



Sustainable Environment and the built Space: Integrating Ecology, Planning and Human Well-being

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**IGBO ARCHITECTURE AS A FRAMEWORK FOR SUSTAINABLE CLIMATE DESIGN IN A
REFORMATORY FACILITY FOR JUVENILES IN CONFLICT WITH THE LAW IN
SOUTHEASTERN NIGERIA**

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Abstract

Southeastern Nigeria faces severe climatic pressures characterized by intense solar radiation and high relative humidity. Concurrently, institutional facilities for juveniles in conflict with the law remain heavily reliant on punitive, poorly ventilated, and energy-inefficient designs utilizing high-embodied-energy materials like concrete and glass, which induce severe thermal discomfort in tropical zones, and rely on restrictive, isolating layouts that hinder psychological rehabilitation. This paper presents an eco-cultural architectural framework for a juvenile reformatory facility by adapting the passive cooling strategies and socio-spatial configurations of vernacular Igbo architecture to address contemporary environmental and social challenges. This study highlights how traditional concepts - specifically the decentralized courtyard compound, Ezi, the central communal hall, Obi, thick earthen wall systems, and passive cooling strategies - can serve as both a rehabilitative tool and a climate-responsive solution. The methodology combines qualitative analysis of Igbo architectural features with case study of an existing juvenile facility. Findings reveal that Igbo architecture-inspired designs - such as courtyard layouts provides an organic spatial psychology that balance passive surveillance with personal autonomy, dignity, and peer socialization, high-thermal-mass earthen walls, and passive cooling strategies such as north-south building orientation, long eaves which significantly reduce energy consumption while fostering communal rehabilitation and cultural identity. This study emphasizes the importance of cultural sustainability, environmental resilience, and restorative justice in reformatory facility design. The study concludes that synthesizing Igbo vernacular building knowledge with modern low-carbon materials directly advances UN Sustainable Development Goal (SDG) 11 (Sustainable Cities and Communities) and SDG 16 (Peace, Justice, and Strong Institutions).

Keywords: Traditional Igbo Architecture, Sustainable Design Strategies, Juvenile Rehabilitation, Spatial Psychology

1. INTRODUCTION

The design of custodial and reformatory infrastructure for juvenile offenders requires a delicate balance between security, environmental sustainability, and therapeutic rehabilitation. This dual imperative directly aligns with United Nations Sustainable Development Goal 16 (Peace, Justice, and Strong Institutions), which targets the promotion of peaceful, inclusive societies and the provision of humane, restorative justice systems that safeguard human dignity. In South Eastern Nigeria, which is geographically characterized by a

hot-humid tropical climate, contemporary institutional buildings rely heavily on energy-intensive modern materials like sandcrete blocks, unshaded corrugated metal roofs, and artificial mechanical cooling (Mba et al., 2024). The juvenile justice framework in Nigeria traditionally relies on infrastructural design focused heavily on containment and punishment rather than therapeutic correction (Thanni & Nyekwere, 2025). These design choices generate hostile, high-glare, and thermally oppressive indoor environments that aggravate the psychological stress of institutionalized youth.

Standard correctional layouts emphasize continuous linear isolation, high perimeter walls, and minimal connection to nature. Existing juvenile institutional facilities mirror adult maximum-security prisons: they feature dark, airless cells, concrete and corrugated metal envelopes, and high walls that trap heat. This severe thermal discomfort induces chronic psychological distress, heightens aggressive impulses, and sabotages rehabilitation efforts (Olakunle & Olabode, 2016). Concrete and metal envelopes act as severe institutional stressors, producing intense thermal discomfort and localized heat traps.

To break this loop, architectural practice must pivot toward indigenous knowledge systems. This shift addresses UN SDG 11 (Sustainable Cities and Communities) by fostering cultural preservation, climate-resilient building frameworks, and a drastically reduced carbon footprint within public infrastructure. Traditional Igbo vernacular architecture offers centuries-tested, low-carbon strategies uniquely tailored to the hot-humid climate of Southeastern Nigeria (Dorcas Mobolade & Pourvahidi, 2020). Through strategic building orientation that leverages prevailing South-East and South-West trade winds, the use of high-thermal-mass earth materials, and open communal courtyards, traditional spaces maintain natural microclimate comfort without mechanical cooling (Aneke, 2025).

By integrating the domestic, non-linear spatial dynamics of traditional Igbo building principles - such as inward-oriented compound zoning - architectural planning can provide informal zoning and high passive visual surveillance without relying on restrictive, aggressive, overt security measures (Oostermeijer et al., 2022). According to therapeutic spatial psychology, restorative, biophilic, and cool spaces reduce traumatization and lead directly to rehabilitative success (Ames & Loebach, 2023; Oostermeijer et al., 2022).

2. LITERATURE REVIEW

Vernacular architecture across Nigeria's ecological zones is shaped by passive strategies suited to local climates. Igbo vernacular architecture evolved direct responses to effective climate-resilient design to address heat gain, humidity control, ventilation, and rain. The principles employed include courtyard systems, passive cooling strategies, orientation, and use of locally sourced biobased materials. The Igbo compound is typically made up of the man's hut (obi), wives' huts (Mkpuke) shared with the children and arranged behind the obi around the courtyard (ezi) (National Commission for Museums and Monuments, n.d).

Traditional southeastern building techniques are designed to handle the heavy annual rainfall, prolonged relative humidity (frequently exceeding 75%), and consistent solar radiation of the tropical rainforest zone (Aneke, 2025; Mobolade & Pourvahidi, 2020). It's hot all day, with steady diurnal temperatures ranging between 28°C and 34°C. In such regions, mechanical cooling systems create high energy demands and operational costs. Bioclimatic design demonstrates that thermal comfort in humid environments relies on continuous air movement to promote evaporative cooling along the human skin (Gamage, 2025). Contemporary public infrastructure in southeastern Nigeria often ignores these principles by favouring highly conductive glass and uninsulated concrete envelopes that turn building interiors into greenhouse traps (Okoye, Ogbuagu, Ohaedeghasi, & Ngwu, 2020).

Passive Mitigation Strategies in Traditional Igbo Architecture

Compounds are structured around interconnected open spaces that generate a micro-scale thermal chimney effect as seen in figure 1 and 2. Cooler air drawn from shaded vegetative zones replaces rising hot air in central common zones. This is an organisational core of the traditional Igbo compound. Physically, it is an open-to-sky space enclosed by decentralised buildings (obi, Mkpuke), (Dmochowski, 1990, Nsude, 2018). It serves as a multifunctional space that addresses physical, social, and economic needs (Ilesanmi & Egbe, 2013). It is an environmental moderator, a thermal chimney, a climate modifier. Architecturally, it acts as a "thermal lung." The open central void, is a system that facilitates the stack effect, where warm air rises and is replaced by cooler air drawn from the surrounding shaded rooms (Mba et al., 2024). This constant air exchange is vital in hot-humid regions to prevent heat stagnation. Furthermore, the courtyard provides a microclimate that remains significantly cooler than the external environment during the day due to the shading provided by the surrounding building mass (Onyejebu, Okonkwo, & David-Ojukwu, 2023). The courtyard also establishes a spatial hierarchy allowing for privacy while maintaining a connection to the outdoors. Traditional Igbo houses are designed to turn inward, creating shaded, cooler, and socially useful spaces that protect residents from the harsh glare of the tropical sun.

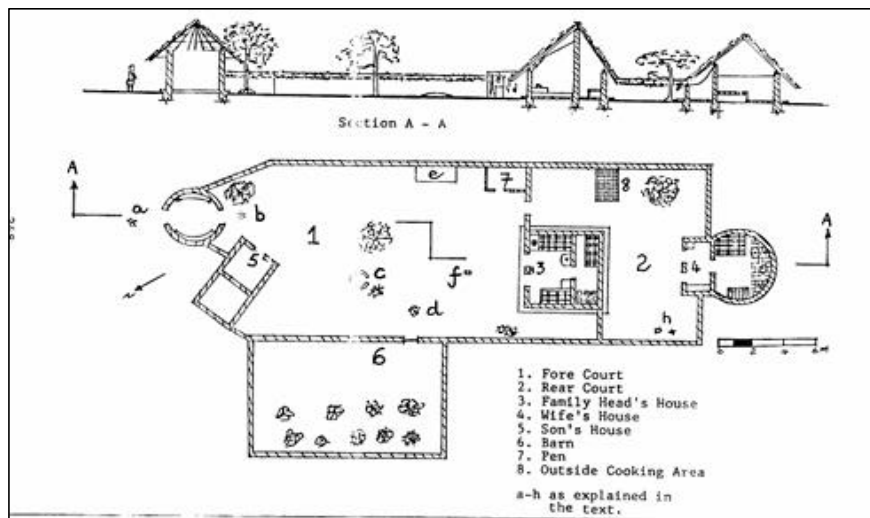


Figure 1: Compound of Mazi Aro Ukwu in Akegbe

Source: Adapted from Nsude (1987)

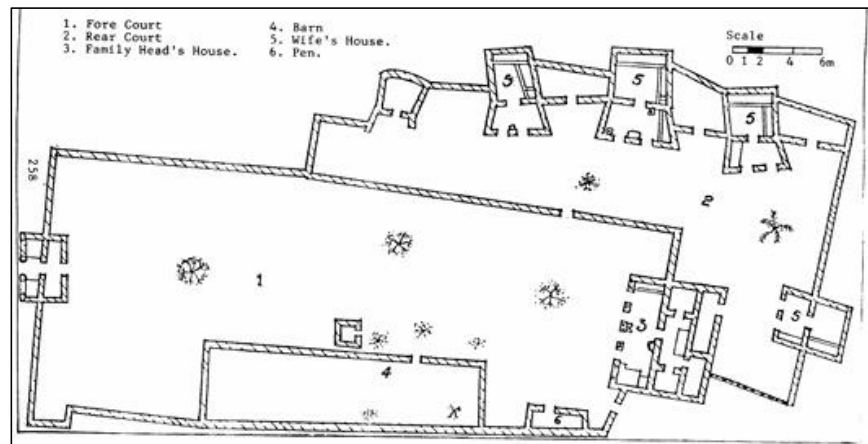


Figure 2: Compound of Chief Arum Ogbodo in Akwuke.

Source: Adapted from Nsude (1987)

Passive cooling in Igbo architecture is achieved through a combination of material selection and natural ventilation. Considering breathable roof structures that are constructed using lightweight, high-pitched deeply overhanging framing covered in local raffia palm thatch, these roofs function as dynamic passive filters. Thatch roofs promote natural cross-ventilation, create a thick insulating layer with low thermal conductivity and allows hot air to escape through the ridge while providing excellent insulation against solar radiation. This aligns with modern bioclimatic principles that prioritise the building envelope as the first line of defense against heat gain (Akande, 2010). The deeply overhanging eaves shield the breathable mud walls from driving tropical rains and provide solar shading to the exterior perimeter (Nsude, 1987). Cross-ventilation is maximized by orienting building openings along the prevailing northeast and southwest monsoon winds, directing airflow across living areas to maximize natural cooling. The use of high-mass thick earthen walling (Aja-ani) traditionally constructed out of puddled clay or wattle-and-daub matrices, have low capacity for heat transfer into indoor living quarters during peak solar periods (Aneke, 2025). They delay external solar heat transfer during peak daylight hours and release it at night when outdoor temperatures drop. These mud-based constructed walls are often reinforced with timber and palm fronds (Onyejebu et al., 2023). Studies have shown that these earth-based buildings can reduce cooling energy demand by approximately 30% to 40% compared to conventional concrete structures (Aigbodua, Thompson, & Festus, 2025).

In the Igbo architectural context, shading is not just an additive feature but an integral part of the building form. It is achieved through use of overhangs, vegetative shading, and use of verandas. The deep and extended eaves of the thatched roofs which are supported by forked wooden posts create a deep covered porch (veranda). This serves a dual purpose: protecting the mud walls (aja uno) from erosion during heavy tropical downpours and providing deep shading for the walls and window openings (Nwalusi, Chukwuali, Nwachukwu, & Chike, 2019). Verandas act as transitional buffer zones between the hot exterior and the cool interior. These shaded semi-outdoor spaces allow for airflow while blocking the blinding glare of the sun, creating a comfortable environment for socializing without the need for artificial cooling.

Traditional Igbo builders demonstrated an intuitive understanding of solar geometry and wind patterns. The placement of compound responds to sun, wind, and cosmology. Proper building orientation is a primary

passive strategy in southeastern Nigeria to reduce solar heat gain and maximize the intake of prevailing breeze. By orienting the longer axes of buildings in an East-West direction, the exposure of the walls to the intense morning and afternoon sun is minimized. Conversely, openings are often strategically placed to capture the South-West monsoon winds, ensuring that even low-velocity breezes can penetrate the living spaces (Mba et al., 2025)

Trauma-informed design

This is a purposeful architectural strategy that integrates the principles of trauma-informed care into the built environment. Its aim is to create environments that emphasize both physical and emotional safety, while ensuring spatial clarity, predictability, and opportunities for personal autonomy. By intentionally shaping the built environment, this approach fosters psychological recovery and reduces the risk of re-traumatization for vulnerable occupants (Justus & Raghani, 2025).

Spatial psychology and reformatory infrastructure in juvenile reform facilities

Juvenile rehabilitation requires a physical environment that reduces anxiety, builds trust, and encourages positive behaviour. Modern environmental psychology establishes a direct connection between custodial facility architecture and the behavioral outcomes of institutionalized youth (Oostermeijer, Dwyer, & Tongun, 2022). Trauma-Informed Healing Architecture (TIHA) demonstrates that natural light, biophilic elements, and clear sightlines dramatically reduce institutional violence and recidivism. Common design choices that negatively impact mental health include continuous isolation, high noise levels, and limited natural light. Also, carceral design elements such as razor wire, narrow steel doors, and long, dark corridors trigger hyper-vigilance and trauma response in adolescents (Afzhoor & Akcay, 2025). Conversely, facilities that incorporate natural daylight, natural acoustics, private quiet spaces, open communal zones, and nature views can help reduce stress and support behavioral rehabilitation. Recent developments in juvenile custodial design emphasize ‘relational security’ – a constructive relationship between staff and young people in custody which is supported by a therapeutic and ‘open’ custodial environment. This is achieved through small residential units (typically 4-8 beds) and open floor plans, rather than relying strictly on bars, security screens, grilles, isolated cell rows, and isolated corridors (Oostermeijer et al., 2022). The spatial layout of the traditional Igbo homestead provides a valuable framework here. The focal assembly point (Obi) and its open courtyard system offer natural, low-stress surveillance and communal interaction. This arrangement supports adolescent rehabilitation by providing clear visibility without resorting to overt, oppressive containment. A contemporary design approach known as neo-vernacular architecture which reinterprets traditional, region-specific building techniques and materials for modern, sustainable, and culturally resonant structures can be adopted (Turkusic, 2011).

3. METHODOLOGY

This study adopts a qualitative multi-method case study design. Primary data were collected through field case study of a selected juvenile reformatory facilities, involving site observations, photographic documentation, and informal interviews with facility officials. Secondary data were obtained through document analysis of published ethnographic accounts and architectural surveys of traditional Igbo architecture and building techniques. Thematic analysis was used to synthesize findings across primary and secondary sources to identify resilient eco-cultural design strategies.

Case study 1:

Special Reformatory Centre for Girls

Location: 11/13 Ojerinde street, Idi-Araba, Lagos State. It lies adjacent to the Lagos University Teaching Hospital (LUTH), which provides potential access to healthcare and outreach services.



Figure 3: Study area boundary delineated on Google Earth Imagery (6°31'19.55"N 3°21'08.51"E)

Source: Google Earth (2025)

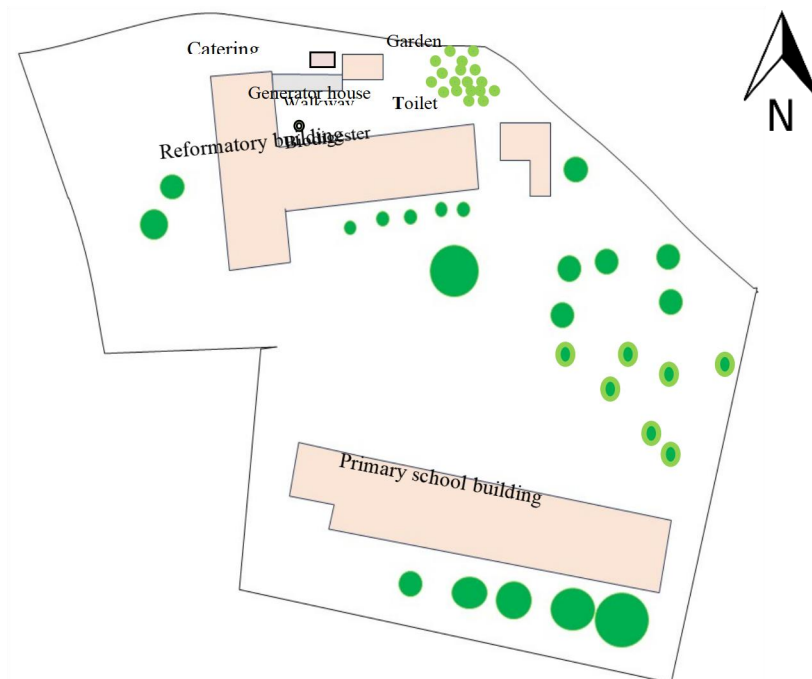


Figure 4: Layout of the of Special Reformatory Centre for Girls, Idi Araba

Source: Fieldwork (2025)

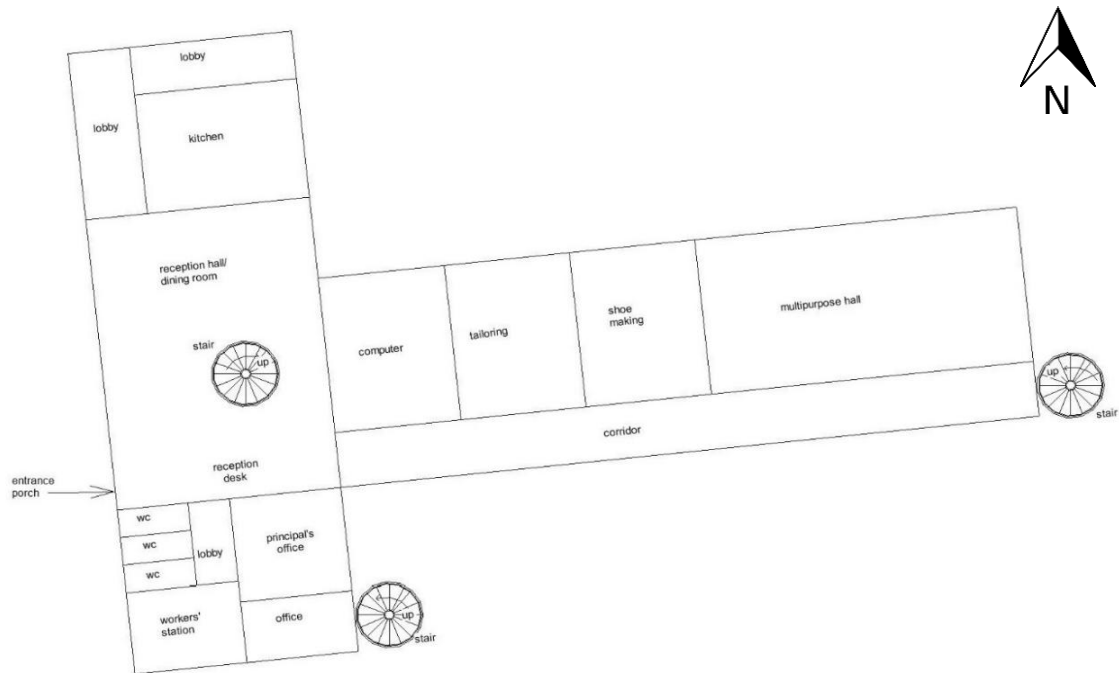


Figure 5: Spatial configuration of the ground floor of the Special Reformatory Centre for Girls, Idi Araba

Source: Fieldwork (2025)

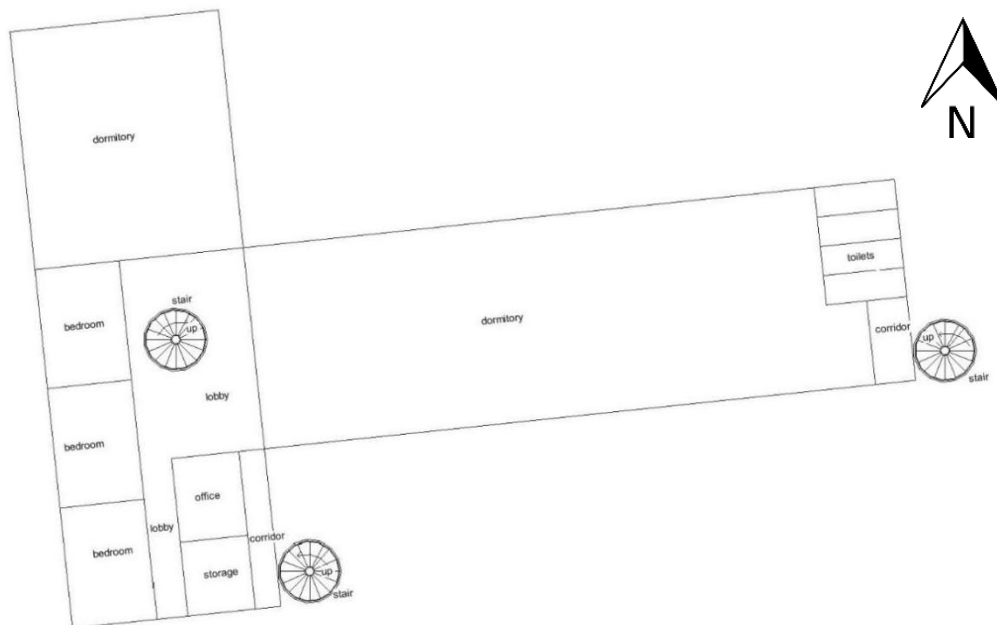


Figure 6: Spatial configuration of the first floor of the Special Reformatory Centre for Girls, Idi Araba

Source: Fieldwork (2025)

Background:

The Red Cross society established the centre for its humanitarian activities in the 1960's and later the building was taken over by the Lagos State government for housing and rehabilitating young girls who conflict with the law, or vulnerable girls due to abuse, neglect, or abandonment. The goal of the centre is to basically reform, empower and reintegrate the girls into the society. It houses girls between the ages of 11 to 17. It is called Special Correctional Centre because of the peculiarity of the cases there such as girls in conflict with the law, child offenders, girls beyond parental control, victims of abuse or neglect. They are admitted to the centre through the Lagos State Ministry of Youth and Social Development and by court injunctions. The centre offers rehabilitation programs aimed at reforming the girls. It is a haven for vulnerable girls and there are vocational training and basic education to empower the girls.

Categories of girls in the centre include; Child offenders with cases such as stealing, murder, kidnapping, girls beyond parental control, sexually and domestically abused girls, and vulnerable girls

Spaces in the facility are:

- i. Multipurpose visitors' lounge: Also used as dining room, reception area, reading room, and incorporating the principal's office
- ii. Kitchen adjacent to the visitors' lounge with connecting walkway from the kitchen to generator house and backyard
- iii. Dormitory with 24 double bunk beds for 84 girls at a time
- iv. Rooms dedicated for vocational training in tailoring, computer works, art and crafts, shoe making, hair dressing, and catering
- v. Multipurpose hall for recreational and social activities
- vi. ICT library
- vii. Primary school building
- viii. Recycling system (biodigester that generate cooking gas from waste)
- ix. External toilet facilities



Plate 1: Oblique approach view into the facility compound

Source: Fieldwork (2025)



Plate 2: Entrance into the reception area

Source: Fieldwork (2025)



Plate 3: Right-hand view of the facility showing windows of dormitory on upper floor and workshops for vocational studies on ground floor

Source: Fieldwork (2025)



Plate 4: Biodigester gas generating scheme
Source: Fieldwork (2025)



Plate 5: Open green courtyard in front of the primary school building for the girls

Source: Fieldwork (2025)

Merits of the design

- i. There is presence of sustainable infrastructure through use of renewable materials, waste recycling and passive cooling to reduce costs and environmental impact
- ii. Therapeutic architecture is seen in the green spaces in the compound
- iii. There are spaces for vocational training

- iv. The longer side of the building is situated on the south-north orientation, thus making use of abundant natural light and ventilation and reducing solar gain in the building
- v. Sustainable design strategies – long eaves, building orientation and abundant fenestration

Demerits of the design

- i. The facility lacks fluid circulation seen in its spatial configurations
- ii. No designated private space for girls for personal reflections
- iii. The use of one space as reception area and for dining
- iv. The residential area was not designed to cater for different behavioural needs
- v. There is insufficient dormitory space and classrooms for formal education
- vi. There are no medical facilities such as clinics and sickbay on the site
- vii. Some parts of the building are dilapidated

Case Study

Special Correctional Centre for Boys Oregun

Location: 75A Kudirat Abiola Way, Oregun 101233, Lagos, Nigeria



Figure 4: Study Area Boundary Delineated on Google Earth Imagery (6°3'7.92"N 3°21'33.12"E)

Source: Google Earth (2025)

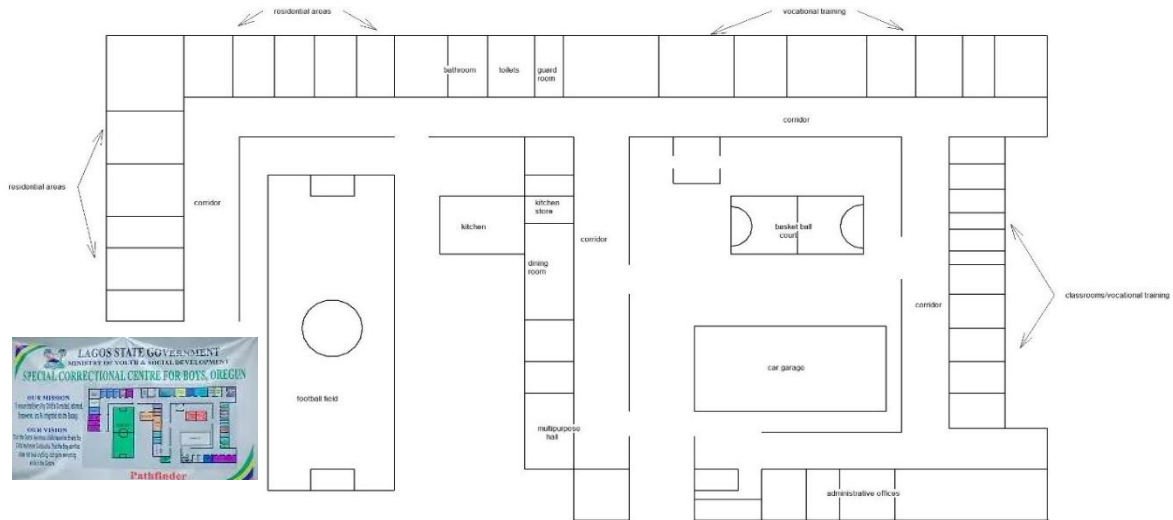


Figure 5: Schematic Diagram of the Site Plan of Boys Reformatory Centre Oregon, Lagos

Background

A correctional home was discussed during the colonial era and actualised in Lagos with the establishment of a remand home in 1942 on Lagos Island. The home was later moved to Sabo, Yaba and then to Oregon in 1976 where it is still standing and managed by the Lagos State government through the Social Welfare Department. This centre was called a remand home until 2007 when the Lagos State government adopted the Child Rights Act and changed its nomenclature from remand home to Special Correctional Centre. Admission into the centre is through family courts in what is called Care Order which is guaranteed under the Child Rights Act. Departure from the centre is also through court order. A diligent and social inquiry is also made before a child is admitted.

Categories of boys in the centre

- i. Boys in conflict with the law (criminal acts)
- ii. Sheltered boys (internally displaced due to human and natural disasters)
- iii. Boys beyond parental control
- iv. Homeless boys
- v. Abused and vulnerable boys

Spaces in the centre

- i. Tailoring class
- ii. Photograph printing class
- iii. Kitchen
- iv. Dormitory
- v. Basketball and handball courts
- vi. Multi-purpose hall for meetings and religious activities

vii. Administration offices

viii. Classrooms



Figure 6: Entrance gate into the reformatory centre.

Source: <https://ng.worldorgs.com/catalog/lagos/social-welfare-center...>



Plate 6: Courtyard with basketball court, and car parking. Surrounding it are classrooms and workshops for different vocational studies. Source:

Source: Fieldwork (2025)



Plate 7: Dormitory area with football playing field. Source:

Source: Fieldwork (2025)

Merits of the design

- i. Integration of sustainable architecture through passive ventilation and lighting and use of courtyards
- ii. Clear spatial organisation of the centre into public, semi-public and private zones
- iii. Micro climate control through use of courtyard
- iv. Use of open, glazed corridors that maximises natural light and staff lines of sight from various vantage points
- v. Spaces for vocational training
- vi. Presence of accommodation for carers
- vii. Spacious corridor (1.8 metres) that act as shading device for the residential area that is oriented eastward

Demerits of the design

- i. Lack of organisation of residential spaces to serve different delinquent groups and needs
- ii. No standard classroom blocks for formal education
- iii. Lack private rooms for meditation and reflection
- iv. Lack of spacious common room for socialisation
- v. No medical facilities such as clinics and sickbay

Ethnographical accounts

Early ethnographic accounts by (Aniakor & C, 1979) expresses Igbo architecture as a building technology, conceptually, an enclosure of space which emphasises on the nature and quality of the space created by the technology, a formal materialization of Igbo values, cosmic dualism, and symbolic systems as seen in figure 1 above. Dmochowski 1990, identified the socio-spatial logic of the Igbo compound shown in figures 1 and 2 above. By organizing separate residential huts, mkpuke, (the domestic units of the wives), around a central hut, the obi (central ancestral lounge) and an open courtyard, Ezi, the layout promotes social cohesion while maximizing natural ventilation. This separation of units prevents heat traps, ensuring constant airflow—a necessity in the humid tropical climate. His account documented a high-efficiency use of local materials tailored to regional micro-climates such as thick red earth walls in the northern Igbo regions and steep thatched roofs for high thermal mass and effective rain runoff and wattle-and-daub techniques in the southern regions. Concurrently, Nsude (1987) established that Igbo traditional architecture possesses valid ordering and design principles, technical solutions, and upgradeable materials.

Architectural surveys

Nwalusi et al., 2019 in their experimental analysis and subjective assessments of thermal comfort in 66 randomly selected traditional residential buildings in southeastern states of Nigeria, observed that morning indoor temperature recorded 27.99°C and aligns perfectly with the regional comfort average of 28.0°C. Traditional Igbo materials like thick earth walls and thatch roofs successfully delay heat transfer from the morning sun. However, afternoon indoor temperatures spike to 31.82°C, causing occupant discomfort. The relative humidity stays around 50% to 53%. Their empirical testing showed that under intense tropical heat, these buildings successfully achieved internal thermal sensations hovering around the neutral point. Because of mud's thermal flow characteristics, it delays the transfer of heat from the outside to the inside during the hot daytime, maintaining comfortable indoor spaces. At night, the heat stored within the thick walls radiates back inside to offer gentle warmth.

4. DISCUSSION OF FINDINGS

The Special Reformatory Centre for girls in Idi-Araba, Lagos

This facility demonstrates commendable sustainability and therapeutic design strategies through use of renewable materials, passive cooling, green therapeutic spaces, waste recycling, building orientation and long eaves. Green spaces within the compound are a form of therapeutic architecture that provide restorative environments which support mental health and rehabilitation. The dedicated areas for skill acquisition encourage self-reliance and reintegration into society. The optimal orientation of the long axis of the building in east-west axis maximizes natural light and ventilation, reduces solar gain and energy costs. The use of long eaves protect interiors from excessive heat and rainfall, enhances comfort and is a sustainable design strategy. The spatial configuration of spaces in the building lacks fluid movement, leading to congestion and inefficiency. There is severe multifunctional overlap in the use of one space for visitors, reception, and dining room. There is limited individual care of peculiar cases in the girls using a general dormitory. The small spaces for vocational training are insufficient. The parts of the building that are dilapidated undermine safety and rehabilitation. The lack of fluid spatial configuration and circulation results in restricted autonomy for the girls. This likely reinforces institutional rigidity rather than reformation. This spatial configuration completely compromises functional zoning and privacy. The generalized dormitory strips the girls of the personal space required for emotional healing and solitude. The structural integrity of the building is undermined by dilapidated sections, which actively compromise user safety and threaten the long-term viability of its rehabilitation programs.

Special Correctional Centre for boys in Oregun, Lagos

The architectural design of the Special Correctional Centre for Boys in Oregun, Lagos, presents a dual narrative. It effectively leverages environmental and organizational strategies to create a functional, healthy space, yet it faces significant challenges in meeting the holistic, psychosocial, and educational needs of the residents. The merits identified highlight a strong focus on bioclimatic design and clear functional zoning, which are essential for creating a humane environment. The use of courtyards and passive ventilation is an excellent architectural response to the tropical climate of Lagos. As courtyards serve as ‘thermal lungs’, they facilitate cross-ventilation and reduce heat buildup. This not only lowers operational costs but also improves the psychological well-being of residents by providing a connection to the outdoors, which is vital in confined settings. The glazed corridors and intentional staff lines of sight represent a shift toward passive surveillance. By allowing staff to observe spaces naturally, the design reduces the need for intrusive, prison-like security measures, fostering an atmosphere that is more supportive and less oppressive. Clear division into public, semi-public, and private zones prevents overcrowding and operational friction. Additionally, the inclusion of vocational training spaces and carer accommodation suggests a design intent that prioritizes long-term rehabilitation and human-centred support over mere incarceration.

The demerits reveal a critical gap between the physical structure and the rehabilitative mission. While the building functions as a shelter, it lacks the specialized soft infrastructure required for effective juvenile reformation. The lack of differentiated residential spaces for different delinquent groups or needs is a major oversight.

The absence of formal classrooms and private reflection and meditation rooms suggests an environment that prioritizes custody over development. Education and self-reflection are the primary vehicles for changing a young person’s life course. Without these, the facility risks becoming a ‘holding area’ rather than a true centre for correction. The lack of a spacious common room for socialization is a significant flaw in a youth-centric facility. Communal areas are where social skills are developed and where youth can interact under positive, supervised conditions. A lack of these spaces can lead to social isolation or, conversely, unmanaged, chaotic interactions in smaller, less suitable areas.

Ethnographic accounts

Ethnographic accounts reveal Igbo architecture as socially embedded while architectural surveys verify its thermal and hydrological performance. Traditional Igbo residential layout explicitly segregates public, semi-private, and private activities. The principal building contains distinct apartments for resting and separate day-houses left open at the sides to receive guests. Also, wives' quarters feature distinct separations between open day-houses and fully walled, plastered sleeping spaces.

Architectural Survey

The architectural survey proves that thick mud walls act as effective thermal masses, delaying daytime heat transfer and releasing warmth during cooler nights. Additionally, porous thatch roofs operate as a porous skin, letting hot air escape while remaining fully impervious to heavy downpours. Empirical surveys demonstrate that traditional Igbo earth and thatch structures inherently provide superior thermal comfort in the hot-humid climate of Southeastern Nigeria.

The Climate Adaptation and Socio-Spatial Framework

This section synthesizes the empirical findings gathered from the architectural surveys, ethnographic accounts, and the evaluation of the juvenile reformatory case study. A hybrid architectural framework that will translate historical Igbo ethnographic principles into a secure, therapeutic, and contemporary juvenile reformatory facility in Southeastern Nigeria is addressed. By deliberately departing from conventional, punitive institutional models, this synthesis demonstrates how modern security demands can be balanced with passive environmental design and indigenous cultural typography.

Field observations of contemporary institutional infrastructure show a heavy reliance on conventional sandcrete blocks. This leads to indoor heat trapping and heightened stress among occupants. To mitigate these environmental stressors, this framework upscales traditional earth construction into Compressed Stabilized Earth Blocks (CSEB) for load-bearing walls which retains the high thermal mass performance of vernacular architecture. By absorbing daytime radiant heat and delaying its transfer to the interior, the envelope stabilizes the indoor macro-climate. This directly minimizes long-term reliance on mechanical air conditioning, addressing the study's sustainability criteria.

To minimize solar heat gain and intense glare, two vernacular shading systems are synthesized:

- i. **Deep Verandas:** Inspired by the traditional portico, deep verandas shield lower envelope openings from direct vertical solar radiation. This ensures interior spaces receive soft, diffused natural light while eliminating intense solar glare and radiant heat loading.
- ii. **Ventilated hybrid roofing:** The design pairs corrugated metal sheets with ventilated ridge caps, underlaid with insulated timber tongue-and-groove planks or woven bamboo matting. This structural configuration replicates the natural ventilation and cooling behaviours of traditional thatch roofs while ensuring institutional durability.

Micro-climate regulation is further enhanced through solar panel integration, energy-efficient lighting, and the strategic use of indigenous plants in shaded garden areas to create therapeutic, restorative outdoor environments. Sustainable waste systems, such as biodigester strategies, are incorporated to lower operational while actively teaching environmental responsibility to the youth during their reformation.

The analysis of the existing institutional case study highlights a critical architectural failure - the reliance on monolithic, single-mass residential block which generates intense psychological friction, isolation, and a claustrophobic "prison corridor" dynamic that acts as a trauma trigger. To resolve these conflicts, this study translates the zoning of the traditional Igbo compound into a clear, spatial hierarchy.

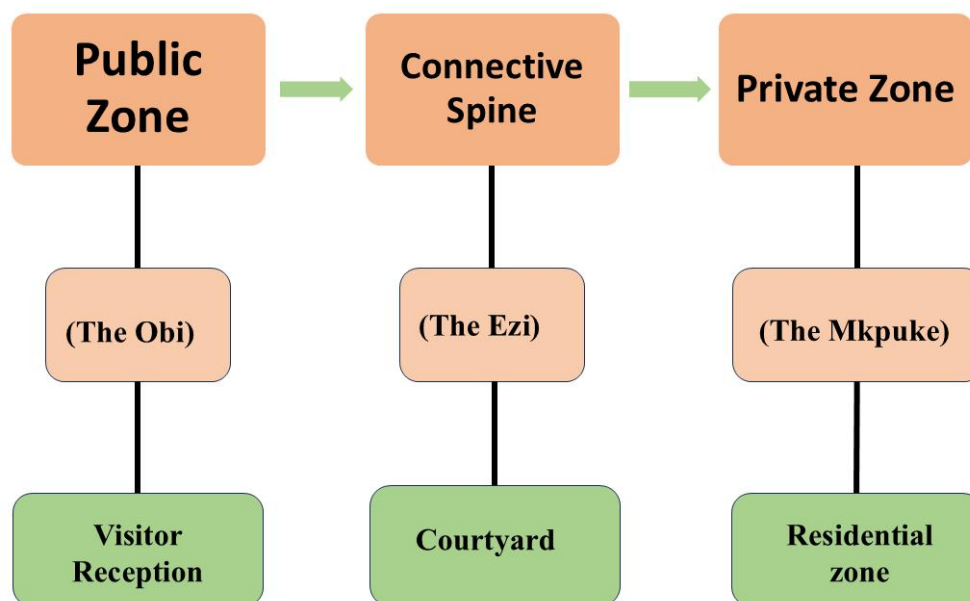


Figure 7: Translation of Traditional Igbo compound into a clear, spatial hierarchy.

In traditional Igbo architecture, the Obi serves as the vital front pavilion for receiving guests and communal governance. The synthesis transforms this concept into a dedicated, semi-open entrance pavilion positioned at the public-institutional interface. Reimagined for a reformatory context, this space safely accommodates family visitations, and public exhibitions of vocational items crafted by the residents. Its open and welcoming architecture lowers defensive psychological barriers immediately upon entry.

Rather than trapping residents within unyielding institutional corridors, the layout adopts a modular, decentralized compound system. The Ezi (courtyard) acts as an open, fluid connective spine that facilitates natural cross-ventilation, daylighting, and shared activities. This arrangement provides juveniles with visual openness, psychological sense of liberty and structural legibility. Furthermore, it allows staff to maintain clear sightlines naturally, enabling passive visual surveillance without the need for aggressive, overt security barriers like heavy iron bars.

Conversely, the private residential zones are mimic the Mkpuke - the intimate, fully walled personal shelters of the traditional compound. The synthesis breaks down massive, high-capacity dormitories into small, interconnected residential clusters. This layout respects individual human dignity by providing youth with the spatial privacy necessary for emotional regulation, self-evaluation, and personal reflection. The transition between these private quarters and the communal zones remains completely fluid and horizontal, minimizing the psychological distress caused by forced spatial containment

A juvenile reformatory facility must not function as a machine for isolation. Instead, the physical environment must directly support the social and psychological goals of rehabilitation. Designing spaces that encourage shared activity - such as open-air workshops for skill development, community-oriented pavilions, and agricultural zones - mirrors the collective, kinship-based values of traditional Igbo society. By synthesizing localized materials, cultural motifs, and familiar spatial arrangements, the architecture transforms the facility from an imposing container into a supportive, culturally grounded environment. This spatial familiarity lowers defensive psychological reactions in troubled youth, easing their path toward emotional recovery, personal accountability, and successful reintegration into society.

5. RECOMMENDATIONS

Based on the socio-spatial and bioclimatic findings of this study, the following architectural interventions are recommended for the development of future juvenile reformatory infrastructure in Southeastern Nigeria:

- i. Specify Compressed Stabilized Earth Blocks (CSEB) for load-bearing envelope walls to preserve high thermal mass, regulate indoor micro-climates, and dramatically reduce institutional reliance on mechanical air conditioning.
- ii. Reject monolithic, double-loaded "prison corridors" in favour of a modular, decentralized layout that mirrors traditional compound spatial hierarchies to reduce the psychological friction of forced containment.
- iii. Utilize the open-air central Courtyard (Ezi) to naturally mitigate overcrowding, maximize cross-ventilation, enhance natural day-lighting, and provide a legible, visually open framework for passive surveillance.
- iv. Reimagine and design semi-open, welcoming entrance pavilions inspired by the traditional Obi to serve as dedicated zones for family visitations, counselling, and public reception.

- v. Replace massive single-mass dormitories with small, clustered residential rooms that mimic the intimacy of the Mkpuke, granting youth the privacy necessary for emotional regulation and personal dignity.
- vi. Integrate deep shading verandas to shield lower wall openings from intense solar radiation and glare, ensuring interior spaces receive soft, diffused natural light.
- vii. Implement durable corrugated metal roofing specified with ventilated ridge caps and insulated internally with wooden ceiling designs to replicate the thermal cooling performance of traditional thatch.
- viii. Integrate regenerative and socio-technical systems through dedicated outdoor architectural zones for collective, kinship-based rehabilitation - such as open-air vocational workshops, therapeutic green gardens, and sustainable biodigester waste networks

6. CONCLUSION

A Framework for the Future

This research reveals a powerful truth: when Igbo vernacular building traditions are fused with modern low-carbon materials, they generate not just architecture, but a movement toward climate-responsive, scalable design. Reviving ancestral techniques becomes an act of sustainable innovation, advancing UN Sustainable Development Goal (SDG) 11 by shaping resilient urban settlements and SDG 16 by nurturing institutions rooted in culture and community.

The urgency of decarbonizing the built environment demands models that unite regional identity with global climate imperatives. One powerful illustration lies in the design of a juvenile reformatory facility: here, architecture is not only about walls and roofs, but about healing, resilience, and belonging. By embedding traditional knowledge into such spaces, we create environments that restore dignity, foster community, and embody sustainability at its core.

This framework, therefore, is more than a technical solution. It is a visionary blueprint for the future. It calls on architects and policymakers to recognize that the wisdom of tradition, when reimagined through sustainable innovation, can transform institutions into catalysts of hope and resilience, guiding humanity toward cities and communities that are inclusive, restorative, and aligned with the planet's needs.

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