Sandbags:

a steadfast tool for flood fighting

Sandbagging is one of the most versatile of flood fighting tools and is a simple, effective way to prevent or reduce flood water damage.

Although sandbags do not guarantee a watertight seal, they are a proven deterrent to costly water damage.

Sandbags have been used to:

- prevent overtopping of levees.
- direct a river's current flow to specific areas.
- construct ring dikes around boils on levee back slopes, levee toes or behind levees.
- use as weight on back slopes of saturated levees.
- weigh down visquine and straw bales.
- build buttresses on back slopes and the toes of saturated levees.
- reduce seepage at closure structures.

Read this brochure to learn proper filling and placement methods aimed at increasing productivity of sandbagging operations. Included are hints, safety tips and correct procedures which will minimize work-related injuries and strain and will maximize essential time.

THE FIRST LINE OF DEFENSE

Sandbag construction is a centuries old technique that has changed little. Bags are made from different materials including treated burlap and plastic. They measure approximately 14 inches wide and 24 inches long.

Sandbags filled one-half to two-thirds full should generally be left untied. Tied bags, filled slightly fuller, have specific purposes: filling holes, holding visquine or straw bales in place, or forming barriers backed by supportive planks or aluminum sheet piles.

If access to the flood site is limited to boat, tractor or helicopter, then pallets and forklifts may be needed to load and off-load sandbags.

Unused empty bags can be stockpiled for emergency and will be serviceable for years if kept dry and properly stored.

FILL MATERIALS

Sand is by far the easiest material for filling and shaping sandbags and becomes heavier when saturated from rain or moisture.

In emergencies, other materials such as silt, clay, gravel or a mixture of these may be used, but none work as well as sand.

When vehicle access is cut off to the flood site, and you have no other choice, use the back side of the levee or an adjacent field to find whatever material is available to fill sandbags.

Here are pros and cons on use of other materials:

- Silty soils get soft when wet and are more difficult to shape, and finer particles leak through the weave in the material.
- Clay materials are difficult to shape and to bag.
- Coarse-grained gravels are pervious and are also difficult to shape but can be used for redirecting the main stream flow while allowing seepage through bags.

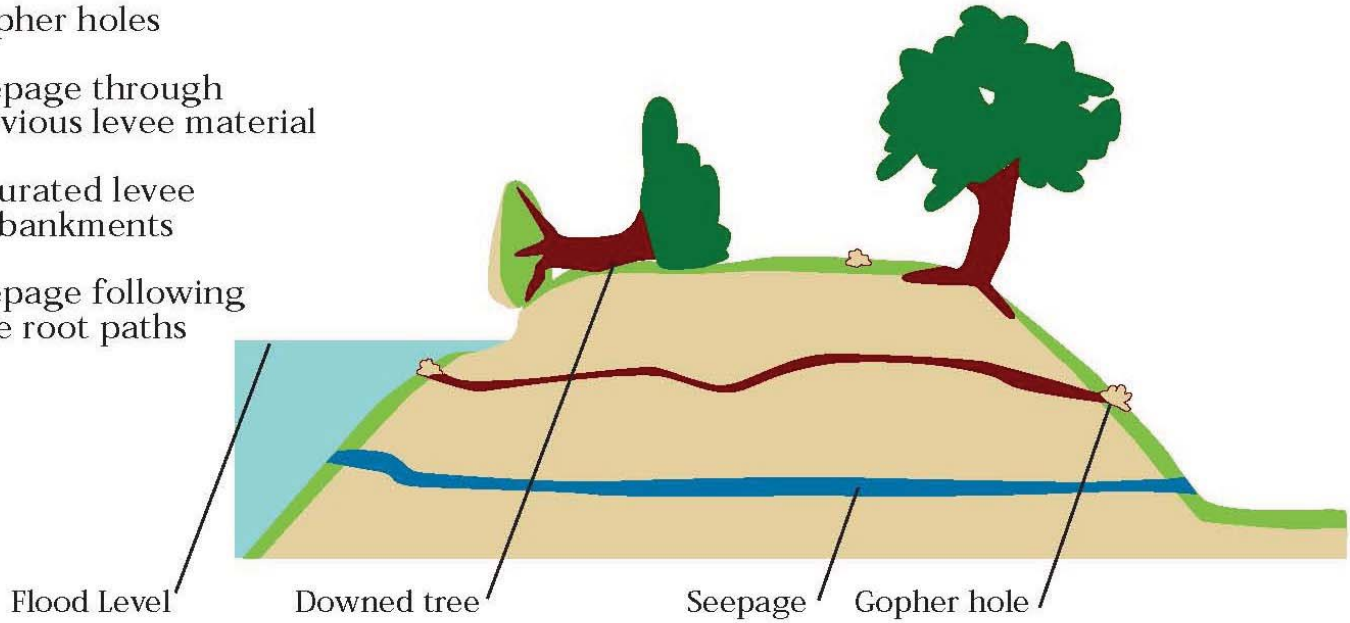
ALTERNATIVES

Other methods and remedies for flood fighting are as follows:

- Readily available, straw bales are an economical alternative. They range in size from 18 inches high by 30 inches long to 4 by 4 by 8 foot long blocks. Secure the bales by driving 4 to 10 foot stakes (or rebar) through the straw into the levee top, and weight down with filled sandbags. Water swells the straw, making the bales heavier and watertight.
- Concrete Jersey Barriers or Ecology Blocks can be used to divert water and can be cost effective solutions.
- Plastic sheeting can be used effectively by placing sand along a fold.

CAUSES OF LEVEE FAILURE

- Overtopping
- Downed trees on levee slope
- Gopher holes
- Seepage through pervious levee material
- Saturated levee embankments
- Seepage following tree root paths



CORRECT FILLING PROCEDURES

Filling sandbags is normally a two or three person operation. One member of the team, while crouching with feet apart and arms extended, should place the bottom of the empty bag on the ground.

The opening of the bag is folded outward about 1-1/2 inches to form a collar and held open to allow the second team member to empty a fully rounded No. 2 shovel of material into the open end of the bag.

Don't hurry. Haste can result in undue spillage and added work. The third team member stockpiles or stacks the open sacks. The three team members should rotate duties often to reduce job-specific muscle fatigue.

This two-member team uses correct positions for sandbag filling.

Untied bags should be filled approximately one-half to two-thirds full. Tied bags can be filled slightly more, but with enough room left at the top to tie the bag off properly.

Always use gloves to protect your hands during the filling operation. After handling treated bags, avoid contact with your eyes and mouth.

Dress appropriately and layer clothing. Safety goggles should be used on dry and windy days. Sandbag filling operations are done either near the actual placement site or at centrally located filling sites such as fire

stations, diking districts or sand pits.

If the bags are filled at a distant location, vehicle transportation and access to the flood site are primary planning considerations.

For large scale operations, a variety of specialized filling equipment - such as funnels on the back of dump trucks - is commercially available.

Such equipment is not always available during an emergency and may be best suited for a staging area where bags can be filled and then delivered to the site.

PROPER PLACEMENT

Remove any debris from the areas where bags are to be placed. Place the bags lengthwise and parallel to the direction of flow. Fill the low spots first before placing bags the full length of the area to be raised.

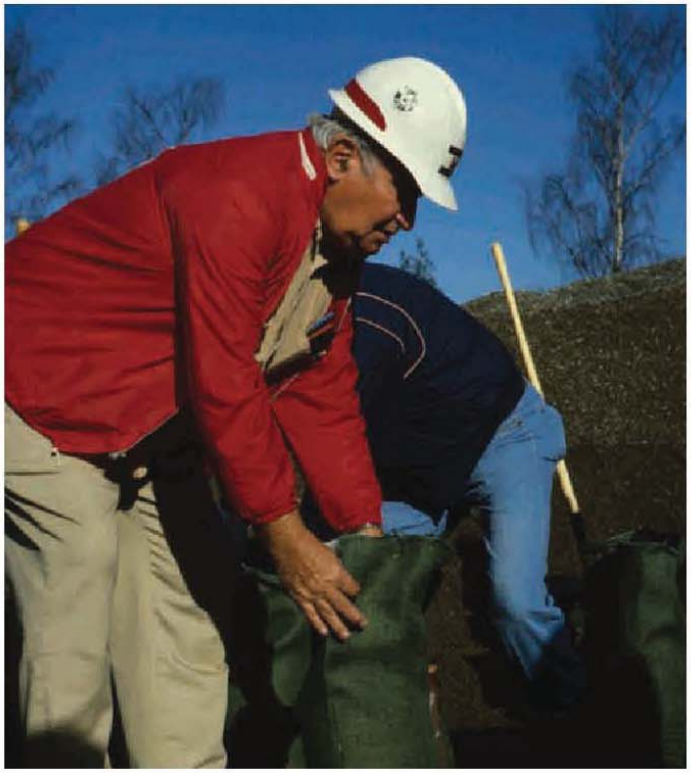
Start at approximately 1 foot landward from the river or levee's edge. Fold the open end of the bag under the filled portion. Folded end of bag should face upstream. Place succeeding bags with the bottom of the bag tightly and partially overlapping the previous bag.

Place each succeeding bag tightly against and parially overlapping the previous one. Compact and shape each bag by walking on it.

Offset adjacent rows or layers by one-half bag length to avoid continuous joints.

To eliminate voids and form a tight seal, compact and shape each bag by walking on it and continue the process as each layer is placed.

This flattens the top of the bag and prevents slippage between succeeding layers.



Veteran flood engineer Ernie Sabo demonstrates that the sandbag should be two-thirds full, folded at the top.

SINGLE STACK PLACEMENT

Single stack placement

Sandbags stacked in a single row work well in flood areas where there is no streamflow velocity or danger from floating debris, such as logs and tree stumps, or from wave action which could topple the bags.

Although generally not recommended to be above three courses or layers in height (approximately 1 foot), higher single stack placement can be effectively used as a barricade to protect structures from impending water damage as shown in the photo.

PYRAMID PLACEMENT METHOD

Use pyramid placement to increase the height of sandbag protection; however, use caution when rasing the levee height. Determine the height of the sandbag raise by using the best available forecasts of flood conditions.

An example: When the water level is currently 1 foot below the top of the levee and is predicted to rise 3 more feet, construct a 2-1/2 foot sandbag operation which includes one-half foot of height as a safety factor.

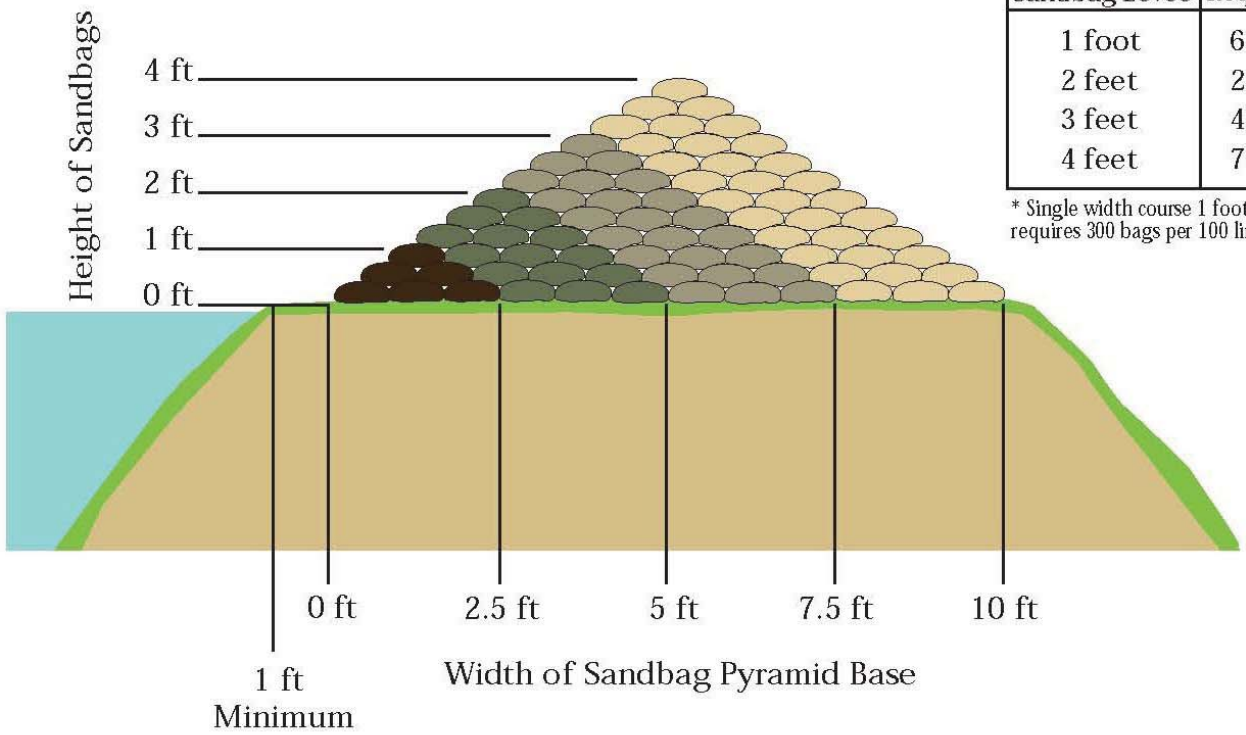
It's important to compact each bag in place by walking on it, butting the ends of the sacks toether, maintaining a staggered joint placement and folding under all loose ends.

Watch for flooding elsewhere, and watch for boils on the landward side of the levee due to the increased water elevation.

TYPICAL PYRAMID SANDBAG PLACEMENT

Bags Required Per 100 Linear Feet of Levee	
Height of Sandbag Levee	Bags Required
1 foot	600*
2 feet	2100
3 feet	4500
4 feet	7800

* Single width course 1 foot high requires 300 bags per 100 linear feet.



The pyramid placement method issued to increase the height of sandbag protection.

Use this rule of thumb in determining dimensions of the pyramid:

- 1 bag in length equals about 1 foot
- 3 bags in width equals about 2-1/2 feet.
- 3 bags in height equals about 1 foot.

Place the sandbags by laying an equal number of horizontal rows on the bottom as there are vertical layers.

It's important to compact each bag in place by walking on it, butting the ends of the sacks together, maintaining a staggered joint placement and folding under loose ends.