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CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN FRAMEWORK IN ABUJA METRO STATION: AN EMPIRICAL CASE STUDY

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ABSTRACT

Purpose: *Public metro stations function as high-traffic, multimodal nodes that are inherently vulnerable to systemic socio-spatial security threats, a growing trend in most Urban centres especially in Nigeria. This study examines the structural application of Crime Prevention through Environmental Design (CPTED) parameters within existing infrastructure to develop an architectural blueprint for transportation security sectors. The aim of this study is to identify physical vulnerabilities at the Abuja Metro Station and to propose a context-specific passive security framework for developing sub-Saharan urban environments.*

Design/ Methodology/ Approach: *A qualitative case study methodology was employed, involving 20 purposively selected transit stakeholders including urban planners, transit security personnel, and daily commuters. Data collection included structured field observations, qualitative walkthroughs, thematic analysis, and visual estimation techniques to assess architectural blind spots and ambient illumination.*

Findings: *The results show significant operational deficits, including a critical performance score in Territorial Reinforcement with a 20% implementation rate and a low-illumination profile, resulting in 12 distinct structural dead zones. Structural columns and the absence of formal commercial activity (0% activity support) undermine natural surveillance.*

Research limitations/Implications: *The research is restricted to a qualitative assessment of a single transit hub in Abuja with 20 participants. Academically, it shifts focus from expensive active surveillance to design solving passive security suitable to West African.*

Practical Implications*: The ability to overcome these vulnerabilities requires shifting from reactive policing to passive architectural measures. Municipal authorities should institutionalise localised CPTED codes, integrate structured informal retail, and mandate light-reflective materials to create secure, climate-resilient transit environments.*

Originality/Value: *The study delivers an empirical redevelopment framework taking advantage of architectural transparency, enhanced natural surveillance, and clear territorial boundaries adapted to sub-Saharan realities.*

Keywords: *Metro Station, Transportation Hubs, Passive Security Design, Transit Security, Abuja*

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1.0 INTRODUCTION

The rapid and frequently unregulated pace of urbanisation in developing countries has significantly altered public transportation networks, placing considerable operational and structural demands on metro systems and their supporting infrastructure. In contemporary metropolitan contexts, metro stations function not only as transit points but also as essential macro-economic conduits for mass transit. They facilitate the daily movement of millions of urban passengers and simultaneously serve as highly sensitive, high-risk security targets (Alam et al.,2024).

High pedestrian density, complex entry and exit thresholds, and continuous spatial accessibility create unique socio-spatial conditions that increase vulnerability to various forms of criminal activity, including opportunistic theft, institutional vandalism, unauthorised access, and localised violence (Abdullahi,2021). Ensuring passenger safety in these dynamic environments requires both robust physical protection and psychological comfort, extending beyond traditional, resource-intensive active security measures such as closed-circuit television (CCTV) systems and stationary armed personnel (Schuitema,2025).

Environmental design and passive architectural strategies are essential, proactive tools for mitigating risk, promoting natural surveillance, and enhancing user confidence and psychological well-being in public transportation systems. In Abuja, Nigeria's administrative capital, recurring incidents of petty crime, platform overcrowding, and deficiencies in active monitoring underscore the urgent need for security-sensitive, context-aware station design (Adejoh,2013). Security design based on the core principles of Crime Prevention through Environmental Design (CPTED) offers a proactive behavioural approach by shaping the physical environment to deter criminal intent before it materialises (Yoade et al.,2023). Unlike active security measures that rely on consistent power supplies, advanced software, and continuous manpower, passive architectural strategies integrate safety features within spatial layouts, structural column configurations, lighting schemes, material choices, and intuitive, non-electronic wayfinding systems. These interventions not only reduce opportunities for crime but also foster a self-policing perception of public security, encouraging responsible and communal use of transit spaces.

This study explores the systematic integration of passive security design principles in the redevelopment of the Abuja Metro Station as a fundamental measure to curb the rising level of insecurity faced in the transportation sector in Nigeria's Federal Capital Territory (FCT). The Abuja Metro Station functions as a central multi-modal hub, strategically situated in the Central Business District (CBD) adjacent to the World Trade Centre. Jointly managed by the Federal Capital Territory Administration (FCTA) and the Nigerian Railway Corporation (NRC), the station represents a vital node in the city's regional transit network, connecting the high-density metropolitan core to remote expansion satellites such as Kubwa and Idu. Its primary operational purpose is to facilitate the seamless, safe movement of approximately 1.4 million commuters daily, offering a sustainable, rapid rail alternative to the city's significant road traffic congestion and associated transit vulnerabilities.

While global transit systems have successfully institutionalised comprehensive CPTED frameworks into their public building codes, there remains a marked academic and practical gap in applying these principles within the unique socio-spatial, climatic, and economic realities of West African urban centres. Prior regional architectural research highlights that high-traffic hubs in developing nations remain highly

vulnerable to localised theft and structural vandalism due to an over-reliance on resource-intensive, reactive security deployment rather than preventative, design-led solutions (Badiora and Adeyemi, 2021).

A critical shortage exists in evidence-based academic frameworks that address localised challenges such as high-density informal commerce, severe climate-induced visibility reductions, and infrastructure maintenance deficits. This study is positioned at the intersection of architectural design and urban safety, aiming to shift the design paradigm from high-cost active surveillance to design-led passive security. Through a systematic evaluation of the Abuja Metro Station's current CPTED adherence, which is rated as critical, this research provides a localised redevelopment framework that employs architectural transparency, optimised natural surveillance, and clear territorial reinforcement to promote a more resilient, safe, and secure transit environment.

2.0 LITERATURE REVIEW

The concept of Crime Prevention through Environmental Design (CPTED) emerged in the early 1970s as a multidisciplinary strategy to reduce crime by reshaping the layouts and physical attributes of the built environment. CPTED was initially developed by criminologist C. Ray Jeffery and significantly expanded by architect Oscar Newman through his seminal theories on "defensible space" (Mihinjac and Saville,2019). CPTED suggests that the physical environment can be designed to alter human behavior, thereby reducing both crime opportunities and the underlying fear of crime among genuine users.

The foundational CPTED framework is based on four core, interdependent principles: natural surveillance, natural access control, territorial reinforcement, and maintenance or management, as this study adopts the foundational CPTED principles originally established by (Jeffery,1971 and Newman, 1972). However, the specific conceptual mapping and structural redevelopment framework tailored to public transit architecture within Sub-Saharan Africa are uniquely developed by the author to address regional infrastructural realities as presented in Figure 1 below.

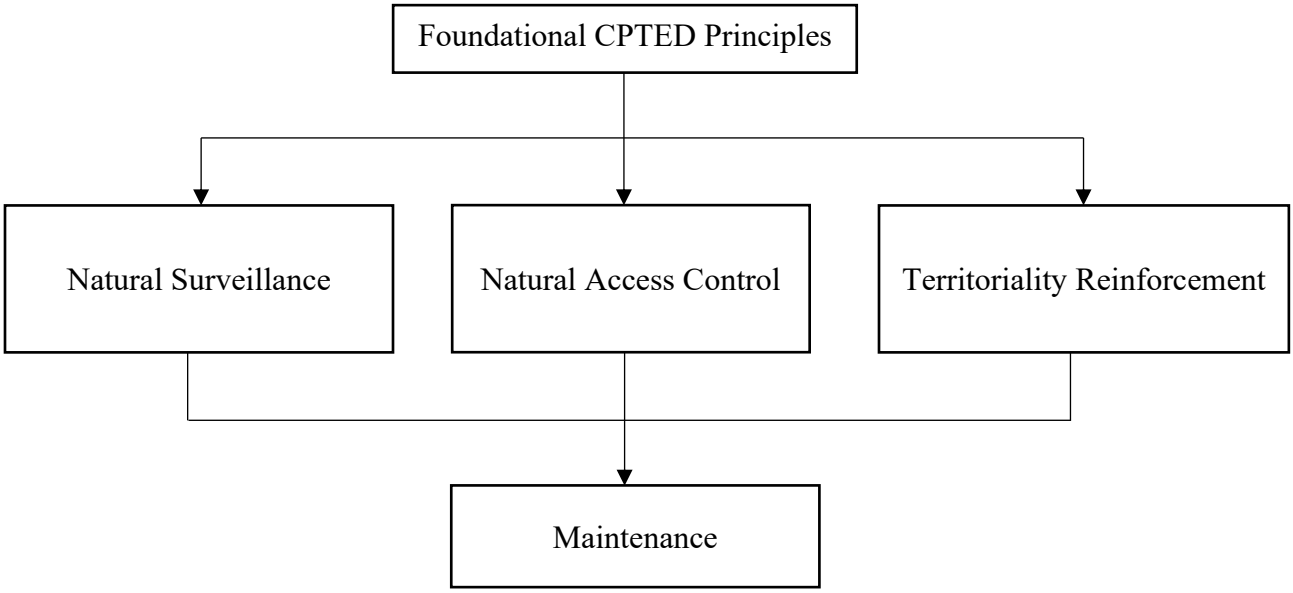

Figure 1. Conceptual mapping of foundational CPTED principles within public transit architecture.
Source: Author, 2026

In public transportation infrastructure, these passive security measures cannot be treated as optional fixtures; they must be integrated directly into the physical layout. This involves using strategic high-output lighting mediums, open and uninterrupted sightlines, clear territorial zoning barriers, and highly durable, low-maintenance materials to ensure security is embedded into basic architectural decisions, making safety less intrusive, highly sustainable, and more cost-effective than active policing (Ikani, 2021). Comparative international experiences, such as the spatial design of the Singapore MRT and the continuous upgrades to the London Underground, demonstrate that passive strategies like open station layouts, minimised column obstructions, and natural wayfinding significantly enhance operational efficiency and passenger safety (Izak,2025; Li et al.,2024).

However, the academic and institutional adoption of CPTED is not void of intense critiques. CPTED critics argue that overly relying on physical design cues can easily lead to "fortress architecture," characterised by hostile, defensive enclosures that potentially displace crime to adjacent, unmanaged neighborhoods rather than eliminating it, while creating exclusionary public spaces that marginalize vulnerable or low-income populations (Binnington & Russo, 2022). Furthermore, recent literature (Molnar, 2024) suggests that an exclusive focus on physical design cues often ignores the underlying socio-economic drivers of urban crime, such as systemic poverty and unemployment, potentially providing a false sense of security if not matched with comprehensive social interventions and operational management.

Within the Abuja Metro Station context, the strategic implementation of passive security offers distinct advantages in terms of long-term cost-effectiveness and cultural relevance. Integrating CPTED principles during the architectural redevelopment phase reduces the high, recurring operational costs associated with active surveillance technology, which are often compromised by Nigeria’s inconsistent municipal power supply and grid failures. Additionally, the strategic placement of communal seating and transit-oriented commercial spaces leverages the traditional Nigerian concept of communal protection, transforming ordinary commuters into active, informal participants in station security (Alemika, 2011; Cozens, 2014).

However, the implementation of these strategies in Abuja encounters localised environmental, structural, and institutional constraints. Abuja’s tropical wet-and-dry climate and heavy seasonal Harmattan dust necessitate specialised material resilience to prevent rapid environmental degradation, which could otherwise trigger the "Broken Windows" effect, signalling an unmanaged environment to potential offenders. The station’s location within a high-density zone requires a flexible, transparent layout that accommodates informal commercial activities without compromising critical security sightlines or obstructing entry and exit routes (Ekblom et al., 2013). Although passive design reduces the burden on formal law enforcement, its effectiveness in Abuja depends on a robust maintenance culture and adaptability to rapid urban growth.

Whilst examining against international best practices, the challenges at the Abuja Metro Station highlight the importance of adapting global lessons to local contexts. Singapore’s open design philosophy emphasizes unobstructed sightlines and spatial transparency, offering an effective model for enhancing natural surveillance. Similarly, London’s extensive use of integrated lighting systems offers valuable strategies for addressing lighting-related safety concerns in high-density transit environments. Mexico City’s gender-responsive approaches, such as women-only train cars and intentionally placed retail

outlets, are highly relevant in Abuja, where gendered safety concerns are pressing, and socio-cultural similarities make these strategies particularly impactful (see Table 1). However, successful adaptation of these practices requires careful consideration of Abuja's tropical climate, limited maintenance resources, and socio-economic realities to ensure long-term sustainability (Gadiaga et al.,2025).

Table 1: Comparative Matrix of Global Transit CPTED Applications vs. Abuja Realities

City / System	Core CPTED Strengths	Environmental & Socio-Economic Constraints	Adaptability to Abuja Context
Singapore (MRT)	Open station layout, 360-degree transparency, state-of-the-art wayfinding systems.	Low baseline crime, high capital funding, controlled climate-conditioned environments.	Features High Architectural Relevance with emphasizes on the structural necessity of eliminating opaque columns to optimize natural surveillance corridors.
London (Underground)	Integrated high-lux lighting matrices, clear territorial zoning guidelines.	Historic structural constraints, high energy expenditure for active lighting systems.	Highlights the operational necessity of reaching a minimum 200-lux safety baseline in high-traffic zones which is Highly Adaptable.
Mexico City (Metro)	Gender-sensitive zoning, strategic integration of formal retail barriers.	Extreme peak-hour overcrowding, high rates of gendered pocket-picking and theft.	Fits Abuja's high-density informal commercial pressures and addresses vulnerable commuter demographics via spatial programming.
Abuja Metro Station	Favorable structural shell and strategic urban footprint within the CBD.	Harmattan dust obscuration, inconsistent power grid, lack of commercial activity support.	Requires a transition from reactive, high-cost policing to localised, climate-resilient passive design.

3.0 AREA OF THE STUDY

The area selected for the study is situated in the Federal Capital Territory (FCT) of Nigeria, a site selected for its regional strategic importance and prominent architectural challenges related to physical visibility, lighting levels, and access control. The Abuja Metro Station functions as a central multi-modal hub, strategically situated in the Central Business District (CBD) adjacent to the World Trade Centre. It is jointly managed by the Federal Capital Territory Administration (FCTA) and the Nigerian Railway Corporation (NRC), the station represents a vital node in the city's regional transit network, connecting the high-density metropolitan core to remote expansion satellites such as Kubwa and Idu. Abuja Metro Station primary operational purpose is to facilitate the seamless, safe movement of approximately 1.4

million commuters daily, offering a sustainable, rapid rail alternative to the city's significant road traffic congestion and associated transit vulnerabilities.

4.0 METHODOLOGY

This study adopts a qualitative case study approach to investigate the integration of passive security design principles in the redevelopment of the Abuja Metro Station. This research design is highly appropriate for gaining an in-depth, multifaceted understanding of user interactions within the built environment and evaluating the impact of spatial interventions on human safety perceptions. The study area is situated in the Federal Capital Territory (FCT) of Nigeria, a site selected for its regional strategic importance and prominent architectural challenges related to physical visibility, lighting levels, and access control.

4.1 Participant Selection and Sample Characteristics

Participants were selected through purposive sampling to ensure a broad triangulation of technical design expertise and lived commuter experience. A total sample of $N = 20$ participants was recruited, as detailed in Table 2. Ethical approval was obtained from the Institutional Review Board of the Federal University of Technology, Minna, ensuring informed consent, confidentiality, and data protection for all participant groups.

Table 2. Demographic breakdown and operational criteria of study participants

Participant Group	Sample Size (N)	Percentage (%)	Selection Criteria / Research Contribution
Metro Administrative & Operational Staff	5	25%	Provided insights into daily facility management and operational bottlenecks.
Security Experts	5	25%	Transit police and urban security consultants familiar with local crime trends and vulnerability patterns.
Regular Commuters	10	50%	Captured diverse, firsthand perceptions of physical safety, transit vulnerabilities, and spatial anxiety.
Total Sample	20	100%	Data saturation achieved with no new thematic insights observed.

4.2 Field Data Collection Procedures

Data collection employed multiple concurrent methods to ensure strict construct validity. Semi-structured interviews were conducted with the ten (10) key institutional stakeholders (staff and security experts), while the ten (10) commuters provided qualitative data through guided field interactions and walkthroughs. This sample size was justified by achieving clear data saturation, in which no new thematic insights regarding the station's CPTED adherence or spatial failures emerged across successive interactions.

To complement these interviews, rigorous field observational studies were conducted using a quantifiable Indicative Scale (Table 3) and detailed photographic documentation to record specific architectural vulnerabilities. Also, quantitative empirical metrics were introduced alongside qualitative data by mapping spatial visibility percentages and tracking artificial illumination coverage across critical egress paths, platforms, and stairwells at different intervals of the day (morning peak, off-peak afternoon, and evening peak).

Table 3: Unified CPTED Framework Scaling & Empirical Benchmarks

Scale	Rating	Lighting & Illumination Quality Profile	Spatial & Sightline Optimisation	Diagnostic Status
Extremely Adequate	5	Full illumination coverage i.e. Zero shadow zones and all fixtures are functional	100% optimised sightlines: Zero architectural dead zones	✓ Optimal Design ✓ High Security
Exemplary	4	High illumination coverage i.e. Minor shadowing restricted to non-walking areas	Minimal obscuration (less than 5%): Minor column interference.	✓ Standard Adherence ✓ Acceptable
Strong	3	Clear facial recognition possible and minor fixture gaps providing moderate illumination.	Minimal sightline fragmentation: Structural dead zones mitigated by design.	✓ Moderate Pass ✓ Low Risk
Moderate	2	Deep shadows over walking paths; limited facial recognition creating Partial illumination.	Noticeable sightline fragmentation; Pillars create 4 to 6 unmonitored alcoves	✓ Critical Vulnerability ✓ Action Required
Minimal	1	Pervasive dark zones; high reliance on ambient city glare having Severe illumination deficit.	Severe spatial obscuration: Geometry creates 7 to 12 distinct dead zones.	✓ Severe Failure ✓ High Risk
Poor	0	Total absence of operational lighting i.e. Complete darkness across transit envelopes.	Total sightline fragmentation: Complete structural enclosure of unmonitored alcoves	✓ Absolute Deficit ✓ Extreme Danger

4.3 Data Analysis

Data were analysed using thematic analysis following the rigorous six-phase framework established by Braun and Clarke. This process involved generating initial codes from interview transcripts, clustering codes into overarching themes, and socializing them to interpret how environmental cues and user perceptions intersect. These codes were specifically clustered into micro-environmental spatial typologies to track how specific architectural elements, such as massive concrete column configurations and deep structural alcoves, correlate directly with the psychological anxieties and safety gaps reported by transit users.

5.0 PRESENTATIONAND DISCUSSION OF RESULTS

5.1 Security Overview at the Abuja Metro Station

The comprehensive security assessment of the Abuja Metro Station identifies a significant, systemic disconnect between its high-visibility urban context in the central business district and its internal architectural efficiency; the station fundamentally fails to meet basic safety-by-design benchmarks. The research highlights that while the central concourse provides a short-lived impression of safety, the critical under-performance in Territorial Reinforcement and Facility Maintenance creates severe blind spots that facilitate unauthorised access, structural vandalism, and petty theft. Consequently, the station remains a high-vulnerability environment, requiring urgent architectural intervention to move beyond minimal safety adherence. To establish the empirical necessity for a regional redevelopment framework, the following subsections provide a detailed diagnostic profile of the station's baseline CPTED parameters.

5.2 Spatial Typology and Natural Surveillance Analysis

The Abuja Metro Station’s natural surveillance has an insufficient average efficiency ratio of 48.75%, as shown in the dual-axis chart in Figure 2. While the physical site location scores highly at 4 out of 5 (80%) due to its central urban positioning, its practical security value is severely compromised by a total failure (0% efficiency) in both gated access control and perimeter boundary definitions. Furthermore, architectural obstructions, specifically the massive, opaque circular structural columns, heavily fragment internal sightlines, spatial arrangements, and the overall design layout, which all accumulated at a moderate score of 3 (60%). This structural deficit is compounded by a low site plan rating of 2 (40%), pointing to a critical lack of integrated lighting and spatial transparency across the wider platform layout. To resolve these operational vulnerabilities, the station's architectural shell must transition away from heavy visual barriers toward open-view design philosophies that eliminate structural blind spots and reinstate natural guardianship.

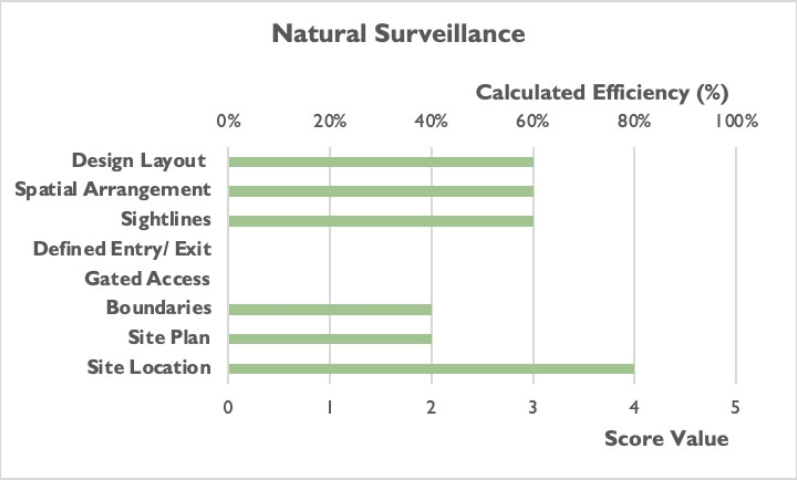

Figure 2. Natural Surveillance calculated Efficiency

5.3 Access Control and Pedestrian Flow Dynamics

As detailed via the consolidated baseline metrics, access control operates at a limited 45% efficiency. A significant disparity exists between the heavily built entrance shells (80%) and their practical operational utility. The system breaks down entirely at platform access thresholds (40%) and due to non-existent wayfinding systems (0%) captured in Figure 3. The resulting formation of non-sterile zones and localised crowding creates high-vulnerability pockets. Without restoring hardware functionality and establishing crisp, intuitive pedestrian zoning, the station envelope remains a soft target despite its substantial concrete mass. Robust initial entrance infrastructure, but rendered ineffective by non-functional control hardware, severe screening gaps at platform access points, and a total absence of intuitive wayfinding typography.

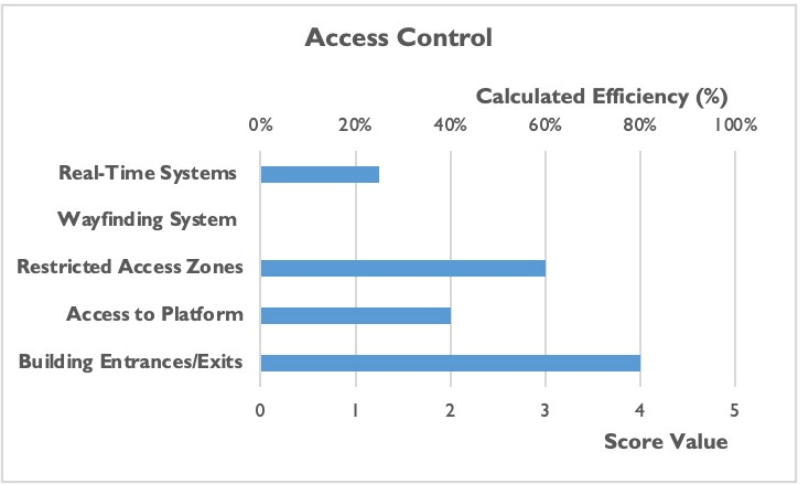

Figure 3. Access Control calculated Efficiency

5.4 Territorial Reinforcement and Activity Support Deficiencies

Territorial reinforcement is the weakest passive security principle at the station, with an overall implementation of only 20% (Figure 4). The field audits confirmed a complete absence of proprietary cues, community markers, or symbolic public art (0%). Weak landscaping and boundary fencing (40%)

exacerbate spatial blurring, making the perimeter easy to breach. This lack of territorial definition disproportionately impacts vulnerable demographics, particularly female commuters during low-occupancy hours. This vulnerability is compounded by an exceptionally weak Activity Support score of 27%, directly due to a total absence of managed commercial retail options (0%), which could otherwise generate informal community guardianship. Critical deficiency in proprietary cues seen in Figure 5. There is lack of symbolic boundaries, community markers, or expressive public art leads to acute spatial neglect and higher user anxiety. Complete absence of integrated commercial retail platforms. Deprives the station environment of transaction-driven natural guardianship ("eyes on the street").

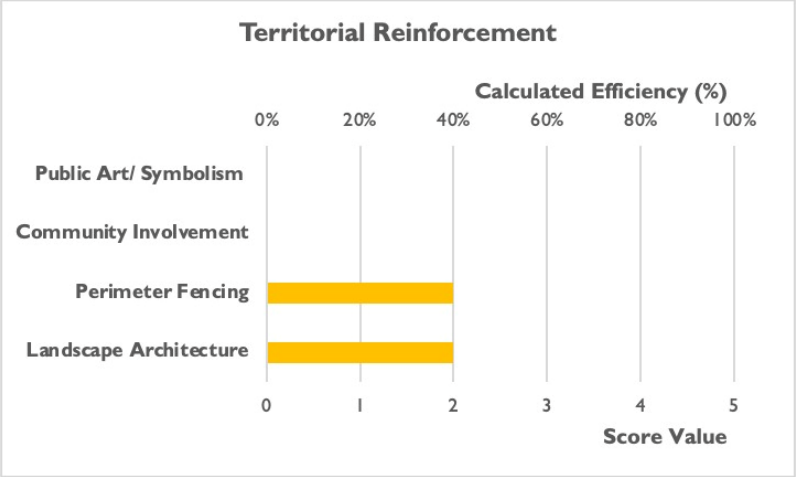

Figure 4. Territorial Reinforcement calculated Efficiency

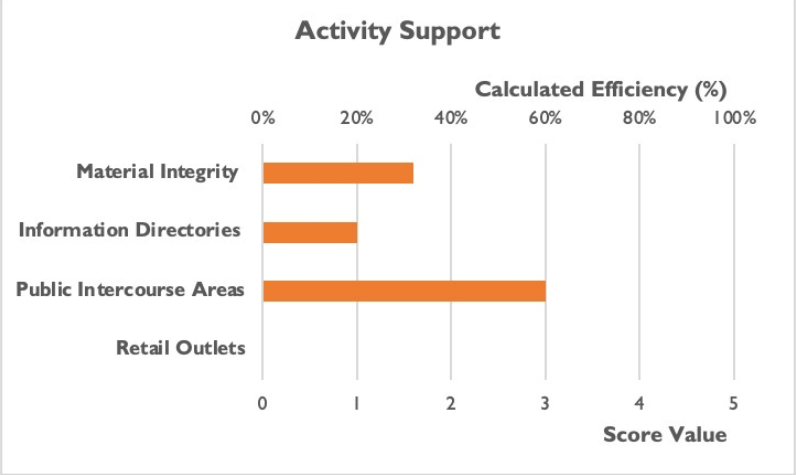

Figure 5. Activity support calculated Efficiency

5.5 Micro-Environmental Typological Analysis

5.5.1 Structural vulnerabilities and spatial blind spots

The primary structural vulnerability identified during the intensive architectural audit of the Abuja Metro Station is the prevalence of massive, opaque circular columns supporting the main concourse deck. These deep reinforced concrete elements act as severe visual barriers across the passenger floor plate.

Quantitative spatial mapping indicates that a significant percentage of the station's total floor area is completely shielded from direct sightlines.

This spatial fragmentation has generated 12 distinct "dead zones" and unmonitored architectural pockets where anti-social or criminal behaviour can occur completely shielded from both human sightlines and electronic CCTV camera angles. The density and physical girth of these columns directly violate CPTED continuous sightline protocols, providing potential offenders with ample concealment options and severely undermining the station layout's inherent security.

5.5.2 Poor lighting and environmental deterrence

Quantitative photometric assessments executed using visual estimation and visual tracking matrices revealed that ambient illumination levels across critical exits, stairwells, and passenger waiting zones average less than 50 lux. This creates a sharp, dangerous contrast to the 200-lux international safety standard required for high-traffic transit hubs. These dark zones function as a significant environmental deterrent, greatly exacerbating passenger fear and reducing station utility during the winter Harmattan dust seasons or after dusk.

Furthermore, this low illumination creates a severe technical failure point: it heavily degrades the capture quality of active CCTV cameras, rendering the electronic surveillance systems effectively blind. The lack of visibility discourages legitimate "eyes on the street" and reinforces a negative perception of the station as an unmanaged, high-risk environment.

5.6 Synthesis and Discussion: The Sub-Saharan Redevelopment Framework

The empirical findings reveal that safety at the Abuja Metro Station is a highly integrated architectural problem: structural blind spots (the column shadow effect) directly intersect with severe photometric deficits (<50 lux) to maximize localised security risks. These physical vulnerabilities cannot be solved via isolated active surveillance or localised security guards. Instead, they demand a structured, reproducible framework designed specifically to withstand the unique environmental and socio-economic pressures of Sub-Saharan transit hubs.

To fulfill the primary objective of this study, the empirical failures identified at the Abuja Metro Station are translated below into an actionable, scalable architectural and policy blueprint. This framework bridges the gap between raw spatial data and regional municipal application.

Table 4: Actionable CPTED Redevelopment Framework for Sub-Saharan Transit Hubs

Framework Pillar	Empirical Trigger (Abuja Deficit)	Targeted Architectural & Material Intervention	Sub-Saharan Scalability Mode
1. Structural Transparency	12 Distinct Column-Induced Spatial Dead Zones; 45% Surveillance Efficiency.	i. Replace or wrap lower sections of opaque structural columns with high-durability reflective panels. ii. Install convex programmatic mirrors at all architectural alcoves.	**Design Typology Standard:** Mandatory integration into municipal building codes for high-density rail stations across

		iii. Transition future platform expansions to open-span steel trusses to maximize clear sightlines.	developing West African cities.
2. Climate-Resilient Photo metrics	Illumination levels averaging <50 lux; severe CCTV pixel degradation.	i. Install automated high-output LED matrices engineered with dust-sealed IP65 housings to withstand Harmattan weather. ii. Establish a minimum 200-lux safety baseline at all egress corridors. iii. Pair lighting loops with localised solar-inverter back-ups to bypass grid instability.	**Infrastructure Baseline:** Universal lighting standard enforced via facility management key performance indicators (KPIs).
3.Transaction-Driven Guardianship	0% Activity Support via Retail Integration; lack of natural human presence.	i. Design integrated, modular retail kiosks directly into underutilised platform zones. ii. Formalize informal commerce into structured, transparent stall micro-zones to maintain clear visual sightlines.	**Socio-Economic Model:** Leverages local commercial pressures to generate self-funding, passive security through continuous human presence.
4. Sterile Zoning & Wayfinding	0% Wayfinding Efficiency; open, non-sterile platform infiltration.	i. Implement color-coded, high-contrast, non-electronic floor and wall wayfinding graphics immune to power outages. ii. Re-engineer pedestrian flows using physical glass/steel barriers to clearly separate public concourses from sterile passenger zones.	**Operational Blueprint:** Standardizes passenger processing layouts to eliminate overcrowding and prevent pocket-picking at peak hours.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This comprehensive study underscores that passive security design constitutes both a technical and policy imperative for the sustainable redevelopment of transit systems in rapidly urbanising regional centres.

Through the evaluation of the Abuja Metro Station as a primary case study, the findings demonstrate that CPTED-based interventions—specifically enhanced natural surveillance, robust territorial reinforcement, and optimised spatial layouts—can effectively mitigate recurring operational challenges such as opportunistic theft and platform overcrowding, while significantly improving passenger psychological comfort. The findings reveal three core insights regarding transit system optimisation. First, public safety perceptions serve as a foundational pillar that directly dictates a transit network's long-term operational viability and economic success. Second, deliberate spatial design decisions directly shape the built environment, either fostering or inhibiting opportunities for informal community guardianship and natural surveillance. Finally, public security achieves its maximum efficiency only when passive architectural features are seamlessly integrated with active technological systems and rigorous, day-to-day operational management.

This study advocates for embedding security considerations into the initial design phases of infrastructure projects, ensuring that international best practices are contextually adapted to local socio-cultural and environmental realities. Such an approach provides a resilient blueprint for inclusive public transportation across sub-Saharan Africa.

6.2 Policy and Institutional Recommendations

To facilitate municipal approval, a multi-phased implementation plan is recommended, scaling from immediate spatial modifications to long-term governance frameworks. Over the first 6 months, immediate priority must be given to critical infrastructure upgrades. This includes deploying high-output LED fixtures in high-risk waiting zones and egress corridors to elevate illumination from sub-50 lux to a universally compliant minimum of 200 lux, effectively eliminating camera blindness, and fitting structural alcoves and dead zones with convex mirrors or transparent paneling to maximize sightlines around massive circular columns.

Subsequently, aligning into a medium-term timeline of six to eighteen months, efforts of transitioning to spatial reconfiguration involving integrating modular retail kiosks and managed informal commerce spaces within underutilised dead zones to generate activity support and foster continuous natural surveillance, while simultaneously restructuring pedestrian directional flow using clear, intuitive wayfinding typography and structural barriers to establish defined, sterile transit zones.

Lastly, looking beyond eighteen months, long-term governance frameworks must be institutionalised. It is recommended that the Federal Capital Territory Administration (FCTA) and the Nigerian Railway Corporation (NRC) formally adopt the CPTED performance metrics established in this study into standard building control codes for all future transit infrastructure developments in Nigeria, while embedding Smart Lighting Systems and Video Content Analytics within the physical architectural layout to actively complement the passive CPTED design shell (Marzbali et al., 2012; Rowland et al., 2024).

7.0 LIMITATION OF THE STUDY

This study is limited to the qualitative evaluation of a single transit facility, the Abuja Metro Station, using a purposive sample of 20 stakeholders. Whilst examining against international best practices, implementation of passive security strategies in Abuja encounters localised environmental, structural, and

institutional constraints. Abuja's tropical wet and dry climate and heavy seasonal Harmattan dust necessitate specialized material resilience to prevent rapid environmental degradation. The long-term effectiveness of these recommendations depends heavily on establishing a robust municipal maintenance culture and institutional adaptability to rapid urban growth. Therefore, future research should expand this framework across other urban transit hubs and structural typologies within sub-Saharan Africa.

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