3. STUDY AREA

India is well known for its cultural and historic values. Indian monuments represent one of the most outstanding facets of the multi-feature of Indian culture. The Indian monument is a remarkably splendid sample of unbelievable artistry, covering a sense of mystery, deception and cultural. They are the marvel in white marble (Taj Mahal), red stone (Red Fort) and outstanding art works (Khajuraho, Konark and Hampi). Monuments are witnesses of India's past; the monuments of India are also the guardian pillars of India's cultural heritage. Culture heritage includes tangible culture, intangible culture and natural heritage. Monuments and buildings belong to tangible culture (Ruggles and Sinha, 2009). The monuments of India have become an inspiration for the future generation of citizens of the country.

A heritage site is an official location where cultural and social history have been preserved. The Archaeological survey of India (ASI) which is the nodal agency for protecting such monuments in India has several monuments across the country which are under its control. India has several monuments protected under this act by Archaeological Survey of India (ASI). To ensure the proper administration and maintenance of such monuments of each states, they are protected under respective ASI zones or circles.

The state of Gujarat is home to a large diversity of monuments present all over which represent the arts and value of the cultural past of the state. In Gujarat, the number of monuments which are currently under ASI protection stands at 317 (ASI, 2020). Among them, the oldest monument is at Lothal. This dates back to the Indus valley civilization around 2500 BC. Other monuments include the 19th century, Tambekar’s wada in Vadodara city which was built during the Anglo-Maratha War. A large number of important monuments like the Buddhist Cave (Uperkot fort) - Junagadh, Ahmed Shah's Tomb-Ahmedabad, Champaner- Panchmahal complex etc are found which date back from a few to several centuries in the past. These monuments were made up of different materials like igneous rocks, sedimentary rocks, dolomite, metamorphic rocks (limestone), marble, granite and bricks etc. (Jayanthi, 2007). Based on the structure, arts and cultural past, some of these monuments have been designated as World Heritage Sites by UNESCO for appreciation of their importance globally. In the current study, several sites which represented different ages, substratum and structural types were visited and monuments from two sites were finalized for

detailed studies. The study includes monuments from two broad sites, viz., the Champaner-Pavagadh complex in Panchmahal District and The Maharaja Sayajirao University of Baroda campus in Vadodara District.

3.1 The Champaner-Pavagadh Complex

Champaner is a historical city in the state of Gujarat and is located in Panchmahal district. It is situated about 47 kilometres, northeast of Baroda. Thakur (1987) first proposed a management plant for preservation of monuments at Champaner – Pavagadh complex. A new study was jointly prepared by researchers from the University of Illinois and the Heritage Trust of Baroda with the objective of proposing it as a World Heritage Site to UNESCO (Ruggles andSinha, 2009). In July, 2004 Champaner-Pavagadh was officially designated a World Heritage Site and was named as the Champaner-Pavagadh Archaeological Park (Ruggles and Sinha, 2009; Ravdandekar, 2014). This world heritage site comprises various monuments at Champaner and the adjoining Pavagadh hills (Table 3.1) (Sinha *et al*., 2004; Modi, 2008). It has a split identity between Pavagadh hill as the adobe of a Hindu goddess and Champaner with remains of a historical Islamic city (Sinha *et al*., 2004; Ruggles and Sinha, 2009). Within the impressive natural setting there is a temple of Kalika Mata at top of the Pavagadh Hills. The rests of the site comprise a few standing structures, fortifications, water tanks, etc. from 8th to 14th century (Saxena, 2002; Ravdandekar, 2014). Historians date the founding of the first urban settlement of Champakdurga to the eighth century. The city served as political and economic capital for the Chauhan Rajputs from approximately 1300 AD through to major part of the fifteenth century and for the Mahmud Begada dynasty of Muslim sultans from 1484 until the Mughal conquest in 1535 (Saxena, 2002). The main Pavagadh hill is the highest point in the district, rising to a height of 800 m surrounded by several small hillocks ranging from 200m - 300m in height. High escarpments on the west and south render it impenetrable. Towards the North east, the land slopes gently with plateaus in between. The hill comes down in five successive plateaus viz., Naulakhi, Mauliya, Bhadrakali, Machi, and the Atak Plateau. Machi is situated in the middle of the Pavagadh hill (Anon, 2004). The temple of Kalika Mata has immense value it the region and is visited by over 2 million pilgrims annually (Ruggles and Sinha, 2009; Ravdandekar, 2014). From the top of Pavagadh Hill, one can see continuous series of flat terraces and steep cliff faces. The entire scene that holds the eye is dotted with walls, bastions and other types of medieval military architecture. Hence, it is a popular tourist place of central Gujarat. The area also attracts international tourists because of the world heritage site tag. The medieval city of

Champaner-Pavagadh has a large number of historical monuments of various religious beliefs (Saxena, 2002; Ruggles and Sinha, 2009; Ravdandekar, 2014).

Table 3.1 – List of different monuments of Champaner Pavagadh complex

Sr. No.	Name of the Monuments	Broadly location
1.	Jami Masjid	Champaner
2.	Kevda Masjid	
3.	Nagina Masjid	
4.	Ek-Minar Masjid	
5.	Fortresses and wall	
6.	Kabutarkhana Pavilion	
7.	Helical stepped well	
8.	Mandvi	
9.	Saher ki Masjid	
10.	Atak gate	Pavagadh Hill
11.	Budhiya gate	
12.	Gulan-Bulan gate	
13.	Sat Manzil or Sat Kaman	
14.	Makai Kothar	
15.	Navlakha Kothar	
16.	Jain temples	
17.	Lakulish temple	

Some of these historical monuments are vanishing on account of natural and man-made causes of which the major one is the traffic of pilgrims. The monuments listed in table 3.1 are protected by the ASI. Among these, some of the monuments, mostly temples at Pavagadh are regularly repainted due to their religious importance while some are subjected to cleaning and preservation measures by the ASI workers (Ruggles and Sinha, 2009). However, there are still several monuments at the Pavagadh hills which are at different stages of degradation (Plate 1 - fig. B, D, F) and also monuments at Champaner which are also degrading (Plate 2). The degradation seems to be due to the growth of biological organisms

as well as anthropogenic activity due to the heavy rush of tourists. There is hence, an urgent need to preserve such monuments which have historical as well as cultural importance. Therefore, six monuments were selected for the study from the Champaner Pavagadh site. The locations of the six monuments have been given in the map (Fig. 3.1) below. Three monuments namely Makai kothar, Navlakha kothar and Jain temple are located on the Pavagadh hills. Two of the other three monuments, Saher ki Masjid and Mandavi are located next to each other within the Champaner fort while Amir manzil (not ASI protected but under its supervision) is located outside the fort ramparts. A brief introduction of all the monuments have been given below.

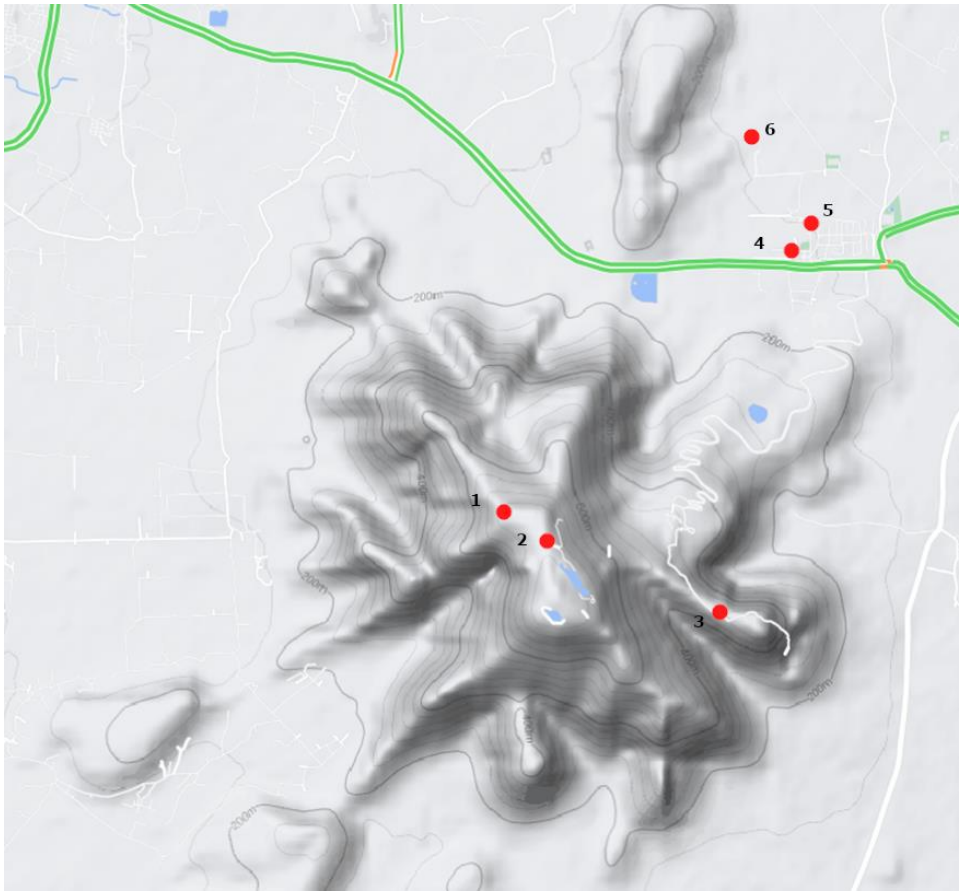

Fig. 3.1 – Outline map of Champaner-Pavagadh complex showing location of the six selected sites. 1. Navlakha Kothar, 2. Jain Temple, 3. Makai Kothar, 4. Saher ki Masjid, 5. Mandavi, 6. Amir Manzil

3.1.1 Makai Kothar (22° 27′ 54.40″ N, 73° 31′ 20.30″ E)

Makai Kothar is a three domed structure that overlooks a deep valley. As the name suggests it was employed for storing maize for the garrison. It is a granary constructed in the Islamic style with brick vault domes along with water tank. This structure has one layer of

construction in stone which has been covered by another layer of brick (Sinha and Kesler, 2001). (Plate 1 - Fig. A &B). One of the three domes has collapsed and while there is a board which specifies that the monument is protected, there is rarely any security person around it and tourists can be seen moving around the structure

3.1.2 Navlakha Kothar (22° 28′ 02.19″ N, 73° 30′ 40.79″ E)

Navlakha Kothar is a building from the Rajput era. Constructed on the Naulakh plateau, it is situated on the edge of the cliff, commanding a breath-taking view of the landscape. It was rebuilt with nine domes in the Islamic period and probably served as a granary. It was constructed by stone which was covered with another layer of bricks on it (Sinha and Kesler, 2001). This building had nine domes built in a "T" shaped fashion (Ruggles and Sinha, 2009) but, currently only seven domes are seen and appears "L" shaped. (Plate 1 - Fig. C &D). Due to its distance from the main temple track, it has much fewer visitors but again due to lack of continuous monitoring, the walls of the monument are subjected to damage by the visiting tourists

3.1.3 Jain temple (22° 28′ 00.8″ N, 73° 30′ 54.7″ E)

The Jain temples are near the Navlakha Kothar. The date of construction of this temple is deduced to be between the 14^{th}–15^{th} centuries. The temples are all constructed with local stone and have elaborate carvings of Gods and Goddesses in seated or standing position. The images of the Jain pantheon are seen on the outer walls of the temple (Sinha and Kesler, 2001). They are located on the Mauliya Plateau. (Ruggles and Sinha, 2009). (Plate 1 - Fig. E&F). These temples are still in use and the surroundings are regularly cleaned. The upper parts of the temple are however rarely cleaned or scrubbed which has resulted in the growth of biofoulants.

3.1.4 Champaner fort (22° 29′ 0.94″ N, 73° 31′ 53.60″ E)

Champaner is a medium sized fort and has the presence of three ASI protected monuments namely Saher ki masjid, three cells and Mandavi within the fort premises. Among these, Saher ki Masjid and Mandavi were selected for the current study.

3.1.4.1 Saher ki Masjid

This masjid is very attractive and is quite popular among tourists. It has five mehrabs. At the front, the entrance has an arched doorway. Each of the five mehrabs has a large dome

in the centre and four small domes at the four sides of it. It was built using sandstone and mortar materials. A rectangular ablution tank is observed on the platform, which is made up of bricks and mortar. (Plate 2 - Fig. A, B &C).

3.1.4.2 Mandavi

Mandavi located in the centre of the Champaner's fort next to the field ASI office. It is mainly built with stones and lime material. At a few places on the outer side of the monument, bricks are also used. It is also known as custom house. This was probably used as a guard room (Campbell, 1879). (Plate 2 - Fig. D, E &F).

3.1.5 Amir Manzil (22° 29′ 25.08″ N, 73° 31′ 44.17″ E)

It is located outside the fort periphery and site is currently surrounded by lush greenery. It is an excavated site that is made up of bricks and mortar materials. Excavation of this site was done by the Ancient history and Archaeology department of the Maharaja Sayajirao University of Baroda. Though it is not protected by ASI, it is under its supervision. (Plate 2 - Fig. G &H).

3.1.6. Geology

The area contains some of the oldest rock formations in the area, which is quite distinctive and can be immediately recognised from the top. The "pre cambrains" or the older rocks found in the area beyond Wada Talao constitute the Champaner series formation (Anon., 2004). The rocks comprising quartzite, rhyolite, green bedded tuffs, phyllites, slates, olivine dolerite, porphyritic basalt and non-porphyritic basalt arranges formed the Pavagadh hill (Merh, 1995). The stone that the hillside is made up of is called 'rhyolite' a type of igneous rock which have red yellow colouring (Anon., 2004). The rhyolite rocks' light yellow colour with red-tinged look, gives it an appearance like the colours of Champa flower. Thus, the name Champaner has emerged (Ravdandekar, 2014). Special rock types such as Nimar sandstones, a type of Infra-Trappeans rock are found only in this location. Deccan Trap is found in the Pavagadh hill in which various horizontally bedded lava flows are exposed. The imposing character of the hill is also largely due to the great height of the vertical craps which bound the various lava-flows and impart to the hill its terraced appearance (Merh, 1995; Ravdandekar, 2014).

3.1.7 Climate

Sites of the Champaner Pavagadh are the best to visit between October to February months. During this duration, the temperature ranges between 12 °C to 29 °C with pleasant weather. During winters, which are cool, the days having an average temperature of 26 °C while the nights are as cold as 9 °C. In summer season, the temperatures are severe, reaching up to 44 °C. This duration of summer is scorching. The average annual rainfall in the region is 944 mm. The major rain months are July and August. Five years (2016 to 2020) cumulative data of average monthly rainfall and temperature for the Panchmahal district is show in fig. 3.2.

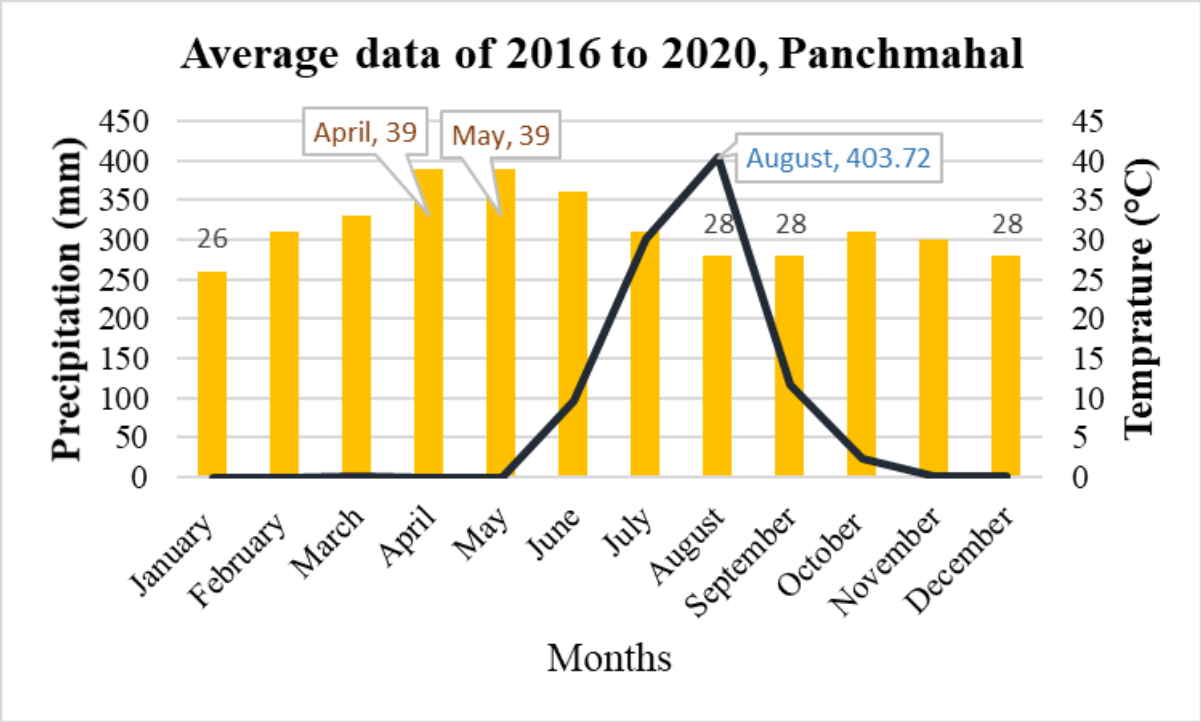

Fig. 3.2 – Average monthly temperature and rainfall data for 2016-2020 for Panchmahal district

(Source: IMD, 2021)

3.2 Buildings of the main campus of the Maharaja Sayajirao University of Baroda

The Maharaja Sayajirao University of Baroda campus (MSU) in Vadodara city is also one of the locations where a few important buildings were selected for the study. The buildings of the University were constructed from 1880 onwards (Plaque on the building) and were earlier part of the Baroda College. The foundation stone of Baroda Collage was laid by Sayajirao III in 1879. In 1881 Baroda collage was established which was affiliated to the Bombay University in the faculties of Arts, Science and Law. Baroda collage was opened to

students in 1882. It embarked on teaching of science in 1887, law classes in 1891 and a chair of the comparative studies were established in 1915. After many years, Baroda college became the Maharaja Sayajirao University of Baroda in April, 1949 (Trivedi, 1993).

The Maharaja Sayajirao University has several buildings which are more than 100 years old and are having impressive architectural designs. The building material of the monuments of the University consisted of bricks and mortar materials along with lime at few places. Generally, most of these buildings are under regular maintenance and are periodically painted. On a few buildings, specialized chemical treatment was also done before using paint to preserve its architectural and structural integrity. However, there are some buildings which appear faded and discoloured at the exposed surface despite restoration work. Two such monuments, the Faculty of Arts – Main building and the Dadabhai Naoroji (D. N.) Hall were selected for the current study. Plate 3 shows top and side views of these two impressive building.

Basic periodic maintenance work is undertaken at both these buildings as they are still in use. However, the facades of both these buildings have a rundown look and the architectural beauty has been spoilt due to the growth of different groups of biofoulants. This was the major reason for the selection of these two sites for the current study. Both these monuments are situated in the main campus of this university. This campus is located at the centre of the city of Vadodara and is next to the Central bus station and Railway station. The selected sites, other few buildings of the main campus and surrounding area of this university are depicted in the location map shown in fig. 3.3.

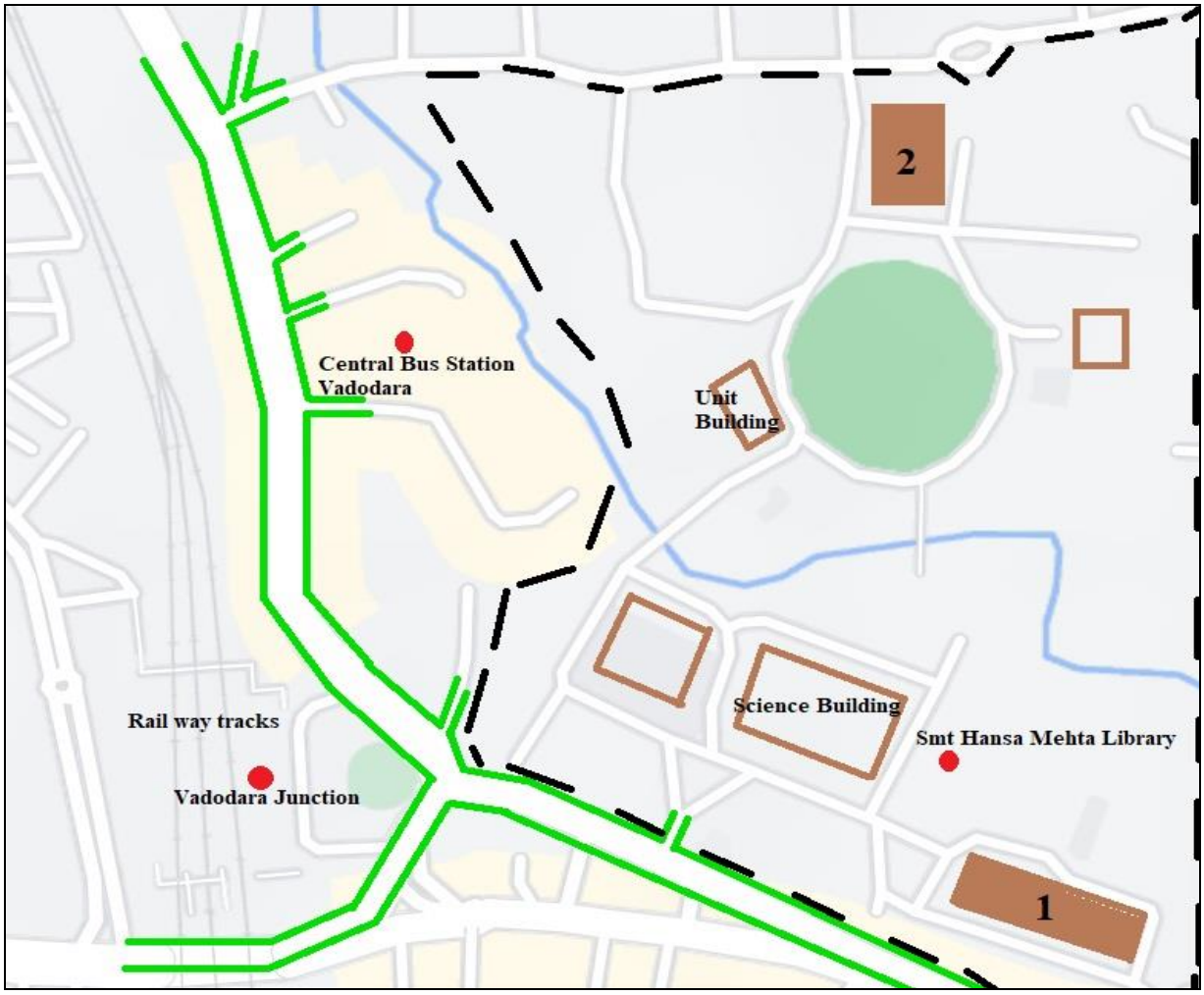

Fig. 3.3 – Outline map of a part of the M. S. University showing location of the two selected sites. 1. Dome of the Arts Faculty Building 2. D. N. Hall. (The black dashed line represent the boundary of the MSU main campus)

3.2.1 Arts faculty building dome

The Arts faculty building manifests a union of different styles of architectures with elements ranging from Buddhist chaityas to the Ottomman style (Trivedi, 1993). It was built around two huge courtyards and this has created an "E" shaped building. This building is most famous for its massive dome. It has a large masonry dome and was one of the first buildings constructed among the other buildings of this university and is currently more than 130 years old. (Fig. 3.6 - B) The dome has an external diameter of about 70 feet and is the second largest masonary dome in Asia after the Gol Gumbaz of Bijapur (Vaidya, 2015). This main dome is a double skinned structure standing on a series of squinches which resemble lotus petal. Further the dome is pierced with two rows of small windows, one of which are circular in shape while the other row also has circular windows but with a 'star' shape

inscribed in the circle (Trivedi, 1993; Vaidya, 2015). This dome structure exposing facades have lost their embellishments and have blacked overtime (Anon, 2021). The dome is blackish by different biological organisms growing on their exposed surface (Plate x3, Fig. D). To preserve this iconic, historical and architecturally important structure it was selected in current study.

3.2.2 D. N. Hall

The D. N. Hall building which was initially part of a boy's hostel, now houses the Department of Architecture since 2000. This building is also more than 100 years old (Plate x3 Fig. B). This building was built by bricks and mortar, and their terrace wall and domes were covered by lime coating. This building has a very vintage design of architectural structures. But facades of this building had become blackish due to growth of biological organisms on exposed surface of the building. This building was restored several times but the biofoulants return to grow on it and the building has become blackish over a period of time. Hence, there was a need to study those biofoulants and their growth mechanism for long lasting preservation. This building was thus selected for the current research study.

3.2.3 Geology

Vadodara district is located in the central part of the Gujarat. Some area such as Chhota Udepur, Kavant, Jambughoda and Naswadi taluka of eastern side of the Vadodara district have a hilly terrain with several ridges, plateaus and isolated relict hills. The rest of the district on the western and southern part comprising of Mahi and Narmada area have a plain level with gentle undulating terrain. The region surrounding the Mahi, Vishwamitry, Dhadahar and Orsang rivers have riverine landforms (Merh, 1995). The land area of Vadodara city is a plain territory. The main Maharaja Sayajirao University of Baroda is located in the centre of the Vadodara city. Other campuses are spread out in different areas across the city. Selected buildings in current study are from the main campus which is located at Pratapgunj locality.

3.2.4 Climate

Vadodara has tropical climate. The average temperature is 27.2 °C. April and May are the hottest months of the year where the day temperature exceeds 40 °C The average annual

rainfall is 711 mm. Five years (2016 to 2020) cumulative data of average monthly rainfall and temperature of Vadodara district showing in the fig. 3.4.

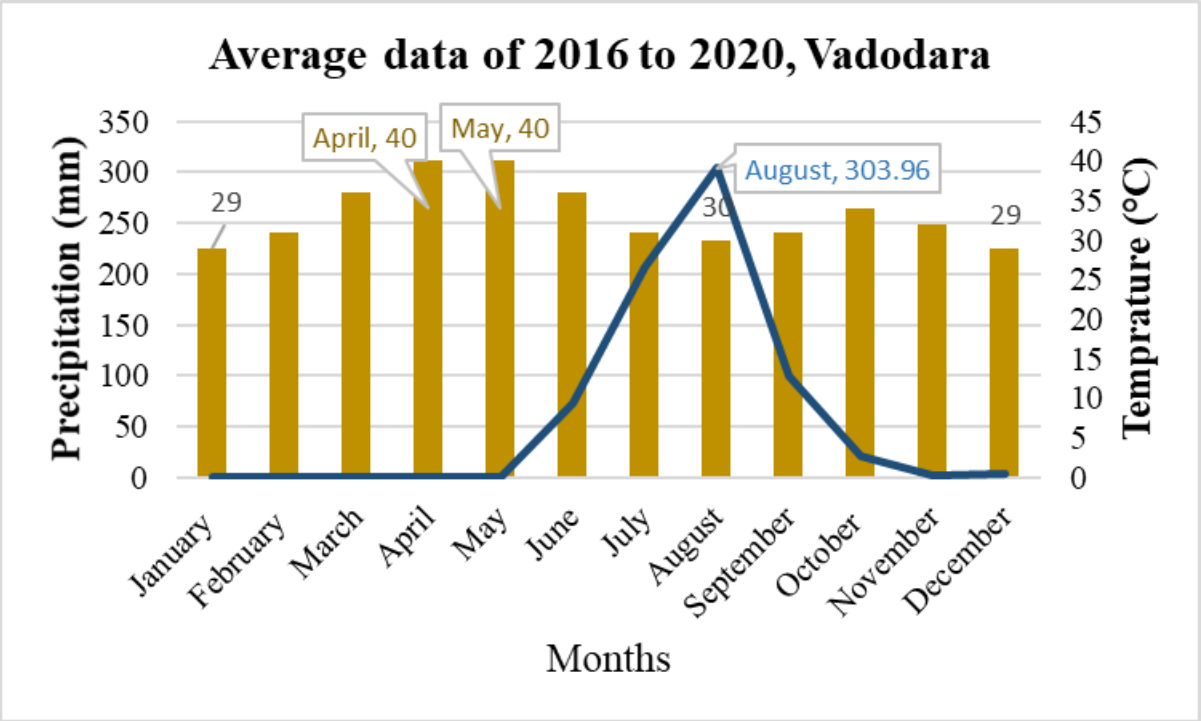

Fig. 3.4 – Average monthly temperature and rainfall for Vadodara (2016-2020)

(Source: IMD, 2021)

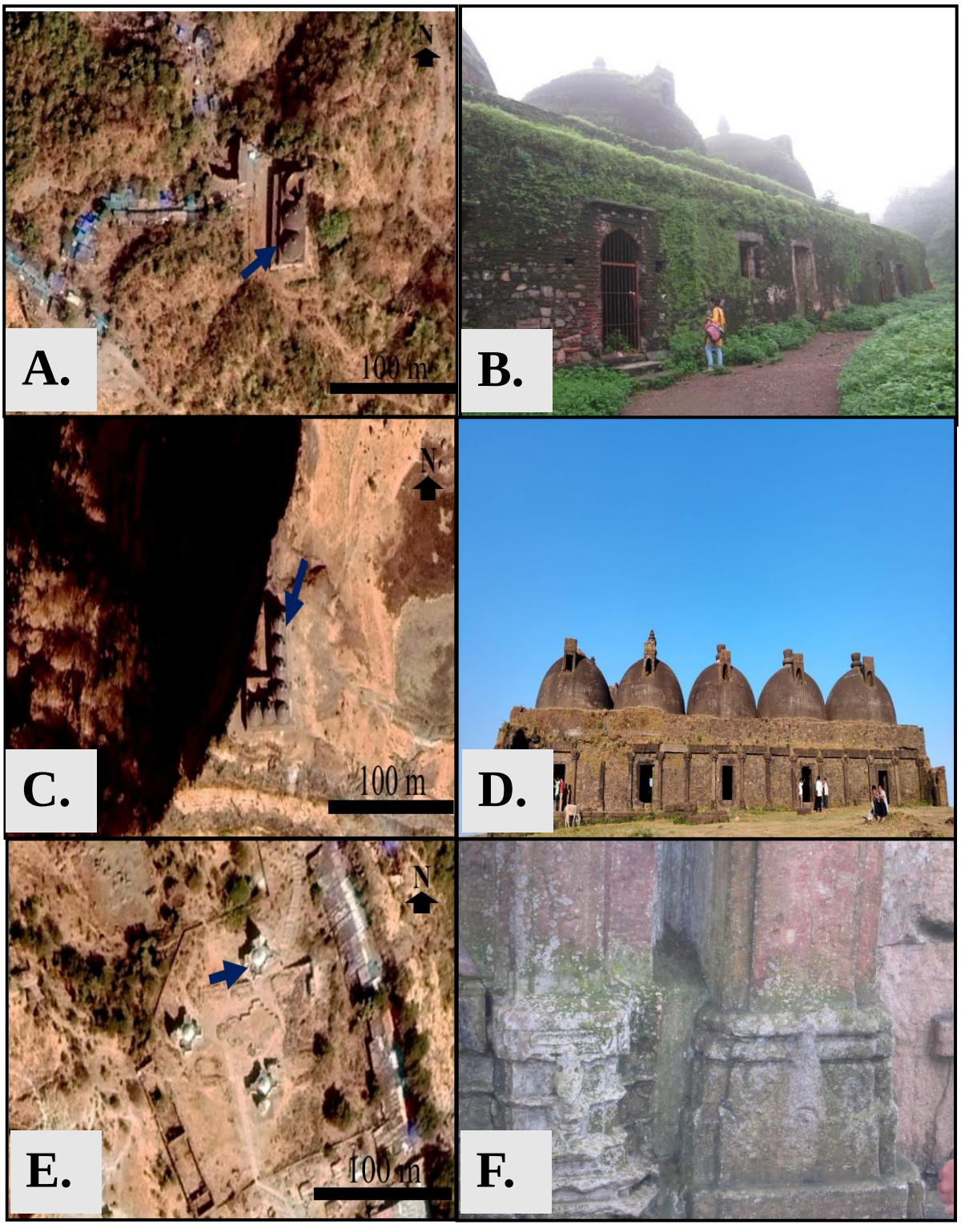

Plate 1 – Photographs of selected sites of Pavagadh hill

A, C & E. – Image from the Google Earth of Makai Kothar, Navlakha Kothar and Jain temple respectively; B, D & F – Field Photograph of Makai Kothar, Navlakha Kothar, Jain temple respectively

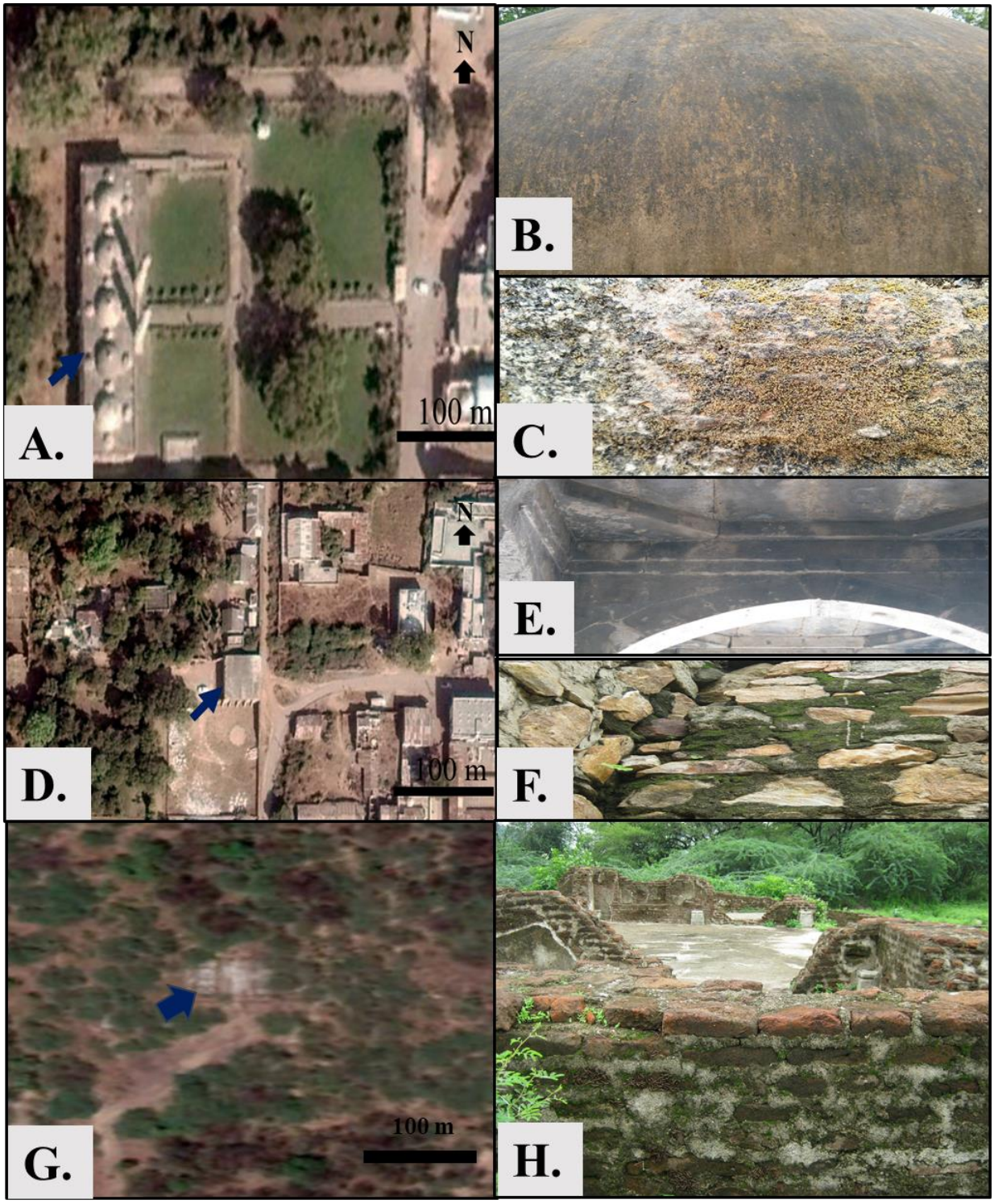

Plate 2 – Photographs of selected sites of Champaner

A. Google Earth image of Saher ki Masjid, B. Dome of the Saher ki Masjid covered by biofilms, C. Biofoulants on Abulation Tank in the premises of Saher ki Masjid, D. Google Earth image of Mandvi, E. Showing biofilm internal side of the Mandvi, F. Biofoulants on exposed surface of the Mandvi, G. Google Earth image of Amir Manzil, H. Field photographs of Amir Manzil

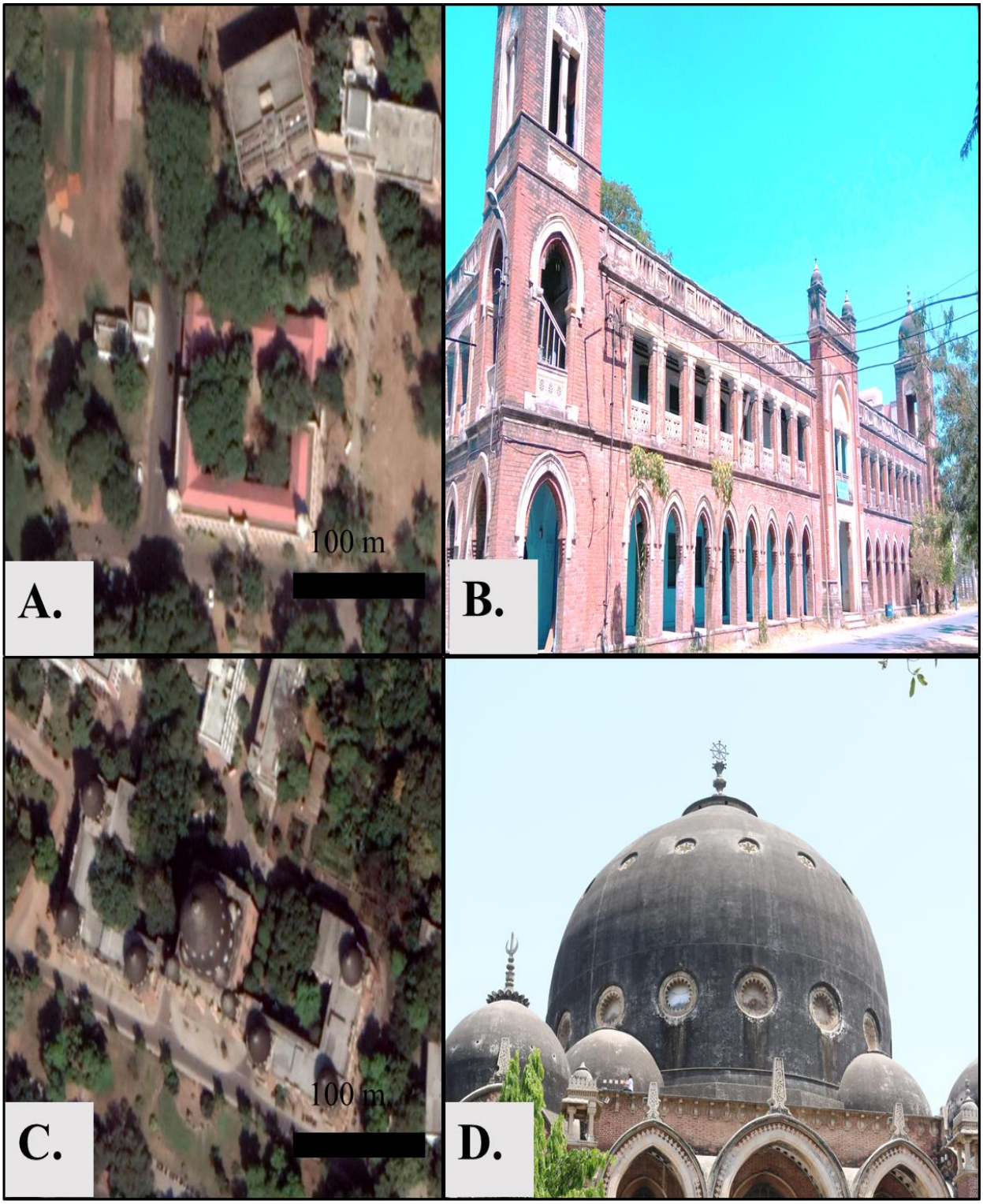

Plate 3 – Images of selected monuments from the MSU campus

A. Google Earth image of D. N. Hall B. Field view of D. N. Hall, C. Google Earth image of Arts Dome, D. Field view of the Dome of Arts building covered by Biofoulants