

Zoo Design & Zoo Management : Designing in a zoo for easier maintenance

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Summary

The Zoo Administrator

This article focuses on the need to keep issues of maintenance and management in mind when designing zoos or components of zoos. Zoo administrators are expected to wear many hats, from dealing with the management of animals, visitors, and zoo employees to the logistics of running a complex operation on a day-to-day basis. As a result, they are usually too busy with daily zoo management to be concerned about how design can make life simpler for them. In South Asia, good planning and design is not something usually looked at by zoo administrators as a way of making life simpler for themselves and their staff.

The Zoo Architect

Zoos and components of zoos are usually designed by specialists and architects, who, in this part of the world at least, have a vested interest in keeping the technicalities of their profession hidden from the zoo administrators - since it increases their value to the client. Thus the zoo administrator is often at a disadvantage when it comes to dealing with the zoo design professional in decision making, and the decisions are usually left to the professionals with the zoo staff only formulating a few basic requirements. In India at least, the local architects who design most of the buildings and enclosures in zoos have little idea about alternatives to conventional materials and processes, etc.

In the following paragraphs, we examine the management of a zoo under three different heads, namely:

I. Building Management: structure, fittings, and maintenance

II. Site Management: erosion control & drainage, visitor amenities, and horticulture

III. Energy Management: Solar power, building insulation, day lighting

Maintenance issues are highlighted and solutions provided along with alternative materials and products that are easier to maintain. Most of the product-types, if not the products, are now available in larger cities across the sub-continent. The contact details of those sources known to me have been provided in the table that follows the article - they are cross-referenced to the text. The sources in the table are generally considered to be amongst the best manufacturers in India of the particular product-type in question.

I. Building Management

A. Building structure: Zoo buildings are usually made out of brick masonry and concrete, due to the impression that this is the only way to achieve *pukka* (permanent) construction. Brick masonry usually needs to be re-plastered which itself slowly erodes over time. Moisture can

also damage brick construction permanently. Reinforced concrete, unknown to most, has a limited life due to the rusting of steel inside the concrete, which slowly corrodes the structure.

Structural material alternatives

- **Aerated concrete blocks** - made out of cement, lime, and fly ash a by-product of thermal power stations, are extremely light and ecologically sound. They involve semi-dry construction in arid areas, and provide high thermal insulation, high fire resistance, high sound absorption, and faster construction than brick. Made by Ballarpur Industries all over India. (*Product reference No.1*)

Wall finish alternatives

- **Concrete tile cladding** - is longer lasting than nearly all conventional wall finishes. They are water resistant, available for roof and wall cladding, in a range of colours and patterns including brick finish. (*Product reference No.2*)

- **Grit (aggregate) finishes** - are commonly found in better architecture all over the subcontinent and are an economical alternative to wall cladding. It is longer lasting than plain cement plaster finish since the grit provides the surface with a better texture for adhesion. The aggregates are available in a range of colours including greys, reds, browns, whites, yellows depending on type of local stone quarried.

- **Exterior textured paints** - are developed by all the top paint companies in the subcontinent, and are designed for marine and other highly erosive environments and are thus long-lived than snowcem. They have anti-fungal qualities, better adhesion and are weather-proof. Two examples are Berger Weathercoat textured paint, Jenson & Nicholson Armor Quartz textured paint.

Floor finish alternatives

- **Vacuum-finished concrete** - is an industrial grade floor finish, commonly used for industrial sheds all over the subcontinent. It uses conventional concrete materials but is much harder and longer-wearing due to the vacuum finish, which requires a special machine. With finish almost as smooth as marble, it is easier to clean than regular concrete floors.

- **Pre-cast concrete unit pavers** - are now used as standard finishes for petrol pumps in the Indian metros and even for public sidewalks - being almost the same cost as regular concrete. Since they are cast-like bricks at the factory, they have a better compressive strength and quality control. Being placed directly on a coarse sand bed, the installation process for unit pavers is faster and cheaper and less messy than concrete. Available in a small range of

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colours, they can be arranged into attractive patterns as well. The pre-cast concrete grass-grid paver is a variation of this product – with holes that allow for grass planting in between. Well known manufacturers of these products in North India are Nimco Prefab, Nitco Tiles, and Konkrete Products. (Product reference No.3)

B. Building fittings: Doors and windows in zoo buildings – particularly holding and service structures, deteriorate due to constant usage, sun and rain. Doors and windows are typically made out of wood or mild steel – both of which are highly susceptible to corrosion. Since aesthetics are not an issue in such buildings, doors and windows (other than those for animals) should preferably be made out of a durable composite.

Door / window material alternatives

- **Aluminium** – doors and windows are commonly used in architecture all over the subcontinent. They are of course more expensive than steel, but show no dimensional changes (warping, cracking etc.) over time, are extremely weather resistant, and require zero maintenance. They are available as powder coated / anodised, and in multiple colours.

- **Fibreglass** – doors are durable, rot, termite, and fungus proof, water and weather proof, fire retardant, chemical resistant, lightweight. They require no maintenance and their colours do not fade. (Product reference No.4)

- **Fibre-reinforced thermoplastic composite** - doors are durable, rot, termite, and fungus proof, water and weather proof, fire retardant, chemical resistant. They show no dimensional changes (warping, cracking etc.) over time, and require zero maintenance. As with fibreglass they are lightweight and exhibit no colour fading. Sold under the trade name Ecowud, they are also ecologically friendly, being made out of recycled plastic. (Product reference No.5)

C. Building maintenance: Buildings deteriorate over time due to usage, including thermal stresses created by the sun, and most importantly – corrosion created by rainwater. Good waterproofing is the single most important factor in lengthening the life of a building in the subcontinent.

Rainwater protection

- **Sloped roofs:** As a general rule, all zoo building should have sloped roofs, whether the basic structure is made out of concrete, steel, or tile. Sloped roofs do not retain water unlike flat roofs and are thus much easier to maintain in the long run.

- **Plinth protection:** All zoo buildings, particularly those in moist climates, should be provided with wide (0.6M-1.0M) horizontal plinth protection to protect the walls from moisture penetration. In particularly rainy areas, this should be combined with continuous ring drains to remove water into drainage systems. Building protected this way will last much longer than those that are not – as can be seen in the newest constructions at the Singapore Zoo.

Waterproofing

- **Concrete admixtures** - are integral waterproofing admixtures for water retaining structures such as aquatic species pools and ponds as well as protecting buildings from moisture penetration. These admixtures produce denser concrete with reduced permeability, resulting in longer life of the structure.

- **Penetrating sprays, sealants, coatings** – can be applied to concrete after curing, or a brick masonry so that all cracks are sealed.

The type of waterproofing required depends on the time of application (pre or post construction), type of use (dry, aquatic) etc. (Product reference No.6)

II. Site Management

A. Erosion control & drainage: Zoos with sandy soils often have a problem of rainwater eroding away sloped areas – while zoos with clay / silt soils often have a problem of draining rainwater out of water-logged soils. While the conventional solutions of masonry embankments for erosion, and concrete drains for drainage are always there – these are very expensive to construct on a large scale but cheaper and as effective alternatives are available.

Erosion control alternatives

- **Geotextile fabrics** - are modern non-woven synthetic geotextile fabrics that are used underneath soil layers to prevent erosion – and are commonly used in mining and hydraulic projects in the subcontinent. They are ideal as slope protectors underneath lawn grass or wild grass cover. They are also used as soil separators to prevent mud from clogging up under-drainage layers in sub-soil drainage systems. (Product reference No.7)

Groundwater recharge systems

- **Dry drains** – consisting of linear dry gravel trenches (with or without side brick walls), are excellent for absorbing small to medium amounts of rainwater from hard surfaces and buildings. They work well in all soils except the most clayey types.

- **Porous paving:** granular surfaces (gravel, bajri) and unit-paver (discussed earlier) surfaces without cement joints on sand beds – all allow moderate amounts of rainwater to absorb directly into the ground. These are ideal for low-use pathways in zoos.

- **Reverse bore-wells** – also called injection wells, are being now installed in every city in India with water shortages, it is a legal requirement in larger developments in Delhi. It is basically a tube-well in reverse, which allows rainwater passing through a gravel filter to flow down into an aquifer and recharge the groundwater table. These are best installed in the middle of large grass areas, which act as natural filters for pollutants. Medium to large zoos in the subcontinent have enough space to implement a zero-runoff policy – that no rainwater should be allowed to drain off the site into the city stormwater system.

B. Visitor amenities: Wear and tear of fixtures due to regular usage by visitors as well as vandalism is very high

in zoos and hence the need for durable equipment. Most zoos provide concrete table and benches, which apart from being uncomfortable are not long lasting due to corrosion of the reinforcement inside. As with doors and windows described earlier, plastics are a very good alternative to concrete and steel.

Furniture & fittings

- **Benches and tables** – can be made out of reinforced thermoplastics, and are more durable than wood furniture, better looking than concrete furniture, and cheaper than steel furniture. (Product reference No.5)
- **Garbage cans** – are commonly made out of fibreglass or polyethylene. These are all more durable than conventional steel dustbins as well as far more attractive to look at.
- **Garden pot planters** – made out of hardened plastic are available in a range of sizes, and last much longer than earthen pots. (Product reference No.8)

C. Horticulture maintenance: Supplying enough water for horticulture, of which zoos have vast amounts, is always a problem. In addition, procuring manure and fertilizer for horticulture adds to maintenance costs while disposing of leaf litter is a headache unless integrated into the system.

Irrigation systems (Product reference No.9)

- **Sprinkler systems** – require a certain extra amount of capital investment, but save on costs in the long run through more efficient water consumption and lower labour requirements. They also result in more even watering for the landscape.
- **Drip Irrigation** - Is extremely water efficient and is the proven method to irrigate trees and shrubs in areas of water scarcity as the Israeli's have shown the whole world. They are economical to install, and only cannot be used in areas of high salt content in the groundwater.

Organic recycling

- **Composting** – should be mandatory in every zoo in the subcontinent, given the large amount of vegetative matter in all zoos. A leaf litter-recycling program makes complete economic sense (through reduced fertilizer consumption) and ecological sense (since leaf-litter does not need to be burned).
- **Vermiculture** - is an even more effective way to recycle leaf litter as well as all the food preparation leftovers - using red earthworms. Given that a zoo manages a multitude of animal species, it should be easy enough to maintain earthworms. Zoo manure can also be sold to visitors to generate more income – it is a common practice in zoos worldwide.

III. ENERGY Management

Solar power: Zoos are generally not heavy consumers of electricity, but nonetheless electricity consumption can be lowered through sensible use of solar power. In addition the availability of hot water is an important factor in maintaining health and hygiene standards in zoos. The

usual method is to install geysers but these are prone to rusting and electrical problems and therefore have a limited life. Solar hot water systems, used all over the subcontinent, are a solution to these problems and have the huge advantage that they are independent of the vagaries of state electricity supply.

Solar powered electricity (Product reference No.10)

- **Solar electric panels** - are made all over the subcontinent and some state governments even subsidize their installation. Good for areas with plenty of sunlight and capable of generating small amounts of power. Very large zoos will find this a more than viable option over expensive cabling that is required for transmitting electricity to the boundaries of the zoo. The panels can be installed on top of poles or roofs.
- **Solar street lighting** - is an excellent way to ensure a continuous supply of electricity for night street lighting in medium to large zoos. As with solar panels, these cannot work in the shade of trees, and being expensive may be prone to theft.

Solar hot water systems (Product reference No.11)

- **Integral roof top systems** – have the entire system sitting on top of the roof from where hot water is piped down to food preparation or other service areas. They can be conveniently installed above each holding / service building.
- **Split systems** - are a variation of the above where the solar panels are mounted on the roof while the hot water tank is kept below or underground.

Building insulation - is an often ignored, but important factor for zoos at higher altitudes, or even for those in cooler climates during winters such as most of north India. Good thermal insulation creates better working areas and holding buildings and helps keep animals warm without the use of expensive electrical heaters.

Structural Insulation

- **Trombe walls** – are systems where the south facing masonry wall is painted black and a parallel glass wall constructed with an air-gap between the two. The air-layer inside the gap heats up and warm air enters the holding building at the top keeping it warm during cold sunny weather.
- **Cavity walls** - such as rat-trap bonds for brickwork not only save on materials, but by introducing an air-gap into the brickwork make for excellent low cost insulation.

Non-structural Insulation

- **Fibreglass wool pads** - are available in mats that can be applied over false ceilings, under concrete roofs, under sloped metal roofs, these provide highly efficient insulation at low cost, and are lightweight, rot and vermin proof, fire safe. (Product reference No.12)

Day-lighting: Good day lighting inside a zoo service building is important for work efficiency, safety through better visibility, and health for the animals. Most holding buildings

tend to receive their daylight only through the doors making them overly dark and humid. Daylight can be effectively introduced into service and holding buildings through skylights.

polycarbonate, lightweight, long lasting and corrosion proof. (*Product reference No.4*)

Skylights

- **Polycarbonate skylights** – are unbreakable and therefore far more long lasting than glass, better than fibreglass, and are ideal for skylights and greenhouses. Sold under the trade name Lexan, the material is available as flat or corrugated sheets, and can be bent. (*Product reference No.13*)

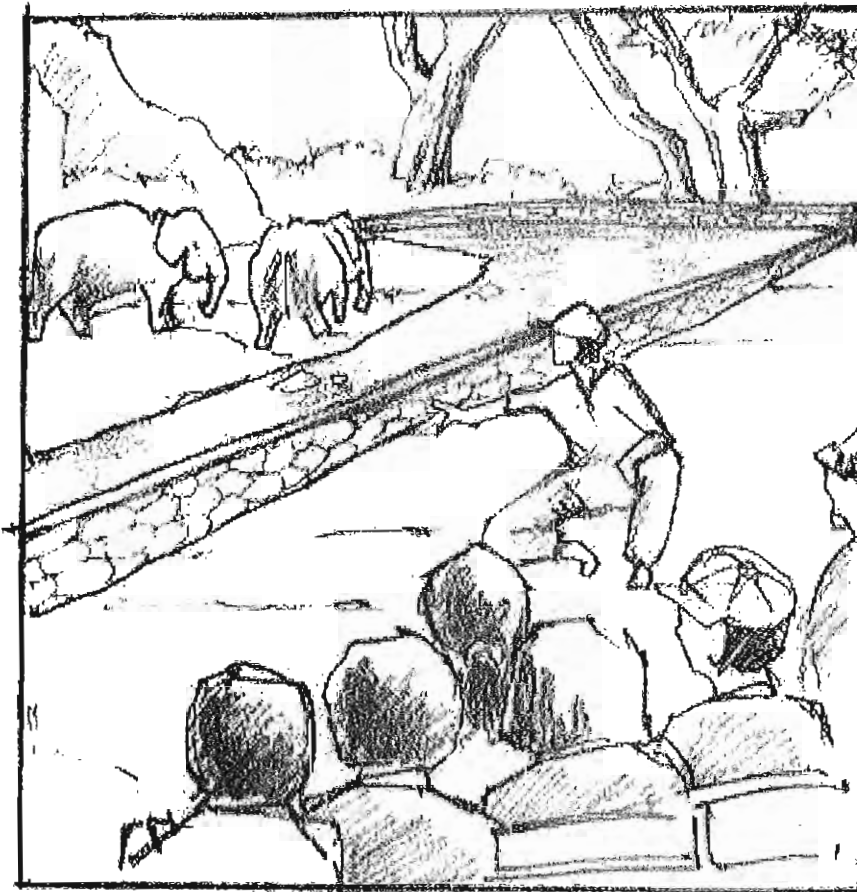
- **Fibreglass skylights** – are made of machine moulded, UV resistant, acrylic modified polyester resin. These are also impact resistant, more cost effective than

Table showing the details of the products suggested for zoo enclosures

Ref	Product-type	Manufacturer	Address / website	Phone
1	Aerated concrete blocks	BILT	Ballarpur Industries Limited (Unit AAC), Thapar House, 124 Janpath New Delhi 110001	2332-8332
2	Concrete wall / roof tiles	DYNA TILES	Dyna Brick (I) Pvt. Ltd. A-29 Sector-7 NOIDA Distt Ghaziabad, U.P.	2684-6114 2683-6005
3	Concrete Unit Pavers	NIMCO	Nimco Prefab 57/11 Old Rajinder Nagar New Delhi 110060	2581-4787 2581-4818
		KONKRETE	Koncrete Products 12/16 Sarvapriya Vihar New Delhi 110016	2696-9550 2686-4895
		NITCO	Northern Indian Tile Corporation Jindal Trust Building 1/8-B Asaf Ali Road New Delhi 110002	2323-1556 2323-4664 2323-9376
4	Fibreglass products (glazing, doors, windows etc)	SIMBA	Simba FRP (P) Limited 53, East of Kailash New Delhi 110065 URL: www.simbaworld.com	2646-5013 2684-2869
5	Recycled thermoplastics (doors, benches etc)	ECOWUD	Amarnath Enviroplast Ltd. PS Group Mangalam Apartment 12C Chakraberia Rd. (North) Calcutta 700020 URL: www.ecowud.com Email: luniask@yahoo.com	2475-6891 2475-7896 2475-6404 2474-9533 (fx)

6	Waterproofing (concrete sprays, concrete admixtures, concrete sealants, wall coatings, paint primers, mortars, bonding agents, coatings, polymer membranes, wall finishes etc)	DOW CORNING (USA)	Distributed countrywide	
		STP (USA)	Distributed countrywide	
		FAIRMATE	Fairmate Chemicals Pvt. Ltd. 8/1 Sai Sudha Arunoday Society Alkapuri, Vadodara 390007 (Regional offices in Ahmedabad, Surat, Chennai)	233-1193 233-0803
		KLA	KLA Construction Chemicals T-1 Green Park Extension New Delhi 110016	2616-0717 2619-9866
		GREENSBORO	Greensboro Polychem P. Limited I-4 Lajpat Nagar-1 New Delhi 110024	2691-0118
7	Geotextile fabrics	OCEAN NON – WOVENS	Filter Fabs RR-24 Mian Wali Nagar Main Rohtak Road Near Peera Garhi New Delhi 110041	2528-7366 2526-3332
		CA POLYTECH	CA Polytech 4671-73 Ansari Road Daryaganj Delhi 110002	2325-9785 2325-4303
8	Plastic dust-bins (commercial size) & garden planters	DIPLAST	Diplast Plastics Ltd. 52, Sector 28-A Chandigarh 160002 Email: diplast@ch1.vsnl.net.in	265-1395 265-1554
9	Irrigation Systems	NAANDAN (Israel)	R.S.Products Pvt. Ltd. A-22 Okhla Industrial Area Ph-I, New Delhi 110020	2681-3189 2681-0413
		RAINBIRD (USA)	Harvel Irrigations Pvt. Ltd. 301-304 Meghdoot 94 Nehru Place New Delhi 110019	2648-5365 2641-3370
		DRIP N'DRIP	Ajay Industrial Corporation Irrigation Division Gopal Das Bhawan, 13th floor 28 Barakhamba Road New Delhi 110001	2373-0505 2373-0606
10	Solar Energy	IREDA	Indian Renewable Energy Development Agency Limited (A Govt. of India Enterprise) India Habitat Centre, Core 4-A Lodhi Road New Delhi 110003	2460-1344 2464-2367 2460-2855 (fx)

11	Solar Hot Water Systems	SOLAR EDWARDS (Australia)	Solar Edwards India No.6, Vasant Apartments Vasant Vihar New Delhi 110057	2614-9124 2614-9127
12	Fiberglass Wool Insulation	TWIGA INSUL	U.P. Twiga Fibreglass Limited 3, Community Centre East of Kailash New Delhi 110065 (Regional offices in Ahmedabad, Bangalore, Calcutta, Chennai, Hyderabad, Mumbai)	2646-0860 2643-1588 (fx)
13	Polycarbonate sheets	LEXAN (USA)	GE Plastics India Limited Plot No. 405-B, Sector-20 Udyog Vihar, Phase-III Gurgaon 122016	234-1801 234-1817 (fx)



Erratum

Read November 2003 issue as Vol. XVIII No. 11 instead of Vol. XIX No. 11.