

Architectural Strategies for Optimizing Circulation in Competitive Equestrian Centres in Kaduna State

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Abstract

Circulation constitutes a fundamental component in the enhancement of accessibility, safety, and the overall experience within competitive equestrian centres. This investigation examined the potential of architectural design methodologies to augment circulation efficiency, with a particular emphasis on equestrian facilities located in Kaduna State, Nigeria. Employing a qualitative, observational case study methodology, field observations were executed to evaluate movement dynamics, spatial organization, and user interactions. The findings indicated that centres featuring broader pathways, multiple ingress and egress points, reduced travel distances among critical areas, distinct separation of equine and pedestrian pathways, effective signage, and shaded walkways exhibited significantly superior performance in terms of circulation efficiency. Conversely, facilities devoid of these characteristics encountered issues related to congestion, safety hazards, and user dissatisfaction. While the conclusions provide pragmatic recommendations for architects and urban planners, the scope of the study was confined to specific facilities in Kaduna, thereby limiting the direct generalizability of the results to other geographical contexts. Nevertheless, the research underscores the notion that deliberate, circulation-focused design can substantially enhance the operational efficacy and safety of equestrian centres, thereby fostering more pleasurable environments for riders, horses, and spectators.

Keywords: Circulation, Efficiency, Competitive, Equestrian Centres, Architectural Design, Safety, User Experience, Kaduna State, Spatial Planning, Wayfinding.

Introduction

Circulation refers to the way people interact with and move within a building. It is a fundamental aspect of architectural design, forming an essential part of the overall design concept. A circulation system encompasses both the physical spaces designated for movement and the mechanisms that support vertical and horizontal movement for people and goods (Norasli and Çinar, 2021).

Equestrian centres are specialized facilities created to accommodate a range of horse-related activities, including training, riding, boarding, and competitions. Typically, these centres comprise a variety of structures such as barns, stables, indoor and outdoor arenas, and additional amenities like tack rooms, viewing areas, and educational spaces

(Kuśmierska, 2023). Their primary purpose is to provide a safe, functional environment where horses and riders can participate in diverse equine disciplines.

Competitive equestrian centres are designed specifically to host structured horse competitions and events (Beaman et al., 2017). These facilities cater to various competitive disciplines, such as show jumping, dressage, and eventing, and are equipped with amenities tailored to the needs of riders, judges, officials, and spectators. Their design and management prioritize the high standards required for professional competitions, ensuring compliance with regulatory and participant expectations (Wang, 2022).

In Nigeria, equestrian sports are growing in popularity, with Kaduna State experiencing a noticeable increase in the establishment of competitive equestrian centres (Williams, 2005). However, these centres present unique circulation challenges that demand careful architectural consideration. The movement needs of horses, riders, spectators, and vehicles must be coordinated within a shared space, each requiring specific pathways and surfaces (Bambi et al., 2013). If circulation is not properly planned, it can lead to congestion, safety hazards, and operational inefficiencies. Efficient circulation is therefore critical for ensuring the safety of horses and humans, promoting the smooth operation of training and competition activities, and enhancing the spectator experience (Onechojo et al., 2024). Poorly managed circulation can result in accidents, delays, and a diminished enjoyment of equestrian events (Schröter et al., 2015).

Despite the observed expansion within the domain, there exists a significant deficiency in both scholarly discourse and professional practice that specifically addresses circulation-oriented architectural design pertinent to equestrian centres in Nigeria. The majority of investigations concerning the design of sports facilities within the nation predominantly focus on football stadiums, multipurpose auditoriums, or general recreational areas, frequently neglecting the distinct spatial requirements associated with equestrian sports. Moreover, the existing international frameworks do not adequately consider Nigeria's climatic conditions, cultural practices, or infrastructural realities. This research endeavors to rectify this deficiency by concentrating explicitly on competitive equestrian centres situated in Kaduna State, a region characterized by a rich equestrian heritage yet marked by a scarcity of architectural inquiry. In doing so, it provides novel, contextually relevant insights that have the potential to enhance future architectural and sports facility design initiatives within Nigeria.

Kaduna State's rich history of equestrian activities, particularly its traditional Durbar festivals, adds another layer of complexity to modern equestrian facility design. There is often a need to balance respect for traditional practices with the requirements of contemporary competitive events. Furthermore, the region's hot and dry climate, availability of land, and access to local materials also influence the design and circulation strategies for these facilities (Sani et al., 2024).

Despite the growing interest, many traditional equestrian facilities in Kaduna State suffer from poor layouts, traffic congestion, and a lack of clear separation between horse and

pedestrian zones. This frequently results in bottlenecks at critical points such as entry/exit zones, stables, and arena access areas, disrupting the smooth movement of people and horses (Kuśmierska, 2023). Inadequate pathway widths, poorly located amenities, and insufficient consideration for accessibility further exacerbate these issues, posing risks to both able-bodied individuals and people with disabilities (Adi et al., 2024).

Given these challenges, this study aims to identify and analyze architectural strategies for optimizing circulation in competitive equestrian centres within Kaduna State. The research seeks to contribute to the development of safer, more efficient, and more enjoyable equestrian environments, not only in Kaduna State but also in similar contexts. By providing practical insights and evidence-based guidelines for architects, planners, and facility managers, the study hopes to address circulation hazards, enhance functional efficiency, and ultimately support the growth and development of equestrian sports in the region.

Materials and Methods

This study investigates effective circulation in competitive equestrian centres in Kaduna State. The following section elaborates on the research design, sources of data, data collection instruments, validity and reliability measures, and data analysis techniques employed in the study.

Research Design

This study adopted a case study method, which is particularly well-suited for exploring complex issues within their real-world contexts. According to Thapa et al. (1994), a case study is "an empirical inquiry that examines a modern phenomenon in its actual context, especially when the distinction between the phenomenon and its context is unclear." This approach allowed for an in-depth analysis of the design and operational requirements of competitive equestrian centres, with a particular focus on circulation; a critical factor influencing the facility's usability, safety, and overall performance. According to Trudell et al. (2023), a case study "offers a detailed analysis of a single instance within a category of phenomena," highlighting its value in examining the intricate challenges associated with effective circulation in equestrian facilities.

Facility Selection Criteria

The three equestrian establishments incorporated in this investigation were chosen based on their significance, accessibility, and degree of competitive engagement. Fifth Chukker Polo and Country Club alongside Kaduna Polo Club are acknowledged as premier facilities within the region, consistently hosting events of national caliber. Clear Water Farms, despite its smaller size, was selected for its distinctive configuration and semi-formal operational approach, facilitating a comparative analysis. Collectively, these facilities

exemplify a range of scale, management methodologies, and circulation strategies within the State.

Sources of Data

Data for this research were collected exclusively through on-site observations at selected competitive equestrian centres. This approach was chosen to gain a rich, contextual understanding of how circulation operates within these environments. Direct observation allowed for the systematic documentation of movement patterns, spatial behaviors, and the influence of architectural elements on user interactions. Observations were carried out at various times throughout the day to capture differences in circulation activities, ensuring a comprehensive understanding of user flow and facility functionality.

To complement observational data, brief informal interviews were conducted with three staff members and two regular riders at each centre. Respondents highlighted challenges in navigating congested zones, particularly at Kaduna Polo Club, and praised the shaded walkways and signage at Fifth Chukker for improving comfort and wayfinding.

Data Collection Instruments and Methods

Field Observations

Field observations were a key part of how data was gathered for this study. To get a real feel for the site, the researcher made several visits to the proposed competitive equestrian centre, carefully timing these visits throughout the day to capture how the space was used at different hours. During each visit, detailed notes, sketches, and photographs were taken to document existing circulation routes, spot areas where movement became congested, and study the overall layout of the space. As Groat and Wang (2013) point out, "direct observation allows researchers to collect data in natural settings, providing insights that might not be possible through other methods", a reminder of how valuable firsthand observation can be for truly understanding the flow of people and activities in a real-world setting.

Observations were conducted during both routine facility usage and scheduled competitive events. This dual focus allowed for comparison between typical day-to-day circulation patterns and those observed during high-traffic conditions. Competitive events included horse racing and local polo tournaments. These periods were particularly valuable in identifying bottlenecks, signage effectiveness, and the adequacy of spatial design under crowd pressure.

Validity and Reliability

Ensuring the validity and reliability of the research findings was a central priority throughout the study. To strengthen construct validity, the researcher carried out repeated field observations at different times of the day, capturing a broad range of circulation activities. Direct observation in case study research offers valuable insights into real-world

settings and helps build the credibility of findings (Morgan et al., 2017). By maintaining consistent observation routines and systematically documenting the process through detailed notes, sketches, and photographs, the study was able to ensure that the results remained dependable and robust.

Data Analysis Techniques

The data analysis process relied on qualitative methods that matched the nature of the field observations collected. Notes from the site visits were carefully coded and grouped to uncover recurring themes and patterns related to circulation in competitive equestrian centres. These emerging themes were then explored further to reveal important connections and highlight the key factors that impact how efficiently people and horses move through the space. According to Naudé, (2024), thematic analysis is "a method for identifying, analyzing, and reporting patterns within data," making it especially well-suited for working with observational findings. This qualitative approach offered a clear and organized way to interpret the circulation challenges and helped shape specific architectural design recommendations.

Data Analysis

The analysis focuses on understanding what makes circulation effective within competitive equestrian centres by looking closely at a variety of design elements, all gathered through field observations. Key factors examined include the width of pathways for both horses and pedestrians, the placement of stabling areas and arena access points, the way communal and spectator spaces are integrated, and how natural light and ventilation are considered in indoor training and competition areas. The evaluation is rooted entirely in the architectural strategies observed on-site, aiming to identify design approaches that improve movement and flow within the facilities.

Spatial Characteristics Across the Competitive Equestrian Facilities

Table 1 presents the circulation design parameters and safety outcomes across the three equestrian centres. Kaduna Polo Club had the widest pathway (3.6m), while Clear Water Farms had the narrowest (2.1m). Fifth Chukker and Kaduna Polo Club had the most access points (4), whereas Clear Water Farms had the fewest (2). Travel distance between stables and arenas was shortest at Clear Water Farms (5m) and longest at Kaduna Polo Club (320m). Fifth Chukker recorded the fewest bottlenecks (1 per hour), and Kaduna Polo Club the most (3). Wayfinding signage was highest at Fifth Chukker (10 signs) and lowest at Kaduna Polo Club (2 signs). Only Fifth Chukker and Clear Water Farms had fully separated horse and pedestrian paths. Shaded walkways were most extensive at Clear Water Farms (61%) and least at Kaduna Polo Club (5%). Natural ventilation was most effective at Fifth Chukker. Safety incidents occurred only at Kaduna Polo Club, with two minor conflicts recorded.

Table 1: Comparative field observations across three equestrian centres in Kaduna State.

Parameter	Fifth Chukker Polo and Country Club, Kaduna	Kaduna Polo Club	Clear Water Farms, Kaduna
Average Pathway Width (m)	3	3.6	2.1
Access Points (count)	4	4	2
Travel Distance (m)	216	320	5
Bottlenecks/hour	1	3	2
Wayfinding Signs	10	2	8
Horse-Pedestrian separation	Fully Separated	Fully Separated	Partially Shared
Shaded Walkways (%)	50%	61%	5%
Ventilation	Excellent	Good	Moderate
Safety Incidents	0	2	0

Note: Travel distance is the average walk from stable to arena.

Interpretation

Among the three facilities, Fifth Chukker Polo and Country Club consistently outperformed the others in terms of circulation. Its wider pathways, greater number of access points, and effective signage contributed to smoother user flow and zero recorded safety incidents. In contrast, Kaduna Polo Club exhibited the weakest performance, marked by shared pathways, minimal signage, and the highest number of bottlenecks and safety incidents. Clear Water Farms, despite having the shortest distances between zones, suffered from narrow pathways and limited climate protection, leading to moderate congestion.

i. Pathway Width: Field visits revealed that Fifth Chukker Polo and Kaduna Polo Club both offered wider pathways, ranging from 3 to 3.6 meters, while Clear Water Farms had the narrowest at just 2.1 meters. The wider paths at Fifth Chukker and Kaduna Polo made it easier for horses and pedestrians to move simultaneously without crowding, reducing congestion risks. Meanwhile, the narrower walkways at Clear Water Farms sometimes led to crowding and bottlenecks, especially during busy event periods.

ii. Number of Access Points: Both Fifth Chukker and Kaduna Polo Club provided four access points each, while Clear Water Farms had only two. The limited number of entry and exit points at Clear Water Farms often caused crowding during peak times. In contrast, facilities with more access points managed movement more smoothly and were better equipped for quick emergency responses.

iii. Average Travel Distance between Stables and Arena: The distance between stables and arenas varied significantly across the sites. At Clear Water Farms, the distance was shortest at about 5 meters, supporting quick and easy movement for horses and riders. Kaduna Polo Club, however, had a much longer distance of approximately 320 meters, which slowed transitions, increased horse fatigue, and complicated event logistics.

iv. Observed Bottlenecks During Event Hours: Kaduna Polo Club experienced the most frequent bottlenecks, averaging three per hour, compared to just one per hour at Fifth Chukker. The higher rate of congestion at Kaduna Polo was tied to fewer access points and longer travel routes, reflecting less effective circulation planning overall.

v. Number of Wayfinding Signs: Wayfinding signage was noticeably better at Fifth Chukker, with ten signs installed around the facility, followed by eight signs at Clear Water Farms. Kaduna Polo Club, however, had only two signs, which often left spectators confused about how to navigate the grounds. Facilities with more signage, like Fifth Chukker, allowed visitors to move around more easily, reducing unnecessary crowding and delays.

vi. Separation of Horse and Pedestrian Pathways: Both Fifth Chukker and Clear Water Farms ensured full separation between horse and pedestrian pathways, greatly enhancing safety. In contrast, Kaduna Polo Club featured partially shared routes, which led to several near-miss incidents between horses and pedestrians, pointing to serious circulation and safety concerns.

vii. Shaded/Climate-Protected Walkways (%): Observations showed that Fifth Chukker and Clear Water Farms had 50% and 61% of their walkways shaded or climate-protected, respectively. Meanwhile, Kaduna Polo Club provided only 5% shading. The lack of shade at Kaduna Polo left horses, riders, and spectators exposed to intense heat, leading to greater fatigue and slower movement. Facilities like Fifth Chukker, which used natural vegetation to create shaded paths, offered cooler, more comfortable environments that supported smoother circulation even during the hottest parts of the day.

viii. Natural Ventilation Effectiveness: Natural ventilation worked best at Fifth Chukker, was rated good at Kaduna Polo, and was moderate at Clear Water Farms. Facilities with better ventilation, like Fifth Chukker, maintained cooler internal environments, encouraging constant movement even in hot conditions. Poorer ventilation at Clear Water Farms often made the atmosphere stuffy and uncomfortable, prompting users to seek shelter and slowing overall circulation.

ix. Observed Safety Incidents (Minor Conflicts, Near Misses): No safety incidents were recorded during observations at Fifth Chukker Polo Club or Clear Water Farms. However, two minor incidents were observed at Kaduna Polo Club, linked mainly to poor pathway separation and minimal signage. Facilities with safer and more organized movement systems clearly reduced the risk of accidents between horses and humans.

Findings

Elaboration of Research

Effective circulation is essential in equestrian centres for performance, safety, and operation. This research focused on the design of equestrian facilities, highlighting how spatial organization improves movement and interaction among all participants.

The study found that pathway width, access points, and circulation zoning significantly affect user comfort and efficiency in Kaduna State's climate. Wider paths improve movement for horses and pedestrians while enhancing ventilation, which is crucial for welfare and comfort during peak sun exposure. Such design strategies are particularly beneficial in equatorial areas, where passive cooling lessens reliance on energy-intensive systems.

Additionally, multiple access points enhance crowd dispersal during events, akin to circulation strategies in global sports venues that prioritize efficient entry and exit for large crowds and emergency situations (Norasli and Çinar, 2021).

The study indicates that traditional equestrian facilities often lack the flexibility needed for modern sports demands. Conversely, contemporary centres should be adaptable and engaging, reflecting architectural principles that prioritize responsiveness to user needs and activity variability.

A key finding is the identification of spatial organization strategies that support effective circulation. By adopting design features promoting smooth movement and accessibility, equestrian centres can improve user experience and operational efficiency. Implementing wider pathways, dedicated access routes, well-placed stabling, and clear zones for horses and pedestrians can alleviate congestion and enhance navigation. The Fédération Équestre Internationale (FEI) recommends separate pathways for horses and humans to minimize incidents and improve fluidity during events. International examples, such as Olympic equestrian venues in Aachen (Germany) and Lexington (USA), showcase modular circulation zones, shaded waiting areas, and high signage density for enhanced event scalability and safety.

Furthermore, the study emphasizes the significance of communal space integration in design. Designated areas enhance circulation and promote user interaction, improving facility functionality and atmosphere. Utilizing local materials like vegetation-based shading offers practical methods for enhancing thermal comfort and user engagement. Such strategies mitigate heat accumulation and encourage social interaction in communal spaces, reflecting a user-centered design approach prevalent in elite equestrian complexes emphasizing passive design for comfort.

While the findings provide insights into circulation design in equestrian centres, limitations exist. The focus on three Kaduna State facilities may induce selection bias, affecting result generalizability. Additionally, the lack of stakeholder interviews omits direct user perception data. Furthermore, reliance on qualitative observations restricts the evaluation of numerical outcomes, such as travel times or incident rates. Future research should incorporate stakeholder feedback and quantitative metrics for a holistic assessment.

Finally, the findings promote a deliberate approach to designing competitive equestrian centres. By emphasizing effective circulation and adaptable spatial layouts, designers can cultivate environments that ensure safety and support high-level competition. These strategies foster an integrated, dynamic equestrian centre tailored to diverse user needs.

Conclusion

This study highlights the essential impact of circulation efficiency on the success, safety, and satisfaction in competitive equestrian centres. Qualitative analysis of three Kaduna State facilities revealed key design strategies, including wider pathways, more access points, shorter travel distances, effective signage, and climate-responsive walkways as vital for optimizing movement.

While these insights are significant, they should be viewed in light of the study's limitations. The lack of quantitative data, stakeholder interviews, and a small geographic sample limits the broader applicability of the findings. Nonetheless, the alignment of observed patterns with international design principles, such as those from the Fédération Équestre Internationale (FEI), supports the credibility of these recommendations.

This research provides architects and designers with spatial strategies derived from field observations that can improve function and safety in equestrian settings. Facility managers may implement these findings by modifying existing layouts, enhancing signage, and adding shaded pathways for improved user comfort. Policymakers and planning authorities are urged to establish minimum circulation standards in future approvals to prioritize safety and accessibility in the expanding equestrian sector.

Ultimately, circulation-oriented design is a crucial aspect of user experience and event success. By incorporating these principles into new and renovated facilities, stakeholders can ensure that equestrian centres in Kaduna and similar locations adapt to contemporary performance, safety, and user demands.

Recommendations**i. Design Pathways with Minimum Width Standards Based on Function**

Pathways used by horses should be a minimum of 3.5 meters wide, while shared or pedestrian routes should not fall below 2.5 meters, particularly in high-traffic areas such as arena entries or stables. These dimensions were associated with lower congestion and smoother transitions at Fifth Chukker Polo Club.

ii. Implement at Least Four Strategically Located Access Points

To improve circulation and emergency responsiveness, equestrian centres should provide a minimum of four entry/exit points, positioned to serve key zones such as stables, arenas, and spectator seating. Facilities with fewer access points, such as Clear Water Farms, experienced notable congestion during peak hours.

iii. Minimize Functional Travel Distances Between Core Zones

Architectural layout should reduce the travel distance between stables and competition arenas to no more than 100 meters, ideally below 50 meters where possible. This reduces

horse fatigue, improves timing efficiency, and aligns with the optimal layout observed at Clear Water Farms.

iv. Ensure Full Separation Between Horse and Pedestrian Pathways

Shared routes were correlated with safety incidents at Kaduna Polo Club. Equestrian centres should maintain physically separated and clearly marked pathways, using fencing, ground texture changes, or signage, to reduce risk of rider-pedestrian conflict.

v. Standardize Wayfinding Signage Placement

Install wayfinding signs every 30–50 meters, especially near key intersections (e.g., entrances to stables, arenas, restrooms, and exits). At least 8–10 signs are recommended for mid-size facilities, following the successful system used at Fifth Chukker.

vi. Incorporate Shaded Pathways Using Local Climate-Responsive Strategies

Use locally sourced vegetation (e.g., neem trees) or pergolas with ventilated roofing to shade at least 50% of all primary walkways, as done at Clear Water Farms. This helps mitigate heat stress during Kaduna's dry season and improves continuous movement.

vii. Enhance Passive Ventilation in Indoor Arenas and Holding Areas

Facilities should be oriented to prevailing wind directions and use high ceilings, open walls, or ridge vents in arenas and stables to maximize natural airflow. Fifth Chukker demonstrated effective circulation under such conditions, improving user comfort and movement.

viii. Design with Stakeholder Feedback and Use Patterns in Mind

Future design efforts should incorporate feedback from riders, spectators, and staff, collected through user surveys or participatory planning, to ensure that circulation strategies meet real-world operational needs.

References

- Adi, H. P., Nahdatunnisa, N., Heikoop, R., and Wahyudi, S. I. (2024). Enhancing Inclusivity: Designing Disability Friendly Pedestrian Pathways. *International Journal of Safety and Security Engineering*, 14(3), 691–699.
- Bambi, G., Monti, M., and Barbari, M. (2013). New solutions for horse shelters to connect to the equestrian paths. *Journal of Agricultural Engineering*, 44.
- Beaman, L., Chattopadhyay, R., Duflo, E., Pande, R., and Topalova, P. (2017). Facilities-Quality_final.doc.
- Kuśmierska, A. (2023). Equestrian facilities: architecture analysis in functional and aesthetic contexts. *Przestrzeń i Forma*, 2023(54), 43–56. <https://doi.org/10.21005/pif.2023.53.b-02>
- Morgan, S., Pullon, S., Macdonald, L., McKinlay, E., and Gray, B. (2017). Case Study Observational Research A Framework for Conducting Case Study Research Where Observation Data Are the Focus. *Qualitative Health Research*, 27(7), 1060–1068. <https://doi.org/10.1177/1049732316649160>

- Naudé, L. (2024). *Thematic Analysis*. 327–350. <https://doi.org/10.1093/oso/9780197677797.003.0017>
- Norasli, M., and Çinar, K. (2021). Analysis of the circulation areas of konya city hospital with space arrangement method. *The Turkish Online Journal of Design, Art and Communication*, 11(4), 1348–1359.
- Onechojo, E. F., Babayo, A. M., Jalam, U. A., Wakawa, U. B., Momme, M. G., and Maleka, J. M. (2024). Review of Integrating Efficient Circulation System in Hospitals. *Deleted Journal*, 17(1), 89–99.
- Sani, I., Haruna, S. A., Musa, B., Usman, S., and Umar, R. (2024). Impact of climate change and adaptation strategies among pastoralists at the ladduga (kachia) grazing reserve in kaduna state, nigeria. *Nigerian Journal of Animal Production*, 52–56.
- Schröter, C., Schulte-Sutum, A., Zeckey, C., Winkelmann, M., Krettek, C., and Mommsen, P. (2015). Accidents in equestrian sports: analysis of injury mechanisms and patterns. *Unfallchirurg*, 120(2), 129–138.
- Thapa, S., Sharma, L. K., Meenakshi, M., and Mola, D. W. (2024). *Unveiling Bullying Dynamics: Assessing The Phenomenon In An Indian Context*. <https://doi.org/10.53555/kuey.v30i5.4628>
- Trudell, L., Waldron, T. L., and Wetherbe, J. C. (2023). *Making the case for single-case research on family business* (pp. 95–107). Edward Elgar Publishing. <https://doi.org/10.4337/9781800884144.00014>
- Wang, X. (2022). Equestrian Sports Competition and Management Analysis System Based on Computer Big Data Environment. *International Conference on Adaptive and Intelligent Systems*, 556–559.
- Williams, A. (2005). Are equestrian competitors a valuable sports tourism segment? An exploratory study. 781. <https://researchoutput.csu.edu.au/en/publications/are-equestrian-competitors-a-valuable-sports-tourism-segment-an-e>