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Critical Regionalism in Indonesian International-Standard Sports Facilities: Architectural Identity and Resilience

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Abstract: The development of internationally standardized sports facilities in Indonesia often adopts uniform global design standards to meet international federation requirements, risking the loss of Nusantara architectural identity and limiting adaptation to tropical climates and long-term operational needs. This study formulates a critical regionalism strategy for planning internationally standardized sports facilities that integrates Nusantara architectural identity with architectural resilience. A qualitative comparative multiple-case study was conducted on three facilities: the Mandalika International Street Circuit in Lombok, the Muncar BMX Circuit in Banyuwangi, and Manahan Stadium in Surakarta. The analysis focused on contextual typomorphology, regionalist tectonic strategies, and spatial resilience. The findings reveal three key strategies: integrating site topography and geo-climatic conditions into massing and track design, translating cosmological values and vernacular typologies into contemporary tectonic expressions rather than decorative forms, and creating loose-fit spaces that support flexible post-event functions for long-term economic and social sustainability. Architectural resilience is strengthened through tropical climate-responsive design, adaptable circulation systems, and community participation in post-construction management. This study contributes a cross-typology analytical framework that integrates critical regionalism, Nusantara architectural identity, and architectural resilience, offering a comprehensive reference for planning internationally standardized sports facilities in Indonesia.

Keyword: Critical Regionalism, Nusantara Architectural Identity, Architectural Resilience, International Sport Facilities.

INTRODUCTION

The rapid growth of international sporting events in Indonesia over the past decade has driven the construction of sports facilities that comply with the technical standards of international federations, including the Fédération Internationale de Football Association

(FIFA), Fédération Internationale de Motocyclisme (FIM), Fédération Internationale de l'Automobile (FIA), and Union Cycliste Internationale (UCI). These facilities are intended not only to satisfy the requirements for hosting international competitions but also to represent the nation's image through high-quality sports infrastructure. However, the technical standards governing track dimensions, corner radii, run-off areas, grandstand configurations, and safety systems are generally developed based on the geographical and climatic conditions of non-tropical countries. Consequently, the design of sports facilities in Indonesia frequently adopts global design typologies without adequately considering the country's tropical climate, topographical conditions, and local cultural identity.

This phenomenon reflects Frampton (1983) critique of universal civilization, which argues that modern architecture tends to produce homogeneous, placeless buildings detached from their local context. In sports facilities, such design homogenization not only diminishes local architectural identity but also affects the long-term operational sustainability of these buildings after major sporting events. Many stadiums and sports arenas constructed for national and international competitions in Indonesia have exhibited the characteristics of *white elephants*, high-cost facilities that experience declining utilization and become maintenance burdens because they were not designed to support sustainable community activities beyond the competition period.

As a response to these challenges, the concept of critical regionalism offers an approach capable of reconciling international technical standards with local characteristics. Unlike conventional regionalism, which merely reproduces traditional forms as decorative elements, critical regionalism emphasizes a critical interpretation of topography, climate, natural lighting, materials, and local culture, translating these aspects into a contemporary architectural language (Curtis, 1985; Frampton, 1983; Tzonis & Lefaivre, 1981). Within the context of sports facilities, this approach enables the creation of buildings that comply with international regulations while preserving local identity and adapting effectively to tropical environmental conditions.

This concept is closely associated with Nusantara architectural identity, which has evolved in response to Indonesia's geographical, climatic, and cultural characteristics. According to Prijotomo (1992) and Tjahjono (1998), Nusantara architectural identity is expressed not merely through the visual appearance of traditional buildings but through fundamental principles such as spatial orientation, responsiveness to the tropical climate, the use of local materials, and connections with cultural cosmology. Therefore, applying Nusantara architectural identity to modern sports facilities should be understood as a process of reinterpreting local values within contemporary design rather than simply reproducing decorative architectural elements.

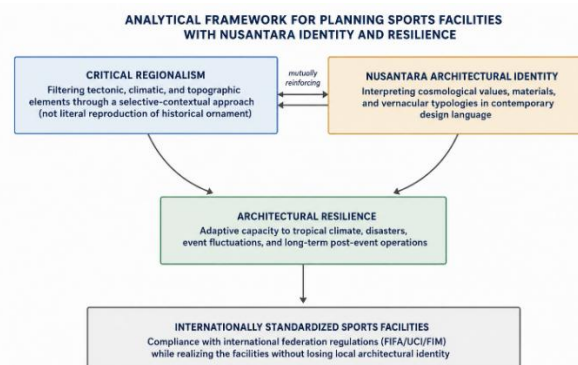
Beyond preserving local identity, sports facilities are also expected to possess the adaptive capacity to respond to changing functions, environmental conditions, and community needs after major sporting events. From the perspective of architectural resilience, buildings are viewed as systems capable of absorbing disturbances, adapting to change, and maintaining their core functions over the long term (Meerow et al., 2016; Walker & Salt, 2006). In sports facilities, resilience extends beyond the ability to respond to tropical climatic conditions; it also encompasses spatial flexibility, operational sustainability, economic efficiency, and community engagement, thereby reducing the risk of *white elephant* developments.

However, the implementation of critical regionalism in internationally standardized sports facilities continues to face significant challenges because it must comply with the technical regulations established by respective international sports federations. These standards govern technical aspects such as track dimensions, safety requirements, spectator capacity, circulation systems, and the visual quality of competition venues (Fédération Internationale de Football Association, 2011; John et al., 2013). Although these standards are universally

applied, architectural expression, material selection, building massing, and landscape integration still provide opportunities to implement context-sensitive design strategies through a critical regionalism approach.

Studies on critical regionalism and Nusantara architectural identity in public buildings have developed considerably. Setiawan & Prijotomo (2017) examined the tectonic characteristics of Nusantara tropical architecture in contemporary public buildings, while Wibowo & Salura (2019) criticized the homogenization of modern stadium design that neglects local identity. Hartono & Wijaya (2020) demonstrated that Javanese cosmological values can still be incorporated into urban sports facilities, although their study did not relate these aspects to the operational sustainability of the buildings. Regarding technical regulations, Pratiwi & Kusuma (2019) and Santoso & Aulia (2022) highlighted the challenges of implementing FIFA and UCI standards within the Indonesian context, but their discussions primarily focused on technical compliance without linking it to strategies for strengthening architectural identity. Meanwhile, Nugroho & Santosa (2018), Putra & Handayani (2021), and Wardhani & Kurniawan (2023) explored the post-event sustainability of sports venues from the perspectives of operational management and community participation. Other studies by Yuniarti & Prasetyo (2020) and Iswanto & Rahmawati (2021) emphasized the importance of local materials and tropical climate mitigation strategies but did not comprehensively integrate these findings within a critical regionalism framework.

Based on this review, several research gaps remain. First, previous studies have generally examined critical regionalism, Nusantara architectural identity, architectural resilience, and international technical standards as separate areas of inquiry, leaving the absence of an analytical framework that integrates these four dimensions. Second, most existing research has concentrated on a single type of sports facility, particularly football stadiums, providing limited understanding of how critical regionalism can be applied across different sports facility typologies with distinct functional characteristics. Third, no study has explicitly explained how a critical regionalism approach can simultaneously satisfy international technical regulations while enhancing spatial resilience and the long-term operational sustainability of sports facilities after major events. To address these gaps, this study develops an analytical framework integrating critical regionalism, Nusantara architectural identity, architectural resilience, and international sports facility standards through a comparative analysis of three sports facility typologies in Indonesia: the Mandalika International Street Circuit, the Muncar BMX Circuit in Banyuwangi, and Manahan Stadium in Surakarta. The conceptual framework illustrates the interrelationship among these four domains as the analytical basis for evaluating contextual, adaptive, and internationally compliant sports facility design strategies, as presented in Figure 1.



Source: Authors' elaboration

Figure 1. Analytical framework integrating critical regionalism, Nusantara architectural identity, architectural resilience, and international sports facility standards.

Based on this framework, the study aims to analyze how geo-climatic characteristics and topography influence the implementation of critical regionalism, identify how these strategies are translated into tectonic elements, material selection, and spatial organization across the three case studies, and formulate spatial resilience mechanisms capable of ensuring the functional, economic, and social sustainability of internationally standardized sports facilities during the post-event period. Accordingly, this study is expected to contribute an integrative conceptual model that serves as a reference for designing internationally standardized sports facilities that not only comply with technical regulations but also preserve local architectural identity and promote long-term sustainability.

METHOD

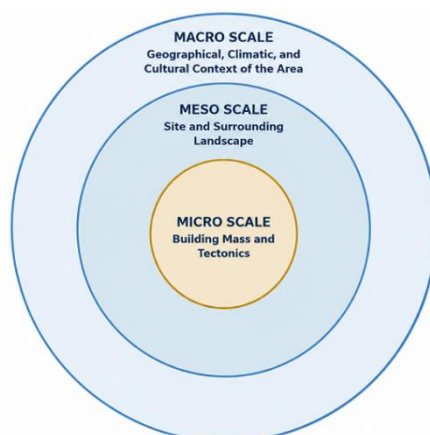
Research Approach and Design

This study employed a qualitative rationalistic approach with a comparative multiple-case study design (Yin, 2014) involving three internationally standardized sports facilities in Indonesia. This approach was selected because the study aims to examine and compare the application of critical regionalism and architectural resilience theories across facilities with different typologies, scales, and cultural contexts, rather than generating new theory solely from empirical field data. The analytical process followed a deductive logic, in which the theoretical parameters formulated in Figure 1 were used to examine the typo-morphological characteristics, tectonic expressions, and circulation systems of each case study, which were subsequently compared to develop a synthesized model.

Study Location and Case Selection

This study investigated three sports facilities representing different typologies to provide comparative diversity. The first case is the Mandalika International Street Circuit in Kuta, Central Lombok, West Nusa Tenggara, a street circuit certified to FIM and FIA standards for MotoGP and World Superbike events, situated within a coastal landscape characterized by Sasak cultural traditions. The second case is the Muncar BMX Circuit in Muncar District, Banyuwangi, East Java, an extreme sports facility at the community scale, constructed on coastal hilly terrain within the cultural context of the Using community. The third case is Manahan Stadium in Surakarta, Central Java, a multifunctional stadium renovated to comply with FIFA standards for the 2023 FIFA U-20 World Cup, located within the cosmological setting of the Javanese royal palace tradition.

Observations of each case study were conducted across three analytical scales: the micro scale, focusing on building massing and tectonic characteristics; the meso scale, examining the site and surrounding landscape; and the macro scale, considering the broader geographical, climatic, and cultural context, as illustrated in Figure 2.



Three Scales of Observation for Critical Regionalism in Case Studies

Source: Authors' elaboration based on Frampton (1983), Tzonis and Lefaivre (1981), and field observation
Figure 2. Three analytical scales of critical regionalism in the case studies, ranging from the regional context to building tectonics.

Data Collection Methods

Data collection in this study consisted of primary and secondary data to obtain a comprehensive understanding of the implementation of critical regionalism in internationally standardized sports facilities. Primary data were obtained through direct field observations, including physical mapping and visual documentation of tectonic elements, material applications, and site layout configurations across the three case studies. The observations also involved mapping circulation patterns and user activities during both event and non-event periods to identify variations in spatial utilization and the functional adaptability of the facilities. In addition, aerial and ground-based photographic documentation was conducted to analyze the relationship between site topography, track alignment, and building mass orientation.

Secondary data were collected through document analysis, including planning documents, technical regulations issued by international sports governing bodies, namely the Fédération Internationale de l'Automobile (FIA), the Fédération Internationale de Motocyclisme (FIM), the Union Cycliste Internationale (UCI), and the Fédération Internationale de Football Association (FIFA), as well as official reports from the respective facility management authorities. These included the Indonesia Tourism Development Corporation (ITDC) for the Mandalika International Street Circuit, the Banyuwangi Regency Government for the Muncar BMX Circuit, and the Surakarta City Government for Manahan Stadium. Furthermore, precedent studies were conducted on internationally recognized sports facilities that successfully integrate local identity with global technical standards, such as the Suzuka Circuit in Japan, which preserves its natural hilly terrain as an integral component of the racing track, and the Singapore Sports Hub, which adapts its roof design to the tropical climate of Southeast Asia. Media reports and construction documentation were also analyzed to reconstruct the design decision-making process and the development trajectory of the three case studies.

Operationalization of Analytical Variables

All collected data were analyzed using four interrelated theoretical variables, as summarized in Table 1.

Table 1. Operationalization of the Research Analytical Variables

Theoretical Variable	Analytical Parameters	Theoretical References
Critical Regionalism	Utilization of site topography; selective incorporation of tectonic elements and local materials; integration with modern structural systems	(Frampton, 1983; Tzonis & Lefaivre, 1981)
Indonesian Architectural Identity	Cosmological orientation; vernacular typology; tropical climate responsiveness in façade and roof elements	(Priyotomo, 1992; Tjahjono, 1998)
Architectural Resilience	Tropical climate mitigation; loose-fit spatial flexibility; post-event community engagement	(Meerow et al., 2016; Walker & Salt, 2006)
International Sports Facility Standards	Compliance with track/field dimensions; spectator safety; sightlines and VIP/media circulation	(Fédération Internationale de Football Association, 2011; John et al., 2013)

Source: Developed by the authors based on Frampton (1983); Tzonis and Lefaivre (1981); Curtis (1985); Priyotomo (1992); Tjahjono (1998); Walker and Salt (2006); Meerow et al. (2016); and Fédération Internationale de Football Association (2011); John et al. (2013).

Data Analysis Procedures

Data analysis was conducted through five sequential phases, as illustrated in Figure 3: (1) literature review and identification of research gaps; (2) contextual typo-morphological analysis of the site in each case study; (3) evaluation of critical regionalism strategies applied to tectonic elements and site layout; (4) assessment of spatial resilience under both event and non-event scenarios; and (5) synthesis of a comparative model integrating the findings from the three case studies into a comprehensive strategic framework.

Comparative Analysis Process Flow of Case Studies


Mandalika International Street Circuit | Muncar BMX Circuit Banyuwangi | Manahan Stadium Surakarta

Source: Developed by the authors.

Figure 3. Workflow of the comparative analysis across the three research case studies

RESULT AND DISCUSSION

Geo-Climatic and Topographic Context of the Three Case Studies

The three case studies occupy significantly different geo-climatic contexts. The Mandalika International Street Circuit is located along the southern coast of Lombok on relatively flat coastal terrain directly facing the shoreline, characterized by a tropical dry climate with strong sea winds throughout the year. The Muncar BMX Circuit is situated on the coastal hilly landscape of Banyuwangi, featuring more varied topography and a humid tropical climate with relatively high seasonal rainfall. Meanwhile, Manahan Stadium is located within the urban context of Surakarta City on relatively flat terrain but is embedded within the

Javanese royal cosmological framework, which influences the orientation of significant surrounding buildings. This diversity of contexts provides an essential basis for comparing critical regionalism strategies in the following sections, as design approaches appropriate for one context cannot always be directly applied to another.

Mandalika International Street Circuit: Coastal Topography as a Generator of Alignment

At the Mandalika International Street Circuit, the coastline and coastal landforms are not treated merely as technical constraints but actively shape the alignment of the 4.3-kilometer circuit, which follows the site's natural topography. This strategy is consistent with the principles of critical regionalism, which regard topography as a generator of design (Tzonis & Lefaivre, 1981), rather than simply land to be leveled in order to satisfy the standardized geometry of a racing circuit. Supporting facilities, including the paddock and control tower, incorporate layered roof structures and open corridors adapted from tropical coastal architectural principles to maximize cross-ventilation in response to the area's high temperatures and humidity. Elements of Sasak cultural identity are selectively integrated through locally woven textile motifs applied to signage and non-structural partitions, ensuring that compliance with the stringent homologation standards of the FIM and FIA regarding circuit geometry and structural materials remains uncompromised.

From a resilience perspective, the primary challenge facing Mandalika is maintaining the economic sustainability of the area during non-event periods, given that the circuit is intensively used only several times a year for international competitions. The resilience strategy therefore includes utilizing the circuit's infield for tourism activities, training programs for local motorsport communities, and music and cultural events during periods without racing, allowing facilities designed to international standards to continue supporting everyday community activities.

Muncar BMX Circuit: Hilly Terrain and Adaptive Tectonics at the Community Scale

In contrast to the mega-event scale of Mandalika, the Muncar BMX Circuit represents a community-scale extreme sports facility that utilizes the existing hillside contours as the basis for the track geometry without requiring extensive cut-and-fill operations. This approach demonstrates that critical regionalism can be implemented more flexibly in smaller-scale facilities, as the regulatory requirements established by the UCI for BMX tracks are relatively less restrictive than those governing international motorcycle racing circuits. Local materials, including andesite stone and processed timber, are employed for shelters and simple spectator stands, while the shelter roofs adopt the steep roof pitches characteristic of Banyuwangi's humid tropical architecture to facilitate rapid rainwater drainage.

The resilience of the Muncar BMX Circuit is largely derived from its modest scale and operational flexibility. The track and supporting facilities are designed for daily use by the local community rather than being limited to official competitions, thereby minimizing the risk of becoming a "white elephant" compared with mega-event sports facilities. Furthermore, the active involvement of the local BMX community in the facility's day-to-day management strengthens its social resilience.

Manahan Stadium: Javanese Cosmology and Urban Multifunctional Resilience

The renovation of Manahan Stadium to comply with FIFA standards for the 2023 FIFA U-20 World Cup presented a distinct challenge: integrating elements of Javanese cultural identity into a facility whose structural components were largely required to conform to standardized international technical specifications. In this case, critical regionalism was implemented by maintaining the building's alignment with the cosmological axis of Surakarta

City, incorporating batik motifs and Javanese geometric ornaments into the secondary façade and entrance gates, and designing open grandstands that utilize natural ventilation characteristic of tropical architecture, rather than adopting the fully enclosed configurations commonly found in modern stadiums located in temperate climates.

From a resilience perspective, Manahan Stadium incorporates loose-fit spaces surrounding the main playing field, including parks and public plazas, which can be adapted for recreational sports, community markets, and urban public activities during non-event periods. This strategy aligns with the principles of economic and operational resilience, emphasizing that city-scale sports facilities should remain integrated into everyday community life rather than functioning solely as venues for official competitions.

Comparative Analysis of Resilience and Identity Across Facility Typologies

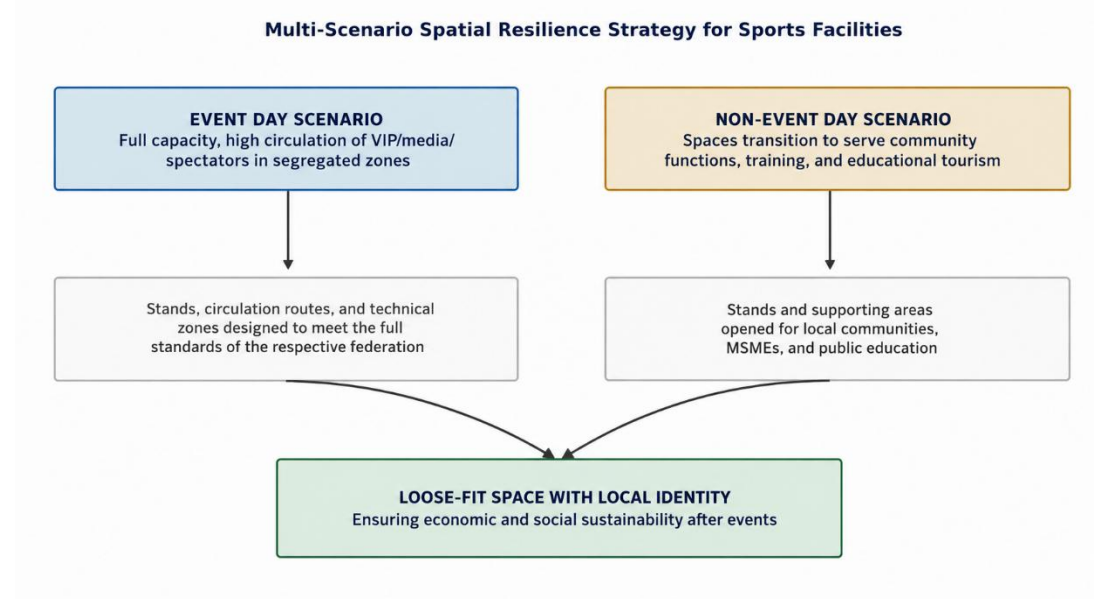
A comparison of the three case studies demonstrates that, despite differences in scale and typology, all apply similar principles of critical regionalism by utilizing the site's geo-climatic conditions and topography as fundamental design generators rather than treating them merely as technical constraints to be overcome. The principal distinction lies in the degree of design flexibility, with community-scale facilities such as the Muncar BMX Circuit possessing greater opportunities for contextual adaptation than mega-event facilities such as the Mandalika International Street Circuit, which must comply with highly stringent homologation regulations. A comparative matrix of critical regionalism strategies across the three case studies is presented in Figure 4.

Comparative Matrix of the Application of Critical Regionalism Principles in Three Case Studies		
Mandalika International Street Circuit, Lombok	Muncar BMX Circuit, Banyuwangi	Manahan Stadium, Surakarta
Coastal topography and shoreline as the alignment element	Existing land contours as the geometric basis of the track	Javanese ornaments and philosophy on the façade and roof
Use of local materials in supporting facilities (paddock)	Adaptive roofs and shelters for humid tropical climate	Building orientation toward urban cosmological axis
Tropical climate mitigation (heat and wind)	Small scale, flexible design for daily events and community use	Natural ventilation in open tribunes for the tropical climate

Source: Developed by the authors.

Figure 4. Comparative matrix of critical regionalism principles applied across the three case studies.

From the perspective of resilience, all three case studies exhibit a consistent pattern by differentiating spatial use between event and non-event scenarios. During major events, all facilities operate in full compliance with federation technical standards, featuring clearly separated circulation systems for VIPs, media personnel, and spectators to ensure safety and operational efficiency. During non-event periods, these same spaces are repurposed for community activities, training programs, small and medium-sized enterprises (SMEs), and public education initiatives, thereby maintaining the facilities' economic and social productivity. This multi-scenario spatial resilience strategy is illustrated in Figure 5.

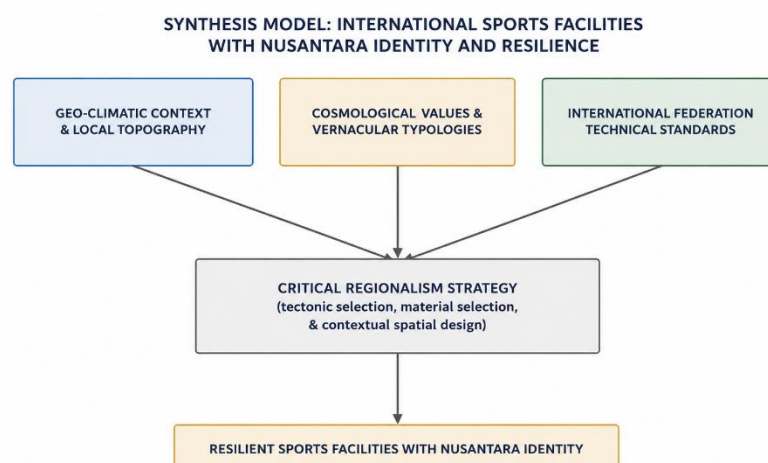


Source: Developed by the authors.

Figure 5. Spatial resilience strategy for sports facilities under event and non-event scenarios.

Synthesis Model: An Integrative Strategy of Critical Regionalism and Architectural Resilience

Based on the findings from the three case studies, this study proposes a synthesis model illustrating how three key inputs, local geo-climatic and topographic conditions, cosmological values and vernacular typologies, and the technical standards established by international sports federations, are critically filtered through a critical regionalism strategy to produce sports facilities that are both resilient and reflective of the architectural identity of the Indonesian archipelago. The model demonstrates that compliance with international standards and the preservation of local identity are not mutually exclusive objectives; rather, they can be integrated through carefully selected design intervention points, including secondary tectonic elements, façade materials, landscape design, and post-event space utilization strategies, without compromising the core structural components that must conform to established technical regulations. The proposed synthesis model is illustrated in Figure 6.



Source: Developed by the authors.

Figure 6. Synthesis model of the integrative strategy of critical regionalism and architectural resilience for internationally standardized sports facilities.

CONCLUSION

This study demonstrates that compliance with international technical standards for sports facilities does not necessarily require sacrificing the architectural identity of the Indonesian archipelago. Through the lens of critical regionalism, the three case studies—Mandalika International Street Circuit, Muncar BMX Circuit, and Manahan Stadium—demonstrate that international regulatory requirements can be effectively integrated with local characteristics through context-sensitive design strategies. The findings reveal three principal insights. First, the geo-climatic conditions and site topography function as design generators that determine track alignment, building mass orientation, and landscape organization, transforming natural conditions into design opportunities rather than merely technical constraints. Second, the architectural identity of the Indonesian archipelago is critically interpreted through secondary tectonic elements, including non-structural façades, signage, material selection, and landscape design, enabling the expression of local cultural identity without compromising compliance with the technical regulations established by international sports federations. Third, the implementation of the adaptive loose-fit space concept enables sports facilities to accommodate a wide range of activities during both event and non-event periods, thereby enhancing spatial resilience while strengthening long-term economic and social sustainability and reducing the risk of white elephant developments.

From a theoretical perspective, this study contributes by developing an analytical framework that integrates critical regionalism, the architectural identity of the Indonesian archipelago, architectural resilience, and the technical standards of international sports facilities into a comprehensive conceptual model. From a practical perspective, the findings provide a useful reference for governments, architects, planners, and sports facility managers in designing infrastructure that satisfies international standards while preserving local identity and ensuring long-term sustainability. Future research is recommended to complement these findings through quantitative assessments of thermal performance, energy efficiency, and economic feasibility related to the implementation of critical regionalism strategies and loose-fit spaces across various typologies of international-scale sports facilities.

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