National School WaSH Design and Construction Manual

By Mesfin H.

Contributors for the manual preparation

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- ***World Vision Ethiopia.***

Presentation outline

- **CHAPTER I: Introduction**
- **CHAPTER II: Type of Water Source and Supply Systems**
- **CHAPTER III: Design and Construction of Water Supply Systems**
- **CHAPTER IV: School Sanitation Facilities**
- **CHAPTER V: Design and Construction of Dry pit Latrines**
- **CHAPTER VI: Design and Construction of Flush Toilets**
- **CHAPTER VII: Design and Construction of Hygiene Facilities**
- **CHAPTER VIII: Wastewater management**
- **CHAPTER IX: Facilities for Solid Waste Collection & Disposal**
- **CHAPTER X: Monitoring Activities During Construction**
- **CHAPTER XI: Bill of Quantities (BOQ)**

Chapter I: Introduction

- Schools are a key environment on which to concentrate WASH efforts, since schoolchildren and teachers spend their **whole day there, five or even six days a week.**

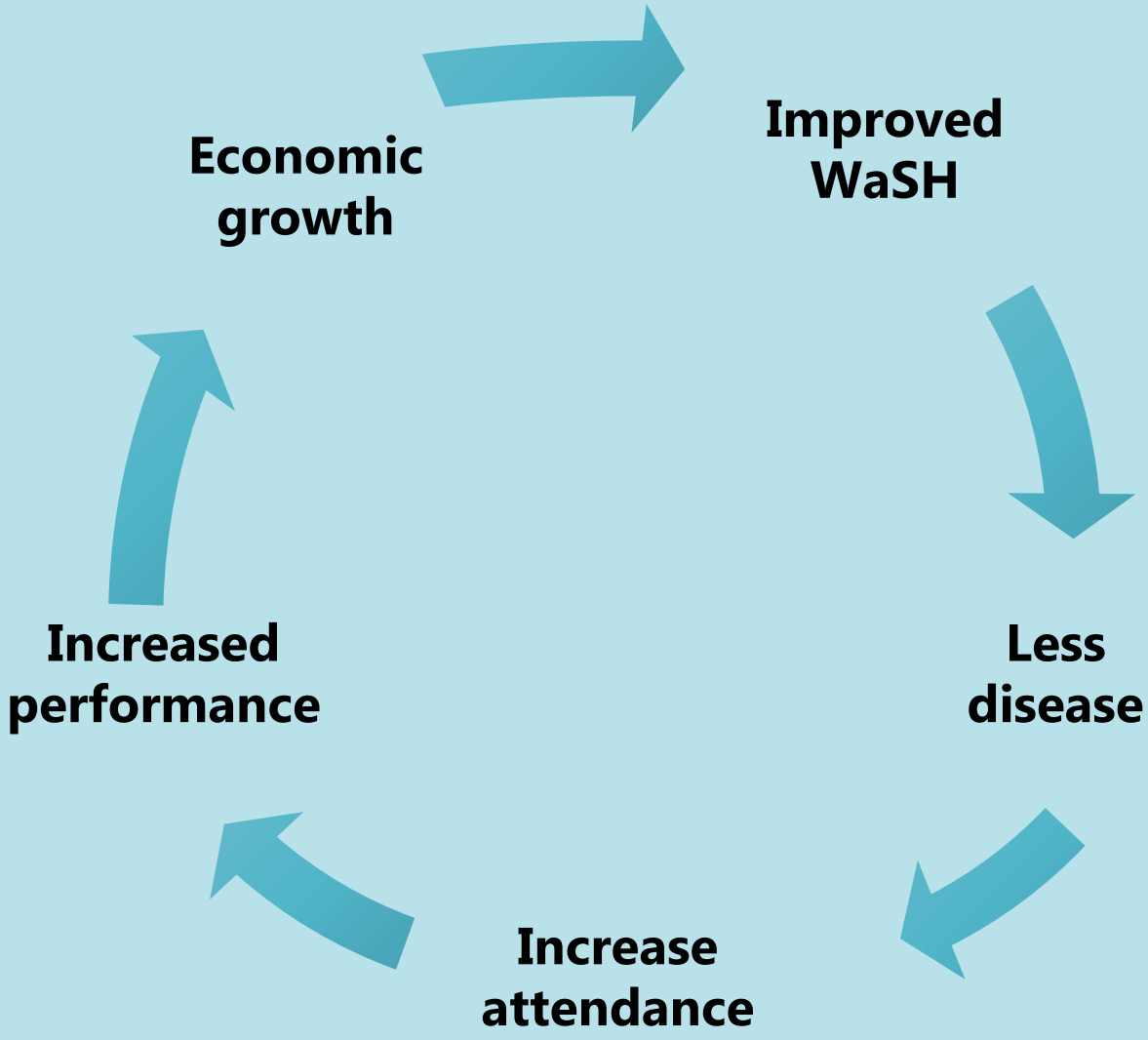
- It is a densely populated community with vulnerable young persons.

- The experiences and knowledge school children gain from interacting with WASH facilities can be passed on first to their household members and then spread to the communities in their villages at large.

Why is WaSH in Schools important?

- Every child around the world deserves an opportunity to learn in a safe and healthy/clean environment.
- Reduce student absence
- Visible increase in student's enrollment and reduction in drop-out rates.
- Improve (increase) nutritional status or (decrease malnutrition rate)
- Students perform better
- Invests in life-long positive skills
- Reduce soil-transmitted helminthic infection, diarrheal diseases and acute respiratory infection
- Reduce child mortality and develop healthy and productive generation.
- Address issues of gender and socio-economic equity

WaSH in School boosts attendance and achievement



Chapter I: Introduction contd.

- The total number of primary schools for this year is 35,980. 93% of primary schools are government owned across the country, with the exception of Addis Ababa.

- The total number of secondary schools for this year is 3,481. 89.3% of primary schools are government owned across the country, with the exception of Addis Ababa & Diredawa.

- SWASH facilities as per recently released figures from MoE's School WASH mapping analysis report in 2019/20 show that:

Chapter I: Introduction contd.

Table 3.17 Water Access in Primary and Middle Schools by Region, 2020/21

	Availability of Water			Water Supply Type												Accessible to-	
Region	Number of Respondent Schools	Schools With Water Supply	Schools With Water Supply Functional	Bottled Water	Cart With SmallTank/Drum	Pipe Water in School	Protected Dug Hole	Protected Spring	Public Tap/StandPipe	Rain Water Collection	Surface Water (River,Dam,Lake)	Tanker-Truck	TubeWell/Borehole	Unprotected Dug Hole	Unprotected Spring	Other (including Blank)	Children with Special Needs (Number of Schools)	Young Children (Number of Schools)
Afar	688	228	173		3	126	4	2	6	4			1	1	1	25	126	149
Amhara	9,101	3,877	2,021	2	9	1,017	223	42	274	252	20	2	29	29	10	112	1,186	1,572
Oromia	15,086	5,734	4,847		81	3,121		522		487	465				171		2,430	2,748
Somali	1,941	418	254			16	6					2				230	257	284
Benishangul-Gumz	586	253	215		1	97	63		6	4	5		1	7	1	30	86	128
SNNP	5,764	2,285	1,915	14	7	1,429	48	12	97	51	81	7	18	17	19	115	1,315	1,606
Gambella	265	257	236			198	6		5			1			2	24	184	236
Harari	91	57	50			36	1		1	2						10	39	43
Addis Ababa	784	755	724	1	5	597	19	1	9			10	1	1	6	74	634	704
Dire Dawa	132	102	89		1	77			4			1				6	54	77
Sidama	1,200	438	390	3		322	12	1	18	5	3	2	2	2	2	18	300	368
National	**35,638**	**14,404**	**10,914**	**20**	**107**	**7,036**	**382**	**580**	**420**	**805**	**574**	**25**	**52**	**57**	**212**	**644**	**6,611**	**7,915**

Chapter I: Introduction contd.

Table 3.18 Toilet Facilities in Primary and Middle Schools by Region, 2020/21

	Student Toilet					Toilet Type							Handwash		Teachers Toilet	
Region	Number of Ressponden Schools	Schools with Functional Toilets	Schools with Different Boys and Girls Toilet	Accessible to Children with Special Needs	Accessible to Young Children	Biogas producer Toilet	Can be Washed	Fertlzer Producer Toilet	Improved	Traditional	Used Water	Other	Availability (Number of Schools)	Fuunctionality (Number of Schools)	Schools with Functional Teachers Toilets	Schools with Different Male and Female Toilet
Afar	688	355	261	215	219		41	1	210	29	3	11	208	183	193	137
Amhara	9,101	7,851	5,920	5,616	5,922	17	493	9	2,654	3,128	37	19	6,065	5,884	6,240	5,330
Oromia	15,086	14,273	14,273	2,626	3,768				4,621	9,280		1,036	5,287	4,829	10,363	8,566
Somali	1,941	1,941	549	370	332			1	18	96	26	38	425	347	131	91
Benishangul-Gumz	586	553	470	156	246	1	101		215	193	1	43	273	209	323	178
SNNP	5,764	5,638	4,838	2,629	3,512		198		2,071	3,807			3,558	3,299	4,544	3,954
Gambella	265	265	248	245	246				187	20			239	102	189	187
Harari	91	91	78	53	70		2		37	40	2	3	76	65	58	49
Addis Ababa	784	784	772	668	758	3	416	2	61	11	111	11	773	730	664	654
Dire Dawa	132	132	111	82	89		14	1	39	9	49	3	107	68	94	81
Sidama	1,200	1,176	1,018	615	837								555	505	1,013	876
National	**35,638**	**33,059**	**28,538**	**13,275**	**15,999**	**21**	**1,265**	**14**	**10,113**	**16,613**	**229**	**1,164**	**17,566**	**16,221**	**23,812**	**20,103**

Chapter I: Introduction contd.

Table 4.7 Water Access in Secondary Schools, 2020/21

	Availability of Water			Water Supply Type											Accessible to-	
Region	Number of Resspondent Schools	Schools With Water Supply	Schools With Water Supply Functional	Bottled Water	Cart With SmallTank/Drum	Pipe Water in School	Protected Dug Hole	Protected Spring	Public Tap/StandPipe	Rain Water Collection	Surface Water (River,Dam,Lake)	Tanker-Truck	TubeWell/Borehole	Unprotected Dug Hole	Unprotected Spring	Children with Special Needs (Number of Schools)	Young Children (Number of Schools)
Afar	45	28	17			11										15	
Amhara	601	453	272			209	16	3	27		1		3		1	195	
Oromia	1296	877	791		3	699		42		16	23				8	506	
Somali	231	49	36													22	
Benishangul-Gumz	87	35	32		2	15	6		2		1		1	1		18	11
SNNP	732	470	434		1	372	7	2	12	4	3	4	2	1	1	351	1
Gambella	65	47	43			42										27	
Harari	18	16	15			12	1								1	10	
Addis Ababa	215	211	202		1	139	8		2	1				1		186	
Dire Dawa	27	27	25			23					1					20	
Sidama	111	72	68			63			1			1	1	1	1	61	
National	**3,428**	**2,285**	**1,935**		**7**	**1,585**	**38**	**47**	**44**	**21**	**29**	**5**	**7**	**4**	**12**	**1,411**	**12**

Chapter I: Introduction contd.

Table 4.8 Toilet Facilities in Secondary Schools, 2020/21

	Student Toilet					Toilet Type							Handwash		Teachers Toilet	
Region	Number of Ressponded Schools	Schools with Functional Toilets	Schools with Different Boys and Girls Toilet	Accessible to Children with Special Needs	Accessible to Young Children	Biogas producer Toilet	Can be Washed	Fertlzer Producer Toilet	Improved	Traditional	Used Water	Other	Availability (Number of Schools)	Fuunctionality (Number of Schools)	Schools with Functional Teachers Toilets	Schools with Different Male and Female Toilet
Afar	45	35	26	18	35	1	101	1	97	27	12	4	26	26	18	18
Amhara	601	585	526	443	585		4		13	5		2	482	481	519	519
Oromia	1296	1255	1255	345	1255	7	91	1	311	48	8		785	692	1020	841
Somali	231	72	52	31	72				730	496		52	37	37	10	10
Benishangul-Gumz	87	76	58	27	47				3	17	3	2	32	30	52	35
SNNP	732	696	666	484	696		17		32	24		9	495	495	615	615
Gambella	65	49	49	49	49		57		396	261			23	23	44	44
Harari	18	17	17	9	17				55	1			14	14	18	18
Addis Ababa	215	210	209	186	210		6		8		1	2	207	207	150	150
Dire Dawa	27	27	27	19	27	1	115		11	3	49	9	26	26	26	26
Sidama	111	107	105	86	107		3		4	3	14	1	77	77	99	99
National	**3,428**	**3,129**	**2,990**	**1,697**	**3,100**	**9**	**394**	**2**	**1,660**	**885**	**87**	**81**	**2,204**	**2,108**	**2,571**	**2,375**

Chapter I: Introduction contd.

Table 3.19 Toilet Facilities in Primary Schools, 2009 E.C. (2016/17)

REGION	% Schools that responded to toilet, handwash and menstruation sanitation questions	% Schools that have toilet	% Schools with traditional toilets	% Schools with improved toilets	% Schools with functioning students toilets	% Schools with functioning teachers toiletst	% Schools with male and female toilets far from each other	% Schools with toilets accessible for special needs students	% Schools with toilets accessible for young children	% Schools with solid waste disposal	% Schools with sewage system	% Schools free from open defecation
Tigray	86	70	28	72	62	46	43	35	47	62	15	45
Afar	96	41	21	79	44	34	28	22	27	49	21	49
Amhara	100	80	57	43	71	68	27	29	41	73	15	60
Oromiya	100	89	67	33	82	72	43	38	51	69	14	63
Somali	97	50	45	55	48	44	22	21	23	23	17	21
Benishangul-Gumuz	98	73	30	70	75	53	39	34	42	69	23	63
SNNP	97	93	68	32	89	83	52	30	43	60	33	66
Gambella	84	24	44	56	87	88	88	89	90	91	91	89
Harari	100	77	27	73	71	66	52	37	54	57	35	35
Addis Ababa	97	89	10	90	96	96	75	71	90	60	85	92
Dire Dawa	99	90	28	72	87	66	48	28	53	79	47	73
Total	98	83	63	37	78	70	41	34	46	65	20	61

Chapter I: Introduction contd.

Chapter I: Introduction contd.

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Chapter I: Introduction contd.

Chapter I: Introduction contd.

Chapter I: Introduction contd.

The objective of the manual

- To produce a **standard** design and construction manual that provides **technical guidance** for implementation of school WASH facilities including water supply systems, latrines, hand washing stations, menstrual hygiene management safe spaces and solid waste disposal mechanisms.

- This ensures students have safe and adequate WASH facilities and services.

Chapter I: Introduction contd.

This revised manual has the following new additions:

i. WASH facility designs for Pre-Primary schools

ii. A Menstrual Hygiene Management (MHM) facilities design

iii. Various latrine options for various contexts for compost type (dry pit, swampy area, rocky area latrines) and flush type (piped)

iv. Expanded latrine block design and construction to 6, 8 and 10 seat room toilets

v. Designs for pastoralists considering their cultural norms and values

Chapter I: Introduction contd.

vi. New incinerator design for infectious waste disposal

vii. New sanitary pad disposal box for girl's latrines and MHM block

viii. All WASH facilities are designed to be inclusive for all students

ix. New companion manual A Guide to School WASH Facilities Management, Operation and Maintenance developed

x. The design manual has an annex of architectural, structural and electrical drawings for each type of WASH facility, Bill of Quantities (BoQ) and optional L-shape latrine drawings

Chapter I: Introduction contd.

Design and Construction Principles

i. Address gender-related needs and roles:

ii. Adequate capacity and minimal waiting time:

iii. Appropriate dimensions and adjustments for children:

iv. Physically separate facilities:

v. Appropriate orientation of facilities:

vi. Appropriate location of toilets:

vii. Appropriate designs for different age groups:

viii. Facilities should encourage hygienic behavior:

ix. Address the needs of children with disabilities:

x. Do not harm the environment:

xi. Low-cost solutions without compromising quality:

Chapter I: Introduction contd.

Minimum standards for school WASH facilities

Minimum standards are threshold minimums below which services are believed to be poor and can affect public health.

Item	Recommendation
Pupil to cubicle Ratio	One stand/cubicle per 50 girls for rural schools and one stand per 25 girls for urban One stand per 75 boys in rural schools, and one stand per 50 boys for urban Separate (three seats) latrine block for staff (one female, one male and one for staff with disabilities)

Item	Recommendation
Drinking water tap	▪ One tap/100 student in rural schools ▪ One tap/50 students in urban schools

Item	Recommendation
Location	▪ Latrine should be located 30m or more away from classrooms • Handwashing basins/stations next to latrines and school feeding centers • Physically separated latrine blocks for boys and girls by at least 20m. Should be constructed to face in opposite directions to each other • For cistern flush toilets where there is a piped water supply system - the pit bottom should be a minimum of 2m above the groundwater table and should also be 50m away from drinking water sources

Chapter I: Introduction contd.

- All users of this manual should respect the fact that all local, state and federal codes and regulations wherever applicable must be satisfied on all projects and program. If these standards differ from state or federal requirements, **the more restrictive and minimum standard shall apply**.

- The designs are intended to augment rather than **replace sound engineering judgments** which are made on a site specific, case by case basis.

- The designs set out in this manual **are not prescriptive**. Instead they serve **as a well-informed guide** that will help ensure facilities that are appropriate for students.

Chapter II: Type of Water Source and Supply Systems

- Each student requires 5L per day for meeting *drinking, sanitary and hygiene requirements*. It is needed to keep the toilets clean, wash urinals as well as hand washing basins.

- Site investigation needs to be done specifically to assess water resource potential within and surrounding the premises of the school. It includes feasibility for development and use, and detailed characterization .

- It is also always advantageous to have this investigation done in advance while school construction is at the planning stage.

Chapter II: Type of Water Source and Supply Systems

There are two major water supply sources that can be effectively developed, adapted and used for schools:

1. Ground water source
   - ✓ Spring with or without gravity pipe system
   - ✓ Hand dug well with fitted with Rope/hand pump
   - ✓ Shallow borehole (SBH) fitted with hand/motorized pump
   - ✓ Deep borehole (DBH) with pipe system
2. Surface/rainwater source
   - ✓ All schemes from river/lake source with piped system
   - ✓ Rooftop Water Harvesting System

Chapter II: Type of Water Source and Supply Systems

The design and construction of water supply sources may require **mixing and adapting different technology** options to meet the desired water demand for schools with different population sizes and geographic contexts

Chapter II: Type of Water Source and Supply Systems

Rooftop Water Harvesting System

Roof water harvesting is an important investment choice for three reasons:

i. In areas where groundwater development is either difficult or has been rendered unusable by high levels of fluoride content or salinity

ii. In areas where the only available water source option is surface water.

iii. When accessing other water sources is expensive, roof water harvesting can be taken as a temporary solution.

Chapter II: Type of Water Source and Supply Systems

Piped water supply to schools

Whenever there is *an existing water supply system* near a school, connection with the system will be made considering the following four guidelines:

Chapter II: Type of Water Source and Supply Systems

1. Existing System Water Supply Capacity Assessment

- Assess source **yield/discharge** of the existing water supply system.
- Assess the **current and projected population** served by the existing water supply system. Relevant woreda/district offices should be consulted to collect secondary data (if any) on the existing system and beneficiaries.
- Assess **current and projected water demand** by the beneficiary community.
- Estimate the **water demand of the school**.
- **Compare** the school's demand vis-à-vis the supply - whether there is room for connection with the system. **The school's demand should not affect the demand of the current beneficiaries as much as possible**.
- ***If the school's demand cannot be satisfied from the existing system, consider another water source (such as rainwater harvesting).***

Chapter II: Type of Water Source and Supply Systems

2. Existing System Hydraulic Capacity Assessment

If water supply obtained from the existing system against demand is not an issue:

- Assess the conveyance capacity of the existing **distribution line** near the school facility to accommodate the additional demand imposed by the school. If required and possible, increase the size of the existing pipeline.
- Identify or estimate the elevation difference between the water source (could be elevated tank) and the school's water point considering the most feasible/economical route.
- Check **head loss** between the above points and assess the availability of sufficient head at the school's water point.
- ***If not the above, consider improving the existing system or another water source (such as rainwater harvester).***

Chapter II: Type of Water Source and Supply Systems

3. Economic Evaluation

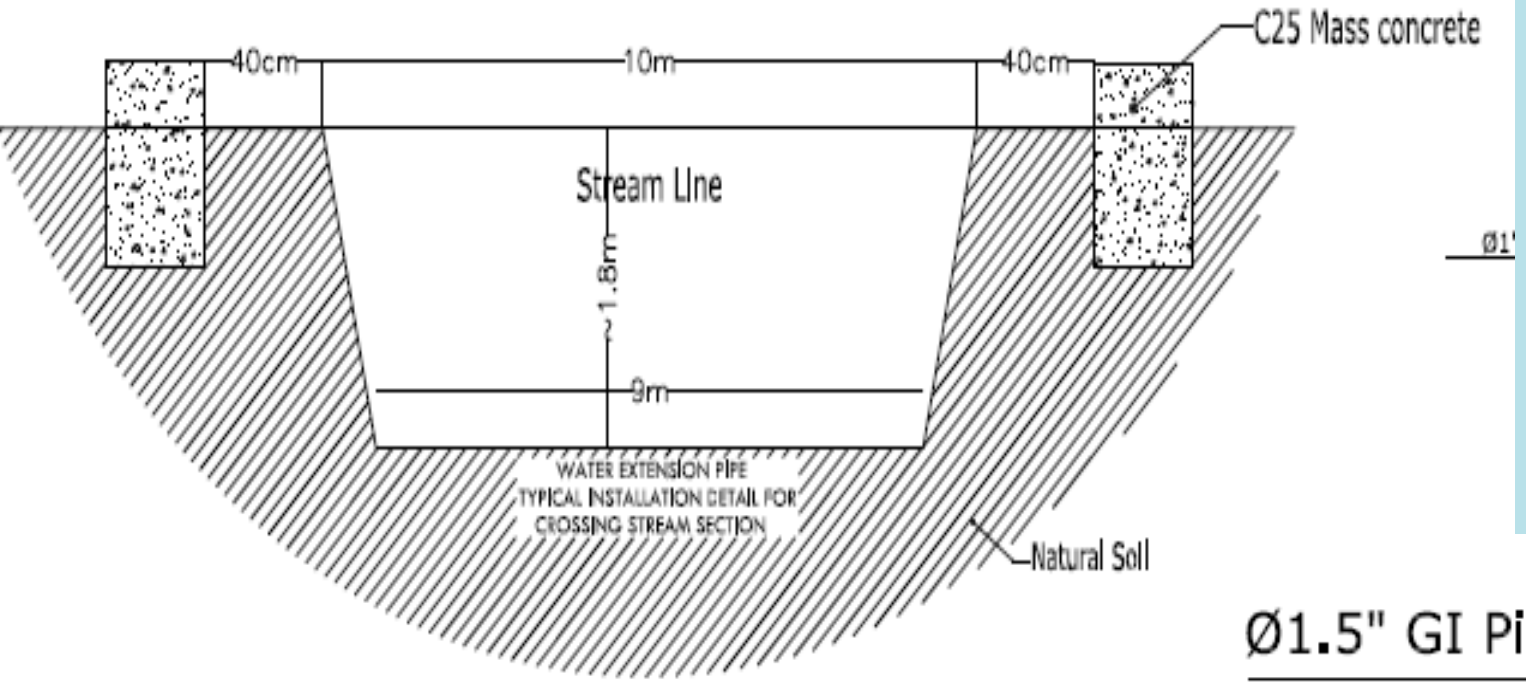
- Assess the connection cost with development of other water sources stated above.

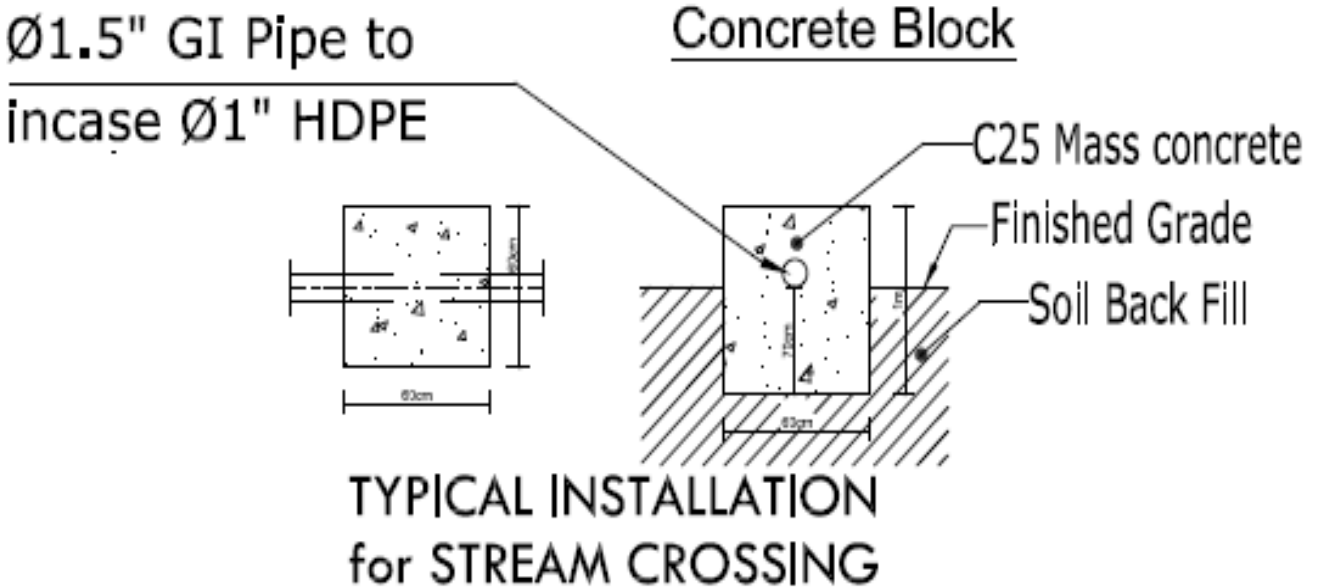
Chapter II: Type of Water Source and Supply Systems

4. Installation Considerations

- Trench depth - *minimum trench depth should be 80cm.*
- Backfilling - *pipelines shall be sufficiently backfilled after pipe installation.*
- Pipes - *High density polyethylene (HDPE) pipes can be used in trenches while all above ground pipe installation should be galvanized steel.*
- Valves - *isolation valve (enclosed in chamber) shall be provided. Water meter will be installed (if necessary)*
- Road and natural drainage crossings (if any) - *enclose pipes in galvanized iron (GI) pipes or cover with concrete. Provide supporting anchor blocks where necessary.*

Chapter II: Type of Water Source and Supply Systems





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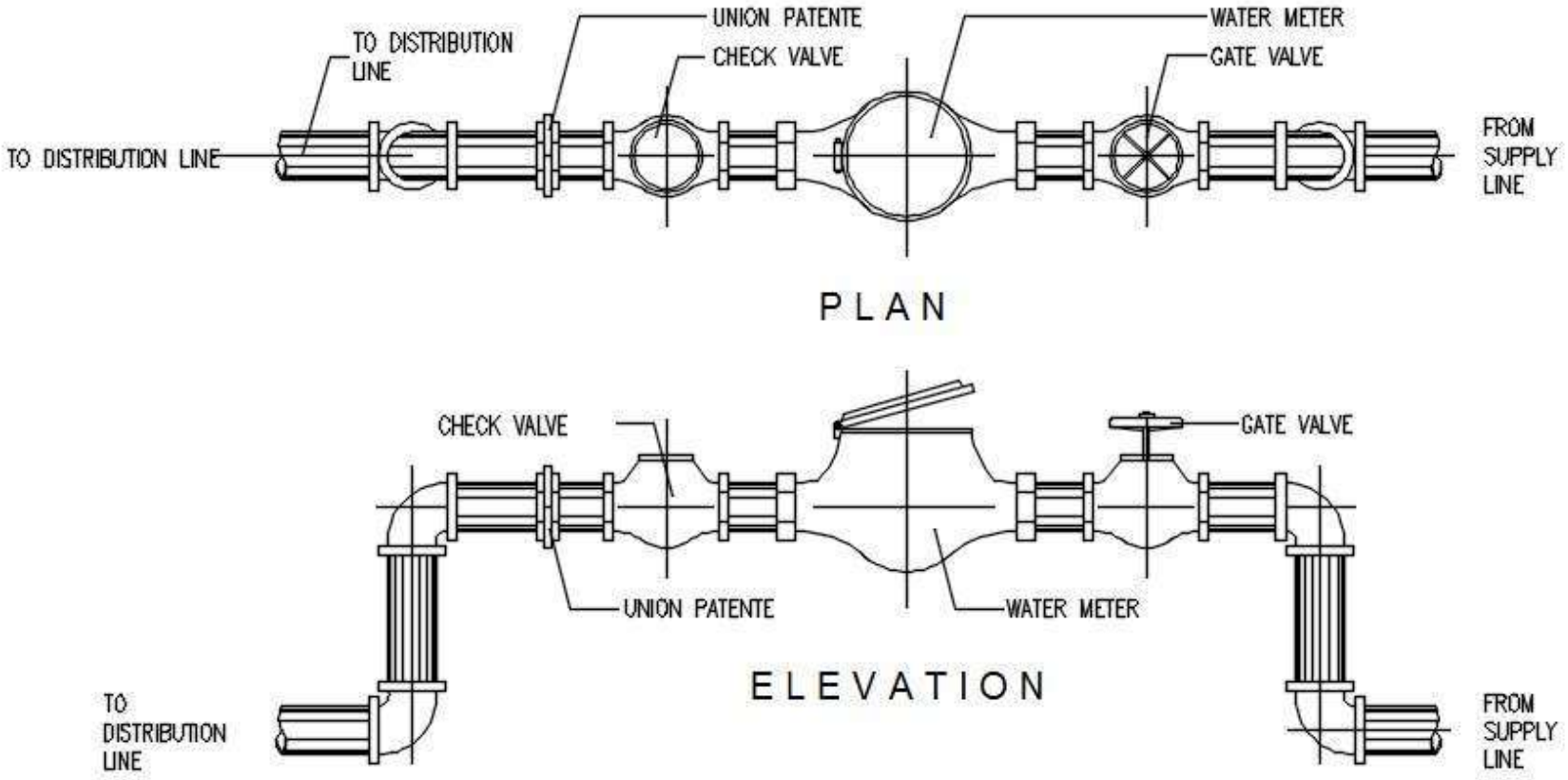


Chapter II: Type of Water Source and Supply Systems

Chapter III: Design and Construction of Water Supply Systems

- In many ways, the design and construction of water supply systems in schools is **not too different** from community water supply systems. The only differences are that there are **fewer choices available**.

- Piped (extension), Bored/drilled shallow/deep wells, RWH, hand-dug wells and springs *are options to meet the water requirements for school WASH facilities.*

Chapter III: Design and Construction of Water Supply Systems

Water Demand

- Each student requires 5L per day for meeting drinking, sanitary and hygiene requirements. It is needed to keep the toilets clean, wash urinals as well as hand washing basins.

Chapter III: Design and Construction of Water Supply Systems

Roof water harvesting system design

✓ Using the rule of thumb of one quarter of the yearly total as the design value for storage facility, this is still a relatively expensive proposition

$$V = CRA$$

✓ Other method is the monthly water balance method.

RWH & GUTTER *GUGUMA HC*

- Limiting factors and sustainability.

Chapter III: Design and Construction of Water Supply Systems

EBCS 9-2013

PLUMBING SERVICES OF BUILDINGS

Table 7-1 Recommended Runoff Coefficient C for Various Selected Land Uses

Description of Area	Runoff Coefficients
Business: Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Residential:	
Single-family areas	0.30-0.50
Multi units, detached	0.40-0.60
Multi units, attached	0.60-0.75
Suburban	0.25-0.40
Residential (0.5 hectare lots or more)	0.30-0.45
Apartment dwelling areas	0.50-0.70
Industrial:	
Light areas	0.50-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.10-0.25
Playgrounds	0.20-0.40
Railroad yard areas	0.20-0.40
Unimproved areas	0.10-0.30
Street:	
Asphalt	0.70-0.95
Concrete	0.80-0.95
Drives and walks	0.75-0.85
Roofs	0.75-0.95

Source: Hydrology, Federal Highway Administration, HEC No. 19, 1984

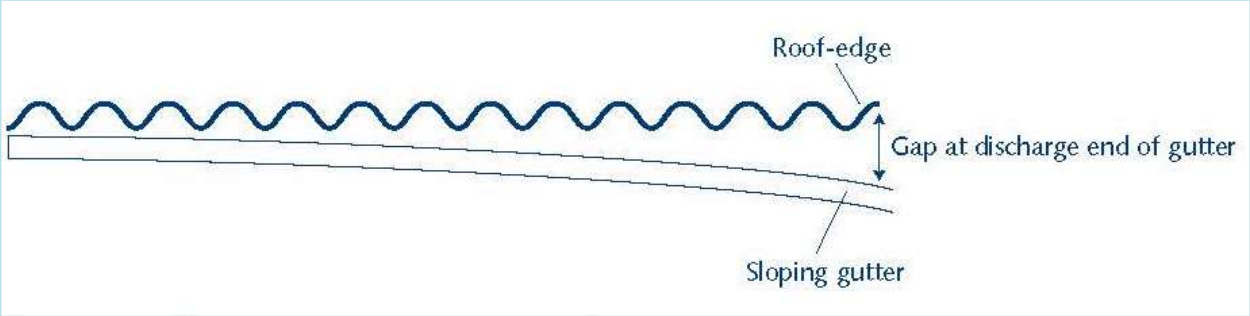
Chapter III: Design and Construction of Water Supply Systems

Roof water harvesting system design

- When possible, use ***multiple smaller takers instead of one large size***. This This is because if one tank or its roof catchment **needs repair**, the other tank on the other side of the building block can still provide some water. Secondly, such a design would allow for a **shorter slope length** for the gutter, reducing overflow and spillage. However, this is still an expensive option.

- Choosing the right slope of the gutter: It is important that slope should ensure the full capture of the roof runoff.

Chapter III: Design and Construction of Water Supply Systems



Chapter III: Design and Construction of Water Supply Systems

- The rainwater collected from roofs in most schools is considered less safe for drinking.
- The two major reasons are:

(i) a roof can be a natural collection surface area for dust, leaves, blooms, twigs, insects, bird feces (source of salmonella bacteria), and airborne residues such as pesticides and insecticides (especially in areas with commercial farms); and

(ii) the water quality status of rainwater can deteriorate after it is stored for several days, before the storage tank receives freshwater from rain again.

- First flush diverter and screen

Chapter III: Design and Construction of Water Supply Systems

- Screen
- Roof cleaning

Chapter III: Design and Construction of Water Supply Systems

- Collection pipe
- First flush diverter and screen

Chapter III: Design and Construction of Water Supply Systems

- Overflow
- Inlet

Chapter III: Design and Construction of Water Supply Systems

Spring water supply system design

The spring capping and protection work has four major infrastructural works:

i. Spring box

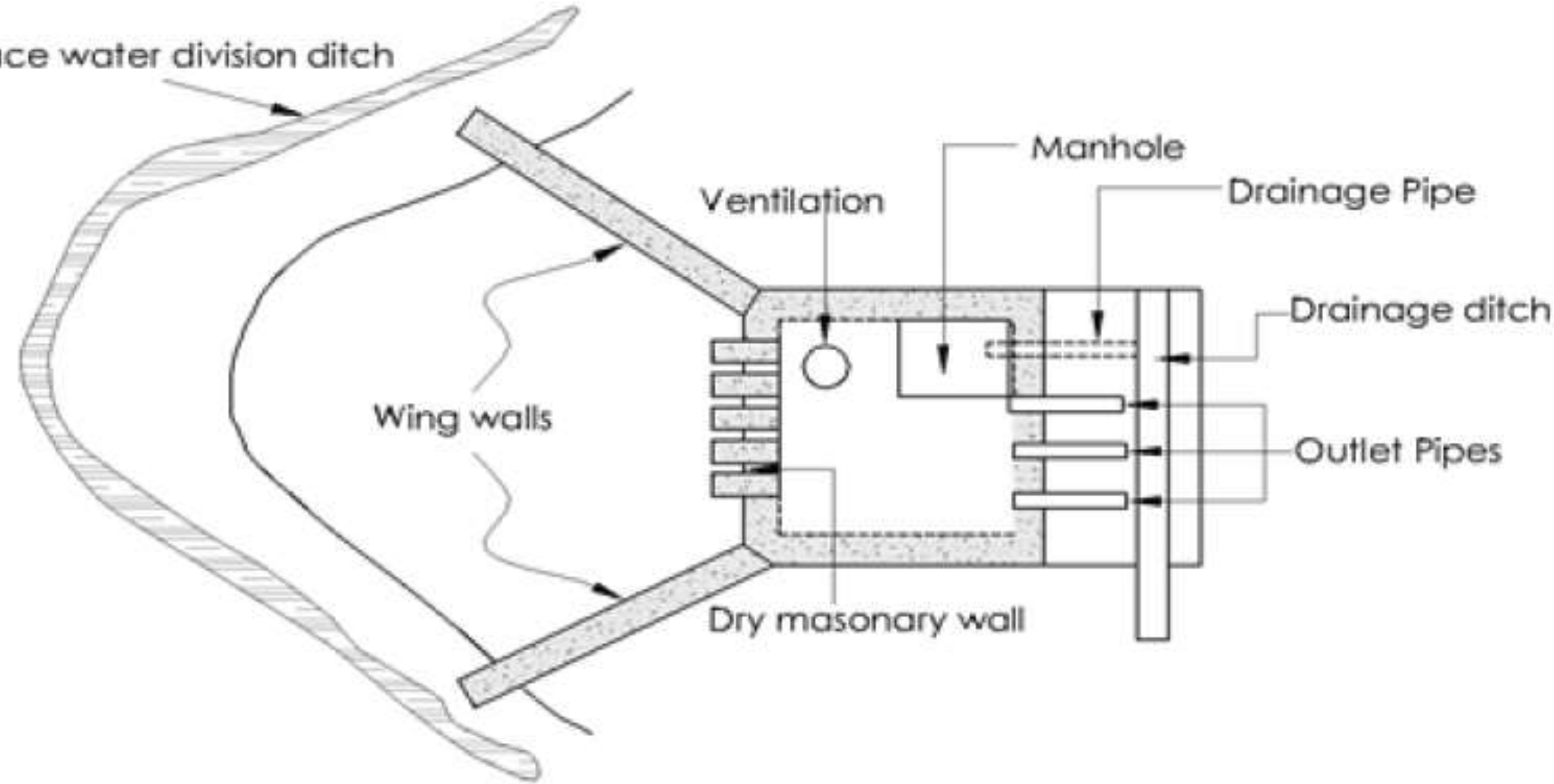
ii. Collection chamber/reservoir

iii. Tap stands

iv. Catchment conservation, protection and development

Chapter III: Design and Construction of Water Supply Systems

Spring water supply system design



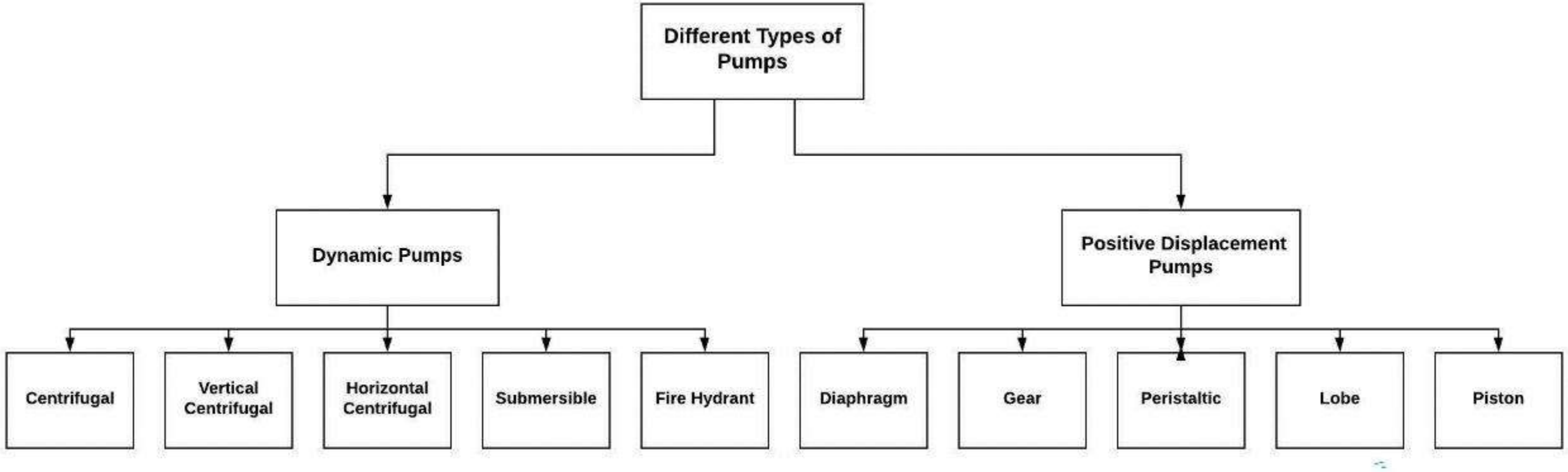
Chapter III: Design and Construction of Water Supply Systems

Water wells

(A) Preferred site for water well	(B) Bad site for water well
■ Nearby springs ■ In low lying area or valley bottom, depression or dry river bed, ■ The presence of evergreen bushes and shrubs ■ Weathered rock zones	■ On a hill ■ Near latrine or sewer line ■ Flood prone area ■ Swampy ground

Chapter III: Design and Construction of Water Supply Systems

Types of Pumps



Chapter III: Design and Construction of Water Supply Systems

Piped (extension) water supply system

The common requirements for a pipe line selection are:
i. it must convey the quantity of water required
ii. it must resist all external and internal forces (load) coming upon it
iii. it must be durable

The carrying capacity of pipelines depends on the total head losses determined during the engineering survey. The size of pipe should be in accordance with Hazen-Williams Formula.

$$h_f = 10.7 * (\frac{Q}{C})^{1.852} * (\frac{l_p}{d^{4.87}})$$

$$V = kCR^{0.63}S^{0.54}$$

Chapter III: Design and Construction of Water Supply Systems

Piped (extension) water supply system

Chapter III: Design and Construction of Water Supply Systems

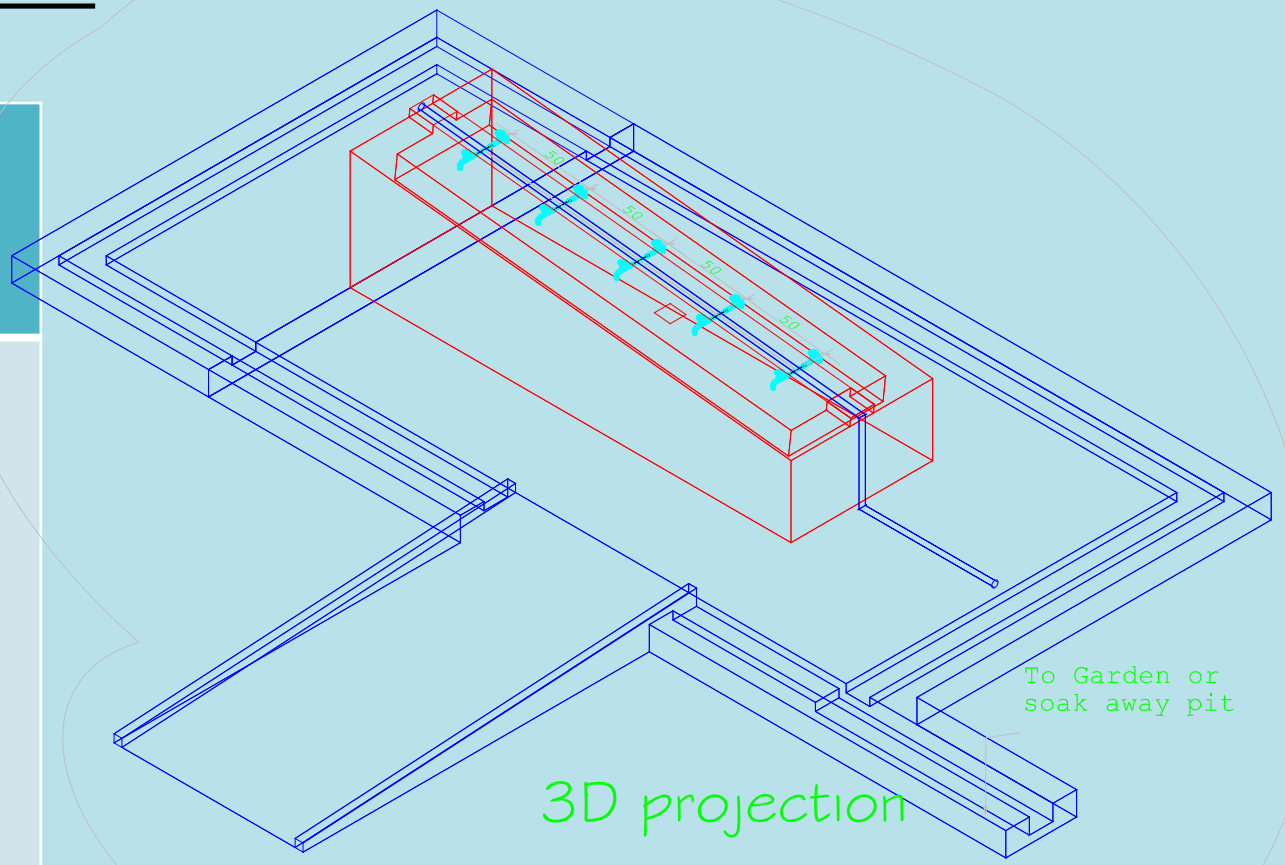
Storage reservoir

A minimum of 5000L water storage facility is required for each of the primary and secondary schools. The storage tank will be placed at 4-6m height above the ground and it is supported either by a steel or concrete tower.

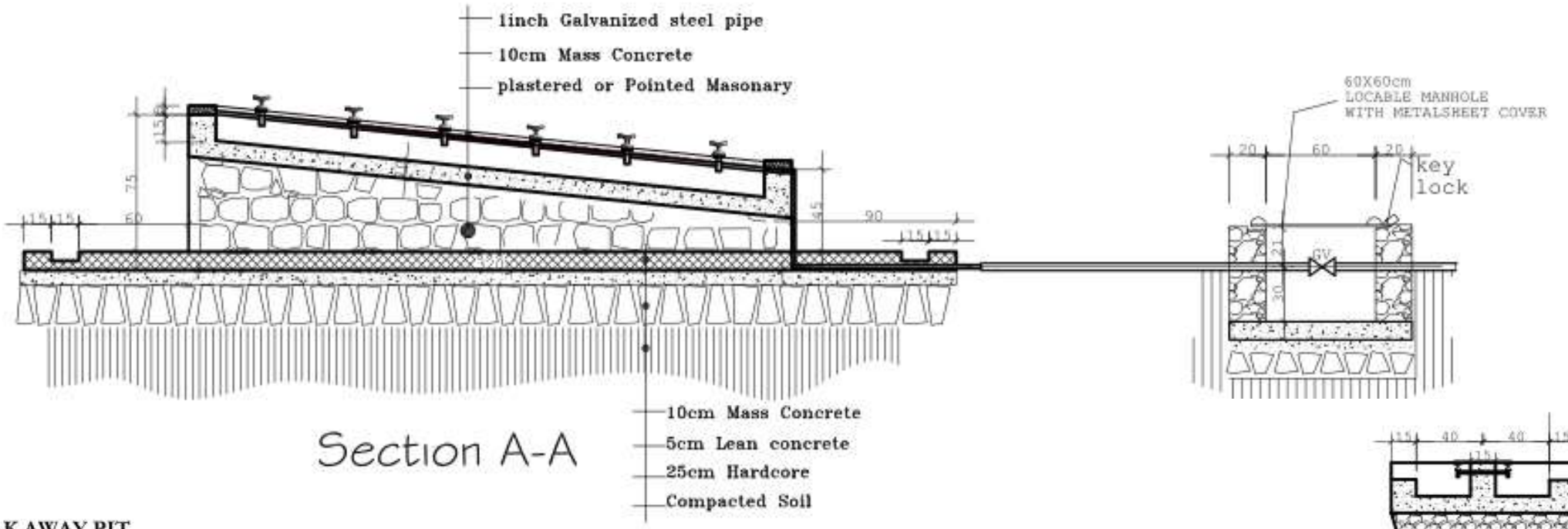
Chapter III: Design and Construction of Water Supply Systems

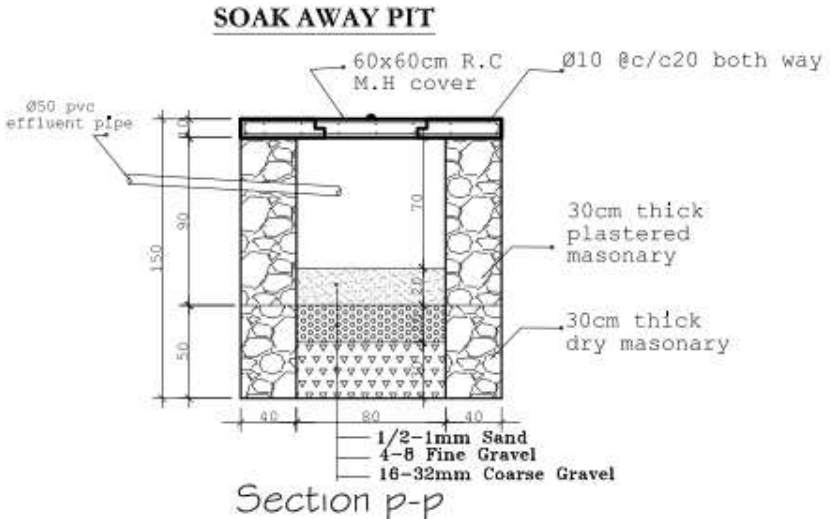
No. of Taps used for drinking fountains

Item	Recommendation
Drinking water tap	▪ One tap/100 student in rural schools ▪ One tap/50 students in urban schools



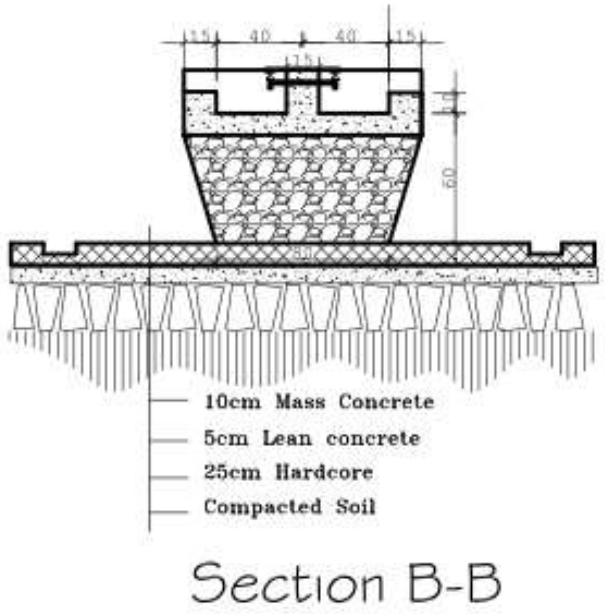
Chapter III: Design and Construction of Water Supply Systems





Sample Taps used for drinking fountains

12 taps



There should be a small edge of 5 cm on each side of the ramp to prevent a wheelchair falling off and act as guide for people with visual impairments

Chapter III: Design and Construction of Water Supply Systems

The ramp should be placed in front of the (lower) tap, meant for the child with disabilities.

Chapter III: Design and Construction of Water Supply Systems

Water Quality test

- **Physical, chemical (*fluoride, arsenic and sodium levels*) and biological (*coliform*) water quality tests need to be undertaken before any construction** at the water source to ensure the water source is safe in line with Ethiopian and WHO standards.

Chapter III: Design and Construction of Water Supply Systems

Water Quality test

- Regular water quality surveillance is needed **every three months** by taking water samples for testing along the **distribution line, storage facilities and from tap water.**

- **More frequent water** quality testing may be needed in woredas where water quality is a concern.

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

1. Rooftop water harvesting

- Installation faults of the gutters, getting the slope wrong and leakage at bends in the gutters can cause major loss of harvested water and damage school buildings.
- The use of unnecessarily large and expensive gutters and down pipes
- The taps from the water storage are the wrong height and are located in a ditch with no outlet for drainage of excess water
- Water quality is always a major problem

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

2. Spring protection

- Inadequate consultation with the downstream communities
- Error while constructing the wing walls at upstream side in an attempt to collect and divert the flow into a suitable outlet. *Such work could create backflow which could potentially change the flow direction.*
- Spring catchment is not protected and managed, it could be degraded and the yield could decline or even disappear.

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

2. Spring protection

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

3. Hand-dug and drilled wells

- **Poorly constructed wellhead**: surface runoff, flood and drainage water from areas used by livestock or other contaminant sources could enter the well head if it is poorly constructed
- **Insufficient depth at water intake areas** could result in drying up of the well
- **Failure to keep the well shaft straight** could result in the breakage of the casing and eventual damage to the well,

- Gravel packs(size) selection and placement (order)

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

4. Drinking fountains

- **Improper height** of the taps for the different age groups could cause damage to the taps and prevent access
- **Poor management** could cause filthy, poor drainage, and unattractive drinking fountains

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

Chapter III: Design and Construction of Water Supply Systems

Common problems observed in water supply system construction

5. Water carting

- Low quality water due to possible contamination and pollution
- Becomes expensive as fuel prices and labor cost increase dramatically

CHAPTER IV: School Sanitation Facilities

Well designed and constructed school sanitation facilities help make schools **disease free and user friendly**. It create a favorable learning space for children and improve the quality of education.

This has short-term public health benefits, and long term economic and social benefits to the nation.

CHAPTER IV: School Sanitation Facilities

Two types of latrines provided depending on the **availability of water**.

- Dry pit latrine (compost type)
- Flush type latrine

Common problems with school latrines

- The pit is too small so it fills up too quickly and needs emptying after few years/more frequency.
- The pit cannot be easily emptied, and the only option becomes to seal it off and build a new toilet elsewhere.
- The pit is not lined, the soil cannot take the weight of the superstructure, and the toilet superstructure collapses into the pit.

CHAPTER IV: School Sanitation Facilities

Common problems with school latrines contd.

- The pit walls are fully sealed with no provision for leaching liquid water into the surrounding soil. This results in the pit flooding.
- More wastewater is diverted into the pit than can be absorbed by the soil, so the pit floods.
- The vent pipe is missing, or its diameter is too small.
- No provision is made for air flow through the cubicle, making the toilet smelly.
- The fly screen is missing so the toilet becomes a source of flies, potentially spreading disease.

CHAPTER IV: School Sanitation Facilities

Urinals

- Offer additional capacity to the existing services of the toilets, reduce queuing time and the pressure on toilets.

Handwashing facilities

- Handwashing facilities near toilets
- Water tanker

Menstrual Hygiene Management (MHM)

- Study shows, girls are commonly absent from 1-4 days every month due to menstruation
- One per school

CHAPTER V: Design and Construction of Dry pit Latrines

- The number of latrine blocks and cubicles for boys and girls are planned in each school based **on number of students**. As per National SWASH guideline, Male and female latrines are **physically separate facilities**.

Accordingly,

- For girls, one cubicle serves 50 girls in rural areas and 25 girls in urban areas
- For boys, one cubicle serves 75 boys in rural areas and 50 boys in urban areas
- Both boys and girls have separate urinal facility
- Three seat latrines for teachers

CHAPTER V: Design and Construction of Dry pit Latrines

Schools	Student/ Staff	Population	Pupil to cubicle Ratio	Required number of cubicles	Existing Usable Latrines	Adjusted Number of Cubicles	Adopted Latrine	
							Number of Cubicle	Number of Block
Bule secondary & preparatory (9-12)	Boys	660.00	1:50	13.2	1 (4)	14	8.0	2.0
	Girls	498.00	1:25	19.9	1 (4)	16	8.0	2.0
	Teachers	78.00	-	3.0		3	3.0	1.0
1gna Okolu primary school	Boys	276.00	1:75	3.68	-	4	4	1
	Girls	212.00	1:50	4.24	-	6	6	1
	Teachers	23.00	-	3.0		3	3.0	1.0

CHAPTER V: Design and Construction of Dry pit Latrines

Location consideration for Latrines

- **The normal wind direction** - *down-wind of the classrooms*
- **The distance between toilet block & classroom** - *if possible, should be at least 30m away not more than 50m for small children*
- **The distance between Girls and Boys toilet blocks** - *Should be decided through consultation. For some schools 20m or more may be needed to secure the privacy and security needed by girls.*
- Distance between the latrine and the boundary wall. *Here it is best to get girls opinion.*
- **More space** where the sludge or compost is to be picked up by a tractor-trailer - enough space for vehicle access and movement.
- The latrine should be a minimum of **30m downstream** side distance from a well or borehole to avoid any risk of contamination.
- **Future plan's**

CHAPTER V: Design and Construction of Dry pit Latrines

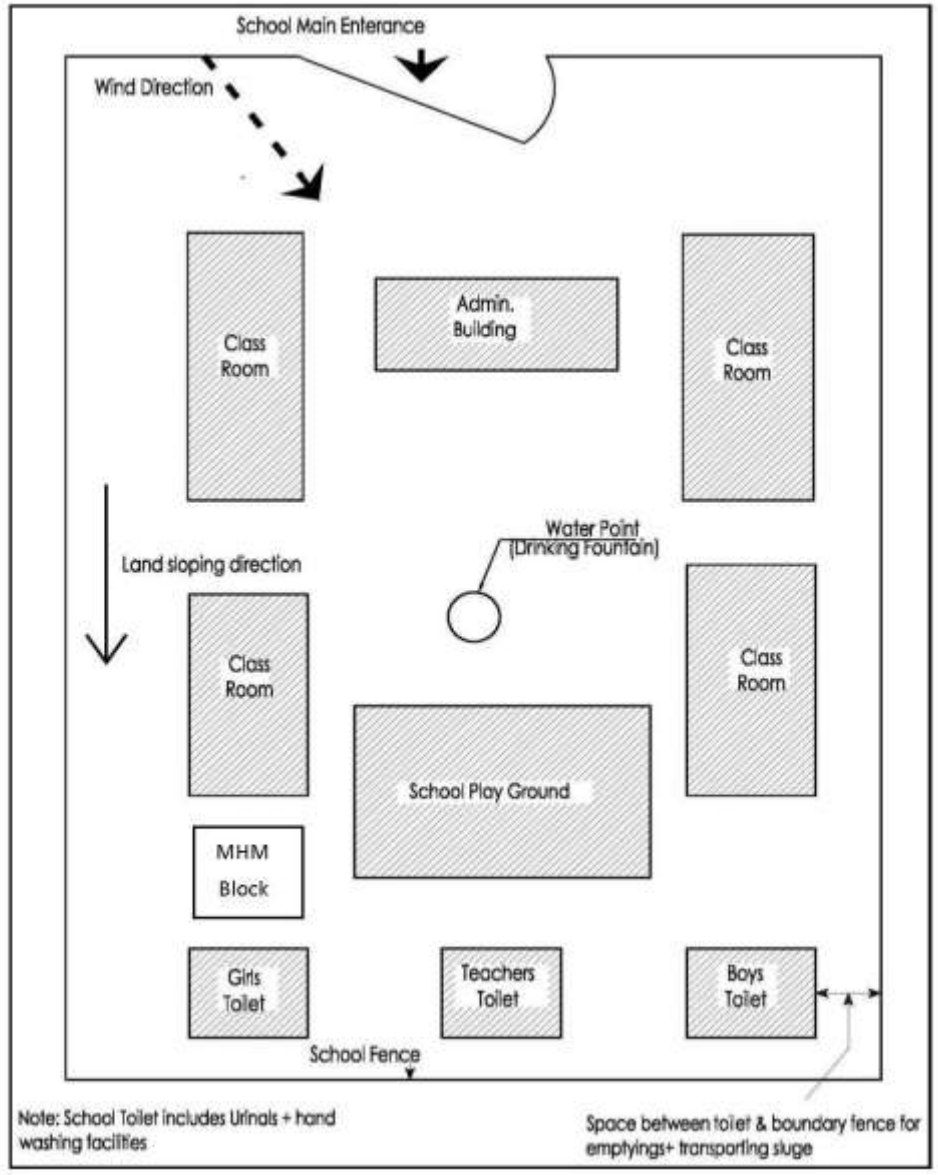
Location consideration for Latrines contd.

- **Soil conditions** - *avoid rocky outcrops, unstable ground conditions and depressions with a shallow water table.*
- **Drainage** - *ensure that rainwater cannot flood the pit.*
- **Pathway accessibility** of latrines to users including disabilities.
- Where **natural light** can be a part of the lighting scheme
- **Social and cultural considerations** have paramount significance
- 5-10m from the fence **for suction trucks to access** the latrine blocks and remove (de-sludge) the content.

CHAPTER V: Design and Construction of Dry pit Latrines

Orientation of the sanitation facilities

Social and cultural considerations have paramount significance, and it is important to consult with boys, girls and teachers.



CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER V: Design and Construction of Dry pit Latrines

Location consideration for water Taps

- There are no strict rules and regulations on deciding where to locate drinking water fountains.

- Generally, it is recommended that the site be *near the feeding centers, latrine blocks and playgrounds* (*At least 3m from Larine or feeding center*)

CHAPTER V: Design and Construction of Dry pit Latrines

Compost dry pit latrines

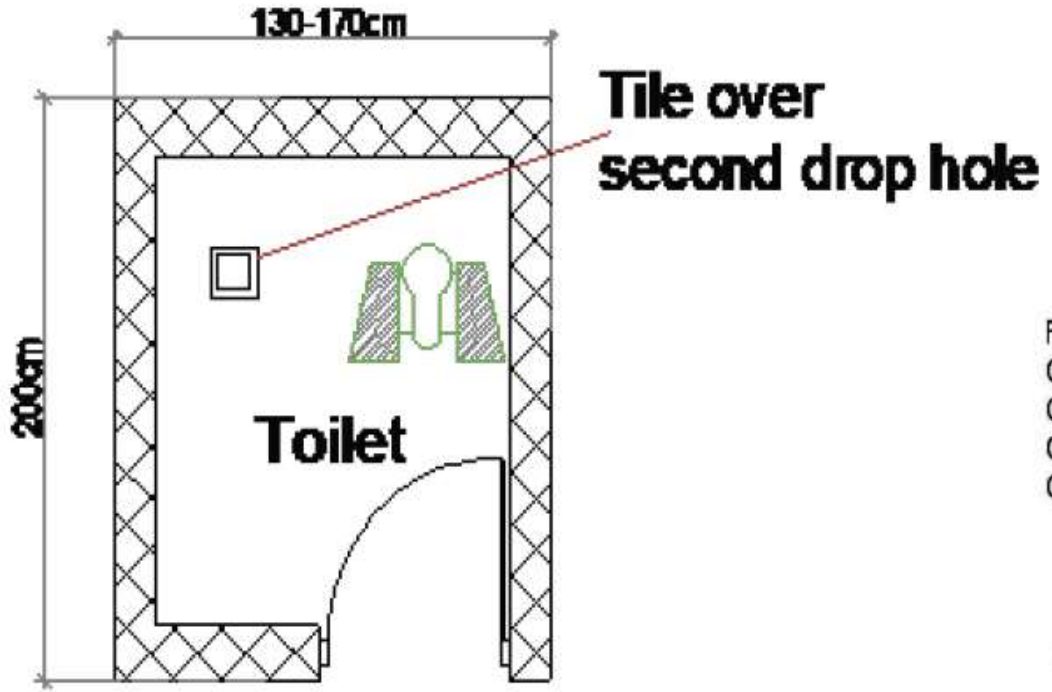
Compost dry pit latrines are provided in this manual.

- Alternating twin drop hole toilet cubicle with ***partitioned pit***

- Alternating twin pit toilet cubicle with ***no partitioned pit***

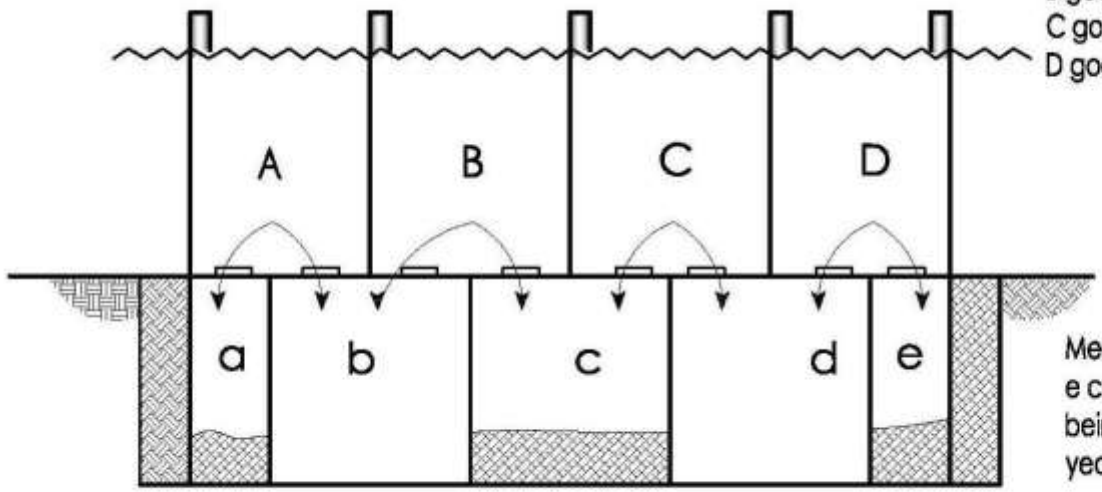
"In areas where land for latrine construction is not a constraint and it is technically and financially feasible, it also presented as an option for others."

CHAPTER V: Design and Construction of Dry pit Latrines



For First year
Cubicle A uses pit a
Cubicle B uses pit c
Cubicle C uses pit c
Cubicle D uses pit e, etc

For second year original squat holes sealed
Second hole opened
A goes to pit b
B goes to pit b
C goes to pit d
D goes to pit d, etc



Mean while material in pits a,c + e composts for 1year before being empty. At begining of year 3 cycle repeats.

CHAPTER V: Design and Construction of Dry pit Latrines

The masonry wall will have a top width of 40-50cm, and the bottom width ranges between 40-120cm depending on the soil.

CHAPTER V: Design and Construction of Dry pit Latrines

Partitioning the pit wall

- Once the pit wall is lined with masonry, for compost type latrines the next step is to partition the pit with three coat plastered solid concrete blocks (SCB), reinforced concrete beams and columns as shown in the drawings. "***RC shear wall can be designed as an option taking all the possible load combinations with a minimum of 10cm thickness***."

- The partition wall needs to properly anchorage to floor slabs

CHAPTER V: Design and Construction of Dry pit Latrines

Partitioning the pit wall

General Note:

If there is a justified need to construct dry pit latrine without composting the fecal waste, there is an option which can be adopt a typical design of piped latrine sub structure part or avoid the partition wall on compost dry pit latrine design.

CHAPTER V: Design and Construction of Dry pit Latrines

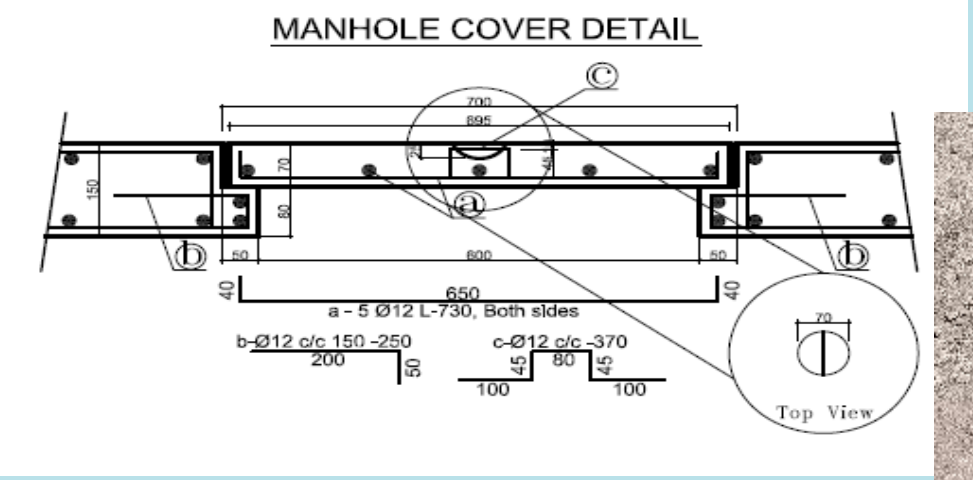
Dry pit

Piped

CHAPTER V: Design and Construction of Dry pit Latrines

Cover slab for access-hole to each pit

The slab that covers each inspection access hole will have a dimension of 70cm-by-70cm concrete cover slab with 60cm-by-60cm access hole as specified in the drawings.



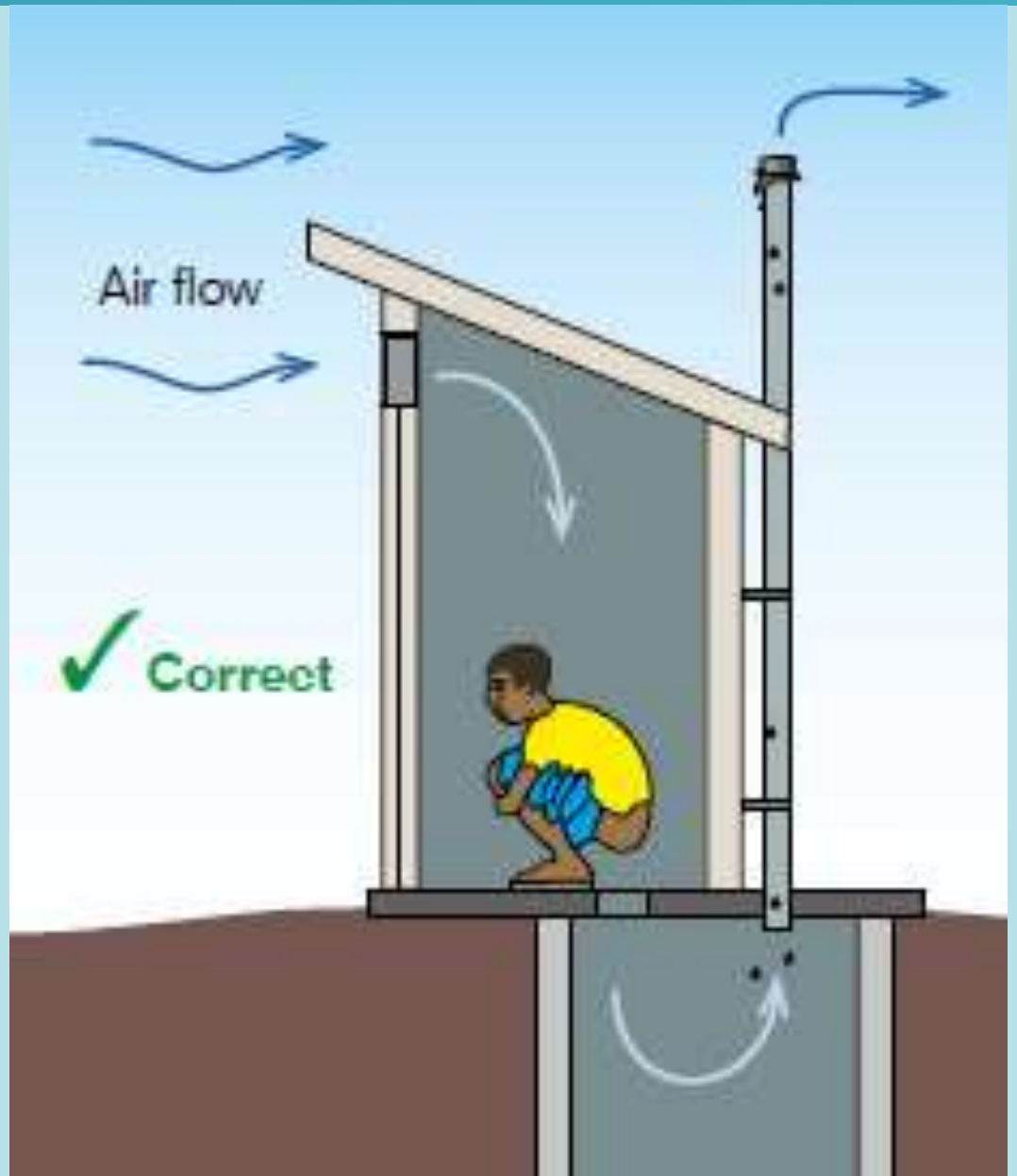
CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER V: Design and Construction of Dry pit Latrines

Vent pipe

- Must be provided with vent cap and Fly screen/mesh wire to trapping flies
- Ø110mm PVC pipe, **black/paint**
- Extends by 50cm from the top of the highest roof level
- Enough bracket support (≥2)

CHAPTER V: Design and Construction of Dry pit Latrines



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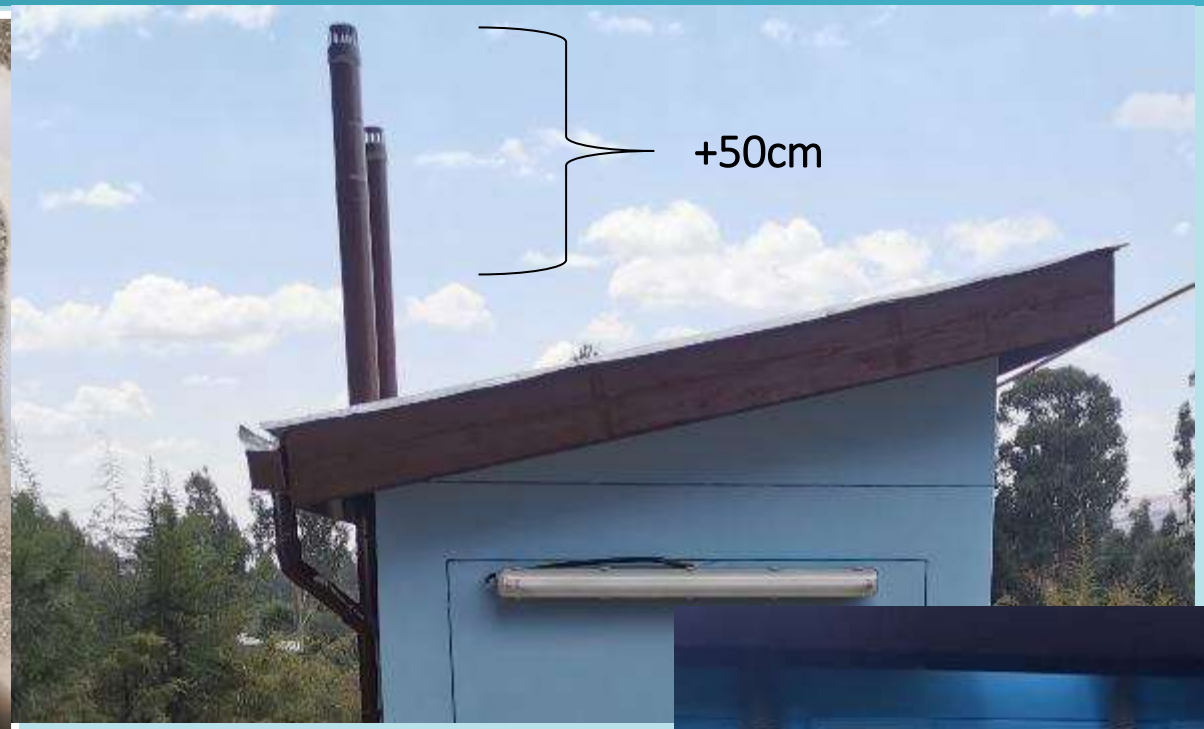


Fly screen/
mesh wire

CHAPTER V: Design and Construction of Dry pit Latrines

Latrine cubicles & Doors

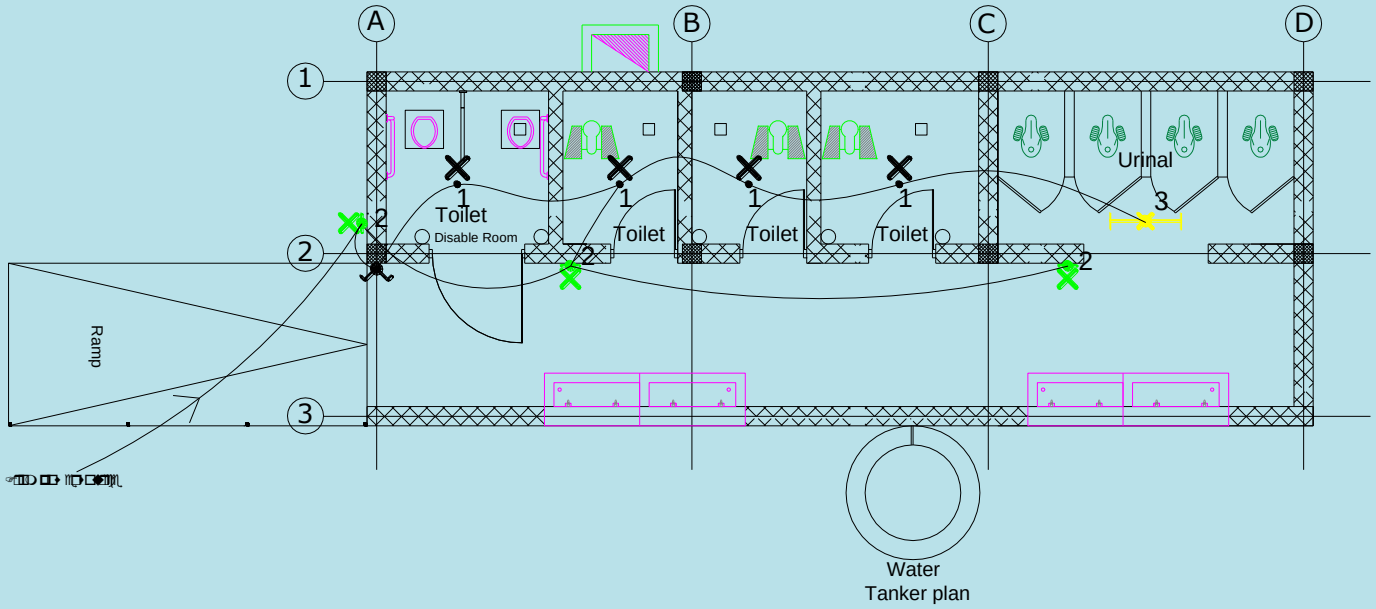
- Each cubicle has a minimum floor area of 1.2m (width) by 1.6m (length).
- The cubicle for students with a disability is 1.7m by 1.6m.
- Door Lock on both sides
- The disability friendly toilet door should measure 100cm and have an emergency door attached to the main door.
- Plastic cover on top of metallic doors at lower 40cm in the internal part

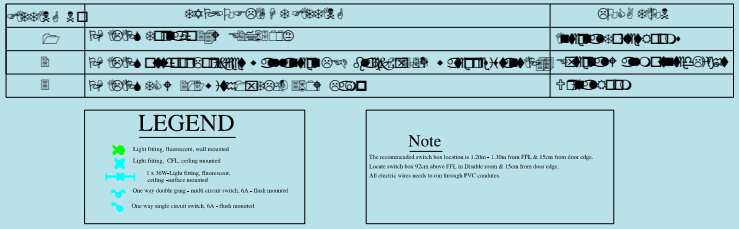
CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER V: Design and Construction of Dry pit Latrines

Electrical design

- Option for electrical light and switch layout is given for all blocks.



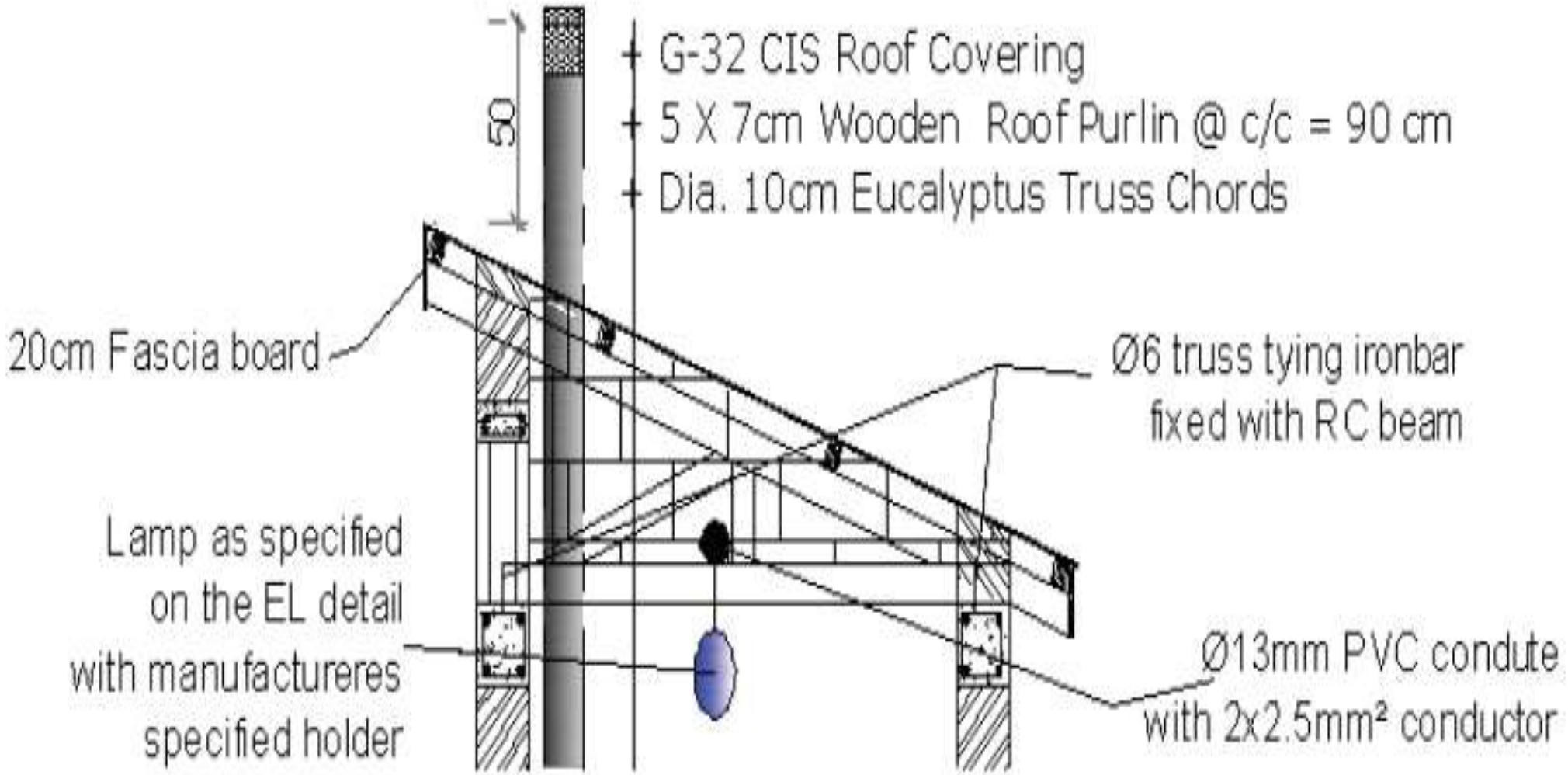


CHAPTER V: Design and Construction of Dry pit Latrines

Roof

- Truss tied with 6mm tie bar to TTB.
- A 30cm high and 70cm wide gap covered with wire mesh at the top of doors for ventilation
- The roof is sloping down from front to back with an overhang from the wall of 30cm on all sides.
- It is covered with a minimum of Gauge (G32) galvanized corrugated iron sheet (CIS). **When possible, G28 roof cover is a preferred option.**

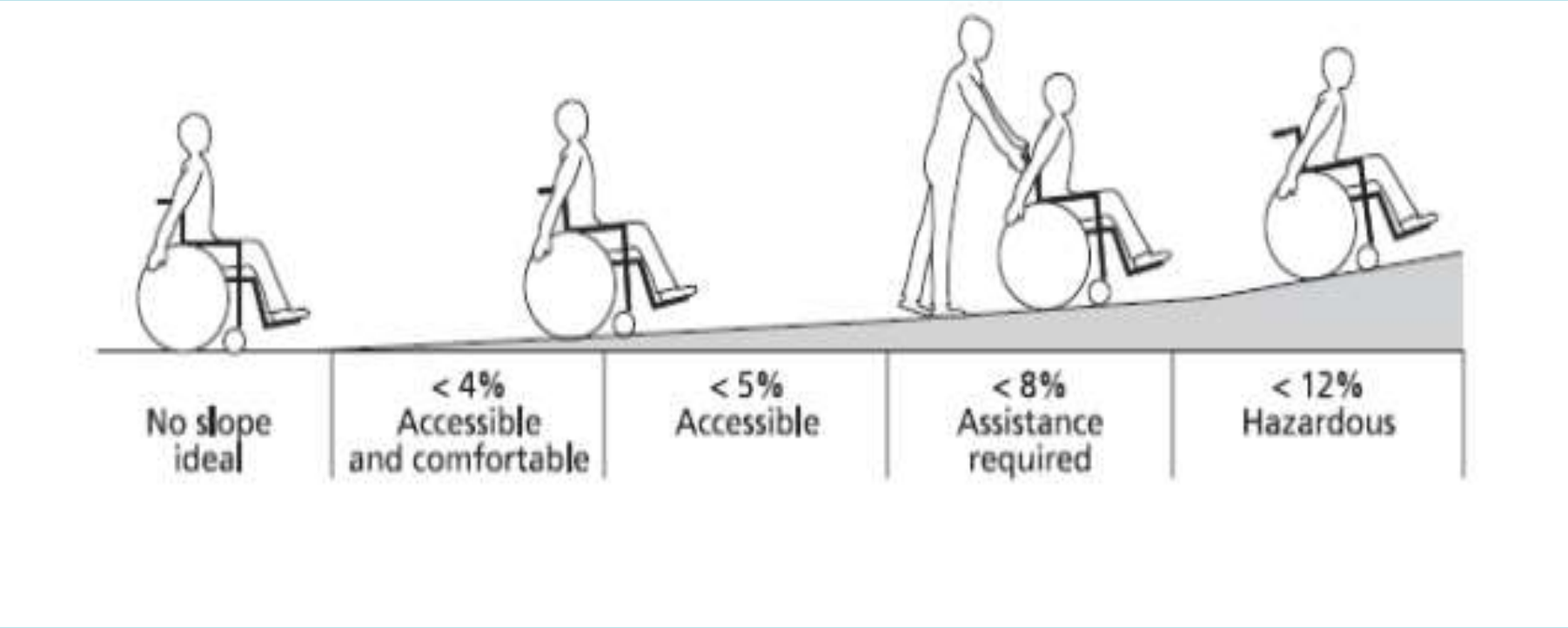
CHAPTER V: Design and Construction of Dry pit Latrines



CHAPTER V: Design and Construction of Dry pit Latrines

Ramp, Handrails and raised seat

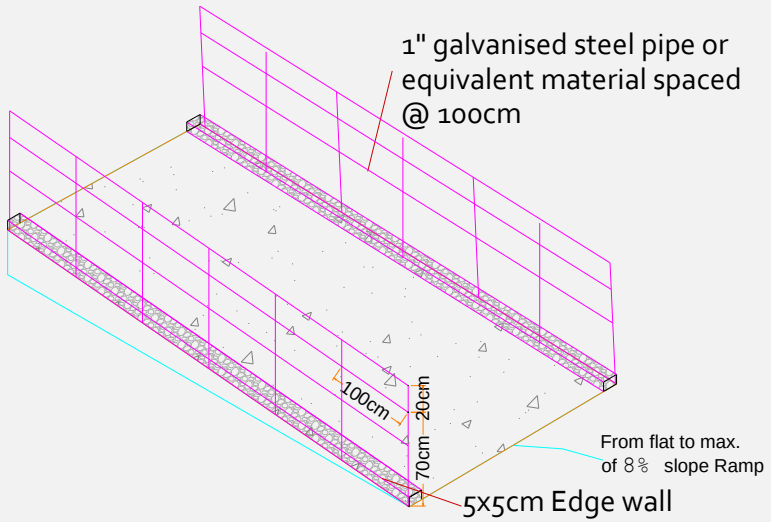
- The preferred slope for ramp is 5% (1cm height :20cm length) and the maximum acceptable slope is 8% (1cm height: 12cm length)



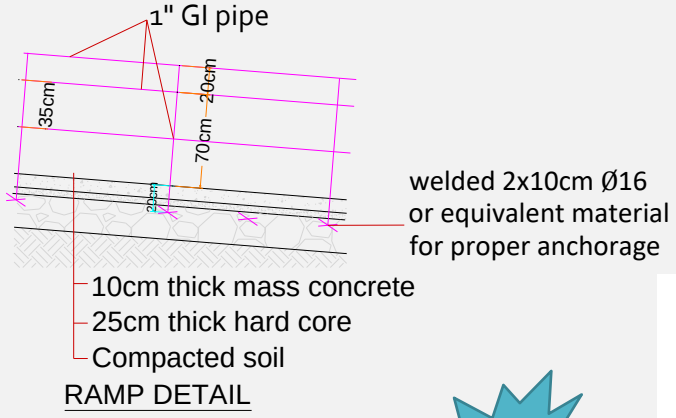
CHAPTER V: Design and Construction of Dry pit Latrines

Ramp, Handrails and raised seat contd.

- Handrail is made of 1” galvanized pipe.
- Handrails are properly anchored to the ground slab and to the walls.
- If the ramp is longer than 6m or changes directions, it needs resting areas of at least 150cm.

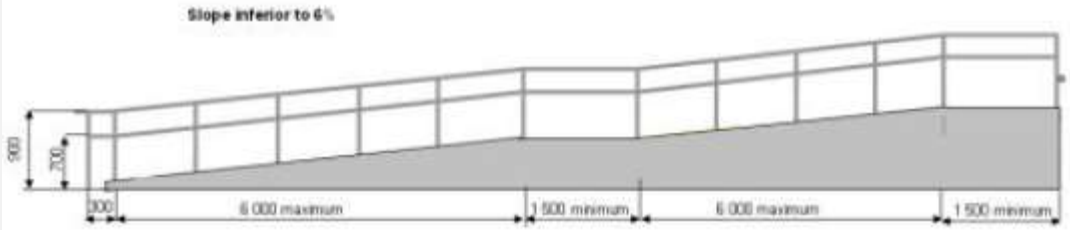


RAMP DETAIL FOR PEOPLE LIVING WITH DISABILITIES



RAMP DETAIL

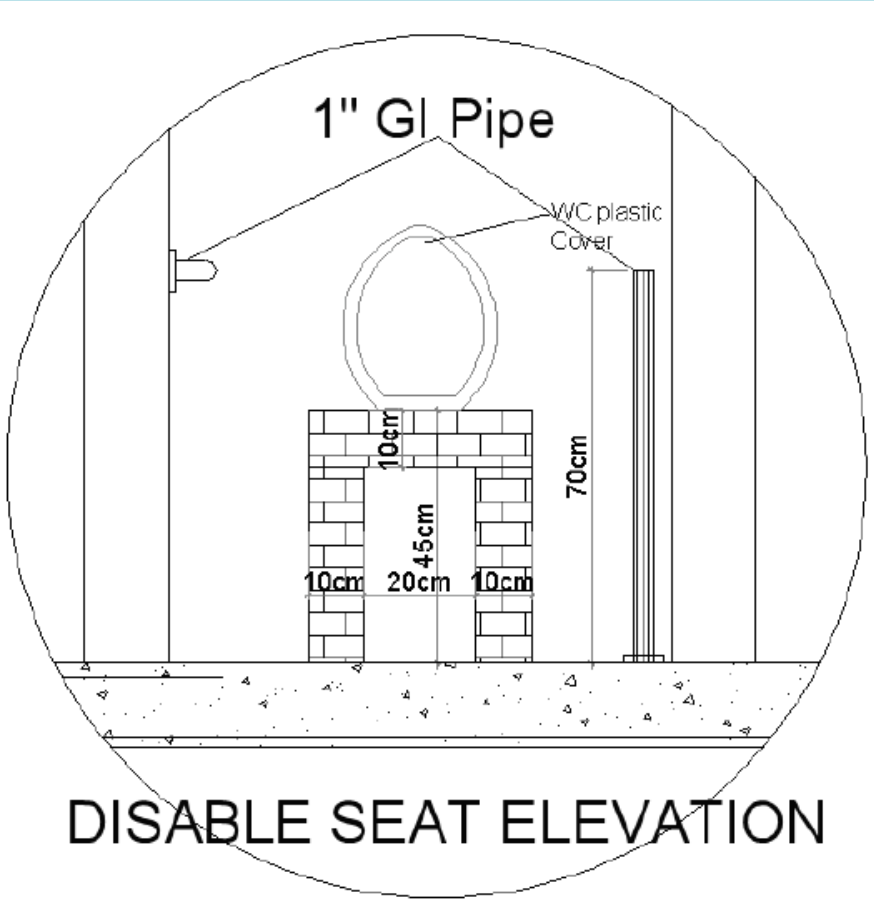
At least 10% of WASH facilities should be accessible for people with disabilities.



CHAPTER V: Design and Construction of Dry pit Latrines

Ramp, Handrails and raised seat contd.

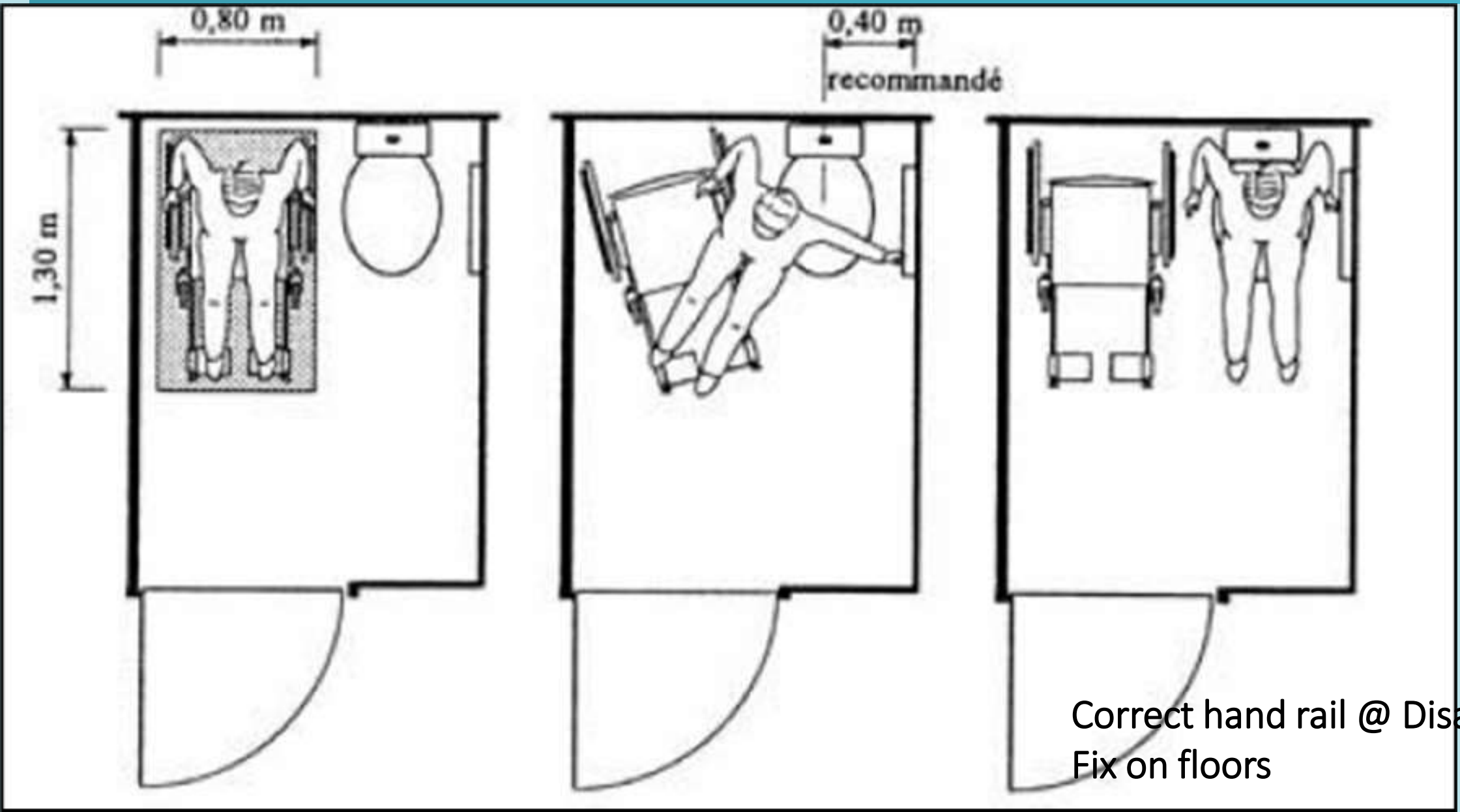
- A disability toilet seat is made of plastered HCB box with WC plastic cover, or ready-made ceramic WC.



DISABLE SEAT ELEVATION

Correct hand rail @ Disable room
Fix on floors

CHAPTER V: Design and Construction of Dry pit Latrines



Correct hand rail @ Disable room
Fix on floors

CHAPTER V: Design and Construction of Dry pit Latrines

Ramp, Handrails and raised seat contd.

CHAPTER V: Design and Construction of Dry pit Latrines

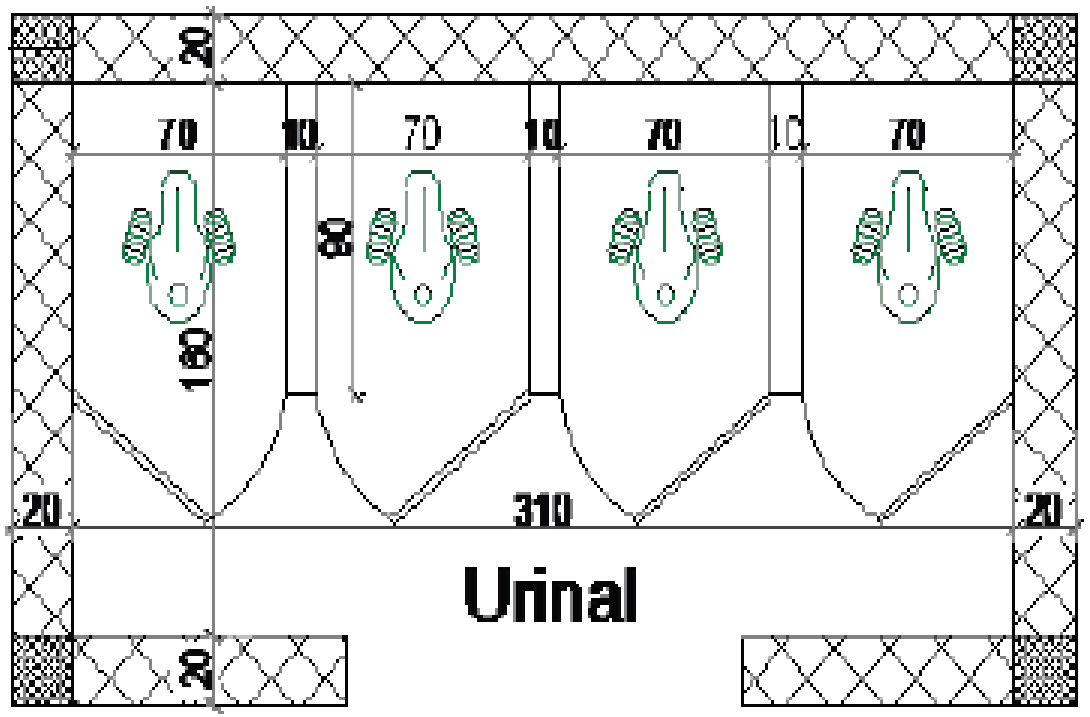
Latrine for Afar and Somali regions

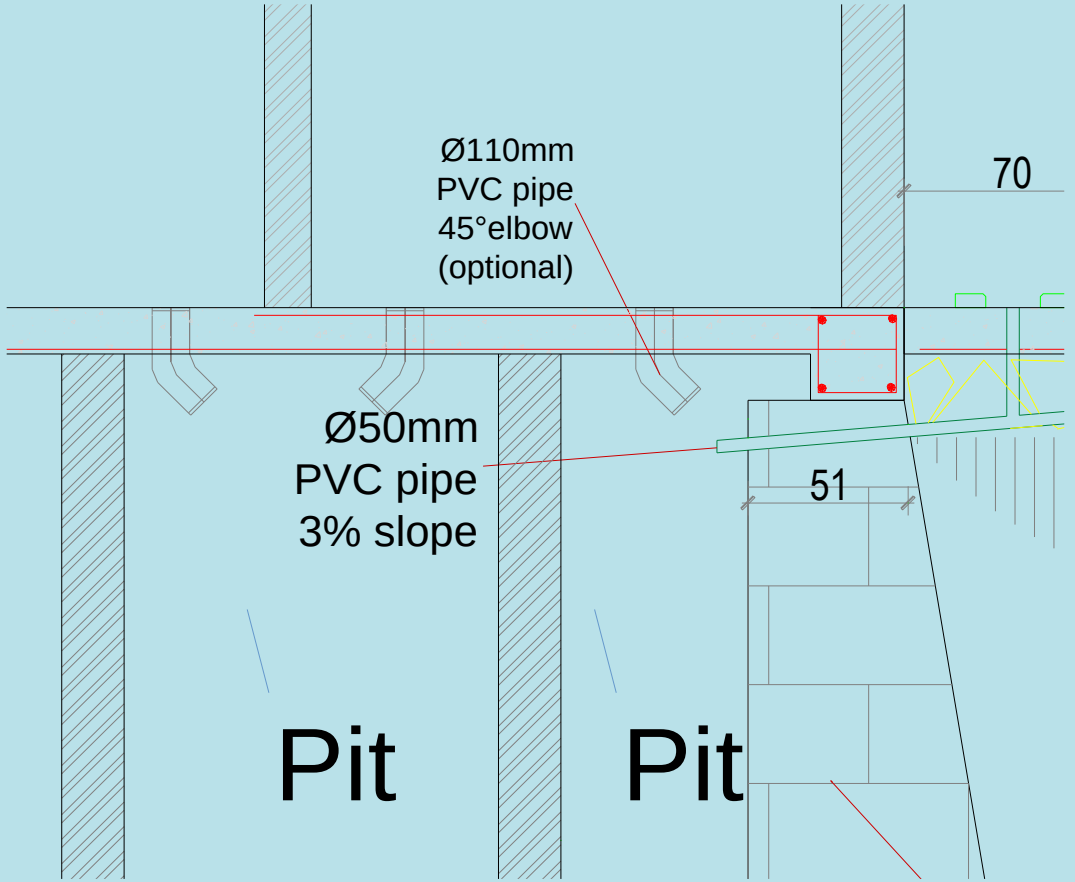
- In certain communities, such as in Afar and Somali Regions, covering and fully controlling human feces is a cultural norm. It is culturally taboo to see feces.

- **The PVC elbow is installed as** shown in the annexed drawings of Afar and Somali (as an option) to avoid seeing the feces down through the hole directly.

- The **urinals are separated** with doors and/or partitions for both girls and boys to provide privacy.

CHAPTER V: Design and Construction of Dry pit Latrines





CHAPTER V: Design and Construction of Dry pit Latrines

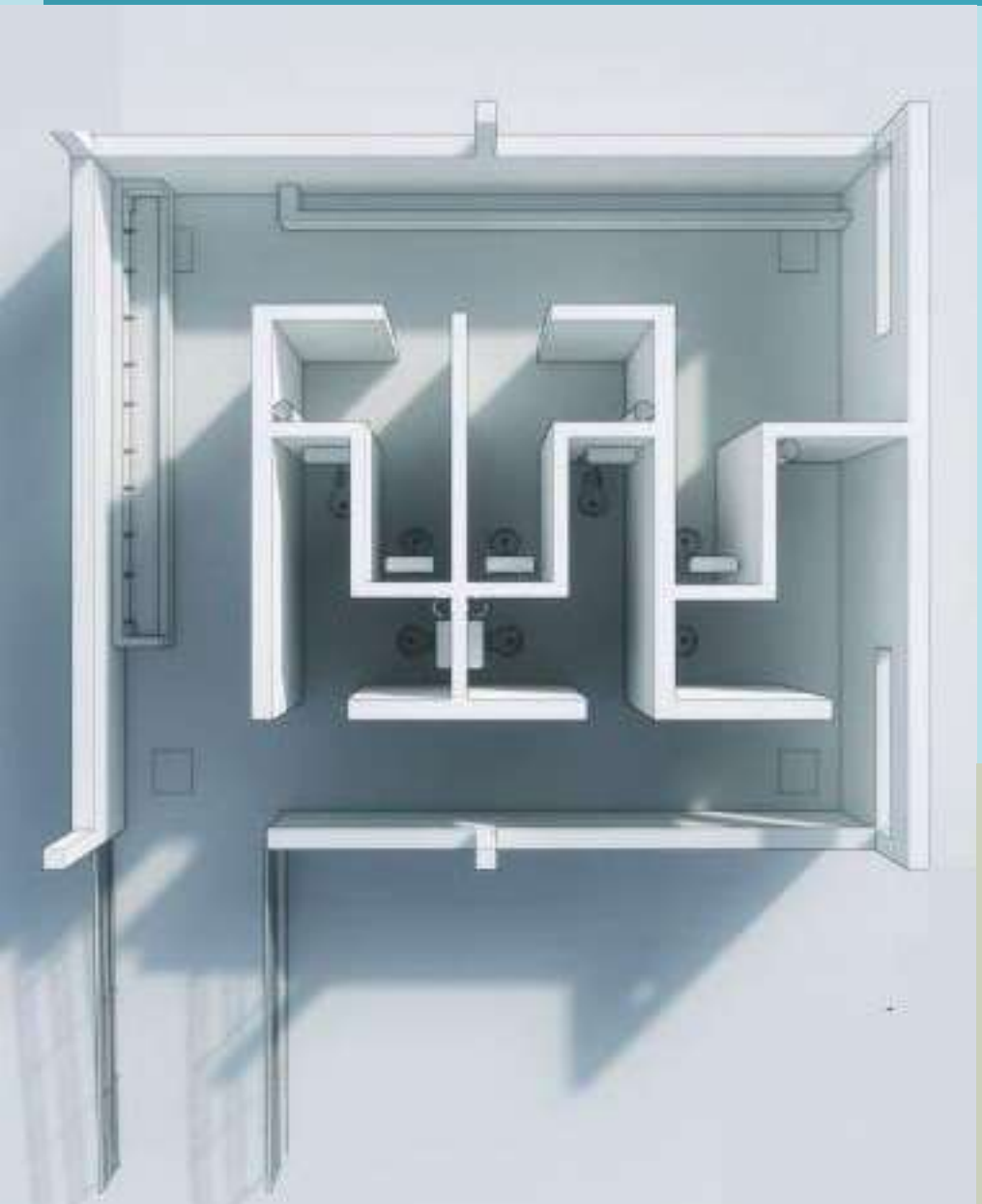
Latrine for Pre-Primary schools

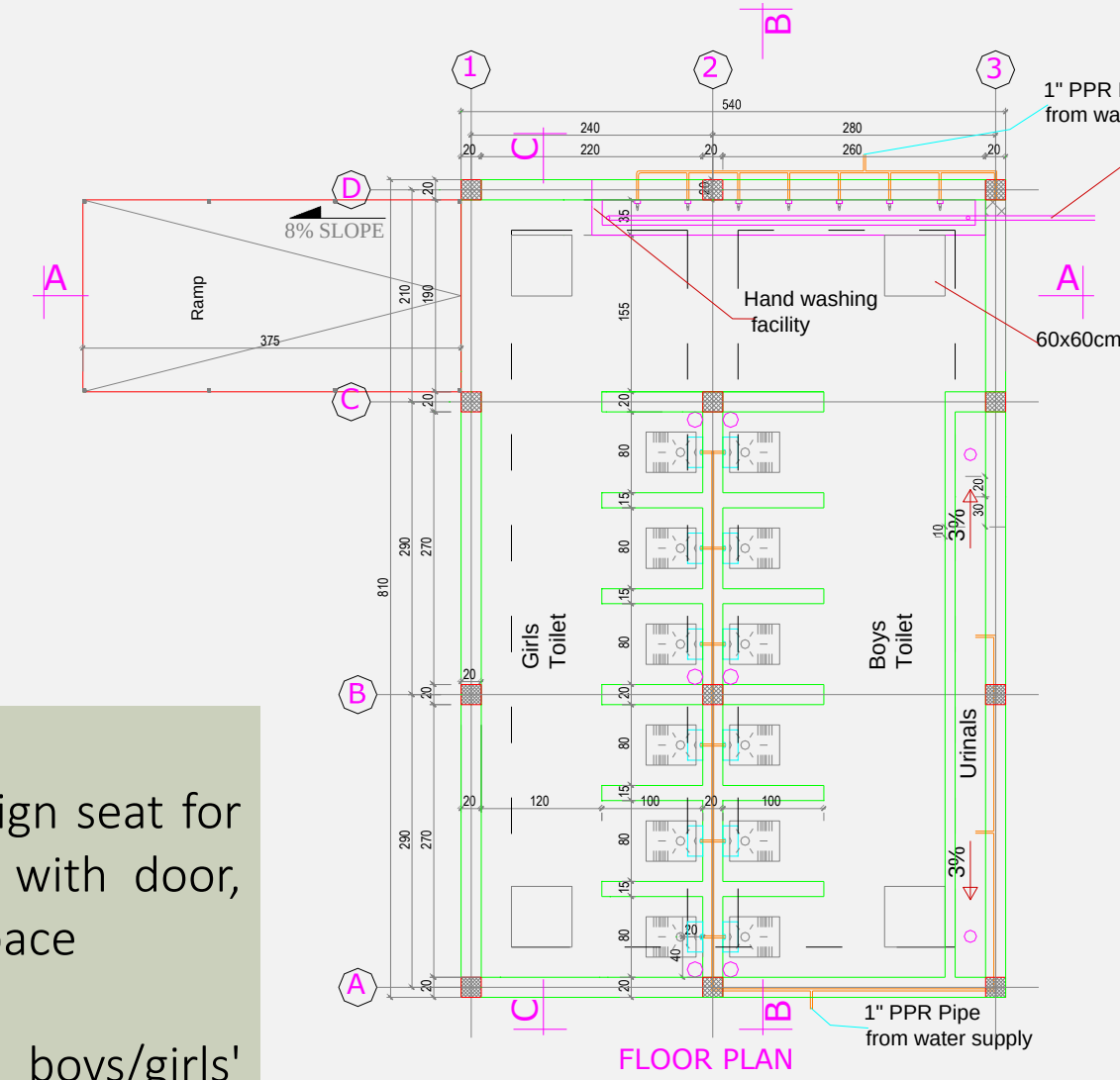
- Common block for Boys and Girls
- Urinals for Boys
- Common Hand wash facility with mirror
- Alternate squatting pit
- Ceramic squatting pan

CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER V: Design and Construction of Dry pit Latrines



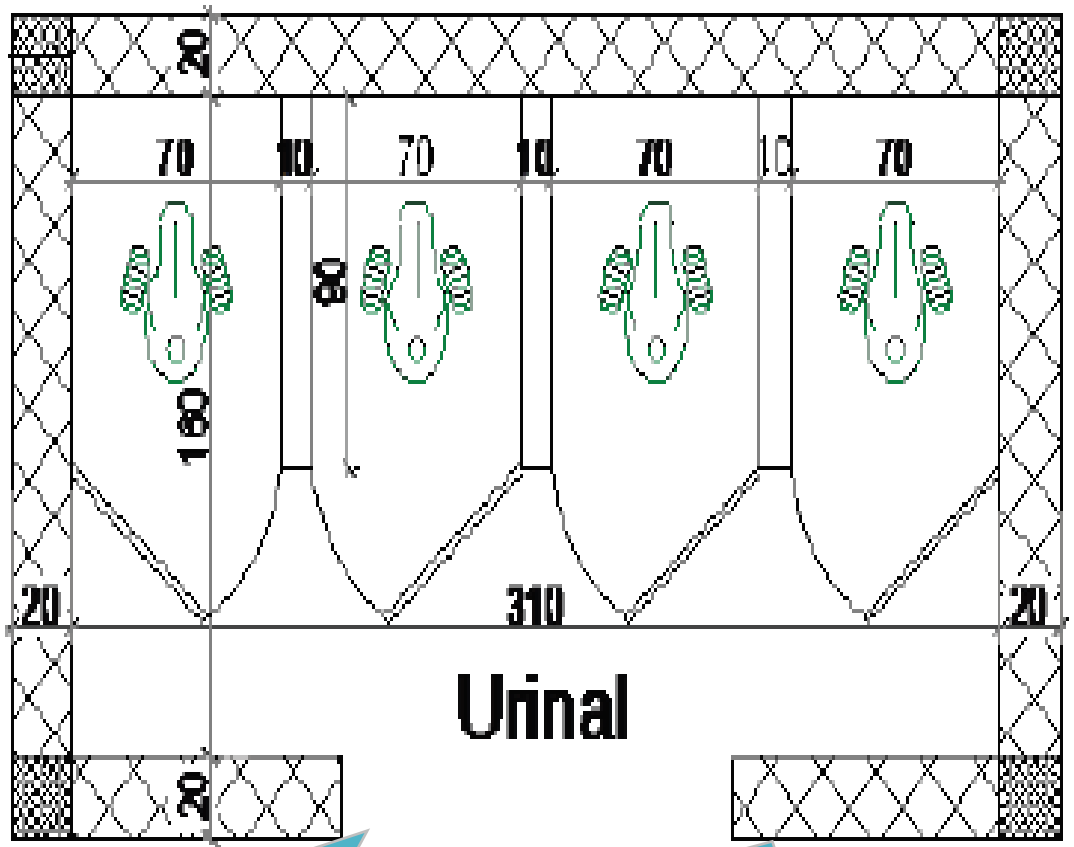


Pre-Primary

- Modify and assign seat for disabled students with door, WC and enough space

- Separate the boys/girls' latrines by partition wall

CHAPTER V: Design and Construction of Dry pit Latrines



- Urinal front wall removal

CHAPTER V: Design and Construction of Dry pit Latrines

Urinals

- Urinals are designed and constructed as part of the latrine block structure
- A privacy wall with a door is provided for all girls' and in boys' (in Somali & Afar) urinals
- Urinal trough for boys except in afar & Somali

CHAPTER V: Design and Construction of Dry pit Latrines

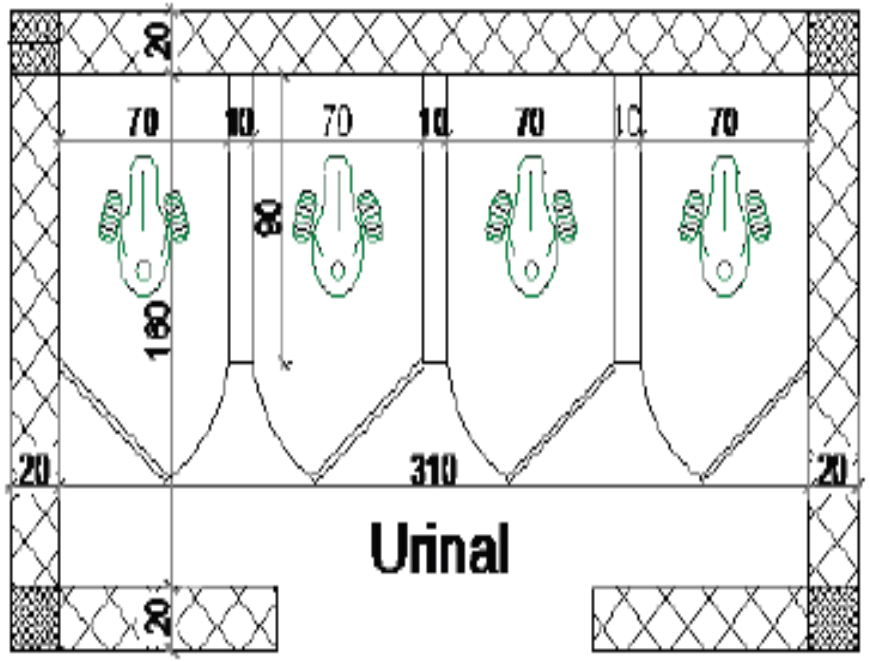


Figure 24: Urinals for girls

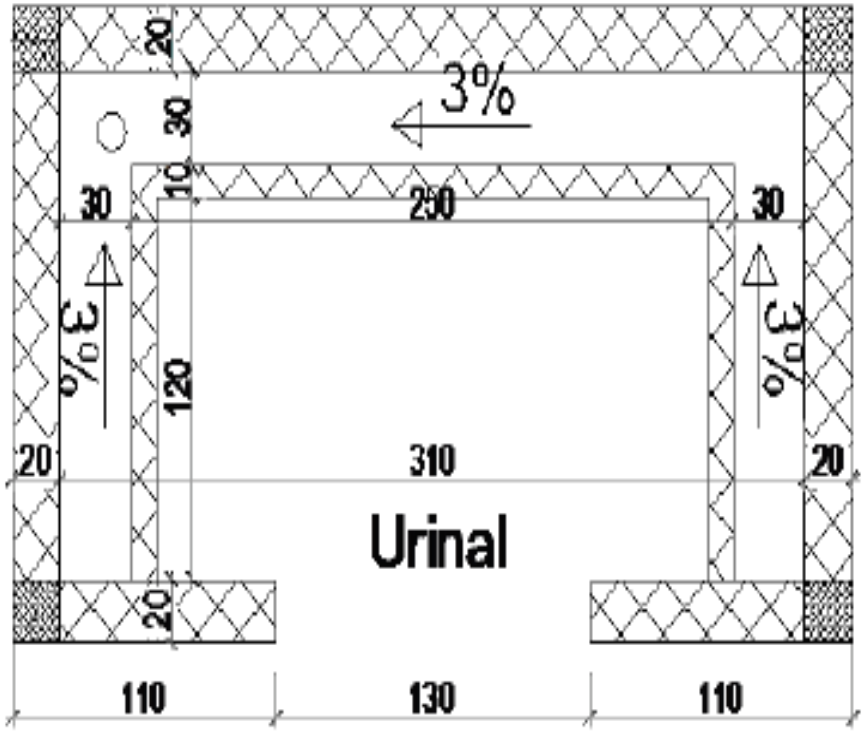


Figure 25: Urinal for boys

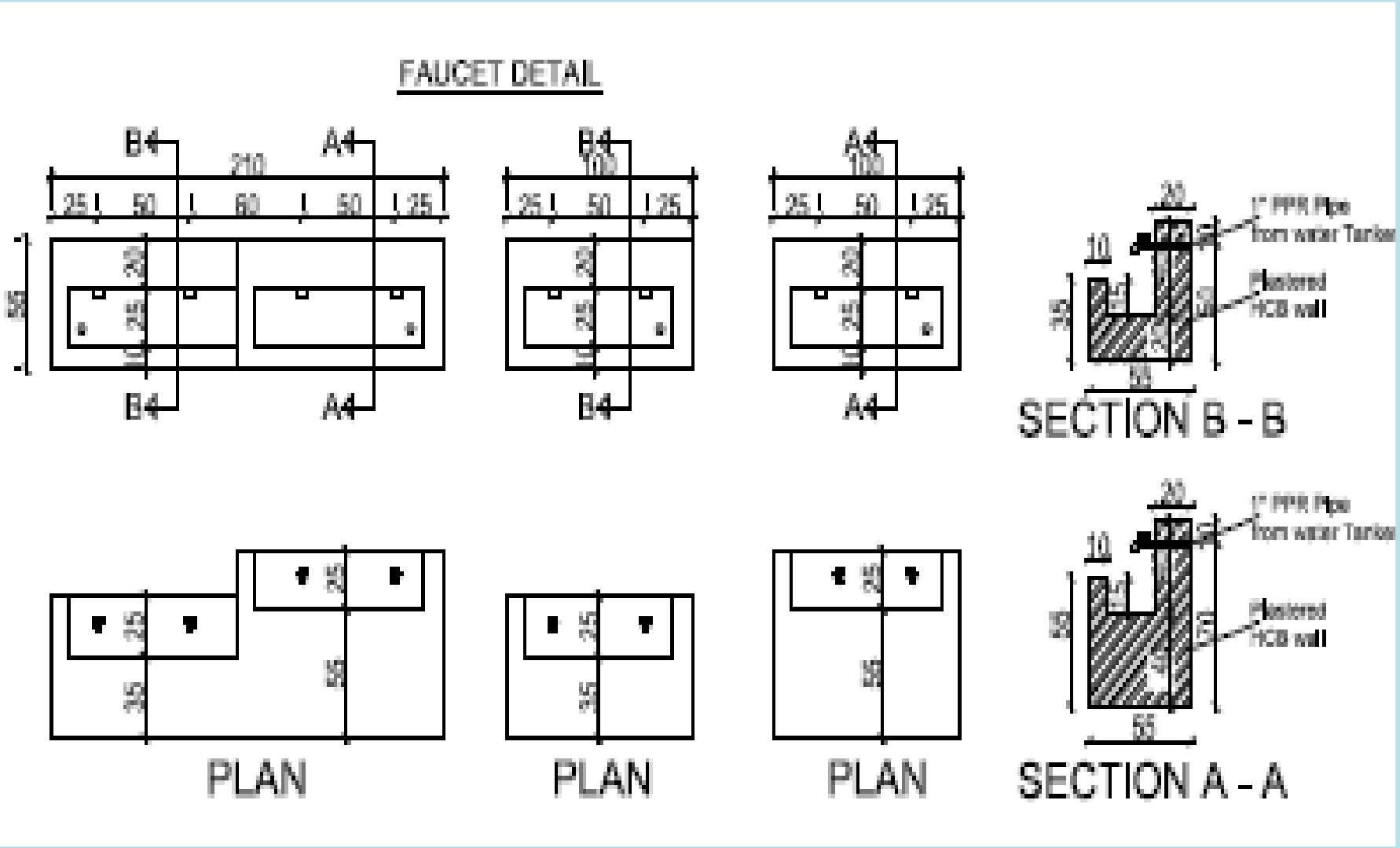
CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER V: Design and Construction of Dry pit Latrines

Handwashing facility

- Within latrines (≥1)
- Outside (conveniently placed)
- It needs to be supplied with soap or ash
- Each facility is supplied with taps at different heights to suit students of different ages.
- Grey water collected from hand washing facilities should be diverted into a soak-away pit.

CHAPTER V: Design and Construction of Dry pit Latrines



CHAPTER V: Design and Construction of Dry pit Latrines

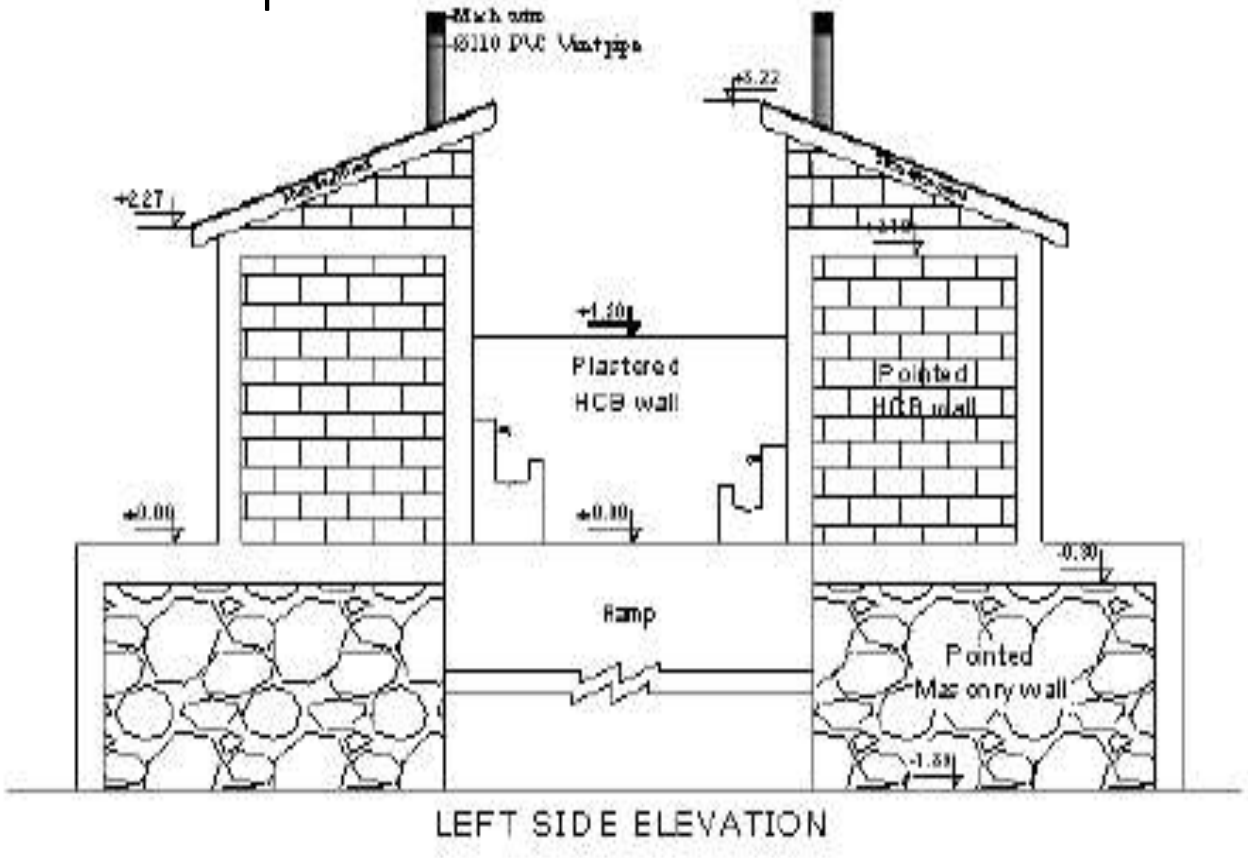
Pit latrines for rocky sites and flooded areas

- In areas where the proposed site for building school latrines is ***prone to seasonal flooding or the water table is very shallow***, the solution is to build raised latrines.
- A large part or the entire latrine pit can be designed and constructed above the ground if the selected space is fully resting on rocky ground difficult to excavate.
- ***The sides of the latrine's pits need to be raised and watertight to stop the sewage seeping into and mixing with the ground water.***

CHAPTER V: Design and Construction of Dry pit Latrines

Swampy and Rocky sites

- Elevated AGL
- Ramp



LEFT SIDE ELEVATION

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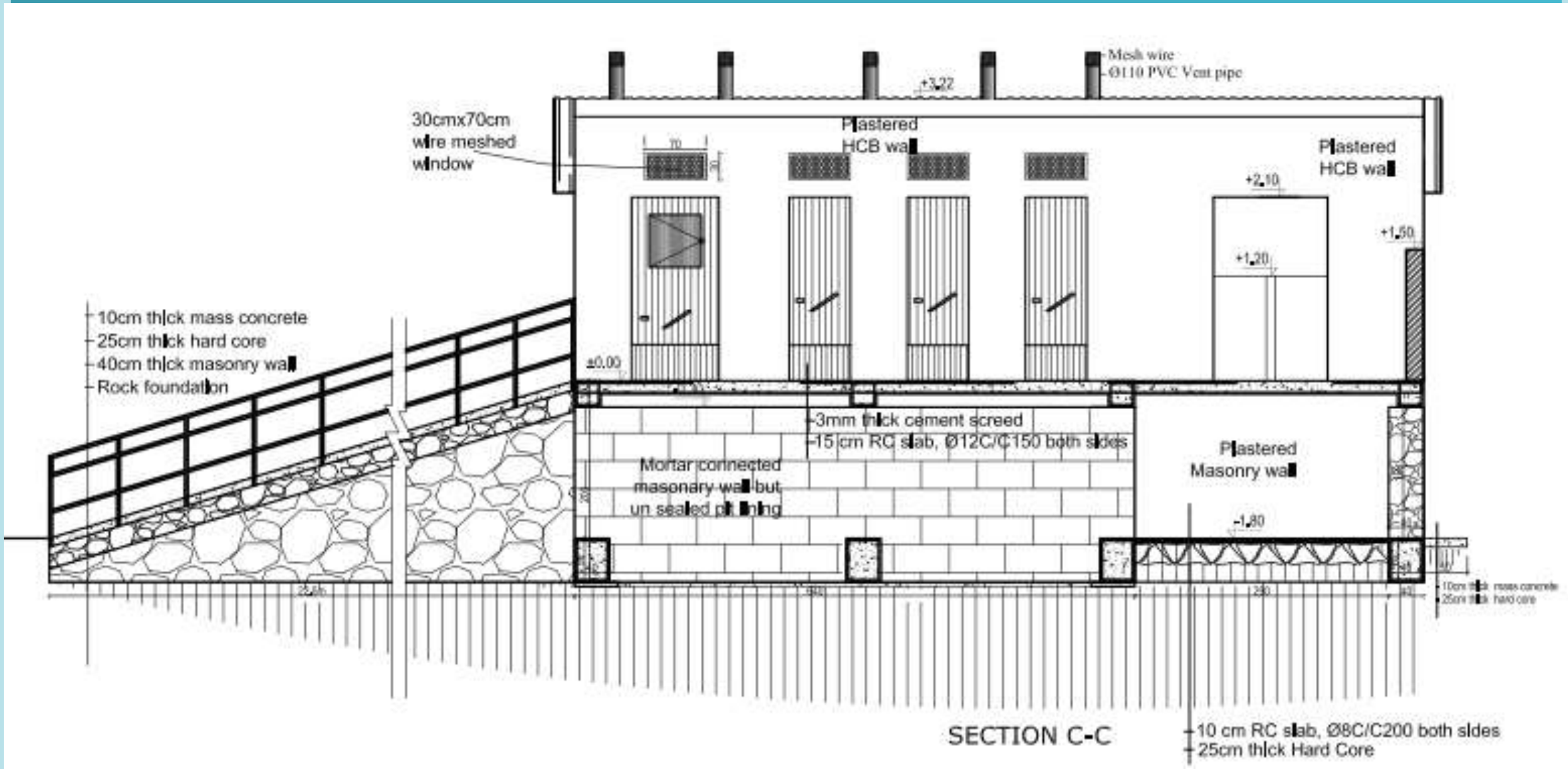

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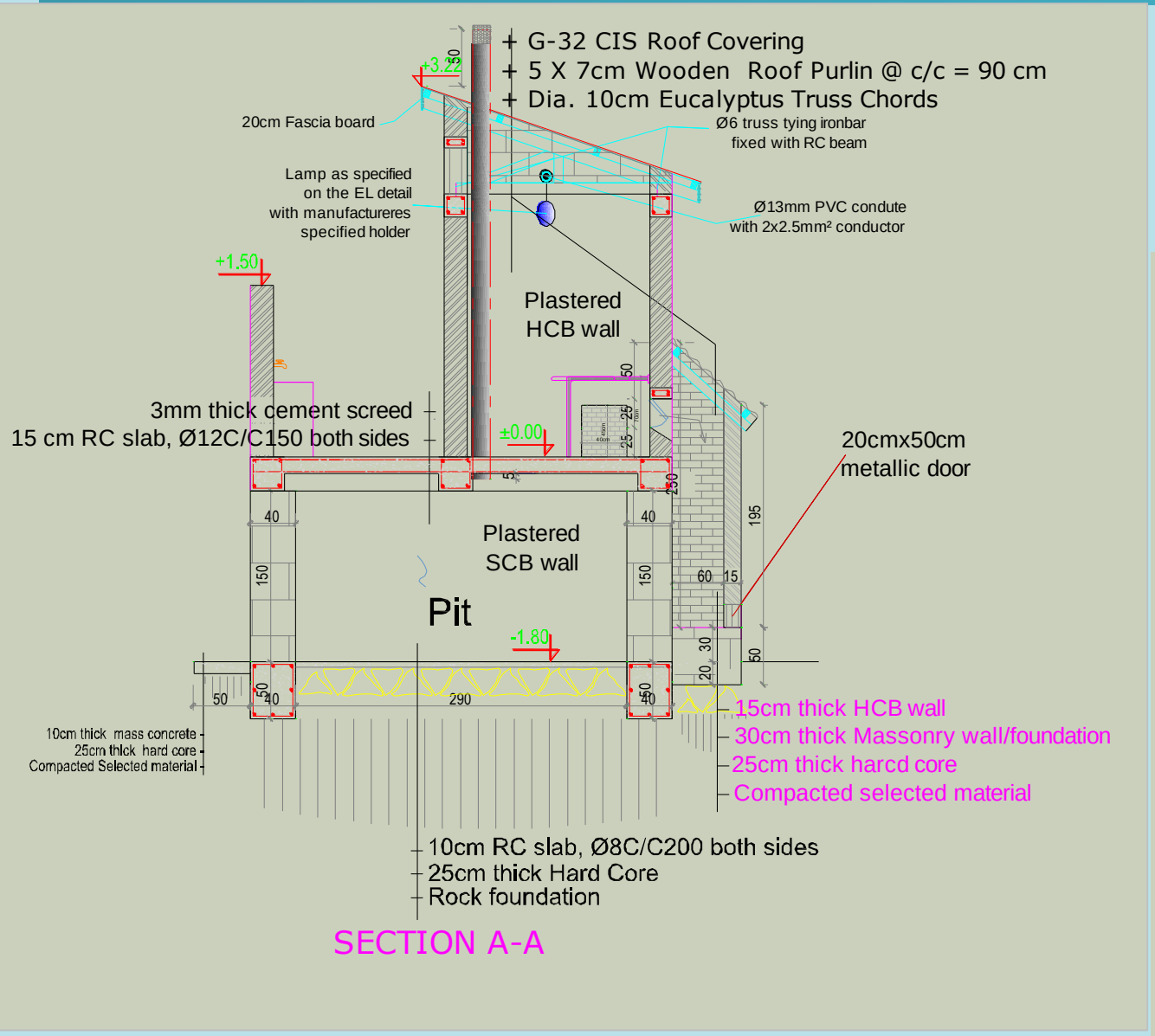
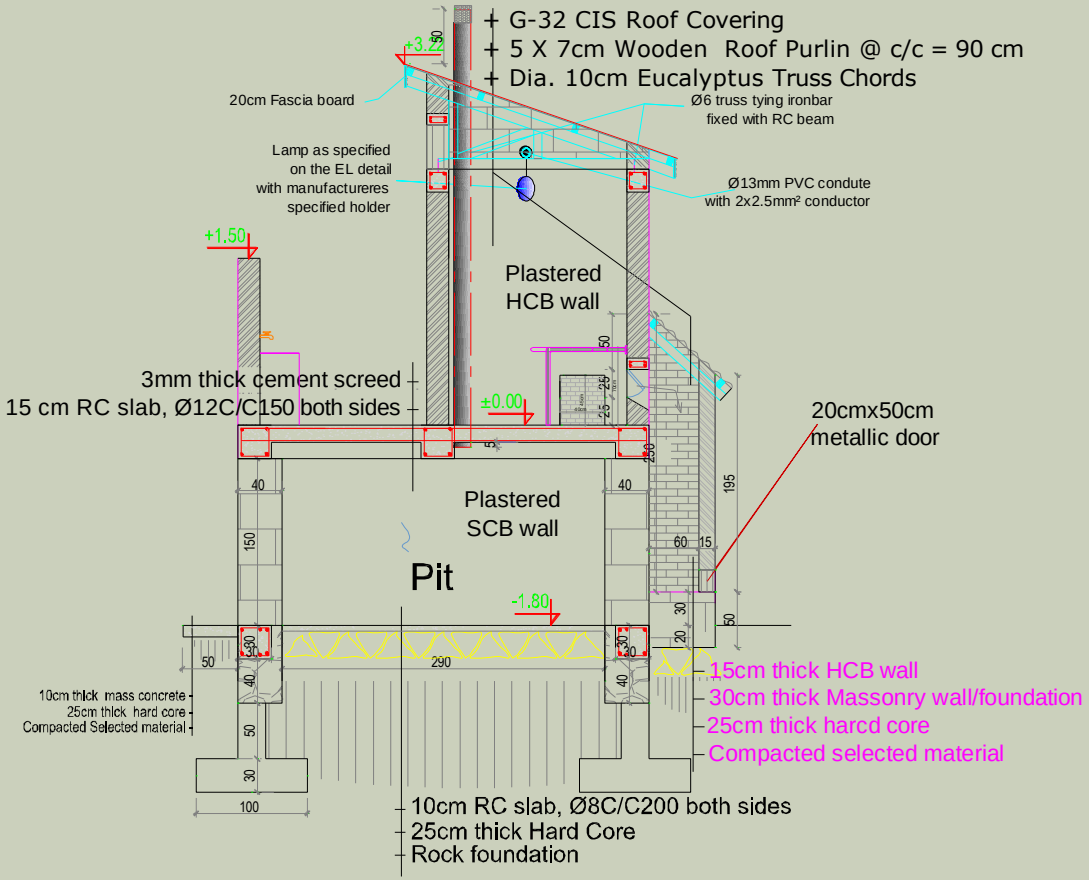


SECTION A-A

Swampy and Rocky sites

- Foundation
- Elevated AGL



SECTION A-A

CHAPTER V: Design and Construction of Dry pit Latrines

Latrine in windy sites

- In sites where the wind is strong, the proposed roof design can be modified by covering the roof with concrete block parapet at least on three sides above the top tie beam and remove/reduce extended CIS part of the remaining exposed part.

- In all areas including this one, roof truss members need to be tied to beams with 6mm iron bars.

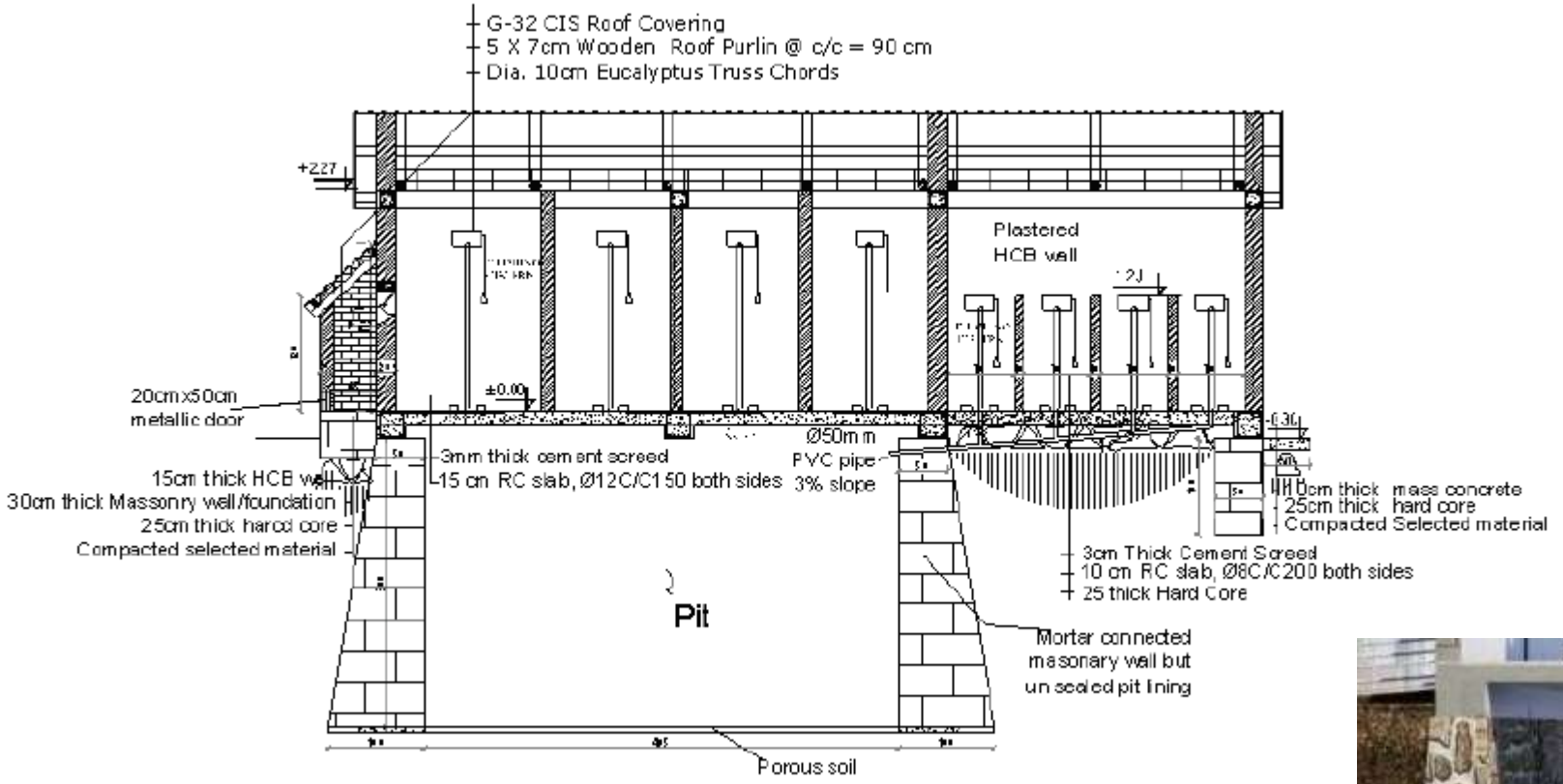
CHAPTER V: Design and Construction of Dry pit Latrines

CHAPTER VI: Design and Construction of Flush Toilets

- The flush toilet is a water-based sanitation system that uses water for carrying away human excreta to a pit, septic tank or a main sewer line where one exists nearby.

- This system of sanitation requires a continuous piped water supply system.

CHAPTER VI: Design and Construction of Flush Toilets



CHAPTER VII: Design and Construction of Hygiene Facilities

Hygiene facilities in schools include:

- ✓ Handwashing facilities
- ✓ MHM Block & Box

1. Handwashing facilities: Schools can access water for handwashing by either:
    - connecting to piped water supply line
    - by paying for water to be transported by animals and filling the water tankers placed for this purpose. *Transportation of water manually could be an effective option if the school administration is committed to such services.*

In each latrine, there will be a minimum of one handwashing facility with water taps.

CHAPTER VII: Design and Construction of Hygiene Facilities

Schools	Total School Population	Pupil to Tap Ratio (Pupil/Tap)	Required Number of Taps	Number of Stands and Taps	
				Adopted Number of Taps	Number of Stands
Bule secondary & preparatory (9-12)	1,236.00	50	24.72	25	2 stands with 7 taps each side of stand
1gna Okolu primary school	1,577	100	15.77	16	1 stands with 8 taps each side of stand

Item	Recommendation
Drinking water tap	▪ One tap/100 student in rural schools ▪ One tap/50 students in urban schools

CHAPTER VII: Design and Construction of Hygiene Facilities

CHAPTER VII: Design and Construction of Hygiene Facilities

CHAPTER VII: Design and Construction of Hygiene Facilities

These will be in addition to the external water taps provided around the school Latrine facilities.

CHAPTER VII: Design and Construction of Hygiene Facilities

2. Menstrual Hygiene Management (MHM) Facility

The separate building infrastructure is planned to have four rooms:

(i) a counseling room,
(ii) a waiting room,
(iii) a resting room with a resting bed and mattress, and
(iv) a washroom with a washing basin for washing pads and clothes, elevated water storage container (1000L) a shower water supply system and a solid waste (sanitary pad) collection box.

For girl's latrine blocks, each will have one dedicated solid waste (sanitary pad) collection box shown in the drawings.

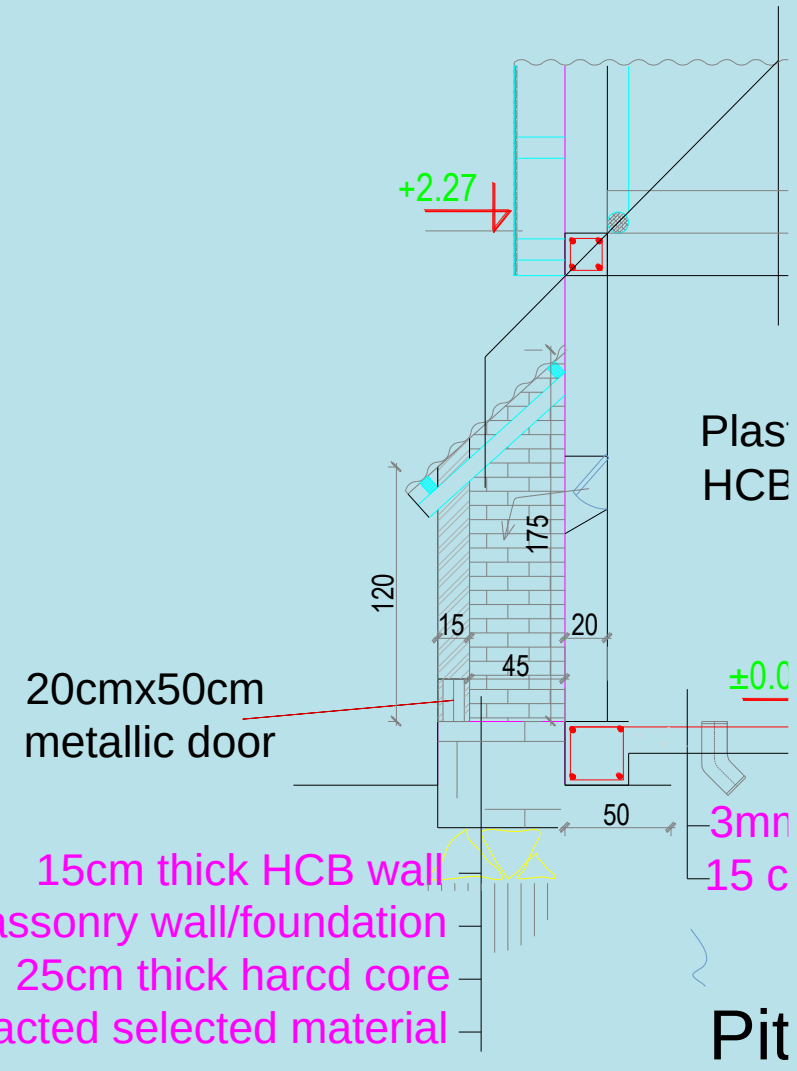
CHAPTER VII: Design and Construction of Hygiene Facilities

CHAPTER VII: Design and Construction of Hygiene Facilities

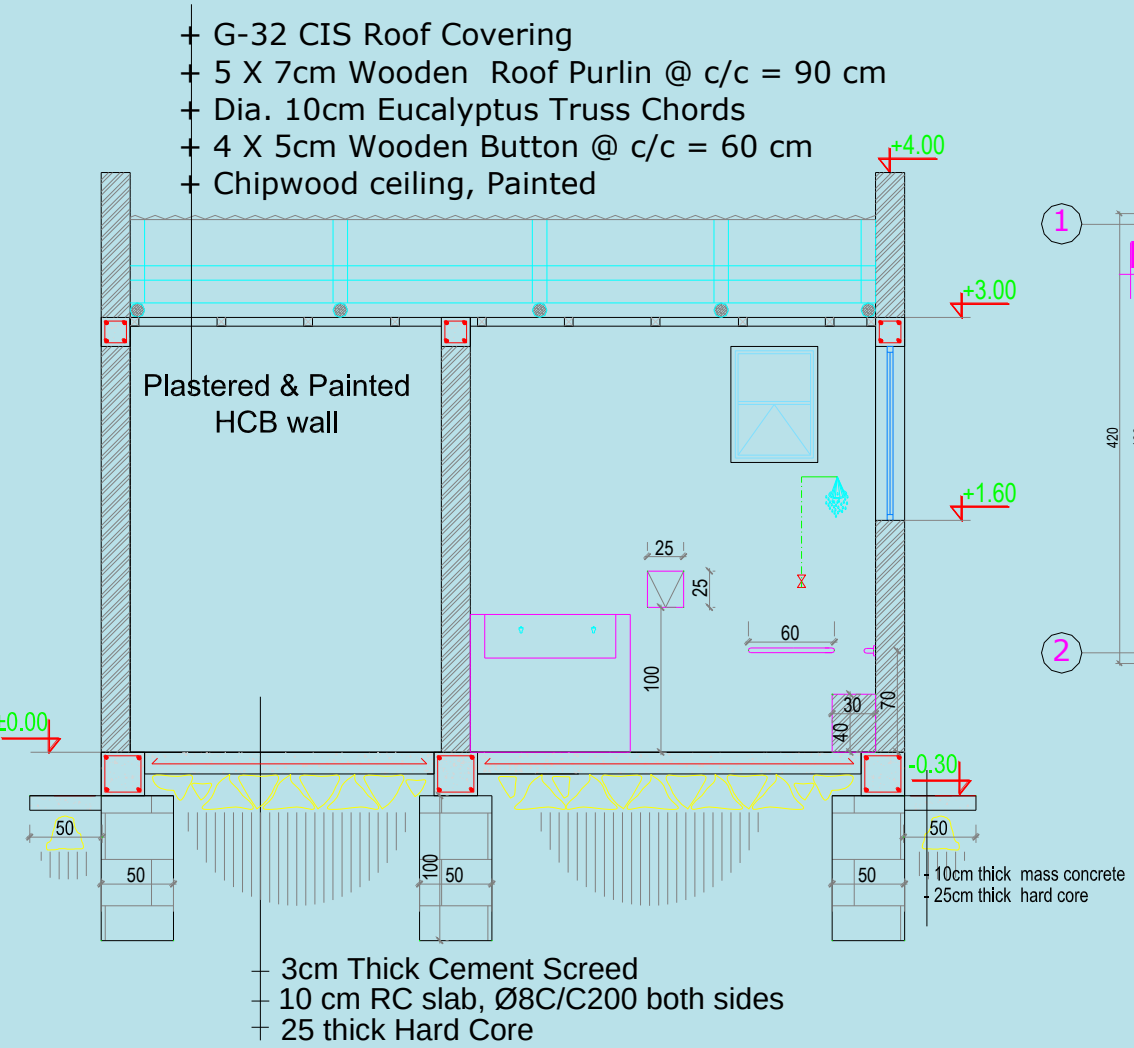
· Water Tanker

CHAPTER VII: Design and Construction of Hygiene Facilities

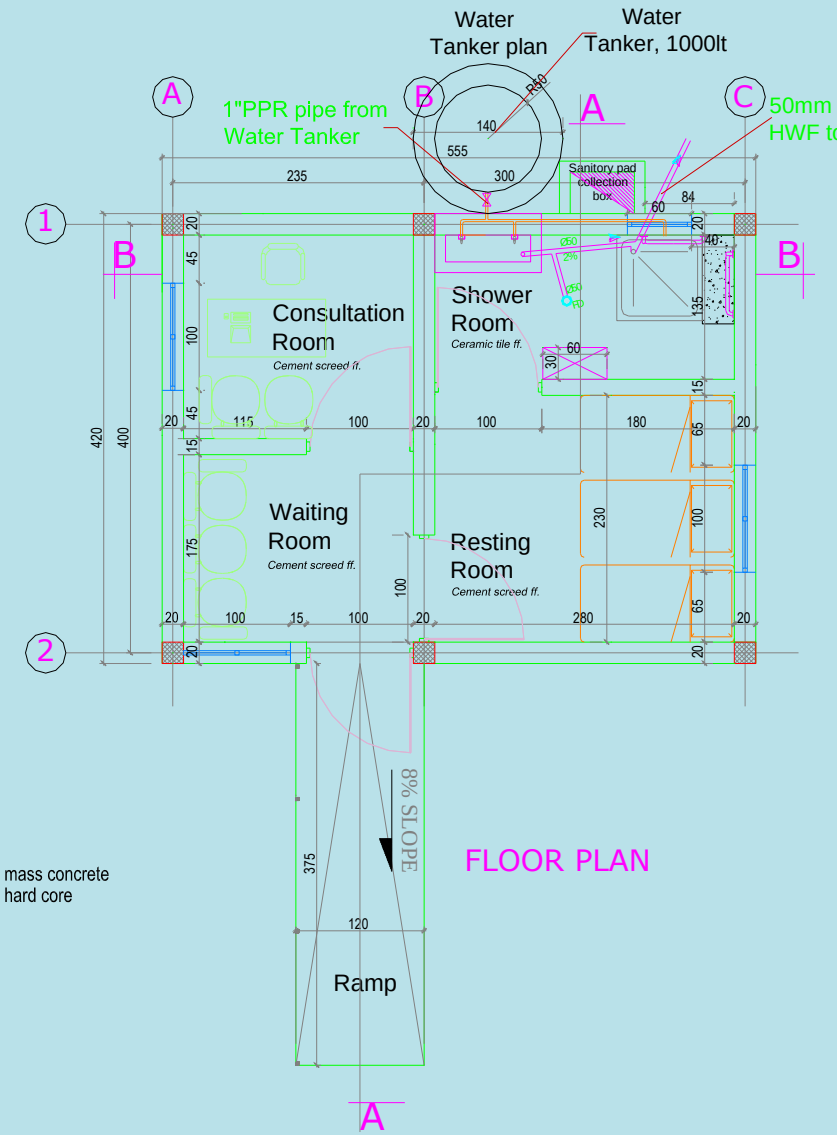
· NO Toilet seat



CHAPTER VII: Design and Construction of Hygiene Facilities



SECTION B-B

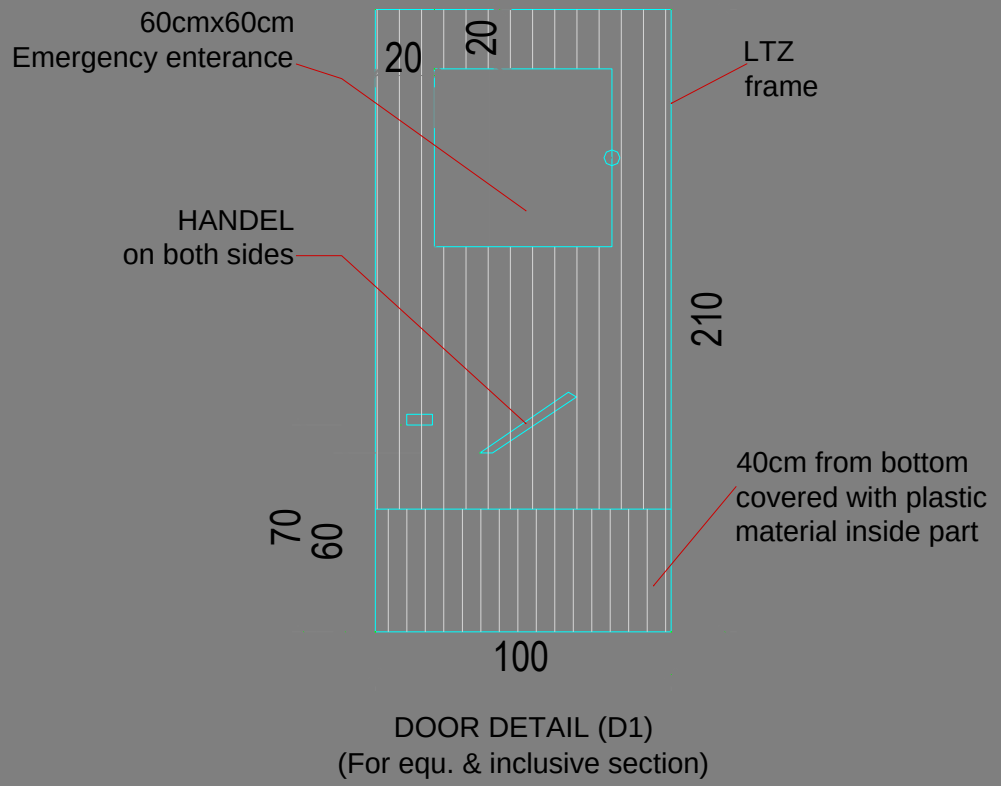


FLOOR PLAN

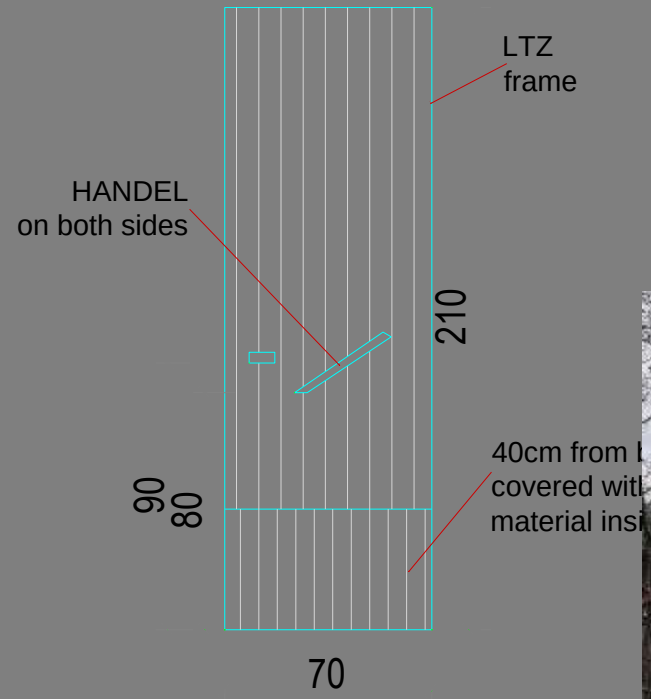
- Increase resting room dimension to add enough space accessibility for student with wheelchair
- Provide a tap at lower height for easier access to water for girls who want to only wash part of the body but not take a full shower.
- The drawing does not indicate that the toilet door to disability toilet shall also have a handle on both sides of the door. Also the height of the handle shall be indicated in the drawing.

CHAPTER VII: Design and Construction of Hygiene Facilities

- 60-70cm height handle for door of disability access



DOOR DETAIL (D1)
(For equ. & inclusive section)



DOOR DETAIL (D2)
(For non inclusive section)

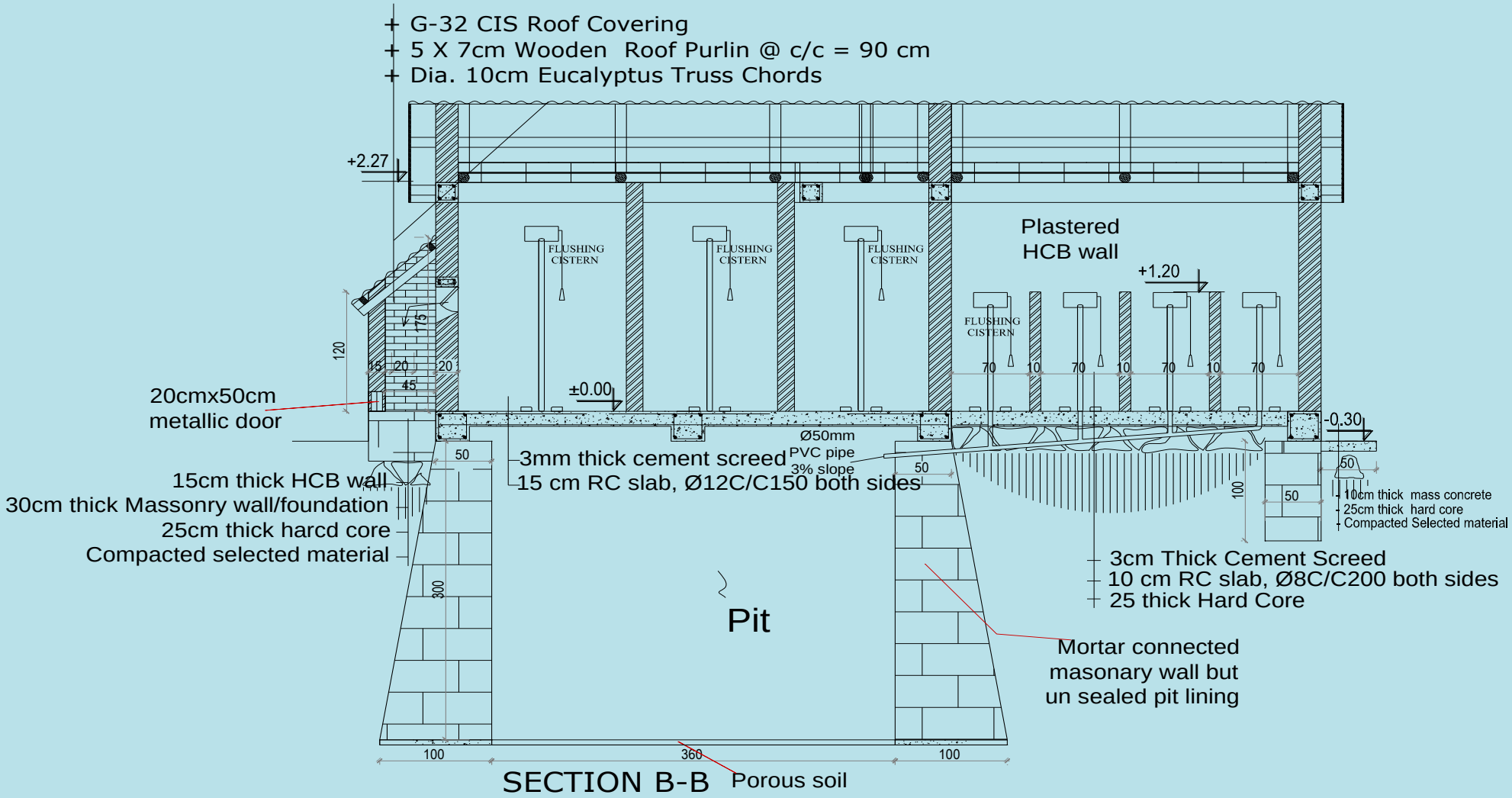
- Lock on both sides

CHAPTER VII: Design and Construction of Hygiene Facilities

- Alternate options

CHAPTER VII: Design and Construction of Hygiene Facilities

CHAPTER VII: Design and Construction of Hygiene Facilities



CHAPTER VIII: Wastewater management

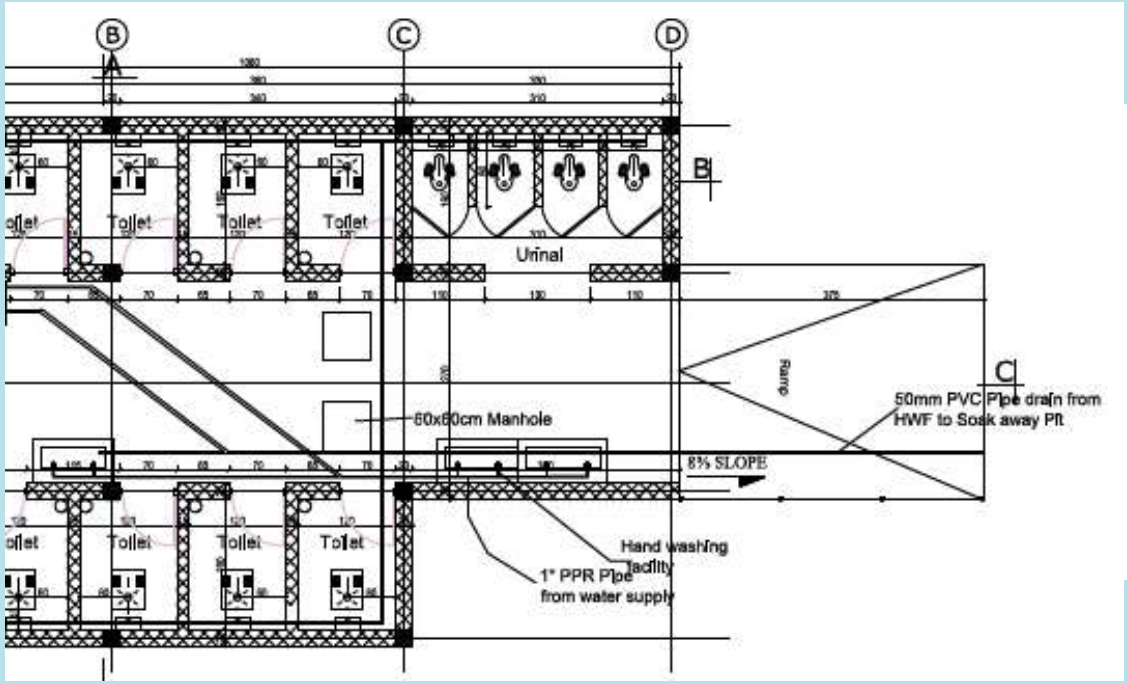
- Wastewater is excess water from water supply sources, drinking water fountains, latrines, urinals and handwashing facilities at the toilet.

- Management of black water and grey water is very important.

- If properly handled, grey water can be reused for cleaning toilets and urinals, or for watering trees and plants. ***Wastewater use in this way requires more careful handling.*** *School WASH Operations and Maintenance Manual will be described in more*.

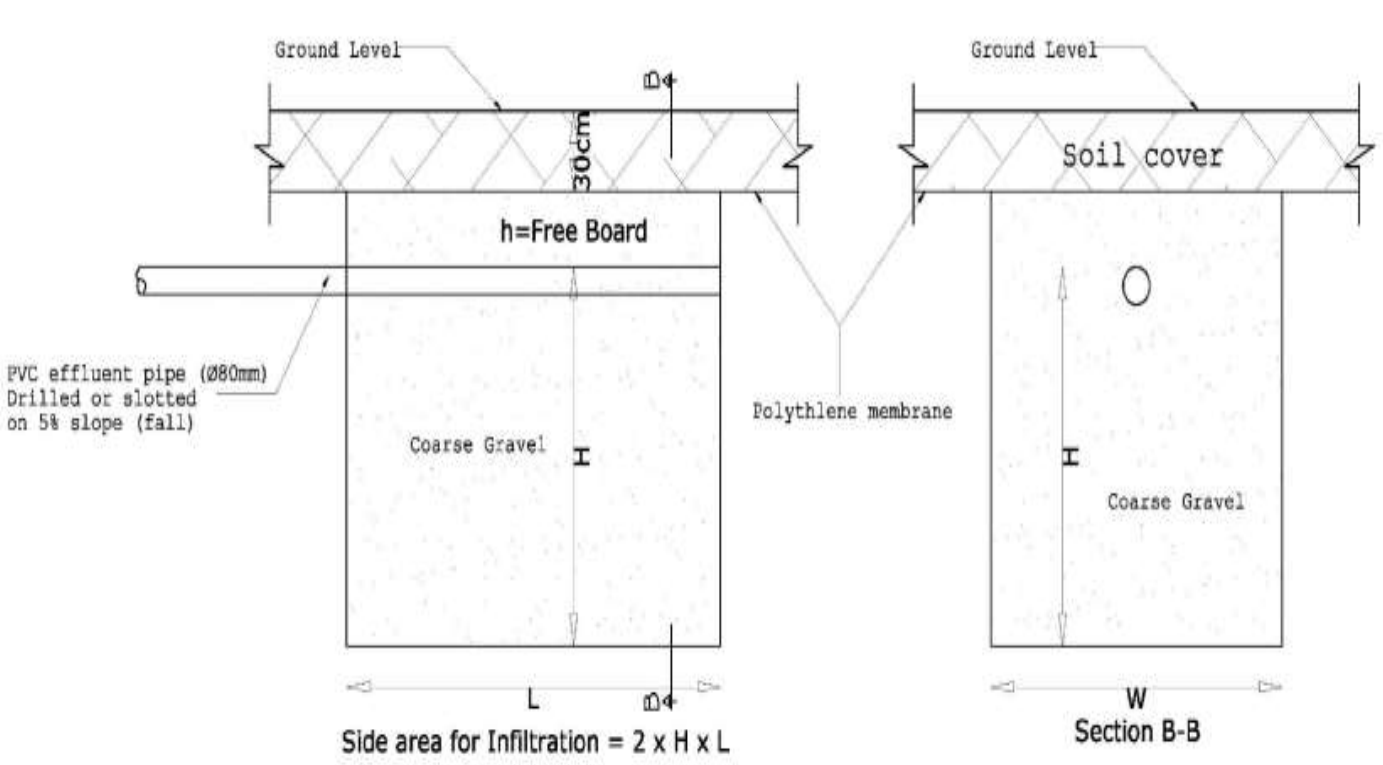
CHAPTER VIII: Wastewater management

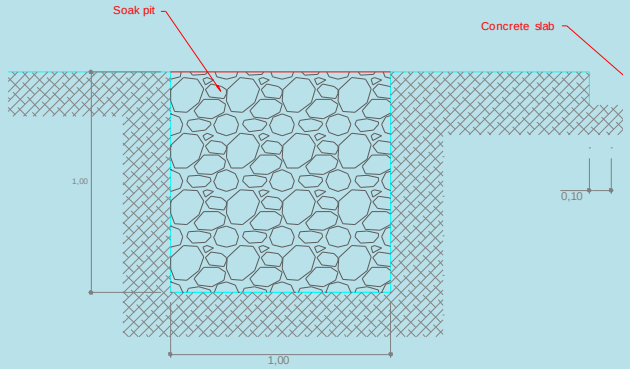
- Assuming the decision is made to dispose of grey water rather than reuse it, Infiltration of water back into the ground may work in terms of reducing the health risk. **Infiltration trench and Soak away pit** is recommended in this manual.



Soil Type	Infiltration Rate I (l/m2)
Coarse to mediium sand	>50
Fine sand, loamy soil	33
Sand loam	25
Porous silt clay	10
Expansive clay	<10

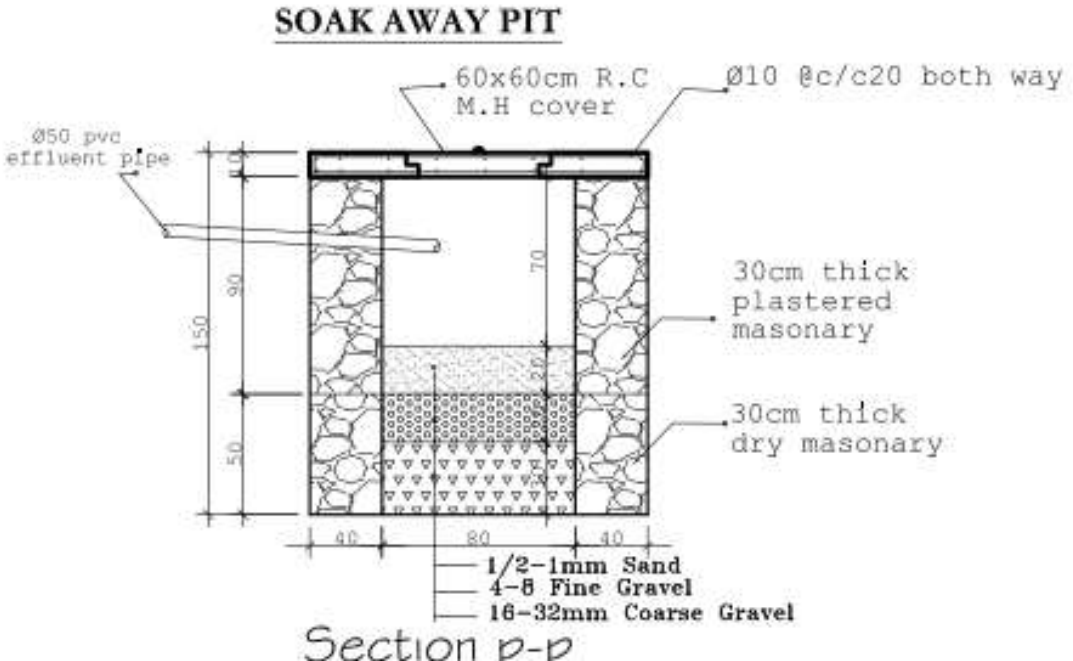
CHAPTER VIII: Wastewater management





Hand washing. Rear elevation

SCALE 1/15



CHAPTER IX: Facilities for Solid Waste Collection & Disposal

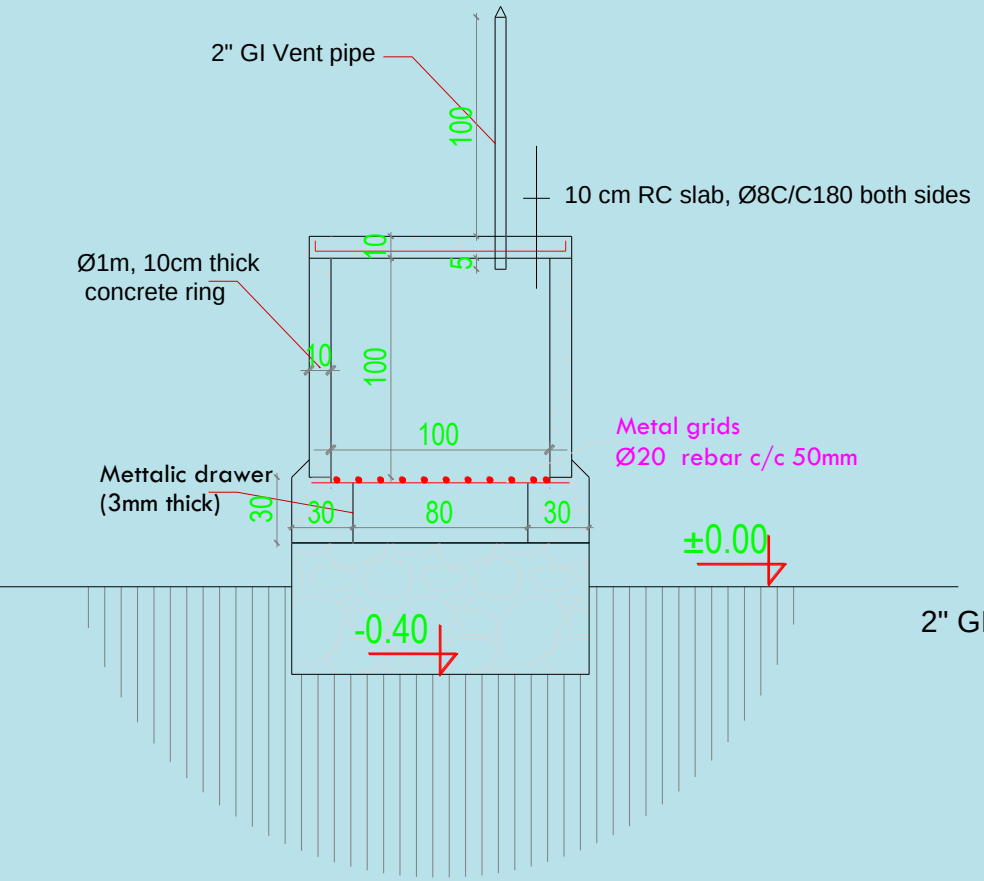
- Solid waste, if not collected and managed properly, can harbor rats & vermin's, and support the spread of vector borne diseases such as diarrhea, malaria and others.

- The collected solid waste need to be disaggregated into hazardous and non-hazardous waste.
  - ✓The non-hazardous waste is dumped in a pit prepared for this purpose.
  - ✓The hazardous waste such as sanitary pads must be incinerated.

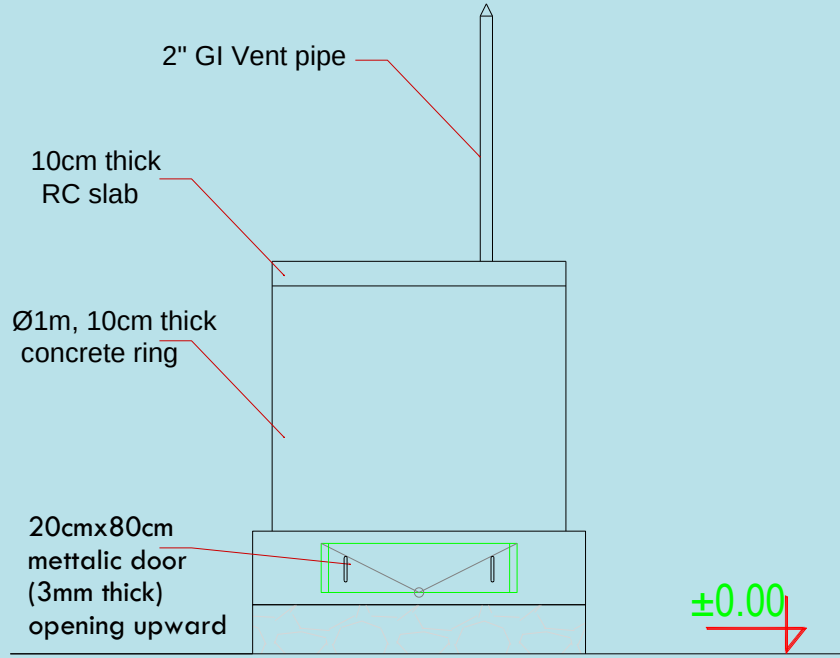
Two Incinerator design options are presented in this manual.

CHAPTER IX: Facilities for Solid Waste Collection & Disposal

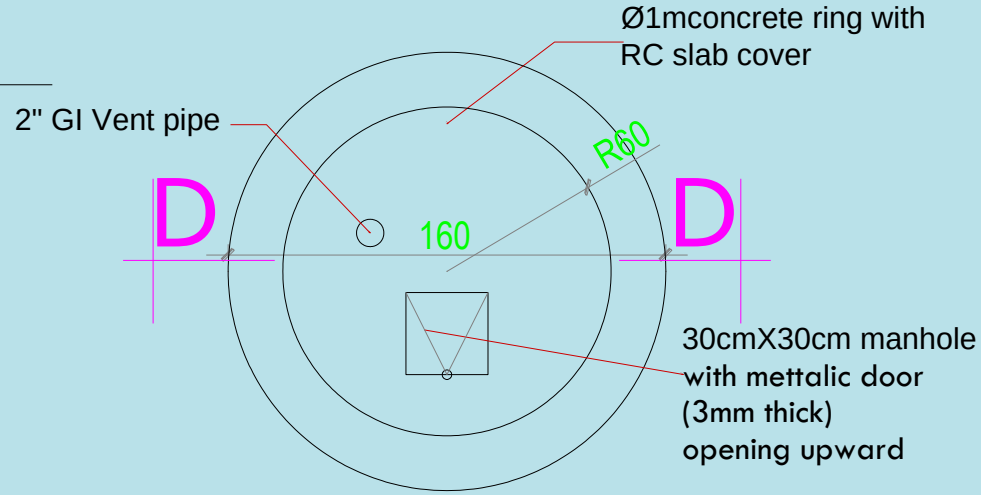
CHAPTER IX: Facilities for Solid Waste Collection & Disposal



SECTION D-D



ELEVATION



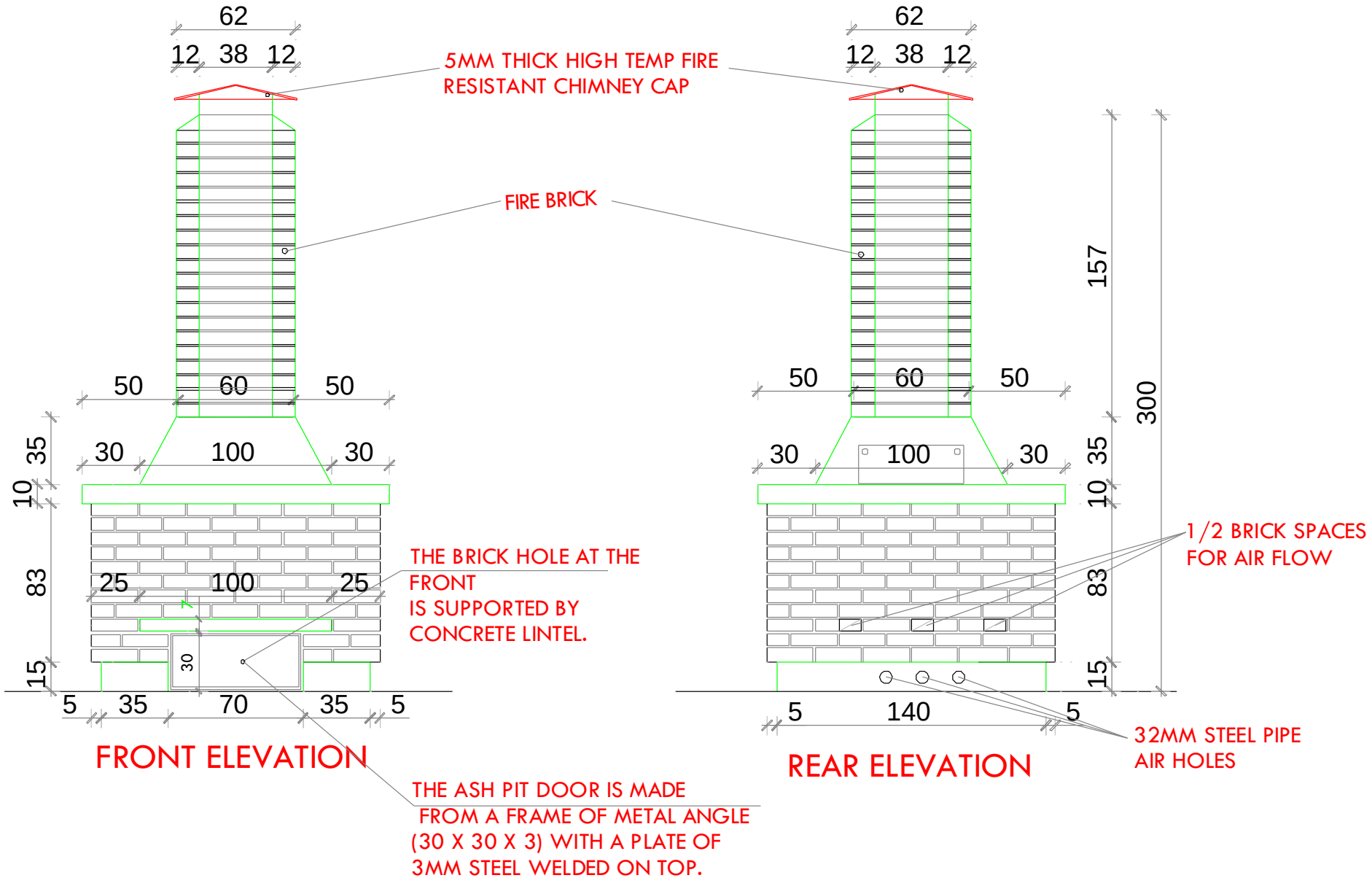
PLAN

CHAPTER IX: Facilities for Solid Waste Collection & Disposal

- Holes for Air flow needs to be provided

Not shown in the drawing

CHAPTER IX: Facilities for Solid Waste Collection & Disposal



CHAPTER X: Monitoring Activities During Construction

- Based on field surveys and experience, following constructions based on the standard designs **is a huge challenge.**

- The challenge demands the need for strong monitoring and close supervision, particularly for composting type latrine blocks.

- This is often overlooked:

  - first at the planning stage,
  - second during the project implementation (construction)
  - third during its function/operation.

CHAPTER X: Monitoring Activities During Construction

Cornerstones of quality management

QUALITY
CAUSE

1. Layout stage
2. At the end of Excavation
3. Before pouring concrete for the Grade beam
4. Column and ground floor Supervision
5. Hollow concrete block work
6. Top tie beam Level
7. Before Roof Covering
8. Plastering work
9. Site Work, Sanitary and Electrical Installation
10. Final Inspection

Site Book

CHAPTER X: Monitoring Activities During Construction

- **Regular monitoring** is a key tool and instrument to ensure quality construction work. There must be a strict follow-up of the construction as per the drawings.

- Monitoring with **regular reports** (formal as required) indicating what has been observed and actions taken on the facilities. These reports should be shared among the school administration, PTA, partners and woreda sector offices on a regular basis.

Monitoring requirements for water supply systems and Latrine construction is given in the manual.

CHAPTER XI: Bill of Quantities (BOQ)

- Bill of Quantities (BOQ) shall be read and constructed in conjunction with the **architectural, structural and electrical drawings**.
- All quantities given in the BOQ are **estimated quantities** of the work to be done and **they are not** to be taken as **actual quantities of the work**. It varies from site to site based **on actual site condition and measurement**.
- Any increase or decrease will be as **stipulated in the contract signed with the contractor**.

- All materials to be used during the construction are to be of the **best quality available material** and subject to **employer/engineer approval**.

CHAPTER XI: Bill of Quantities (BOQ)

Materials

- All materials to be used during the construction are to be of the best quality available material and subject to employer/engineer approval. Materials should be ***durable and manufactured according to the applicable Ethiopian code of Standards***.

- Items that contain materials or products of specific items: with names of manufacturers, are to be taken as samples of what will be required. ***Subject to employer/engineer approval***, the contractor may, at his discretion, offer similar products of other makes if the equivalent quality of the specified materials is guaranteed.

CHAPTER XI: Bill of Quantities (BOQ)

-Black cotton soil shall be removed entirely & suitable selected material shall be backfilled (compacted in 20cm layers).

-Min 1m extra excavation & selected fill on all sides

CHAPTER XI: Bill of Quantities (BOQ)

5.14	Provide ceramic squat for the drop holes & urinals with size of 45cm by 60cm or as approved by the engineer. The price includes flushing cistern, piping and all other necessary works there to as shown in the drawing. Cost also includes provision of Ø50mm PVC pipe connected to the pit latrine as per the detail of the drawing for urinals. (This is for Latrines to be used for Classes above 4th grade). Optional to # 5.15
5.15	Provide foot rest made of concrete as specified on the drawing. The price includes all necessary works there to. (This is for Latrines to be used for Classes above 4th grade). Optional to # 5.14

Dry pits

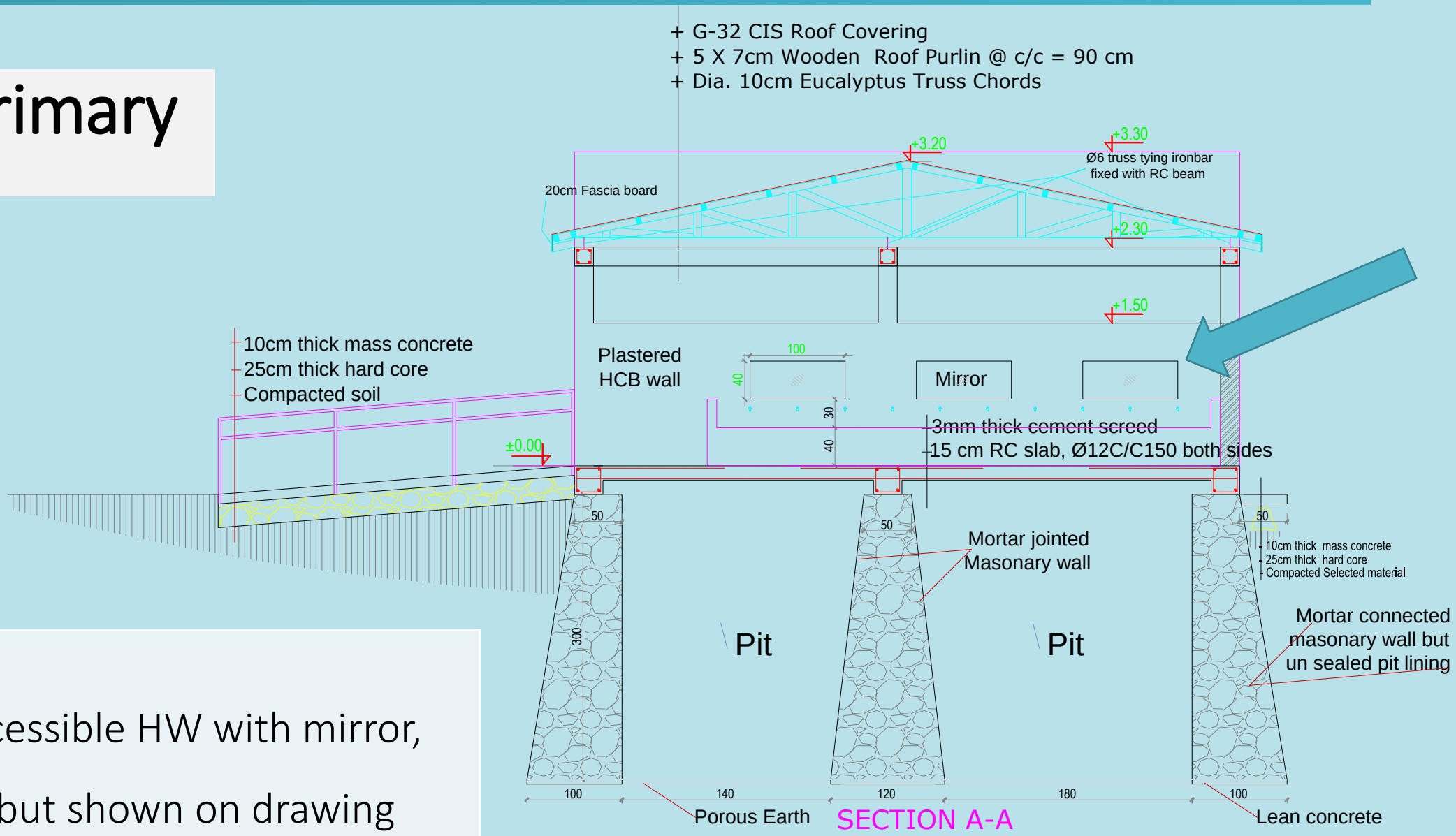
CHAPTER XI: Bill of Quantities (BOQ)

5.14	Provide ceramic squat for the drop holes with size of 45cm by 60cm or as approved by the engineer. The price includes all necessary concrete works and all other necessary works there to. The price includes flushing cistern, piping and all other necessary works there to for piped Latrines

Pre-Primary

CHAPTER XI: Bill of Quantities (BOQ)

Pre-Primary



- Provide accessible HW with mirror,
- No in BOQ but shown on drawing

CHAPTER XI: Bill of Quantities (BOQ)

Separate (three seats) latrine block for staff (one female, one male and one for staff with disabilities)

Thank you