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Understanding Architectural Interventions at Global Geoparks and Discussing Architectural Design Strategies for a Potential Geopark Site in India

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Abstract

Geoparks are globally recognized sites of geological importance where geological heritage, ecological conservation, and cultural identity converge. There are many Global Geoparks established worldwide; India has yet to develop one. This research examines the architectural interventions in enhancing visitor experience, education, supporting conservation, and fostering community engagement at the geopark.

The research is based on qualitative analysis methodology, including literature review and comparative analysis of case studies of architectural intervention at geoparks.

Architecture in geoparks must function more than infrastructure, serving as an interpretive and sustainable medium. Principles such as integration with the landscape, use of local materials, and community-centered design etc, are considered. The outcome is the generalized design considerations for geoparks and design strategies for a potential geopark site in India. The research underscores architectural potential to transform the geopark into inclusive, resilient, and culturally rooted spaces.

Keywords: Geopark, Geological heritage, Ecological identity, Conservation, Cultural identity, visitor experience, community engagement, Sustainable design, Architectural intervention

1. INTRODUCTION

Humans are always adapting to their natural environment; however, as human needs expanded, resulting in industrialization, urbanization, and population growth and these interventions started reshaping the natural landscape. This leads to the overuse of natural and cultural resources, causing irreversible degradation to biodiversity and ecosystems. In response, the idea of nature conservation emerged as a global priority, moving from a restrictive, protectionist approach to a more inclusive model.

The establishment of the UNESCO World Heritage Committee (1972), the Digne Declaration (1991), and the Rio Earth Summit (1992) started redefining conservation approaches (Baylak, December-2020) The concept of Geopark emerged as a modern conservation strategy for managing geoheritage. Geoparks include the idea of not only geological preservation but also serve as a platform for environmental education, cultural identity, tourism, and community engagement (Szilárd MALATYINSZKI, 2025). In the idea of Geoparks, the landscapes and landforms of aesthetic, scientific, or cultural values become accessible for public tourism and safeguarded for future generations.

The increase of visitor numbers fosters economic growth, but it also threatens ecological integrity, hence community involvement and sustainable management, and essential while planning Geoparks so that they contribute positively rather than causing degradation (Szilárd MALATYINSZKI, 2025).
For Geoparks, architecture plays a crucial role in providing infrastructure such as visitor centres, trails, and accommodations etc, but also it can act as a connecting link between humans and landscapes, supporting conservation goals, enhancing visitor experience, and fostering community participation.
There is no official geopark in India till now within the framework of UNESCO Global Geopark in spite of its rich geological and cultural heritage. For establishing the first geopark in India, the understanding of Global Geoparks and architectural intervention at the Geopark can provide crucial insights. The discussion of such sites must address the challenges and opportunities for tourism, conservation, and community wellbeing while integrating into India's unique cultural and ecological context.
This research helps to explore the architectural intervention that can contribute to the effective development of the Geopark in India by studying international case studies and existing literature. It results in a discussion of design strategies for the Indian potential site that balances conservation with socio-economic benefits, presenting the geopark as an instrument of sustainable development.

2. AIM

Investigate the architectural role in enhancing visitor experience, education, conservation, and community engagement within global geoparks, and discuss an architectural design strategy for a potential geopark site in India.

3. OBJECTIVE

1. Understanding the concept of Geopark and its criteria.
2. To discuss the geopark in the Indian Context and the potential site (The case of Bagh).
3. To investigate architectural interventions at geoparks through global case studies.
4. To discuss generalized architectural design considerations in global geoparks.
5. To suggest architectural design strategies at a potential geopark site (The case of Bagh).

4. SCOPE

1. Geographical scope - Study of global Geoparks.
2. Thematic Scope- Architectural design and spatial planning for Geoparks.
3. Visitor experience enhancement.
4. Integration of local identity and ecological sustainability in built interventions.
5. Discussion of design strategies at the potential geopark site.

5. LIMITATIONS

1. Limited access to on-site surveys
2. Reliance on secondary data.
3. The research does not fully address the bureaucratic, Policy and Planning, financial feasibility of establishing geoparks in India.
4. Discussion of generalized architectural interventions at geoparks may require site-specific adaptations according to need.

6. Research Methodology

To achieve the objective 1 methodology includes the understanding of terminologies and the concept of Geopark.

Objective 2 is fulfilled by discussing the geological, archaeological and cultural significance with potential and constraints of the site through the literature available.

Objective 3 is achieved by comparative analysis of case studies of global geopark with architectural interventions, reviewed through common parameters.

In objective 4 the discussion on findings of a case study includes generalised design considerations.These architectural design findings from a study are then validated through the survey responded by practicing architects.

From the results of all objectives, objective 5 is achieved, which is the recommendation of design strategies for a potential geopark site in India.

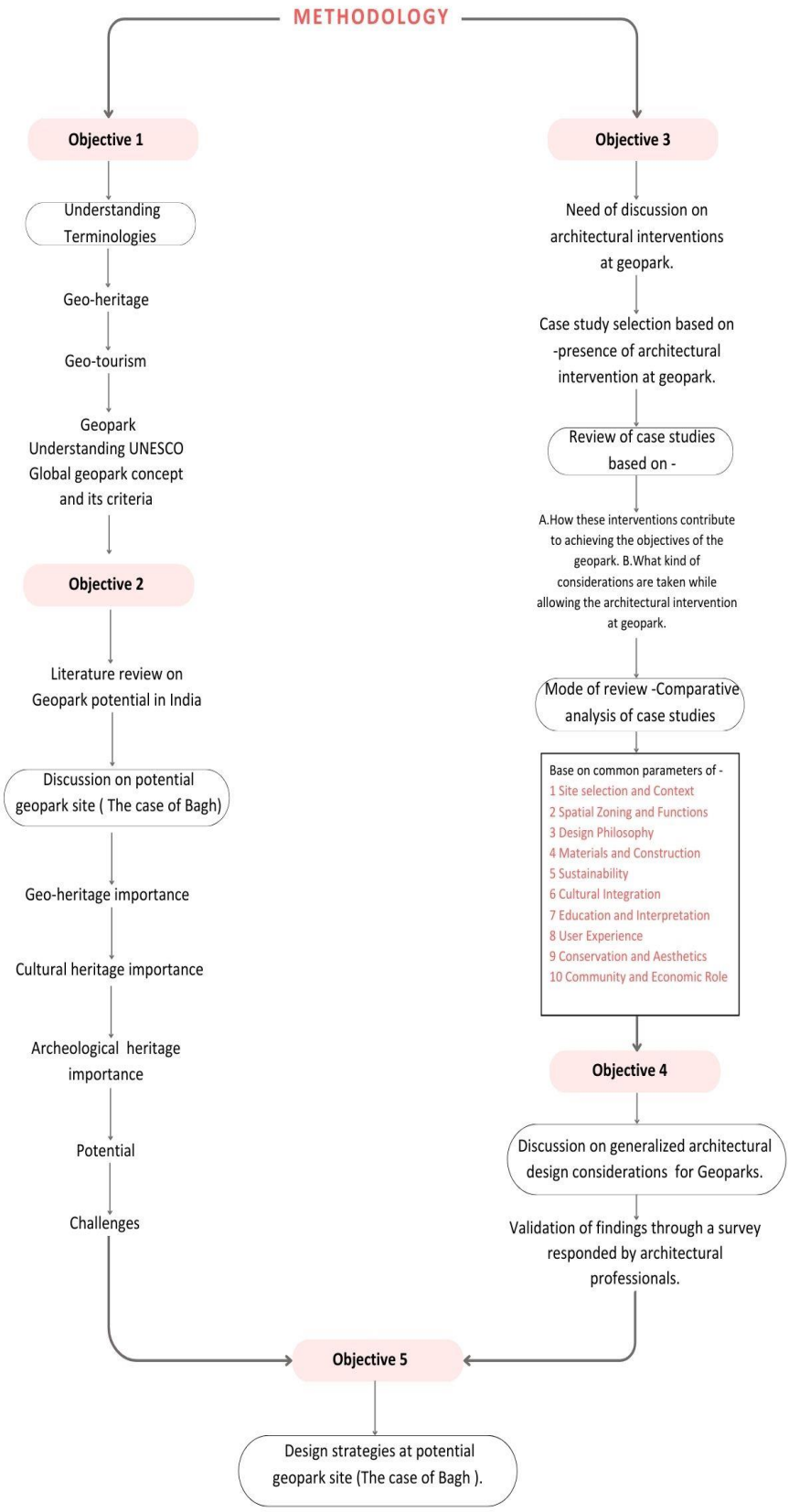


Fig.1 Research Methodology Char

7. Literature Study

7.1 Geo-heritage

Geo-heritage means geological and geomorphological features that show the significance of Earth's evolution through time. Geo-heritage includes landforms, caves, minerals, fossils, and other geological features that are visually unique and scientifically valuable. Such features are irreplaceable and often under threat from natural or human factors (Baylak, December-2020). Geo-heritage also contributes to Geo tourism, where it supports education, conservation, and sustainable development. Promoting geo heritage helps conserve natural history and benefits local communities economically and culturally.

7.2 Geo-tourism

It is tourism that deals with the geological features and landscape of a particular region. It is a kind of tourism that preserves and highlights the geographical characteristics, environment, culture, aesthetics, and heritage of a region (Szilárd MALATYINSZKI, 2025). Geo-tourism offers visitors a deeper understanding of the geological and geomorphological processes of the Earth, which leads to the education and appreciation of the natural world. Geo tourism helps local economies by attracting tourists to rural and less-visited areas. This type of tourism protects and conserves geological sites from overuse and degradation. Geo-tourism is an effective management of geo sites with a balance of tourism activities and conservation (Szilárd MALATYINSZKI, 2025).

7.3 Concept of Geopark and UNESCO Global Geopark

A geopark is a modern management concept of geological heritage. These are the areas that combine geotourism, research, conservation, and education. They protect the geological sites of scientific, aesthetic, cultural, and economic value by encouraging socio-economic development. A geopark is an area with clearly defined boundaries, with sufficient area to support regional economic development (Baylak, December-2020). Geoparks may overlap with national parks and other protected areas, but their purpose is to integrate culture, history, nature, and human activity together. Geoparks encourage communities to reconnect with their heritage and engage in cultural revitalization. (Baylak, December-2020)

The UNESCO Global Geopark initiative began in 2001 due to the emerging need for nature conservation, followed by the Global Geopark Network in 2004 (Baylak, December-2020). UNESCO defines geoparks as areas of international geological importance managed for conservation, education, and development. Their goal is to protect geo heritage, raise awareness of climate change and natural disasters, and promote local business opportunities through geo tourism (UNESCO, 2020). There are four fundamental features of UNESCO Global Geopark-

1. Geological Heritage of International Value- The geological site must be acknowledged by experts as having global significance.
2. Management – Each Geopark must have a legally recognized management body and a comprehensive plan that ensures a balance between geological conservation and the social and economic needs of local communities.
3. Visibility- Geoparks should effectively promote themselves through websites, maps, and visitor information supported by strong branding and a clear identity.
4. Networking- Membership in the Global Geopark Network is mandatory, fostering collaboration among Geoparks to exchange knowledge and intercultural understanding. (UNESCO, 2015)

7.4 Criteria for UNESCO Global Geoparks

1. The geopark represents a new category of geoheritage conservation.

2. It differs from completely protected or strictly regulated areas as it integrates conservation with sustainable community development.
3. The responsible Geopark authority ensures the protection of geological heritage in accordance with local traditions and Legislative obligations.
4. The national government is responsible for the protection and determines the level and specific measures of protection for individual sites.
5. Each Geopark must be a single, unified geographical area with clearly defined boundaries and interconnected geological features. These areas should be large enough to support the local economy and cultural development.
6. The geological heritage must include several internationally significant sites or a collection of geological entities of exceptional scientific importance, rarity or beauty.
7. All Global Geoparks should be connected within a Global Geopark Network.
8. Geoparks must promote awareness and education about- Geological process, sustainable resource use, Geohazards, climate change, Evolution of life, and empowerment of indigenous people.
9. Each geopark must have a legally recognized management body with authority over the entire designated area.
10. The UNESCO Global Geopark status should complement and add value to other UNESCO designations (World Heritage Sites or Biosphere Reserves) while maintaining its own independent identity.
11. Local communities and Indigenous people must be actively involved in co-management and decision-making processes with their traditional knowledge integrated into management.
12. Membership in the Global Geopark Network(GGN) is mandatory, ensuring collaboration and knowledge exchange among Geoparks worldwide.
13. All geological heritage sites must be legally protected and function as a geopark for one year before they apply for UNESCO designation.
14. Geopark should respect all local and national laws related to the protection of geological heritage and be managed by a local or regional authority.
15. Management must prohibit the sale of fossils or minerals and actively discourage any unsustainable trade in geological materials.
16. Sustainable collecting for educational or research purposes may be permitted only in exceptional cases and must receive approval from UNESCO.
17. Compliance with these criteria is verified through official checklists during the evaluation and revalidation process. (UNESCO, 2015)
18.

7.5 Geopark in the Indian Context and potential site (The case of Bagh)

India has not been able to get any site designated as a UNESCO Global Geopark by 2025. India has begun taking steps. There was the first-ever national-level workshop on UNESCO Global Geopark held by the Geological Survey of India (GSI) and UNESCO in 2024 (UNESCO, 2025). GSI is identifying geological heritage sites as National Geological Monuments, which is a foundational step. Many sites are being considered, but none have been officially accepted into UNESCO Geopark. One of the sites considered is the Bagh, which has the potential to be developed as a geopark.

7.5.1 Bagh -A potential site for Geopark

Bagh, located in the Dhar district of Madhya Pradesh, is the site of immense geological, archaeological, and cultural importance. The Bagh Fossil Park preserves late Cretaceous dinosaur fossils, eggs and petrified wood, while the nearby Bagh Caves and traditional Bagh printing reflect a rich human and cultural history (Apurva D. Shitole, 9 October 2023). The unique landscape along the Narmada valley records millions of years of Earth's evolution. The blend of geo heritage, living traditions and tribal culture, Bagh has the potential to emerge as India's first UNESCO Global Geopark. Its development could harmonize conservation, education and sustainable livelihood.

7.5.2 Geological Importance

The Bagh Dinosaur National Park exposes a stratigraphic sequence from the Precambrian to the Late Cretaceous including Bagh Beds, Lameta Group and Deccan Traps. These formations record marine transgression, continental sedimentation and the mass extinction event associated with the Deccan Volcanism (Apurva D. Shitole, 9 October 2023). The park contains dinosaur fossils, eggs, nests and petrified wood representing one of Asia's earliest fossil discoveries and a globally significant record of the Late Cretaceous environment. The proposed Bagh Geopark region, encompassing approximately 1200 sq.km

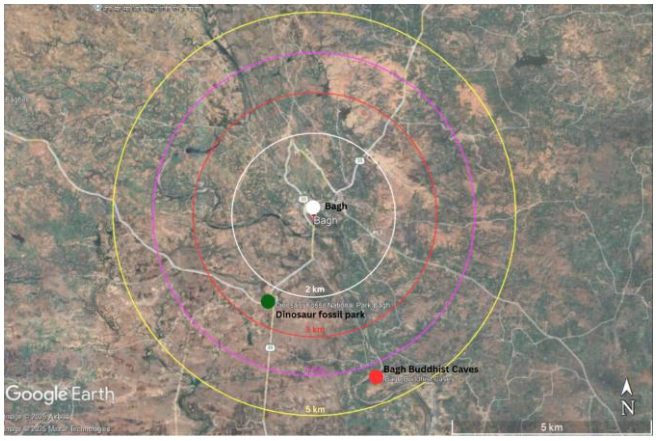


Fig.2 Proximity of Dinosaur Fossil National Park and Bagh Buddhist cave from Bagh village.

Fig.3 A Bagh Group rocks. B 100 dinosaur egg from lameta formation. C Nimar sandstone (Apurva D. Shitole, 9 October 2023)

7.5.3 Cultural Importance

Bagh is home to world-renowned Bagh Print, a centuries-old hand block printing craft using natural dyes and the mineral-rich water of the Baghini River. Practiced primarily by the Khatri artisan community, this tradition features geometric and floral motifs (Anshika Jain, 4, November_2024). Bagh print not only sustains local livelihoods but symbolizes the region's sustainable craftsmanship and cultural identity. The surrounding Bhil and Bhilal tribal communities enrich this cultural landscape through their folklore, art and nature-linked traditions, often integrating fossils into their mythological beliefs.

Fig. 4 Bagh block printing process

7.5.4 Archaeological Importance

The Bagh Cave, dating to the 5th -6th century CE are nine rock cut monuments carved in Nimar sandstone along the Baghini River. Known for their intricate Buddhist paintings and architecture, these caves are protected by the Archaeological Survey of India. They connect Bagh's geo heritage with ancient cultural and religious expressions.

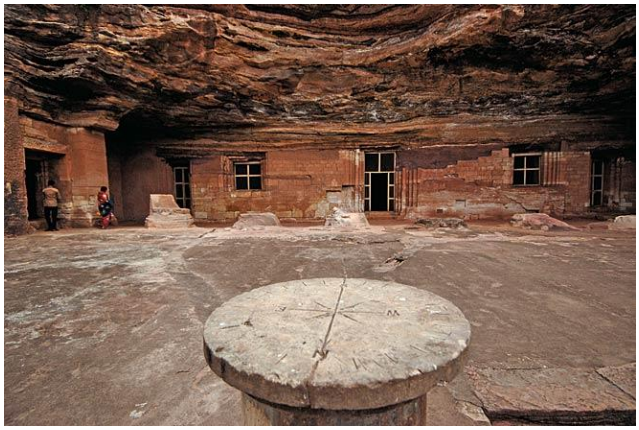


Fig. 5 Bagh Buddhist Caves

7.5.5 Potential of Bagh as a Geopark

Bagh holds exceptional potential to be India's first UNESCO Global Geopark because it fulfils nearly all UNESCO criteria

- International Geological Value- One of the most complete Cretaceous Paleogene sequences with globally significant fossil records (Apurva D. Shitole, 9 October 2023).
- Education and research- The site can serve as a natural classroom for earth sciences, palaeontology knowledge.
- Cultural integration- Combines tangible and intangible heritage, aligning with the holistic Geopark concept.
- Community Empowerment- development of eco-tourism, women-led tribal haats and geo guide can create inclusive livelihoods (Apurva D. Shitole, 9 October 2023).
- Sustainability goals – Quality education, gender equality, climate action and responsible consumption (Apurva D. Shitole, 9 October 2023).
- Tourism and awareness- Proposals of festivals, fossil trails and educational hub (Apurva D. Shitole, 9 October 2023).

7.5.6 Challenges

- Lack of Comprehensive Documentation- Detailed mapping and inventory of geo sites are still in process.
- Infrastructure Gaps- Limited tourist amenities like information centers, signs, toilets and transport connectivity (Apurva D. Shitole, 9 October 2023).
- Community Awareness- Local tribes require more engagement and training in geo heritage interpretation (Apurva D. Shitole, 9 October 2023).
- Conservation threats-Illegal fossil collection and unregulated tourism risk damaging sensitive sites (Apurva D. Shitole, 9 October 2023) .
- Market and policy – Bagh print artisans face challenges such as low income, market access and imitation products (Anshika Jain, 4, November_2024).

Bagh where ancient geological formations, rich biodiversity, and traditional crafts coexist. With strategic planning, community involvement and conservation-based tourism, it can evolve into a model UNESCO Global Geopark representing India's integration of Earth heritage, people and culture.

7.6 Architectural Interventions at Geoparks

To fulfil the goal of a geopark, such as community empowerment, environmental education, sustainable tourism and cultural identity, the development of essential infrastructure is crucial. In this context, architecture plays a vital role. Despite its importance current discussion around geoparks often lacks the architectural dimension. However, to truly meet the objective outlined by UNESCO, a focused discussion on architecture within geoparks is essential.

Architectural interventions in geoparks can support a wide range of functions, including recreation and educational facilities, exhibition spaces, geo trails and research centres. These spaces enhance visitor experience and also serve as tools for interpretation and knowledge gain. In addition, supporting amenities such as hotels, cafes, restaurants and markets can help accommodate tourists while boosting local economies and small businesses.

Many geoparks across the world have already introduced architectural interventions such as visitor centres, museums, and marketplaces to support their activities and engage the public effectively.

Building in such ecologically sensitive and heritage-rich areas demands careful consideration. architectural designs should minimize environmental impact and be harmoniously integrated into the

geological landscape. the focus must be on sustainability, conservation and respect for geological features, ensuring that the built environment supports rather than disturbs the integrity of geo sites.

7.7 Architectural Intervention at Geopark(Case Studies)

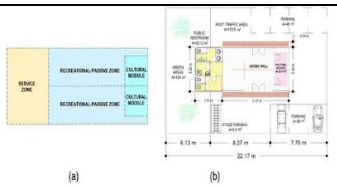
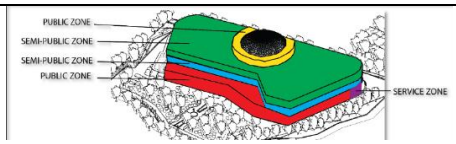
By adopting the method of reviewing worldwide case studies, we are able to identify the common parameters that are considered while allowing architectural infrastructure within the geopark. Case studies are selected on the parameters that architectural intervention should be introduced at the geopark. Different geopark case studies have been reviewed based on two key aspects-

1. How do these interventions contribute to achieving the objectives of the geopark?
2. What kind of considerations are taken while allowing the architectural intervention at the geopark?

The case study presentation is organized through a thematic comparison, using a set of common parameters. By analysing these case studies through the defined parameters, it becomes possible to draw conclusions about what considerations and measures should be taken into account when introducing architectural interventions within a geopark.

TABLE 1. COMPARATIVE ANALYSIS

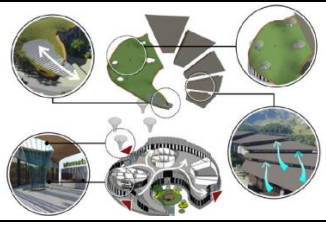
PAREMETERS	CASE STUDY 1	CASE STUDY 2
	Interpretation Centre at Santa Elena Peninsula Geopark (Ecuador)) (Gómez, Hernández, Montalvo, & Soto, 2024)	Toba Caldera Geopark Museum in Balige, Indonesia (Chrescensia Febriyana Sinambela, 2022)
Site selection and Context	Interpretation centres located at 4 impacted sites, not at core of geo site ensuring minimal disturbance, close to area already affected by human interventions.	chosen for accessibility, proximity to cultural/geological attractions, and integration with existing tourism infrastructure.
Spatial Zoning and Functions	Modular Zones- 1. Recreational terraces,2. Services,3. Cultural/Educational spaces	Clear zoning-public, semi-public, private and green. 3 exhibition halls for geo, bio, cultural diversity. Supporting labs, theatre, library, café, shop and outdoor zones.
Design Philosophy	Community integrated modular design, low cost and flexible. Architecture as tool for geo education + entrepreneurship	Green architecture with principles of conservation, passive cooling, harmony with site, universal access. Symbolism-curved forms of caldera hills.
Materials and Construction	Local traditional -Guadua cane, adobe, bahareque, ecofriendly, through community labor.	Stone, wood, glass, dome shaped roofs, modern finishes balanced with natural harmony.
Sustainability	Eco -materials, solar panels, natural ventilation, living fences.	Passive strategies -skylights, cross ventilation, solar panels, minimal site disturbance.
Cultural Integration	Reflects local traditions (oil heritage, artisanal mining)	Form represent Batak culture

Education and Interpretation	Panels, samples, interpretative media, community meeting places and education hubs.	Interactive exhibition-3D theatre, digital displays, indoor outdoor continuity of learning spaces through terraces, landscapes, etc.
User Experience	Spaces follow Ecuadorian construction norms, accessible buildings (ramps, singes), shaded terraces.	Inclusive accessibility, natural lighting, courtyards for comfort.
Conservation and Aesthetics	Build on already - disturbed land, harmony of ecology	Massing reflects the Toba caldera formation, with curved lattice facades, vertical gardens, and surrounding green landscaping.
Community and Economic Role	Employment in building, hubs for souvenirs, food services, Centres function as community meeting places	Homestay potential, local products market (coffee, rice, onions) but facilities underdeveloped.
Images		

PAREMETERS	CASE STUDY 3	CASE STUDY 4
	Fangshan Geopark Museum, Beijing, China (Junbo Wang, 2021)	Natural History Museum, Lesvos, Greece (Junbo Wang, 2021)
Site selection and Context	Chosen to be a gateway facility - central, accessible, and close to key geological attractions.	Located next to the Petrified Forest Monument, small coastal village context, blending tourism with community life.
Spatial Zoning and Functions	Functional zoning-1st floor-Six exhibition halls - Introduction, Geological Evolution, Scenic Areas, Geoparks Network, Specimen Exhibition, and Cinema (with 4D/VR). 2nd floor- Administrative offices. 3rd/top floor- Cinema screenings and temporary exhibitions. Includes an open-air square, outdoor educational zones	2 exhibition halls (fossil, flora/fauna, geology), research labs, multimedia rooms, outdoor Amphitheatre, guest accommodation.
Design Philosophy	Monumental and symbolic form inspired by Yanshan tectonic movement, emphasizing scientific	Context sensitive, modest, fits into context scale, avoids monumentalism.

	identity.	
Materials and Construction	Modern materials - emphasis on monumental construction and multimedia, less on vernacular.	Modest stone, plaster, wood, blending with village style.
Sustainability	Strong on technological sustainability (VR, multimedia)	Focus on preservation and controlled access to fossils, minimal new energy systems.
Cultural Integration	Symbolism of tectonic and geological history	Building scale matches Sigri village culture.
Education and Interpretation	Multimedia (4D films, VR, interactive models), sequential narrative flow.	fossil parks, guided trails, museum+ field-based learning.
User Experience		Combines tourist, student, researcher needs, guest rooms support long stays.
Conservation and Aesthetics	Monumental aesthetic.	Preservation driven
Community and Economic Role	Gateway tourism hub	Combines research and small tourism economy in Sigri village
Image		

PAREMETERS	**CASE STUDY 5**	**CASE STUDY 6**
	Museum of Wangwu Mountain International Geo- Park, China (Baofeng LI, 2008)	Wonocolo Geo-Heritage Center ,Bojonegoro NGP, Indonesia (I K Fauziah, 2020)
Site selection and Context	Site location with panoramic views, designed as smaller fragmented volumes to adapt to terrain.	Hilltop location in degraded oil mining landscape, design mitigates harsh climate and integrates with natural contours.
Spatial Zoning and Functions	Geological squares divided by eras (Proterozoic, Palezoic, Mesozoic, Cenozoic), Exhibitions linked directly to outdoor squares.	Visitor centre, museum, hostel, green communal spaces, spatial continuity with indoor-outdoor blending, multi-level massing.
Design Philosophy	Green architecture focused on harmony, symbolic facades inspired by rift valley tectonic and Taoist cultural narratives.	Organic architecture, building belong to hill, forms mimic topography, climate responsive.
Materials and Construction	Local stones (Taihang red granite, sandstone), rough textured concrete, local artisans involved in the	Teak, stone, exposed concrete, green roofs, rainwater harvesting integrated.

	construction process. Follows the colour palette of mountain stones.	
Sustainability	Vegetation preserved, trees integrated into plazas, minimal cut and fill.	Rainwater harvesting, ventilation via roof forms, green roofs to restore ecology.
Cultural Integration	Inspired by Taoist myths and geology, architecture tells cultural geological story.	Integration of Islamic values and natural metaphors.
Education and Interpretation	Exhibition squares correspond to geological eras, architecture is storytelling.	Interactive spaces, flexible layouts, architecture itself part of interpretation
User Experience	Squares as rest spots, trees integrated into plazas for shaded comfort.	Seamless indoor outdoor communal terraces, user friendly organic design.
Conservation and Aesthetics	Geological facades, coloured stone palette, embedded into slope.	Low impact, blends into contours, natural finishes.
Community and Economic Role	Employs artisans in stonework, museum as cultural and scientific hub.	Community hub, hotels etc supports local economy.
Image		

8 ANALYSIS OF THE STUDY

8.1 Discussion of common architectural strategies found through comparative study of case studies.

In most of the case studies, architectural intervention within geoparks takes the form of Interpretation centres, museums or community centres which address the core UNESCO Global Geopark criteria of education, tourism, community empowerment and geo heritage preservation. A comparative analysis of these interventions reveals several generalised architectural strategies and highlights how these interventions fulfil the UNESCO objectives.

8.1.1.1 *Location -Buildings are sited on land already affected by human intervention or close to a community area, minimizing ecological disturbance. Many times, buildings are strategically positioned to offer the best views of geo heritage sites. The choice is guided by the priority and intent of the building.*

8.1.1.2 Spatial Zoning and Function -Essential zones identified through case studies are a. Learning Spaces b. Service areas c. Recreational spaces such as cafes, restaurants, markets, etc. d. Open and green spaces connecting different functional zoning.

8.1.1.3 Design Principles- Building form and façade are inspired by the surrounding natural context and cultural identity. Non-relevant or intrusive structures should be avoided, ensuring harmony with the environment.

8.1.1.4 Materiality and Construction-Construction materials are primarily local, traditional or eco-friendly, reducing environmental impact.

8.1.1.5 Sustainability and Conservation- Design emphasis sustainability through passive strategies, conservation practices and principles of green architecture. Buildings are adapted to existing terrain with minimal modification, preserving the natural landscape with solar panels installation, rainwater harvesting and greywater reuse.

8.1.1.6 Cultural Integration and Aesthetics- Architecture reflects local traditions and culture through forms, façade treatment, material palette, storytelling and exhibition design.

8.1.1.7 Education and Interpretation- Case studies employ diverse educational approaches, from interactive exhibitions to digital media. Common spaces include exhibition halls, community gathering spaces and transitional areas that connect different learning experiences.

8.1.1.8 User Experiences- Visitor comfort and accessibility are prioritized through universal design, provision of amenities, resting spaces and recreational opportunities.

8.1.1.9 Community and Economic Impact- Architectural interventions play a significant role in supporting local economies through employment, creation of markets, food services and amenities. They promote local art and artisans, enhance the branding of geoparks and foster community involvement.

While introducing an architectural intervention at the geopark, these design principles should be taken into consideration.

9 VALIDATION OF STUDY FINDINGS

The survey was conducted to validate the findings of the research through the feedback from architectural professionals. The survey form included the key findings of the research and the Likert scale to measure the agreement and disagreement on the research findings. A total of 20 professionals responded to the survey. Through the responses, it is found that 19 out of 20 participants agreed on research findings and confirmed validity.

The survey included some open-ended questions to gather further suggestions or additions from the professionals. These inputs suggested ideas such as social media attractions, flora and fauna care and rehabilitation programs, and creating a multimodel **'Living Heritage Hub'**, etc. These suggestions provide guidance for future design for architectural intervention at the geopark.

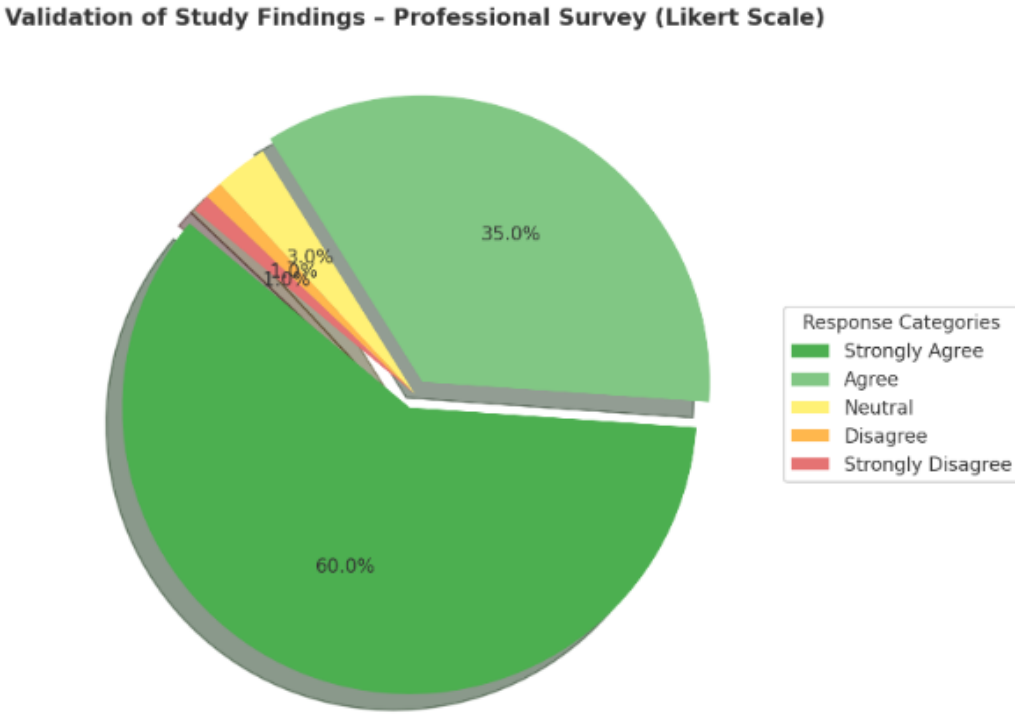


Fig. 6 Validation of Study

For the detailed survey responses, refer to Appendix A-Responses of the Survey. The survey confirms that the research findings are validated by practising professionals.

10 Discussion of Architectural Design Strategies at Bagh.

For the proposal of architectural design strategies in the context of Bagh, the design parameters identified from the case studies, which are applied for architectural interventions at the geopark, are taken as the basis for the development of strategies.

10.1.1 Site selection

For any architectural intervention in the potential geopark, the site which will be in proximity with Bagh village, the Bagh National Fossil Park and the Bagh caves would be ideal, as all three allow for an amalgamation of geological, cultural and archaeological heritage, without encroaching their protected land, can draw visitors while preserving sites.

Locate facilities close to existing tourism routes so they are easy to access. The entire region bears an excellent blend of geological, cultural and archaeological heritage; the site should bridge Bagh's tribal communities and its rich geology, positioning facilities where locals gather, reinforcing the Geopark's holistic vision.

10.1.2 Spatial Zoning and Functions

Exhibition zones- Organize indoor spaces into clear thematic halls, separate galleries could include various information for geology, culture and archaeology.

Education and Interactive spaces- Allocate spaces for hands-on learning, geology labs, fossil handling stations, craft workshops and market. Include an outdoor amphitheatre for festivals, performances.

Visitor amenities and services- Providing shops selling Bagh print textiles and other local items will help in employment. Design terraces, courtyards and walkways that flow between interior halls and the landscape. Like other geoparks, it blends indoor exhibits with exterior integration to enhance visitor

experience. Outdoor interpretation areas can directly connect to trails leading to the fossil beds and caves.

10.1.3 Design Philosophy

Use architecture itself as a teaching tool, for example, walls showing exposed layers of rock or tools to provoke curiosity.

Let building massing echo Bagh's geology and culture. Avoid grandiose monuments; instead, favor humble, context-sensitive forms.

Promote passive and green design principles in architecture, the goal is to achieve harmony with the site and context, and architecture that teaches conservation through its own form.

Infuse designs with local meanings. The symbolic storytelling, inspired by local culture and geological history, helps visitors immediately connect to the context.

10.1.4 Materials and Construction

Use local materials in construction, like Bagh's Deccan trap basalts and sandstones. The earth tone materials directly tie buildings to the region's geology.

Employ techniques practiced by local artisans and involve local labour in construction work. This uses readily available skills and reinforces cultural pride.

10.1.5 Sustainability and Conservation

Design with passive strategies at the forefront. This includes shaded courtyards, clearstory windows, cross ventilation paths and thermal mass walls, etc. to even out temperature swings.

The Deccan plateau has abundant sunlight that can be used to install solar panels and solar water heaters. Harvest monsoon rainwater for irrigation and greywater reuse. Preserve any existing trees by routing around root zones; trees can be incorporated into courtyards. This keep vegetation preserved approach was key in other green-centered designs.

Build on land already degraded. Balance cut and fill so the site requires little earth moving. Green roofs and native plant landscaping should restore any soil lost. These sustainable infrastructures yield lower lifecycle impact and align with UNESCO's emphasis on eco-friendly materials.

10.1.6 Cultural Integration and Aesthetic

Celebrate the local textile art by embedding its motifs into architecture. Interior accent walls or ceilings might feature Bagh-style murals or prints.

Honor the rock-cut Bagh Caves by designing some galleries or meditation nooks with carved stone walls and subdued lighting, evoking cave ambiance.

Integrate local legends and languages into signage and exhibit narratives. Feature tribal art in décor. Use natural finishes and earthy colours so structures recede into the backdrop and further soften appearance.

By reflecting Bagh's local traditions and values in the form and content, the architecture weaves a deeper cultural story.

10.1.7 Education and Interpretation

Design displays that let visitors handle fossils. Include large floor maps and cross-section models of the Bagh site to visualize layers. Use multimedia (touchscreens, VR) to illustrate dinosaur life and volcanic processes.

Guided trails to reach on-site geosites with interpretative signage.

Provide studio spaces where artisans teach Bagh printing or local crafts to visitors. Exhibits could include live demonstrations of block carving and dyeing, linking geology (minerals for dyes) with craft. This merges the cultural interpretation with practical education.

Weave geology, ecology and culture into single exhibits. Include lecture halls, a small reference library and a classroom for school groups. Provide interactive panels and specimen collections as found in successful geopark info centres. Ensure most spaces have natural light and courtyard views to reinforce learning via nature.

10.1.8 User Experience

Design all areas for universal access. In line with case examples, provide shaded terraces, benches and quiet seating under trees to allow rest for visitors.

A central plaza or lobby can serve as a gathering place. Include indoor and outdoor breakout zones so visitors can linger. Provide a cafeteria or restaurant serving local cuisine where tourists and locals mingle.

Offer small eco lodging or homestay connections for researchers and travellers, which extends visits and benefits the economy. Ensure clean restrooms, parking for vehicles and secure paths so users of all ages feel safe and guided.

All signs and audio guides should be in Hindi and English with illustrations to aid understanding for non-specialists. Provide maps and orientation displays at entrances to manage visitor flow seamlessly.

10.1.9 Community and Economic Role

Prioritize hiring tribal and village labour for construction, guiding and maintenance, and management. Train local youth as geo guides and workshop instructors. This ensures economic benefit stays in Bagh and leverages community knowledge.

Include spaces for a craft bazaar where artisans sell Bagh-printed textiles and local produce. Design spaces for village meetings or cultural festivals. Experiential program curated by local people demonstrating local culture. This makes a true community hub reflecting UNESCO's goal for keeping local citizens at the centre of the geopark.

Encourage homestays by providing training and promotion of village accommodations. Use revenue from tours, parking and events to fund conservation and community projects. By creating a tourism hub, the geopark can diversify the rural economy.

Partner with schools and institutes for internships and research. Involve artisans in curriculum demonstrations like dyeing and printing workshops to keep traditions alive. Ensure the operation involves community representatives, fostering a sense of ownership and long-term sustainability.

11 Conclusion

Geopark is a new approach of the conservation of geological heritage by allowing human intervention without disturbing the geoheritage. Geopark combines geotourism, research, conservation, and education. To achieve these objectives of the geopark, the architectural infrastructure is required,howerver currently the discussion around the architectural infrastructure at the geopark is messing. To fulfil this gap, the research is conducted to identify the architectural strategies and considerations at existing geoparks and compare them on common parameters to get the generalised design strategies that can be applied to architectural infrastructure at geoparks. Also, the survey is conducted responded by architectural professionals, validating the research findings. there is no geopark in India yet, despite its geological diversity. Hence, the second part of the study included the discussion on a potential geopark site in India, that is 'Bagh', Madhya Pradesh, and its opportunities and constraints, and after studying Bagh, site-specific strategies are suggested in the research. Thus, this

study is helpful in terms of design strategies while proposing s architectural infrastructure at the geopark and potential geosite Bagh with site-specific design strategies.

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