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Visitor Circulation Patterns in Mountain Tourism Areas: A Comparative Study of Ketep Pass, Puncak Suroloyo, and Nepal Van Java

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Abstract. Mountain tourism destinations represent environmentally sensitive landscapes characterized by steep terrain, limited accessibility, and dynamic visitor movement patterns. In many Indonesian highland tourism areas, circulation systems evolve without comprehensive spatial integration, resulting in congestion, pedestrian–vehicle conflicts, safety risks, and diminished visitor experience. This study aims to identify, classify, and comparatively analyze visitor circulation patterns in three mountain tourism destinations in the Magelang region: Ketep Pass, Puncak Suroloyo, and Nepal Van Java. A qualitative descriptive-comparative approach was employed through a literature review, field observation, spatial mapping, and classification of circulation typologies. The analytical framework integrates architectural circulation theory and sustainable tourism principles. The findings reveal three distinct typologies: formal linear-structured circulation (Ketep Pass), topography-adaptive linear-natural circulation (Puncak Suroloyo), and community-integrated linear circulation (Nepal Van Java). The study demonstrates that circulation morphology is influenced by terrain gradient, infrastructure planning intensity, and socio-spatial integration. This research contributes a contextual circulation model for mountain tourism planning that emphasizes terrain responsiveness, pedestrian prioritization, and community participation to achieve sustainable spatial development.

Keywords: architectural circulation; mountain tourism; spatial morphology; sustainable planning; visitor circulation

1. Introduction

Mountain tourism has emerged as a significant sector in regional development strategies due to its ecological appeal, panoramic landscapes, and experiential value [1] [2]. Highland destinations offer climatic comfort, scenic viewpoints, and recreational activities that attract both domestic and international visitors. However, the spatial planning of mountain tourism areas presents inherent challenges due to steep topography, environmental sensitivity, and infrastructural limitations [3] [4].

Tourism planning theory emphasizes that successful destinations require integration between attraction, accessibility, amenities, and management systems. Among these components, accessibility and circulation are fundamental to determining the efficiency and safety of visitor flow [5] [6]. In mountainous environments, terrain morphology directly shapes circulation patterns, spatial hierarchy, and visitor experience [7].

Architectural theory positions circulation as a primary spatial element that organizes movement, connects spaces, and shapes perception. Circulation patterns such as linear, radial, grid, loop, and network determine how users navigate built and natural environments [8]. In mountainous tourism contexts, these patterns cannot be applied generically; they must adapt to contour gradients, slope stability, and ecological constraints.

Recent literature on sustainable tourism increasingly addresses environmental conservation and community participation [3] [4]. Studies on mountain tourism management highlight the importance of terrain-sensitive infrastructure and ecological preservation. However, research on circulation morphology in Indonesian mountain tourism destinations

remains limited. Most previous works emphasize economic performance, carrying capacity, or destination branding rather than spatial circulation typology [9] [10].

The Magelang region in Central Java provides a relevant empirical context for examining the morphology of circulation in mountain tourism areas. Within this region, three prominent destinations) Ketep Pass, Puncak Suroloyo, and Nepal Van Java represent distinct development typologies shaped by varying degrees of infrastructural intervention, terrain adaptation, and socio-spatial integration. Ketep Pass reflects a formally planned tourism complex characterized by a structured spatial hierarchy and institutional management. Its development emphasizes organized infrastructure, controlled access points, and clearly defined visitor pathways. In contrast, Puncak Suroloyo is a natural and spiritual tourism destination set in steep mountainous terrain, where circulation systems are primarily shaped by topographic constraints and pedestrian ascent routes. The spatial organization in this area is strongly influenced by contour adaptation rather than centralized infrastructural planning. Meanwhile, Nepal Van Java exemplifies community-based tourism integrated within a terraced settlement morphology. In this destination, visitor circulation is embedded within residential pathways, resulting in a shared socio-spatial environment where tourism activities coexist with daily community life. Despite their shared mountainous context, these three destinations exhibit substantially different circulation characteristics, providing an opportunity to analyze how terrain morphology, planning intensity, and community participation influence spatial movement systems in mountain tourism landscapes.

Despite their shared mountainous context, these destinations exhibit different circulation systems. This variation offers an opportunity to examine how terrain, planning intensity, and community involvement influence the morphology of circulation. This study, therefore, aims to:

- Identify visitor circulation patterns in Ketep Pass, Puncak Suroloyo, and Nepal Van Java.
- Classify these patterns using architectural circulation theory.
- Compare morphological characteristics among the three destinations.

The originality of this study lies in positioning circulation morphology as the primary analytical lens for evaluating the spatial structure of mountain tourism.

2. Methods

2.1. Research Design

This study employs a qualitative descriptive-comparative approach to analyze visitor circulation patterns in mountain tourism areas by integrating field observations and theoretical classifications. The research was conducted systematically (see figure 1), beginning with the development of a conceptual framework grounded in architectural circulation theory and sustainable tourism planning. Case studies were selected based on differences in development intensity, terrain morphology, and socio-spatial characteristics. Field observations and spatial mapping were conducted to document movement flows, pathway configurations, node distributions, and terrain adaptations. The data were subsequently classified into formal, natural, and community-based circulation typologies, followed by a comparative morphological analysis to identify spatial hierarchy, contour responsiveness, and mobility integration. The findings were synthesized to formulate a contextual conceptual model that explains the relationship among terrain conditions, infrastructural interventions, and circulation typologies in mountain tourism landscapes.

2.2 Case Study Selection: The Data Results

The three case studies (Ketep Pass, Puncak Suroloyo, and Nepal Van Java) were selected based on differences in development intensity, terrain characteristics, and socio-spatial integration. Ketep Pass represents a destination with advanced infrastructure and formal spatial organization; Puncak Suroloyo reflects a terrain-dominant natural environment where topography strongly shapes movement patterns; and Nepal Van Java exemplifies community-based tourism embedded within a residential settlement structure.

2.3 Data Collection

Data collection was conducted through systematic spatial mapping and field observation, including the identification of entry and exit points, parking areas, pedestrian and vehicular routes, slope gradients, elevation transitions, circulation width, material characteristics, and primary and secondary nodes. Observations were carried out during both peak and non-peak periods to capture variations in visitor flow dynamics.

2.4 Analytical Framework

Circulation systems were subsequently classified into three typologies: formal circulation, characterized by planned and hierarchical separation of mobility; natural circulation, defined by terrain-responsive pedestrian pathways; and community circulation, represented by organically formed shared routes. Visitor movement was conceptually framed as a function of terrain gradient, infrastructure intensity, and node distribution, emphasizing that circulation patterns emerge from the interaction between physical morphology and socio-spatial structure.

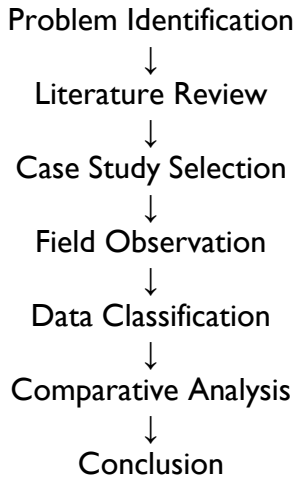

Figure 1 Research Process Scheme
Source: Author Analysis, 2026

3. Results and Discussion

3.1 Ketep Pass

Ketep Pass exhibits a clearly organized, linear circulation pattern, as shown in Figure 2. Visitor movement begins at the parking area, the initial arrival point, proceeds to the ticket gate, which functions as an access control zone, continues to the central plaza, which serves as the primary activity distribution space, and culminates at the viewing platforms, the site's main destination. This sequence forms a hierarchical, directional circulation system in which each spatial component serves a transitional function that supports the orderly flow of visitors. The linear structure not only enhances spatial orientation but also reflects a formal

planning approach that emphasizes movement control, safety, and the efficient distribution of activities within a mountainous tourism environment.

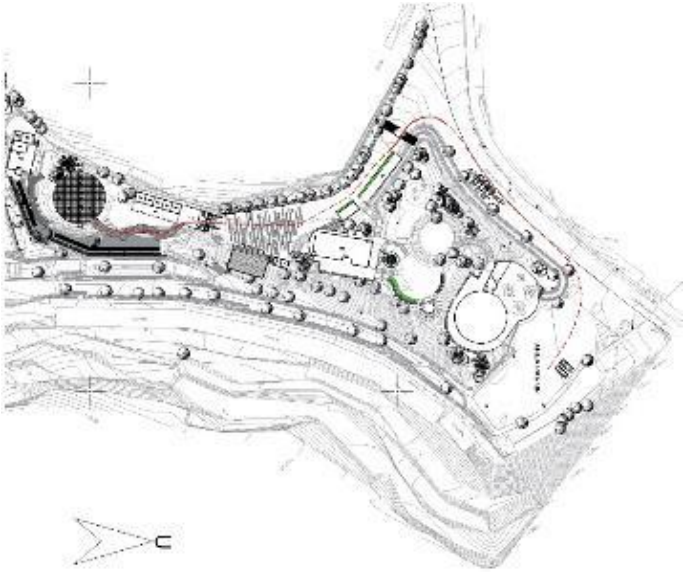

Figure 2 Site Plan of Ketep Pass
Source: Author Analysis, 2026

3.1.1 Spatial Hierarchy

The central plaza functions as the primary node distributing movement toward museums, viewing decks, and secondary attractions. Vehicle and pedestrian circulation are spatially separated, minimizing conflict.

3.1.2 Morphological Characteristics

The morphological characteristics of circulation at Ketep Pass (see Figure 3) indicate a moderate level of terrain adaptation, where pathway configurations respond to existing topographic conditions without extensive alteration of the natural landscape. Pedestrian movement is facilitated through paved corridors that provide structural clarity and physical stability, ensuring safety and accessibility for visitors. Directional signage is clearly positioned along circulation routes, strengthening spatial legibility and supporting user orientation throughout the site. Additionally, the circulation system demonstrates strong centralization, with movement converging toward a dominant activity node that organizes spatial distribution. Overall, this circulation morphology reflects a formal institutional planning approach in which spatial order and hierarchical control are prioritized over exploratory flexibility within the mountainous tourism setting.

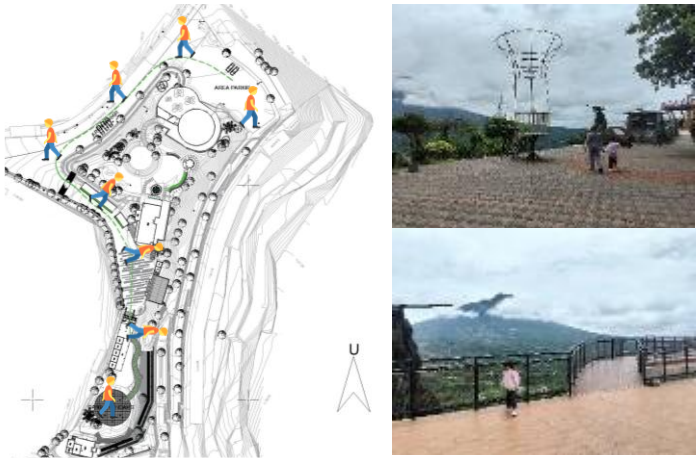

Figure 3 The Circulation of Ketep Pass
Source: Author Analysis, 2026

3.1.3 Interpretation

The structured linear system enhances safety and crowd management. However, centralized orientation may reduce experiential diversity [9] [11]. This typology aligns with formal tourism complex planning models emphasizing control and predictability.

3.2 Puncak Suroloyo

The circulation system at Puncak Suroloyo is characterized by steep stairways connecting the parking area to the summit viewpoint, as shown in Figure 4. The movement pattern follows a linear trajectory shaped directly by the mountainous terrain, where elevation differences significantly influence spatial sequencing. Visitor flow is organized via ascending and descending stair paths that closely follow the natural slope, ensuring continuity of movement despite the steep gradient. This configuration reflects a topography-responsive approach in which the circulation infrastructure follows the contours of the land rather than imposing extensive structural modifications. Consequently, vertical movement becomes an integral component of the spatial experience, reinforcing the natural character of the mountainous environment while maintaining functional accessibility to the primary attraction.

3.2.1 Terrain Influence

The slope gradient significantly influences visitor movement patterns within the site. The steep vertical ascent becomes a dominant experiential element, shaping not only the physical effort required to reach the summit but also the spatial perception throughout the journey [6] [12]. To manage circulation efficiency and safety, separate stairways are provided for ascending and descending movements. This separation reduces potential congestion and minimizes direct conflict between opposing pedestrian flows, thereby improving overall circulation performance within the steep mountainous terrain.

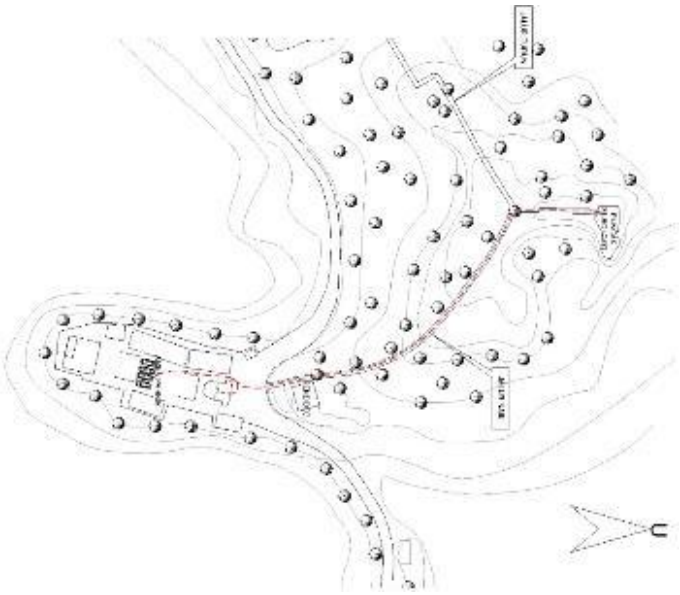

Figure 4 The Site Plan of Puncak Suroloyo
Source: Author Analysis, 2026

3.2.2 Morphological Characteristics

The morphological characteristics of circulation at Puncak Suroloyo demonstrate a high degree of contour adaptation, as pathways closely follow the natural topographic configuration of the mountainous terrain, as shown in Figure 5. Circulation within the site is predominantly pedestrian-oriented, with movement structured around stairways and walking paths rather than vehicular access. Infrastructure intervention remains minimal, reflecting a design approach that prioritizes environmental preservation and the integrity of the natural landscape. Furthermore, the spatial organization converges on a single dominant node at the summit viewpoint, which serves as the primary focal point for visitor movement and orientation within the area.

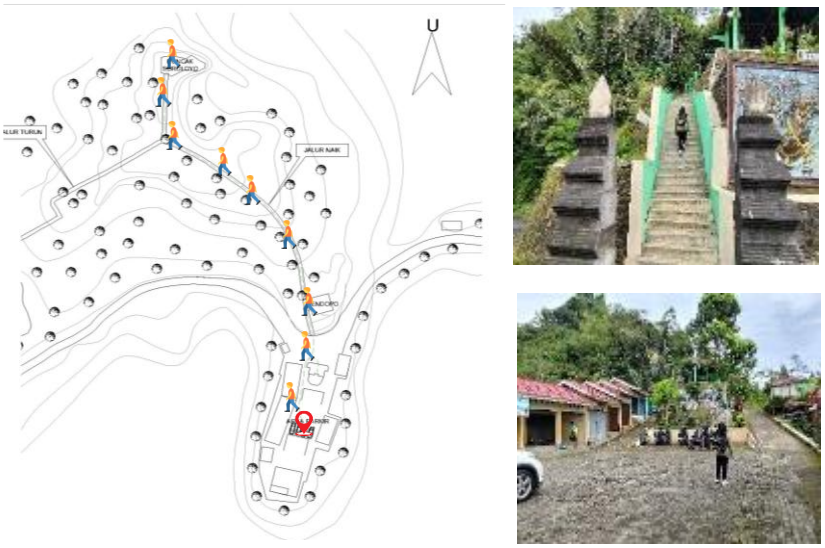

Figure 5 The Circulation of Puncak Suroloyo
Source: Author Analysis, 2026

3.2.3 Interpretation

Movement within the site functions not merely as a means of reaching the destination but as an integral component of the overall spatial experience. The circulation system enhances environmental immersion by allowing visitors to engage directly with the natural landscape throughout their ascent. The gradual progression across the terrain reinforces sensory engagement with the surrounding environment, strengthening the journey's experiential quality. However, the steep terrain may limit accessibility for certain user groups, raising concerns about inclusivity and universal access in mountainous settings.

3.3 Nepal Van Java

Nepal Van Java exhibits a mixed circulation system that is closely integrated with the morphology of its residential settlement, as shown in Figure 6. Unlike formally planned tourism complexes, the circulation network in this area develops organically within the existing terraced housing structure. Visitor movement occurs along pathways that also serve as residential access routes, creating spatial overlap between tourism activities and daily community life. This integration results in a linear yet dispersed circulation pattern in which attractions are distributed across the settlement rather than concentrated at a single dominant node. Consequently, the circulation system reflects a community-based spatial configuration shaped by local socio-spatial dynamics rather than centralized infrastructural planning.

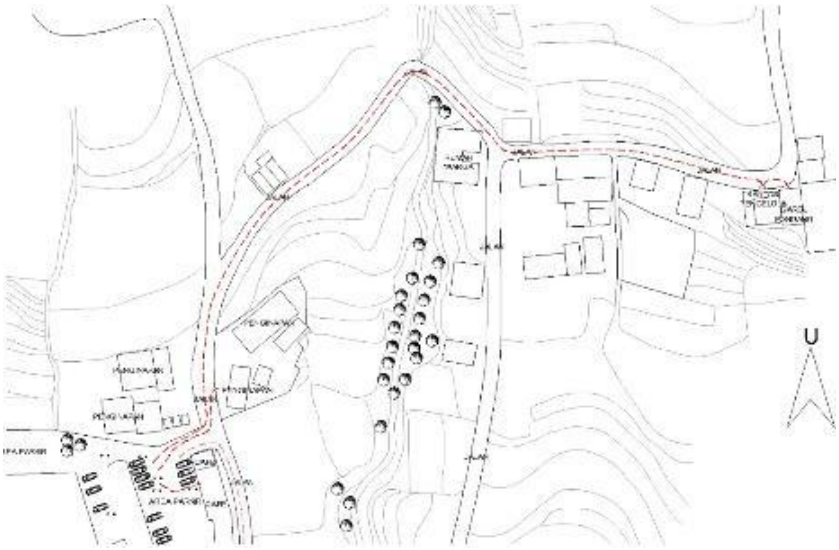

Figure 6 The Site Plan of Nepal Van Java
Source: Author Analysis, 2026

3.3.1 Shared Mobility Corridor

The primary circulation corridor in Nepal Van Java serves as a shared mobility route for both vehicular and pedestrian traffic. This overlapping use creates a mixed-traffic environment in which tourists and local residents navigate the same spatial pathway [8]. Rather than directing visitors toward a single centralized attraction, the circulation system connects multiple points of interest distributed across the terraced residential landscape. As a result, movement patterns are dispersed and sequential, reflecting the settlement's spatial configuration and reinforcing the integration between tourism activities and everyday community life.

3.3.2 Morphological Characteristics

The morphological characteristics of circulation in Nepal Van Java are defined by organically formed settlement pathways that evolve from existing residential structures rather than from formal planning interventions (see Figure 7). The spatial organization exhibits a weak central node, as visitor movement is not directed toward a single dominant focal point but instead is dispersed across multiple attraction areas. Mobility within the area is mixed-use, accommodating both pedestrian and vehicular activities along shared routes. This configuration results in a high level of socio-spatial integration, where tourism circulation is closely intertwined with the daily movement patterns of the local community.

3.3.3 Interpretation

The circulation system in Nepal Van Java reflects a bottom-up development process shaped primarily by community practices rather than centralized planning intervention. This organically formed spatial structure contributes to the preservation of cultural authenticity, as visitor movement remains closely integrated with local residents' daily activities [2] [13]. However, the shared use of circulation routes by pedestrians and vehicles poses safety risks, particularly in areas with limited spatial separation. Consequently, while the existing system supports socio-cultural continuity, it also requires strategic management to enhance pedestrian safety without undermining the destination's community-based character.

Figure 7 The Circulation of Nepal Van Java
Source: Author Analysis, 2026

3.4 Comparative Morphological Analysis

The comparative analysis (as shown in Table 1) indicates that the circulation typology in mountain tourism areas is primarily determined by three interrelated factors: terrain gradient, the extent of planning-authority intervention, and the level of community spatial integration. Terrain gradient influences the physical configuration of pathways and the degree of contour adaptation required in circulation design. Planning authority intervention shapes the level of infrastructural organization, hierarchy, and mobility separation within the site. Meanwhile, community spatial integration affects how circulation networks interact with local settlement structures and daily activities. The findings demonstrate that circulation typology emerges from the dynamic interaction between natural morphology and socio-economic structure, rather than from a single determinant variable [5] [7] [14] [15].

Table 1. Comparative Morphology of Circulation Patterns

Variable	Ketep Pass	Puncak Suroloyo	Nepal Van Java
Development Intensity	High	Medium	Community-based
Terrain Adaptation	Moderate	High	Organic
Vehicle-Pedestrian Separation	Yes	Yes	No
Node Centralization	Strong	Moderate	Weak
Typology	Formal	Natural	Community

Source: Author Analysis, 2026

4. Conclusions

This study set out to identify and comparatively analyze visitor circulation patterns in three mountain tourism destinations in the Magelang region, namely Ketep Pass, Puncak Suroloyo, and Nepal Van Java. The findings confirm that each destination demonstrates a distinct circulation typology shaped by its spatial configuration, development intensity, and terrain conditions. Ketep Pass exhibits a formal, linear-structured circulation system characterized by a clear spatial hierarchy, centralized nodes, and a separation between vehicular and pedestrian movement. Puncak Suroloyo presents a topography-adaptive linear-natural circulation pattern in which pedestrian pathways closely follow steep terrain contours and vertical ascent becomes an integral component of the spatial experience. In contrast, Nepal Van Java features a community-integrated linear circulation system in which visitor movement is embedded within organically formed residential pathways and shared mobility corridors.

The comparative analysis further reveals that the circulation morphology in mountain tourism areas is determined not solely by physical terrain but by the interaction among terrain gradient, infrastructure development intensity, and socio-spatial integration. Destinations with stronger institutional planning tend to exhibit hierarchical and centralized circulation structures, while areas with dominant natural topography emphasize contour-responsive pedestrian systems. Meanwhile, community-based destinations exhibit dispersed, mixed-use circulation patterns shaped by everyday settlement dynamics.

These findings directly address the research objective of classifying and comparing circulation patterns across the three case studies, while also highlighting the contextual determinants that shape their formation. The study concludes that sustainable mountain tourism planning must adopt a context-sensitive approach that prioritizes terrain responsiveness, pedestrian safety, and a balanced integration of tourism infrastructure with local community structures. By positioning circulation morphology as a primary analytical lens, this research contributes a contextual framework for circulation to environmentally sensitive mountain tourism landscapes and expands the discourse on spatial planning within architectural and urban studies.

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