

Redesign of School Amenities: Sanitation

[Product Design Project II]

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APPROVAL SHEET

The industrial design project II titled

Redesign Of School Amenities- Sanitation

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is approved as a partial fulfillment of requirements for

Masters in Design degree in Industrial Design Centre


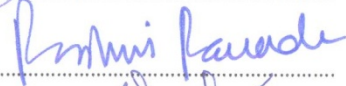

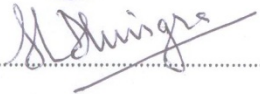
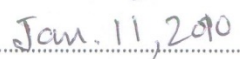
Project guide:

External examiner:

Internal examiner:

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Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signature



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1_ABSTRACT

Schools in India, specially the mid-segment ones, such as the Kendriya Vidyalayas, operate under tough conditions. Large number of students, limited resources and tight budgets are few of the issues that many schools have to deal with. Under such circumstances, where completion of the academic curriculum is alone in itself, a challenging task, then things like provision of proper school amenities like furniture, lab equipment, sanitation and hygiene tend to get a lesser priority.

The project is an attempt in understanding the importance of good sanitation in schools and aims at designing sanitaryware for the same.

MIND MAP

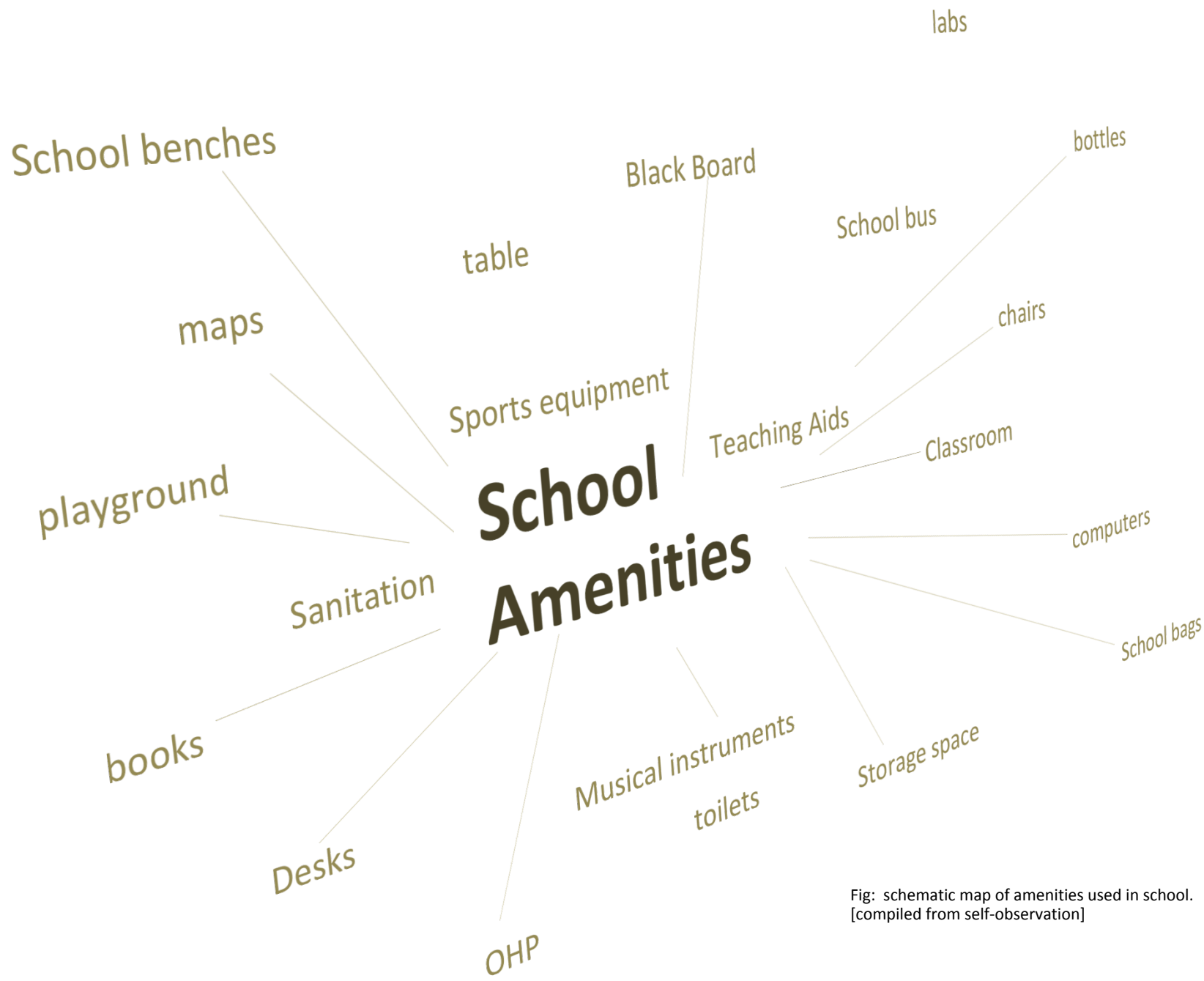


Fig: schematic map of amenities used in school.
[compiled from self-observation]

2_INTRODUCTION

A school consists mainly of people and resources. Facilities and school equipment are as much part of the school setup as are students and teachers. Schools have, over the years become bigger, with larger number of students engaging in a multitude of activities. Times have changed, and we have now come a long way from the modest blackboard and brass-bell era.

Schools are now fast-paced centers of learning with hundreds of students and many a teacher and other people. Smooth functioning of an institution of this kind requires efficient hardware coupled with effective management. The quality of education must not suffer due to provision of improper or unsuitable facilities. This is an attempt to improve/ solve some of the issues. Hence the project.

The project first examines the breadth of objects covered by the term. This includes school furniture, lab equipment, sports facilities etc. A particular area was needed to be chosen for design development. The opinion of parents and teachers, and of course, students was sought regarding these. Considerable time was spent on finding out the area most in need of design intervention.

The initial few weeks were spent in getting (re)acquainted with school and school activities. For all research, user studies and interviews, one has been almost completely dependent on the faculty and students of KV IIT Powai. KV's have an amorphous mix of students and teachers alike, leading to an almost analogous environment in almost all Kendriya Vidyalayas ¹.

The following pages describe the journey of the project and all relevant stages which have been presented in separate chapters.



Fig1: taps at water drinking area. (courtesy KV IIT Powai)

3

Laying the Foundation

[Data Collection, Information gathering]

Contents :

Advice from people

Data from literature

Information from the internet

3_DATA COLLECTION

This project needed a substantial amount of background research. One needed factual data regarding the kind of amenities in the schools, the nature/ frequency of usage, the conditions they were in, etc. . Right from gaining a better understanding as to what works in the kind of school that was targeted, to the kind of role played by school amenities, their importance and place in the school.

The data collection was primarily from three kinds of sources;

From people (exercises/ meetings):

- 3.1_Creativity sessions(common age group, mixed)²
- 3.2_Focus group discussions(teachers, students)²
- 3.3_Interviews- staff, parents
- 3.4_Photo study - school, existing products
- 3.5_Written feedback- Parents

From books:

- 3.6_School Sanitation and Hygiene(MoHRD)
- The Bathroom(Alexander Kira)

From the internet

(Study of current scenario- synchronic analysis):

- 3.7_School toilets, Urinals

Technology :

- 3.8_Flushless urinals, Material study, Auto flushing



Fig 2: diagram showing the essential aspects of the project. The central gray area represents the zone of work.

3.1_Creativity session

Children, it seemed, were the best source of information for the project. Two interaction sessions were arranged with kids to get their opinion on schools and school amenities. They were in the age group of 9-11 years and hence it was important that the session be fun and enjoyable for them. Hence a short verbal discussion was followed by a small drawing session after which they pinned up their work on a board. The exercise was important because it gave an exposure to children and helped in understanding them better. It was important to have a good grip on the nature and behavior of the target users. In the discussions, the children were fun-loving, energetic, excited to learn and eager to perform.

Fig:

1- discussing “things” in the school, their likes and dislikes, favorite thing to do in the school, which part of the school they like, etc.

2- drawing session: the kids were asked to make a list of the things they saw in school and draw what they wanted to from the list

3- the drawings were put up on the soft-board for all to see and appreciate. Each child then spoke about what they'd drawn and why. A short discussion on the things found in school and their role, ensued. The kids shared accounts of the things they liked/ disliked about the school.

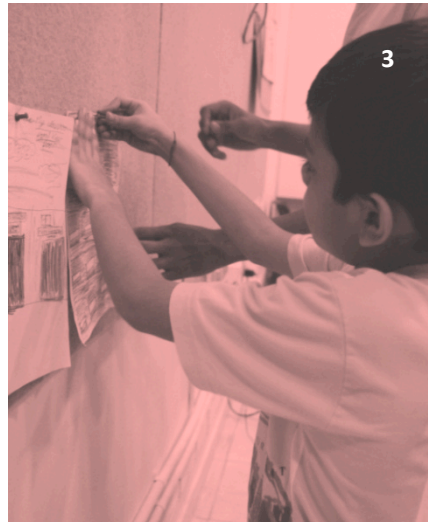


Fig 3: the images on this page show the session in progress.
29 Aug 2009, 1750- 1905 hrs.



3.2. [A]_ Focus group I (students – 6th, 8th & 9th)

Facts:

Date: 5 sep 09

Time: 0800 hrs.

Venue: KV IIT Powai

No. of participants: 18

No. of moderators: 1

Total duration: 1 hr 35 min.

Method of documentation: notes,
handwritten

The creativity sessions, although a fun and an overall highly enjoyable experience, were not very helpful in producing any concrete data about school amenities, or what problems the children had, regarding the latter.

Focus groups¹ seemed like a more

promising tool for information procurement. A focus group is a discussion among a select number of people, all of whom have a common link with the topic under discussion. The logic being that an intense discussion in a group, over a particular subject, is considerably more efficient in generating data than any individual's solo efforts. A focus group discussion involving slightly senior school students, with self as moderator on the subject of *school amenities* was deemed appropriate.

A meeting was arranged with a selected number of students of Kendriya Vidyalaya inside the school premises. The students were from classes 6th to 9th. The intention of this meeting was to get more

objective facts regarding (their) school. Hence the assorted composition of the group. The meeting began with a brief explanation on what school amenities meant and turned into a fast-paced discussion regarding school amenities and problems associated with them. The kids were eager and forthcoming. Suggestions flowed rapidly and soon there was a long list of issues (shown on the next page) which were ranked in order of criticality.

Fig 4: the participants of the focus group



1- www.unicef.org/voy/media/FACILITATOR_GUIDE_English.pdf
www.ioe.org/ioe/1993spring/tt2.php

3.2_Focus group I (contd.)

Results of Analysis:

3.2.1_Issues discussed

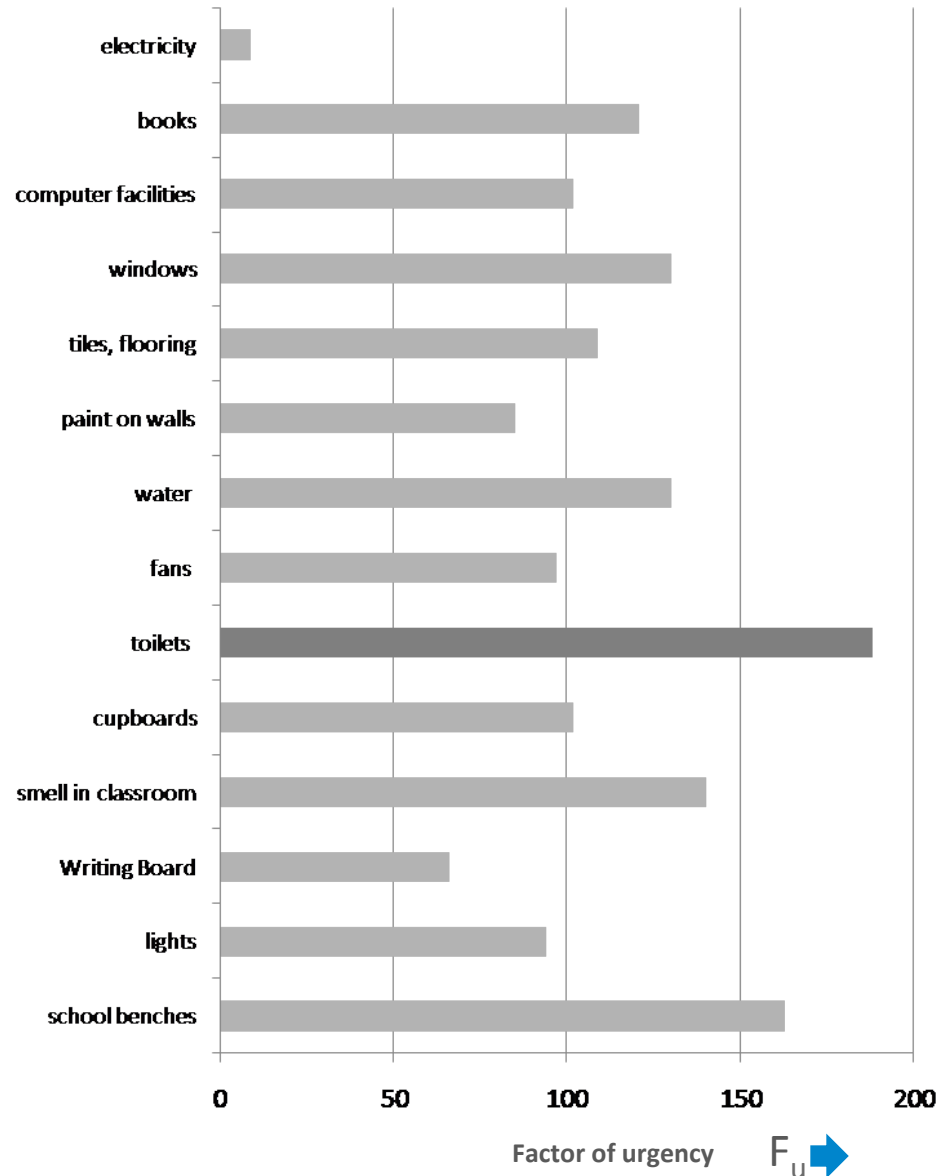
As stated on the previous page, the following are the issues that were discussed. They are given in short, but the kids had no trouble elaborating on issues related to each. The gist of each subject is given below:

- School benches : cramped, no space for bags, instrument of nuisance, vandalism, sometimes broken. Can cause physical hurt
- Sanitation : too many users, subject to abuse, dirty, feels unhygienic, water supply ends soon, difficult to clean , stink in classroom(due to proximity to toilet), broken tiles, slippery floor due to water spillage, security
- Storage space : lockers for every student, pigeon holes
- Monsoons : raincoats, umbrellas, need drying area, floor tiles are slippery, water accumulation in corridors
- Windows: broken, dirty
- Computers: outdated, not enough in number

3.2.2_Results of Analysis:

Are presented on the right side of the page. The analysis presented a cumulative result from the rankings given by the students for each of the issues mentioned above. The ranking is given on a scale of 1 to 9 with the bigger number representing a more critical problem. In other words, the student will award greatest value/number to the problem needing design intervention the most. And that which will get the highest number from most students will stand out on the graph as the issue which needs urgent attention.

Toilets and sanitation was thus **selected** as the area of work.



3.2[B]_Focus groups II (teachers)

A similar meeting, as held with the students previously, was arranged with *five* secondary school teachers in KV. Because they were adults, a smaller group of people (who happened to know each other) seemed more suitable for this exercise.

The teachers spoke at length about a number of issues (the subjects discussed are given below), and specially the issues

regarding sanitation.

The following is the feedback received from them regarding sanitation and other issues;

- **Toilets- too many users**
- **Bathroom equipment is subject to abuse**
- **[Toilets] always dirty**
- **Toilets are difficult to clean**
- **Dull/gloomy feel in bathrooms**

Desks : too small, no space to keep books, Mica desks, need storage space

OHP : for every class

Teaching Aids : maps, globe, models for science manual

3.3_Interview (cleaning staff)

The cleaning staff who were responsible for maintenance and upkeep of toilets was interviewed . Here are some facts learned from them:

Frequency of cleaning: 2 times/day

Equipment: mop, bucket, disinfectant, toilet brush

Other maintenance/ sanitizing procedures: annual maintenance of water tanks, year round plumbing/ electrical repairs

The following is the feedback I got from them regarding sanitation;

- **tiles difficult to clean**
- **maintenance impossible during school hours**
- **bad lighting**



3.4_Photo documentation

The pictures on this page were taken as part of the study of the school's sanitation facilities. This particular bathroom is for the senior class boys. These pictures were taken on the morning of 09th Aug '09 between 1000 to 1100 hrs.

The observations are as under;

Fig:

1- Shows a picture of a washbasin in the particular school, used for study. The unit is constructed on site and is very crudely built. The dimensions are completely inappropriate for use and the essential features like a slope towards the back, placement of drain and faucets does not adhere to any standards.

2- the picture shows the cleaner filling water for washing the toilet. He must stand in the awkward square(which, by itself is difficult to clean) and haul the water from that point in a separate bucket.

3- the platform on which the student is supposed to stand while using the washbasin is highly incorrect

4- Urinals absent, Waste accumulation in gaps between tiles, Odour generated as a result, cleaning problems. Flushing system absent.

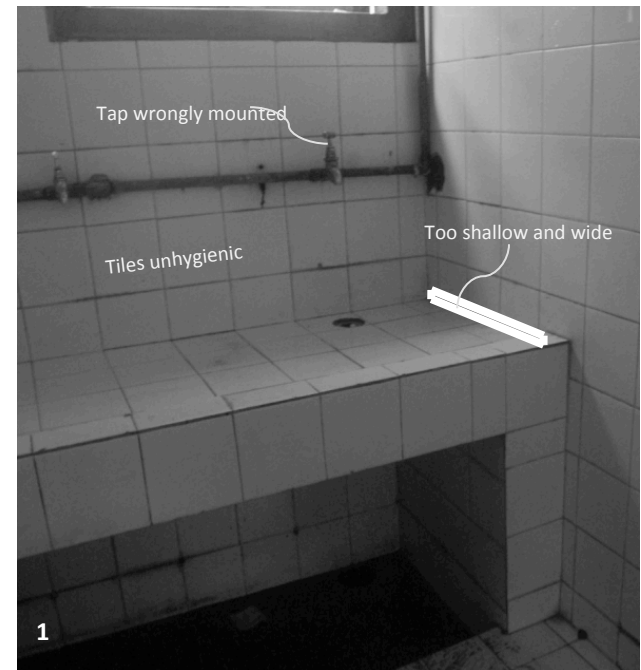


Fig 5: the images on this page are from one of the toilets in the school. 8 Sep 2009, 1000- 1100 hrs.



3.5_Survey form for parents

Although parents do not feature anywhere in the three essential aspects of the project, the project would be incomplete without getting their take on the subject. It was decided to involve the parents of the smallest lot of school goers (standard 1, 2 and 3) for the following reasons:-

- The issue of sanitation is of extra concern for parents of small children.
- It was difficult to address this subject directly to the smallest children.

A feedback form (shown opposite) was circulated among parents of children studying in the said standard. The form was given out to the parents of 47 children.

The response received was amazing. Parents welcomed the move [of redesigning sanitation facilities]and responded enthusiastically explaining various issues in great detail, suggesting solutions and possible corrective measures. Some of the most common exaltations of the parents were as follows:

_For boys urinal

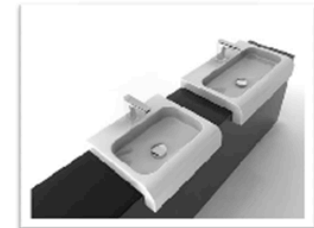
- Mounting at suitable height for the smaller kids
- Sensor operated flush
- Disinfectant dispenser
- Exhaust fan(for bathroom)
- Flush-less urinal

Fig 6: the images on the right is of the feedback form given to the parents

Name: _____

Age: _____

FEEDBACK FORM: As part of a student project currently underway in IDC IITBOMBAY, feedback is sought from parents with respect to **SCHOOL SANITARYWARE**, and issues associated therewith. Kindly highlight any concerns/ issues one might have regarding the condition of school sanitaryware, namely; **Urinals(boys)** and **washbasins**. Any information provided would be valuable to the project and will be used solely for that purpose only. Please feel free to elaborate on what is needed in this KV and other similar schools.
[The following images are given for reference purposes only].

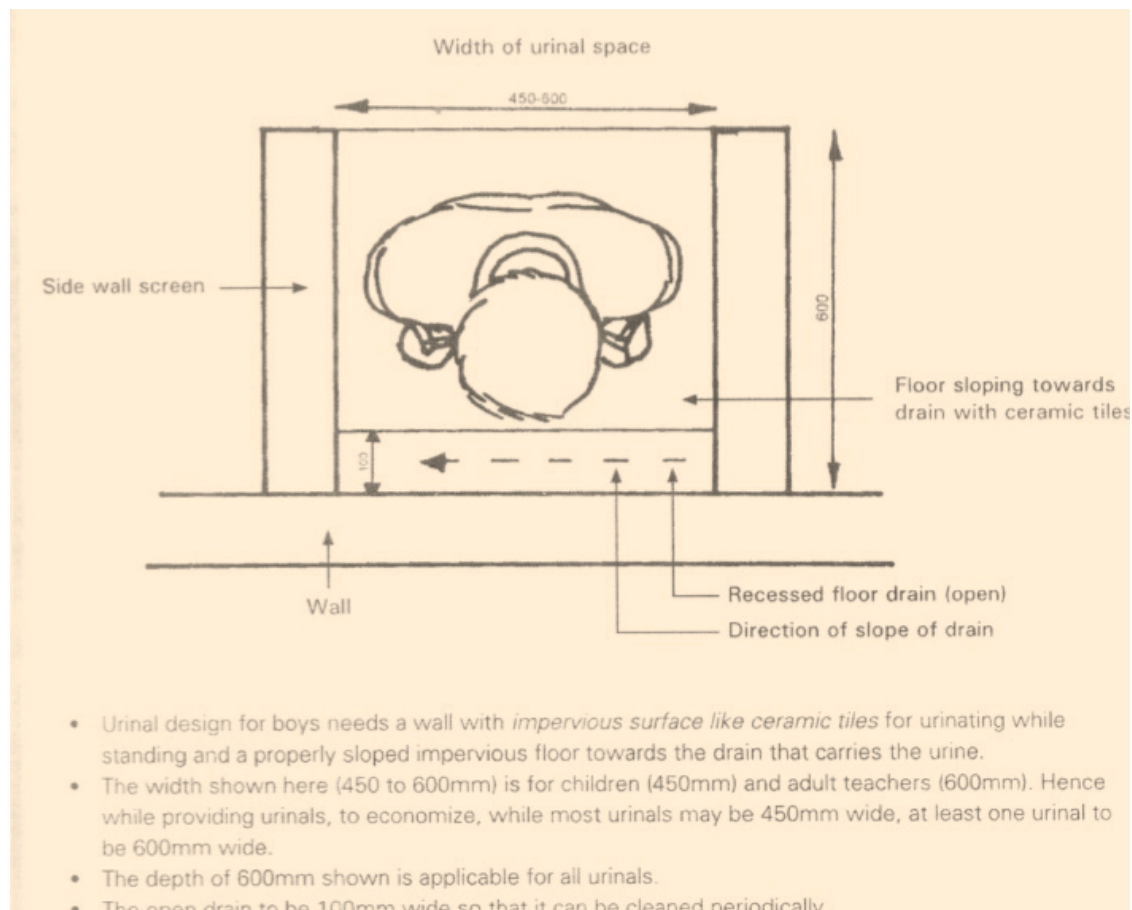


3.6_School Sanitation and Health Education – technical note series (SSHE)

Is a comprehensive manual which articulates in detail, designs best suited for a toilet in a rural schools. The study has examined and explained, in depth, the various issues regarding construction of sanitation facilities in rural schools and what measures must be taken while building a toilet block for the same.

This manual was very helpful in providing design and anthropometric data about the design of toilet blocks for schools, as well as providing a clearer picture as to what is needed for the correct and efficient design of a toilet in a school.

Fig7: the fig on the right is a scan of an image from the book. The image shows the basic dimension of a standard boys urinal. The image however does not show the location or mounted position of the actual urinal.

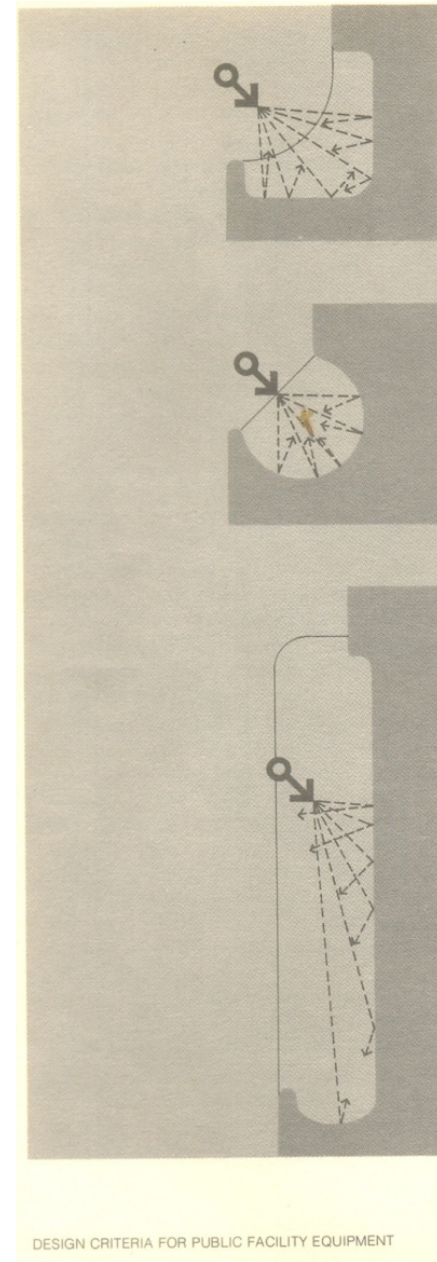
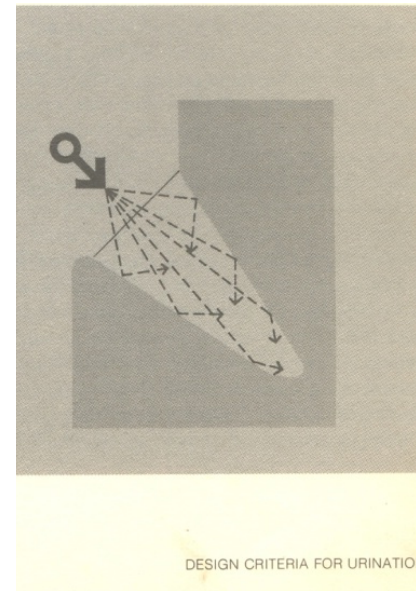


3.6[contd.]_”THE BATHROOM”- A. KIRA.

These images are scans from a book titled “The Bathroom”, which is a comprehensive text on the subject of sanitation and personal hygiene.

The author talks in detail, among other things, about various aspects of urination- physiological, psychological and the design criteria for public facility equipment.

Fig 8: the fig on the right are scans from the same book. Image 1 and 2 show the various sectional possibilities for a men’s urinal and the “splash” controlling ability in each of them.



3.7.1_synchronic analysis

School toilets

The images on this page are of school toilets from around the world: The images on the page offer one an idea about the state of sanitation in schools around the world.

Fig 9:

1- good lighting, space between basins

2- there are no partitions between urinals

3 – a low cost but effective solution from a public school in Bali, Indonesia

4 – steel drop-fit washbasins and angular taps. and a durable soap dispenser

5- Indian urinal: to the left is a picture of an Ecosan toilet (made in FRP), a concept in which the waste human matter is processed and utilized In other activities like agriculture. The unique shape of the pan is to allow separation of solid and liquid waste and the point of generation itself. Even the cleaning water is collected separately. The waste is then treated and used in agricultural activities, etc.

6- Child friendly toilet. Built based on norms prescribed by the ministry of Health and Education



5- http://commons.wikimedia.org/wiki/File:Sulabh_ecosan_toilet.jpg

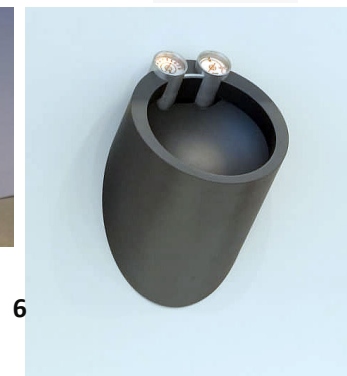
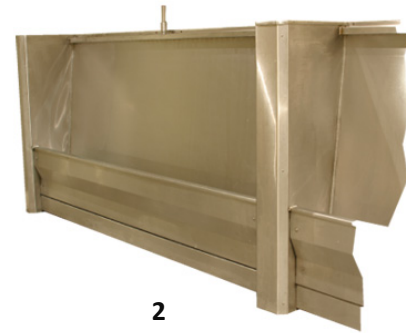
6- <http://www.wssc.org/en/media/media-guide/world-water-week-2008/index.htm>

3.7.2_Synchronic analysis: Urinals

Fig 10:

This page shows a short study on the kind of public urinals found throughout the world. The images offer an idea regarding the various possibilities, when it comes to designing public urinals.

#	description	features	advantages	disadvantages
1	Public urinal in Europe	Single piece FRP body, lightweight	tough, simple design	Limited privacy, waste disposal, flushing
2	Steel sheet common urinal	Single-sheet body, simple construction	Efficient design, hygienic, ease of cleaning	Privacy, no bottom bowl/pan
3	Fancy urinal	Theme based, unique looking	Attractive, user delight	-
4	Out-of-the-ground public urinal	Steel body, lighting fixture,	Concealable, unique design	Expensive, inefficient, limited no. of users
5	Variety of urinal form, material	Variations possible in ceramic and steel	Possible combinations of material and form	-
6	Fancy urinal	Backlit, character in form, visual metaphors	Freedom in designing, formal flexibility in product	Not meant for the mass market



3.8_TECHNOLOGY

3.8.1 Flush-less urinals

Assessment of Benefits of Flushless Urinals- [Excerpts from a study conducted at University of San Francisco]*

The premise: Conventional urinals use at least three liters of water per flush, whereas flushless urinals need neither water nor a flushing system. The objective is to analyze the benefits of a flushless urinal over a conventional one.

Working of the flushless urinal- The siphon contains a liquid sealant that has a specific density that is lighter-than-water. This floats to the top, allowing the urine to flow through it and away, taking any odors with it. The liquid sealant remains in the siphon.

The price- Most expensive flushless urinal model on the market sells for \$471.58 each. The least expensive unit available costs about \$230.

Problems- If installation is improperly undertaken, the urinal may fail. The two most frequent problems are caused by either an insufficient slope for the drain line, and **poor maintenance** of the cartridge which keeps it from living up to its promised 7,000 use lifetime. Poor choice of cleaners, such as those of an alkaline nature is known to cause the liquid sealant to break down. Using hard water to clean the urinal may promote calcium build-up that eventually leads to odor problems.

The result- is that there is some financial benefits of using this technology, but the most important one, naturally is the saving of precious water

The verdict- A The functional advantages of using a flushless system over a conventional one are quite obvious. However, the system is new and its durability is not fully tested. The product itself demands a certain amount of maintenance (the cartridges need replenishment). And there is considerable amount of resource needed for the initial setup of a system for sale and replenishment of the cartridges. Plus maintenance management.

Moreover, there is also a lot of doubt connected with absence of cleansing water in the urinals. The fact that some amount of waste matter will definitely adhere to the insides of the bowl and shall, in due time, start stinking is quite obvious. The articles on this technology are quiet about tackling this part of the process. One has personally interacted with some people who have used this technology and it was reported that the urinals stink.

The technology has huge benefits, and will be very appropriate in the Indian context once a network of maintenance providers is set up. It is only a matter of time before these get serious attention and implemented all over. But for now, the use of this technology in the project shall not be a part of the proposal.

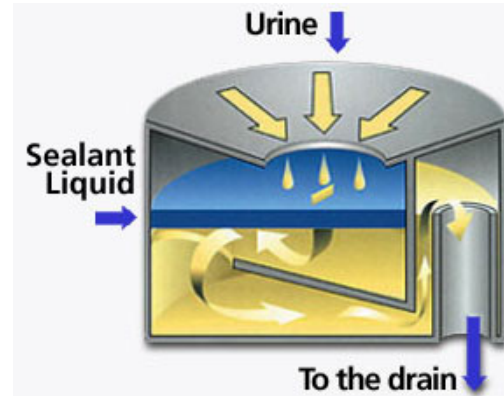


Fig 11: The image is a schematic of the siphon units working.



Fig 12: the image above shows the formal possibilities that exist in the design of flush-less urinals

3.8.2_ Materials

The materials used in sanitary ware are primarily ceramic, stainless steel and stone, to an extent. However some new, alternate materials are also available, that have unique properties/ benefits over the existing lot. This page shows examples of washbasins made in unconventional materials. Ex.-

- fiberglass-reinforced synthetic materials (polyester)
- Steel- brushed, polished
- Enamel coating over Cast Iron or Steel
- Granular composites

Authors Note:

The choice of material, for either urinal or washbasin, is dependent upon the context of use. Popular materials in our country are glazed ceramics and stainless steel, with the latter being used in kitchens and as process equipment mostly.

Ceramic has been the preferred material for sanitaryware and its properties such as excellent surface finish, durability and low cost have made it a leader in that market. However, SS washbasins and toilets have also long since been used on trains. This is mostly due to the properties of the material i.e. - low weight, strength, durability and hygiene.

In the context of this project, the choice of material will be dependent on various factors like cost, number of pieces needed, type of use, life of product etc.



Stainless Steel

Stainless steel: AISI 304. Numerous products are produced from this high-grade stainless steel and furnished with a variety of surface finishes: highly polished mirror-finish, matt-brushed, matt or satin-finished.



Steel enamel

Steel Enamel: Enamel coated steel washbasin.



Cast mineral material

Cast mineral material- This is a composite material made from natural minerals and polyester resins. The gel coat forms an extremely robust surface that stands up well to physical and chemical forces. The non-porous surface is easy to clean and any damage can be corrected afterwards.

3.8.3_Auto-Flush

Automatic sensor-operated valves;

- Saves water
- Hygienic
- Greater efficiency
- Better economy

About EcoPower¹:

EcoPower sensor flush valves are energy-saving, durable and provide maximum performance in even the most demanding, high-traffic commercial spaces.

TOTO EcoPower flush valves offer easy installation without the cost and downtime required to install power supplies and wiring for each valve. A hydro-powered turbine charges the power supply during usage, eliminating the need for battery replacement. The advanced “hands-free” technology ensures a clean and sanitary bathroom.

Authors Note: Use of auto flushing most-definitely has its advantages and is also the most sensible solution to the problems related to manual flushing, consumption of water, hygiene, etc. It is also a common request from almost all the parents too and is appropriate for implementation in schools. As far as the feasibility of such equipment is concerned, i.e. issues of maintenance/ repair/reliability etc., the cost of electronics is only getting lower by the day and one will be a witness to more and more efficient and trouble-free technology in the future.



Fig 14: Auto-flush , casing and schematic

4

What to design?

[Deciding the Project Brief]

Contents :

Insights

Problem listing

Defining project scope, brief

4.1_INSIGHTS

4.1.1_Insights from creativity session

The following is a list of the feedback received from the creativity sessions with kids. The list is a compilation of answers that the kids gave, when asked about *what they wanted* in school. Although not all of the following are completely viable problems, they are fun to read and discuss, and are helpful in providing ideas to start off with the ideation.

• Super games

• A disco

• Light weight school bag

• Swimming pool-4

• Nice teachers-2

• Bigger playground

• Computer at every table

• Air-conditioning in classroom-3

• Spring-bed to sit on

• All sports periods

• More friends

• More art periods

• Bigger classroom

• Place for bags

• No space in row between benches

• Worksheet instead of notebooks

• Secret communications device for kids

• Drier in monsoons

• Jumping floor

• Walky-talky

• Movies

• Automatic exam writer

• Flying bus

Background: shows a picture of the board with the kids' work put up. The work is an assortment of sketches and written data, the condensed version of which, is presented above.

4.1.2_ Insights- Focus group I (students)

The list of issues discussed and results of the quantitative ranking of problems is given below;

- need more toilets
- unclean, in general
- Tiles slippery, always dirty
- broken tiles
- fixtures
- taps are loosely mounted
- taps leak/too tight
- [they] don't like touching anything

- placement of basin
- bad odor, smell
- water gets over by lunchtime
- cubicles need hooks
- Toilet seats are dirty
- latch on cubicle door is dirty/ too tight
- need dustbins

4.2_TABLE- Problems, Possible solutions

Problem	Cause	Possible solutions	advantages	remarks
need more toilets	Rise in no. of users, no space for new fittings	smaller sized toilets, modular toilets /urinals	Modularity-multiple combinations possible, easy installation, flexible system. Smaller size-less floor area consumption	Considered
unclean, In general	Surfaces difficult to clean	easy to reach surfaces, self-cleaning sanitaryware, materials, faucet design, drainage layout	Sanitaryware- must considered wetted/non-wetted surfaces.	Tiles- out of scope
Water accumulates on floor	Improper slope, planarity. gap between tiles	Use of better skilled labor, bigger tiles	no water accumulation	Beyond scope
tiles are slippery, always dirty	water spill, leakage	Coarser texture on tiles for better grip, finer mating of tiles	More texture means more grip, but get dirty faster	Beyond scope
broken fixtures	rough use, poor quality of hardware	stronger, more durable materials, vandal –proofing	Tough materials mean longer life	Beyond scope
[they] dislike physical contact	taps, flush –handles are unclean	contact free operation, automatic sensors, auto flushing	prevent spreading of germs, save water, encourage clean use of toilets	Considered
Washbasin placement	single mounting ht. is unsuitable for all body types	different mounting heights, modular arrangement	Proper mounting heights- Essential for ease of use. Modularity- allows for flexibility in design, multiple configurations possible	Considered
bad odour, smell	Improper maintenance, unclean surfaces	more effective flushing system, auto-dispensing of disinfectant, easy to clean surfaces	auto flush : no manual cleaning needed in school hours , auto dispensing of disinfectant possible	Considered
water runs out	no water-saving measure applied	auto taps, efficient flushing system, reuse of water, auxiliary tanks	water saving taps are very appropriate for a school toilet, dual advantage- hygiene and saving	Considered
cubicles need hooks	for clothes, kids carry things on their person	space for hanging, shelf space	practical solutions often overlooked while designing	fuzzy area
need dustbins	for disposal of waste, paper soap bits, food wrappers	a waste-bin	-do-	fuzzy area
Dull/gloomy feel in bathrooms	lack of natural light, bad lighting	Bright colors, good lighting	feeling of cleanliness is enhanced by a well lit space, improves overall feel of interiors	beyond scope

4.3

Scope of the Project & Design Criteria

- Some issues stated in the previous table have solutions which lie in the architectural(or any other besides Industrial design) domain. Ex.- problems such as slipperiness of tiles and the fact that they are difficult to clean, or improper maintenance etc.

- This project concerns itself only with **products** in the bathroom that need redesigning.

- Thus the **scope of the project** is fixed to the products found in the school toilet. That means the following;

**Urinal, Washbasin, WC, Faucet
Tiles, cubicle doors, panels
Plumbing, Electrical fittings**

- Objective - To redesign one of the above items to make it child-friendly and more suitable for use in schools.

- Of these, accessories like cubicle door, soap dispensers, flush cisterns etc. are **not considered** for their role, although important, is supportive. The **WC** is **not considered** since it is a complete

subject in itself and the problems associated with it are complex and divers. And its use is also **less frequent** , compared to the the other sanitaryware object, i.e. Urinal. The urinal offers challenges aplenty and has ample scope for redesigning. There are a number of children-specific issues(see list on next page) connected to it.

- Thus, the scope of my project extends to the redesign of a **Urinal for boys**.

What: Boys Urinal

Why

- Mass application in schools
- Frequent use

USP: urinal for **Boys** to be used in **schools**.

4.4_ School Urinal : Problems, possible solutions

The school urinal is a unique item, in that it is a public facility whose primary users are children. Currently, the urinals in the school are the same as in any other public restroom.

Problems:

Big, bulky, uses more flush-water, intimidating for small kids

Design Criteria:

- child-friendly form
- Size proportional to the children's body
- Auto-flushing
- Right ergonomics
- Colorful
- make the urinal less repulsive
- Ease of mounting and maintenance- bracket

•List of attributes for “schoolchildren”

- | | | |
|-------------------|--------------|---------------|
| •brash | •rough | •Naughty |
| •rash | •impatient | •Alert |
| •Insensitive | •Hurried | •Cautious |
| •eager to learn | •pliable | •Quick |
| •careless | •insensitive | •Fun |
| •Foolhardy | •Active | •Enthusiastic |
| •Eager to perform | •Energetic | |
| | •mischievous | |

Problem	Source of Information	Cause	Possible solutions
Repulsive	Student, Parents, self-observation	Unclean, big, bulky form, smells	Unclean-Regular cleaning, easy-to-clean, easy-to-reach surfaces Form- compact, proportional to kids' body sizes Smell- reduce inside surface area
Outside, top surface unclean	self-observation	Surfaces difficult-to-reach, -to-clean. Fixtures, Plumbing makes things harder to clean	Make all surfaces easy to reach, to clean.
Surfaces difficult-to-reach, -to-clean	Cleaning staff, Self	Little space left in urinal cubicle	Smaller, compact urinal. Less volume
Big, intimidating	Parent's accounts	Urinal size too big, inside surface too open	Smaller, friendly-looking urinals
Not suitable for Children	Dull, uninviting,	Bad flushing system,	Child-friendly
Manual Flushing is a put-off	Parents, Students	Flush handle/ faucet is dirty, location is unsuitable. It is also a separate <i>post-act</i> activity and calls for courtesy and patience in the user.	Automatic flush

Above table shows problems specific to school urinals and the possible solutions

4.5_PROJECT BRIEF

To redesign a Urinal [boys] for schools.

Must have's:-

- **Appropriate for schools:** friendly-looking, hygienic-looking, durable build, hygienic materials
- **Ease of use:** convenient for all body sizes(from ages 6-16), right ergonomics
- **Ease of maintenance:** excellent surface finish, smooth form, easy to clean surfaces
- **Modular(with proper student-unit ratio):** 1 urinal for every 20 boys + gent teacher⁴

5

Ideation

[Sketches, Ideas]

Contents:

Mood Board- "Kids + School"

Sketches

5.1 Mood Board



Fig 15: Mood Board- kid's products + school

5.1 Ideas

5.1.1_urinal + washbasin: Urinals consume a lot of flush water, which is often from the same storage. In other words, a lot of fresh water is used up in flushing.

- This concept ponders the idea of marrying the two items (urinal and washbasin) in one.
- The reason was to provide saving in amount of water used, and use grey water for flushing
- The material would be ceramic and the two items could be manufactured separately and then assembled into a single unit

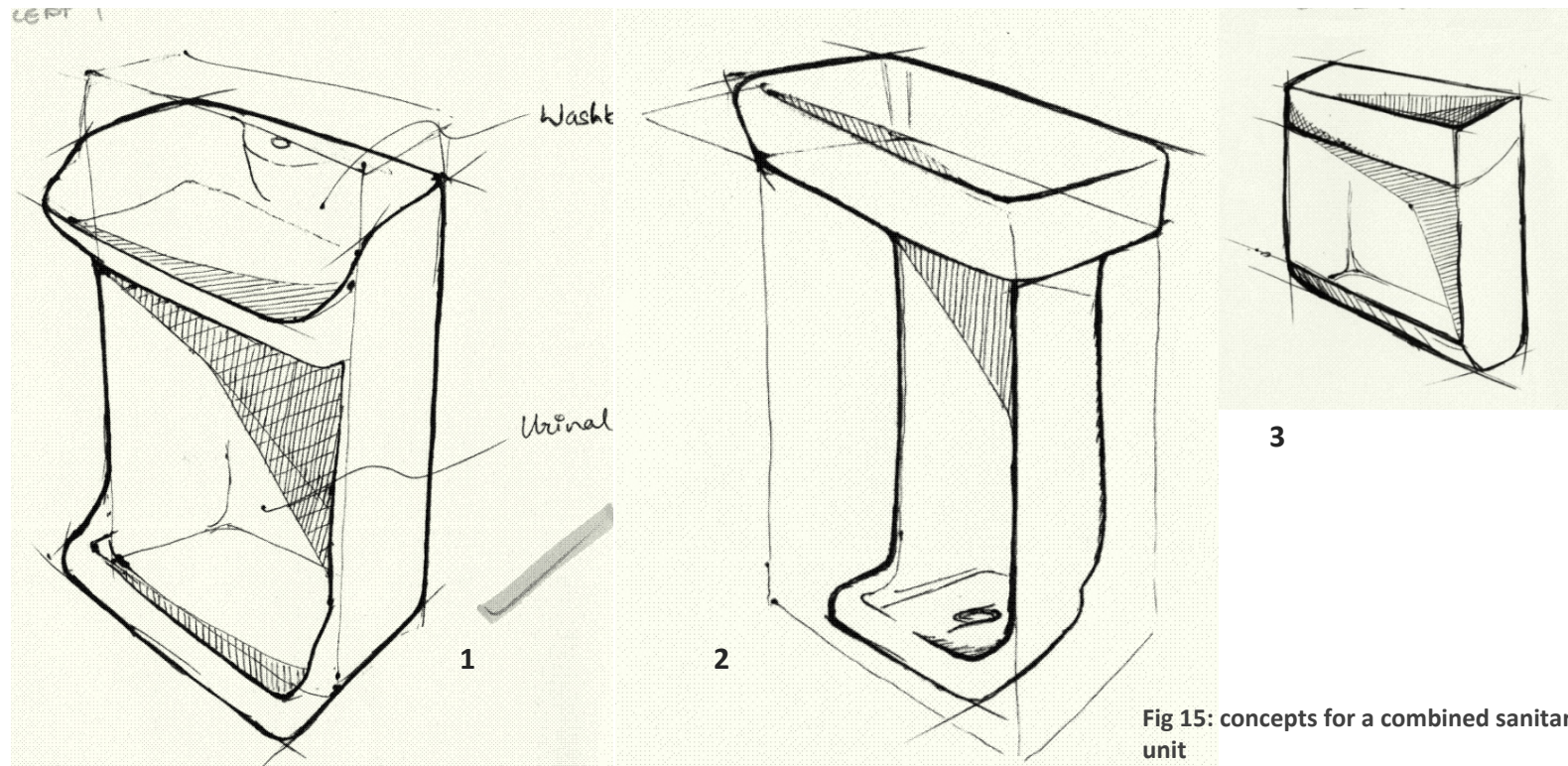


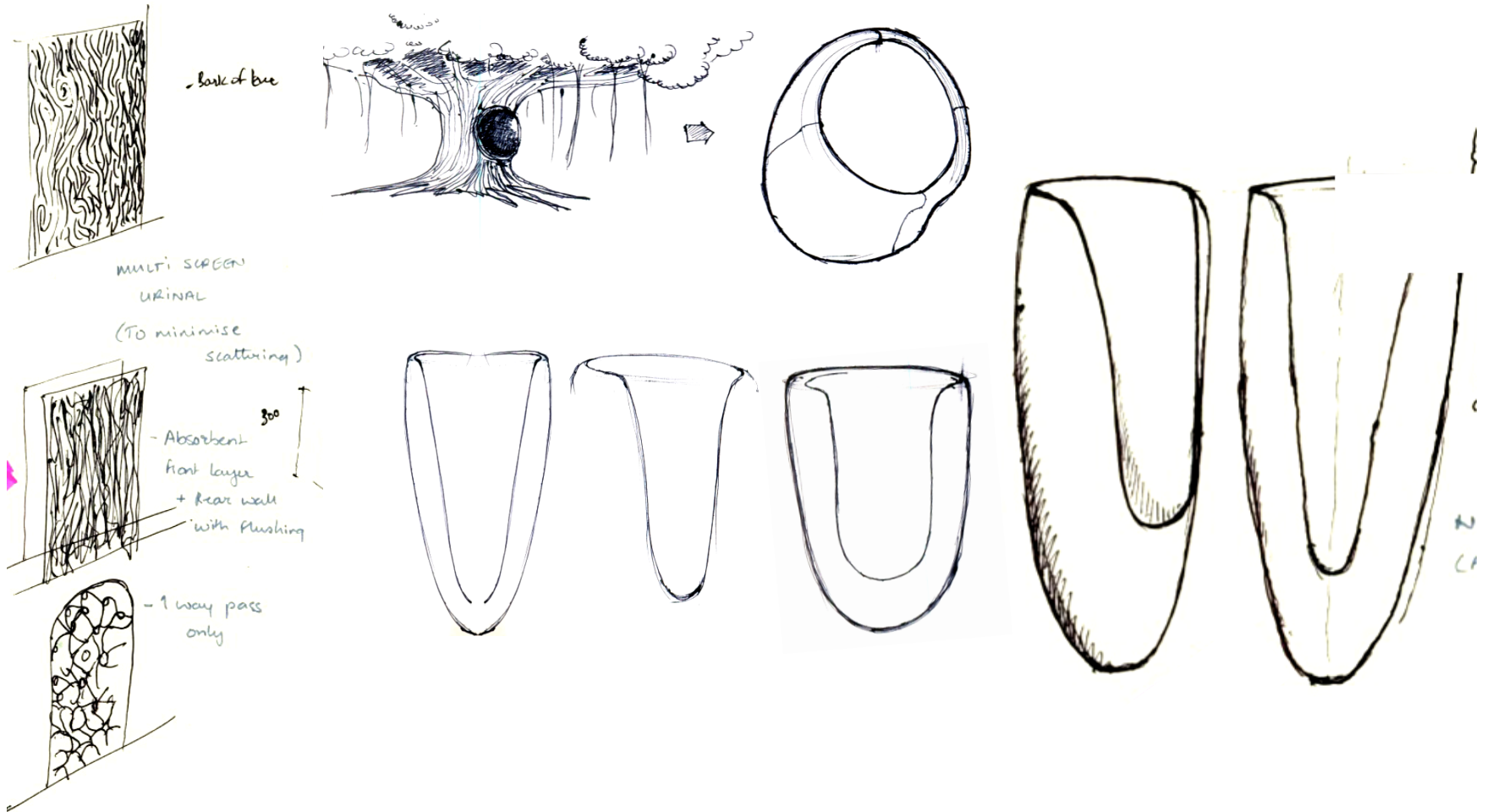
Fig 15: concepts for a combined sanitary unit

5.2.2_analogy from nature

The idea was to borrow design inputs from nature, take inspiration from natural forms that would give an element of surprise in the product. Some of the ideas were

1- using a urinal shaped like the hollow in a tree

2- a double walled urinal, containing a permeable, non-reflecting outer layer and a inner biological growth that would diminish the smell.



wing analogies borrowed from nature

21

SINK vs. SPSIN

Basin tops: 700, 800, 417, 516, 617
> <

Tap tops: 700, 785, 870, 862, 962
< >

Dist betⁿ taps (plan); minimum 450 mm

403

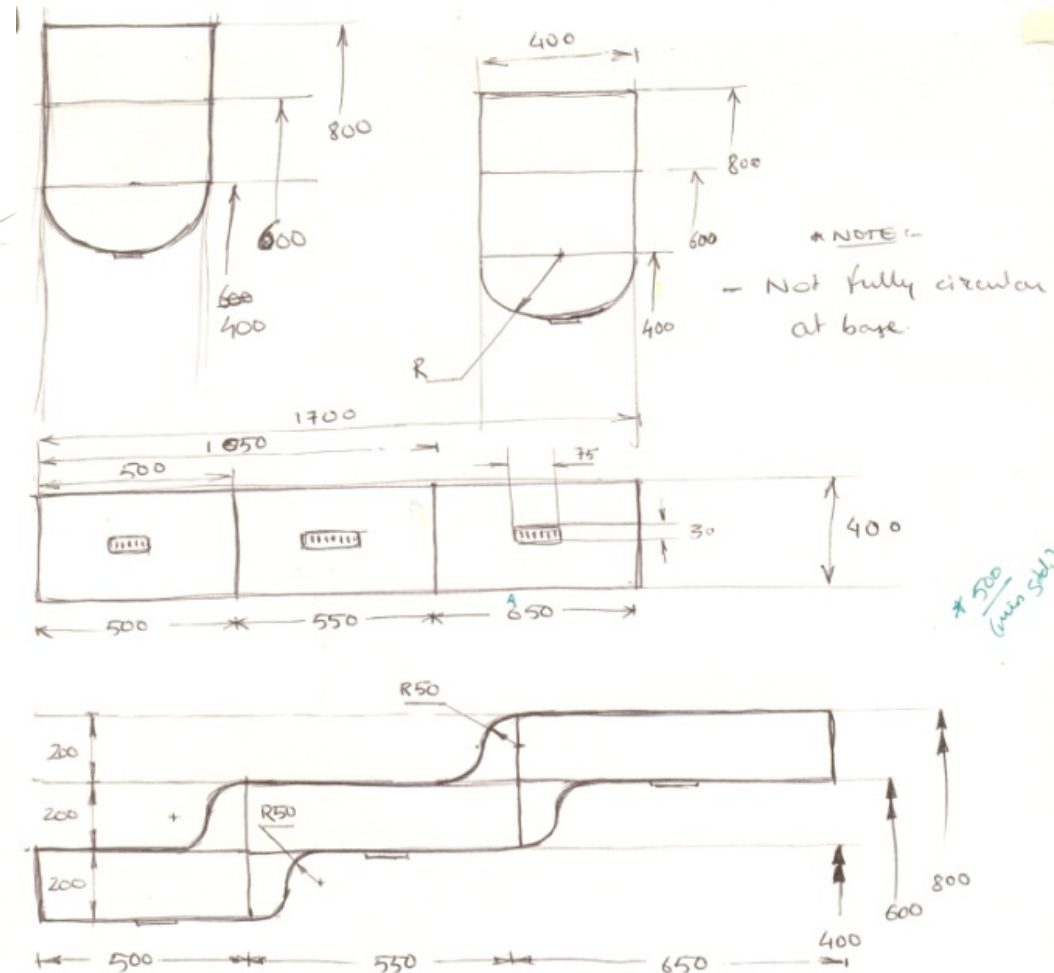
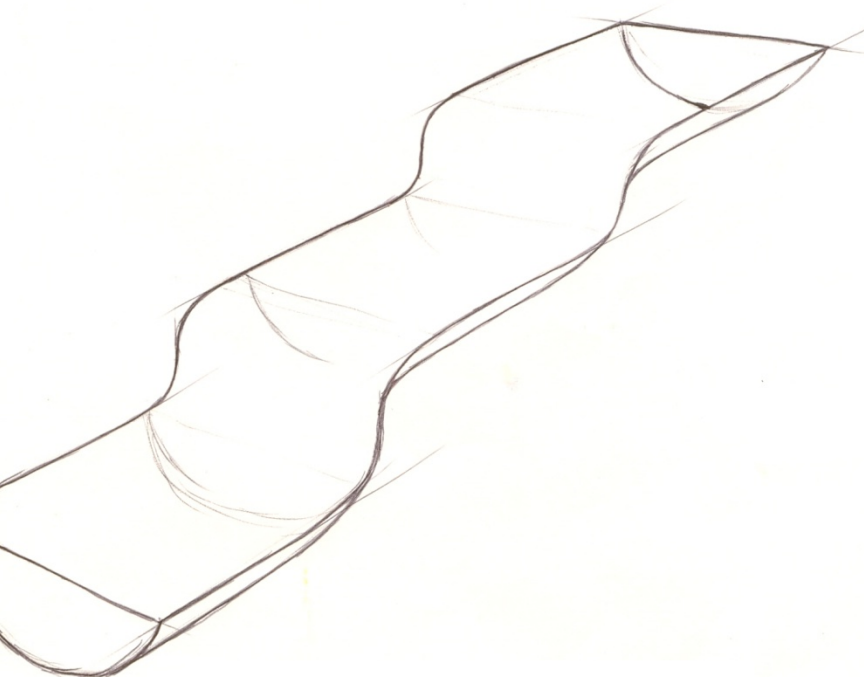
450

785

800

962

- _single piece drawn sheet
- _Simple form
- _one size fits all
- _ease of manufacturing: single piece SS sheet



5.2.4_Small urinal:

The following images give an overview of the developments in the urinal design. The brief in this ideation exercise was to design a compact, clean and friendly-looking urinal, keeping in mind the following;

1- the size of the urinal must be compact, for reasons explained in the Appendix.

2-the form of the urinal must be clean and friendly-looking.

3-flush water in the urinal will be dispensed with the means of an auto-flush, through a flush spout inside the bowl.

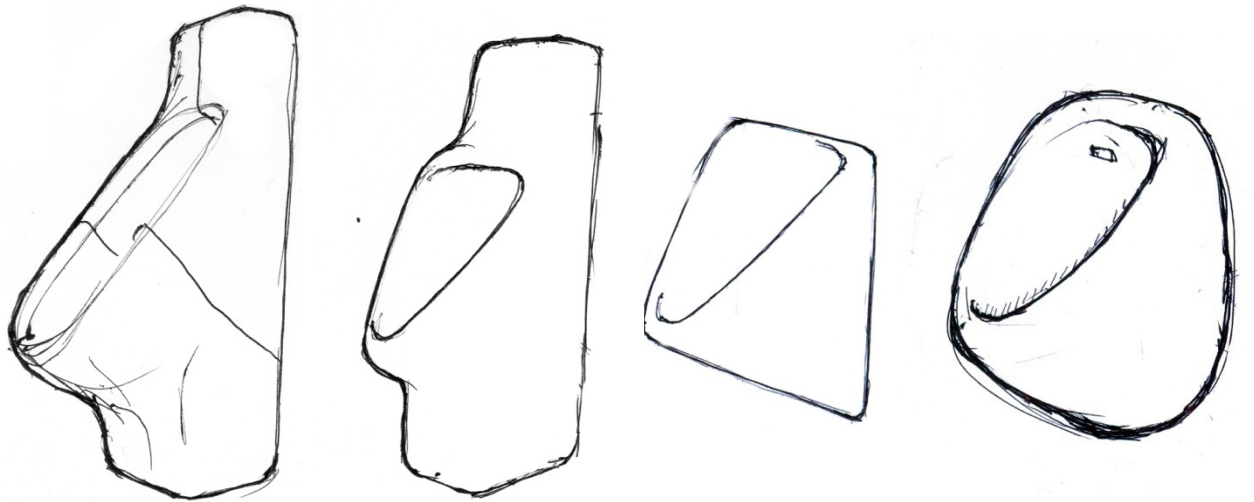


Fig 19: form possibilities for compact urinal

5.2.5(contd.)_idea development:

Further development of the same idea is shown here.

Main features:

- ceramic used in inner bowl only
- outer case in FRP- to protect
- Protects auto flush and bottom piping
- Attractive colors
- Clean looking

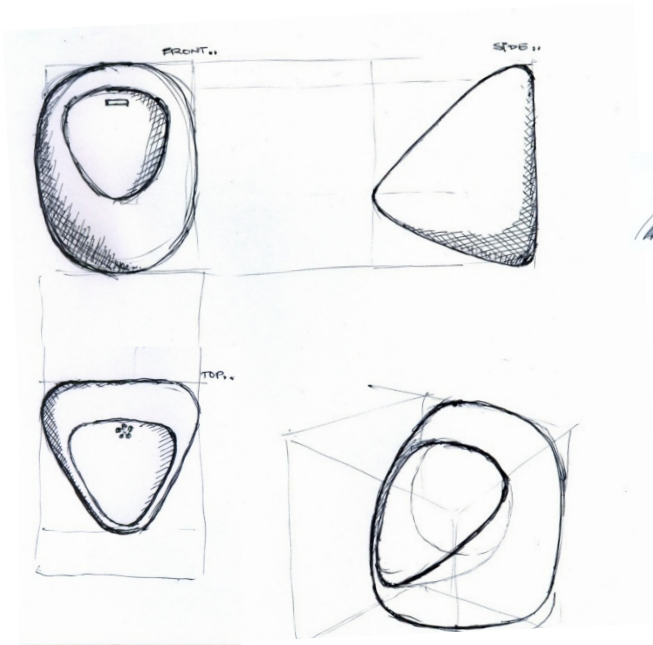


Fig 23: Same urinal, in different views

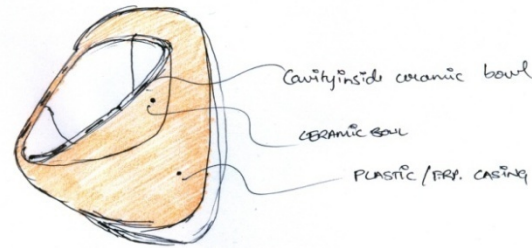


Fig20: The figure on the left shows the basic 2-part assembly of the urinal.

Fig21: The outer protective casing will house the auto-flush system and the bottom plumbing.

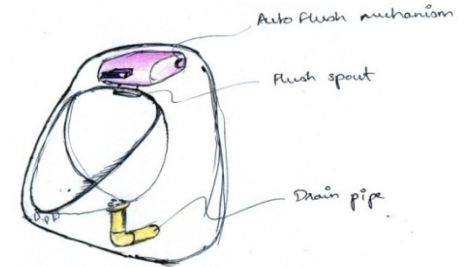
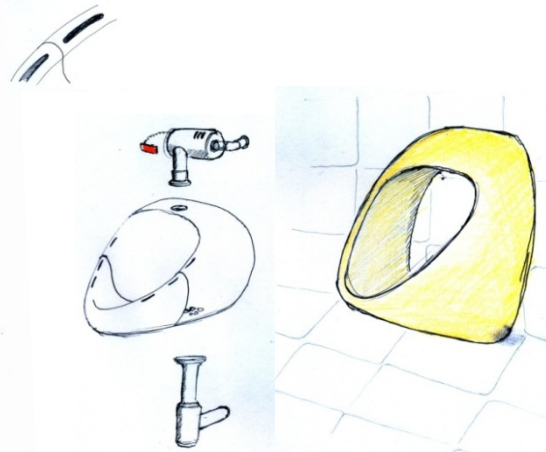


Fig22: The plastic cover will lock onto the ceramic bowl with the help of hooks provided on the inside of the cover, which latch onto the slits inside the bowl.



6

Idea Development

[Concepts]

Contents:

Concept1

Concept2

Concept3

Concept4

Concept5

6.1_Concept 1

_This form was conceived as a result of efforts to reduce splash-back from the inside surface.

_Splash can be controlled by limiting the striking angle of the fluid to a small value.

_This was achieved by providing a form that had a circular shape, thus ensuring that the pee always struck the surface tangentially(see fig).

Features;

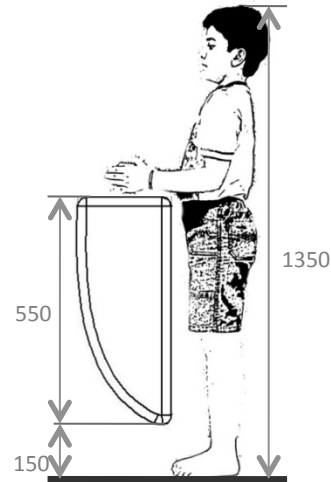
- Curved shape to reduce splash back
- Unique form

Advantages:

Splash control
Elegant form

Disadvantages:

No pan at front.
Unfinished product



Above dimensions in mm

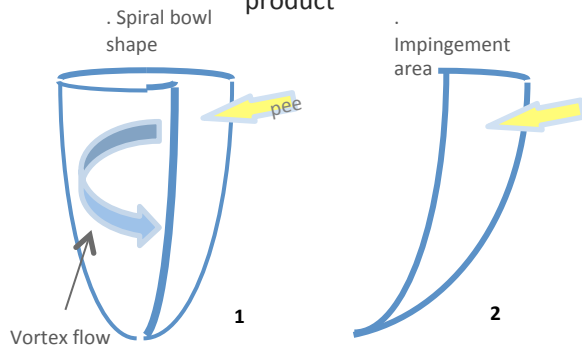
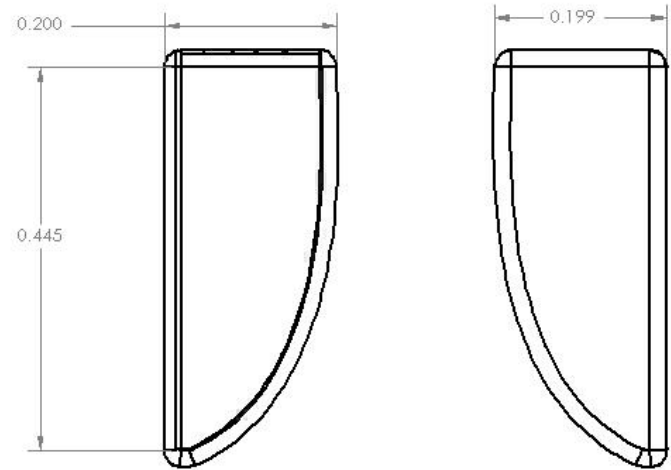
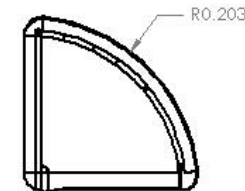


Fig: Above diagrams show the how the idea was conceived. The amount of splash depends on the angle between the direction of fluid flow and the plane of the inner surface (smaller angle = less splash). The premise was based on the intention of getting the urine to strike the urinal surface tangentially.

1 - Hence the spiral shape for smooth evacuation of the waste liquid.

2 – A development over the basic idea: the 1st form has frontal area that is unusable. In this form, only the area meant to receive the urine stream is kept.



Above dimensions in meters

6.2_Concept 2

This is a development over the first concept, wherein the curved surface is packaged inside a more proper form to make it a usable product.

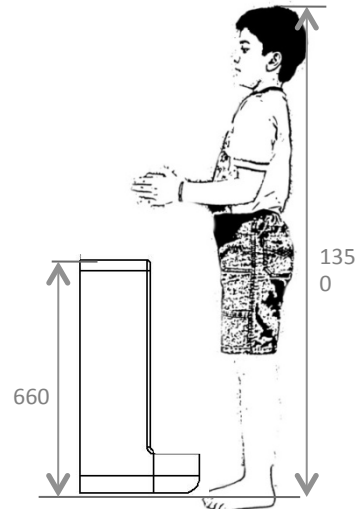
This form has certain improvements over the previous concept;

Advantages

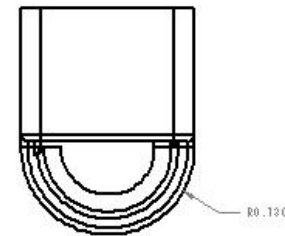
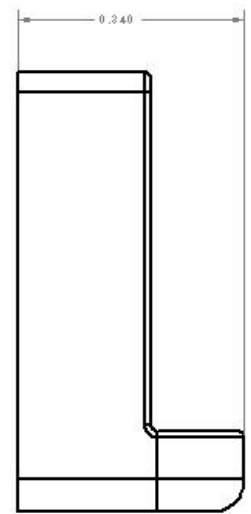
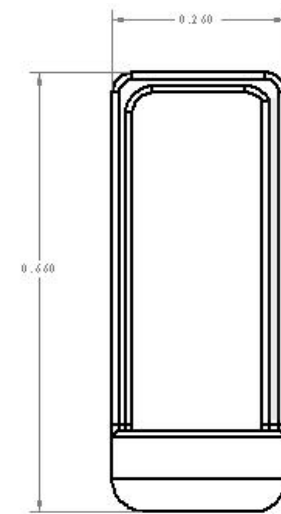
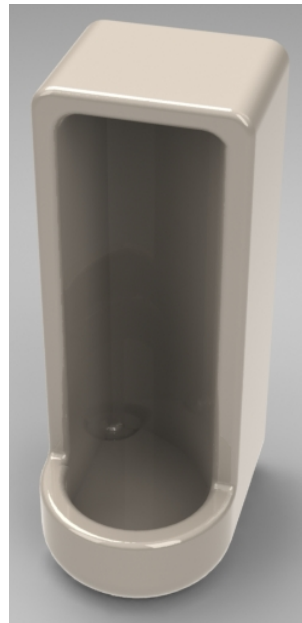
- Splash control
- Floor Mounted
- Large Pan
- Drain at back

Disadvantages

- Large in size
- Tough to clean insides



All dimensions in mm



Above dimensions in meters

6.3_Concept 3

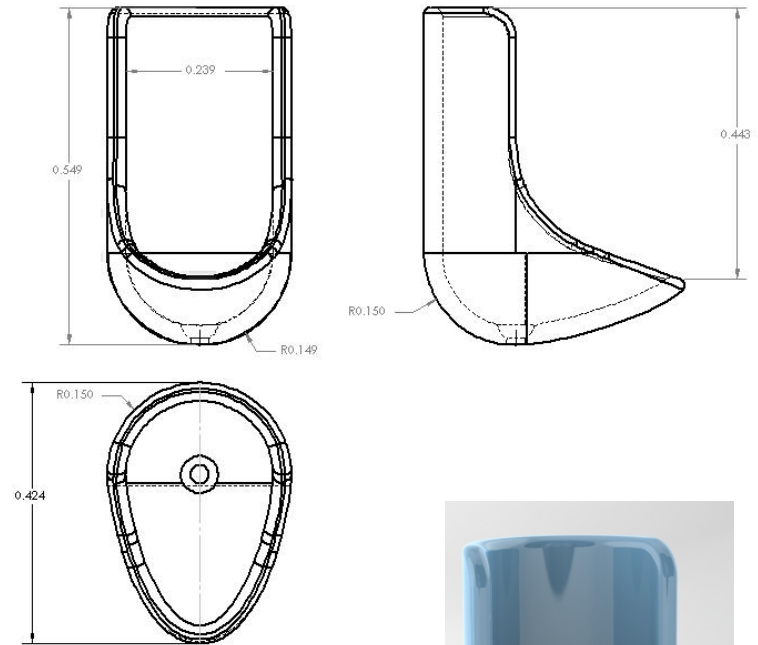
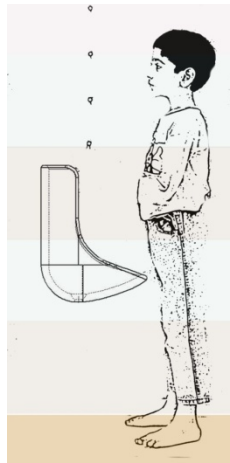
This was a further evolution from concept 2. Concept 2 had problems of cleaning and that it looked too bulky. Plus the floor mounted urinals are not preferred by all.

Advantages:

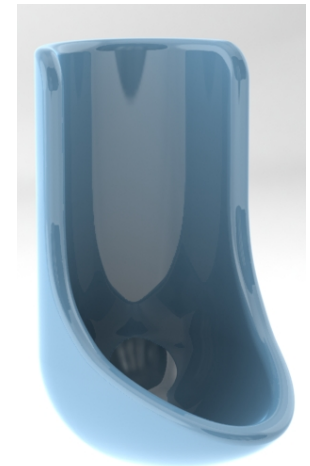
- splash free
- easy to clean
- Hygienic
- Friendly-looking form

Disadvantages:

- Form looks conventional
- Size unnecessarily big



All dimensions in meters



6.4_Concept 4

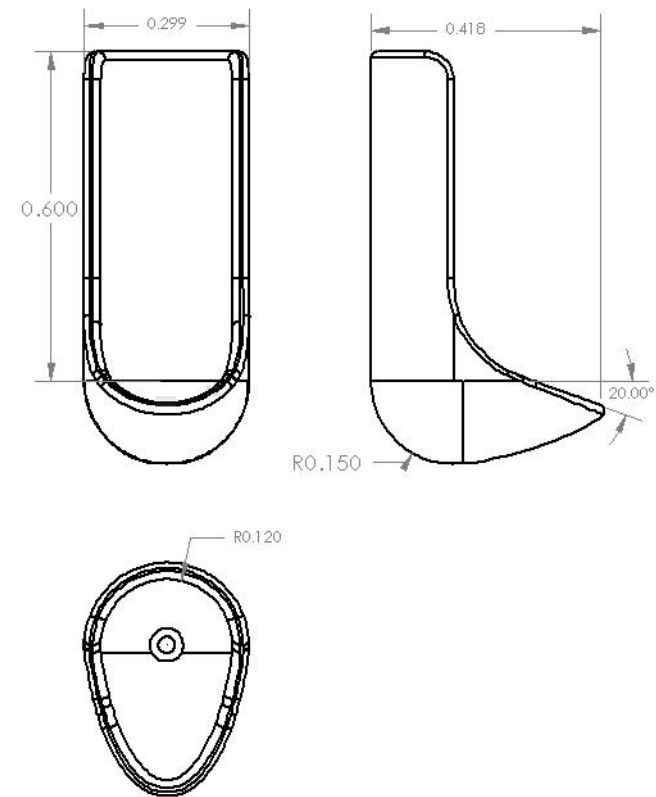
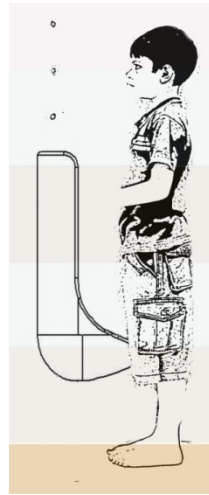
The concept no. 4 is same as no. 3, but has a taller back surface. This allows for mounting at a lower height, giving access for the smaller children.

Advantages:

- splash free
- easy to clean
- Hygienic
- Friendly-looking form
- 1 size fits all (low rim height)

Disadvantages:

- Form looks conventional
- Size unnecessarily big



6.4_Concept 5

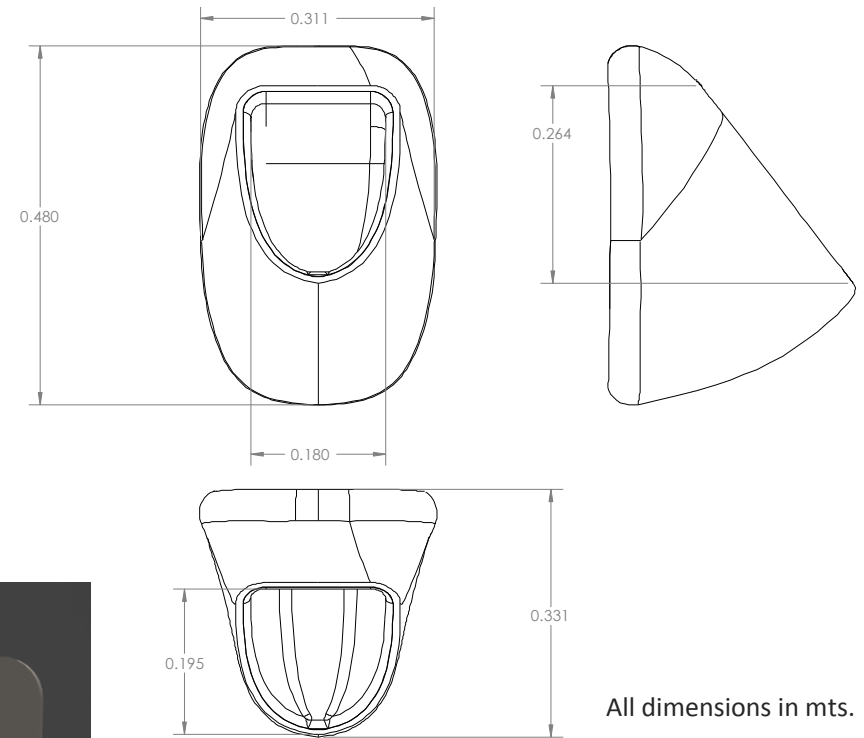
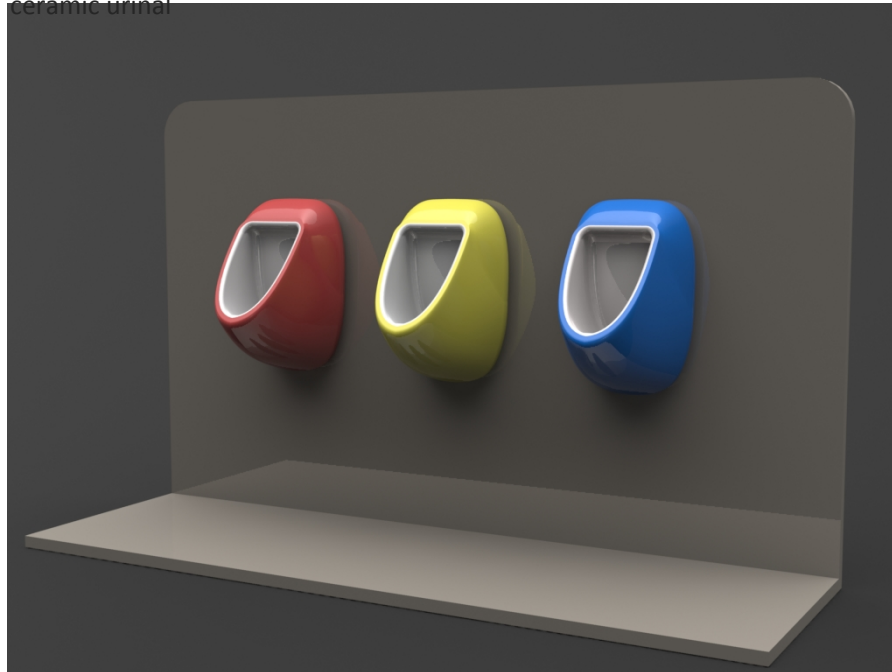
The thought on which this concept is based is given in Appendix- I.

Advantages:

- Compact, easy to use
- Friendly-looking form
- Ergonomic-right proportions, scale
- Hygienic-looking
- Maintenance- Easy-to- clean, concealed piping , auto-flushing
- Ease of installation

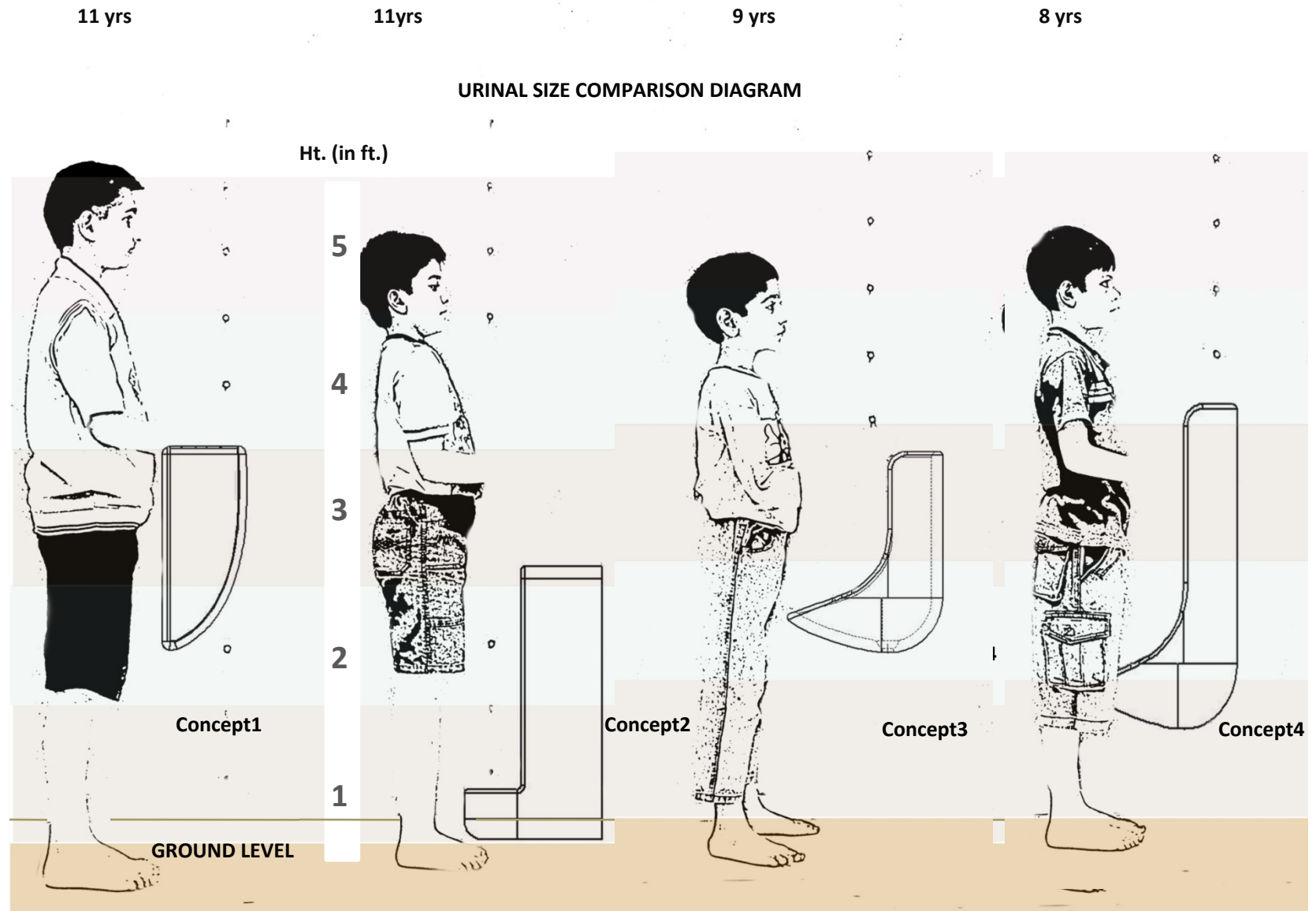
Disadvantages:

- More expensive than a conventional ceramic urinal



6.6_Urinal Size Comparison Diagram

The figure shows the proportion of various urinals w.r.t. each other, as well as different body sizes



All dimensions in mm

7

Strengthening the design

[Ergonomics, Technical validation]

Contents:

Determining the rim height

Deciding dimensions

Ergonomics

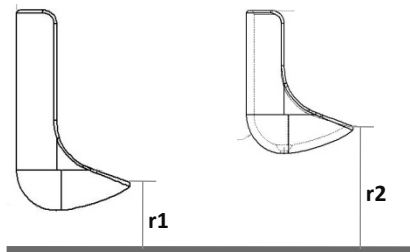
7.1_ERGONOMICS

7.1.1_Mounting height for urinal

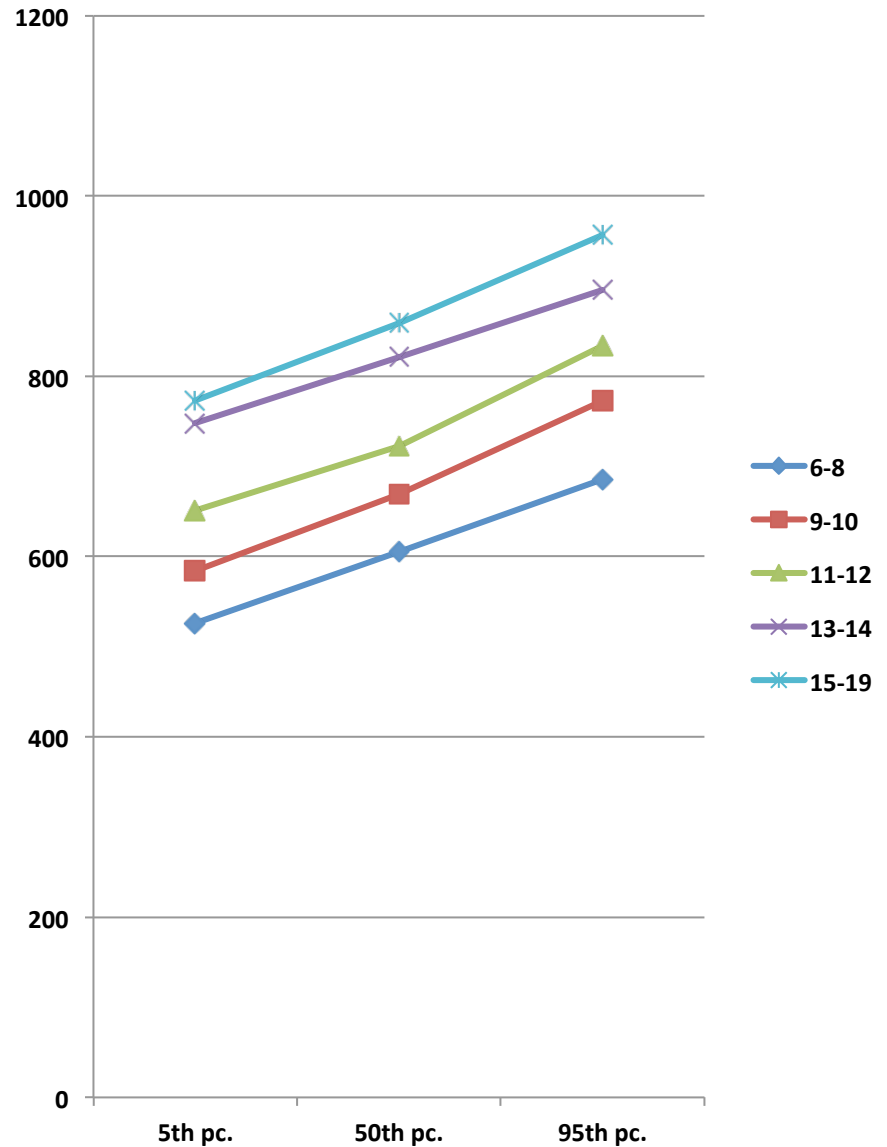
Since the user group has a very diverse range of body-sizes, it is important to determine the mounting height for the urinal, such that it is easily accessed by all. The mounting-height term, basically implies the height of the lowermost point of the urinal bowl rim, as shown in diagram below.

The mounting height/s was decided as follows;

1. A chart was compiled from the Anthropometric data pack of Indian school children¹.
2. The Chart: The individual lines represent each age group, with each marker showing the mean crotch(the region between the legs where they join the torso) height of that age group.
3. The X-axis represents the percentile category and the Y-axis represents height in millimeters.
4. Observation: No. of age clusters and the respective crotch heights;
Above 500: 15
Above 600 : 13
Above 700: 09
Above 800: 05
Above 900: 01



r1, r2 = "Rim" height [Mounting height parameter for urinals]



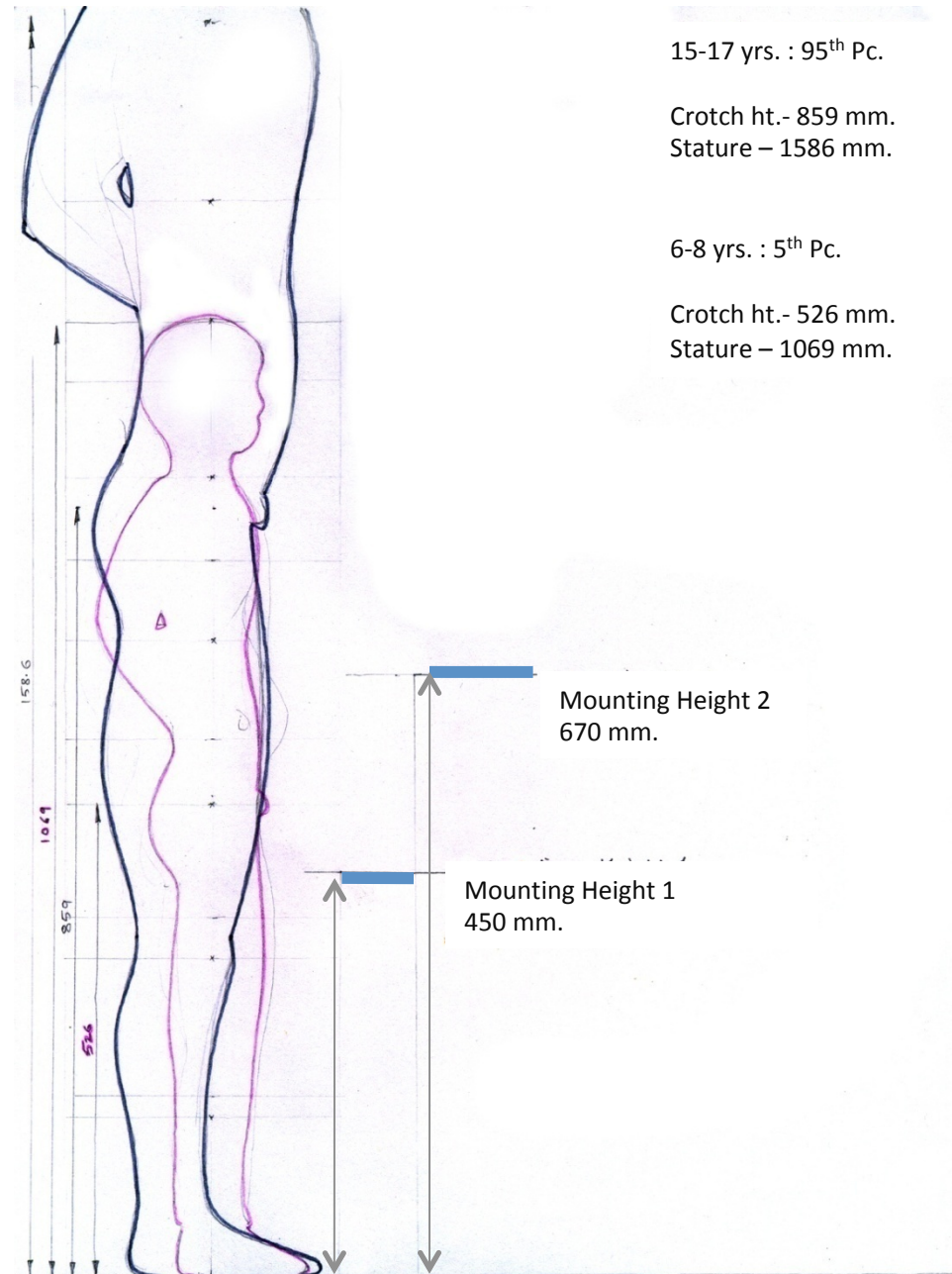
Crotch-height chart¹

7.1.2_Mounting height for urinal

The smallest and the largest possible body type were considered initially to understand the range of body types and the mounting heights. The mounting height for the urinal was decided as follows;

- Naturally, a common mounting height for the whole range is not possible.
- It is obvious that the lowermost mounting ht. will be decided by the smallest body size. Hence the junior mounting height is determined at 450 mm.
- Also, the usable vertical range of a urinal is 260 mm*. This means that the crotch heights up to 710 mm. are catered for. Hence the other mounting height must be located around this figure.
- A height of 670 mm. will provide an overlap of about 40 mm. with the lower urinal and will suffice for the upper body sizes too.
- This (670 mm.) is hence suited as the second mounting height.
- The urinals are to be mounted at two heights;
Junior ht. – 450 mm.
Senior ht. - 670 mm.

Fig shows the two selected mounting heights for the urinals



* - the final selected urinal has a working range of the same amount.

7.2_Technical Validation

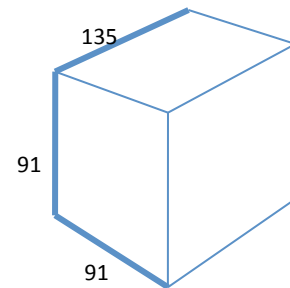
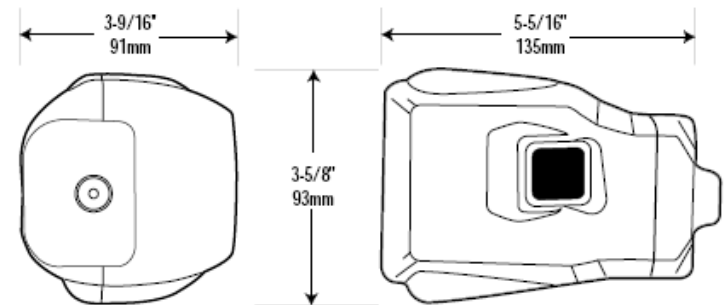
7.2.1_Auto Flush, Drainage assembly

A urinal, as a product is part of a system on which its proper functioning depends. There are a few external factors, some dimensional constraints that influence the design of the urinal, a bit.

The objects influencing the design of the urinal, are described below:

1- **Auto Flush:** consists of a casing which houses the different components of the flush including the sensor, motor, circuitry etc. It also has hard piping of certain dimension.

2- **Drainage:** Implies the connection between the urinal drain and the gutter* in the toilet. That too, can be in a variety of materials and configurations.



Auto flush box dimensions- mm.

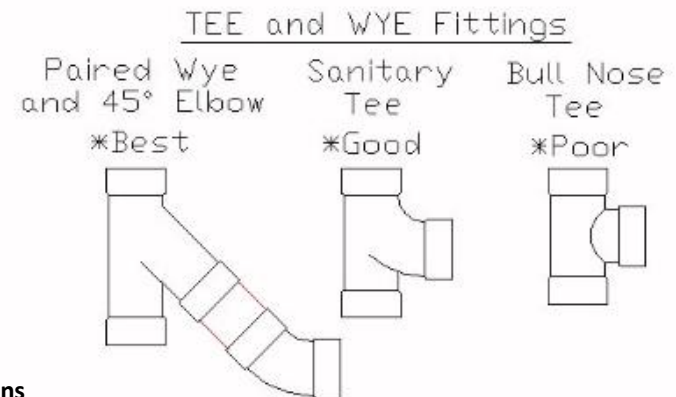


Fig: Rigid drain pipe options

8

Evaluation + Conclusion

[Analysis + comparative graphs + Conclusion]

Contents:

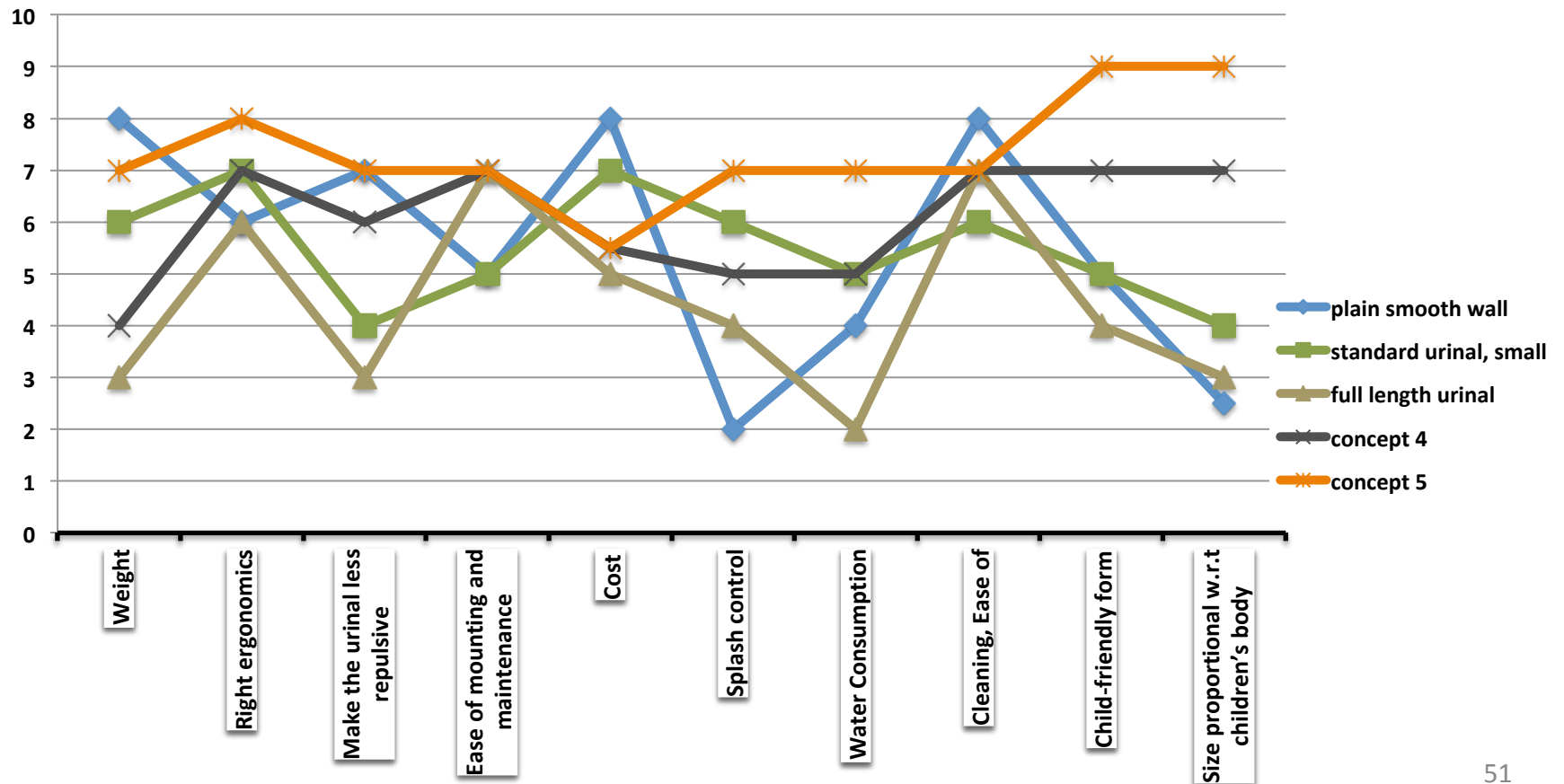
Analysis Chart

Final Design

Conclusion

8.1_EVALUATION

Product Analysis and Comparison



Final Concept



Fig1: Final Concept

The image alongside [fig.1] is a visualisation of the final concept. Construction[See fig. 2];
The urinal is a two-part construction in Stainless Steel and Plastic (Polypropylene). It also comprises of a sensor flush at the top, which is housed inside the plastic casing.

This design has several advantages to offer;

- ***Size and Weight:*** The product falls under the category of compact urinals, meaning that it is small in volume and weighs less. The smaller volume makes the product less intimidating for the kid. It also enables the user to come closer to the object while using it, thus ensuring that the splash is kept to a minimum. The narrow, tapered front end further facilitates this activity. Less splash equals implies better hygiene.
- ***Strength & Hygiene:*** The inner bowl is made of SS, a very strong material with excellent surface finish. It is not only sturdy and resistant to vandal acts, but is also hygienic and gives a clean look to the product.
- ***Visual appeal:*** The plastic casing serves a dual purpose - not only is it saving in cost, as PP is much cheaper than SS, but allows for the possibility of having different colors, thus giving a cheerful touch to the bathroom ambience.



Fig2: Construction

Conclusion

The image alongside is a visualization of an assembly of urinals installed on a wall.

The subject of sanitation in schools is a wide and complicated area of study. A number of issues exist regarding the design, maintenance and usability of such amenities. Also, schools in India are spread across a broad economic spectrum.

Therefore, different solutions will be needed for different schools. Although the project began with a focus on middle-rung schools of the country, the final product will probably be better suited in institutions that are financially stable/ surplus.

Also, since the problems observed with the sanitation in schools were so interwoven with each other, one perceives this as a system level problem that would benefit greatly if the approach and thinking was at a system level too.

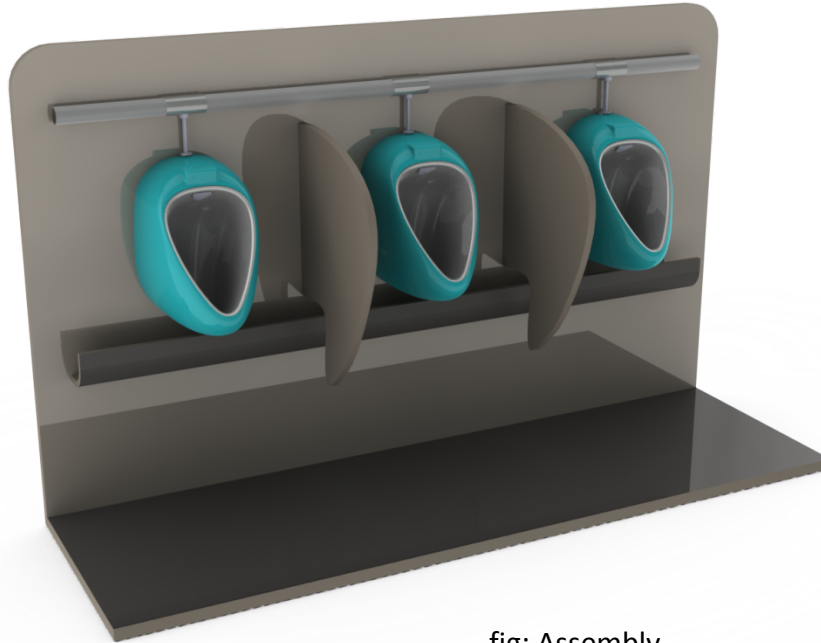


fig: Assembly

Appendix

Contents:

Note: Compact Urinals

List of images

References

A.1_Note: Small-size urinals

Over the years,(and specially in the last few) the size of the urinals has shrunk quite dramatically. The days of grand full wall-length urinals or large blocky ones seem to have gone now.

The latest urinals in the market are the ones that are small, organically shaped and around whom, the body fits perfectly. It is truly a form that follows function. The advantages of using a urinal of this kind are;

1. The small size lets the user come closer
2. This greatly enhances the users aim and reduces chances of splashing.
3. The bowl of these urinals is deep
4. Inside is rounded and the lesser surface area needs lesser water for flushing(Pint Urinal – see table on right)

Description	Pint Urinal (listed above)	Waterless Urinal (cartridge type)	1.0 gpf Urinal
Side by Side Cost Analysis Assumptions			
Gallons Per Flush	0.125	0.000	1.000
Daily Uses (per urinal)	50	50	50
Typical Use (per day/ per user)	2	2	2
Uses (per cartridge)	-	3,500	-
Cost (per cartridge)	-	\$55.00	-
Days of Operation (per year)	260	260	260
Total Uses (per year)	26,000	26,000	26,000
Annual Water Usage Comparison			
Water Use (gallons/ day)	12.5	-	100
Water Use (gallons/ year)	3,250	-	26,000
Cartridge Use (quantity/year)	-	7.42	-

Fig 17, below: shows the different sizes of urinals, over the years.

1- The Queens hotel, 1979



2- Waterless urinals



2- steel urinal- small in size



3- Latest from Kohler- 8" X 14"



A.2_Image List

1. - taps, school toilet. KV IIT Powai
2. -Diagram depicting basic elements of project
3. - Photo: session held In IDC on 29.08.09
4. - Photo focus group with children. KV IIT Powai
5. - Photos: School toilet, KV IIT Powai, 8 sep. 09
6. - Survey form
7. - Scan from book titled "School Sanitation and Hygiene"
8. - Scans from book titled "The Bathroom"
9. - Composition, school toilet
10. - Composition, toilets
11. - Diagram, flushless urinals (
<http://www.waterless.com/SaveEval.pdf>)
12. - Models of flushless urinals ([Flushless urinals.pdf](#))
13. - Basin materials (www.interiordesignshop.com/.../)
14. - Auto flush: (www.interiordesignshop.com/.../)
15. - Sketches: Urinal & Washbasin
16. - Sketch: Analogy from nature
17. - SS washbasin
18. - Size reduction in urinals ()

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