OSWEGO RIVER DAM
PUNCH BOWL DAM

SCHUYLER COUNTY, NEW YORK
INVENTORY NO. N.Y. 10743

"Original contains color plates; all DTG reproductions will be in black and white"
Based on the evaluation of the existing conditions, the condition of the Punch Bowl Dam is considered to be good. The examination of documents and the visual observations did not reveal conditions which constitute a hazard to human life or property.
The spillway capacity was evaluated according to the recommended procedure and the dam was found to pass 100 percent of the Probable Maximum Flood (PMF) without significantly affecting the stability of the dam. Therefore, the spillway capacity is rated as adequate.
This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.
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H. PREVIOUS INSPECTION REPORTS/AVAILABLE DATA*

I. REFERENCES

*Not included due to lack of pertinent data.
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Punch Bowl Dam
N.Y. 1343

State Located: New York

County Located: Schuyler

Stream: Glen Creek (a tributary of Seneca Lake)

Date of Inspection: June 25, 1981 and July 15, 1981

ASSESSMENT

Based on the evaluation of the existing conditions, the condition of the Punch Bowl Dam is considered to be good. The examination of documents and the visual observations did not reveal conditions which constitute a hazard to human life or property.

The spillway capacity was evaluated according to the recommended procedure and the dam was found to pass 100 percent of the Probable Maximum Flood (PMF) without significantly affecting the stability of the dam. Therefore, the spillway capacity is rated as adequate.

The following recommendations should be implemented within 12 months from the final issuance date of this report:

1. An all-weather access route to the dam should be provided to permit inspection of the dam and the implementation of action in the event of an emergency during severe weather conditions.

2. Means should be developed to drain the reservoir in the event of an emergency.

3. An emergency action plan should be developed, including a formal warning system to alert the downstream residents in the event of an emergency.

4. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.
Assessment - Punch Bowl Dam

Lawrence D. Andersen, P.E.
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Pittsburgh, Pennsylvania

Approved by: Col. W. M. Smith, Jr.
New York District Engineer

Date: 14 Sept
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
PUNCH BOWL DAM
N.Y. 1343
DEC I.D. NO. 60C-4405
OSWEGO RIVER BASIN
SCHUYLER COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority
The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection
The inspection was to evaluate the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to life and property, and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances
The Punch Bowl Dam is a concrete arch dam with a maximum height of 38 feet from the downstream toe. The dam spans a narrow gorge approximately 100 feet wide. No design and construction information is available. According to the approximate field measurements, the crest length of the arch is approximately 110 feet and the thickness of the arch at the crest level is about 5 feet. The dam appears to be a single curvature arch. Based on field measurements, the radius of curvature is about 70 feet.

A 35-foot-wide, 2-foot-deep low section, located at the center of the arch, constitutes the normal flow spillway. A gated opening through the dam, located approximately 30 feet below the dam near the right abutment, is the low level outlet facility of the structure. According to state park personnel, the low level outlet sluice gate has not been operated since the completion of the dam.

b. Location
The dam is located in Watkins Glen State Park on Glen Creek about two miles upstream from its mouth at Seneca Lake in Dix Township, Schuyler County, New York. Plate 1 illustrates the location of the dam.
c. Size Classification
The dam is classified as a small dam based on its 38-foot height and a maximum storage capacity of 190 acre-feet.

d. Hazard Classification
The dam is classified to be in the high hazard category. Downstream from the dam, Glen Creek flows through a narrow gorge in Watkins Glen State Park, and then through commercial and residential areas within the town of Watkins Glen. Finally, Glen Creek discharges into Barge Canal at the south end of Seneca Lake about two miles downstream from the dam. In Watkins Glen, the stream flows through a 50- to 60-foot-wide, 10- to 15-foot-deep channel. Based on visual observations, it is estimated that failure of the dam could cause loss of more than a few lives and appreciable property damage in both the Watkins Glen State Park and the town of Watkins Glen.

e. Ownership
The dam is owned and operated by the New York State Department of Parks and Recreation. (Address: Mr. Robert DeNardo, Park Superintendent, Watkins Glen State Park, P.O. Box 304, Watkins Glen, New York 14891, 607-535-4511).

f. Purpose of Dam
According to the Park Superintendent, the dam was designed and constructed for the purpose of controlling sediment runoff into Watkins Glen State Park.

g. Design and Construction History
No references were found to document the design and construction history of the dam. According to state files, construction of the dam was completed in 1936.

h. Normal Operating Procedure
The reservoir is normally maintained at the spillway crest level of the dam.

1.3 PERTINENT DATA
Elevations referred to in this and subsequent sections of the report were obtained from field measurements assuming the spillway crest to be at Elevation 915 (USGS Datum) which is shown as the pool level of the reservoir on the Beaver Dam 7.5-minute USGS quadrangle.

a. Drainage Area (sq. mi.) 21.5

b. Discharge at Dam (cfs)
   Spillway at top of nonoverflow section 310

c. Elevation (USGS Datum) (feet)
   Top of dam (overflow section) 915
   Top of dam (nonoverflow section) 917
<table>
<thead>
<tr>
<th></th>
<th>Surface area at top of overflow section</th>
<th>Surface area at top of nonoverflow section</th>
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<tr>
<td><strong>d. Reservoir (acres)</strong></td>
<td>12.9+ (1)</td>
<td>13.6+</td>
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<td><strong>e. Storage Capacity (acre-feet)</strong></td>
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<tr>
<td>Top of dam (overflow section)</td>
<td>160 (2)</td>
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<tr>
<td>Top of dam (nonoverflow section)</td>
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| **f. Dam** |                                      |
| Type       | Concrete arch                         |
| Length     | 110 feet                              |
| Height     | 38 feet                               |
| Top width  | 5+ feet                               |
| Side slopes| Downstream: Vertical                  |
|           | Upstream: Vertical                    |
| Cut off    | Unknown                               |
| Grout curtain | No                               |

| **g. Primary Spillway** |                                      |
| Type                  | Concrete overflow section            |
| Length                | 35 feet                               |
| Crest elevation       | 915 feet                              |

| **h. Reservoir Drain** |                                      |
| Type                  | Gated opening through dam (size unknown) |
| Length                | Not applicable                        |
| Access                | Not accessible                        |
| Regulatory Facility   | Manually operated hoist mechanism     |

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(i) Planimetered from USGS 7.5-minute Beaver Dam quadrangle. Original reservoir area was reported to be 16 acres. Reservoir is now significantly silted.

(2) Design storage capacity.
SECTION 2: ENGINEERING DATA

2.1 DATA AVAILABLE

Available information was obtained from the New York State Department of Environmental Conservation, Dam Safety Division files. The only information available in the files was a field inspection checklist dated June 8, 1980. The State Parks and Recreation Department Offices in Albany and the Finger Lakes field office were contacted in an effort to obtain additional information. However, both offices reported that no design or construction information was available for the dam. An internal correspondence provided by the State Park Superintendent, dated July 6, 1972, and prepared by Mr. J. W. Miller, Senior Park Engineer, was found to include some information on the pertinent dimensions of the dam.

2.2 GEOLOGY

The Punch Bowl Dam is located in the glaciated Allegheny Plateau section of the Appalachian Plateau Province. This region is characterized as a maturely dissected plateau with the topographic features modified by continental glaciation. The modification consists of rounding off of the high areas and deposition of glacial till in the valleys.

The dam site is located near the axis of a northeast trending anticline (trending approximately north 70 degrees east). The folding is gentle with the maximum dip of the limbs of one to two degrees. The dip of the strata is affected locally by the folding; however, regionally, the rock strata dip southwest at approximately 100 to 150 feet per mile. The most prominent fracture orientations in the region have a strike of north 25 degrees west. Less prominent fractures strike north 75 degrees west and north 10 degrees east. Also, there is a north-trending normal fault approximately one mile west of the dam.

The rock strata in the area consist of unconsolidated Pleistocene glacial till (Wisconsin Drift) underlain by strata of the Sonyea Group (Upper Devonian Age). The glacial till consists of a mixture of clay and silt with varying quantities of gravel. The glacial till is relatively thin on hilltops and slopes and thicker in the valleys. The bedrock consists of a thick sequence of interbedded gray calcareous shale, gray and greenish-gray siltstone and silty shale, brown, gray, and dark gray shale, and black fissile shale.

2.3 SUBSURFACE INVESTIGATION

No reference was found relative to a subsurface investigation.
2.4 EMBANKMENT AND APPURTENANT STRUCTURES

As noted before, very limited information is available concerning the design and construction of the dam. Sketches in Plate 2 illustrate the plan view and typical cross section of the dam as derived from the available information. The 1972 correspondence indicates that the radius of curvature of the dam is about 70 feet. The thickness of the arch wall is reported to be five feet at crest level and seven feet at the bottom of the dam. It is also reported that the dam was keyed into the abutments in the range of 8 to 25 feet and into the foundation by about 6 feet. It is reported that steel reinforcement was provided on both faces of the dam.

2.5 CONSTRUCTION RECORDS

No construction records are available. Visual observations indicate that no postconstruction changes were instituted.

2.6 OPERATING RECORDS

No operating records are maintained.

2.7 EVALUATION OF DATA

The available information is very limited. However, in conjunction with visual observation, the available data are considered to be adequate for Phase I inspection purposes.
SECTION 3: VISUAL INSPECTIONS

3.1 FINDINGS

a. General
Visual inspections of the dam were conducted on June 25 and July 15, 1981. On both dates, the pool level was approximately at the crest level of the overflow section.

b. Dam
No identifiable signs of distress or misalignment were observed. No seepage was observed at the junction of the dam and the abutments. The base of the dam is submerged by the spillway plunge pool; therefore, it could not be inspected for signs of seepage. The concrete comprising the main structure was found to be in good condition. Some sections of the stone veneer on the crest of the dam and the concrete in the vicinity of the low level outlet were found to be deteriorating.

c. Spillway
A 35-foot-wide and approximately 2-foot-deep low overflow section on the crest of the dam constitutes the spillway of the dam. The overflow section was found to be in good condition; no significant concrete erosion was noted.

d. Reservoir Drain
A gated opening through the dam, located approximately 30 feet below the dam crest near the right abutment, constitutes the low level outlet for the facility. The sluice gate and hoist are located on the downstream side of the dam. The outlet is not accessible for inspection. According to the park superintendent, the outlet has not been operated since the completion of the dam.

e. Downstream Channel
The stream channel downstream from the dam is a deep gorge. The channel appears to be stable within the vicinity of the dam.

f. Reservoir
It appears that the reservoir is silted to within several feet of the spillway overflow crest. The original reservoir surface area is reported to have been 16 acres. Visual observations indicate that the present reservoir area is in the range of 13 acres.

3.2 EVALUATION

The dam was found to be structurally in good condition. However, the sluice gate and its hoisting equipment appear to be corroded and are reported to be nonfunctional. Minor concrete deterioration was also observed.
SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The reservoir is normally maintained at the spillway crest level with excess inflow discharging over the spillway. The dam has no formal operating procedure.

4.2 MAINTENANCE OF THE DAM

The dam is maintained by state park personnel. The low level outlet gate was found to be corroded and requires reconditioning. Further, the outlet is not accessible for thorough inspection or for maintenance.

4.3 WARNING SYSTEM IN EFFECT

There is no formal warning system in effect. It is reported by state park personnel that the dam is inspected following major storms. It was found that the dam is accessible by a foot path only which may not be passable during severe weather conditions.

4.4 EVALUATION

The maintenance condition of the low level outlet operating facilities is considered to be poor. These facilities should be maintained to prevent further corrosion. Access to the dam should also be improved to permit inspection of the dam and implementation of emergency action, if necessary, during severe weather conditions.
SECTION 5: HYDRAULIC/HYDROLOGY

5.1 DRAINAGE AREA CHARACTERISTICS

The Punch Bowl Dam drains an area of 21.5 square miles. The basin is comprised of woodlands, farmlands, and pasturelands. Two dams are located upstream from the Punch Bowl Dam on Glen Creek.

5.2 ANALYSIS CRITERIA

As previously stated, the Punch Bowl Dam is classified as a small dam in the high hazard category. Under the recommended criteria for evaluating spillway discharge capacity, such impoundments are required to pass one-half to full PMF.

The PMF inflow hydrograph for the reservoir was determined using the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers. The data used for the computer input are presented in Appendix D.

5.3 SPILLWAY CAPACITY

The 35-foot-wide, 2-foot-deep low section along the crest of the dam constitutes the primary spillway. The capacity of the primary spillway is calculated to be 310 cfs. During inflow conditions in excess of the capacity of the primary spillway, the entire crest of the dam can function as an emergency spillway.

5.4 RESERVOIR CAPACITY

The original storage capacity of the dam is reported to be 160 acre-feet but the reservoir has significantly silted. The present surcharge storage capacity is estimated to be in the range of 20 to 30 acre-feet.

5.5 FLOODS OF RECORD

None available.

5.6 OVERTOPPING POTENTIAL

The PMF inflow hydrograph, determined according to the recommended procedure, was found to have a peak flow of 28,500 cfs. The capacity of the low overflow section of the dam (310 cfs) corresponds to one percent of the PMF. The 50 percent PMF peak flow is 14,200 cfs. The PMF and 50 percent PMF inflow hydrographs were routed through the reservoir and it was found that the crest of the dam would be overtopped by 11.4 feet during the 50 percent PMF and by 18.5 feet during the full PMF.
5.7 EVALUATION

The results of a preliminary stability analysis, which is discussed in Section 6, indicate that the dam will likely be stable during the passage of full PMF; therefore, the spillway capacity is considered to be adequate according to the recommended criteria.
SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations
As discussed in Section 3, the field observations did not reveal any signs of distress that would adversely affect the stability of the dam at this time.

b. Design and Construction Data
As previously noted, very limited design information is available to aid in the assessment of the structural stability of the dam. No design drawings or calculations are available.

c. Stability Analysis
A preliminary stability analysis was conducted to determine the order of magnitude of the stresses in the arch during the passage of the full PMF. The stability analysis is included in Appendix G. A representative unity height of the dam was analyzed as an arch with pinned supports. In view of the lack of any quantitative design information, such as type and strength of the concrete and strength of the abutment rocks, a more detailed analysis could not be conducted. The results of this approximate analysis indicate that the maximum arch compressive stress is in the range of 300 psi, which is likely to be within the allowable strength of the abutment rock and the concrete used to construct the dam. Based on visual observations, the stability of the dam under normal pool conditions is considered to be adequate.

d. Postconstruction Changes
No postconstruction changes were reported.

e. Seismic Stability
The dam is located in Seismic Zone 1. Based on the recommended criteria for evaluation of the seismic stability of dams, the structure is presumed to present no hazard from earthquakes.
SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety
Visual observations indicate that the Punch Bowl Dam is structurally in good condition. No conditions were observed that would adversely affect the stability of the structure at this time. The dam was found to pass the required spillway design flood without significantly affecting its stability. Therefore, the spillway capacity of the dam is classified to be adequate.

The operating equipment of the low level outlet was found to be in poor condition and requires maintenance. It was reported by State Park personnel that the low level outlet facility is nonfunctional. Because the reservoir has significantly silted, the low level outlet facility cannot be used to drain the reservoir. Therefore, other means of draining the reservoir should be devised to drawdown the lake in the event of an emergency condition.

Another condition noted was that the dam is accessible by a foot path only, which may not be passable under severe weather conditions. Therefore, access to the dam should be provided to permit inspection of the dam and implementation of emergency action during severe weather conditions, if necessary.

b. Adequacy of Information
Available information, in conjunction with visual observations, is considered to be sufficient to make a Phase I evaluation.

c. Need for Additional Investigations
No additional investigation is considered to be required at this time.

d. Urgency
The following recommendations should be implemented within 12 months from the final issuance date of this report.

7.2 RECOMMENDATIONS

1. An all-weather access route to the dam should be provided to permit inspection of the dam and the implementation of action in the event of an emergency during severe weather conditions.

2. Means should be developed to drain the reservoir in the event of an emergency.

3. An emergency action plan should be developed, including a formal warning system to alert the downstream residents in the event of an emergency.

4. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.
PHOTOGRAPH NO. 1
Dam Crest (looking north)

PHOTOGRAPH NO. 2
Left Abutment
PHOTOGRAPH NO. 3
Right Abutment

PHOTOGRAPH NO. 4
Low Level Outlet Sluice Gate
PHOTOGRAPH NO. 5
Watkins Glen State Park
(1.0 mile downstream)

PHOTOGRAPH NO. 6
City of Watkins Glen
(1.5 miles downstream)
APPENDIX B

VISUAL INSPECTION CHECKLIST
1) Basic Data

a. General

Name of Dam: Punch Bowl Dam
Fed. I.D. #: N.Y. 1343  DEC Dam No. 60C-4405
River Basin: Oswego River Basin
Location: Watkins Glen State Park, one mile south of Watkins Glen in Schuyler County
Stream Name: Glen Creek
Tributary of: Seneca Lake
Latitude (N): 42° 22.4'  Longitude (W): 76° 53.9'
Type of Dam: Concrete arch
Hazard Category: High
Date(s) of Inspection: June 25, 1981 and July 15, 1981
Weather Conditions: Sunny, Temp. 75 degrees
Reservoir Level at Time of Inspection: El. 915

b. Inspection Personnel: Lawrence Andersen, P.E.; James Poellot, P.E.; Bilgin Erel, P.E.; and Michael Bort

c. Persons Contacted (Including Address & Phone No.): Mr. Robert DeNardo, Park Superintendent, Watkins Glen State Park, P.O. Box 304, Watkins Glen, New York 14891, 607-535-4511
d. History:

Date Constructed 1936 Date(s) Reconstructed N/A

Designer Unknown

Constructed by Unknown

Owner New York State Department of Parks and Recreation

2) Embankment

a. Characteristics

(1) Embankment Material Concrete

(2) Cutoff Type N/A

(3) Impervious Core N/A

(4) Internal Drainage System N/A

(5) Miscellaneous --

b. Crest

(1) Vertical Alignment Good

(2) Horizontal Alignment Good

(3) Surface Cracks None

(4) Miscellaneous --

c. Upstream Slope

(1) Slope (Estimate) Vertical

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A
(4) Slope Protection N/A

(5) Surface Cracks or Movement at Toe None
d. Downstream Slope

(1) Slope (Estimate) Vertical

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions N/A

(4) Surface Cracks or Movement at Toe None

(5) Seepage None visible.

(6) External Drainage System (Ditches, Trenches, Blanket)
None

(7) Condition Around Outlet Structure N/A

(8) Seepage Beyond Toe None
e. Abutments - Embankment Contact
No problems observed.
(1) Erosion at Contact  N/A

(2) Seepage Along Contact  None

3) Drainage System

The dam has no internal drainage system.

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, etc.)

None
5) Reservoir
   a. Slopes  Moderate slopes, no problems observed.
   b. Sedimentation  Silted to within five to six feet of the spillway crest.
   c. Unusual Conditions Which Affect Dam  None observed.

6) Area Downstream of Dam
   a. Downstream Hazard (No. of Homes, Highways, etc.)  Glen Creek flows through a narrow gorge in Watkins Glen State Park; then, approximately one mile farther downstream, it flows through commercial and residential areas of the town of Watkins Glen.
   b. Seepage, Unusual Growth  None
   c. Evidence of Movement Beyond Toe of Dam  None
   d. Condition of Downstream Channel  Good

7) Spillway(s) (Including Discharge Conveyance Channel)
   a. General  Service Spillway: A low overflow section of the dam constitutes the spillway.
   b. Condition of Service Spillway  Good
c. Condition of Auxiliary Spillway   N/A  

______________________________  

______________________________  

d. Condition of Discharge Conveyance Channel   N/A  

______________________________  

______________________________  

8) Reservoir Drain/Outlet  

Type: Pipe _____ Conduit _____ Other Opening through dam  

Material: Concrete _____ Metal _____ Other Unknown   

______________________________  

Size: Unknown Length  

Invert Elevations: Entrance Unknown Exit Unknown  

Physical Condition (Describe): Not observable.  

Material:  

______________________________  

Joints:  

______________________________  

Alignment  

______________________________  

Structural Integrity:  

______________________________  

Hydraulic Capability:  

______________________________  

Means of Control: Gate X Valve _____ Uncontrolled  

Operation: Operable _____ Inoperable X Other  

Present Condition (Describe): The reservoir drain is reported to be inoperable.
9) Structural

a. Concrete Surfaces The dam appears to generally be in good condition with some spalling near the right abutment and near the low level outlet gate.

b. Structural Cracking None observed.

c. Movement - Horizontal & Vertical Alignment (Settlement) None observed.

d. Junctions with Abutments or Embankment No problems observed.

e. Drains - Foundation, Joint, Face No problems observed.

f. Water Passages, Conduits, Sluices N/A

g. Seepage or Leakage None observed.
h. Joints - Construction, etc.  
   No problems observed.

i. Foundation  
   Not visible.

j. Abutments  
   N/A

k. Control Gates  
   Reported to be inoperable.

l. Approach & Outlet Channels  
   Good

m. Energy Dissipators (Plunge Pool, etc.)  
   None

n. Intake Structures  
   N/A

o. Stability  
   N/A

p. Miscellaneous  
   ---
10) **Appurtenant Structures** (Power House, Lock, Gatehouse, Other)

a. **Description and Condition**

None
APPENDIX C

ENGINEERING DATA CHECKLIST
APPENDIX C
ENGINEERING DATA CHECKLIST
NAME OF DAM: PUNCH BOWL DAM

AREA-CAPACITY DATA:

<table>
<thead>
<tr>
<th></th>
<th>Elevation (feet)</th>
<th>Surface Area (acres)</th>
<th>Storage Capacity (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Top of Dam</td>
<td>917.0</td>
<td>13.6</td>
<td>190.0</td>
</tr>
<tr>
<td>2) Design High Water (Max. Design Pool)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3) Auxiliary Spillway Crest</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>4) Service Spillway Crest</td>
<td>915.0</td>
<td>13.9</td>
<td>(design value) 160.0</td>
</tr>
<tr>
<td>5) Crest of Orifice (Normal Pool)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
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</table>

DISCHARGES

<table>
<thead>
<tr>
<th>Discharge (cfs)</th>
<th>1) Average Daily</th>
<th>2) Auxiliary Spillway at Maximum High Water(1)</th>
<th>3) Auxiliary Spillway at Design High Water</th>
<th>4) Principal Spillway at Auxiliary Spillway Crest Elevation</th>
<th>5) Low Level Outlet</th>
<th>6) Total of All Facilities at Maximum High Water(1)</th>
<th>7) Maximum Known Flood</th>
<th>8) At Time of Inspection</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>50+</td>
<td>28,490</td>
<td>N/A</td>
<td>310</td>
<td>N/A</td>
<td>28,490</td>
<td>Unknown</td>
<td>50+</td>
</tr>
</tbody>
</table>

(1) Maximum high water is assumed to equal the full PMF. The dam is capable of passing the full PMF.
**DAM:** Punch Bowl Dam  

**CREST ELEVATION:** 917.0  

**Type:** Concrete arch  

**Width:** 5 feet  **Length:** 110 feet  

**Spillover:** Low overflow section of the dam.  

**Location:** Center of the dam.  

---  

**SPILLWAY:**  

| SERVICE | AUXILIARY  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>915.0 Elevation</td>
<td>917 Elevation</td>
</tr>
<tr>
<td>Overflow section Type</td>
<td>Dam crest Type</td>
</tr>
<tr>
<td>35-foot Width</td>
<td>5 feet Width</td>
</tr>
</tbody>
</table>

**Type of Control**  

| Uncontrolled | Uncontrolled | N/A  
| Controlled | N/A  

**Type (Flashboards; Gate)**  

| N/A | N/A  
| N/A | N/A  

**Size/Length**  

| N/A | N/A  
| Concrete | Invert Material | N/A  

**Anticipated Length of Operating Service**  

| N/A | N/A  
| N/A | Chute Length | N/A  

5 to 6 feet Height Between Spillway Crest and Approach Channel Invert (Weir Flow)  

---  

PAGE C2 OF 4
Hydrometeorological Gages:

Type: None
Location: N/A
Records:
  Date - N/A
  Max. Reading - N/A

FLOODWATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (Mechanisms):
None
DRAINAGE AREA: 21.5 square miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Woodlands, farmlands, and pasturelands

Terrain - Relief: Moderate to steep slopes

Surface - Soil: Low permeability

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

Moderate to high runoff potential due to moderate to steep slopes and low infiltration rate.

Potential Sedimentation Problem Areas (natural or man-made; present or future)

Punch Bowl Dam was designed and constructed to act as a sediment collection basin and is presently silted into within five to six feet of its spillway crest. Thus, there is an erosion problem within the watershed, the problem most likely associated with the farmland areas.

Potential Backwater Problem Areas for Levels at Maximum Storage Capacity Including Surcharge Storage:

None observed.

Dikes - Floodwalls (overflow and nonoverflow) - Low Reaches Along the Reservoir Perimeter:

Location: None

Elevation: 

Reservoir:

Length at Maximum Pool: 2,400+ feet

Length of Shoreline at Normal Pool: 3,700+ feet
APPENDIX D

HYDROLOGY AND HYDRAULIC ANALYSES
**HYDROLOGY AND HYDRAULIC ANALYSIS**

**DATA BASE**

**NAME OF DAM:** Punch Bowl Dam (NY DEC 60C-4405)

**PROBABLE MAXIMUM PRECIPITATION (PMP) = 21.5 INCHES/24 HOURS**

<table>
<thead>
<tr>
<th>STATION</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td><strong>Station Description</strong></td>
<td>Punch Bowl Lake</td>
<td>Punch Bowl Dam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drainage Area (square miles)</strong></td>
<td>21.5</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cumulative Drainage Area (square miles)</strong></td>
<td>21.5</td>
<td>21.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adjustment of PMP for Drainage Area (K)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Hours</td>
<td>111</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Hours</td>
<td>123</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 Hours</td>
<td>132</td>
<td>—</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>48 Hours</td>
<td>142</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>72 Hours</td>
<td>—</td>
<td>—</td>
<td></td>
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<td></td>
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<tr>
<td><strong>Snyder Hydrograph Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( C_p/C_c(2) )</td>
<td>0.60/2.0</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( L ) (miles)(3)</td>
<td>8.0</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( L_{ca} ) (miles)(3)</td>
<td>3.5</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_p = C_c(L-L_{ca})^{0.3} ) (hours)</td>
<td>5.3</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spillway Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crest Length (ft)</td>
<td>—</td>
<td>35.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeboard (ft)</td>
<td>—</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge Coefficient</td>
<td>—</td>
<td>3.1</td>
<td></td>
<td></td>
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<tr>
<td>Exponent</td>
<td>—</td>
<td>1.5</td>
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</tr>
</tbody>
</table>

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.
(2) Snyder's Coefficients.
(3) \( L \) = Length of longest water course from outlet to basin divide.
\( L_{ca} \) = Length of water course from outlet to point opposite the centroid of drainage area.

PAGE D1 OF 4
<table>
<thead>
<tr>
<th></th>
<th>AT</th>
<th>SNYDER UNIT HYDROGRAPH: SPILLWAY AND D Am OVERTOPPING ANALYSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>A2</td>
<td>PUNCH BOWL DAM (NY 60C-4405) SCHUYLER COUNTY N.Y.; PROJECT # 8U-718-1A</td>
</tr>
<tr>
<td>3</td>
<td>A3</td>
<td>FOR 53, 10% 20% 30% 40% 50% 7% 80% 8% AND 1% PROBABLE MAXIMUM FLOODPMF</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>300 30 0 0 0 0 0 0 0 -4</td>
</tr>
<tr>
<td>5</td>
<td>B1</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>J</td>
<td>1 9 1</td>
</tr>
<tr>
<td>7</td>
<td>J1</td>
<td>0.05 0.10 0.20 0.30 0.40 0.50 0.70 0.80 1.00</td>
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<tr>
<td>8</td>
<td>K</td>
<td>0 1</td>
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<tr>
<td>9</td>
<td>K1</td>
<td>CALC OF SNYDER INFLOW HYDROGRAPH TO PUNCH BOWL DAM (NY 60C-44(5))</td>
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<tr>
<td>10</td>
<td>M</td>
<td>1 1 21.5 21.5 1</td>
</tr>
<tr>
<td>11</td>
<td>P</td>
<td>21.5 111 123 132 142</td>
</tr>
<tr>
<td>12</td>
<td>T</td>
<td>1.0 0.05</td>
</tr>
<tr>
<td>13</td>
<td>W</td>
<td>5.30 0.60</td>
</tr>
<tr>
<td>14</td>
<td>X</td>
<td>-1.2 -0.05 2.0</td>
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<tr>
<td>15</td>
<td>K</td>
<td>1 2</td>
</tr>
<tr>
<td>16</td>
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<td>ROUTING FLOW THROUGH PUNCH BOWL DAM (NY 60C-4405)</td>
</tr>
<tr>
<td>17</td>
<td>Y</td>
<td>1 1</td>
</tr>
<tr>
<td>18</td>
<td>Y1</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>$A$</td>
<td>0 12.9 14.7 20.2 22.0</td>
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<tr>
<td>20</td>
<td>$C$</td>
<td>277.0 915.0 920.0 930.0 940.0</td>
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<td>21</td>
<td>$SS$</td>
<td>915.0 35.0 3.1 1.5</td>
</tr>
<tr>
<td>22</td>
<td>$SD$</td>
<td>917.0 3.1 1.5 75.0</td>
</tr>
<tr>
<td>23</td>
<td>K</td>
<td>99</td>
</tr>
</tbody>
</table>

**COMPUTER INPUT OVERTOPPING ANALYSIS**

PAGE D2 OF 4
### Peak Flow and Storage (End of Period) Summary for Multiple Plan-Ratio Economic Computations

**Flows in Cubic Feet per Second (Cubic Meters per Second)**

**Area in Square Miles (Square Kilometers)**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Station</th>
<th>Area</th>
<th>Plan Ratio 1</th>
<th>Ratio 2</th>
<th>Ratio 3</th>
<th>Ratio 4</th>
<th>Ratio 5</th>
<th>Ratio 6</th>
<th>Ratio 7</th>
<th>Ratio 8</th>
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</thead>
<tbody>
<tr>
<td>Hydrograph At</td>
<td>1</td>
<td>21.50</td>
<td>1424</td>
<td>2849</td>
<td>5698</td>
<td>8540</td>
<td>11395</td>
<td>14244</td>
<td>19347</td>
<td>22799</td>
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<tr>
<td></td>
<td>2</td>
<td>55.68</td>
<td>40.31</td>
<td>80.67</td>
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<td>242.01</td>
<td>322.67</td>
<td>413.33</td>
<td>504.00</td>
<td>604.69</td>
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<td>Routed To</td>
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<td>21.50</td>
<td>1423</td>
<td>2848</td>
<td>5657</td>
<td>8540</td>
<td>11395</td>
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<td>19441</td>
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<td>40.31</td>
<td>80.65</td>
<td>161.33</td>
<td>242.03</td>
<td>322.68</td>
<td>413.33</td>
<td>504.00</td>
<td>604.62</td>
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**Flood Routing Analysis**

Page D3 of 4
## SUMMARY OF DAM SAFETY ANALYSIS

### PLAN 1

<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>INITIAL VALUE</th>
<th>SPILLWAY CREST</th>
<th>TOP OF DAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>STORAGE</td>
<td>915.00</td>
<td>915.00</td>
<td>917.00</td>
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<tr>
<td>OUTFLOW</td>
<td>163.0</td>
<td>163.0</td>
<td>190.0</td>
</tr>
<tr>
<td></td>
<td>0.0</td>
<td>0.0</td>
<td>307.0</td>
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<table>
<thead>
<tr>
<th>RATIO OF RESERVOIR</th>
<th>MAXIMUM DEPTH</th>
<th>MAXIMUM STORAGE</th>
<th>MAXIMUM OUTFLOW</th>
<th>CURATION</th>
<th>TIME OF MAX OUTFLOW</th>
<th>TIME OF FAILURE</th>
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</thead>
<tbody>
<tr>
<td>PMF</td>
<td>OVER DAM AC-FT</td>
<td>CFS</td>
<td>OVER TOP HOURS</td>
<td>HOURS</td>
<td>HOURS</td>
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<td>.05</td>
<td>918.87</td>
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<td>.80</td>
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<td>45.00</td>
</tr>
</tbody>
</table>

**OVERTOPPING ANALYSIS SUMMARY**

PAGE D4 OF 4
NOTE:
POOL LEVEL AT DATE OF INSPECTION: PRIMARY SPILLWAY CREST.

PLATE 2
PUNCH BOWL DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: JUNE 25, 1981

D'APPOLONIA

NOT TO SCALE
APPENDIX F

GEOLOGY MAP
LEGEND

CANADAWAY GROUP
800-1200 ft (240-370 m)
- Machias Formation—shale, siltstone Rushford Sandstone; Caneadea, Canisteo, and Hume Shales; Canaseraga Sandstone, South Wales and Dunkirk Shales in Pennsylvania Towanda Formation—shale sandstone.

JAVA GROUP
300-700 ft (90-210 m)
- Wiscoy Formation—sandstone shale Hanover and Pipe Creek Shales

WEST FALLS GROUP
1100-1600 ft (340-490 m)
- Nunda Formation—sandstone, shale
- West Hill and Gardeau Formations—shale, siltstone; Roricks Glen Shale; upper Beers Hill Shale; Grimes Siltstone
- Lower Beers Hill Shale; Dunn Hill, Millport, and Moreland Shales
- Nunda Formation—sandstone, shale West Hill Formation—shale, siltstone, Corning Shale
- "New Milford" Formation—sandstone, shale
- Gardeau Formation—shale, siltstone Roricks Glen Shale
- Slide Mountain Formation—sandstone shale, conglomerate
- Beers Hill Shale; Grimes Siltstone, Dunn Hill, Millport, and Moreland Shales

SONYEA GROUP
200-1000 ft (60-300 m)
- In west: Cashqua and Middlesex Shales
- In east: Rye Point Shale, Rock Stream ("Enfield") Siltstone, Pulteney, Sawmill Creek, Johns Creek, and Montour Shales

GENESEE GROUP AND TULLY LIMESTONE
200-1000 ft (60-300 m)
- West River Shale, Genundewa Limestone; Penn Yan and Genesee Shales; all except Genesee replaced eastwardly by Ithaca Formation—shale, siltstone and Sherburne Siltstone
- Oneonta Formation—shale sandstone
- Unadilla Formation—shale siltstone
- Tully Limestone

LOCKPORT GROUP
80-175 ft (25-55 m)
- Oak Orchard and Penfield Dolostones, both replaced eastwardly by Sconondoa Formation—limestone, dolostone

GEOLGY MAP LEGEND

REFERENCE
GEOLOGIC MAP OF NEW YORK, FINGER LAKES SHEET
DATED: 1970, SCALE 1:250,000

D'APPOLONIA
APPENDIX G

STABILITY ANALYSES
Geometric data on this arch dam is shown below in plan.

From field measurements: 6/23/81

This data was obtained from a copy of an internal memorandum from J.W. Miller, Sr. Geol. Engineer, N.Y. State Parks & Recreation Dept., 7/6/72.

Computation:

\[ \theta = 2 \left( \sin^{-1} \left( \frac{30}{70} \right) \right) = 14.47^\circ \]

\[ \theta = 2 \left( \sin^{-1} \left( \frac{20}{70} \right) \right) = 28.96^\circ \quad \Delta = 2^\circ \]

\[ \theta = 2 \left( \sin^{-1} \left( \frac{30}{70} \right) \right) = 33.2^\circ \quad \Delta = 0^\circ \]

Arc length: \( L = 2 \pi R \sin \left( \frac{30.27}{2} \right) = 2 \pi (70) (0.700) = 110.28' \)

\[ L = 2 R \sin \left( \frac{30.27}{2} \right) = 2 \times 70 \times 0.700 = 99.23' \]

\[ \Delta = R - \frac{90}{2} \cos \left( \frac{30.27}{2} \right) = 70 \left( 1 - 0.27 \right) = 28.02' \]

Arch angle \( \theta = \frac{1}{2} \Delta = \frac{70.27}{2} = 45.14^\circ \)
Typical Cross-Section of Dam & Loadings

- Overtopping Height: \( h \)
- Average Width: \( \frac{5 + 7}{2} = 6' \)
- Approx. Silt Line 1981
- Key: 38'

Hydraulic Pressure @ Mid-Base: \( Fw \)

Silt was noted on the upstream face of the dam approximately 6' below the crest. Assume the silt is 3' below the dam crest. (Per Conversation 7/28/81)

Typical values of unit weight of loose silt are:
- 00-100 pcf (J.E. Bowles, Physical Geo.), \( \gamma = \frac{5}{12} \) or \( 37.5 \)
Consider a 1 ft thick section at the mid height of the dam. (Ignore Poisson's effect, axial shear deformations)

Slice Area = (6x12) (1x12) = 564 in²

\[ I_{xx} = \frac{bd^3}{12} = \frac{(12)(72)^3}{12} = (72)^3 = 373.248 \text{ in}^4 \]

Assume that the structure may be analyzed as a two-hinged circular arch

\[ H = \frac{\int M^2 y \, ds}{\int y^2 \, ds} - \frac{\int P^2 \, ds}{\int E_4} \]

\[ \text{(Eq. 6.5.1, Ref. 1)} \]

where

\[ \int M^2 y \, ds = \frac{qR^5}{EI} \left\{ \frac{2}{3} \sin^3 \phi_0 - \sin^3 \phi_0 \right\} \]

\[ \int P^2 \, ds = \frac{2qR^2}{3E_4} \sin^3 \phi_0 \]

\[ \text{(Ref. 1, A.7.7)} \]

\[ s \gamma^2 \frac{ds}{EI} = \frac{R^2}{EI} \{ \phi_0 + 2 \phi_0 \cos \phi_0 - 3 \sin \phi_0 \cos \phi_0 \} \]

\[ s \left( \frac{dx}{d\phi} \right) \frac{dx}{EA} = \frac{R}{EA} \{ \phi_0 + \sin \phi_0 \cos \phi_0 \} \]

we have \( \phi_0 = 45.14^\circ = 0.788 \text{ rad} \),

\[ R = 840'' \]
\[ I = 373,248 \text{ in}^4 \]
\[ A = 864 \text{ in}^2 \]

The modulus of elasticity, \( E \), will divide out of the equation for \( H \).

Then

\[ \int M_3' \gamma \frac{ds}{EI} = \frac{(840)^4}{373,248} \left\{ \frac{2}{3} (0.356) - 0.788 (0.356) + 0.278 - 0.176 \right\} \]

\[ = \frac{(840)^4}{373,248} \times 0.0603 = 79676.8 \]

\[ \int P' \frac{dx}{A} = \frac{2 \times (840)^2}{3 (864)} \left\{ (0.709)^3 \right\} = 1948 \]

\[ \int \gamma^2 \frac{ds}{I} = \frac{(840)^3}{373,248} \left\{ (0.702)^3 \right\} = 114.60 \]

\[ \int \left( \frac{dx}{d\phi} \right) \frac{dx}{A} = \frac{840}{864} \left\{ 0.788 + (0.709) (0.705)^2 \right\} = 1.25 \]

\[ \rightarrow H = \frac{79676.8 - 1948}{114.60 - 1.25} = 701.39 \]

From the annotated summary of the HEC-1 computer program run for this dam, over 10% depth at 100% PMS = 15.43' \approx 17.5' = h
Assuming that $k_0 = 1.0$ for the silt loading, the horizontal pressure at the midheight of the dam can be computed.

$$ P = q_0 + q_s = (18.5 + 10.3) \times 22.4 + (14.9) \times 37.6 $$

(100% DMF)

$$ = 2340 + 526.4 = 2866.4 \text{ lb/ft}^2 $$

Avg. loading per half arc length

$$ h = \frac{2866.4}{12} \approx 239 \text{ lb/ft} $$

$$ h = 701.3 (239) = 167,594 \text{ lbs} $$

$$ V = \frac{gh}{2} = \frac{(2866.4)(98.1)(239)}{2} = 142216 \text{ lbs} $$

Resultant

$$ R = (h^2 + V^2)^{1/2} = 219802 \text{ lbs} $$

$$ \theta = \arcsin \left( \frac{142216}{219802} \right) = 40.32^\circ $$

$$ S = R \cos (85.46^\circ) = 17409 \text{ lbs} $$

$$ N = R \sin (85.46^\circ) = 219112 \text{ lbs} $$
Stresses on faces of abutments

Shear = S/A = (17409/864) = 20.6 psi

Compression = N/A = (219112/864) = 253.6 psi

Observations at the site indicate that abutment rock is composed of calcareous and/or silt/shales primarily, with some siltstone also reported.

According to ETL 1110-2-18, the lowest strength parameters for shales listed are for the Orogenic Shale. These parameters will be used in this calculation.

\[ \phi = 28^\circ, \quad S = 40 \text{ psi} \]

Factor of safety - Abutment sliding

Shear strength = \( (\Sigma V) \tan \phi + S \cdot \text{(area)} \)

\[ = N \tan 28^\circ + (40.0) \cdot (864) \]

\[ = 219112 \cdot (0.52) + 34560 = 151064 \text{ psi} \]

\[ F = \frac{\text{Shear strength}}{\text{Shear}} = \frac{151064}{11409} = 8.68 > 1 \rightarrow \text{OK} \]

253 psi compression is OK. Even if Poisson's effects are multiplied by 2, it is.
CHECK MID SPAN STRESS AT MID HEIGHT

Moment @ Midspan = \( M = V\left[\frac{b}{2}\right] - \left(\frac{b}{2}\right)^2H \epsilon \)

we have \( V = \frac{b}{2} \rightarrow M = \frac{b}{4} - \frac{b}{4} - H\epsilon \)

\( M = \frac{b^2}{4} - H\epsilon \) \( l = 29.62 \), \( L = 99.23 \), \( H = 234 \)

\( M = \frac{(234)(99.23\times12)^2}{8} - (167594.1)(29.62\times12) \)

\( = 4.23 \times 10^6 - 4.147 \times 10^6 \)

\( = 8.9 \times 10^5 \) in-lb.

\( \sigma = \frac{M}{A} = \frac{M}{5} \) \( 5 = \frac{bd^2}{6} = \frac{13(72)^2}{6} = 12368 \)

\( = \frac{167594.1}{864} \times \frac{8.9 \times 10^5}{10368} = 1704 \pm 86 \) psi.

Tensile stress = 0 Max. compressive stress = 280 psi

Allowable compressive stress assuming a concrete strength of 3000 psi, \( \frac{1}{c} = 0.45 \), \( c = 2.2 \text{ psi.} \)

Stresses are OK.
APPENDIX I

REFERENCES
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