Bringing New York Dams into Compliance

May 3, 2019

Hans Hasnay, PE – Dams and Water Resources Lead
Theresa Chu, EIT – Water Resources Engineer
6 NYCRR Part 673

Title 6 of the New York Codes, Rules, and Regulations (NYCRR)

Part 673: Dam Safety Regulations

Purpose: Administer Environmental Conservation Law Article 15 and regulate dam safety and dam safety programs
NYSDEC Dam Safety Regulations: Hazard Classification

**Class A – Low Hazard Dam**

Dam failure is **unlikely** to result in damage to anything more than isolated and unoccupied buildings and undeveloped lands.

**Class B – Intermediate Hazard Dam**

Dam failure is **likely** to pose the threat of personal injury or result in substantial economic, environmental, or infrastructure loss. Loss of human life is not expected.

**Class C – High Hazard Dam**

Dam failure is **likely** to result in widespread substantial economic, environmental, or infrastructure loss. Loss of human life is likely.
## NEW YORK STATE DAM SAFETY REGULATIONS

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>FREQUENCY</th>
<th>C HIGH</th>
<th>B INTERMEDIATE</th>
<th>A LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection &amp; Maintenance Plan</td>
<td>On-going</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Annual Certification</td>
<td>Annually by Jan 31</td>
<td>☑</td>
<td>☑</td>
<td>N/A</td>
</tr>
<tr>
<td>Emergency Action Plan</td>
<td>Annual Review and Update</td>
<td>☑</td>
<td>☑</td>
<td>N/A</td>
</tr>
<tr>
<td>Dam Safety Inspection</td>
<td>2 Years for Class C, 4 Years for Class B</td>
<td>☑</td>
<td>☑</td>
<td>N/A</td>
</tr>
<tr>
<td>Engineering Assessment</td>
<td>Every 10 Years</td>
<td>2022</td>
<td>2025</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- Indicates requirement that must be fulfilled
NYSDEC Dams Inventory

Dam Hazard Classification:
- Class A (4289)
- Class B (626)
- Class C (408)
Required every 10 years for Class B and C dams or if assigned Condition Rating of “unsafe” or “unsound”

- Safety Inspection
- Hydrologic and hydraulic analysis
- Spillway capacity determination
- Stability and structural analysis
- Hazard Classification
- Emergency Action Plan Review
Common Rehabilitation Issues

- Insufficient Spillway Capacity
- Inadequate Stability Factors of Safety
- Insufficient Low Level Outlet Capacity
- Dam Condition Issues
Spillway Design Floods for Existing Dams

<table>
<thead>
<tr>
<th>Hazard Classification</th>
<th>Spillway Design Flood (SDF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100 year</td>
</tr>
<tr>
<td>B</td>
<td>150% of 100 year</td>
</tr>
<tr>
<td>C</td>
<td>50% of Probable Maximum Flood</td>
</tr>
</tbody>
</table>

Guidelines for the Design of Dams, 1989, NYSDEC Division of Water

Mount Beacon Dam Spillway (Class C Dam)
Hydrologic Analysis

Digital Elevation Model

Hydrologic Soil Group

Land Use and Land Cover

Elevation (ft NAVD88)
High: 602.69
Low: 198.491

Hydrologic Soil Group
A
B
C
D
## Stability Analysis: Gravity Dam Guidelines

<table>
<thead>
<tr>
<th>Load Case</th>
<th>Load Condition</th>
<th>Minimum Required Factor of Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Normal</td>
<td>1.5</td>
</tr>
<tr>
<td>Case 2</td>
<td>Ice</td>
<td>1.25</td>
</tr>
<tr>
<td>Case 3</td>
<td>Spillway Design Flood (SDF)</td>
<td>1.25</td>
</tr>
<tr>
<td>Case 4</td>
<td>Seismic</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Stability Analysis: Typical Gravity Section
<table>
<thead>
<tr>
<th>Loading Condition</th>
<th>Slope to be Analyzed</th>
<th>Minimum Required Factor of Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady Seepage with Normal Loading Conditions</td>
<td>Downstream</td>
<td>1.5</td>
</tr>
<tr>
<td>Steady Seepage with Design Loading Conditions (SDF)</td>
<td>Downstream</td>
<td>1.4</td>
</tr>
<tr>
<td>Seismic Loading Conditions</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Upstream</td>
<td>1</td>
</tr>
<tr>
<td>Rapid Drawdown with Normal Loading Conditions</td>
<td>Downstream</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Upstream</td>
<td>1.1</td>
</tr>
<tr>
<td>Rapid Drawdown with Design Loading Conditions (SDF)</td>
<td>Downstream</td>
<td>1.3</td>
</tr>
</tbody>
</table>
Stability Analysis: Embankment Section

Normal Pool

Flood (SDF)

Seismic Upstream

Seismic Downstream
Stability Analysis: Embankment Section

Normal Pool - Rapid Drawdown Upstream

Normal Pool - Rapid Drawdown Downstream

Flood (SDF) - Rapid Drawdown Downstream
Low Level Outlet

The low level drain is required to have sufficient capacity to discharge 90% of the storage below the lowest spillway crest within 14 days, assuming no inflow into the reservoir.

Guidelines for the Design of Dams, 1989
NYSDEC Division of Water
General Conditions

- Undesirable vegetation
- Deteriorating concrete
- Irregular dam crest
- Potential piping
- Wet embankments
Spillway Capacity: St. Joseph’s Lake Dam

Increase capacity by raising non-overflow section and adding auxiliary spillway

Before

After
Spillway Capacity: St. Joseph’s Lake Dam - After
Spillway Enhancement: Browns Dam

Increase capacity by raising non-overflow section

Before

After
Spillway Enhancement: Pleasure Lake Dam

New emergency spillway
Spillway Enhancement: Lake Louise Marie

New auxiliary spillway
Concrete Dam - Anchoring

Stability Improvements: St. Joseph’s Dam
Concrete Dam – adding mass
Stability
Browns Dam
Embankment Remediation

Embankment Dam – flatten downstream slope and seepage blanket
Low Level Outlet Repair: St. Joseph’s Dam

Low Level Outlet

Temporary Valve
Low Level Outlet: Lake Louise Marie

New LLO drains 40% of Lake

Pumping to assist and drain remainder
Installing new LLO’s in existing dams can be risky and expensive
- Excavation Risk
- Cofferdam Risk
- Seepage Path in Embankment Dams

Pumping Alternatives
- Pumps as supplement (Lake Louise Marie and Wolf Lake)
- Pumps Only (Pleasure Lake)
- Pump sizes must be reasonable and readily available
- Develop a documented plan, get DEC approval, and include in EAP
Undesirable Vegetation

Issues:
- Difficult to inspect – hides problems
- Attracts borrowing rodents
- Tree roots create seepage paths
Deteriorating Concrete
Potential Piping

INITIATION
Leakage exists on d/s side of core and backward erosion initiates

CONTINUATION
Continuation of erosion

PROGRESSION
Backward erosion progresses back to the reservoir

BREACH/FAILURE
Breach mechanism forms

(a) Backward erosion piping in the embankment

Swinging Bridge
Financing Strategies

- Bank Loans
- Homeowner Assessment (HOA)
- Project Phasing
- Available Grants through Consolidated Funding Application (CFA)
Thank you!

Hans Hasnay, PE  
Dams & Reservoirs Practice Leader  
845-781-0635  
Hans.Hasnay@wsp.com

Theresa Chu, EIT, ENV SP  
Water Resources Engineer  
914-449-9130  
Theresa.Chu@wsp.com

Allan Estivalet, PE, CFM  
Water & Environment Area Manager  
718-473-2427  
Allan.Estivalet@wsp.com

wsp.com