Chapter 2
Data Collection

Example Study

1. Ecorium

Location: part of Ecoplex in seocheon-gun, South Korea

Figure 2-2: **Ecorium view**

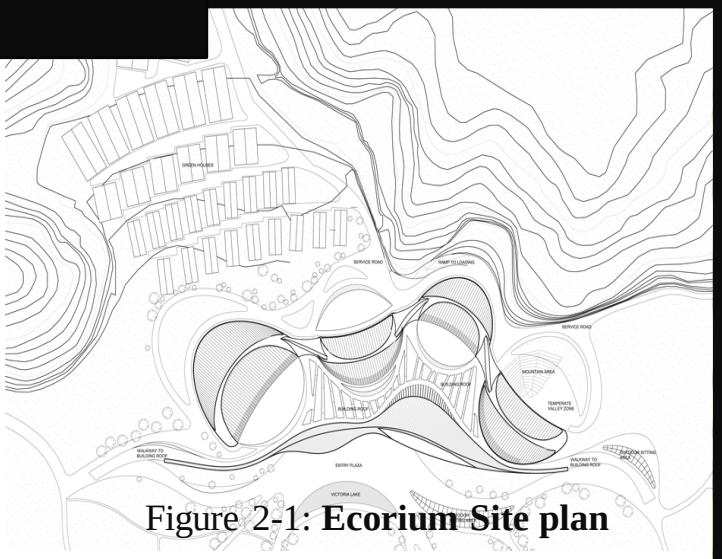


Figure 2-1: **Ecorium Site plan**

Concept: composed of Various greenhouses & controlled environments in order to reproduce the global ecosystem of the 5 different climate zones; tropical, desert, Mediterranean, temperate & polar.

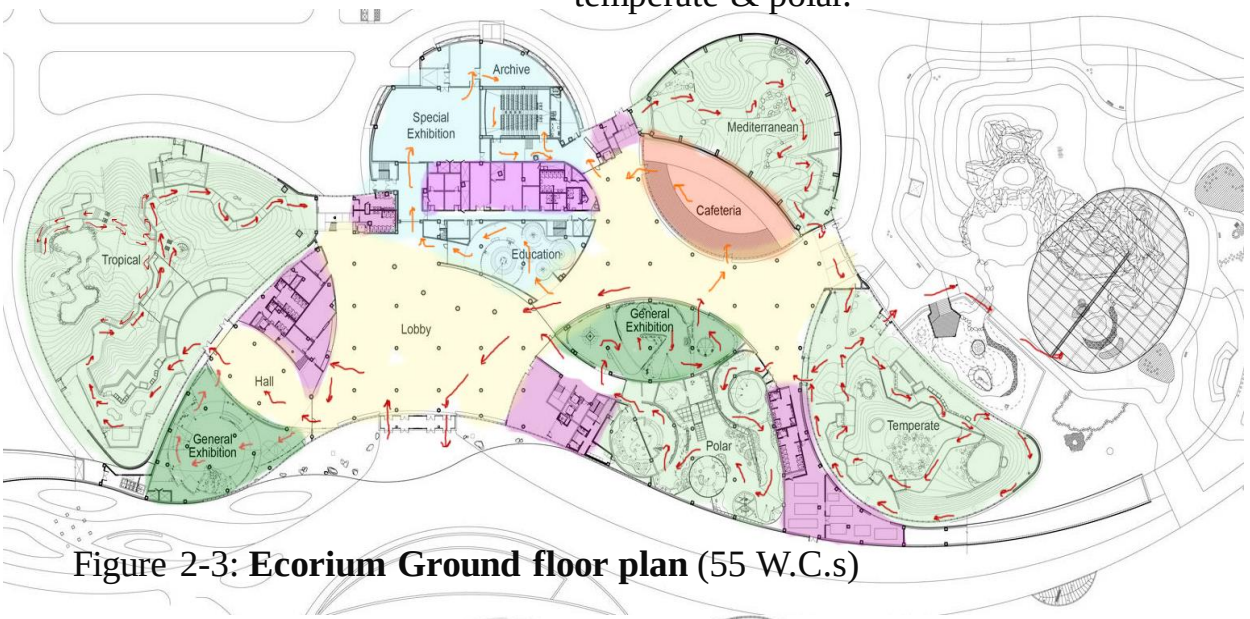


Figure 2-3: **Ecorium Ground floor plan** (55 W.C.s)

Figure 2-4: Ecorium **First floor plan** (6 W.C.s)

Exhibitions		Educational		Services		Commercial	
Tropical	2830	Education hall	400	General	1500	Outdoor cafe	530
Desert	1400	Cinema	210	Lobbies	3170	cafe	370
Mediterranean	1110	Archives	100			Restaurant	1390
Temperate	1470	Eco gallery	4090				
Polar	1040	Total site area				33090 sqm	
General	1100	Total floor area				23800	71%
Special	350	Total built area				15000	45%

Table 2-1: Ecoruim Area study

Structure:

large greenhouses supported by a mega-structure main arch which provides stability to the whole structure. It is equipped with horizontal band-truss which provides lateral stability & integrity to the whole structure. Slopped vertical trusses connected to the main arch support the curtain wall as well as resistance to wind

(Note: This same structure will be used in my design**)**

Sustainability:

1. alignment & orientation of green houses were simulated to create an ideal environment depending on the climate of each one
2. natural ventilation effects could be maintained through the 4 seasons for necessary facilities
3. sloped curtain wall gathers rainfall
4. total energy consumption is reduced by 10%

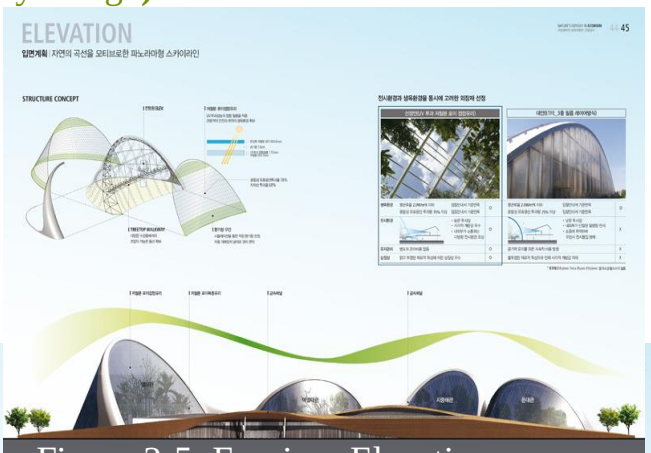


Figure 2-5: Ecorium Elevation

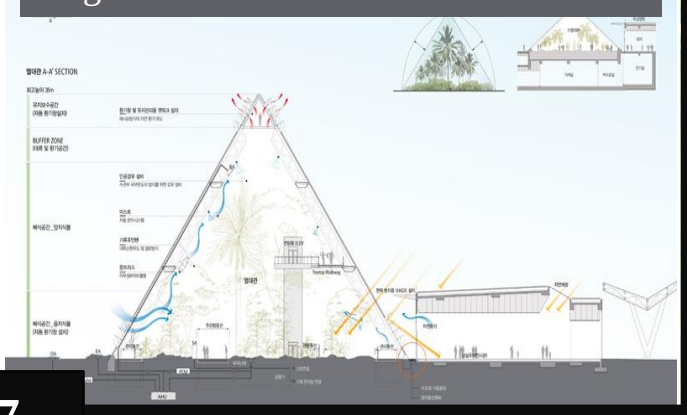


Figure 2-6: Ecorium Section

Advantages:

- ✓ Buffer zones before each exhibit
- ✓ Use of contours, plants &animals gives a naturalistic feel
- ✓ Good link between floors
- ✓ Bathrooms grouped to 4 locations
- ✓ Clear &controlled entrances

Disadvantages:

- × Not enough bathrooms upstairs
- × Circulation inside exhibits is confusing
- × Poor link between last 2 exhibits

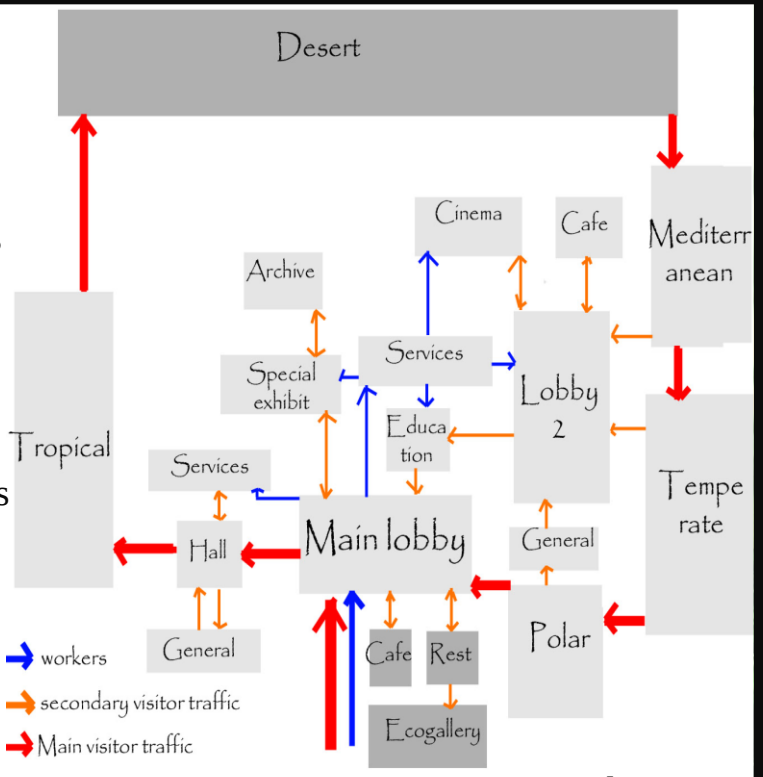


Diagram 2-1: Ecorium circulation

Figure 2-7: Gardens by the bay view

2. Cooled conservatories

Location: part of gardens by the bay, Singapore

Figure 2-8: Gardens by the bay Site plan

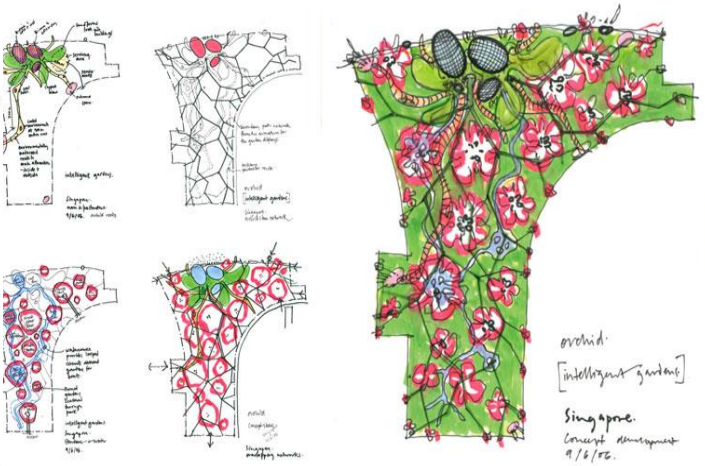


Figure 2-9: Gardens by the bay concept

Concept: two of the largest conservatories in the world, part of a 54 hectare botanic garden, they imitate the climate of Mediterranean & cloud forest region.

Area study	
Flower dome	10818
Retail	760
Fine dining	315
Services	1200
Cloud dome	6800

Table 2-2: Area study

Figure 2-10: Indoor waterfall

Figure 2-11: flower meadows

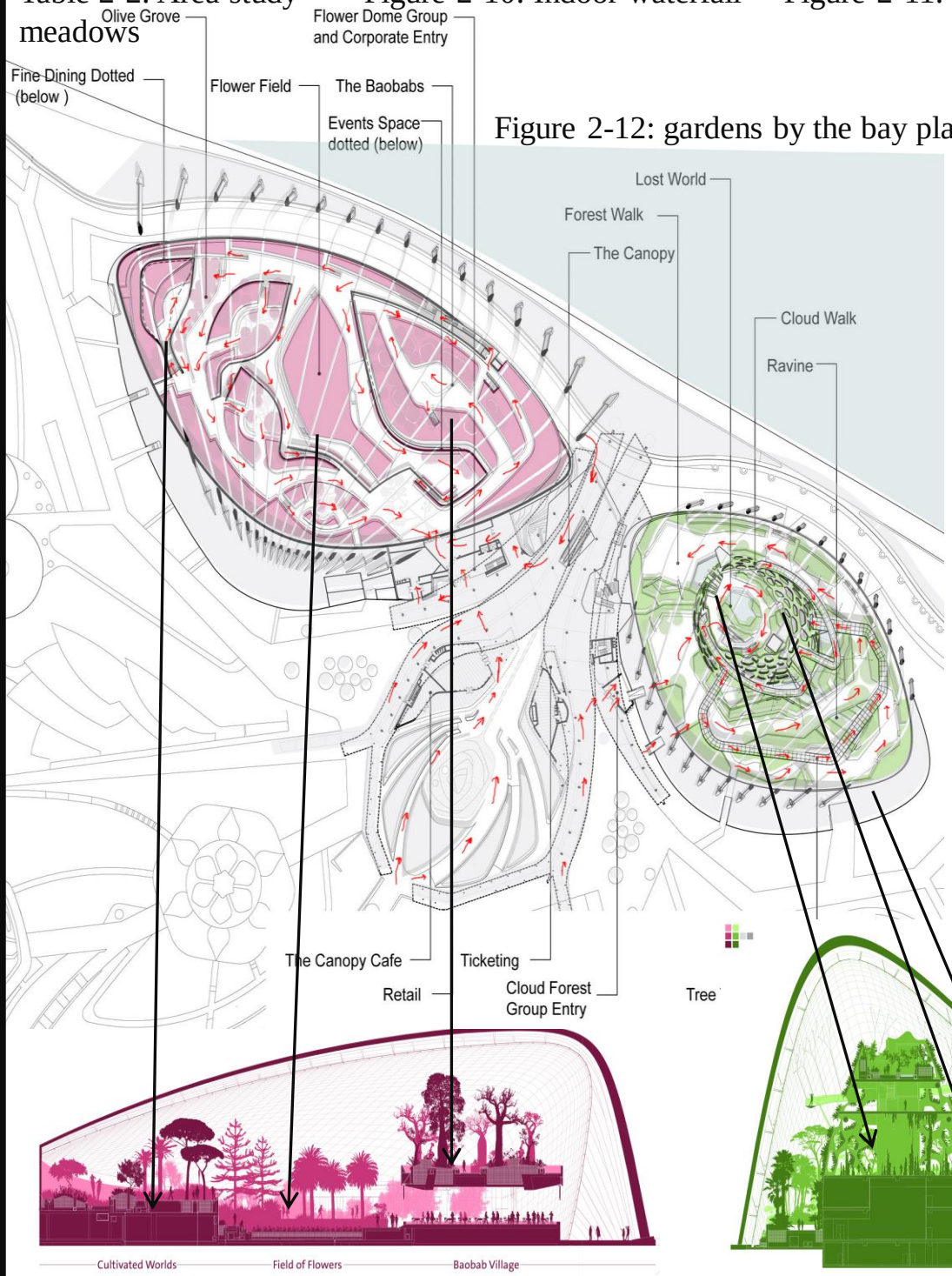


Figure 2-12: gardens by the bay plan

Figure 2-12: Gardens by the bay Section A

Figure 2-13: Gardens by the bay Section B

Structure: Egg-shaped steel and glass gridshell supported by Steel arches to resist lateral wind loads

Figure 2-14: Deployable shades

Sustainability system:

1. Deployable shades: automatically controlled depending on the sunshine & heat needed

2. Super trees that expel the hot air from the conservatory & produce energy via solar panels while also providing shade

(Note: because this project is also in a hot climate, The same technical sustainability solutions are used in my design)

3. Recycling of rainwater to be used in irrigation & of waste to make fertilizer & burn it to produce energy

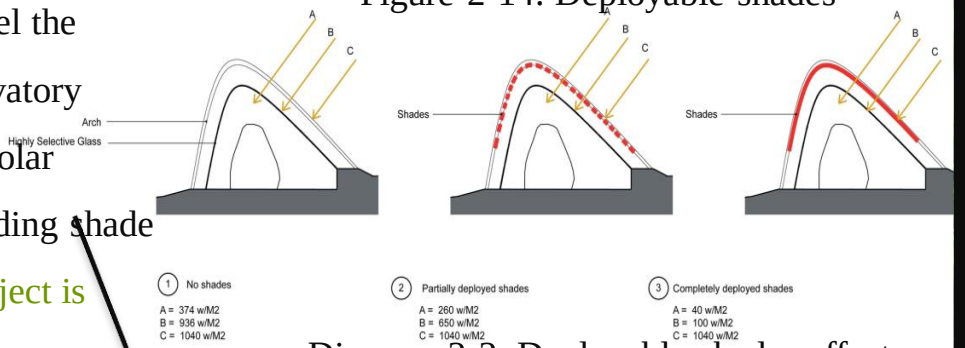


Diagram 2-2: Deployable shades effect

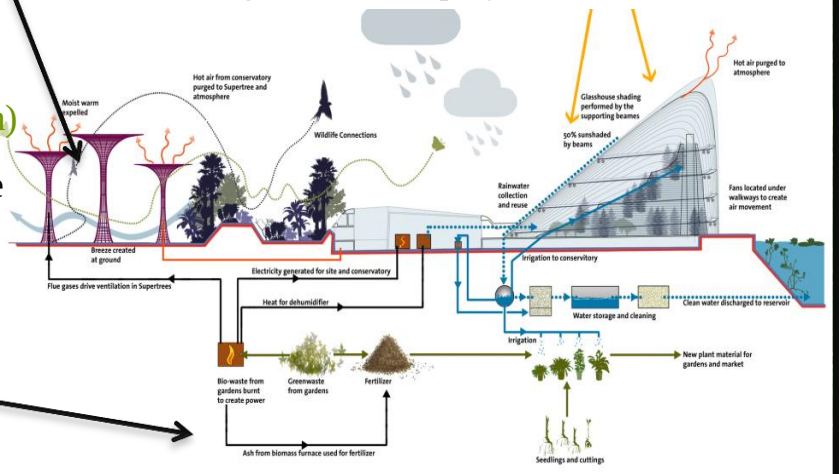


Diagram 2-3: Gardens by the bay ecosystem

Advantages:	Disadvantages
Maximum sustainability because the building is self-sufficient &adapts to the climate changes	The vegetation is clearly separated from the path which gives it an un-natural feeling
Many distinctive features such as the waterfall, the lost world & Super trees	No animals in the building
The site is well planned & has a clear concept	Very poor services & lack of educational sector
The full height of the greenhouse is used efficiently whether from above or bel1ow (for plant rooms)	Too much entrances to site (9) & the building entrance isn't very clear or controlled

Table 2-3: Gardens by the bay advantages and disadvantages

Zoo design

1. Circulation

- Visitor services are around the distribution plazas
- One way pedestrian flow preferred, 5-6 m wide main paths 3-4 m wide secondary paths

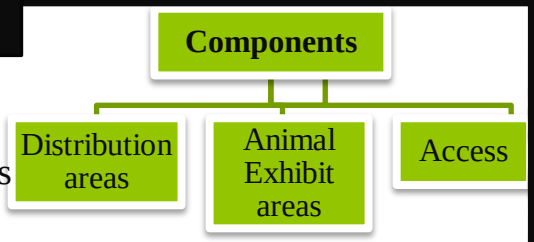
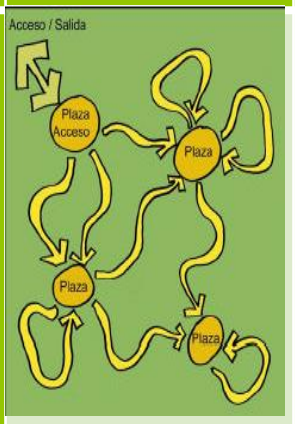
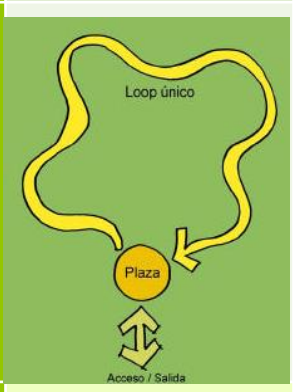
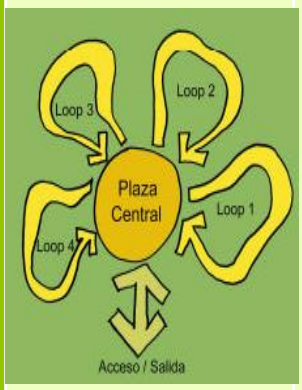


Diagram 2-4: zoo components

Pattern	Illustration	Advantages	Disadvantages
Without hierarchy ❖ **Most common** ❖ **Developed without planning**		❖ Presents multiple circulation options from a multitude of disparate distribution spaces	❖ Easy to get disoriented & lost ❖ uncomfortable ❖ visitors can miss exhibits ❖ educationally, it is difficult to build a rational story line with it
With hierarchy unique loop ❖ **one access, one distribution space &one loop**		❖ emphasizes hierarchy ❖ works well for small zoos with one single theme	❖ Not practical for larger zoos with many parallel themes because animal exhibits along the loop become too long
With hierarchy, multiple loops ❖ **For the largest zoos** ❖ **The hierarchy can be extended to have several exhibit loops that begin & end at one distribution space.**		❖ provides structure to develop a different theme for each loop, with the distribution space as the transition from one theme to the other ❖ visitors can select the zones they wish to visit &the sequence of visitation depending on the time &energy they have, always encountering the visitor services &the exit in the distribution space ❖ service circulation can be located on the periphery of the zoo, thereby minimizing the conflict of crossings with visitor circulation	

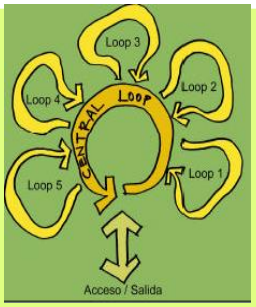
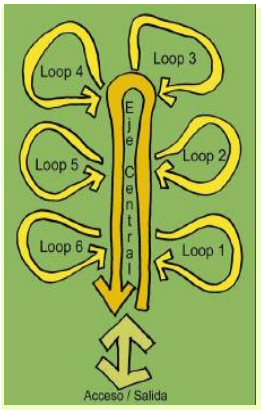
With hierarchy, Central main loop • **a main loop that functions as the distribution space.**		For zoos that have an icon in the middle, such as a lake or a heritage structure, or a space that provides a traditional activity.
With Hierarchy, central axis • **Incorporates a main axis, or corridor, which functions as the distribution space.**		it allows a long, distribution corridor that provides the opportunity for more loops originating from it &ending in it. Allows greater dispersion of visitors into the various exhibit zones.

Table 2-4: Zone Circulation types

Sub theme zones: (The challenge is to divide a themed loop into two sub theme zones.)

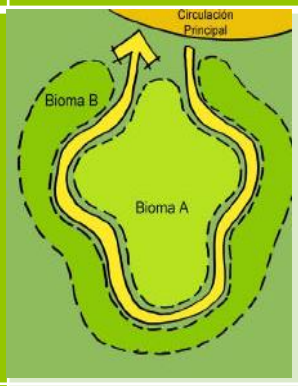
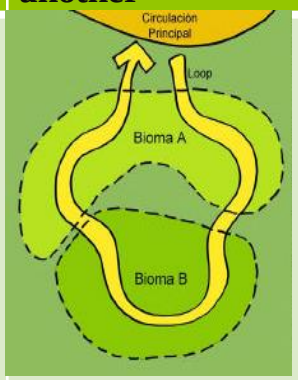
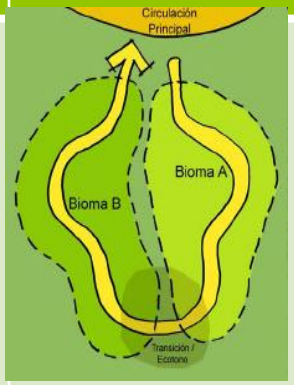
Method	**place one theme on one side of the visitor path & another theme on the other side.**	**to pass through one theme on a unique loop & then enter another**	**position one theme at the beginning of a loop then a transition zone**
			
Notes	Not recommended since attempts to create an immersion experience is lost because it is impossible to immerse the visitor in two, parallel, often conflicting themes and/or environments.	problem in the return to the original distribution point, where in it is necessary to again traverse & retrace the path of the originating theme.	The transition zone would allow a succession into a second theme zone. This concept can be repeated so that the visitor can pass through any number of theme zones.

Table 2-5: Sub-Zone Circulation types

2. Barrier design:

Barriers are needed at the exhibits to separate animals from visitors either physically or visually

Guide lines:

1. Controlled Viewing

Animal exhibit areas & barriers should be designed in a way that cross views of other people are avoided

Viewing locations & barriers should also ensure that visitors cannot see entire exhibit areas from any one point or from all points (360 degree viewing)

Primary Barriers

provide safe physical containment for the animals both on & off exhibit in areas used by the animals on a regular basis

Secondary barriers

provide temporary physical animal containment if the animals escape from primary keep visitors from contacting animals

Tertiary Barriers

To keep animals out of planted areas or away from primary barriers use "hot" or electrified wires disguised as natural features

Diagram 2-5: Barrier levels

2, Respecting the animal

Animal exhibit areas should be designed along with the barriers to place the animal either at or above human eye-level.

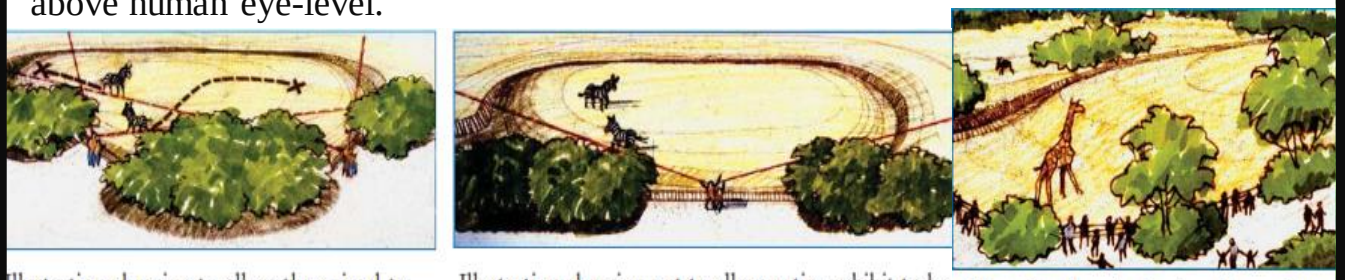


Illustration showing to allow the animal to move through the view areas

Illustration showing not to allow entire exhibit to be seen areas

Illustration showing breakup viewers into the smaller groups

Figure 2-15: Controlled viewing

- ✓ Makes exhibit more interesting and impressive to the viewer
- ✓ The animals also experience less stress.

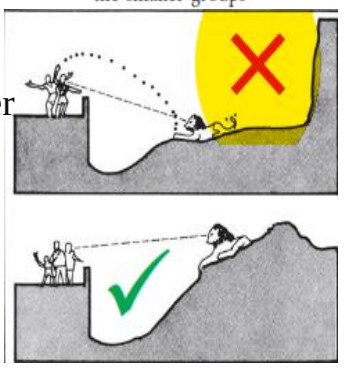


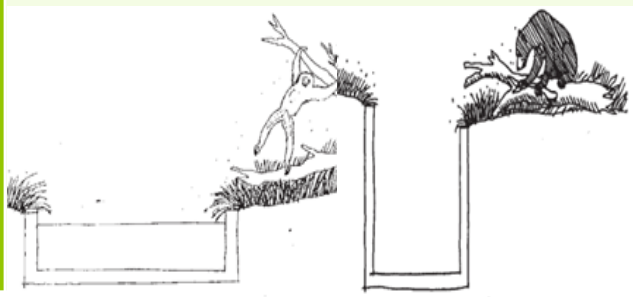
Figure 2-16 Respecting the animal

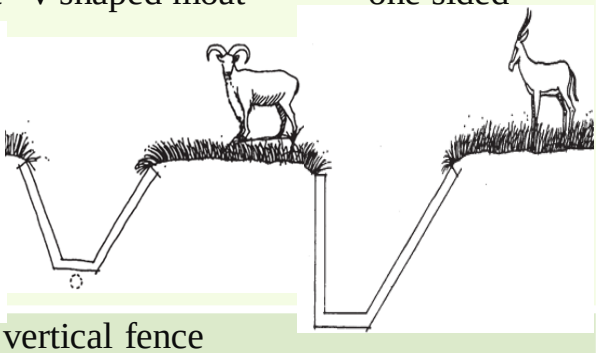
3. Physical barrier & their types:

Naturalistic Moats

wet or dry, hidden barriers are disguised as natural features like streams

Shallow dry box moat Hidden box moat v shaped moat one sided

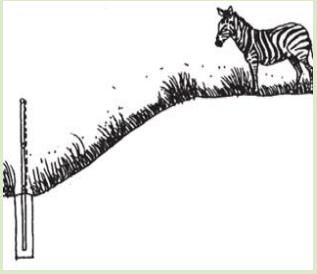


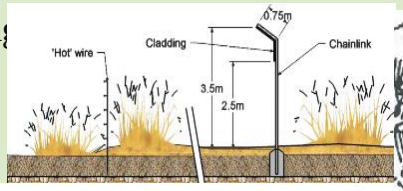


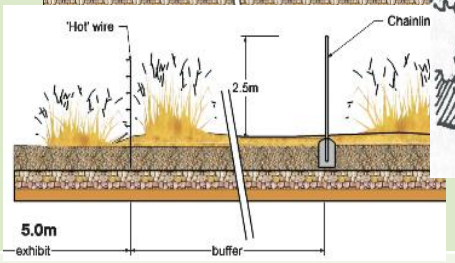
Fencing

Vertical fencing: Depressed vertical fence

Mesh fence with overhang





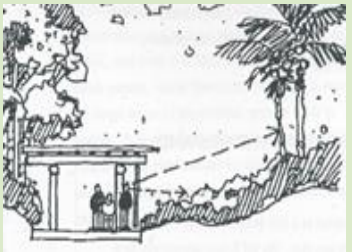


Piano wire

Stretched vertical wires used for bird aviaries & housing small mammals &large reptiles with no visual obstruction.

Glass

Toughened glass used as barrier in limited scale, used in reptile (snake) enclosures & aquariums



Boardwalk

walk thru viewing Elevated boardwalk viewing

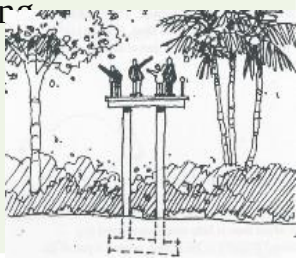


Table 2-6: Physical barriers and their types

4. Barrier Recommendations

Terrestrial species / jumping & climbing: Lion

Front barrier:

a) 'U' or 'V' type dry moat, top width: 7.5m depth: 5m including the parapet wall. Don't use a wet moat.

b) if space if limited: Chain link mesh barrier that is 5mm in height fixed to 75mm x 75mm x 6mm angle iron posts. **Mesh dimension** 5cm x 5cm x 8g. **Barbed wire overhang**: 0.5m on the top with horizontal member in the middle of post. The mesh should be fixed on the inner side of enclosure.

c) Rear barrier: 5m high of the type mentioned in (b) above or of brick or rock masonry

Terrestrial species – jumping

Jackal, hyena, antelopes

a) Front: dry moat 3.5m wide & 2.5m deep

b) Rear: wall of 2.5m height or of 3.0m chain link mesh of 5cmx5cmx10g. (7.5cmx7.5cmx10g for waterbuck, dik dik) (5cmx7.5cmx10g for large deer)

c) if space is limited: the viewers' side can have 3.0m chain link mesh fence as above. The use of small opening (too small for feet) discourages climbing

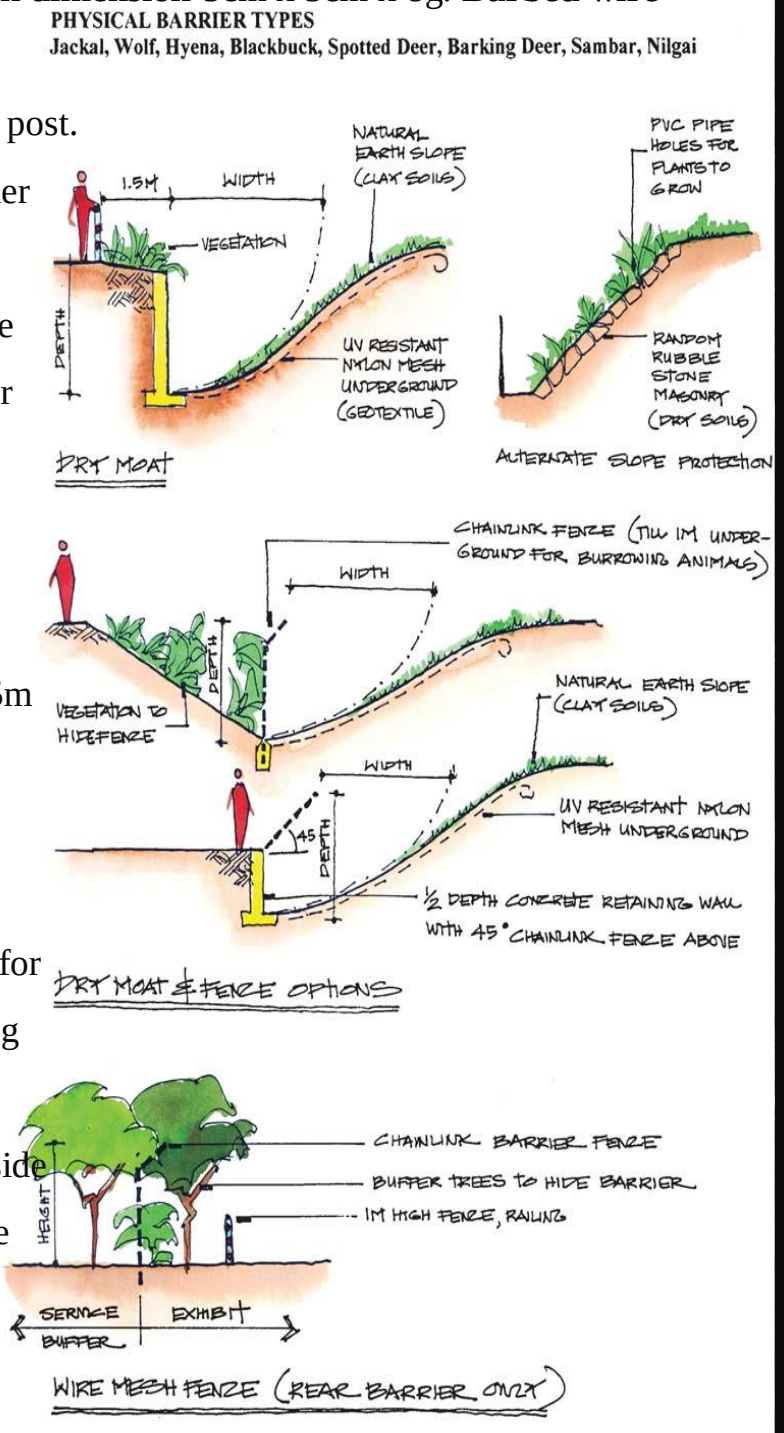


Figure 2-17: jumping species barrier

Conclusion:

(recommended solution)

V-shaped (flat bottomed) dry moat.

- ✓ more natural looking than U-shaped moats & cheaper to build & are therefore desirable.
- ✓ the animal can enter the moat making it less visible to visitors. This can be dealt with by providing enough enrichment within the habitat itself & by keeping the moat grass-free

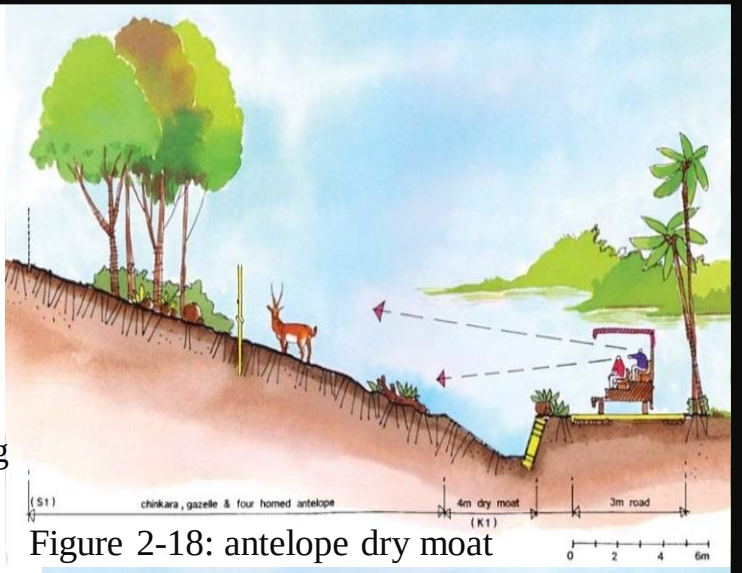


Figure 2-18: antelope dry moat

Arboreal species jumping & climbing Monkeys

Front: dry V moat, 4.5m wide & 4.5m deep

Rear: 5m high wall OR a 5m high chain link fence with 1m wide inward inclined steel plate overhang

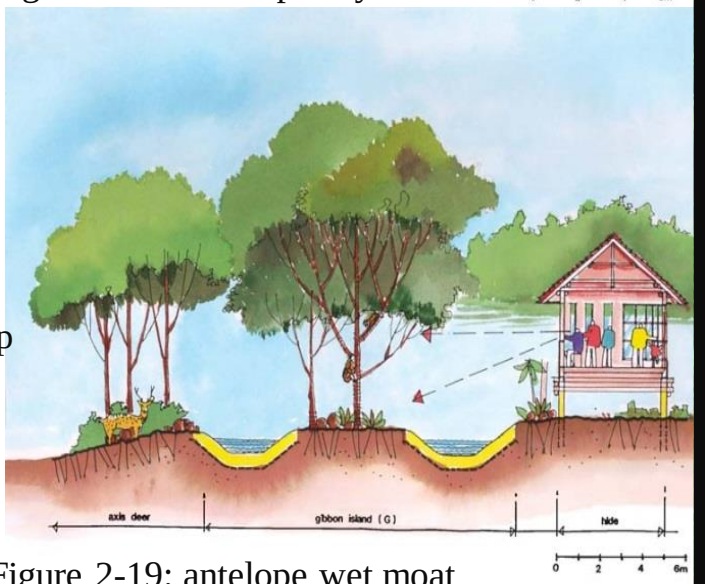


Figure 2-19: antelope wet moat

Limited space: Chain link mesh open air enclosures of 5.5m height with 1m steel plate over hang.

- ✓ Reduce cost of construction
- ✓ Structure shall be simple
- ✓ Can care large vegetated patches.

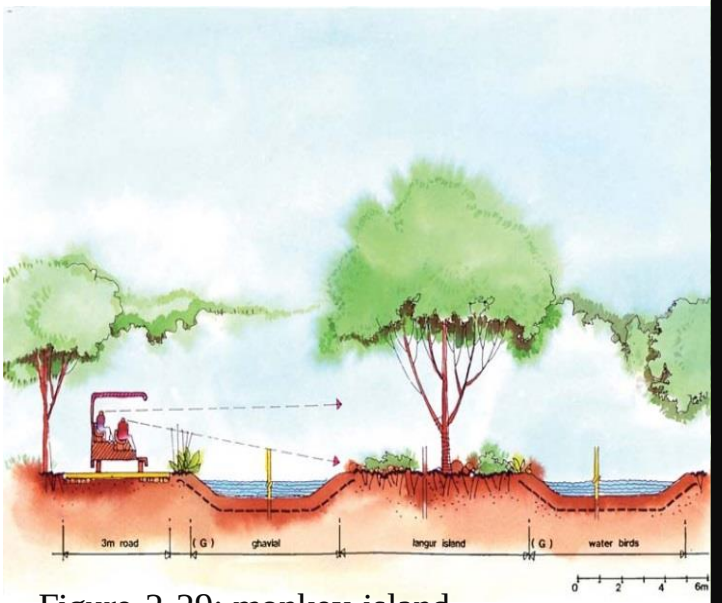


Figure 2-29: monkey island

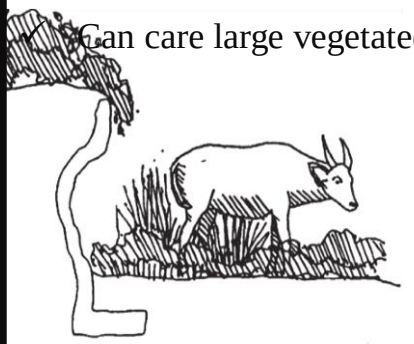


Figure 2-21: using a wall as a barrier

Leopard:

Housing in open moated exhibit with using tools like solar fencing, has been found to be risky due to their climbing & jumping ability besides timidity.

- ❖ Often kept in covered chain link mesh enclosures.
- ❖ Can also be kept in open air enclosures with 5m high chain link mesh fence with 1m wide inclined steel plate fixed on top leaning inwards.
- ❖ Must make sure that no tree branch is within jumping distance from the fence.

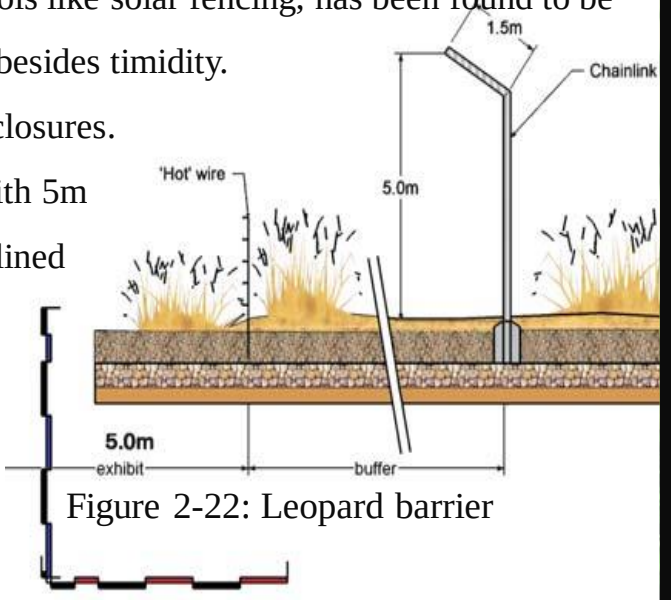


Figure 2-22: Leopard barrier

Conclusion:

1. If enough space is available, different types of moats are the most realistic barriers for an open-air monkey exhibit as these animals are agile enough to climb most types of walls & fences.

- ❖ creates a monkey island type of situation

2. Recommended front & rear barriers:

1. Shallow wet moat

0.5 to 0.75 m deep water designed to look like a naturalistic stream.

* less intimidating to the visitor than a deep moat due to small animal size.

* has to be used in with an hot-wire fence in the middle of the moat to prevent the monkeys from wading across. The hot-wire fencing is a problem as it has to be insulated from the water surface

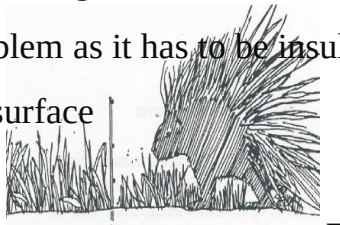


Figure 2-23: Hot wire

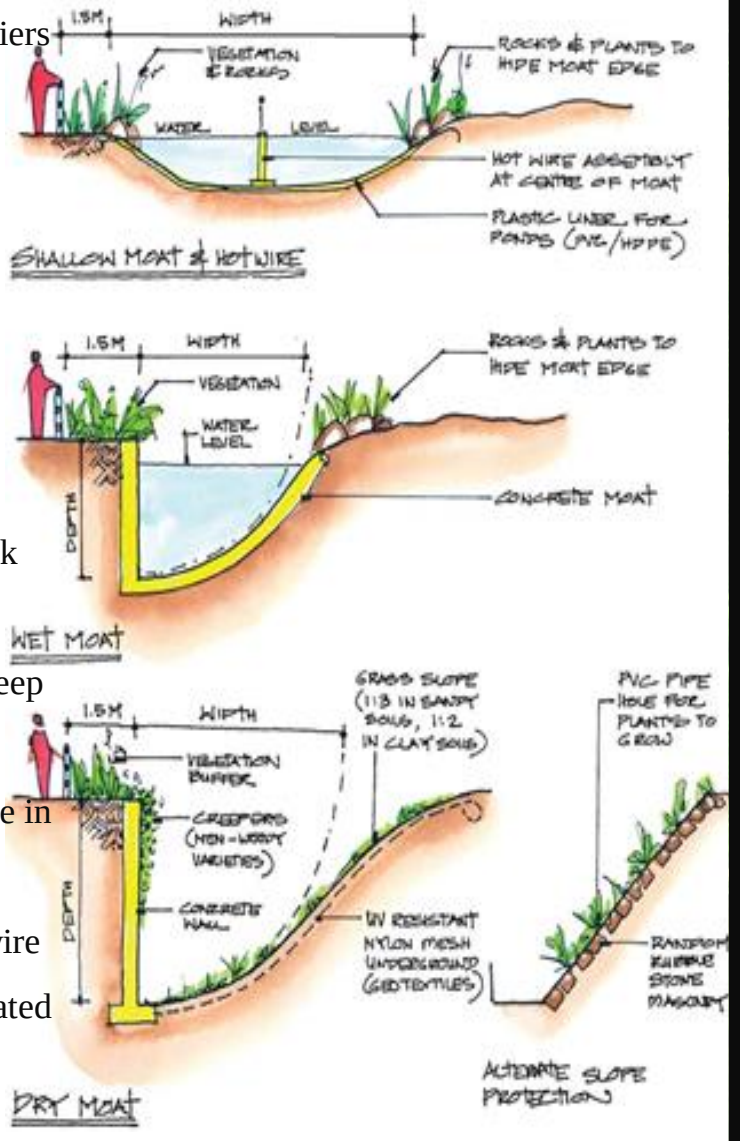


Figure 2-24: Moat types for jumping and climbing

- **Deep wet moat** (Max water-depth: 0.5 m to 0.7 m) Only used if the animal can't swim.
- **Deep dry moat** larger than the minimum jumping distance as the front & rear barrier.

Terrestrial species – non-jumping: Wild Boar

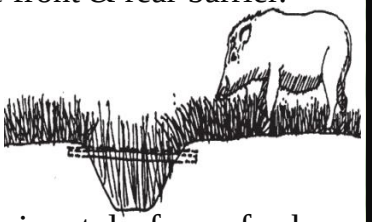


Figure 2-25: horizontal fence for boar

Fig.64. Illustration showing horizontal fence as a barrier.

Front: dry moat 4m wide 15m deep.

•**Rear:** low wall or of chin link mesh.

In chain link mesh is used, it should been insured that the mesh is thick & properly embedded in to the concrete base as they can dig & escape.

Rhinoceros

Viewers side: dry moat 3.5m wide & 2.5m deep

Back side 2.0m rubble wall is ideal .

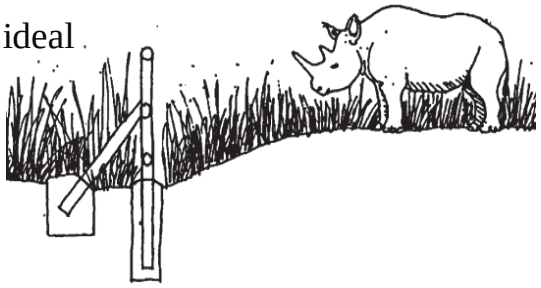
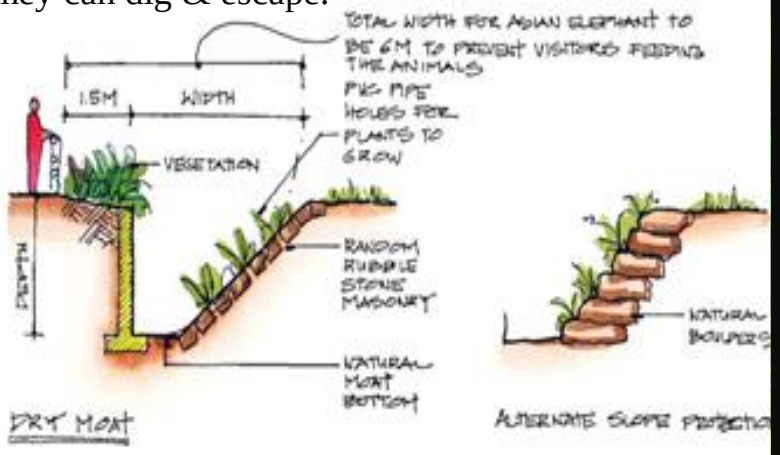
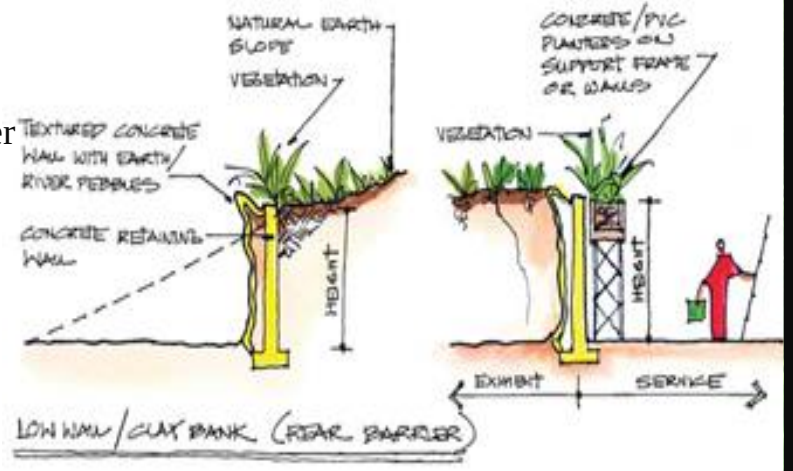


Figure 2-26: Reinforced pipe barrier

Fig.63. Illustration showing reinforced pipe as a barrier.





Elephant

Front & rear barriers: dry moat 3.5m wide & 2.5m deep.

A low rubble wall on sides other than viewers' side can be provided.

Other options:

- B.G. rail barrier: 1.2m high away from viewers, so that the trunk can't reach them.
- Rubble walls:1.5m high 0.75m wide

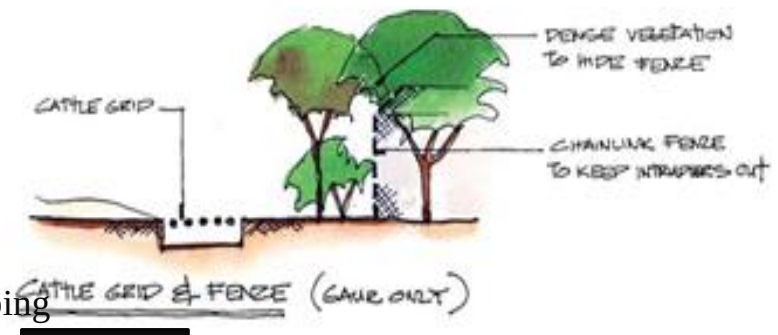


Figure 2-27: Barriers for non-jumping

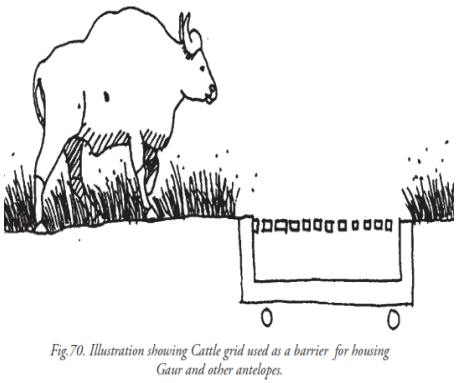


Fig.70. Illustration showing Cattle grid used as a barrier for housing Gaur and other antelopes.

Figure 2-28: Cattle grid for antelopes

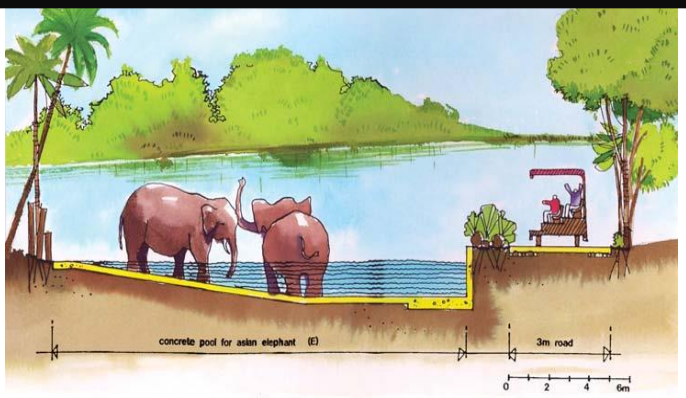


Figure 2-29: elephant waterhole

Conclusion:

(recommended solution)

V-shaped (flat bottomed) dry moat

- to prevent the animals from falling in
- The moat should have steps/ ramp for emergency with suitable door at far end of the moat as elephants, gaurs, & rhinos are rhinos are not agile enough to walk back up the sloped sides, if they get inside the moat.
- These animals that tend to destroy a natural moat edge, so the sloped moat edge should be constructed out of exposed random rubble stone masonry in which holes can be left for natural scrub vegetation to grow
- This is more natural looking than concrete or plastered brick

Rear barrier:

- if space & a view is available behind the exhibit: V-shaped (flat bottomed) dry moat
- If not available: a low wall that can be disguised as a clay river bank.

If the ground behind the wall is higher than the exhibit, then this clay-bank acts as a retaining wall.

- Vegetation can be grown on the earth just behind it.
- A rail barrier or thick pipe can keep the elephants confined.

For gaur's rear barrier: a wide cattle grid beyond which a chain-link fence hidden in vegetation can be used to keep intruders out of the exhibit.

- Cheaper than either moats or walls while being just as effective.

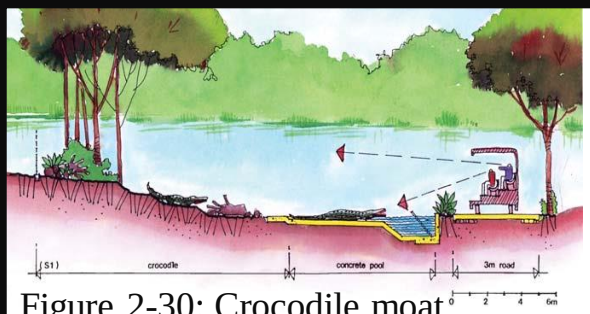


Figure 2-30: Crocodile moat

Aquatic & semi-aquatic species – non-jumping

Hippopotamus, Crocodile

1) Viewers side: moated or partly moated enclosures, wet or dry 3m wide & 2m deep

2) Back side: rubble walls 2m high. If dry moat used, the water body should be away.

3**) If glass barriers are used:** for underwater viewing min moat width 5m & depth 1.5 with raised wall above the glass viewing window.

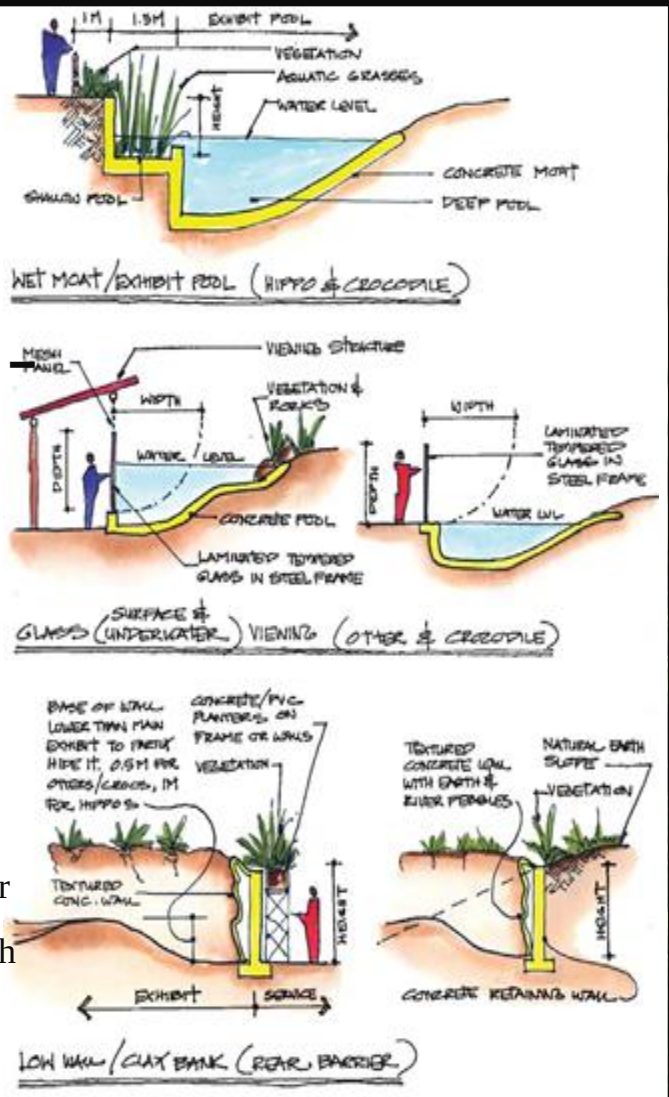


Figure 2-31: aquatic species moats

Conclusion:

	Front barrier			Rear barrier		Remarks
	Type	Depth	Width	Type		
Lion	V dry moat	5	8	U dry moat or high rock wall	5	Use hot wire in moat
leopard	Moat	5	With overhand of hot wire			
Hyena, jackel	V dry moat	2.6	5	V dry moat or chain link fences	2.5	
Small cats	U or V dry moat			U or V dry moats or high smooth walls	4	
Monkeys	U or V dry moat or shallow wet	5	7			Hot wires on inner side of enclosure & 9m tree clearance
Antelopes	V dry moat	2.5	6	V dry moat		Turf the slope
Rhinos, elephants, buffalo	V dry moat or low clay wall			cattle grid or sunken B.G. 5m away or Rail or depressed camouflaged hot wire	1.5	
Crocodile	V dry moat	20% water & with sand areas				

Table 2-7: barrier conclusions