Impact of Built Environment on Animal Behavior in Healthcare Facilities

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Abstract — The design of healthcare facilities for animals plays a critical role in influencing their behavior, recovery rate, and overall well-being. Unlike human hospitals, animal healthcare environments must respond to species-specific sensory perceptions, stress triggers, and behavioral patterns. This study investigates how architectural elements such as spatial planning, lighting, acoustics, material selection, and landscape integration impact animal behavior in veterinary and wildlife healthcare centers. Through case studies and literature review, the research identifies key environmental stressors and proposes design strategies to create healing environments. The findings suggest that a well-designed built environment can significantly reduce stress, improve treatment efficiency, and enhance recovery outcomes in animals .

Index Terms— Animal behavior, built environment, veterinary architecture, wildlife healthcare, healing architecture.

I. INTRODUCTION

The built environment has a profound impact on the psychological and physiological behavior of living beings. In the context of animal healthcare facilities, architectural design becomes even more critical as animals cannot verbally communicate discomfort or stress. Veterinary hospitals and wildlife rehabilitation centers often expose animals to unfamiliar environments, leading to anxiety, aggression, or withdrawal.

Animals rely heavily on sensory perception such as sound, smell, and light. Poorly designed spaces with high noise levels, harsh lighting, and improper spatial zoning can negatively affect their behavior and slow down recovery

Therefore, understanding the relationship between built environment and animal behavior is essential for designing effective healthcare facilities.

This research aims to analyze how architectural design influences animal behavior and to propose design strategies that enhance healing and reduce stress.

II. METHODOLOGY

The research is based on:

- Literature review of animal behavior and environmental psychology.
- Case studies of veterinary hospitals and wildlife healthcare centers
- Analysis of spatial planning, lighting, acoustics, and materials
- Comparative study of conventional vs. behavior- sensitive Design.
- To study the relationship between built environment and animal behavior.
- To identify key architectural factors affecting animal stress and recovery
- To analyze existing veterinary and wildlife healthcare facilities.
- To propose design guidelines for behavior-responsive healthcare space.

III. OBJECTVES

- To analyze the impact of built environment elements on animal behavior in healthcare facilities.
- To evaluate key design parameters such as spatial zoning, lighting, acoustics, and landscape integration.

- To study how architectural planning influences stress levels, recovery, and overall well-being of animals.
- To identify gaps in existing animal healthcare facility design with respect to behavioral needs.
- To propose design strategies for creating efficient, humane, and animal-centered healthcare environments.

IV. SCOPE

- The study focuses on the role of built environment elements such as spatial planning, lighting, acoustics, and ventilation in influencing animal behavior.
- It covers different types of animal healthcare facilities, including veterinary hospitals and wildlife rehabilitation centers.
- The research evaluates behavioral responses such as stress levels, movement patterns, and recovery rates in relation to architectural design.
- The study is limited to design-based analysis and does not include detailed medical or pharmaceutical treatment aspects.
- The outcome aims to develop design guidelines for creating efficient, safe, and animal-friendly healthcare environments.

V. FACTORS AFFECTING ANIMAL BEHAVIOR

A. Spatial Planning

Proper zoning is essential to separate different species, especially predators and prey. Overlapping circulation paths can increase stress levels. Isolation wards, quarantine zones, and recovery areas must be strategically placed.

B. Lighting Conditions

Natural lighting is beneficial for animals as it maintains circadian rhythms. Excessive artificial lighting can cause stress, especially in nocturnal species.

C. Acoustic Environment

Noise is one of the biggest stress factors. Barking dogs, machinery, and human activity create high noise levels that can lead to anxiety and aggressive behavior. Acoustic insulation and zoning are crucial.

D. Material Selection

Materials should be non-toxic, easy to clean, and non-reflective. Slippery floors or reflective surfaces can confuse animals and cause discomfort.

E. Olfactory Environment

Animals are highly sensitive to smell. Strong disinfectants or mixed scents from different species can trigger stress responses.

F. Landscape and Open Spaces

Access to outdoor spaces improves mental well-being. Green areas, natural elements, and controlled exposure to nature help in faster recover.

VI. BASIC AMENITIES FOR ANIMALS

1. Species-Specific Enclosures

Enclosures should be designed according to the size, behavior, and habitat of different species, ensuring adequate space, safety, and comfort.

2. Shaded and Climate-Controlled Areas

Provision of shaded zones, natural ventilation, and thermal comfort systems to protect animals from extreme weather conditions.

3. Clean Water and Feeding Zones

Continuous access to clean drinking water and designated feeding areas that reduce competition and stress among animals.

4. Isolation and Quarantine Units

Separate spaces for injured, diseased, or newly rescued animals to prevent cross-infection and allow proper monitoring.

5. Natural Habitat Elements

Inclusion of vegetation, rocks, logs, and water bodies to replicate natural surroundings and encourage normal behavior.

6. Quiet and Low-Stress Zones

Areas designed with minimal noise, controlled lighting, and limited human interaction to reduce anxiety and aggression.

7. Safe Circulation and Handling Areas

Proper pathways, holding zones, and treatment access points to ensure safe movement of animals and staff.

8. Waste Management and Hygiene Facilities

Efficient drainage, cleaning systems, and waste disposal to maintain hygiene and prevent disease spread.

VII. DATA COLLECTION

DATA TABLE: Standards for Animal Healthcare Facility Design .

i. Spatial and Enclosure Standards.

Facility Elements	Standard Requirement
Small Animal Enclosure	Minimum 1.5-2.5m^2
Large Animal Enclosure	10-25m^2 per animal [Species Dependent].
Isolations Units	Separate enclosure with Controlled assess
Ceiling Height	Minimum 3.0m for ventilation and comfort
Corridor Width	Minimum 1.8-2.4m for Safe animal movement.

ii. Environmental Comfort Standards.

Parameter	Standard
Temperature Range	18^c -30^c [Species Specific].
Ventilation	Minimum 8-12 air Change/Hour
Natural Light	30-50% Daylight Penetration.
Noise Level	Bellow 60db For Stress Reduction.
Humidity Level	40% -- 70%.

iii. Hygiene and Sanitation Standards.

Elements	Standard
Drainage Slope.	1:60 minimum
Floor Finish	Anti-slip, Non-toxic, easy to clean.
Waste Disposal	Segregated biomedical Waste system.
Cleaning Frequency	Minimum 2 Times/Day.
Water Supply	Continuous, potable [as per IS Standards].

iv. Accessibility and Movement Standards as per Norms.

Elements	Standard
Ramp Slop	1:12

Door Width	Minimum.1200-1500mm[Animal Movement.]
Turning Radios	1500-2000mm
Separate Circulations	Staff, animals, visitors
Emergency Access	Direct access to ICU and operations areas.

v. Behavioral and Safety Design Standards.

Parameters	Standard
Visual Barriers	Required between predator & prey species.
Zoning	Isolations, treatment, recovery clearly separated.
Human Interaction	Controlled & minimized
Enclosure Design	CCTV/ indirect observation recommended.

VIII. UDCPR & Forest, Guidelines for Animal Healthcare Facilities.

Reference Framework

- UDCPR (Unified Development Control and Promotion Regulations, Maharashtra)
- Forest & Wildlife norms (buffer, eco-sensitive planning, minimal disturbance.

i. Land use and Zoning Standards.

Elements	Guideline [UDCPR/ Forest Norms.]
Land use	Must fall under public/semi-public or special use zone
Buffer from Forest	Minimum 50–100 m eco-sensitive buffer
Built-up Coverage	Limited (30–40%) to preserve natural land
Open Space	Minimum 30–50% green/open area
Building Heigh	Low-rise preferred (G+1 / G+2 max).

ii. Environmental Protection Guidelines.

Parameter	Standard
Tree Preservation	Existing trees to be retained
Noise Control	Minimal disturbance to wildlife zones
Light Pollution	Controlled, low-intensity lighting
Water Management	Rainwater harvesting mandatory
Waste Disposal	Scientific & eco-safe disposal system

iii. Wildlife-Sensitive Planning.

Elements	Guidelines
Habitat Integration	Design should mimic natural habitat
Movement Corridors	Uninterrupted animal pathways
Human Restriction	Limited access zones
Fencing	Non-intrusive, safe, and natural barriers
Rehabilitation Zones	Separate from public areas

iv. Accessibility & Infrastructure.

Elements	Standard
Road Width	6–9 m access road
Emergency Access	Direct entry for rescue vehicles.
Service Zones	Separate from animal zones
Parking	Peripheral (not inside core animal zone].

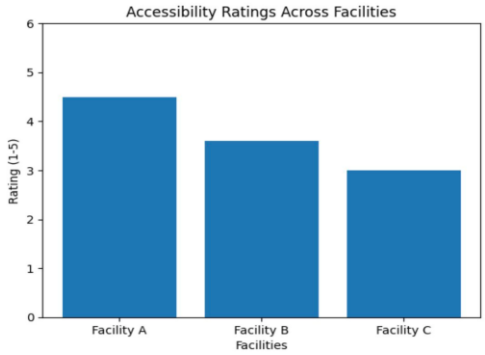
IX. SPATIAL ZONING DATA (Based on Guidelines)

Facility	Rating
Facility A	4.8
Facility B	3.6

Explanation of Data:

i. Accessibility:

1. Facility A (4.5): Designed with separate entry/exit for animals, smooth circulation, and minimal human interference, reducing stress.



2. Facility B (3.6): Moderate accessibility but lacks specialized movement paths.

3. Facility C (3.0): Poor accessibility with unplanned circulation leading to anxiety.

ii. Spatial Zoning:

1. Facility A: (4.7): Proper segregation of species, isolation wards, ICU, and OPD ensures controlled environment.

2.Animal- Centered Amenities:

Unlike human-centric design, animal healthcare facilities must prioritize behavioral

comfort. Providing shaded resting areas, species-specific enclosures, water access, and minimal visual stress zones enhances recovery.

Elements such as hiding spaces for prey animals, elevated platforms for felines, and perches for birds create a familiar environment that reduces anxiety. Properly designed amenities improve both physical healing and psychological well-being.

iii. Climate-Responsive Design:

Climate plays a major role in animal recovery and behavior. Passive design strategies such as shaded

pathways, green roofs, natural ventilation, and thermal buffers help maintain comfortable microclimates.

Use of vegetation, water bodies, and orientation reduces heat gain and creates cooling effects. Climate-responsive design ensures that outdoor and semi-open spaces remain usable throughout the year, especially in tropical regions like India.

iv:Behavioral Zoning and Stress Reduction:

Zoning is one of the most critical aspects in animal healthcare design. Separation of noisy and quiet zones, predator and prey species, and treatment and recovery areas is essential.

Isolation wards, quarantine zones, and ICU spaces should be located away from public and high-activity areas. Visual barriers, controlled circulation, and restricted human interaction help reduce stress and aggressive behavior.

v. Human-Animal Interaction Control:

Minimizing unnecessary human interaction is crucial, especially in wildlife rehabilitation centers. Design should incorporate one-way viewing panels, concealed service corridors, and indirect monitoring systems.

This reduces fear and helps animals retain their natural instincts, which is important for successful rehabilitation and release back into the wild.

vi.Landscape Integration and Healing Environment:

Landscape acts as a therapeutic element in animal healthcare facilities. Natural habitats, green enclosures, and water features help simulate real environments, encouraging natural behavior.

Healing landscapes not only reduce stress but also improve recovery rates. Outdoor exercise yards, sensory gardens, and habitat-specific zones are essential design components.

vii. Sensory Environment [Light, Sound, Smell]: Animals are highly sensitive to sensory stimuli:

- Light: Natural daylight supports circadian rhythms.
- Sound: Acoustic control reduces fear and aggression.
- Smell: Proper ventilation prevents stress caused by mixed odors.

Designing with controlled sensory inputs creates a calm and healing environment.

X. BENEFITS OF BUILT ENVIRONMENT ON ANIMAL BEHAVIOR

Well-designed built environments in animal healthcare facilities play a crucial role in improving both physiological and psychological conditions of animals.

Behaviorally, appropriate spatial planning, reduced noise levels, and controlled human interaction help minimize stress, fear, and aggression in animals. This

Medically, environments with proper zoning, hygiene, ventilation, and lighting contribute to faster recovery rates and reduced chances of infection. Isolation wards and species-specific enclosures ensure effective treatment and monitoring.

Psychologically, daylight helps replicate natural habitats, promoting comfort and reducing captivity stress. This is especially important in wildlife rehabilitation centers. access to natural elements such as vegetation, open enclosures, and

Overall, a well-designed built environment enhances animal welfare, treatment efficiency, and rehabilitation success, making healthcare facilities more effective and humane.

XI. CASE STUDY ANALYSIS:

Case Study 1: Karun Ashram Wildlife Rescue and Rehabilitation Centre.

i. Overview and Background

Karun Ashram is a wildlife rescue and rehabilitation center located in Wardha, Maharashtra, established in 1999 and operated by People for Animals. The facility focuses on rescuing, treating, and rehabilitating injured, orphaned, and distressed wildlife, particularly those affected by human-animal conflict. The center is recognized by national authorities and functions as an important rescue hub in Central India.

ii. Functional Zoning and Infrastructure

The campus is organized into multiple functional zones including:

- Wildlife rescue and treatment areas
- .Operation theatre and diagnostic units
- Species-specific enclosures (for leopards, bears, deer, birds, etc.)
- Administrative and record-keeping spaces

It also includes animal ambulances and transport cages for emergency rescue operations, ensuring efficient movement and handling of animals.

iii. Medical and Rehabilitation Facilities:

The Centre is Occupied with advanced Veterinary Infrastructure such as:

- .Fully Functional Operation Theatre.
- .Diagnostic equipment [X-ray, hematology, Biochemistry units.]
- . ICU and treatment cages for large and small animals
- The primary goal is treatment + temporary care + release, rather than long-term captivity, promoting ethical wildlife rehabilitation.

iv. Wildlife-Sensitive Design Approach:

Karun ashram follows a rehabilitation-based approach where:

- Enclosures are designed to support natural behavior
- Human interaction is minimized
- Natural vegetation and open spaces are integrated.

The facility emphasizes short-term recovery and reintroduction into natural habitats, aligning with wildlife conservation principles.

v. Role in Rescue Operations and Conservation.

- The center handles complex rescue cases including:
- Injured wild animals (tigers, leopards, bears, birds)
- Conflict-related rescues near villages
- Endangered species rehabilitation (e.g., pangolins, vultures)

It works closely with the Forest Department and has treated thousands of animals, making it a key regional wildlife support system.

vi. Observations of Case Study.

- The facility prioritizes function over aesthetics, indicating scope for improved architectural planning.
- Clear zoning exists, but behavior-based design (acoustic control, sensory design) can be further enhanced.
- Strong integration of medical infrastructure, but landscape-based healing spaces can be expanded.
- Circulation and rescue logistics are efficient due to ambulance access and service zones.
- Overall, the center demonstrates a practical model of wildlife healthcare, but with potential for architectural optimization.

Case Study 2: People for Animals Wildlife Rescue and Rehabilitation:

The People for Animals (PFA) Wildlife Rescue and Rehabilitation Centre in Bengaluru is a non-profit organization established in 1996. It focuses on rescuing, treating, and rehabilitating injured, displaced, and orphaned urban wildlife, with the aim of releasing them back into their natural habitats.

The center operates throughout the year and plays a major role in addressing wildlife issues caused by rapid urbanization.

i. Functional Zoning and Infrastructure

- components including:
- Rescue and emergency intake zones
- Veterinary treatment and operation areas
- Species-specific enclosures
- Rehabilitation and recovery spaces
- The facility is organized into multiple functional

The center also includes rescue vehicles, equipment zones, and support infrastructure, enabling quick response to emergency wildlife cases.

ii. Medical and Rehabilitation Facilities The centre provides:

- Specialized veterinary care for multiple species
- Emergency treatment and surgical interventions
- Rehabilitation programs focusing on recovery and release.

It follows a 4R approach—Rescue, Recovery, Rehabilitation, and Release, ensuring animals are not kept in captivity longer than required.

iii. Wildlife-Sensitive Design Approach The design approach focuses on:

- Creating enclosures that mimic natural habitats
- Minimizing human interaction
- Providing safe and stress-free environments

The facility emphasizes temporary care and ecological reintegration, aligning with sustainable wildlife conservation principles.

iv. Role in Rescue Operations and Conservation The center has:

- Rescued over 50,000 animals across 200+ species
- Worked closely with forest departments and authorities
- Responded to urban wildlife conflicts and emergencies

It plays a critical role in conserving biodiversity within urban ecosystems.

v. Observations of Case Study:

- Strong rescue and medical infrastructure supports high-volume operations.
- Effective coordination with forest authorities improves response efficiency.
- Limited architectural emphasis on behavioral design (acoustic & sensory control).
- Urban context increases stress factors due to noise and human proximity.
- High efficiency in rescue operations, but scope exists for improved landscape integration and zoning refinement.

XII. CHALLENGES AND LIMITATIONS

Despite its importance, designing animal-responsive healthcare environments faces several challenges.

One of the major issues is lack of awareness and research integration, where many facilities are still designed using human-centric approaches rather than animal behavior-based planning.

Budget constraints often limit the use of advanced materials, acoustic treatments, and landscape integration, resulting in compromised design quality.

In existing facilities, retrofitting becomes difficult due to rigid layouts, lack of space, and improper zoning, which negatively impacts animal comfort and movement.

Another challenge is managing different species, especially predator and prey animals, which require strict zoning and separation to avoid stress and conflict.

Additionally, poor maintenance, inadequate ventilation, and lack of climate-responsive design reduce the usability and effectiveness of spaces over time.

These limitations highlight the need for integrated design approaches, combining architecture, veterinary science, and behavioral studies.

XIII. RESULTS AND DISCUSSION

The study reveals that animals respond positively to environments that mimic their natural habitats. Reduced noise, proper zoning, and access to natural elements significantly lower stress levels. Facilities designed with behavioral considerations show improved recovery rates and better handling of animals.

XIV. CONCLUSION

The comparative analysis of Karun ashram Wildlife Rescue Centre, Wardha and People for Animals Wildlife Rescue Centre, Bengaluru highlights the significant influence of the built environment on animal behavior, recovery, and overall welfare

Both case studies demonstrate that effective wildlife healthcare facilities must go beyond basic medical infrastructure and incorporate behavior-responsive design principles. Karun ashram, located in a relatively natural setting, benefits from

lower environmental stressors and better integration with natural surroundings, which supports calmer animal behavior and smoother rehabilitation processes. In contrast, the PFA Bengaluru centre operates in an urban context, where increased noise, human activity, and spatial constraints contribute to higher stress levels among animals despite having advanced rescue and medical facilities.

The study clearly indicates that zoning, circulation planning, and sensory control (light, sound, and human interaction) are critical factors in reducing stress and improving recovery outcomes. Facilities that integrate natural elements, provide adequate enclosure space, and minimize unnecessary human interaction show better behavioral responses in animals.

Furthermore, while both centres are functionally efficient in rescue and treatment operations, there is a noticeable gap in the integration of architectural design strategies focused on animal psychology, such as acoustic insulation, habitat simulation, and climate-responsive planning.

In conclusion, the built environment plays a crucial role in shaping animal behavior in healthcare facilities. A well-designed, wildlife-sensitive environment not only enhances medical efficiency but also promotes faster recovery, reduced stress, and successful rehabilitation. Therefore, future animal healthcare facilities must adopt an integrated design approach, combining architecture, veterinary science, and environmental psychology to create humane and effective healing environments.

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