

Flood Fighting: Sandbag Procedures

What is a Sandbag Barrier?

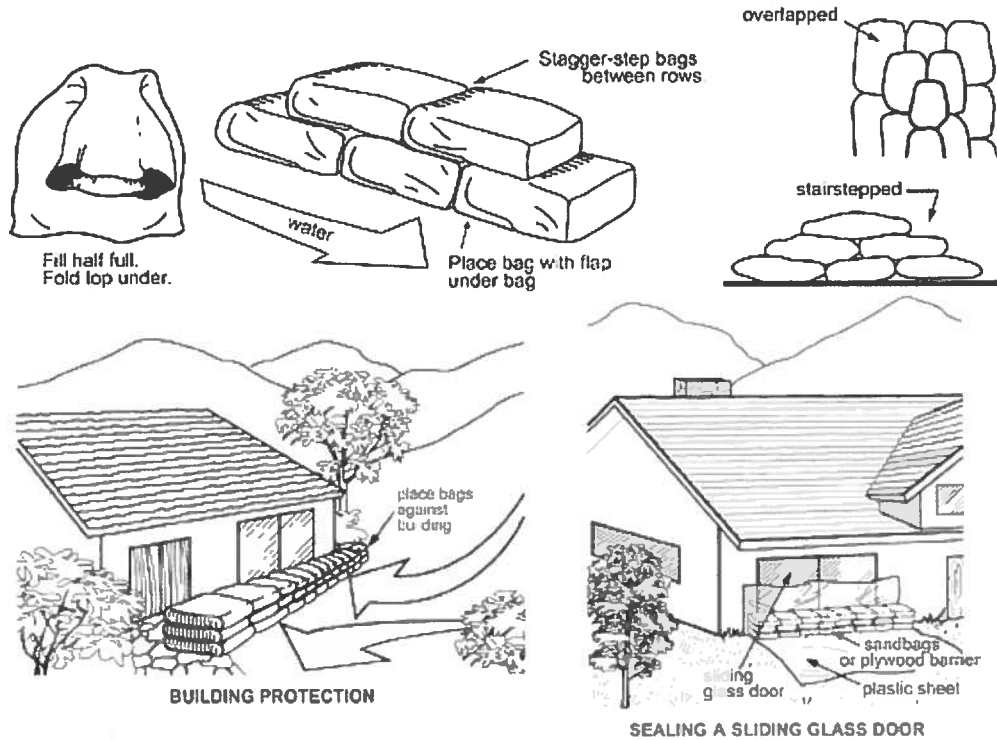
A sandbag barrier is an inexpensive, temporary barrier or wall, one to two feet high that is constructed by stacking sand-filled or earth-filled sandbags and placing them to divert mud and other debris flows away from buildings. However, these barriers do not provide protection from high debris flows.

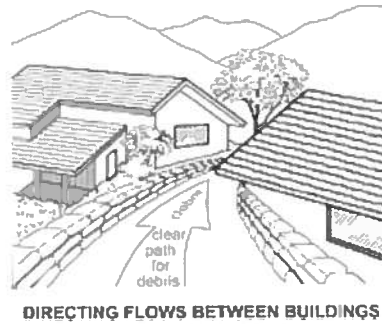
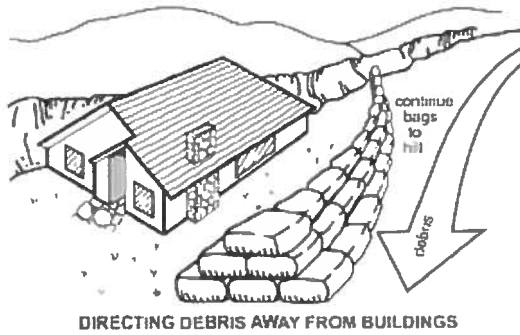
When is a Sandbag Barrier Used?

These barriers are used to protect building sites vulnerable to low mud debris flows from steep, erodible slopes that are partially or completely void of vegetation due to wildfire burns. This is an inexpensive, temporary protection method that can be used by homeowners before predicted rainfall. Sandbags deteriorate when exposed to continued wetting and drying for several months. If the bags need to be used for more than a few months, cement can be mixed with the sand. The cement and sand mixture will harden when the bags dry.

How is a Sandbag Barrier Installed?

Fill sandbags half full using sand or local soil, fold the top of the sandbag down, and then place the bag on its folded top. Place each sandbag as shown, finishing each layer before starting the next. Limit placement to two layers unless they are stacked against a building or sandbags are pyramided. It is important to place the bags with the folded top in the upstream or uphill direction facing the flow of water to prevent them from opening when water runs by.





High and Dry

Every spring, when the floodwaters begin to rise in communities across Canada, sandbag dikes are the go-to defense for keeping them at bay.

It was found that sandbag dikes built using the Province of Manitoba template are strong up to a height of a meter and a half, but any higher and a person trained in the “nuances” of dike construction should be brought in to ensure that the strength of the barrier is upheld. For instance, a 1:1 ratio--adding 30 cm to the base for every additional 30 cm in height--provides considerably more stability to dikes taller than a meter and a half. It was also found that if water is getting through the barrier, adding another buttress at the same ratio will significantly reduce the amount of seepage.

SEALING ENTRANCES AND WORKING WITH FROZEN SANDBAGS IN WINTER CONDITIONS

If you are planning to erect a flood barrier you should do so for all non essential entrances or exits prior to flood and freezing weather. Do not block emergency exits while building is occupied. Maintain a stockpile for your needs. Delivery may be impeded by closures, traffic and weather conditions. Freezing winter conditions may limit or prevent the ability to deliver sandbags or build sandbag barriers. Sandbags can freeze making them hard to handle or stack effectively. If you have the option or have the space to bring them inside, do so. This will insure that when they are needed they will not be frozen. If you do not have the ability to store them out of the weather, then you will have to soften them much like breaking up a bag of ice by impacting the bag before stacking. (toss them on the ground to person stacking)

If all you plan to do is create a flood barrier at the openings to your building, try the following method. This utilizes your building as structural support for your sandbag wall allowing you to stack sandbags vertically

Not recommended if floodwaters are expected to be higher than 3 feet. (May result in structural collapse)

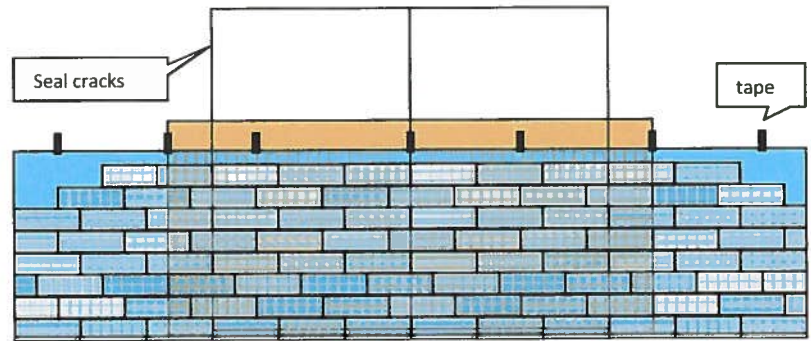
This procedure designed to minimize flood damage. (Takes 30 to 45 minutes with 2 people per entrance)

- Execute shut down procedures and evacuate non essential employees from your facility.
- Secure your facility (lock up)

- Seal door cracks with duct tape, sealant \ caulking or expanding polyurethane foam. (**foam works best**)
- Place duct tape over any sharp edges of building that may tear plastic.
- If you are barricading glass windows or doorways you should have sheets of ¾ in plywood to stretch between framework and keep load off of glass. This may require some additional structural framing depending on span. (Consult a contractor if needed)
- Stretch a plastic barrier against wall extending past openings several feet in each direction and tape.
- (**note: a freestanding wall would require plastic on outside of wall**)
- Stack your sandbags against wall. Stagger your sandbags with top of bag pointing in direction of the next bag your stacking to lock in place. (*see fig 1*)
- Anchor the plastic with additional sandbags

Supplies to keep handy

- Duct tape
- Sealant (Caulking)
- Roll of thick plastic
- Razor knife (to cut plastic)
- Sandbags



If required

- Sheets of ¾ " plywood
- Framing Lumber

To calculate the required amount of sandbags for a vertical sandbag wall
 run sandbag wall 3 ft past opening on each end so if you have a 6 ft opening,
 figure on 12 linier feet of wall sandbag foot print = 1 ft x 4 in high

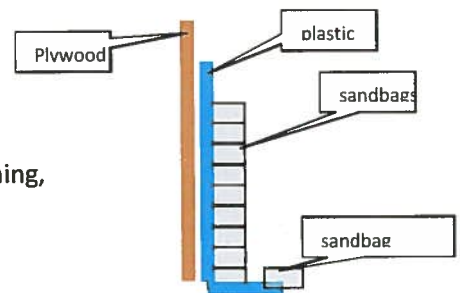


figure 1



(Sandbag Wall Height X 3 bags per ft) X length of sandbag wall

$$(3\text{ft high} \quad \times 3 \text{ bags per ft}) \times 12 \text{ ft long} \quad = 9 \times 12 \text{ or}$$

108 sandbags needed for barrier plus additional for anchors (2 pallets of 84 sandbags) for double door entry

How to Use Sandbags

Deciding when to build your sandbag flood wall

- Buy your sandbags well before you will need them.
- When the threat of flooding is imminent, thousands of people will be rushing to purchase them at the same time.
- Be smart and get your sandbags now to protect your property from floodwaters.

What do you fill a sandbag with?

- You can use any earth product you wish that is readily available such as dirt or gravel.

How do you fill a Sandbag?

- Using teams of 2 persons will work best for filling your sandbags.
- One method for filling sandbags is to use a couple of sawhorses and stretch a ladder or a couple 2 x 4's across them.
- If you use 2 x 4's, nail the cones to the boards. If needed, cut the tip of cone off to allow more flow.
- Invert construction cones in between the ladder rungs or boards. Larger cones will work better.
- One person places a bag up around the inverted cone, the second person shovels the sand into the cone.
- Fill your sandbags approx half full (remember, you have to carry them to the flood wall).
- This will give you a sandbag that weighs approx 35 lbs to 40 lbs.

Stacking Sandbags and Constructing Your Floodwall

Always stagger (overlap) your sandbags. Any wall over a couple feet should be constructed in a pyramid shape as shown in the diagram.

Build the wall from the backside by layering for each increase in height as shown in the gray portion of image.

If you do not, the flood waters will topple your wall. Zip ties work best for closing your bags, or you can place directly on your flood wall by folding the open end of the bag underneath. The bags weight will keep the end closed. You may also use plastic on the "flood water side" of wall to prevent seepage.

Number of Sandbags Required

The following formula can be used to determine the number of sandbags required per linear foot of wall.

Make the **width that is three times the height of wall**. (Making the base twice the height would be minimum recommended).

Number of sandbags per linier foot of wall = (3 x Height) + (9 x Height x Height) divided by 2 .

Example of the number of sandbags required to construct a **wall 3 feet tall**.

per ft of 3 ft wall = (3 x 3) + (9 x 3 x 3) / 2 = 45 bags

The approx number of sandbags needed for a 100 foot long wall is:

Sandbags stacked flat are approx 4 " high with a 1 ft X 1 ft footprint, so you need three layers per foot of height

4 foot-high wall: 7,800 sandbags (78 per linier ft of wall)

3 foot-high wall: 4,500sandbags (45 per linier ft of wall)

2 foot-high wall: 2,100 sandbags (21 per linier ft of wall)

1 foot-high wall: 600 sandbags (6 per linier ft of wall)

Sandbag Construction

The use of sandbags is a simple, but effective, way to prevent or reduce flood water damage. Properly filled and placed, sandbags can act as a barrier to divert moving water around instead of through buildings. Sandbag construction does not guarantee a water-tight seal, but is satisfactory for use in most situations. Sandbags are also used successfully to prevent overtopping of leveed streams and for directing current flow to specific areas.

Untied sandbags are recommended for most situations. Tied sandbags should only be used for special situations when pre-filling and stockpiling may be required for specific purposes such as filling holes, holding objects in position or to form barriers backed by supportive planks. Tied sandbags are generally easier to handle and to stockpile, however sandbag filling operations can generally best be accomplished at or near the placement site and tying of bags would waste valuable time and effort. If the bags are pre-filled at a distant location, due consideration must be given to transportation vehicles and placement site access.

The most commonly used bags are polypropylene sacks available from feed or hardware stores. Empty bags can be stockpiled for emergency use and will be serviceable for several years if properly stored. Filled bags of earth material will deteriorate quickly.

A heavy bodied or sandy soil is most desirable for filling sandbags, but any usable material at or near the site has definite advantages. Course sand could leak out through the weave of the bag. To prevent this, double bag the material. Gravelly or rocky soils are generally poor choices because of their permeability characteristics.

Sandbag barriers can easily be constructed by two people, as most individuals have the physical capabilities to carry or drag a sandbag weighing approximately 30 pounds.





How to Fill a Sandbag

Filling sandbags is a two-person operation: One member of the team should place the empty bag between or slightly in front of wide-spread feet with arms extended. The throat of the bag is folded to form a collar and held with the hands in a position that will enable the other team member to empty a rounded shovel full of material into the open end. The person holding the sack should be standing with knees slightly flexed and head and face as far away from the action of the shovel as practical.

The person shoveling should carefully release the rounded shovel full of soil into the throat of the bag. Haste in this operation can result in undue spillage and added work. The use of safety goggles and gloves is desirable and sometimes necessary.

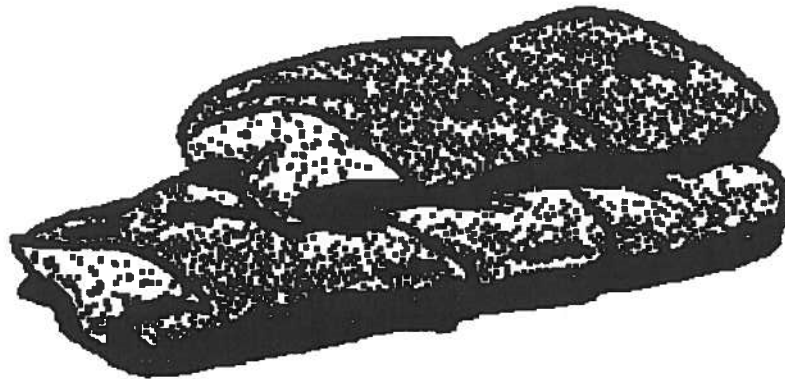
For large scale operations, filling sandbags can be expedited by using bag holding racks, metal funnels, and power loading equipment. However, the special equipment required is not always available during an emergency.

Bags should not be filled more than half full or less than one third their capacities.

Placement

Remove any debris from the area where bags are to be placed. Place the 1/2-filled bags lengthwise and parallel to the direction of flow.

Fold the open end of the unfilled portion of the bag to form a triangle. (If bed bags are used, flatten or fire the tied end.)



Place succeeding bags on the folded or fired portion of the previous bag and stamp into place to

eliminate voids and form a tight seal.

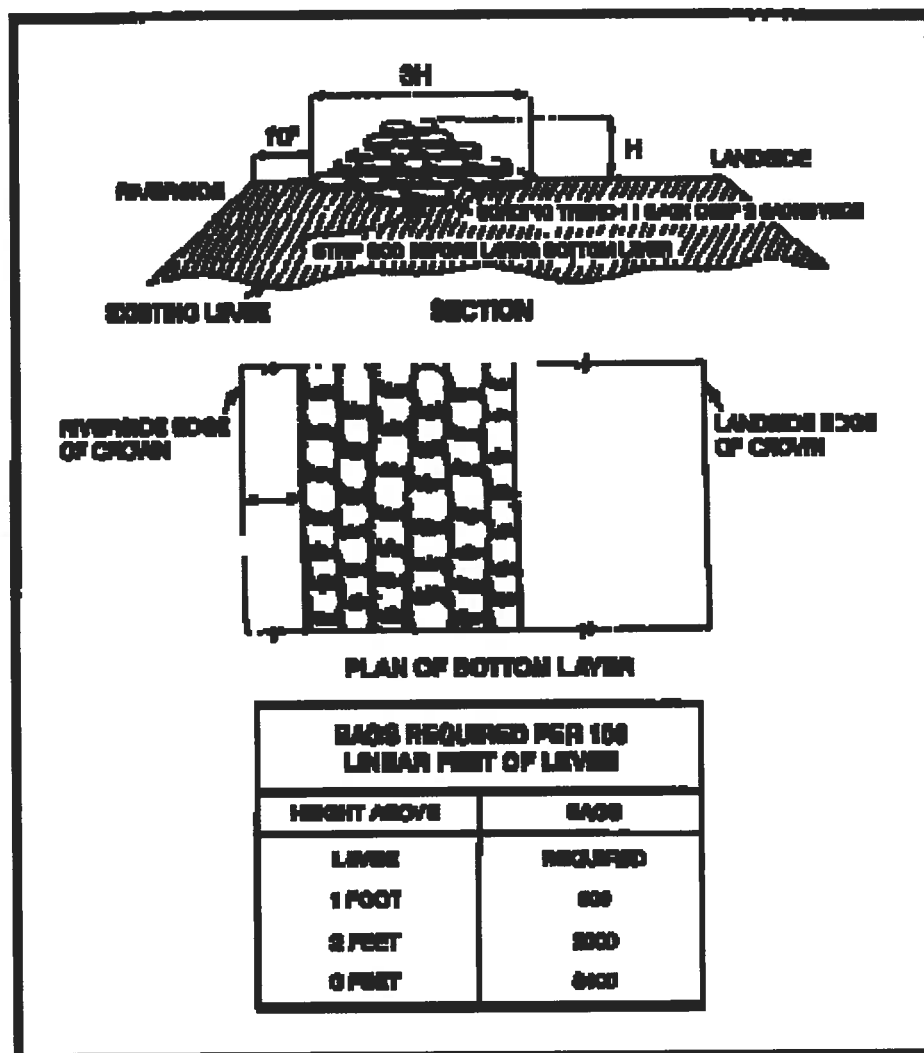
Stagger the joint connections when multiple layers are necessary. For unsupported layers over three courses high, use the pyramid placement method.

Pyramid Placement

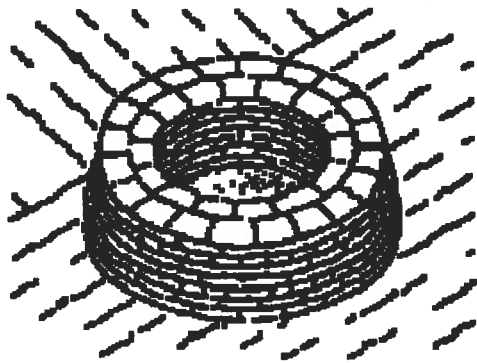
Pyramid placement is used to increase the height of sandbag protection.

Place the sandbags to form a pyramid by alternating header courses (bags placed crosswise) and stretcher courses (bags placed lengthwise).

Stamp each bag in place, overlap sacks, maintain staggered joint placement and tuck under any loose ends.

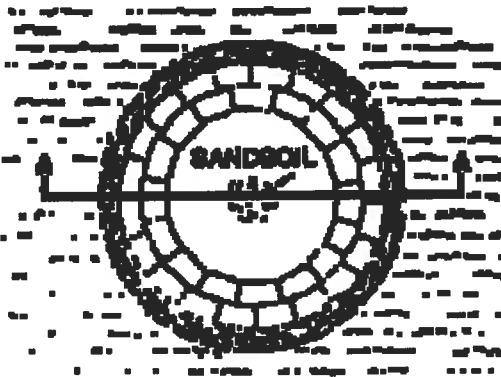


Ringed Sand Boils



NOTES:

- Do Not sink ball which does not put out material
- Ball to be cleared of debris and overfilled
- Tip into level of ball in rear toe
- Loose earth to be used between all stacks
- All joints to be staggered
- Be sure to clear sand discharge
- Nearest target is completely clear through ball



PLAN



Height should be only sufficient to create enough head to slow down flow through ball so that no more material is displaced and ball runs clear

SECTION A-A
Scale 1/8" = 1'-0"

Sand Estimation Worksheet

Individual Homes:

1. Bagging foundation opening, per house (250 to 500 each)

Estimated Number of Homes: _____

Estimated Bags per Home (x) _____

= Bags Subtotal _____

2. Protection of groups of buildings with Levees and Dikes (per linear foot of dike/levee)

Height Required	Number of Sandbags
1 Foot	8
2 Feet	20
3 Feet	34
1 Ton of Sand	50 Sandbags

Estimated Linear Feet of Dike/Levee: _____

Bags for Height per Linear Foot : (x) _____

= Bags Subtotal _____

Grand Total Estimated Number of Bags : _____

3. Sand Estimate (@ approximately 40lbs per bag)

Grand Total number of Bags (above): _____ (divide this number by 50)

Equals the number of tons of sand : _____

(i.e. 2000 sandbags requires 40 tons of sand)