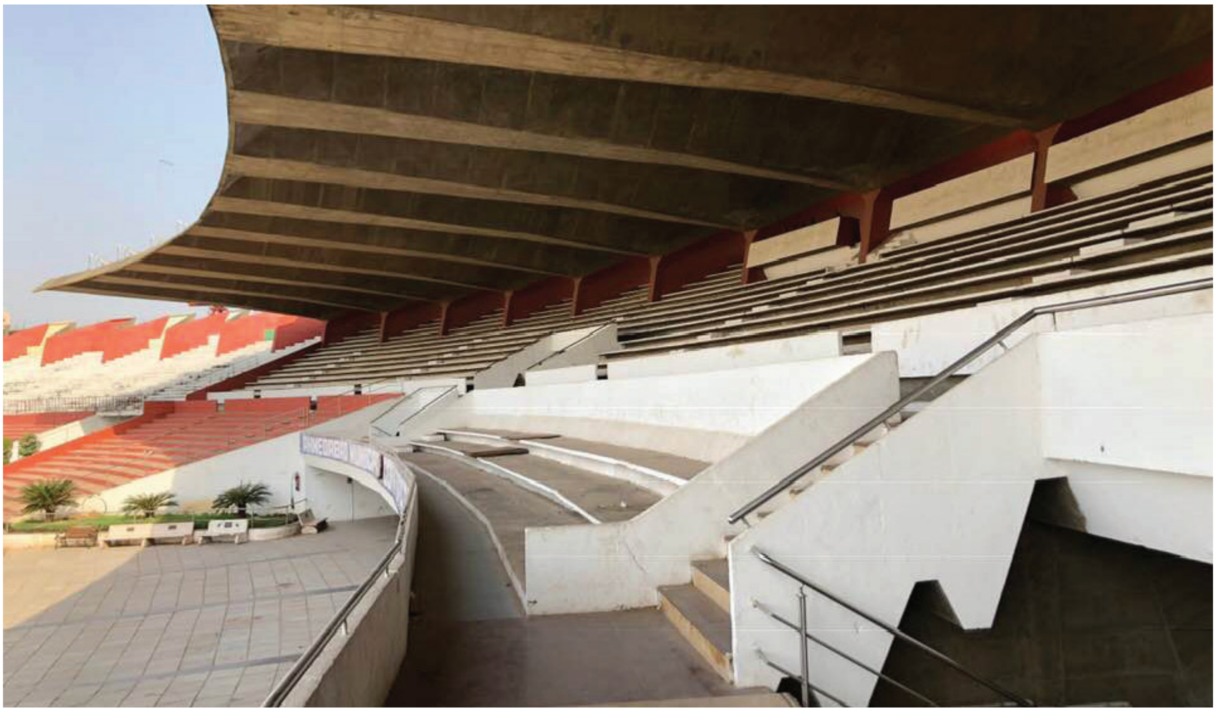
1.1 Background

Located in the heart of Ahmedabad, Sardar Vallabhbhai Patel Stadium represents the progressive ideals and experimental spirit that characterised India's post-Independence period. Designed in the 1960s by renowned architect Charles Correa and engineer Mahendra Raj, the stadium is part of a larger constellation of structures built in Ahmedabad by a generation of local and international architects who helped create a new architectural language in India. Following the partition of the State of Bombay in the 1960s, the stadium became emblematic of the cultural and economic importance of Ahmedabad.

Originally built to host international cricket matches, including the first ever One Day International match in 1981, the stadium later became a regular venue for India's domestic cricket season after Motera Stadium, Known today as Narendra Modi Stadium, was constructed nearby in 1982. Open to the public today, SVP Stadium has become an important recreational hub for the local community that also uses it to host events for schools in the city, and is still a unique resource for quality open space in a country where urban encroachment is increasing by the day.

In spite of being situated in the heart of the city and used everyday by a large number of people, the stadium has suffered significant physical degradation as a result of decades of poor maintenance and lack of funding. Recognition as a cultural heritage site would perhaps ensure its protection and prevent its potential loss.

Fig. 1: Aerial view of Sardar Vallabhbhai Patel Stadium, Ahmedabad, India



2020 World Monuments Watch

Fig. 2: Perspective view of the South Pavilion at SVP Stadium

Courtesy: Ram Rahman, 2018, © Rohit Raj Mehndiratta & Vandini Mehta

SVP Stadium was placed on the World Monuments Watch in 2020. The World Monuments Watch, a flagship advocacy programme of the New York based private, non-profit organisation, World Monuments Fund (WMF), draws international attention to heritage places in critical need of protection and galvanizes action and support for their preservation. Every two years, WMF launches a new Watch that includes 25 heritage sites from around the world with the impetus for developing new field projects that provide local solutions with global relevance. The sites are nominated by governments, conservation professionals, site caretakers, non-governmental organisations (NGOs), concerned individuals, and others working in the field of conservation. Based on the significance of the sites, the urgency of the threat, and the viability of both advocacy and conservation solutions, an independent panel of international experts then selects 25 sites from these entries to be part of the Watch. For the succeeding two-year period, until a new Watch List is published, these 25 sites can avail grants and funds from WMF, as well as from other foundations, private donors and corporates by capitalising on the publicity and attention garnered from the inclusion on the Watch.

The call for the 2020 Watch nomination was announced in January 2019, with the submission deadline set for March 2019. More than 250 nominees were submitted. SVP Stadium nomination was filed by two independent Heritage Management Consultants— Annabel Lopez and Chirashree Thakkar — with consent from the Commissioner of Amdavad Municipal Corporation. Twenty-five sites were selected to be included in the Watch List and SVP Stadium was one of them, along with 24 other heritage sites such as Notre-Dame de Paris.

SVP Stadium was included on the 2020 World Monuments Watch to draw attention to the complex challenges of preserving not only an iconic 20th-century modern structure, but an emblematic public space for the people of Ahmedabad. WMF's aim in listing the site was to encourage a Comprehensive Conservation Management Plan (CCMP) that would include the communities that support and benefit from the building. As part of this objective, an application was made to the Getty Foundation under the Keeping it Modern initiative for a grant for the preparation of a CCMP.

Keeping It Modern Grant, Getty Foundation

Fig. 3: Perspective view of Sardar Vallabhbhai Patel Stadium

Courtesy: Sanat Jhaveri & Co., World Monuments Fund

In July 2020, Getty Foundation announced that SVP Stadium was one of the 13 significant 20th-century buildings to receive funding from Keeping it Modern—an initiative created in 2014 to aid the conservation of modern architecture. With the final year of Keeping it Modern, Getty Foundation will have awarded a total of 90 grants. The stadium is indeed fortunate to have been a recipient in a year Getty Foundation calls 'the initiative's largest and most geographically diverse year of applicants'. The 13 winners of the competition are scattered across five continents, with three buildings appearing as repeats from earlier grant cycles. With Getty Foundation's support, WMF specialists from both the United States and India collaborated with a team of local experts to create this CCMP and highlight the site's heritage values.

Keeping It Modern does not award grants to privately owned buildings; it aims to support conservation projects that 'advance the long-term preservation, protection and maintenance of outstanding 20th-century buildings.' Although the grant programme is finishing this year, the 'Conserving Modern Architecture' initiative that is part of it shall continue. Furthermore, on its website, Getty Foundation makes available conservation reports from previous recipients of Keeping It Modern grants; the CCMP under preparation for SVP Stadium, shall feature on it as well.

1.2 CCMP: Objectives and Methodology

Objectives

The main objective of the CCMP is to offer a framework that would facilitate the conservation, maintenance and operation of SVP Stadium. The CCMP also enumerates policies to help Amdavad Municipal Corporation, the stadium's owner and custodian, in the long-term management of this globally significant 20th-century architecture.

Methodology

The CCMP has been prepared by a multidisciplinary team engaged by World Monuments Fund, comprising subject-area specialists—conservation architects, structural engineers, planners, placemaking and heritage management consultants with past experience in conservation of significant 20th-century architecture in India. The principles identified in the Burra Charter, Madrid–New Delhi Document and the Conservation Principles for Concrete of Cultural Significance served as guidelines in the preparation of this CCMP.

The project methodology can be categorised into five segments, with sub-sections to further elaborate the approach:

- Documentation and Research
- Establishing Significance
- Surveys and Investigation
- Outreach
- Planning and Recommendations

The team also worked closely with the primary stakeholder—Amdavad Municipal Corporation—to ensure everyone was in agreement with the way forward. The group identified this engagement as the most critical aspect of the entire process as it would facilitate the implementation of the CCMP in future.

Documentation And Research

Archival Research

Archival evidence in the form of original drawings, construction photographs, model images, newspaper clippings, oral records and several other resources were collated from different organisations and knowledge partners: Charles Correa Foundation; Mahendra Raj Consultants; Mahendra Raj Archives; Amdavad Municipal Corporation (historical records and oral history); other stakeholders, including local residents, past contributors (original contractor) and online resources.

The team also approached many other organisations of local and national significance in the hope of gathering more relevant information that would enable a comprehensive understanding of 20th-century buildings, their context, sporting history and socio-cultural landscape. Unfortunately, due to lack of access and documentation, it was not possible to retrieve more archival documents from these sources.

Site Documentation

Raj Survey Consultant, an Ahmedabad-based firm, was appointed to conduct a total station survey to generate a drawing set. These base drawings were used to prepare the as-built drawing set that would serve as a blueprint for all future surveys. Additionally, a separate set of open / unfolded measured drawings was also created by the project team to aid in the conditions survey.

Identifying Typologies, Material and Building Systems

The on-site team examined and classified the stadium building into distinct components, which were further categorised into typologies, building material and structural configuration. This exercise helped the team conduct a broad-based initial investigation, create a preliminary condition glossary and draft the complete building description.

Establishing Significance

Initiate Engagement with the Local Community

To offset the limited archival information and enable a participatory process, the project team began engaging with the local community. Such engagements also enabled the team to draw up a shortlist of representatives from the community who were able and willing to engage informally over the course of the project and beyond.

Value Assessment and Assessing Significance

The team also conducted a value-based and an analytical assessment of the stadium complex and its immediate surroundings to identify its cultural significance. This task was undertaken to ensure that all attributes of the complex considered meaningful by heritage professionals and its community are 'retained, revealed or, at least, impaired as little as possible.'[1] Finally, a 'Statement of Significance' was drafted to enumerate all the findings of this exercise.

Surveys And Investigations

Initial Survey and Condition Glossary

The on-site team did an initial reconnaissance to understand the existing conditions of the structure, identify different deterioration patterns for each material, and other anomalies that may need further research or investigation. This resulted in the creation of a condition glossary that facilitated the subsequent mapping exercise. Additionally, a separate assessment was undertaken to identify the current infrastructure, services, risks and use of the stadium.

Condition Assessment

Based on the scale of the building, results from the initial survey and access to the different components, the project team arrived at an assessment strategy executed on-site by a team of conservation architects and architects. First, the conditions were recorded in the field, and then, the field notes were digitised for each building element. Based on the extent of damage and previous interventions noticeable in some areas of the stadium, it was decided that these issues shall only be broadly categorised, and photo-documented.

1. Kerr, James, 'Semple Conservation Plan, the 7th edition: A Guide to the Preparation of Conservation Plans for Places of European Cultural Significance.' Australia ICOMOS, 2013.

The visual mapping was conducted primarily from the ground level, using the measured open / unfolded surface plans and condition glossary. However, equipment such as boom lifts and drones were employed to evaluate areas that were otherwise inaccessible. The city-wide lock-down during the course of the project impacted the implementation of this mapping exercise.

Scientific Testing and Investigation

Based on the assessment, a testing programme was formulated for the concrete elements at the stadium. The programme included characterisation and analysis of materials for basic properties as well as understanding the deterioration due to carbonation and other factors. These investigations were carried out based on available standards for field and laboratory testing methods. This exercise was also employed to ensure that all the visual cues recorded during the condition survey could be confirmed through scientific testing. Additionally, the tests would also inform the proposed recommendations and corrective measures, ensuring they are compatible and sustainable. Finally, structural and seismic analyses were also undertaken to examine the stadium's current state, and to ascertain its long-term structural stability.

Activity Mapping

This study was carried out in three phases—data collection, visualisation and analysis. The project team conducted site visits to record information through visual observation and personal interviews. This survey was then depicted in the form of photographs, drawings, and graphs / charts. Finally, all the information collated was analysed to develop a deeper understanding of how the stadium is currently utilised by different users.

Outreach

Community and Stakeholder Consultation

Beyond the initial engagement, the project team expanded their stakeholder engagement efforts by interviewing past and present users from a large cross-section of the community—cricketers, coaches, umpires, curators, athletes, fitness enthusiasts, students, local residents, and officials from Amdavad Municipal Corporation. Additionally, the team also interviewed a diverse group of professionals with a background in architecture and engineering. This initiative was aimed at giving voice to a broader range of stakeholders, and facilitated their active participation in the creation of the CCMP.

The team also established a 'Friends of SVPS' programme to evaluate the placemaking needs of the stadium. Through this programme, the team provided its users a common platform, and facilitated discussion on their current needs and future hopes for this 'people's place'. The programme also intended to bolster a stronger association of the users with this community space.

Workshops

During the course of the project, the team organised three workshops: 'Assessing Significance'; 'Community and Stakeholder Consultation', and 'Conservation of 20th-Century Reinforced Concrete Structures.' All the workshops were conducted on a virtual platform, and were open to the general public. This initiative also aimed to broaden the discourse around 20th-century heritage, facilitate knowledge sharing, and expose the audience to practical tools that would help them conserve significant modern marvels of India in future.

Competitions

Towards the end of the project, the team also organised a photography and a design competition to generate interest in a diverse group of city dwellers, including photography enthusiasts, and design and architecture students. This initiative also aimed to spread awareness among the citizens and motivate them to engage with the stadium.

Planning And Implementation

Master Plan of the Stadium Complex

In the course of the project, the team also recognised the need to look at the stadium complex as a whole, and began to evaluate the existing condition of the stadium through the twin lens of spatial configuration and infrastructure. Cues from these archival drawings, ongoing surveys and site investigations were analysed to formulate design recommendations that would enable the site managers to integrate new use into the property without either spoiling its visual appeal or losing its essence as 'a people's place'.

Policies and Recommendations

Based on the outcomes at different stages of the CCMP, the team finally prepared a set of policies and recommendations that could be implemented by AMC, the custodian of the stadium. These guidelines have been formulated to provide the primary stakeholder with tools to protect the structural integrity of the stadium, and enable future interventions that would add value to the property without diminishing its cultural significance.


Courtesy: Sanat Jhaveri & Co., World Monuments Fund

2.0
HISTORICAL DEVELOPMENT

Credit: Charles Correa Foundation

Historical Development

2.1 Modernism and Post-Independence Building Activity in India

Globally, the term 'modern movement' refers to the phenomenon at the turn of the 20th century when designers were ideologically influenced by the socio-political and technological advancements of the time, and were deeply aware of the changing societal processes. This newfound awareness was, in turn, responsible for a newly emerging language in art, architecture and urban planning, reflected in the appearance of towns and cities. 'They addressed the "spirit of the times" instead of following historical precedents to create new architecture and cities. The exemplary products of this shift in focus are now acknowledged as valuable cultural expressions of the times.'[2]

As recounted by Prof. Kulbhushan Jain, 'The first modern building to be built in India was perhaps the Aurobindo Ashram in Pondicherry. Designed in 1945 by Antonin Raymond, this building responded to the climate and the local context, and was the first concrete building in India. It heralded that it was time to respond to climatic factors. The large louvres on the façade of the building were a clear expression of concern for the climate. Many other buildings that were built after 1947 followed this ideology.'[3]

Fig. 4: Antonin Raymond with Noémi Pernessin Raymond in New York, c. 1914

Source: Mari Sakamoto Nakahara, Ken Tadashi Oshima, Wikimedia Commons, CC BY-SA 4.0, 2007

2. Excerpts from A.G.K. Menon's intervention at the symposium titled 'Post-Independence Architectures Of India—Significance & Context.'
3. Conversation with architect Prof. Kulbhushan Jain on 'Evolution of Architecture Ideologies in the 20th Century,' conducted as a Community Engagement Initiative as part of the preparation of this CCMP. For more, see the document on, 'Stakeholder and Community Engagement.'

Fig. 5: Street view of Golconde Ashram, also known as Aurobindo Ashram, in Puducherry, designed by Antonin Raymond and George Nakashima

Source: Aleksandr Zykov, Wikimedia Commons, CC BY-SA 2.0, 2011

India's independence from colonial rule provided a huge impetus for building activity in mid-20th-century India. Prof. A.G.K. Menon elaborates on the reason in a paper presented at the symposium titled 'Post-Independence Architectures of India—Significance & Context,' held at India International Centre, New Delhi on 6 July 2017. 'After Independence, Indian architects too wanted to create a new architectural identity in consonance with the "India will awake" as Nehru famously declaimed in his "Tryst with Destiny" speech. This spirit inspired Indian architects to visualise imaginative opportunities to modernise the architecture of independent India, not unlike the spirit that motivated European architects to transform their architecture at the turn of the last century. But there was a difference in the Indian narrative—it was imported through the works of the new generation of architects who had studied at universities in the West, and had often worked directly under the masters of the modern movement.' For instance, Charles Correa had studied at MIT, Achyut Purushottam Kanvinde had studied at Harvard and Balkrishna Vithaldas Doshi had worked with Le Corbusier. They transferred to their Indian projects what they had absorbed to be ideals and symbols of modernity during their education.

Fig. 6: Le Corbusier and Pandit Jawaharlal Nehru during the inauguration of the High Court building, Chandigarh, India

Source: Unknown, Wikimedia Commons, 1955. https://www.cca.qc.ca/en/search/details/collection/object/434403

Fig. 7: Perspective view of the Assembly House and High Court from the Secretariat building with the UNESCO World Heritage Site, Capitol Complex, Chandigarh, India

Source: Eduardo Guiot, Wikimedia Commons, CC BY 2.0, 2008

Fig. 8: Perspective view of Mahatma Gandhi's statue in the Sabarmati Ashram complex, Ahmedabad, India

Source: Hardik Jadeja, Wikimedia Commons, CC BY 3.0

Prof. Jain further explains the evolution of modern architecture in India, 'Soon after Independence, projects of an urban nature were initiated, and this first happened in Delhi. Ashoka Hotel, for instance, was among the first of its kind by a Parsi architect, E.B. Doctor. Vigyan Bhawan, also from the same period, was designed by a government architect, R.P. Gehlot. All these were rather large architectural projects. Thus, in India, though the mechanisms that sustained Modernism and its development in the West were missing, in time, this process of transference led to an indigenous brand of modern architecture—the so called "Indian" identity. Indian motifs were very superficially used in Ashoka Hotel; Vigyan Bhawan's main entrance has a Chaitya window in green marble—perhaps not the best way to represent Indian identity, but this was what emerged at the time. Around the same time, Chandigarh was being built, and Le Corbusier was asked to make some kind of contribution that was Indian. In the earlier projects, Pandit Jawaharlal Nehru had a say, but what we see in Chandigarh was largely Le Corbusier's ideas as he was able to convince Pandit Nehru about his concepts. The Physical Research Laboratory (PRL) project in Ahmedabad by Achyut Kanvinde also had some kind of participation from the Prime Minister who pushed forward his thinking, but this was more evident in Vigyan Bhawan. During this phase, Le Corbusier was accepted and so was concrete as a material.'

In time, the Indian architectural narrative became both varied and complex. To a large extent, it was influenced by the works of Le Corbusier and Louis Kahn—acknowledged masters of the international Modernist movement—who designed important buildings in India. Their influences on Indian architecture were further transformed by local architects to address local exigencies. The latter more evolved styles formed distinctive strands of Indian Modernism. For instance, the designs of Anant Raje and Shiv Nath Prasad were obviously inspired by the works of the masters they emulated.

From 1915, the presence of Mahatma Gandhi in Ahmedabad, and his ideological beliefs served as catalysts in the initial phase of the development of the city. During this period, all initiatives by the Mahatma in Ahmedabad were supported by distinguished members of Ahmedabad's elite. Between 1910 and 1920, first Kochrab Ashram was established followed by Sabarmati Ashram. Even after the Mahatma left Ahmedabad, his philosophy remained the guiding light for the mill owners who continued to support and fund the development of the city by donating generously.

Around 1920–25, when Sardar Vallabhbhai Patel was President of Ahmedabad Nagar Nigam, a number of institutions were established with the support of mill owners. During his tenure, one of the biggest landmarks—V.S. Hospital (Vadilal Sarabhai Hospital)—was built in collaboration with the Vadilal Raghibhai Sarabhai family who donated funds for its development.

Around 1935, another landmark—the City Town Hall—came up. Supported by the Textile Association, Gujarat College, among the leading educational institutions of the time, was also built during this period. Apart from educational institutes, social infrastructure too was developed in Ahmedabad.

In post-Independence India, workspaces, banks, research centres, educational buildings were among the buildings designed by noted architects. After Gujarat became a state in 1960, the state government was keen to support any endeavour that earned plaudits for Gujarat, especially in the field of education. Hence, with government support, a large number of educational and cultural institutions were built in Ahmedabad during this period. Government architects were notable for their range of works like the Bank of India building, and colleges for Ahmedabad Education Society. These architects were responsible for making Ahmedabad an important centre of education and trade by propagating 'good' architecture.

During this time, mill owners, philanthropists and other distinguished citizens of Ahmedabad took the initiative to persuade the respective authorities and stakeholders to take up development work for the benefit of the city.

In the 1950s, the Ahmedabad Municipality was converted into the Municipal Corporation. The first mayor was Sheth Chinubhai Chimanlal (1950–1956; 1957–1961), the owner of several mills. Two other mayors— Jayakrishanbhai Harivallabhdas Patel (1961–1965) and Navrottam Keshavlal Zaveri (1969–72)—were equally committed to development work in Ahmedabad. Both textile mill owners, Patel and Zaveri were also great lovers of cricket.

During 1960–65, Ahmedabad witnessed the construction of landmark structures like Tagore Memorial Hall, Sanskar Kendra, Mill Owner's Association, and more.

Other institutions like the Indian Institute of Management, Ahmedabad (IIMA), Ahmedabad Textile Industry's Research Association (ATIRA) and National Institute of Design (NID) were established by the community of visionary textile mill owners who were interested in developing the city as an exemplary modern Indian town. Among the prominent families were the Sarabhais, the Mangaldass and the Lalbhais.

Fig. 9: Perspective view of Sanskar Kendra Museum, Ahmedabad, India

Source: Nizil Shah, Wikimedia Commons, CC BY-SA 3.0, 2012

Fig. 10: B.V. Doshi (left) with Stefan A. Schumer during an event at CEPT University, Ahmedabad, India

Source: Drashti Unit, Wikimedia Commons, CC BY-SA 4.0, 2013

Not all of them were part of the local administrative body, but they initiated significant development programmes for the cause of the city. ISRO was established under the mentorship of Vikram Sarabhai at Jodhpur Tekra which, at the time, was on the outskirts of the city. Sarabhai also established the Physical Research Laboratory, aided in this initiative by Jamnadas Patel, an administrative officer, and Jiivraj Mehta, the first Chief Minister of Gujarat State, who arranged for land to be allotted for the laboratory.

In the 1970s, Ahmedabad became the hub of Indian Modernism, with some of the finest architects of the time—Achyut Kanvinde, B.V. Doshi, Charles Correa and Hasmukh Patel—working on projects in the city.

In the 1980s, there was a shift in perspective with the attempt to portray India as a nation that had both a past and a future. Consequently, a distinctive architectural language emerged, defining the postmodernist era in India. Buildings by Kanvinde, Doshi and Correa from the postmodernist era bore strong references to India's rich past.

In India during the late 1980s, Anant Raje, among others, tried to respond to the new ways of thinking about space and the aesthetics of architecture. Architecture also had to respond to a distinct and changing societal framework. This period marked an important stage in the evolution of 20th-century architecture in Ahmedabad. Le Corbusier and Louis Kahn were highly revered here too, especially in architecture schools. All in all, architecture in Ahmedabad now had a distinct cultural, climatic, and geographical framework.

2.2 Techniques and Materials of the Period: Brutalism

India and Brutalism

After Independence, India was looking for an architectural style that would represent and symbolise a young, new nation. Under Pandit Jawaharlal Nehru, independent India's first Prime Minister, the vision of a modern India was articulated. Emphasis was laid on science and technology, and methods to support industries. The First Five-Year Plan provided a boost to the building industry and its assocaited professionals to experiment with new materials and techniques. Gradually, India's search for its national identity began reflecting in the works of Indian architects and 20th-century Indian architecture. Meanwhile, after World War II, Brutalism, an architectural style that celebrated bold forms with unpretentious exposure of the materials in which the building was built, spread across the world. Concrete became synonymous with Brutalist architecture as its properties allowed it to be cast in different forms, and its surfaces offered the truthfulness intended and desired by this architectural style.

Already in use in India before Independence, reinforced cement concrete (RCC) remained the preferred material of construction even after Independence, when concrete technology was increasingly used, redefining the social and technical landscape of construction in India. Despite some exceptional buildings that came up during this period, there was no Brutalist structure besides the Golconde Ashram in Pondicherry designed by architects Antonin Raymond and George Nakashina and built much before 1947—an unusual time for the relatively modern use of exposed concrete.

When Le Corbusier was invited to plan Chandigarh city with its Capitol Complex, and some other structures in Ahmedabad, his monumental work in exposed concrete, precast panels, glass and metal set a benchmark for Brutalist design in India. Concrete in its exposed, imperfect and true form was detailed and executed. Many Indian architects trained under and worked with Le Corbusier and his team in Chandigarh as well as in Ahmedabad. The newly trained and inspired architects and engineers started to create structures in exposed concrete in Chandigarh, Ahmedabad and New Delhi. Various architects, engineers and their teams envisioned, experimented, and executed techniques that were new to India.

In Ahmedabad, B.V. Doshi and Charles Correa pioneered the use of exposed concrete in structures like Premabhai Hall, Central Bank, Tagore Memorial Hall and Sardar Vallabhbhai Patel Stadium—a lasting testimony to technology and creativity. All these are iconic structures with structural experimentations like cantilevered folded-plate for the roof, A-Frames along the periphery (SVP Stadium) and frames in folded plates on the façades (Tagore Memorial Hall).[4] Surface finishes in all these buildings were fairly simple—exposed formwork without added embellishments.

Fig. 11: Perspective view of the front entrance to the Secretariat building in Capitol Complex, Chandigarh, India—a UNESCO World Heritage Site

Source: Nicholas Iyadurai, Wikimedia Commons, CC BY-SA 4.0, 2007

4. Mehta, Vandini Rohit Raj Mehndiratta & Ariel Huber, The Structure: Works of Mahendra Raj, Park Books, Zurich, 2016.

Fig. 12: Bird's-eye view of the cantilevered roof and A-Frames constructed using folded plates in SVP Stadium

By the late 1960s, influence of the architecture in Chandigarh became evident in Delhi, with its first exposed concrete building, Shri Ram Centre for Performing Arts, followed by Akbar Hotel, both collaborations between architect Shiv Nath Prasad and structural engineer Mahendra Raj. While Shri Ram Centre was designed to have radial beams cantering from columns, with parasol roof on the auditorium, Akbar Hotel was designed to use post-tensioned girders, tapered ribbed beams, and a free-standing staircase cantilever from a pin wall.[5] The Hall of Nations designed by Raj Rewal was followed by a fleet of iconic structures such as the NCDC building and Palika Kendra, both collaborations between architect Kuldip Singh and structural engineer Mahendra Raj. With its tapering, zigzagging, thin shear walls, NCDC is a landmark in Delhi. Architect J.K. Chowdhry also created an exposed concrete administration block in collaboration with structural engineer Gulzar Singh at IIT Delhi. Visual articulation of exposed concrete can be seen in Shri Ram Centre, with timber formwork arranged horizontally and vertically. Kuldip Singh took Brutalism in India to another level through the finesse of exposed concrete in structures like the NCDC building, with vertical, horizontal and geometric patterns in its formwork.

5. Ibid.

Techniques

Brutalism consciously let go of plastering and cladded surfaces, exposing all stages and parts of the structure, including its formwork. Concrete was used for beams, columns, and walls as well. At times, brick walls were used in combination with concrete frames and other building elements.

In the initial phase of Brutalism, building materials like concrete and brick were used and left as is after the formwork was removed and the construction was complete. Soon, the exposed textures, during and after the construction, drew appreciation. The flaws and defects that were either inherent to the material or caused during construction were not hidden, and left untreated. Formwork played an important role in the construction of exposed concrete or form-finished concrete. The architects and engineers planned and designed the layout of the formwork for the exposed surfaces very carefully. Mostly timber was used as formwork as concrete was poured according to the frame outline defined by construction joints. The holes from installing the formwork too became a design element.

However, as Brutalism progressed, the raw unaltered surfaces registered many detractors. Compared to the initial structures and their features, some architects and engineers used more sophisticated and evolved techniques to achieve finer surfaces. Several types of surface finishes like corrugated surfaces with closely spaced parallel lines were explored. Another notable feature of Brutalist surfaces was concrete with exposed aggregates. Like the formwork, aggregates were planned to be incorporated in the concrete. Exposure of aggregates also involved techniques such as brushing, sand-blasting and washing.

Fig. 13: Perspective view of Tagore Memorial Hall designed by architect B.V. Doshi and structural engineer Mahendra Raj

Source: Imfarhad7, Wikimedia Commons, CC BY-SA 4.0, 2021

Fig. 14: Perspective view of Mill Owners Association, Ahmedabad, India

Source: Sanyam Bahga, Wikimedia Commons, CC BY-SA 2.0. 2009

Concrete Construction in Ahmedabad

Prof. Neelkant Chayya talks about the introduction of concrete in construction, 'The earliest concrete buildings in India go back to 1910−1912. From the 1940s, books published by cement companies, featuring hundreds of houses, showed how to build a house using concrete. In Saurashtra and Porbandar, cement was being manufactured, and an entire pre-casting industry was developed. By the 1950s, people were substantially using concrete throughout India.'[6]

He further elaborates, 'It was the patrons in Ahmedabad who allowed the use of concrete as a building material. When Le Corbusier was invited to Ahmedabad for four buildings, the patrons agreed to his choice of using concrete in the Mill Owners Association building. The patrons were the richest people in the city, and they were expected to ask for the use of highly finished and expensive materials, such as marble. They were a discerning lot of people as they believed in being frugal in their daily lives, and one would imagine that for them, it would have been torturous to be given only kotah stone instead of marble. However, they accepted concrete like it was a great material and, hence, they accepted its use. Along with the patrons, Sheth Chinubhai Chimanlal, the mayor of Ahmedabad, was instrumental in getting the Sanskar Kendra built. Seeing this, the citizens got used to the idea of exposed finishes. Therefore, in Ahmedabad, it was prestigious to have a building with an exposed finish. Interestingly, Ahmedabad was the only city to use such austere materials, and this had to do with the general idea of simple living. At the same time, they believed that if great artists were using concrete, then they too should adopt it as a material of everyday use.'

This section has been collated with excerpts from conversations with Prof. Neelkanth Chayya and Prof. Kulbhushan Jain, held as a Community Engagement Initiative as part of the preparation of this CCMP.

6. Conversation with architect Prof. Neelkant Chayya on 'Evolution of Architecture Ideologies in the 20th Century,' conducted as a Community Engagement Initiative as part of the preparation of this CCMP.

2.3 Stadiums

SVP Stadium is part of the global thematic family of iconic concrete 20th-century sports venues of similar vintage, value and significance in various parts of the world that face similar issues of structural deterioration, functional obsolescence, conservation, re-purposing and re-use.

The designs of stadiums have been hugely varied, mainly because of the range of uses for which they were conceived, designed and built. The shapes range from rectangular, to rectangular with rounded-off corners, to oval, elliptical or U-shaped. These designs and forms would have been impossible without the use of concrete. The building of large stadiums in the 20th century has been greatly facilitated by the use of reinforced concrete; this material has made possible the construction of daring new designs that would previously have been impossible to sustain structurally.

A basic difficulty with a roofed stadium was the interference by the columns supporting the roof with the sight line. After studying various designs of stadiums, folded plates and folded-plate cantilevers, the design of Miami Marine Stadium would perhaps be the closest to SVP Stadium. The roof structure comprises 8 sets of a combination of four hyperbolic-paraboloid shells with straight edges. Each set of four hypars is supported by a set of three columns, one in the centre (main interior column), which bears the entire weight of the four hypars, and two at the back (diagonal tension columns), preventing the thin shells from tilting. When it was constructed in 1963, its 326-ft. folded-plate roof was the longest span of cantilevered concrete on earth.

Fig. 15: Perspective view of Miami Marine Stadium, United States

Source: Bumbiti, Wikimedia Commons, CC BY-SA 4.0

In the case of SVP Stadium, this challenge was superbly met with the introduction of a 20 m-long cantilevered folded plate, which gave a column-free covered pavilion from where spectators could watch the pitch without obstructions—a fact deeply appreciated by players till today.

Established in Calcutta (now Kolkata), Bengal, in 1864, Eden Gardens is the oldest and second largest cricket stadium in India after the newly built Narendra Modi Stadium, and the third largest in the world after Narendra Modi Stadium, and Melbourne Cricket Ground in Australia. Currently, the stadium can accommodate 50,000 spectators. Located at Bahadur Shah Zafar Marg, New Delhi, Arun Jaitley Stadium was established in 1883 as Feroz Shah Kotla Stadium. Currently, the stadium has a capacity of 68,000. M.A. Chidambaram Stadium in Chennai, Tamil Nadu, India, popularly known as Chepauk Stadium, was established in 1916, and is the second oldest international cricket stadium still functional in India, after Eden Gardens, Kolkata.

Stadiums are among the most remarkable building typologies in the modern era. Currently in grave danger of being destroyed, their conservation problems can be caused by their material itself—concrete—or flaws in construction and in detailing. In several cases, their obsolescence is caused by external reasons, particularly the new requirements stipulated by sports federations and public bodies, which include new dimensions for courts, new legislation on accessibility, safety, and the number of parking spaces. Above all, the main cause of the problems is the lack of preventive maintenance. Globally, stadiums belonged to clubs or associations which did not have, with very few exceptions, a professional management, or they belonged to the state, known for is bureaucracy and poor management. Additionally, there was a deeply held belief that materials like concrete did not need maintenance, and would last forever.

The intangible values of sports arenas go beyond the emblematic built forms of sports arenas, encompass the community, and the associational meanings and values connected to sporting activity. There is a oft not recognised social value of sporting places—stadiums give rise to a collective cultural sentiment in the hearts of the community associated with them. Hence, it is important to recognise the interdependence of the tangible and intangible values while conserving sports heritage. Stadiums are also notable for their spirit of inclusivity, highlighting yet again the critical role of the community in a site's continued relevance in future.

Across the globe, experiences of conserving, valorising, interpreting, and promoting historic sporting and leisure venues has been based on the interplay of the tangible and the intangible, and the challenges of striking a balance between cultural and economic significance. There is a need to devise culturally appropriate ways of communicating to stakeholders the importance of protecting and preserving the maximum values—tangible and intangible—so that these can meaningfully inform the CCMP.

Sports stadiums are places of social aggregation, designed to accommodate large gatherings of people for recurring events such as sports, matches and competitions, or exceptional events such as concerts, cultural events, or celebrations of various typologies. In some cases, stadiums have also been the scene of important historical events, which have marked the life of the communities and sites where these are located. For such reasons, sports stadiums embody the expectations and dreams of entire generations, as also their historical memories, at times dramatic.

The social dimension of the surroundings plays an important role in the significance of a stadium: a building's authenticity is an important factor, but the recreational quality of its surroundings is part of the social dimension of its heritage values.

Fig. 16: Drone view of the practice net near the North stand of SVP Stadium

2.4 Evolution of Cricket in India

Origins of Cricket in India, Particularly in Gujarat

Cricket originated in southern England, c. 1550. The British introduced cricket to India in the early 1700s, with the first cricket match being played in 1721. Since then, the game was played first in Calcutta (now Kolkata), then madras (now Chennai) in the mid-1700s, and finally in Bombay (now Mumbai). In 1848, the parsi community in Bombay established the oriental cricket club, the first cricket club to be established by Indians. It became popular in India in the second half of the 19th century, after India became a British colony. After slow beginnings, Europeans eventually invited the parsis to play a match in 1877. Eventually, the British organised tournaments, and teams were put together for various communities—hindu gymkhana, parsi gymkhana and muslim gymkhana. Some form of an annual tournament was organised on a regular basis. The game then spread to other regions in India.

Fig. 17: Mylapore Recreational Club, which won the 1927 Buchi Babu tournament, photographed at Luz House, Madras (known today as Chennai)

Source: Unknown, Wikimedia Commons

Mylapore Recreation Club which won the 1927 Buchi Babu tournament photographed at Luz House. Centre, middle row, is the skipper, C.R. Pattabhi Raman, on his right Bhatt and left Baliah.

Fig. 18: Indian cricket team's Phiroze Palia (left) and Mushtaq Ali walking out to bat for India during a practice match against AP Freeman's XI at Gravesend, England

Source: Unknown, Wikimedia Commons, 1936

History of Cricket in the State of Gujarat

Thanks to the large number of princely states, cricket became popular in Gujarat. The game was patronised by the *rajwadas* [7], especially those of Jamnagar and Baroda, although it was first introduced in Limbadi and Rajkot in Saurashtra. Saurashtra is considered important in the evolution of the cultural heritage of Gujarat. At the time Sardar Vallabhbhai Patel Stadium was being built, there were already many stadiums in Saurashtra. In fact, Limbadi and other rajwadas had stadiums where cricket was played quite regularly.

7. Royalty.

Many of the royal families spent a lot of time in England, and were familiar with the game. A number of rulers of princely states were educated in England and were introduced to cricket matches, and they were the first to play cricket and start promoting the game. So, wherever there was a rajwada, the people of that kingdom grew very fond of cricket, and the game was promoted. Simply put, wherever there was a rajwada, there was cricket.

The game was also patronised by other princely states across India like the Patiala gharana, and by other communities in Maharashtra like the Holkars in Vidarbha. In South India, in Andhra Pradesh, 'Vijaynagaram' patronised the game, locally. As a result, the earlier players hailed either from Jamnagar, Saurashtra, Rajkot or Baroda and, of course, from other parts of India like Calcutta, Bombay and Madras.

A little before the World War II, the Indian cricket team made its debut in Test Cricket. The first team went to England to participate in its first ever, Test Match against England in 1935. Earlier, the rajwadas merely played among themselves or patronised other talent in the region. They encouraged new talent, and included them in their teams. Subsequently, these players were absorbed into the national team. Nurturing cricketing talent was not formalised. Protégés of a particular rajwada had regular jobs, and during the cricket season, they played cricket.

In the last quarter of the 19th century, cricket became popular in the towns of Baroda (now Vadodara), Jamnagar and Rajkot. These states were instrumental in the formation of Baroda Cricket Association, which was responsible for instituting the Ranji Trophy—the premier championship trophy—in honour of Jamsahib Ranjit Singh, the ruler of Navanagar and a great cricketer himself.

Fig. 19: 1932 Indian test cricket team, including Phiroze Palia (back row, 2nd from left), which toured England

Source: Unknown, Wikimedia Commons, 1932

Formalisation of the Game, Contribution of the Local Administration and Inputs from Society—1890s–1970s

Sometime in the 1930s, the game started being formalised. Jamsahib Ranjit Singh played test cricket for England. The Board of Control for Cricket in India (BCCI) was founded in 1928, and Ranji Trophy, the oldest qualifying tournament, was started in 1934–35. Earlier, different khands or geographical locations / territories under princely kingdoms like the Holkars, Vijaywada, Baroda, Patiala, had their own team, and they too started participating in inter-territory / khand matches. The Holkars had a team as did Saurashtra. Subsequently, in 1935, a trophy was instituted by BCCI in the memory of Jamsahib Ranjit Singh. Experience and talent determined which team would emerge the winner.

Cricket was formally established as a game in post-Independence after the formation of individual states. Subsequently, individual State Cricket Associations were formed. BCCI also took on a more formal shape, and members from different regions were included. Gujarat had three different associations (this continues till today)—the state of Gujarat, and Saurashtra and Baroda had an independent association each. Due to their long association with cricket, they were included independently in BCCI. The third such association was the Gujarat Cricket Association.

Different test and international matches started taking place in India, and the Indian team participated in these matches and also in matches in other countries.

Raj Singh Dungarpur and Fatehsing Gaekwad held important posts in BCCI, but their main contribution was towards the game as it was played in Bombay.

Fig. 20: Mahendra Shukla and his teammates from BHU; Shukla was a former first class cricketer who played for the Holkars, United Provinces and Uttar Pradesh

Source: Shutri1981, Wikimedia Commons, CC BY-SA 3.0, 2013


AHMEDABAD
MUNICIPAL CORPORATION
WELCOMES YOU

Cultural Context In Ahmedabad in the 1960s

Ahmedabad was neither a princely state nor a rajwada but a mercantile town. While the cultural ethos in the princely states of Gujarat was perpetuated by the rajwadas, in the city of Ahmedabad, it was the mercantile class that were philanthropists, responding to the needs of society, be it education, healthcare, or other such fields. From the very beginning, Ahmedabad's mercantile class was a driving force in the city, something that continues even today.

This class created a tremendous impact on society by founding schools, colleges, museums, research centres, transport services, and more. The various buildings that came up during this period are a reflection and physical manifestation of the thoughts and processes that led to the modernisation of society. To that end, the mercantile class performed the same role that the rajwadas performed in their respective princely states. They also managed finances in a modern fashion, and created a common commercial instrument called hundi, which helped in trading. The mercantile class also patronised and encouraged the emergence of a bilingual class in Ahmedabad.

In the absence of rajwadas in Ahmedabad, cricket too was patronised by the mercantile class, and the game became a symbol of upward social mobility. This class patronised cricket and supported it in order to show that they too were modern. This class in Ahmedabad patronised the game in general but not individual players. In the late 70s, they started promoting cricketers on their own. Like Ahmedabad, Surat too had patrons for the game, while Bhavnagar, Limdi and Jhalwada had patrons who, apart from cricket, also patronised art and culture.

In Ahmedabad, the formation of the Gujarat Cricket Association (GCA) in 1933–34 was a landmark event, formalising the game even further. Ultimately, it was brought under the umbrella of BCCI.

During the British era in Ahmedabad, from the late 1880s onwards, the game was played by the rajwadas who lived in the city, and not by the mercantile class, which was more interested in setting up textile mills as it was a great commercial opportunity at that point in time. About 215 textile mills were established in the city till Independence. The founders of the Textile Mill Association drove development in the region. Between 1925 and 1960, mill owners also helped establish medical colleges in Ahmedabad. A study of the buildings which came up in Ahmedabad in this period clearly indicates that they were either sponsored, patronised, or funded by mill owners.

Till that time, cricket was not on any priority list, even though it was played in the city, predominantly in Gujarat College, as it had a very large campus. Established in 1845, it was managed by the British outside the fort wall.

In 1935, the Gujarat education society was formed, and several colleges came up which allowed for cricket grounds. During this time, major cricket matches were being played only in the metros where players from different countries came and demonstrated talent. However, most of these international players were invited to Ahmedabad to play friendly matches. Local teams started being formed and exposure to foreign matches was encouraged for better training and experience. If any international team or player was visiting the city, the matches would be held in the Gujarat College campus.

From 1935, cricket matches were hosted on the large grounds of educational institutions like H.L. College of Commerce. Subsequently, in 1944, a club was also established where anyone interested in the game, started playing and organising matches .The Cricket Association of Ahmedabad (CCA) was established.

Fig. 21: View of the cricket ground from the media box at SVP Stadium, with a match in progress

Timeline of Key Events in the Evolution of Cricket

1721	First cricket match played by Mariners of East India Company at Cambay (Gujarat)
1791–92	Calcutta Cricket Club established
1845	Gujarat College established
1848	Orient Cricket Club formed in Mumbai by the Parsi community—the first Indian civilian community to take up cricket
1861–1930	Over 200 textile mills established in Ahmedabad
1915–17	Gandhiji's stay in Ahmedabad; Kochrab and Sabarmati Ashram established in Ahmedabad
1920-30	Presence of Sardar Vallabhbhai Patel in Ahmedabad (President of Municipal Council)
1928	Board of Control for Cricket in India (BCCI) established
1933-34	Gujarat Cricket Association formed
1935	Ranji Trophy inaugurated; foundation of Ahmedabad Education Society
1940	Start of Cricket Radio Commentary in India
1944	Ahmedabad Cricket Club formed
1949	Gujarat University established
1950	Ahmedabad Municipal Corporation formed
1988	Sachin Tendulkar played his 1st Ranji Trophy match in Gujarat College Ground

2.5 Inception of Sardar Vallabhbhai Patel Stadium

Popularising Cricket in Ahmedabad

As cricket become increasingly popular, a number of educational institutions had a cricket ground. Hence, as and when the need arose, one institution or the other would offer its ground for a game, which became a rather chaotic affair. In Rajkot, cricket was played on a parade ground, whereas in Ahmedabad, the Gujarat College ground was used for cricket around the 1930s. Domestic matches became more frequent as the popularity of cricket in Ahmedabad increased from the 1930s onwards. People started loving and enjoying the game, and began organising more and more games. This increase in cricketing activities, and the game's popularity gave birth to the idea of constructing a stadium in Ahmedabad.

Emergence of the Idea of a Cricket Stadium

The game caught the attention of members of Ahmedabad's influential business houses. One of them, Sheth Chinubhai Chimanlal, the mayor of Ahmedabad, was notable for the proactive measures he took to change Ahmedabad into a people-centric city, with significant developments. His proposals included setting up important institutions, stadia, parks, and other community facilities. He took the initiative of developing a stadium in Ahmedabad, and in 1950, land was transferred to AMC to this end. Around this time, the Sports Club of Ahmedabad was formed. This marked the beginning of the collaboration between CCA (Cricket Club of Ahmedabad) and AMC for the cause of cricket, connecting the game to the people of the city. With Chinubhai Chimanlal's push for a collaborative approach, the industry started taking ownership of the city's development, with AMC becoming the executing authority. Among such collaborative moves were conceptualising the stadium, arranging for the donations to build the stadium, and handing it to AMC for execution to support the cause of sports in the city. Chinubhai Chimanlal even arranged for various guilds to collaborate with AMC in articulating a unified approach towards development.

Philanthropists and Industrialists of the Time

SVP Stadium was conceived and built in Ahmedabad in the post-Independence era—the period from the 1950s to the 1970s. The seed, however, was sown during the tenure of Sheth Chinubhai Chimanlal, and subsequently taken forward by Jayakrishanbhai Harivallabhdas Patel and Navrottam Keshavlal Zaveri. These three people were instrumental in the development of this structure. The Cricket Club of Ahmedabad (CCA) was formed in 1944, with the founder members promising to promote the cause of cricket. The club was gifted land and the founder members were responsible for the upkeep of the land, its use and for organising the games. The CCA and AMC signed an agreement on creating a stadium which would be funded by the public and a club that would be funded by themselves only for sports activity. Until the structure was built, the games were held using temporary tents. Eventually, the founder members and AMC collected enough funds to build the South Pavilion.

The stadium came up during the tenure of J.H. Patel, Mayor of AMC during the period 1961–65. Therefore, the facility enjoyed the patronage of AMC. A cricket enthusiast, J.H. Patel was very keen on building a stadium in Ahmedabad. Finally, it was the collective effort of citizens to uplift the city culturally and socially.

Sheth Chinubhai Chimanlal and N.K. Zaveri, office bearers of Gujarat Cricket Association (GCA), who rooted for a stadium on this ground where they could invite foreign players and their teams, and where the city could watch the official Test matches. The objective was also to create training centres for upcoming cricketers where they would be trained in a professional environment. To meet the growing enthusiasm for the game, and the important national and international matches that were being played in multiple locations like HL College, Gujarat College, and elsewhere in the city ,the need for a proper stadium was deeply felt.

This popularity of cricket among the citizens of Ahmedabad, nurtured by mercantile class, played a key role in the development of the stadium. During this time, Ahmedabad was the Mecca of cricket as it had backing of the financial sector, royalty, corporates and philanthropists. The mercantile class also brought in expertise. For instance, Ravi John Matthai, the first full-time Director of the IIMA, a great educationist and institution builder, hailed from Kerala. Similarly, other experts at IIMA hailed from all over India. This integration of expertise from across the country was indeed an addition to Ahmedabad's society at the time.

Sardar Vallabhbhai Patel, an eminent freedom fighter, a statesman and one of the forefathers of independent India had strong connections with the city. During his tenure as President of AMC, the city witnessed a new wave of industrial development and civic governance, assuring a better life for its citizens. This was reflected in the form of sterling establishments such as good training institutions, cooperatives, public health centres and hospitals, agricultural markets and sports facilities. Sardar Patel was primarily responsible for Ahmedabad emerging as an important sustainable city in post-Independence India, the impact of which can be felt in the modernisation of the city even today.

Cricket Association of Ahmedabad

Cricket in Ahmedabad was largely played on the grounds of the Gujarat College, L.D. Engineering College, H.L. College, M.J. Science College, and so on. Even the Ranji Trophy matches, and friendly international matches were held at such locations in the city. The more important matches were always hosted in Bombay. At this time, only one location in the city of Ahmedabad had a turf wicket—Sardar Vallabhbhai Patel cricket ground, a large open field. In 1934, approximately, 80,000 sq. yd. of land was gifted to the CCA by the Province of Bombay. Till 1950, this remained government land, and was maintained by the state of Gujarat. In 1950, when AMC was formed, the land was handed over to them, and the project of developing the stadium was launched. A group of people proposed organising cricket and other sports-related activities on this ground. So, they granted a tenure-based lease to the Sports Club of Gujarat. In 1960, AMC received a government grant to construct the stadium.

It was at this point that Charles Correa and others were involved. Correa, who was gaining prominence in architectural circles, was appointed as the architect of the stadium. He, in turn, collaborated with Mahendra Raj for the structure. The collaboration resulted in this masterpiece that now adorns the cityscape of Ahmedabad. The stadium design was prepared, and the approval granted by AMC. Budgetary allocations were made, and construction started in the early 1960s. The construction of the South Pavilion of the stadium was completed in 1966.

Politics and Cricket

After 1967, there was a change of guard in the political leadership. Jayakrishanbhai Harivallabhdas Patel, the head of GCA and BCCI Gujarat, was succeeded by his son Bhrugesh Harivallabhdas Patel, who became the Chairperson of GCA.

At this time, there was a disagreement between the contractor of the first phase and AMC over payments and timelines. Due to this change in political leadership, and lack of funds from AMC, the second phase of construction was stalled. So, the rest of the stadium was constructed much later, with a new set of advisors and contractors.

After the completion of the South Pavilion, the stadium became a popular venue for several matches, and the tickets became prized commodities. Those were days when TV was not common.

With an increase in the popularity of cricket, an arrangement was arrived at whereby CCA parented the Sports Club while the stadium was looked after by GCA. Eventually, there was a dispute between the Sports Club and AMC. The Sports Club was rented to the committee by AMC. At the time, Navrottam Keshavlal Zaveri who was part of AMC, the Cricket Association of Gujarat, and the Sports Club, tried to resolve the dispute, and a seat sharing system was agreed upon between the Sports Club, AMC, GCA and the ordinary citizens. While the seating capacity of the South Pavilion was limited, the stakeholders very many. Tickets and the sharing of revenue becoming a bone of contention, leading to ego clashes and political confrontations. Madhavsingh Solanki was the then Chief Minister of Gujarat. The owner of a leading publishing house emerged as a prominent stakeholder, and used the power of the pen to publicise the everyday functioning of the stadium. At the time, Raifuddin Sheikh was the Mayor of AMC and due to his strained relationship with then Chief Minister, SVP Stadium was overlooked and the seeds were sown for an alternate stadium. Land was allotted on the outskirts of the Sabarmati Power House near the ash pond in Motera village. The dispute between AMC, GCA and the Sports Club on the issue of sharing seats and revenue also resulted in GCA disassociating with AMC.

Between 1981 and 1983, the new Motera Stadium, set up by GCA, was built, and inaugurated when the West Indies team toured India. With all the important matches now being played at Motera, SVP Stadium was deprived of the revenues it formerly earned, and the stadium started being used mainly for cricket training camps and coaching classes, its central location making it convenient for these activities. So, AMC and other stakeholders explored alternate options to make this stadium self-sustaining.

The idea of constructing a commercial centre in front of the stadium to generate revenue for AMC was floated by Prahlad Patel of the Bharatiya Janata Party (BJP). However in 1992–93, Atal Bihari Vajpai, another well-known member of the BJP strongly opposed the idea. The idea did not sit well with the managing authorities of AMC either.

Over time, with the introduction of other sporting facilities within the stadium complex, the primary function of SVP Stadium also evolved. The Tennis club was given a part of the land for setting up tennis courts. The Gujarat Tennis Association, an active body, set up tennis courts on the land within the SVP Stadium complex alloted to them in the southwestern corner. In 1965, the Davis Cup match was played here by renowned players Ramathan Krishnan, Ranjit Lal and Jaydeep Mukherjee. They represented India in a match against Iran, organised by Suresh Mashruwalla and Jamshed Kekobad. Later, in 1978, singles and doubles matches played by Anand Amritraj and Shashi Menon from India and Atet Wijono and Yustedjo Tarik of Indonesia were also hosted here.

Cricket as a sport received a boost as players from the city, notably Dipak Shodhan and Jasu Patel, came into the limelight. Ahmedabad emerged as the Mecca of cricket because of the financial patronage and training facilities.

The success of many players who used the stadium ushered in the trend of cricket coaching as an important activity for students of schools and colleges in the city. GCA started focussing on an organised cricket coaching centre. This was followed by BCCI promoting cricket training, and formulating a selection procedure for candidates.

Emergence as a Training and Coaching Centre

Presently, the stadium has coaching camps curated by CBCA, a fully sponsored coaching by BCCI where the candidates are selected by a three-tier selection process, and post coaching sessions, they are presented to the selection committee of the national team. This coaching camp is co-hosted by GCA. There are about nine parallel private coaching camps hosted here under the mentorship of well-known coaches. AMC hosts coaching camps based on a preliminary selection process, with nominal fees. The coach is employed by AMC for this purpose, the aim being to reach out to aspiring cricketers and hobby cricketers from larger sections of society.

People's Attachment to the Space

The characteristic appeal of the space and its capacity to adapt itself to multiple uses probably explains why several events that connect the people with culture, state-level celebrations, mass participatory activities and health activities, have been organised here.

The International Folk Dance Festival, the International Yoga Day (2018) when 3000 people performed yoga on the lawns, the Swarnim Gujarat celebration

Fig. 22: Students and teachers from the cricket training and coaching centre doing warm-up exercises on the steps of the lower section of SVP Stadium

(2010, Golden Jubilee of the formation of Gujarat State) are among the landmark events that have been held here.

Around 1995, the walking track was added, allowing citizens to use the space widely. There are users who have been coming here every morning for the last 35 years. There are senior citizens who have met here in their younger days and become friends. This bond of friendship brings them here everyday.

Ever since its inception, AMC has supported the use of this space for health-related activities. Some people compare the walking track to the stepped ghats of Benaras bustling with multiple activities along the riverbank. The 450 m-long circular track with steps offers the flexibility of multiple activities for groups of people who use the space creatively to do yoga, calisthenics and aerobics. The sheer size and expanse of the space elevates the spirit. Some people come here to sit and ponder or meditate to improve their thought process.

Over the years, the citizens' interest in athletics, swimming and other sports has grown considerably. The location of the stadium and the soothing greenery have led to people using this space for fitness and related activities. Decent upkeep, parking facility, safety, well-guarded against misuse / miscreants have made the stadium a buzzing community space.

Located next to the Sports Club, which has a large membership, is an added advantage as many regular users of the club walk or exercise in the stadium before leaving the club. Regular visitors to the stadium speak of the aesthetic appeal of the structure and how it is part of the city's and the citizens' DNA.

2.6 Architect Charles Correa, Engineer Mahendra Raj, and Other Contributors

Charles Correa

Charles Correa was commissioned by AMC to design SVP Cricket Stadium and Sports Complex in Ahmedabad.

Fig. 23: Portrait of Charles Correa
Credit: Charles Correa Foundation

Charles Mark Correa, (born 1 September 1930, Secunderabad, Hyderabad, British India [now in Telangana State, India]—died 16 June 2015, Mumbai, India), was an Indian architect and urban planner known for his adaptation of Modernist tenets to local climates and building styles. In the realm of urban planning, he was particularly notable for his sensitivity to the needs of the urban poor, and for his use of traditional methods and materials. [8]

8."Charles Correa," Encyclopædia Britannica (Encyclopædia Britannica, inc.), accessed December 31, 2021, https://www.britannica.com/biography/Charles-Correa

He has to his credit more than 100 buildings in India, ranging from low-income housing to luxury condos. In each project, Correa endeavoured to respect the local culture around the site, and made an effort to use local materials and technology to provide creative and modern solutions for his designs. In recognition of his exemplary architecture, he received the Padma Shri (1972) and Padma Vibushan (2006), two of India's highest honours. He was also the recipient of numerous prestigious architectural awards, including the Royal Gold Medal for Architecture (1984) from the Royal Institute of British Architects (RIBA), the Praemium Imperiale for Architecture (1994), awarded by the Japan Art Association, and the Aga Khan Award for Architecture (1998).

In post-Independence India, Correa played a crucial role in nation-building activities. Though he drew inspiration from Modernism as it evolved in the West, and his experiences during his post-graduate education, his work remained deeply rooted in the local traditions of India, the place and the climate. His early work, for instance, combined traditional architectural features—as embodied in the bungalow with its verandah and open-air courtyard—with the Modernist use of materials exemplified by figures such as Le Corbusier, Louis Kahn and Buckminster Fuller. In particular, Correa was influenced by Le Corbusier's use of striking concrete forms. The importance of the site was a constant in Correa's approach, as is evident in works like the Gandhi Smarak Sangrahalaya (1958–63) in Ahmedabad and Kala Academy in Goa (1973−83).

Many of Correa's designs were driven by the climatic conditions of the context. For residential projects, he favoured a design he developed called the 'tube house,'—essentially a narrow house form designed to conserve energy. This form was used in the Ramkrishna House (1962–64) and the Parekh House (1966–68), both in Ahmedabad, a city with a hot and arid climate. In other climatic conditions, he responded to the local climate with a large oversailing shade roof or parasol. This element has been effectively used in the Engineering Consultant India Limited complex (1965–68) in Hyderabad.

Fig. 24: Perspective view of Gandhi Smarak Sangrahalaya designed by Charles Correa in the Sabarmati Ashram complex, Ahmedabad, India

Source: Helfmann, Wikimedia Commons, CC BY-SA 4.0, 2007

Fig. 25: Archival photograph of the Gun House

Credit: Charles Correa Foundation

Quoting David Adjaye, designer of an exhibition by RIBA[9] , 'Charles Correa is a highly significant architect, globally and for India. His work is the physical manifestation of the idea of Indian nationhood, modernity and progress. His vision sits at the nexus defining contemporary Indian sensibility, and it articulates a new Indian identity with a language that has a global resonance. He is someone who has that rare capacity to give physical form to something as intangible as "culture" or "society"—and his work is, therefore, critical—aesthetically, sociologically, and culturally.'

9. David Adjaye, architect, and designer of the first major UK exhibition by the Royal Institute of British Architects (RIBA) , titled, Charles Correa: India's Greatest Architect showcasing the work of renowned Indian architect Charles Correa, Charles Correa: India's Greatest Architect.

Dr. Irena Murray, Curator of the same exhibition said, 'Correa is brilliantly inventive in his deployment of certain timeless themes in Indian culture and philosophy—journey, passage, void and the representation of the cosmos. He uses these as a means to create ambitious new spaces and structures. His deep understanding of the implications of climate, demographics, transport and community life has a universal quality.' [10]

At the time, in the early 1960s, the city of Ahmedabad appointed architects to design several infrastructure projects. Correa himself designed ten buildings in the city. Several of them were infrastructure—the AMTS Workshop, the Wadaj Bus Terminal, the Navrangpura Bus Terminal and the Gun House (each of which was highly innovative)—buildings that would most likely have been undertaken by the Public Works Department or by architects employed by the state, as elsewhere in India. This, therefore, was an interesting shift, and the city benefitted from a number of architect-commissioned buildings in the public realm. As a result, Ahmedabad has an enviable collection of 20th-century architecture.

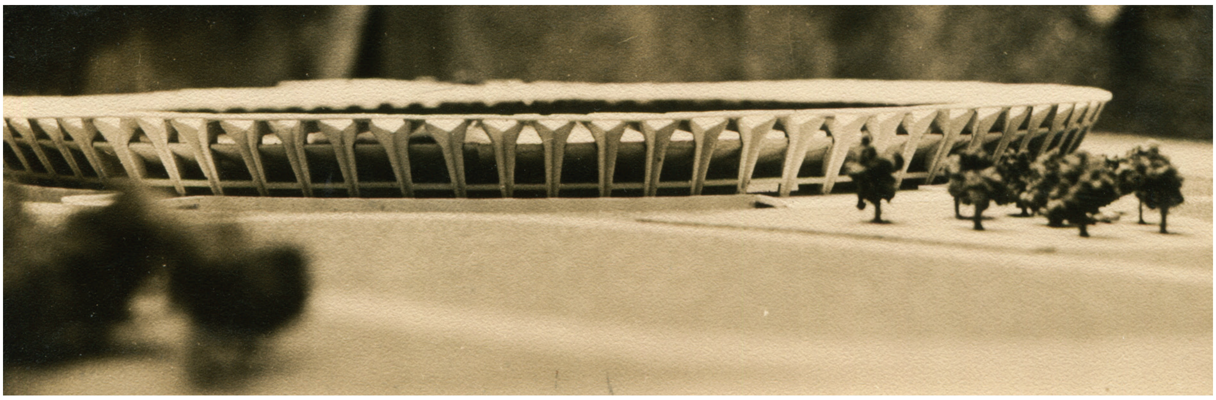
The Navrangpura Bus Terminal still exists, but only part of it was ever built. The entire structure was designed so that advertisements and other hoardings could be integrated into the building. Within the structure of the Gun House, the headquarters for the Rifle Association, was a waffle slab placed on the diagonal that opened up the space quite differently. For the Wadaj Bus Terminal, Correa was trying to find ways of using the Gujarati otla as the waiting place, as opposed to the usual way of everyone standing at a bus stop. He designed a workshop with beautiful North light roofs for the transportation authorities, and the Gandhi Smarak Sangrahalaya built within the historic Sabarmati Ashram where Mahatma Gandhi lived from 1917 to 1930.

Correa had invited Mahendra Raj to join him as the structural engineer for the design of the SVP Stadium. The innovation and experimentation with design were considerable, and especially in the stadium, the unique team of architects and engineers working together, developing design solutions, was remarkable. As related by Nondita Correa, Director, Charles Correa Foundation, 'What seems to have deeply influenced Charles Correa in creating this design is the University of Michigan Stadium in Ann Arbour which he saw being extended in 1949 during his undergraduate studies there. He would often talk about how this was a very low building, hardly a storey high, that was set in a natural boulder and yet you came in right at the top from where you saw this enormous stadium.' The total programme called for a stadium to seat 35,000 people, an extensive clubhouse and swimming pool, tennis courts, badminton courts, a skating rink, etc., but was only partially built due to lack of funds.

This profile has been collated with excerpts from the paper, 'The Architecture of Infrastructure: Sardar Vallabhbhai Patel Cricket Stadium And Sports Complex' presented by Nondita Correa Mehrotra at the workshop, 'Assessing Significance', organised as part of the preparation of this CCMP.

Fig. 26: Photograph of the model of SVP Stadium, with the moat (unbuilt) and connecting bridges (unbuilt)

Credit: Charles Correa Associates / Courtesy: Charles Correa Foundation



10.Curator Dr Irena Murray of the exhibition by the Royal Institute of British Architects (RIBA) , titled, Charles Correa: India's Greatest Architect showcasing the work of renowned Indian architect Charles Correa, Charles Correa: India's Greatest Architect.

Mahendra Raj

A distinguished figure in the history of modern structural engineering, Mahendra Raj, with his structural ingenuity made an unparalleled contribution to the built landscape of post-Independence India. The structure of SVP Stadium, completed in 1966, is among the first of its kind in the world, and stands tall in Raj's extraordinary oeuvre.

The design of the stadium can best be described as the 'The Art of Engineering' because it is evident that the way Mahendra Raj thought about structures and articulated them, was a culmination of what he had understood and learnt through his transnational experiences, and through unique collaborative forces that brought together talented architects and him as an engineer. Post-Independence was a remarkable time for construction activity in India, and whether it was Le Corbusier, Louis Kahn, Charles Correa, B.V. Doshi, Achyut Kanvinde or Raj Rewal, Mahendra Raj worked with all of them. And each individual building, created through a different process each time, was unique.

Fig. 27: Portrait of Mahendra Raj
Courtesy: Ariel Huber

Mahendra Raj started his career in Chandigarh in 1951 as the design engineer for the High Court, in the newly planned city that was being designed by Le Corbusier. This was the first time he had designed a structure. Till then, he had been a civil engineer. From the High Court, he went on to work on the Secretariat as the engineer in charge. Here again, he had an encounter with Le Corbusier. By this time, he had already built a reputation for himself as one of the only engineers who could stand up for the design of the structure, so all the engineers thought it best to let him reason with Le Corbusier.

The energy of the work done in Chandigarh propelled Raj towards the United States to undertake further studies in Structural Engineering. While in New York, he worked for Ammann & Whitney, one of the most avant-garde engineering firms at the time. It was here that he developed an attitude towards structure as art. His son Rohit Raj quotes Aba Tor, a colleague and a family friend, who also worked with Ammann & Whitney: 'Boyd Anderson—Andy to us—was the partner-in-charge of the Special Structures Division. He was an inspired and inspiring engineer. He made us look at structure as a breathing, living, dynamic, moving and, sometimes, even mischievous creature. We all got rid of the notion of "statics" and "make it stand up". Our real job was to tame the structure, allow it to move within limits without affecting its serviceability in the process.'

Fig. 28: Night view of the Assembly Hall in Champaign, Illinois

Source: Gct13, Wikimedia Commons, CC BY-SA 3.0, 2005

It was this very nurturing international environment where structure was truly thought of as 'a breathing mass that had to have a subtle refined solution', that was at the core of all that inspired Raj while he was in the United States. He designed several structures with Ammann & Whitney, particularly folded-plate structures that were exemplary at the time. One such structure was the TWA Hangar, a 1500-ft. cantilever, balanced on both sides. In the Assembly Hall at Illinois University, Raj was responsible for the roof while Aba Tor was responsible for the bottom sphere that was also made of folded plates. Again here, Raj contributed to the aesthetics and the way the folds were used, influencing the architectural design. He also worked with sculptural columns like in the U.S. Embassy in Dublin. Enriched with this variety of experience, he returned to India in the 1960s, to work for Ammann & Whitney on the Yamasaki Pavilion in Delhi.

Correa and Raj's engagement goes back to this point in time. It is amazing how they influenced each other's careers and lives. Apparently, Correa sought him out and said, 'I have heard about you. You must come back to India. We need engineers like you.' At the time, Raj was already thinking about his family and mulling over the idea of returning. Correa's generous recognition of his work tilted the scales, and Raj came back to India.

Besides working with Correa in the city of Ahmedabad, Raj also worked with B.V. Doshi on other important structures in the city like the Tagore Memorial Hall. These were built at the same time as the stadium, with the technology and labour available at the time.

In the Central Bank, again with B.V. Doshi in 1969, Raj brought in transfer girders and suspended Rendal systems in some of the stands. The Premabhai Hall had wall-like girders, and a clear span for the lobby. Raj also worked with Louis Kahn on the IIMA where he was adviser, and introduced the idea of the tie in the arches that Louis Kahn had wanted to use. So, there was an intense fertile space for architects and engineers to work together on seminal projects, having had exposure abroad and within India.

There is a heart-warming story of Charles Correa and Mahendra Raj related to the design of the SVP Stadium. Correa came to Raj, saying, 'I have got this stadium to do (design). I have been asked to do only part of it and the rest they will do themselves, but they are giving Rs. 50,000. Let's do it. I'll share half the fee with you.' And Raj said 'Yes.' What a wonderful story of generosity. Correa did not hesitate to equal the engineering to the architectural design, something that is rare today. The term '88 fold' emerged in 1965. The reason it was referred to as 88 fold was that 88 folds made the entire circle of the stadium; only a part of it was developed.

In his work, Mahendra Raj talked about the stadium, 'To my knowledge, the structure was the first of its kind at the time—folded plate as a cantilever. We were all very nervous in those days. There was no proof checking, so we double-checked within the office.' He added, 'Dr.Vakil and I started working on the stadium with Charles, who invited Fred Taylor, his friend from MIT, to help him design it. We worked on a number of alternate designs, made models, had long discussions on the architectural, structural, and constructability merits and demerits of each design. All the options we worked out were folded-plate structures. I had already worked on the design of plates and shells during my higher studies and at work, especially on the Mohawk Airlines Hangar—my first project in the office of Ammann & Whitney Consulting Engineers, New York—which was also a cantilever hangar, although different as it was a balanced one.'[11]

Prof. Rabindra Vasavada once said that Raj was India's Nervi (Pier Luigi Nervi). Nervi had famously stated: 'The pattern of steel should always have an aesthetic quality and give the impression of being a nervous system capable of bringing life to a dead mass of concrete.' This was strongly reflected in his work. As an architect, one thinks of the outside, but as an engineer, one thinks of the inside. So, it takes considerable integrity to be able to fine-tune and create an aesthetic internal system which shall never be visible except in the structural engineer's drawings. Such a desire for precision and aesthetics was also evident in Raj's calculation sheets.

This profile has been collated with excerpts from the paper, 'Structuring Sardar Vallabhbhai Patel Stadium—Understanding Mahendra Raj's Creative Aesthetic Rigour,' presented by Rohit Raj Mehndiratta at the workshop, 'Assessing Significance', organised as part of the preparation of this CCMP.

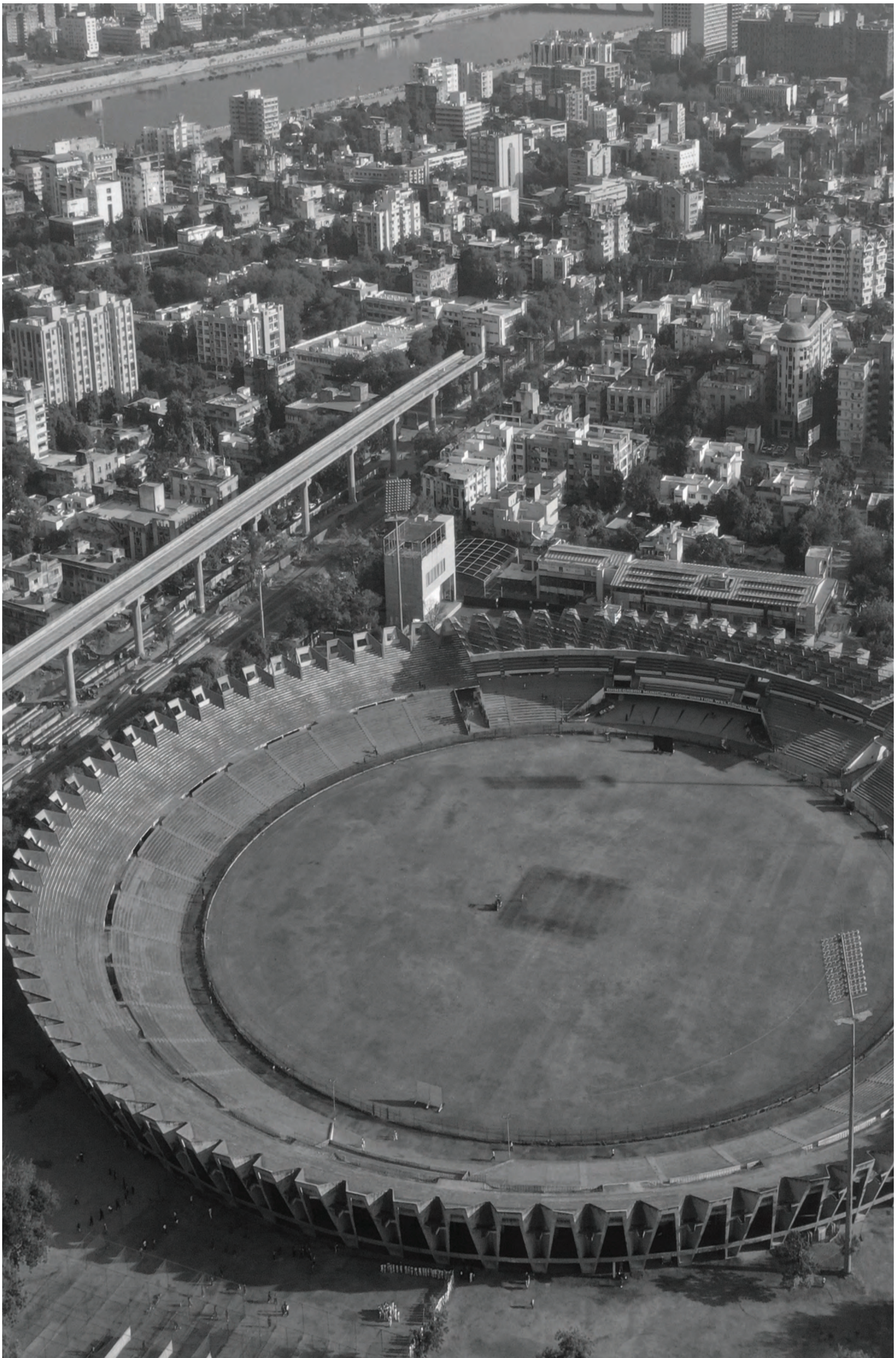
Fig. 29: Archival photograph of Hall of Nation, Delhi, India

Source: Ariel Huber, Wikimedia Commons, CC BY-SA 3.0, 2008

11. Excerpt from the paper, 'Structuring Sardar Vallabhbhai Patel Stadium—Understanding Mahendra Raj's Creative Aesthetic Rigour,' presented by Rohit Raj Mehndiratta at the workshop, 'Assessing Significance', organised as part of the preparation of this Conservation Management Plan.

3.0

SITE OVERVIEW



Site Overview

3.1 Context

Sardar Vallabhbhai Patel Stadium is an iconic sports facility located in the heart of Ahmedabad, India. It is situated approximately 860 m from the western banks of Sabarmati River. The river divides the city into two distinct sections: the Historic City of Ahmedabad, a UNESCO World Heritage City (East) and the newer Ahmedabad (West). The construction of Ellis Bridge in 1892 followed by the production of many more established a connection between the eastern and the western parts of the city, enabling residents to move outside the walled boundaries of the historic core.[12] This furthered the development of the new suburbs in the western part of Ahmedabad, and led to the creation of neighbourhoods such as Paldi and Navrangpura in the early 20th century. [13]

Situated in the Navrangpura locality of Ahmedabad, the stadium complex covers a total area of 24.33 acres, with one of the largest open space within the property, accessible to the local community and city dwellers alike. Other than the stadium, the neighbourhood also has many reputed research and educational institutions such as Center for Environmental Planning and Technology (CEPT), Gujarat University and Physical Research Laboratory within a predominantly residential zone.

Fig. 30: Bird's-eye view of SVP Stadium located in the neighbourhood of Navrangpura

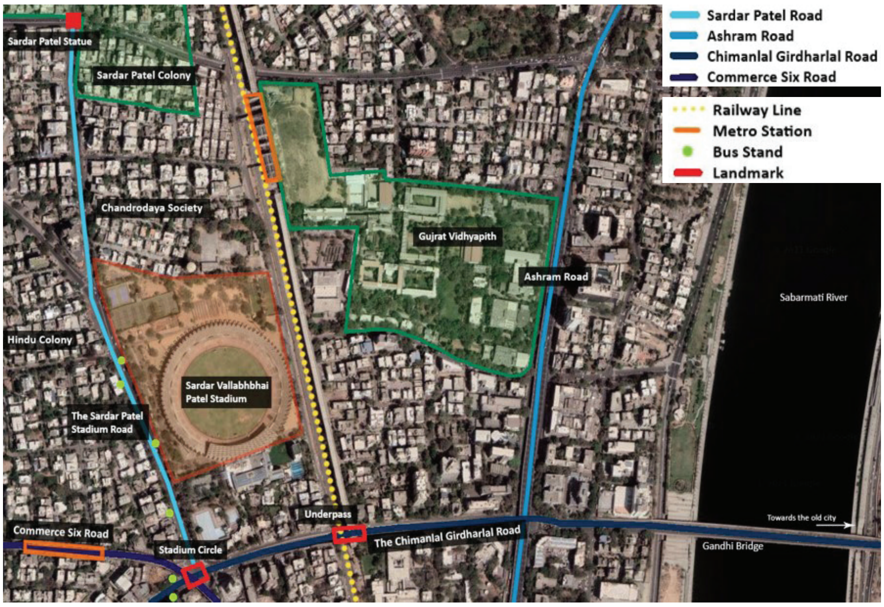
12.Sharik Laliwala, 'Tracing the History of Ahmedabad, a City of Limited Emancipation,' The Wire, https://thewire.in/history/tracing-the-history-of-ahmedabad-a-city-of-limited-emancipation. Accessed 11 January 2022.
13.Ibid.

3.2 Setting

SVP Stadium is centrally located within Navrangpura. It is easily accessible by local public transport, and the nearest bus stand is situated only 60 m from the main entrance.

The stadium is enclosed on the South and West by two main roads—Chimanlal Girdharlal Road (C.G. Road) and Sardar Patel Stadium Road, respectively, by railway tracks on the East, and by a residential colony on the North. At a nearby popular crossroad known as Stadium Circle, these major roads also intersect with another throughfare—Commerce Six Road.

Running along the western periphery of the site, Sardar Patel Stadium Road gets its name from its proximity to the stadium, and was developed simultaneously along with the stadium in the early 1960s. A statue of Sardar Patel is situated 930 m North of the stadium, along Sardar Patel Stadium Road. The residential area located 565 m to the northern side of the site developed around the same time, and was christened Sardar Patel Colony, after the adjoining road and next-door sports facility.



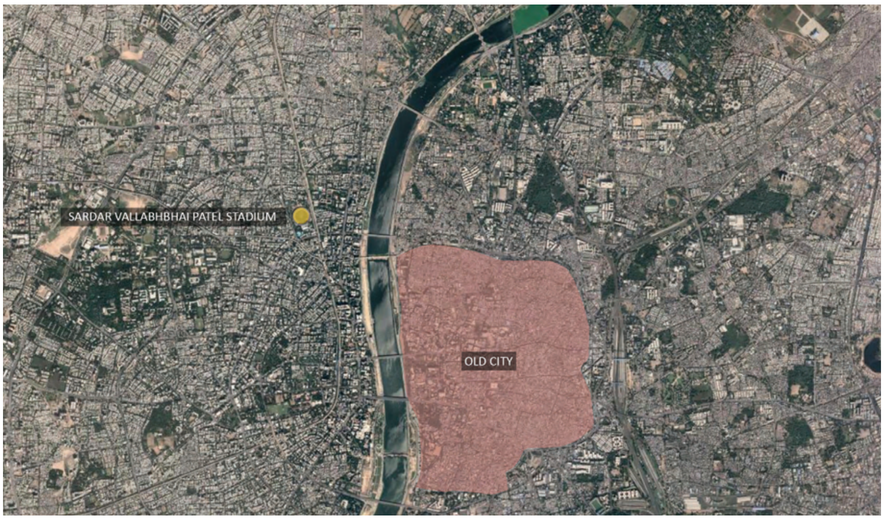


Fig. 31a: Map illustrating the local landmarks seen near SVP Stadium and its surroundings

Fig. 31b: Map illustrating the central location of the stadium - w.r.t the historic side of the river and the new development

Source: Google Earth (Base Map)

Historically, both sides of C.G. Road connecting the Ashram Road to the Ambadi area, were lined with bungalows built by the city's mercantile elite, forming the Sardar Patel Colony, moving from the walled city to the peripheral village of Naranpura and Navrangpura. Several industrial and philanthropic families like the Mangaldas and Lalbhai families eventually donated much of their land, gardens and buildings in this vicinity to enable the city's development. Furthermore, in the 1980s, this road transformed into the economic hub of the city, with numerous shopping complexes, markets, and streets springing up around Law Garden. Among these, for instance, is Happy Street renowned for its culinary delights and handicraft market in the evening. This was again a recreation of the Manek Chowk concept of the walled city where different types of markets would be set up at different times of the day in the same space—vegetable market early in the morning, parking space for the bullion market during the daily working hours, and a road lined with street food eateries in the evening.

Ashram Road, an arterial road 560 m East of the stadium circle developed in the 1970s when numerous businesses from Relief Road moved their enterprises to this road. An underpass 190 m from the stadium directly connects to the old city through C.G. Road and Ashram Road via the Income Tax crossroad junction and Gandhi Bridge. Ashram Road runs parallel to Sabarmati River, and has played a key role in the development of the city. Many important landmarks such as Sabarmati Ashram, Gujarat Vidyapith (institute set up by Mahatma Gandhi for holistic skill-based learning), Darpan Academy, M.J. Library, Mill Owners Association building, Sheth Mangaldas Town Hall, Patang Hotel (revolving restaurant) and Reserve Bank of India are situated on this road. The campus of Gujarat Vidyapith is just 500 m from the eastern periphery of the stadium complex.

These three thoroughfares—Sardar Patel Stadium Road, Ashram Road and C.G. Road—have played a vital role in the expansion of Ahmedabad. And due to the stadium's proximity to these motorways, it has witnessed an historic evolution.

Currently, a new metro line is being constructed on Commerce Six Road; the metro station is merely 325 m from the stadium. Commerce Six Road also connects the stadium with the locality where Ahmedabad University and Gujarat College are situated. Another metro line and station, 225 m from the stadium, are also currently under development. This new expansion runs parallel to the railway tracks East of the stadium, that have been non-operational since the 1960s.

3.3 Evolution of the Site

Originally, the shape of the site was a multipronged polygon which was visually divided to incorporate three primary functions: the sports complex, clubhouse, and a utilities area for the Municipal Corporation. Over time, due to ownership, economic and management disputes, these visual segregation were formalised with the construction of a compound wall along the northeastern and southern section of the property. This separation resulted in the formation of three individual entities that were managed by different organisations. However, the land continues to remain under the ownership of Amdavad Municipal Corporation.

Fig. 32: Map of original extent of the stadium complex with the current site boundary

Source: Google Earth (Base Map)

The site of the sports complex is the only property being considered for the preparation of this CCMP, although in some sections, certain aspects of the divided spaces have been identified to ensure this study assesses the sports complex in a holistic manner.

At present, the stadium can be split into three visually distinct areas within the complex: the stadium building, GCA's training centre and the tennis court with a separate parking lot.

3.4 Access, Infrastructure & Sports Facilities

Access

The stadium has six gates that can be used to enter / exit the site—three on the West side and the remaining three on the East side of the complex. However, at present, only Gate 1 and Gate 6 are actively used. Gate 1 is the primary gate used by all the people to enter and exit the site. Located at the Southwest corner of the site, it opens to Sardar Patel Stadium Road. Gate 3, located at the Northwest corner along this road, is used as a service gate, and unlocked only when required. Gate 6, situated on the Southeast corner is used by AMC and the stadium staff to access the Water Distribution Area, located on the North side of the complex. It is also used by some people who enter the stadium on foot.

The remaining Gates 2, 4 and 5 are used only when the venue hosts large-scale events. During such festivities, Gates 1, 2 and 3 are used for entry and exit, regulating the flow of incoming and outgoing users. And Gates 4, 5 and 6 are used as service gates.

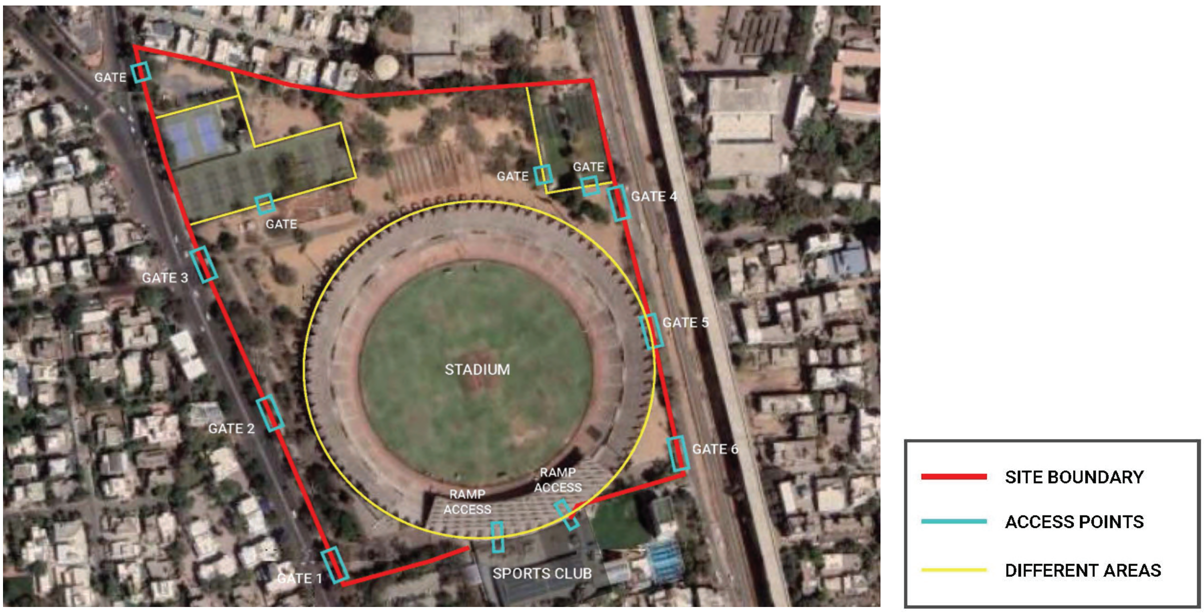
The concourse of the North, East and West stands are easily accessible from the adjoining green or parking areas that run along the circumference of the building. Access to the other areas of the stadium is monitored and provided on a need-only basis. For instance, in the South Pavilion, grille gates have been installed at A-Frames 5 and 13 along with additional grilles fixed in each bay between the aforementioned A-Frames. In the North Stand, the dugout area has been shut with a metal fence, and a swing gate that regulates movement into the stadium ground. The two entrances to the stadium situated on the East and West ends of the South Pavilion are also mostly kept locked. These gates are only opened when vehicular equipments have to be allowed into the stadium for ground maintenance. All these provisions have been planned to enable security personnels to keep different areas shut during non-operational hours.

Additionally, to monitor efficient user movement and discourage loitering during non-peak and after hours, access through the stadium gate situated at every stairway along the concourse has also been secured with operable grilles padlocked and closed for everyday use.

Finally, the mezzanine access to the stadium from the clubhouse is also fenced and locked to regulate movement into the stadium from the clubhouse, and vice versa.

Fig. 33: Map of site boundary with property gates and other access points

Source: Google Earth (Base Map)



Infrastructure

An AMC-owned water tank is located in the Northeast corner, beyond the compound wall of the complex. Although this structure is not situated within the sports facility, it was designed and constructed as part of the first wave of construction, and is an integral part of the stadium's built scape.

The Southwest area close to the building, within the complex is dedicated for parking, available for use to everyone who visits the stadium. In 2010, this parking space with internal roads was resurfaced with paved block and tar as part of the major upgradation campaign undertaken by AMC.[14]

Solar panels have been installed on the cantilevered canopy of the stadium's South Pavilion.[15] Electricity created using this resource is directed to the central grid of the local power company, M/s.Torrent Power Ltd., against which transfer, AMC receives a power subsidy.

In 2007–08[16], to ensure longevity of the stadium as an asset despite the construction of Motera Stadium, AMC also installed flood lights around the stadium. This addition enabled the stadium to function as a popular venue for exhibition matches in the years to come.[17]

Other services such as toilets, administrative offices, storage and changing rooms are situated along the concourse. The strategic placement of these provisions enables people to easily access and use them while they move between different areas within the stadium.

Fig. 34: Map highlighting property boundary with all the infrastructure found on the site

Source: Google Earth (Base Map)

14. According to the historical imagery available on Google Earth, the parking lots and internal roads were laid in 2010. This development is visible in aerial images captured starting May 2010.
15. According to the historical imagery available on Google Earth, the solar panels were installed in early 2013. This development is visible in aerial images captured starting March 2013. However, according to the minutes of the meeting between the project team and Rushi Y. Pandya, the solar panels were installed around 2014–15.
16. According to the historical imagery available on Google Earth, the flood lights were installed in 2007–08. Their shadows are visible in the aerial images captured starting October 2008.
17. Indicine Team, 'Salman Khan at CCL (Celebrity Cricket League) Match at Sardar Vallabhbhai Patel Stadium in Ahmedabad,' Indicine, 26 January 2015, https://www.indicine.com/movies/bollywood/salman-khan-at-ccl-match-in-ahmedabad-photos/. Accessed on 25 December, 2021.

Sports Facilities

The stadium complex continues to be used as a sporting facility with access to tennis courts, cricket training facilities and a cricket stadium with a total capacity of 54,000 people.

The tennis courts are situated in a compounded area in the Northwest corner of the complex, with a gate that is easily accessible from the adjacent parking area that runs along the northern periphery. This parking space with direct access to Sardar Patel Stadium Road is primarily used by members of the Tennis Association of India. Visually, these courts appear to be separate entities with separate entry and exit points. However, there is a locked gate that can be used to access this area from within the sports complex.

There are three designated areas within the complex that are used by GCA, cricket training agencies, and other users such as school children and young adults, for cricket practice and training. These people also use the adjacent concourse for storage and toilet facilities.

A 3.3-m walking track runs along the periphery of the cricket ground inside the stadium.[18] Finished with rammed earth, this area is located comfortably between the first row of the stadium seats and the cricket ground.

The cricket ground is solely used by cricket associations to play cricket matches. The ground can be booked in advance by paying a nominal fee to AMC. Other than the players, the ground is only accessed by the stadium staff for regular maintenance and upkeep.

Fig. 35: Map highlighting property boundary with all sports facilities available on site

Source: Google Earth (Base Map)

18. According to an off-record interview with one of the stadium's security personnel, this walking track was introduced very recently at the behest of a prominent government official who frequented the stadium.

3.5 Site Stakeholders

Ever since its inception, several organisations and individuals have been involved directly and indirectly with SVP Stadium. These stakeholders—groups and individuals—who care about or benefit from the stadium, the facilities it provides and its central location, can be classified as:

- Custodians: Amdavad Municipal Corporation (AMC)
- Cricketing Community: Cricket associations like the Gujarat Cricket Association (GCA), cricketers—past and present, coaching and training centres
- Tennis: Tennis associations, Tennis clubs and players
- Daily Users: Sports enthusiasts, health-conscious citizens and local residents
- Patrons: Industrial and merchantile communities
- Statutory Bodies: Ahmedabad Urban Development Authority (AUDA) and Gujarat Sports Authority (GSA)
- Other Beneficiaries: Events organisers, sports clubs, architecture and engineering professionals and students, and architecture enthusiasts.

Over the decades, the involvement of the above-listed stakeholders with SVP Stadium, necessitates an understanding of their perspectives and expectations which shall, in turn, inform the CCMP. Their memories, experiences, and aspirations for SVP Stadium lend to this space its uniqueness, and form the backbone of its operations today. As the game of cricket, and the way it is viewed, have evolved, it is critical to re-examine the utility of this iconic building. Therefore, its engagement with the community is an integral part of the process of preparing the CCMP. The stakeholders' connection with the stadium and its associational value contribute to its future use.

Custodians

Since 1961, when the decision of constructing a stadium was taken, the land and the project were handed over to the Amdavad Municipal Corporation. The body has served as the stadium's custodian and has supported its operations. Due to AMC's people-centric approach, in 1995, the walking track was added, making the stadium friendlier for joggers and walkers; it still remains a free public space used by residents of the city for health, fitness, and sports activities. In order to reach out to aspiring cricketers and young cricket enthusiasts from all sections of society, the stadium also holds regular cricket coaching camps at low cost, with AMC-appointed cricket coaches. AMC also organises inter-department cricket matches regularly. AMC is in charge of the stadium's upkeep, and manages its various departments—water, electricity, horticulture, sanitation, and so on. It is the principal authority that undertakes any development or collaboration, and grants permission for events to be held at the stadium, making AMC a key stakeholder in SVP Stadium.

Cricketing Community

The primary users of SVP Stadium are cricketers—a direct outcome of the love for cricket, and the patronage and popularity the game enjoyed in Ahmedabad in the early 20th century. Over time, the British coaching, initially reserved exclusively for the royals, spread further to include other Indian boys who were interested in the game, and who went on to become experts. The young population of Gujarat and other parts of the country were attracted to the game.

The matches gained huge spectatorship. Hence, a dedicated cricket stadium was built. To date, SVP Stadium has hosted matches of various levels, including international, national, state, domestic, and local. The stadium has served as a training ground for several prominent cricketers from the Indian cricket team, including Jaspreet Bumrah, Parthiv Patel, and Priyank Panchal. Senior cricketers, including Kapil Dev, Sunil Gavaskar, Bimal Jadeja, Anshuman Gaekwad, and Karsan Ghavri, have practised and played at this stadium. All these cricketers have fine memories of the stadium, and a strong emotional attachment to it. That said, they also support cricket coaching and domestic matches, and regularly attend cricket-related events held here. Therefore, as patrons of cricket-related activities and founding figures of Gujarat's cricket culture, cricketers are among the leading stakeholders of SVP Stadium.

Founded in 1934, Gujarat Cricket Association (GCA) is the first governing body for the development and organisation of cricket in Gujarat State, and is affiliated to the Board of Control for Cricket in India (BCCI). Since 1973, the GCA has been involved with SVP Stadium, organising and hosting cricket matches here. Since 2012, the Central Board of Cricket Ahmedabad (CBCA) has regularly held cricket training camps co-hosted by the GCA and sponsored by the BCCI, at the stadium. Together, they have the potential to create better opportunities for the city's aspiring cricketers by providing them with quality training at the stadium.

Tennis

• The Ahmedabad City Tennis Foundation is an important stakeholder too. They have 7 courts in the general area, and 4 separate courts for women in the dedicated area.

• The Tennis Club has been allotted approximately 6,433 sq. m. of land since 1961.

• The office of the Tennis Academy too is located here. The academy has a considerable membership, and is used regularly by tennis enthusiasts. Coaching camps are held here as well.

Daily Users

The community / citizenry use the SVP Stadium regularly. Men, women, schoolgoing children, senior citizens among others, all use this space for health-related activities, athletics and sports practice. From 6 am to 8 pm, the facility is made available free of charge to the citizens of Ahmedabad. The users are proud of this facility and boast of their joint effort with AMC to tackle issues related to security and encroachment. The parking facility is an added advantage for the users. It is interesting to see the fixation people develop for a space, and the withdrawal symptoms they experience if they do not visit the facility for a few days.

Patrons

In the 1960s, the industrial elite of Ahmedabad had a vision of build Ahmedabad into a centre of excellence in several fields, and was very conscious of the buildings that were going to lend character to the city. SVP Stadium is one such historic structure that adds character to the city not only through its visual appeal but also as a place that the community can use, and where it can congregate on special occasions. Industrialists continue to support the custodian of the stadium, while exploring ways to support conservation of the tangible and intangible aspects of the stadium, in order to keep it active all year round.

Statutory Bodies

Ahmedabad Urban Development Authority (AUDA) has played a critical role in guiding development policies in the city. As experts in the field of urban planning, their recommendations and collaboration are indispensable to a project's success. As the approving authority for the new sports enclave in Motera that shall include swimming pools, badminton courts, lawn tennis courts, hockey playgrounds, and gymnastics facilities, AUDA shall be an important stakeholder for the rejuvenation of the SVP Stadium campus.

Other Beneficiaries

The stadium has been a site that architecture students not only from Ahmedabad but from architecture institutions across India visit regularly to study its unparalleled design and structural assembly. They too become stakeholders as a result of their interest and involvement in the development of academic research on the location, of the building itself becoming a source of education for them, and the creation of architectural study material for future. Professionals draw inspiration from this building as it was truly a collaborative masterpiece by Charles Correa, an Indian architect and Mahendra Raj, an Indian structural engineer, built in the period of post-colonial economic and social growth. To truly appreciate the historical significance of this structure, it is important to understand its construction processes as well as the state of architecture and engineering in India at the time of its making. Subject experts are also invited to critique the significance of this structure against the backdrop of pioneering 20th-century architectural, and make appropriate recommendations for its future development.

Being part of the same campus, the Sports Club, which has a large membership, too is a stakeholder—an added advantage to both the stadium and the club as many regular users of the club take a round of the stadium before leaving the club. The stadium also uses the Sports Club as an extended facility for its matches and events. Regular visitors to the stadium speak highly of its aesthetic appeal.

Discussions and interactive one-on-one meetings with representatives from various stakeholder groups were held as part of the stakeholder consultation process, which helped in concretising the adaptive reuse programme.

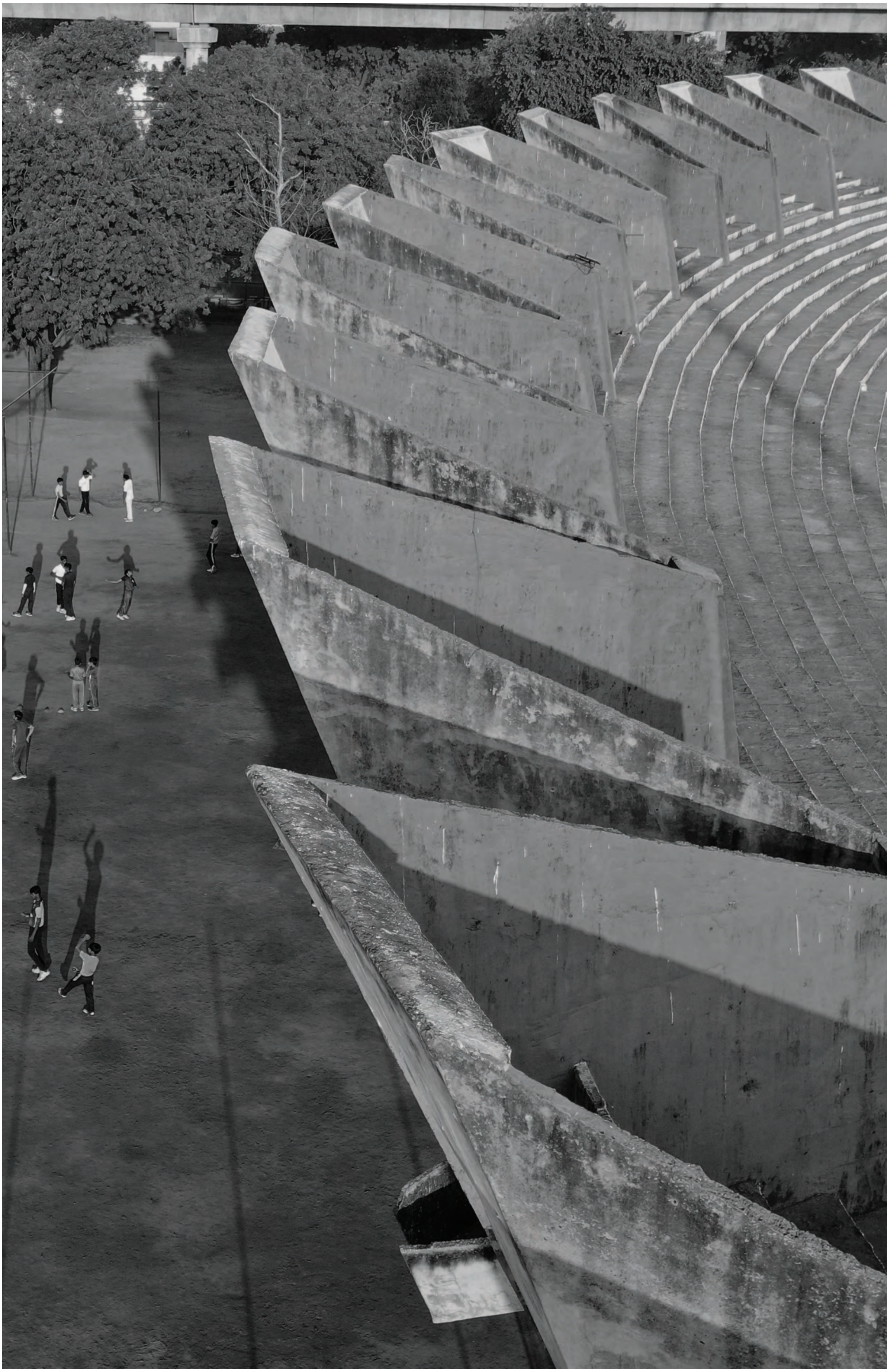
4.0
STADIUM BUILDING

4.1 Design Development

4.2 Building Description

4.3 Construction Materials and Techniques

4.4 Significant Features



Stadium Building

4.1 Design Development

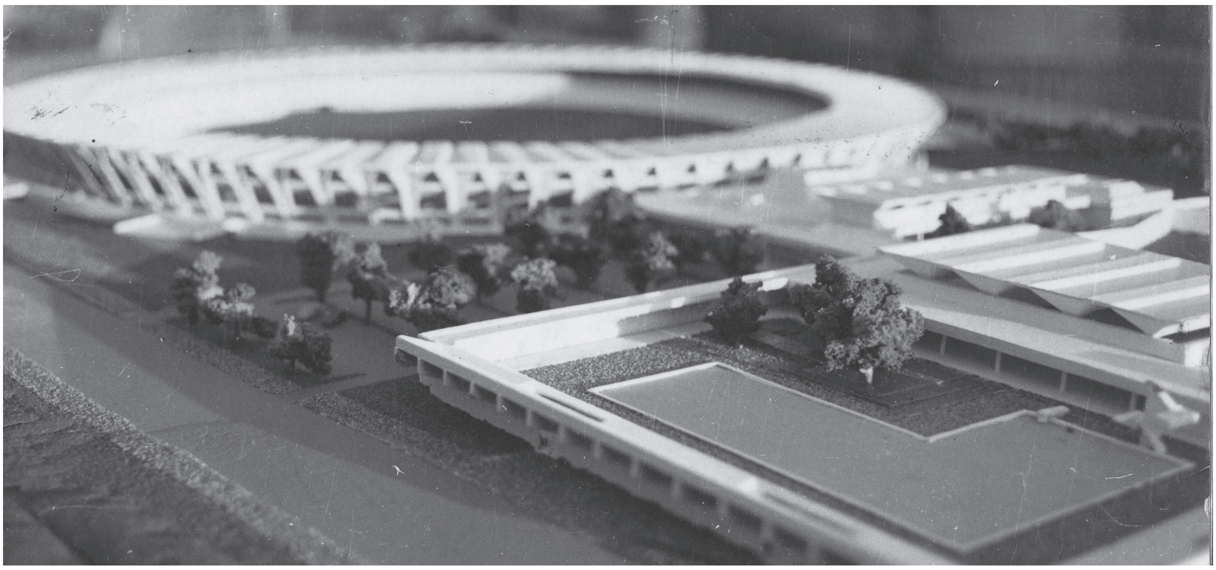
Sardar Vallabhbhai Patel Stadium was executed in two phases—1959–66; 1981–89[19] —over a span of 20 years, The collaboration and partnership between Charles Correa and Mahendra Raj resulted in the creation of the master plan for the entire sports complex, including the on-site construction of the South Pavilion. In the years that followed, this part served as a model for the construction of the remaining stands of the stadium.

Archival research uncovered a series of design iterations created for this project.[20] One of them revealed that apart from the stadium, clubhouse, and utility buildings (seen on site), numerous facilities such as a skating rink, badminton hall, swimming pool, tennis court, and an athletic field were also envisioned to be part of the sports complex.

In one of the earliest iterations, the stadium is connected to the clubhouse and the swimming pool. At this level, the swimming pool, badminton courts and all the stands, etc., are integrated into the clubhouse space. The three tennis courts, with their own stands, and the skating rink are placed independently. In another iteration, a section details out how the spaces are integrated, and how the ground plane is manipulated to work with all the other stands—aspects that truly make the stadium stand apart. Yet another iteration shows the stadium again with the clubhouse that is located on the North side of the site. It is unclear here as to why there is a separate entrance—that comes in off the street—for the tennis courts, the badminton courts and the swimming pool. Apart from this, there is an entrance for public circulation and a separate private one for the clubhouse. Later iterations show the stadium becoming far more articulated, with the folded plates clearly visible.

Fig. 36: Archival photograph of the model of SVP Stadium, with a swimming pool, badminton hall and clubhouse in the foreground

Credit: © Mahendra Raj Archives, courtesy Mahendra Raj Consultants Pvt Ltd



19.The second phase of construction began in 1981–82, and was carried out in parts over a duration of 7 years.

20.Research also reveals that in 1957, Bombay-based C.M. Bhuta & Associates were involved in the design development of the stadium, identified in the drawings as Municipal Stadium, Ahmedabad. This design iteration is square in plan, with rounded corners and a RCC shell roof structure. The entire periphery of the stadium was meant to be lined with 8-ft wide ramps, supported by brick piers and 14-inch retaining walls. No other information is currently available to ascertain why this association fizzled out.

One component that shows up repeatedly in the iterations is the skating rink. An elegant structure, it has an on-ramp and an off-ramp, and stairs that could be taken to climb up and come in, and get under it. There is another section that is ramped too. Then, there is a little bench that one can sit on to put roller skates on, and then go up the ramp. Yet another section shows the relationship of the skating rink to the ground. This relationship also shows up in many other buildings. So, it is a pity that the skating rink did not get built.

Research also revealed that the stadium was always meant to have a folded-plate roof structure. However, the use of folded plate to design the vertical frames was a later decision. It is this unique structural configuration, along with its exposed concrete surface finish, that lends the stadium its iconic imageability.

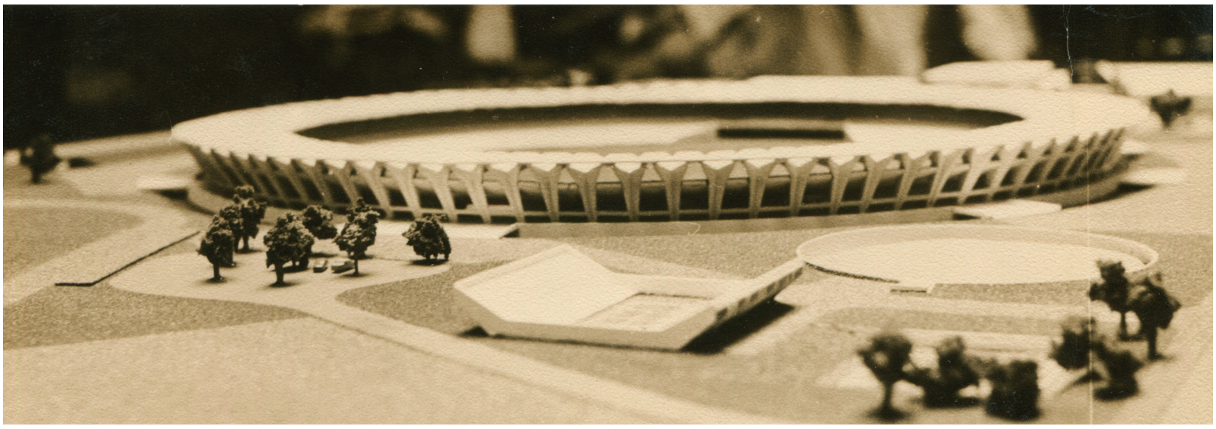
Charles Correa was also keen to use folded plates for most of the structures on site, including the badminton courts, tennis courts and connected stands for the spectators. Several skylights were included in the designs to bring light into the spaces. The structure for the badminton courts did not get built either, though that would have been a very beautiful and handsome structure. In the badminton courts, the top of the stands connects to the terrace, which then defines the ground plane and then slopes back again. Similar relationships can be seen in the tennis courts and the stands for the tennis courts. So, it is really interesting to see how each of these buildings was placed, and their relationship to the ground. SVP Stadium, however, has a different presence. It is the only building in the complex that has a different relationship with the viewer. While the other sports facilities were far more integrated into the ground, the stadium stands tall and frames dramatic views of the skies.

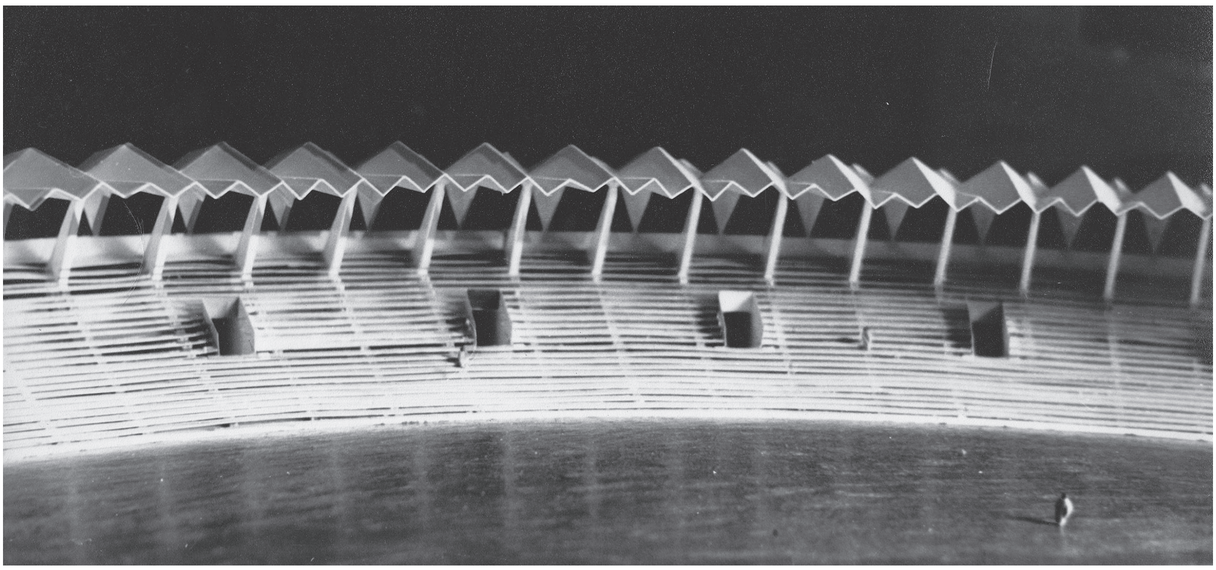
Fig. 37: Archival photograph of the model of SVP Stadium with the moat (unbuilt) and the connecting bridges (unbuilt) in the background, and the skating ring (unbuilt) and tennis courts (unbuilt) in the foreground

Credit: Charles Correa Associates / Courtesy: Charles Correa Foundation

Fig. 38: Archival photograph of the model of one of the design iterations of SVP Stadium

Credit: © Mahendra Raj Archives, courtesy: Mahendra Raj Consultants Pvt Ltd





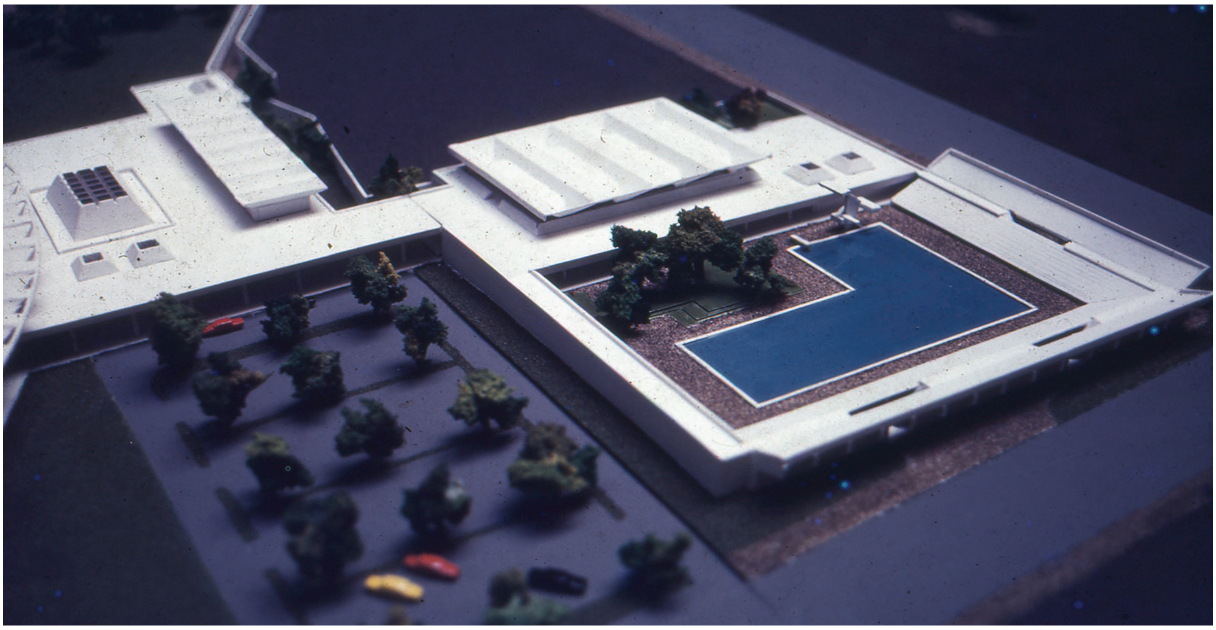


Fig. 39: Archival photograph of the model of the clubhouse, badminton hall and swimming pool of the stadium complex

Credit: Charles Correa Associates / Courtesy: Charles Correa Foundation

When one visits the site today, it is evident that some design features associated with the spatial arrangement and circulation of the stadium were left out from the execution phase of the sports complex. According to the archival material shared by the Charles Correa Foundation, elements such as the moat and connecting bridges were designed to run along the periphery of most of the external façade. These features, if implemented, would have established a more fluid transition between the grounded landscape and the majestic stadium.

The cause for this exclusion may have been the appointment of a new team of architects, engineers and contractors for the planning and implementation of the remaining stands of the stadium. This section of the stadium stayed true to the larger circulation and spatial configurations originally proposed by Charles Correa and Mahendra Raj. However, for reasons unknown, the space allocation and details, both structural and architectural, have been significantly altered.

For instance, many significant alterations have been introduced into the structural and architectural elements of the stadium. [21] Some of these include modifications to certain structural components, the exclusion of the cantilevered canopy, and the introduction of gallery seats, cast in-situ [22], in place of the originally designed precast seats. Archival research conducted during the course of the project also revealed that lack of funds led to the exclusion of the cantilever canopy in the remaining stadium, and the gallery seats now served as seats and shelter for the concourse area below.

According to the original master plan designed by Correa, the concourse area was meant to function as a transitional space that enables users to easily move to the stadium aisle, leading them to their respective seats. Additionally, this space was also envisioned to house other utilities such as drinking water fountains, refreshments counters and restrooms, among others. Although the majority of these utilities were incorporated within the second phase of construction, their architectural quality was significantly modified, especially the ladies and gents toilets around the stairway leading to the stadium aisles. The architectural form of the RCC ledge that runs along the periphery of the main frames of the South Pavilion has been significantly modified and minimised in its expression along the façades of the North, East and West stands.

21.Archival drawings and images suggest that additional seats, labelled 'typical seating', were meant to be mounted throughout the stadium on top of all the seating slabs, cast in-situ and precast. However, no evidence of this intervention can be seen in the images taken right after the completion of the first phase of construction. No further evidence is available on why this was not implemented on site.
22.In a conversation with the project team, Paresh Dodiya (see endnote 30) informed the team that in the tender documents for the second phase of construction, the seats were meant to be precast. However, due to some problems, and the pressure to complete the project at the earliest, it was decided that the seats would be cast in-situ.

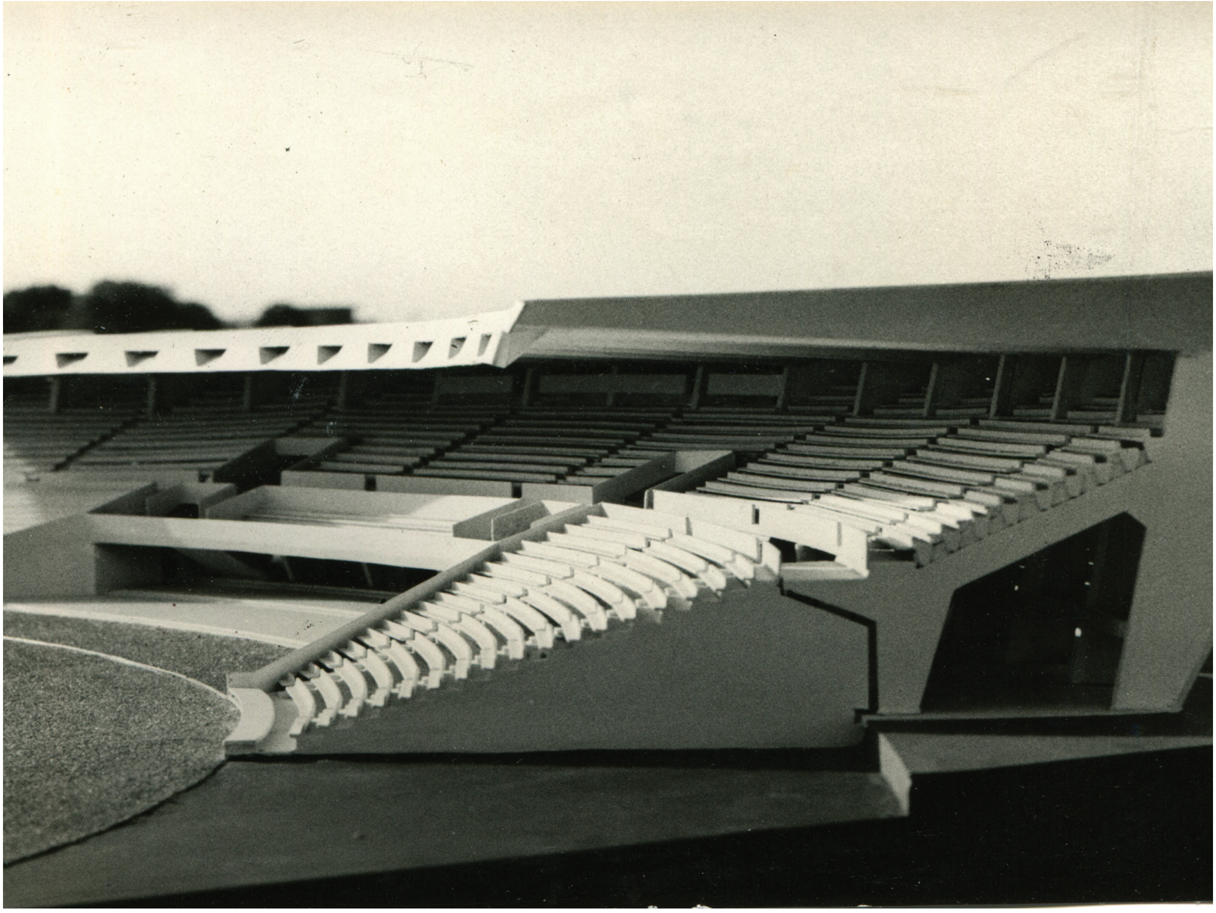


Fig. 40: Archival photograph of the model of the South Pavilion with structural details as seen on site

Credit: Charles Correa Associates / Courtesy: Charles Correa Foundation

The original structural drawings shared by Mahendra Raj Archives highlight the precision with which the structural elements were detailed out for implementation. The details included information on the positioning of construction joints, reinforcement details, the geometry of the folded-plate components (A-Frame / rear leg and roof), the concrete mix [23], the shuttering pattern [24] and element outline details as identified for each component, among other. The notes also reveal that the contractors [25] worked in close collaboration with Raj. [26]

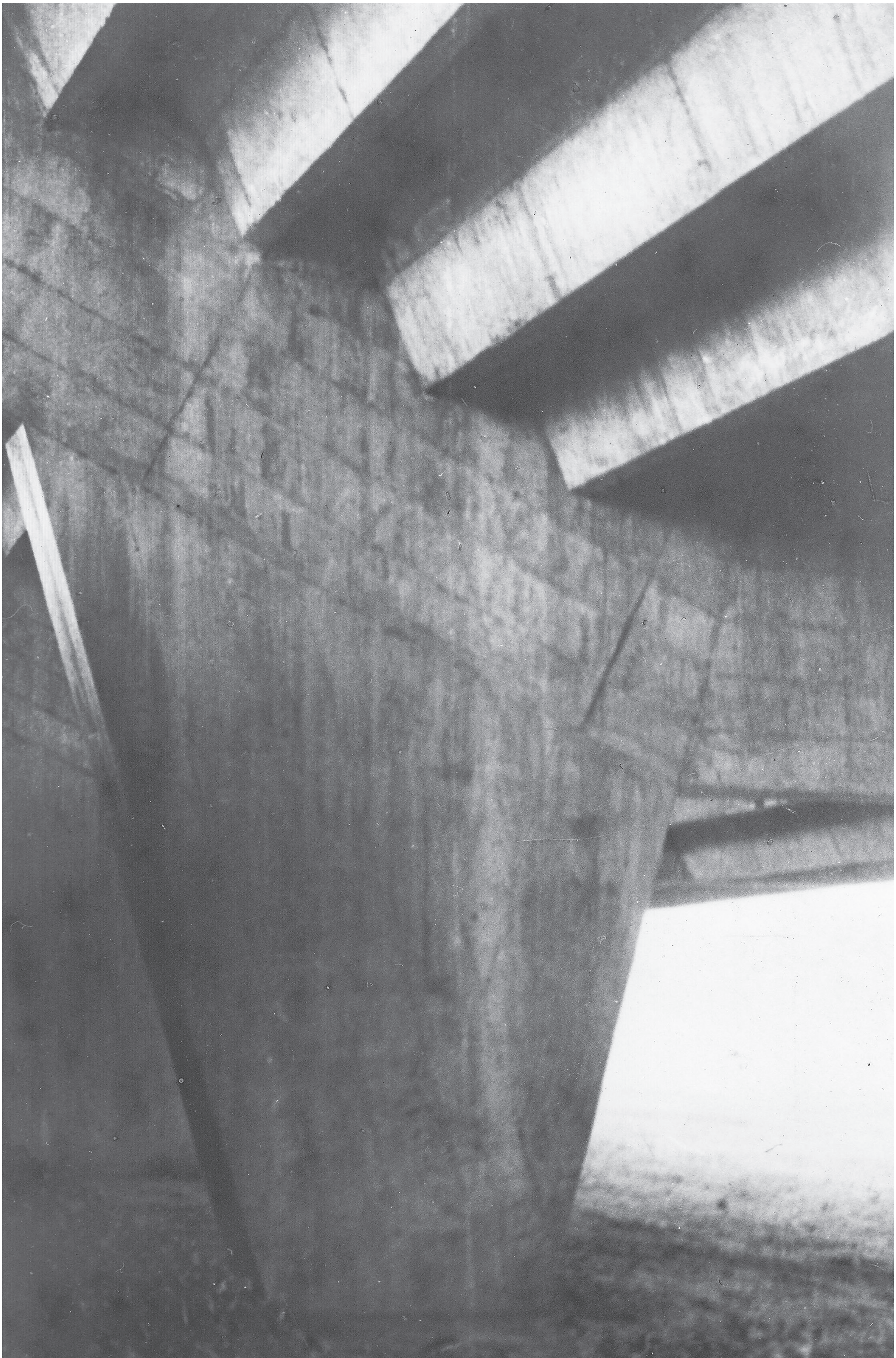
The striking visual identity of the stadium, especially the South Pavilion, is a result of the collaborative effort of the original team—the architect, the engineer and the contractor.

23.In conversation with the project team, the current proprietors of Messrs K.B. Mehta mentioned that the aggregates and sand were acquired from Sevalia and Sugadh, respectively. They further added that the cement was supplied by AMC, probably ACC (Associate Cement Company), and mild steel, i.e., 250 grade steel, was used for reinforcement.

24. According to the archival drawings, shuttering details, patterns and dimensions were designed for each component that was poured on site for the construction of the South Pavilion. Planed 4-inch teakwood planks were recommended to be used as formwork. However, in conversation with the project team, the current proprietors of Messrs K.B. Mehta mentioned that they used well-fitting, well-formed, well-oiled shuttering plates for the formwork, with H traps for support, and that they employed skilled labour to assemble the shuttering system. All these shuttering patterns are still visible on site, and add artistic value to the structural significance of the stadium.

25.Messrs. K.B. Mehta was appointed as the contractor for the construction of the South Pavilion. In conversation with the project team, the current proprietors of Messrs K.B. Mehta mentioned that in the 1960s, their company was pioneering construction technology in Gujarat, like the folded-plate structure, along with the slip form concreting. They believed that durability of concrete is a key aspect in any exposed-concrete structure.

26.In conversation with the project team, the current proprietors of Messrs K.B. Mehta mentioned that C.B. Shah, previously an AMC engineer, joined the firm around the same time, and was a key member for the concrete mix design of SVP Stadium. They further added that special care was taken with regards to the water-cement ratio, maintained as 0.4 for durable concrete, and that there was strict control for each mixture since they were all individual mixers, and there was no mass mixing of concrete. They added that according to Mr. Shah, three key things were crucial for the production of good quality of concrete—water-cement ratio, good compaction and shuttering plates. They concluded by saying that the contractors found Mahendra Raj's drawings very clear and comprehensive. So, they never needed to ask follow-up questions.



4.2 Building Description

Fig. 41: Archival photograph of the seating frame of the South Pavilion with the underside of the precast seats seen on top

Credit: © Mahendra Raj Archives, courtesy Mahendra Raj Consultants Pvt Ltd

Fig. 42: Archival photograph of the A-Frame of the South Pavilion under construction with shuttering, scaffolding, reinforcement and foundation details visible

Credit: © Mahendra Raj Archives, courtesy Mahendra Raj Consultants Pvt Ltd

While SVP Stadium has the same set of structural elements seen in most sports stadiums worldwide, the ingenuity of its form lies in the way it incorporates the cantilever canopy, folded plates, precast module and compression-tension ring members in its architectural assembly. Additionally, the creativity and skill of labour evident in the implementation of the form-finished concrete construction makes this sports facility a unique national architectural icon.

Its structural system can broadly be categorised into the following building elements: cantilevered roof, A-Frames, seating frames, retaining walls and buttresses, seats (cast in-situ and precast), floors (cast in-situ) and transitional components.

In this section, the different segments of each building element have been identified. A supporting illustrated document that enables visual comprehension of these terminologies is included in the document, 'Documentation And Condition Assessment Drawings'.

Cantilevered Roof

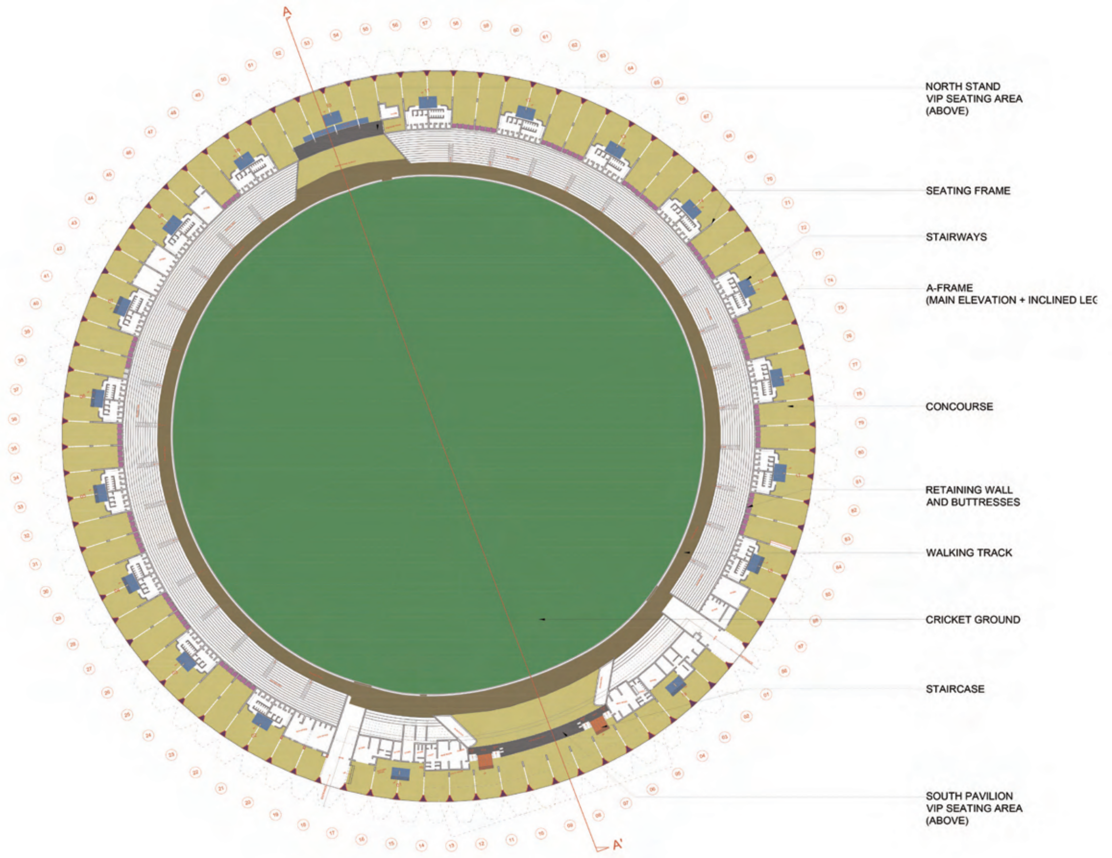
An iconic structural component of the stadium is the 25 m-deep cantilevered canopy constructed using a folded-plate system, connected to the A-Frames at a critical knee joint. Originally designed to cover the entire stadium, at present, the roof only covers the South Pavilion that was built during the first phase of construction. The overall form of the roof is made of multiple ridges formed at the intersection of consecutive valleys, noticeable as V- and W-shaped (interior and end) plates with joints. Most of these joints run parallel to the ridge, and have been sealed to function as construction joints. However, two exceptions have been left open to act as expansion joints. Most specifications of the cantilevered canopy match the structural details available in the original drawings shared by Mahendra Raj Archives. According to the design, the expansion joints of the roof are 1-½ inches in width and the construction joints are 1-ft. wide.

Examined from the top, the profiles of the ridges and the valleys match what is visible on the underside, with an inclusion of some additional details—a continuous facia, three sets of ties and a bracing set along the outer edge of the roof. The continuous facia situated along the cantilevered part of the roof acts as a diaphragm that ensures all the folds have sufficient horizontal support to withstand lateral loads. Additionally, three sets of ties run parallel to the curvature of the cantilevered roof, spaced out at a distance of 20 ft, centre to centre. These ties, the first one set 25 ft. from the cantilevered edge, are

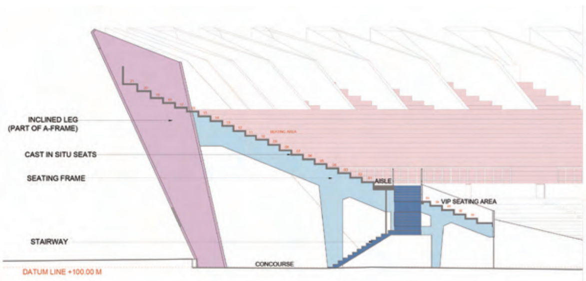
Fig. 43 (bottom): Drone view highlighting the folded plate profile of the cantilevered canopy in the South Pavilion

Fig. 44 (right top): Nomenclature of different building elements identified in the concourse level plan of SVP Stadium

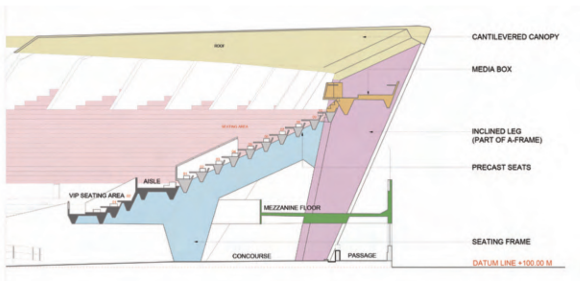
Fig. 45 (right bottom): Nomenclature of different building elements identified in the part sections and elevations of SVP Stadium



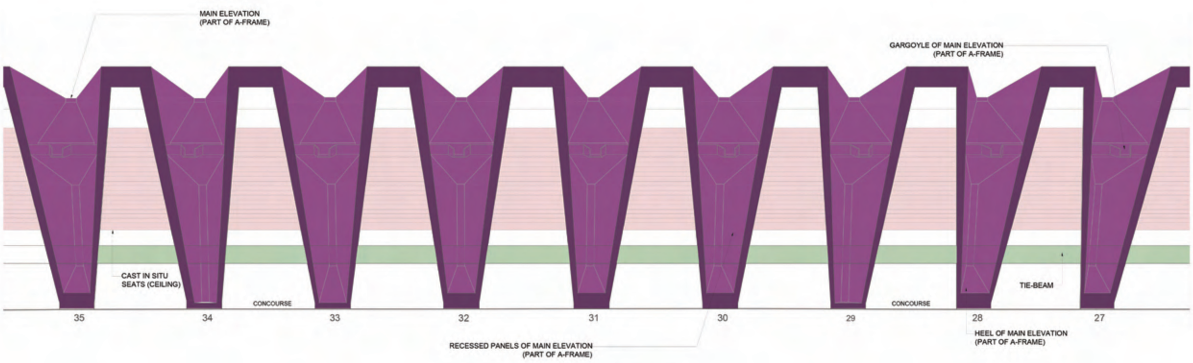
PLAN AT CONCOURSE LEVEL
SCALE 1:500



SECTION A - A': NORTH STAND OF THE STADIUM [ZOOM-IN DETAIL]
SCALE 1:100



SECTION A - A': SOUTH PAVILION OF THE STADIUM [ZOOM-IN DETAIL]
SCALE 1:100



WEST SIDE ELEVATION
SCALE 1:100

composed of three metal rods each, embedded into the ridges of the canopy and capped with an additional concrete casing. An additional bracing system consisting of four metal rods is connected to the upper flanges of the A-Frame, positioned 3 ft. from the outer edge of the roof. The location of the ties and bracing system also match the information available in the archival drawing set.

A-Frames

This character-defining feature is visually the most prominent component of the stadium. It covers the entire external façade and incorporates the structural principles of folded plates in its design form. A total of 88 in number, each A-Frame comprises a V-shaped member that forms the core elevational detail, and runs the entire length [27] of the module with three subsections in-between that, when connected at different positions, form the exterior part of the building element—the main elevation.

The upper section of the main elevation consists of three to four flanges that once connected to a channel, and the diaphragm details create a distinguishable gargoyle segment. The middle section is made of four recessed panels, a tie beam and trough-like details that vary in configuration, depending on the frame in consideration. Finally, four recessed panels anchored to a trapezoidal section of the core elevational detail and a rectangular section, form the lower section of the elevational detail—the heel segment. The lowermost rectangular piece of the heel is either exposed or submerged, depending on the site's topography next to the element in consideration.

The interior part of the A-Frame is composed of two sloped surfaces connected to each other by a narrow rectangular section to form an inclined leg, which is further connected to the stadium seats and seating frames, —other structural elements of the stadium—to form the character-defining spatial quality of the concourse—the portico.

Three typologies of this module have been identified across the stadium. Type A can be seen between Frames 1 to 4 and 14 to 17. In this typology, the mid-section of the two consecutive A-Frames is connected to each other by a trough-like detail—the ledge that transforms into a tie beam within the main elevation of each Frame. Type B can be seen between Frames 5 to 13, and comprises two visually separate entities with the same subsections of varying dimensions, and an additional beam and slab feature with a void in the centre, running along the mid-section of two consecutive A-Frames. This is due to the introduction of the mezzanine floor in this section of the stadium. Both these typologies were built between 1962–66 during the first phase of construction, and are part of the South Pavilion. Type C can be seen between Frames 18 to 88, built between 1980–85, during the second phase of construction. In this typology, the mid-section of the two consecutive A-Frames is connected to each other by a slender tie beam, and transforms into a trough-like detail within the main elevation of each frame.

Although each typology is composed of the same items, minor differences in the form and proportions of the individual parts have resulted in this categorisation.

Fig. 46: Perspective view of the A-Frames (Type C) built in the 1980s

Fig. 47: Perspective view of the A-Frames (Types A & B) built in the 1960s

27.The length of the V-shaped member in each A-Frame varies, depending on the typology of the Frame. Its measurement averages approximately 14.36 m, i.e., 47 ft. from the datum in height.

Seating Frames

This is another visually prominent component of the stadium that comprises a raker beam and trapezoidal columns, collectively identified as a seating frame. Positioned along the same radial axis as the A-Frames, this element is connected to the inclined leg segment of the A-Frame at one end, and cantilevered or rested on partition walls at the other. Due to the phase-wise development of the stadium, this component can also be classified into two broad categories: the seating frames of the South Pavilion and those in the remaining stadium. These categorisations can be further classified into seven variations—three in the South Pavilion and four in the remaining stands, introduced by altering the overall form of the component based on the programmatic changes incorporated within the overall design. Each variant is primarily composed of the same two items—a raker beam connected to trapezoidal-shaped columns, two in number, with partition walls positioned under the frame, depending on their location within the stadium.

Retaining Walls and Buttresses

Fig. 48: View of the inclined leg of the A-Frames and the seating frames at the concourse level in the North, East and West stands

Fig. 49: View of the seating frames and parts of the A-Frames at the concourse level in the South Pavilion

Fig. 50: View of the retaining walls and buttresses at the concourse level under the North, East and West stands

This component is only found in the bays underneath the North, East and West stands, constructed during the second phase of construction. It is designed to function as a retaining wall, with added support in the form of perpendicular buttress walls. The upper edges of the subsections are connected to the underside of the seats in the lower section. The mildly curved retaining walls measure 6.11 m (l) X 2.57 m (h), and three buttress walls measure 0.26 m (l) X 1.25 m (d) each per bay. Made of brick and plaster, these walls retain the earth infilled under the seats of the lower section, running along the circumference of the 15th step of the lower section in the North, East and West stands.

Seats (Cast in-Situ And Precast)

Seats as a component can be classified into four subsections: lower section, central aisle, upper section and the ceiling. The central aisle runs along the circumference of the entire stadium, dividing the seating, visually and functionally, into two sections. The lower section comprises seats that start from the present ground level of the walking track and end with a parapet wall connected to the inner edge of the aisle. Depending on the site topography, the ground level of the walking track varies, resulting in the change in the number of seats present in this section for each sector. The upper section consists of seats that begin at the outer edge of the aisle and end at the parapet wall connected to the sloping surfaces of the inclined legs on the concurrent A-Frame. Depending on the typology, the underside of some seats has been identified as the ceiling, and the rest have been included as part of the seating unit.

Two typologies of this module have been identified across the entire stadium: precast seats (Type A) and seats cast-in-situ (Type B). Implemented during the first phase of construction, precast seats can only be found in the South Pavilion. There are four typologies of these seats that have been identified: media / press boxes, upper section seats, aisle, and VIP seating. This classification is based on the minor differences in form and proportion, based on their location and function. However, the seats in the lower portion of the South Pavilion are cast in-situ and form the ceiling to the rooms at the concourse of the grandstand.

During the second phase of construction, cost-based decisions led to the change in the way the stadium seats were constructed. So, all the seats in the upper and lower sections of the seating area built in the North, East and West stands, including the aisles, are cast in-situ. The seating in these parts have an underside recognised as the ceiling.

Floors (Cast In-Situ)

Most of the stadium has been built with all its utilities and services configured at one level—the concourse. However, the South Pavilion has two levels—the concourse and the mezzanine floor.

The concourse in the South Pavilion is built with a plinth under it. However, the concourse in the rest of the stadium does not have a plinth, and follows the site gradient with minimum to no difference in level and softscape around it. But one can see a plinth wall that runs between A-Frames 50 to 58 in the North Stand. This step up towards the practice net, retains all the rammed earth that may have been added over time.

The ramps connected to the central aisle led users to the mezzanine floor of the South Pavilion. Connected to the roof of the clubhouse, the mezzanine was originally designed to enable its members to easily move into the stadium, and get directly to their respective seats. This connection, however, is currently closed and cannot be used for movement. The floor at this level is finished in concrete with no cladding material carpeting it. Additionally, a parapet wall with drop beam detail, constructed in form-finished concrete, runs along the inner perimeter of the floor.

Fig. 51: View of the cast-in situ seats of the West Stand

Fig. 52: View of the precast seats of the South Pavilion


CORPORATION WELCOMES YOU

Transitional Components

There are three kinds of transitional components identified across the stadium—stairways, staircases and ramps.

A total of 19 in number, the stairways, also referred to as gates, begin at the concourse, and lead the users to the central aisle, directing them to their seats. Three typologies of this component have been identified in the stadium. Type A can be seen at Gates 1 and 19 in the South Pavilion. Type B can be seen at Gate 10 at the North Stand, leading users to the VIP seating in this section. And Type C can be seen at the remaining gates of the North, East and West stands. The soffit of this typology partly forms the ceiling of the toilet blocks in these stands.

The staircases and ramps are only found in the South Pavilion. Two in number, both these building elements can be found in the bay between Frames 6–7 and 11–12. The staircases led the user from the concourse to the VIP seating, and then further on to the central aisle of the South Pavilion. And the ramps led the users from the central aisle to the mezzanine floor of the South Pavilion.

Although most of these transitional components may be regarded secondary in value, their presence, and in some cases, built quality, significantly contribute to the design language and spatial experience of the stadium.

Fig. 53: View of the ramp with past interventions as steps, leading to the mezzanine floor in the South Pavilion

4.3 Construction Materials and Techniques

This iconic stadium was built using form-finished construction technique, with reinforced concrete cement as the building material and folded-plate building assembly for the main frames and roofing system. All the building elements have been listed in the Table 1.They have also been classified according to the building material, construction technology and their location within the stadium.

FEATURE(S)	BUILDING MATERIAL	CONSTRUCTION TECHNOLOGY	LOCATION
Roof	Reinforced concrete	Form-finished construction; cantilevered folded-plate system; plywood for shuttering [28]	South Pavilion
A-Frames (Phase 1)	Reinforced concrete	Form-finished construction; folded-plate system; deodar planks [29] for shuttering	South Pavilion
A-Frames (Phase 2)	Reinforced concrete	Form-finished construction; folded-plate system; plywood for shuttering	North, East and West stands
Seating Frames (Phase 1)	Reinforced concrete	Form-finished construction; polygonal columns with joined raker beams; deodar planks for shuttering	South Pavilion
Seating Frames (Phase 2)	Reinforced concrete	Form-finished construction; polygonal columns with joined raker beams; plywood for shuttering	North, East and West stands
Walls	Brick wall and plaster	Retaining walls and buttresses; partition walls	North, East and West stands
Seats (Type A)	Reinforced concrete	Precast construction; form-finished construction	South Pavilion
Seats (Type B)	Reinforced concrete	Cast in-situ; form-finished construction	North, East and West stands; lower section of South Pavilion
Floors (Mezzanine Level)	Reinforced concrete	Cast in-situ; form-finished construction; deodar planks for shuttering	South Pavilion
Staircase (leading to VIP seating)	Reinforced concrete	Cast in-situ; form-finished construction; deodar planks for shuttering	South Pavilion
Stairway (Phase 1)	Reinforced concrete	Cast in-situ; form-finished construction; deodar planks for shuttering	South Pavilion
Stairway (Phase 2)	Reinforced concrete	Cast in-situ; form-finished construction; plywood for shuttering	South Pavilion

Table 1: List of the architectural features of SVP Stadium, with information on their building material, construction technology and location

28.In a conversation with the project team, the current proprietor of Messrs K.B. Mehta mentioned that they used plywood formwork for the construction of the cantilevered roof.

29.The shuttering patterns on different building elements like the A-Frame, seating frame, staicase, and stairways suggest that wooden formwork—most likely deodar as it is easily available in this region—was used for shuttering on site.

4.4 Significant Features

The collaboration between Charles Correa and Mahendra Raj led to the creation of many features that add structural, architectural, and aesthetic value to the stadium building.

The cantilevered canopy, an awe-inspiring structural component covering the South Pavilion, is one such element. To create this stadium roof, the team used one of the many fundamental forms of roof construction—a cantilevered system with a critical joint at the exterior end. This assembly enabled the designers to envision large span covers that offered flexible configuration and unobstructed views of the ground in the middle. What makes this design ingenious is the manner in which they also incorporated the use of folded plates within the larger arrangement.

Other than the roof, a folded-plate system can also be found in the A-Frames that form the exterior façade of the stadium. This part, along with the seating frame, makes up the core members of the framing system. Radially aligned across the entire circumference of the stadium, these Frames also form the concourse. Repetitive in pattern, both these Frames also add rhythm and spectacle to the experiential quality of this transitional space. Additionally, by enabling movement of users from the concourse to the stands via the stairways, the user is drawn towards the vastness of the open sky—a relationship Correa hoped to reinforce through every aspect of spatial configuration in the stadium building.

The textural and visual qualities of the form-finished concrete, especially as seen in the South Pavilion, add artistic value to the stadium building. This creative quality of the construction technique is another significant character-defining feature of the stadium. Unfortunately, the surface finish of the North, East and West stands does not match the finesse of that seen in the South Pavilion.[30]

30.Paresh Dodiya was an employee of the contractor firm that executed the second phase of construction. In a conversation with the project team, he mentioned that they used waterproof ply for shuttering. Due to the unwillingness of the labourers to work with his then employer, they were unable to use the shuttering system used in the South Pavilion. He shared that M25 and M20 concrete mix was used to construct the A-Frames and seating frames, respectively. He further added that the reinforcement was supplied by AMC, Tata Steel (T form bar) and 80 per cent of the cement was imported in paper bags, probably from Korea.


AHMEDABAD MUNICIPAL

5.0 ASSESSING SIGNIFICANCE

Assessing Significance

Ahmedabad's Sardar Vallabhbhai Patel Cricket Stadium was designed as the focal building of a large sports complex that was to include an extensive clubhouse, swimming pool, tennis courts, badminton courts and a skating rink. While the last two were not built, the realised components of the scheme contribute to the site's cultural heritage significance. The 'Statement of Significance' presented here has been prepared after examination of the multiple cultural attributes of the place, as also the deep meanings and associations the place holds for its local, national and global stakeholders. Considering the importance of community engagement in the conservation of leisure and sports arenas, a special section has been added to highlight various local traditions in which SVP Stadium stands rooted.

5.1 Significance of the Local Context

SVP Stadium belongs to the time when the city of Ahmedabad was witnessing several developmental projects, moving towards modernisation, and establishing its progressive identity. The major period of significance of the site may be understood as extending from the early 1960s to the early 1980s, during which time, SVP Stadium was conceived, designed, built and used for its original purpose of hosting international cricket matches. Despite the shifting of the international cricketing venue to the new Motera Stadium, SVP Stadium continues to demonstrate its original significance in its fabric, especially in its social associations with cricketing history and as a place of memory. It remains the locus of several cricketing activities by the local community, and is a popular venue for numerous cultural and leisure pursuits.

Ahmedabad's Heritage of Social Progress

While SVP Stadium per se was conceived and created during India's post-Independence drive for nation-building, the development of modern infrastructure for Ahmedabad's social, economic and cultural growth, including sports facilities, was initiated several decades earlier by national political leaders Mahatma Gandhi and Sardar Vallabhbhai Patel, and local visionary philanthropists such as Kasturbhai Lalbhai. India's Independence and the formation of Gujarat State provided a fresh impetus to Ahmedabad's heritage of social progress, leading to the involvement of the best international and national intellectuals and creative personalities to give form to the city's visions of modern institutions and infrastructure that Ahmedabad boasts of today. SVP Stadium, along with several other examples of pioneering modern architecture such as Sanskar Kendra, National Institute of Design, Indian Institute of Management, Ahmedabad, Sabarmati Ashram, that were planned in the 1960s, symbolises the city's 'heritage of progressive imagination' to absorb new approaches encountered during its many multi-layered interactions with foreign lands.

Ahmedabad's Heritage of Cricket

The history of cricket in Ahmedabad goes back to 19th century, a cricket ground for local use having been established within the Gujarat College in 1845. The Gujarat Cricket Association (GCA), formed in 1933–34, was one of the first organisational units responsible for coaching players and conducting tournaments. The Cricket Club of Ahmedabad (CCA) was also established during the pre-Independence period in 1944 to carry out a similar range of cricketing activities. Thus, the tradition of cricketing was well established in Ahmedabad when, in 1950, the Bombay State made a grant of land for building a cricket stadium to the CCA. While SVP Stadium marks a critical shift in the history of cricket and design of cricket stadiums in India, it is also significant as an integral part of the city's history of cricketing culture.

The success of the many players who were users of the stadium started the trend of cricket coaching as an important activity for school- and college-going students of the city. GCA started focussing on an organised cricket coaching centre. This was followed by BCCI promoting cricket training and formulating a selection system for the candidates, making this stadium a major coaching centre for cricket.

A Fertile Ground for Modern Architecture and Infrastructure Projects

Ahmedabad's heritage of progressive thinking and the city's capacity to adopt new ideas are particularly reflected in its array of remarkable modernist architecture, including landmark projects by masters such as Le Corbusier, Louis Kahn, B.V. Doshi, Charles Correa, Achyut Kanvinde and Mahendra Raj, who are admired for their pioneering designs, engineering feats, particularly their exploitation of the aesthetic potential of materials such as form-finished concrete and exposed brick. A very special characteristic of this era in Ahmedabad was commissioning architects to design infrastructure projects (such as bus terminals) normally undertaken by the Public Works Department. While rooted in the broader global and national panorama of 20th-century architectural heritage, SVP Stadium is a significant component of this local tradition of post-Independence modernity.

The Urban Setting

Sardar Vallabhbhai Patel Stadium and Sports Complex was sited in a 'modern' institutional zone established by the British in the mid-19th century. At the time, the site was at a considerable distance from the city's larger residential segment in the traditional walled area. With Ahmedabad having grown substantially over the years, the site is now surrounded by developments of various categories, and provides a much-valued and easily accessible large open space in a highly dense urban fabric.

5.2 Analysis of Cultural Significance

The multiple values that SVP Stadium expresses are grouped under three main clusters—1. Historical and Educational Significance; 2. Architectural-Aesthetic-Technological-Environmental Significance, and 3. Social-Economic-Associational Significance—each of which is described below:

Historical and Educational Significance

The historical value of SVP Stadium is rooted in its being an example of India's post-colonial, nation-building activities, particularly the development of modern infrastructure for social and cultural growth. Besides symbolising local and national aspirations, the stadium is significant for being part of the global mid-20th century narrative of decolonisation, and the widespread progressive efforts of emerging nation states, including the economic and technological challenges of the period. These larger processes have, in turn, assigned to SVP Stadium a prominent place in the evolution of Ahmedabad as well as modern architecture of India.

At the level of the city, SVP Stadium is the result of the commitment of a succession of Ahmedabad's social and political leaders. It was their collective progressive vision, innovative spirit, and the ability to form successful partnerships that overcame various challenges to realise this landmark, considered one of the first modern stadiums of post-Independence India. The stadium's abiding cultural value, therefore, is also a consequence of the close collaboration and the exchange of ideas between numerous sets of stakeholders, be these decision-makers, sponsors, sportspersons, designers or constructors.

The historical significance of SVP Stadium is strengthened due to its symbolic or actual association with locally and nationally prominent personalities such as Sardar Vallabhbhai Patel who, along with Mahatma Gandhi, initiated the process of modernisation of social infrastructure in pre-Independence Ahmedabad, and inspired prosperous local mill owners such as Kasturbhai Lalbhai to sponsor such projects. The most prominent contributor to the development of Ahmedabad's society and built environment during the post-Independence era was Sheth Chinubhai Chimanlal of the Lalbhai family, who, during his tenure as the city's Mayor, invited several internationally renowned architects as well as Charles Correa to design and build the several 20th-century icons, including SVP Stadium, that Ahmedabad boasts of today.

SVP Stadium is also valued for its place in the cricketing history of India, for the fact that it was here that India had hosted its first One Day International cricket match. The stadium has also been the venue for several other international first-class matches and preparatory matches by visiting teams. It is valued for its association with several local, national, and international cricketers who have played here and, especially for serving as the training ground for many renowned cricketers hailing from the city and the region. This was also the first 'turf' ground in India, and thus served to further the cause of cricket in the country.

Given the paucity of well-researched publications on India's post-Independence modern architecture, structural design, concrete constructions and heritage management, SVP Stadium is a living laboratory with immense potential to add to existing knowledge on the subjects. Additionally, the study of its history may reveal information that would contribute significantly to our understanding of the evolution of Ahmedabad, or Gujarat's cultural history.

Formal Attributes : Architectural, Structural, Aesthetic, Technological and Environmental

This will examine the stadium's visual, architectural, structural / engineering, and technical-construction attributes, and the challenges of design and execution to list cultural values embodied in its physical setting and fabric, establishing it as a landmark in India's history of stadium design in particular, and post-independence modernist architecture in general. Seen in terms of its highly creative architectural form, the pioneering structure as well as the innovative construction technology, SVP Stadium can be considered a masterpiece of human creative genius, recognised nationally as an icon of 20th-century, exposed-concrete architecture in India, an important link in the global narratives of sports arenas of the 1960s–70s.

Architectural and Structural Values

A fundamental value of SVP Stadium is its having been designed as an integral component of the larger sports complex. While its monumental scale establishes the focal role of the stadium, and distinguishes it from other sports facilities of the complex, all are bound together with the thematic elements of folded plates and form-finished, exposed-concrete surfaces. The stadium was one of the first and largest RCC folded-plate cantilever structures in India. Its formal value derives from its immense circular form, with an internal diameter of around 86.5 m at the roof level, the 88 folded supports of 13.5 m height, and the first ever folded-plate cantilever of over 24.3 m—all of which were integrated innovatively to produce a unique structural system and architectural profile. Other distinguishing architectural attributes remain the highly inventive way of connecting different spaces, the manner in which the rake slab of the original section of the grandstand, the seats, the rails, and the steps were integrated, the gargoyles to drain the enormous cantilever and the skylights to bring light into the interior spaces. SVP Stadium is important for demonstrating innovation in architectural design, structural system, and detailing for large-span RCC constructions in post-Independence India.

Aesthetic Value

The unique visual and sensual attributes of SVP Stadium include its landmark presence, the aesthetics of form-finished concrete and shuttering patterns, its characteristic formal features such as the 88 folded supports, the gargoyles, and the fantastic challenge to gravity posed by the immense cantilever that also symbolises the dynamism inherent in sports.

Technological and Environmental Values

SVP Stadium's link to global, national and local contexts stems from its unique structural conception; the material, economic and environmental sustainability embedded in its system of construction, and the indigenous systems devised to overcome paucity of technical and financial resources. The technology of construction used for SVP Stadium, in addition to other similar works in Ahmedabad, also became a way of showcasing the capabilities of young Indian professionals and building contractors who, working with inexperienced local craftsmen, achieved excellence in execution. The level of perfection achieved with minimal technology—when everything was largely done by hand, including extremely complex bar bending, shuttering and batch mixing of concrete—is one of the most significant values of the heritage of modern construction in India.

Locational Value

The central location of the stadium has made it a much frequented place. Almost equidistant from the development on the historic side of Sabarmati River, and the new development on the stadium side, it is almost at the confluence of the city's developemental radius. As the city grew, the stadium occupied the central position in the new development. (as seen in figures 31a and b in section 3.2)

Other Aspects

Apart from the value of its built legacy, the cultural of significance of SVP Stadium is also to be evaluated through the huge cache of associated archival objects—the meticulously detailed hand-made drawings of the 1960s, the numerous scale models, and the written notes to aid design and construction—all of which express commitment to rigour in the working styles of both Correa and Raj, the two key professionals responsible for the project. These archival objects also speak of the value of collaborative work between the architect, the engineer and the contractors as necessary engagements for creating outstanding works not just in India, but across the globe.

Social, Economic, Use, Associational and Bequest Values

Assessment of the intangible components of the many values of SVP Stadium is made on two counts—first, through the manner in which the place symbolises the broader social and economic values of cricket in the context of India, and second, on the basis of the present use by the community and the community's past memories and associations that endow the stadium with a bequest value.

Apart from symbolising the significance of cricket as a sporting activity that builds up one's physical ability and cultivates the spirit of collective endeavour for achieving a common goal, and representing a tool for building national character, SVP Stadium stands as a manifestation of 'cricket as a social equaliser' and the spirit of tolerance and inclusivity. Beginning in late 19th century, Indian cricket teams cut across religion, class and caste, with players from Hindu, Muslim, Parsee, British backgrounds, and all classes and castes, levelling all traditional barriers on the cricket ground, and changing perceptions of the caste system in India.

Like other similar arenas, SVP Stadium also represents the economic value of cricket in post-Independence India, be it in the early practice of the erstwhile princely states employing professional cricketers to play for their States, or the means for organisers and cities to earn revenues from broadcasting and sponsorships of tournaments. The Stadium, today, is valued as a place that offers means for financial rewards not only to players, but several other industries and professionals.

SVP Stadium is actively used for conducting local and regional cricket tournaments, conducting quality coaching for aspiring cricketers, organising mega cultural events, musical concerts, educational and political events. Being the only large open space in the heart of the city, and easily accessible, it is highly popular with the elderly population as a venue for morning walks, yoga and other passive activities. Despite the new Motera Stadium being favoured for international games, the many ways in which Ahmedabad continues to engage with this iconic stadium express its particular significance as a cultural asset for the community.

The associational significance of SVP Stadium is based on the community's pride in how its design contributed to the development of modern cricket in India, and on treasured memories of the many national and international cricketers who have trained and played on its grounds. Senior members of the local community, who still use the facility on a regular basis, recall the awe that the stadium's landmark form and construction evoked in the 1960s, as well as its ability to remain unharmed by the major earthquake of 1980. Former players and trainers express pride in the uninterrupted view enabled by the pioneering design of the cantilevered roof, and the advantages accrued to local players by its 'turf' ground and other must-have attributes of international cricket grounds. The community's collective attachment and the bequest value of SVP Stadium are best expressed in the words of Ravindra Joshipura, a former Ranji Trophy player and marathon runner, 'This ground is really a temple for me! I don't go to a temple regularly, but I make sure I come here everyday.'

5.3 Statement of Significance

Levels of Significance

The cultural significance of SVP Stadium can be seen at various levels. At the local level, it contributes significantly to our understanding of the developmental history of the modernisation of Ahmedabad's society, infrastructure and urban scape. At the level of Gujarat State, it enables understanding of the wider pattern and evolution of the development priorities and cricketing history of the newly established state. The place is of national significance for its outstanding contribution to cricketing history, architectural history, and development of the indigenous technology of RCC structures. At the global level, it connects to the significance of sports and health infrastructure and the family of large RCC stadiums built during the 1960s, and adds to the understanding of the dissemination of modern architecture and technology, the creation of its regional expression, and the cultural significance of form-finished concrete, a material that brought together thought processes across nations and cultures in manners that were context-specific, yet shared.

Significance to Past and Present Generations

After collating several conversations with representatives from a cross-section of society, it was evident that the previous generation values SVP Stadium as a representative of all that was dynamic, progressive, pathbreaking and unique in the history of local and national cricket. The stadium was and continues to be regarded as a social, cultural and physical focal point for the city, its symbolic nature contributing to the city's sense of identity. Community-level expressions of the present generation's value for SVP Stadium include work by the local sports organisations, other stakeholders, local people who benefit from its use, Amdavad Municipal Corporation, the original designers and builders, and the conservation professionals to protect, conserve and manage the stadium's sustainable development and continued relevance in future.

Besides being an aweinspiring structure of architectural and technical significance, the stadium was a landmark structure and recognised for its positional identity. The nearby crossing is named Stadium Crossing. Ever since the jogging track has been added, it is being recognised as a place with multiple stakeholders.

Twenty years ago, SVP Stadium could be recognised largely for its architectural or technical significance in the city, but now one recognises many more stakeholders and their social values and relationship to the use of the stadium. It is the community's engagement with the place on a day-to-day basis that will probably result in the stadium being saved.

6.0

STRUCTURAL ASSESSMENT AND APPRECIATION OF THE CONCEPTUAL DESIGN

6.1 Structural Form

6.2 Stability Under Gravity Loads

6.3 Stability Under Wind Loads

6.4 Stability Under Seismic Loads

6.5 Seismic Assessment for the As-Built Configuration

6.6 Foundation Check

6.7 Role of Tie Beam : Developing Additional Redundancy

6.8 Effect of Non-Uniform Deflections of the Folded-Plate Roof

6.9 Conclusions from Structural Design and Construction

Credit: © Mahendra Raj Archives, Mahendra Raj Consultants Pvt Ltd

Structural Assessment and Appreciation of the Conceptual Design

The concept of functionality of a structure dictating its structural form is pertinent in the design of stadiums. The elegance of a stadium layout lies in its ability to provide maximum utility for the spectators by accommodating a significant capacity, with efficient circulation, and an unobstructed view of the event. All these should be achieved without compromising on the structural stability and safety. Therefore, establishing a structural form which ensures the functional requirements of the stadium becomes the fundamental aspect of stadium design.

The most significant challenge in establishing the structural form involves the extremely large clear spans required for ensuring an unobstructed sight line. Hence, stadium roofs are considered as long-span structures. A structural layout that could span long distances requires a careful balance of structural mass and stiffness. An increase in span requires increased section capacities, which results in increased depths of the section, making economic use of material a serious challenge. This results in a significant dead load acting on the structure, which further amplifies earthquake loads and serviceability constraints. Hence, minimizing dead loads becomes imperative for stadium design. However, this in turn could result in challenges for stability under wind loads. Thus, a unique design challenge exists in the design of a long-span structure, with achieving a delicate balance by minimizing the mass and maximizing stiffness becoming the highlight of the stadium roof design. In the present-day scenario, there exists a spectrum of innovative materials and structural forms, including lightweight tensile membranes, cable networks, cable-stayed fabrics and large-span steel trusses for achieving this objective, apart from the luxury of sophisticated structural analysis software that can handle complex structural forms and systems. However, at a time when even steel was rarely used for stadium roofs, to achieve this design balance required engineering skill and innovation of the highest level.

6.1 Structural Form

SVP Stadium: Principal Structural Elements

The principal structural elements for SVP Stadium can be identified as shown in Fig. 54. The roof of the stadium is an 82-ft-long cantilevered, reinforced concrete, folded-plate structure. The thickness of the plates increases from 3 inches at the free end of the cantilever to 6 inches at the exterior support as shown in Fig. 54. Furthermore, the depth of the trough reduces from 9 ft. at the support to 3 ft. at the free end of the cantilever. The cantilevered roof is connected to the supporting main frame of the grandstand, which is also designed and constructed as a reinforced concrete folded plate, with a depth of close to 19 ft. at the junction of the roof, and 5 ft. at the base. Additionally, the main frame is connected to the seating frame through a raker beam.

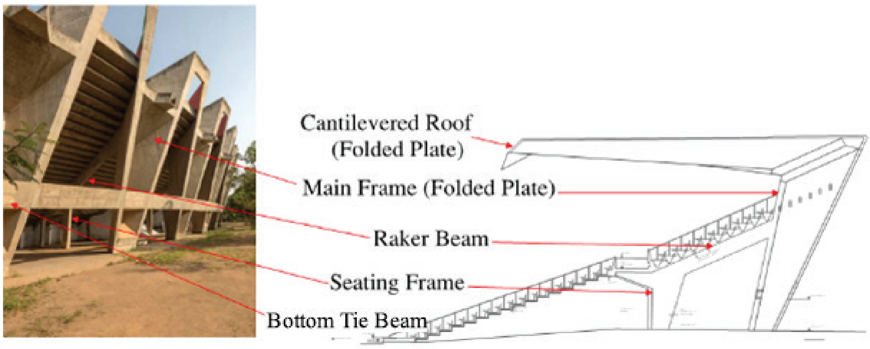


Fig. 54: Principal structural elements of SVP Stadium

Fig. 55: Post and Beam structure, Corryong Recreation Reserve, Corryong

Source: 'A piece of Corryong's history to be razed,' The Land. https://www.theland.com.au/story/3590131/a-piece-of-corr yongs-history-to-be-razed/?cs= 4951. Accessed 29 December 2021

Fig. 56: Goal Post structure, The North Stand, Leicester Tigers, Birmingham

Source: Steel Construction.info

Fig. 57: Cantilevered roof structure, Municipal Stadium, Florence

Source: Structurae.net

Evolution of the Structural Form

At least nine fundamental structural forms for stadium roofs have been identified in the literature: post and beam structure, goal post structure, cantilever structure, concrete shell structure, air supported roofs, compression and tension ring, cable net structure and tensile membrane structures (Yaroni, 2012). The last three among the aforementioned structural forms became more common for modern stadiums during the last part of the twentieth century, mainly due to the possibility of incorporating innovative materials (Cable net structures becoming common after the 1972 Munich Olympic Stadium, tensile membranes after the Shanghai Stadium in 1997). Air supported roofs were used for dome shaped stadiums where the inflatable roof keeps the shape due to the internal pressure developed.

If the evolution of stadium roof designs is analysed, most of the stadiums in the past consisted of either post and beam structure, goal post structure or cantilever structure (Fig. 55, 56, 57).

Post and Beam is the simplest structural system, with the columns, girders and raker beams arranged in a grid pattern as shown in Fig. 55. The roof would be placed on the beams connecting the main girders. However, this structural form has limitations in the form of its geometry, as the edges of the stadium would have to be rectilinear in plan. Hence, depending on the location of the columns, there can be obstructions in the sight line of spectators. Unlike a Post and Beam structure, a Goal Post structure (Fig. 56) has columns only at the perimeter. Hence, even though obstructions to spectator sight line are minimized, the shape of the stadium would still be limited to a rectangular form.

These limitations were tackled in the cantilevered roof structure, supported only at the exterior edge (Fig. 57) and provided unobstructed sight line for the viewers. For a cantilevered roof structure, there was also more flexibility in the choice of the layout and form compared to the then existing structural forms. Berta Stadium in Florence, constructed in 1930−1932 and Olympic Flaminio Stadium in Rome constructed in 1957−1959, both conceived by Pier Luigi Nervi (1891−1979) are examples of stadiums which incorporated this structural form in the early days (Adriaenssens and Billington, 2013). Giovanni Berta Stadium as shown in Fig. 58 has a bifurcating cantilever roof with a support frame, and a thrust line analysis indicates that the resultant force falls within the two columns. According to Nervi, 'The fact that the resultant force falls within the two columns eliminates the necessity for costly foundation anchorages.' Proportioning the supporting structure in such a way that the resultant eccentricity on the foundation is minimized is one of the fundamental principles of economic design of foundation for a cantilevered roof.

The roof was constructed as a thin reinforced concrete shell supported between 15 curved reinforced concrete cantilever beams. The cantilever beams were 14.6-m long with a 7.4-m backspan, and the structure had an expansion joint at every third beam. The twisting of the beams was prevented by a longitudinal beam running perpendicular to the cantilever beam at the roof level.

In 1957, Nervi designed Olympic Flaminio Stadium (Fig. 59) with a cantilevering roof made of monolithically interconnected V-shaped beams. The roof beams

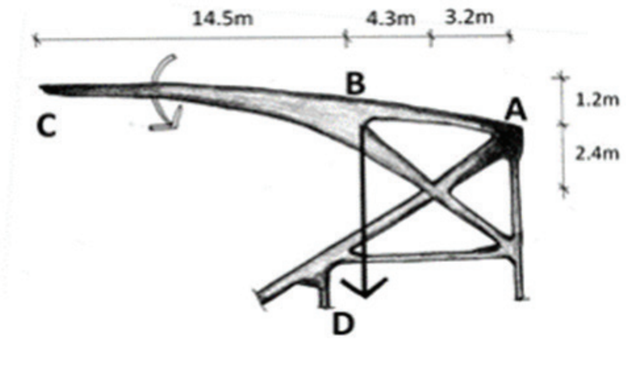


Fig. 58: Giovanni Berta Stadium, Florence

Source: Adriaenssens & Billington, 2013

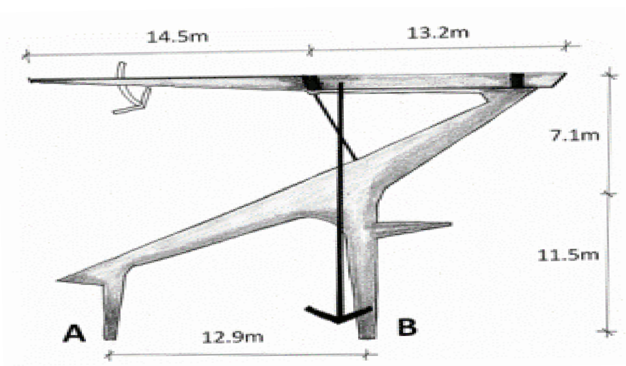


Fig. 59: Olympic Flaminio Stadium, Rome

Source: Adriaenssens & Billington, 2013 spanned 27.7 m, with a 14.5-m cantilever and a 13.2-m backspan. These interconnected beams forming a corrugated section that was 1.42-m wide, 400-mm thick, and had a height varying from 1.17 m at the support to 0.4 m at the free end. This section connects to the grandstand at two points, was supported on concrete supports at the exterior of the stadium, and further supported by inclined steel tubes filled with concrete at midspan, that arose from the seating. The self-weight of the cantilever was reduced by using low density ferro-cement concrete.

Both these stadiums were based on the fundamental of reducing the dead loads for the cantilever part, designing the longitudinal profile of the roof in accordance with the bending moment diagram, and designing the cantilevered roof and grandstand frame such that there is no uplift on the foundations.

SVP Stadium: Towards Cantilevered Folded-Plate Roof Systems

For an economic and cost-effective design of a stadium with a long span cantilevered roof, three aspects are essential as highlighted in the previous section: a. The grandstand main frame and the cantilevered roof should be designed such that the resultant eccentricity on the foundation is minimized and is not subjected to uplift forces; b. The self-weight of the cantilever has to be minimized so that the cantilever moments are not exceedingly high such that the allowable stresses for concrete in the superstructure elements and foundation are not exceeded, and c. The longitudinal profile of the roof follows the bending moment profile of the roof.

The uniqueness in the structural form of SVP Stadium lies in achieving the above-mentioned objectives by the innovative use of reinforced concrete folded plates as the principal load-bearing elements for both the main frame and the cantilevered roof. Folded-plate structures can be defined as assemblies formed by joining thin, flat slabs along their edges so as to create a three-dimensional spatial structure (ACI 318−89). Folded plates derive their strength and stiffness from their form rather than the thickness of the cross-section. They have an intrinsic form-based rigidity and strength through the curvature, which makes them economical for long spans.

This type of construction is reported to have originated in Germany, and by the 1940s, folded-plate structures started becoming popular in the United States. The ACI building code started including the necessary information for the design and construction of shells and folded plates as a separate chapter in 1971, although a practice and commentary was published in 1964. To conceive and implement this idea for a large-span structure in India even before an official design guide was published in the United States shows the insight of the structural designer.

Fig. 60: Zarzuela Hippodrome, with its distinctive roof, Madrid

Source: Outisnn, Wikimedia, CC BY SA 4.0, 2008

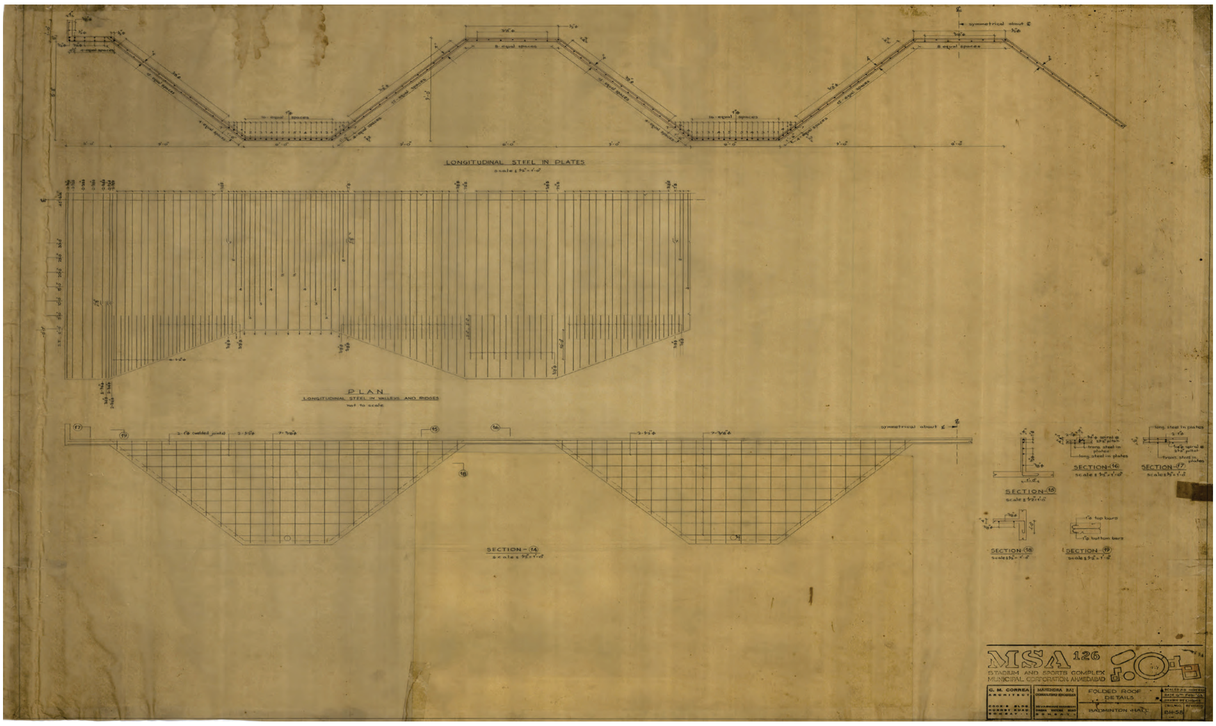
While considering alternative structural forms for the roof, the same large-span cantilevered roof can be designed as a thin shell structure as shown in Fig. 60 for Zarzuela Hippodrome in Madrid, designed by engineer Eduardo Torroja.

However, the construction costs will be relatively lesser for folded plates since simpler reusable formworks could be used. In the 1960s, for a country like India with limited skilled manpower and mechanisation technologies available, this choice plays a crucial role in designing a large-span structure economically and reliably. Additionally, wind pressure under the roof may create a serious problem of causing uplift forces on the cantilevered roof, which could be destructive at times. The possibility of this problem is particularly high in lightweight structures which have insufficient mass to naturally counter the wind-induced movements. Increasing the weight of the roof to counteract the uplift forces becomes impractical due to the increase in dead load of the cantilever. An alternative approach is to adequately stiffen the lightweight structure through hold-down mechanisms, as in the case of Olympic Flaminio Stadium where inclined steel tubes filled with concrete were utilised for holding the roof down. However, these could be subject to massive compressive loads when the roof undergoes uplift.

In the case of SVP Stadium, the structural form of the folded plate has been relied upon to effectively resist the wind-induced uplift forces. The geometry of the folded-plate roof with a staggered reinforcement layout, makes it equally effective for bending under wind-induced uplift forces as with gravity forces.

The negative aspects of using concrete shells are the cost and requirement for specialised designers. Construction costs for shell structures are naturally high, and even more so if in-situ concrete is used. The time and expertise needed to create the birdcage formwork drive up the construction cost substantially.

In summary, the structural design of SVP Stadium achieves the basic design objectives of a stadium with cantilevered roof by effectively employing the advantages of a folded-plate structural form for structural stability and construction economy. The fact that these were achieved without complex computer-based mathematical models adds to the uniqueness of the design and construction of this stadium. The following sections explore each of the above aspects through simplified yet robust structural models.



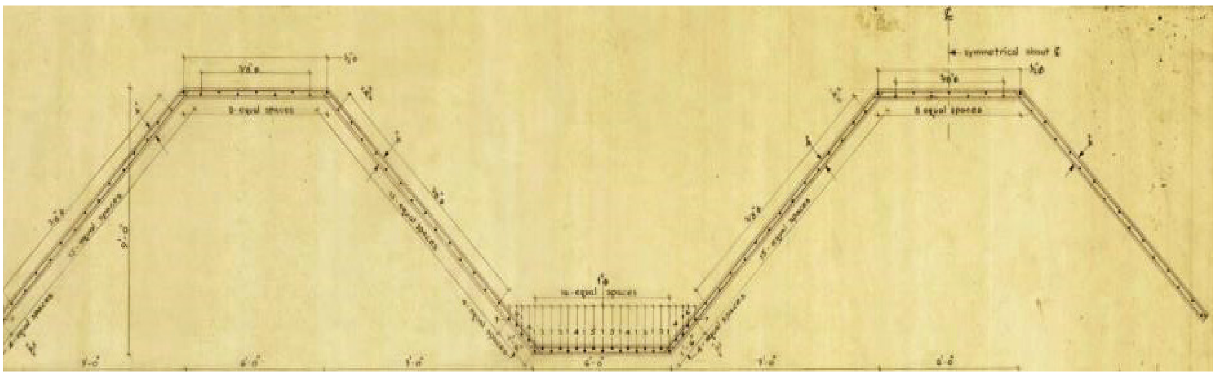


Fig. 61: Archival drawings of the folded-plate cantilevered roof, with reinforcement layout details (zoomed-in image)

Credit: © Mahendra Raj Courtesy: Mahendra Raj Archives and MRC

6.2 Stability Under Gravity Loads

A two-dimensional frame idealisation was made for the stadium structure, by IIT Madras, as shown in Fig. 62. The folded plates were idealised as line elements, and the structure was modelled in SAP 2000. The A-frame and seating frame were modelled with fixed boundary conditions at the base. A horizontal translational restraint was introduced at the level of the tie beam to incorporate the restraint offered by the beam. The geometry of the folded plates was created using section designer in SAP 2000. Superimposed dead loads, corresponding to the precast seating units were estimated as 3.75 kN/m2, and a live load of 4 kN/m2 was considered for the analysis and applied on the structure for a tributary width of 15 ft. (Fig. 63). A limitation of this modelling strategy is that the flexibility and out-of-plane effects of shell buckling shall not be captured in the model for which, a shell-based modelling and analysis strategy was adopted as discussed in Chapter 5. The structure was analysed under the gravity load combinations for allowable stress design (both Dead load & Dead load + Live load combination) and the bending moment and axial force diagrams were obtained as shown in Fig. 64. It was observed from diagram that the inclination of the main frame was carefully chosen so as to reduce the moment transferred to the foundation by the inclined main frame and, hence, minimize the eccentricity of the resultant force at the foundation.

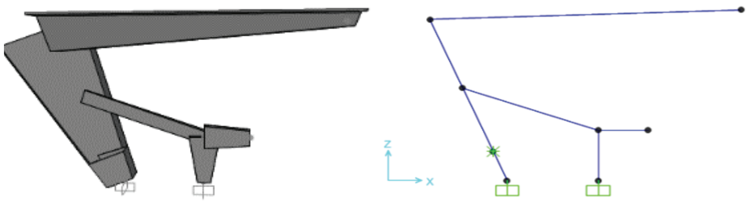


Fig. 62: 2D model in SAP 2000

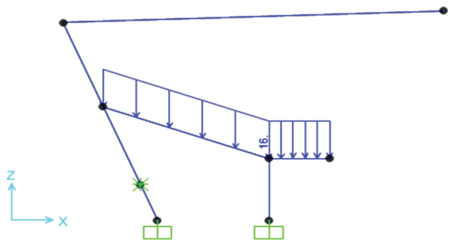
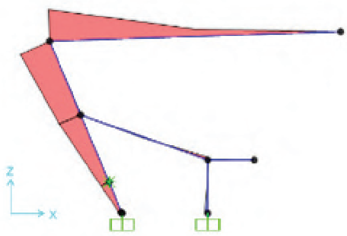
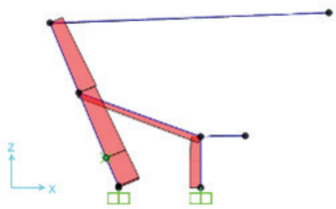


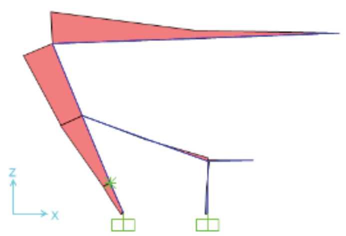
Fig. 63: Superimposed dead loads on the structure.



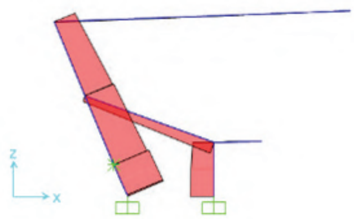
Bending Moment Diagram (Dead loads)



Axial Force Diagram (Dead loads)



Bending Moment Diagram (Dead loads plus Live loads)



Axial Force Diagram (Dead loads plus Live loads)

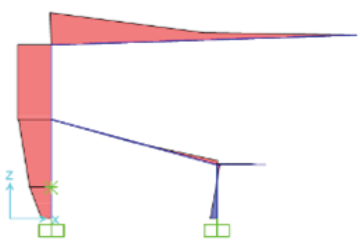
Fig. 64: Bending Moment Diagram and Axial Force Diagram (Dead load and Dead load + Live load combination)

Moreover, the same analysis was carried out without any inclination of the main frame to demonstrate the careful choice of inclination adopted in the design. The results of the analysis in the form of bending moment diagram and axial force diagram are shown in Fig. 65. This demonstrates that a main frame without inclination transfers a significant amount of gravity load moments to the foundation, which could result in an uneconomical foundation design.

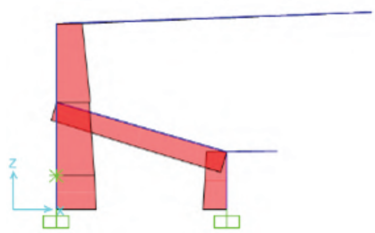
This aspect is highlighted as, 'The incline allows the centre of gravity of the super loads on the cantilevered folded plates to pass through the combined strip footing. This way, the large cantilever moment on the frame is dissipated by the time it reaches the foundations, making each part of the structure work with the other in a fine balance.' (Mehta et al., 2016).

6.3 Stability Under Wind Loads

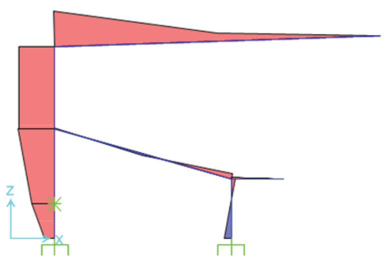
Wind loads were applied according to the prevailing IS 875-Part 3 for the city of Ahmedabad. A basic wind speed of 39 m/s was considered, and risk category of I and terrain category of II were assumed for the structure. The pressure coefficients on the roof and main frame were calculated according to Table 21 of IS 875-Part 3, corresponding to the pressure coefficients of the grandstands open on three sides. Wind loads were estimated for the tributary width of 15 ft. and applied on the model as shown in Fig. 66. The bending moment and axial force diagrams for the Frame are shown in Fig. 67. Details of the wind-load analysis are shown in Annexure 12.2. The results show that the forces generated by the wind load are not high enough to cause uplift at the base of the structure. The dead loads of the structure effectively counteract the uplift forces due to wind load as shown in Fig. 67d.



a. Bending Moment Diagram (Dead loads)

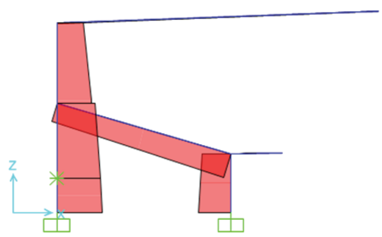


b. Axial Force Diagram (Live loads)



c. Bending Moment Diagram

(Dead plus Live loads)



d. Axial Force Diagram

(Dead plus Live loads)

Fig. 65: Bending Moment Diagram and Axial Force Diagram for the mainframe without inclined legs (Dead load and Dead load + Live load combination)

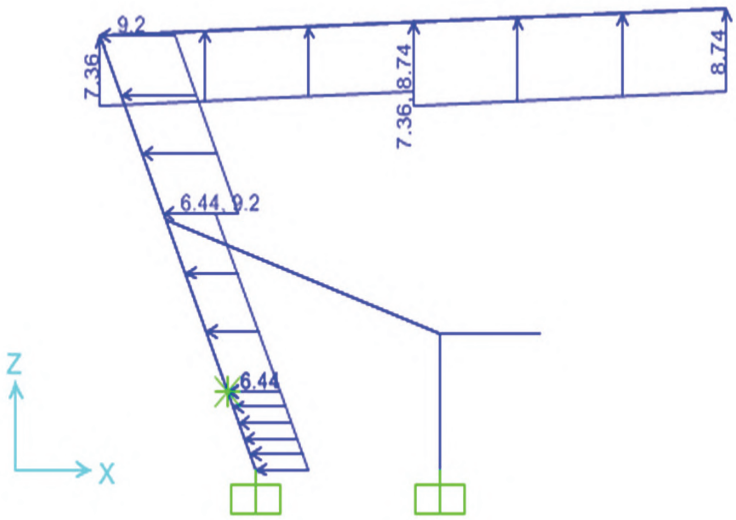
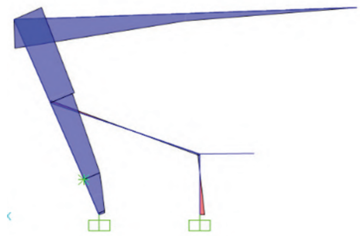
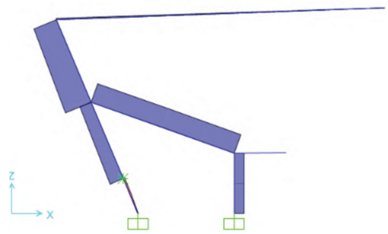


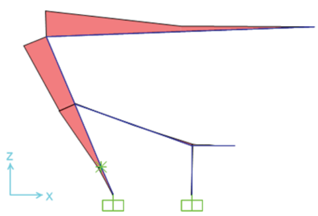
Fig. 66: Wind load application.



a. Bending Moment Diagram (Wind load)

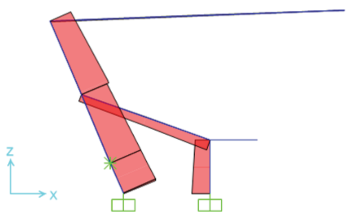


b. Axial Force Diagram (Wind load)



c. Bending Moment Diagram (

Dead plus Wind loads)



d. Axial Force Diagram

(Dead plus Wind loads)

Fig. 67: Bending Moment Diagram and Axial Force Diagram under Wind loads

(Wind load and Dead load + Wind load combination)

6.4 Stability Under Seismic Loads

A preliminary seismic analysis was carried out for the structure with the 2D frame model, by IIT Madras. Based on modal analysis, the fundamental time period of the idealised frame was obtained as 0.49 s as shown in Fig. 68, with an effective seismic weight corresponding to the dead load plus 50% of the live load.

Corresponding to a time period of 0.49 s, the seismic coefficient of the structure was obtained as 0.2 for a Zone factor of 0.16 (Zone III) for the city of Ahmedabad from the prevailing seismic code: IS 1893-Part 1 (2016). An importance factor of 1.0 was assigned while the response reduction factor was not applied. The horizontal seismic force (EQx) was estimated as 300 kN, and was applied on the frame as a linearly varying load (inverted triangular force distribution) as shown in Fig. 69a. Since this structure has a significant mass acting at the roof level, the vertical acceleration component needs to be considered and, therefore, it was taken as 2/3rd of the horizontal seismic load. The vertical seismic load (EQz) was applied as a linearly varying load to match the deformed shape of the cantilever as shown in Fig. 69b. Both the horizontal and vertical forces were applied in the opposite direction as well to represent the roof uplift case as shown in Figs. 69c. & d. Load combinations consider 30% of the vertical seismic force as per IS 1893-Part 1 (2016).The seismic load calculations are attached in Annexure 12.3. The bending moment diagrams and axial force diagrams for the four cases (D+EQx, D-EQx, D+EQx+0.3EQz, D-EQx-0.3EQz) are obtained as shown in Fig. 70.

As shown in Fig. 70, for the combination D+EQx+0.3EQz, there is flexural moment induced at the bottom of the Frame.

a. b.

Fig. 68: a. Undeformed shape; b. Deformed shape—Modal analysis

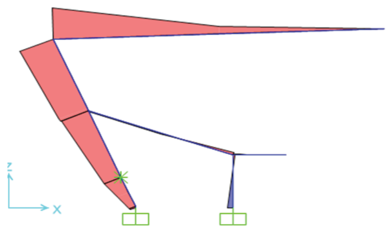
a. Horizontal seismic loads

b. Vertical seismic loads

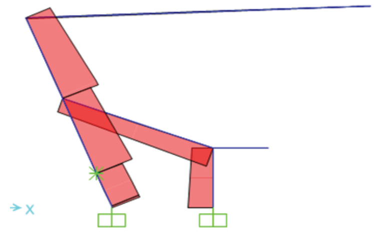
c. Horizontal seismic loads—Negative Bending

d. Vertical seismic loads—Negative Bending

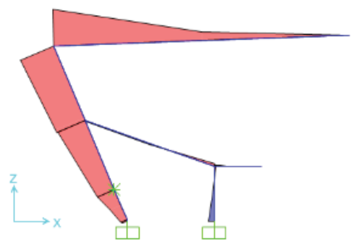
Fig. 69: Seismic load application



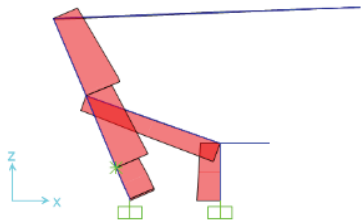
a. Bending Moment Diagram (D+EQx)



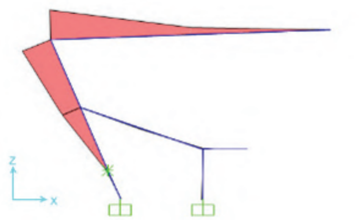
b. Axial Force Diagram (D+EQx)



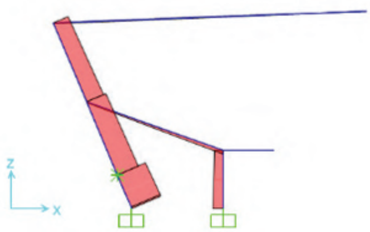
c. Bending Moment Diagram (D+EQx+0.3EQz)



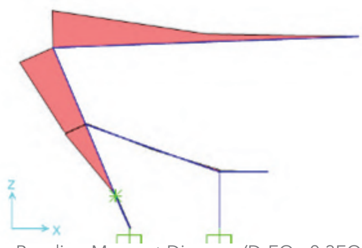
d. Axial Force Diagram (D+EQx+0.3EQz)



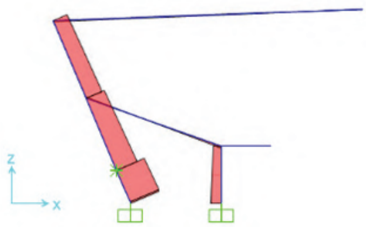
e. Bending Moment Diagram (D-EQx)



f. Axial Force Diagram (D-EQx)



g. Bending Moment Diagram (D-EQx-0.3EQz)



h. Axial Force Diagram (D-EQx-0.3EQz)

Fig. 70: Bending Moment Diagram and Axial Force Diagram under seismic loads

6.5 Seismic Assessment for the As-Built Configuration

In continuation with the seismic stability checks, seismic assessment was carried out for the as-built configuration of the stadium. A three-dimensional numerical model of the structure was developed using Non-Linear Finite Element Modelling in DIANA (Fig. 71).

The numerical model consists of a typical RC unit comprising the A-Frame, seating frame, roof and raker beam. The adjacent RC units on either side are also incorporated into the model to capture the effects of partial restraints offered by these. M20 grade concrete was modelled using total strain-based cracking model. The mild steel reinforcement was modelled with a yield stress value of 250 MPa, and without any hardening. Tetrahedral solid elements were used for modelling the concrete structure. The reinforcement was modelled as mesh grids, with the bar diameter and spacing provided according to the as-built drawings (Fig. 72).

Due to limitations in the availability of data from the as-built drawings, assumptions as appropriate were made regarding the percentage of reinforcement in different structural elements. Fixed boundary conditions were applied at the base of the structure (Fig. 73), and seismic assessment was carried out using the capacity spectrum method.

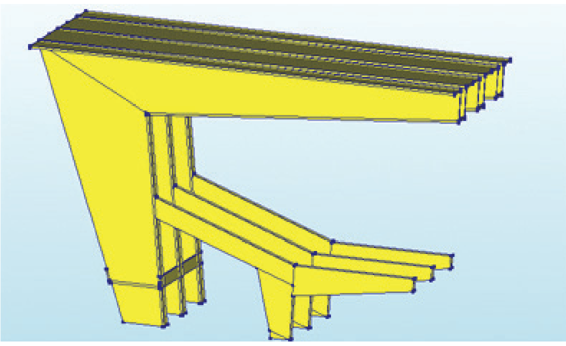


Fig. 71: NLFEM model (DIANA)

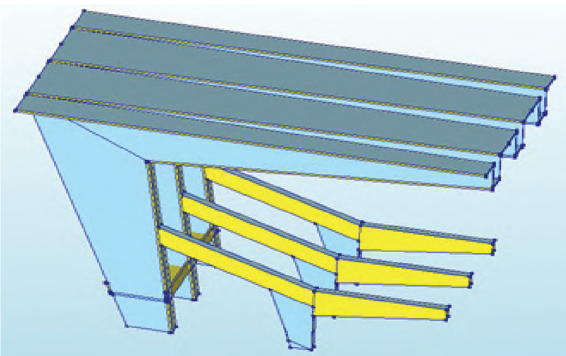


Fig. 72: Matrix reinforcement (Blue colour-NLFEM)

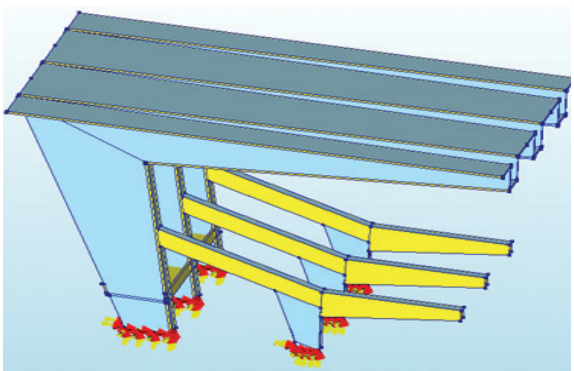


Fig. 73: Boundary conditions

Capacity Spectrum Method

The capacity spectrum method is a procedure which correlates the expected seismic demand and the building performance. The procedure compares the capacity of the structure (in the form of a capacity curve) with the demand on the structure (in the form of a response spectrum). The graphical intersection of the two curves approximates the performance of the structure. By converting the base shears and roof displacements from a non-linear pushover curve to equivalent spectral accelerations and displacements, the pushover curve becomes the capacity curve. The capacity curves of the stadium model obtained from the pushover analysis along positive x-direction (downward movement of the roof plate) and negative x-direction (upward movement of the roof plate) are shown in Fig. 73.

The capacity curve (Fig. 74) for the structure resembles a rocking system characterised by limited ductility. The capacity spectra for the structure obtained after superimposing the capacity curves and the demand spectrum are shown in Fig. 75.

The performance point obtained corresponded to a spectral acceleration of 0.3 g and a displacement of 4 mm. The crack strain propagation is shown in Fig. 76, and the principal failure mode of the structure was obtained as overturning with respect to the base. Additionally, the structure is characterised with limited redundancy as indicated by the failure mode and crack pattern observed from the results of the seismic assessment.

Although the results indicate that the structure has adequate capacity to safely accommodate the expected level of seismic demand corresponding to Zone III, the primary failure mode of the system deserves attention. The failure mode is associated with reduced ductility and, therefore, minimum sign of warning can be expected once initiation of failure starts in the structure. The stability of the structure is derived from its geometry and the proportioning of its structural elements. Any change from the as-built condition in the form of partial failures of structural elements or member deterioration can result in initiation of failure.

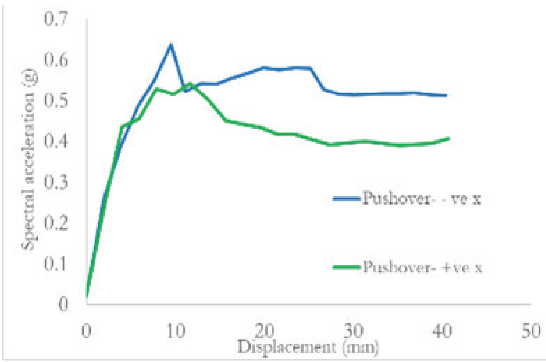


Fig. 74: Capacity curves

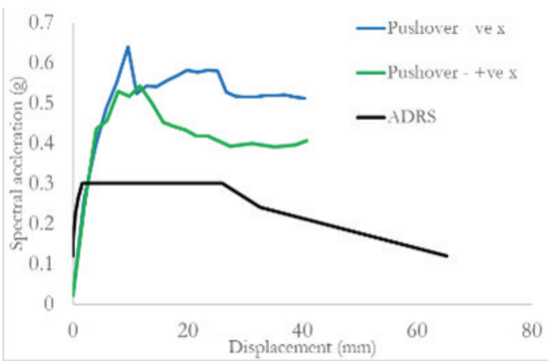


Fig. 75: Capacity spectra

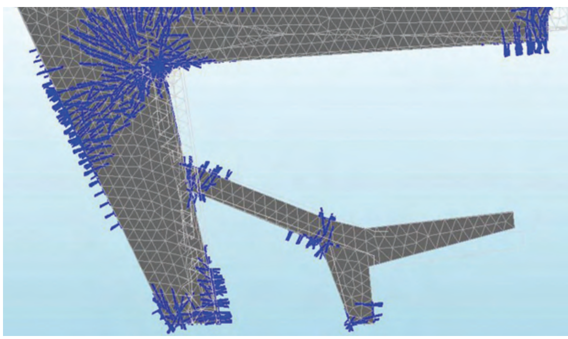


Fig. 76: Crack strain propogation

6.6 Foundation Check

The structure consists of the main frame and the seating frame resting on a combined strip footing as shown in Fig. 77.

The maximum bearing pressure for the foundation was calculated for different load combinations. A maximum bearing pressure of 106 kN/m2 on the compression side and a minimum bearing pressure of 46 kN/m2 on the tension side were obtained under gravity loads. Under earthquake loads, a maximum compressive stress of 120 kN/m2 and a minimum stress of 22 kN/m2 were obtained. The calculations are attached in Annexure 12.4.

These results correspond to the as-built condition of the structure and need to be compared with the bearing capacity of the soil from soil test reports. Since the primary failure mechanism of the structure is overturning with respect to the base, differential movements / settlements and uplift forces at the foundation require special attention in future structural inspections, and need to be addressed with suitable repair measures, if encountered.

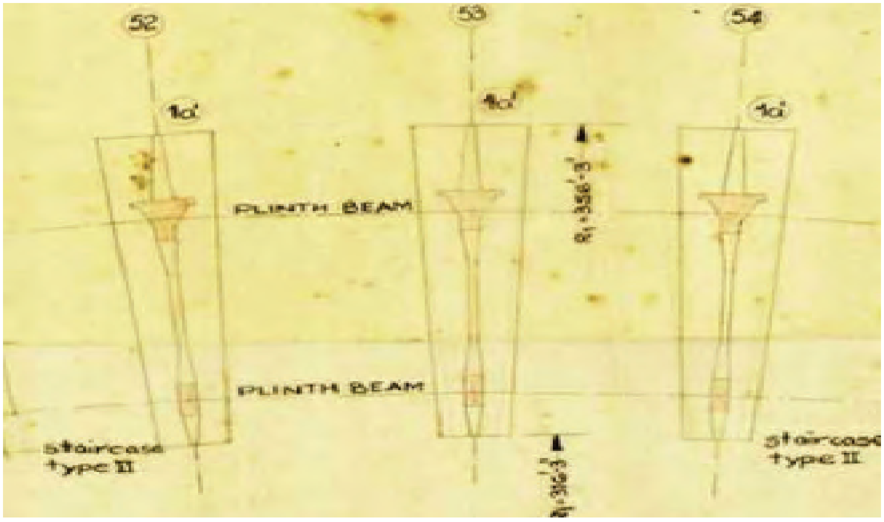
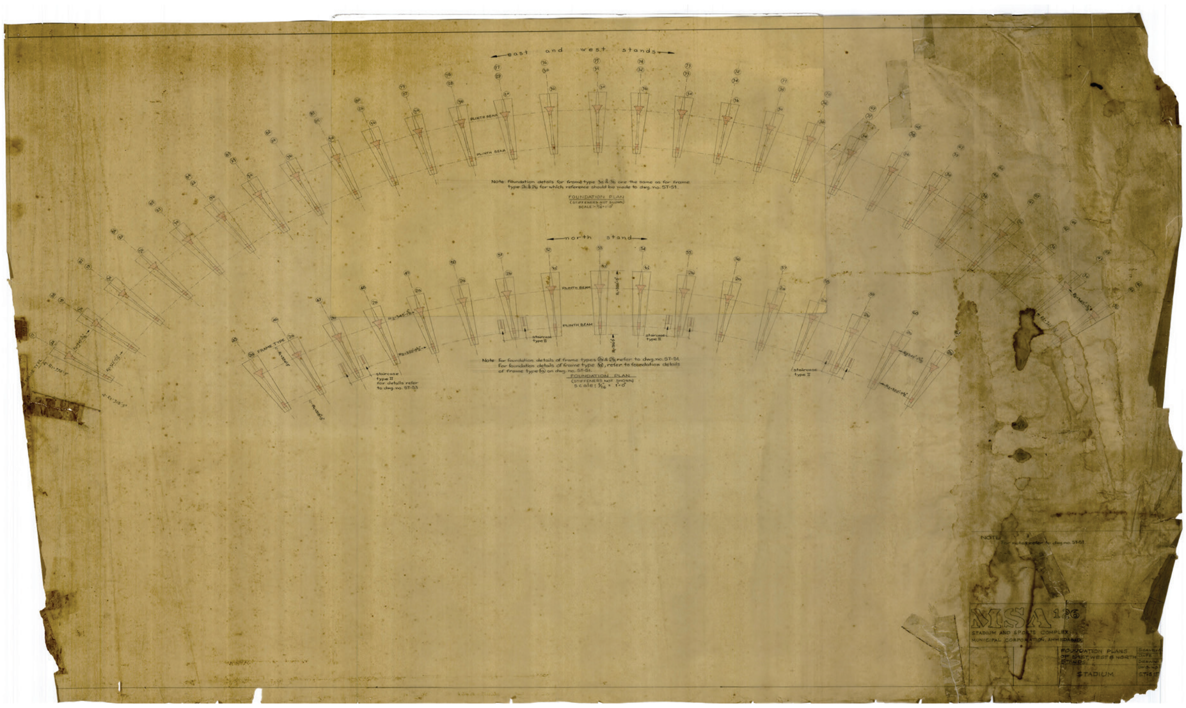


Fig. 77: Combined strip footing

Credit: © Mahendra Raj, courtesy Mahendra Raj Archives and MRC Pvt Ltd



6.7 Role of Tie Beam: Developing Additional Redundancy

The tie beam shown in Fig. 78 has the primary role of connecting the inclined legs and reducing its effective length, thereby minimizing the effects of localised shell buckling. However, this element could also be critical in providing a redundant load path for minimizing the flexural moments transferred to the footing. The 2D frame model consisted of restraint applied at the level of the tie beam as explained in Section 6.2. This essentially provides an alternate load path for resisting the overturning moments as shown in Fig. 79. The primary load path (shown with red arrows) consists of resisting the applied moments through a tension and compression couple on the main frame and seating frame. The secondary load path (shown with blue arrows) consists of the couple formed due to the horizontal reactions induced at the base of the main frame and the level of the tie beam. Hence, the provision of this secondary load path also reduces the tensile force acting on the main frame due to the applied overturning moment.

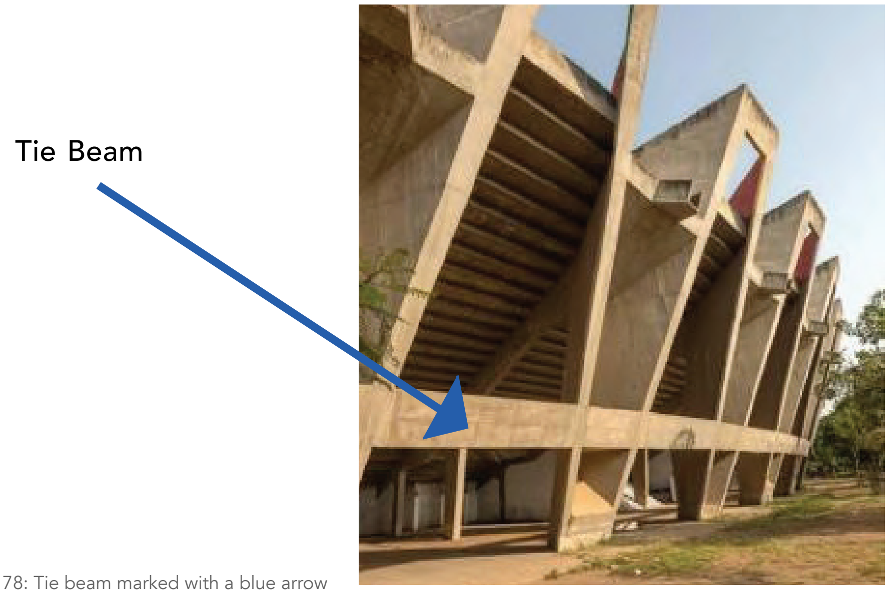


Fig. 78: Tie beam marked with a blue arrow

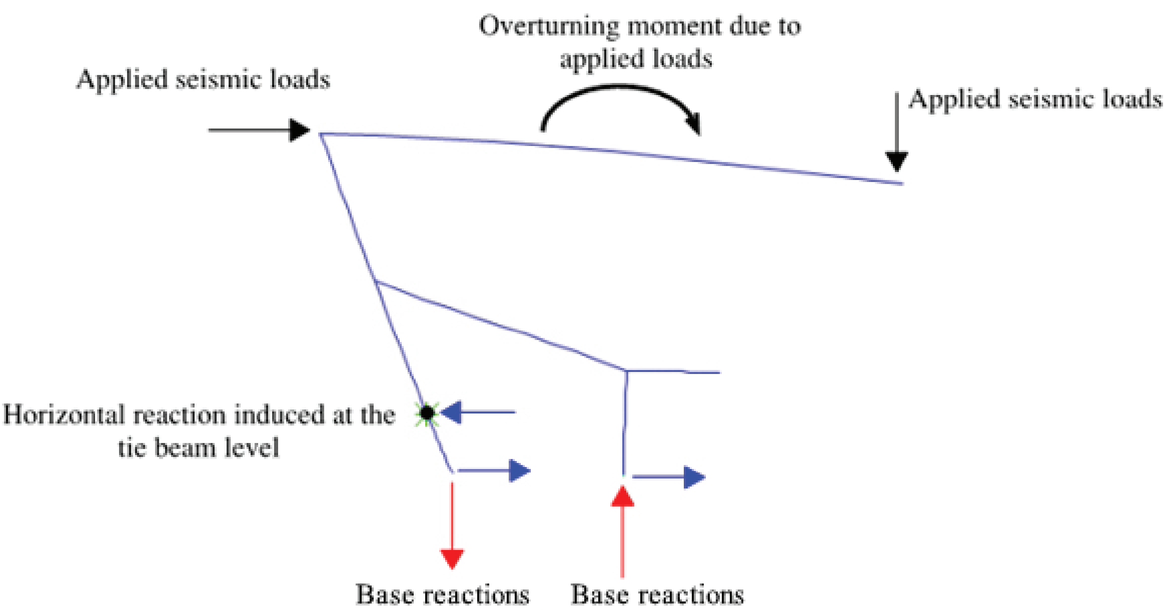


Figure 79: Load paths for resistance to overturning

Therefore, it is essential to investigate the effect of the tie beam getting cracked, and the secondary load path becoming inactive, on the overall load path of the structure. Hence, considering a cracked tie beam, analysis was carried out without the presence of restraints at the level of tie beams. The results showed larger flexural moment getting transferred to the footing once the tie beam was unable to provide the restraint. Table 2 summarizes the results for stresses at the top of the main frame and at the bottom of the main frame for different load combinations. The results indicate close to 40% increase in the compressive stresses and 150% increase in tensile stresses at the base of the main frame once the tie beam is cracked. Annexure 12.5 shows the modified bearing pressures at the foundation due to a cracked tie beam. A maximum bearing pressure of 137 kN/m2 and a minimum bearing pressure of 6 kN/m2 were obtained at the foundation for the combination D+EQx+0.3EQz. The value of minimum bearing pressure indicates that there are chances of uplift of foundation once the tie beam gets cracked and damaged, and is unable to provide restraints. This aspect needs to be investigated in detail while carrying out seismic assessment using a 3D model.

Furthermore, the effect of the tie beam in minimizing the localised impacts of shell buckling was investigated using a shell-based model as shown in Fig. 80. In this approach, the folded-plate elements of the main frame and the roof were modelled, using shell elements. Fixed restraints were applied at the base of the structure, the tie beam was explicitly modelled, and lateral restraints were applied at the ends of the tie beam. Similarly, lateral restraints were applied at the ends of the roof. The fundamental time period was obtained as 0.56 s, and the time period and mode shape matched closely with the 2D frame model (Fig. 81). The analysis under gravity loads shows that in addition to providing a redundant load path for resisting overturning moments, the tie beams effectively restrain the folded-plate elements from local buckling effects where their thickness is reduced (Fig. 82).

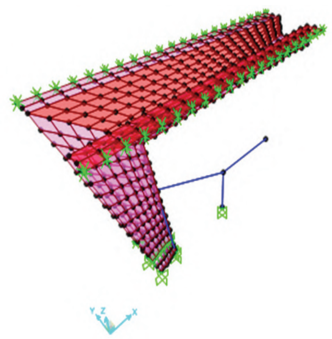


Figure 80: Shell-based model

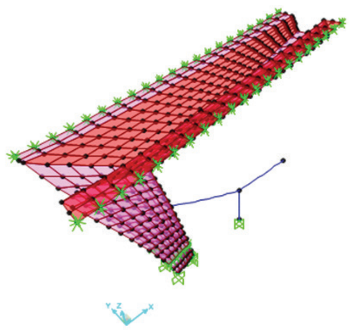


Fig. 81: Mode shape: Mode 1 (T = 0.56s)

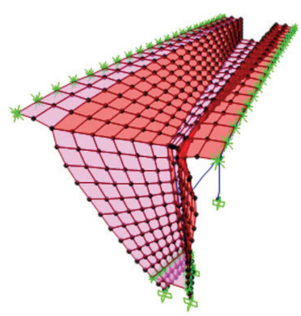


Fig. 82: Shell local buckling under gravity

Location	Load Combination	P(kN)	M (kNm)	A (sqm)	S (cum)	Compressive stress (MPa)	Tensile stress (MPa)	% reinf required	Seating Frame	
Main Frame Top		516	4919	1.9	1.8	3.00	-2.47	1.23	P(kN)	M (kNm)
Main Frame Bottom	D	953	244	0.4	0.2	3.30	1.27			
Main Frame Top		516	4919	1.9	1.8	3.00	-2.47	1.23		
Main Frame Bottom	D+L	1061	208	0.4	0.2	3.38	1.65		536	281
Main Frame Top		351	3087	1.9	1.8	1.90	-1.53	0.76		
Main Frame Bottom	D+W	958	-181	0.4	0.2	3.02	1.32			
Main Frame Top		516	4919	1.9	1.8	3.00	-2.47	1.23		
Main Frame Bottom	D+Ex	750	804	0.4	0.2	5.13	-1.57	0.79		
Main Frame Top		516	4919	1.9	1.8	3.00	-2.47	1.23		
Main Frame Bottom	D-Ex	1176	-315	0.4	0.2	1.47	4.10			
Main Frame Top		553	5618	1.9	1.8	3.41	-2.83	1.42		
Main Frame Bottom	D+Ex+0.3Ez	971	936	0.4	0.2	6.20	-1.60	0.80	481	791
Main Frame Top		470	4213	1.9	1.8	2.58	-2.10	1.05		
Main Frame Bottom	D-Ex-0.3Ex	-1177	-448	0.4	0.2	-4.66	-0.92	0.46		
IF NO TIE BEAMS WERE THERE										
Main Frame Top		553	5618	1.9	1.8	3.41	-2.83	1.42		
Main Frame Bottom	D+Ex+0.3Ez	944	1511	0.4	0.2	8.53	-4.06	2.03	506	963
Main Frame Top		351	3087	1.9	1.8	1.90	-1.53	0.76		
Main Frame Bottom	D+W	839	-785	0.4	0.2	-1.28	3.26	2.63		

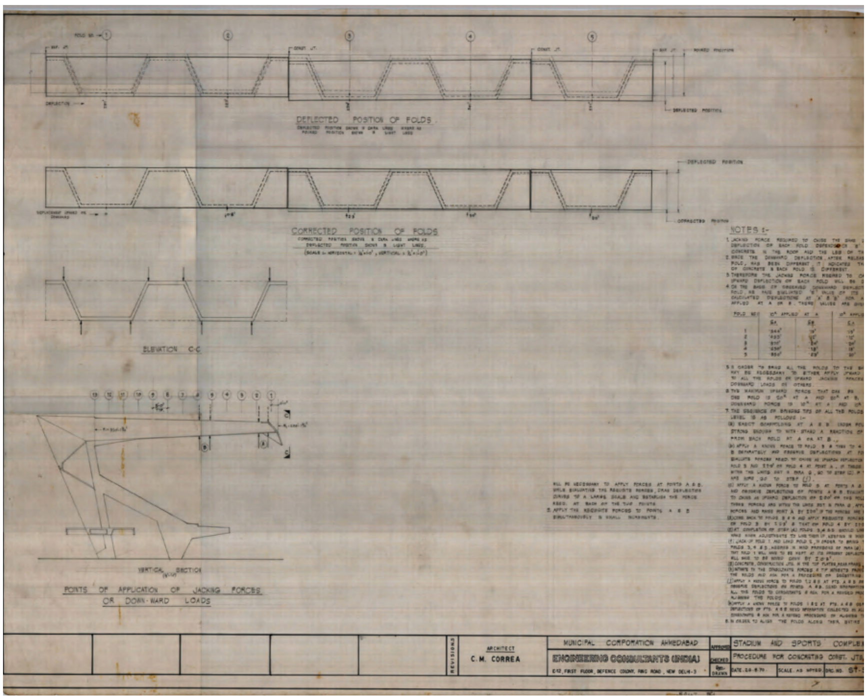
Table 2: Summary of results of stresses at the top and bottom of the main frame at different load

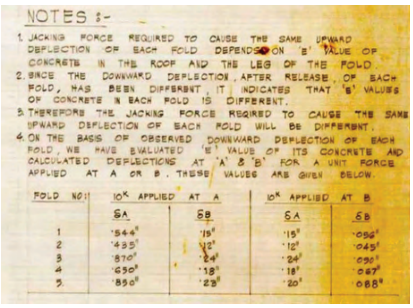
6.8 Effect of Non-Uniform Deflections of the Folded-Plate Roof

Folded-plate systems require precise planning for removal of formworks and calculation of deflections from flexural tests on field-cured specimen so as to avoid stability or deflection-related issues during the formwork removal. ACI 318-89 states as follows:

'When early removal of forms is necessary, the magnitude of the modulus of elasticity at the time of proposed form removal must be investigated in order to ensure safety of the shell with respect to buckling, and to restrict deflections. The value of the modulus of elasticity must be obtained from a flexural test of field-cured specimens. It is not sufficient to determine the modulus from the formula even if it is determined for the field-cured specimen.'

The approach by which the designers achieved this is well explained in the drawings that show the astute engineering skills applied in the erection stage. After the casting of one segment of the cantilever roof, deflections at the tip of the cantilever were equalised by applying jacking forces at different folds (Fig. 83). The notes clearly indicate the methodology adopted to estimate the modulus of elasticity of the roof and the inclined leg of each fold. Additionally, a detailed method of statement is provided for the contractor to carry out the operations. As indicated in ACI 318, the immediate elastic deflections of the folds are a function of the modulus of elasticity of concrete at the time of formwork removal. Deflections were observed to vary among folds, which could possibly be due to variations in the intervals for formwork removal, or slight variations in the grade of concrete for each fold. In this case, the modulus of elasticity of each fold was back calculated from the observed value of deflections of different folds and, thereby, the jacking force required for each fold to bring it back to the intended configuration was estimated. After the application of the jacking force, the folds were connected by a diaphragm at the discontinuous end to maintain the folds at the same level.





NOTES :-

1. JACKING FORCE REQUIRED TO CAUSE THE SAME UPWARD DEFLECTION OF EACH FOLD DEPENDS ON 'E' VALUE OF CONCRETE IN THE ROOF AND THE LEG OF THE FOLD.
2. SINCE THE DOWNWARD DEFLECTION, AFTER RELEASE, OF EACH FOLD, HAS BEEN DIFFERENT, IT INDICATES THAT 'E' VALUES OF CONCRETE IN EACH FOLD IS DIFFERENT.
3. THEREFORE THE JACKING FORCE REQIRED TO CAUSE THE SAME UPWARD DEFLECTION OF EACH FOLD WILL BE DIFFERENT.
4. ON THE BASIS OF OBSERVED DOWNWARD DEFLECTION OF EACH FOLD, WE HAVE EVALUATED 'E' VALUE OF ITS CONCRETE AND CALCULATED DEFLECTIONS AT 'A' & 'B' FOR A UNIT FORCE APPLIED AT A OR B. THESE VALUES ARE GIVEN BELOW.

FOLD NO:	10^K APPLIED AT A		10^K APPLIED AT B	
	δA	δB	δA	δB
1	·544"	·15"	·15"	·056"
2	·435"	·12"	·12"	·045"
3	·870"	·24"	·24"	·090"
4	·650"	·18"	·18"	·067"
5.	·850"	·23"	·20"	·088"

Fig. 83: Equalisation of deflection—Original Method statement

Credit: © Mahendra Raj, courtesy Mahendra Raj Archives and MRC Pvt Ltd

6.9 Conclusions from Structural Design and Construction

In summary, the structural design and construction of SVP Stadium, Ahmedabad could be regarded as a rare instance of engineering excellence. The structural layout of the stadium consists of a careful balance of structural mass and stiffness. By adopting folded plates as the principal structural elements, an increased cantilever span was achieved without resulting in increased section sizes. This in turn resulted in reduced dead loads and, thereby, reduced seismic loads on the structure. While doing so, the stability under wind loads was not compromised either, as the geometry of the folded plates makes it equally effective under wind-induced flexural actions in the opposite direction.

The grandstand main frame and the cantilevered roof required to be designed such that the resultant eccentricity on the foundation was minimized and was not subjected to uplift forces. This was achieved in SVP Stadium by an intelligent choice of the inclination of the main frame legs which reduced the moment transfer to the base of the structure. The self-weight of the cantilever and main frame was considerably reduced by the choice of folded plates as the principal structural elements, thereby reducing the support moments at the exterior support. This also achieved the objective of maximizing the stiffness of the system without increasing the weight of the structure which was of utmost importance for a long-span cantilevered structure. The cross-sectional geometry of the folded plates made it equally effective for bending under both dead loads and wind loads. Providing tie beams close to the base of the main frame provided an additional redundancy to resist the lateral loads. It also reduced the local effects of shell buckling in the folded-plate main frame legs.

Thus, achieving a delicate balance by minimizing the mass and maximizing stiffness posed a unique design challenge, and the solution to that challenge exist in the design of the structural form of SVP Stadium. The fact that the stadium was designed and constructed completely using reinforced concrete at a time when materials and structural forms such as slight weight tensile membranes and cable networks were not prevalent, makes this design even more unique and instructive. Additionally, in a country where significant limitations existed with respect to skilled labour and mechanisation, the deliberate choices made by the designer for the cost-effective design and build of the stadium make it a shining example of structural engineering genius.


Courtesy: Sanat Jhaveri & Co., World Monuments Fund

7.0
BUILDING ASSESSMENT

7.1 Past Repairs And Alterations
7.2 Current Condition Summary
7.3 Current Use Assessment
7.4 Service Use Assessment
7.5 Risk Assessment

Building Assessment

7.1 Past Repairs and Alterations

Listed in Table 3 are the different repairs and alterations that were carried out at the Sardar Vallabhbhai Patel Stadium in the recent past as part of its maintenance and upgradation campaigns. These details have been itemised from the different conversations the project team has had with Amdavad Municipal Corporation. A major part of the information associated with the 2010 repairs has been gathered from copies of the tender documents shared by AMC. But a conversation with officials from AMC has brought to our notice that only 70% of these tasks were eventually carried out on site, and not enough information is available on which of these were completed and which were left out for a later campaign.

YEAR	WORK	DETAILS	REFERENCE
1996	Renovation of toilets	Metal jalis [31] installed over toilets near Gate 1 in the South Pavilion	20210121_SVPS_PCT_ MoM with Rushi Y. Pandya on site
Before 2007	Steel railing	Seen along aisles of North, East and West stands	20210121_SVPS_PCT_ MoM with Rushi Y. Pandya on site
2007	Renovation of GCA office	Section between bays 18 to 20	20210121_SVPS_ PCT_MoM with Rushi Pandya on site
2010	Repair and renovation of the existing structure at the time of Swarnim Gujarat	• Fixing metal plates over seats as temporary provisions for shelter and shade • Renovating toilets, included repairing partition walls, installing doors, tile flooring, painting partition walls, installing washbasin and mirrors, plumbing repairs • Pitch rebuilding, gardening, planting trees • Rebuilding roads inside site boundaries and repairing main roads around site • Flooring done at concourse level and paver block • Parking and installing light polls	20210121_SVPS_PCT_ MoM with Rushi Y. Pandya on site

31.Ornamental metalwork in wood, metal, stone, etc.

YEAR	WORK	DETAILS	REFERENCE
2010	Repair and renovation of the existing structure at the time of Swarnim Gujarat	• Dismantling brick work, tiling, stone, cement mortar, old plaster or skirting, raking of joints, and cleaning the surface for plaster; steel work, CI pipes, GSW pipes • Scraping paint from concrete surfaces and making surfaces even at all heights • Repairing damaged walls—crack repairs (less than 5 mm); crack repairs (more than 5 mm); crack repairs (more than 10 mm) • Providing TMT bar reinforcement for RCC work • Grouting in RCC members with epoxy and cement grout • Providing and applying cement concrete patches—1:2:4 (cement:sand:aggregate) • Providing and placing micro concrete with Renderoc RG of FOSROC or equivalent made with 50% by weight of 10 mm down • Premoulding asphalt filler joints • Removing concrete till a depth of 25–40 mm; priming with ZINCRICH • Providing and fixing MS/Tor bars shear keys for 12–25 mm dia. upto 200 mm in length • Treating walls for termite control • Retrofitting / carrying out structural repairs **REDOING OF DISMANTLED WORK** • Providing and laying cement concrete 1:3:6 (cement:coarse sand:stone aggregates) • Providing and laying controlled cement concrete M-250 • Brick work • Plastering brick walls with 15 mm cement • Finishing with floating coat of neat cement slurry • Plastering ceiling and soffits of stairs • Putting 20-mm thick sand-faced cement plaster on surfaces up to 15 m above ground level **CIVIL REPAIR** • Putting one coat of paint on all steel and metal surfaces • Whitewashing wall surfaces with lime • Applying acrylic smooth exterior paint • Providing waterproofing treatment on roof surface • Applying cement rendering on all exposed concrete surfaces	AMC tender document
2014–15	Solar panels	Installing solar panels on top of the South Pavilion canopy (on an area of approx 2775sqm)	20210121_SVPS_PCT_ MoM with Rushi Y. Pandya on site
2017	LPS overlaying on seats	Preparing for Yoga Day celebration at the stadium	20210121_SVPS_PCT_ MoM with Rushi Y. Pandya on site

Table 3: List of repairs and alterations carried out at SVP Stadium

7.2 Current Condition Summary

Sardar Vallabhbhai Patel Stadium, predominantly built using reinforced concrete, is in a fair state of conservation. However, most of the building elements are showing signs of decay and require immediate attention.

The stadium can be broadly classified into seven elements and some transitional components as described in Chapter 4, Subsection 'Building Description'. Using this categorisation, a complete set of unfolded drawings have been created where each surface per component is accounted for. These have then been laid out in a manner that would enable quick fieldwork and, in future, would also serve as base drawings over which all the proposed treatments would be visually enumerated.

For condition assessment, as a methodology, first a quick survey was undertaken to identify the different material-specific issues seen on site. This investigation, and additional exploration of deterioration listed in other reference standards such as Preservation Brief 15: 'Preservation of Historic Concrete' by Paul Gaudette and Deborah Slaton, and concrete conservation case studies implemented in the recent past, informed the creation of a visual condition glossary.

This lexicon consists of representative site photographs, supporting descriptions and probable causes, and can be found in Annexure 12.1. Additionally, to enable quick fieldwork, easy identification of components and coherent understanding of patterns across subsections of components, all the building elements have also been further categorised into smaller parts where necessary. These segments have been labelled, and this illustrated document can be found in the document, 'Documentation And Condition Assessment Drawings'.

Due to the set project timelines, scale of the building, and other challenges related to resource management during the pandemic, only a visual survey was carried out on site. The general notes, and digitised version of the fieldnotes that inform this summary, have also been collated, and can be found in document, 'Documentation And Condition Assessment Drawings'.

In this section, the current conditions and their probable causes have been identified for each building element as also their location. A summary of these observation can be found below:

Cantilevered Roof

This building element is one of the most prominent structural components to be built during the first phase of construction. During condition mapping, the roof was surveyed in two parts—the ceiling as seen from the seats underneath and the outer surface exposed to natural elements.

In the recent past, a repair campaign was undertaken to cover the entire outer surface of the roof, making it difficult to identify if any other issues exist on the canopy surface. Other than this repair, multiple solar panels have also been fitted on the roof over a corroding framework that rests over strategically positioned load-bearing pedestals. However, it is unclear whether these pedestals are just resting on the roof or have been attached to the canopy. Irrespective, these interventions have altered the way monsoon rainwater drained off the roof.

The primary issues on the ceiling of the canopy include rust stains and signs of previous repair campaigns, identified in large patches along the valley and ridge sections of each A-Frame throughout the canopy. Other issues include exposed rebars and surface deterioration, seen especially on the valleys and ridges of the Frames closer to the roof edge on the East and West sides. Most expansion joints of the roof have been partially re-patched, with circular openings positioned at regular intervals. Additionally, water stains can be seen throughout the canopy, with a significant number of active seepage areas identified in the valleys of the canopy, near the critical knee joint. A few cracks, delamination and previous repair failures have also been identified throughout the canopy, especially on the wings of the valley, close to the critical knee joint and the outer edge of the ridges (cantilevered side).

A-Frames

The A-Frames, including both the main elevation and the inclined leg, are in a fair state of conservation. However, different patterns of deterioration can be seen on these modules, depending on the variation noted in their physical form, their location within the building, and how they have been connected to the other components and aged over time.

The prominent issues seen on this building element, especially in the South Pavilion, include signs of previous repair campaigns, rust stains, and the presence of numerous exposed and corroded rebars. Overall, very few signs of delamination and failure of previous repair campaigns can be seen on this feature. But a significant amount of bio growth and water stains can be seen along the gargoyle section of the elevation and, in some cases, on the recessed panels in the middle section of the main elevation. This anomaly of water stains and some bio growth on recessed panels has been caused due to holes / drains that have been made on the tapering panel at some point in the past. This drain empties all the seasonal rainwater that gets directed into the hollow section behind it. This change in flow has been caused due to cracks, although small in number and length, on the sloping flange of the gargoyle section.

Most of the ledges between A-Frames, Type A, are filled with a considerable amount of garbage in the trough-like section. This has resulted in accumulation of water, leading to moisture infiltration, causing the surface underneath to spall and expose its corroded rebar. Due to the presence of a mezzanine floor between A-Frames, Type B, not many issues can be seen at the heel of the A-Frames. However, water infiltration issues such as water stains, delamination and exposed rebars have still been identified around most drains in the horizontal recessed panel, and in some other parts of the heel. Additionally, some issues have been identified on the beam and the slab feature between these A-Frames. These conditions have been enumerated in the subsection 'Cast In-situ Floors'.

The most significant issues seen on this feature across the remaining stands include signs of previous repair campaigns and cracks, structural and moderate. Most cracks have been identified along the upper and lower sections of the A-Frames. Partial or complete separation of joints have also been identified along the edges of the recessed panels and the trapezoidal section of the heel. Other issues like surface deterioration can be seen along the narrow edge above the upper section, and in the lower section of the component. These issues have been caused due to the lack of, or improper, coping details or poor consolidation of concrete during the time of construction. A few cracks can be seen on the recessed panels in the middle section of the main elevation. And some tie beams between two A-Frames located in the Northwest and Southeast sections have partially cracked, or separated at the junction where they are connected to the V-shaped core elevational detail. Most gargoyle segments in this typology of the component have a hatch configured onto the sloping flange. Although most of these hatches are partially cracked and tend to fail, the hatch of A-Frame 23 is completely missing and open to the sky, causing water to collect in the void space underneath during the monsoon season.

Due to its proximity to the practice nets, and the general overuse of the area around the North Stand, the A-Frames in this section, especially the main elevations, show more signs of deterioration compared to the signs of decay seen in this feature at other locations of the stadium. The most significant issues seen here include multiple cracks—moderate and structural—in the gargoyle segment, rust stains in the trough-like detail in the middle section and exposed rebars in the heel and gargoyle segment of these A-Frames. Some signs of previous repair failures and loss of material have also been observed on the surface of these features.

Overall, very few efflorescence, delamination and spalling patterns have been observed on the A-Frame across the entire stadium. The upper section of the elevational detail, visible from the concourse, and the inclined leg are completely painted. Interestingly, clad panels have been introduced as architectural interventions near the middle section of A-Frames 18–20. And water stains and bio growth can be seen on most surfaces of the element throughout the stadium.

Issues on the surface of some A-Frames could not be assessed completely due to limited access to some subsections. Other issues observed in moderate scale include termite infestation, construction waste blocking the channels of the gargoyle, and architectural interventions such as electrical conduits, metal straps, insertion of multiple anchors / nails and projecting metal rods. All finish issues identified on this element reduced the visual quality of surface finish, and need attention.

Seating Frames

The seating frames are in a fair state of conservation. Although there are seven variations that have been identified within the two typologies of this element, the majority of the conditions have been seen to appear at similar positions on the surface of this component. Additionally, water stains and bio growth can be seen on most surfaces of this element.

In the South Pavilion, this module has been constructed in three variations, with signs of previous repair campaigns, surface deterioration and rust stains as the most significant issues identified on them. Other issues include water stains, surface deterioration and architectural intervention in the form of electrical conduits and nails or anchors at different levels on the component. Very few cracks, loss of material, spalling and delamination issues have been identified in this typology of the component. In addition to the the decay pattern, the variability seen in the surface finish of this element has lessened the textural and visual quality of the surface finish.

In the remaining stands, this element has been configured in four ways, depending on the ways it had to be integrated with the other components. The prominent issues seen in this section include signs of previous repair campaigns, and exposed rebars, concentrated along the step profile of the raker beam. Another condition found across this feature is architectural interventions, mostly observed on the middle and lower sections of the element, including on the surface of neighbouring partition walls. Other issues include joint separation, cracks, delamination and surface deterioration, especially at the heel of the frame. Very few spalling issues have been identified on this component across the stadium.

Furthermore, the infill brick walls under some seating frames primarily show signs of previous repair campaigns, their failure, rising damp and loss of material. Cracks, especially a few structural ones, can also be seen in the lower half of these walls, especially the inner side of the frame that is close to the retaining walls and buttresses. These crack patterns correlate to the patterns seen in most of the retaining walls and buttresses.

The probable cause or accelerator for the signs of decay observed throughout this element is water seepage through the holes and cracks formed due to the separation of cold joints between the seats above. Other probable causes for deterioration include the accumulation of water on the floor, and capillary movement of water from underneath the flooring due to lack of waterproofing solutions implemented during the second phase of construction.

Retaining Walls And Buttresses

This component can be seen primarily under the seats that were cast in-situ during the second phase of construction along the North, East and West stands. The primary issues identified in this module are rising damp, loss of material, cracks and signs of previous repair campaigns.

Significant structural cracks, running parallel to the steps above have also been identified in the retaining walls, especially in the walls adjacent to the seating frames. Some signs of failing previous repairs have also been recorded on this component throughout the stadium. Most issues seen on this module have been caused due to the capillary movement of water from the earthen fill behind the wall and the flooring underneath. This has occurred due to lack of waterproofing solutions implemented during construction.

Cast In-Situ Seats

This module seen throughout the North, East and West stands was constructed during the second phase, and shaped on site. Recently, all these seats were covered with IPS finish that has now weathered in some sections and remained intact in others. Original seat forms and finishes have been identified in sections where the IPS finish has weathered. These original seat finishes appear to be in a fair state of conservation. However, major issues such as joint separation, loss of material and multiple cracks, possibly hairline, have been identified in these parts. These issues need attention as they also are probable causes for the deterioration that is visible on the underside of the seats—the ceiling.

The most significant issues seen on the ceiling are signs of previous repairs, their failure, exposed and corroded rebars, and many joint separation cracks, with active water seepage during the monsoon season. In all probabilty, as a result of water ingress issues from the seats above, and the subsequent corrosion-induced decay, the ceiling is in a poor state of conservation, with varying degrees of rot, and in urgent need of attention.

Similar seats can also be seen in the lower seating sections of the South Pavilion. With signs of previous repair as the main issue, this section has been assessed to be in a good state of conservation.

Precast Seats

Located under the cantilevered roof of the South Pavilion, this component and its varying expressions are relatively in fair condition. However, there is a need to come up with a holistic plan to conserve these seats. The primary issues seen in the seats in the upper section include signs of previous repair campaigns, spalling and loss of material. Few cracks, exposed rebars and delamination issues can also be seen on them. Surface deteriorations can also be seen on some precast steps. The seats, especially along the top tiers of each bay, are painted, and have many bird droppings. Black stains have also been observed in this section, though the cause of this issue is unknown. Finally, the thinner surface of each precast seat is painted and, in most cases, also has deteriorated edges.

The most significant issues seen in the media boxes are signs of previous repair campaigns, exposed rebars and surface deterioration. Other issues such as rust stains, loss of material and cracks can also be seen on the different surfaces of the element. Additionally, over time, some surfaces of the element have also been painted, though it is unclear when this intervention was implemented.

The primary issues seen in the VIP seating include signs of previous repair, exposed rebars and cracks. Additional issues on the seats include cracks, spalling, loss of material and surface deterioration. The primary issues observed on the underside of the VIP seating comprise cracks, exposed rebar and surface deterioration.

The most prominent issue on the aisles is the recently laid flooring along the entire length of the corridor of the South Pavilion. This intervention was not carried out along the stairways that lead to the concourse level.

Additionally, water stains can also be seen throughout the surface of all these variations of precast seats, though in moderation compared to those seen on the different elements in the remaining stands. And a small number of medium-length cracks can be seen across most undersides and open plans of the VIP seating, aisles and other miscellaneous precast connectors in the South Pavilion.

Cast In-Situ Floors

Two levels of floors have been identified within the entire stadium building—the concourse and the mezzanine floor.

The mezzanine floor in the South Pavilion has been cast on site, and made with reinforced concrete cement. This part of the stadium can be classified into three subsections: the flooring, the ceiling and its connected parapet walls. The primary issues identified in the flooring include signs of previous repairs, and numerous networks of cracks. Surface deterioration, delamination and water stains have also been seen in moderate scale within this subset of the mezzanine floor.

The most significant issues on the ceiling include exposed rebar and delamination around circular holes / drains that have been made at regular intervals in the beam and slab feature between the main frames. Other issues in this part include cracks, loss of material, and architectural interventions in the form of multiple anchors / nails embedded on the surface of the ceiling. Additionally, water stains have been observed across this segment.

The primary issues visible on the parapet wall include signs of previous repairs, their failure, exposed rebars and surface deterioration. Delamination, water stains, loss of material and architectural interventions in the form of embedded anchors / nails have also been observed on the parapet. Additionally, some rust stains were also identified, specifically in bays 7–8 and 9–10.

One can see Kota stone laid in three patterns in the concourse level across the entire stadium—the portico, the South Pavilion and the open bays along the stadium were built in the second phase. The flooring pattern seen along the portico of the concourse in the North, West and East stands was introduced during an upgradation campaign in 2010. However, it is unclear if the other patterns seen at the concourse level are original. Due to the recent intervention and regular maintenance campaigns carried out in these areas, very low to no signs of deterioration have been observed along these sections.

7.3 Current Use Assessment

SVP Stadium is currently open to all residents of Ahmedabad as a public space for everyday use. The complex currently provides parking for 50 4-wheel vehicles and 200 2-wheel vehicles, and some space for autorickshaws along the western periphery of the site.

During its open hours, one can find members of the local community walking, jogging, doing yoga, karate, warm-up exercises, and so on, in different spaces of the facility. When on site, the users also engage with the stadium and its infrastructure in intimate and creative ways that aid them achieve their fitness goals.

In the morning hours, the bays at the concourse underneath the West Stand are used mainly as an open-air gym and fitness training areas. At other times, these transform into spaces for strength training, stamina building and yoga for everyday users. Evidently, some open-air gym activities are also performed on the long stretches of tar roads in the parking area.

With numerous benches, transition spaces, and easy access to the ground and walking track inside the stadium, the concourse of the South Pavilion witnesses the most movement of users in a day. At any given time of the day, the benches in the concourse are filled with everyday users, fitness enthusiasts and stadium staff spending their time discussing the latest developments—from the recent news cycle to upcoming festivities—that they are looking forward to in future.

The lower seating section of the South Pavilion, made with poured concrete cast in-situ, transforms every morning into open-to-sky yoga workrooms, conducive for group sessions. Small groups or individuals choose to use the mezzanine floor for their practice. And some use the same space for warm-up or floor-based exercises. A moderate sized group of long-standing users gather near the entrance between the South Pavilion and East Stand for their body-building workouts. This set-up is also open to the sky, with a lean set of equipment, stockpiled by the collective in a dedicated storage space within the complex.

Fig. 84: Students and cricket coaches using the sports complex for fielding and catch practice

Fig. 85: Aspiring cricketers during warm-up exercises along the walking track

Currently, a significant part of the site is also used for tennis coaching and practice. Leased to the Tennis Association of India, this gated facility within the complex has multiple tennis courts, and a separate parking lot that can accommodate approximately 25 4-wheel vehicles and 75 2-wheel vehicles.

Other than these recreational activities, the complex is also known for its long-standing relationship with the cricket-loving community of Ahmedabad. So, the stadium is currently also used as a dedicated training facility for cricket coaching, attracting young athletes in large numbers. Besides the practice nets installed behind the North Stand and the Southeast section of the site, part of the site in the Northeast corner is also used by the Gujarat Cricket Association for their educational operations. Besides these dedicated spaces allocated for school-going, aspiring cricketers, most bays under the North and East stands are also used by trainees to practice batting stances. Every so often, one can also see them doing warm-up exercises and other skill-building activities in this area. To train students in bowling and fielding drills, trainers generally use the open sections of the ground around the practice nets in the northern part of the complex. The focussed use of this part for cricket training also encourages parents and family members of the learners to use the stairways in the North and East stands as seating areas, while they wait for the practice sessions to end.

The cricket ground is primarily used for cricket matches, scheduled through the Stadium Manager's office that is situated within the stadium. For most of the remaining time, the ground is closed and tended to by the stadium's groundskeeping team. The machinery used by the staff for this purpose is usually brought in from the entrance between the East Stand and the South Pavilion. And after use, these machines are parked in the concourse between bays 1–4 in the South Pavilion. Sometimes, one can also find the smaller lawn-mowing motors parked under the staircases in the concourse of the South Pavilion.

Introduced in the recent past, the walking track along the periphery of this ground is regularly used by walkers, joggers, and marathon runners. Other than this rammed earth resource, users, especially cricket trainees, can be seen doing other cardio-vascular exercises on the stadium seats of the North, East and West stands. During the sunnier parts of the day, when the stadium is partially closed, members the Sports Club use the concourse of the entire stadium as their walking track.

Considering the stadium is centrally located and can be accessed by a large section of citizens from different walks of life, every part of the stadium is used to its full capacity. Moreover, despite the availability of other training facilities for cricket coaching in Ahmedabad, the stadium is considered a sacred space for teaching and learning by coaches and aspiring cricketers alike. This demand has resulted in the overuse and, in some cases, misuse of facilities within the complex, especially the bays under the North and East stands, exposing the components in the concourse area to regular hits from season balls. This demand also has led to the overuse of the few storage spaces that have been created in the Northwest and Southeast section of the stadium, highlighting the need for more storage space.

To ensure the stadium does not fall prey to illegal activities and circulation, access to most areas in the complex is strictly controlled, especially the toilets and the stairways along the North, East and West stands.

For supporting drawings and reports mapping the different activities on site, refer to the document on 'Stakeholder And Community Engagement'.

7.4 Service Use Assessment

Having been constructed in multiple phases over a long period of time, some of the services within SVP Stadium have been introduced on a need basis.

The South Pavilion of the stadium comprises a modest set of changing rooms with attached bathrooms and toilets. Although the changing rooms are in relatively good condition, the toilets and bathrooms, currently in use, need some mending in future. Apart from these amenities that were built during the first phase of construction, the South Pavilion was originally built to also have some office spaces and staff quarters for the groundkeepers. Currently, these spaces are either lying vacant or being used as storage facilities.

In the recent past, the stadium has also played host to numerous cultural events of local, national and international significance. In order to accommodate a large group of people who would flock to the stadium on such occasions, AMC made multiple upgrades to the infrastructure within the complex. One such improvement campaign led to the construction of toilets in the North, East and West stands in 2010. Due to misuse and lack of regular maintenance, most of these toilets are in poor condition and need substantial improvement. Parallel to the toilet blocks, one also can spot manholes installed along the concourse to facilitate waste management. Considering not many toilets are in active use, it is imperative to inspect and repair them, if necessary, during upgradation.

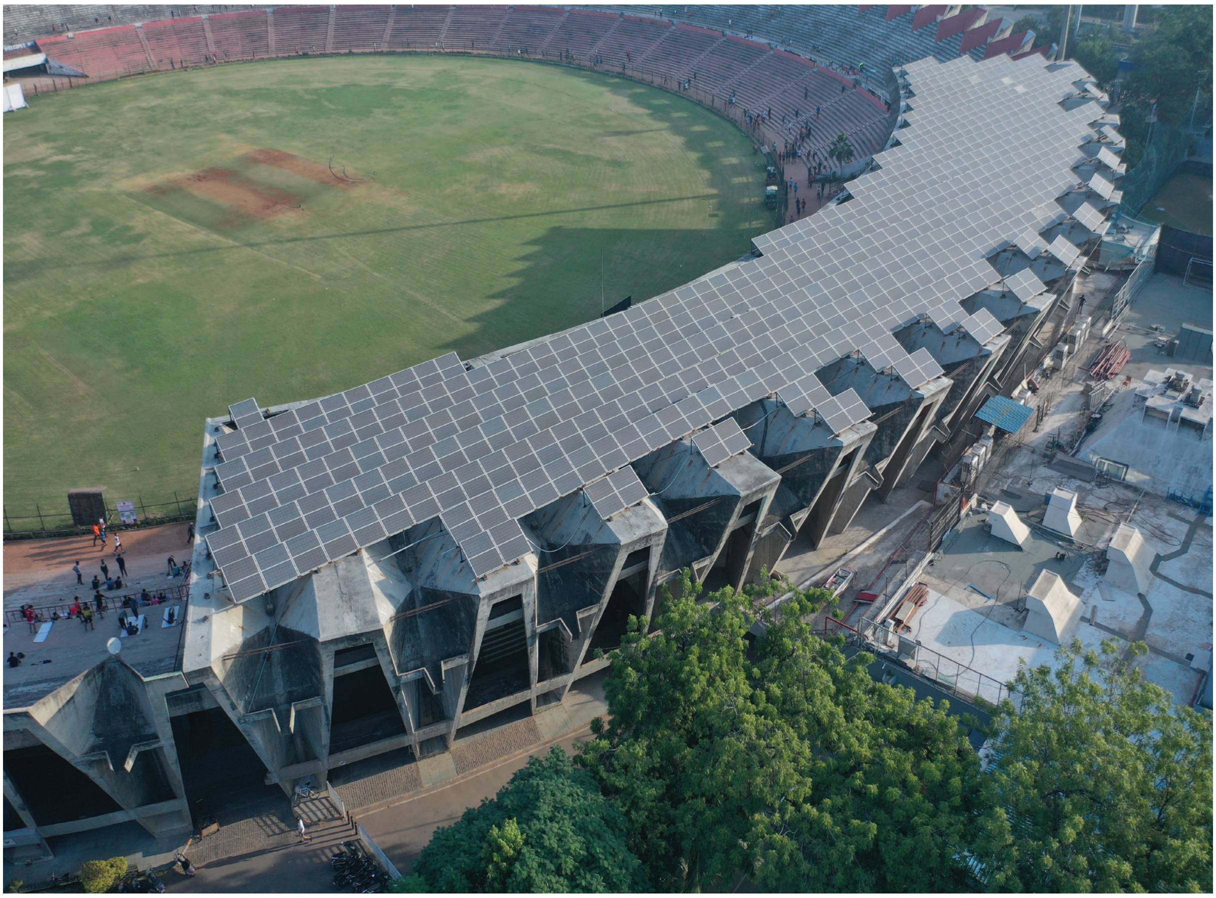
In the same year, another development resulted in the creation of an office cabin for the Stadium Manager on the concourse, close to the western end of the South Pavilion. Although this addition is relatively small in area and volume, its location in a prominent part of the South Pavilion makes this an invasive intervention that disrupts the spatial quality of the concourse—a character-defining feature of the stadium.

Another addition seen along the concourse of the South Pavilion is the utilities room along the walls of the changing room. Like the office cabin, this intrusion also disrupts the spatial quality of the concourse. Hence, moving it to another area of the stadium is worth considering. Additionally, many electrical conduits are fixed to the concrete elements, suggesting that the electrical system of the building might have been incorporated after the construction was completed. This intervention devalues the significance of the surface finish—an integral attribute of the form-finished construction. Therefore, an alternative routing of this building system should be incorporated in future.

In 2007–08, to ensure longevity of this asset even after the construction of Motera Stadium, AMC also installed flood lights and supporting electrical panels around the stadium. This addition enabled the stadium to function as a popular venue for exhibition matches in the years that followed. However, implemented in an ad hoc manner, the electrical panels installed around the lower part of the A-Frames put these A-Frames and their sub-structure under severe threat. Apart from these panels, many smaller and, in some cases, individual panels have also been fixed to the inclined leg of the A-Frames along the entire concourse. It is critical to revisit this building system and find an alternative route that is less intrusive, and causes minimal visual impact.

In the last decade, multiple solar panels were installed on the cantilever roof of the South Pavilion as an opportunity to offset the stadium's electrical consumption, and generate additional income by directing the surplus power to the city grid. A novel idea, this addition has many advantages for the upkeep of the stadium. However, installation of the panels on the canopy needs reassessment. This cantilever roof is an iconic feature of the stadium, with high value of integrity. And the outcomes from the condition assessment undertaken on site reveal the need to re-examine the way the panels were installed, as they may be a probable cause of the deterioration patterns seen on the underside of the roof element.

Fig. 86: Solar panels installed on the cantilevered canopy of the South Pavilion



7.5 Risk Assessment

This assessment aims to identify the stadium's vulnerabilities that have not been addressed in the previous chapters of the CCMP.

Fire

Built primarily using reinforced concrete, the stadium building is not at significant risk of fire. Nevertheless, the presence of paved and rammed earth pathways along the periphery of the stadium ensures that in case of an emergency, a fire tender shall be able to move into the ground and around the stadium to arrest the fire that may need tending. The only exception to this access is the area on the concourse and mezzanine level between structural Frames 5–13. However, this area can be accessed by foot for firefighting.

Although multiple fire extinguishers have been identified across different sections of the stadium, no first-aid hose reels with water access were discovered. Moreover, the presence of ad hoc electrical panels, and conduit wiring system installed on the structural components of the stadium, pose a significant threat to its integrity in future. These issues highlight the lack of clarity on firefighting protocols for the site.

Defacement

The stadium is a beloved community space actively utilised by people from a diverse cross-section of society. Interactions with the community have highlighted that they understand the aesthetic and architectural value of this public place, and value the maintenance efforts undertaken by its custodian. However, one can see many nails, corroded wires, remains of old posters, signages and paint finishes across different components of the stadium that devalue the artistic value of its surface finish. Additionally, the application of paint on the A-Frames impacts the architectural significance and imageability of the stadium. Since the stadium's construction technique is an integral component that adds to the significance of the structure, these issues need to be studied more closely, and the associational value embedded in the surface finish of the stadium needs to be re-examined.

Water Management

Currently, water is among the more significant risks that is putting the site under threat. There is a need to reassess its overall movement, and the types of impact that it has throughout the property. Rising dampness due to the lack of plinth, seepage issues in the built fabric, and systemic alterations to the landscape features, like the loss of drainage channels during the introduction of the walking track, have altered the way water flows on the site. And, the maintenance of the cricket ground requires approximately 60,000 litres of water. Moreover, the level difference between the road and the site have caused water to flow into the complex during extreme weather conditions such as flash floods. These matters highlight an urgent need to assess water management across the site, and incorporate a plan to mitigate such risks.

Unplanned Interventions

To fulfil the need to modernise the administrative, functional, and other necessities within the stadium, multiple ad hoc architectural additions such as cladding interventions, creation of new storage rooms, and office blocks have been executed on site. Although the scale and kind of interventions vary, it has been observed that these add-ons have altered the experiential quality, architectural integrity and functionality of the different areas in the stadium. It is critical to categorise all these interventions and find a way forward.

Security and User Movement

Movement of users into and within the stadium is strategically regulated by the limited number of security personnels currently employed on site. Despite the fact that this has enabled the stadium staff to maintain the property in a fair condition on an everyday basis, the change in circulation and access to some services have intensified the overuse and, sometimes, misuse of the utilities available within the property. During extremely hazardous situations, these issues, along with a reduced number of entry and exit points, may slow down emergency evacuation efforts. Additionally, very limited signages are seen across the complex, making it difficult for a first-time visitor to move efficiently within the property.

Left unattended, these weaknesses can adversely affect the aesthetic, architectural and socio-cultural values associated with the sports complex. So, a more detailed investigation for the listed issues should be undertaken in future. This will ensure that their full impacts are assessed in a holistic manner, and these aspects can be converted into opportunities for advancement.

8.0

INVESTIGATION AND SCIENTIFIC TESTING

8.1 Significance of Tests Conducted on the Structural Elements of SVP Stadium

8.2 Investigation at the Site on Samples Collected from the Site


Courtesy: Sanat Jhaveri & Co., World Monuments Fund

Investigation and Scientific Testing

Based on the observations made during the thorough visual inspection, some key inferences were drawn, and suitable recommendations were made for the following tests to be conducted on various elements of the structure:

1. Compressive Strength; 2. Cover Depth; 3. Concrete Resistivity; 4. Half-Cell Potential; 5. Chloride Concentration; 6. Carbonation Depth, and 7. Corrosion Rate. The significance of each test is explained below:

8.1 Significance of Tests Conducted on the Structural Elements of SVP Stadium

Compressive Strength

The compressive strength of concrete is the measure of the concrete's ability to resist loads under compression. It is measured by crushing cylindrical concrete specimens (for field study) or concrete cubes (generally, for laboratory study) in a compression-testing machine.

Cover Depth

Cover depth is the clear cover of concrete provided to the reinforcing bars. This cover provides protection to the rebars from deleterious elements such as moisture, oxygen, chlorides, carbon dioxide, etc. The cover depth is designed for the expected service life of reinforced concrete structures by considering the diffusion coefficient of concrete.

Concrete Resistivity

Electrical concrete resistivity, ρ, is the characteristic property of concrete (independent of the geometry of the test sample), which is calculated through measuring electrical resistance, R, in an appropriately designed circuit, and applying a certain geometry factor, γ. Equation 1. provides a simple representation of such a relationship.

$\rho = \gamma R$ Equation 1.

The electrical resistivity of concrete helps determine the reinforced concrete's susceptibility to corrosion. The higher the resistivity of concrete, the lower the rate of corrosion. The electrical resistivity of concrete is measured using the Wenner 4-Probe Resistivity meter. The Wenner test involves placing four equally spaced and in-line electrodes into the ground. The two outer electrodes (current electrodes) inject current into the soil. The two inner electrodes (potential electrodes) measure voltage, which is then used to calculate soil resistance.

Half-Cell Potential

The Half-Cell Potential (HCP) method is used to identify the probability of corrosion activity of the steel reinforcement embedded in concrete structures. HCP measurement is based on the coexistence of corroding areas (anodic half-cells) and non-corroding areas (cathodic half-cells) on a rebar. The measurement is calculated as the potential differences between the reference electrode and the steel–concrete interface, which can be attributed to the corrosion activity at the surface of the steel. For this purpose, a reference electrode was connected via a high-impedance voltmeter to the steel reinforcement, and placed at grid points marked on the concrete surface. A more negative HCP reading indicates the probability of corrosion. However, if all the HCP values in the area of interest are highly negative, with no difference between each other, then the rebars in this region may not be undergoing corrosion. Therefore, instead of the magnitude of the HCP, it is recommended to look at the potential gradient. The higher the potential gradient, the greater the rate of corrosion.

Chloride Concentration

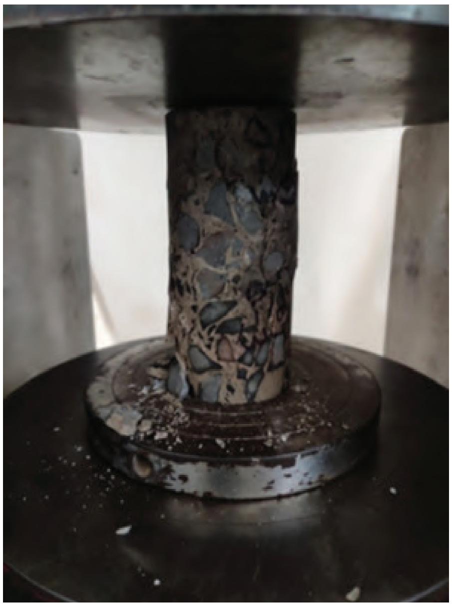
Chloride concentration tests on the surface of the concrete, and at various depths in the concrete until the rebar level, can indicate the availability of chlorides in the atmosphere and the diffusion of chlorides. If the chloride concentration at the rebar level is greater than the chloride threshold of the steel-cementitious system, it can be concluded that there is chloride-induced corrosion. Chloride threshold is the concentration of chlorides required to initiate the corrosion of steel in concrete.

Carbonation Depth

Carbonation of concrete is the chemical reaction between carbon dioxide in the atmosphere and calcium hydroxide and hydrated calcium silicate in the concrete, to give calcium carbonates and other carbonates. This process slowly changes the pH in the concrete, starting at the outer layers, from about 13 to about 9. This change in pH can disrupt the passivation of steel reinforcement. The rate of carbonation is higher when relative humidity in the concrete is in the range of 60–70%. The depth of carbonation can be determined by spraying phenolphthalein on freshly fractured concrete surface. If the colour of the concrete does not change, it indicates that the depth of concrete until unchanged colour has been carbonated. However, if the colour of the concrete changes to pink, it indicates that the concrete is not carbonated.

Corrosion Rate

Corrosion rate is the rate at which the rebars corrode in concrete. Note that this measurement shall give the instantaneous rate of corrosion, which is dependent on the temperature, availability of moisture, and other local factors. Therefore, the results should be in relative order—where the rebar is corroding more than the other sections—and not in absolute numbers.



8.2 Investigation at the Site on Samples Collected from the Site

Locations were marked on various elements for extraction of core samples. Also, trial testing with some tests such as measurement of cover depth and half-cell potential were carried out on representative locations to ensure the quality of testing. Then, cylindrical concrete core samples of 70 mm diameter and 200 mm depth were extracted from the marked locations. The hollow portion was filled with repair concrete material. Fig. 87 shows a team taking a half-cell potential reading on a ≈250 mm c/c grid points on an element. Fig. 88 shows the measurement of cover depth of the slab, using a cover meter. The extracted core samples and rebars were shipped to IITM on 17 September 2021. Figs. 89 shows the extracted core samples received at IITM. This section summarises the condition of various structural elements, and suggests a pilot project.

Fig. 87: Half-cell potential measurement

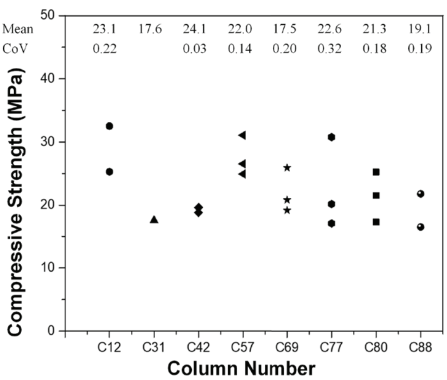
Fig. 88: Cover depth measurement

Fig. 89: Extracted core samples received at IIT Madras

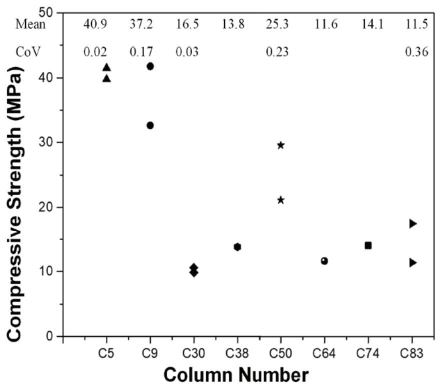
Fig. 90: Cylindrical concrete cored specimen under compression testing

Frames (Old and New Construction)

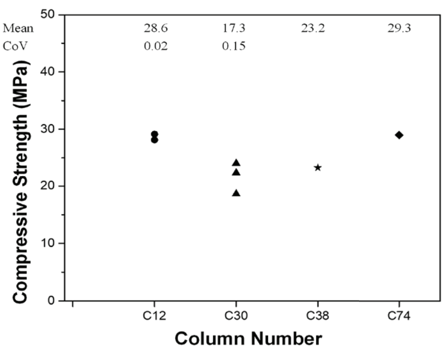
Compressive strength test was carried out on extracted concrete core samples to determine the strength of concrete. The extracted core samples were surface ground for leveling and cut to 134 mm length (length/diameter = 2). Fig. 90 shows the core sample placed in a compression testing machine. The samples were loaded with a rate of 0.25 MPa/sec and stress at rupture of concrete cylindrical core was recorded. Figs. 91a, b, c, and d show that the equivalent cube compressive strengths of concrete in the outer columns, middle seating columns, inner columns and beams were between 6 MPa–35 MPa. The variation in compressive strength within each element was found to be large (about 20%). This might be due to different levels of compaction of concrete during construction. For acceptance, the compressive strength needs to be greater than 15 MPa, which is satisfied in most of the tested specimens, except for C30. Note that for the lesser compressive strength for specimens extracted from C30 can be due to local defects in the extracted core samples. For beams of the seating frames, the equivalent cube compressive strength of the cylindrical core extracted from the beam specimen were found to be greater than 15 MPa, which is within acceptable range. It can, therefore, be concluded that the compressive strength of concrete in frame elements is within acceptable range. The cover depths can indicate the protection layer of concrete on steel rebars, which is presented next.



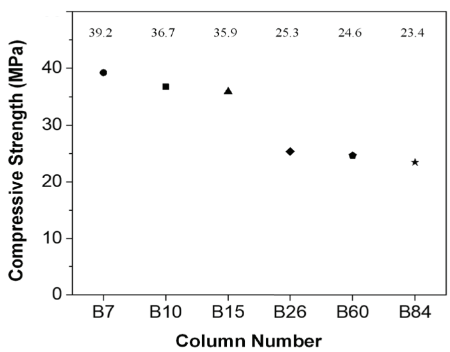
a. Outer columns



b. Middle seating columns



c. Inner columns



d. Beams

Fig. 91: Equivalent cube compressive strength obtained from cylindrical concrete core samples extracted from various elements

According to the drawings of SVP Stadium, the prescribed clear cover depth for the columns is 40 mm. Fig. 92 shows the provided clear cover depth to columns is significantly lower in a few locations. Note that only 10 measurements of cover depth were taken on one column of the prescribed columns. This may not be a true representative of the cover depths in all the columns, especially, for the locations towards the top of the columns. During site visits, it was visually recorded that the cover depth at many locations was negligible (≈ 0 mm), because the impressions of the rebars were visible on the concrete surface. Inadequate cover to the rebars can result in availability of moisture, oxygen, and carbonation of concrete clear cover on the rebars, and initiate corrosion early in the life of the structure. Fig. 93 shows that the coefficient of variation of cover depths provided to the columns is 8%, which is within acceptable range. However, the corrosion conditions need to be identified by determining concrete resistivity, chloride concentration at the rebar level, and carbonation depth measurement, which is presented later in the CCMP.

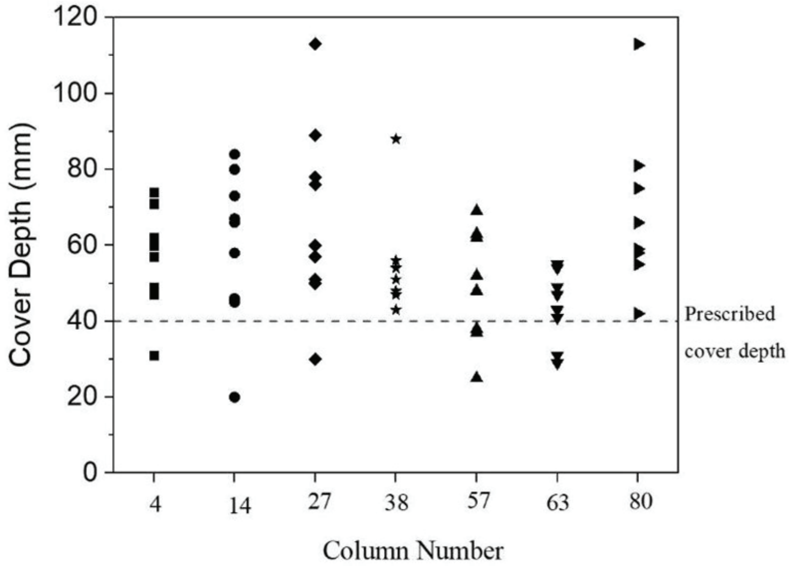


Fig. 92: Measured cover depths for the columns of the frames (Note: Only 10 measurements of cover depths were taken on one column in the prescribed columns, which may not be the true representative of the cover depths in all the columns, especially for the locations towards the top of the columns. During this and the previous site visits, it was visually noticed that the cover depth at many locations were negligible (≈ 0 mm), because the impressions of rebars were visible on the concrete surface.)

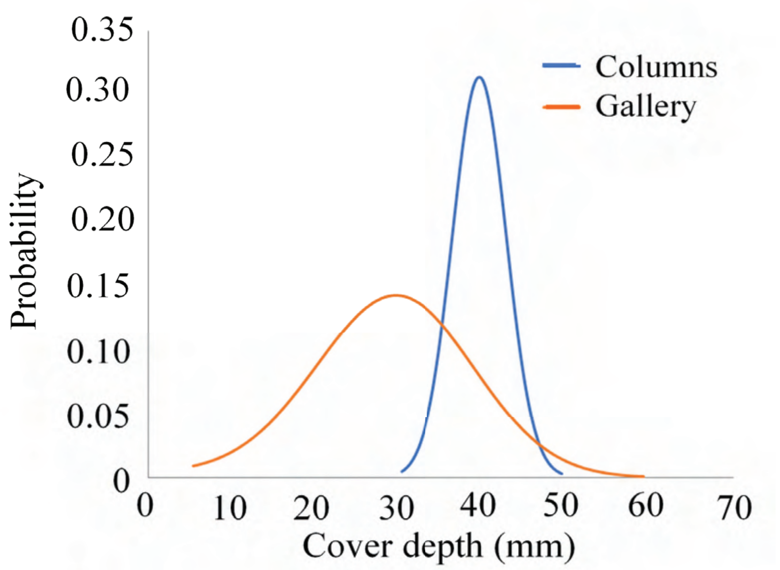
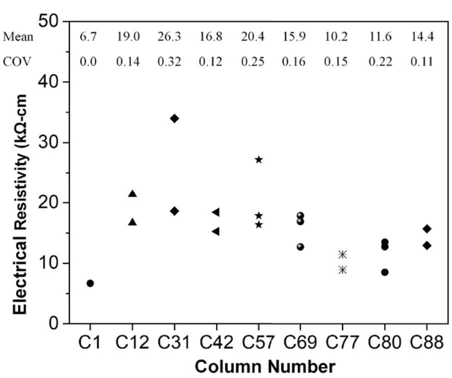
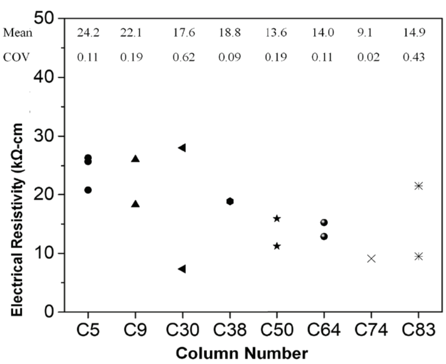


Fig. 93: Log normal distribution curves of provided cover depths to columns and gallery (Note: Same as Fig. 92)

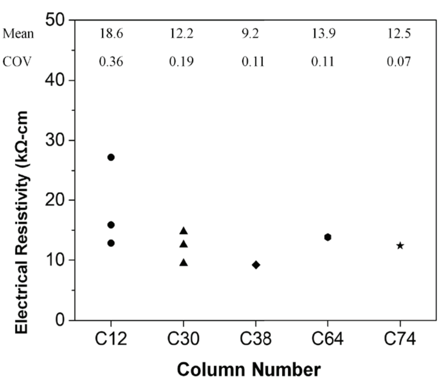
Figs. 94a, b, c, and d show the resistivities of the concrete core samples of the A-Frame, and the middle and inner trapezoidal columns, respectively. It is observed that the resistivity of most of the specimens collected, is in the range of 10–30 kΩ-cm, which is expected from a concrete made with OPC, and concrete mix designs used during the construction time (the 1960s and 1980s). Specimens from a few elements such as C1, C30, C74 and C83 have lower electrical resistivity than 10 kΩ-cm, indicating that the concrete in these elements may offer less resistance to ionic transfer, and may support the corrosion process. Low resistivities in concrete can be either due to local defects, or the concrete used in these elements may have been of inadequate quality. The average electrical resistivity of concrete [LN (mean, coefficient of variation)] from the outer, middle, and inner columns are LN (16, 0.69), LN (17, 0.38), and LN (14, 0.37), respectively. Note that the specimens collected from the same element have significant variations of electrical concrete resistivity (70%, 40% and 40% for the outer, middle, and inner columns, respectively). Therefore, these lower concrete resistivities may be due to local defects in the extracted concrete sample. In short, electrical concrete resistivities are within acceptable range. The cause of corrosion is required to be identified, which is presented next.



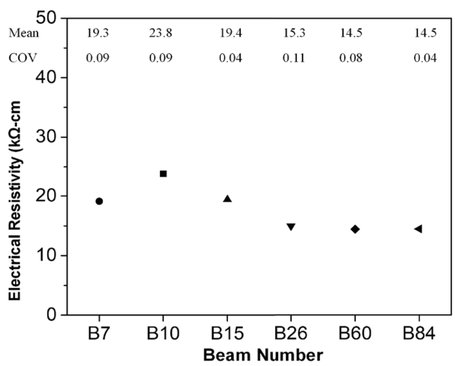
a. Outer columns



b. Middle seating columns



c. Inner columns

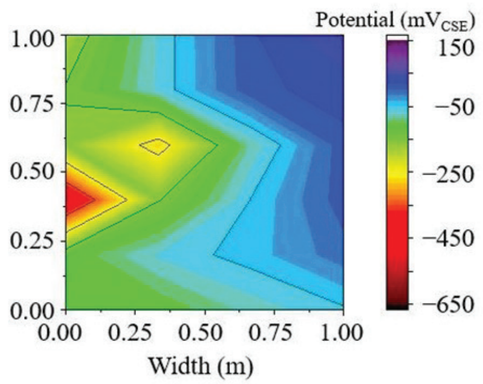


d. Beams

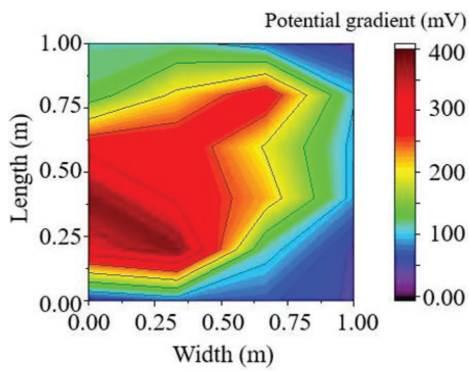
Fig. 94: Concrete resistivity of various elements of the A-Frames and Seating Frames

Half-cell potential measurements were recorded at ≈ 250 mm c/c grid points for (1×1) m2 in representative regions of Columns 4, 14, 27, 38, 57, 64, and 80. It was observed that many columns had a high potential gradient, indicating the probability of a high rate of corrosion. Fig. 95 shows the HCP contour plot and gradient plot for Outer Column 63 as representative location. Other contour plots are presented in Annexure 12.8. Note that the HCP is not monitored on all the columns. Therefore, this issue can be found on many of the columns. Additionally, a detailed visual inspection was carried out during the extraction of the cores and measurement of the HCP. Most columns near the bathrooms have shown visible distress—perhaps due to continuous availability of moisture near them. Therefore, if the corrosion issue is not addressed soon, it might lead to significant corrosion of the steel rebars. This part of the study indicated that though there are no visible signs of corrosion on the concrete surface, it has already started (Fig. 95). Therefore, the cause of corrosion was identified by chloride concentration tests and carbonation depth measurements.

Chloride concentration at the surface and the depth of the rebar level was found to be significantly less (<0.01 % by weight of binder; see Table 4). Therefore, it can be concluded that the corrosion is not because of the chlorides. To investigate the cause of the corrosion, carbonation of concrete was determined. Figs. 96a, b, c, and d show the photographs of the fractured core samples after spraying phenophthalein solution [Column 5 from South, Column 38 from West, Column 57 from North and Column 77 from East]. The carbonation of concrete in the specimens extracted from the eastern side of the stadium was found

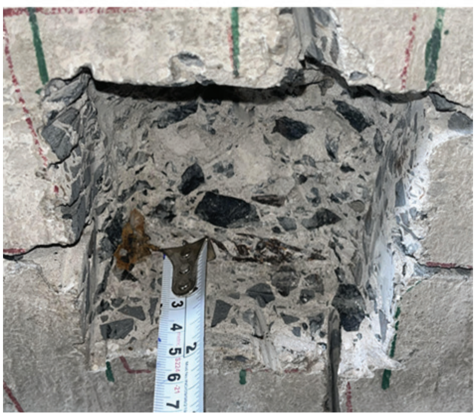


a. Half-cell potential



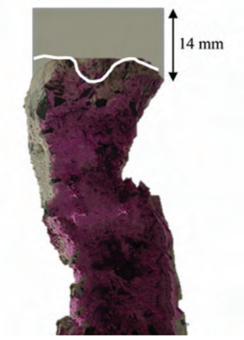
b. Potential gradient

c. Column with no corrosion distress on concrete surface

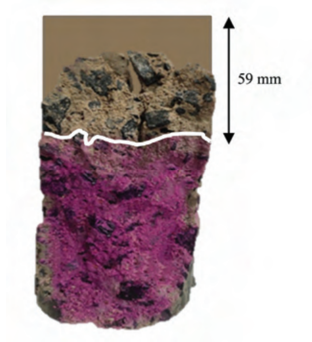


d. . Ongoing corrosion of steel rebar

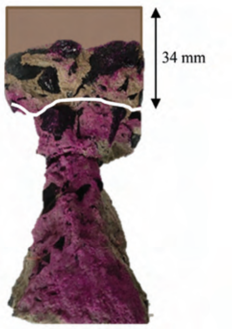
Fig. 95: Contour plots for Column 63



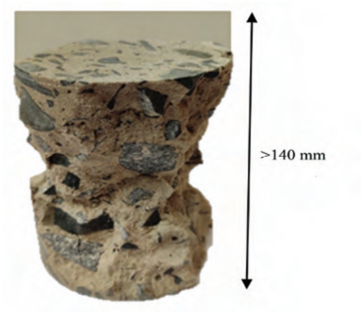
a. Column 5 (South)



b. Column 38 (West)



c. Column 57 (North)



d. Column 77 (East)

Fig. 96: Carbonation depth in concrete (Note: The extended grey region is the ground concrete part from the concrete core. The grinding was done to enable the Compressive Strength testing.)

Sl. No.	Sample ID and depth of measurement	Chloride content (% by wt. of binder)
1.	C 5 at exposed surface	0.002
2.	C 5 at 40 mm depth	0.001
3.	C 38 at exposed surface	0.002
4.	C 38 at 40 mm depth	0
5.	C 57 at exposed surface	0.003
6.	C 57 at 40 mm depth	0
7.	C 80 at exposed surface	0.002
8.	C 80 at 40 mm depth	0.003

Table 4: Chloride concentration test results

to be significantly higher than the rest of the frame elements of the stadium. This can be attributed to the continous availability of moisture on the concrete surface due to moisture in the air from Sabarmati River (see Fig. 97). Note that the concrete was ground for a few millimeters (7-10 mm) to enable compressive strength testing. Therefore, the depth visible in Fig. 96 may be less, but the carbonated concrete depth includes the ground part of the concrete. It is observed that the concrete core samples of the column from the East side of the stadium have exhibited high depth of carbonation. Figs. 98a, b, c, and d show the depth of carbonation in the cylindrical cored concrete samples extracted from the outer frame columns, middle seating columns, and inner columns and beams, respectively. It is observed that the depth of carbonation in most regions are greater than the provided cover depth. Therefore carbonation of concrete (resulting reduced pH) is the reason for the corrosion of the steel rebars.

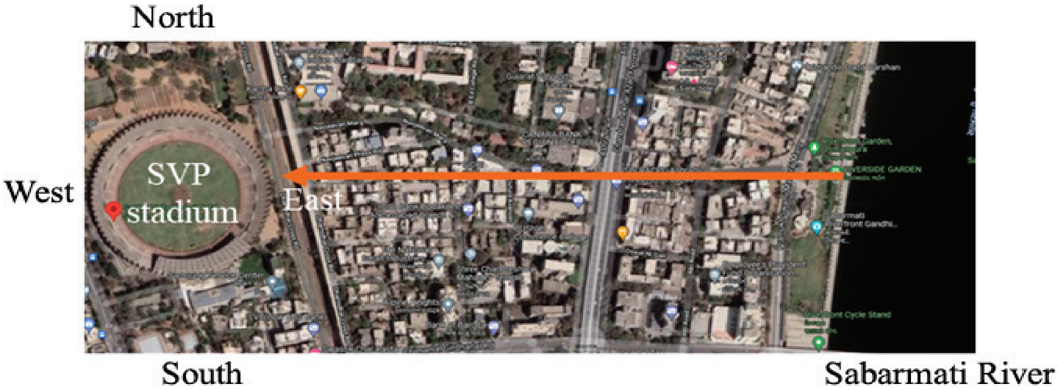
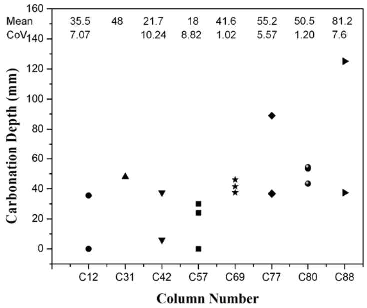
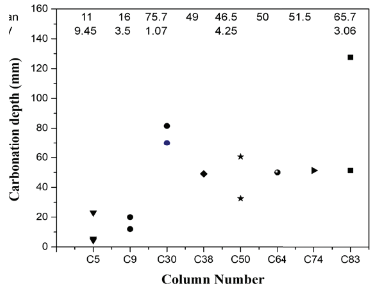


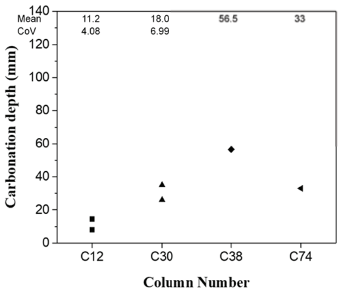
Fig. 97: Satellite view showing the location of the stadium with respect to Sabarmati River (moisture from the river possibly travels to the stadium and provides adequate moisture conditions to increase the rate of carbonation.)



a. Outer columns



b. Middle columns



c. Inner columns

Fig. 98: Carbonation depth in the concrete core samples extracted from the columns of the frames

Locations	Corrosion rate of longitudinal rebars	Chloride content (% by wt. of binder)
C4	1.83	0.46
C14	0.16	0.35
C27	0.28	0.12
C38	1.85	0.56
C57	2.89	1.99
C63	5.13	1.41
C80	5.25	0.96
C88	0.31	0.23
Canopy 1	0.90	0.59
Canopy 2	1.08	1.11
Ramp to mezzanine 1	4.16	8.88
Ramp to mezzanine 2	2.50	4.19
Ramp to mezzanine 4/5	3.02	0.64
Ramp to mezzanine 14/15	0.76	0.71

Table 5: Corrosion rate measured from various locations of the stadium

Additionally, the rates of corrosion of the longitudinal rebars and stirrups were measured on various locations of the stadium. Table 5 shows the measured rates of corrosion from the columns, ramp to the mezzanine, and the canopy elements. It is observed that the corrosion rate of the longitudinal and stirrup rebars in the columns (constructed in the 1960s) is in the range of ≈ 0.3 to 1.5 μA/m2—indicating moderate to severe rate of corrosion. However, the corrosion rate in columns cast in the 1980s construction is in the range of 1.0 to 5 μA/m2—indicating severe rate of corrosion, and needs immediate treatment. Similar results showing severe corrosion were obtained from the canopy and the ramp to the mezzanine (see Table 5).Additionally, the rates of corrosion of the longitudinal rebars and stirrups were measured on various locations of the stadium. Table 5 shows the measured rates of corrosion from the columns, ramp to the mezzanine, and the canopy elements. It is observed that the corrosion rate of the longitudinal and stirrup rebars in the columns (constructed in the 1960s) is in the range of ≈ 0.3 to 1.5 μA/m2—indicating moderate to severe rate of corrosion. However, the corrosion rate in columns cast in the 1980s construction is in the range of 1.0 to 5 μA/m2—indicating severe rate of corrosion, and needs immediate treatment. Similar results showing severe corrosion were obtained from the canopy and the ramp to the mezzanine (see Table 5).

Gallery

Fig. 99 shows that the provided cover depths to the rebars in the gallery were significantly lower than the prescribed cover depths. Also, the coefficient of variation of cover depths within the element was about 30%, which is significantly high. The measurement was taken from the bottom and top of the element, according to the ease of accessibility to the structural element. The bottom part of the beam is expected to have less cover depth due to sagging of the rebars during construction. Therefore, the cover depths in Fig. 99 greater than 40 mm can be the cover depths measured from the top of the gallery, which may not represent the true cover concrete depths. Fig. 100 shows that the carbonation depth of concrete is greater than 40 mm in most of the specimens tested, which is higher than the provided cover depth, leading to carbonation-induced corrosion. As the steel rebars were significantly corroded in the galleries and beams, the chloride and carbonation tests were not conducted. Taking into account the results obtained from the condition assessment of the frames, it can be concluded that corrosion of the steel rebars is due to greater carbonation of concrete than the provided / measured cover depths.

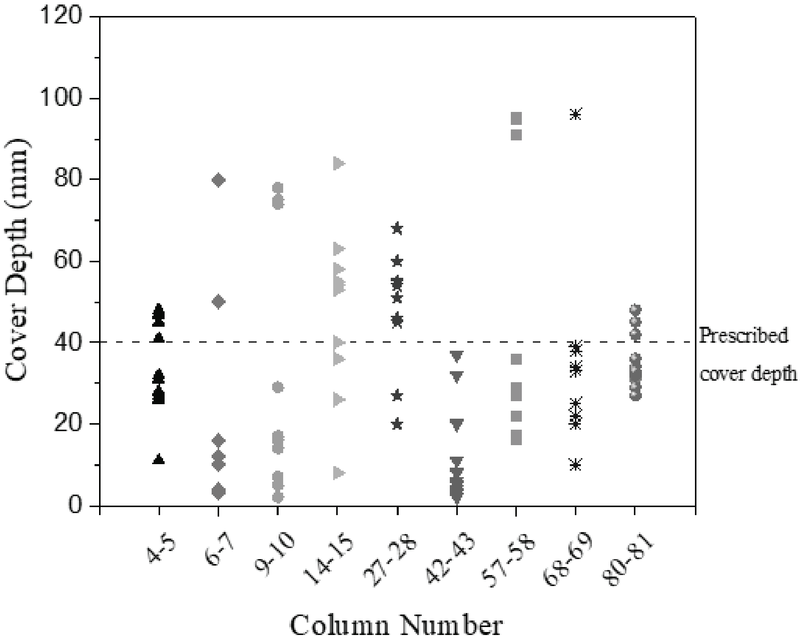


Fig. 99: Cover depths measured for the steps of the gallery (Note: The measurements were taken from the bottom and top of the element according to the ease of accessibility to the structural element. The bottom part of the beam is expected to have less cover depth due to the sagging of rebars during construction. Cover depths greater than 40 mm can be the cover depths measured from the top of the gallery.)

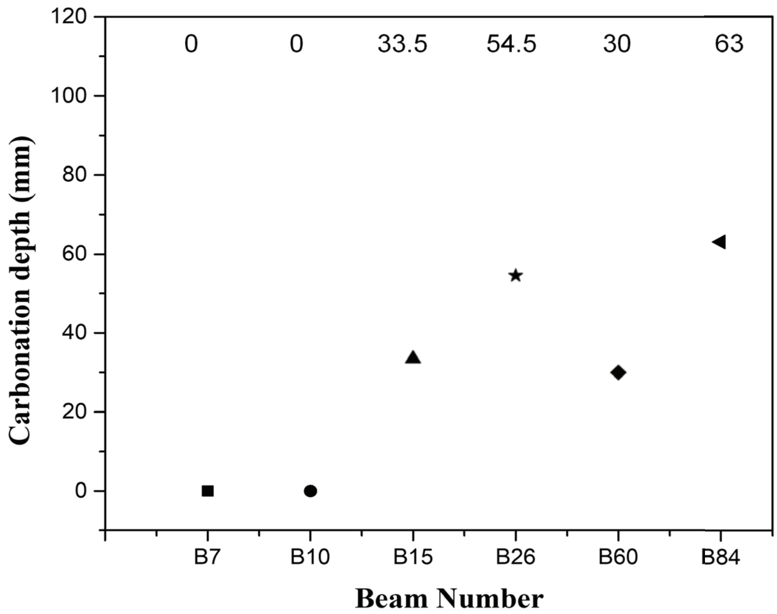


Fig. 100: Carbonation depth in concrete core samples of gallery beams

Fig. 101: Corrosion-induced spalling of concrete in the staircase

ID	(i) Least surface area		(ii) Average surface area		(iii) Nominal surface area		Percentage reduction in yield stress [(i-iii)/iii]/100
	UTS	YS	UTS	YS	UTS	YS	
A	381	370	326	320	312	305	240
B	554	420	446	350	417	330	378
C	528	390	445	375	416	370	78
D	443	350	395	400	382	340	35
E	403	350	343	300	287	250	350
F	425	325	397	310	391	300	81
G	446	425	397	370	385	355	297
Average							≈200% (≈2 times reduction)

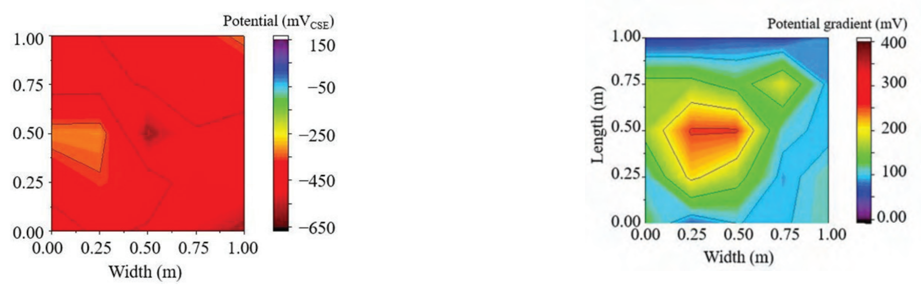
Table 6: Ultimate and yield stresses of collected steel rebars

Staircases

Staircases at all the locations (old and new) were found to be severely corroded on the underside as shown in Fig. 101. The steel rebars were hanging, and the cross-section of the rebars was significantly reduced. All the staircases have shown significant deterioration. Therefore, tests such as HCP measurements, resistivity of cover concrete, carbonation depth, chloride concentration, and additional tests are not required for this element. To check the residual tensile strength of the steel rebars, tension tests were conducted on collected rebar samples. Table 6 shows the tensile strength of the steel rebars, considering the nominal, minimum, and average cross-sectional area of the tested rebars. The ultimate nominal tensile stresses of the rebars were found to be significantly lower than the ultimate tensile stresses with the minimum cross-sectional area of the rebars, indicating that the tensile capacity of the steel rebars in the stairs have significantly reduced (by ≈ two times). Considering this, many of the staircases may be unsafe for use.

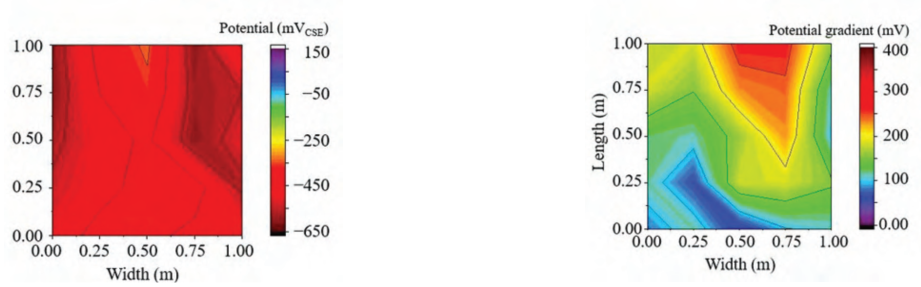
Ramp To The Mezzanine (North, East And West Stands)

Like the column elements of the seating frame, the ramp to the mezzanine has not shown visible distresses on the concrete surface. However, the HCP and potential gradient mapping for the ramp to the mezzanine near Columns 27, 38 and 80 show high potential gradient of about 400 mV, indicating higher corrosion rate (Figs. 102, 103, and 104). If these are not addressed soon, the distresses due to corrosion shall be visible on the concrete surface.



a. Half-cell potential　　b. Potential gradient

Fig. 102: Contour plot for the ramp to the mezzanine of Column 27



a. Half-cell potential　　b. Potential gradient

Fig. 103: Contour plot of the ramp to the mezzanine of Column 38

a. Half-cell potential　　b. Potential gradient

Fig. 104: Contour plot of the ramp to the mezzanine of Column 80

Canopy

The canopy showed no distresses due to corrosion on the concrete surface except at the construction joints. Fig. 105 shows that the carbonation depth in the canopy element is about 20 mm. The thickness of the canopy at the free end is about 75 mm. Therefore, the cover to reinforcement at the free end would be less than 20 mm, indicating that the corrosion of the rebars may have initiated or shall initiate in the near future. Additionally, the average resistivity of concrete from the three extracted cylindrical concrete specimens from the trough of the canopy was found to be 1.4 kΩcm, which is significantly lower than in the other elements of the stadium, indicating that if corrosion is initiated, the concrete may not offer adequate resistance to ionic conduction. On the other hand, the average resistivity of the crest of the canopy was found to be 100 kΩcm. Stagnation of water in the troughs of the canopy may be one of the reasons for the low resistivity of the concrete. The potential gradient for the investigated region of the canopy trough and crest were measured to be about 150 mV, indicating that corrosion cells with such high potential gradient may to lead a high rate of corrosion (Fig. 106). Stagnation of water due to inadequate drainage may support the corrosion process. Therefore, corrosion prevention strategy for this element is essential. The first step in this direction is to regularly (once in three months) clean the drainage from the top of the canopy. Other repair strategies are discussed later.

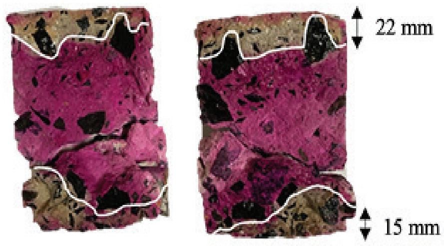
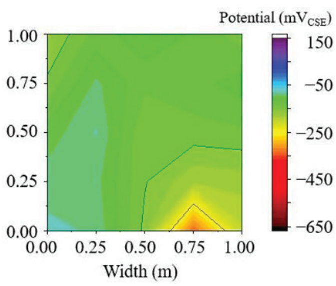
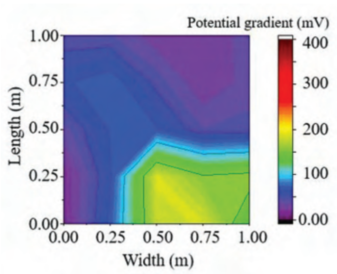


Fig. 105: Carbonation of concrete in the canopy

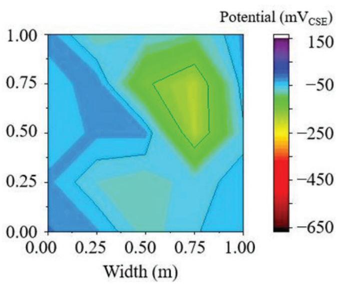


HCP

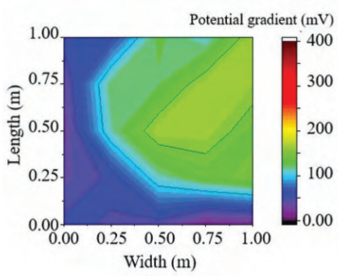


Potential gradient

a. Trough



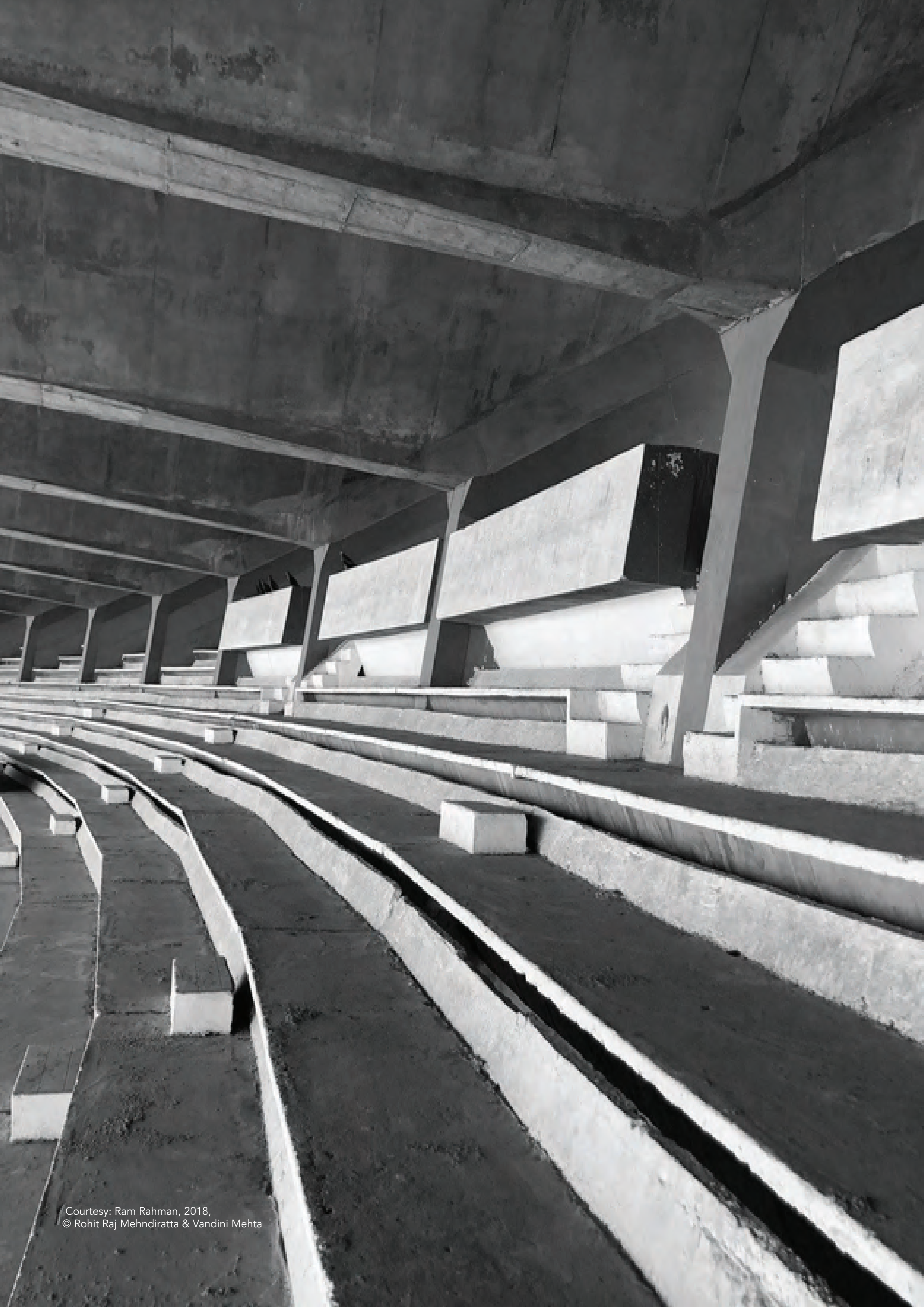
HCP



Potential gradient

b. Crest

Fig. 106: Contours of HCP and potential gradients for elements of the canopy



Courtesy: Ram Rahman, 2018,
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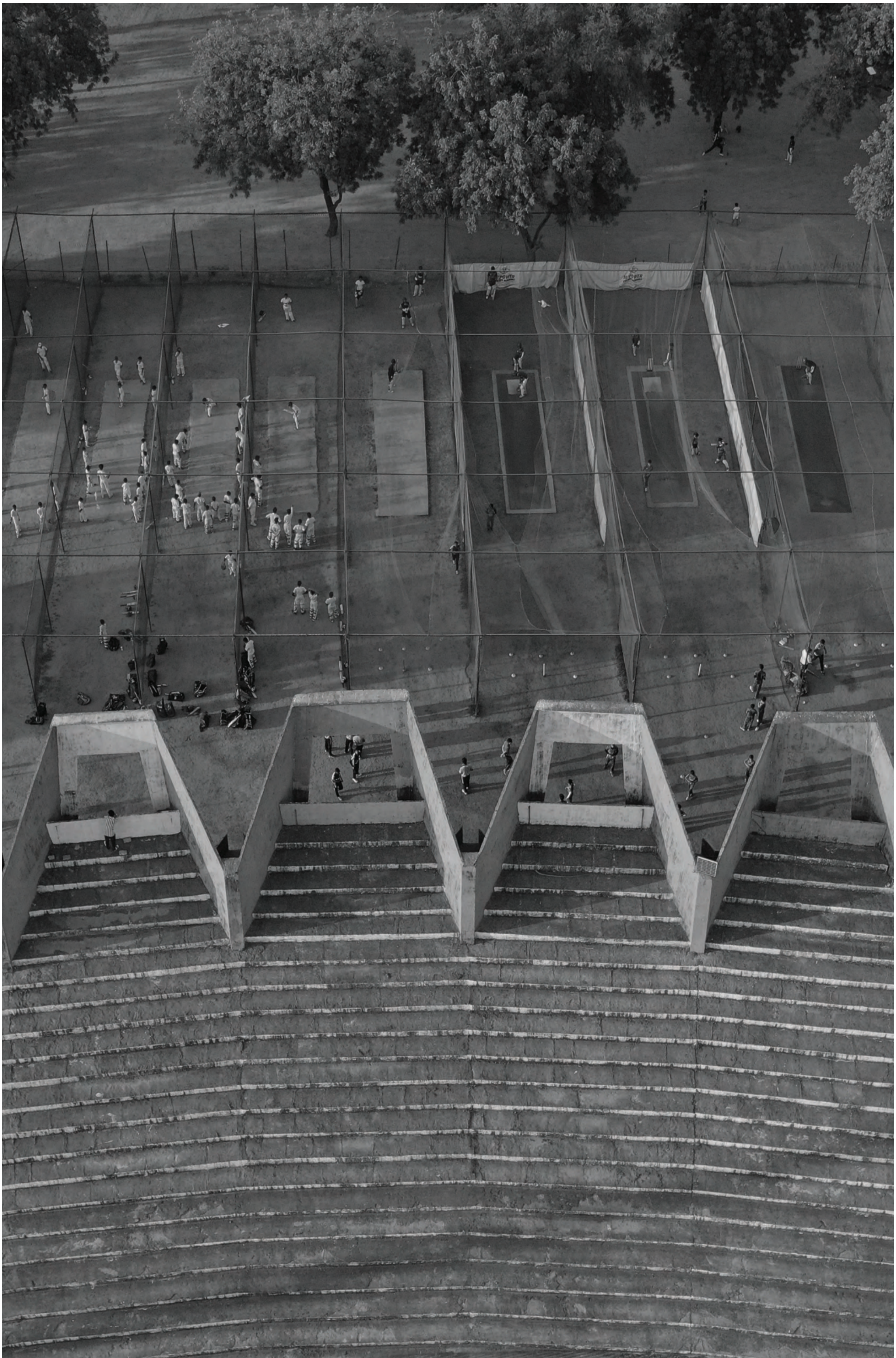
9.0 PLACEMAKING



Placemaking

As part of the rejuvenation process , SVP Stadium offers many opportunities. The pros and cons of such opportunities have been studied carefully to ensure that the stadium built in 1961 adapts and remains useful not only today but in future as well, especially, since the game of cricket has evolved over time.

Among the notable strengths of the stadium are its location, the grandeur of its architecture and the versatility of the structural design, particularly, at a time when engineers had no more than a slide rule to help them with their calculations. The design, however, incorporated only basic facilities for the comfort of the users (i.e., the players and the spectators). This makes it imperative for the stadium to adapt, and incorporate new facilities, amenities and features now required because of the way the game is played and watched today.

9.1 Why the Stadium was a Much Utilised Space

In the 1960s, easy accessibility from anywhere in Ahmedabad made the stadium a popular venue for watching the game live. Moreover, other forms of entertainment were limited, for instance, there was no television, and despite the expert commentators on the radio, cricket lovers preferred visiting the grounds and watching the game live. Affordable pricing of tickets, especially for the West and East stands, was an added attraction.

Nonetheless, the amenities at the stadium were basic and not conducive to player or viewer comfort, as is the norm in the newer stadiums today. That notwithstanding, spectators still watched the game in the stadium because of their passion for cricket. Over time, however, the level of comfort expected by the players and the spectators using cricket stadiums has evolved. Thanks to the hype created by the print media around the game, fans visited the ground to get a 'real and live' feel of what they had read in print.

Around 1970, several stadiums were built in other cities across India, and like SVP Stadium, in the heart of each city. While that may have been due to easy availability of land within each city, it provided spectators easy access to the stadium, garnering tremendous popularity for the game of cricket.

The new-age dynamics started with television bringing in huge revenues for the game. With growing revenues came the demand for quality and the possibility of determining price points and values. The need for change at stadiums began with the telecaster wanting to upgrade the quality of live relays. Camera positioning, PCR (Production Control Rooms), media centres for commentary teams, facilities for in-stadium advertising / branding, all called for a drastic rehauling.

With the professional management of teams, player demands changed too. Structural changes allowing alterations in the dressing room interiors, and in other facilities were undertaken to provide the players the best means for maximum performance.

For the lack of an alternate use for Indian cricket grounds beyond the five-days of test matches, the Ranji Trophy fixtures or the IPL, during the off-season, these grounds are poorly maintained—a huge concern when managing the operating costs of a stadium. It is difficult to decide how much money should be invested for its upkeep and modernisation, to balance it with the return that would be generated. Hence, a realistic and judicious revenue-generating approach becomes important.

While considering addition of facilities to the stadium, it is crucial to strike the right balance between what is being offered to the users and spectators, and an appropriate management of these activities. Earlier, this was not a major concern.

Over the years, a large number of citizens—nearly 850, at last count—have started using SVP Stadium every day for jogging, walking, yoga practice, free hand exercise, and more. This is particularly significant as this connects the stadium to a wide range of users, making it not only a unique piece of modern architecture but a living part of community life.

A detailed market research needs to be conducted before any investment is made in the value additions that are perceived to be potential revenue generator

9.2 Use of Cricket to Inculcate Values in Children and Youth

1. It is important to create models that directly benefit children, based on their aspirations. Irrespective of where he comes from, a sportsperson's shared goals remain the same—inculcating and imbibing team spirit, leadership and discipline.
2. Appropriate opportunities need to be provided to youngsters to use sports as a tool to acquire qualities that make them good human beings.
3. Whether pitched as amusement or entertainment, or aimed at the development of a child, the training should metamorphose from a child to an able youth.
4. How you play is not the only important thing. After all, sports reflects the kind of person you are.

Today, cricket is a well-organised industry, with its main focus being on excellence and performance. Thanks to their quality performance, cricketers have become role models of success. Compared to the film industry, film-making and cricket are a team sport. And, cricketers like movie stars, are celebrities in their own right. But in this day and age, among other aspects, money is a key motivator that draws young aspirants to the game. However, it is equally important to promote ethics that make cricket a noble game.

9.3 Changes in 'New Age Stadiums' and Their Sustainability

- It has been observed that recently, a number of new stadiums are being built mainly because of funding from BCCI, and other subsidies being made available to build them. While some of these stadiums shall survive, others shall find it difficult to sustain themselves unless there is a sustainable plan for revenue generation.
- It may be important to develop a revenue model similar to that of a club—with exclusive health and sports-centric facilities, where members using the multiple facilities take ownership and become part of the system and the process. In addition to cricket facilities, one can incorporate other indoor facilities, enhance the coaching facility, add more fun activities like skating and, perhaps, even dining facilities.

- It is important to have in place a rationalised system of building a corpus, perhaps, by charging membership / life membership / corporate fees, to generate decent revenues to sustain the stadium, taking into account the maintenance overheads and other monthly recurring costs. There could be a drive to get patrons and CSR collaborators.
- Activities like spectator sports involving the player as well as the spectators—skating, bowling, perhaps, even virtual games—should be considered. The pleasure of playing, with people enjoying the sport could make the stadium a happening place and generate revenue.
- With technological advancements like Augmented Reality, one can conceive games like 'Virtual Cricket' where one can transform into a cricket personality of one's choice, play virtually and enjoy it as if in real life. Such revenue-generating fun games can target the young. In the evening, or during non-sporting hours, like peripheral activities in shopping malls, food courts and sports good shops could further increase the footfalls and the revenue.

9.4 Activities Proposed in SVP Stadium

After discussions with several experts, it can be inferred that there are three major types of activities that can be considered for the stadium complex. The basic categories of usage may be grouped into:

1. Events / activities / functions possible without damaging the pitch and the ground, such as literature fests that can be organised in the stands.
2. Events / activities / functions possible with some maintenances or repair of the pitch and the ground, such as rock concerts, exhibitions or fairs of less than three days duration.
3. Non-permissible events / activities / functions that are to be completely avoided as they would damage the pitch and the ground such as high footfall events of more than 3-7 days, etc.

In earlier times, the ground would be prepared just before a cricket match as that was financially viable. In present times, the use of the stadium on a daily basis calls for its regular upkeep—a drain on the resources as there are no revenue-generating activities.

9.5 Motera Stadium and its Shadow Effect on SVP Stadium

- The main cricketing activity has now shifted to the newly built Motera Stadium. Given that a new sports complex is coming up near Motera, any plans for SVP Stadium have to be drawn up with these two aspects in mind.
- All care needs to be taken to avoid duplication. SVP Stadium can act as a support to Motera Stadium, without aiming for the same goals and objectives.
- SVP Stadium's strengths have been training, coaching and practice. These should be enhanced and concentrated on with new vigour and able mentorship.
- Capitalising on the locational value, the focus could be training schoolchildren and organising national level matches.

The Cricket Club of India (CCI) was once an epicentre of the Bombay State Association, but after Wankhede Stadium came up, CCI was used for racing and even hosting family dinners. Soon, it metamorphosed into a self-sustainable club, with a strong revenue model focussing on activities like swimming, badminton, and squash.

It becomes pertinent to develop a revenue-generating model for SVP Stadium. Given that this stadium cannot compete with Motera as the preferred venue for international cricket matches, SVP Stadium needs to evolve as a cricket training ground and a multi-sports centre. This again raises concerns on the permissible additions to the stadium.

1. The city lacks a multi-sports centre. Youngsters are drawn to spaces that offer a variety of sports and activities for holistic development. The stadium should attract youngsters and encourage them to hone their skills. Outdoor games like kabaddi, kho-kho and even volleyball can be developed without disturbing the cricket pitch.
2. The concourse can be creatively used as an exhibition space to showcase the architectural glory and cricketing history of India. With proper lighting, the concourse can be a multi-purpose space during non-cricket hours.

9.6 Integrate and Build a Relationship Between Sports, Community and Government

- With the consensus of multiple stakeholders, and given the alternate and multi-use value of the stadium, it must be promoted as a holistic cricket and sports activity centre to the government. The local authorities, various cricketing and tennis associations, government and managing authorities must be made important participants involved in the sustainable management of the complex. A consensus on the activities available in Ahmedabad and what can be developed at SVP Stadium, is of utmost importance.
- To draw people to this space, it shall require a brand ambassador like, perhaps, someone as famous as Sachin Tendulkar, who shall be a mentor and advisor for cricket coaching and other cricket-related activities.

A potential concern with the rejuvenating process is the possibility of it becoming too expensive.

The other potential worry is overinvesting in infrastructure and facilities based on projections and perceptions, and not on ground reality. Professional expertise is required to handle each activity independently, including the placement, pricing and positioning of the facility, and the activities.

9.7 Design Brief for Master Plan

Scope of Work

Requirements addressed by the Adaptive Reuse Consultant:

1. Master Planning
2. Zoning Within the Stadium Building at the Concourse Level
3. Introduction of a New Building—Indoor Stadium

Stakeholder Organisations

- Sports Authority of India
- Sports Authority of Gujarat
- Department of Sports, Youth and Culture
- AMC

Master Planning

Prepare an integrated master plan by reorganising the existing components around the stadium building to accommodate new requirements, and if possible, an indoor stadium, without impacting the visual integrity of the existing stadium structure.

Area of Campus incl. the Courts	80, 680 sq. m.
Area with the Stadium	40, 036 sq. m.
Footprint of the Stadium	35, 621 sq. m.
Concourse Area	10, 570 sq. m.

Existing Components

Stadium

Seating capacity—50,000 (approx 35,000 if bucket seats are introduced)

Sports Facilities

10 wickets in one cluster, western side / single wicket in the east

Gujarat Cricket Association practice court in the northwest corner

Trees

450 trees (girth available)

Tennis Courts

Part of the campus but with a separate identity, independent gate and parking, all managed by the Tennis Association

Tennis court—6,286 sq. m.

Use—Tennis matches, tennis coaching classes

Parking

Parking for 50 four-wheelers and 300 two-wheelers.

Future Requirements

Planned Circulation

Planned movement for all users with minimum conflict; the community should not be alienated from the space which they have been using over the years

VIP movement without disruption of routine activities

Access for emergency services like fire engines, ambulance, etc., to be planned

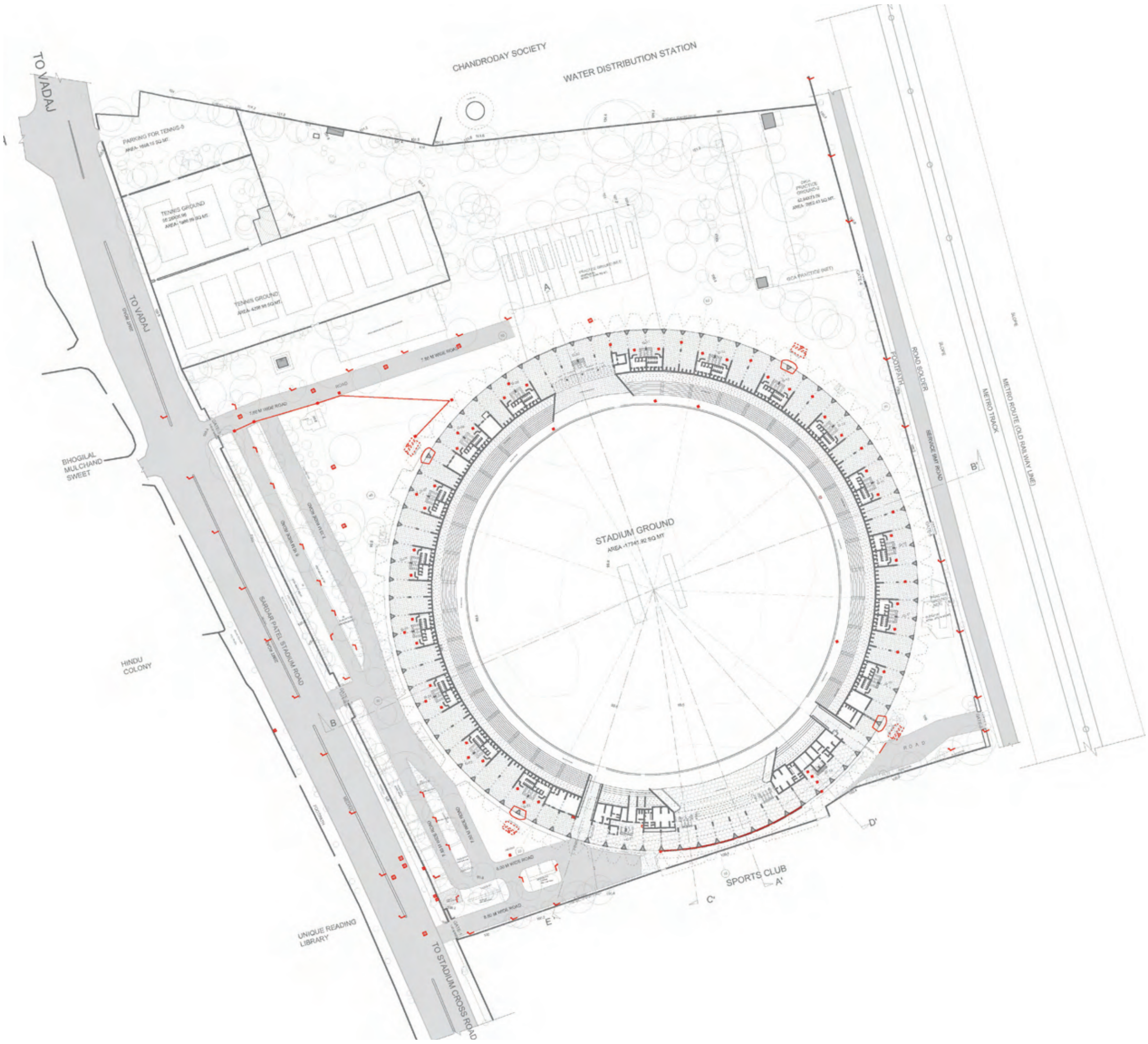


Fig. 107: Site plan of SVP Stadium with the existing components.

Additional Sports Facilities

Cricket wickets—At least 8 to 10 nos. (new), each 12.2 m. x 3.05 m.

Warm-up football field (1/2 football ground)—1,750 sq. m.

Skating rink—1800 sq. m.

Tennis

Integrate the courts as part of the main campus

Demarcate space for seating stands around the tennis courts

Parking

When important state events are organised here, parking requirement goes up to 3,000 vehicles. To accommodate such a large number, additional land may need to be acquired for parking,which can be used as paid parking through the year. Alternatively, a vertical parking system can also be proposed to avoid blocking the structure and cutting the trees.

VIP parking with their security and media parking needs to be planned too.

Security

All the gates should have security cabins and surveillance

Additional Facilities, and improvement and modernisation of the existing facilities to make the stadium relevant today

Value Addition Facilities that would increase foot fall and generate revenue .

Zoning within the Stadium at the Concourse Level

Existing Uses and User Groups

Central Pitch

- Domestic cricket matches
- Cultural events—Music, Yoga
- State celebrations

Outer Periphery of Pitch

- Morning walkers
- Joggers

Stadium Seating & Concourse Level

- Open air gym
- Yoga classes
- Cricket coaching camps
- Karate coaching classes
- Meeting space for senior citizens

Existing Facilities at the Concourse Level

Gym with physio facilities—83.53 sq. m.

Men's dressing room 1—104.5 sq m.; Women's dressing room 1—105 sq. m. in the North

Men's dressing room 2—103 sq. m; Women's dressing room 2—86.13 sq. m. in the South

16 toilet blocks under the stands. Toilet blocks 1 & 16 have an area of 40.34 sq. m. each. Toilet blocks 2 to 15 have Gents and Ladies; the combined area of each block is 80.68 sq. m.

Office space for AMC—9.36 sq. m.

Office space for GCA for 6 people, with a meeting space for 8 to 10 people—115 sq. m.

Proposed Requirement at the Concourse Level

Amenities for Sportspeople

Massage room—22.5 sq. m. (Size: 5 m. x 4.5 m with a massage table measuring 1.8 m. x 9 m.)

Warm up rooms—15 sq. m.

Locker rooms with drinking water facility for coaching class pupils—37.13 sq. m.

Locker room for coaches and support staff—20 sq. m.

Medical emergency room with approximately 2 beds—13 sq. m.

Office Spaces

Ground staff, 4 to 5 people—14.63 sq. m.

Match referee and umpire (3 + 1) cupboards, refrigerator and small dining table—16.7 sq. m.

SPV (Special Purpose Vehicle) of 4 people, with meeting space for 10 people—27 sq. m.

Cricketing services users of the area—47 sq. m.

Coaching services office—180 sq. m.

AMC meeting space – 56 sq. m.

Broadcasting Facilities

Commentator's room with PCR at the back—56.12 sq. m.

Broadcaster's room with a café for the broadcast team and TV crew—80 sq. m.

Media centre with a conference room for 15 to 20 people—167.28 sq. m

Video analyser's room, attached to the dressing rooms with glass window—9.2 sq. m. x 2 nos.

Franchised Services

Coffee shop, franchise—140 sq. m

Coffee shop, health food—100 sq. m

Sports goods shop—110 sq. m

Interpretation Centre

Cricket library: Should have printed books, video / digital library of memorable games in the history of cricket, area with coffee shop—56 sq. m.

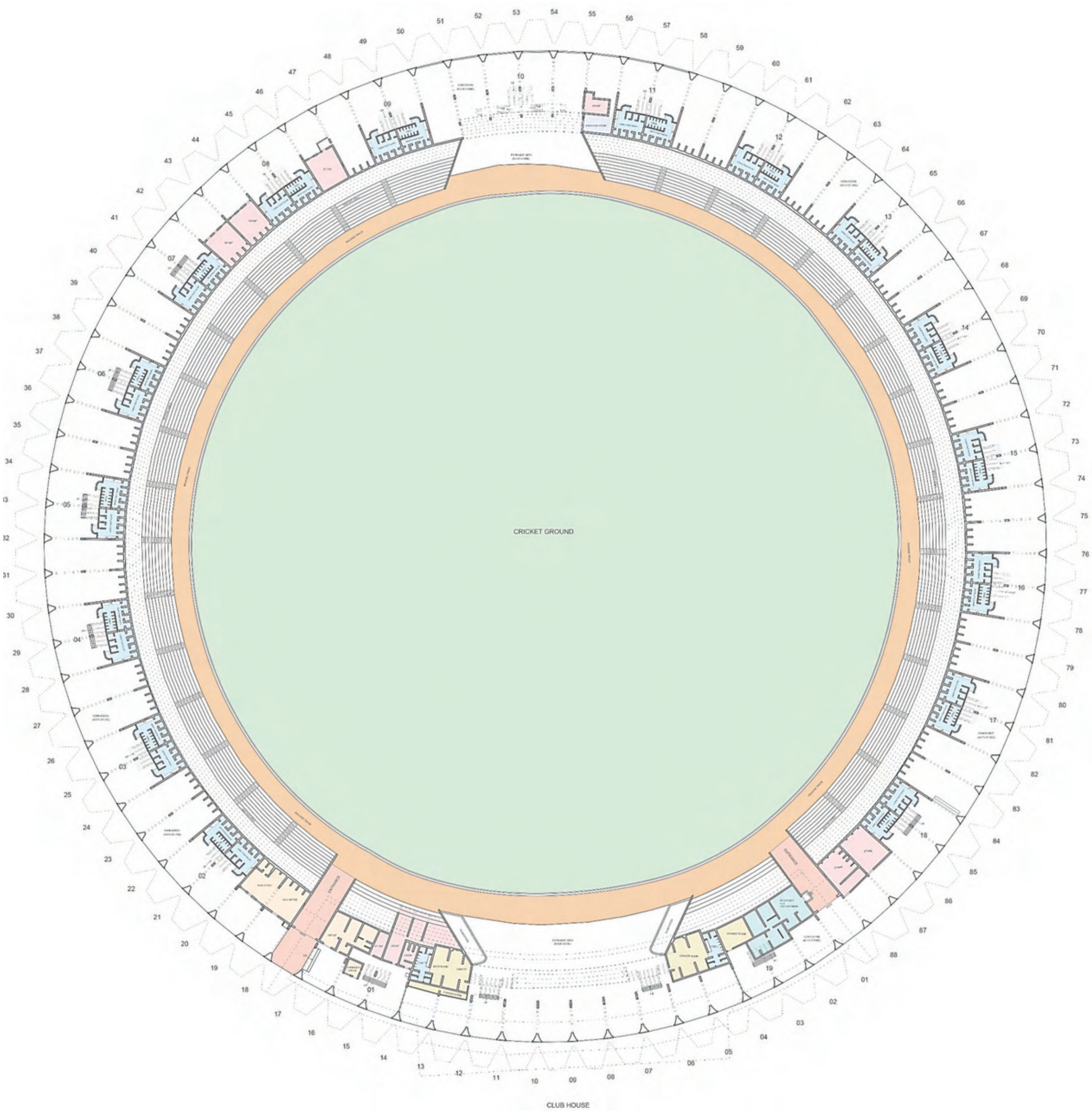
Cricket museum—300 sq. m.

Audio visual room—capacity 25 people

Conference hall with projection facility (classroom type), with a capacity of 50 people; the hall shall be multi-functional, and can be used as a classroom for cricket coaching, especially, when there are no games—180 sq. m.

Exhibition Space

Temporary exhibition space to be rented out for revenue generation



ENTRANCE
CRICKET GROUND
WALKING TRACK
OFFICES
PLAYER'S CHANGING ROOM
RESIDENCY FOR GROUNDSMAN
STORE
EXERCISE ROOM
TOILET

Fig. 108: Plan of the concourse level with the existing facilities.

Indoor Stadium (New Building)

(Between tennis court and cricket court)

Explore the possibility of a new building within the stadium complex, and establish the scale and dimension of the same. Area of 2,405 sq. m.

It is important to understand the value of the land and use the land judiciously without overcrowding, or cutting existing trees. According to the standards laid down by the Olympics and Sports Authority of India, the following facilities may be considered:

Wrestling ring, square-shaped—165 sq. m. (field + 15% extra)

Shooting range: 10 m. / 15 m. / 25 m.—270 sq. m.

Kabaddi, men's—143 sq. m. (130 sq. m. + 10% extra)

Kho kho—432 sq. m.

Table tennis (2 tables) —86 sq. m.

Squash—62.51 sq. m.

10.0
POLICIES


AHMEDABAD MUNICIPAL CORPORATION WELCOMES YOU

Policies

This chapter aims to outline conservation policies to enable Amdavad Municipal Corporation, the owner of Sardar Vallabhbhai Patel Stadium, to conserve it and other 20th-century marvels that fall within their jurisdiction. It also seeks to articulate site-specific policies that would serve as a handbook for the facility managers, aiding them to interpret, manage and safeguard the significance of the stadium while enabling it to evolve over time.

These policies also hope to highlight the relationship between the character-defining features of the stadium complex, and the threats that put these at risk of losing the underlying values embedded in the site. In future, this set of guidelines shall help strategize and implement proposals in a comprehensive manner.

10.1 Overarching Policies

- The significance of the stadium should be conserved, interpreted and managed as part of its future use. It is essential that this statement guides the conservation of all the significant attributes of the stadium, structural elements and areas included, and that the integrity of the overall built fabric is maintained.
- The owner should consider listing the property at the municipal [32], state, and national level [33] to reap benefits of the designation, such as spreading awareness about this iconic structure, securing a sustainable functioning, and guaranteeing future protection of this public space.
- The conservation policies laid out in this chapter should be adopted by AMC as a manual to assist with the conservation, interpretation and management of the stadium, and ensure smooth governance. Additionally, these policies should be reviewed periodically by AMC in collaboration with a technical committee composed of an experienced conservation agency or a multi-disciplinary group of professionals. This committee would serve as an advisory body and review the policies every five years to certify that they remain relevant, and enable future implementation.
- This advisory body should also ensure only experienced and relevant professionals or agencies are engaged to strategize, develop, implement and supervise the different work proposals that are approved by AMC, especially the repair, maintenance and interventions made within the sports complex. This committee should consist of professionals with experience of conserving 20th-century properties and ensure the work proposals preserve the stadium's significance.
- The technical committee in collaboration with AMC should also lay down qualifications required for the consultants and contractors, and design a vetting process to ensure that the work is only awarded to skilled professionals.

32.A list has already been prepared by the Heritage Committee of AMC. However, this list has not yet been ratified by the governing body.

33.A few years ago, the Archaeological Survey of India (ASI) outlined the criteria for 'National Cultural Heritage Sites', a listing initiative in which properties with outstanding national values would be registered. Reference: https://timesofindia.indiatimes.com/india/National-list-of-unique-heritage-sites-on-cards/articleshow/45961273.cms . Acessed 28 December 2021.

- All work implemented within the sports complex, especially in the South Pavilion should be accomplished in a pre-planned and systematic manner. All these additions should be reversible in nature, well documented and properly reviewed by a technical committee to ensure that the authenticity of the stadium is not lost, and that no ad hoc interventions are introduced over time.

10.2 Maintenance Policies

- Commission a maintenance manual that informs the site manager about the different tasks that need to be performed to enable proper upkeep of the facility. This document shall also identify a cleanliness protocol to maintain hygiene and monitor water consumption, when periodic inspections should be conducted, which phases of the facility need investigation, and provide accompanying procedures to implement the work.
- Every five years, photo-document all the character-defining features of the stadium such as the street elevations, structural elements, spatial quality of the concourse, the cricket ground with the surrounding seats and cantilevered roof, among others. This shall help the site managers record changes over time, and build an archive that would help them uphold the significance of the stadium. Some digital methods of documentation recommended for this survey include photography, photogrammetry, aerial mapping and laser scanning. It is advised that a documentation strategy is identified in the beginning of this activity, and recommended tools used as necessary.
- Consider designating visually less intrusive areas within the site, or in the vicinity for vehicular parking. Additionally, prohibit parking of maintenance vehicles along the concourse of the stadium at any point.
- Avoid storing appliances, special event equipment, maintenance tools and gadgets in areas such as unused toilets, overhangs or unused office spaces. Use only allocated storage spaces within the stadium.
- Maintain a logbook of all work proposals (structural and architectural) implemented within the property, especially for the stadium building. These notes should have pertinent information such as before / after images, drawing proposals, tender documents, list of works implemented, recommended methodology, and list of hired professionals, among others. Furthermore, ensure all these documents are regularly digitised and easily accessible to the owner, site managers and advisory body. This workflow and access shall empower everyone to take informed decisions.
- Periodic material and building system assessment should be carried out to ensure the maintenance process is proactive in nature instead of reactive. During this action, ensure the surface finish of the building elements is closely evaluated to ensure there is no breach in the protective barrier, and the aesthetic and artistic quality of the form-finished concrete can be maintained regularly.
- Periodic services audits should be carried out to ensure the infrastructure upkeep process is proactive in nature and informs future upgrades.

10.3 Conservation Policies

Context and Setting

- The current site and the adjoining properties (part of the original lot) owned by AMC must be conserved, utilised and managed in a holistic manner, guaranteeing that the story and values associated with the origin, evolution and development of the sports complex are retained in the long term.
- All the existing structures, especially the ones that were a part of the original design and development of the sports complex such as the stadium building, clubhouse, swimming pool, etc., should be retained to ensure longevity of the stadium's significance.
- Appoint a consultant to undertake a detailed study of the existing terrain, including the flora, fauna and hardscape. Review the findings and chart out a comprehensive plan to combine the tangible and intangible qualities of the landscape (existing and proposed) with the built fabric within the site.
- All the trees within the property should be retained, maintained and integrated into the landscape management plan to the extent possible.
- New developments should be avoided and restricted to the extent possible. These should be considered a viable option only when these are essential to making the site viable for future long-term use. Even in such cases, the new proposals must be regulated by all the relevant policies enumerated in the CCMP.

Built Fabric

- The stadium is a fine example of an artistic collaboration between Charles Correa and Mahendra Raj. So, ensure that the intent of the architect and engineer are preserved at all times, especially in the South Pavilion. This includes significant views, the spatial arrangement, structural configuration and visual quality of form-finished concrete.
- All the significant views to, from and within the stadium complex should be conserved to the extent possible. Undertake a detailed analysis of the existing views in conjunction with the meticulous survey of the stadium's existing landscape. This shall enable the site management to make informed decisions about which views need to be preserved as is, and where there may be some tolerance for change.
- The cantilevered canopy of the stadium, an engineering accomplishment, should not be altered. All previous interventions like the installation of solar panels, lightning arrestors and electricity conduits that alter the authenticity of the structure should be re-engineered or relocated.
- Ensure no new interventions, big or small, impact the visual, structural or material integrity of the stadium building. Additionally, relocate the office space that was recently added to the concourse of the South Pavilion.
- Ensure that the spatial integrity of the structure, formed by building elements such as the cantilevered roof, seats, grounds, and portico along the concourse, are preserved in their original form.
- Retain the architectural value of the stadium's exterior facade, and preserve the legibility of the structural elements [34] that add to the image-ability of the stadium. Additionally, ensure that the stadium's visibility along the line of sight, especially from Sardar Patel Road, is not obstructed.

34.A-Frame, seating frames, cantilevered canopy, mezzanine floor, and precast seats are the most significant features of the stadium. See Chapter 4, Subsection 'Building Description' to learn more about these building elements.

- Maintain the aesthetic and artistic value of the form-finished concrete used to construct the stadium, especially the South Pavilion. The surface finish, colour and texture of the concrete should not be altered. A chromatic study should be commissioned to ensure the patchwork or coatings carried out retain the visual quality of this construction technique.
- Ensure the conservation recommendations are executed by relevant and experienced professionals who understand the architectural significance of this engineering marvel, and shall ensure its artistic value is conserved. It is critical that this work is supervised by the technical committee in collaboration with AMC.

Material and Finishes

- Safeguard the original material palette and structural configuration of the stadium, especially the South Pavilion. Additionally, maintain the colour and texture of the form-finished concrete, including all the historic layers of the surface finish.
- Undertake a detailed study of the surface finishes of the stadium building, and its perception by the local community, especially the painted finish of the A-Frames and the flooring. Review the findings and develop a strategic plan to combine the tangible and intangible qualities added to or removed from the visual appearance of the stadium building.
- Commission a detailed examination of the chromatic properties of the form-finished concrete surface that would inform the repair strategy for the surface finish in order to safeguard the artistic value associated with the cultural significance of the stadium.
- Considering no information is available on whether the floors along the concourse are original or not, and the existing flooring finish is in relatively good condition and weathered well, the floors shall be retained.
- All repairs at the South Pavilion shall be carried out in small scales through mock-ups, and then executed in place. Ensure the mock-ups are carried out at a discreet location, away from the most-used areas of the South Pavilion

New Intervention

- The South Pavilion is the most significant section of the stadium, so, it should be preserved in its entirety. No new interventions that can alter the original intent and design should be allowed.
- Ensure that the spatial quality of the stadium seating along the North, East and West stands is retained. In special cases, a temporary cover can be installed to cover parts of the seating area. It is critical to ensure that the intervention is reversible, and designed using alternative materials. The concept, development, implementation, and eventual removal of canopies, need to be approved by the technical committee in collaboration with AMC.
- The bays with retaining walls and buttresses along the concourse of the North, East and West stands can be spatially utilised to accommodate new facilities. However, it is vital to ensure that alternative materials are used to create these new additions, and the intervention is reversible, with the only exception being the reconstruction of toilets.
- Ensure that amenities on the cast in-situ seats in the North, East and West stands such as benches, handrails, footrest, and any additional finishes introduced onto the surface of the seats are alterable and non-intrusive.

- It Is also vital that they are fitted in a manner that they do not compromise the structural capabilities of this building element. Additionally, it is imperative that the reversibility of the proposal be reviewed and approved by the technical committee in collaboration with AMC.

Site Facilities and Infrastructure

- Review the existing security measures being undertaken within the stadium complex, and recommend processes that need to be included to improve the safety of the users and the significant features within the site.
- Reassess the current grade of the walking track, and the water movement in its vicinity. Review the findings from this research, and integrate the recommendations into the landscape management plan drawn out for the stadium complex.
- Engage with a specialist to draw up a comprehensive plan to re-establish the ground and storm-water movement, and drainage within the entire stadium complex. Additionally, commission a detailed assessment to develop a deeper understanding of the other existing utilities and services of the stadium and site, such as water supply, drainage (sewerage), electrical, emergency response and fire protection systems, among others. Review the findings from the studies, and integrate these into the cyclic repair and maintenance programme created for the smooth functioning of the facility.
- When mounting equipment such as air conditioners, water tanks and exhaust fans to facilitate the everyday operations of the stadium, make sure they are mounted in the least visually obstructive manner. Avoid mounting fitments, especially electrical conduits, on the structural components, as these mar the surface finish and texture of all the concrete elements, especially in the South Pavilion. Additionally, relocate all the electrical panels that are sporadically placed round some A-Frames along the concourse of the North, East and West stands.
- Relocate the solar panels currently installed on the cantilevered canopy of the South Pavilion to the utilities area adjoining the northeastern section of the site. Alternatively, it is recommended to move them over the roof of the new interventions planned within the stadium complex. This repositioning is essential as the support system of the solar panels has already compromised the structural integrity of the cantilevered roof at the critical knee joint near multiple A-Frames.
- Inadequate toilet provision within the stadium, both in terms of spatial quality and amenities, has continued to adversely impact the way people currently utilise the stadium. Upgrading this facility across the entire stadium shall greatly improve user experience, and facilitate smooth functioning of the stadium as a sports facility.
- No signages should be mounted on any of the structural elements made in concrete. Additionally, the signage system should be reversible. The signage should be designed and implemented according to the recommendations specified in the document 'Master Plan Design', a part of the CCMP.

Placemaking and Visitor Management

- Make sure that the significant themes, key stories and placemaking opportunities gathered as part of this research phase, are incorporated into a holistic interpretation plan—an essential part of the conservation planning process.

- Envisage a way to utilise the extensive conservation work carried out on site as an opportunity for interpretation. This programme needs to be developed by relevant and experienced professionals, with the technical committee and AMC. The appointed consultant should employ cutting-edge storytelling and curation tools to spread awareness of this iconic 20th-century building, and its long-standing relationship with the city and its cricket culture.
- Strategize and develop access routes and visitor movement within the stadium that can be implemented on site, depending on the study undertaken as part of the community engagement initiative, and need for additional security measures. It is imperative that these variations ensure that the spatial experience of the community does not degrade due to any number of reasons, and that local residents are able to enjoy the space in a more refined manner than they have in the past.
- Create a Special Purpose Vehicle within the site management office that monitors and administers the sustainable upkeep of the property.
- Appoint a cricket training and education management personnel with relevant experience to oversee the strategic development and operations of the facility.

10.4 Implementation Planning Policies

- A Landscape Management Plan (LMP) should be prepared in accordance with the philosophy and approach of the CCMP. It is important that detailed studies are undertaken to better understand the flora and fauna currently flourishing on site. This plan should also outline the tangible and intangible opportunities that can be integrated into the comprehensive development of the stadium complex.
- A cyclic maintenance and repair plan should be prepared and implemented for the stadium building.
- A concrete repair management system (structural and cosmetic) should be prepared and implemented in the stadium building, especially in the South Pavilion. This shall ensure that the repairs carried out over time remain consistent, and do not devalue the architectural value and structural ingenuity of the stadium.
- An interpretation plan should be prepared in accordance with the philosophy and approach of the CCMP.

11.0

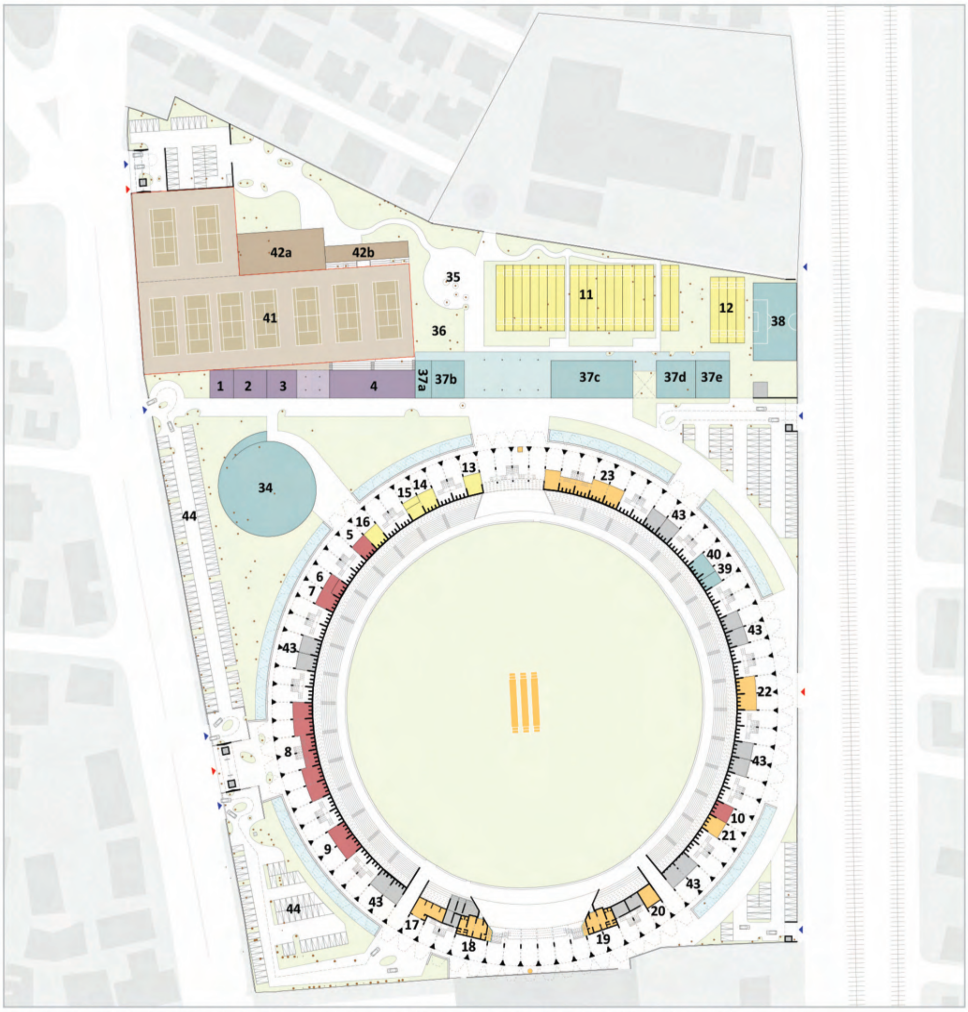
PROPOSED MASTER PLAN OF THE SVP STADIUM

Proposed Master Plan of SVP Stadium

The master plan proposes to re-organise circulation in the stadium complex to create easy connectivity between the different blocks on site, and proposes a new building configured as a bar, to the North of the stadium to house the new indoor and outdoor activities mentioned in the brief. This new building is designed as two blocks—one with indoor sports facilities and other block as a set of retail shops that may be rented out. Two movement axis are created—one between the existing Sports Club and the new building, and other through an open street along the North end connecting the West and East ends of the complex along which the new building is located. Addressing the need for a skating rink, a circular outdoor rink is proposed near the West entry, at the same location proposed in the original design. Zones are identified within the stadium complex, and programmes allotted, depending on the connectivity required between each of these spaces. Areas used during cricket matches and cricket training are clubbed together, and other indoor and outdoor activities are separated, to be used by the public without interfering with the cricket facilities.

New facilities to make the cricket stadium adept for large matches are added to the stadium. A new block on the upper seating level is proposed to house a necessary media centre and commentator's room for cricket matches, without interfering with the existing heritage structure. The new structure is designed, detached from the old structure, with an elevator to easily access the rooms designed on the upper levels without disturbing the public movement areas. An elevator is added to access the media rooms on the upper level from the broadcaster's room at the ground level on match days. While there was provision in the original scheme to build a staircase to connect the seating and the lower concourse levels, it never got built on site. The new intervention on the upper level of the seating in the South Pavilion is designed to accommodate individual rooms for the third umpire, video analysis and related functions required during a cricket match. These additions, along with the ones made in the North Pavilion, shall provide the stadium the facilities required to host a professional cricket match effectively. New proposed additions have been designed, keeping in mind the heritage structure, and ensuring minimum interference in the existing concrete folded plates.

Fig. 109: Proposed master plan of SVP Stadium with detailed programme distribution at concourse level



Plan showing the distribution of all proposed programs on the concourse level, organised based on zones proposed

LEGEND

Retail Shops — 828 sq.m.

A. Master Plan Level

1. Health Food/Coffee Shop
2. Franchise Coffee Shop
3. Sports Shop
4. Additional Retail Space

Cricket Coaching — 223 sq.m.

A. Master Plan Level

11. Wickets - 19 Nos.
12. GCA Wickets - 4 Nos.

B. Concourse Level

13. Conference Hall
14. Locker Rooms (Students)
15. Locker Rooms (Coach + Support Staff)
16. Coaching Office

Other Sports Facilities — 4,588 sq.m.

A. Master Plan Level

34. Skating Rink
35. Yoga Space and Jogging Track
36. Outdoor Gym
37. Indoor Games
    a. Squash
    b. Table Tennis
    c. Shooting Range
    d. Wrestling
    e. Kabaddi
38. Warm up Football Field

B. Concourse Level

39. Massage Room
40. Gym Room

Administration Areas — 603 sq.m.

B. Concourse Level

5. AMC Office and Meeting Space
6. Special Purpose Vehicle Room
7. Office
8. Hall of Fame
9. Cricket Library
10. Police Control Room

Cricket Matches — 1,284 sq.m.

B. Concourse Level

17. GCA Office
18. Men's Dressing Room
19. Women's Dressing Room
20. Medical Emergency Room
21. Ground Staff Office
22. Conference Room
23. Broadcaster's Room

C. Seating Level

24. Commentator's Room
    a. World feed
    b. Hindi
    c. Regional
    d. Studio
    e. Radio
25. Media Box
26. Crew Catering Area
27. Store
28. VIP Seating
29. Corporate Box
30. Elevator
31. Cameraman's Deck
32. Video Analyzer's Room
33. Umpire's Room

Tennis — 6,775 sq.m.

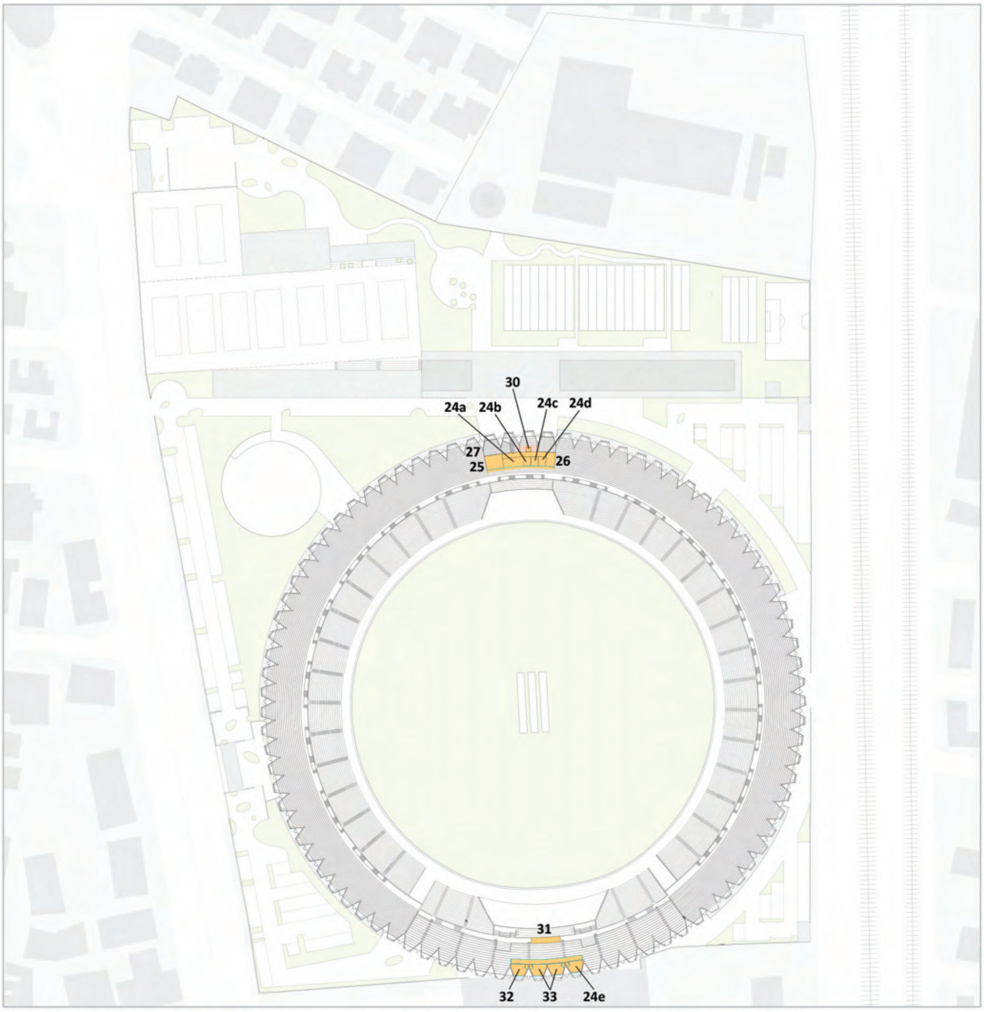
41. Courts
42. a. Stadium
    b. Ancillary Program of Tennis Courts

Services

43. Toilets + Drinking Water Fountain - 7 Nos.
44. Parking - 273 cars

Vehicular Entry

Pedestrian Entry



Plan showing the distribution of all proposed programs on the seating level, organised based on zones proposed

LEGEND

Retail Shops — 828 sq.m.

A. Master Plan Level

1. Health Food/Coffee Shop
2. Franchise Coffee Shop
3. Sports Shop
4. Additional Retail Space

Administration Areas — 603 sq.m.

B. Concourse Level

5. AMC Office and Meeting Space
6. Special Purpose Vehicle Room
7. Office
8. Hall of Fame
9. Cricket Library
10. Police Control Room

Cricket Coaching — 223 sq.m.

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12. GCA Wickets - 4 Nos.

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13. Conference Hall
14. Locker Rooms (Students)
15. Locker Rooms (Coach + Support Staff)
16. Coaching Office

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32. Video Analyzer's Room
33. Umpire's Room

Other Sports Facilities — 4,588 sq.m.

A. Master Plan Level

34. Skating Rink
35. Yoga Space and Jogging Track
36. Outdoor Gym
37. Indoor Games
    a. Squash
    b. Table Tennis
    c. Shooting Range
    d. Wrestling
    e. Kabaddi
38. Warm up Football Field

B. Concourse Level

39. Massage Room
40. Gym Room

Tennis — 6,775 sq.m.

41. Courts
42. a. Stadium
    b. Ancillary Program of Tennis Courts

Services

43. Toilets + Drinking Water Fountain - 7 Nos.
44. Parking - 273 cars

Vehicular Entry

Pedestrian Entry

The landscape on site integrates the buildings and outdoor facilities to create a comprehensive experience of the entire sports complex. Open areas and paths between buildings are created as public spaces. A new swale system—an unrealised idea from the original mater plan—that runs around the main stadium building is added to overcome current water logging issues on site. Footprints of the new buildings are designed clear of existing trees, and in unavoidable cases, trees that need to be removed, shall be transplanted at conducive areas on site. New trees shall be planted as visual barriers and path markers. As part of the landscape design plan, outdoor public seating is proposed in public areas, which is a combination of built-in and loose furniture.

An open yoga area and jogging track are planned along the new retail block and the existing tennis courts. The new retail block creates a porous threshold between the tennis court, indoor sports facilities and the cricket ground. Designed as a retail block with a small viewing pavilion at the back of the shops, it creates a softer threshold between the shops and tennis courts. The entrance gate from the Stadium Road is identified as the main entry to the stadium, with a public plaza for pedestrians which can be converted into a parking space for upto 50 VIP cars on event days. The other gates support the main entrance in times of events and matches, or when larger volumes of visitors are expected. A clear plan is proposed, with separate parking lots for common and VIP use. By doing this, areas on the site are opened for public use. On event days, an additional parking of 400 cars can be provided on the adjoining AMC plot.

To realise the conservation and reuse potential of the stadium, it is important to create an institutional structure to monitor the tasks that shall have to be carried out over an extended period of time to safeguard the intent as well as the integrity of the structure. Along with a set of guidelines for design interventions, the master plan proposal also includes a possible organisational structure, and a step-by-step task list for the committee in order to appoint consultants for the implementation of the master plan.

Figure 110: Proposed master plan of SVP Stadium with detailed programme distribution at seating level

12.0

ANNEXURE


Courtesy: Sanat Jhaveri & Co., World Monuments Fund

Annexure

12.1 Condition Glossary

Concrete

CONDITION	DESCRIPTION	PHOTO
CRACKS	Linear separation of concrete into two parts, less than 3 mm wide.	
STRUCTURAL CRACKS	Condition resulting from separation of one part from another, more than 3 mm caused by forces on the structure.	
EXPOSED REBARS	Loss of concrete cover exposing the rebar, mostly corroded.	

SPALLING	Condition that results in loss of concrete cover as a result of internal expansive forces, due to corrosion or loss of cohesion, resulting in a void.	
DELAMINATION	Loss of cohesion resulting in separation from the surface.	
PREVIOUS REPAIRS	Repairs carried out as a part of maintenance regime in the past. Most of these have altered the original character and aesthetics.	
PREVIOUS REPAIR FAILING	Past repairs that have failed over time.	
JOINT SEPARATION	Opening of joint due to weathering, erosion, or movement of the building elements.	

SURFACE DETERIORATION	Surface erosion or loss of original finished surface exposing large areas with coarse Aggregate.	
WATER STAINS - ACTIVE	Ingress of water in the form of stains.	
WATER STAINS - PASSIVE/DRIED	Ingress of water in the past now visible as staining due to drying.	
EFFLORESCENCE	Presence of whitish, powdery substance on the surface composed of salts.	
RUST STAIN	Orange, iron oxide stains on the surface of concrete indicating underlying conditions	
BIO GROWTH	Presence of microorganisms such on the concrete surfaces. Dry/inactive algae leaving black stains.	

TERMITES	Termites' infestation on surfaces	
General notes: Bird droppings, dust, cobwebs seen across different elements of the structure.		

Brick Walls

PLASTER LOSS/ DETACHMENT	Separation of cement plaster from the partition brick walls.	
STRUCTURAL CRACK	Condition resulting from separation of one part from another, more than 3 mm caused by forces on the structure.	
VEGETATION	Growth of small vegetation plants, roots penetrating into structure.	

Others

ARCHITECTURAL INTERVENTIONS	Addition of new uses;	
INFRASTRUCTURAL INTERVENTIONS	Addition of electrical panels, solar panels, and light fixtures among others.	

12.2 Wind Load Calculations

WIND LOAD CALCULATIONS

Basic wind speed at Ahmedabad

$$V_b := 39\frac{m}{s}$$

Risk factor

$$k_1 := 1$$

Since the maximum height of the stadium is less than 20m, it belongs to class A. Cosnidering a terrain category II,

$$k_2 := 1.05$$

$$k_3 := 1$$

Design wind speed,

$$V_d := V_b \cdot k_1 \cdot k_2 \cdot k_3 = 40.95\frac{m}{s}$$

Design wind pressure,

$$P_d := 0.6 \cdot (40.95)^2 \cdot \frac{N}{m^2} = 1.006 \cdot \frac{kN}{m^2}$$

12.3 Seismic Load Calculations

SEISMIC LOAD CALCULATIONS

Fundamental period for the structure was obtained as 0.49s from the structural model

$S_a := 2.5g$ Spectral Acceleration corresponding to the fundamental period

$Z := 0.16$ Zone Factor

$I := 1$ Importance Factor

$R := 1$ Assuming no response reduction since the checks are carried out based on WSM

$C_s := \frac{Z}{2} \cdot \frac{S_a}{g} \cdot \frac{I}{R} = 0.2$ Base shear coefficient

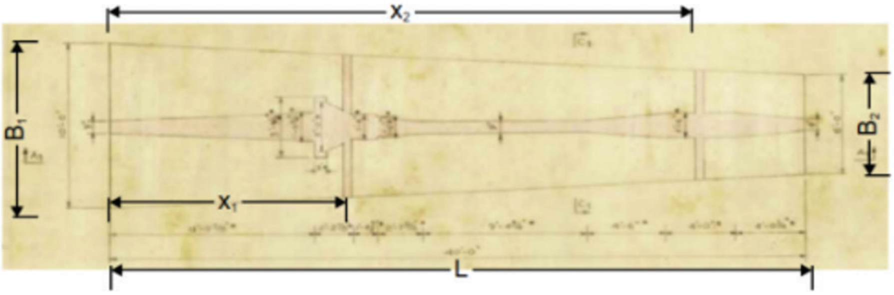
$W := 1500kN$ Seismic weight of the structure

$V := C_s \cdot W = 300 \cdot kN$ Total base shear

$V_v := \frac{2}{3}V = 200 \cdot kN$ Vertical seismic force considered as 2/3rd of the horizontal force

12.4 Foundation Checks (Gravity & Earthquake Loads)

FOUNDATION CHECKS-GRAVITY LOADS



$L := 40ft = 12.192\,m$

$B_1 := 10ft = 3.048\,m$

$B_2 := 6ft = 1.829\,m$

$x_1 := 14ft = 4.267\,m$

$x_2 := 34ft = 10.363\,m$

$A_{footing} := 2\cdot\frac{1}{2}\cdot(2ft)\cdot 40ft + 40ft\cdot 6ft = 29.729\,m^2$ **Area of the footing**

$S_{footing} := \frac{L\cdot(B_1 + B_2)\left(B_2^{\,2} + 7B_1^{\,2}\right)}{48\cdot\frac{B_1}{2}} = 55.577\cdot m^3$ **Second moment of area**

$x_{cg} := \frac{L}{3}\cdot\frac{(B_1 + 2B_2)}{(B_1 + B_2)} = 5.588\cdot m$ **CG of the footing**

$P_{1gravity} := 1061kN$ $P_{2gravity} := 536kN$

$M_{1gravity} := 208kN\cdot m$ $M_{2gravity} := 281kN\cdot m$

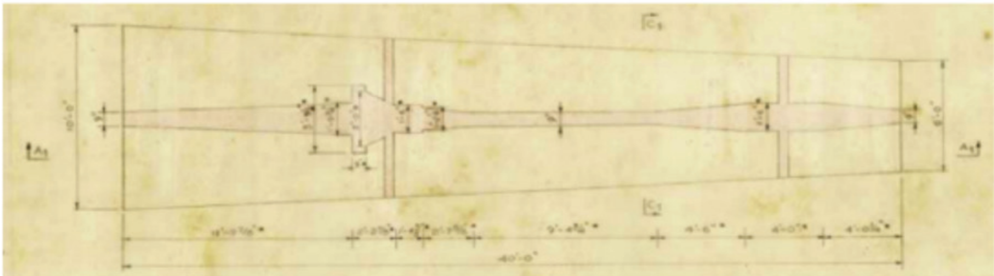
Reactions obtained from SAP model

$x_{cgloads} := \frac{P_{1gravity}\cdot x_1 + P_{2gravity}\cdot x_2 + M_{1gravity} + M_{2gravity}}{(P_{1gravity} + P_{2gravity})} = 6.619\cdot m$

$e := x_{cgloads} - x_{cg} = 1.031\,m$ **Resultant eccentricity**

12.5 Foundation Checks (With Cracked Tie Beams)

FOUNDATION CHECKS-EQ LOADS (ASSUMING TIE BEAM CRACKED)



$L := 40ft = 12.192\,m$

$B_1 := 10ft = 3.048\,m$

$B_2 := 6ft = 1.829\,m$

$x_1 := 14ft = 4.267\,m$

$x_2 := 34ft = 10.363\,m$

$$A_{footing} := 2 \cdot \frac{1}{2} \cdot (2ft) \cdot 40ft + 40ft \cdot 6ft = 29.729\,m^2$$ **Area of the footing**

$$S_{footing} := \frac{L \cdot (B_1 + B_2)\left(B_2^{\,2} + 7B_1^{\,2}\right)}{48 \cdot \frac{B_1}{2}} = 55.577 \cdot m^3$$ **Second moment of area**

$$x_{cg} := \frac{L}{3} \cdot \frac{(B_1 + 2B_2)}{(B_1 + B_2)} = 5.588 \cdot m$$ **CG of the footing**

12.6 Resultant Forces Summary

Location	Load Combination	P(kN)	M (kNm)	A (sqm)	S (cum)	Compressive stress (MPa)	Tensile stress (MPa)	% reinf required	Seating Frame	
Main Frame Top		516	4919	1.9	1.8	**3.00**	**-2.47**	**1.23**	P(kN)	M (kNm)
Main Frame Bottom	D	963	244	0.4	0.2	**3.30**	**1.27**			
Main Frame Top		516	4919	1.9	1.8	**3.00**	**-2.47**	**1.23**		
Main Frame Bottom	D+L	**1061**	**208**	0.4	0.2	**3.38**	**1.65**		**536**	**281**
Main Frame Top		361	3087	1.9	1.8	**1.90**	**-1.53**	**0.76**		
Main Frame Bottom	D+W	958	-181	0.4	0.2	**3.02**	**1.52**			
Main Frame Top		516	4919	1.9	1.8	**3.00**	**-2.47**	**1.23**		
Main Frame Bottom	D+Ex	750	804	0.4	0.2	**5.13**	**-1.57**	**0.79**		
Main Frame Top		516	4919	1.9	1.8	**3.00**	**-2.47**	**1.23**		
Main Frame Bottom	D-Ex	1176	-316	0.4	0.2	**1.47**	**4.10**			
Main Frame Top		563	5618	1.9	1.8	**3.41**	**-2.83**	**1.42**		
Main Frame Bottom	D+Ex+0.3Ez	**971**	**936**	0.4	0.2	**6.20**	**-1.60**	**0.80**	**481**	**791**
Main Frame Top		470	4213	1.9	1.8	**2.58**	**-2.10**	**1.05**		
Main Frame Bottom	D-Ex-0.3Ez	-1177	-448	0.4	0.2	**-4.66**	**-0.92**	**0.46**		
IF NO TIE BEAMS WERE THERE										
Main Frame Top		563	5618	1.9	1.8	**3.41**	**-2.83**	**1.42**		
Main Frame Bottom	D+Ex+0.3Ez	**944**	**1511**	0.4	0.2	**8.53**	**-4.06**	**2.03**	**506**	**963**
Main Frame Top		361	3087	1.9	1.8	**1.90**	**-1.53**	**0.76**		
Main Frame Bottom	D+W	839	-785	0.4	0.2	**-1.28**	**5.26**	**2.63**		

12.7 Half-Cell Potential Readings And Potential Gradient

(a) Frame: Outer and Seating Column

Bay 4

Half- Cell Potential Readings

-79	-1.3	22.5	32	12.5
-10	32.1	-6.7	14.2	38
23.2	11.2	-41.4	-34.8	14.3
-3.6	-62	14.9	17.3	17.7
-41.9	20.4	24.2	26	29.5

Potential Gradient

111.1	77.7	29.2	38.7	25.5
69	111.1	42.7	63.6	72.8
85.2	73.2	81.5	72.8	49.1
58.4	86.2	76.9	66.7	52.5
62.3	82.4	86.2	11.1	12.2

Bay 14

Half- Cell Potential Readings

115	78.1	75.4	99.6	93.1
70.2	-4.2	-75.4	43.5	45.4
40.4	-97.2	-22.6	55	15.7
42.3	31.2	26.2	44.9	15.6
32.7	13.8	31.2	28.6	20.5

Potential Gradient

44.8	153.5	150.8	175	49.6
167.4	119.2	175	175	54.2
137.6	167.4	77.6	130	39.3
139.5	128.4	123.4	67.5	39.4
18.9	28.5	17.4	16.3	24.4

Bay 27

Half- Cell Potential Readings

-90.1	-61.9	-39.3	-48.3	-57.5
-82.4	-66.4	-54.5	-91.6	-130
-102.4	-101.7	-135.5	-147.8	-197.6
-94.1	-189.5	-187.3	-170.3	-232.7
-132.8	-84.6	-118	-191.5	-262.3

Potential Gradient

28.5	28.2	52.3	81.7	72.5
20.5	69.1	93.3	106	81.7
87.1	87.8	81	93.3	106
95.4	104.9	102.7	92	84.9
56.7	104.9	73.5	70.8	92

Bay 38

Half- Cell Potential Readings

139.6	133.4	94.9	47.1
128.2	109.9	71.4	14.8
-96.2	49.2	-22.4	-45
52.6	-29.7	-128.4	-134.9
-11	-60.4	-149.5	-272.7
-138.2	-175.4	-281	-367.1

Potential Gradient

29.7	62	80.1	47.8
224.4	206.1	116.4	80.1
224.4	177.6	132.3	116.4
148.8	119.8	177.6	137.8
164.4	115	217.6	144.3
127.2	164.4	220.6	217.6

Bay 57

Half- Cell Potential Readings

90.5	128.9	97.8	83.4
117.1	104.6	111.2	106.9
65.6	11.9	22.7	76.7
52	-109.4	-32	59.5
43.6	39.4	36.6	44.7
30.5	32.9	7.9	-13.3

Potential Gradient

38.4	38.4	31.1	27.8
51.5	92.7	99.3	84.2
175	121.3	132.1	108.7
161.4	175	108.7	91.5
153	148.8	146	76.7
13.1	25	36.8	58

Bay 63

Half- Cell Potential Readings

-178.8	-64	14.3	52.7
-146.4	-63.3	12.2	23.9
-159.5	-273.6	-78.2	11.9
-443.4	-152.3	-48.5	9.9
-116.3	-63	-41	-6.6
-109.6	-115.4	-76.4	-53.2

Potential Gradient

115.5	114.8	78.3	40.5
127.2	210.3	285.8	102.1
283.9	285.8	195.4	90.1
380.4	291.1	225.1	88.1
327.1	380.4	111.3	46.6
46.6	74.4	69.8	46.6

Bay 80

25.5	37.9	45.1	47.8
21.3	19.7	-4.3	-9.5
-18.9	-40.1	-36.9	-88.4
-82.6	-106.2	-116.3	-201.9
-212.4	-240.8	-254.6	-251.4
-264.6	-262.8	-250.8	-253.6

12.4	42.2	54.6	57.3
61.4	59.8	84.1	78.9
87.3	76.2	165	113.5
153.2	148.4	148.4	165
129.8	158.2	138.3	135.1
52.2	50.4	12	2.8

(b) Ramp to Mezzanine

Half- Cell Potential Readings **Potential Gradient**

Bay 4

-209.5	-221.6	-262.3	-257.4	-307.5
-279.5	-281.4	-307.9	-302.3	-379.4
-315.9	-297.2	-350.2	-333.8	-320.2
-348.5	-293.6	-287.5	-260.8	-374.5
-276.7	-242.7	-202.3	-252	-316.2

71.9	86.3	45.6	122	71.9
70	68.8	86.3	77.1	122
36.4	53	89.4	73	59.4
105.8	56.6	85.2	113.7	122.5
105.8	105.8	91.3	122.5	64.2

Bay 14

-142.2	-129.5	-146.8	-176.6	-168.6
-160.2	-144.8	-205.1	-204.6	-192.3

18	75.6	58.3	29.8	36
83.5	241.3	181	181.5	46.4

Bay 27

-501.6	-448.3	-450.1	-390.2	-331.6
-483.6	-480	-438.5	-380.5	-421.5
-318.8	-315.8	-570	-460.8	-472.3
-418.2	-358.9	-404.5	-494.6	-455.6
-489	-434.3	-459.4	-500.7	-571.4

53.3	53.3	69.6	59.9	89.9
164.8	164.2	131.5	189.5	89.9
164.8	254.2	254.2	109.2	91.8
102.4	211.1	165.5	90.1	115.8
130.1	75.4	100.5	96.2	115.8

Bay 38

-594.3	-415.3	-335.9	-600.9	-440.6
-600.2	-448.6	-368.4	-579.3	-551.2
-572.3	-486.7	-434.9	-598.5	-514.8
-536.4	-480.4	-416.9	-413.8	-568.5
-498.6	-418.7	-430.6	-470	-459.9

179	184.9	265	265	160.3
184.9	151.6	232.5	243.4	110.6
123.7	113.5	163.6	230.1	101
117.7	63.5	181.6	184.7	154.7
79.9	117.7	49.8	98.5	108.6

Bay 57

-118.6	-135.1	-131.6	122.9	-165.9
-142.7	-114.7	-123.4	-123.2	-153.6
-117.5	-123	-134.3	-130.6	-178.4
-129.9	-148.2	-152	-137.5	-160.9
-124.2	-161.8	-135.6	-149.8	-136.7

24.1	20.4	16.9	43	43
28	28	11.7	55.2	30.7
30.7	29	19.6	47.8	55.2
31.9	30.7	29	40.9	30.6
37.9	37.6	26.2	14.2	24.2

Bay 64

-242.8	-344.1	-250	-250.7	-237.4
-311.6	-304.4	-250	-243.7	-233
-273.4	-270.5	-269.1	-268	-238.4
-296.4	-234.8	-318.4	-282.4	-230.4
-331	-250	-253.6	-250.3	-216.9

101.3	101.3	94.1	17.7	13.3
68.8	61.6	94.1	25.4	35
38.6	47.9	34.3	50.4	44
61.6	96.2	83.6	65.5	52
96.2	81	64.8	68.1	65.5

Bay 80

-390.2	-431.6	-443.8	-410.3	-365.3
-368.8	-499.9	-520	-363.6	-400
-363.2	-479.8	-571.3	-413.5	-436.3
-380.1	-521.3	-582.3	-388.1	-400.5
-405.3	-415.9	-515.6	-392.3	-454.1

109.7	88.4	80.2	109.7	45
131.1	136.7	156.4	207.7	36.4
158.1	102.5	207.7	168.8	72.7
141.2	158.1	194.2	194.2	53.6
116	166.4	127.5	190	66

1(c) Canopy

Half-Cell Potential Readings **Potential Gradient**

Trough

-169.4	-126.4	-101.7	-118.1	-144.5
-146.5	-95.5	-128.8	-124.1	-107.3
-108.9	-82	-149.3	-138.7	-135.7
-91.9	-93.5	-148.3	-180.5	-175.2
-78.4	-86	-155	-333.6	-203.8

43	43	27.1	26.4	37.2
64.5	73.9	46.8	25.2	37.2
37.6	67.3	67.3	41.8	44.8
17	61.5	185.3	152.5	158.4
15.1	69	178.6	185.3	129.8

Crest

-24.1	-81.4	-64.3	-84.6	-27.2
-46.4	-20.3	-143	-192.4	-33.2
-48.1	-28.7	-27	-191.2	-54.5
-28.4	-67.4	-79.4	-56.1	-43.7
-14.3	-30.7	-75.5	-51.5	-38.7

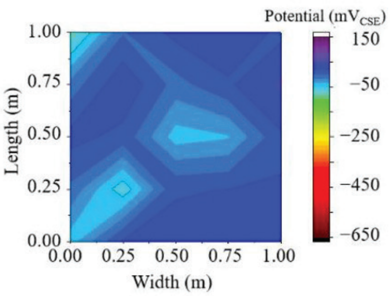
57.3	61.6	128.1	107.8	165.2
35	122.7	122.7	165.4	159.2
27.8	114.3	165.4	164.2	137.9
39	53.1	111.8	135.1	147.5
53.1	48.7	44.8	12.8	17.4

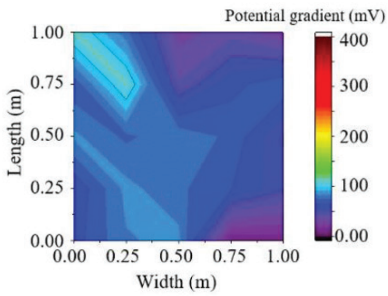
12.8 Contour Plot Of Half- Cell Potential And Potential Gradient

(a) Frame: Outer and Seating Column

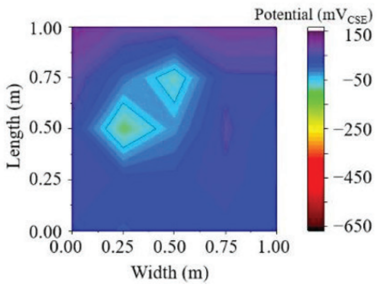
Half- Cell Potential **Potential Gradient**

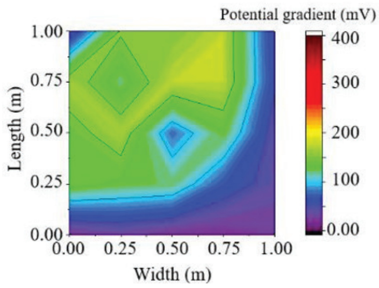
Column 4



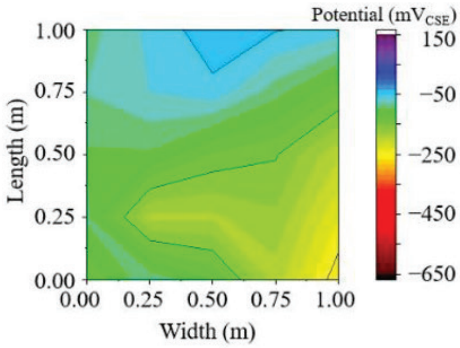


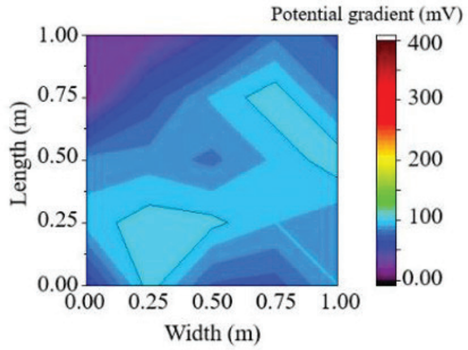
Column 14





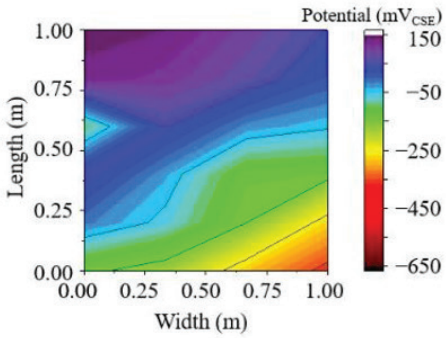
Column 27

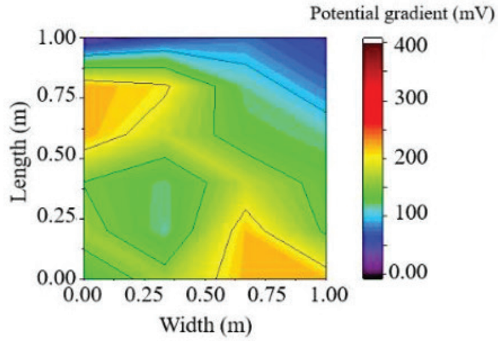




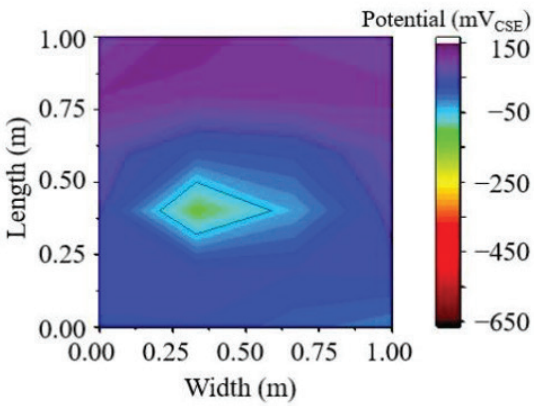
Half- Cell Potential **Potential Gradient**

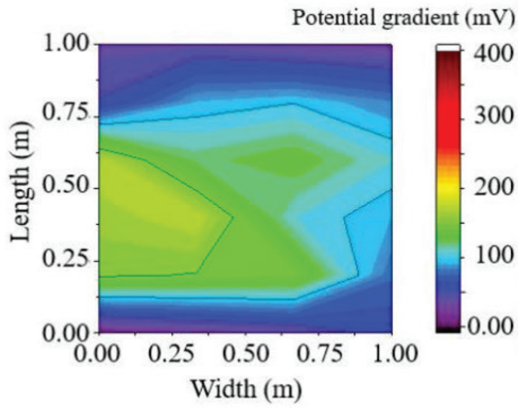
Column 38



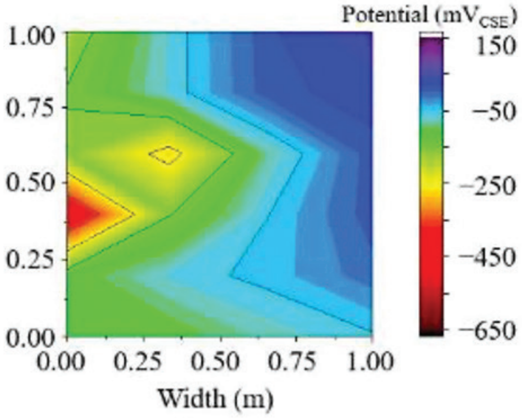


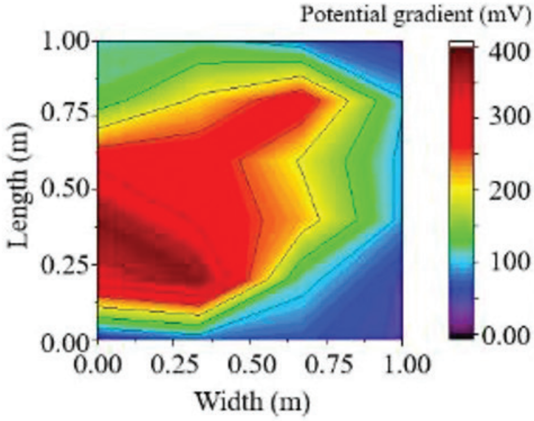
Column 57





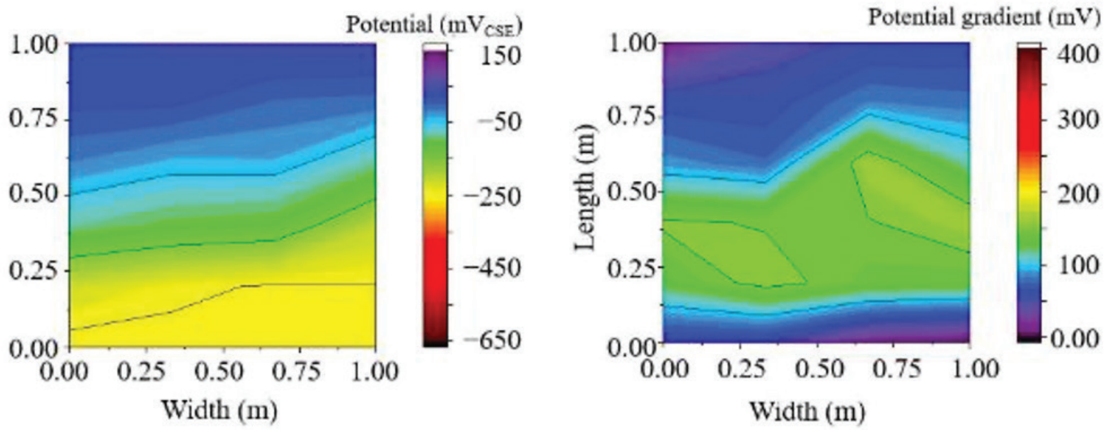
Column 63





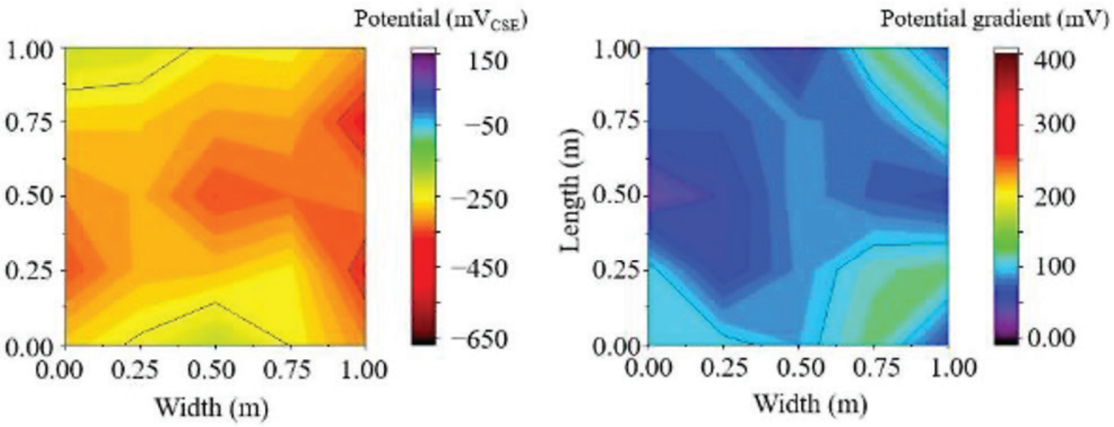
Half- Cell Potential | **Potential Gradient**

Column 80

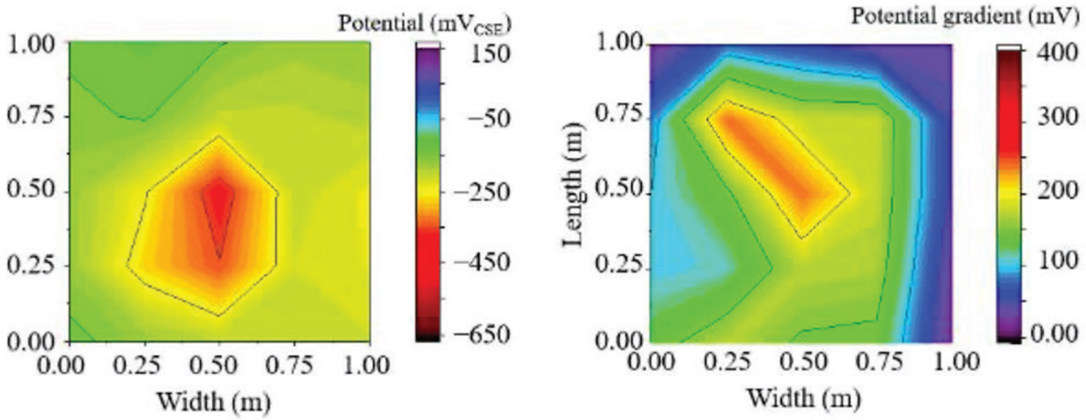


(b) Ramp to Mezzanine

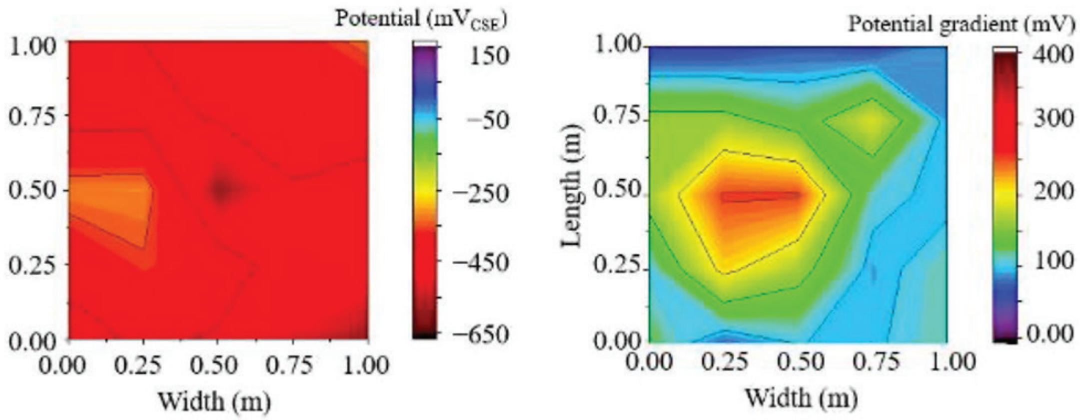
Column 4



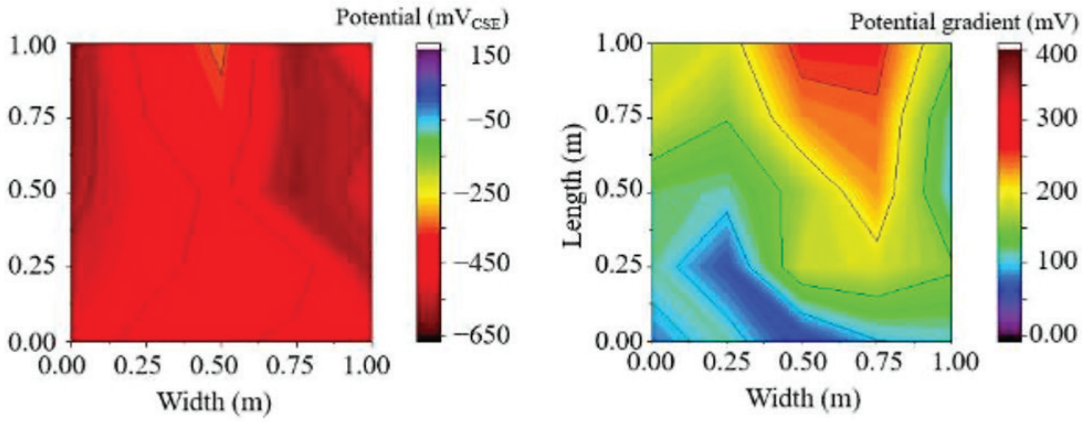
Column 14



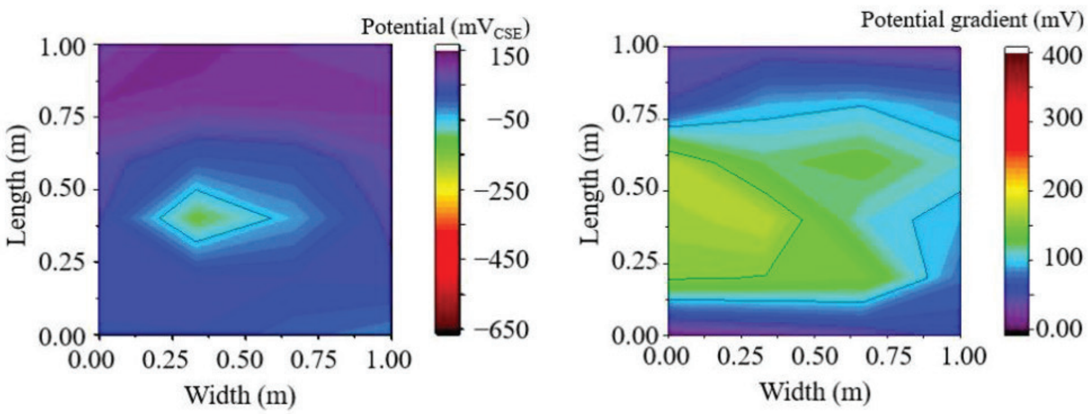
Column 27



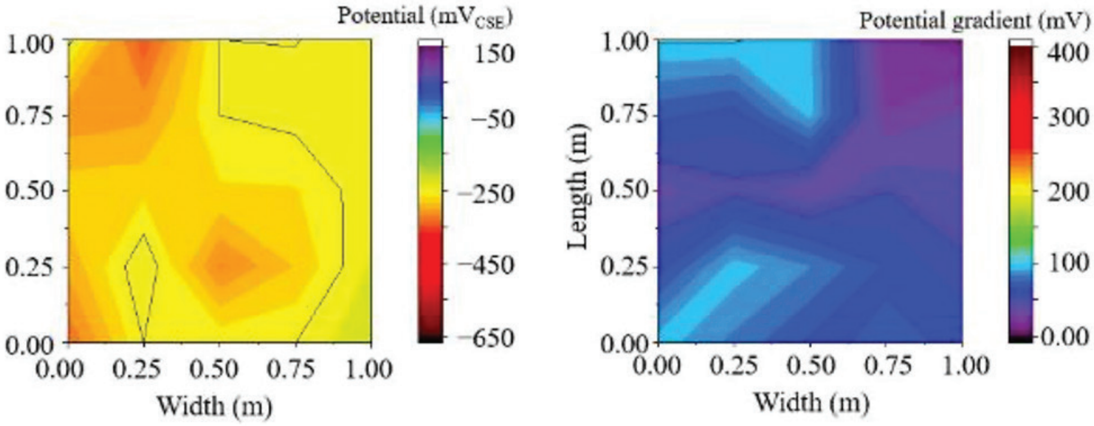
Column 38



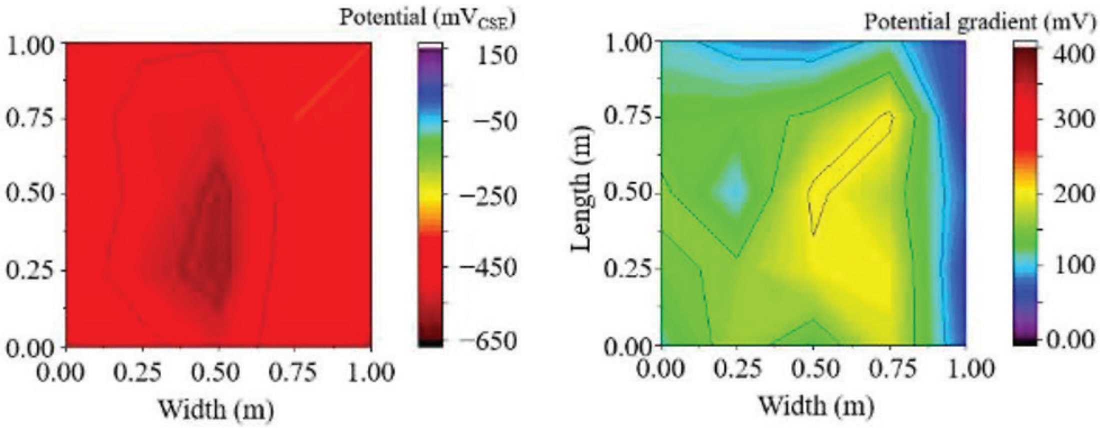
Column 57



Column 64



Column 80



12.9 Cover Depth Measurements

Elements	Bay No	Cover depth (mm)									
		1	2	3	4	5	6	7	8	9	10
Frame: outer and seating column	4	74	71	62	60	57	57	71	49	31	47
	14	80	46	66	66	20	45	58	84	73	67
	27	57	60	76	113	76	78	89	51	50	30
	38	51	54	56	47	48	51	43	47	47	88
	57	37	25	37	38	38	48	52	62	69	63
	63	43	41	29	31	47	55	49	55	54	55
	80	75	81	58	66	113	59	55	58	42	55
Gallery: old ,precast	Bay 4-5	27	32	47	45	41	48	26	28	31	11
	Bay 6-7	20	80	10	4	3	16	10	50	10	12
	Bay 9-10	2	16	5	7	29	74	17	14	78	75
	Bay 14-15	63	55	53	58	84	36	54	8	26	40
	Bay 27-28	20	46	51	27	55	54	60	68	45	46
	Bay 42-43	32	37	8	11	20	6	4	5	3	2
	Bay 57-58	27	36	29	36	36	22	16	17	91	95
	Bay 68-69	33	25	22	38	39	33	34	96	20	10
	Bay 80-81	31	34	48	45	32	42	36	29	33	27

12.10 Concrete Resistivity Measurements

(a) Frame: Outer Columns

Column ID	Resistivity (kΩ-cm)				
	1	2	3	4	Average
C1- O2	6.7	6.7	6.7	6.7	7
C12- O1	17.3	18.4	15.7	15.3	16.7
C12-O2	20.9	20.8	21.8	22.1	21.4
C31-O1	17.8	17.1	19.8	19.8	18.6
C31- O3	30.4	33.6	35.1	36.9	34
C42- O1	18.6	18.9	17.2	19	18
C42- O3	14.3	17.4	14	15.3	15
C57- O1	16	16.6	16.2	16.7	16
C57-O2	16.3	18.6	19.7	16.8	18
C57- O3	28.6	26.2	25.4	28.5	27
C69- O1	16.1	18.3	18.4	19	18
C69- O2	13.7	12	12.4	13.1	13
C69- O3	16.3	17.6	17.8	16.2	17
C77- O2	10.4	8.2	9.1	8.3	09
C77- O3	12.2	11.7	11.4	10.9	11
C80- O1	7.7	8.9	9.3	8.5	8
C80- O2	13.2	14.4	13.1	13.6	13
C80- O3	10.6	11.7	14.2	14.8	13
C88-O1	12.9	12	12.9	14.3	13
C88- O2	16	15.5	15.7	15.9	15

(b) Frame: Middle Seating Columns

Column ID	Resistivity (kΩ-cm)				
	1	2	3	4	Average
C5-M1	20.8	20	20.8	21.5	21
C5-M2	23.3	24.9	26.9	27.7	26
C5-M3	25.4	27.2	26.2	26.5	26
C9-M1	26.2	28.2	25.2	24.6	26
C9-M3	16.4	18	19.8	18.9	18
C30-M2	6.1	7.9	7.8	7.6	07
C30-M3	29.2	29.5	25.2	28.2	28
C38-M2	18.9	16.6	20.3	19.6	19
C50-M1	15.5	15.2	15.3	17.8	16
C50-M3	11	12	11.4	10.7	11
C64-M1	15.2	16	15.9	14	15
C64-M2	14.5	12.7	13	11.4	13
C83-M1	23	20.3	21.9	20.9	21
C83-M2	9.5	10	9.8	8.9	09

(c) Frame: Inner Columns

Column ID	Resistivity (kΩ-cm)				
	1	2	3	4	Average
C12- I1	23.4	31.7	28.8	24.9	27
C12-I2	13	12.3	14.2	11.9	13
C12-I3	15.7	15.6	16.5	15.7	16
C30-I1	14.5	15.4	14.3	14.9	15
C30-I2	13	12.6	11.2	13.5	12
C30-I3	9	9.8	10	9.2	09
C38-I1	10.6	8.9	8	9.4	09
C64- I1	15.9	12.4	13.1	14.3	14
C74- I1	11.7	12.4	12	13.9	12

(d) Gallery: Beams

Sample ID	Resistivity (kΩ-cm)				
	1	2	3	4	Average
B-7	18.4	17.1	20.4	20.6	19
B-10	26.5	24.5	23.1	21.2	24
B-15	20	18.9	20.1	18.6	19
B-26	17.6	13.9	14.3	14.3	15
B-60	13.6	13.5	15.8	15.1	14
B- 84	13.9	14.7	14.4	15.2	14

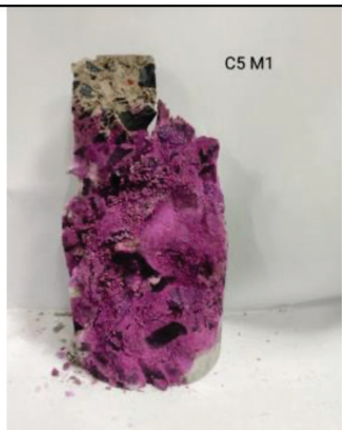
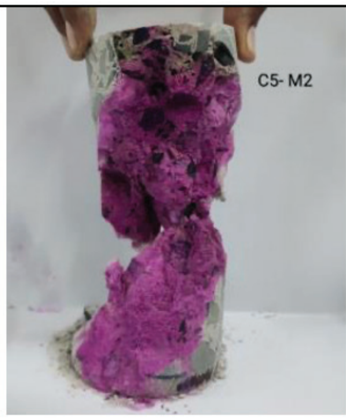
***Note: C- Column, O- Outer Column, M- Middle Seating Column, I- Inner Column, B- Beam**

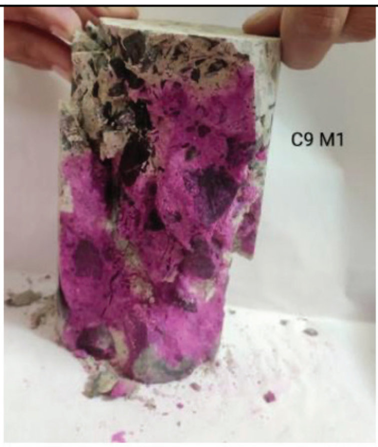
12.11 Compressive Strength Of Concrete

`Sample ID	Height (mm)	Diameter (mm)	Weight (kg)	Load (kN)	Stress (MPa)
Frame Columns					
C5-M1	134	67	1.134	117	33
C5-M2	134	67	1.173	112.1	32
C5- M3	134	67	1.192	116.9	33
C9-M1	134	67	1.117	117.8	33
C9-M3	134	67	1.142	92.1	26
C12-I2	134	67	1.163	79	22
C12-I3	134	67	1.124	82.3	23
C12-O1	123	67	1.008	71.3	20
C12-O2	134	67	1.189	91.7	26
C30-I1	134	67	1.158	67.8	19
C30-I2	134	67	1.14	52.6	15
C30-I3	134	67	1.157	63.1	18
C30-M2	134	67	1.027	29.9	08
C30-M3	134	67	1.071	27.9	08
C31-O1	134	67	1.133	49.7	14
C38-I1	134	67	1.127	65.7	18
C38-M2	134	67	1.172	39	11
C42-O1	134	67	1.169	66.5	19
C42-O3	134	67	1.164	69.3	19
C50-M1	134	67	1.192	83.4	23
C50-M3	134	67	1.152	59.5	17
C57-O1	134	67	1.151	74.9	21
C57-O2	134	67	1.201	87.6	25
C57-O3	134	67	1.187	70.4	20
C64-M2	127	67	1.193	32.9	09
C69-O1	134	67	1.207	54	15
C69-O2	134	67	1.175	58.6	16
C69- O3	134	67	1.214	73	21
C74-I1	134	67	1.151	82.7	23
C74-M1	134	67	1.139	39.7	11
C77-O1	89	67.7	0.804	94.4	24
C77-O2	134	67	1.143	48.2	13
C77-O3	134	67	1.179	56.8	16
C80-O1	134	67	1.106	48.8	14
C80-O2	134	67	1.151	71.1	20
C80-O3	134	67	1.179	60.6	17

C83-M1	134	67	1.165	32.2	09
C83-M2	134	67	1.103	49.2	14
C86	134	67	1.105	58.3	16
C88-O2	134	67	1.207	61.4	17
C88-O3	134	67	1.082	46.6	13
Gallery Slab					
GS1-C3	77	67.8	0.688	157.6	39
Inner Beam					
IB 7	134	67	1.211	110.6	31
IB 10	134	67	1.144	103.7	29
IB 15	134	67	1.144	101.3	28
IB 26	134	67	1.071	71.4	20
IB 60	134	67	1.182	69.4	19
IB 84	134	67	1.249	66	18

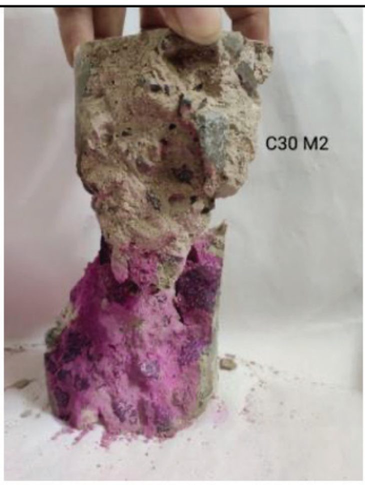
12.12 Carbonation Depth

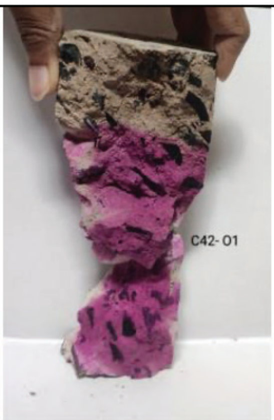
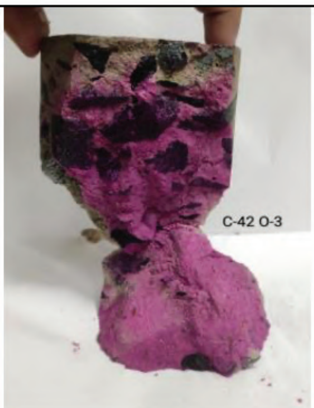
Sample ID	Average carbonation depth (mm)			Photograph
	Face 1	Face 2	Average	
C5-M1	22	24	23	
C5-M2	6	5	5.5	
C5- M3	5	4	4.5	

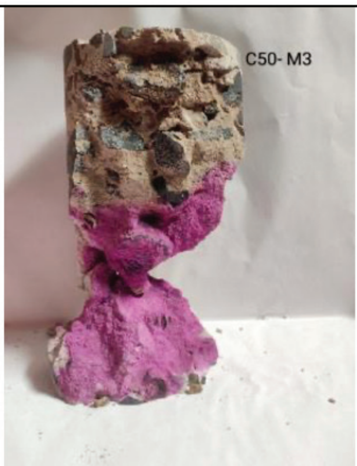
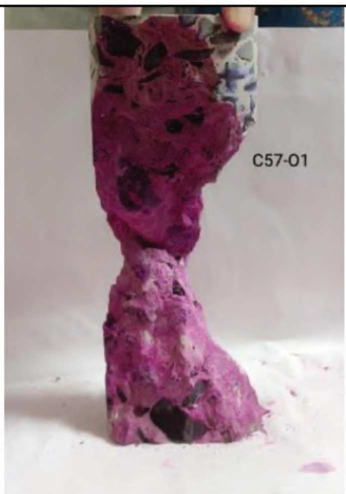
C9-M1	20	19	20	
C9-M3	11	13	12	
C12-I2	14	15	14.5	

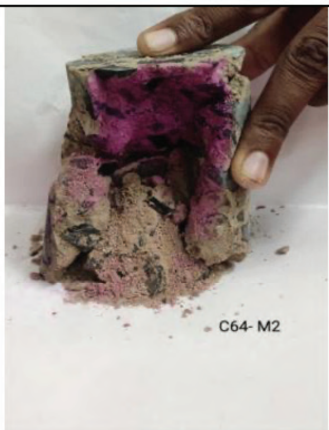
C12-I3	9	7	8	
C12-O1	0	0	0	
C12-O2	35	36	35.5	

C30-I1	29	23	26	
C30-I2	21	29	25	
C30-I3	03	04	35	

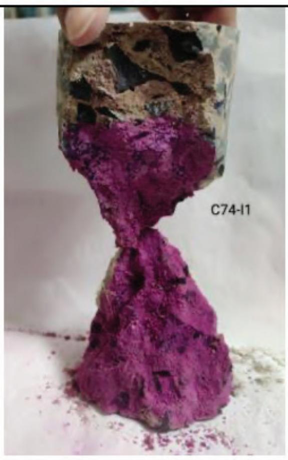
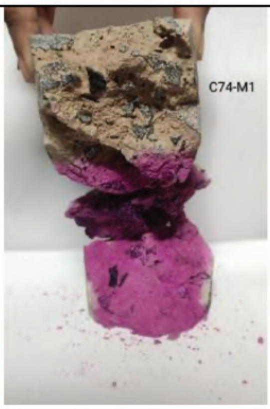
C30-M2	69	71	70	
C30-M3	88	75	81.5	
C31-O1	50	46	48	

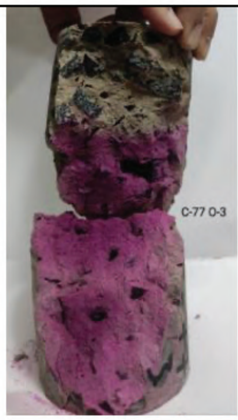
C38-I1	57	56	56	
C38-M2	48	50	49	
C42-O1	37	38	37.5	
C42-O3	7	5	6	

C50-M1	31	34	32.5	
C50-M3	62	59	60.5	
C57-O1	0	0	0	

C57-O2	25	23	24	
C57-O3	28	32	30	
C64-M2	49	51	50	

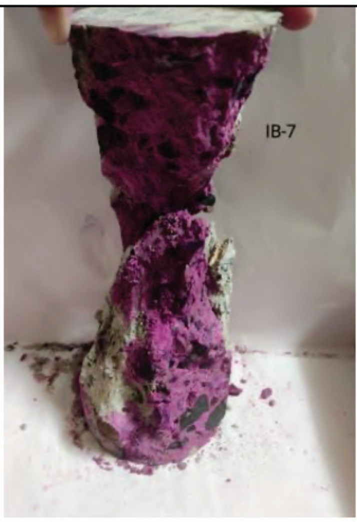
C69-O1	37	38	37.5	
C69-O2	42	41	41.5	
C69- O3	45	47	46	

C74-I1	32	34	33	
C74-M1	51	52	51.5	
C77-O1	>134	>134	>134	

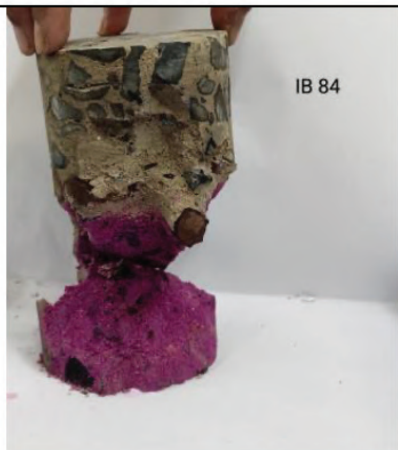
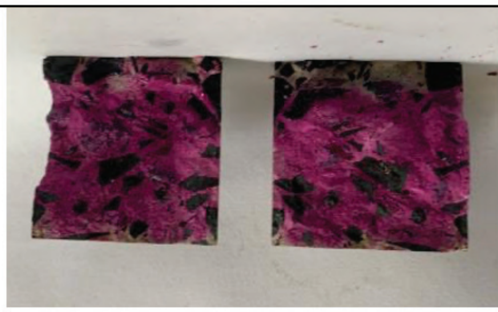
C77-O2	39	35	37	
C77-O3	36	37	36.5	
C80-O1	55	52	53.5	

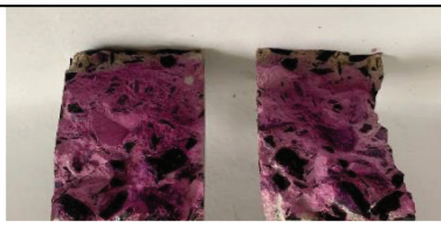
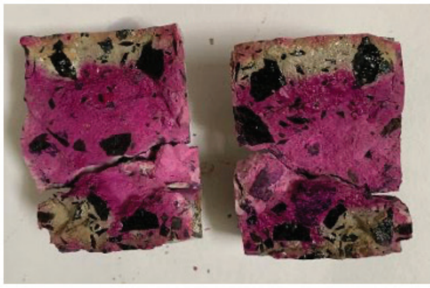
C80-O2	41	46	43.5	
C80-O3	54	55	545	
C83-M1	128	127	127.5	

C83-M2	56	47	51.5	
C86	40	37	38.5	
C88-O2	36	39	37.5	

C88-O3	124	126	125	
GS1-C3	21	20	20.5	
IB 7	0	0	0	

IB 10	0	0	0	
IB 15	36	31	33.5	
IB 26	52	57	54.5	

IB 60	27	33	30	
IB 84	64	62	63	
Canopy trough 3	12	10	11	
Canopy crest slab 3	18	13	15.5	

Canopy trough 1	15	20	17.5	
Canopy crest 1	17	22	19.5	
Trough slab 2	15	22	18.5	

Courtesy: Sanat Jhaveri & Co., World Monuments Fund

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COMPREHENSIVE CONSERVATION MANAGEMENT PLAN TEAM

AMDAVAD MUNICIPAL CORPORATION

Additional City Engineer, West Zone

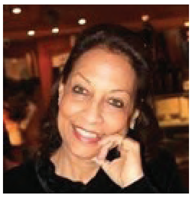
Rushi Pandya is the Additional City Engineer, West Zone. He graduated in 1999 in Civil Engineering and was selected as a Class-1 officer in Feb-2007. He has to his credit various projects like the BRTS, Road Projects, Drainage Projects and repair and renovation works of the Sardar Vallabhbhai Patel Stadium in 2010. He handles landmark projects like the Construction of an International Sports Complex, Sabarmati Ashram Precinct Area Development Works, Structural repair works for Sanskar Kendra and Town Hall.

SVPS IN-CHARGE

Dipen Dineshchandra Gandhi is the Stadium Manager. A qualified Mechanical Engineering, he has a degree in English and a Post-Graduate Diploma in Computer Application. He has played cricket in the Physically Challenged Category at State, National & International level and represented India in England and in Bangladesh. He was the Team Manager for India during the India – Afghanistan bilateral series and the accompanying official in the World Series Cricket Tournament in England. He was the Honorary Secretary for the Gujarat Cricket Association for the Disabled.

WORLD MONUMENTS FUND

Executive Director, WMF India



Amita Baig has been the regional representative of World Monuments Fund, India for over two decades during which time she has stewarded its conservation projects across the country, including several award-winning projects. She has served as a member of the India's Advisory Committee on World Heritage as well as a Council Member of the National Culture Fund.

Program Manager, WMF

Javier Ors Ausín is an architect with significant experience in preservation, planning, and research. At World Monuments Fund, he oversees the Modern Architecture Program, the Jewish Heritage Program, the Crisis Response Program, and a diverse portfolio of conservation field projects in across the world. He has presented research at the Royal Geographical Society, the Society of Architectural Historians, and ICOMOS, and has been a guest critic in many universities. Javier holds a Master in Architecture from the Universidad Politécnica de Valencia in Spain, and a Master in Critical Conservation from the Harvard University Graduate School of Design (GSD).

KNOWLEDGE PARTNERS

Charles Correa Foundation

Charles Correa Foundation (CCF) was the initiative of internationally renowned architect and urban planner Charles Correa. The organisation believes in creating meaningful discourse within the community of architects and designers to influence positive change. CCF's mandate is to identify ideas with potential and process them into tangible, structured projects that can be pitched to the stakeholders and authorities. Over the span of many years since its inception, the Foundation has worked on projects and ideas that aim to make significant impacts in the public realm.

Nondita Correa is an architect with over three decades of experience in India and the US. Some of Nondita's noteworthy contributions have been to projects like the Brain and Cognitive Sciences building at Massachusetts Institute of Technology, and the Ismaili Centre in Toronto. She teaches at University of Michigan, MIT, and Rhode Island School of Design. She has served on the Master Jury of the Aga Khan Award for Architecture and the Lafarge Holcim Awards for Sustainable Construction. She was one of the finalists for the design of the symbol for the Indian Rupee, an idea she initiated with the Reserve Bank of India in 2005.

Mahendra Raj Consultants

Mahendra Raj Consultants Private Limited (MRC) was founded by Mr Mahendra Raj in 1976.The organisation is an eminent civil engineering firm with extensive experience in design and management of highest quality projects. Its sister concern Engineering Consultants India (ECI) was founded in 1960 and Studio – VanRo in 2007. The company's portfolio includes some of the most iconic 20th century buildings including, Tagore Memorial Hall (1963-65), Shri Ram Centre of Art and Culture (1968-70), Hall of Nations (1971-72), Unilever Pavilion (1971), and Indoor Sports Stadium (1972-82), among other.

Mahendra Raj is the structural designer for the Sardar Vallabhbhai Patel Stadium. He graduated as a civil engineer from Punjab College of Engineering and Technology, Lahore in 1946. Later, he joined Punjab PWD and worked on buildings of Le Corbusier in Chandigarh. He has worked with leading international and Indian architects such as Minoru Yamasaki, Louis Kahn, Charles Correa, BV Doshi, JA Stein, Raj Rewal and many more. Among other accolades, Mahendra Raj was awarded the Chairman's Award (1995) by the Prime Minister of India, for his outstanding contributions in giving a new aesthetic dimension to Architecture in India using innovative structural systems.

Mahendra Raj Archives

Mahendra Raj Archives (MRA) founded in 2016 seeks to preserve, publish, and exhibit Mr Raj's work that spans over 60 years and is led by Rohit Raj Mehndiratta and Vandini Mehta. They have together designed and edited the book, "The Structure: Works of Mahendra Raj" published by Park Books, Zurich in 2016 and recently helped conceptualize the exhibition ,"Structuring Form: The Innovative Rigour of Mahendra Raj" held from 17th Nov 2019 to 8th Jan 2020 in Kiran Nadar Museum of Art, New Delhi.

Rohit Raj Mehndiratta is an architect, artist, and urbanist. His work at Studio VanRO is the outcome of years of international experience, engagement in the public domain through presentations, art/architecture exhibitions, publications in urban and architectural research, and academic teaching. The firm's work has been published and presented nationally & internationally and has won many awards and recognitions. Rohit co-edited The Structure: Works of Mahendra Raj, a monograph on his father, published by Park Books in 2016, and co-curated a retrospective on Mahendra Raj titled 'Structuring Form: The Innovative Rigour of Mahendra Raj,' held at Kiran Nadar Museum of Modern Art in 2019.

PROJECT LEADS

Annabel Lopez is an architect and heritage management consultant with over three decades of experience. She provides consultancy services to organizations like INTACH and World Monuments Fund. She is involved in the preparation of World Heritage Nomination Dossiers and Conservation Management Plans and her interests range from documentation to legislation for 19th and 20th C architecture and planning. She trained at UNESCO in the preparation of Heritage Impact Assessments, and this forms a large part of her professional activities. Annabel Lopez is the Coordinator of NSC 20 C, ICOMOS India and an expert member of ICOMOS, ISC 20 C.

Chirashree Thakkar is the Principle Architect with Thakkar Associates, Ahmedabad, Gujarat. Her rich academic accomplishments include a Smithsonian-sponsored IEP scholar with US-ICOMOS in 2016 and Master of Heritage Management, Ahmadabad in 2017. Since 1991, she has worked on crucial restoration and conservation projects such as the heritage buildings of Rattan Haveli and Sirsi Haveli in Jaipur, multiple locations of the IIM Ahmadabad in the old and new campus. She is actively engaged with Heritage and Conservation Management projects and has led projects like the revitalization of the heritage structures in Devbhoomi Dwarka , Heritage toolkit for Jodhpur with UMC and revitalization of Barton Library in Bhavnagar. Her portfolio also includes architectural and interior design projects such as IIM Udaipur and the Tata Consultancy office.

CONSERVATION ARCHITECTS

Bhawna Dandona is a conservation architect and a faculty at School of Art and Architecture, Sushant University. She has an MSc in Historic Preservation from University of Pennsylvania, with specialization in architectural materials conservation. Her conservation work experience spans in India and the United States. Bhawna has keen interest in historic building materials, investigative and documentation tools for the built heritage. She was awarded the INTACH Research Scholarship towards her research on Lakhori brick. She has research experience with organizations such as INTACH, American Institute of Indian Studies and Getty Conservation Institute and has co-edited the book Haryana Cultural Heritage Guide.

Nityaa Lakshmi Iyer is a conservation architect with a keen interest in 20th-century architecture, material conservation and adaptive reuse. Nityaa has an MSc in Historic Preservation from University of Pennsylvania and is an alumnus of the Getty Graduate Internship Program. She believes community-driven initiatives add high value to heritage conservation projects. Over the course of her career, she has had the opportunity to work with a multidisciplinary team on conservation and capacity building projects worldwide. Before this, she led numerous initiatives at Art Deco Mumbai Trust as Head - Documentation, Research and Outreach. She is also an associate member and EP representative of ICOMOS ISC20C.

STRUCTURAL ENGINEERS

National Centre for Safety of Heritage Structures
Department of Civil Engineering, Indian Institute of Technology Madras (IIT MADRAS)

Dr. Radhakrishna Pillai

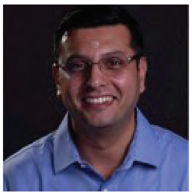
Scope: Service life of concrete

An associate professor in the Dept. of Civil Engg. at IIT Madras. He earned BE (civil) degree from M N Regional Engg. College, Allahabad and earned MS and PhD in civil engg. from Texas A&M University, USA. His areas of interest are corrosion and its control, construction materials, concrete technology, and repair, rehabilitation, and service life of concrete structures.

Dr. Manu Santhanam

Scope: Diagnostics for concrete

A Professor at the Department of Civil Engineering, IIT Madras. He obtained his B Tech degree from IIT Madras in 1994, followed by MS from Purdue University in 1996. After a few years with Sika Corporation, USA, as a R&D Chemist, he went back to Purdue University for his PhD, which was completed in 2001, on the topic of sulphate attack of concrete. Prof. Santhanam specializes in research on cementitious materials from an interdisciplinary approach, wherein sophisticated analytical techniques from chemistry and materials science are used to explore the link between micro-structure and performance of cement based materials.



Dr. Arun Menon

Scope: Structural Assessment

An Associate Professor of Structural Engineering at IIT Madras, holds a first degree in architecture, and PhD in earthquake engineering from University of Pavia, Italy. His research interests are in structural aspects of historical constructions, earthquake behaviour of historical masonry structures and earthquake-resistant structural masonry. He currently coordinates the activities of National Centre for Safety of Heritage Structures (NCSHS), a Ministry of HRD (Govt. of India) -supported research centre at IIT Madras.

Dr. Amlan K. Sengupta

Scope: Reinforced concrete design

A Professor at Department of Civil Engineering, IIT Madras. He earned his B. Tech from IIT Kharagpur in 1990, followed by MS from Rice University in 1994 and a PhD. from University of Missouri-Rolla, USA in 1998. Prior to joining IIT Madras, he worked for four years as an engineer and later within the Advance Technology Group in Ove Arup & Partners in Los Angeles and London respectively. Prof. Sengupta areas of interest are in research of behaviour reinforced concrete, prestressed concrete members, experimental investigation of cast-in-place and precast reinforced walls, analysis, design, and seismic retrofit of reinforced concrete buildings.

DESIGN

RMA Architects

Rahul Mehrotra, the founder principal of RMA Architects, divides his time between working in Mumbai and Boston and teaching at Harvard University as Professor of Urban Design and Planning, and John T. Dunlop Professor in Housing and Urbanization. In 2012–2015, he co-led a Harvard University-wide project 'The Kumbh Mela: Mapping the Ephemeral Mega City,' published in 2014, and extended in 2017 as 'Does Permanence Matter?' Mehrotra also co-authored 'Taj Mahal: Multiple Narratives' in 2017. His most recent book titled 'Working in Mumbai' (2020) is a reflection on how his practice evolved through its association with the city of Bombay/Mumbai.

ADVISORS

Kiran Joshi, an Architect-Academic, is known for her contribution to the field of 20th Century Heritage, especially her seminal work, "Documenting Chandigarh – The Indian Architecture of Pierre Jeanneret, Maxwell Fry and Jane Drew" (Mapin, 1999) that introduced the notion of "Modern Heritage" in India. Besides promoting historic resources of Chandigarh, she continues to explore the diverse manifestations of 19th & 20th Century Modern and Shared Heritage of India. She has published and lectured extensively on the subject and is associated with key global organisations on 20th century heritage including ICOMOS ISC20C, of which she is now the Secretary General (2021-23).

P.K. Ghosh is an administrator and planner with significant experience in urban development, infrastructure, and heritage conservation. He is a retired member of Indian Administrative Services (IAS), where he worked for thirty-five years, primarily in Municipal and Urban administration and Infrastructure. He also officiated as Principal Secretary and Additional Chief Secretary of Gujarat, Urban Development. Since 2002, Mr Ghosh has served as Convenor of INTACH for Gujarat and advised various state governments on their Heritage and Conservation efforts. In 2017, under his chairmanship of Ahmedabad Heritage Conservation Cell, Ahmedabad became the first Indian city to be inscribed in UNESCO's World Heritage City List.

Shishir Hattangadi is a freelance cricket analyst for media houses and news channels. Shishir Hattangadi is a member of Senior Selection Committee for Mumbai Cricket Association (MCA) and Cricket Improvement Committee. He has done pioneering work in talent scouting, and an exemplary career in cricket, spanning over a decade. He captained Mumbai at all levels from Junior Cricket to University Cricket, Under 22 and Ranji Trophy. He is a recipient of the Shivaji Chhatrapati Award, Government of Maharashtra, and the Best Cricketer award, MCA (1989). He was Director Cricket for IPL franchise Deccan Chargers and Mumbai Indians in Indian Premier League (Season 2).

OTHER TEAM MEMBERS

Architects
Shachi Sheth, Project Architect
Mrinalini Singh, Conservation Architect

Condition Assessment
Neha Chandel, Site survey and Digitisation
Nirzary Pujara & Raman Bhardwaj, Digitisation

Scientific Investigation and Structural Assessment
Deepak K. Kamde & Krishnachandran S

Community Engagement
Isha Chouksey, Srishti Jauhri, Dhriti Kapur, & Khushi Shah, Activity Mapping

Design
Payal Patel, RMA
Jay Vadodaria, RMA

Dissemination
Yagya Sharma
Saranya Dharshini


Courtesy: Ram Rahman, 2018,

Courtesy: Ram Rahman, 2018,
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PROMOTERS AND COLLABORATORS

Ahmedabad Municipal Corporation

The Ahmedabad Municipal Corporation or the AMC, established in July 1950 under the Bombay Provincial Corporation Act, 1949, is responsible for the civic infrastructure and administration of the city of Ahmedabad. The Ahmadabad Municipal Corporation is the owner of the Sardar Vallabhbhai Patel Stadium and is responsible for its regular maintenance.

Multiple divisions of the Ahmadabad Municipal Corporation take care of the maintenance and upkeep of the building. The organizational structure is as follows:

- Administration – West Zone Office of AMC
- Building and property maintenance – West zone Estate Department of AMC
- Infrastructure –West Zone Engineering Department of AMC
- Electrical works – Lighting and Electrical Department of AMC
- Landscape – Director of Parks and Garden AMC

World Monuments Watch 2020

The Sardar Vallabhbhai Patel Stadium was placed on the World Monuments Watch in 2020. The World Monuments Watch is a flagship advocacy program of the New York-based private non-profit organization World Monuments Fund (WMF) that calls international attention to cultural heritage around the world that is threatened by neglect, vandalism, conflict, or disaster. Every two years, it publishes a select list known as the Watch List of Sites that are in urgent need of preservation funding and protection. The sites are nominated by governments, conservation professionals, site caretakers, non-government organizations (NGOs), concerned individuals, and others working in the field. An independent panel of international experts then select 100 candidates from these entries to be part of the Watch List, based on the significance of the sites, the urgency of the threat, and the viability of both advocacy and conservation solutions. For the succeeding two-year period until a new Watch List is published, these 100 sites can avail grants and funds from the WMF, as well as from other foundations, private donors, and corporations by capitalizing on the publicity and attention gained from the inclusion on the Watch List.

The 2020 Watch List call for nomination was announced in January 2019 with the deadline in March 2019. More than 250 nominees were submitted. The Sardar Vallabhbhai Patel nomination was filed by two independent Heritage Management Consultants, Annabel Lopez and Chirashree Thakkar with consent from the Commissioner of the Ahmadabad Municipal Corporation. Twenty five sites were selected to be included in the list and Sardar Vallabhbhai Patel was one of them.

The Sardar Vallabhbhai Patel Stadium was included on the 2020 World Monuments Watch to draw attention to the complex challenges of preserving not only an iconic twentieth-century modern structure, but an emblematic public space for the people of Ahmedabad. WMF's aim in listing the site was to encourage a Conservation Management Plan that would include the communities who support and benefit from the building. As part of this objective, an application was made to the Getty Foundation for a grant for the preparation of a Conservation Management Plan, under the Keeping It Modern Initiative.

The Getty Foundation Grant

The Sardar Vallabhbhai Patel Stadium was one of the thirteen recipients of a grant from The Getty Foundation in its seventh and final round of Keeping It Modern Grants. KIM is an initiative created in 2014 to aid in the conservation of modern architecture. With its final year of Keeping It Modern, the Getty Foundation will have awarded a total of 90 grants. The stadium is indeed fortunate to have been a recipient in a year that the Getty is calling "the initiative's largest and most geographically diverse year of applicants." The thirteen winners of the competition are found on five continents, with three of the buildings appearing as repeats from earlier grant cycles.

Keeping It Modern does not award money to privately owned buildings, and it aims at supporting conservation projects that "advance the long-term preservation, protection, and maintenance of outstanding 20th-century buildings." Although the grant program is finishing this year, the Conserving Modern Architecture Initiative that it is part of will continue. Furthermore, the Getty makes available conservation reports from previous recipients of Keeping It Modern grants on its website, where the Conservation Management Plan under preparation for the Sardar Vallabhbhai Patel Stadium will also eventually appear.


PORATION WELCOMES YOU


Courtesy: Sanat Jhaveri & Co., World Monuments Fund