

Manifestations of Culture and Vernacular Built Heritage Around Canals: Insights from the Ganga Canal Route in India

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Abstract

Water canals have played a vital role in shaping urban and rural landscapes throughout history, fostering economic growth, and improving the quality of life of its inhabitants. Built by Sir Proby Cautley, the Ganga Canal in India, is one such engineering marvel dating back to 1854. The canal originating from Haridwar is a key part of India's colonial history that has led to significant rural and urban transformations in the Gangetic plains. The system consists of a main canal of about 438 km and about 6438 km long distribution channels, designed to bring water to the dry areas in western Uttar Pradesh, turning them into productive farmland. Over time, the canal has grown from a colonial engineering project into an important tool for managing water systems and supporting regional growth, highlighting its lasting importance and recognition today. This study examines the development of cultural and vernacular built heritage along this Ganga Canal Route in time. The study area spans from its origin at Haridwar up to Roorkee railway bridge.

The study employs archival research, photographic documentation, interviews with locals and stakeholders from living sites and secondary literature to examine the canal's impact on the built vernacular heritage and its significance over time.

In conclusion, the research identifies and discusses tangible and intangible aspects contributing to a deeper understanding of Canal 'Routes' through its Vernacular 'Roots'. Its historical significance, both in engineering and cultural impact, continues to shape the region's development. By integrating conservation efforts with modern advancements, the canal offers opportunities for sustainable tourism and heritage preservation.

Keywords: Built heritage, Canal, Cultural heritage, Intangible heritage, Vernacular.

Introduction

Canals have shaped civilizations and global trade for centuries, connecting regions and promoting economic growth. From ancient Egypt to modern engineering feats like the Suez and Panama Canal, they have transformed transportation and commerce. Canals have not only served as trade routes but have also influenced artistic expressions and cultural heritage. According to Shaw (1966), the Erie Canal in the United States, opened in 1825, spurred westward expansion and economic growth while becoming a popular symbol in American folklore and songs. However, in India, canal studies have traditionally focused on their use for irrigation, often overlooking their broader architectural, cultural, and heritage-related impacts. Moreover, the narratives that do exist about the influence of canals are less and have not been systematically documented.

There is little research on historic canals in Asian and Indian geographies that examine canals from a perspective of architecture, vernacular built heritage and human settlements. This gap highlights the need for a more comprehensive study that looks at how canals, such as the Ganga Canal, shape the surrounding landscape both tangibly and intangibly. This canal influences the architectural landscape and cultural identity of the region, while also adding a new architectural value to the city. Understanding its role beyond irrigation could reveal its impact on the local environment, industrial growth, urban development & placemaking.

Water canals have historically been a crucial lifeline for both rural and urban regions, playing a pivotal role not only in agricultural productivity but also as economic development, and the shaping of cultural identities. One such canal, the Ganga Canal, stands as an engineering masterpiece that has significantly transformed the landscape of the Gangetic plains. Designed by Sir Proby Cautley in the 19th century, the Ganga Canal was initially conceived to bring water to the arid lands of western Uttar Pradesh, turning them into fertile farmlands. Over time, this colonial infrastructure project has evolved into a multifaceted entity, influencing regional development and leaving a profound impact on the cultural and built heritage of the regions it traverses.

This study examines the Ganga Canal's cultural and historical significance, focusing specifically on its journey through the state of Uttarakhand from Haridwar to Roorkee. It delves into how this irrigation canal has shaped vernacular heritage in the region. Its aim is to explore the enduring legacy of the Ganga Canal in Uttarakhand, the ways these canal routes have manifested cultural identities and built vernacular heritage of the Uttarakhand region in time. Its objectives are as follows.

- To trace different layers of cultural and vernacular built heritage developed around the Ganga Canal route.
- To photo document the present day cultural and built heritage around the Ganga Canal route.
- To analyze the Ganga Canal's contribution to the development and regional growth.

Theoretical Framework

Throughout history, scholars worldwide have offered various definitions for Cultural Heritage and Vernacular Architecture. In "House Form and Culture," Rapoport (1969) proposes that vernacular architecture is influenced by cultural norms, climate, available resources, and social practices, serving as a direct representation of the values and way of life of the community. UNESCO on the other hand, characterizes cultural built heritage as "monuments, groups of buildings, and sites with historical, aesthetic, archaeological, scientific, ethnological, or anthropological value." This comprehensive definition highlights the physical structures that hold cultural significance, often emphasizing buildings and locations that embody a specific historical or cultural identity. Researchers such as Howard Davis and Julian Smith have expanded our understanding of cultural and vernacular-built heritage. In the seminal work titled 'Culture of Building', Howard Davis connects these concepts by explaining how vernacular architecture reflects a community's cultural values. He argues that vernacular structures are not only cultural artifacts but also reveal significant information about the society that created them through their design, purpose, and symbolic meaning (Davis, 2006). Similarly, Julian Smith, in Cultural Landscapes and Vernacular Heritage, broadens the scope of this discussion. He contends that cultural

and vernacular built heritage encompasses more than just individual structures; it includes entire landscapes that mirror the cultural practices, beliefs, and social organizations of the communities responsible for their creation (Smith, 2007). According to Viejo-Rose, over the last two decades, the perspective on cultural heritage has undergone significant changes. It has expanded beyond just monuments and museum collections to include a multi-faceted framework of significance, values, connections, and associated ideas. Because of these change, cultural heritage has transitioned from being understood as property or an object, to being assessed as a process, progressing through several intermediary and frequently simultaneous interpretations such as place, product, project, and performance (Viejo-Rose, 2015).

Canals serve as both practical infrastructure and markers of cultural identity, and scholars have recognized this dual role by developing various important theories to explain the cultural and physical history surrounding them. According to Nora's theory, some locations—like canals—act as archives for shared memories. Particularly in old cities, canals take on the significance Sites of Memory, signifying a common history and identity. For instance, the canals of Venice and Amsterdam serve as both transit routes and cultural icons, representing a long history of human contact with water (Nora, 1989). Canals provide orientation, acting as recognizable features that help people navigate urban spaces while simultaneously fostering a sense of continuity and historical significance as discussed by Kevin Lynch in his seminal work "The Image of the City" (Lynch, 1960). According to Aldo Rossi's Theory of Urban Artifacts, canals function as urban artifacts—structures that persist through time, contributing to the city's collective memory and identity.

Canals are also investigated by anthropologists as liminal spaces—transitional areas where various social practices and cultural traditions intersect. As historical crossroads for people, ideas, and things, canals—especially those linked to established trade routes—become culturally significant. Their constructed legacy reflects a variety of influences, and the surrounding industries, architecture, and urban forms serve as symbols of exchange and hybridization of cultures.

In summary, the evolving understanding of cultural heritage and vernacular architecture underscores the profound influence of both tangible and intangible elements in shaping our built environment. Canals, as dynamic infrastructure, exemplify this interplay by embodying historical significance, cultural identity, and social interactions, thus enriching our comprehension of their role in urban and cultural landscapes.

Review of Literature

Several studies related to canals have been conducted focusing on aspects like hydrological studies, irrigation and agricultural related practices, environmental impact, landscape studies etc. In the global context, a few research are conducted focusing on the historic and cultural significance of water canals. For example, Grześkow and Iga (2020) studies construction history, technological advancements, and revitalization efforts of the Old Canal, Bydgoszcz (a city in Poland), Huan Xu (2018) discusses possible threats to the Grand Canal, China which is a UNESCO world heritage site and Fei Qiao and Chih-Ming Shih (2020) delves into traditional vernacular dwellings in the Li Canal reach of the Grand Canal. Furthermore, concepts like Canal-Oriented Development (COD) are studied by Stephen Buckman (2016) focusing on urban development.

European cities are centuries-old networks of social and cultural interactions where a particular model of group life and culture has been shaped by the history and legacy of successive generations. In this connection, Grześkow and Iga (2020) talk about the culture-forming regeneration of urban space as the modern significance of the Old Canal region for the downtown Bydgoszcz (a city in Poland) and its influence on the evolution of the cultural landscape of the city. They focus on the construction history, technological advancements, and revitalization efforts of the canal. They examine how the canal has been used in the development of tourism and inland navigation, and emphasize its historical importance to the city. The canal area has also seen various cultural, sports, and leisure projects initiated by the local associations. These initiatives not only aim to revitalize the area but also to reconstruct social traditions associated with the canal, highlighting its importance to the local community (Grześkow, 2020).

The Grand Canal is recognized as a significant cultural heritage site, reflecting the ancient wisdom of Chinese civilization. The Yangzhou section is part of this heritage, which was inscribed on the UNESCO World Heritage List in 2014. Huan Xu (2018) examines the Grand Canal's Yangzhou section (in China) and the possible threats for the canal. He uses Remote Sensing (RS) and Geographic Information System (GIS) applications for analyzing landscape patterns and classification. The surrounding urban areas are facing severe degradation due to rapid development. He highlights the rapid construction and the changes in land use which have disrupted the historical landscape and need immediate preservation efforts (Xu, 2018). In contrast, Fei Qiao and Chih-Ming Shih (2020) examine the Li Canal reach of the Grand Canal which encompasses various aspects of architectural styles, cultural influences, and historical significance. They have conducted a comparative study of 397 cases of typical vernacular dwellings. They have analyzed these from the viewpoints of layout, structural style, and construction methods. The vernacular dwellings in Huai'an and Yangzhou are characterized by their use of gray bricks and gray-tiled roofs, showcasing a blend of firmness from northern styles and the delicate elegance typical of Jiangnan architecture. The unique architectural style is a result of the cultural interpenetration between the north and south. Fei Qiao (2020) thus attributes local climatic conditions and regional customs as fundamental reasons for the unique styles observed in the dwellings along the canal.

Canals have emerged as significant sites for waterfront development, particularly in urban areas that do not have direct access to rivers or harbors. They provide opportunities for creating vibrant, water-driven, place-based developments that focus on leisure, recreation, and economic growth while promoting environmental stewardship. Buckman (2016) has carried out a Canal-Oriented Development (COD) study characterized by its adaptability to various community needs and canal types. It allows for multiple development sites of different scales, which can create hubs of activities tailored to the specific characteristics of the community and its transportation network (Buckman, 2016). The idea is inspired by the Transit Oriented Development (TOD). He employs ethnographic observation methods to analyze three case studies: Bricktown, Mandalay Canal, and the Waterfront. This method allows for an in-depth understanding of how these developments engage with their communities and the effectiveness of their design. The analysis reveals that successful canal-oriented developments must integrate the canal into the broader urban fabric. For instance, the Mandalay Canal case study highlights the pitfalls of neglecting access, linkages, and community engagement, which can lead to a lack of vibrancy and integration within the urban environment. In contrast, successful developments demonstrate the importance of holistic design that considers various urban design aspects.

The literature emphasizes that canal-oriented developments should not treat the canals as afterthoughts. Instead, canals must be central components of comprehensive urban design strategies that foster sociability, accessibility, and sense of place. This approach is essential for creating successful urban spaces that thrive and contribute positively to their communities (Buckman, 2016).

Srichandan (2021) has conducted a similar study along the transhuman routes, not directly related to canals, where she has gone along the route in the Pithoragarh region of Uttarakhand. She has employed a qualitative ethnographic research approach, and has produced archival maps, academic texts, web and blog content, and visual sources such as videos and photographs.

Canals hold not only functional importance but also significant historical, cultural, and social values. Studies show that while canals contribute to urban development, tourism, and local culture, they are also vulnerable to environmental and developmental pressures. Each case employs a different methodology, giving the authors possible methods to approach and understand the Canal Routes. These studies show that canals have been extensively examined although not so much from the perspective of their relevance to architecture, vernacular practices and human settlements.

Research Methodology

This study employs a multifaceted research methodology combining archival research, photographic documentation, interviews, and secondary literature analysis to comprehensively examine the impact of the canal on built vernacular heritage and its evolving significance over time.

Archival Research: Extensive archival research forms the foundation of this study, providing historical context and insights into the canal's construction, development, and the surrounding vernacular architecture. This includes a review of old maps, government records, construction documents, and historical writings and photography housed in local and national archives. "Report on Ganga Canal Works, Proby. T. Cautley" was retrieved from M.G Central Library, IIT Roorkee archive sections. The other archival reports and photographs are sourced from the web. An old photograph was received from one of the stakeholders at the living sites near Bheemgoda Headworks. The archival materials help trace the chronological development of the canal and its relationship with the built environment.

Photographic Documentation: A systematic photographic documentation of the canal and its adjoining structures has been carried out from August to October 2024 to visually capture the current state of the tangible and intangible heritage. A physical walk was carried out to and from Roorkee to Haridwar along the canal route. Photographs are taken to document architectural details, materials, and the overall condition of these structures spanning from Bheemgoda Headworks, Haridwar to Railway Bridge, Roorkee. This visual record serves both as a tool for analysis and as a means of comparison with historical photographs obtained during archival research.

Interviews with Locals and Stakeholders: Six non-structured interviews are conducted around the canal with local stakeholders and the community. These interviews gathered personal narratives on how the canal has influenced architectural styles and building practices over time. The interviews were conducted among a range of stakeholders including shopkeepers, residents of Dhanori and Bheemgoda, gwala community (milkman) and the care-taker of the Dam Bungalow at Haridwar. These interviews were strategically selected to ensure a comprehensive understanding of the socio-cultural dynamics and the impact of architectural heritage on local communities.

Secondary Literature Review: A comprehensive review of existing literature related to vernacular architecture, water infrastructure, and historical development around the canal globally is undertaken. This includes journal articles and conference papers that provide theoretical frameworks and literature studies relevant to the research.

The data collected from archival research, photographic documentation, interviews, and literature reviews are synthesized to identify patterns, trends and its impact on tangible and intangible heritage in the study area of Ganga Canal Route. Qualitative analysis is used to interpret the interviews and historical narratives, while visual analysis methods are applied to the photographic documentation to assess the different layers of built heritage over time, classified into three time periods that are Pre-Colonial, Colonial and Post Colonial works. The findings were then produced in several maps showing the evolution in time for various built and cultural heritage along the canal route. The maps include eight categories of built heritage and various events mapped along the canal route. Further synthesizing all the research findings to conclude how the canal has shaped its heritage and its significance in contemporary times. The study reflects on the implications of these findings for future conservation efforts and policymaking in the region.

The Study Area and the Context of Ganga Canal

The Indian state of Uttarakhand is situated in the Northwest of the Country. The Tibetan Autonomous Region of China borders it to the Northeast, Nepal to the Southeast, the state of Uttar Pradesh to the South and Southwest, and the state of Himachal Pradesh to the Northwest. The 27th state of India, Uttaranchal, was created on November 9, 2000, when Uttar Pradesh was divided into two states. The state's name, Uttarakhand, was adopted in January 2007 to reflect the area's tradition the

name of "Northern region". The region is further divided into 13 districts. The Ganga Canal originates from Haridwar, Uttarakhand and goes up to Kanpur, Uttar Pradesh (Mathur, 2024).

The landscape encompassing varies layers of built and cultural heritage from Haridwar to Roorkee sees a series of changes and interconnection as one moves from the former to the latter. Haridwar is characterized predominantly by Hindu religious influences, visible through the numerous temples and old havelis that may have served as religious sites, particularly extending to the Kankhal. The holy Ganga River holds immense significance for the Hindus, shaping the spiritual landscape of Haridwar and enhancing the prominence of its canal route. Moving further along the canal towards Roorkee, the landscape reflects a blend of colonial and religious heritage. The development of the canal by the British introduced various colonial structures, which are still evident along the old routes, connecting settlements and reflecting the historical significance of the area. The canal route navigates through areas like Ranipur, Pathri, and Dhanori, which historically facilitated various trade activities, including those associated with the annual Kanwar Yatra during the Sawan month, a Hindu religious pilgrimage.

A notable religious point along this route is Piran Kaliyar, a prominent Muslim Sufi Saint shrine dating back to the 13th century. The shrine is a focal point for people-centric development and reflects the area's rich Sufi heritage. Traditional modes of transportation, such as horse carriages, were historically common between Roorkee and Piran Kaliyar, underscoring the connectivity and significance of this route. In Roorkee, the canal route is marked by colonial heritage, including old churches and a cemetery, workshops etc. Roorkee also stands out as an educational hub, primarily due to the presence of Indian Institute of Technology Roorkee (formerly known as Thomson College of Civil Engineering and University of Roorkee), further diversifying the landscape with institutional influences. Additionally, Roorkee's strategic location has fostered the development of an army center, contributing to the region's multifaceted heritage. Overall, the Ganga Canal route from Haridwar to Roorkee showcases a multilayered landscape of colonial, religious, and institutional heritage, reflecting the area's historical evolution and cultural diversity.

Famine and crop failure in Upper India between 1887 and 1838 caused catastrophic occurrences that are still remembered today. It was questioned if the irrigation canal would have saved the government money and spared the populace's suffering. It was suggested by Governor-General Lord Auckland that the government grant a few thousand rupees to investigate the Ganga Khadir and ascertain the viability of canal work from Haridwar to Kanpur. The inquiry began in December 1839 by Proby Cautley. In September 1841, the Court highlights the financial advantages and significance of the canal irrigation project and on the 25th of February 1842, orders were issued by the Agra Government for the commencement of the work. On the 16th of April the following ground was broken in the neighborhood of Kankhal by a commencement of the excavation of the channel. For Indians, Ganga is not just a river but a life-giver that has nourished successive civilizations alongside holding a profound religious significance. The canal work system consists of a main canal of 272 miles and about 4,000 miles long distribution channels (Fig 1).

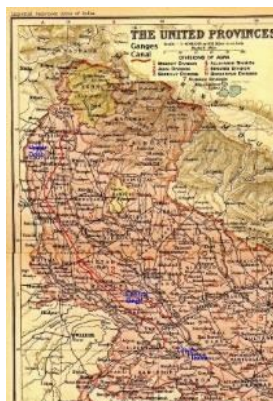


Fig. 1: Map of United Provinces highlighting the canal work from Haridwar to Kanpur.
Source: Imperial Gazetteer of India Atlas, 1908

The canal is administratively divided into the Upper Ganges Canal from Haridwar to Aligarh, with some branches, and the Lower Ganges Canal which constitutes several branches below Aligarh (Cautley, 1860). As discussed earlier, the research scope is limited to the study of the canal lying between Haridwar to Roorkee. Considered an engineering marvel of the time, the canal is truly one till date completing almost 180 years of standing still. Over the span of 180 years, the canal has facilitated agricultural development, has supported urban trade and industrial growth, and has influenced local heritage, including religious and colonial aspects. At present, the canal stands true to the grandeur with which it was first made. A small patch from the Jatwara Bridge, Haridwar to Solani Park, Roorkee is redone, and a new canal and aqueduct is built just along the one built in 1840. The new construction is said to be done in 2001, as remembered by one of the local stakeholders at Dhanori.

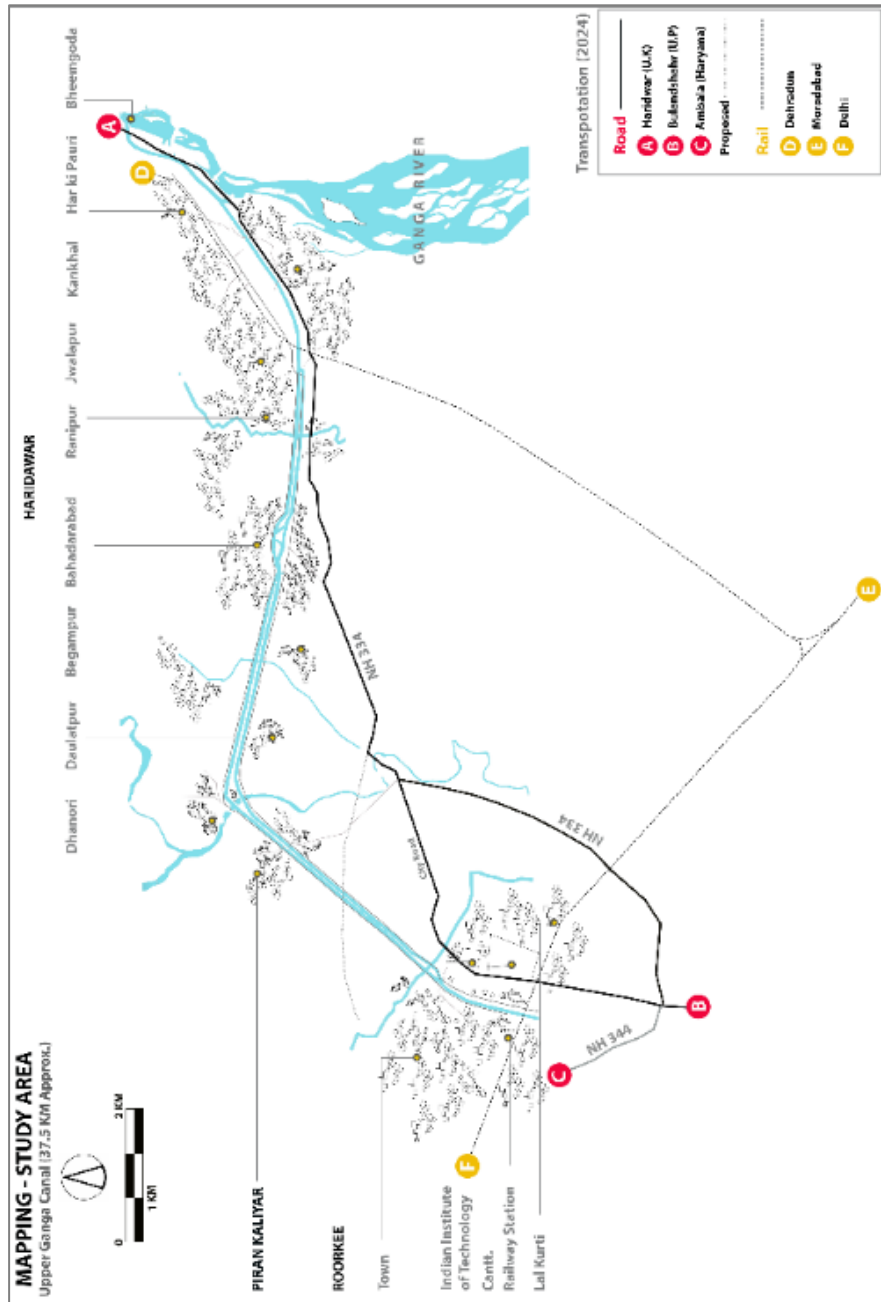


Fig. 2: Map of the study area from Haridwar to Roorkee.


Source: Developed by Authorss, 2024

The study area from Haridwar to Roorkee can be identified by seven major zones or areas as mentioned in the records of Report on the Ganges Canal Works (Volume I,II,III)(Cautley Proby T, 1860) and Saharanpur-District Gazetteers of the United Provinces of Agra And Oudh (Nevill, H. R , 1909) namely Haridwar, Mayapur, Kankhal, Ranipur, Bahadarabad, Dhanori, Piran Kaliyar and Roorkee (Fig.2).

Haridwar, often known as the "gateway to gods," is one of the most revered pilgrimages in the country. Nested in the foothills of Himalaya, the city houses a number of temples, ghats and ashram. Hindus believe that bathing in the Ganga's hallowed waters is sacred and cleansing. The city attracts a lot of tourists due to its location and religious significance. Nonetheless, the city also has a rich colonial past housing, check posts, bungalows and workshop constructed for the aid in Ganga Canal work. The Ganga canal originates from the head works of Haridwar, today known as Bhimgoda Barrage (N29° 58' 15.303", E78° 11' 1.53"). However, upon the site visit, it was observed that it is not the barrage but a small opening near Sarvanand Ghat, Haridwar where the canal starts (Fig.5). The construction of the dam near the canal's mouth, according to the Hindu priests of Haridwar, would "imprison" the Ganga's sacred waters. Cautley therefore gave them his word that he would leave a gap in the dam through which unrestricted water flow would occur. The headworks have a memorial installed marking the great engineering marvel with sectional details and the discharge levels however lost from the public eye (Fig.6).

Table 1: Canal Works and Associated Built Heritage, Haridwar.

Source: Authors,2024

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|---|--|---|
|  <p>Fig. 3: Photograph of the head works of the Ganges Canal in Haridwar. Source: Samuel Bourne,1860</p> |  <p>Fig. 4: An image of boats used to check the waterworks. Source: Local Resident,2024</p> |  <p>Fig. 5:The point of origin of Ganges Canal. Source: Authors,2024</p> |
|  <p>Fig. 6 :The stone memorial Source: Authors,2024</p> |  <p>Fig. 7: The residential colony, Haridwar. Source: Authors,2024</p> | |

The location contains several dwellings (Fig.7) and factories (Fig.8) purportedly constructed in 1929 to accommodate the employees responsible for maintaining the canal, as recounted by a resident of the colony. The now living quarters are said to be stable for the horses. The Uttar Pradesh Irrigation and Water Resources Department currently oversees the colony. The resident, reminiscing, presented a vintage photograph and recounted how, in earlier times, boats were employed to traverse the river and

reach the barrage for maintenance purposes (Fig.4). Subsequently, it has also been discovered that the old crossing bridge has had a malfunctioning railway line that is said to be utilized to transport materials to the workshops (Fig.9).

There is another bungalow near the site called “Lal Kothi”. The specific ownership of the same bungalow is not explicitly mentioned, but it could be inferred that it served as a residence for an officer. Nevertheless, the construction dates back to year 1929, in line with the residential and workshop settlement suggesting a strong interrelationship.

Table 2: Canal Works and Associated Industrial Heritage, Haridwar.

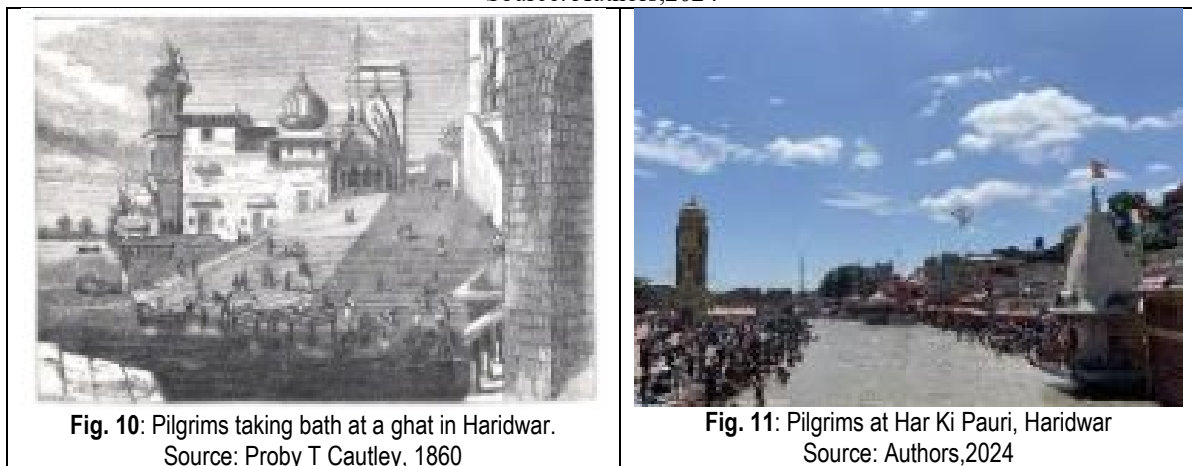
Source: Authors,2024



Moving ahead of the settlement site, one crosses a number of ghats which highlights one of the most important aspects of the city. As discussed earlier, the city is famous among the Hindus, for the purpose of taking bath in the holy waters of Ganga. This practice has evidently been long-standing, also illustrated in a photograph found in the Report on the Ganges Canal Works (Volume II) (Cautley, 1860) (Fig.10). In the photograph taken at one of the well-known ghats called “Har Ki Pauri”, one could see the drastic development that has happened around the ghat recently (Fig.11)

Table 3: Canal Works and Associated Religious Heritage, Haridwar.

Source: Authors,2024



The quote below amply describes the way in which the area has been organised in relation to the Canal.

“At Mayapur too, just below Ganosh-ghat, are the head works of the Ganges canal, and on the opposite side of the bridge over the regulator are the canal offices and the inspection bungalow, the latter being in a beautiful situation looking northwards up the river, with a magnificent view of the town, the gorge and the hills beyond”

Nevill, H.R., 1909:265.

The archival photographs of the same “Dam Bungalow” (Fig 12) could be found and the bungalow still stands. The building has undergone renovation during the covid times and is currently serving as a government guest house as mentioned by the manager present on the site.(Fig.13-14).

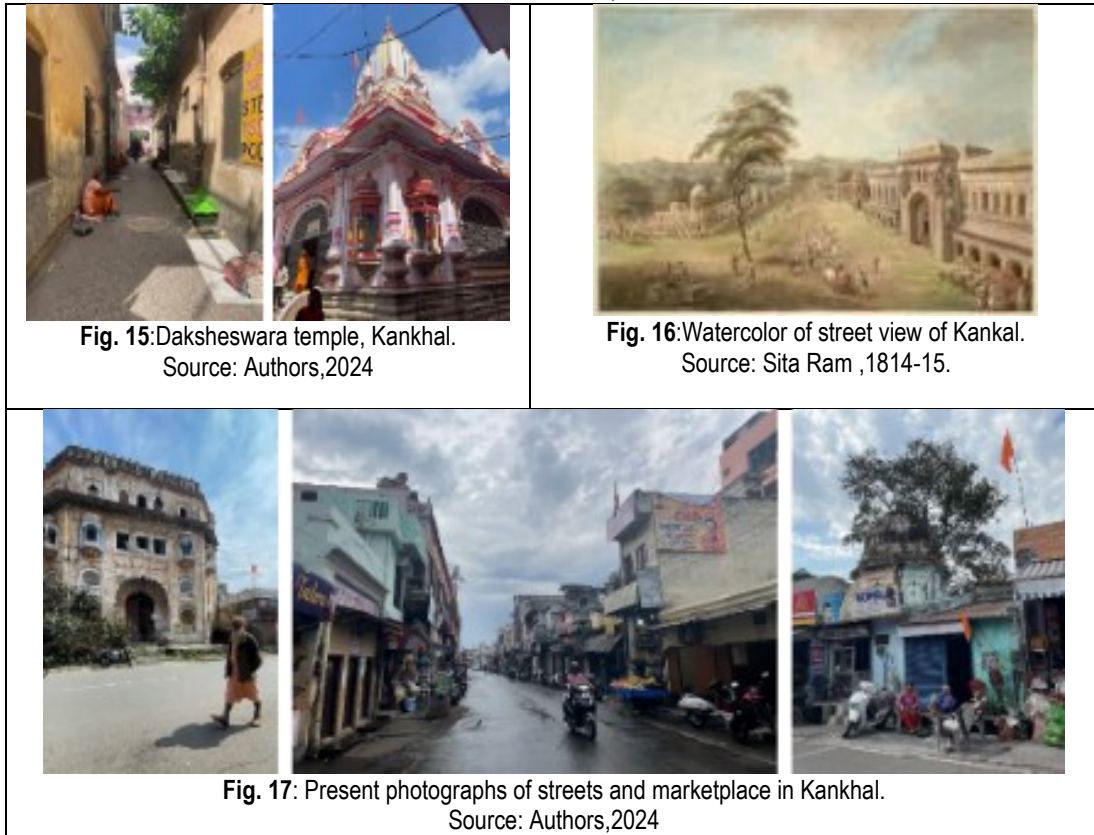
Table 4: Canal Works and Associated Residential Heritage, Haridwar.

Source: Authors,2024



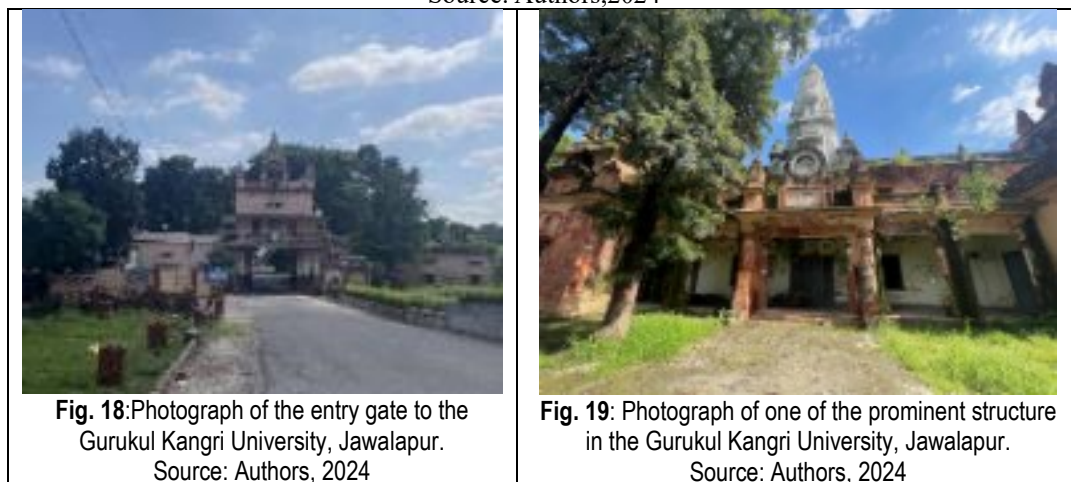
Further encountered is another historically significant town, Kankhal, which is also a major religious site. Kankhal's importance predates that of Haridwar. However, as Haridwar rose to prominence as a hub for trade and pilgrimage in the late 19th century, Kankhal's significance has gradually diminished. The town's main temple, 'Daksheswara'(Fig.15), is situated at its southern edge. According to traditional Hindu scriptures, this site marks the location where 'Sati', the daughter of 'Raja Daksha' and spouse of 'Mahadev', self-immolated in flames. The 'Sati Kund' is also linked to this event. The town extends across a vast expanse, featuring a stone-paved market street with brick-built shops and substantial residences flanked on either side (Fig.17). Kankhal was a scenic locale, abundant with trees, religious structures, and dwellings adorned with exquisite frescoes. The town took pride in its numerous gardens, enclosed by tall walls and accessible through ornate entrances. Kankhal was also home to multiple 'Akharas' (Nevill, 1909).

Table 5: Kankhal
Source: Authors,2024



As per the Saharanpur District Gazetteers of United Provinces of Agra and Oudh 1909, Jwalapur has housed a number of Sanskrit pathsahla along with an American mission school. Upon investigation, the Gurukul Kangri University was located in Jawalapur (Fig.18-19). The institution has been established in 1602 by Swami Shraddhanand. The university comprises numerous buildings, the construction dates of which could not be determined; however, several noteworthy architectural features were observed. These elements were distinct from other colonial structures encountered, suggesting an earlier origin. However, the school could not be located at present.

Table 6: Institutional Heritage, Jwalapur.
Source: Authors,2024



Beyond Kankhal, the canal crosses Jawalapur and proceeds to the riverbeds of three waterways: Ranipur, Pathri, and Rutmoo, in that order. To ensure uninterrupted water flow, it was necessary to devise appropriate crossing methods that considered each river's basin and flow characteristics. Consequently, two super passages were suggested for crossing the Rutmoo and Pathri rivers (Fig.20). The colonial powerhouse(Fig.23), which dates back to 1930 and is situated in Bahadarabad between these two super passageways. In addition, a field research station was established in 1946 in collaboration with the Roorkee Irrigation Research Institute. There is another power house that has come up in the near vicinity i.e. the the Pathri power house (Fig.24).

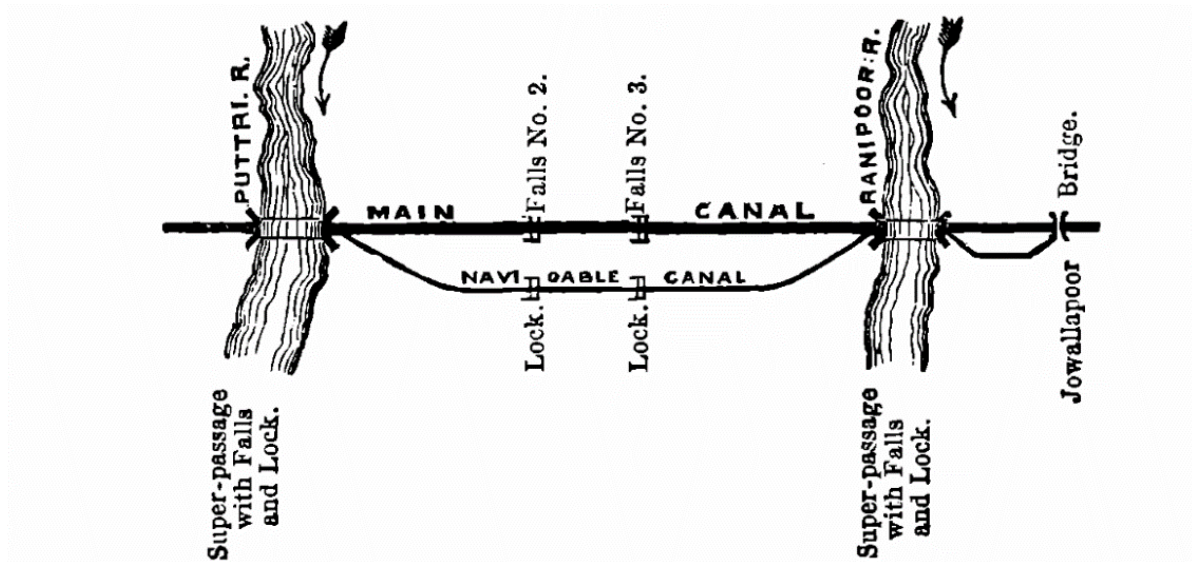


Fig. 20: Canal drawings for the two super passages.
Source: Proby T. Cautley, 1860.

Table 7: Canal Works at Ranipur and Begampur.
Source: Authors,2024



Fig. 21: Canal passing below Putri river in Ranipur.
Source: Authors, 2024



Fig. 22: Canal passing below Rutmoo river in Begampur.
Source: Authors, 2024

Table 8: Canal Works and Associated Industrial Heritage.

Source: Authors,2024

**Fig. 23:** Bahadarabad power house built in 1930, Bahadarabad.

Source: Authors, 2024

**Fig. 24:** Pathri power house.

Source: Authors, 2024

Dhanori is recognized as yet another significant milestone in the evolution of colonialism. A colonial colony and offices for the regulation work has been established in the vicinity with the advent of Dhanori works (Fig.25). On either side of the canal, the property has the remnants of colonial buildings. The remnants of the structure (Fig.28) on the right bank downstream are currently a part of the area police station. According to a resident in the area, one of the residential buildings is recalled as "Taj Babu Kothi"(Fig.27). The residential colony and workshops to the left are now a part of the irrigation department (Fig.26). The remnants of a boat that was formerly used to travel along the canal are kept in the workshop.

Table 9: Canal Works and Associated Industrial Heritage.

Source: Authors,2024

**Fig. 25:** Archival photograph of Dhanori works.

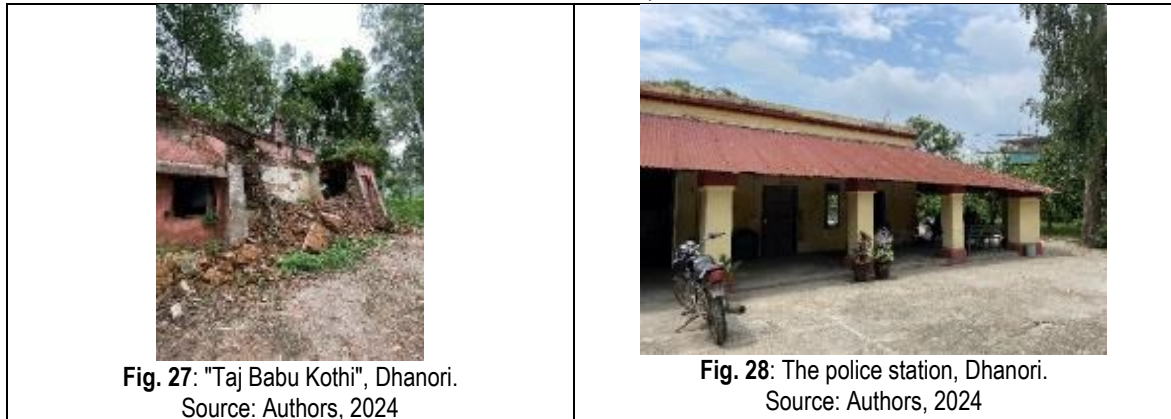
Source: T.G.Glover,1867

**Fig. 26:** The workshop shed, Dhanori.

Source: Authors, 2024

Table 10: Canal Works and Associated Industrial Heritage.

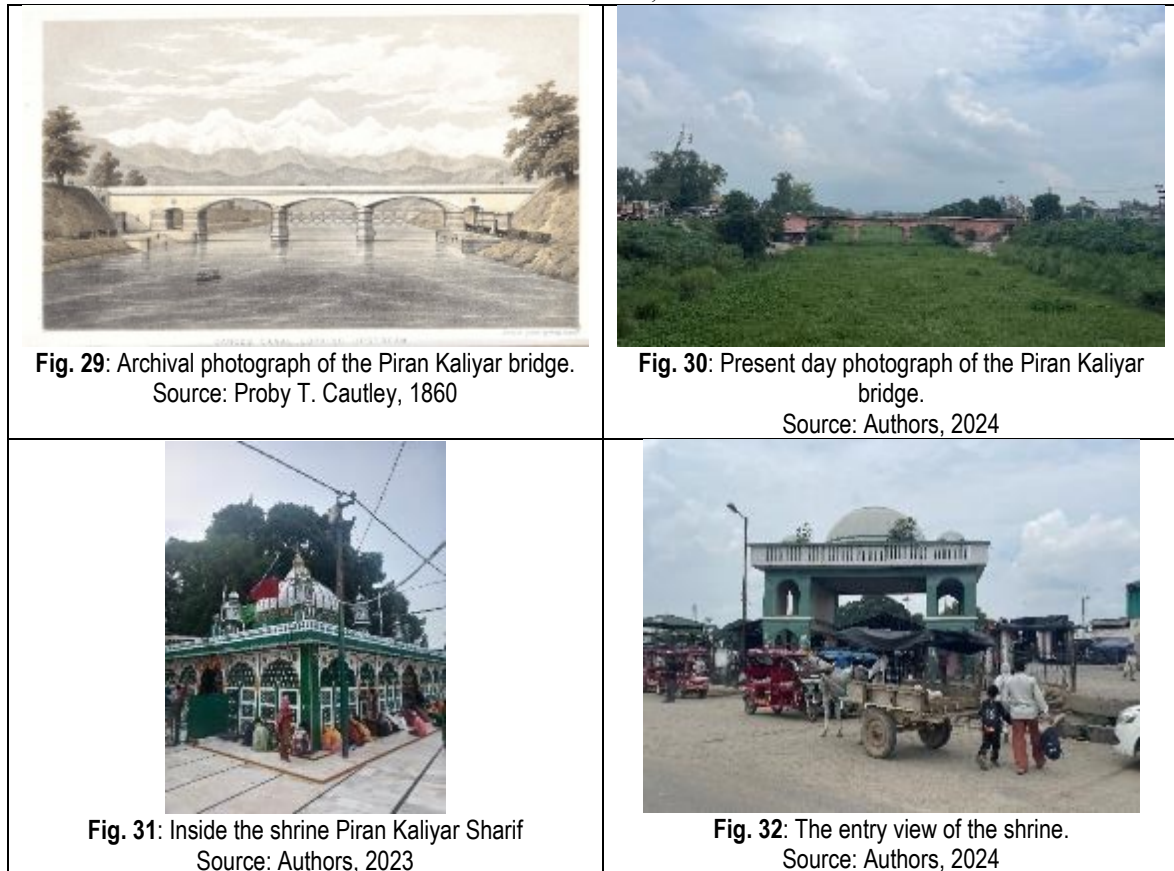
Source: Authors, 2024



The enormous dome in Piran Kaliyar that encloses the grave of the Sufi saint Alauddin Ali Ahmed Sabir is the most noticeable aspect of Piran Kaliyar Sharif (Fig.31) dating to 13th century. Colonial bridges (Fig.29-30), historic gates, regional food, and vernacular transportation (Fig.32) may all be found along the route. Owing to the ideals of the Sufi Saints, it is a place where one could encounter a multifaith hybrid culture and visitors. Over the years, it has developed into major religious tourism point within the Muslim community.

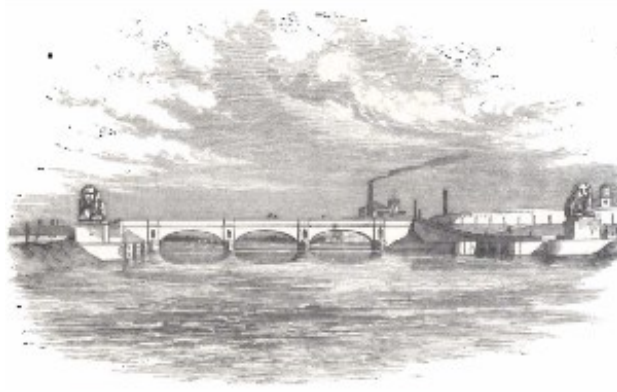



Table 11: Religious Heritage, Piran Kaliyar

Source: Authors, 2024



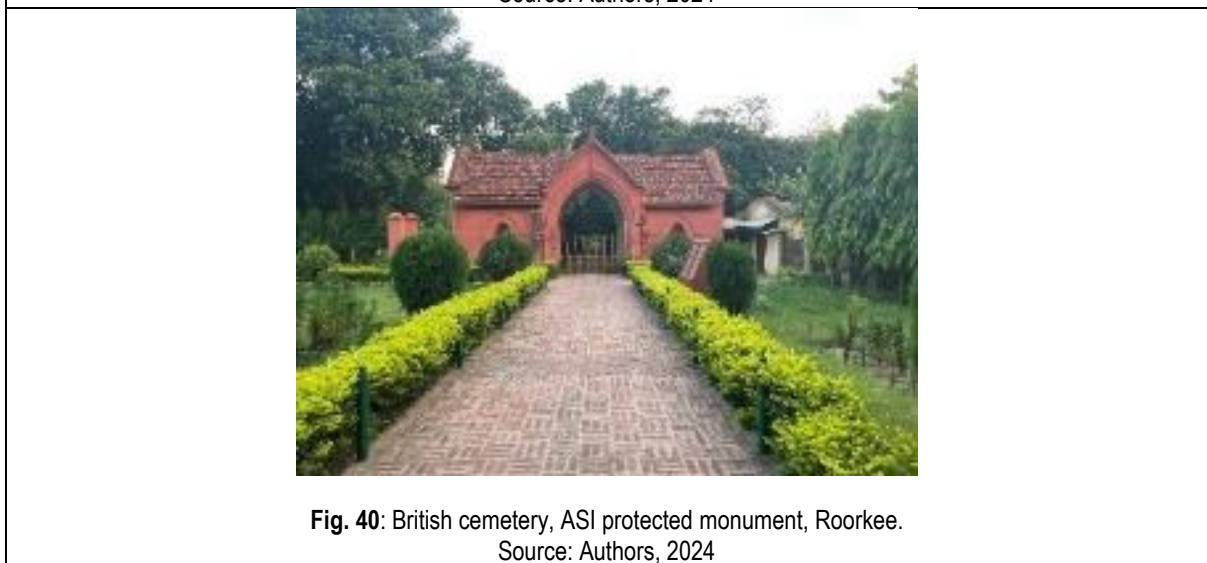
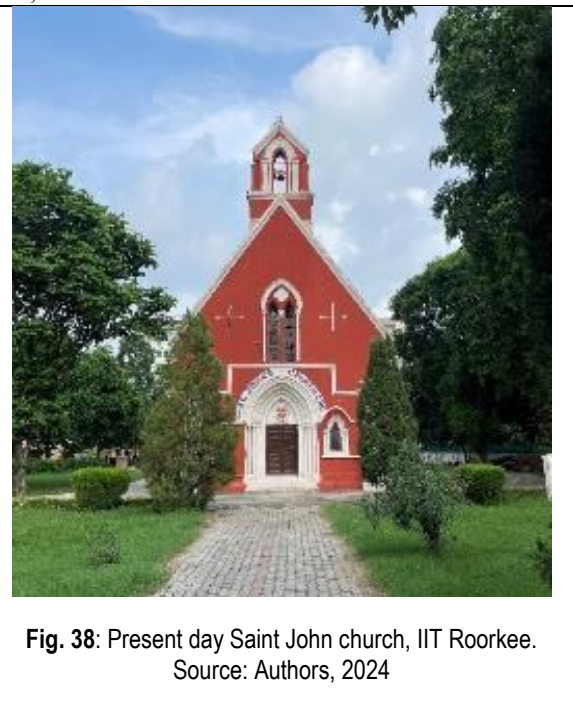
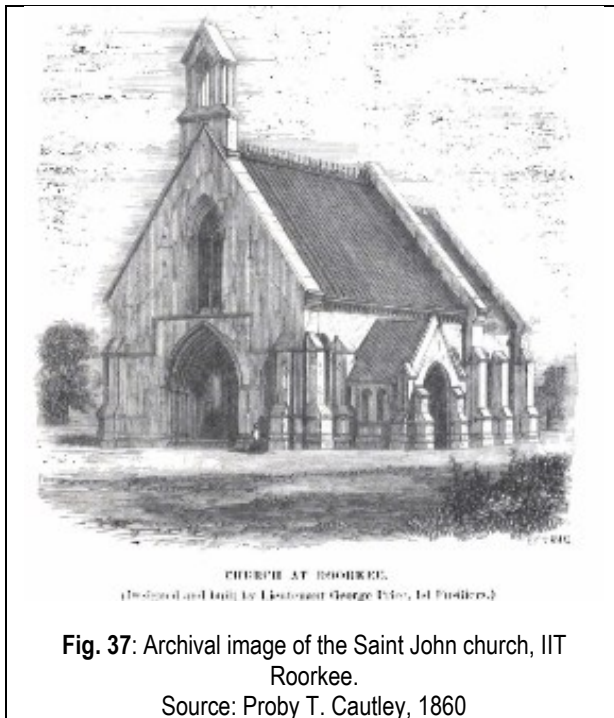
As one approaches Roorkee from Piran Kaliyar, two magnificent statues of lions await, positioned on either side of the canal. In the Roorkee's city core, there are two more (Fig.33). It is stated that these Statues of lions are positioned to indicate high flow and slope of water. In fact, another lion also exists; it was ideally the first lion, constructed as a model that would be replicated (Fig.35). Away from the spotlight, though, the same stands amid a neighborhood called "Sher Kothi" close to Saint Andrews Church (Cautley, 1860). It is believed that these lions served as the model for the statues of lions at the London Trafalgar Square (Fig.36).

Table 12: Canal Works and Associated Heritage, Roorkee
Source: Authors,2024

| | |
|---|--|
|  <p>Fig. 33: Archival photograph of the canal looking upstream, Roorkee. Source: Proby T. Cautley, 1860</p> |  <p>Fig. 34: Present photo of the lion and the canal, Roorkee. Source: Authors, 2024</p> |
|  <p>Fig. 35: The first lion built as a prototype, Roorkee. Source: Authors, 2024</p> |  <p>Fig. 36: Lion at Trafalgar Square, London. Source- Jacqueline Banerjee "sir Edwin Landseer's Lions at the base of Nelson's Column, Trafalgar Square. Available at: https://victorianweb.org/sculpture/misc/landseer1.html (Accessed: 15 September 2024).</p> |

The city contains several churches that originated during the colonial period, representing a significant religious dimension to the growth surrounding the canal: the Saint Andrews church, Sacred Heart church (1889), Anglican Methodist church (1890), Saint John church (1857) (Table:13). One of the ASI-protected monuments in the town, the British Cemetery (Fig.40) is another structure that has been a part of this colonial ecclesiastical growth.

Table 13: Canal Works and Associated Religious Heritage, Roorkee
Source: Authors,2024



Solani aqueduct is one of the most prominent engineering marvels and a monument of industrial archeology arising from the canal construction (Fig 42-43). A water-carrying channel 25m above the Solan River's bed, the Colonial-era aqueduct is a 980 feet long aqueduct consisting of 15 50-foot-high arches that are separated by 10 feet wide piers. The structure has been built using 85 million bricks, which have been locally made developing a new type of brick in kiln called the “Roorkee kiln” (Cautley, 1860).

To facilitate the smooth construction of canal work and the aqueduct, there has been an emerging need of engineers. Thus, the well-known Thomson College of engineering has been established in year 1847, which has later become the Indian Institute of Technology, Roorkee (Fig.44). As supporting infrastructure, the Ganga Canal workshop (Fig.45-46) and Iron Foundry to supply articles for the canal works had already been established here in 1843. Lesser-known fact, the first ever railway line in India has also been set up between Piran Kaliyar and Roorkee in 1851 for the transportation of soil. This was two years before the first passenger train ran from Bombay to Thane in 1853. The drawings suggest that the line was laid in the canal bed itself thus the remains are not to be found (Fig.41). The locomotive named “Mary Lind” was imported from Britain, and a replica of the engine is currently displayed at the Roorkee Railway Station (Fig.47). Roorkee also has become home to the Bengal Sappers and Miners in 1853 (Cautley, 1860)

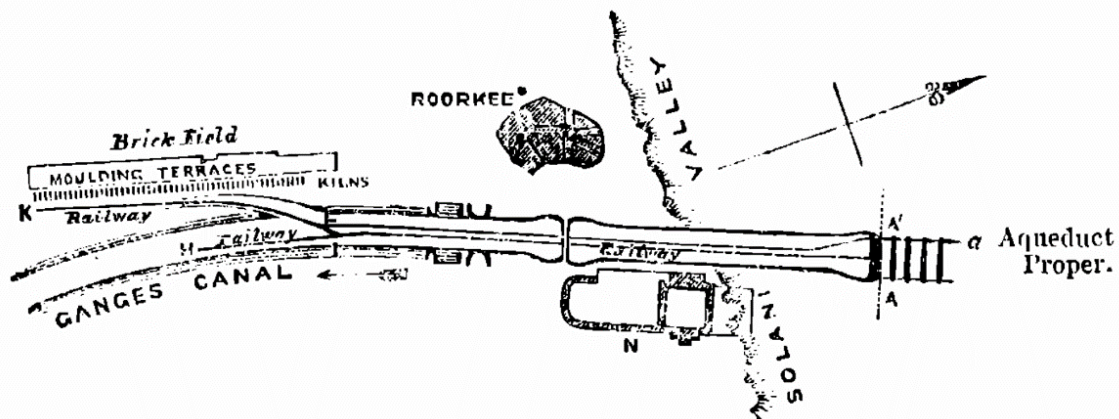


Fig. 41: Plan showing the railway track, workshop, aqueduct and brick fields.

Source: Cautley, 1860

Table 14: Solani Aqueduct, Roorkee

Source: Authors, 2024



Fig. 42: Archival photo of the Solani Aqueduct, Roorkee.

Source: Samuel Bourne, 1860



Fig. 43: Current view of the Solani aqueduct, Roorkee.

Source: Authors, 2024

Table 15: Canal Works and Associated Heritage, Roorkee.
Source: Authors,2024



Fig. 44: Current view of the main James Thomson building, IIT Roorkee.
Source: Authors, 2024



Fig. 45: Archival photo of the workshop in Roorkee.
Source: T.G.Glover, 1867



Fig. 46: Present view of the workshop taken from across the canal, Roorkee.
Source: Authors, 2024



Fig. 47: Replica of the locomotive, outside Roorkee railway station.
Source: Authors, 2023



Fig. 48: Entry to Roorkee Cantonment area.
Source: Authors, 2024











Fig. 49: Institutes along the canal in Roorkee.
Source: Authors, 2024

Intangible Heritage

Table 16: Intangible Heritage around Canal.

Source: Authors, 2024

| | |
|---|---|
|  |  |
| <p>Fig. 50: Kavar Yatra, July 2024, Roorkee Source: Authors, 2024</p> | |
|  |  |
| <p>Fig. 51: Idol immersion on the last day of Navratri being done at the ghat in Roorkee Source: Authors, 2024</p> | <p>Fig. 52: People sitting along the ghat in Roorkee on Janmashtami. Source: Authors, 2024</p> |
|  |  |
| <p>Fig. 53: Fishing activity in the canal, Roorkee. Source: Authors, 2024</p> | <p>Fig. 54: Kids enjoying along the ghats of the canal. Source: Authors, 2024</p> |
|  |  |
| <p>Fig. 55: Celebration of Ganesh Chaturthi around the canal road. Source: Authors, 2024</p> | <p>Fig. 56: Economic activities along the edge of the canal. Source: Authors, 2024</p> |

The findings led to the production of maps of the tangible and intangible heritage in time with respect to Pre-Colonial (Fig.58), Colonial (Fig.59), and Post-Colonial (Fig.60) time in India. Tangible heritage is categorized into eight types: Water Works Engineering (W), Religious (R), Army (A), Industrial (Y), Railways (T), Socio Economic (S), Residence (H) and Educational Institute (E) upon their characteristics and use and then marked in the map as per timeline. The intangible aspects are also marked along the canal route map (Fig.62).

Table 17: Categorization of Built Heritage around the Canal from Haridwar to Roorkee.
Source: Authors,2024

| LOCATION | IDENTIFIED BUILT HERITAGE | Water Works Engineering (W) | Religious (R) | Army (A) | Industrial (Y) | Railways (T) | Socio Economic (S) | Residence (H) | Educational Institute (E) |
|----------------------------------|--|-----------------------------|---------------|----------|----------------|--------------|--------------------|---------------|---------------------------|
| Haridwar | Bheemgoda Headwork | W1 | | | | | | | |
| | Workshop Bhemmgoda | | | | Y1 | | | | |
| | Govt. Residences Bheemgoda | | | | | | | H1 | |
| | Old Railway Bridge | | | | | T1 | | | |
| | Laal Kolhi | | | | | | | H2 | |
| | Railway Tunnel | | | | | T2 | | | |
| | Har ki Pauri | | R1 | | | | | | |
| | Old Market Har ki Pauri | | | | | | S1 | | |
| | Havelis Haridwar | | | | | | | H3 | |
| | Ganesh Ghat Mayapur | | R2 | | | | | | |
| | Dam Banglow | | | | | | | H4 | |
| | Kankhal Town | | R3 | | | | | | |
| | Gurukul Jwalapur | | | | | | | | E1 |
| | Jatwara Bridge | W2 | | | | | | | |
| | Ranipur Passage | W3 | | | | | | | |
| | Settlement | | | | | | | | H5 |
| | Pathri Power House | | | | | Y2 | | | |
| | Bahdarabad Power House | | | | | Y3 | | | |
| | Small Canal | W4 | | | | | | | |
| | Field Research Station (Irrigation Research Institute) | | | | | | | | E2 |
| Pathri Super Passage | W5 | | | | | | | | |
| Settlement | | | | | | | | H6 | |
| Dhanori Workshop | | | | | Y4 | | | | |
| Dhanori Government Inter College | | | | | | | | E3 | |
| Piran Kaliyar | Kaliyar Sharif | | R4 | | | | | | |
| | Kaliyar Bridge | W6 | | | | | | | |
| | Haridwar University | | | | | | | | E4 |
| | Lion Statue | W7 | | | | | | | |
| Roorkee | Solani Aquaduct | W8 | | | | | | | |
| | Roorkee Workshop | | | | Y5 | | | | |
| | Saint Andrew's Church & Lion | | R5 | | | | | | |
| | College of Civil Engineering (IIT Roorkee) | | | | | | | | E5 |
| | Roorkee Cantonment | | | A1 | | | | | |
| | Lion Statue | W9 | | | | | | | |
| | Methodist Church | | R6 | | | | | | |
| | Sacred Heart Church | | R7 | | | | | | |
| | Old Cemetary | | R8 | | | | | | |
| | Irrigation Research Institute Roorkee | | | | | | | | E6 |
| | State Water Informatics Centre Roorkee | | | | | | | | E7 |
| Boat Club House | | | A2 | | | | | | |
| Railway Station Roorkee | | | | | T3 | | | | |

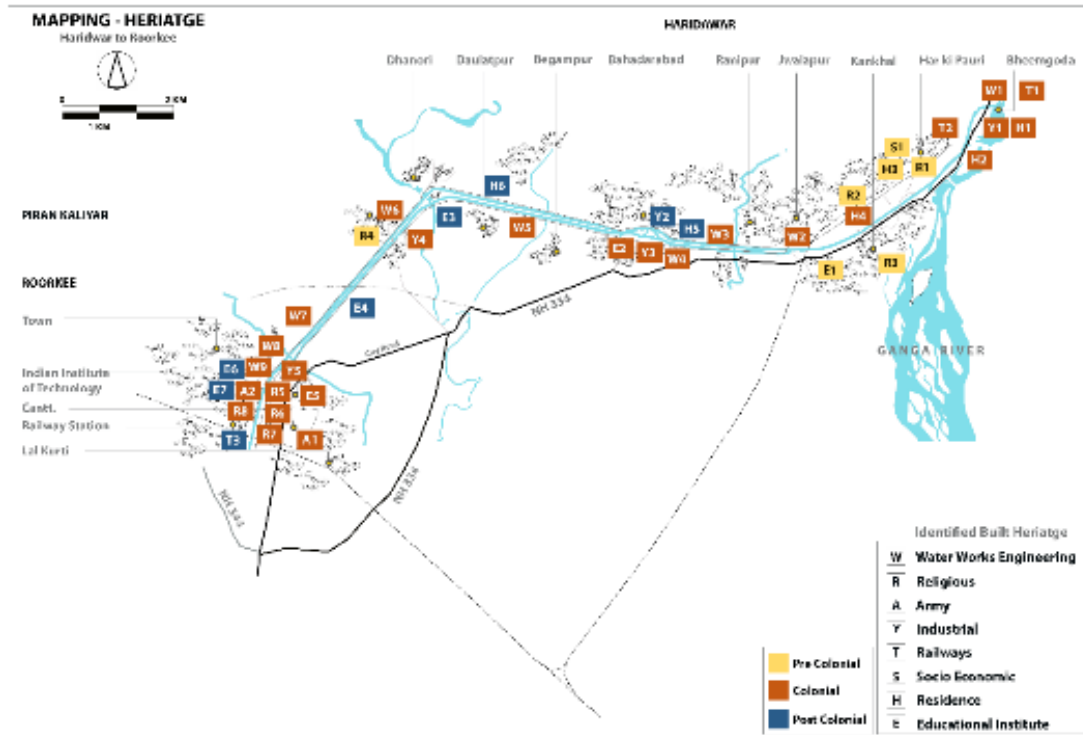


Fig. 57: Map Showing Built Heritage at Different Locations, from Haridwar to Roorkee.
Source: Developed by Authors, 2024

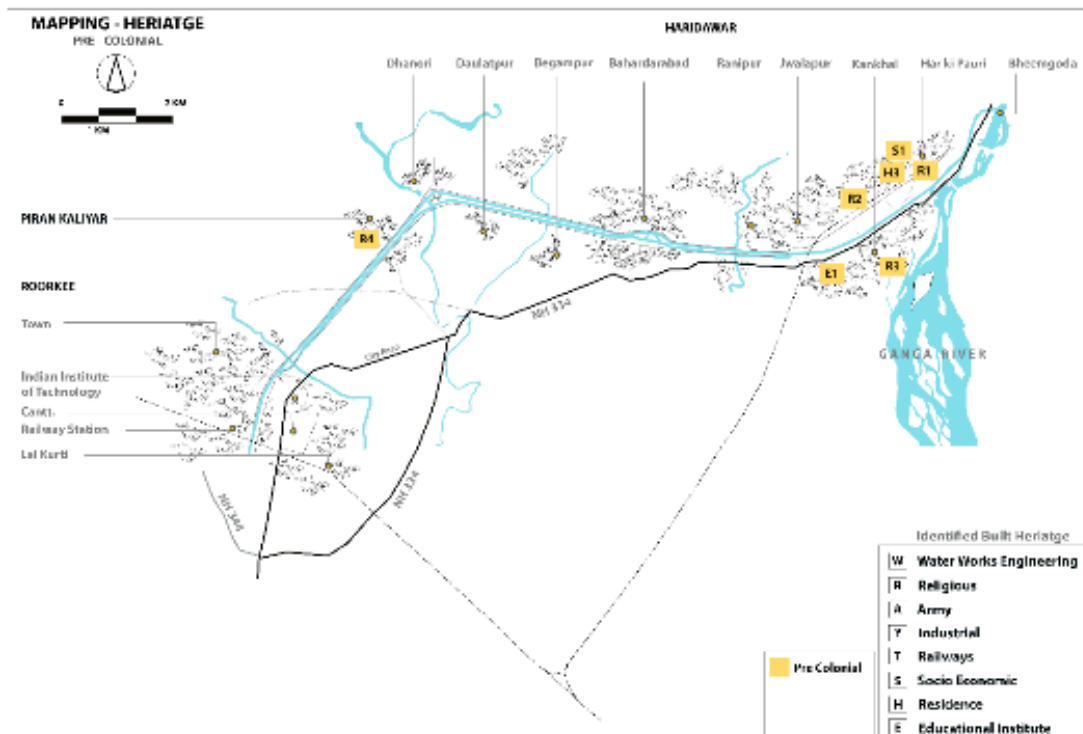


Fig. 58: Map Showing Pre-Colonial Built Heritage at Different Locations, from Haridwar to Roorkee
Source: Developed by Authors, 2024

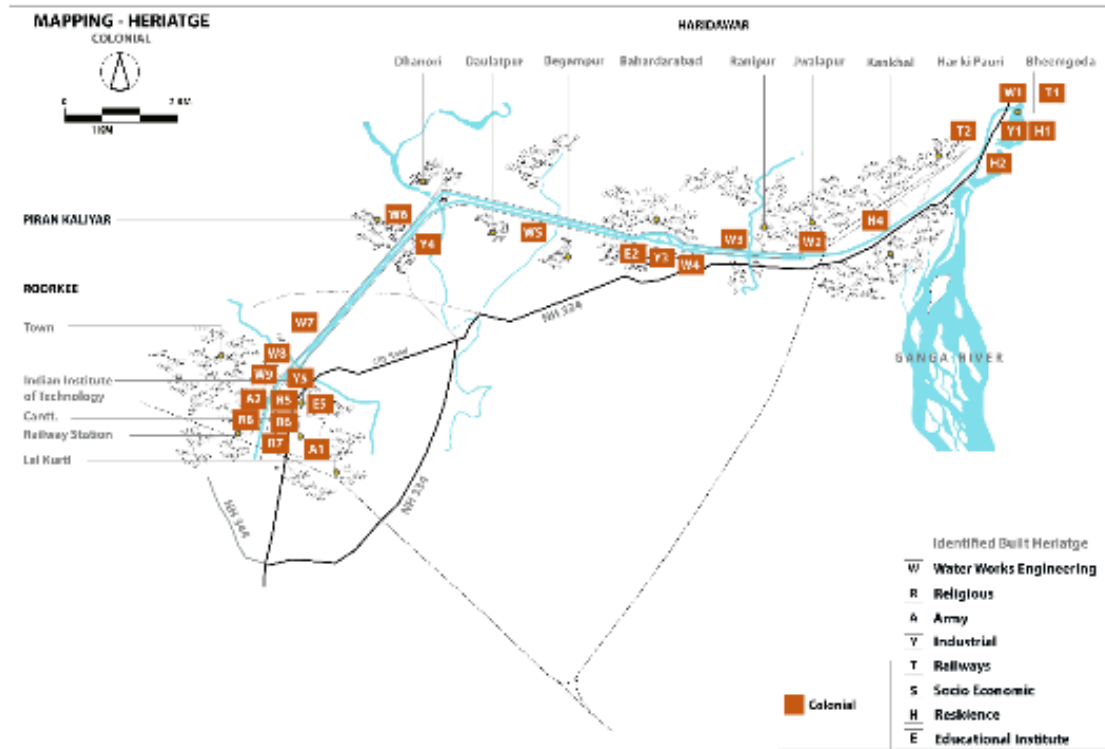


Fig. 59: Map Showing Colonial Built Heritage at Different Locations, from Haridwar to Roorkee
 Source: Developed by Authors, 2024

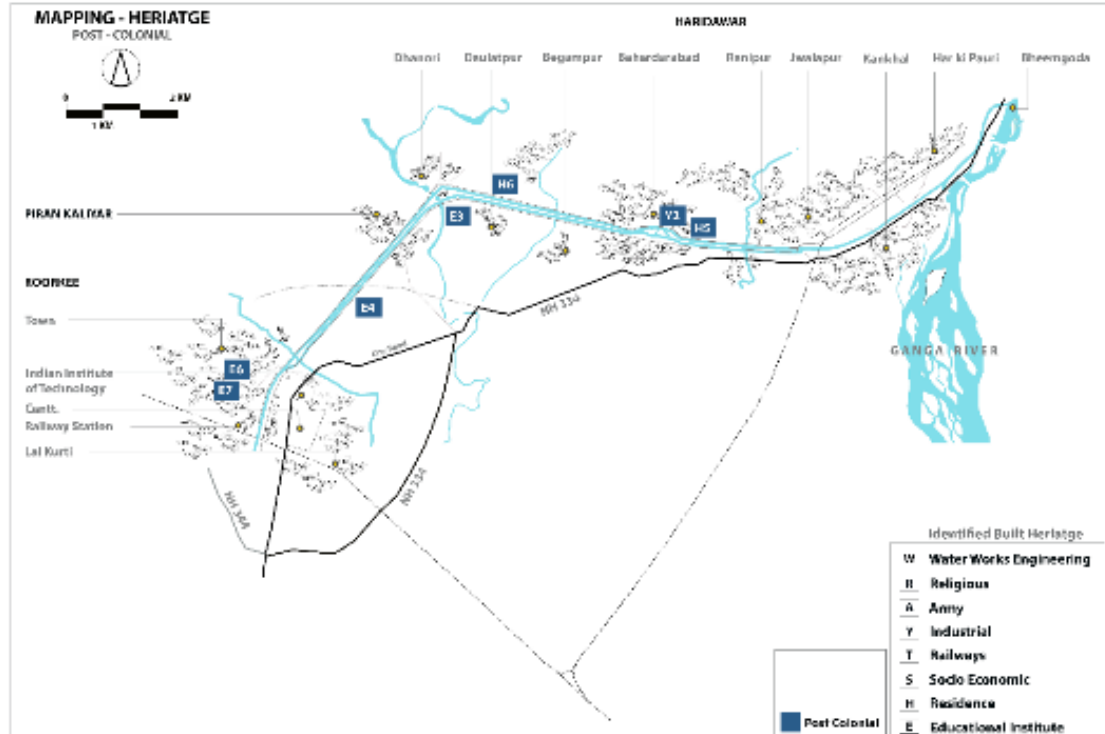


Fig. 60: Map Showing Post Colonial Built Heritage at Different Locations, from Haridwar to Roorkee
 Source: Developed by Authors, 2024

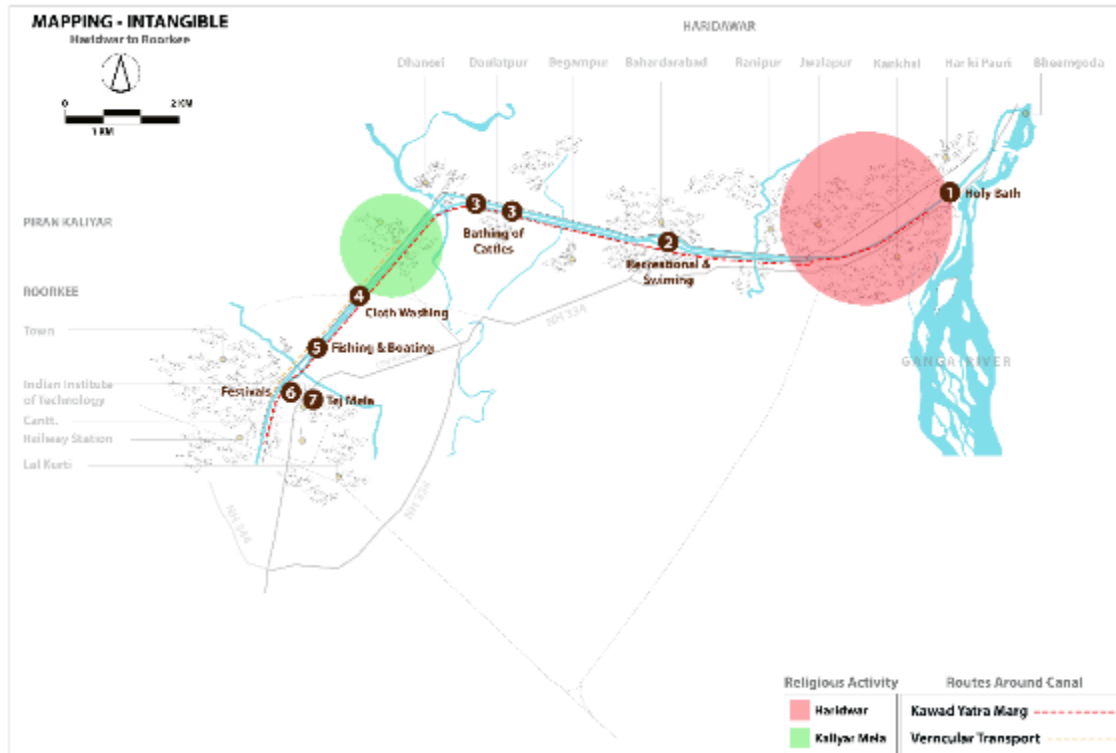


Fig. 61: Map Showing Intangible Heritage at Different Locations, from Haridwar to Roorkee.

Source: Developed by Authors, 2024

Discussion

The investigated study area is split into four macro levels, each of which explores a specific facet of manifestation for built and unbuilt history and its relationship to the upper Ganga Canal path, in light of the significance of scale at both the macro and micro levels. The study can be organized with the use of the insights gained from conversations and interactions with the local population.

- Pattern and Movement of Canal Route:** The Upper Ganga Canal carves a unique landscape as it moves through the religious and colonial spaces of Haridwar. Starting from Haridwar, the canal flows towards Roorkee, juxtaposed against the sacred ghats and temples of the Ganga. The colonial water engineering on the South side shapes the modern infrastructure, while traditional religious structures thrive alongside it. The canal takes a noticeable shift near Dhanori, where colonial-era structures and a dam illustrate the influence of British civil engineering on the Indian landscape. The route subtly bends and meanders to accommodate the natural topography and existing waterways, with aqueducts allowing rivers to flow beneath the canal. The Ganga Canal thus mirrors both natural and engineered patterns, blending history with function.
- Connectivity of the Canal Route Across Locations:** The Upper Ganga Canal links several key regions, establishing not only hydrological connections but also infrastructural ties between colonial and religious sites. It runs parallel to the Ganga, creating a duality between spiritual and colonial development in Haridwar. Bahadarabad, home to an electricity generation plant, shows the intersection of industrial progress to the canal route. Historical super passages, such as those near Ranipur and Begampur, where rivers cross over the canal through aqueducts, highlight the engineering feats that enhance connectivity while preserving natural water flows. This canal also parallels the new national highway connecting Haridwar to Delhi, illustrating its continuing relevance in shaping the geography and infrastructure of the region.

- **Ranges of Cultural Exchange:** The canal's path is a conduit for cultural blending, particularly in places like Piran Kaliyar, where the tomb of the Sufi saint Alauddin Ali Ahmed Sabir attracts pilgrims from across India. The presence of both colonial and vernacular architectural elements, like the Buland Darwaza and colonial bridges, further symbolizes the merging of cultures. The diverse religious practices along the canal's route, from Hindu temples in Haridwar to the Islamic influence in Piran Kaliyar, underscore the intermingling of beliefs fostered by this canal. The coexistence of these different religious structures reflects a vibrant cultural exchange, a byproduct of historical trade and spiritual journeys along the canal's course.
- **Evolutionary Projects and Marvels:** The Upper Ganga Canal itself stands as a marvel of colonial engineering, demonstrating the British expertise in water management and civil infrastructure. Roorkee, with its engineering college i.e. Indian Institute of Technology, Roorkee, is a direct result of the canal's construction, making it a significant hub for engineering and technological advancements. The super passages, dams, and aqueducts scattered along the canal are remarkable for their time, illustrating a mastery of integrating human-made structures into the natural environment. The colonial legacy continues to shape the region through these projects, transforming it into a centre for education, industry, and cultural exchange. The town of Dhanori, with its colonial government buildings, dam, and liveable environment, exemplifies the socio-cultural and infrastructural impact of the canal project.
- **Intangible Identity of the Canal Route:** The Upper Ganga Canal is not just a physical structure of water management and engineering; it also holds a significant intangible identity deeply rooted in the cultural and religious practices of the people living along its route. Two prominent festivals encapsulate the canal's spiritual importance: the Kawar Yatra during the Hindu month of Sawan, and the Piran Kaliyar Mela during the Islamic month of Rabi' al-Awwal. These festivals transform the canal route into a vibrant, living space where the water from the canal is revered as holy, reflecting the shared yet distinct spiritual significance for both Hindu and Muslim communities. The concept of "one water with different colours" aptly describes how a single waterway serves diverse religious purposes, illustrating the dynamic interplay of faiths along the canal. Beyond these major religious events, other celebrations such as Janmashtami, Eid, and even Independence Day see the canal as a focal point for gathering and festivities. These events further reinforce the canal's role as a shared space for communal activities, bridging gaps between different social and religious groups. In terms of transportation, the canal route also preserves elements of traditional mobility. Horses and local buses are commonly used, blending modernity with older modes of transport. The steps along the canal serve as informal seating areas, facilitating social interaction. Spaces like Solani Park and various spots along the canal have evolved into social gathering places where people meet, relax, and engage in various social activities.
- **Economic Development:** Economically, the canal plays a role in supporting livelihoods. Fishing along its banks is a common practice, and specific areas function as dhobi ghats, where cloth washing takes place. Additionally, recreational activities such as boating and water-based training exercises can be observed, indicating that the canal is not just a utilitarian structure, but also a space for leisure and sport.

In sum, the Upper Ganga Canal embodies a unique intangible identity that transcends its physical presence. It fosters a rich tapestry of religious, social, and economic activities, making it a living entity that serves as a cultural and spiritual artery for the communities along its banks.

Conclusion

The findings suggest that before the construction of Ganga Canal, the landscape of the region has remained predominantly religious in Haridwar and as a mud-built village in Roorkee. With the development of the Ganga Canal, the landscape has started developing with workshops and institutes

in the mid 1800's and continues to date. The study demonstrates how the Ganga Canal has significantly influenced and has manifested the region and its surrounding through "vernacular built heritage, cultural landscapes, and intangible values". They are presented in details below.

- **Educational:** The Ganga Canal system, incorporating natural watercourses and later integrated with engineered structures, has profoundly impacted regional development since the 19th century under British rule. It established a commercial hub and led to the founding of "Asia's first civil engineering college" and "India's first engineering college" in 1847, currently known as the Indian Institute of Technology Roorkee. The "Central Building Research Institute (1950)" has also been established for research and development. These developments have made the Ganga Canal route a major educational hub for architecture and civil engineering works. Other prominent research institutes like "National Institute of Hydrology (1978)", "Irrigation Research Institute (1954)", "State Water Informatics Centre Roorkee" and "Irrigation Design Organisation (1978)" for the design of multipurpose hydroelectric projects in the Ganga and Yamuna Valley in the Himalayas contribute to the canal's significance.
- **Defence:** The canal facilitated commerce and trade growth, supported by one of India's oldest cantonments established as "Bengal Engineers Group" in 1853 by the Britishers. The cantonment is situated next to Indian Institute of Technology. The institute houses an old hangar currently being used as a convention hall with the structure remaining original. The hangar is said to be used for repairing the aircrafts during the "World War II".
- **Industrial & Engineering Marvels:** Beyond irrigation, the canal has served as a catalyst for broader infrastructural development, including "Government Workshop (1843)" established for the fabrication of hydro mechanical equipment for the construction of canal. Key engineering accomplishments such as the Dhanori level crossing, Pathri Supper Passage, Ranipur Syphon and India's first aqueduct, the Solani Aqueduct, mark the region's engineering heritage. "Pathri Power House" and "Hydraulic Research station Bahadrad" are also shaping the canal's significance. Roorkee's symbolic Lion Statues, incorporated into IIT Roorkee's logo, have been constructed to serve as slope-warnings for the canal. Five such statues have been made in Roorkee, with the first prototype being located near the St. Andrew's Church.
- **Railway Development:** The canal's construction in Roorkee has led to the use of India's first freight trains. The service has begun on December 22nd 1851 between Roorkee and Piran Kaliyar with 8 K.M long track. The track is laid down during the Construction of the Solani Aqueduct.
- **Cultural Activities:** The Ganga Canal has transformed the landscape it has traversed, enhancing the religious significance for both Hindu and Muslim communities. Haridwar and Kankhal remain centres for Hindu rituals, closely tied to the sacred waters of the Ganga River, while Piran Kaliyar, a settlement dating back to the 13th century, is a revered site for the Muslims due to its association with a Sufi saint. Sir Proby Cautley, the canal's chief engineer, has thoughtfully integrated these cultural and religious elements into the canal's design and route. The region's British influence has also introduced Christian elements, leaving remnants such as one of India's oldest British cemeteries, a protected monument by the Archaeological Survey of India, and several old churches in Roorkee dating back to the 19th century. From Haridwar to Roorkee, the canal features numerous ghats that host festivals and rituals. Boating training activities are conducted by the Indian Institute of Technology through its boat club. On national and religious festivals, local authorities organize artistic

light and music performances near the canal, creating a vibrant atmosphere and boosting the local economy. People are observed using the ghats for socializing and recreational visits.

- **Navigation:** The canal also serves as a navigational link between Haridwar and Roorkee, connecting through national highways and railway tracks. The canal's route continues to shape the social and economic landscape of areas like Haridwar and Roorkee. The proposed Eight-Lane Upper Ganga Canal Expressway aims to connect Uttarakhand with Bulandshahr (Uttar Pradesh), offering a direct route to New Delhi and Western Uttar Pradesh, reducing travel time. The canal route is also central to the "Kawad Yatra" pilgrimage during the month of Sawan, further reinforcing its cultural importance.

Today, in the 21st century, more than a century and a half after the construction of the Ganga Canal, the surrounding landscape continues to evolve to meet emerging needs. The developments along the canal have led to an interrelated form of cultural landscape and built vernacular heritage. These sites hold significant heritage value and are integral to the region's history, yet some remain overlooked and unrecognized. As a lasting example of the intersection between engineering and culture, the Ganga Canal continues to shape the region's landscape, presenting opportunities for tourism, religious pilgrimage, and heritage conservation. The concept of canal-oriented developments demonstrate how a single infrastructural project can intertwine with cultural heritage and historical layers. Technological advancements like remote sensing and geographic information systems can help map the canal routes and associated landscapes. There is potential for development authorities to connect these layers of physical heritage, cultural landscapes, and intangible values. Through these efforts, the Ganga Canal route has the opportunity to create a future that harmonizes development with cultural and historical preservation.

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