ENGINEERING REPORT

GARRISON
FLOOD CONTROL

Hydrostatic Pressure on Structures With Flood Panels Deployed

Client: Garrison Systems, LLC

Date: 01.30.2024

Project #: 25002-S01

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REV:0

Contents

1. General

The goal of this report is to show how much pressure different-sized barriers transfer to the structure (constructed with various materials as noted below), and how much hydrostatic pressure is transferred to the building at different heights.

The goal is to confirm the existing walls can resist the hydrostatic pressures from the water and the panels.

The following wall types will be considered:

- CMU block 8" - reinforced/unreinforced
- CMU block 12" - reinforced/unreinforced
- Poured concrete walls with rebar

The opening sizes we plan to analyze (width):

40" Outside Mount
72" Outside Mount
96" Outside Mount
96" Inside Mount
120" Outside Mount
120" Inside Mount

The number of planks we plan to analyze (height):
- 5 planks
- 7 planks
- 10 planks
- 14 planks

The calculations will be performed by utilizing MATLAB software.

2. Input

- The installation is not a floodway, V-Zone or Coastal A-Zone
- Stillwater depth is at 3ft
- There is no screening upstream.

Material properties and constants:

The flood barriers are from material aluminum 6063-T6, the panel is ST19627 while the posts are ST19630A.

$\rho_{wate} = 62.4\ lb/ft^3$ ....*density of water*

$g = 32.2\ ft/s^2$ ....*acceleration due to gravity*

$plank_{weight} = 2.180\ lb/ft$..*linear weight of plank*

$post_{weight} = 1.621\ lb/ft$..*linear weight of post*

$height_{plank} = 8\ in$..*height of one plank in inches*

planks for barrier= [5,7,10,14]..........................number of planks for each barrier configuration

Length of barriers in inches(opening sizes)=[40,72,96,120]

Material properties for walls(compressive strength in psi):

Strength of CMU 8" wall unreinforced=1500 psi ....Safety Factor=3

Strength of CMU 8" wall reinforced=2500 psi...Safety Factor=2

Strength of CMU 12" wall unreinforced=2000 psi..Safety Factor=3

Strength of CMU 12" wall reinforced=3000 psi...Safety Factor=2

Strength of poured concrete wall=4000 psi..Safety Factor=1.5

3. Calculations

The hydrostatic pressure at any given depth in a fluid is given by the following equation

$$P = \rho \cdot g \cdot h$$

Where:

P- hydrostatic pressure

ρ- density of fluid

g-acceleration due to gravity

h-depth of fluid

The total hydrostatic force on a vertical flood barrier can be calculated by integrating the pressure over the area of the flood barrier in contact with the water. The total hydrostatic force F on a vertical flood barriers is obtained by equation:

$$F = \frac{1}{2} \cdot \rho \cdot g \cdot h^2 \cdot A$$

Where:

h- height of the water

A-area of the flood barriers

The self-weight of the flood barriers is calculated by summing the self-weight of the planks and the posts. Since one plank has a weight of 2.180 lb/ft and the post weight is 1.621 lb/ft, then the total self-weight of the plank will be obtained by:

$Flood\ barrier_{selfweight}$
$$= number\ of\ planks \cdot plank\ weight \cdot barrier\ length + 2 \cdot posts\ weight \\ \cdot total\ height$$

The total weight is:

Total weight=The hydrostatic pressure force + Flood barrier self-weight   [lb]

To calculate how much pressure is transferred to the buildings need to calculate the pressure on the wall by using equation:

$$P_{wall} = F/A_{wall}$$

F- force from the flood barrier

A_{wall}-area of the wall

The obtained pressure transferred to the building needs to be compared to the pressure that the wall type can carry.

4. MATLAB Script

```
% Material Properties and Constants

rho_water = 62.4;      % density of water in lb/ft^3

g = 32.2;              % acceleration due to gravity in ft/s^2 (using imperial units)

height_plank = 8;      % height of one plank in inches

plank_weight = 2.180;   % linear weight of one plank in lb/ft

post_weight = 1.621;    % linear weight of outside mound post in lb/ft

insert_weight = 2.150;  % linear weight of post insert in lb/ft

planks_per_barrier = [5, 7, 10, 14]; % Number of planks for each barrier configuration

% Lengths of the barriers in inches

barrier_lengths = [40, 72, 96, 120];

% Material Properties for Walls (compressive strength in psi)

strength_CMU_8_unreinforced = 1500;  % psi

strength_CMU_8_reinforced = 2500;    % psi

strength_CMU_12_unreinforced = 2000; % psi

strength_CMU_12_reinforced = 3000;   % psi

strength_poured_concrete = 4000;     % psi

% Safety Factors for each wall type (for comparison)

safety_factor_CMU_8_unreinforced = 3;

safety_factor_CMU_8_reinforced = 2;

safety_factor_CMU_12_unreinforced = 3;

safety_factor_CMU_12_reinforced = 2;

safety_factor_poured_concrete = 1.5;
```

```
% Convert height of planks to feet

height_in_feet = height_plank / 12; % converting one plank height to feet

% Loop over each barrier length and number of planks

for i = 1:length(barrier_lengths)

    barrier_length = barrier_lengths(i); % in inches

    barrier_length_ft = barrier_length / 12; % convert to feet

    fprintf('Calculating for barrier of length %d inches...\n', barrier_length);

    % Loop over each configuration of planks (5, 7, 10, 14)

    for j = 1:length(planks_per_barrier)

        num_planks = planks_per_barrier(j); % number of planks for current configuration

        total_plank_height = num_planks * height_in_feet; % total height of the barrier in
feet

        % Calculate Hydrostatic Pressure at water depth

        hydrostatic_pressure = rho_water * g * total_plank_height; % pressure  in lb/ft^2

        % Calculate total force

        force_per_plank = (hydrostatic_pressure * barrier_length_ft *
total_plank_height)/2; % total force

        % Self-weight of the flood barriers

        total_self_weight = num_planks * plank_weight * barrier_length_ft + 2 *
post_weight * total_plank_height;

        % Wall Area (ft^2)

        wall_area = barrier_length_ft * total_plank_height; % area of the wall

        % Total Force on the wall (hydrostatic + panel weight)

        total_force = force_per_plank + total_self_weight; % total force applied to the wall

        % Calculate the stress on the wall (lb/ft^2)

        stress = total_force / wall_area; % stress (in lb/ft^2)

        stress_psi = stress / 144; % convert lb/ft^2 to psi
```

% Output forces and stress for analysis

fprintf('Total hydrostatic pressure for %d planks: %.2f lb/ft^2\n', num_planks, hydrostatic_pressure);

fprintf('For %d planks, total hydrostatic pressure force = %.2f lb\n', num_planks, force_per_plank);

fprintf('Total self weight of barrier = %.2f lb\n', total_self_weight);

fprintf('Total pressure transferred to the building: %.2f psi\n', stress_psi);

% Comparison of stress with wall types

% Unreinforced CMU 8" - Compare stress with strength

wall_capacity_CMU_8_unreinforced = strength_CMU_8_unreinforced / safety_factor_CMU_8_unreinforced;

fprintf('CMU 8" Unreinforced Wall Capacity = %.2f psi (Strength = %.2f psi, Safety Factor = %.2f)\n', ...

        wall_capacity_CMU_8_unreinforced, strength_CMU_8_unreinforced, safety_factor_CMU_8_unreinforced);

fprintf('CMU 8" Unreinforced Wall Stress = %.2f psi\n', stress_psi);

if wall_capacity_CMU_8_unreinforced >= stress_psi

    fprintf('CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).\n');

else

    fprintf('CMU 8" Unreinforced wall *cannot* handle this load (Capacity < Stress_psi)!\n');

end

% Reinforced CMU 8" - Compare stress with strength

wall_capacity_CMU_8_reinforced = strength_CMU_8_reinforced / safety_factor_CMU_8_reinforced;

fprintf('CMU 8" Reinforced Wall Capacity = %.2f psi (Strength = %.2f psi, Safety Factor = %.2f)\n', ...

```
        wall_capacity_CMU_8_reinforced, strength_CMU_8_reinforced,
safety_factor_CMU_8_reinforced);

        fprintf('CMU 8" Reinforced Wall Stress = %.2f psi\n', stress_psi);

        if wall_capacity_CMU_8_reinforced >= stress_psi

           fprintf('CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).\n');

        else

           fprintf('CMU 8" Reinforced wall *cannot* handle this load (Capacity <
Stress_psi)!\n');

        end

        % Unreinforced CMU 12" - Compare stress with strength

        wall_capacity_CMU_12_unreinforced = strength_CMU_12_unreinforced /
safety_factor_CMU_12_unreinforced;

        fprintf('CMU 12" Unreinforced Wall Capacity = %.2f psi (Strength = %.2f psi, Safety
Factor = %.2f)\n', ...

            wall_capacity_CMU_12_unreinforced, strength_CMU_12_unreinforced,
safety_factor_CMU_12_unreinforced);

        fprintf('CMU 12" Unreinforced Wall Stress = %.2f psi\n', stress_psi);

        if wall_capacity_CMU_12_unreinforced >= stress_psi

           fprintf('CMU 12" Unreinforced wall can handle this load (Capacity >=
Stress_psi).\n');

        else

           fprintf('CMU 12" Unreinforced wall *cannot* handle this load (Capacity <
Stress_psi)!\n');

        end

        % Reinforced CMU 12" - Compare stress with strength

        wall_capacity_CMU_12_reinforced = strength_CMU_12_reinforced /
safety_factor_CMU_12_reinforced;

        fprintf('CMU 12" Reinforced Wall Capacity = %.2f psi (Strength = %.2f psi, Safety
Factor = %.2f)\n', ...
```

```matlab
        wall_capacity_CMU_12_reinforced, strength_CMU_12_reinforced,
safety_factor_CMU_12_reinforced);

        fprintf('CMU 12" Reinforced Wall Stress = %.2f psi\n', stress_psi);

        if wall_capacity_CMU_12_reinforced >= stress_psi

            fprintf('CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).\n');

        else

            fprintf('CMU 12" Reinforced wall *cannot* handle this load (Capacity <
Stress_psi)!\n');

        end

        % Poured Concrete with Rebar - Compare stress with strength

        wall_capacity_poured_concrete = strength_poured_concrete /
safety_factor_poured_concrete;

        fprintf('Poured Concrete Wall Capacity = %.2f psi (Strength = %.2f psi, Safety Factor
= %.2f)\n', ...

            wall_capacity_poured_concrete, strength_poured_concrete,
safety_factor_poured_concrete);

        fprintf('Poured Concrete Wall Stress = %.2f psi\n', stress_psi);

        if wall_capacity_poured_concrete >= stress_psi

            fprintf('Poured Concrete wall can handle this load (Capacity >= Stress_psi).\n');

        else

            fprintf('Poured Concrete wall *cannot* handle this load (Capacity <
Stress_psi)!\n');

        end

        fprintf('\n'); % Add space for clarity between each configuration

    end
  end
```

5. Results

Calculating for barrier of length 40 inches...

Total hydrostatic pressure for 5 planks: 6697.60 lb/ft^2

For 5 planks, total hydrostatic pressure force = 37208.89 lb

Total self weight of barrier = 47.14 lb

Total pressure transferred to the building: 23.29 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 23.29 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 23.29 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 23.29 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 23.29 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 23.29 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 7 planks: 9376.64 lb/ft^2

For 7 planks, total hydrostatic pressure force = 72929.42 lb

Total self weight of barrier = 66.00 lb

Total pressure transferred to the building: 32.59 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 32.59 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 32.59 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 32.59 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 32.59 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 32.59 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 10 planks: 13395.20 lb/ft^2

For 10 planks, total hydrostatic pressure force = 148835.56 lb

Total self weight of barrier = 94.28 lb

Total pressure transferred to the building: 46.54 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 46.54 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 46.54 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 46.54 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 46.54 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 46.54 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 14 planks: 18753.28 lb/ft^2

For 14 planks, total hydrostatic pressure force = 291717.69 lb

Total self weight of barrier = 131.99 lb

Total pressure transferred to the building: 65.15 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 65.15 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 65.15 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 65.15 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 65.15 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 65.15 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Calculating for barrier of length 72 inches...

Total hydrostatic pressure for 5 planks: 6697.60 lb/ft^2

For 5 planks, total hydrostatic pressure force = 66976.00 lb

Total self weight of barrier = 76.21 lb

Total pressure transferred to the building: 23.28 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 23.28 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 23.28 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 23.28 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 23.28 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 23.28 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 7 planks: 9376.64 lb/ft^2

For 7 planks, total hydrostatic pressure force = 131272.96 lb

Total self weight of barrier = 106.69 lb

Total pressure transferred to the building: 32.58 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 32.58 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 32.58 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 32.58 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 32.58 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 32.58 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 10 planks: 13395.20 lb/ft^2

For 10 planks, total hydrostatic pressure force = 267904.00 lb

Total self weight of barrier = 152.41 lb

Total pressure transferred to the building: 46.54 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 46.54 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 46.54 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 46.54 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 46.54 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 46.54 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 14 planks: 18753.28 lb/ft^2

For 14 planks, total hydrostatic pressure force = 525091.84 lb

Total self weight of barrier = 213.38 lb

Total pressure transferred to the building: 65.14 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 65.14 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 65.14 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 65.14 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 65.14 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 65.14 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Calculating for barrier of length 96 inches...

Total hydrostatic pressure for 5 planks: 6697.60 lb/ft^2

For 5 planks, total hydrostatic pressure force = 89301.33 lb

Total self weight of barrier = 98.01 lb

Total pressure transferred to the building: 23.28 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 23.28 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 23.28 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 23.28 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 23.28 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 23.28 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 7 planks: 9376.64 lb/ft^2

For 7 planks, total hydrostatic pressure force = 175030.61 lb

Total self weight of barrier = 137.21 lb

Total pressure transferred to the building: 32.58 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 32.58 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 32.58 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 32.58 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 32.58 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 32.58 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 10 planks: 13395.20 lb/ft^2

For 10 planks, total hydrostatic pressure force = 357205.33 lb

Total self weight of barrier = 196.01 lb

Total pressure transferred to the building: 46.54 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 46.54 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 46.54 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 46.54 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 46.54 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 46.54 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 14 planks: 18753.28 lb/ft^2

For 14 planks, total hydrostatic pressure force = 700122.45 lb

Total self weight of barrier = 274.42 lb

Total pressure transferred to the building: 65.14 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 65.14 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 65.14 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 65.14 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 65.14 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 65.14 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Calculating for barrier of length 120 inches...

Total hydrostatic pressure for 5 planks: 6697.60 lb/ft^2

For 5 planks, total hydrostatic pressure force = 111626.67 lb

Total self weight of barrier = 119.81 lb

Total pressure transferred to the building: 23.28 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 23.28 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 23.28 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 23.28 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 23.28 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 23.28 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 7 planks: 9376.64 lb/ft^2

For 7 planks, total hydrostatic pressure force = 218788.27 lb

Total self weight of barrier = 167.73 lb

Total pressure transferred to the building: 32.58 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 32.58 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 32.58 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 32.58 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 32.58 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 32.58 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 10 planks: 13395.20 lb/ft^2

For 10 planks, total hydrostatic pressure force = 446506.67 lb

Total self weight of barrier = 239.61 lb

Total pressure transferred to the building: 46.54 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 46.54 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 46.54 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 46.54 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 46.54 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)

Poured Concrete Wall Stress = 46.54 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

Total hydrostatic pressure for 14 planks: 18753.28 lb/ft^2

For 14 planks, total hydrostatic pressure force = 875153.07 lb

Total self weight of barrier = 335.46 lb

Total pressure transferred to the building: 65.14 psi

CMU 8" Unreinforced Wall Capacity = 500.00 psi (Strength = 1500.00 psi, Safety Factor = 3.00)

CMU 8" Unreinforced Wall Stress = 65.14 psi

CMU 8" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 8" Reinforced Wall Capacity = 1250.00 psi (Strength = 2500.00 psi, Safety Factor = 2.00)

CMU 8" Reinforced Wall Stress = 65.14 psi

CMU 8" Reinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Unreinforced Wall Capacity = 666.67 psi (Strength = 2000.00 psi, Safety Factor = 3.00)

CMU 12" Unreinforced Wall Stress = 65.14 psi

CMU 12" Unreinforced wall can handle this load (Capacity >= Stress_psi).

CMU 12" Reinforced Wall Capacity = 1500.00 psi (Strength = 3000.00 psi, Safety Factor = 2.00)

CMU 12" Reinforced Wall Stress = 65.14 psi

CMU 12" Reinforced wall can handle this load (Capacity >= Stress_psi).

Poured Concrete Wall Capacity = 2666.67 psi (Strength = 4000.00 psi, Safety Factor = 1.50)
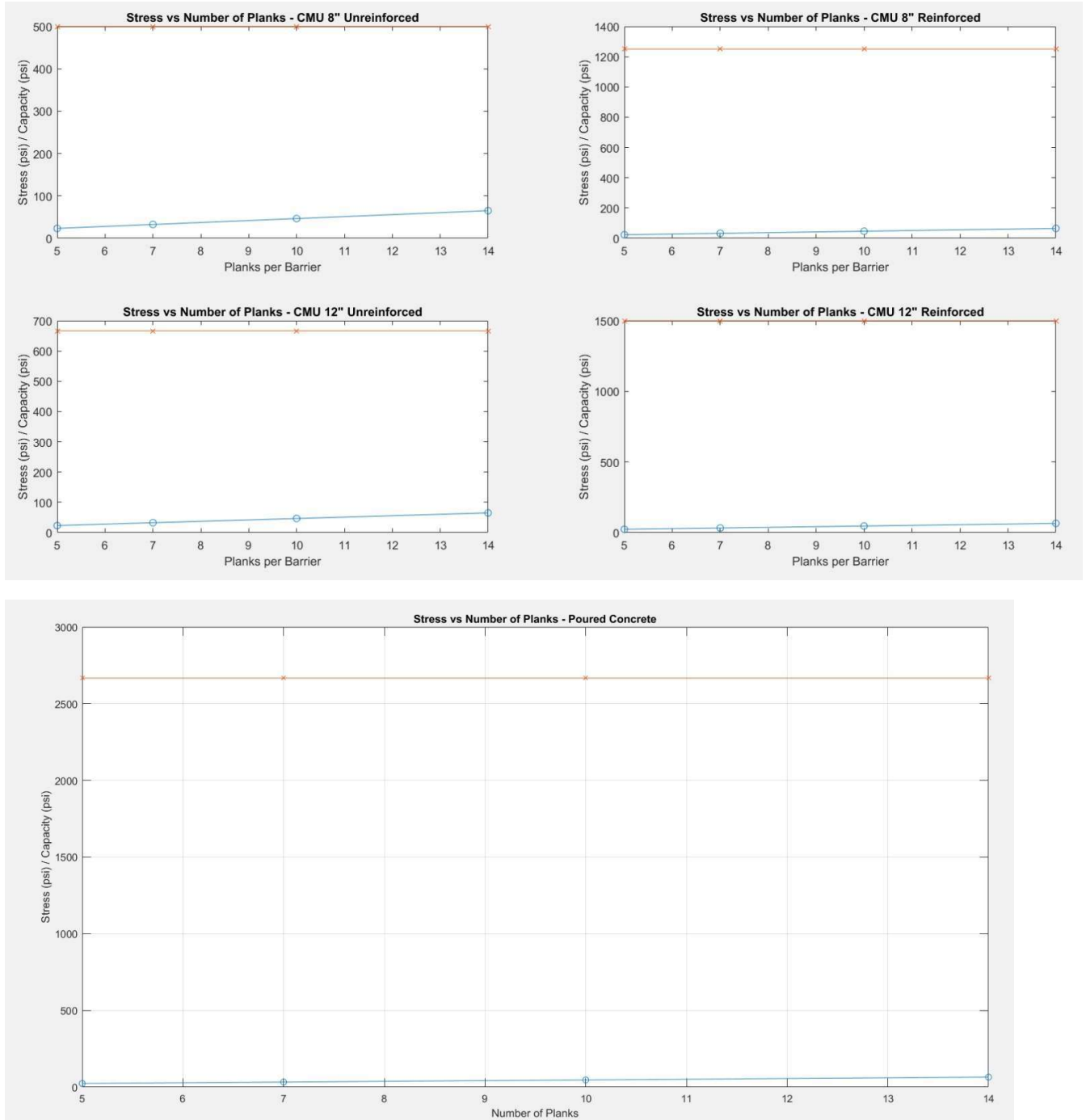
Poured Concrete Wall Stress = 65.14 psi

Poured Concrete wall can handle this load (Capacity >= Stress_psi).

All results are shown in the graph for all type of walls:

1. Orange is the capacity of the wall
2. Blue is the stress on the wall.

6. Conclusion

All wall types can resist the flood barriers with the following openings sizes:

40" Outside Mount
72" Outside Mount
96" Outside Mount
96" Inside Mount
120" Outside Mount
120" Inside Mount

including each of the following heights:
- 5 planks
- 7 planks
- 10 planks
- 14 planks