

FOOTING CATALOGUE

V1. November 2018

The footing catalogue is a supporting document to the Transitional Shelter Assistance (TSA) Technical Guidance. It has been developed based on the ARUP technical guidance note 01: Wind Loading for the Design of Upgraded Emergency Shelters¹, Mid-term Shelters and Community Structures and the Wind Loading Tool developed by University of Bath².

In this document different footing options that can be used in TSA are presented. Those footings have been tested for uplift³. Other footing options can be developed and used if they meet the following requirements:

- Minimum depth: 2' + plinth height (6") = total 2'6"
- Minimum elevation of bamboo from the floor level: 2"
- Minimum number of bolts to connect bamboo: 2 (bamboo node has to be in between the bolts)
- Minimum uplift force to be resisted: 700kg (based on a shelter size of 22m² and 9 footings)
- Removable by using hand tools only
- Minimum life span: 3 years
- Maximum cost: 1,200BDT

One of the most crucial factors is extensive soil compaction during and after installation of footings. Compaction is extremely important as it increases soil shear strength, density and reduces porosity.

Prior to provision of any footings (including the ones included in the catalogue) a workshop with the community needs to be conducted to

ensure that the community is 'comfortable' using the footings selected, knows how to properly install them, maintain them and why are they being used. It is strongly advisable to develop IEC⁴ in the Rohingya language for the type of footing provided; showing:

- Purpose of footings
- Position of the footing in the shelter
- Depth of the footing
- Protection of the shelter structure during installation (*removal of the existing posts*)
- Process of installation and compaction of the footing
- Fastening bamboo to the footing
- Footing maintenance (*checking for rust, cracks, termite tunnels, unfastening of bolts...*)

It is essential to provide training to all beneficiaries receiving TSA, technical assistance and labour support is essential for EVIs and advisable for all other beneficiaries.

The footing catalogue is a live document. New footings developed, tested and meeting requirements can be included.

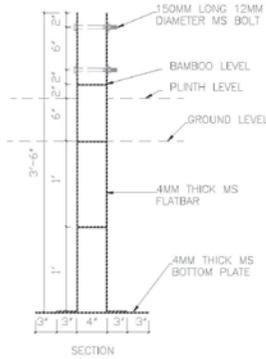
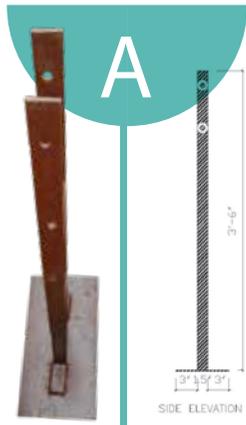
Testing of the footings and development of this catalogue was made possible with support of University of Bath, Caritas/CRS, DRC, IOM, MEDAIR/World Concern and Save the Children.

¹ ARUP Technical Guidance Note 01, available at: <https://www.humanitarianresponse.info/en/operations/bangladesh/document/wind-loading-design-shelters>

² Bath University; Wind Loading Tool, available at: <https://drive.google.com/file/d/1ckLS4y5pREW2aAA8GMavN6voPpptwrHN/view?usp=sharing>

³ Temporary testing site in Camp 5.

⁴ IOM developed ToT - Shelter Improvement and Maintenance includes a section on footings which can be taken as reference to develop further IEC.



Cost: 10-13.5\$ | 850-1000 BDT

Material specifications

Mild steel flat bar:

Width: 38mm | Thickness: 4mm | Holes: 14mm diameter

Base plate: 400x200x4mm

Painted with at least 2 layers of red oxide primer

Bolts: 2 no. of Mild steel 12mm diameter full thread bolts of length 150 mm, matching nuts and 4 washers (2 per bolt)

Uplift resistance: 900kg

Life span: 3-5 years (when coated with red oxide primer)

Complexity of production: **Easy. One material, welding needed. Skilled labour needed.**

Location of production: **Can be produced in or out of camps. Electricity is needed.**

Complexity of installation: **Medium. When installing on existing structure the structure has to be propped. Compaction is essential.**

Maintenance: **Medium. Frequently observe the area where footing is in the contact with the ground. Scrape off any rust and paint it with the red oxide.**

Are of use: **Not to be used in the areas with high water table, close to the water bodies and in areas with high salt content (Shamlapur).**

Transport: **Easy to transport**

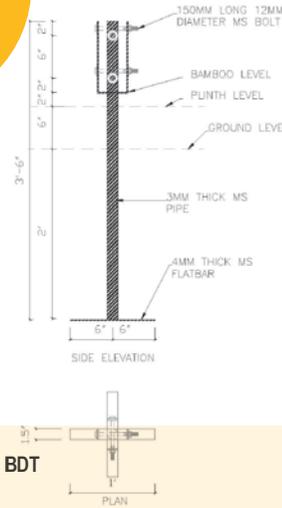
Advantages/disadvantages:

→light and easy to carry

→easy to prefabricate and install

→Footings will rust and lose their strength, potentially failing dramatically (short life span)

→The rusty metal can also present a risk of injuries



Cost: 10-13.5\$ | 850-1000 BDT

Material specifications

Mild steel flat bar:

Width: 38mm | Thickness: 4mm | Holes: 14mm diameter

Pipe:

Diameter: 50 mm inner | Pipe Wall thickness: 3 mm

Painted with at least 2 layers of red oxide primer

Bolts: 4 no. of Mild steel 12mm diameter full thread bolts of length 150 mm, matching nuts and 8 washers (2 per bolt)

Uplift resistance: 800kg

Life span: 3-5 years (when coated with red oxide primer)

Complexity of production: **Medium. Two materials, welding needed. Skill labour needed.**

Location of production: **Can be produced in or out of camps. Electricity is needed.**

Complexity of installation: **Medium. When installing on existing structure the structure has to be propped. Compaction is essential.**

Maintenance: **Medium. Frequently observe the area where footing is in the contact with the ground. Scrape off any rust and paint it with the red oxide.**

Are of use: **Not to be used in the areas with high water table, close to the water bodies and in areas with high salt content (Shamlapur).**

Transport: **Easy to transport**

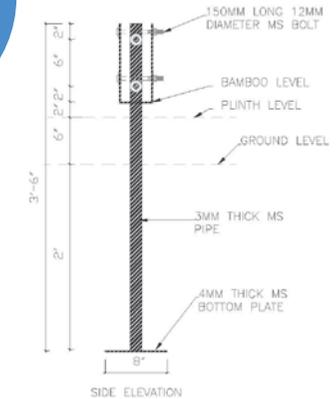
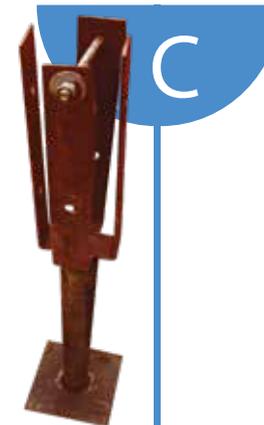
Advantages/disadvantages:

→light and easy to carry

→easy to prefabricate and install

→Footings will rust and lose their strength, potentially failing dramatically (short life span)

→The rusty metal can also present a risk of injuries



Cost: 10-13.5\$ | 850-1000 BDT

Material specifications

Mild steel flat bar:

Width: 38mm | Thickness: 4mm | Holes: 14mm diameter

Pipe: Mild Steel | Diameter: 50 mm inner

Pipe Wall thickness: 3 mm

Painted with at least 2 layers of red oxide primer

Bolts: 4 no. of Mild steel 12mm diameter full thread bolts of length 150 mm, matching nuts and 8 washers (2 per bolt)

Uplift resistance: 800kg

Life span: 3-5 years (when coated with red oxide primer)

Complexity of production: **Medium. Two materials, welding needed. Skill labour needed.**

Location of production: **Can be produced in or out of camps. Electricity is needed.**

Complexity of installation: **Medium. When installing on existing structure the structure has to be propped. Compaction is essential.**

Maintenance: **Medium. Frequently observe the area where footing is in the contact with the ground. Scrape off any rust and paint it with the red oxide.**

Are of use: **Not to be used in the areas with high water table, close to the water bodies and in areas with high salt content (Shamlapur).**

Transport: **Easy to transport**

Advantages/disadvantages:

→light and easy to carry

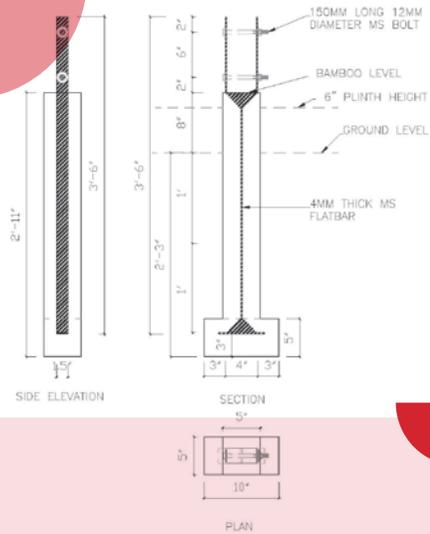
→easy to prefabricate and install

→Footings will rust and lose their strength, potentially failing dramatically (short life span)

→The rusty metal can also present a risk of injuries



D



Cost: 12-13.5\$ | 1000-1100 BDT

Material specifications

Mild steel flat bar:

Width: 38mm | Thickness: 4mm | Holes: 14mm diameter

Concrete: **Grade 15 - ratio 1:2:4, w-c ratio not more than 0.64 (32 litres per 50 Kg bag of cement)**

Cement: OPC Grade 43 (1 part) | Sand: Washed coarse sand (2 parts)

Aggregate: First class brick aggregate 20 mm size (4 parts)

Flat bars protruding from concrete painted with at least 2 layers of Red oxide primer

Bolts: 2 no. of Mild steel 12mm diameter full thread bolts of length 150 mm, matching nuts and 4 washers (2 per bolt)

Uplift resistance: 1000kg | Life span: 5 years

Complexity of production: **Complex. Two materials, welding needed. Electricity and water needed. Strict quality control is essential.**

Location of production: **Advisable to make it in the close proximity of distribution sites as transport might cause cracking.**

Complexity of installation: **Medium. When installing on existing structure the structure has to be propped. Good compaction is essential.**

Maintenance: **Easy. Frequently observe stirrups for rust. Scrape off any rust and paint with red oxide.**

Are of use: **Anywhere.**

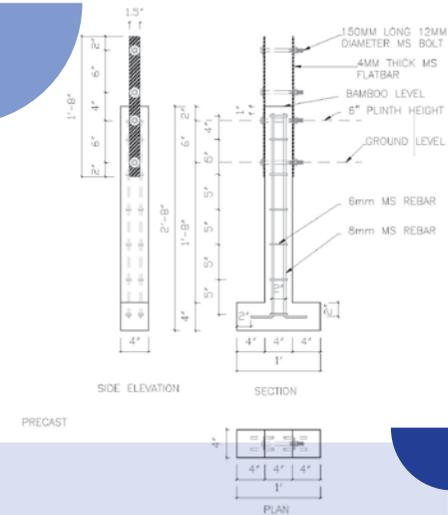
Transport: **Medium - footings are heavy.**

Advantages/disadvantages:

- Long life span
- Low maintenance
- Good quality of the concrete and proper curing time as well as curing process are essential and need to be closely monitored
- Footings of poor quality will fail.
- Footings are heavy and difficult to transport



E



Cost: 13.5-14.5\$ | 1100-1200 BDT

Material specifications

Re-bar:

8mm MS Re-bar 60 grad | stirrups 6mm MS Re-bar 60 grad

Mild steel flat bar: 2 no., 38mm x 4mm, 20" long | Holes: 14mm diameter

Concrete: **Grade 15 - ratio 1:2:4, w-c ratio not more than 0.64 (32 litres per 50 Kg bag of cement)**

Cement: OPC Grade 43 (1 part) | Sand: Washed coarse sand (2 parts)

Aggregate: First class brick aggregate 20 mm size (4 parts)

Flat bars bolted to the concrete painted with at least 2 layers of Red oxide primer

Bolts: 4 no. of Mild steel 12mm diameter full thread bolts of length 150 mm, matching nuts and 8 washers (2 per bolt)

Uplift resistance: 1000kg | Life span: 5 years

Complexity of production: **Complex. Three materials, welding needed. Electricity and water needed. Strict quality control is essential.**

Location of production: **Advisable make it in the close proximity of distribution sites as transport might cause cracking.**

Complexity of installation: **Medium. When installing on existing structure the structure has to be propped. Good compaction is essential.**

Maintenance: **Easy. Frequently observe stirrups for rust. Scrape off any rust and paint with red oxide or replace stirrups.**

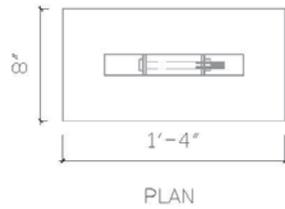
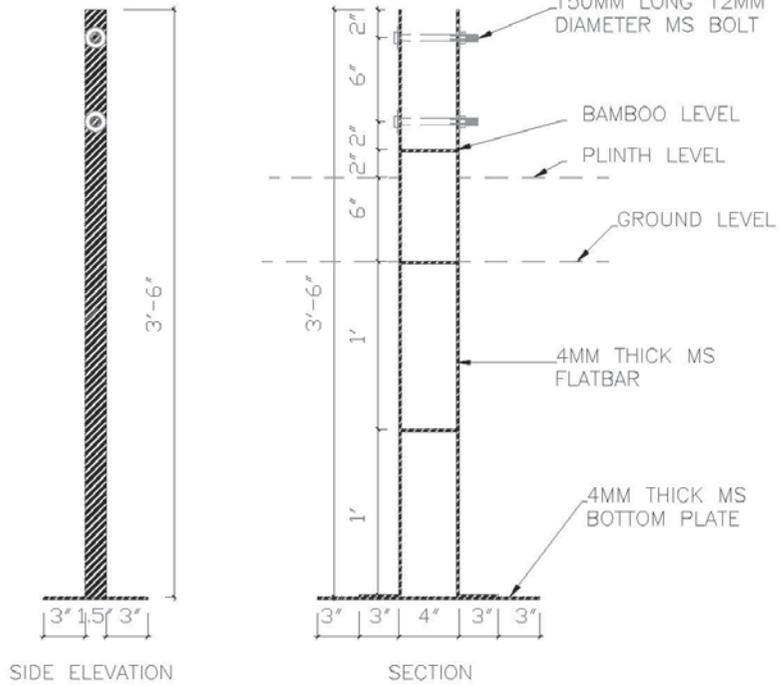
Are of use: **Anywhere.**

Transport: **Medium - footings are heavy.**

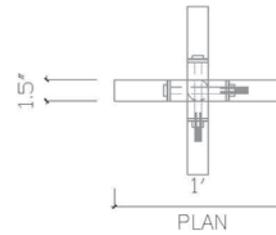
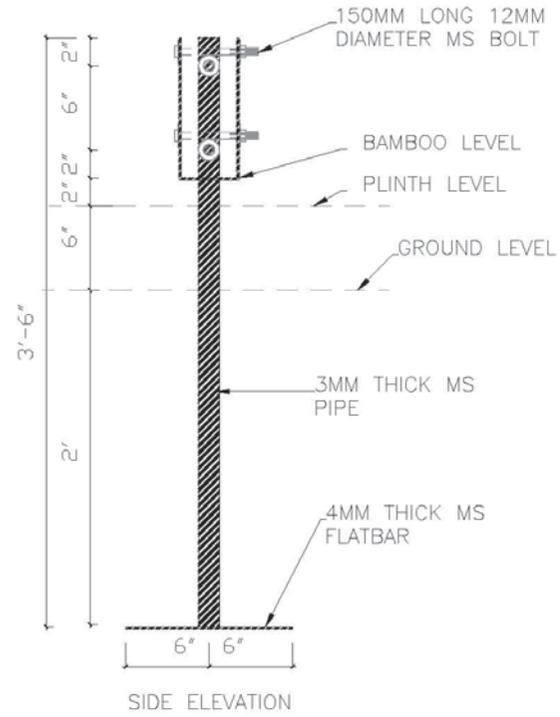
Advantages/disadvantages:

- Long life span
- Low maintenance
- Stirrups can be easily replaced if rusted
- Good quality of the concrete and proper curing time as well as curing process are essential and need to be closely monitored
- Footings of poor quality will fail.
- Footings are heavy and difficult to transport

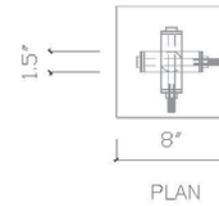
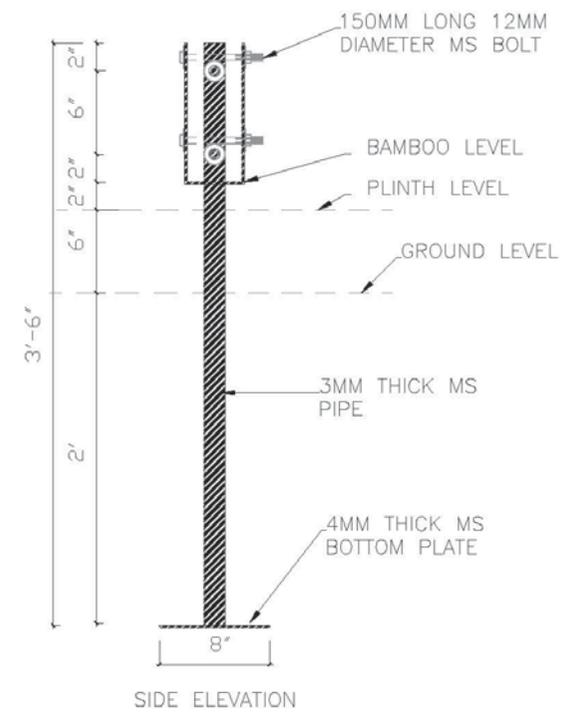
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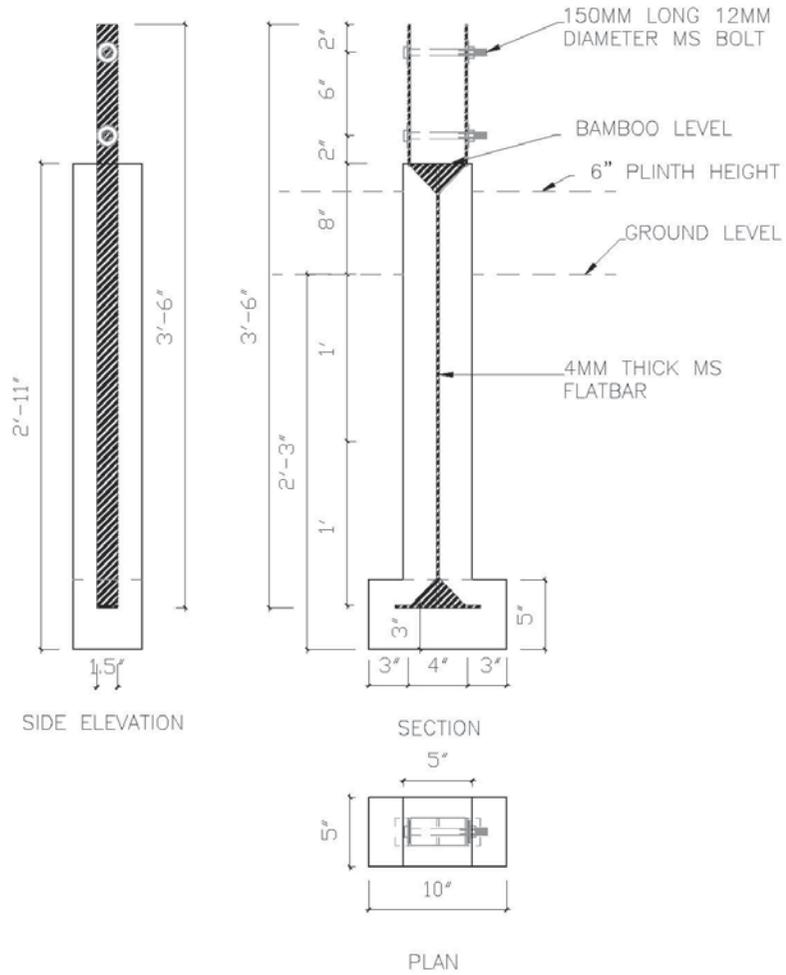
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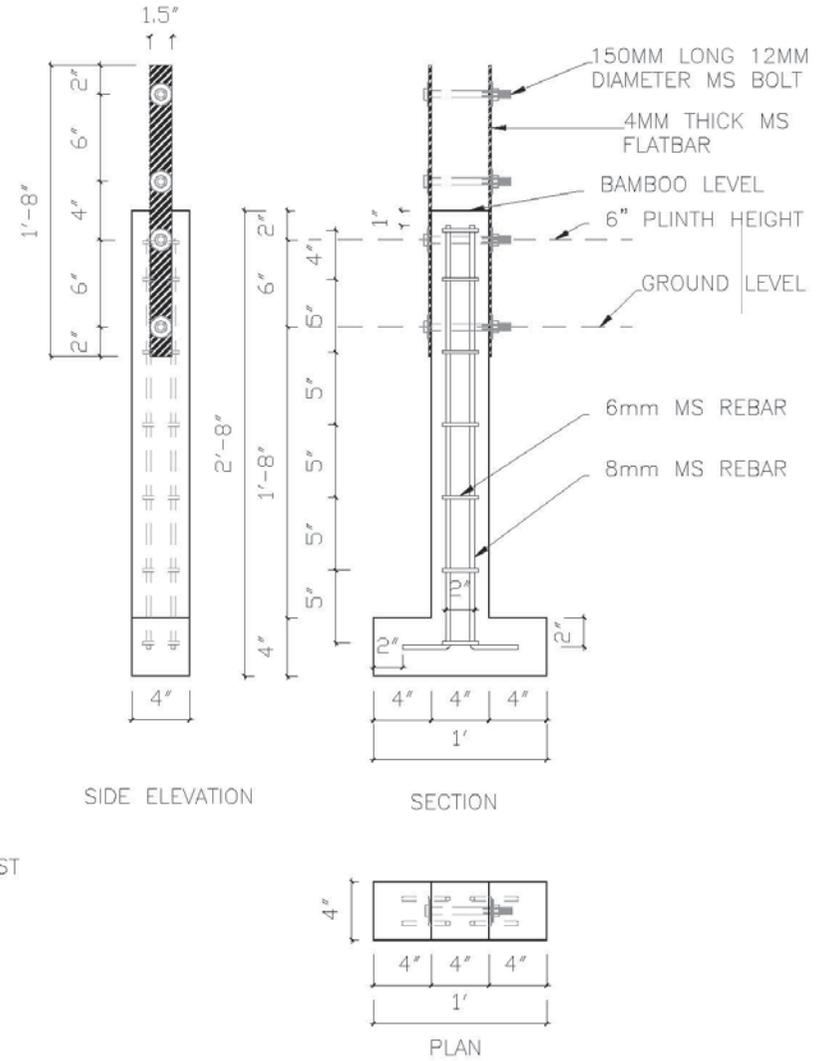
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D



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PRECAST