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# Locally Based Architectural Construction Strategies in Rural China: Textual Analysis of Architects' Design Thinking

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**Abstract:** The distinctive constraints and opportunities present in rural China underscore the importance of exploring sustainable architectural construction models in such areas. Architects engaged in rural projects have contributed design thinking that incorporates construction operations in response to local elements, resulting in significant benefits for the sustainability of rural construction. This study investigates these design approaches as locally based architectural construction strategies and seeks to identify their latent wisdom as a reference for future practices through the textual analysis of 63 articles showcasing outstanding architectural design in rural China. By organizing related design thinking with respect to three key elements, extracting these elements, and analyzing their correlations from the textual descriptions, 14 types of locally based architectural construction strategies are identified. Via analysis and discussions of these types, this research identifies the paramount concerns in Chinese rural architectural practices as revolving around fundamental issues of technology, livability, and aesthetics. These fundamental issues emphasize different kinds of sustainability—the pursuit of sustainability in local-based rural construction activity through diverse technological explorations, environmental sustainability through special building envelope designs, and cultural sustainability through the establishment of new local rural aesthetics with material and other visible expressions.

**Keywords:** rural China; locally based; architectural construction strategies; textual analysis; architects; design thinking



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## 1. Introduction

Rural architectural projects in China face a range of constraints, such as limited building materials, poor construction quality, and non-standardized construction processes. Such projects require more adaptive construction strategies than urban projects. However, they also have access to abundant natural resources and distinctive traditional crafts and techniques that can offer them unique opportunities for innovation. Such projects must consider rural lifestyles and economic conditions, which differ significantly from urban ones, when addressing climate and geological challenges. How can architecture respond effectively to these constraints and opportunities through appropriate construction strategies? Due to the lower level of experience and increasing attention on rural development in China [1], this has become an important topic for seeking a sustainable development model that suits rural contexts.

To address this topic, architects participating in rural projects tend to achieve their various goals by interpreting local elements in their context and exploring the most appropriate methods of construction for each project. These strategies depend on various local factors, such as local constraints, opportunities, or features, and they result in benefits that are crucial for rural construction. Due to their rootedness in local attributes, the final built architecture often exhibits distinctive local features, and the positive response of architects to the environment also meets sustainability requirements.

In this study, locally based architectural construction strategies are defined as approaches that influence the formation of building material entities, such as structural designs, construction methods, the construction processes, and materials selection, that are closely related to local elements and have significant benefits for rural construction. This study explores how these constructions respond to local context and conditions, as well as what they bring to locals, with a focus on the architects' perspectives in certain exemplary rural construction projects in China. By providing a structured and standardized analysis of the textual descriptions of the projects, this study reveals the general trends and the underlying principles of locally based architectural construction strategies. It is hoped that this will provide a reference for future rural practices, and thereby contribute to sustainability in rural construction.

## 2. Literature Review

In the fifth plenum of the 16th CPC central committee held in 2005, the concept of "let industry back feed agriculture and city support village" was introduced, along with specific requirements of "neat village appearance" for the construction of new social villages. This marked the first time that rural construction was elevated to a high priority in the national development agenda in China. These policies were subsequently reflected in China's *11th Five-Year Plan (2006–2010) for National Economic and Social Development*, with a requirement to "guide peasants to build houses rationally and protect the characteristic rural building style and features" [2].

Since 2005, the government's attention to rural construction has remained consistent, as evident in the formulation of a series of national standards and guidelines related to rural construction. The *Urban and Rural Planning Law of the People's Republic of China* (2008) [3], and *Technique Code for Village Rehabilitation (GB50445-2008)* (2008) [4] have become the macro-level guidance and basis for conducting planning and design in rural construction. The *Code for Design of Cultural Center Buildings in Towns and Villages (JGJ 156-2008)* (2008) [5] establishes standards to enhance the quality of the cultural center buildings in towns and villages, catering to the requirements of cultural activities. The *Evaluation and Accreditation Criteria System for Traditional Villages (Trial Implementation)* (2012) [6] serves as a basis for the evaluation and accreditation of traditional villages, highlighting the importance placed on the cultural heritage value of traditional rural areas. The *Design Standard for Energy Efficiency of Rural Residential Buildings (GB/T 50824-2013)* (2013) [7] provides standards to improve indoor thermal environments and enhance energy efficiency in rural residential buildings, indicating the emphasis placed on energy conservation in rural construction. The *Guidelines for the Construction of Beautiful Villages (GB/T 32000-2015)* (2015) [8] provide guidelines for constructing sustainable beautiful villages, which is a goal proposed in China's "No. 1 Central Document" of 2013 [9]. Additionally, in the 19th National Congress of the CPC in 2017, "rural vitalization" is proposed [10], and the subsequent *Rural Vitalization Strategic Plan (2018–2022)* (released in September 2018) proposed requirements for enhancing the design quality of rural houses, highlighting local and regional cultural characteristics, protecting the traditional cultural heritage and promoting green and energy-efficient buildings in rural areas, as well as guiding and supporting individuals such as architects to serve the rural revitalization efforts through volunteerism [11]. Therefore, the year 2005 can be seen as the starting point of a new period of rural construction in China [12]. This trend has also facilitated the involvement of architects in rural projects, whereas their previous practices were primarily focused on urban areas [13]. Given the limited applicability of urban experiences to rural areas and the increasing significance of rural regions as a focal point for architectural design activities, it becomes crucial to furnish architects with sustainable references for rural construction.

Due to the emphasis on rural development and climate change mitigation in China in recent years, there has been extensive research that focuses on specific technologies aimed at achieving environmental sustainability in rural building constructions. Chang et al. discussed the feasibility of designing a nearly zero-energy building (nZEB) for rural houses in Xi'an, China. They proposed and examined passive design strategies (e.g., adding wall and roof insulation, using double glazing windows, adding a sunroom) and renewable energy systems (a photovoltaic system and a storage battery) that can be used to instruct the residents to build the nZEB in rural areas with similar conditions to Xi'an [14]. Yin et al. examined the energy sustainability of bio-based wall construction through applications in rural residential buildings in northeast China. They highlighted the effectiveness of bio-based wall construction in reducing heating energy requirements and can solve the problem caused by straw burning in northeast China [15]. These studies are typically based on a specific region to investigate the applicability of a particular technology, highlighting the significance of geographical factors in technology adaptation.

Additionally, research regarding how to adopt these technologies is also abundant. Not only research focused on China but also studies addressing similar application issues on a global scale have valuable insights and can serve as references. Gan et al. examined the potential barriers impeding the adoption of green building technologies in China's rural self-built housing and proposed several suggestions to overcome the core barriers. The study pointed out that there is no universal model for all rural regions and continuous exploration based on the specific situation of rural areas is needed [16]. Lucchi examines the challenges and opportunities of integrating photovoltaic systems in architecturally sensitive areas, such as historical towns and protected landscapes. The study explores the design criteria and policy implications for the successful integration of solar technologies, while respecting heritage values and addressing energy needs. One of the rules points out that regional-level policies are appropriate if there are significant differences in heritage features [17]. As a vast country, rural areas in China exhibit different characteristics due to different geographical locations and climates. The cultural customs, traditions, and distinctive features of traditional architectural heritage vary across different regions. This emphasizes the importance of local context in rural construction practices in China.

Furthermore, besides these studies that focus on specific technologies and their applications, studies that relate to public engagement are also abundant. Wang discussed the co-construction in rural China, and pointed out that architects should interact with villagers and other organizations engaged in construction, playing a role in coordinating and guiding the involved parties. He believes that collaborative construction in the new rural construction will give rise to a new building culture [18]. Regarding research on public engagement in rural areas beyond China, Balest et al. explore public engagement in repurposing abandoned historical buildings for sustainable development in rural areas, emphasizing the integration of cultural and social elements for long-lasting outcomes. It highlights the importance of community involvement, heritage management, and resource utilization in energy retrofit planning to preserve the buildings' identity [19]. These studies highlight the importance of public engagement in rural construction, and the specific condition in rural China enables architects to play an important role.

However, although there are abundant studies that offer valuable references for rural practices, their focus is primarily on specific strategies or policymaking rather than providing a comprehensive reference for architects. Since the government's emphasis on rural construction after 2005 promotes the engagement of architects in rural construction, their practices provide a valuable database for future practices in rural China. Revealing the latent knowledge in previous cases can provide architects with more direct and practical references.

As studies focusing on architects' rural practices in China, Wan et al. introduced an innovative rammed earth construction approach that is suitable for southwest rural China, based on one project that used the technology and followed the principle of "local material, local technology, local labor" in Kunming [20]. Wang et al. summarized low-cost rural construction strategies using five cases, indicating that the key to achieving farmer participation and cost controls lies in using conventional tools and techniques appropriate for locals [21]. Zhang et al. discussed typical cases of rural construction from the perspectives of business models and construction methods, indicating that architects in rural construction should adjust their strategies according to the prevailing local conditions [22]. While sharing an emphasis on the importance of local adaptation for construction strategies in architects' rural practice, this study focuses more on the latent relationship between the various construction approaches and their responses to local factors. In addition, different from studies that focus on specific architects or design teams, such as Wan et al. [20], and Wang et al. [21], this study aims to reveal latent knowledge based on examining rural cases that encompass a broader range of architects or design teams. Moreover, recent plural sets of case studies on rural China, such as the study by Zhang et al. [22], relying primarily on the direct exposition of precedent cases, lack a reproducible approach to revealing architects' strategies across a large number of cases. Therefore, this study establishes a systematic textual analysis method that can objectively unveil latent laws in cases focusing on locally based architectural construction strategies, ultimately facilitating a more comprehensive examination.

## 3. Materials and Methods

With a focus on architects' design thinking, this study is based on the theory that the use of language is a significant element in architects' design processes [23], and writing is an important way for them to express their thoughts on architecture [24]. Among the established precedents in this field, Okuyama et al. explored the use of textual analysis in studying architects' design theory by conducting serious research that takes architects' articles published in a Japanese journal, *Shinkenchiku*, as study objects [24,25]. Kitagawa et al. introduced correspondence analysis into the textual analysis, which improved the objectivity and representativeness of the research [26], and we have extended the research method to Chinese case studies [27]. Based on these earlier studies in textual analysis, this study developed the textual analysis method for locally based architectural construction strategies in rural China.

### *3.1. Study Objects*

To uncover the construction strategies through which architects interpret and demonstrate respect for the local context in rural areas, this study examines architects' commentaries on their buildings, as they express their intentions for employing specific construction methods. The *Architectural Journal* (*Jiànzhùxuébào*) was selected as the primary source for this study for the following reasons:

(1) The *Architectural Journal* (*Jiànzhùxuébào*) is the earliest and most authoritative architectural journal in the People's Republic of China. It has continuously published significant architectural designs and their commentaries to date. It is the only domestic journal among the T1-level journals of the High-Quality Scientific Journal Ranking List in the Field of Architectural Science (2020) (selection is led by the Architectural Society of China) that focused on architectural design and theory and publishes architects' commentaries [28].

(2) It has minimal bias in its literature with respect to regions, periods, or building types due to its aim to capture the comprehensive development of Chinese architecture, and the large number of papers and important works of design that it has published have established it as the most comprehensive reference for the study of Chinese architecture [29].

(3) Sufficient data are available, given that it has focused on rural construction since its foundation [30].

Furthermore, as stated in Section 2, the year 2005 marked the onset of a new phase in rural construction in China. Given that architects had previously focused primarily on urban areas and few commentary articles on rural projects could be found, this study specifically examines the period after 2005, when architects began to increasingly engage in rural construction projects and commentary articles on rural projects emerge. By reviewing articles on rural construction published in the *Architectural Journal* (*Jiànzhùxuébào*) between

2005 and 2021, a total of 63 articles [31–93] from which enough information could be extracted were selected as study objects.

### 3.2. Methods

The research unfolds in the following phases.

Step 1. Definition and extraction of {Construction Operation}, <Local Element>, and 'Effect'.

The key contexts are defined in the commentaries as sentences that describe a particular construction operation that addresses local conditions and brought specific benefits. They are broken down into the following three key elements (Table 1): {Construction Operation}, <Local Element>, and 'Effect' to structuralize architects' design thinking on using a particular construction operation to respond to certain local elements and consequently bring specific benefits. {Construction Operation} describes the approaches that directly refer to the materialization of the design, such as the construction process, structural system approaches, materials selection, and construction methods of walls or other components. <Local Element> pertains to the local conditions that {Construction Operation} respond to, such as local resources, local climate, and local cultural traditions. 'Effect' concerns the benefits that could be obtained from the {Construction Operation}.

**Table 1.** Extraction and classification examples.

| | | | |
|---|---|---|---|
| **Key Context** | "In the junction between the roof and the rammed earth wall, we also utilized a considerable amount of corn cob residues, which are commonly used as fuel and animal feed. We collected a large quantity locally to serve as insulation filling material in the wall head, aiming to minimize thermal bridges" [64] (p. 25) | | |
| **Extracted Element** | {Construction Operation} | <Local Element> | 'Effect' |
| **Extracted Words** | "corn cob residues … to serve as insulation filling material" | "corn cob residues" | "minimize thermal bridges" |
| **Classification** | {Insulation Material Selection} | <Agricultural Plant-based Resources> | 'Improving Thermal Performance' |

If there are multiple combinations of the three elements {Construction Operation}, <Local Element>, and 'Effect' in the description of one article, all of the combinations are individually extracted. If any item of the three elements is not identified in a key context, that context is considered invalid and excluded from the research. As a result, 731 combinations of the three elements {Construction Operation}, <Local Element>, and 'Effect' from 186 text fragments in 63 articles are found.

Step 2. Classification of {Construction Operation}, <Local Element>, and 'Effect'.

The three elements, {Construction Operation}, <Local Element>, and 'Effect', are respectively classified based on their descriptive meanings. To establish the appropriate criteria for the classifications without using arbitrary decisions, an affinity diagram (also known as the KJ method) [94] endorsed by multiple architectural experts including the authors is employed. An affinity diagram organizes a large number of concepts into their natural relationships. It was created in the 1960s by the Japanese scholar Jiro Kawakita. In this study, it was conducted as follows for each element:

(1) The extracted words for an element are grouped by their affinity in their descriptive meanings.
(2) After all extracted words are grouped, a discussion among the experts is conducted to define categories and create a summary for each group. In this step, the grouping of those controversial ones can be modified based on the discussion.
(3) When the extracted words are grouped to the experts' satisfaction, a name is assigned to each classification.

As a result, {Construction Operation} is classified into 16 categories (Table 2) according to the affected construction phase and the related architectural components. <Local Element> is grouped into 24 categories (Table 3), with attention paid to whether these referred to solid matter or concepts, culture or nature matter, and constraints or recourses. 'Effect' is grouped into 28 categories (Table 4) with attention to the life cycle it refers to, and whether it is a physical or emotional effect.

**Table 2.** Classification of {Construction Operation}.

| No. | Classification | Definition and Extraction Example | Ct. |
|---|---|---|---|
| {1} | {Surface Material Selection} | Choose material for the surface layer of the wall, ground, or roof. e.g., "palm rope was used on the external surface" [91] (p. 31) | 93 |
| {2} | {Multilayered Envelope} | Wall, roof, or ground with multiple construction layers. e.g., "multilayered external wall" [46] (p. 74) | 80 |
| {3} | {Structural Material Selection} | Choose main material for structure. e.g., "use steel structure" [69] (p. 65)/"bamboo structure" [50] (p. 14) | 73 |
| {4} | {Main Material Selection} | Choose main material for building. e.g., "brick remains the main material of the building" [34] (p. 28) | 73 |
| {5} | {Fenestration Optimization} | Optimize the construction, size, and position of the building's doors and windows. e.g., "glass lighting strips with wooden rafter sunshade grille" [81] (p. 16)/"add variable external sunshade elements to southern openings" [66] (p. 86) | 53 |
| {6} | {Detail Construction} | Construction method of the connections or part of a component. e.g., "slot steel and angle steel are respectively embedded at the connection" [64] (p. 25) | 48 |
| {7} | {Innovative Structural System} | Design a new structural system. e.g., "the flexible structural system of a bamboo umbrella" [84] (p. 41) | 47 |
| {8} | {Surface Finish Construction} | Construction methods of the perceivable surface of the building. e.g., "achieved through a curtain wall construction method" [91] (p. 31) | 38 |
| {9} | {Roof Shape Adjustment} | Adjust the shape of the roof, such as its slope and the width of the eaves. e.g., "the eaves' overhang is relatively large" [59] (p. 13) | 35 |
| {10} | {Use Masonry Technique} | Use certain masonry techniques to build. e.g., "use brickwork of unplastered masonry wall" [33] (p. 31) | 34 |
| {11} | {Construction Process Optimization} | Optimize the construction flow and tools. e.g., "a comprehensive standardization of the local traditional rammed earth construction process was carried out" [54] (p. 12) | 34 |
| {12} | {Wall Structure Construction} | Formation of the physical entity of the wall. e.g., "reinforced gabion wall" [38] (p. 40)/"add built-in construction column and distributed steel mesh" [44] (p. 68) | 34 |
| {13} | {Innovative Construction Technology} | Use of relatively new technology. e.g., "robotic plastic printing build" [86] (p. 45)/"industrialized prefabricated assembly system" [60] (p. 82) | 29 |
| {14} | {Component Modularization} | Making component units for exchange. e.g., "'modular' floor units" [76] (p. 45)/"unitized construction" [84] (p. 38) | 23 |
| {15} | {Insulation Material Selection} | Choose insulation material for the insulation layer or connections. e.g., "use rice husk and straw board as insulation" [31] (p. 24)/"use threshed corn cob as insulation material" [64] (p. 25) | 22 |
| {16} | {Structural Element Optimization} | Adjust shape or position of structural elements or expose structural elements. e.g., "adopting I-section steel with minimum cross-section" [69] (p. 65) | 15 |
| | | Total | 731 |

**Table 3.** Classification of <Local Element>.

| No. | Classification | Definition and Extraction Example | Ct. |
|---|---|---|---|
| <1> | <Construction Limitation> | Construction constraints and limitations. e.g., "the practical conditions of rural construction sites are characterized by limited space and a lack of engineering equipment" [80] (p. 77) | 56 |
| <2> | <Climate> | Long-term average weather conditions. e.g., "the local harsh and cold climate" [93] (p. 63) | 56 |
| <3> | <Residents> | Livelihood, lifestyle, cognition, and opinion of the local people. e.g., "the daily habits of the villagers" [65] (p. 89) | 54 |
| <4> | <Traditional Use of Materials> | Practice of using materials that have been used for generations. e.g., "constructing houses using raw earth has been a traditional practice in this small village" [64] (p. 24) | 46 |
| <5> | <Artificial Resources> | Common local materials generated by industry or craft. e.g., "a U-shaped horse nail was found in the village blacksmith's shop" [34] (p. 30)/"the corner waste from a nearby stone processing plant" [80] (p. 76) | 46 |
| <6> | <Economic Conditions> | The state of the local economy. e.g., "the village school is facing financial difficulties in its daily operations" [46] (p. 74) | 39 |
| <7> | <Traditional Building Technology> | Building techniques or methods that have been passed down from generation to generation. e.g., "traditional rammed earth construction technology" [63] (p. 3) | 38 |
| <8> | <Regional Architectural Style> | Distinct features and aesthetic qualities of architecture across a relatively large region where the site is located. e.g., "the architectural style of the Jiangnan region is characterized by a lightweight structure" [69] (p. 65) | 34 |
| <9> | <Local Envelope Construction Method> | Local techniques that are used to construct the outer shell or envelope of a building. e.g., "many rudimentary houses in Maoping village use vertically oriented wooden boards as the enclosure structure" [34] (pp. 29–30) | 34 |
| <10> | <Forest Resources> | Natural resources that are derived from forests (including bamboo forests). e.g., "the surrounding mountains are rich in timber resources, and there is an abundance of bamboo resources" [35] (p. 87) | 34 |
| <11> | <Natural Disasters> | Extreme environmental phenomena that occur naturally and can cause severe damage. e.g., "the southwest region has been an earthquake-prone area since ancient times" [54] (p. 11) | 31 |
| <12> | <Village Characteristics> | Distinguishing features and attributes of the local village, including its physical and cultural characteristics. e.g., "a village with a mix of old and new architectural styles" [71] (pp. 88–89) | 29 |
| <13> | <Cons of Traditional Envelope> | Drawbacks of the traditional envelope of local buildings. e.g., "the traditional rural houses in northern China have poor air tightness, and the walls are not insulated" [32] (p. 24) | 29 |
| <14> | <Local Building Style> | Features in the visual or scale of the buildings in the locality. e.g., "the prototype of the aged, rammed earth houses in local areas" [80] (p. 76) | 29 |
| <15> | <Interior Performance Issues> | Problems that arise within the indoor spaces of the building. e.g., "insufficient natural lighting is one of the most common performance issues in the kitchens of rural houses in Xiangxi" [85] (p. 71) | 27 |

**Table 3.** *Cont.*

| No. | Classification | Definition and Extraction Example | Ct. |
|---|---|---|---|
| <16> | <Decline of Craftsmanship> | Decline in traditional local artisanal craftsmanship or loss of local artisans. e.g., "the traditional craftmanship that lacks demand is gradually becoming extinct" [91] (p. 31) | 23 |
| <17> | <Traditional Building Structure> | Structural system of traditional buildings. e.g., "the traditional building structure of rural residences consists of a mixed load-bearing system composed of timber framework, rammed earth walls, and brick piers" [73] (p. 56) | 22 |
| <18> | <Craftsman> | Skilled artisans who reside and work in local areas. e.g., "bamboo master craftsman" [84] (p. 42) | 19 |
| <19> | <Natural Mineral Materials> | Natural stone materials from the locality. e.g., "the dried-up riverbeds in the mountainous areas of western Sichuan are filled with cobblestones" [38] (p. 40) | 19 |
| <20> | <Traditional Architectural Space> | Spatial organization and layout in traditional architecture. e.g., "the courtyard served as the center of the architectural space in the past" [88] (p. 64) | 19 |
| <21> | <Agricultural Plant-based Resources> | Byproducts of agricultural plants. e.g., "most of the vast rural areas in the north are rich in rice straw" [31] (p. 24) | 13 |
| <22> | <Local Masonry Technique> | Masonry methods that are commonly used by locals. e.g., "the traditional technique involves the construction of hollow brick walls using a 'two up, one down' alternating pattern" [71] (p. 88) | 13 |
| <23> | <Loss of Traditional Techniques> | The fact that traditional building techniques are gradually disappearing. e.g., "manual construction techniques have gradually been lost in the local area" [90] (p. 11) | 12 |
| <24> | <Deconstruction Waste> | Materials generated during the dismantling or deconstruction of buildings. e.g., "many existing rural houses are decorated with tiled facades, and deconstruction generates a large amount of construction waste" [68] (p. 99) | 9 |
| | | Total | 731 |

**Table 4.** Classification of 'Effect'.

| No. | Classification | Definition and Extraction Example | Ct. |
|---|---|---|---|
| '1' | 'Thermal Performance Improvement' | Enhancement of the building's thermal performance ability. e.g., "reducing the amount of heat lost by the building by approximately 50%" [32] (p. 26) | 81 |
| '2' | 'Cost-effectiveness' | Cost reduction. e.g., "effectively reduce construction costs" [37] (p. 60) | 67 |
| '3' | 'Ease of Construction' | Ease of construction. e.g., "the construction is simple, and farmers can easily operate it" [31] (p. 25) | 53 |
| '4' | 'Local Style Expression' | The reflection of the traditional architectural styles and cultural elements of the locals. e.g., "embodies the traditional architectural spirit of the residential buildings in southern Henan" [55] (p. 20) | 47 |
| '5' | 'Enhancing Safety' | Improvement in safety performance. e.g., "more secure, and reliable" [69] (p. 65) | 46 |
| '6' | 'Enhancing Architectural Aesthetics' | Improvement of visual and artistic qualities of the building. e.g., "rich in visual appeal" [60] (p. 20) | 43 |

**Table 4.** *Cont.*

| No. | Classification | Definition and Extraction Example | Ct. |
|---|---|---|---|
| '7' | 'Locally Inspiring' | Inspiring and promoting a sense of local pride and identity, or a sense of new concepts such as environmental protection, among the community. e.g., "instilled a newfound appreciation and confidence in the local rural construction team, villagers, and township officials towards the use of red bricks in traditional architecture, reflecting a greater appreciation for local culture" [89] (p. 55) | 41 |
| '8' | 'Inheritance' | Preservation and continuation of traditional architectural techniques and cultural values, passing down the legacy to future generations. e.g., "established a solid foundation for the continuation of rural construction techniques in the future" [59] (p. 11) | 35 |
| '9' | 'Eco-friendliness' | Positive impact on the environment. e.g., "maintaining its biodegradable properties" [54] (p. 12) | 34 |
| '10' | 'Harmony' | Integration with the surroundings and the cultural context. e.g., "dialogue and continuity with the surrounding houses" [34] (p. 28) | 31 |
| '11' | 'Mechanical Rationality' | Reach a state that exhibits a high degree of mechanical efficiency, stability, and functionality. e.g., "the mechanical and durability properties of the rammed earth wall can be greatly enhanced" [54] (p. 12) | 30 |
| '12' | 'Creating Specific Experiences' | Able to shape and create certain experiences within a space. e.g., "created a space experience that is both familiar and completely different" [77] (p. 73) | 28 |
| '13' | 'Representing Rural Characteristics' | Reflection and showcase the unique features and cultural elements of rural areas. e.g., "this satisfies people's psychological expectations for simplicity and straightforwardness in rural areas" [89] (p. 55) | 18 |
| '14' | 'Habitability' | Able to provide a comfortable living environment. e.g., "improving the comfort of living" [32] (p. 24) | 18 |
| '15' | 'Improving Waterproof Performance' | Being able to prevent water from penetrating. e.g., "good waterproofing effect" [34] (p. 29) | 17 |
| '16' | 'Ease of Maintenance' | Easy to perform maintenance and repair work on the building over time, or a building with high durability that needs less maintenance. e.g., "easy to maintain" [62] (p. 35)/"ensure the durability of the wall" [31] (p. 25) | 17 |
| '17' | 'Flexibility' | Allows the building to adapt to different needs and circumstances. e.g., "it can be freely moved and combined to meet different usage requirements" [76] (p. 45) | 16 |
| '18' | 'Participatory Building' | Allows the local community to be involved in the construction process or be able to be built mainly by the residents. e.g., "non-professional disaster victims can participate in building construction" [45] (p. 82) | 15 |
| '19' | 'Improving Lighting' | Enhancement of the building's indoor lighting. e.g., "improve indoor lighting" [56] (p. 43) | 14 |
| '20' | 'Local Industry Promotion' | Promoting and supporting local industries and businesses. e.g., "rearranging the issues of deep processing of resources and the strategy of industrial integration" [50] (p. 14) | 12 |
| '21' | 'Lightness' | Effect of losing weight or appearing light, weightless, and delicate. e.g., "diminished the heaviness feeling of brick walls" [89] (p. 54)/"could reduce the weight by about half" [45] (p. 83) | 12 |
| '22' | 'Ease of Use' | Having the capacity to meet functional requirements and provide appropriate spaces for usage. e.g., "it meets the requirements of large-span production spaces and is in line with the functional properties of factories" [74] (p. 55) | 12 |

**Table 4.** *Cont.*

| No. | Classification | Definition and Extraction Example | Ct. |
|---|---|---|---|
| '23' | 'Improving Ventilation' | Enhancement of the building's indoor ventilation.<br>e.g., "helps to promote natural ventilation" [38] (p. 40) | 11 |
| '24' | 'Time-efficient' | Reduction in the time needed to finish the building.<br>e.g., "completed in a short amount of time" [84] (p. 38) | 10 |
| '25' | 'Material Perception' | Having the impact of the physical properties of materials on human senses and emotions.<br>e.g., "retain the warmth of the bamboo material" [38] (p. 41) | 9 |
| '26' | 'Improve Soundproof Performance' | Enhancement of soundproof performance.<br>e.g., "can effectively improve the sound insulation effect of the room" [35] (p. 87) | 5 |
| '27' | 'Indicative Capability' | Able to communicate other information such as the division of space and time.<br>e.g., "reflect the scale of time" [74] (p. 54) | 5 |
| '28' | 'Structural Expression' | Able to communicate the form and function of the structural component.<br>e.g., "faithfully presents the structural logic and relationships of the wall itself" [64] (p. 25) | 4 |
| | | Total | 731 |

Step 3. Review relationships between {Construction Operation} and <Local Element>, and between {Construction Operation} and 'Effect' through correspondence analysis.

Correspondence analysis [95] is applied to review the relationships between {Construction Operation} and <Local Element>, and between {Construction Operation} and 'Effect'. The correspondence analysis allows for the visualization of similarities, differences, and associations between row elements and column elements of a cross tabulation by representing them as points on a multidimensional map [95]. To interpret tendencies, the following steps were taken for each analysis:

(1) A cross tabulation was created by counting the combinations between the classifications of two elements. To eliminate the influence of the third element, the same combination between the two elements is counted only once in one article, even if there are multiple corresponding instances of the third element.

(2) Correspondence analysis is conducted using the "ca" function of the "ca" package in R (version 4.2.2), with the cross tabulation as the input data. The result of the analysis displayed the classifications of the two elements as points on a multidimensional map, with the distances between points representing their correlations [95]. In this study, two-dimensional scatterplots are used for tendencies interpretation, taking into account the complexity of the results and the eigenvalue report.

(3) In the scatterplots, classifications plotted closer together indicate a higher affinity between them. Moreover, the further the classifications are located from the origin, the more unique they are from other classifications. For classifications of the same element, points plotted in the same direction from the origin indicate higher similarity between them (e.g., <23> and <16> in scatterplot in Section 4.1), while those plotted in the opposite direction from the origin indicate less similarity between them (e.g., <23> and <21> in scatterplot in Section 4.1) [95]. Therefore, those points plotted relatively far away from the origin and close to each other in a similar direction indicate a tendency in the relationship between the two elements.

As a result, scatterplots of the correspondence analysis between {Construction Operation} and <Local Element>, and between {Construction Operation} and 'Effect' rendered the correlational strength of the classifications whereby tendencies are created.

Step 4. Semantic grouping and discussion.

By cross-referencing the tendencies of each scatterplot obtained in step 3, a series of semantic groups are organized based on the affinity of their meanings. Upon establishing the groups, their meanings are reassessed on the level of the source texts to ensure their validity. From the semantic groups, further classifications and examinations are attempted to draw conclusions.

## 4. Results of the Correspondence Analysis

This section shows the results of step 3 in Section 3.2. As previously explained in step 3, the cross tabulations used as input data for applying correspondence analysis are created first. To create the cross tabulation, the influence of the differences for 'Effect' is eliminated by counting the same combination between {Construction Operation} and <Local Element> only once in one study object, even when there are plural corresponding instances of 'Effect'. This produces 407 combinations of their classifications for correspondence analysis (Table 5). Similarly, the influence of differences in <Local Element> for the same relation between {Construction Operation} and 'Effect' is also removed, and 455 combinations of their classifications are confirmed (Table 6).

With Table 5 as the input data, the correspondence analysis of {Construction Operation} and <Local Element> is conducted through the "ca" function in R (version 4.2.2). Table 7 shows the eigenvalues, inertias, and cumulative inertias of all dimensions in the result of the correspondence analysis of {Construction Operation} and <Local Element>. Similarly, with Table 6 as the input data, the correspondence analysis of {Construction Operation} and 'Effect' is conducted, and Table 8 shows the eigenvalues, inertias, and cumulative inertias of all dimensions in the result of the correspondence analysis of {Construction Operation} and 'Effect'. In correspondence analysis, each dimension can be interpreted as a latent variable that accounts for part of the total variation in the data, and the eigenvalues corresponding to each dimension indicate the amount of variation explained by each dimension [96]. An inertia of a dimension is calculated by dividing its eigenvalue by the total sum of eigenvalues. Therefore, inertias corresponding to each dimension indicate the percentage of explained variances of each dimension. The higher the inertia value, the more variances are explained by the corresponding dimension. Cumulative inertias measure the cumulative amount of inertia of a subset of dimensions. The cumulative inertias are computed as follows: first, the inertia of the first dimension is taken as the first value of the cumulative inertia; second, for each subsequent dimension, the inertia of that axis is added to the cumulative inertia of all previous dimensions to obtain the corresponding cumulative inertia value.

In both Tables 7 and 8, the inertia of dimensions after 3 are relatively low and they are comparable (e.g., in Table 7, compared with a difference of 8.5% between inertias of dimensions 2 and 3, there is only a difference of 1.8% between inertias of dimensions 3 and 4, and 1.1% between inertias of dimensions 4 and 5, etc.). Additionally, for both of the correspondence analysis results, the dimensions after 3 barely add significant explanatory value. Although using more dimensions can explain more variance in the data set, since it is hard to imagine a point in a space with more than three dimensions and the visualization of the points becomes very complex beyond two dimensions, the two-dimensional ones are usually the display of choice [95]. Furthermore, the cumulative inertia of the first two dimensions is 48.1% in Table 7 and 44.1% in Table 8, which are acceptable for interpreting the tendencies. Therefore, scatterplots with the first two dimensions are used for tendencies interpretation for both the correspondence analysis of {Construction Operation} and <Local Element>, as well as {Construction Operation} and 'Effect'.

**Table 5.** Cross tabulation of {Construction Operation} and <Local Element>.

| | <1> | <2> | <3> | <4> | <5> | <6> | <7> | <8> | <9> | <10> | <11> | <12> | <13> | <14> | <15> | <16> | <17> | <18> | <19> | <20> | <21> | <22> | <23> | <24> | Sums |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| {1} | 1 | 2 | 5 | 7 | 8 | 1 | 2 | 5 | 1 | 2 | | 4 | | 2 | 1 | 1 | 2 | 3 | 6 | | 1 | 1 | | 4 | 59 |
| {2} | 4 | 11 | 3 | | | 4 | | | 3 | 1 | | 1 | 4 | 2 | 4 | | | | | 1 | 1 | | | | 39 |
| {3} | 5 | 2 | 3 | 4 | | 2 | 2 | 3 | | 2 | 2 | 2 | | 3 | 1 | 2 | 3 | 2 | | 1 | | 2 | 1 | | 42 |
| {4} | 3 | 2 | 1 | 5 | 6 | 1 | 4 | 2 | | 3 | | 2 | | 2 | | 1 | | 2 | 1 | | 1 | 1 | 1 | 2 | 40 |
| {5} | 3 | 6 | 2 | | 1 | 2 | 1 | 1 | | | | 2 | 4 | 2 | 5 | | 1 | | | | | | | | 30 |
| {6} | 2 | 3 | 2 | | 1 | | 1 | | 2 | | 2 | 1 | 3 | 1 | 2 | | 1 | 2 | | 1 | 1 | | | | 25 |
| {7} | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 | 1 | 1 | 4 | | | 2 | | 1 | 2 | | | 1 | | | 1 | | 25 |
| {8} | | 1 | 4 | 1 | 4 | | | 2 | 3 | 2 | | 2 | 1 | 1 | | 1 | | 1 | | | | 3 | | 1 | 27 |
| {9} | | 2 | 3 | | | | | 3 | 1 | | | | 1 | 1 | | | 1 | 1 | | 2 | | | | | 15 |
| {10} | | 1 | 2 | 2 | 4 | 1 | 2 | 1 | | | | 1 | | 1 | | | | 1 | 2 | | | 6 | | | 24 |
| {11} | 2 | | | 1 | | | 1 | | | 1 | 1 | | | | | 1 | | | | | | | 1 | | 8 |
| {12} | 3 | 2 | 1 | 2 | | 1 | 1 | 1 | 1 | | 3 | 1 | 2 | | 1 | | 1 | | 2 | | | | | | 22 |
| {13} | 5 | 1 | | 1 | 1 | 1 | | | | 1 | | 1 | | | | 3 | 1 | 1 | | 1 | | | 1 | | 18 |
| {14} | | | | | 1 | 1 | 1 | | | 1 | 1 | 2 | | | | 1 | | | | 1 | | | | | 9 |
| {15} | | 3 | | | | 2 | | | 2 | | | | 2 | | | | | | | | 3 | | | | 12 |
| {16} | 1 | 1 | | | | 1 | | 2 | | | 2 | 2 | | 1 | | | 1 | | | 1 | | | | | 12 |
| Sums | 30 | 38 | 27 | 25 | 27 | 19 | 18 | 21 | 14 | 14 | 15 | 21 | 17 | 18 | 14 | 11 | 13 | 13 | 11 | 9 | 7 | 13 | 5 | 7 | 407 |

**Table 6.** Cross tabulation of {Construction Operation} and 'Effect'.

| | '1' | '2' | '3' | '4' | '5' | '6' | '7' | '8' | '9' | '10' | '11' | '12' | '13' | '14' | '15' | '16' | '17' | '18' | '19' | '20' | '21' | '22' | '23' | '24' | '25' | '26' | '27' | '28' | Sums |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| {1} | 3 | 5 | 3 | 8 | 2 | 6 | 3 | 4 | 1 | 7 | 1 | 2 | 4 | | 1 | 2 | | 1 | | | 4 | 1 | | | 3 | | 1 | 1 | 63 |
| {2} | 16 | 3 | 1 | 2 | 2 | | 1 | 1 | 3 | 1 | | | 1 | 7 | 5 | 2 | | | | | 1 | 2 | | | | 2 | | | 50 |
| {3} | 1 | 3 | 4 | 3 | 5 | 2 | 1 | 5 | 2 | 1 | 3 | 1 | 1 | | | | 2 | 1 | 1 | 2 | 1 | 1 | | | 1 | 1 | 1 | 1 | 44 |
| {4} | 3 | 9 | 6 | 3 | | 3 | 6 | 2 | 3 | 2 | | 1 | 3 | | | | 1 | 2 | | 1 | 1 | | 1 | 1 | 1 | | | | 49 |
| {5} | 8 | 1 | | 4 | | 1 | 1 | 1 | 2 | | | 1 | | 4 | 1 | 1 | | | 5 | | | | 2 | | | | | 1 | 33 |
| {6} | 5 | 2 | 4 | | 1 | 1 | | 2 | 1 | | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 1 | | 1 | | | | 29 |
| {7} | | 2 | 4 | 1 | 6 | 1 | 2 | 2 | | 1 | 5 | | | | | | 1 | 1 | | 2 | 1 | 1 | | 1 | | | | | 31 |
| {8} | 2 | 1 | 1 | 3 | 1 | 2 | 3 | 2 | | 1 | | 1 | 1 | | 2 | | | | 3 | | | | | | | | 1 | | 24 |
| {9} | 1 | 1 | 1 | 3 | | 3 | 2 | 3 | 1 | 1 | | 2 | | | | 1 | 1 | | 2 | | 1 | 1 | | | | | | | 24 |
| {10} | 2 | 2 | | 1 | | 6 | 3 | | 1 | 2 | | 1 | 1 | 1 | | | | | | | 1 | | 1 | | 1 | | | | 23 |
| {11} | | 1 | 2 | | 1 | | | | 1 | | 2 | | | | 1 | 1 | | 1 | | | | | | 1 | | | | | 11 |
| {12} | 2 | 2 | 2 | 1 | 2 | 2 | 1 | | | 1 | 1 | | | | | 1 | | | | | | | | | | | | | 15 |
| {13} | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | 2 | 3 | | | | | | | | 2 | | | | 2 | | | | | 16 |
| {14} | | 2 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | 1 | 4 | 1 | | | | | | 2 | | | | | 15 |
| {15} | 6 | 3 | 1 | | | | | | 1 | | | | | 1 | | | | 1 | | | | | | | | | | | 13 |
| {16} | | | | | 3 | 1 | | 1 | 1 | 3 | | 2 | | | | 1 | | | | | 1 | 1 | | | | | | 1 | 15 |
| Sums | 49 | 38 | 31 | 30 | 25 | 30 | 25 | 24 | 18 | 20 | 17 | 16 | 12 | 14 | 11 | 11 | 10 | 9 | 11 | 7 | 11 | 7 | 5 | 7 | 7 | 3 | 3 | 4 | 455 |

**Table 7.** Eigenvalue report of {Construction Operation} and <Local Element>.

| Dimension | Eigenvalue | Inertia | Cumulative Inertia |
|---|---|---|---|
| 1 | 0.367181 | 28.8% | 28.8% |
| 2 | 0.24525 | 19.2% | 48.1% |
| 3 | 0.136284 | 10.7% | 58.8% |
| 4 | 0.113645 | 8.9% | 67.7% |
| 5 | 0.098999 | 7.8% | 75.5% |
| 6 | 0.090656 | 7.1% | 82.6% |
| 7 | 0.056102 | 4.4% | 87.0% |
| 8 | 0.045719 | 3.6% | 90.6% |
| 9 | 0.040802 | 3.2% | 93.8% |
| 10 | 0.026045 | 2.0% | 95.8% |
| 11 | 0.020165 | 1.6% | 97.4% |
| 12 | 0.0127 | 1.0% | 98.4% |
| 13 | 0.009758 | 0.8% | 99.2% |
| 14 | 0.007257 | 0.6% | 99.7% |
| 15 | 0.003504 | 0.3% | 100.0% |
| Total | 1.274065 | 100.0% | |

**Table 8.** Eigenvalue report of {Construction Operation} and ‘Effect’.

| Dimension | Eigenvalue | Inertia | Cumulative Inertia |
|---|---|---|---|
| 1 | 0.358006 | 27.0% | 27.0% |
| 2 | 0.225516 | 17.0% | 44.1% |
| 3 | 0.153512 | 11.6% | 55.7% |
| 4 | 0.13525 | 10.2% | 65.9% |
| 5 | 0.105016 | 7.9% | 73.8% |
| 6 | 0.080476 | 6.1% | 79.9% |
| 7 | 0.057209 | 4.3% | 84.2% |
| 8 | 0.048875 | 3.7% | 87.9% |
| 9 | 0.043034 | 3.3% | 91.1% |
| 10 | 0.034365 | 2.6% | 93.7% |
| 11 | 0.026743 | 2.0% | 95.8% |
| 12 | 0.019274 | 1.5% | 97.2% |
| 13 | 0.017621 | 1.3% | 98.5% |
| 14 | 0.010619 | 0.8% | 99.4% |
| 15 | 0.008598 | 0.6% | 100.0% |
| Total | 1.324113 | 100.0% | |

### *4.1. Correspondence Analysis of {Construction Operation} and <Local Element>*

According to the principles explained in (3) in step 3 of Section 3.2, in scatterplot of {Construction Operation} and <Local Element> (Figure 1), points that plot relatively far away from the origin and close to each other in similar directions illustrate three tendencies between {Construction Operation} and <Local Element>. Each tendency is interpreted by examining the shared characteristics and correlations of the classifications that are plotted near the corresponding direction, with points that are plotted relatively further from the origin a relative priority in interpretation. Consequently, three tendencies, namely localized technological progress in response to rural semi-industrialization; enclosure construction that prioritizes environmental responsiveness; material selection and expression responding to visual aspects of local construction, are obtained and are illustrated as labels near the corresponding directions in Figure 1. Sections 4.1.1–4.1.3 explained these tendencies by demonstrating their representative correlations between classifications of {Construction Operation} and <Local Element>.

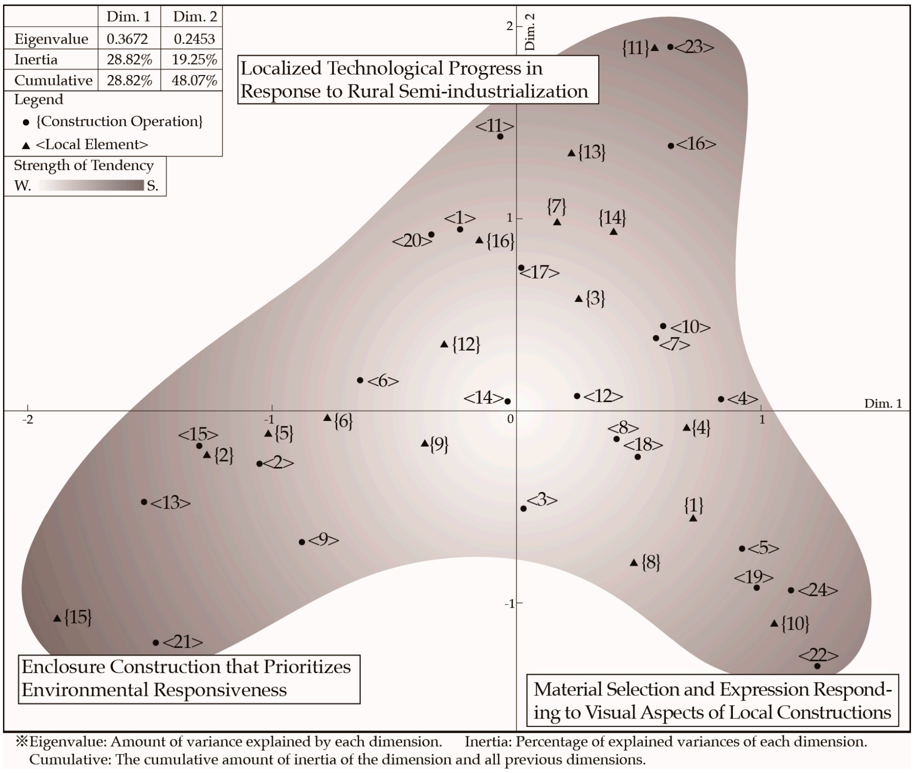


**Figure 1.** Scatterplot of {Construction Operation} and <Local Element>.

#### 4.1.1. Localized Technological Progress in Response to Rural Semi-Industrialization

The correlation between {Construction Process Optimization} and <Loss of Traditional Techniques>, as well as between {Construction Process Optimization} and <Traditional Building Technology> is manifested in descriptions such as the following: "Over the centuries, people have harnessed all available local resources to gradually develop a range of building anti-seismic construction techniques based on rammed earth and wooden structures . . . with the shift in housing perspectives and the decline of traditional craftsmen, the core techniques of traditional rammed earth construction have gradually been lost . . . To attain sufficient compaction strength, our team has improved traditional local rammed earth tools with conventional materials such as lightweight angle steel and cast iron. Meanwhile . . . our team has comprehensively standardized the local traditional rammed earth building process" [54] (p. 12), which indicates that architects are tapping into traditional construction wisdom and using new knowledge and technology to improve building tools or processes, providing traditional techniques with new life and vitality in the new rural construction. The correlation between {Innovative Structural System} and <Natural Disasters> can be observed in the following text: "the brick-concrete school became a dangerous building in the Wenchuan '5.12' earthquake . . . its composite structure is jointly constructed by C-shaped light steel frame and enclosure panels" [46] (p. 74), demonstrating that architects are seeking new structural systems that are adapted to rural conditions to address the lack of both traditional and modern industrialized disaster-resilient techniques in semi-industrialized rural areas. The correlation between {Innovative Construction Technology} and <Decline of Craftsmanship> shows that although modern industrialization causes problems such as the loss of craftsmen for traditional rural construction, it also presents opportunities for the adaption of new technologies, which might lead to a technological boom in rural areas, as observed in articles including the following: "Rural construction is facing common problems such as loss of local skilled workers . . . building a system of construction that use 3D printing as technical means, industrialized prefabricated assembly as a foundation, networked remote processing, logistics supply chain transportation, and local assembly" [80] (p. 77). These combinations suggest that architects are seeking appropriate construction technologies for rural areas, bridging traditional and modern technology to lift up rural areas from their semi-industrialized state. This can be regarded as a tendency for localized technology progress that is responding to rural semi-industrialization.

#### 4.1.2. Enclosure Construction That Prioritizes Environmental Responsiveness

The correlation between {Insulation Material Selection} and <Agricultural Plant-based Resources> can be observed in quotations such as the following: "Most of the vast rural areas in the north are rich in rice straw . . . a combination of straw board and rice straw were used as insulation material" [31] (p. 24), which illustrates the use of passive enclosure construction materials that can leverage the unique resource advantages of rural areas with predominantly agricultural economies. The correlation between {Multilayered Envelope} and <Cons of Traditional Envelope> is demonstrated in descriptions such as the following: "The traditional rural houses in northern China have poor air tightness, and the walls are not insulated. To address this issue, external wall insulation technology was employed, with a 60 mm thick polystyrene insulation board attached to the 240 mm thick brick wall . . . The roof was also reinforced for insulation, with a 150 mm thick polystyrene insulation board and small blue tiles laid on top" [32] (pp. 24–26). This highlights that implementing a multifunctional envelope with multiple layers in rural areas is a fundamental strategy used to tackle the inadequate thermal performance of traditional wall and roof enclosures. The correlation between {Fenestration Optimization} and <Climate> can be observed in text such as the following: "local cold climate . . . makes the dormitory door into an insulated door with a door closer" [93] (pp. 63–67), which indicates the treatment of doors and windows as a special part of the building envelope, with adjustments made for local climates. These combinations indicate that the architects' focus on local living conditions, such as agricultural-based lifestyles and the inadequacies of local buildings to cope with the climate, incorporate their efforts toward the construction of building enclosures that respond to the local living environment. This can be viewed as a tendency of enclosure construction that prioritizes environmental responsiveness.

#### 4.1.3. Material Selection and Expression Responding to Visual Aspects of Local Constructions

The correlation between {Use Masonry Technique} and <Local Masonry Technique> can be extracted from language such as "the use of traditional local masonry techniques to create a 'checkered brick' wall surface" [41] (p. 70), which indicates that masonry, a prevalent craft in rural China, can exhibit abundant expressive qualities that make it a collective memory that can be employed by architects. The correlation between {Surface Material Selection} and <Deconstruction Waste> can be observed in quotations such as "with the onset of urbanization, more and more old buildings will be demolished . . . recycled low-quality broken bricks cover the roof . . . the remaining waste bricks are used to decorate the outdoor platform-style assembly plaza" [51] (pp. 19–21), which indicates that in the face of rapid urbanization and the loss of the traditional memory associated with old buildings, architects use local deconstructed materials in new surfaces, not only as a decoration or for ecological purposes, but also as a way to resist the extinguishing of the past. The correlation between {Surface Finish Construction} and <Artificial Resources> can be observed in descriptions such as "effectively combine the small-scale Daoming bamboo weaving, which was mostly used for containers, with the design and construction of the bamboo building facade" [77] (p. 73), demonstrating architects' concern with respect to local artificial resources and efforts in utilizing them in terms of surface construction where people could perceive them. These combinations illustrate architects' attention to the origin of the material, as well as to its expression, to create a connection with the local factors that possess visual collective memory of the site. Hence, a tendency can be noted for material selection and expression in responding to visual aspects of local constructions.

*4.2. Correspondence Analysis of {Construction Operation} and 'Effect'*

According to the principles explained in (3) in step 3 of Section 3.2, in scatterplot of {Construction Operation} and 'Effect' (Figure 2), points that are relatively far away from the origin and close to each other in similar directions illustrate three tendencies between {Construction Operation} and 'Effect'. Each tendency is interpreted by examining the shared characteristics and correlations of the classifications that are plotted near the corresponding direction, with points that are plotted relatively further from the origin requiring relative priority in interpretation. Consequently, three tendencies, namely high-performance structural and construction systems that prioritize the feasibility of on-site construction; passive envelopes for improved habitation; new rural aesthetics established through perceivable construction, are obtained and are illustrated as labels near the corresponding directions in Figure 2. Sections 4.2.1–4.2.3 explained these tendencies by demonstrating their representative correlations between the classifications of {Construction Operation} and 'Effect'.

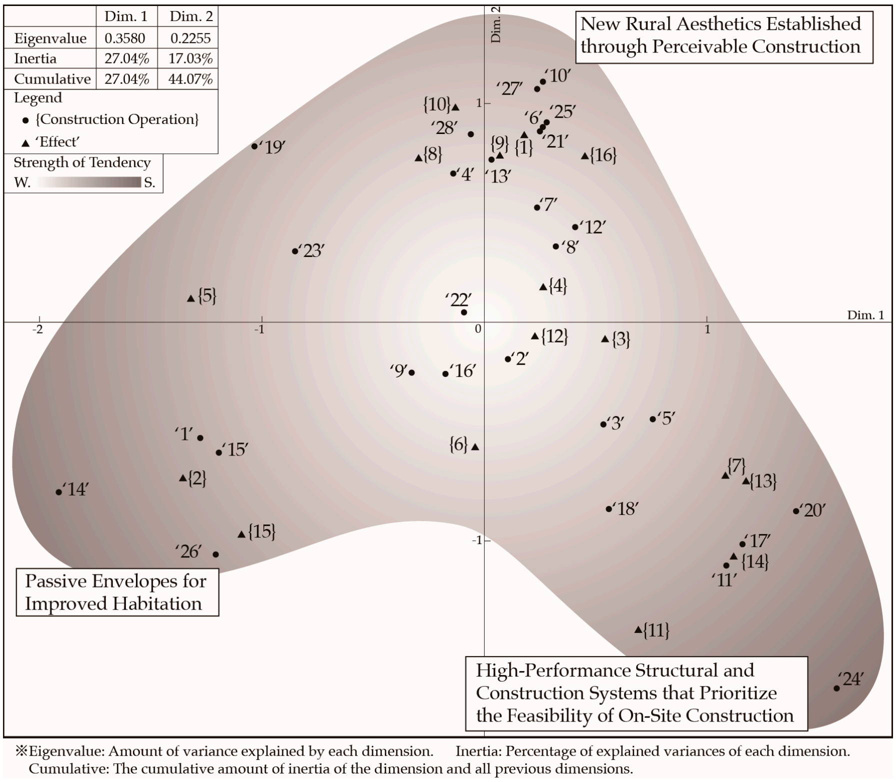


**Figure 2.** Scatterplot of {Construction Operation} and 'Effect'.

4.2.1. High-Performance Structural and Construction Systems That Prioritize the Feasibility of On-Site Construction

The correlation between {Innovative Structural System} and 'Ease of Construction' can be observed in text such as "the building is composed of 48 rows of trusses, and all components are connected using bolts. This structure enables dry installation on-site, simplifying the construction and installation process" [47] (p. 14). This exemplifies the creation of a novel structural system that emphasizes connections in simplified on-site assembly in rural regions. The correlation between {Construction Process Optimization} and 'Mechanical Rationality' can be observed in quotations including "Improvement and standardization of construction methods and tools … by adding around 5% hydrated lime to the raw soil or wall debris commonly used by local villagers, and controlling the water content to 15–20%, the mechanical and durability properties of the rammed earth wall can be greatly enhanced" [54] (p. 12). This indicates improvements being made to material proportions, tools, or other components that are sufficiently closely related to perform the construction process itself to ensure a reasonable level of strength for rural buildings. The correlation between {Component Modularization} and 'Flexibility' implies the incorporation of modularization principles, including those that are commonly found in industrialized construction systems, to create building systems that can accommodate diverse local requirements. An example of this can be observed in the following text: "The basic standard wooden house structure components, similar to the mortise and tenon joint structure, are repetitively used ... The simple construction system creates two distinct spaces, indoor and outdoor, ensuring the overall inclusivity of the project" [43] (p. 60). These combinations suggest that architects are exploring structural systems or technologies that are easily applicable for on-site building to achieve enhanced performances such as lower operational complexity, increased construction speed, and reliable firmness, which are critical for rural areas. In addition, 'Participatory Building' and 'Local Industry Promotion' are also evident, emphasizing the additional benefits of promoting local community involvement and creating new opportunities for new industry development of these operations. These develop as a tendency of high-performance structural and construction systems to prioritize the feasibility of on-site construction.

#### 4.2.2. Passive Envelopes for Improved Habitation

The correlation between {Multilayered Envelope} and 'Habitability' can be observed in text such as "the waterproof layer and insulation layer are laid on the ground ... the walls and roof are equipped with insulation layers ... putting people's sense of security and comfort in the first place" [81] (p. 16). This illustrates architects' focus on user experience, realized through an envelope that emphasizes environmental adaptability with different functional layers rather than the singular material expression that is typically pursued in architecture. The correlation between {Insulation Material Selection} and 'Improving Thermal Performance' is evident in descriptions such as "the use of dry-laid concrete paver blocks in the bedroom floor increases the thermal mass of interior materials, achieving thermal stability. Beneath the waterproof layer, a mixture of rice husks and clay is employed to enhance the thermal-physical performance" [66] (p. 86). This highlights the emphasis placed on selecting appropriate materials to enhance the thermal performance of the building envelope, to achieve thermal comfort. The correlation between {Fenestration Optimization} and 'Improving Ventilation' can be observed in articles including "longitudinal window casings, iron barrel openings, rafter openings and other simple and easy opening modes of doors, windows and openings to enhance the indoor ventilation effect" [54] (p. 13), illustrating the attention to natural ventilation by proposing a simpler construction method for incorporating operable openings within the building envelope. These combinations underscore the significance of the primary function of a house as a shelter for habitation, where passive methods are incorporated into the building envelope to enhance comfort in the indoor space. This can be considered a tendency of passive envelopes to improve habitation.

#### 4.2.3. New Rural Aesthetics Established through Perceivable Construction

The correlation between {Using Masonry Technique} and 'Enhancing Architectural Aesthetics' can be observed in text such as "the use of traditional local masonry techniques to create a 'checkered brick' wall surface enriches the facade texture and produces interesting light and shadow effects" [41] (p. 70). This exemplifies the pursuit of visually rich expression of masonry that aligns with the preference for the representation of materials construction in the field of architecture. The correlation between {Surface Material Selection} and 'Harmony' is manifested in text such as "using grey and white pebbles arranged in patterns to decorate the ground does not only make full use of local materials and achieve stylistic unity with traditional building" [33] (p. 31). This suggests that whether local materials or new materials are used for the visual skin, a sense of harmony can be obtained by following the traditional value that is considered essential in architecture for rural construction. The correlation between {Surface Finish Construction} and 'Locally Inspiring' can be observed in descriptions such as the following: "The technique of using weaved palm ropes as exterior cladding was achieved through a curtain wall construction method, outside the building's main enclosure structure . . . The participation of local villagers in the construction process created a sense of pride as they saw the unique building created by their own hands" [91] (p. 31), illustrating an intention to enhance local awareness through creating a novel visual expression using common materials. These combinations indicate architects' desire to maximize the potential of fundamental principles in architecture and bring new aesthetics to rural China through their efforts to construct the visible exterior. Thus, it can be characterized as a tendency toward new rural aesthetics, established through perceivable construction.

## 5. Types of Locally Based Architectural Construction Strategies in Rural China

This section showcases types of locally based architectural construction strategies in rural China by conducting a comparative and comprehensive analysis of {Construction Operation}, <Local Element>, and 'Effect'. These tendencies and their correlational strength from Figures 1 and 2 are used to evaluate the combination of {Construction Operation}, <Local Element>, and 'Effect'. By examining them on the level of the original texts, a series of groups based on the affinity of the meanings are formed. The groups are plotted along a horizontal axis made from the tendencies of {Construction Operation} and <Local Element> and a vertical axis made from the tendencies of {Construction Operation} and 'Effect'. All 731 items and their key contexts are reviewed to establish the accuracy of the analysis, and the number of corresponding articles for each type was counted to facilitate a quantitative discussion. It should be noted that this framework captures groups that cut across multiple tendency axes, which are more strongly associated with a single element of the axis rather than with both. In addition, the axial divisions are drawn with dashed lines to indicate their territorial positions, which may overlap semantically. Based on the methodologies and criteria above, this study identifies at least 14 distinct types of design thinking in locally based architectural construction strategies, from A to N (Figure 3).

Type A aims to enhance local traditional construction techniques by integrating modern knowledge, with the goal of preserving traditional wisdom as feasible methods suited to the present rural conditions (Appendix A). (9)

Type B addresses local construction challenges by introducing modern techniques and innovative structures that are currently suitable for use in rural areas at present. The aim is to identify appropriate techniques and explore multiple possibilities for future rural development (Appendix B). (7)

Type C presents a flexible approach to enhance building safety by utilizing appropriate technology in response to the inadequacies of existing rural constructions in addressing natural disasters (Appendix C). (8)

Type D exemplifies the flexible utilization of local abundant resources and the resolution of limited construction conditions in structural selection by architects to achieve optimal structural efficiency and cost-effectiveness in rural areas (Appendix D). (6)

Type E presents the insight of utilizing agricultural byproducts as insulation materials and the corresponding construction methods improvements (Appendix E). (3)

Type F draws inspiration from the traditional building envelope to create high-performance building enclosures that can be constructed easily through detailed designs or innovative enclosure construction methods (Appendix F). (5)

Type G addresses the shortcomings of traditional rural housing in coping with the local climate by implementing passive energy-saving envelopes. This allows for the creation of a comfortable indoor microclimate, entailing a smaller economic burden during operation (Appendix G). (19)

Type H showcases visually prominent structural elements drawn from rural architecture, influenced by the traditional Chinese architectural style for presenting structure, while also ensuring building safety and quality through visible supervision (Appendix H). (4)

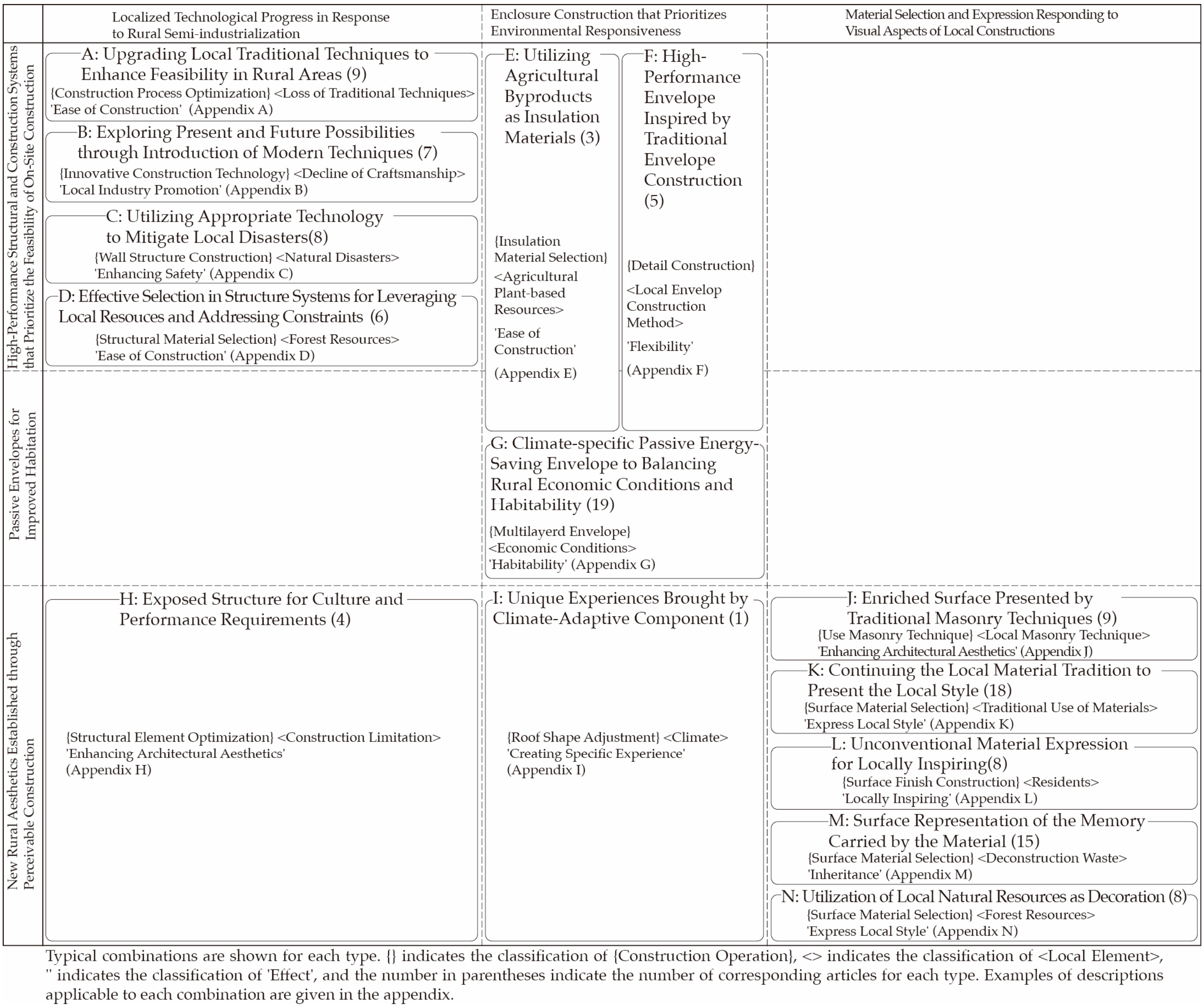


**Figure 3.** Design thinking of locally based architectural construction strategies in rural China.

Type I adjusts building component forms for climate adaptation, such as deep overhanging eaves for rain, which not only meet functional needs but also create a unique spatial experience and architectural style (Appendix I). (1)

Type J utilizes the construction method of common masonry forms in Chinese rural architecture, creating new buildings that incorporate traditional craftsmanship and the architect's own aspirations for expressing material construction forms (Appendix J). (9)

Type K presents the continuation of the local material tradition to create a building style that expresses a regional character, exemplifying the commitment of the architectural discipline to preserving and sustaining regional building cultural traditions (Appendix K). (18)

Type L employs unconventional rural materials or elevates techniques for the construction of a facade beyond local norms to create a building that serves as a reference point for the region, inspiring local residents and positively impacting the future development of the rural areas (Appendix L). (8)

Type M utilizes the debris of dismantled old buildings or commonly used rural materials on the visible surface, adopting materials as carriers of memory and inheriting the collective consciousness that is contained within them (Appendix M). (15)

Type N draws on abundant local natural resources in a perceptible way to construct buildings, showcasing the unique natural characteristics of the local area (Appendix N). (8)

## 6. Locally Based Architectural Construction Strategies in Rural China

Section 4 presents two sets of tendencies that are focused on three fundamental aspects of architecture: technology (tendencies of Sections 4.1.1 and 4.2.1), which includes the structural and constructional elements that ensure building stability and robustness; livability (tendencies of Sections 4.1.2 and 4.2.2), which includes the protective and functional aspect of architecture related to building utility; and aesthetic (tendencies of Sections 4.1.3 and 4.2.3), which includes the cultural and artistic aspects of architecture that then relate to building beauty. These cases are mainly concentrated in areas in which two tendencies with the same focus combine, resulting in a concentration of types that is summarized in Section 5 along the diagonal that is shown in Figure 3. This indicates that architecture in rural China mainly revolves around these classic themes. The following subsections will explore locally based design thinking in the types that emphasize technology, livability, and aesthetic aspects of architecture separately, and then their different approaches to sustainability will be compared.

### *6.1. Locally Based Design Thinking in Types Emphasizing Technology*

Types A, B, C, D, and H, which share the tendency to focus on technology, can be grouped around two main points based on their locally based design thinking.

#### 6.1.1. Diverse Technological Explorations Linking the Past and Future

The disappearance of traditional techniques and craftsmanship in rural China is a widespread issue, which relates to two distinct attitudes among architects. Type A illustrates respect to accumulated locality in traditional technology; through learning from the tradition, architects inherit their low-tech and environmentally friendly nature. Conversely, type B exhibits the introduction of new technologies to address the numerous problems faced by local construction. The former approach expresses the greater expectation of preserving regional characteristics against their wipeout, which came about due to modernization in rural areas, while the latter relates to the various disadvantages of the countryside as opportunities for embracing future-oriented technologies. However, type B does not mean an attitude of disregarding the rural tradition. In contrast, architects who employ new technology such as digital fabrication and prefabrication to the rural area pursue a new industry that can incorporate local traditional craftsmanship [77], and architects who utilize prefabrication to realize a specially designed structure believe that representing the rural atmosphere rather than showing off the high-tech is important [70]. Compared with type A, which shows the architects' effort to pass on traditional architectural construction technology, type B illustrates the architects' attitude toward preserving rural identity differently. These explorations establish technological diversity that links the past and future in rural areas, where local economic and technological conditions are significant factors that influence specific strategies.

#### 6.1.2. Appropriate Technology Selection in Response to Resource and Limitation Influences

In type D, architects explore different local resource advantages, including abundant bamboo, to maximize these local characteristics by applying suitable construction techniques. In types C, D, and H, architects choose structural types that balance economy and safety when faced with local natural disasters or construction quality limitations. These types reflect architects' adaptive selection of technology in the face of unique resources and construction constraints of rural areas to obtain the most appropriate local method of construction. In addition, type H demonstrates the trend to incorporate aesthetic concerns in structural design. Around 2000, the tectonic theory that incorporates aesthetic judgment into the constructive method was introduced to China by an influential architectural theorist [97] and shows significant influences on Chinese architectural practices [98]. Along with the architects' engagement in rural practices, this influence is also reflected in rural construction, bringing a new value to the locals.

#### 6.1.3. Conclusion for Locally Based Design Thinking in Types Emphasizing Technology

Locally based architectural construction strategies in rural areas are not required to adhere to traditional rural associations, and diverse technological explorations beyond tradition and modern are key to maintaining rural diversity. Regardless of the traditional or modern attributes, making the most suitable technology selection according to different local resources and constraints is a fundamental aspect of rural construction. At the same time, the feasibility of on-site construction that addresses rural constraints and high cost-effectiveness are the common characteristics of these strategies.

Furthermore, although these strategies revolve around technology issues in building and structure, locally based design thinking also reflects the architects' concern for the cultural identity, local living, and aesthetics of rural China. From this perspective, the construction or structure actually stays within the realm of being a means rather than an objective. The main body of rural construction is the cultural identity that makes each site unique.

### *6.2. Locally Based Design Thinking in Types Emphasizing Livability*

Types E, F, G, and I, which have at least one tendency to focus on livability, can be summarized into two main points based on their locally based design thinking.

#### 6.2.1. Climate Response and Utilization

Both the economic foundations and modern livability standards require architects to adopt reasonable strategies to respond to the local climate in rural areas. Types G and I represent two distinct attitudes influenced by climate and habitability. As the type that can be found in most articles, type G emphasizes the rational attainment of physiological comfort in indoor environments including lighting, and temperature. Architects employ high-performance building envelopes to deal with problems caused by harsh cold weather, frequent rain, high humidity, etc. On the other hand, type I, the type with the least articles mentioned, illustrates architects' focus on the psychological experience brought about by climate adaptation. Compared with type G, which shows the attitude of regarding climate as a problem to be addressed, type I demonstrates an attitude of considering climate to be a positive factor that promotes regional characteristics. As a country with a vast territory, climate plays an important role in featuring different regional cultures in China. The rapid urbanization and popularization of air conditioning have reduced this regional difference in urban areas. However, rural areas, where life is more closely connected to nature, still provide a space to preserve and maintain this distinction. The emergence of type I suggests that a highly closed and insulated climate shell is not the only climate adaptation strategy; more open climate adaptation strategies are worth exploring.

#### 6.2.2. The Inspiration Brought by Local Resources

The emphasis of type E on the effective utilization of local specialty agriculture byproducts-based resources and the focus of type F on the traditional building skin's response to the environment bring about unique characteristics for rural architectural practice. This forms a reminder that although many rural areas are in urgent need of improving indoor environmental quality, the optimal solutions remain hidden within the local resources that define the rural character.

Moreover, as the largest agricultural country, crops undeniably serve as a significant resource in the majority of rural areas in China. Utilizing agricultural by-products such as straw and corn husks in construction not only reduces environmental pollution caused by farmers burning straw, but also harnesses local materials for energy efficiency purposes. Many studies [15,99] exploring the utilization of agricultural by-products as insulation materials have recognized the advantages of this strategy. However, when compared to certain cases in type E, disparities between the perspectives of researchers and architects become evident. In relevant studies [15,99], researchers often apply an outer layer such as plaster on both sides to the agricultural by-products insulation layer as a typical construction method, which makes the agricultural by-products invisible. In contrast, architects demonstrate a willingness to showcase these distinctive materials in a visible manner. For instance, corn husks, as insulation fillers, can be directly incorporated at the junction between walls and roofs, reducing thermal bridging while also serving as visual elements that illustrate the connection between the walls and roofs [64]. This, as well as those cases with a visible presentation of construction methods in type F, illustrates the architects' intentions to utilize local resources in the enclosure for better environmental responsiveness and to ensure that this character can be recognized in the building.

#### 6.2.3. Conclusion for Locally Based Design Thinking in Types Emphasizing Livability

Locally based architectural construction strategies in rural areas exhibit a comprehensive interpretation of the climate, local economic conditions, and resources in terms of livability. Livability is closely related to the operation phase of buildings, which accounts for a significant portion of the energy consumption and carbon emissions throughout the building's lifecycle. Consequently, numerous research endeavors have been undertaken to enhance the performance of rural houses. However, types I, E, and F shed light on architects' distinctive perspectives, which go beyond mere functional considerations by incorporating emotional and cultural values inherent to rural areas. The disparity in the number of relevant articles between type G and the other types indicates that beyond the modern mainstream passive enclosure structure approach, additional attention should be focused on new interpretations of local resources and psychological comfort in response to climate change.

### *6.3. Locally Based Design Thinking in Types Emphasizing Aesthetics*

Types H through N, which have at least one tendency to focus on aesthetics, can be grouped around two main points, in relation to locally based design thinking.

#### 6.3.1. Cultural Significance of Local Materials and Their Presentation Methods

Types M and N highlight the use of local materials, while types J and K emphasize the continuation of the methods of presentation of local material. In addition to the economic and ecological benefits of using local materials, these approaches reflect architects' attention to the cultural significance embodied in the visual representation of materials. Through the construction and expression of local materials, regional characteristics can be transferred to the architecture, thus allowing the continuance of collective memories. Moreover, these strategies also reflect the influences of classic architectural theories, such as regionalism and tectonic theory. For example, the preference for using masonry and the attention especially paid to the arrangement of the bricks or stones do not only relate to the local masonry tradition, but also relate to the simplified understanding of tectonics, which leads to a fascination with brick construction among architects in China. Given that architects have significant decision-making power in aesthetic aspects, especially in Chinese rural projects, attention should be paid to avoiding an excessive pursuit of architectural expression.

#### 6.3.2. Familiar yet Unfamiliar Expressions

The use of local materials and their unconventional presentation in type L, the unconventional expression of familiar structures in type H, and the association between familiar climate and unique experiences in type I reflect architects' rediscovery of the familiar in the local context. The modernization process in China does not only influence the building technology and lifestyle of rural areas, but also has a significant impact on the value of aesthetics among the locals. The locals expect an urban life and pursue a building image that could represent urban, which results in a loss of confidence in the aesthetics of the local traditions. These familiar yet unfamiliar expressions in types L, H, and I exhibit the architects' concern on this issue. By presenting familiar objects in ways that are distinct from local customary practices, architecture serves as more than a vehicle for expressing local characteristics, but it is also as a catalyst for inspiring new rural aesthetics and encouraging residents' perceptions and confidence in their own culture.

6.3.3. Conclusion for Locally Based Design Thinking in Types Emphasizing Aesthetics

In terms of aesthetics, which is predominantly controlled by architects, these types manifest traits that conform to universal architectural values. The primary objective is to derive new rural aesthetics from local elements that foster a sense of local identity. However, caution should be exercised to prevent the abuse of this excessive control and to avoid resorting to a trite, sentimental, or ostentatious style of expression.

Moreover, utilizing local materials and rediscovering familiar resources does not merely possess an aesthetic meaning. The familiarity and availability of these materials and resources make it easy for the locals to operate. Given the self-built tradition in rural China, these strategies enable the spread and continuity of these cultural significances in the subsequent building activities without architects. Consequently, the new rural aesthetics does not solely rely on specific buildings designed by the architects, but gained a life among the locals.

*6.4. Sustainability Accompanied with Locally Based Design Thinking in Technology, Livability, and Aesthetics*

Due to the multifaceted nature of sustainability, it is evident that each strategy contributes to sustainability to varying degrees in environmental, social, and economic aspects, based on local concerns. Meanwhile, sustainability is emphasized differently in relation to technology, livability, and aesthetics.

Regarding technology, local concerns prioritize low-cost and easy-to-build features of on-site construction in primary types, which enable new construction modes to be accessible for residents or to local industries, and explore the sustainability of the rural construction activities conducted primarily by locals. Regarding livability, local concerns emphasize low energy consumption during the building-use phase, particularly in the thermal performance of building envelopes. This is supported by ample experimental research [14,15,99] that underscores the importance of mainstream environmental sustainability in the context of energy conservation and emissions reduction. Moreover, architects exhibit different perspectives from the researchers and show concern for emotional and cultural values aligned with the realization of physical comfort. For aesthetics, local concerns are mainly centered on preserving the diversity of rural landscapes, which reflects architecture's role as a cultural carrier. By rediscovering and enhancing rural aesthetics and fostering residents' confidence in their own culture, sustainable rural culture can be achieved.

Additionally, rural construction in China used to be architecture without architects. The engagement of architects in rural construction does not mean entirely changing this situation. Most of the projects introduced in selected articles are only one or a few small buildings, but they function as a trigger for the activation of a large region. The value of their locally based construction strategies is to demonstrate new possibilities for the locals. For instance, traditional building technology can be improved to meet modern requirements, traditional craftsmanship has the potential to incorporate with the new industry and agricultural by-products and familiar resources can be utilized in the buildings for better performance and new aesthetic values. Architects can tap into the local cultural values and possibilities through their locally based design thinking and pass on these values and possibilities to the locals through their architectural design. Since the locals are the main body of rural construction in China, it is this change in the locals that finally incorporate sustainability into the rural construction activity.

## 7. Conclusions

This study investigates the correlations among {Construction Operation}, <Local Element>, and 'Effect' found in 63 articles on rural architectural designs in China, and it identifies 14 types of locally based architectural construction strategies. It highlights that the present paramount concerns in Chinese rural architectural projects revolve around fundamental architectural issues of technology, livability, and aesthetics. In particular, locally based architectural construction strategies in rural China involve the use of appropriate structural systems and modes of construction based on the integration of local techniques, economic factors, and on-site construction conditions, with a focus on promoting the sustainability of rural construction methods that, in their technological aspect, can be primarily conducted locally during the on-site construction phase. These strategies prioritize building envelopes with low energy consumption during the usage phase, taking into account the physiological and psychological experiences of the occupants, mainly focusing on environmentally sustainability in terms of livability. Moreover, these strategies contribute to the diversity of local rural aesthetics by means of rediscovering and highlighting the expression of materials and other perceivable elements of buildings, resulting in encouragement to the residents' confidence in their own culture and contributing to the cultural sustainability in the aesthetics aspect. Furthermore, the local cultural identity that is not limited to aesthetics is always a concern in these strategies. Architects provide their specific perspective to interpret the local identity and opportunities, and architecture that embedded their locally based design thinking function as media to pass on these to the locals. The change in the locals' attitude to their own culture finally enables sustainability in rural construction in China.

The concentration of cases on the diagonal in Figure 3 can be viewed as a property of the current early stage of rural construction in China, where architects are focused on addressing the basic problems of architecture. However, some emerging types of architectural approaches have deviated from this pattern and their combined tendencies focus on different aspects of technology, livability, and aesthetics, suggesting a more diverse and innovative future for rural construction. As architects continue to explore, more types may emerge, even in the areas that are currently blank in Figure 3, which could lead to new forms of sustainability in rural China.

The method of textual analysis used in this study provides an objective approach to comprehending locally based architectural construction strategies utilized by architects in rural construction. In terms of future research directions, a cross-cultural examination can be pursued by analyzing cases of rural construction from other countries, and a comparison among different regions can be conducted.

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## Appendix A

Example for type A: "with the shift in housing perspectives and the decline of traditional craftsmen, the core techniques of traditional rammed earth construction have gradually been lost . . . our team has improved traditional local rammed earth tools with conventional materials such as lightweight angle steel and cast iron. Meanwhile . . . our team has comprehensively standardized the local traditional rammed earth building process . . . its operation is also simple and easy to perform" [54] (pp. 11–12).

## Appendix B

Example for type B: "It is becoming increasingly difficult to find workers under the age of 40 on construction sites, as the traditional building industry is no longer able to attract the younger generation to participate . . . The *In Bamboo* project prefabricated wood structures in a factory . . . Once the future industrialized factories in rural towns, equipped with advanced industrial methods such as robotics, are combined with rural construction industrialization, it will inevitably lead to a more meaningful industrial upgrade . . . and it is particularly important to consider how to create opportunities for traditional craftsmanship to be better integrated into the innovation and production of new industries and technologies" [77] (p. 73).

## Appendix C

Example for type C: "In the design process, it is particularly difficult to resolve the contradiction between local building materials (rubble masonry) and post-disaster 8-degree seismic fortification, as well as the high demand for seismic-resistant structures. The design uses various means such as built-in structural columns and distributed steel mesh sheets to compensate for the looseness of building materials and complete the safe fortification of buildings in earthquake-prone areas" [44] (p. 68).

## Appendix D

Example for type D: "The surrounding areas of Jixi are rich in bamboo, with large bamboo forests on the mountains around Shang Village . . . This project adopts modern bamboo structure . . . As a building material, the processing and construction methods of bamboo are also more convenient for manual operation" [84] (p. 41).

## Appendix E

Example for type E: "Most of the vast rural areas in the north are rich in rice straw . . . This project boldly uses strawboard and rice husk as insulation materials for the enclosure structure of the ecological house . . . This technology is simple to construct and easy for farmers to operate" [31] (pp. 24–25).

## Appendix F

Example for type F: "Many rudimentary houses in Maoping village use vertically oriented wooden boards as the enclosure structure . . . First, the beam end is extended and a 100 mm diameter wooden beam is fixed to the overhanging end with horseshoe nails. Then the wooden boards can be directly nailed to this wooden beam. The middle channel steel is replaced with another 6mm steel bar and tied directly to the wooden board with iron wire. The bottom does not use screws but is directly placed in an upward-opening U-shaped channel steel . . . In this way, wood facades can be randomly hung and replaced at will" [34] (pp. 29–30).

## Appendix G

Example for type G: "The comfortable indoor microclimate in buildings is primarily achieved through an integrated and continuous envelope structure and multi-layered exterior wall construction . . . These features ensure a basic level of comfort and hygiene in school buildings, even in rural areas with tight daily budgets or in situations where there is a complete lack of electricity and water" [46] (p. 74).

## Appendix H

Example for type H: "The structural system of the building is exposed, revealing the positions of structural elements, their forms, component shapes, and connection methods, among others, which are collectively referred to as an open building. This kind of openness is also a distinctive feature of traditional Chinese architecture. Enhancing the transparency of bamboo structures not only enhances their aesthetic appeal, but more importantly, it combats the issue of 'tofu-dreg' construction" [50] (p. 10).

**Appendix I**

Example for type I: "Jiangnan is rainy, but people need to walk through the garden. The eaves are meticulous protection for people . . . The double-slope roof is transformed into two thin plates that overlap and cover each other . . . The deep cantilever enhances the sense of coverage. The thickness of the cantilever is controlled to be extremely light and thin through precise structural calculations, existing as an invisible protection" [75] (p. 62).

**Appendix J**

Example for type J: "The architectural design endeavors to utilize local materials and investigate methods to improve upon traditional local techniques . . . the use of traditional local masonry techniques to create a 'checkered brick' wall surface enriches the facade texture and produces interesting light and shadow effects" [41] (p. 70).

**Appendix K**

Example for type K: "The most common dwelling in Wolong is the Banwu, which combines Qiang and Han cultures. It adopts the Gan-Lan wooden structure and uses flagstone walls as enclosures. The architectural design of Gengda Twelve-year School employs a 'passive' approach to express this local characteristic, using flagstone on the external wall" [52] (p. 56).

**Appendix L**

Example for type L: "The technique of using weaved palm ropes as exterior cladding was achieved through a curtain wall construction method, outside the building's main enclosure structure . . . The binding construction of the palm rope was completed by the aunts in Chenjiapu Village. Many of them had experience in weaving palm ropes before and were familiar with binding methods such as winding and knotting. They also had enough patience to work together tacitly . . . The participation of local villagers in the construction process created a sense of pride as they saw the unique building created by their own hands" [91] (p. 31).

**Appendix M**

Example for type M: "appropriately retain traditional memory symbols . . . embed old wall foundations and column foundation strip stones in the ground paving" [84] (p. 42).

**Appendix N**

Example for type N: "Xiafutou Village in Boai County's Xuliang Town is rich in bamboo . . . Bamboo is used in many places during the renovation of the bathroom, fully reflecting this local characteristic" [33] (p. 31).

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