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INTEGRATING THERAPEUTIC ARCHITECTURE AND OCCUPATIONAL THERAPY IN DRUG REHABILITATION DESIGN: A SPATIAL AND OCCUPATIONAL FRAMEWORK FOR RECOVERY AND REINTEGRATION

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ABSTRACT

The increasing prevalence of substance use disorders (SUD) in Indonesia is not matched by adequate rehabilitation facilities, highlighting the need for more effective and holistic approaches. This study proposes an integrated design strategy for a drug rehabilitation center by combining therapeutic architecture with occupational therapy (OT) to support recovery and social reintegration. Using a qualitative design-based research approach, the study translates behavioral characteristics of users and rehabilitation processes into spatial and architectural strategies. Therapeutic architecture principles such as natural lighting, ventilation, and connection to nature are applied to enhance emotional stability and reduce stress [11][2]. Occupational therapy is implemented through structured activity-based programming to rebuild daily routines and meaningful occupations [1][9]. A key contribution of this study is the integration of hospitality-based programs and mangrove-based activities as forms of real-world occupational engagement. These programs enable users to develop vocational skills, social interaction, and adaptive behaviors within a controlled yet realistic environment. The findings demonstrate that architecture can function as an active therapeutic system when integrated with occupation-based programming, facilitating behavioral transformation, reducing relapse risk, and supporting long-term recovery through the integration of spatial design, meaningful activity, and environmental context

Keywords: *Drug rehabilitation center; Therapeutic architecture; Occupational therapy; Healing environment; Social reintegration; Behavioral-based design; Real-world simulation.*

1. INTRODUCTION

Substance use disorder (SUD) is a complex and chronic condition that affects neurological function, behavior, and social participation. Globally, drug use continues to increase, with significant impacts on public health and socio-economic stability. In Indonesia, particularly in North Sumatra, the number of drug-related cases remains high, while access to rehabilitation services is limited, resulting in a substantial treatment gap.

Existing rehabilitation approaches primarily emphasize medical detoxification and psychosocial interventions. However, these approaches often overlook the role of the built environment in influencing recovery outcomes. Many rehabilitation facilities are designed with institutional characteristics that may create stress, stigma, and disconnection from users psychological needs.

Therapeutic architecture offers an alternative perspective by recognizing the influence of spatial environments on emotional and physiological well-being. Environmental factors such as natural light, ventilation, and access to nature have been shown to reduce stress and improve recovery outcomes [10][11]. Despite its potential, the application of therapeutic architecture in drug rehabilitation facilities remains limited and often lacks integration with behavioral therapy frameworks.

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Occupational therapy (OT) offers a complementary approach by emphasizing the role of meaningful activities in recovery. Rather than focusing solely on clinical treatment, OT supports individuals in reconstructing daily routines, developing productive skills, and re-establishing social roles [1][9]. In the context of substance use rehabilitation, this approach is particularly relevant, as addiction is often associated with occupational disruption and loss of identity. Therefore, integrating occupational therapy into spatial design provides an opportunity to translate activity-based recovery processes into architectural strategies.

Occupational therapy (OT) provides a complementary approach by emphasizing meaningful activity as a medium for recovery. Addiction often replaces productive occupations, disrupting daily routines and social roles. Therefore, recovery requires the reconstruction of meaningful activities that support independence and identity formation [1]. However, the spatial implications of OT are rarely translated into architectural design.

This study addresses these gaps by proposing an integrated design strategy that combines therapeutic architecture and occupational therapy. The research positions architecture as an active agent in recovery by aligning spatial design, environmental experience, and activity programming. Furthermore, the study explores the integration of local ecological and economic potential as part of the rehabilitation system, with a particular focus on Siba Island as the design site due to its ecological potential in supporting an environment-based therapeutic approach.

2. METHOD

This study employs a qualitative design-based research (DBR) approach to develop an integrated architectural strategy for a drug rehabilitation center. Design-based research is selected as the primary methodology because it enables the iterative translation of theoretical frameworks into spatial design solutions while maintaining a strong linkage between analysis and design outcomes.

The research is structured into five research phases to ensure methodological clarity and reproducibility:

1. Problem Identification and Contextual Analysis

The first stage involves identifying the core issues related to substance use disorders (SUD) and the limitations of existing rehabilitation facilities, particularly in North Sumatra. This stage includes a review of statistical data, policy documents, and rehabilitation standards to define the scope of the problem, including the gap between rehabilitation demand and facility capacity. The analysis also considers behavioral characteristics of users, especially during withdrawal phases, where psychological instability, aggression, and anxiety significantly influence spatial requirements.

2. Theoretical Framework Development

The second stage establishes the conceptual foundation of the study by synthesizing three primary domains: therapeutic architecture, occupational therapy (OT), and rehabilitation theory. Therapeutic architecture is examined to identify environmental variables that influence healing outcomes, such as natural lighting, ventilation, spatial hierarchy, and sensory control [11]. Occupational therapy is analyzed to understand the role of meaningful activities in recovery, particularly in reconstructing daily routines and social roles disrupted by addiction [1]. This stage results in a set of design parameters that link behavioral needs with spatial and environmental strategies, forming the basis for subsequent design translation. In this framework, rehabilitation theory functions as a conceptual bridge that links therapeutic architecture and occupational therapy, enabling the translation of behavioral recovery processes into spatial and activity-based design strategies.

3. Precedent and Case Study Analysis

The third stage involves analyzing selected rehabilitation centers and healthcare facilities that incorporate therapeutic design principles. The case studies are evaluated based on spatial organization, zoning strategies, environmental quality, and the integration of therapeutic programs. Particular attention is given to how these facilities address user behavior, privacy, safety, and interaction. The findings from this stage are used to identify best practices and limitations in existing models, providing a comparative basis for developing a more integrated design approach.

4. Site Analysis and Contextual Potential
The fourth stage focuses on site analysis, conducted on Siba Island, a mangrove ecosystem in North Sumatra. The site is evaluated based on environmental, social, and functional criteria, including accessibility, ecological characteristics, security, and distance from negative external stimuli.

In addition to conventional site analysis, this study examines the therapeutic and productive potential of the landscape, particularly the role of mangrove ecosystems in supporting environmental-based occupational therapy. Activities such as ecotourism, nipah processing, and conservation are identified as opportunities to integrate rehabilitation with local ecological systems. However, the site also presents environmental challenges, particularly related to accessibility during periods of heavy rainfall and high tidal conditions, which may affect circulation systems and user safety. These conditions necessitate adaptive spatial and infrastructural strategies to ensure resilience and functional continuity.

5. Design Synthesis and Spatial Translation
The final stage involves synthesizing the findings from previous stages into a comprehensive architectural design strategy. This process translates theoretical frameworks and analytical insights into spatial configurations, zoning systems, and programmatic elements.
Within this final research phase, the design synthesis is further developed through three levels of translation:
a. Behavioral Translation: converting user conditions into spatial requirements (e.g., safety, privacy, adaptability)
b. Therapeutic Translation: applying environmental design principles to support emotional and physiological recovery
c. Occupational Translation: embedding activity-based programs, including hospitality and ecological engagement, into spatial systems

This multi-layered approach ensures that the design is not only responsive to clinical and behavioral needs but also capable of supporting long-term recovery through meaningful occupation and social reintegration.

3. RESULT AND DISCUSSION

3.1. Behavioral-Based Spatial Design

The design responds to the behavioral characteristics of individuals with SUD, particularly during withdrawal, where symptoms such as anxiety, aggression, and depression are prevalent. These conditions require environments that ensure safety while maintaining dignity.

Spatial strategies include controlled observation areas, private counseling spaces, and flexible environments that adapt to changing therapeutic needs. Clear spatial hierarchy is also implemented to improve orientation and reduce stress.

3.2. Therapeutic Architecture Implementation and Spatial Zoning Strategy

Therapeutic architecture is applied through environmental design strategies that support recovery. Natural elements such as mangrove landscapes and water bodies are integrated to promote relaxation and reduce anxiety [11]. Natural lighting and ventilation are maximized to enhance physiological comfort.

Spatial organization balances privacy and social interaction, while sensory elements such as color, material, and acoustics are carefully controlled to stabilize emotional conditions [5]. Safety is achieved through design strategies that avoid institutional characteristics, creating a supportive rather than restrictive environment.

These findings are consistent with contemporary research on healing environments, which demonstrates that access to nature, daylight, and controlled sensory stimulation can significantly improve psychological well-being and reduce stress in healthcare settings [2][8].

In addition to environmental qualities, spatial zoning plays a critical role in supporting therapeutic outcomes. The zoning strategy is organized as a gradient system, transitioning from highly controlled and private areas to semi-public and socially interactive spaces. This spatial hierarchy reflects varying levels of supervision, stimulation, and user independence, allowing a gradual adjustment aligned with the recovery process. Such zoning not only enhances safety and privacy but also supports behavioral progression and social reintegration.

3.3. Occupational Therapy as Spatial System

Occupational therapy is translated into spatial programming by structuring activities that support daily routines, skill development, and social participation. These include life skills training, vocational activities, and recreational spaces.

Meaningful activities are essential in replacing substance-related behaviors and rebuilding identity, as addiction is often associated with occupational disruption and loss of routine [9][4]. Structured occupational engagement has been shown to improve self-efficacy, social participation, and long-term recovery outcomes, particularly when activities simulate real-life roles and responsibilities [6].

3.4. Hospitality-Based Rehabilitation

A significant innovation in this study is the integration of hospitality programs as a form of occupational therapy. Unlike conventional rehabilitation models, this design incorporates resort and ecotourism operations as a controlled realistic work environment.

Participants are involved in activities such as guest services, housekeeping, food and beverage operations, and facility maintenance. This approach enables users to develop vocational skills, rebuild social interaction, and simulate real-world working conditions. The structured routines inherent in hospitality operations contribute to behavioral stability and support reintegration into society.

This approach aligns with emerging recovery models that emphasize community integration, social identity reconstruction, and engagement in meaningful roles as critical components of sustained recovery [4]. By simulating real-world service environments, the design extends occupational therapy beyond controlled settings into socially embedded systems.

3.5. Integration of Local Ecological Potential

The design incorporates mangrove-based activities such as ecotourism, nipa processing, and conservation as forms of ergotherapy. These activities provide meaningful engagement while supporting environmental sustainability.

The integration of the Voluntary Carbon Market (VCM) introduces an economic dimension by generating carbon credits from mangrove conservation. Mangrove ecosystems have high carbon sequestration capacity, making them valuable for sustainable development [3]. This approach creates a self-sustaining model that supports both rehabilitation and environmental preservation. The integration of the voluntary carbon market is proposed as a conceptual framework and requires further feasibility studies in real-world implementation.

3.6. Healing Sequence and User Journey

The design incorporates a structured healing sequence that translates the rehabilitation process into a progressive spatial journey. This approach recognizes recovery from substance use disorder as a non-linear yet staged process, where users gradually transition from highly controlled environments to socially interactive and productive settings. The spatial configuration is therefore designed to reflect and support these stages of recovery, ensuring that architectural experience aligns with psychological and behavioral transformation. Unlike the research phases described in the methodology, the following recovery phases represent the user-centered healing process translated into spatial sequences.

Recovery Phase 1: Stabilization and Detoxification (Controlled Environment)
The initial stage of recovery focuses on physical stabilization and withdrawal management. At this phase, users experience high levels of physiological stress, anxiety, and emotional instability, requiring environments that prioritize safety, control, and minimal stimulation.

Architectural characteristics at this stage include:

a. High level of supervision and controlled access
b. Enclosed and low-stimulation spaces
c. Proximity to medical and nursing facilities
d. Clear and simple spatial layout to reduce cognitive overload
e. This stage establishes a secure foundation for recovery by minimizing external triggers and ensuring user safety.

Recovery Phase 2: Therapeutic Engagement (Semi-Controlled Environment)
As users begin to stabilize, the focus shifts toward psychological recovery and therapeutic engagement. At this stage, users participate in counseling, group therapy, and structured daily routines.

Spatial characteristics include:
a. Semi-private therapy spaces with controlled social interaction
b. Increased exposure to natural light and outdoor environments
c. Flexible spaces for individual and group activities
d. Gradual introduction of social interaction zones
e. This phase supports emotional regulation and the rebuilding of interpersonal skills within a controlled yet supportive environment.

Recovery Phase 3: Occupational Reintegration (Productive Environment)
In the third stage, users engage in structured occupational therapy aimed at rebuilding daily routines and productive skills. Activities include vocational training, environmental engagement, and life skill development.

Spatial strategies include:
a. Workshop and training facilities
b. Outdoor activity spaces integrated with natural landscapes
c. Spaces that simulate daily life routines (ADL & IADL environments)

This stage is critical in replacing substance-related behaviors with meaningful occupations, supporting identity reconstruction and self-efficacy [1]. Spatial strategies include environments that simulate Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL), which refer to routine tasks such as cooking, cleaning, and managing daily responsibilities. These simulated environments enable users to gradually rebuild functional independence and prepare for real-life conditions.

Recovery Phase 4: Social Reintegration (Real-World Simulation Environment)
The final stage introduces users to real-world social and economic systems through hospitality-based programs. This stage represents a transition from institutional recovery to societal participation.

a. Key spatial features include:
b. Hospitality and resort facilities (guest services, F&B, housekeeping)
c. Public interaction zones with controlled exposure
d. Mixed-use spaces allowing interaction between users and visitors

Through participation in hospitality operations, users develop work discipline, social confidence, and responsibility. This stage functions as a simulation of real-life conditions, preparing users for reintegration into society.

Recovery Phase 5: Transition and Exit (Independent Readiness)
The final phase prepares users for full reintegration into society. At this stage, users are given increased autonomy while still operating within a supportive environment.

Spatial characteristics include:
a. Transitional living units with higher independence
b. Reduced supervision and increased personal responsibility
c. Access to external networks and community engagement

3.7. Discussion

The results presented above indicate that the integration of therapeutic architecture and occupational therapy produces a unified spatial-occupational system. The findings of this study demonstrate that integrating therapeutic architecture with occupational therapy produces a more comprehensive rehabilitation environment compared to conventional facility models. While traditional rehabilitation centers tend to prioritize clinical and psychological interventions, this study highlights the role of spatial design as an active component in shaping behavioral outcomes and supporting recovery processes. Recent research also suggests that recovery from substance use disorders is strongly influenced by social environment, identity

transformation, and access to meaningful roles within a community context [4]. In this regard, the integration of hospitality-based programs in this study provides a spatial mechanism to support these processes, extending beyond conventional therapeutic environments.

Compared to existing applications of therapeutic architecture, which often focus on environmental qualities such as light, ventilation, and access to nature [11], this research extends the approach by embedding occupation-based therapeutic processes directly into spatial systems. This integration allows the built environment to facilitate not only emotional stabilization but also behavioral restructuring, such as through the sequencing of spaces from private, highly controlled environments to more open and socially interactive settings [1].

A key contribution of this study lies in the incorporation of hospitality-based programs as a form of real-world simulation. Unlike conventional occupational therapy settings that are often controlled and isolated, the inclusion of hospitality functions introduces structured social interaction and economic activity. This approach supports the gradual transition from institutional recovery to societal participation, addressing a critical gap in rehabilitation models.

Furthermore, the integration of ecological systems, particularly mangrove-based activities, enhances the therapeutic framework by linking environmental engagement with productive occupation. This aligns with emerging perspectives on nature-based therapy, which emphasize the restorative and cognitive benefits of interaction with natural environments. At the same time, the incorporation of the voluntary carbon market introduces a novel socio-economic dimension, although its implementation remains conceptual and requires further feasibility assessment.

Despite these contributions, this study has several limitations. First, the research is primarily design-based and conceptual, and therefore lacks empirical validation through post-occupancy evaluation or user-based studies. Second, the proposed framework is developed within a specific ecological context, which may require adaptation for different environmental and cultural settings. Third, the integration of the voluntary carbon market remains conceptual and has not been supported by detailed financial feasibility analysis, requiring further investigation to assess its practical implementation and long-term viability.

Future research should focus on testing the proposed design framework in real-world applications, including user experience evaluation, behavioral outcome measurement, and economic feasibility analysis. Such studies would further validate the effectiveness of integrating architectural design with occupational therapy in rehabilitation settings.

4. CONCLUSION

This study demonstrates that architectural design actively shapes recovery outcomes in drug rehabilitation by structuring recovery as a spatial and experiential process. Through the integration of therapeutic architecture and occupational therapy, the proposed design framework enables a shift from conventional, treatment-centered facilities toward environments that actively support behavioral transformation, emotional regulation, and social reintegration.

A key contribution of this research lies in embedding of therapy activities into architectural layout, where meaningful activities are embedded into the architectural configuration rather than treated as supplementary programs. The incorporation of hospitality-based functions further extends this approach by introducing real-world simulation as a mechanism for rebuilding social roles, work discipline, and interpersonal skills.

In addition, the integration of ecological systems demonstrates how environmental context can enhance both therapeutic and economic dimensions of rehabilitation. By linking nature-based activities with productive occupation, the design supports long-term recovery while promoting sustainability.

Overall, this study proposes a multidisciplinary framework in which architecture, occupation, and environment operate as a unified system. The findings suggest that future rehabilitation facilities should move beyond clinical models and adopt spatial strategies that facilitate not only healing, but also the reconstruction of identity and social function.

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