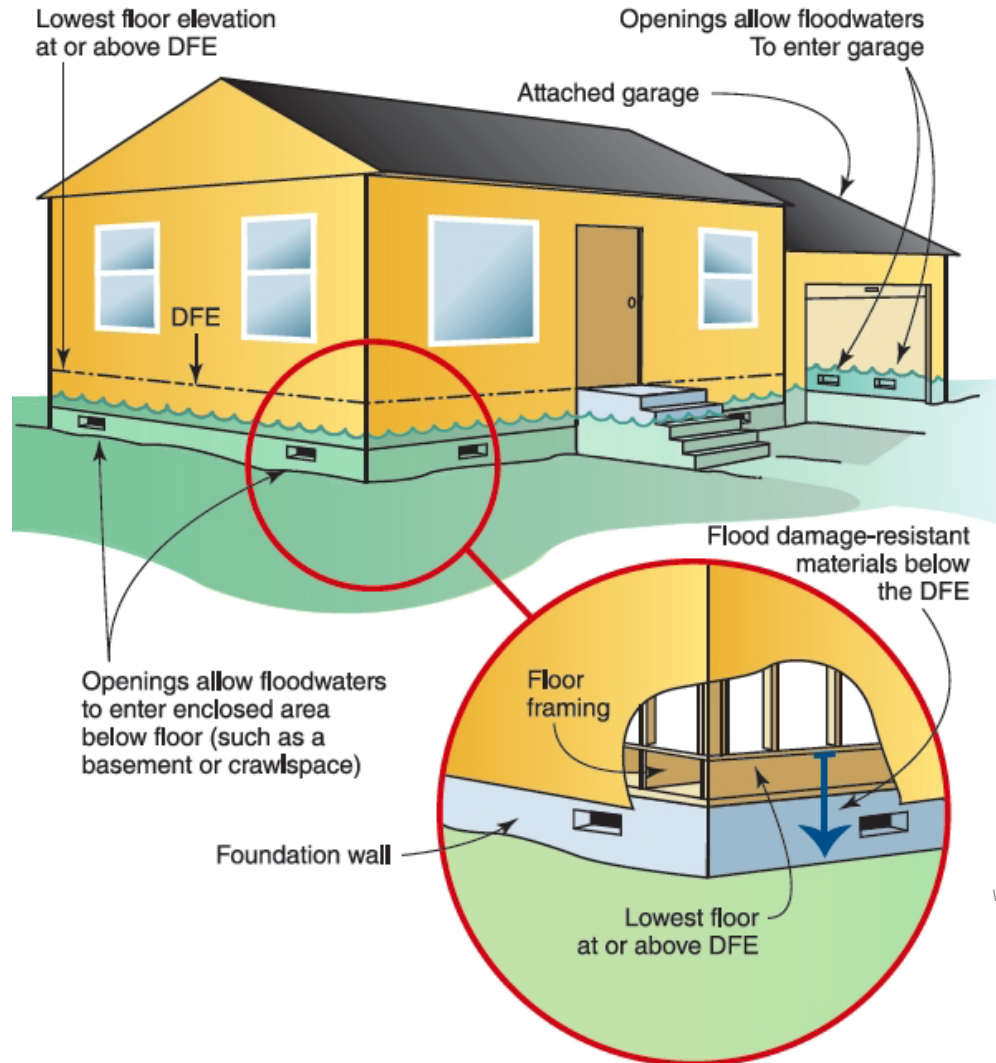


# An Overview of Retrofitting Residential and Commercial Buildings for Flood Mitigation



wet floodproofing graphic from FEMA



# Two nationally recognized methods for modifying an existing home or commercial building

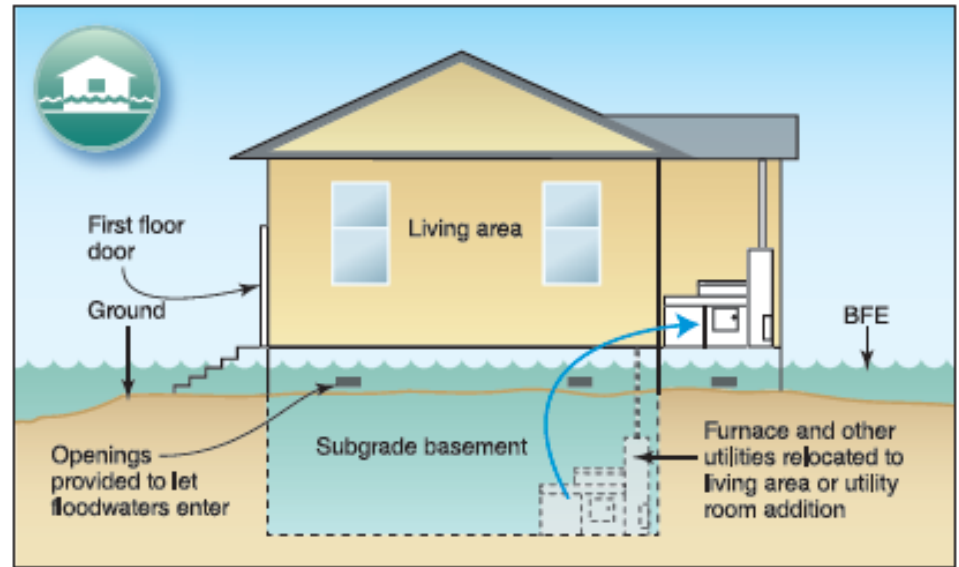
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- Wet floodproofing – [view FEMA documents](#)
- Dry floodproofing – [view FEMA documents](#)

While these measures can minimize damage to individual homes or commercial buildings, they do **not**:

- address impacts to public and private streets, bridges and other public infrastructure.
- eliminate the need to evacuate in certain flooding conditions.

# Wet Floodproofing



## How does it work:

- Modifies existing portions of the house (such as a crawlspace, basement, garage or other uninhabited enclosures) so that floodwaters will enter the space but not cause significant damage to the rest of the home and its contents.
- By equalizing internal and external water pressure on the house, the likelihood of wall failures and structural damage to the home is reduced.

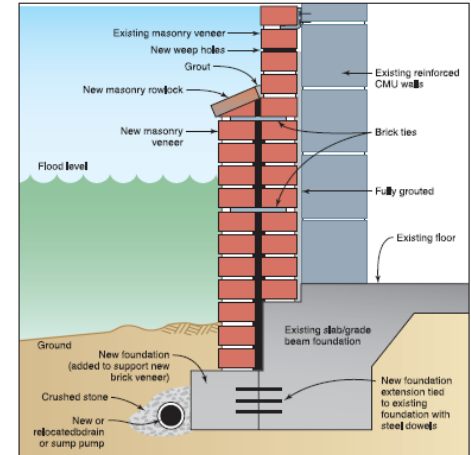
# Wet Floodproofing

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## Considerations:

- Typically not viable for commercial buildings.
- Only practical in a limited number of residential situations.
- Requires relocation of duct work and service equipment such as a furnaces or other utility equipment.
- Requires installation of drainage and/or pump system.
- Loss of storage space under the house
- Requires ongoing maintenance.
- After a flood event, areas below the house (such as the crawlspace) may require extensive clean-up.
- Still need to evacuate in certain flood events.

# Dry Floodproofing



## Benefits of method:

- Installation/construction of barriers, shields and impermeable membranes around the building.
- Reduces the risk of flood damage to a building and its contents.
- Does not require additional land for flood barriers.
- Appropriate for structures of reinforced concrete or masonry.

# Dry Floodproofing

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## Considerations:

- “Only non-residential buildings can use dry floodproofing techniques.” – FEMA, March 2018
- Not recommended for wood-frame buildings (*typical construction type for Marin homes*).
- Intended to remain watertight for a limited duration, generally a few hours, and a flood depth typically less than 3 feet.
- Changes appearance of building due to extensive work to make building watertight, including impermeable membranes and supplemental layers of concrete. Additionally, waterproof shields must be installed over windows and doors.
- National guidelines require annual maintenance, updating and testing.
- Requires adequate warning time to allow for manual preparation for flood event.

# Case Study - San Anselmo Town Hall

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**San Anselmo Townhall** (approximately 17,000 square feet)

- Underwent dry floodproofing in 2008
- Required floodwalls, floodgates, pumps and other modifications.
- Initial design budgeted at \$230,000
- Final cost was **\$365,775**
  - Additional needs were discovered during construction to bring building to current standards for floodproofing.
  - Equates to **approximately \$30 per square foot** (adjusted to 2018 dollars).
- Important to note that this does not include design and project management costs.

# Cost example of dry floodproofing

## Ross Valley's FEMA Special Flood Hazard Area

- 680 commercial buildings in the area
- Assume an average of 1,200 SF per building
- Estimated cost of \$30 per SF (SA Townhall)
- Estimated cost of \$36,000 per building



- **\$24,480,000** to dry floodproof all 680 commercial buildings in the Ross Valley

- This does **not** include design costs of \$5,000 to \$10,000 per building, which would add \$3.4 million to \$6.8 million to the total cost.
- Assumes **no major structural changes** or other modifications are needed

