

UNHCR Urine Diverting Dry Toilet

D45-2015a

**Tools and Guidance for
Refugee Settings**



UNHCR
The UN Refugee Agency

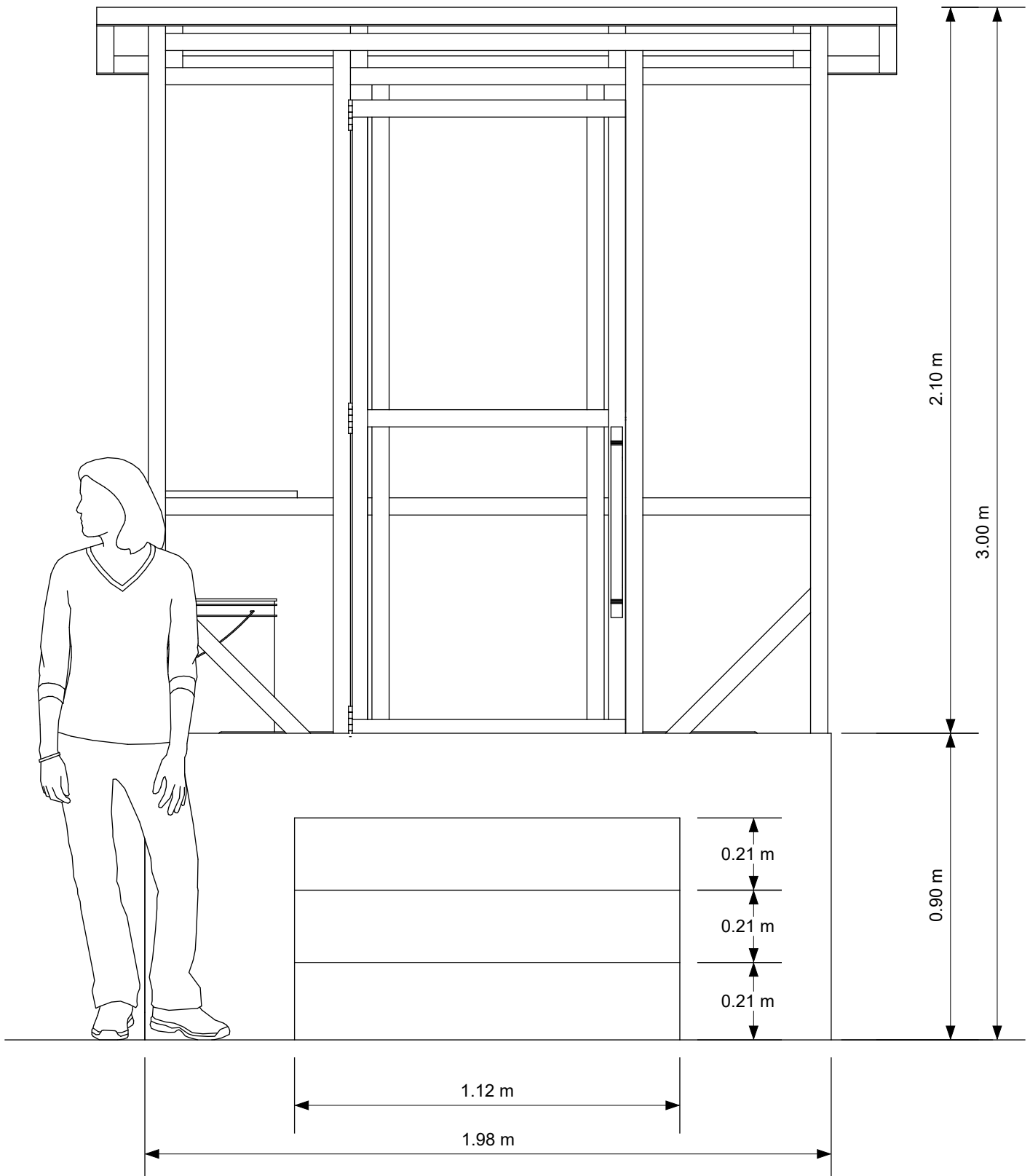
UNHCR Standardized WASH Designs Urine Diverting Dry Toilet (UDDT)

FOREWORD

These urine diverting dry toilet (UDDT) designs form part of UNHCR's series of Standardized WASH Design Guidelines for Refugee Settings which are the result of an extensive review process with WASH actors active in refugee settings. It is recognized that the Standardized WASH Designs will require continuous review and amendment in response to changes in engineering best-practice and feedback from the field. Therefore further review will be managed by a Technical Review Committee which will meet regularly to discuss issues related to the use of the design and an annual review will be reported back to the WASH community. More urgent amendments will be reported as, and when, required. Note that this toilet is based on a design shared by OXFAM GB.

FOREWORD	1
ENGINEERING DRAWINGS	2
STEP-BY-STEP ASSEMBLY DRAWINGS.....	8
BILL OF QUANTITIES	17
VISUAL BILL OF QUANTITIES	18
SPECIFICATIONS FOR TOILET CONSTRUCTION IN REFUGEE SETTINGS	19
400 SCOPE	19
401 SITE SELECTION	19
402 PREVENTION OF SURFACE OR GROUND WATER CONTAMINATION	19
403 GUIDELINES FOR PIT REINFORCEMENT	19
404 GUIDELINES FOR TOILET SLAB STRENGTH	20
405 GUIDELINES FOR TOILET SLAB ANCHORAGE	20
406 GUIDELINES FOR SANITARY SEALING	20
407 GUIDELINES FOR THE USE OF PLASTIC SHEETING	20
408 GUIDELINES FOR TOILET DOORS	21
409 GUIDELINES FOR COMMUNAL TOILET PRIVACY WALLS	21
410 GUIDELINES FOR VECTOR CONTROL MEASURES	21
411 GUIDELINES FOR RAIN AND STORMWATER PROTECTION	22
412 GUIDELINES FOR ADDITIONAL WASH BLOCK ACCESSORIES	22
413 COLLECTION OF ANAL CLEANSING AND SANITARY MATERIALS	22
414 MATERIAL SPECIFICATIONS OF COMMON CONSTRUCTION MATERIALS	22
415 HANDWASHING STATIONS DESIGN CONSIDERATIONS	23
416 SOAKAGE PIT SIZING BASED ON SOIL INFILTRATION RATES	24
417 ENVIRONMENTAL CONSIDERATIONS FOR SOURCING WOOD.....	24
418 DECOMMISSIONING	24
419 UNHCR STANDARD TOILET DESIGNS FOR REFUGEE SETTINGS	25
USEFUL REFERENCES.....	26

Front View



- NOTES**
1. Select an area within the plot as agreed with the owner.
 2. Ensure an area of 2m x 2.25m has been cleared and perfectly leveled.
 3. The back of the UDDT latrine should face towards the predominate sun direction to facilitate drying i.e. towards the equator.
 4. All WASH infrastructure to be located at least 30m from water sources. Distances to be increased near fissured rock.

D-45

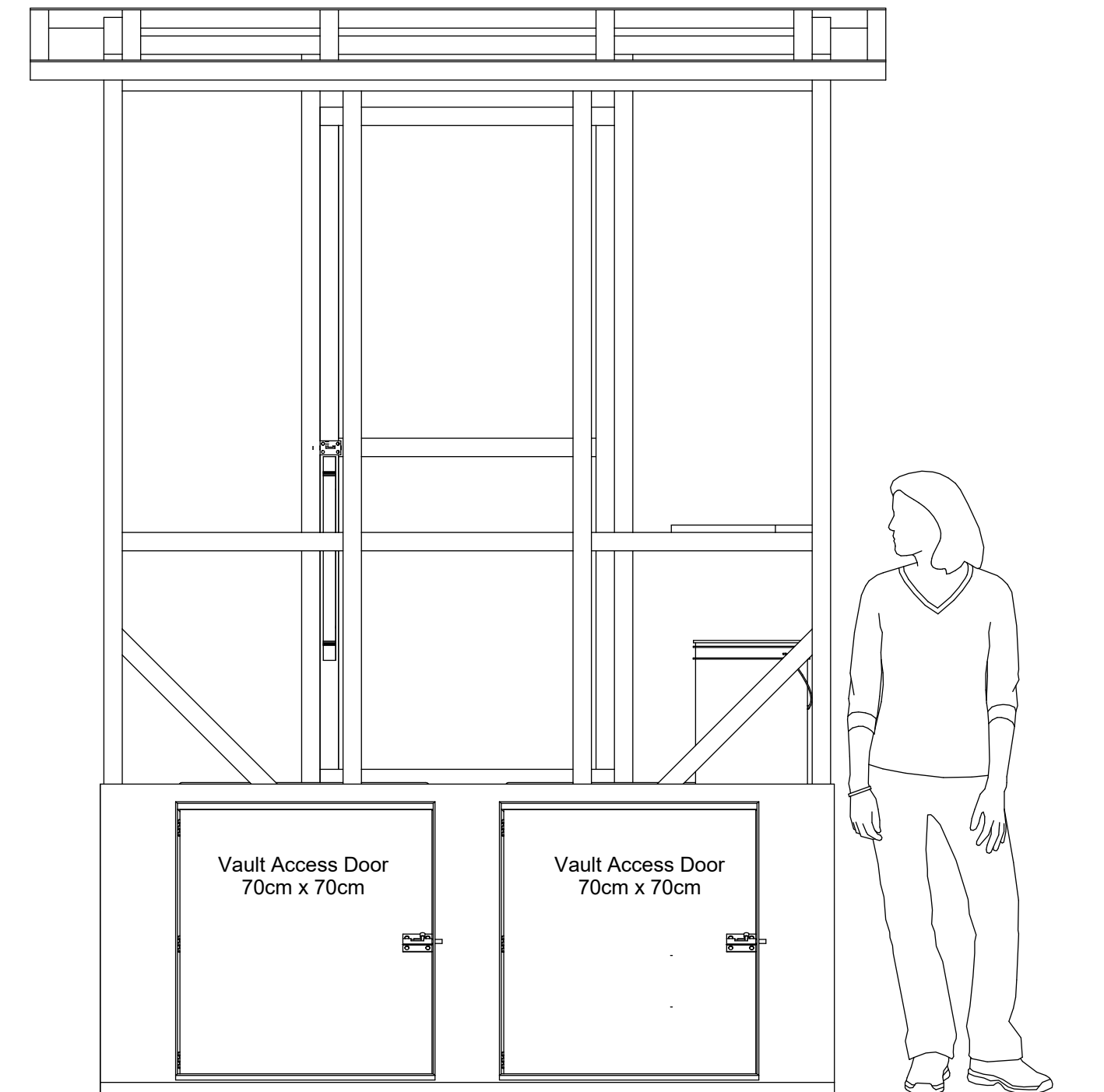
TITLE
Urine Diverting Dry Toilet
 Front View
PROJECT
 Project Name, Country

DRAWN BY
 B. Harvey - 11/10/15
APPROVED BY
 M. Burt - 15/11/15
SCALE
 1:16

UNITS
 metres
SHEET
 1 of 6
DATE PUBLISHED
 15/11/15



Rear View



NOTES

1. Vault access door 70cm x 70cm x 3mm iron access cover with 3 hinges and locking mechanism.
2. Vault access doors should be attached to a 4cm x 4cm x 4mm angle iron frame with four solid anchor points.
3. Vault access door to be painted with at least two coats of matt black paint to absorb solar radiation and promote drying.
4. A bucket should be provided for the addition of ash (pH adjustment and drying agent).
5. After a stabilization period of up to 2 years, the contents may be used safely as a fertilizer and soil conditioner (Guidelines for the Safe use of Wastewater, Excreta and Greywater, WHO 2006). Alternatively, the vault contents may be emptied and disposed.
6. Both squat holes should be covered with tight fitting wooden plugs. A notice should indicate which vault is currently in use.

D-45

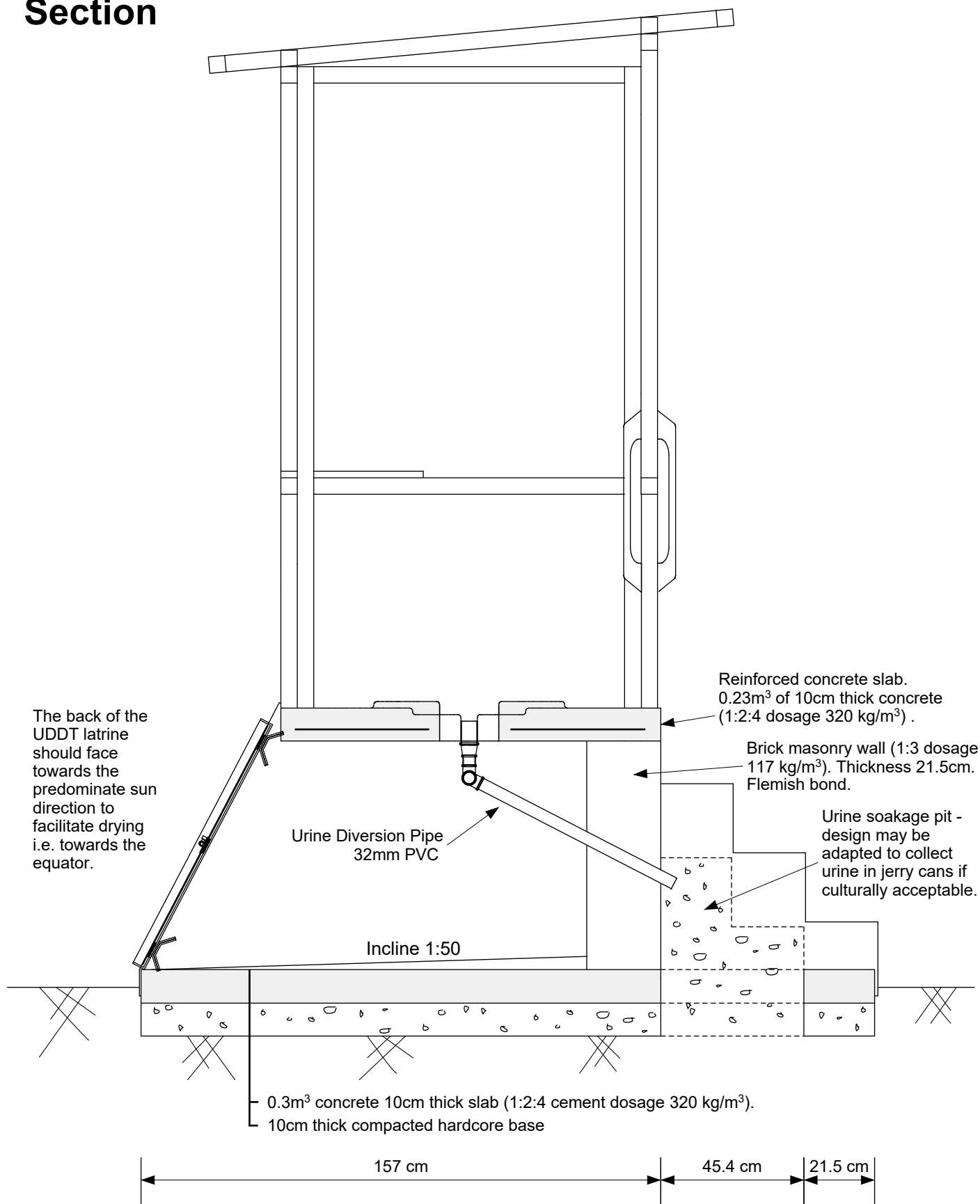
TITLE
Urine Diverting Dry Toilet
 Rear View
PROJECT
 Project Name, Country

DRAWN BY
 B. Harvey - 11/10/15
APPROVED BY
 M. Burt - 15/11/15

UNITS
 metres
SHEET
 2 of 6
DATE PUBLISHED
 15/11/15



Section



NOTES

1. Ensure base slab and vault squatting slabs are kept damp and out of direct sunlight for at least 7 days.
2. Plaster external brickwork with 7mm cement mortar (1 part cement to 3 parts coarse sand).

D-45

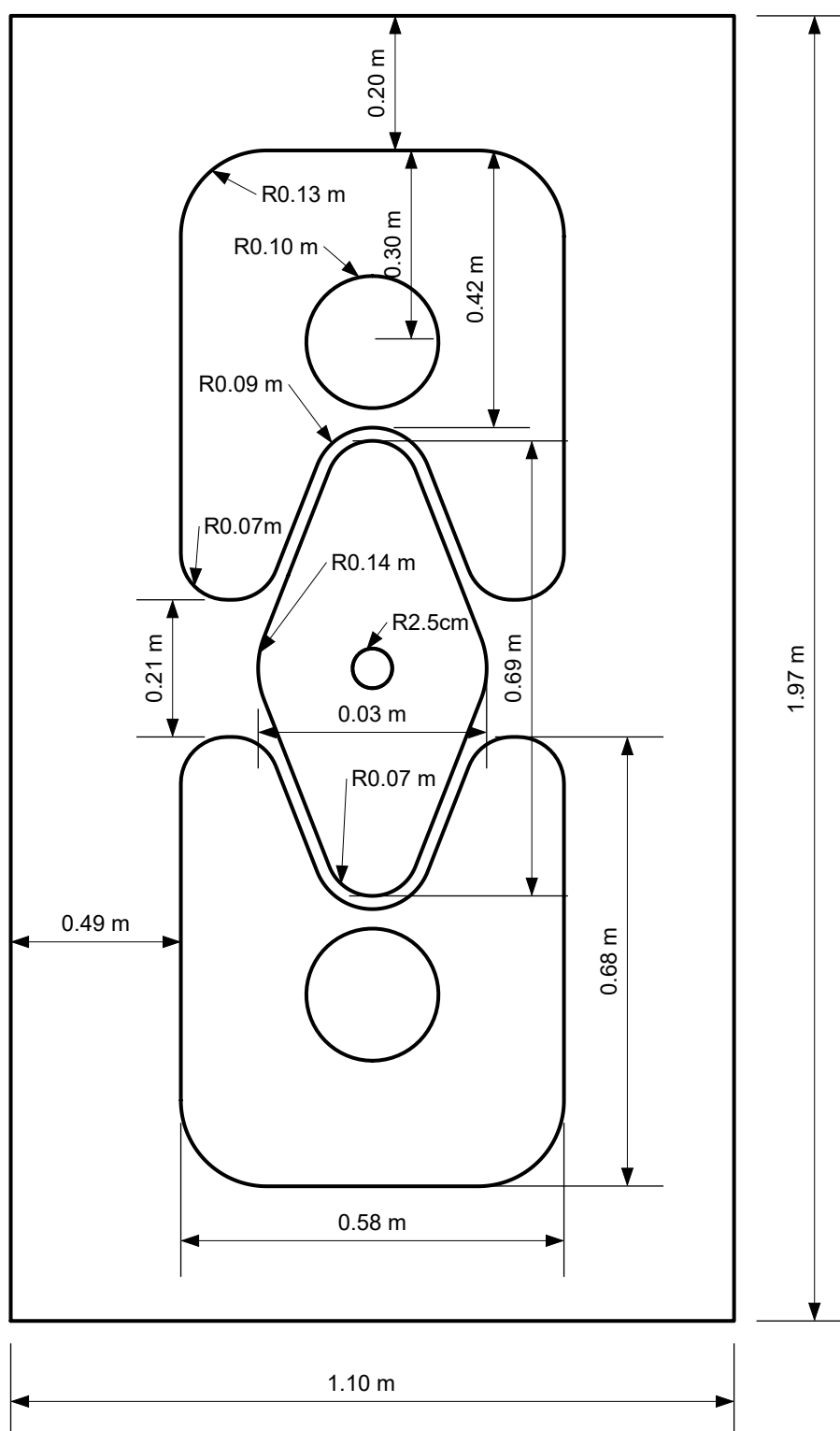
TITLE
Urine Diverting Dry Toilet
Section
PROJECT
Project Name, Country

DRAWN BY
B. Harvey - 11/10/15
APPROVED BY
M. Burt - 15/11/15

UNITS
metres
SHEET
3 of 6
DATE PUBLISHED
15/11/15

 **UNHCR**
The UN Refugee Agency

Keyhole Template



NOTES

1. The keyhole template should be made from 2cm thick wooden board.
2. The shape of the foot rests should ideally be cut out using a jig-saw or other fine saw blade.
3. The urine diversion well template should be cut out from an additional 2cm thick wooden board and screwed to the larger template.
4. The final height of the foot rests is 2cm above the UDDT slab. The urine diversion well is 2cm below the level of the UDDT slab.

D-45

TITLE

Urine Diverting Dry Toilet
Keyhole Template

PROJECT

Project Name, Country

DRAWN BY

B. Harvey - 11/10/15

APPROVED BY

M. Burt - 15/11/15

UNITS

metres

SHEET

4 of 6

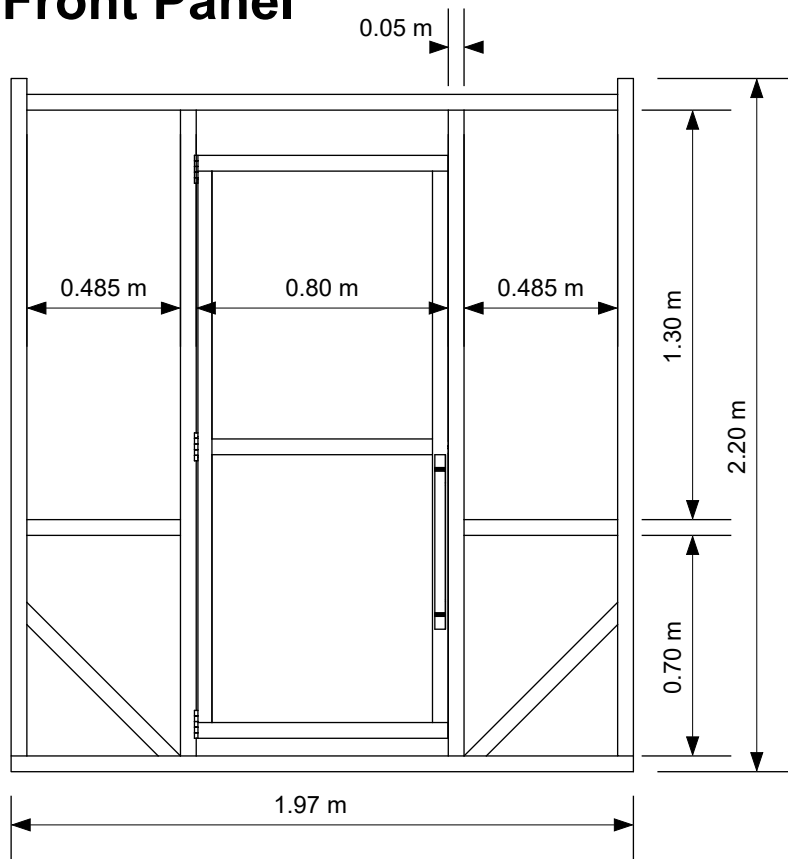
DATE PUBLISHED

15/11/15

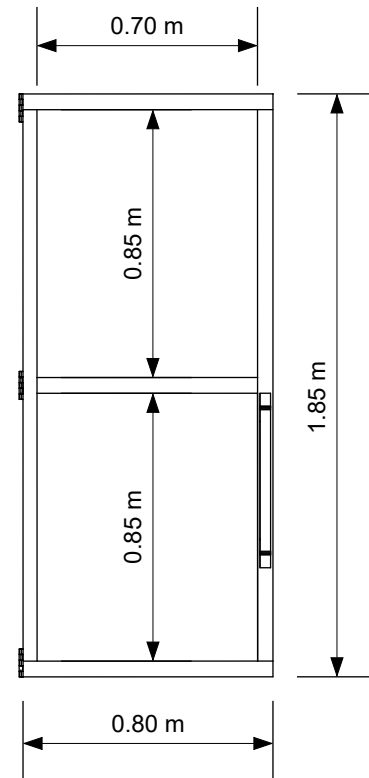


UNHCR
The UN Refugee Agency

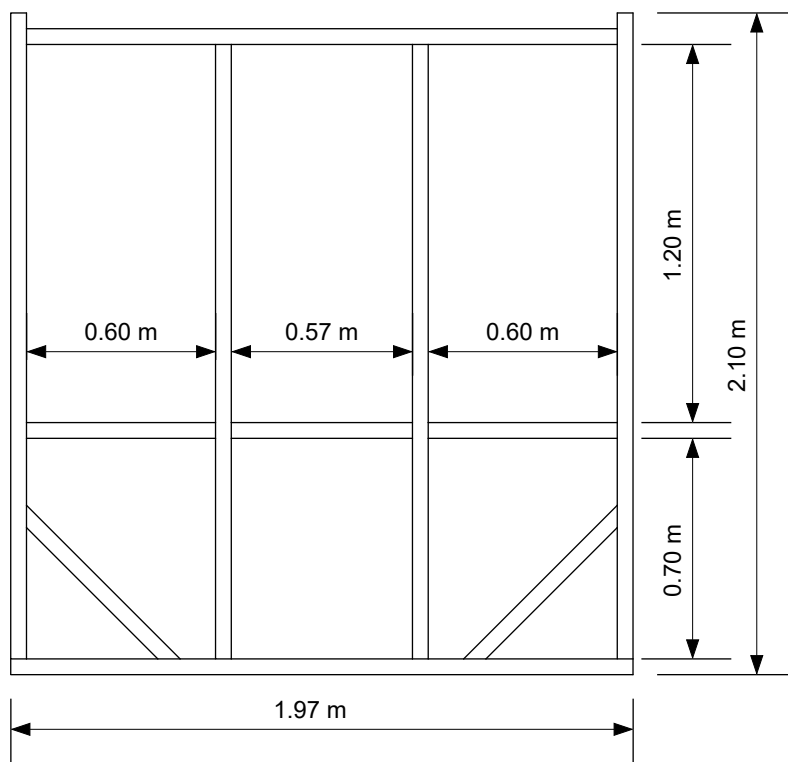
Front Panel



Door Detail



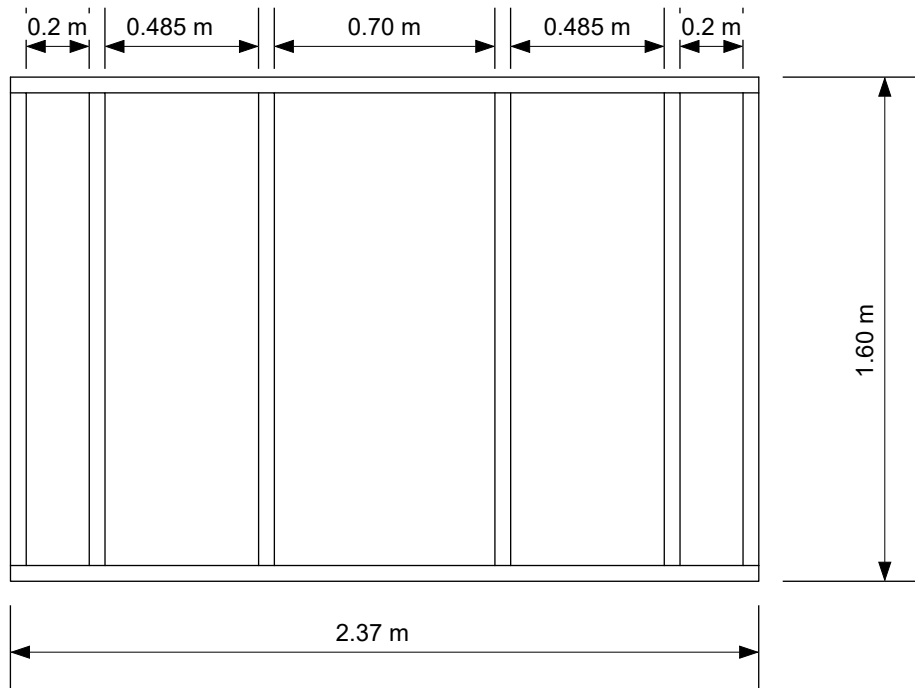
Rear Panel



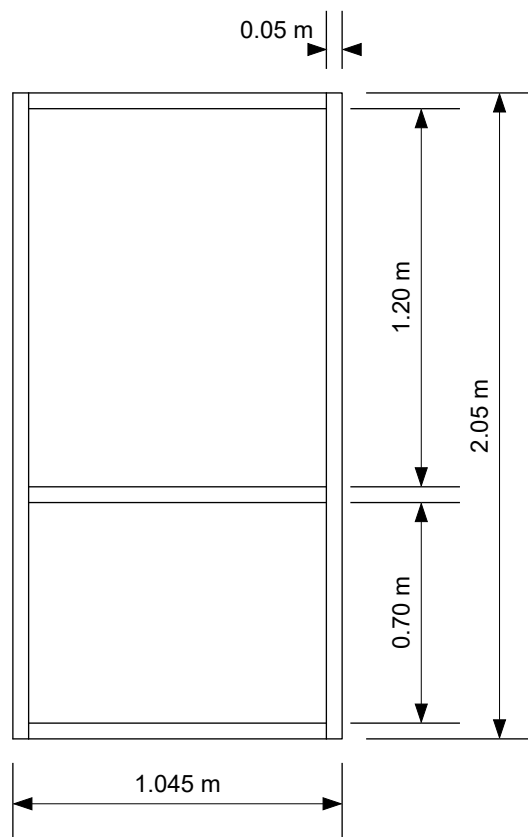
NOTES

1. All doors hung straight and level.
2. All doors equipped with three (3) hinges at least 50cm long. All screw holes filled with screws. Nails not permitted.
3. Maximum gap between door and frame 3mm. Maximum gap between door and floor 10mm.
4. All doors to be equipped with a long child friendly handle of at least 50cm length on both the inside and outside door faces.
5. All doors to be equipped with a child friendly and secure locking mechanism.

Roof Panel



Side Panels



x2

NOTES

1. Individual panels to be prepared in a dedicated mass production facility and transported to the assembly location.
2. Panels timbers to be joined either using galvanized screws or at least two (2) galvanized skewed nails at each connection location.
3. Panel-to-panel connections to be made using M10 bolts for ease of assembly, disassembly or movement to new locations.
4. All plastic sheeting to meet UN humanitarian standards (i.e. 200g/m² 700N tensile strength, UV stabilized laminated woven or braided mesh of black high density polyethylene between two white layers of low density polyethylene).

D-45

TITLE
Urine Diverting Dry Toilet
 Superstructure
PROJECT
 Project Name, Country

DRAWN BY
 B. Harvey - 11/10/15
APPROVED BY
 M. Burt - 15/11/15
SCALE
 1:24

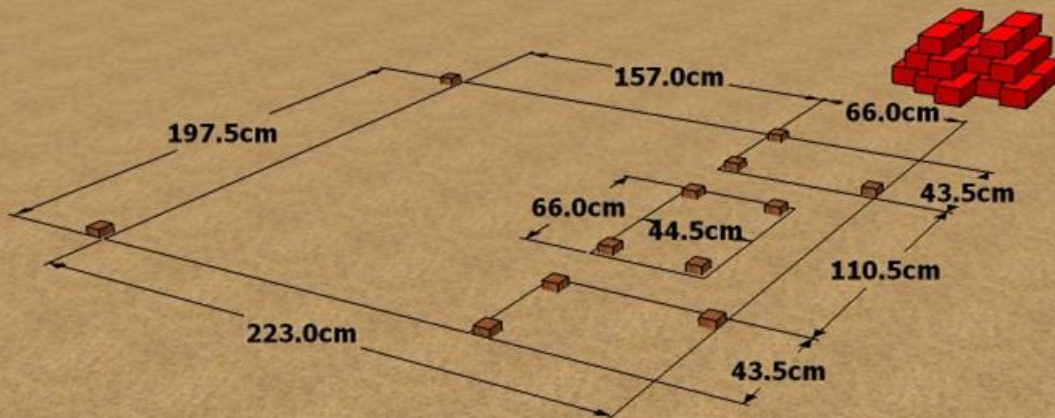
UNITS
 metres
SHEET
 6 of 6
DATE PUBLISHED
 15/11/15



Area of 2m x 2.25m to be cleared and perfectly leveled.

1.

Select an area within the plot as agreed with the owner.
To facilitate drying the back of the UDDT latrine should face towards the predominate sun direction i.e. towards the equator.



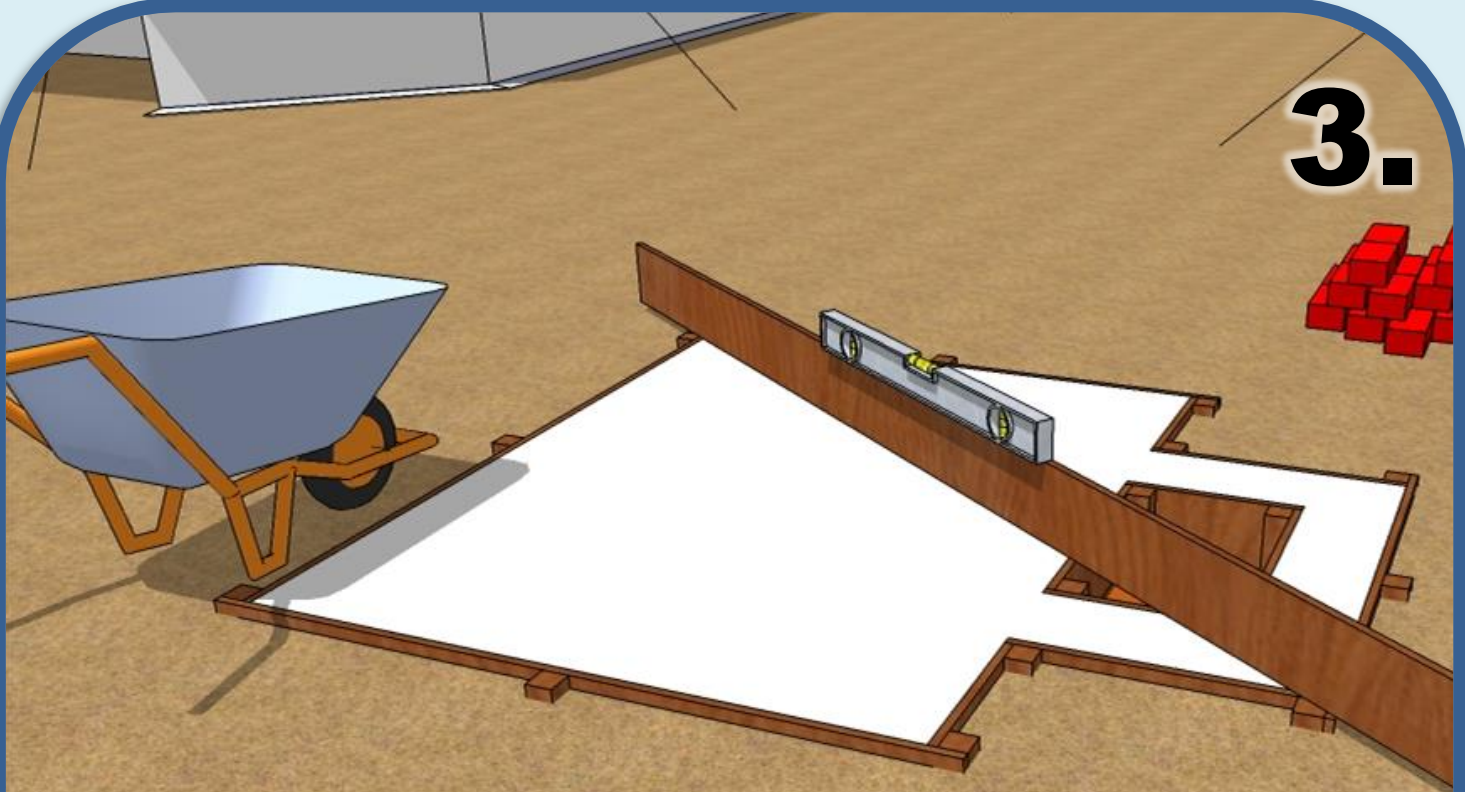
Corner posts 3cm above ground and exactly the same level.

2.



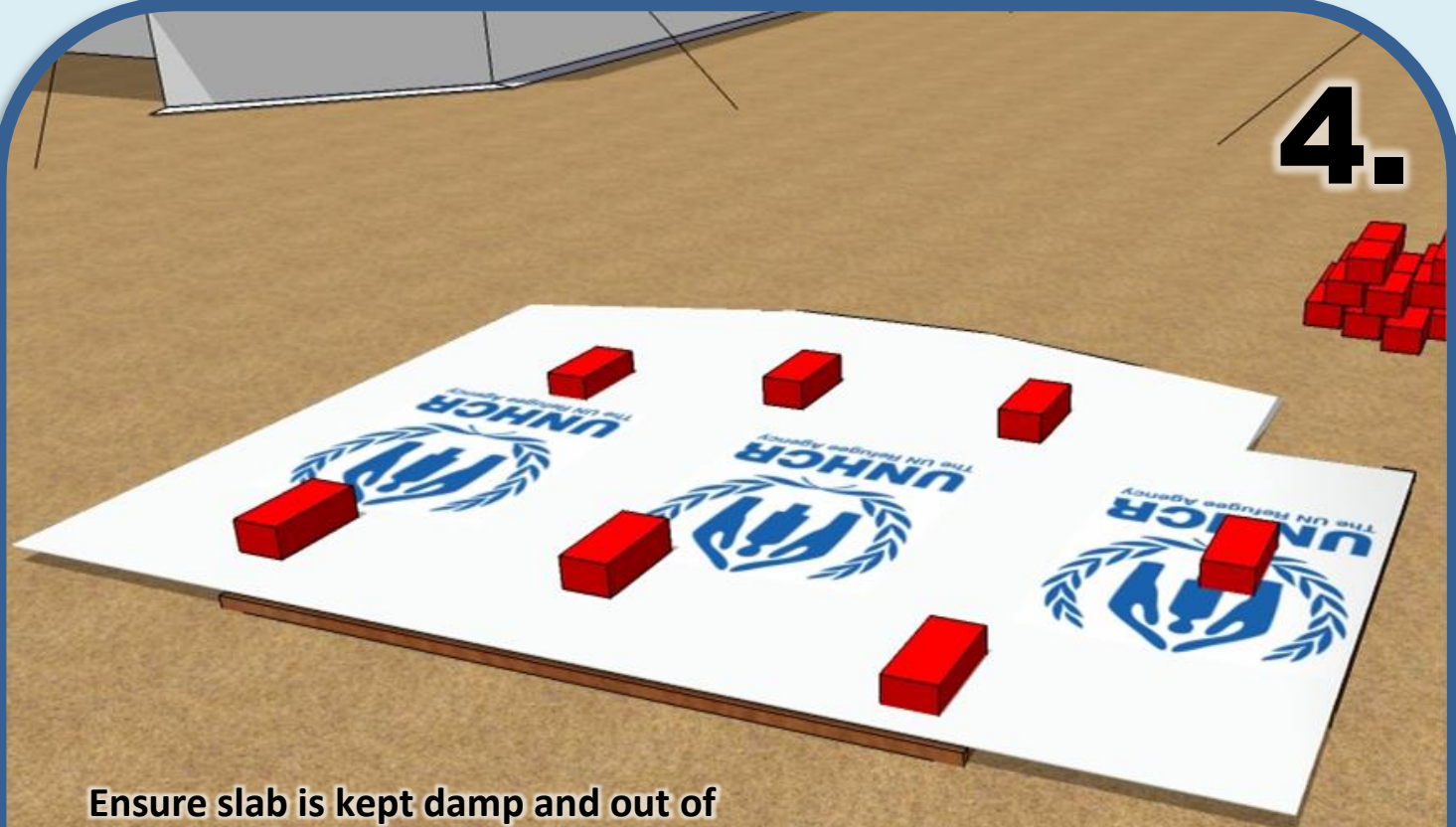
Excavate the base slab to a level 20cm below the top of the posts.
Install 20cm high wooden shuttering and backfill with 10cm crushed and compacted hardcore sub-base.
Ensure the external wooden shuttering is perfectly square and level.

3.



0.3m³ concrete 10cm thick slab (1:2:4 cement dosage 320 kg/m³).

4.

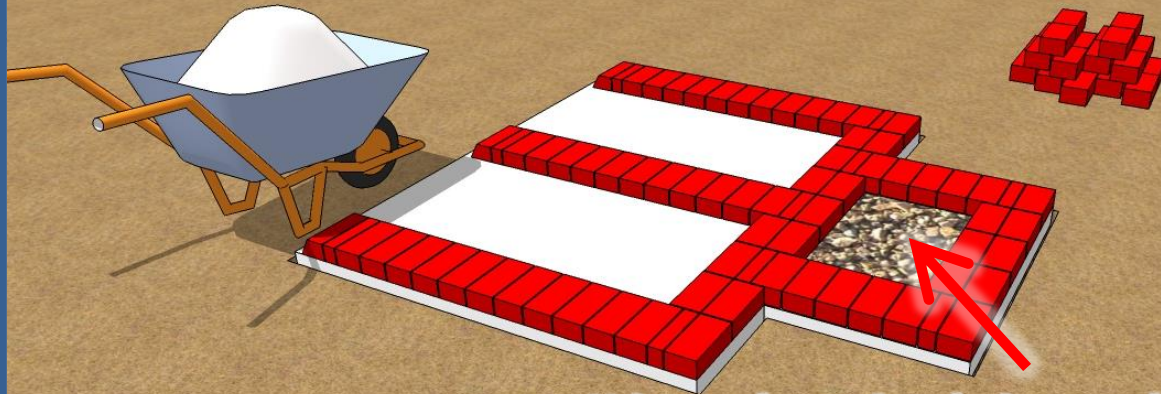


Ensure slab is kept damp and out of direct sunlight for at least 7 days.

Mortar (1 part cement to 3 parts coarse sand).

Soak bricks in water before placement.

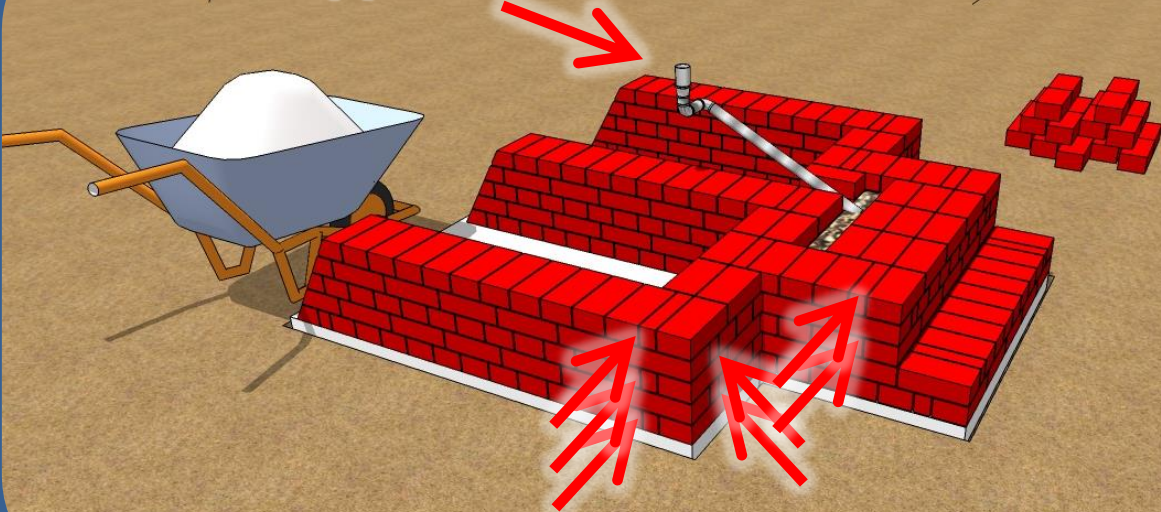
5.



Urine soakage pit – design may be adapted to collect urine in jerry cans if culturally acceptable.

Urine diversion pipe - UPVC

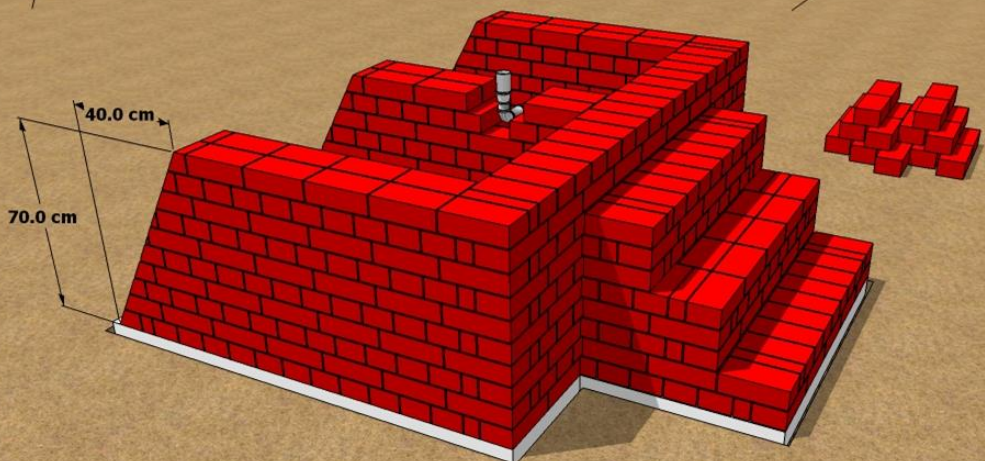
6.



Flemish bond – note the use of half bricks for a strong corner bond.

40.0 cm
70.0 cm

7.



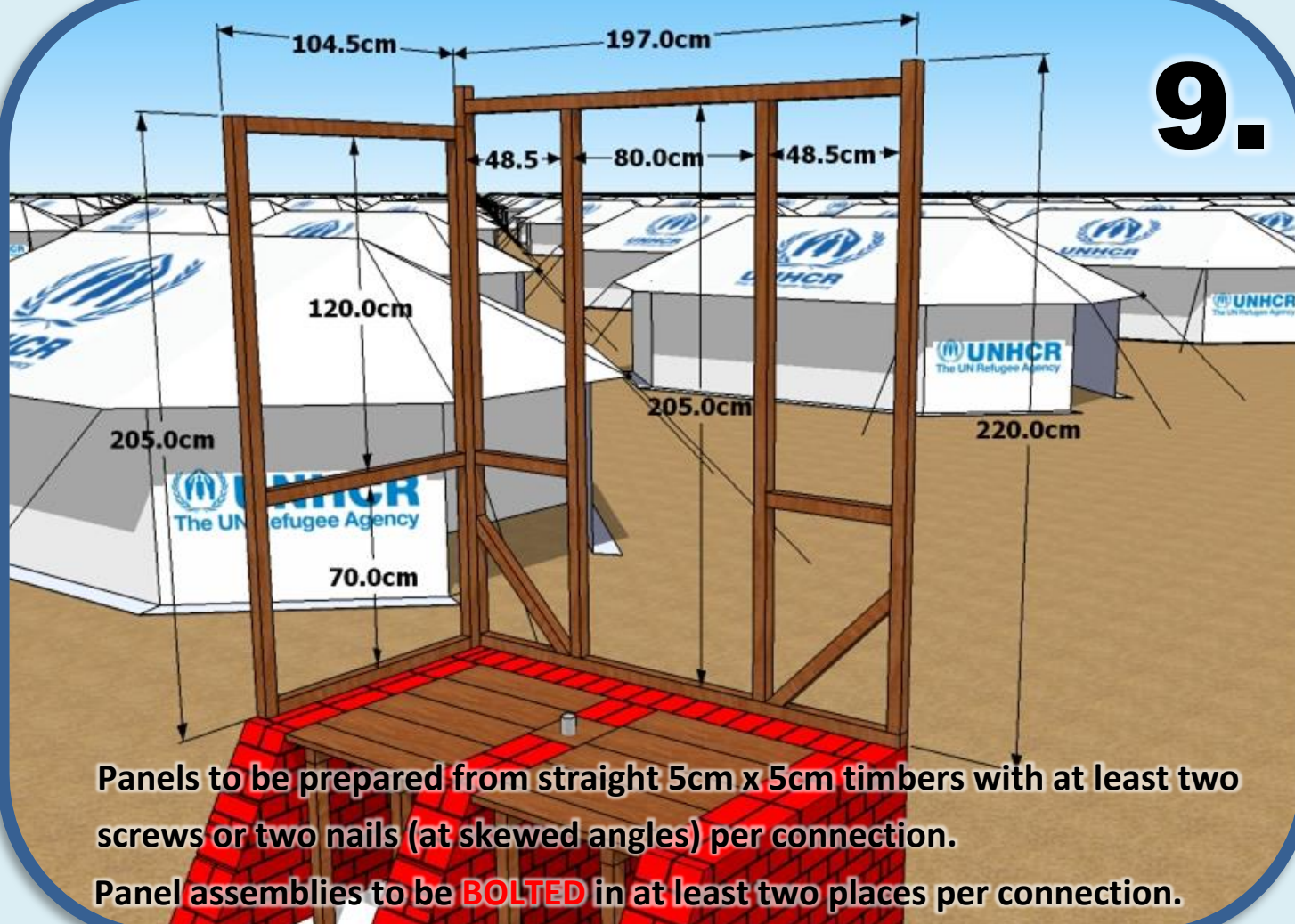
Build the vault walls to approximately 70cm high.

8.



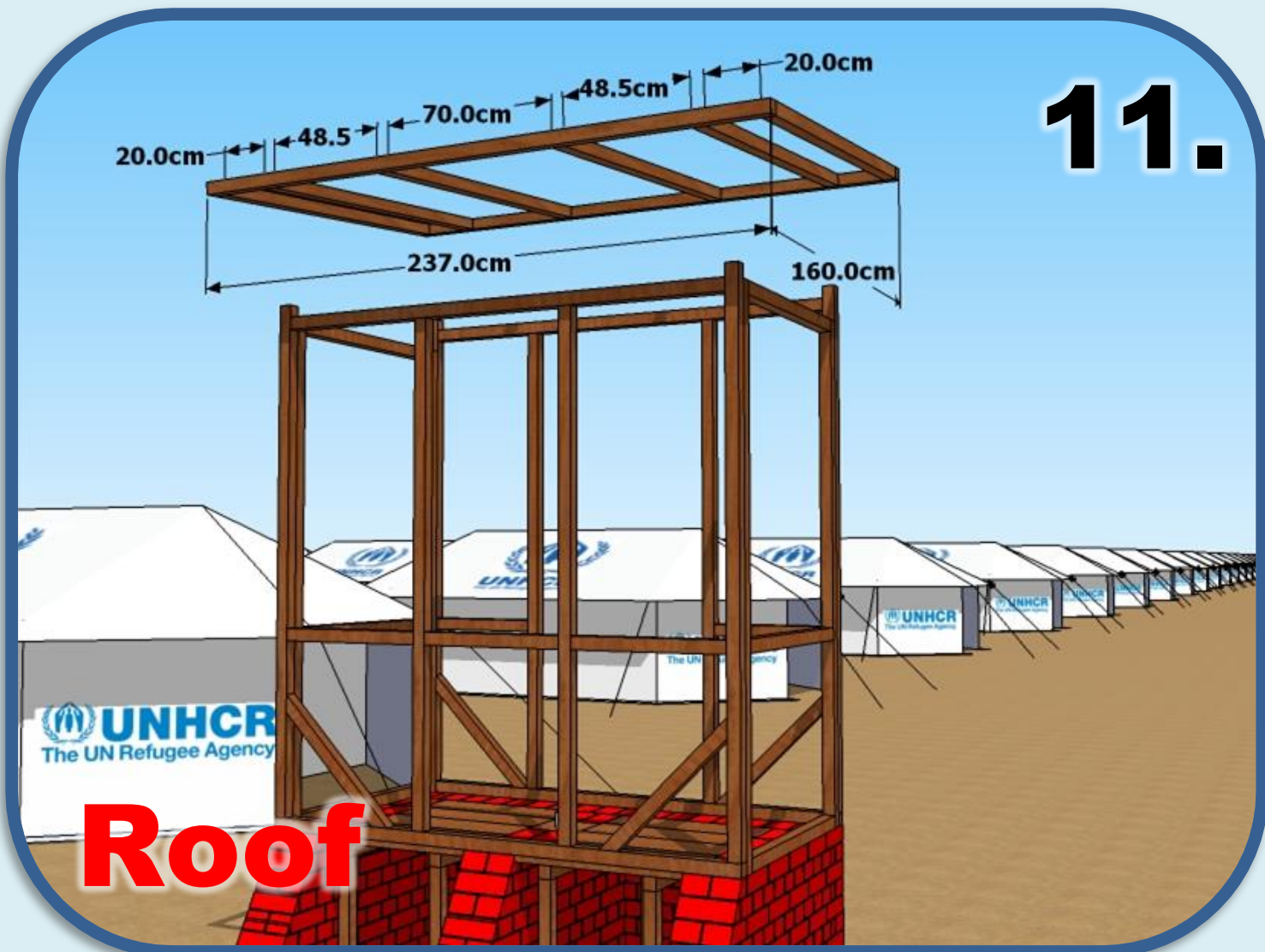
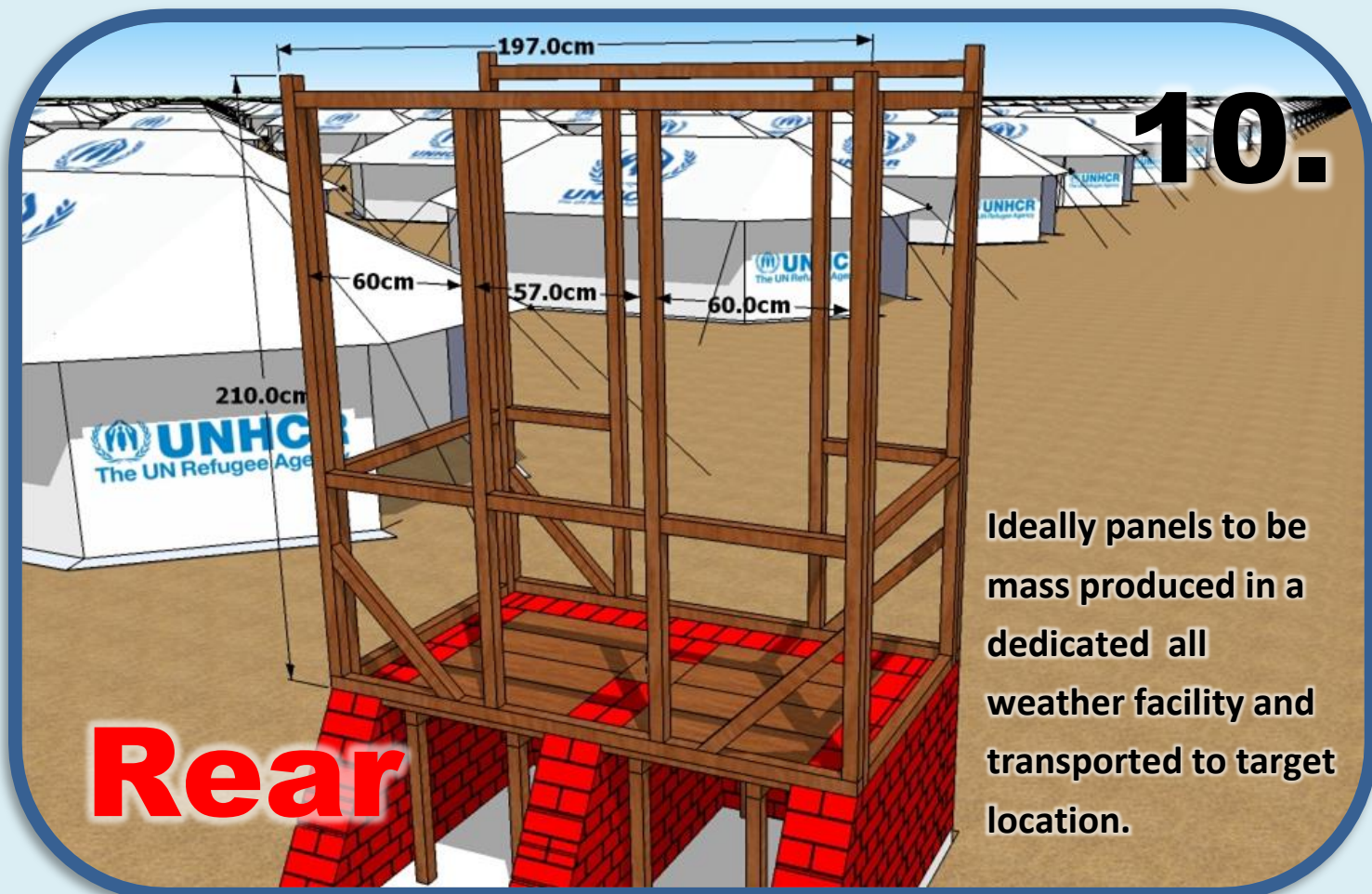
UDDT slab floor shuttering from 2,5cm (1") thick timbers with bracing capable of supporting 250kg of liquid concrete.

9.



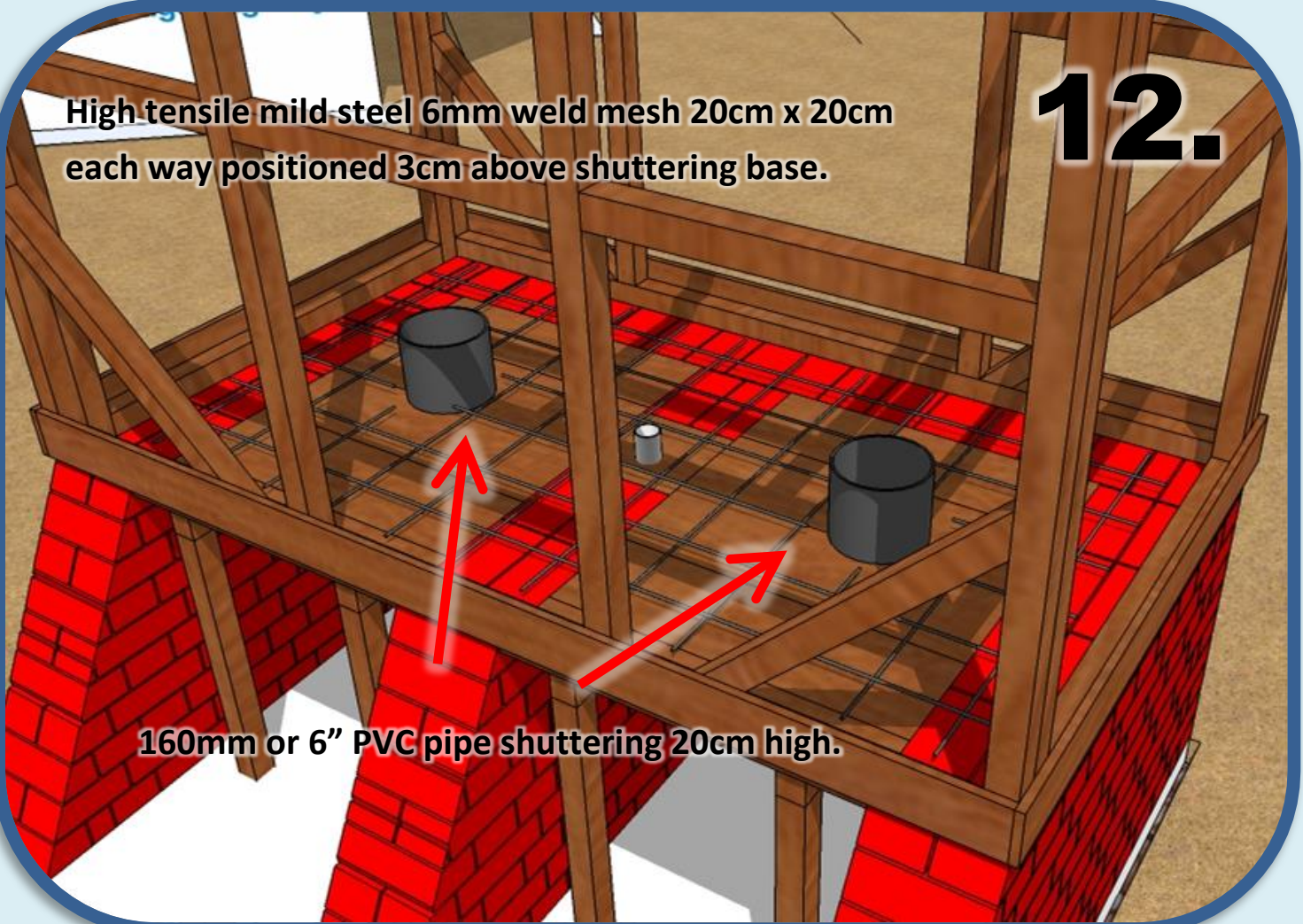
Panels to be prepared from straight 5cm x 5cm timbers with at least two screws or two nails (at skewed angles) per connection.

Panel assemblies to be **BOLTED** in at least two places per connection.



12.

High tensile mild-steel 6mm weld mesh 20cm x 20cm
each way positioned 3cm above shuttering base.



160mm or 6" PVC pipe shuttering 20cm high.

13.

0.23m³ of 10cm thick concrete (1:2:4 dosage 320 kg/m³).

Use keyhole template to form footrests and urine diversion bowl.



14.

70cm x 70cm x 3mm iron access cover attached to a 4cm x 4cm x 4mm angle iron frame with 3 hinges and locking mechanism.

Two coats of matt black paint to absorb solar radiation and promote drying.

14.

Plaster external faces with 7mm cement mortar
(1 part cement to 3 parts coarse sand).

15.

Plastic sheeting cladding may be used initially but should be upgraded to more durable materials e.g. GI sheeting or brick and mortar within 6 months.

Main door to be fitted with a padlock.

If plastic sheeting is used it should meet humanitarian standards i.e. 200g/m² 700N UV stabilized triple layer HDPE.

Vault access panels to be fitted with padlocks.

In cold climates, superstructure panels may be skinned on both sides with 3mm waterproof MDF, plywood, or wooden planks. Interior cavity to be filled with insulation foam or rock wool.



A bucket should be provided for additive material e.g. ash.

16.

Both squat holes should be covered with tight fitting wooden plugs. A color-code system should indicate which vault is currently in use.

Gap between door and floor < 10mm.

BILL OF QUANTITIES

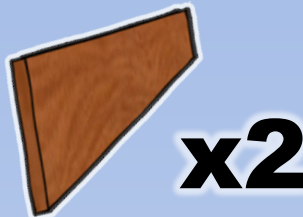
Description	QTY
Wooden Posts (4m x 5cm x 5cm)	18 pcs
Wooden Planks (4m x 20cm x 2.5cm)	2 pcs
Nails (10cm Galvanized)	½ kg
Domed Head Nails (4cm Galvanized)	½ kg
Galvanized Iron Sheeting (3.0m x 0.85m) British Gauge 28	11 pc
Bricks (6.5cm x 10.5cm x 21.5cm)	682 pcs
Plastic Sheeting	4 m ²
Metal Bolts and Washers (M10 x 12cm)	12 pcs
Metallic Door Bolt (4cm Galvanized)	1 pc
Metallic Door Hinge (4cm x 8cm x 2mm Galvanized)	3 pcs
Wooden Grab Rails and Door Handles (Minimum 50cm Length)	4 pcs
Urine Diversion Pipe Assembly (32mm PVC)	1 pc
Metallic Vault Doors (70cm x 70cm) 3mm Iron	2 pcs
High Tensile Steel Weld Mesh 6mm x 20cm x 20cm	2.0 m ²
Coarse Sand	0.6 m ³
Coarse Gravel (6mm – 10mm)	0.2 m ³
Cement (50kg sacks)	4 sacks

Bill of Quantities

1. Wooden Posts (pc)
5cm x 5cm x 4m



2. Wooden Planks (pc)
2.5cm x 20 cm x 4m



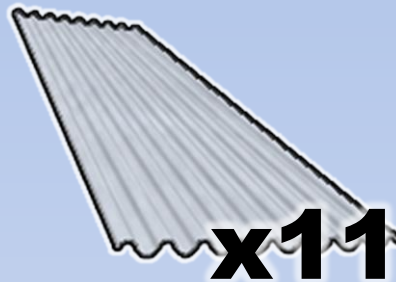
3. Nails 10cm (kg)



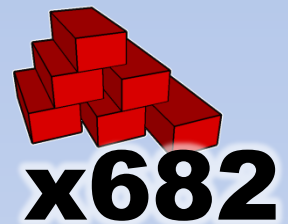
4. Domed Head Nails 4cm (kg)



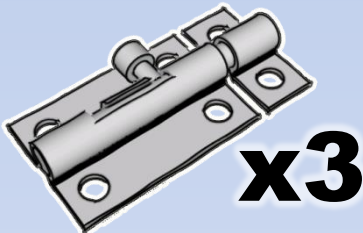
5. GI Sheetting 3m x 0.85m BG28 (pc)



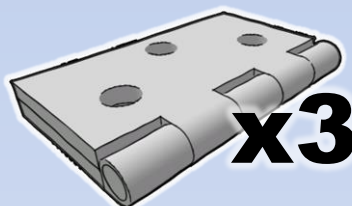
6. Bricks 10.5cm x 6.5cm x 21.5cm (pc)



7. Door Bolt 4cm (pc)



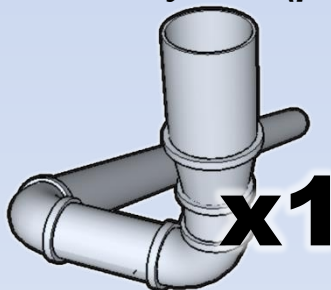
8. Door Hinge (pc)
4cm x 8cm



9. Metal Bolts + Washers
M10 x 12cm



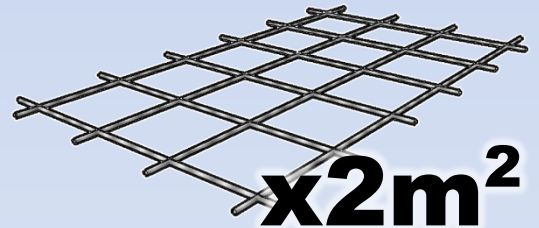
10. Urine Diversion Pipe Assembly PVC (pc)



11. Vault Doors 70cm x 70cm x 3mm Iron (pc)



12. Steel Weld-Mesh
6mmØ x 20cm x 20cm



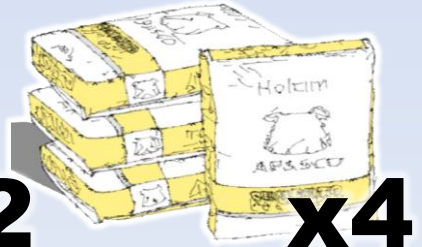
13. Sand (m3)



14. Gravel (m3)



15. Cement 50kg (sacks)



SPECIFICATIONS FOR TOILET CONSTRUCTION IN REFUGEE SETTINGS

400 SCOPE

- 400.1 These design guidelines specifically define the quality of materials and workmanship to be used when constructing toilets in refugee settings. A description of principles of excreta management programmes in addition to excreta management technical options and their advantages and disadvantages can be found in the UNHCR WASH Manual.

401 SITE SELECTION

- 401.1 A basic requirement is that the site selected for the toilet facility is free from the risk of high winds, flooding, subsidence, or erosion.

402 PREVENTION OF SURFACE OR GROUND WATER CONTAMINATION

- 402.1 UNHCR and WASH actors must ensure that all excreta containment systems including any pits, tanks, lagoons, sewerage or soakaway do not contaminate surface water or shallow groundwater sources.
- 402.2 All excreta management systems must be located at least 30 metres away from groundwater sources. The bottom of any pit or soak-away must be at least 1.5m above the highest average groundwater table level. These distances should be increased for fissured rocks and limestone.
- 402.3 In some situations temporary groundwater contamination from on-site excreta management systems may not be of immediate concern if the groundwater is non-potable. An example of this can be found in coastal areas where groundwater is heavily saline beyond drinking water health limits of $1,500\mu\text{S}/\text{cm}^2$. In all cases, local legislation should be respected.

403 GUIDELINES FOR PIT REINFORCEMENT

- 403.1 All toilet pits should have an upper reinforcement ring of either: wooden beams, wooden trunks, brick masonry or concrete to evenly spread the load of the superstructure and raise it above ground level by at least 15cm to avoid water entering the pit.
- 403.2 Any toilet built on soft, sandy or collapsing soils should have a brick or concrete lined pit to at least 1m below the ground surface or greater if the soil is still unstable. Any desludgable toilet should have a fully lined pit that is able to withstand repeated evacuation. Safety should be of the utmost consideration when manually excavating pits. In soft soils, pit walls should be adequately cross-braced and excavation must never exceed 2.0m depth.

404 GUIDELINES FOR TOILET SLAB STRENGTH

- 404.1 The toilet slab and supporting beams must be sufficiently strong to support to support the weight of users and should not flex or give the user reason to doubt its strength. Support beams should span at least 50cm into each of the pit walls.
- 404.2 Wooden, concrete or plastic slabs should be tested with the weight of 6 persons before use. Concrete slabs should be reinforced regardless of their type. Wooden planks, trunks and beams should be free from insect attack of any kind with no other defects which would affect its strength. Wooden structures in contact with the ground should be treated with used engine oil or diesel to deter termites.

405 GUIDELINES FOR TOILET SLAB ANCHORAGE

- 405.1 Latrine slabs should be firmly anchored in place. If plastic latrine slabs are used they should be firmly attached to the support structure either through the use of sufficiently long nails, bolts with washers, metal stakes, or heavy gauge wire.

406 GUIDELINES FOR SANITARY SEALING

- 406.1 In all toilet installations there should be no visible gaps between the squat plate and the pit walls either through the use of at least 50cm of tamped clay or 30cm of concrete sanitary seal.

407 GUIDELINES FOR THE USE OF PLASTIC SHEETING

- 407.1 Plastic sheeting used in toilet super structures should meet the international minimum humanitarian standards (i.e. 200g/m² 700N tensile strength, UV stabilized laminated woven or braided mesh of black high density polyethylene between two white layers of low density polyethylene). Plastic sheeting is typically supplied as sheets 6m x 4m or in rolls 4m x 50m long. Before using plastic sheeting consider if there are more suitable durable materials available locally.
- 407.2 Plastic sheeting should be attached to wooden toilet frames using domed head nails, or standard nails with either wooden battens or some other form of load spreading structure (e.g. bottle tops). The most effective way of attaching plastic sheeting to a wooden frame is to wrap it around a wooden batten and then nail the batten to the support structure. Nails spacing should be no more than every 30cm. Some humanitarian plastic sheeting contains reinforcing bands of grey colour and nails should pass through these bands.
- 407.3 Plastic sheeting should be securely fixed to the ground by wrapping the edge in a wooden post and burying it to at least 40cm deep. If rope is attached to plastic sheeting it should either be attached through a reinforced eyelet or it should be tightly tied around a knot in the plastic sheeting itself.



- 407.4 The use of plastic sheeting toilet superstructures is an emergency solution and must be phased out after the first six months of any response. Flaps of plastic sheeting should never be used as toilet doors.

408 GUIDELINES FOR TOILET DOORS

- 408.1 Every toilet door should be hung straight and vertical with no more than 3mm gap between both sides of the door and the door frame and a maximum 10-20mm gap between the door and floor. All doors should open and close properly without fouling on the floor or door frame.
- 408.2 Each door should have at least three hinges of good quality heavy duty steel at least 50mm long, and every hole in the hinges should be filled with a screw of at least 4cm length.
- 408.3 All doors should be fitted with a long upright handle of at least 50cm length on the inside and the outside that allows both children from 3 years of age and adults to open and close the toilet. A simple to use yet secure internal locking device should be installed that is positioned for use by children and adults (such as a metal bolt).

409 GUIDELINES FOR COMMUNAL TOILET PRIVACY WALLS

- 409.1 Privacy walls should be installed completely around all female toilet facilities. Solid wooden fencing posts of at least 3m length should be installed every 4m to a depth of at least 1m. Wooden braces should be used every 5 posts and at corners. Small holes of 2 or 3cm should be cut in the plastic sheeting every 20cm to reduce wind load and deter theft. A double privacy screen with a small gap may be required in some cultures and contexts where there is a risk of people creating peep holes. Care should be taken on steep ground and a privacy roofing structure may be required to prevent onlookers.

410 GUIDELINES FOR VECTOR CONTROL MEASURES

- 410.1 UNHCR and WASH actors should ensure that the toilet design eliminates fly and mosquito breeding. All vent pipes should be fitted with galvanized metal fly screens. Toilet cubicles should be kept

shaded with lightly sprung self-closing doors. If the toilet is not of the VIP design, tightly fitting closable lids should be used.



411 GUIDELINES FOR RAIN AND STORMWATER PROTECTION

- 411.1 The ground directly around the outside of the toilet facilities should be backfilled and compacted to slope outwards and prevent surface water entering or eroding the toilet facilities. A drainage ditch at least 30cm deep should be installed around the WASH services to minimize external surface water entering the block.

412 GUIDELINES FOR ADDITIONAL WASH BLOCK ACCESSORIES

- 412.1 Small modifications to toilet blocks can greatly increase the dignity of users. UNHCR and WASH actors should ensure that all toilet cubicles are equipped with either hooks or shelves so that users are able to hang additional clothes or possessions off the floor when using the facilities. If possible, the relatively cheap addition of a mirror can greatly improve the experience of using WASH facilities.

413 COLLECTION OF ANAL CLEANSING AND SANITARY MATERIALS

- 413.1 UNHCR and WASH actors should ensure that provision is made for the separate collection and disposal of used anal cleaning materials or women's sanitary material if there is a risk they may block or damage the toilet infrastructure or any desludging equipment. This also has the added advantage of extending the life of the system.

414 MATERIAL SPECIFICATIONS OF COMMON CONSTRUCTION MATERIALS

- 414.1 Gravel used for constructing concrete toilet slabs must be clean and free from mud, dust and plant material. UNHCR and WASH actors must ensure that only aggregates between 6mm and 10mm are used to prevent inter granular crack propagation across the thin toilet slab and to ensure an adequate covering under bars.
- 414.2 Sand used for latrine slabs should be coarse (no fines), clean and free from mud, dust and plant material.

- 414.3 Water should be non-saline and free from organic matter.
- 414.4 Bricks should be fully burnt (ringing sound when two bricks are hit together), of consistent shape and size and should be sufficiently strong (crush test) with a high proportion of clay.
- 414.5 Cement must be fresh (manufactured in the last three months) dry, and should be stored in a safe, dry, place at least 15cm off the ground. Toilet slabs should be cast with a 1:1.5:3 concrete mixture. Care should be taken to ensure that the mixture is not over watered (bucket slump test should show no greater than ¼ reduction in the slump height). Cast slabs should be immediately covered with straw, cement bags, sacking or leaves to keep the concrete moist and cool. The concrete should be cured with frequent watering at least twice daily for at least 10 days before use.
- 414.6 Reinforcement bars should be free from rust and of the correct type and size for concrete construction work (typically a characteristic yield stress of at least 210 N/mm²). Steel reinforcement should be placed on the lower side of the slab (the part in tension) with at least 12mm concrete covering under every bar. Reinforcement should be laid in both directions. Where the slab is rectangular, the bars parallel to the smaller span should be below the bars reinforcing the greater span. All slabs (even domed Mozambican style) must be reinforced with the correct diameter and spacing (see box below).

**Box: Spacing of mild steel bars
for concrete toilet slabs**

	65mm Slab		80mm Slab	
Span	Ø 6mm	Ø 8mm	Ø 6mm	Ø 8mm
1.00m	150mm	250mm	150mm	250mm
1.25m	150mm	250mm	150mm	250mm
1.50m	125mm	200mm	150mm	250mm
1.75m	75mm	150mm	125mm	200mm
2.00m	50mm	125mm	75mm	150mm

Source: Franceys, Pickford & Reed (1992)
'Guide to the development of on-site sanitation'.
World Health Organization, Geneva.

415 HANDWASHING STATIONS DESIGN CONSIDERATIONS

- 415.1 UNHCR and WASH actors must plan for at least one functional hand washing dispenser per communal or public toilet block, ensuring at least one handwashing dispenser for every five toilet cubicles. Handwashing dispensers should be conveniently located within 10m of each toilet exit and their use should be actively promoted. The water dispensing device and soap must be located within easy reach of all users, especially children. Liquid soap, or bars attached to string,

may be used if there is soap theft. All handwashing units that use bars of soap should have a fixed self-draining dish where the soap can be placed between use without getting dirty or becoming mislaid.

- 415.2 Hand-washing water storage containers should be sized to hold at least half a day of hand-washing water. To conserve water and avoid wastage, the hand-washing taps may need to be restricted with orifice plates to flows of 50 cubic centimetres per second (0.05 litres per second). Calculation of the total volume of hand-washing water required should be based on 0.5 to 1.0 litre of water per person per day. Hand washing reservoirs must be covered to prevent contamination or vector breeding.

416 SOAKAGE PIT SIZING BASED ON SOIL INFILTRATION RATES

- 416.1 Soakage pits for WASH infrastructure should be sized according to the expected daily wastewater production rates, the local soil infiltration capacity, and the type of wastewater that will be generated. Soil infiltration capacities should be determined locally based on the procedure in Appendix 20 of Engineering in Emergencies. Alternatively refer to the table of typical soil infiltration rates on page 213 of the UNHCR WASH Manual. Soil infiltration rates should be adjusted to take into account whether the soakage pit will be used to dispose of relatively clean or contaminated wastewater. To ensure longevity, all soakage pit that are likely to be used to dispose of wastewater containing grease (e.g. from washing of cooking utensils) should be equipped with a grease trap.

417 ENVIRONMENTAL CONSIDERATIONS FOR SOURCING WOOD

- 417.1 Ensure that all supplies of wood for household latrine slabs, latrine superstructures, privacy screens, and latrine brick production has been procured from sustainable sources outside of the refugee camp environment.

418 DECOMMISSIONING

- 418.1 The toilet should be decommissioned when the level of excreta is within 50cm of the surface (DO NOT WAIT FOR THE PIT TO FILL TO THE SURFACE OF THE LATRINE SLAB). The superstructure should be removed and the pit should be back-filled with earth to a height of approximately 50cm to allow for settlement. Approximately 10 kg of lime may be used per cubicle to help neutralize the pH of the pit and assist in decomposition and drying. Where possible, quick growing plants or trees should be planted on the site to assist with drying of the pit.

419 UNHCR STANDARD TOILET DESIGNS FOR REFUGEE SETTINGS

419.1 The following drawings should be used in conjunction with these technical design guidelines.

D-40/2015a	Communal Trench Latrine (Poles + Plastic) – EMERGENCY
D-41/2015a	Communal Trench Latrine (Wood + Plastic) – EMERGENCY
D-42/2015a	Communal Raised Latrine (Wood + Plastic) – EMERGENCY
D-43/2015a	Standard Household Toilet / Bathing Unit (1 Family, Dome Slab)
D-44/2015a	Household Raised Toilet (1 Family, Dome Slab, + Bathing)
D-45/2015a	Urine Diverting Dry Toilet (UDDT)

USEFUL REFERENCES

- ◆ ACF (2005), 'Water, sanitation and hygiene for populations at risk – second edition'. ACF, Paris, France.
http://www.actioncontrelafaim.org/publications/fichiers/wsh_acf_0.pdf
- ◆ Bastable A. (2000). 'Guidelines for excreta disposal in emergencies. An Oxfam Technical Manual'. Oxfam GB, Oxford, UK.
http://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/OXFAM/OXF7%20-%20Guidelines%20for%20exceta%20disposal%20%20in%20emergencies.PDF
- ◆ CAWST (2011) 'Introduction to low-cost sanitation'. Centre for Affordable Water and Sanitation Technology CAWST, Calgary, Canada.
http://resources.cawst.org/system/files/Sanitation_Manual_2011-02_en.pdf
- ◆ Franceys, Pickford & Reed (1992) 'Guide to the development of on-site sanitation'. World Health Organization, Geneva. http://whqlibdoc.who.int/publications/1992/9241544430_eng.pdf
- ◆ Harvey P. A (2007) 'Excreta disposal in emergencies: A field manual'. WEDC, Loughborough University, UK. <http://www.unhcr.org/4a3391c46.html>
- ◆ Harvey P. A., Baghri S. and Reed R. A. (2002) 'Emergency sanitation – assessment and programme design'. WEDC, Loughborough University, UK.
<http://reliefweb.int/sites/reliefweb.int/files/resources/2533D212287DCAC6C1256D780035CC8D-lou-water-02.pdf>
- ◆ Lambert, R., and Davis, J. (2002), 'Engineering in emergencies 2nd Ed.', Register of Engineers for Disaster Relief (RedR), London.
- ◆ Obika A. (2004) 'Catalogue of low cost toilet options'. WEDC, Loughborough University, UK. <http://www ircwash.org/sites/default/files/Obika-2004-Catalogue.pdf>
- ◆ PEN (2010). 'Philippine emergency sanitation reference toolkit (excreta disposal)'. Philippine Ecosan Network, Manilla.
http://www.sswm.info/sites/default/files/reference_attachments/PEN%202010%20Philippine%20Emergency%20Sanitation%20Reference%20Toolkit.pdf
- ◆ Reed R. A. (2010) 'Emergency excreta disposal standards and options for Haiti'. DINEPA and Global WASH Cluster, Haiti.
http://wedc.lboro.ac.uk/resources/pubs/Emergency_EDS_and_options_for_Haiti.pdf
- ◆ Tilley, E (2008) 'Compendium of sanitation systems and technologies', SANDEC and EAWAG, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland.
http://www.eawag.ch/forschung/sandec/publikationen/compendium_e/index_EN
- ◆ Van den Noortgate J., Maes P. (2010) 'Public health engineering in precarious situations – second edition'. MSF, Brussels.
http://refbooks.msf.org/msf_docs/en/public_health_en.pdf

D-45/2015a

- ◆ USAID (1982) 'Designing aqua privies. Water for the world technical brief', USAID, Washington USA.
<http://www.lifewater.org/resources/san1/san1d4.pdf>
- ◆ USAID (1982) 'Designing latrine pits. Water for the world technical brief', USAID, Washington USA.
<http://wiki.watermissions.org/GetFile.aspx?Page=Simple%20Excreta%20and%20Washwater%20Disposal%20SAN1&File=san1c2.pdf>
- ◆ USAID (1982) 'Designing latrine slabs. Water for the world technical brief', USAID, Washington USA.
<http://wiki.watermissions.org/GetFile.aspx?Page=Simple%20Excreta%20and%20Washwater%20Disposal%20SAN1&File=san1d1.pdf>
- ◆ USAID (1982) 'Simple methods of excreta disposal. Water for the world technical brief', USAID, Washington USA.
[http://wiki.watermissions.org/\(S\(qmdltna0sc2kvjumvmak4z45\)\)/GetFile.aspx?Page=Simple%20Excreta%20and%20Washwater%20Disposal%20SAN1&File=san1m1.pdf](http://wiki.watermissions.org/(S(qmdltna0sc2kvjumvmak4z45))/GetFile.aspx?Page=Simple%20Excreta%20and%20Washwater%20Disposal%20SAN1&File=san1m1.pdf)
- ◆ WHO (2005) 'Emergency sanitation - planning'. Technical notes for emergencies #13'. World Health Organization, Geneva.
http://www.who.int/entity/water_sanitation_health/publications/2011/WHO_TN_13_Planning_for_excreta_disposal_in_emergencies.pdf
- ◆ WHO (2005) 'Technical options for excreta disposal in emergencies'. Technical notes for emergencies #14'. World Health Organization, Geneva.
http://www.who.int/water_sanitation_health/publications/2011/tn14_tech_options_excreta_en.pdf?ua=1