3D Representation of Rituals in HBIM: The Central Pillar and Fire Pit Space in the Tibetan-Yi Corridor

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3D Representation of Rituals in HBIM: The Central Pillar and Fire Pit Space in the Tibetan-Yi Corridor

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Abstract: In architectural heritage research, rituals and human activities are often overlooked but are crucial for maintaining authenticity and reflecting various cultural values. In the Tibetan-Yi Corridor, one of China's most renowned heritage routes, rituals and behaviours around the central pillar or fire pit reflect the shared culture and history of Di-Qiang ethnic groups, serving as critical indicators in studying their origins. A scientific method linking physical spaces with intangible cultural information is essential to preserve these rituals or activities and understand their interactions with architectural spaces. This study introduces a method utilising HBIM technology to document and analyse the 3D structures of Di-Qiang ethnic architecture and the rituals. It deconstructs rituals into bodily movements represented within the BIM space to simulate the behaviours of various roles. This method visualises ritual types and critical information by encoding different rituals and movements through geometric shapes, sizes, and colours, effectively linking architectural spaces with intangible cultural elements. The study's two main contributions are (i) the HBIM archival method for Di-Qiang ethnic architecture, standardising geometric modelling and semantic information recording to digitise Di-Qiang architectural heritage, and forming a foundational 3D model library and semantic database; and (ii) the 3D representation method for ritual movements, which offers a way to manage intangible cultural information and spatially assess cultural behaviours, and evaluates the authenticity and quality of architectural heritage by analysing bodily rituals in space. This approach introduces a novel method for documenting and researching intangible heritage in cultural studies. Additionally, the digital technology-based research method offers a convenient platform for integrating and connecting digital heritage with digital humanities in the future.

Keywords: HBIM; digital heritage; digital humanities; documentation; heritage routes; Tibetan-Yi corridor; rituals; Di-Qiang ethnic groups

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1. Introduction

1.1. Rituals and Bodily Behaviours in Architectural Heritage

Architecture is a material response to human behaviours and activities, not merely a container [1]. The form, materials, technology, and decorations of a building testify to these behaviours and activities. Architectural heritage, as a type of cultural heritage, emerges from the interplay between materiality and meaning, representing a synchronous relationship involving culture, norms, and values [2]. Tangible elements (form, materials, and technology) and intangible elements (physical movements and behavioural activities) evidence underlying cultural norms and values, creating a symbiotic relationship within architectural heritage [3]. Furniture and utensils constitute invaluable tangible assets, while the actions and rituals form part of the heritage's historical value, becoming intangible assets within the structure. These elements profoundly influence the shaping and utilising of the heritage's spatial form. Comprehensive understanding and the documentation of these rituals and behaviours enhance researchers' insights into architecture and history,

offering heritage conservators a behavioural perspective, and enabling them to preserve the authenticity of architectural heritage more accurately.

In the domain of digital heritage, and particularly, within the Historic Building Information Modeling (HBIM), rituals and bodily behaviours are often represented as parametric values or linked heterogeneous data to form a common data environment (CDE) [4]. In digital museums, these rituals and behaviours are typically recorded as 3D digital representations or multiple media types, with the architectural heritage or sites where they occur frequently serving as peripheral contexts rather than central focuses [5,6].

Is this enough? In digital heritage, can a textual description of rituals and actions, or a video link or 3D simulation, fully encapsulate the value of rituals within architectural spaces? Can it accurately convey the specific location and state of these rituals? While these digital methods offer a visual and perceptual approach to intangible cultural elements, such as rituals, whether they adequately represent the relationship between these elements and architectural heritage remains a thought-provoking question.

Barontini et al. (2022) [7] introduced an innovative HBIM method for materialising abstract objects by simplifying building decay and damage from their associated objects and materials, transforming them into regular-shaped entities with high Levels of Information (LOI) and low Levels of Geometry (LOG), termed "patches". This method assigns decay and damage information to these "patches" rather than directly to real-world objects and materials, simplifying and adding flexibility to system implementation and reducing the cost, complexity, and time required for detection and modelling.

This method introduced new possibilities for visualising and managing intangible rituals in architectural heritage by converting the bodily behaviours of rituals into patch block objects within Autodesk Revit (Version 2024 in this study). Different types of rituals and actions, along with their critical information, can be represented through the shape, size, and colour of these geometric patches, facilitating the visualisation of ritual types and their associated data.

The advantages of this method include the independent handling of intangible information through geometric and semantic management, extracting rituals or bodily behaviours from complex documents or heterogeneous files to meet customised digital research and information management needs, thereby enhancing flexibility and efficiency. Additionally, incorporating attributes of rituals and behaviours connects with interdisciplinary fields such as religious studies, history, and the anthropology of human movement, aiding conservation professionals in understanding both the material and intangible aspects of architectural heritage and offering a new perspective for preserving its authenticity.

1.2. Tibetan-Yi Corridor: "Central Pillar" and "Fire Pit" Spaces

In the 1980s, anthropologist Fei Xiaotong introduced the "Tibetan-Yi Corridor" concept based on historical ethnic migration patterns in the border regions of Sichuan, Yunnan, and Tibet [8]. Over time, this concept gained acceptance in both academic and public spheres, becoming a significant cultural heritage route in China. It is also known as the Tibetan-Qiang-Yi Corridor or the Tibetan-Qiang-Han-Yi Corridor. For simplicity and consistency, this study will refer to it as the Tibetan-Yi Corridor. The north-south mountain ranges and natural river valleys in this region form a prominent "corridor" shape, facilitating early ethnic migrations, while the rugged terrain and harsh climate preserve the independence of these groups, preventing external assimilation [9]. Consequently, the Tibetan-Yi Corridor has become a crucial hub for multicultural exchange and integration in southwestern China, playing a vital role in understanding the region's ethnic patterns and historical development [10].

The Tibetan-Yi Corridor region exhibits a complex ethnic composition (Figure 1). Historical texts indicate that the Qiang people, an ancient ethnic group from western China, migrated in various directions, eventually evolving into diverse ethnic groups, including Tibetans, Qiangs, Yis, Naxi, Pumi, Lisu, Nu, and Bai, all belonging to the Sino-Tibetan language family, specifically, the Tibeto-Burman branch [8]. These groups share a common ancestry and have a long history of

migration, interaction, and integration, resulting in cultural commonalities such as the worship of fire, white stones, and sacred trees. Geographical factors and the complex processes of ethnic differentiation and integration have led to variations in this shared cultural substrate. This shared cultural substrate is evident in the architecture of the Di-Qiang ethnic groups in the Tibetan-Yi Corridor. Further research has clarified this substrate, particularly in the architectural features of the central pillar space [11] and the fire pit space [12].

Figure 1. Culture and architecture of different ethnic groups in the Tibetan-Yi Corridor.

In ancient Di-Qiang architecture within the Tibetan-Yi Corridor, the central pillar is pivotal. Centrally positioned, it may appear singly or in pairs, forming a "parent–child" arrangement (Figure 2). Architecturally, it shares load-bearing duties with other pillars and walls, delineating spatial boundaries. Culturally, it transcends structural function, serving as a spiritual symbol. Different Di-Qiang groups, influenced by unique cultural beliefs, show variations in their reverence for the central pillar, viewing it as a bridge between heaven and earth or a symbol of ancestral worship. This reverence is expressed through intricate decorations, specific construction rituals, and ceremonies, making the central pillar an indispensable cultural symbol in the Di-Qiang heritage.

Figure 2. Different forms of central pillars (images from Qin FQ [13]). (**A**) Malcon Djokovic official residence; (**B**) Mosuo (female pillar); (**C**) Mosuo (male pillar); and (**D**) Tibetan central pillar of the lama pagoda.

The fire pit is another crucial element in ancient Di-Qiang architecture within the Tibetan-Yi Corridor. Typically located in the main room, it serves for heating, lighting, and cooking and can be a shallow, wide pit or a movable structure (Figure 3). Unlike common fire pits and stoves elsewhere, Di-Qiang fire pits embody fire worship and ancestor veneration.

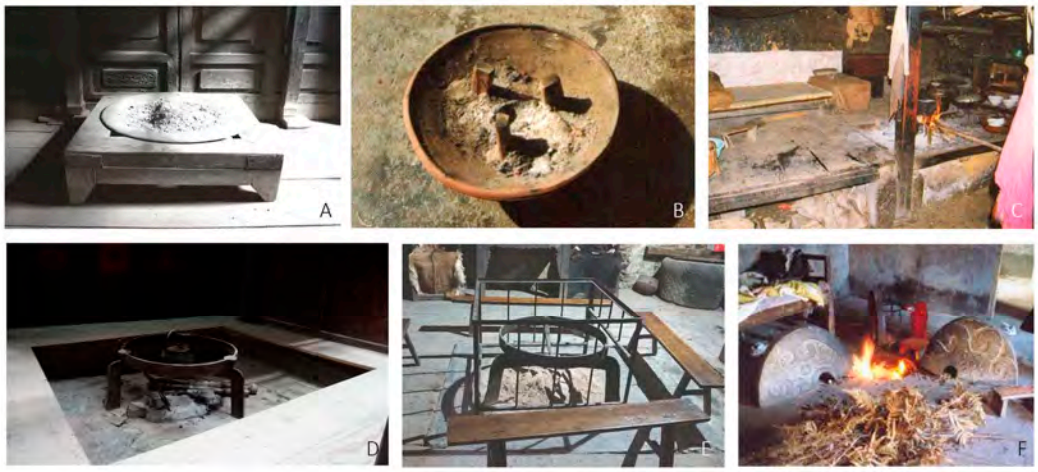

Figure 3. Different forms of fire pits among the Di-Qiang ethnic group. (**A**) Table type; (**B**) bowl style; (**C**) bed style; (**D**) pit type; (**E**) ground type; and (**F**) Guozhuang stone type. (**A**,**D**,**E**) are from Qin Fuqiang [13]; (**B**,**C**) are from "Yunnan Dwellings" [14].

This is evident in the main room's layout centred around the fire pit, the reverence for the three Guozhuang stones (used to support cooking vessels), and the placement of fire deity altars or ancestral plaques around the fire pit. Thus, the fire pit is essential in Di-Qiang architecture and a space rich in cultural significance within the Di-Qiang community.

Traditional architectural elements like the central pillar and fire pit face unprecedented challenges due to societal development, climate, and lack of maintenance, risking decay and modernisation. As younger generations abandon traditional customs, the cultural practices associated with these elements gradually lose continuity. To address these risks, researchers propose using HBIM technology to digitise and protect these structures, focusing on Scan-to-BIM and detailed modelling. However, when physical objects are damaged, and intangible rituals and behaviours disappear, is it sufficient to merely record these architectural elements' morphological characteristics, decorations, materials, and techniques? Can these restored or preserved architectural spaces be considered authentic without documenting and studying residents' rituals and behaviours?

The intertwining of tangible and intangible heritage, exemplified by the central pillar and fire pit, represents a dynamic process of meaning generation. Their value is not inherent but formed through the complex dynamics of society, culture, and physical interaction. Therefore, documenting cultural heritage should start from the material environment's objectivity and bodily behaviour's subjectivity, meticulously recording interactions between human rituals and the surrounding environments. In HBIM, the precise documentation of rituals and behaviours associated with the central pillar and fire pit and exploring the profound relationship between material space and ritualistic behaviour are crucial for studying and preserving the historical integrity of architectural heritage spaces.

2. Research Objectives

Given the reasons above, this study aims to employ HBIM technology to visualise and standardise the modelling and management of rituals and bodily behaviours in the central pillar and fire pit spaces. Additionally, it seeks to preliminarily explore the relationship between rituals and architectural space using this digital methodological model. Due to the interdisciplinary nature of this research, which encompasses anthropology, ethnology,

psychology, and architecture, the study is divided into two main sections: basic research and technical exploration.

1. Research on the central pillar and fire pit in the humanities:
    - Conduct literature reviews and field investigations to study the material forms of the central pillar and fire pit in the Tibetan-Yi Corridor, as well as related rituals and bodily activities.
    - Classify the rituals of the Di-Qiang ethnic groups to align with the architectural perspective of "layout, construction, and use".
    - Introduce anthropological concepts to categorise bodily behaviours within rituals.
2. Digital technology exploration in HBIM:
    - Select suitable Di-Qiang architecture from field surveys, databases, and public sources to ensure the completeness of geometric and semantic information.
    - Establish an HBIM modelling method for the residential architecture spaces of the Di-Qiang ethnic groups in the Tibetan-Yi Corridor and create a database.
    - Propose a methodological framework for expressing intangible rituals and bodily behaviours within the HBIM environment.
    - Develop a semiotic coding system for classifying bodily behaviours and establish a 3D expression method for these behaviours.
    - Explore the application and extension of this method in expressing rituals and bodily behaviours within the HBIM environment.

3. Ethnology and History: "Central Pillar" and "Fire Pit" Spaces

3.1. The Structured Process of "Central Pillar-Fire Pit"

French anthropologist Claude Lévi-Strauss posited that myths fundamentally shape early human social structures [15]. In the Tibetan-Yi corridor, the myths and legends of the Di-Qiang ethnic groups are notably rich and diverse, illustrating how ordinary objects are sanctified and transformed into revered artefacts [16].

Fire plays a crucial role in human civilisation, a universal phenomenon globally [17]. Unlike the Western narrative where fire symbolises complex attitudes towards knowledge, power, and self-awareness, the myths of the Di-Qiang ethnic groups exhibit a purer reverence and awe for fire [11,18]. The sacred pillar (Heavenly Pillar) in these myths symbolises the connection between humans and gods or the stability of the world [19].

In bridging myth and reality, the worship of myths evolved into the veneration of the fire pit and central pillar, forming specific spatial cognitive relationships around them. From an architectural perspective of "ritual–body–space [20]", the Di-Qiang ethnic groups used mythological imagery to create spaces resonating with their sacred beliefs, forming specific spatial layouts and forms. During construction, they performed specific rituals and followed construction logic due to the layout requirements and the sanctity of the fire pit and central pillar. In daily use, the Di-Qiang ethnic groups developed specific ways of using these architectural spaces through "body memory" and ritualised actions. Therefore, this chapter will elucidate the connection between tangible information and intangible culture within these sacred spaces based on the "spatial orientation", "construction logic", and "bodily rituals" of the central pillar and fire pit [21].

3.2. Spatial Orientation

Myths of Di-Qiang ethnic groups emphasise spatial orientation centred around the central pillar, which signifies direction and centrality, representing ancient spatial hierarchies and pathways [13]. Architecturally, the central pillar establishes a spatial orientation focused on the "middle position" and "upper-middle-lower" hierarchy [11], determining the placement of other components and creating an invisible spatial division. It is often subject to rituals and prohibitions, such as rules against leaning on or climbing it.

Compared to the central pillar's symbolism of divine power and vertical communication, the fire pit space primarily consists of the fire pit, Guozhuang stones (three stones supporting cooking pots) (Figure 4), and the seat for the fire deity. Typically square-shaped, the fire pit's "three or four directions" often reflect family hierarchy and gender distinctions, symbolising reverence for the divine.

Figure 4. Different types of Guozhuang stones. (The tripod's (or stones') placement follows strict rules).

The fire pit's orientation dictates spatial hierarchy, attributes, and seating etiquette. In the main room of the Mosuo people, the fire pit's position divides the space into male and female areas, with the male space closer to the interior and the female space near the entrance. Seating arrangements are influenced by gender and family seniority: Elders sit closer to the fire pit, while younger members sit farther away. These arrangements reflect the directional hierarchy and seating etiquette standard among the Di-Qiang ethnic groups (Figure 5).

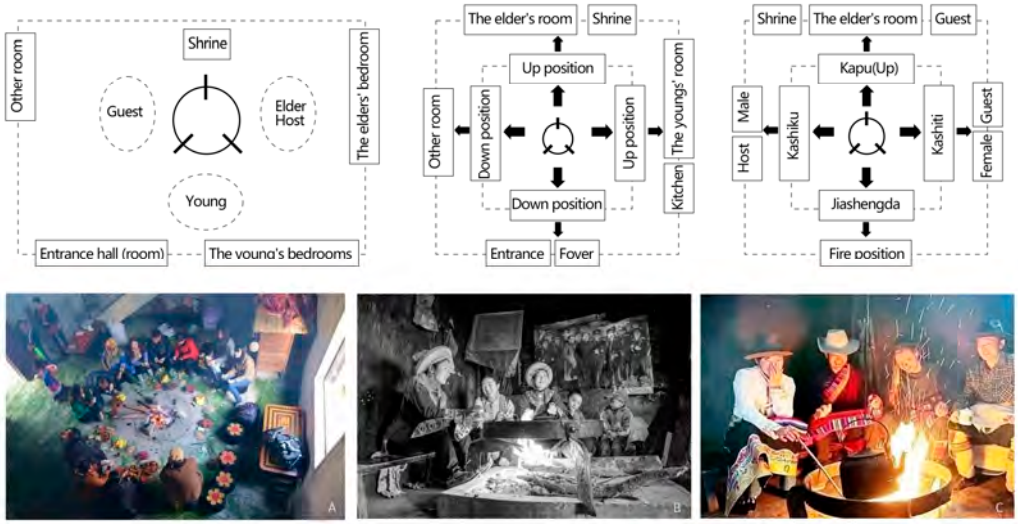

Figure 5. The orientation is reflected in the seating etiquette around the fire pit. (**A**) Yi nationality; (**B**) Qiang nationality; and (**C**) Tibetan nationality.

Overall, the central pillar and fire pit form the core of the architectural design in Di-Qiang ethnic minority dwellings. This spatial orientation is evident in the room layout and hidden attributes, such as the division of sacred spaces, gender-specific areas, and seating etiquette. These architectural elements and rituals reflect the Di-Qiang people's profound understanding of space and social structure.

3.3. Construction Activities

The central pillar and fire pit hold paramount significance and sanctity in the construction process of the Di-Qiang ethnic groups, as evidenced by the construction order and accompanying rituals. Architectural construction typically unfolds in three stages [21].

3.3.1. Site Selection and Material Preparation

During the site selection and material preparation phase, the significance of the central pillar and fire pit is already apparent among the Di-Qiang ethnic groups. The process begins with selecting the construction site, where shamans or experienced carpenters perform divination or rituals to assess the site's auspiciousness and determine the house's orientation and the approximate locations of the central pillar and fire pit. For instance, the shaman Bimo uses traditional methods like rolling eggs and standing rice grains for divination among the Yi. After confirming the site, the Bimo places the foundation stone near the fire pit and shrine. The Di-Qiang ethnic groups prepare building materials, especially timber, at least a year in advance. For example, the Nu people of Yunnan and the Tibetans of Diqing prepare wood for the central pillar 3–5 years in advance, selecting timber thicker than that used for other pillars.

3.3.2. Construction of the Main Structure

During the main structure construction phase, the Di-Qiang ethnic groups in the Tibetan-Yi Corridor adhere to the principle of "erecting the central pillar first", a method compatible with various ethnic housing systems (Figure 6). This principle manifests in three ways:

(1) Erecting the central pillar before other building components, as in Tibetan tent houses.
(2) Erecting the central pillar after connecting the foundation and enclosing structures, as in the wooden houses of the Nu and Naxi peoples.
(3) In roof truss systems, erecting the row frame with the central pillar first, followed by other components, as seen in Yi through-type dwellings and Mosuo grandmother houses.

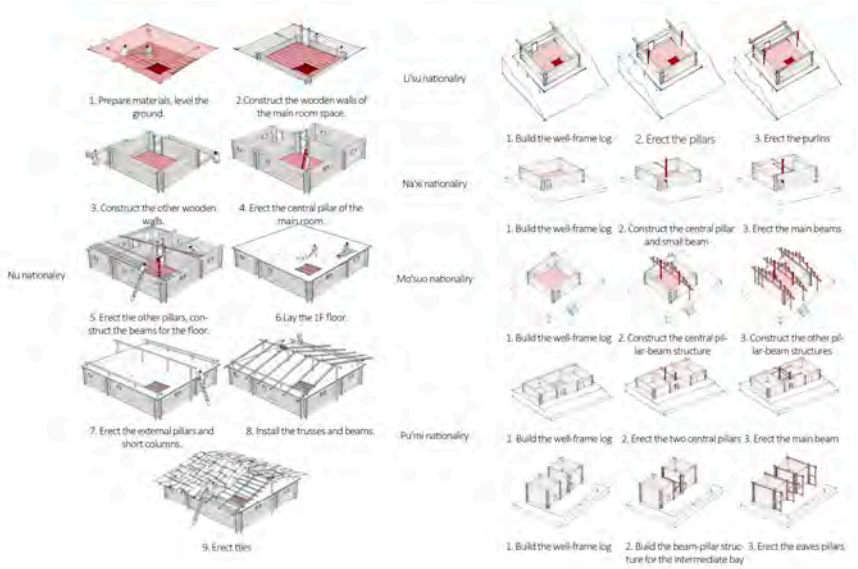

Figure 6. Different construction phases in Di-Qiang. (Redrawn based on Ms. Fu Jiaqi's original survey).

During the process, special rituals and blessings underscore the significance of the central pillar and fire pit. For instance, the Nu people bury grains and coins before erecting the central pillar, praying for a bountiful harvest and good fortune. On the night of the pillar erection, homeowners invite artisans to recite scriptures. Similarly, the Tibetan "Patun" ceremony involves placing tea leaves, grains, and jewellery under the pillar stone, with all relatives participating. The Mosuo people's frame-erecting ceremony includes placing wine near the central pillar, leading a chicken around it, piercing its comb to drip blood into the grains and wine, and releasing the chicken to fly eastward as an encouraging sign.

3.3.3. Interior Arrangement

During the interior arrangement phase, specific ceremonies and actions highlight the significance of the central pillar and fire pit. For instance, the Mosuo and Tibetans first established the fire pit in the main room before arranging matching furniture. The Naxi people consider the house complete once the fire pit is constructed. Subsequently, a Dongba shaman selects an auspicious day to recite scriptures. The homeowner's son ignites the fire, and the daughter-in-law channels water into the trough. Guests are invited to a grand feast, where they chant the "Song of the Grain Spirit" under the Dongba's guidance and offer sacrifices to the mountain deity. Only after these rituals is the remaining furniture moved in.

3.4. Bodily Behaviour

In the sacred space formed by the central pillar and fire pit, the rituals surrounding it can be seen as a form of bodily technique [22]. Chen Wei, Gong Yani, and Hu Bin [20] explored the "ritual–body–space" relationship from a macro perspective, integrating Heidegger's spatial concepts of "orientation (Ausrichtung)" and "distance (Ent-fernung)" with Merleau-Ponty's phenomenology of perception, particularly, the concepts of "centripetal and centrifugal [23]".

This approach symbolically represents ritual behaviour, extracting characteristics of orientation, movement, centripetal gathering, and spiralisation. When shifting from a macro perspective to a specific individual perspective, a more specific and structured methodology is required to accurately describe the ritual attributes within specific architectural spaces. In anthropological dance studies, Drid Williams introduces the spatiotemporal attributes into the study of bodily movements without compromising the expression of the subject culture's meaning [24]. Williams proposes a classification method for bodily movements based on an individual perspective, using a three-dimensional space plus time dimension interpretation. This method defines the human body as the centre of space, describing the spatial direction and positioning of body parts and overall movement from the perspective of the acting subject. It delineates two categories of movements, transitive and intransitive, based on the presence or absence of an objective goal or result.

Drid Williams' classification method is also applicable to the study of Di-Qiang ethnic rituals. By abstracting and distilling behaviours from complex rituals, it simplifies the spatial relationships between the body and points within the ritual space, establishing a "ritual–individual–space" relationship. Simply put, it involves evaluating significant rituals within Di-Qiang residential spaces based on elements such as the orientation and direction of individual movements, spatial points, specific goals and outcomes, and bodily movement. From relatively limited data, four representative attributes of bodily movements are summarised: movement, placement, stillness, and prohibition (Figure 7).

Figure 7. Different bodily behaviour in Di-Qiang. (**A**) Approaching: Tibetan blessing ceremony. (**B**) Placement: Nu people lay the corn for a good harvest. (**C**) Circumambulation: Tibetan dance. (**D**) Stillness: the song of the Nu people around the centre pillar. (**E**) Stillness: Mosuo coming-of-age ceremony (female). (**F**) Stillness: Mosuo coming-of-age ceremony (male). (**G**) Circumambulation: Tibetan wedding circling. (**H**) Circumambulation: Tibetan dance Yangzhuo.

The attribute of movement, as a typical transitive action, possesses specific dynamics, goals, and orientation. This culturally driven behaviour pattern can be categorised into two types. One is non-directional cyclic movements.

In the Tibetan-Yi Corridor, the Di-Qiang ethnic groups perform the "circumambulation" ritual, which involves unidirectional cyclic movements around the central pillar and fire pit within an indoor space [25].

For example, the Nu people's "Kelu" involves circular dancing around the central pillar; the Tibetan "Guozhuang" dance also revolves around the central pillar; and in Tibetan tribal weddings, participants walk clockwise around the central pillar three times to pray for marital happiness. The other type is directional linear movements, typically non-core actions in various rituals, connecting different spatial points, such as moving from the central pillar to the fire pit in many Di-Qiang rituals [13]. Both types help us establish quantifiable and describable regularities closely related to architectural space.

The attribute of placement represents a transient transitive action, completing the interaction among "individual–object–space" through specific positioning, orientation, and resultant actions. For example, in significant rituals such as ancestor worship, dragon ceremonies, and weddings, the Pumi people place incense at the base of the central pillar to express reverence and prayers to deities and ancestors. The Tibetans and other Di-Qiang ethnic groups who practice Tibetan Buddhism often place ceremonial scarves (khata) and prayer flags (lungta) above the central pillar, symbolising blessings, protection, and spiritual connection. During harvest periods, the Nu people and other communities perform specific placement actions, tying corn or grains to the central pillar or placing them at its base to pray for a bountiful harvest and prosperity [13]. Although placement actions are present in the rituals of specific ethnic groups, their core lies in transitioning from behavioural attributes to object attributes, thereby linking with the spatial environment. Therefore, scenarios involving "person–object" or "person–object–person" interactions can mostly be categorised under placement attributes.

Conversely, the attribute of stillness is a typical intransitive action, emphasising direction, position, and purposeless static presence [26,27]. In such ritual behaviours, the subject is viewed as a static entity within the space, becoming part of the architectural environment [22,23]. Therefore, complex ritual behaviours such as dance, worship, and meditation can be abstracted as stillness. The spatial position and direction of the individual become key attributes, establishing a connection with the architectural space or elements. For example, in the coming-of-age ceremonies of the Mosuo and Pumi peoples, stillness is particularly prominent. In Mosuo families, girls stand beside the female pillar under their mother's guidance to perform the "skirt-wearing ceremony", while boys stand beside the male pillar under their uncle's supervision to perform the "trouser-wearing ceremony". In the stillness behaviours near the fire pit, devout believers kneel in front of the fire pit during daily prayers, meditating, chanting, or contemplating, facing the altar.

Another attribute of intransitive actions is prohibition. Prohibited behaviours can be either transitive or intransitive, but adhering to taboos is inherently a non-directional, non-locational, passive individual behaviour without interactive properties, thus classified as non-mobility. Like many ethnic groups worldwide, the Di-Qiang people have numerous taboos in their daily lives. In Qiang and Yi cultures, the central pillar is closely related to the family's fortune and health; thus, children are forbidden from touching the central pillar to avoid inauspicious consequences. If such an incident occurs, special rituals are performed to dispel the misfortune. In the fire pit space, most Qiang ethnic minorities follow strict rules, such as prohibiting random movement near the fire pit, crossing over the fire pit, or discarding trash or water into the fire pit. These rules express respect for deities and ancestors. However, taboos in rituals resemble a form of resistant physical action, thereby categorising them under physical attributes and considering them as significant elements influencing and defining architectural spaces.

Thus, after analysing the ritual behaviours related to the central pillar and fire pit in the dwellings of various Di-Qiang ethnic groups, this study establishes a basic typology of the bodily behaviours (Table 1):

Table 1. Attributes induction of bodily behaviours around the central pillar–fire pit in Di-Qiang.

Body Classification System	Category	Sub-Category	Orientation	Position	Aim/Outcome	Bodily Movement
Transitive Structures	Movement	Moving	High	Low	High	High
		Circumambulation	Medium	Medium	High	High
	Placement	Placement	Medium	High	High	Low
		Delivery	High	Medium	High	Low
Intransitive Structures	Stillness	Pray	High	High	Low	Low
		Stand	Medium	High	Low	Low
		Dance	Medium	High	Medium	Low
	Prohibition	Taboo	Medium	Medium	Low	Medium

4. The BIM Methodology

4.1. HBIM Modelling: Tangible Heritage

Architectural material space is the locus for all actions and rituals and is fundamental to digital architectural heritage research. This chapter examines the HBIM documentation of Di-Qiang ethnic architecture in the Tibetan-Yi Corridor, emphasising a low-demand geometric modelling strategy and a semantic information management framework. This workflow aligns with mainstream HBIM protocols and can be divided into three stages [28,29]: information acquisition, geometric modelling, and semantic enrichment (Figure 8).

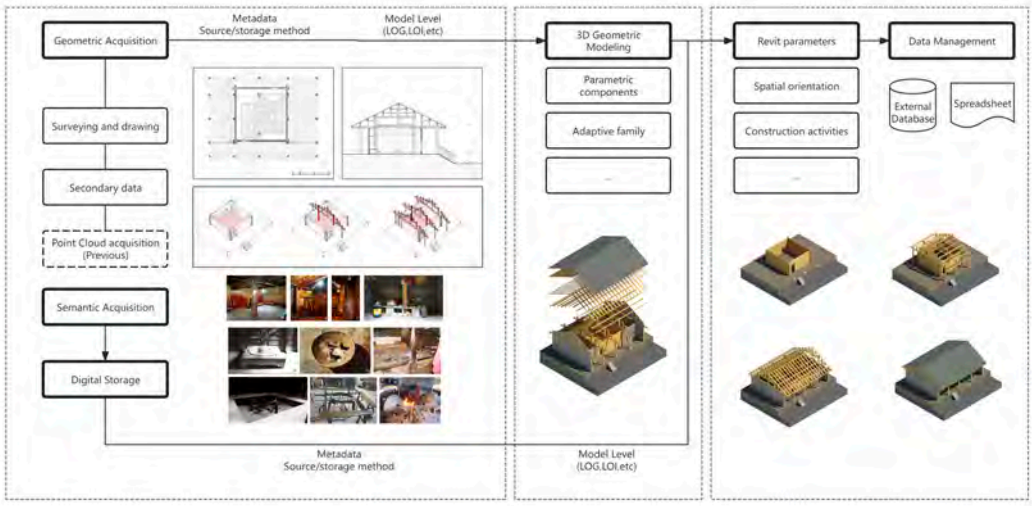

Figure 8. The complete workflow of HBIM modelling of the Di-Qiang ethnic minority.

The information acquisition stage involves collecting and organising physical and non-physical data related to the architectural material space in the Tibetan-Yi Corridor, focusing on methods and strategies for translating heterogeneous information. The geometric modelling stage addresses the modelling of building components and facilities, with variations based on different architectural structures and forms. The semantic enrichment stage pertains to the storage methods for the collected information within the HBIM system.

4.1.1. Data Acquisition

The information acquisition phase is foundational to research and often fraught with challenges due to the data's vast and disorganised nature, difficulties in verifying authenticity, transmission errors, and a lack of standardisation in digital storage. In this study's preliminary phase, nearly 100 sets of original data on traditional residential models of various ethnic minorities in the Tibetan-Yi Corridor were compiled from historical projects, public databases,

and research materials. To ensure the relevance of research samples, buildings that had hosted relevant ceremonies and physical activities were selected, avoiding arbitrary combinations. Three key operational steps and corresponding rules were established for the information collection phase.

Firstly, the study classified architectural heritage information into geometric and semantic categories. Geometric information collection focused on the completeness of architectural component data, particularly, the spatial location and dimensions of critical elements like central pillars and fire pits. Minor geometric details such as building damage and deformation were appropriately ignored to align with the study's core objectives. Semantic information collection examined the completeness of data on ceremonies and physical movements, often extracted from videos, surveys, or other research outputs. The classification and management of other semantic information adhered to standard HBIM documentation protocols [30,31].

Secondly, the study meticulously managed and recorded various types of original information. Geometric data primarily came from DWG drawings, exported PDF drawings, and original point cloud data from surveying projects. Information on ceremonies and physical movements was typically found in videos, photographs, and written interview records. These original documents were preserved as fundamental references and semantically transcribed to facilitate subsequent information comparison and selection.

Finally, the study summarised and evaluated the geometric and semantic information within the buildings, focusing on the central pillar and fire pit spaces and ceremonies and physical movements. Metadata parameters such as information sources, types of original information, storage and transcription methods, and personnel were introduced to record the information collection process, providing references for subsequent work.

Through these procedures, eight samples were ultimately selected, ensuring that the geometric information of the buildings matched the records of ceremonies and physical activities, thus avoiding misinterpretations of the formation and development of architectural spaces and the associated activities (Figure 9).

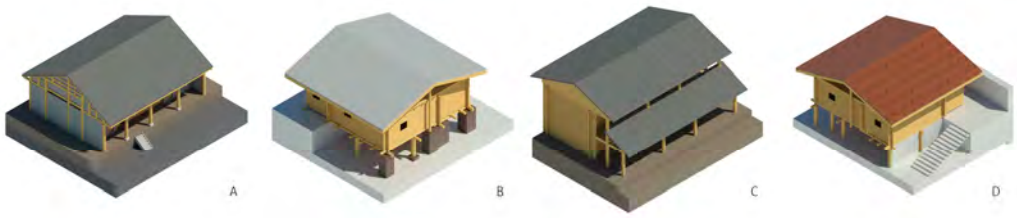

Figure 9. 3D modelling of the dwellings of different Di-Qiang ethnic minorities. (**A**) Mosuo; (**B**) Nu; (**C**) Pumi; and (**D**) Lisu.

4.1.2. Geometric Modelling

This study focuses on efficiently constructing three-dimensional models of traditional Di-Qiang ethnic buildings rather than on the physical preservation of architectural heritage. Consequently, the project does not prioritise high precision and accuracy in representing architectural components. To enhance modelling efficiency, irregular shapes and damaged parts of building components have been omitted, and multi-level detail expressions have been simplified. To prevent misuse in architectural heritage protection, the study introduced the concept of Model Level, which controls quality by quantifying geometric simplification and information richness, aligning with international standards such as Level of Detail (LOD), Level of Information (LOI), and Level of Geometry (LOG) [31].

Various modelling strategies and methods were adopted to suit architectural types and structural features. An adaptive family approach was used for log-cabin construction components, known as the "jinggan" style in traditional Chinese architecture. Roof truss structures, typically composed of columns, beams, and purlins, employed conventional model families or in-place components (Figure 10). Components with parametric constraints utilised parametric modelling techniques for precise constraints and effective reuse. Given the low importance of doors and windows in this study, these components were omitted, and wall openings were

used instead to maintain model integrity. Additionally, to ensure accurate information transfer between software, naming conventions for components and IFC parameter settings were predetermined.

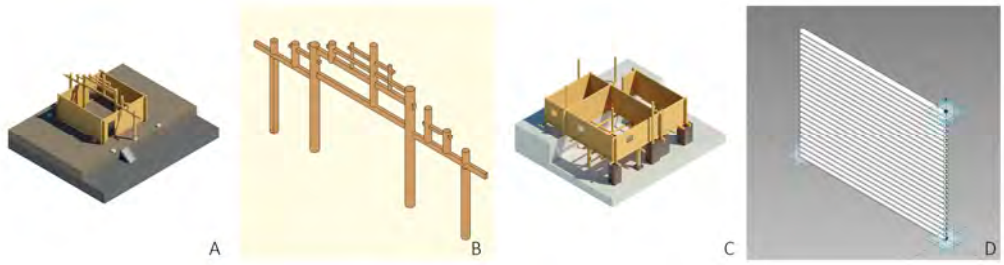

Figure 10. Parametric design of different architectural structures. (**A**,**B**) Mosuo ethnic group: the parametric family structure of lift-beam-style houses. (**C**,**D**) Nu ethnic group: the adaptive family of log-cabin construction.

The study of rituals and bodily movements closely relates to sacred objects and daily items within the space. Therefore, objects such as fire pits and altars were categorised into the furniture category of loadable families with unique attributes and parameters. In-place components represented standard furniture to indicate their specific location and orientation within the architectural space. Parametric components generated by conventional and adaptive model families and highly constrained furniture families demonstrated extensive versatility and reusability across different scenarios.

This digital modelling approach facilitated the construction of a database for Di-Qiang architectural components, providing a rich digital heritage resource for analysing component elements, architectural techniques, and materials. For instance, various styles of fire pits were reconstructed, each with a detailed information table including comprehensive details and metadata such as information sources. Other heterogeneous information, such as scanned drawings or photographs of fire pit decorations, was correctly linked or stored in the database (Figure 11).

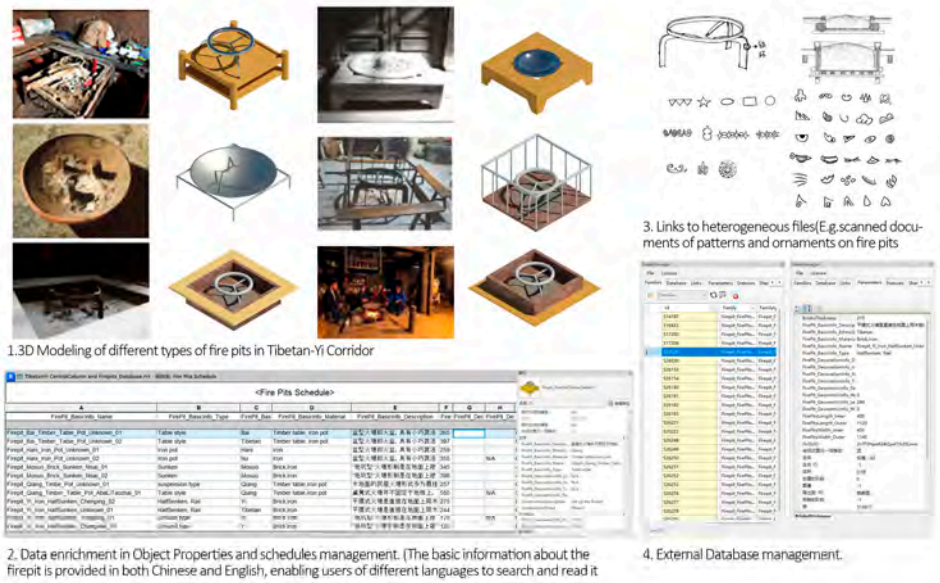

Figure 11. Fire pits management through Revit and Database.

4.1.3. Semantic Enrichment

The material information of architectural components is organised within the material library and defined shared parameters. The material library primarily addresses the physical properties

of materials. At the same time, the shared parameters focus on the acquisition and processing methods, particularly, the detailed preprocessing of specific components like the central pillar and the selection of materials. For example, in Mosuo residential architecture, the two central pillars in the main house are designated as male and female pillars, requiring materials from the same robust tree, unlike other pillars. These characteristics are stored as shared parameters.

In Di-Qiang residential architecture, room definitions are based on functional and sacred uses, especially in the main chamber. The main chamber is a room further divided by the central pillar and fire pit into abstract concepts like male and female spaces. This approach uses the Revit function module "Architecture-Room Division" for room definitions and the function module "Analysis-Analysis Space" for spatial areas within the room, managed through Revit's interoperability tools plugin and specific shared parameters (Figure 12).

Figure 12. Rooms and spaces management.

The construction sequence can be visualised by compiling and translating various information sources into different phases, such as videos, photos, interviews, and research. Each component and architectural object has its construction phase. The study adopted a visualisation strategy in Revit using shared parameters and filters, including the following steps.①Assigning a shared parameter for each component, including the 'construction phase' and its description. ②Setting visibility rules for component display in the visibility filters.③Providing detailed descriptions for each component's construction process through an independent 'component construction description' (Figure 13).

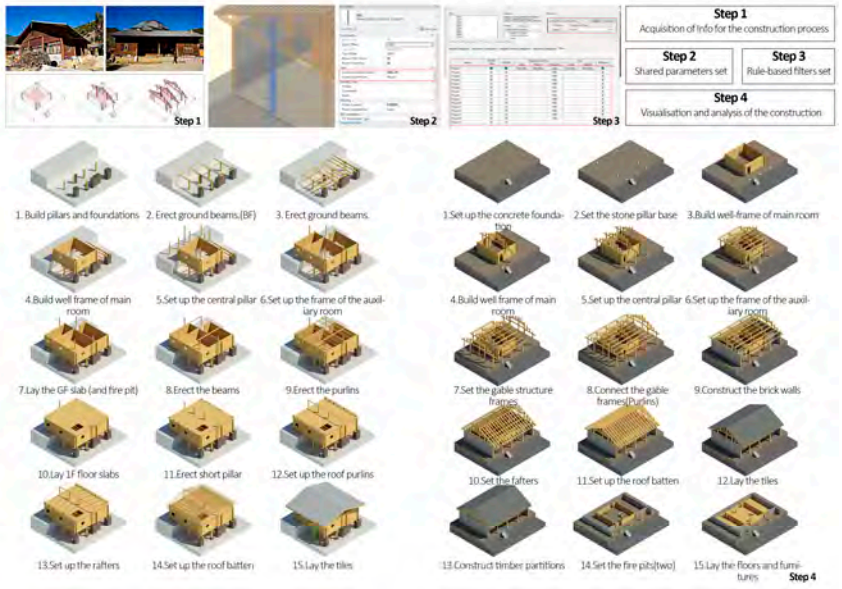

Figure 13. Visualisation and comparison of the construction process of different ethnic minorities (the left is the Nu nationality architectural sample, and the right is the Mosuo nationality architectural sample).

4.2. HBIM Modelling: Rituals and Bodily Behaviours

4.2.1. 3D Representation

In Section 3.4, this study describes a classification method for ritual behaviours. It categorises body movements into Transitive movements and Intransitive movements based on the interaction between the body and external space. Subsequently, it extracts four subsets: pathway, stillness, placement, and prohibition. Each subset includes specific Di-Qiang behaviours. Drawing on semiotic theory, these key features are associated with universally recognised geometric symbols. For example, architectural drawings use arrow lines to indicate directional paths. This approach leads to the development of six standardised symbols (Figure 14): arrow lines for general paths, rotating arrow lines for circumambulation, square symbols for body direction, cylindrical symbols for non-directional body positions, spherical symbols for object placement, and cross symbols for prohibited actions.

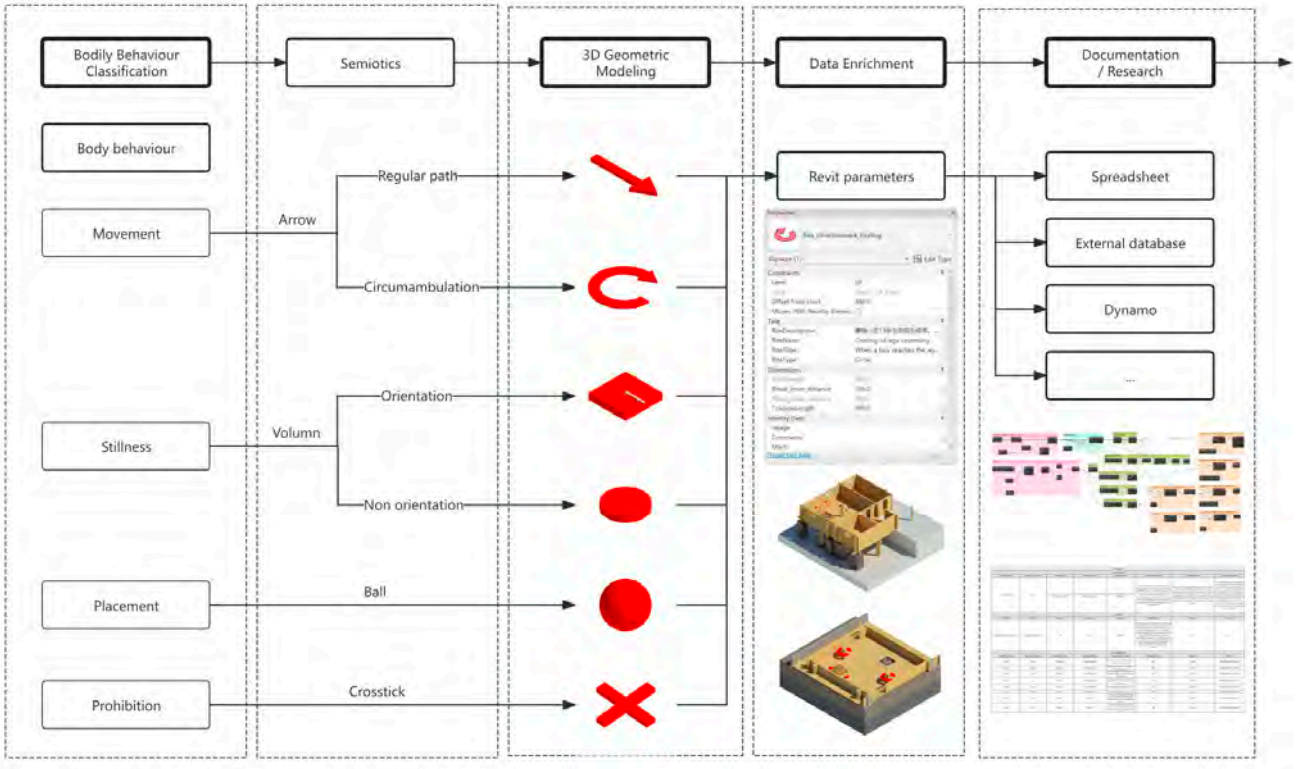

Figure 14. 3D symbolic representation of body movements.

In 3D representation, Barontini A, Alarcon C, and Sousa H S, et al. [7] have utilised the term 'patch' as a symbolic entity to denote damage and decay in architectural heritage, thereby distinguishing these elements from the objects to which they are inherently connected. This methodology has been extensively applied in the preventive conservation and routine monitoring information storage of HBIM [32]. Drawing inspiration from this approach, the proposed solution employs independent entity models, augmented with colour and semiotic elements, to precisely convey the essential characteristics of various rituals and bodily movements.

In Revit, generic family models are employed, and all symbols representing behaviours are categorised as signage, a practice uncommon in HBIM projects. Except for spherical symbols, the thickness of all behavioural symbols is uniformly set at 50 mm to distinguish them from other furniture volumes in the model. All symbol families are designed parametrically to ensure that their dimensions correspond to the dimensions of the behavioural actions. For example, the horizontal width of progression arrows is set at 350 mm, aligning with the average shoulder width of a human body. In contrast, the outer circle width for cir-

cumambulation is adjusted according to ritual descriptions or behavioural actions depicted in videos. Given that the intuitive shapes of these symbols can only convey the essential characteristics of human behaviour and not the intricacies of bodily movements and object handling, detailed information is embedded into the family parameters of the symbol components. Although the symbols are model objects, they can be easily distinguished from architectural components by applying filter views. Additionally, modelling damaged objects can convert them into IFC format, enhancing the system's interoperability.

Throughout the lifecycle of architectural layout (spatial orientation), construction (construction activities), and usage (bodily behaviours), rituals and bodily behaviours centred around the central pillar or fire pit exhibit macro-diachronic attributes. Consequently, this study differentiates the colours of symbol families into red, green, and blue to represent bodily behaviours during the architectural layout, construction process, and usage phase, respectively. When examining a specific ritual behaviour, it may encompass multiple action slices, indicating that some rituals around the central pillar or fire pit consist of several coherent physical actions, representing a micro-diachronic dimension. In this study, the diachronic attributes within the symbol family are configured to express the sequential order of multiple symbols.

Taking the adult ceremony in the Mosuo ethnic group's sample architecture as an example, the behaviours related to the central pillar and the fire pit can be divided into three stages (Figure 15). In the first stage, elders place a sack of pig fat next to the male pillar and a grain sack next to the female pillar (stage one: placing behaviour). In the second stage, the boy stands by the male pillar's sack, and his uncle dresses him in trousers. In contrast, the girl stands by the female pillar's sack, and her mother dresses her in a skirt (approaching behaviour: multiple participants, dressing action, and clear orientation). In the third stage, the boy and girl stand by the fire pit, near the male and female pillars, respectively, and bow to the family elders seated around the fire pit (approaching behaviour, fire pit, multiple participants, and clear orientation). The temporal attributes of the coming-of-age ceremony are implemented through preset "ritual phase" shared parameters and filters, similar to the construction sequence operations described in Section 4.1.2. This allows the ritual process to be divided into multiple distinct phases, each of which can be represented in 3D as different spatial positions and orientations of bodies and objects.

Since this method of expressing bodily actions cannot depict details such as body actions, clothing, facial expressions, and upper limb movements, this study links all heterogeneous information (e.g., photos, videos, textual descriptions) to the relevant symbol patches in the form of URLs and linked images (see Figure 15).

Additionally, specific independent physical actions observed in samples from various ethnic minorities are prevalent across multiple ceremonies. For instance, the circumambulation of the central pillar in Tibetan culture is commonly seen in weddings, sacrifices, and other rituals. Consequently, this study repeatedly models the 3D representation of each circumambulation around the pillar. Despite the geometric shapes being consistent, the attributes and parameters of each circumambulation behaviour differ, allowing each to be retrieved through its unique element ID (Figure 16).

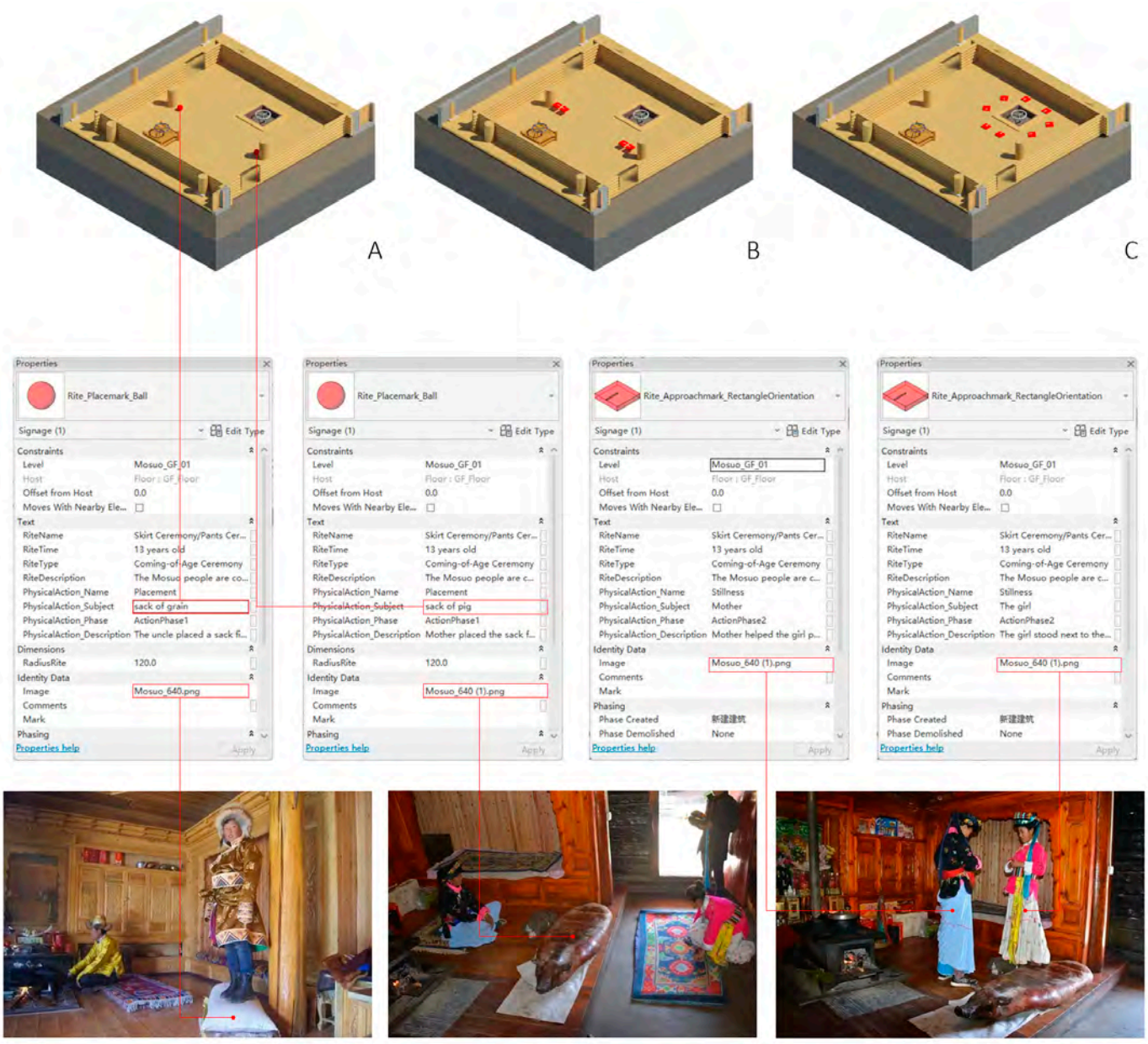

Figure 15. Modelling behaviours related to central pillars and fire pits in the 'coming-of-age ceremony' of Mosuo ethnic sample architecture. (**A**) Phase 1; (**B**) Phase 2; and (**C**) Phase 3.

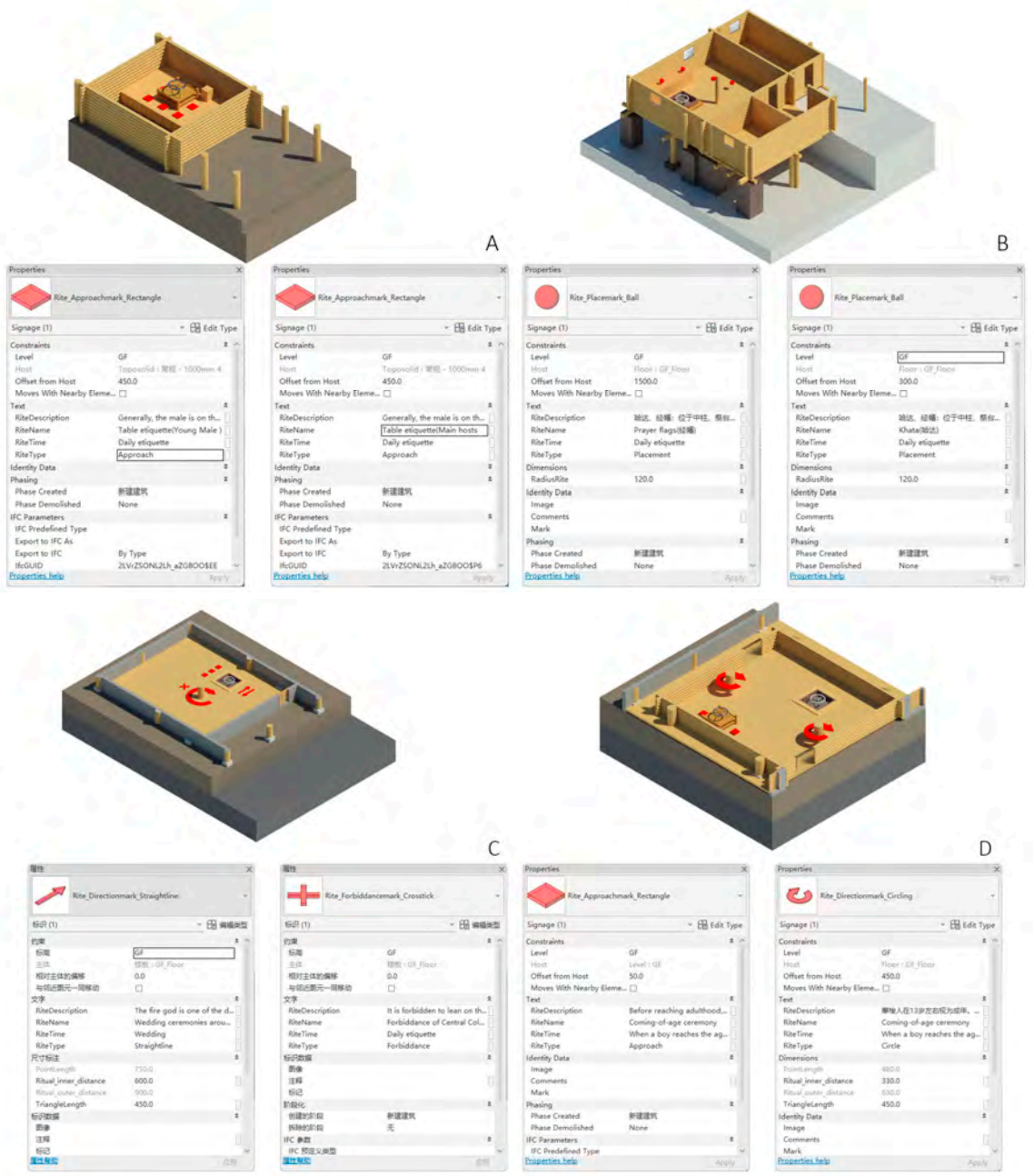

Figure 16. The expression of rituals around the central pillar–fire pit in different Di-Qiang ethnic groups. (**A**) Pumi seating etiquette; (**B**) Nu's placement for harvest; (**C**) Tibetan wedding—stillness; and (**D**) Mosuo's coming-of-age ceremony.

4.2.1. Semantic Management and Share

The semantic richness of body movement parameters is effectively manageable. Each dataset related to body movements is linked to corresponding shared parameters. The overall data are divided into two main parts:

- Semantic Information: This includes the type of body movement, the subject involved, a description of the action, and its relation to the central pillar or fire pit, along with comprehensive ritual information.
- Metadata: This section contains crucial indirect information, such as the recorder, recording time, and information source.

However, merely constructing the parameters of the body movement symbol model is insufficient for completing the research. These parameters only represent a record of

the ritual deconstruction. To illustrate the relationship between the deconstructed body movements, the complete ritual, and the architectural dimension, we have created a custom spreadsheet for the body movements and their associated rituals, termed 'RitualTemplate'.

This template comprises three tiers of content (Table 2):

- Architectural Information: This section contains significant architectural details, recorded and stored in project parameters within Revit projects for subsequent extraction and retrieval.
- Ritual Information: This section includes comprehensive ritual information, such as the ritual's name, type, involved personnel, description, and related metadata, implemented by importing external spreadsheets.
- Information on Deconstructed Body Movements: Information related to body movements associated with the central pillar and fire pit is directly stored in the shared parameters of the 3D symbol model.

Table 2. Data template for a Mosuo historic building and the coming-of-age ceremony in it.

Ritual Template							
1_Architecture Info							
Architecture Name	**Nationality_ EthinicGroup**	**Architecture Type**	**Architecture Location**	**Architecture Belief**	**Architecture Description**	**Architecture Firepit**	**Architecture Central Pillar**
Nisai_Mosuo_01	Mosuo	Well-frame building dominated by frame structure	Nisai Village, Yongning, Ninglang Yi Autonomous County	a. Primitive Religion (Daba).; b. Tibetan Buddhism.	In the courtyard-style dwellings of the Mosuo. . .	Upper Fire Pit: A square, pit-style. . .	The Mosuo people are considered adults.
2_Ritual Info							
RiteName	**RiteType**	**RiteTime**	**MEA**	**RiteLocation**	**RiteDescription**	**RiteNote**	**RiteUrl**
Skirt Ceremony/Pants Ceremony	Coming-of-Age Ceremony	Null	Li	Interior	Females participate in the Skirt Ceremony, and males in the Pants. . .	N/A	N/A
3_Physical Action Info							
PhysicalAction_ Phase	**PhysicalAction_ Subject**	**PhysicalAction_ Name**	**PhysicalAction_ Object**	**PhysicalAction_ Description**	**PhysicalAction_ Note**	**ElementID**	**IFCGUID**
Phase1	Uncle	Placement	CentralPillar_ Male	The uncle placed a sack filled with pig fat next to the male central pillar.	N/A	515240	0NXQCeT0fEg95e1uASQV12
Phase1	Mother	Placement	CentralPillar_ Female	Mother placed the sack full of grain next to the female central pillar.	N/A	515335	0NXQCeT0fEg95e1uASQV7j
Phase2	Boy	Stillness	CentralPillar_ Male	The boy stood next to the sack by the male pillar, his uncle helped him put on his trousers.	N/A	516161	0NXQCeT0fEg95e1uASQSoh
. . .. . .							

This research project introduces two strategies to facilitate the transfer and linkage of parameters between external spreadsheets and BIM components (Figure 17). Firstly, we developed a Dynamo algorithm based on a structured tabular format. This algorithm enables bidirectional data exchange between electronic spreadsheets and BIM model parameters and data extraction from specific fields within the model. This approach allows for highly customised alignment between tables and Revit projects, though it requires the spreadsheet structure to be correct. Additionally, 'The Inspection Form', a web-based custom spreadsheet system, has shown significant potential by mitigating common errors in Excel or WPS, such as Dynamo's inability to recognise attributes after cell merging.

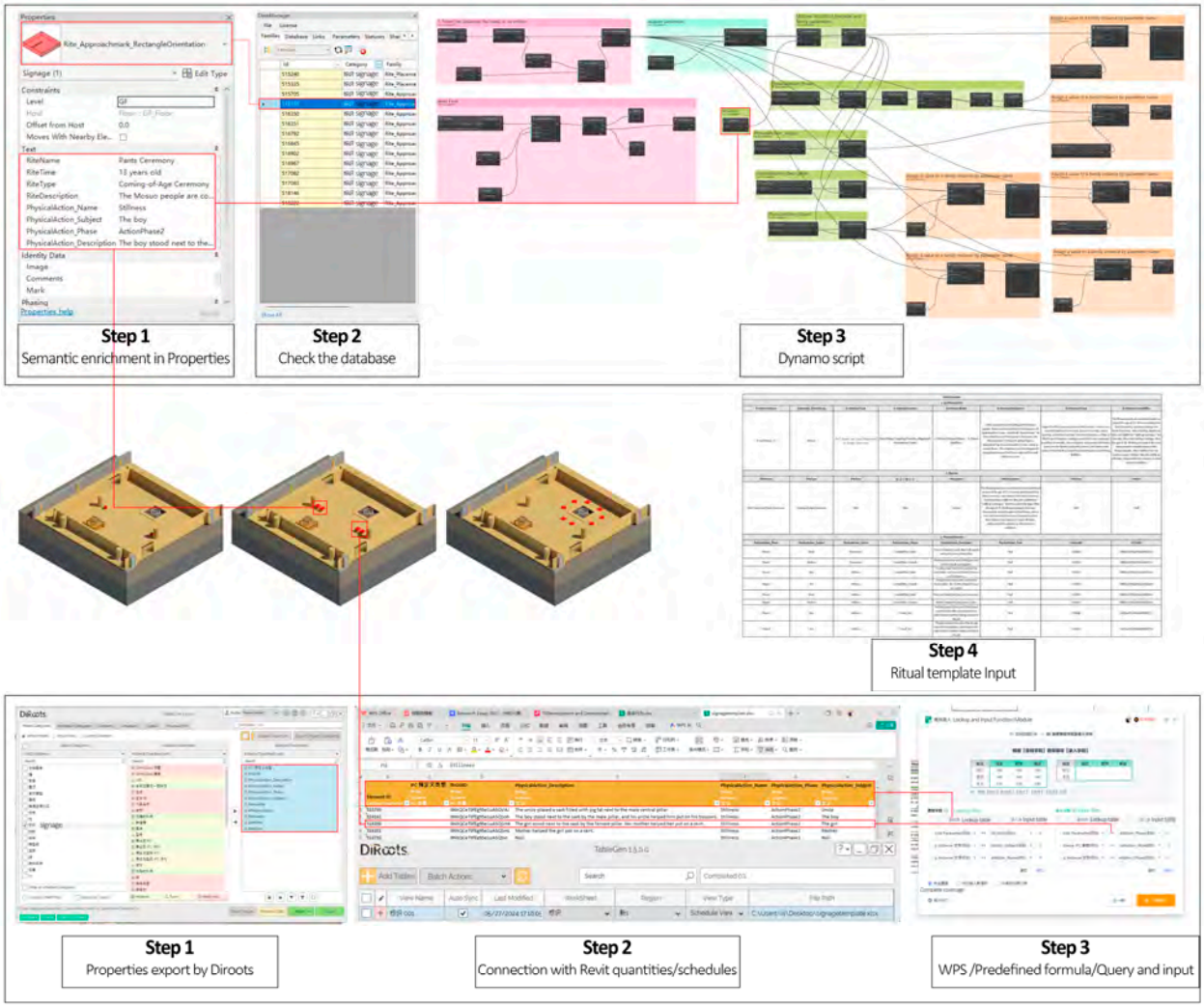

Figure 17. In this study, two methods are used to establish a link between Revit object parameters and data template spreadsheets. The upper approach utilises the Dynamo tool for dynamic parameter transfer, while the lower approach involves using a Revit plugin and integrating it with predefined formulas in WPS Office for parameter auto-population.

Furthermore, the advent of advanced spreadsheet software with VBS or AI capabilities has enabled an alternative method for data transfer. This method does not rely on Dynamo but uses table-linking plugins in Revit and inter-table linking functions in spreadsheet software. The primary process includes (1) using the Linksheet plugin from the DiRootsOne software package (v2.1.1) to export a BIM spreadsheet containing all ritual and physical action symbol families, referred to as the 'master table', which includes all action families within the model, along with Element IDs and IFCGUIDs; and (2) subsequently, in Excel or similar software, using plugins or AI tools to separate different rituals into individual tables, known as 'sub-tables'. These sub-tables are linked to the master table through specific parameter fields or ID information. Ultimately, externally modified tables can be automatically bound to the BIM project through Linksheet, achieving data transfer and real-time updates. This solution is less complex to implement and has a broader application range.

4.2.2. Spatial Analysis of Different Characters in Rituals

The 3D representation of bodily behaviours provides quantifiable geometric attributes for spatial analysis within the HBIM environment. This study examines these attributes

from the perspective of "roles" in rituals, documenting and analysing the spatial experience under various behavioural patterns to identify vital architectural elements related to bodily behaviours. This approach offers a subjective experience-based value assessment for preserving the authenticity of architectural heritage.

Vision, a primary sense for perceiving architectural space, is crucial in architectural design and urban planning. Thus, this study uses physical models to capture the visual information of roles within rituals, exploring the relationship between bodily behaviours and architectural heritage spaces. For instance, the 2D Isovist analysis, targeted at specific physical movements, is a mathematical method used in architecture and urban planning to describe the visible spatial range and form from a particular viewpoint. This study conducts the 2D Isovist analysis using Dynamo scripts, enabling real-time analysis and recording within the HBIM environment without format translation (Figure 18).

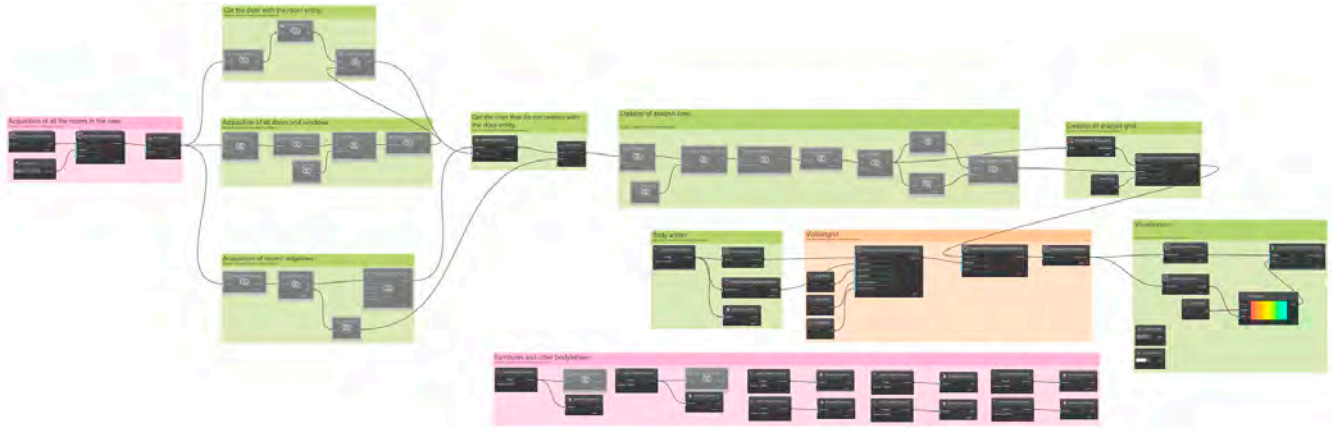

Figure 18. Dynamo script of visual analysis.

The analysis process involves three steps: first, the bodily movement entity serves as the starting point for visibility analysis, establishing a visibility cone based on its orientation; second, the room is divided into an analysis grid, with architectural elements acting as obstacles or perspectival objects with different line-of-sight penetration weights; and finally, the visibility intensity results are visualised by calculating the interaction between the visibility cone and the analysis grid.

For instance, in the adult initiation rituals of the Mosuo sample architecture, the dressing and thanksgiving phases occur around the central pillar and the fire pit space, respectively (Figure 19). Based on this, the study initially assigned obstacle weights to each architectural element in the main chamber. Here, 1.5 m tall cabinets, shrines, and the central pillar were considered non-penetrable obstacles to the line of sight, while the fire pit, doors, and windows were regarded as penetrable by sight. Subsequently, the study set the range and intensity of the visual cone for each participating "bodily action" (role), generated visibility analysis results for each action, and produced corresponding images. To avoid overly complex visual results, the study intentionally disregarded the line-of-sight occlusion relationships between different "roles". Ultimately, the study overlaid the visibility results of various "roles" from the same ritual phase to obtain a composite visibility overlay for that phase.

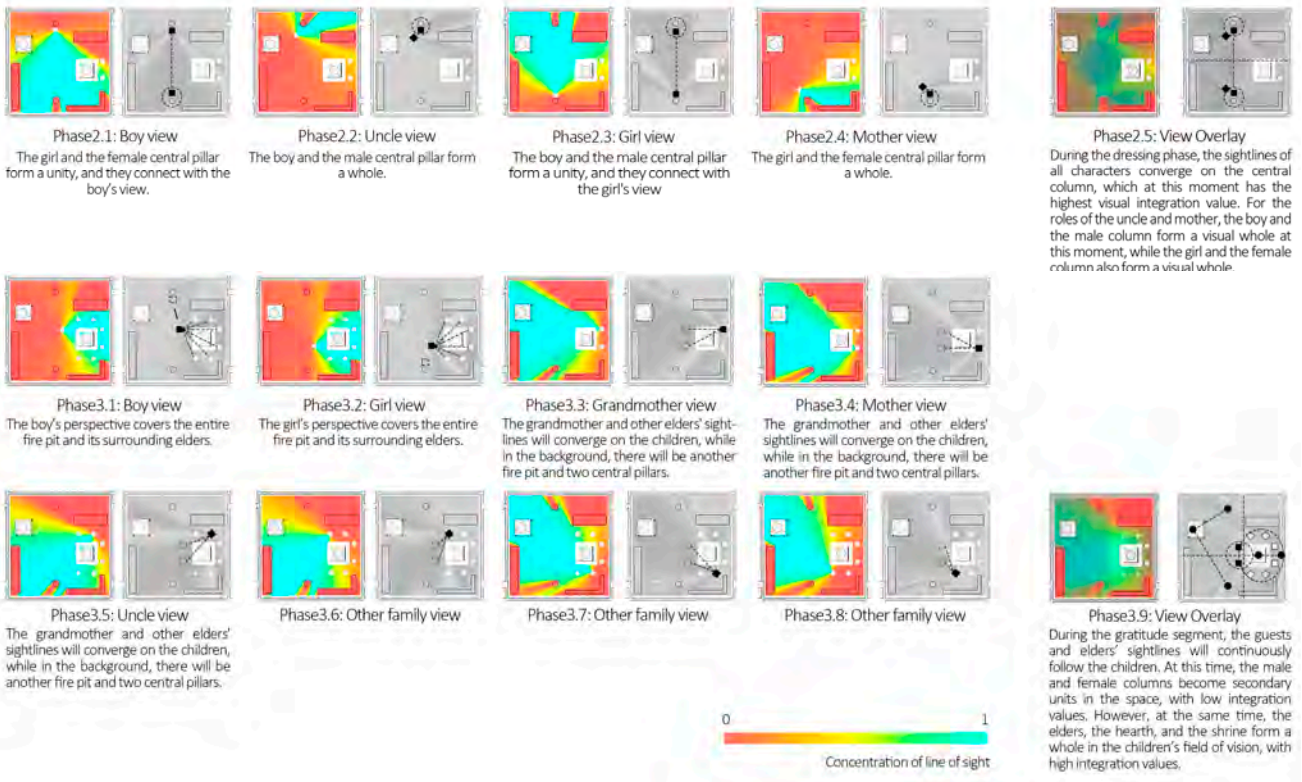

Figure 19. View analysis of different actors in the same ritual. (Mosuo coming-of-age ceremony).

During the attire phase of the coming-of-age ceremony (Phase 2), boys and girls lean against the "male pillar" and "female pillar", respectively, symbolising gender differences. Uncles (Phase 2.2) and mothers (Phase 2.4) assist them in donning new clothes, focusing their gaze on the boys or girls, while the "male pillar" and "female pillar" act as visual barriers (red area). The boys (Phase 2.1) and girls (Phase 2.3) primarily fix their gaze on each other, standing still as required by the ceremony. Currently, the central pillar is not within their line of sight, and the fire pits on either side are also in the non-focused visual area (red area).

An analysis of the visual overlay (Phase 2.5) reveals that during Phase 2, the central pillar is the most critical architectural element (blue area), while the fire pits on either side are in the non-focused visual area (red area). From the perspective of uncles, mothers, and other guests, combined with humanities research, the central pillar symbolises the spiritual carriers of masculinity and femininity. The boys standing next to the male pillar and the girls standing next to the female pillar become the focal points of the ceremony, merging with their respective pillars and symbolising their union with the male and female pillars.

In the gratitude segment of the coming-of-age ceremony (Phase 3), all participants, including children and elders, gather around the fire pit. During the ceremony, the children face the fire pit and the shrine, and the elders are seated around the fire pit to express their gratitude and blessings. The elders accept the children's respect and return blessings in order of seniority. Currently, the boys (Phase 3.1) and girls (Phase 3.2) stand side-by-side below the fire pit, focusing their vision on the fire pit, the surrounding elders, and the shrine behind it.

From the perspective of the elders and guests (Phases 3.3–3.8), the children, the upper and lower fire pits, and the central pillar are all within their field of vision, with the lower fire pit being the closest. In Phase 3, the lower fire pit (Phase 3.9) becomes the core of the entire event. From the perspective of the boys and girls, the elders, the fire pit, and the shrine form the visual centre. Combined with humanities research, the fire pit and shrine represent ancestors and deities. Therefore, from a visual studies perspective, the boys' and

girls' gratitude is directed not only towards the elders but also as a tribute to the ancestors and deities.

Additionally, this model demonstrates the potential for application in other spatial analysis domains, such as path analysis, three-dimensional Isovist analysis, and the correlation analysis between fire pit thermal radiation, architectural components, and human activities. However, these analyses require a more precise description of the geometric characteristics of each element within the architectural heritage space, necessitating further in-depth exploration in future research.

This study also attempted the IFC format output of the HBIM project and conducted tests in various visual analysis software (Space Syntax: v.depthMapX was used in this project). Despite some errors in object recognition requiring manual correction and calibration, this method provides a robust model foundation for future spatial analyses.

5. Discussion

This study investigates the relationship between rituals and bodily behaviours with architectural heritage from a spatial behaviourism perspective, aiming to provide a value judgment for the authenticity of architectural heritage based on the "role" dimension, primarily focusing on bodily behaviours in rituals. To achieve this, the study employs an interdisciplinary methodology to develop the HBIM framework, which considers human movements in rituals as entities within a digital environment, integrating tangible and intangible heritage information. The case study of the central pillar and fire pit spaces in the residential architecture of the Di-Qiang ethnic group in the Tibetan-Yi Corridor illustrates this method's significant advantages and potential in recording intangible cultural behaviours and conducting spatial analysis.

In documenting and preserving the material objects of the Di-Qiang ethnic group's architectural heritage, HBIM demonstrates significant advantages in efficiency and sustainability. This study adheres to advanced HBIM manuals and standards, standardising the entire HBIM workflow into distinct stages and operational norms to ensure normative and collaborative documentation, thereby maintaining consistency in modelling methods for each architectural sample. During the information acquisition and 3D modelling stages, the modelling objectives were clarified, and the precision requirements for geometric information acquisition were deliberately reduced to lower the difficulty of information acquisition. Consequently, the modelling precision for the Di-Qiang ethnic group's residential architecture was reduced, and physical operations were simplified, enhancing modelling efficiency. The introduction of Model Level and Metadata provided safeguards for operations and related information recording during these stages, ensuring proper model usage and offering a reference for future detailed modelling. The parametric modelling of architectural components ensures model sustainability, particularly in the modular design components of traditional Chinese architecture, such as the roof truss system. Additionally, the particular component families of the Di-Qiang ethnic group, such as fire pits, can gradually accumulate into a comprehensive family library, providing a data foundation for the digital heritage of the Tibetan-Yi Corridor.

Conversely, the method of deconstructing Di-Qiang ethnic rituals into a series of bodily movements and establishing them as entity objects within the HBIM environment demonstrates significant potential. Firstly, a repository for intangible heritage information is created by embodying the physical movements of different roles into entity families within HBIM. By leveraging HBIM's capability to manage heterogeneous information, a standardised management method for ritual and bodily movement information can be established. Creating ritual information tables through plugins and external databases manages ritual information within architectural heritage systematically, providing a benchmark for comparing rituals among different Di-Qiang ethnic groups.

Secondly, the 3D representation of bodily movements provides a tangible object of analysis. Considering the 3D expression of bodily movements as an architectural element within the architectural heritage, its orientation, behaviour, and other attributes can be

connected with space, thus exploring the value of rituals and bodily movements to protect architectural heritage. Additionally, based on this entity representation, sightline and path analyses of different bodily movements can be conducted through Dynamo, uncovering the ritual values embedded within bodily movements and offering a new dimension for conserving architectural heritage authenticity.

Furthermore, leveraging the interoperability advantages of HBIM, the established 3D models and databases of Di-Qiang ethnic architecture can be recognised by various software and platforms, facilitating research across different fields, such as Isovist analysis and heat source analysis. This interoperability provides a robust digital foundation for protecting, musealisation, and digitising architectural heritage in the Tibetan-Yi Corridor.

6. Limitation and Future Work

In the current research, several pressing issues remain unresolved. Firstly, the three-dimensional geometric modelling methods for rituals and bodily movements may lack universal applicability. While symbols can represent fundamental characteristics, they often fail to capture complex body language and are difficult to apply to other research topics. Secondly, the study relies on linking heterogeneous information, such as video materials and decomposed diagrams, across various forms of expression. The movements extracted from Di-Qiang ethnic rituals do not comprehensively cover all rituals and bodily movements in the Tibetan-Yi Corridor, making it challenging to use this method universally for other historical architectures. Additionally, there is a lack of standardisation in enriching semantic information. During information acquisition, data on architectural rituals and bodily movements come from residents' oral accounts or other researchers' materials. The scientific allocation of this information to the attributes within the three-dimensional symbol family depends on manual input, and the linguistic rules within the attributes lack clear standards, relying on the operator's personal experience, which may lead to errors. Due to the small sample size of architectural instances and the complexity of information sources, the information level within each sample architecture is inconsistent with the geometric information level, making it challenging to draw exhaustive conclusions. Moreover, many issues require further exploration, such as the absence of geospatial attributes and the lack of interoperability.

Future research should focus on the following aspects: first, establishing the semantic structural relationships between rituals, bodily behaviours, and architectural spaces using CIDOC-CRM and creating a public corpus suitable for different Di-Qiang ethnic groups using ontology languages; secondly, continuing the study of the definitions of rituals and bodily movements and the standardisation of their symbolic expressions, seeking more appropriate alternative methods; and lastly, actively introducing GIS technology to study and establish a geographic information database for the Di-Qiang ethnic groups on a broader geospatial scale, setting more explicit standards and methods for the authenticity dimension of rituals and bodily behaviours in architectural conservation. Additionally, actively exploring other 3D representation methods or information platforms, especially web-based technologies, is crucial. On one hand, they can overcome the limitations of software platforms; on the other hand, they can customise more precise functional modules to accommodate more detailed ritual studies. Such research would not only enhance the understanding of the cultural heritage of the Di-Qiang ethnic groups but also provide a more scientific and systematic method for related fields.

7. Conclusions

In architectural heritage, bodily actions may not only be the driving force behind the formation of architectural entities but also serve as intangible historical testimonies within architectural heritage. This has become a consensus among interdisciplinary scholars. However, how to record, study, and digitally restore these intangible pieces of information to break down research barriers between different disciplines remains a topic worthy of ongoing attention and contemplation. This study adopts HBIM as a research perspec-

tive, aiming to explore a multidisciplinary approach to record and manage the intangible information within architectural heritage. This attempt provides a new line of thought for recording and researching intangible cultural heritage information for other cultural heritage studies. Moreover, research methods based on digital technology are expected to offer a more convenient platform for the future integration and connection of digital heritage and digital humanities.

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