Zoo Architecture - Animal / Visitor / Management Friendly Designs, Presentation at the SAZARC Fourth Annual Meeting, Colombo, December 1-7, 2003

The Principles of Zoo Friendly Architecture
While the term 'zoo friendly' designing is not a formal phrase used in the world of zoo design, it has been coined here to establish some of the basic parameters by which zoos in South Asia can be improved through design. The basic issue at hand is that zoo directors, managers, and curators in this part of the world are too busy with their many duties and responsibilities to be able to effectively manage the design process as well and the task is usually left to a local architect who without zoo experience is unable to do justice to the complex requirements of zoo design.

Zoo design, as the title of this article suggests, needs to be 'friendly' i.e. serve the needs of – animals, visitors, and the management. At the outset therefore it is important to establish the criteria by which a design can be judged as being friendly, namely:

-- An **animal friendly design** is one that a) supports good animal health, b) that keeps animals safe from harm, c) that promotes natural behavioural patterns, and d) that supports ex-situ conservation (controlled breeding).
-- A **visitor friendly design** is one that a) fulfills all functional visitor requirements, b) that keeps visitors safe from harm (within practical limits), and c) that supports visitor interpretation for conservation.
-- A **management friendly design** is one that a) is animal friendly and visitor friendly, b) that supports easy servicing and maintenance, and c) that is sturdy and long-lived

The bottom line is that good design matters, in that it makes life easier for the zoo administrator by improving health and safety standards and supporting easier management.

Categories of Zoo Architecture
A brief summary of the different types of zoo architecture is in order and the relevance of friendly design noted, namely:
-- **Exhibit Architecture**, i.e. exhibit mesh structures that need to be animal friendly (for safety, comfort & behaviour) as well as management friendly (for servicing & longevity).
-- **Visitor Architecture (Interpretation)** such as view structures, interpretation structures, rest structures etc, that need to to be visitor friendly (for safety, comfort & interpretation) as well as management friendly (for servicing).
-- **Visitor Architecture (Facilities)** such as toilets, cafeterias, gift shops etc, that need to be visitor friendly (function & comfort) as well as management friendly (for servicing & longevity).
-- **Holding Architecture**, i.e. all animal holding structures and buildings that need to be animal friendly (for safety, comfort & behaviour) as well as management friendly (for servicing & longevity).
-- **Service Architecture** i.e. food prep buildings, hospital, quarantine, offices etc, that need to be management friendly (for servicing & longevity).

The important aspect in all of this is that the design priorities must be set up at the start make the task of the (usually uninformed) designer clearer. It results in architecture that fulfills the zoo manager's requirements and an appearance, which supports the zoo mission. Too often in South Asia has one seen a zoo building completely inappropriate in visual terms for it's use – a particular new zoo hospital in India comes to mind. This building looks like a upmarket residential structure from a neighbourhood of the same city – full of decoration totally inappropriate for the particular zoo setting – or any zoo setting for that matter.

Exhibit Architecture
The assumption here is that no zoo today should be constructing out-of-date cages with heavy iron bars or brick & glass walled nocturnal-houses and that zoos are all moving towards the concept of open habitat zoos and beyond that – of bioparks. In this scenario structures that are classified as exhibit architecture are generally aviaries and mesh structures both rigid-mesh & flexible-mesh kind.

Some animal-friendly design guidelines:
-- For animal security, safe mesh structures should be designed where animals cannot hurt themselves, i.e. without sharp edges or joints or fittings.
-- For human safety, mesh structures should be designed in which fittings such as nuts cannot be opened by dexterous animals such as apes.
-- For animal safety, paint for mesh structures should be of non-toxic varieties if eaten by animals. Plastic coated wire-mesh should be ultra-violet resistant and should come with a manufacturers guarantee to this effect.
-- For animal health, simple and imaginative exhibits should be designed that simulate the natural habitat of the animal as closely as possible with plenty of behavioural enrichment options.

To conclude, safety is achieved in zoos through sensible design and good management. Also, creating natural habitats only requires imagination and a little effort on part of the zoo staff and designers.

Visitor Architecture (Interpretation)
This type of architecture includes exhibit-viewing structures & exhibit interpretation structures that are usually next to the exhibits, and therefore their appearance from an interpretive point of view, is extremely important. A related type of structure is a shaded rest-area, which may or may not be near an exhibit – but is part of the visitor, and therefore interpretation area.

Some visitor-friendly (safety) design guidelines:
-- For visitor safety, zone off all non-public areas with metal/ wood/bamboo screens to keep visitors away from service and holding areas. Often this is the simplest activity a zoo can undertake to improve it's appearance and management. Most zoos in South Asia have little or no zoning, creating a visual and management mess.
-- Viewing structures next to exhibits need to be integrated with exhibit design (selected view-lines), barrier design (safety), horticulture (green buffers), and pathway design (circulation)

-- Well-designed safety barriers are a boon to the zoo administrator. Guardrails should have vertical bars only so that visitor cannot climb them. A guardrail can have single broad horizontal bar at the top, and a single child-step bar at the bottom.
-- Zoos in this part of the world usually overlook effective warning sign systems. An organised signage system should be developed with standardized lettering, colours, and graphics rather than ad-hoc signs. Long-lasting materials should be used such as aluminum, fiberglass, or powder-coated steel for signage.

To summarize, safety-zoning is easy to achieve, costs little, and offers a lot of benefits. Secondly, safety barriers are an integral part of good zoo design. And finally, good warning signage reflects on the zoo administrators concern for human life.

Some visitor-friendly (interpretation) design guidelines:
-- For visitor interpretation, a vernacular theme can be used that fits with the geographic area represented in the exhibit.
-- Natural habitat design includes the environments occupied by tribal peoples, which are integral to the natural habitats of most wildlife species. Local area craftsmen can easily make for instance village huts and granaries for instance.

To conclude, the integration of viewing/interpretation structures with the rest of the zoo theme is essential to good zoo design

Visitor Architecture (Facilities)
This type of architecture includes the zoo entrance complex, toilets, cafetarias & snackbars and children's play structures where the buildings need to be attractive, visually fit with the zoo mission, and be long-lasting.

Some management-friendly design guidelines:
-- Sloped roofs with large overhangs should be used wherever possible to avoid water seepage and structural deterioration over time. Sloped roof structures are also visually appropriate for wilderness settings.
-- Permanent or hard wearing finishes should be used for walls and floors for ease of maintenance – while avoiding glossy, polished or shining surfaces which do not visually fit a zoo environment.
-- Plenty of garbage cans should be provided in and around all facilities structures, as they are concentration points for visitors.

Table 1 :

Species	CZA Minimum Cubicle Dimensions		WII / Desai Minimum Cubicle Dimensions	
	Area	H	Area	H
Tiger / Lion	4.95	3.00	**5.25**	3.00
Panther / Leopard	3.00	2.00	**4.50**	**2.50**
Clouded / Snow Leopard	3.00	2.00	**4.50**	2.00
Small cats	2.70	1.50	**4.00**	1.50
Elephant	48.00	5.50	48.00	5.50
Rhinoceros (One-horned)	15.00	2.50	15.00	2.50
Bear (Indian)	4.50	2.00	**6.00**	**2.50**
Jackal, Wolf, Wild Dog	3.00	1.50	3.00	1.50
Wild Buffalo	4.50	2.00	**9.00**	**2.50**
Swamp Deer	6.00	2.50	6.00	2.50

Some visitor-friendly design guidelines:
-- Visitor facilities buildings should be made colourful and attractive to look at, while retaining some relationship in appearance to the theme of the visitor interpretation buildings.
-- Play structures and facilities for children must be especially designed as colourful and attractive places. Non Governmental Organizations working in the field of children and environmental education, and schools, are often the best sources of imaginative ideas for such facilities.
-- Plenty of benches should be provided for visitors to sit and rest inside and outside all facilities structures.

In other words, visitor facilities at zoos across South Asia should be designed to the same high standards as successful theme parks to ensure visitor satisfaction and repeat visitation. Secondly children are the most important visitors to and supporters of a zoo, but have a short attention span, which must be catered for through the provision of other activities.

Holding Architecture
This category comprises the largest amount of architecture in a zoo and includes holding buildings of all kinds from lightweight mesh buildings to heavy masonry buildings.

Some animal-friendly design guidelines:
-- To start with, for obvious reasons of animal comfort, it is preferable to use more than the minimum dimensions recommended by the authorities. (Table 1)
-- To ensure optimum animal comfort, each cubicle should be provided with resting, feeding, drinking water and exercising facilities, according to the biological needs of the species. In India, this is a mandatory requirement by the Central Zoo Authority.
-- Some climbing species prefer not to sleep at ground level – and need to be provided raised sleeping platforms. Nocturnal animals prefer dens and need to be provided small enclosed spaces away from keeper doors.
-- Safe structures should be designed where animals cannot hurt themselves - no sharp corners, masonry edges rounded off, metal and wooden joinery is hidden, embedded, or filed off.
-- The provision of proper day-lighting with skylights into interior holding areas helps keep them dry and the animals healthier as a result. Amazingly, zoos in India today are still constructing dark and dingy holding buildings.
-- Provision of proper ventilation inside holding areas can be achieved by incorporating vertical air-shafts and ventilators into the roofs – windows rarely provide enough cross-ventilation. The resulting natural air- cycles will provide a healthier environment for the animals.

Put more simply - providing for the behavioural needs of a species requires a combination of common sense, observation, and research-based knowledge – all organized into action.
Some keeper-friendly design guidelines:
-- New or modify old holding & exhibit areas should be designed to allow remote operation through vestibules, safe zones, double doors, feeding and watering slots. Zoo accidents usually occur through careless behaviour made even riskier by bad design.

-- Dark & unsafe interior keeper areas should be avoided by introducing daylight through skylights - these can be incorporated even into existing holding buildings. An added advantage is that holding areas are well-lit even when there is no electricity, a common problem in India.

In other words, safety is achieved in zoos through sensible design coupled with good management.

Some management-friendly design guidelines:
-- Zoos should use structural systems appropriate to the containment requirement, while fulfilling the needs of servicing. Over-designing structures, a common problem in South Asian zoos does not result in easier maintenance, and certainly results in stretched development budgets.
-- From a zoo design point of view, heavy masonry / concrete buildings do not necessarily last longer while light masonry / mesh buildings are easier to hide from visitor view with vegetation.
-- Building materials used should have finishes designed for longevity and heavy-duty use. For instance alternative economical wall finishes that last longer than conventional finishes are concrete tile cladding, grit finishes, and exterior textured paints. Alternative and economical floor finishes that last longer than conventional floors are vacuum-finished concrete for interior use and pre-cast concrete unit pavers for exterior use. Alternative materials to wood and steel for doors and windows are fibreglass, aluminium and fibre-reinforced thermoplastic composites.

It is important to remember two points here – the first is that alternative materials are readily available all over South Asia and are not necessarily more expensive then conventional materials. Secondly, even a slightly greater initial investment in better finishes pays off in the long run through lower maintenance

Service Architecture
These buildings are the ones that architects are usually more familiar with – hospitals, food kitchens, offices, etc. With the exception perhaps of the zoo office, none of these buildings are to be seen by visitors. Therefore their external appearance is not important and they should be hidden behind vegetation. In fact, more money should be spent on ensuring that these buildings last long and are easy to service, especially since zoos in South Asia usually have very low maintenance budgets.

Some management-friendly design guidelines:
-- Service, and indeed all zoo buildings deteriorate more quickly when the effects of weathering (especially rainfall) and heavy use are not taken into account while designing them.
-- For proper building waterproofing ensure that only sloped roofs with wide eaves are used as well as continuous and wide plinth protection, as part of the building design.
-- -- Comprehensive building drainage can be achieved by properly sloped floors (minimum 1%-2%), continuous open trench drains inside for washing down, and continuous peripheral (ring) drains outside for rainwater disposal.
-- Waterproofing concrete admixtures and penetrating sprays are readily available today to increase the life of masonry buildings, whether old or new.

Though good drainage design and waterproofing are the hallmarks of a well thought-out project, as a general observation, waterproofing and drainage are usually the most ignored aspects of design (since they're invisible) in South Asia.

To conclude, as a rough guess zoos in South Asia are generally about twenty years behind the mainstream architectural profession and suffer from attentions of mediocre architects. Zoos should look beyond old and conventional solutions to current mainstream architectural solutions that often involve new technologies.

The following zoos and associations contributed from $850 - $ 2000 towards the air fare and accomodation of participants from Nepal, India, Bangladesh and UAE and that of the Zoo Design Resource Person.

European Association of Zoos and Aquaria, EAZA;
Association of British Wild Animal Keepers ABWAK;
Koln Zoo, Germany
Appenheul Primate Park, Netherlands
Columbus Zoo Conservation Fund, Ohio;
Hawk Conservancy Trust

Table 2 :

ANIMAL / CONTAINMENT TYPE	TYPICAL SPECIES	HOLDING BLDG WALLS	HOLDING BLDG ROOF	AESTHETIC STRATEGIES
Climbing / Heavy	Tiger, Lion, Bear	Masonry	Concrete with skylights	Hide behind vegetative barriers, mounds, rockwork
Climbing / Medium	Panther, Leopard	Masonry (lower) + chainlink mesh (upper)	Corrugated steel / fibreglass	Paint dark green, use vegetation screen
Climbing / Light	Small cats	Chainlink mesh	Corrugated steel / fibreglass	Paint dark green, use vegetation
Terrestial / Very heavy	Elephants	None required in warm climates	Corrugated steel on concrete	None needed - open to public
Terrestial / heavy	Rhinoceros, Hippoptamus, Wild Buffalo, Large Deer	Masonry (lower) + open (upper)	Corrugated steel on concrete columns	Paint dark green, use vegetation screen
Terrestial (jumping) / medium	Deer sp., Wolves, Jackals, Wild Dogs	Masonry (lower) + chainlink mesh	Corrugated steel / fibreglass	Paint dark green, use vegetation