1927

Echo Dam and Relocated Union Pacific Railroad and Relocated Lincoln Highway around Echo Reservoir

U.S. Department of the Interior, Bureau of Reclamation

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**CONTENTS**

<table>
<thead>
<tr>
<th>Schedules</th>
<th>Statement of equipment</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1-13</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

**General conditions:**
1. Performance bond  
2. Mongolian labor prohibited  
3. Climatic conditions  
4. Rights of way  
5. Quantities and unit prices  
6. Staking out work  
7. Bench marks and survey stakes  
8. Data to be furnished by contractor  
9. Sanitation  
10. Extras  
11. Cleaning up  
12. Failure of Congress to appropriate funds  
13. Patents

**Special conditions:**
14. Explanation of parts 1, 2, and 3 of "Detail specifications"  
15. List of drawings  
16. Commencement, prosecution, and completion of work  
17. Liquidated damages  
18. Engineer

**DETAIL SPECIFICATIONS—PART 1**

*(Relocated railway)*

**Special conditions:**
19. The requirement  
20. Description  
21. Drawings  
22. Materials furnished by the Government

**Construction:**
23. Construction program

**Formation of roadbed:**
24. Alignment  
25. Subgrade  
26. Formation of roadway  
27. Width of roadway  
28. Slopes  
29. Clearings

**Grading:**
30. Extent  
31. Classification  
32. Slopes to be made true

---

**Grading—Continued.**

33. All excavated material placed in embankments  
34. Right to reduce excavations  
35. Large blasts  
36. Rock excavation to be deposited as directed  
37. Side drains  
38. Surface ditches  
39. Material from creek beds, etc., to be placed in embankments  
40. Embankments to be made of suitable materials  
41. Best material to be used  
42. Berms  
43. Embankments built without borrow pits alongside  
44. All excavated materials to be used in embankments  
45. Protection of bridge openings and slopes  
46. Plowing of slopes  
47. Shrinkage  
48. Forming embankments against masonry  
49. Borrow pits  
50. Borrow pits made neat and to drain  
51. Borrow pits not to be made lower than bridge openings  
52. Borrow pits on low side of railway  
53. Slopes of borrow pits  
54. Disposition of waste  
55. Finish roadbed  
56. Grading to be paid for in excavation  
57. Method of handling excavated material  
58. Overhaul  
59. Classification of material in borrow pits  
60. Riprap  
61. Contractor to care for roads, fences, crops, etc  
62. Contractor to preserve stakes  
63. Contractor to take risk from floods, etc  
64. Damage by blasting  
65. Intoxicating liquor  
66. Contractor to personally determine character of work  
67. Application of force
SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE

General:
83. Materials and methods
84. Cleaning
85. Measurement

Materials:
86. Cement
87. Empty cement sacks

Fine aggregate:
88. General requirements
89. Grading
90. Sieve analysis
91. Decantation test
92. Mortar strength test
93. Organic impurities in sand
94. Permissible variations

Coarse aggregate:
95. General requirements
96. Grading
97. Sieve sizes
98. Permissible variations

Storage:
99. Storage of aggregate
100. Water

Metal reinforcement:
101. Reinforcing steel
102. Storage of bars
103. Wire

Proportioning of concrete:
104. Proportioning
105. Consistency

Mixing of concrete:
106. Machine mixing
107. Time of mixing
108. Hand mixing
109. Retempering
110. Premixed aggregate

Forms for concrete:
111. General
112. Earth forms
113. Anchors, bolts, etc
114. Design
115. Workmanship
116. Moldings
117. Oiling
118. Inspection
119. Nose angles for piers
120. Removal

Depositing concrete in air:
121. General
122. Approval
123. Handling
124. Chuting
125. Compacting
126. Removal of water
127. Protection
128. Temperature of concrete
129. Depositing continuously
130. Bonding

Depositing concrete under water:
131. General
132. Proportions
133. Cofferdams
134. Depositing continuously
135. Method
136. Laitance

Metal reinforcement:
137. Cleaning
138. Bending
139. Straightening
140. Placing
141. Splicing
142. Offsets in column reinforcement
143. Future bonding

Joints in concrete:
144. General
145. Joints in columns
146. Joints in floors
147. Expansion joints
148. Sliding joints
149. Water-tight construction joints

Waterproofing:
150. General
151. Integral compounds
152. Water-tight joints

Concrete in alkali soils or waters:
153. Proportions
154. Consistency
155. Placing

Surface finish:
156. General
157. Top surfaces not subject to wear
<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>32</td>
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<td>50</td>
</tr>
</tbody>
</table>

**Detail Specifications—Part 3**

*(Construction of Echo Dam)*

<table>
<thead>
<tr>
<th>Page</th>
<th>Special conditions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>274. The requirement</td>
</tr>
<tr>
<td>51</td>
<td>275. Description</td>
</tr>
<tr>
<td>51</td>
<td>276. Drawings</td>
</tr>
<tr>
<td>51</td>
<td>277. Materials furnished by the Government</td>
</tr>
<tr>
<td>52</td>
<td>278. Sand and gravel pits and quarries</td>
</tr>
<tr>
<td>52</td>
<td>279. Right to change location and plans</td>
</tr>
<tr>
<td>52</td>
<td>280. Foundation test-drilling records</td>
</tr>
<tr>
<td>52</td>
<td>281. Timber for use of contractor</td>
</tr>
<tr>
<td>52</td>
<td>282. Camp site</td>
</tr>
<tr>
<td>52</td>
<td>283. Availability of electric energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Page</th>
<th>Construction:</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>284. Construction program</td>
</tr>
<tr>
<td>53</td>
<td>285. Diversion and care of river and un-watering of foundations</td>
</tr>
<tr>
<td>53</td>
<td>286. Clearing and grubbing dam site</td>
</tr>
<tr>
<td>53</td>
<td>287. Stripping for embankment</td>
</tr>
<tr>
<td>53</td>
<td>288. Plowing dam foundation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Page</th>
<th>Earthwork:</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>289. Classification of excavation</td>
</tr>
<tr>
<td>54</td>
<td>290. Measurement of and payment for excavation and embankment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Page</th>
<th>Excavation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>291. Excavation of trench for drain tile at downstream toe of dam</td>
</tr>
<tr>
<td>54</td>
<td>292. Tunnel and shaft excavation</td>
</tr>
<tr>
<td>55</td>
<td>293. Timbering tunnel and shaft</td>
</tr>
<tr>
<td>55</td>
<td>294. Excavation for upstream cut-off</td>
</tr>
<tr>
<td>55</td>
<td>295. Excavation for spillway, trash rack, valve house, tunnel approach and outlet channel</td>
</tr>
<tr>
<td>56</td>
<td>296. Limits of excavation</td>
</tr>
<tr>
<td>56</td>
<td>297. Preparation of rock foundation</td>
</tr>
<tr>
<td>56</td>
<td>298. Storage and care of explosives</td>
</tr>
<tr>
<td>56</td>
<td>299. Lines and grades</td>
</tr>
<tr>
<td>56</td>
<td>300. Lighting and ventilating tunnel</td>
</tr>
</tbody>
</table>

**Embankment:**

<table>
<thead>
<tr>
<th>Page</th>
<th>Embankment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>301. Embankment construction—General</td>
</tr>
<tr>
<td>57</td>
<td>302. Embankment—Conglomerate fill at downstream toe</td>
</tr>
<tr>
<td>57</td>
<td>303. Embankment—Clay, sand and gravel portion</td>
</tr>
<tr>
<td>57</td>
<td>304. Embankment—Gravel and cobbles on downstream face</td>
</tr>
<tr>
<td>58</td>
<td>305. Embankment—Conglomerate riprap on upstream face</td>
</tr>
<tr>
<td>58</td>
<td>306. Embankment—Sluiced clay blanket</td>
</tr>
<tr>
<td>58</td>
<td>307. Embankment—Highway at right abutment of dam</td>
</tr>
<tr>
<td>59</td>
<td>308. Rolling embankments</td>
</tr>
<tr>
<td>59</td>
<td>309. Back fill around spillway and outlet structures</td>
</tr>
<tr>
<td>59</td>
<td>310. Cut-off—Sprinkled and rolled clay, sand and gravel</td>
</tr>
<tr>
<td>59</td>
<td>311. Cut-off—Clay puddled back fill</td>
</tr>
</tbody>
</table>

**Concrete:**

<table>
<thead>
<tr>
<th>Page</th>
<th>Concrete:</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>312. Composition</td>
</tr>
<tr>
<td>60</td>
<td>313. Cement</td>
</tr>
<tr>
<td>60</td>
<td>314. Sand</td>
</tr>
<tr>
<td>60</td>
<td>315. Broken rock or gravel</td>
</tr>
<tr>
<td>61</td>
<td>316. Use of hydrated lime or other powdered admixtures</td>
</tr>
<tr>
<td>61</td>
<td>317. Water</td>
</tr>
<tr>
<td>61</td>
<td>318. Samples of concrete aggregates</td>
</tr>
<tr>
<td>61</td>
<td>319. Mixing</td>
</tr>
<tr>
<td>61</td>
<td>320. Placing</td>
</tr>
<tr>
<td>62</td>
<td>321. Temperature of concrete</td>
</tr>
<tr>
<td>62</td>
<td>322. Finishing</td>
</tr>
<tr>
<td>62</td>
<td>323. Forms</td>
</tr>
<tr>
<td>62</td>
<td>324. Protection of concrete</td>
</tr>
<tr>
<td>62</td>
<td>325. Damaged or defective concrete</td>
</tr>
<tr>
<td>63</td>
<td>326. Reinforcing steel</td>
</tr>
<tr>
<td>63</td>
<td>327. Measurement of concrete</td>
</tr>
<tr>
<td>63</td>
<td>328. Payment for concrete</td>
</tr>
<tr>
<td>63</td>
<td>329. Division of concrete for payment</td>
</tr>
<tr>
<td>63</td>
<td>330. Concrete—Spillway structure</td>
</tr>
<tr>
<td>64</td>
<td>331. Concrete—Spillway and tunnel outlet channels</td>
</tr>
<tr>
<td>64</td>
<td>332. Concrete—Tunnel and shaft lining</td>
</tr>
<tr>
<td>64</td>
<td>333. Concrete—Emergency gate structure</td>
</tr>
<tr>
<td><strong>Concrete—Continued.</strong></td>
<td><strong>Concrete—Continued.</strong></td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>334. Concrete—Trash-rack structure</td>
<td>335. Concrete—Needle valve structure</td>
</tr>
<tr>
<td><strong>Drainage:</strong></td>
<td>348. Drains at downstream toe of embankment</td>
</tr>
<tr>
<td>351. Drain under outlet structure</td>
<td>352. Drainage system about emergency gate structure</td>
</tr>
<tr>
<td><strong>Grouting—Continued.</strong></td>
<td>355. Setting pipe for grout holes and grout connections</td>
</tr>
<tr>
<td>356. Method of grouting</td>
<td><strong>Structural steel, metal work, and painting:</strong></td>
</tr>
<tr>
<td><strong>Grouting—Continued.</strong></td>
<td>360. Installing high-pressure emergency gates</td>
</tr>
<tr>
<td><strong>Electrical installations:</strong></td>
<td><strong>Electrical installations:</strong></td>
</tr>
<tr>
<td>374. Installing electrical conductors, fittings and apparatus</td>
<td>375. Installing lamp-posts</td>
</tr>
</tbody>
</table>
ECHO DAM AND RELOCATED UNION PACIFIC RAILROAD AND 
RELOCATED LINCOLN HIGHWAY AROUND ECHO RESERVOIR

Bids will be considered on both or either of the schedules. Bidders may make such stipulations as they 
desire regarding a combination of schedules, but no bid will be considered for only a part of any schedule.

SCHEDULE NO. 1

Construction of grading and structures for the relocated Park City and Grass Creek branches of the Union Pacific Railroad and the relocated Lincoln Highway around Echo Reservoir

The detail specifications covering this work are given in Parts 1 and 2.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Work, quantity, and price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>For furnishing all equipment, labor and materials, except as otherwise specifically provided in the specifications, and constructing the relocated railroad and highway together with appurtenant structures, as follows:</td>
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</tbody>
</table>
| 1 Excavation, common: | 150,000 cubic yards, at (Words) | ($.......) per cu. yd. $.......
| 2 Excavation, rock: | 196,000 cubic yards, at (Words) | ($.......) per cu. yd. |
| 3 Borrow, common, dumped in embankment: | 211,000 cubic yards, at (Words) | ($.......) per cu. yd. |
| 4 Borrow, common, spread and rolled in 8-inch layers: | 4,400 cubic yards, at (Words) | ($.......) per cu. yd. |
| 5 Borrow, rock, dumped in embankment: | 30,000 cubic yards, at (Words) | ($.......) per cu. yd. |
| 6 Overhaul: | 7,200,000 station cubic yards, at (Words) | ($.......) per sta. cu. yd. |
| 7 Riprap: | 800 cubic yards, at (Words) | ($.......) per cu. yd. |
### SCHEDULE NO. 1—Continued

Construction of grading and structures for the relocated Park City and Grass Creek branches of the Union Pacific Railroad and the relocated Lincoln Highway around Echo Reservoir—Continued

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Work, quantity, and price</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>8</td>
<td>Constructing and painting wood guard rail: 7,400 linear feet, at _________________________________ $(...) per lin. ft. $...</td>
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<tr>
<td>9</td>
<td>Constructing and painting standard highway fence: 7,200 linear feet, at _________________________________ $(...) per lin. ft.</td>
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<tr>
<td>10</td>
<td>Concrete, plain, 16-foot arch culvert, railway sta. 27+35: 1,745 cubic yards, at _________________________________ $(...) per cu. yd.</td>
<td></td>
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<tr>
<td>11</td>
<td>Concrete, reinforced, 16-foot arch culvert, railway sta. 27+35: 825 cubic yards, at _________________________________ $(...) per cu. yd.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Concrete, plain, 16-foot arch culvert, railway sta. 163+55: 1,300 cubic yards, at _________________________________ $(...) per cu. yd.</td>
<td></td>
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<tr>
<td>13</td>
<td>Concrete, reinforced, 16-foot arch culvert, railway sta. 163+55: 665 cubic yards, at _________________________________ $(...) per cu. yd.</td>
<td></td>
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<tr>
<td>14</td>
<td>Concrete, reinforced, 4 by 4 foot box culvert, railway sta. 126+72: 120 cubic yards, at _________________________________ $(...) per cu. yd.</td>
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<tr>
<td>15</td>
<td>Concrete, reinforced, 7 by 5 foot box culvert, railway sta. 144+40: 247 cubic yards, at _________________________________ $(...) per cu. yd.</td>
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<td>16</td>
<td>Concrete, reinforced, class A overhead crossing, highway sta. 77+04.7: 321 cubic yards, at _________________________________ $(...) per cu. yd.</td>
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<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
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<td>17</td>
<td>Concrete, reinforced, class A 6 by 3 foot box culvert, highway sta. 21+90: 30 cubic yards, at</td>
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<td>18</td>
<td>Concrete, reinforced, class A 12-foot by 4-foot box culvert, highway station 182+15: 43 cubic yards, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per cu. yd.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Concrete in end walls for pipe culverts, railway standards: 230 cubic yards, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per cu. yd.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Concrete, class B in end walls for pipe culverts, highway standards: 60 cubic yards, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per cu. yd.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Concrete, reinforced, cut-off in open trench: 80 cubic yards, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per cu. yd.</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 18-inch diameter, 2 1/2-inch shell: 510 linear feet, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per lin. ft.</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 24-inch diameter, 3-inch shell: 160 linear feet, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per lin. ft.</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 30-inch diameter, 3 1/2-inch shell: 76 linear feet, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per lin. ft.</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 36-inch diameter, 4-inch shell: 32 linear feet, at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Words)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($... ... ) per lin. ft.</td>
<td></td>
</tr>
</tbody>
</table>
### SCHEDULE NO. 1—Continued

*Construction of grading and structures for the relocated Park City and Grass Creek branches of the Union Pacific Railroad and the relocated Lincoln Highway around Echo Reservoir—Continued*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Work, quantity, and price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 42-inch diameter, 4½-inch shell: 168 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 18-inch diameter, 3-inch shell: 476 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 24-inch diameter, 3½-inch shell: 296 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 30-inch diameter, 4½-inch shell: 144 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 36-inch diameter, 5-inch shell: 132 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Hauling and placing precast concrete railroad culvert pipe, 42-inch diameter, 5½-inch shell: 188 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Hauling and placing precast concrete highway culvert pipe, 18-inch diameter, 2½-inch shell: 176 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Hauling and placing precast concrete highway culvert pipe, 36-inch diameter, 4-inch shell: 64 linear feet, at __________________________ (Words) __________________________ ----------------- ($ ______ ) per lin. ft. ______________</td>
<td></td>
</tr>
</tbody>
</table>
### SCHEDULE NO. 1—Continued

**Construction of grading and structures for the relocated Park City and Grass Creek branches of the Union Pacific Railroad and the relocated Lincoln Highway around Echo Reservoir—Continued**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Work, quantity, and price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Hauling and placing precast concrete highway culvert pipe, 48-inch diameter, 5-inch shell: 124 linear feet, at (Words)</td>
<td>($) _________ per lin. ft. $______</td>
</tr>
<tr>
<td>35</td>
<td>Fabricating and placing reinforcing steel in concrete: 357,000 pounds, at (Words)</td>
<td>($) _________ per pound $______</td>
</tr>
<tr>
<td>36</td>
<td>Hauling and placing 18-inch diameter corrugated metal culvert pipe: 738 linear feet, at (Words)</td>
<td>($) _________ per lin. ft. $______</td>
</tr>
<tr>
<td>37</td>
<td>Hauling and placing 24-inch diameter corrugated metal culvert pipe: 216 linear feet, at (Words)</td>
<td>($) _________ per lin. ft. $______</td>
</tr>
<tr>
<td>38</td>
<td>Excavation for structures: 6,220 cubic yards, at (Words)</td>
<td>($) _________ per cu. yd. $______</td>
</tr>
<tr>
<td>39</td>
<td>Placing railing pipe: 625 linear feet, at (Words)</td>
<td>($) _________ per lin. ft. $______</td>
</tr>
<tr>
<td>40</td>
<td>Placing expansion units in crossing structure at highway station 77+04.7: 6 units, at (Words)</td>
<td>($) _________ each $______</td>
</tr>
<tr>
<td>41</td>
<td>Placing elastite in crossing structure at highway station 77+04.7: 246 linear feet, at (Words)</td>
<td>($) _________ per lin. ft. $______</td>
</tr>
</tbody>
</table>

Total for Schedule No. 1: $_________
### SCHEDULE NO. 2

**Construction of Echo Dam**

The detail specifications covering this work are given in Part III.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Work, quantity, and price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Diversion and care of river during construction and unwatering foundations, for the lump sum of $(Words)$</td>
<td>$(Words)$ dollars</td>
</tr>
<tr>
<td>43</td>
<td>Clearing and grubbing dam site:</td>
<td>$(Words)$ per acre</td>
</tr>
<tr>
<td>44</td>
<td>Stripping for embankment:</td>
<td>$(Words)$ per cu. yd</td>
</tr>
<tr>
<td>45</td>
<td>Plowing dam foundation for the lump sum of $(Words)$</td>
<td>$(Words)$ dollars</td>
</tr>
<tr>
<td>46</td>
<td>Excavation: Earth, gravel, or solid rock in tunnel, emergency gate structure, and spiral stairway shaft:</td>
<td>$(Words)$ per cu. yd</td>
</tr>
<tr>
<td>47</td>
<td>Excavation: Earth, gravel, or solid rock in cut-off wall stoping:</td>
<td>$(Words)$ per cu. yd</td>
</tr>
<tr>
<td>48</td>
<td>Excavation: Clay, sand, and gravel in open trench for cut-off wall:</td>
<td>$(Words)$ per cu. yd</td>
</tr>
<tr>
<td>49</td>
<td>Excavation: Solid rock in open trench and open cut for cut-off wall:</td>
<td>$(Words)$ per cu. yd</td>
</tr>
<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>50</td>
<td>Excavation: Solid rock in open cut for spillway and outlet structures and channel, and from borrow: 50,000 cubic yards measured in excavation, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>51</td>
<td>Embankment: Conglomerate fill at downstream toe, from borrow: 5,000 cubic yards, measured in excavation, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>52</td>
<td>Embankment: Clay, sand, and gravel portion, from required excavation and from borrow: 1,350,000 cubic yards, measured in embankment, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>53</td>
<td>Embankment: Gravel and cobbles on downstream face, from required excavation or from borrow: 140,000 cubic yards, measured in embankment, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>54</td>
<td>Embankment: Conglomerate riprap on upstream face, from borrow: 50,000 cubic yards, measured in excavation, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>55</td>
<td>Embankment: Sluiced clay blanket, from borrow: 50,000 cubic yards, measured in embankment, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>56</td>
<td>Back fill around spillway and outlet structures, from required excavation or from borrow: 2,500 cubic yards, measured in place about structure, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
<tr>
<td>57</td>
<td>Cut-off: Clay puddled back fill, from required excavation or from borrow: 600 cubic yards, measured in cut-off trench, at...</td>
<td>($... per cu. yd. $...)</td>
</tr>
</tbody>
</table>
## SCHEDULE NO. 2—Continued

*Construction of Echo Dam—Continued*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Work, quantity, and price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>Highway embankment: Earth and gravel fill, downstream from axis of the dam, from borrow: 3,200 cubic yards, measured in embankment, at...</td>
<td>($... per cu. yd...</td>
</tr>
<tr>
<td>59</td>
<td>Highway embankment: Rolled earth or puddled core in central portion of rock fill upstream from axis of the dam, from borrow: 2,000 cubic yards, measured in embankment, at...</td>
<td>($... per cu. yd...</td>
</tr>
<tr>
<td>60</td>
<td>Highway embankment: Rock fill upstream from axis of the dam, wasted under Schedule 1 and rehandled under Schedule 2: 16,000 cubic yards, measured in excavation, at...</td>
<td>($... per cu. yd...</td>
</tr>
<tr>
<td>61</td>
<td>Highway embankment: Rock fill upstream from axis of the dam, from borrow: 1,000 cubic yards, measured in excavation, at...</td>
<td>($... per cu. yd...</td>
</tr>
<tr>
<td>62</td>
<td>Drilling grout holes: 1,000 linear feet, at...</td>
<td>($... per lin. ft...</td>
</tr>
<tr>
<td>63</td>
<td>Cutting, threading, fitting, placing, and anchoring connection pipes in grout holes: 100 pipes, at...</td>
<td>($... per pipe...</td>
</tr>
<tr>
<td>64</td>
<td>Pressure grouting: 500 cubic feet, at...</td>
<td>($... per cu. ft...</td>
</tr>
<tr>
<td>65</td>
<td>Drilling holes for anchor rods and grouting rods in place: 800 linear feet of hole, at...</td>
<td>($... per lin. ft...</td>
</tr>
<tr>
<td>66</td>
<td>Placing wooden V drains about emergency gate structure: 400 linear feet, at...</td>
<td>($... per lin. ft...</td>
</tr>
<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td>67</td>
<td>Placing 6-inch black metal pipe about emergency gate structure: 60 linear feet, at (Words)</td>
<td>($......) per lin. ft</td>
</tr>
<tr>
<td>68</td>
<td>Laying 4-inch drain tile around emergency-gate structure: 200 linear feet, at (Words)</td>
<td>($......) per lin. ft</td>
</tr>
<tr>
<td>69</td>
<td>Laying 6-inch sewer pipe under floor of spillway structure: 1,200 linear feet, at (Words)</td>
<td>($......) per lin. ft</td>
</tr>
<tr>
<td>70</td>
<td>Laying 8-inch drain tile at downstream toe of embankment: 600 linear feet, at (Words)</td>
<td>($......) per lin. ft</td>
</tr>
<tr>
<td>71</td>
<td>Laying 12-inch drain tile at downstream toe of embankment: 1,400 linear feet, at (Words)</td>
<td>($......) per lin. ft</td>
</tr>
<tr>
<td>72</td>
<td>Laying 18-inch sewer pipe under outlet structure: 112 linear feet, at (Words)</td>
<td>($......) per lin. ft</td>
</tr>
<tr>
<td>73</td>
<td>Placing gravel under spillway channel and gate structure: 175 cubic yards, at (Words)</td>
<td>($......) per cu. yd</td>
</tr>
<tr>
<td>74</td>
<td>Concrete: Cut-off in open cut: 900 cubic yards, at (Words)</td>
<td>($......) per cu. yd</td>
</tr>
<tr>
<td>75</td>
<td>Concrete: Cut-off in open trench: 400 cubic yards, at (Words)</td>
<td>($......) per cu. yd</td>
</tr>
<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>76</td>
<td>Concrete: Cut-off in stope excavation: 300 cubic yards, at ........................................ (Words) ........................................ ........................................ $(<strong>) per cu. yd. ........................................ $</strong></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Concrete: Tunnel lining, sta. 0+90.25 to 5+68.11 and sta. 6+09.36 to 9+28: 1,700 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Concrete: Shaft lining el. 5487.0 to el. 5570.3: 70 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Concrete: Emergency-gate structure, sta. 5+68.11 to 6+09.36 and below el. 5487.0: 600 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Concrete: Trashrack structure, including transition to sta. 0+90.25: 160 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
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<tr>
<td>81</td>
<td>Concrete: Spillway structure from sta. 0−87 to sta. 1+14.55: 1,800 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Concrete: Spillway channel from sta. 1+14.55 to end and tunnel outlet channel from sta. 9+73.67 to lower end: 1,200 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Concrete: Needle-valve structure below el. 5458.67 and between tunnel outlet stations 9+28 and 9+73.67: 300 cubic yards, at ........................................ (Words) ........................................ ........................................ $(__) per cu. yd. ........................................</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Construction of needle-valve house above el. 5458.67 for the lump sum of ........................................ (Words) ........................................ dollars. ........................................</td>
<td></td>
</tr>
<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------</td>
<td>--------</td>
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<tr>
<td>85</td>
<td>Construction of remote-control house for the lump sum of...</td>
<td>$...</td>
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<tr>
<td>86</td>
<td>Concrete: Parapet wall on crest of dam: 725 cubic yards, at...</td>
<td>$(...) per cu. yd.</td>
</tr>
<tr>
<td>87</td>
<td>Concrete: Cradles for 72-inch outlet pipes: 35 cubic yards, at...</td>
<td>$(...) per cu. yd.</td>
</tr>
<tr>
<td>88</td>
<td>Rubble concrete paving downstream from spillway and outlet basin: 1,000 cubic yards, at...</td>
<td>$(...) per cu. yd.</td>
</tr>
<tr>
<td>89</td>
<td>Cutting, bending, and placing reinforcing steel: 400,000 pounds, at...</td>
<td>$(...) per pound</td>
</tr>
<tr>
<td>90</td>
<td>Installing and painting radial gates and operating mechanism: 90,000 pounds, at...</td>
<td>$(...) per pound</td>
</tr>
<tr>
<td>91</td>
<td>Installing and painting 5 feet 0 inch by 6 feet 0 inch high-pressure emergency gates and operating mechanism: 220,000 pounds, at...</td>
<td>$(...) per pound</td>
</tr>
<tr>
<td>92</td>
<td>Installing and painting high-pressure control piping and oil tanks for emergency gates: 5,000 pounds, at...</td>
<td>$(...) per pound</td>
</tr>
<tr>
<td>93</td>
<td>Installing and painting 72-inch outlet pipes: 280,000 pounds, at...</td>
<td>$(...) per pound</td>
</tr>
<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------</td>
<td>--------</td>
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<tr>
<td>94</td>
<td>Installing and painting 60-inch balanced needle valves and control mechanism: 180,000 pounds, at __________________ (Words) ($_________) per pound</td>
<td>$_________</td>
</tr>
<tr>
<td>95</td>
<td>Installing and painting metal stairs and floor system in needle valve structure: 5,000 pounds, at __________________ (Words) ($_________) per pound</td>
<td>$_________</td>
</tr>
<tr>
<td>96</td>
<td>Installing and painting gantry crane and rail: 12,000 pounds, at __________________ (Words) ($_________) per pound</td>
<td>$_________</td>
</tr>
<tr>
<td>97</td>
<td>Installing and painting metal work in trash-rack structure: 70,000 pounds, at __________________ (Words) ($_________) per pound</td>
<td>$_________</td>
</tr>
<tr>
<td>98</td>
<td>Installing and painting spiral stairs: 13,000 pounds, at __________________ (Words) ($_________) per pound</td>
<td>$_________</td>
</tr>
<tr>
<td>99</td>
<td>Installing and painting pipe handrailing: 2,000 pounds, at __________________ (Words) ($_________) per pound</td>
<td>$_________</td>
</tr>
<tr>
<td>100</td>
<td>Installing and painting metal lamp-posts: 25 posts, at __________________ (Words) ($_________) each</td>
<td>$_________</td>
</tr>
<tr>
<td>101</td>
<td>Installing electrical conduits, fittings, and boxes, sizes 1 inch and under: 5,700 linear feet, at __________________ (Words) ($_________) per lin. ft</td>
<td>$_________</td>
</tr>
<tr>
<td>102</td>
<td>Installing electrical conduits, fittings, and boxes, sizes 1\frac{1}{4}-inch; 1\frac{3}{8}-inch: 1,400 linear feet, at __________________ (Words) ($_________) per lin. ft</td>
<td>$_________</td>
</tr>
<tr>
<td>Item No.</td>
<td>Work, quantity, and price</td>
<td>Amount</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>103</td>
<td>Installing electrical conductors, fittings, and apparatus, complete, for the lump sum of ______________________________________________ dollars $ ___________</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Erecting timber in walk along 72-inch outlet pipe, and stairway to emergency gate structure: 4 M ft. b. m., at ___________________________________________ ($ __________ ) per M ft. b. m.</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td>Constructing and painting wood guardrail: 300 linear feet, at ______________________________________________________ ($ __________ ) per lin. ft.</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>Constructing and painting standard highway fence: 600 linear feet, at ______________________________________________ ($ __________ ) per lin. ft.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total for Schedule No. 2</strong></td>
<td></td>
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</table>
## STATEMENT OF EQUIPMENT

Each bidder is required to fill in the following blanks, stating the equipment with which it is proposed to do the work:

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<thead>
<tr>
<th>Number of horses and mules</th>
</tr>
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<table>
<thead>
<tr>
<th>Excavating equipment:</th>
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</thead>
<tbody>
<tr>
<td>Drag lines</td>
</tr>
<tr>
<td>Power shovels</td>
</tr>
<tr>
<td>Elevating graders</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grading tools:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading plows</td>
</tr>
<tr>
<td>Slip scrapers</td>
</tr>
<tr>
<td>Fresno scrapers</td>
</tr>
<tr>
<td>Wheel scrapers</td>
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<table>
<thead>
<tr>
<th>Concrete mixers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other equipment</th>
</tr>
</thead>
</table>

(14)
SPECIFICATIONS

GENERAL CONDITIONS

1. Performance bond.—Unless another sum is specified in the invitation for bids, the contractor shall furnish bond in an amount not less than 20 per cent of the estimated aggregate payments to be made under the contract. Bonds in amounts of $1,000 or less will be made in multiples of $100; in amounts exceeding $1,000 but not exceeding $5,000, in multiples of $500; in amounts exceeding $5,000, in multiples of $1,000; Provided, That the amount of the bond shall be fixed by the contracting officer at the lowest sum that fulfills all conditions of the contract.

2. Mongolian labor prohibited.—Pursuant to section 4 of the act of June 17, 1902 (32 Stat. 388, 389), no Mongolian labor shall be employed under this contract.

3. Climatic conditions.—The contracting officer may order the contractor to suspend any work that may be subject to damage by climatic conditions.

4. Rights of way.—The site for the installation of machinery or the right of way for the works to be constructed under this contract and for necessary borrow pits, channels, spoil banks, ditches, roads, etc., will be provided by the Government.

5. Quantities and unit prices.—The quantities noted in the schedules are approximations for comparing bids, and no claim shall be made against the Government for excess or deficiency therein, actual or relative. Payment at the prices agreed upon will be in full for the completed work and will cover materials, supplies, labor, tools, machinery, and all other expenditures incident to satisfactory compliance with the contract, unless otherwise specifically provided.

6. Staking out work.—The work to be done will be staked out for the contractor who shall, without cost to the Government, provide such material and give such assistance as may be required by the contracting officer.

7. Bench marks and survey stakes.—Bench marks and survey stakes shall be preserved by the contractor, and in case of their destruction or removal by him or by his employees, they will be replaced by the contracting officer at the contractor’s expense, and his sureties shall be liable therefor.

8. Data to be furnished by contractor.—The contractor shall furnish the contracting officer reasonable facilities for obtaining such information as he may desire respecting the character of the materials and the progress and manner of the work, including all information necessary to determine its cost, such as the number of men employed, their pay, the time during which they worked on the various classes of construction, etc. The contractor shall also furnish the contracting officer copies of freight bills on all machinery, materials, and supplies shipped to or from the project in connection with the work under the contract.

9. Sanitation.—The contracting officer may establish sanitary and police rules and regulations for all forces employed under this contract, and if the contractor fails to enforce these rules the contracting officer may enforce them at the expense of the contractor.

10. Extras.—The contractor shall, when ordered in writing by the contracting officer, perform extra work and furnish extra material, not covered by the specifications or included in the schedules, but forming an inseparable part of the work contracted for. Extra work and material will ordinarily be paid for at a lump-sum or unit price agreed upon by the contractor and the contracting officer and stated in the order. Whenever in the judgment of the contracting officer it is impracticable because of the nature of the work or for any other reason to fix the price in the order, the extra work and material shall be paid for at actual necessary cost as determined by the contracting officer, plus 15 per cent for superintendence, general expense and profit. The actual necessary cost will include all expenditures for material, labor, and supplies furnished by the contractor, and a reasonable allowance for the use of his plant and equipment, where required, to be agreed upon in writing before the work is begun, but will in no case include any allowance for office expenses, general superintendence, or other general expenses.
11. Cleaning up.—Upon completion of the work the contractor shall remove from the vicinity of the work all plant, buildings, rubbish, unused materials, concrete forms, and other like material, belonging to him or used under his direction during construction, and in the event of his failure to do so the same may be removed by the Government at the expense of the contractor, and his surety or sureties shall be liable therefor.

12. Failure of Congress to appropriate funds.—If the operations of this contract extend beyond the current fiscal year, it is understood that the contract is made contingent upon Congress making the necessary appropriation for expenditures thereunder after such current year has expired. In case such appropriation as may be necessary to carry out this contract is not made, the contractor hereby releases the Government from all liability due to the failure of Congress to make such appropriation.

13. Patents.—The contractor shall hold and save the Government, its officers, agents, servants, and employees, harmless from liability of any nature or kind for or on account of the use of any patented or unpatented invention, article, or appliance furnished or used in the performance of this contract, excepting patented articles required by the Government in its specifications, the use of which the contractor does not control.

SPECIAL CONDITIONS

14. Explanation of parts 1, 2, and 3 of "Detail Specifications."—The work covered by these specifications includes the construction of the relocated Park City and Grass Creek branches of the Union Pacific Railroad and the relocated Lincoln Highway around Echo Reservoir and also the construction of the Echo Dam and related works. The work relating to the relocated railroad must be done in accordance with detail specifications approved by the Union Pacific Railroad Company. These approved specifications are given under "Detail Specifications, Part 1." The work relating to the relocated highway must be done in accordance with detail specifications approved by the State Road Commission of Utah. These approved specifications are given under "Detail Specifications, Part 2." The detail specifications for the dam and its related works are given in part 3. The provisions of the contract (standard Government form of contract No. 23), the "General Conditions," paragraphs 1 to 13, inclusive, and the "Special Conditions," paragraphs 14 to 18, inclusive, apply to all the work and in case of conflicts therein with any of the provisions of the "Detail Specifications," parts 1, 2, and 3, the contract and the "General Conditions" and "Special Conditions," paragraphs 1 to 18, inclusive, shall govern. In all cases of doubt or question as to such conflicts or as to which part of the specifications apply to any part of the work, decision will be made by the contracting officer. In general, wherever the required grading and embankments for the relocated railroad and the relocated highway join each other such grading and embankments together with the structures, such as culverts, that cross them shall be built under "Detail Specifications," part 1; provided that, "Detail Specifications," part 2, shall be followed in the construction of the culvert head walls on the highway side of such common embankments, and in the construction of all highway guardrail, fences, and the highway overhead structure at station 77 + 04.7.

15. List of drawings.—The following drawings are made a part of these specifications:

1. (23011) 179-D-55—General map—Echo Reservoir.
2. (23012) 4-E-101—Detail location map—Relocation of railroad and highway around Echo Reservoir. (Sheet 1 of 3.)
3. (23013) 4-E-102—Ditto. (Sheet 2 of 3.)
4. (23014) 4-E-103—Ditto. (Sheet 3 of 3.)
5. (23015) 179-D-89—Profile relocation of Union Pacific Railroad around Echo Reservoir between Echo and Coalville.
6. (23016) 4-E-104—Standard typical cross sections—Relocation of railroad and highway around Echo Reservoir. (Sheet 1 of 2.)
7. (23017) 4-E-105—Ditto. (Sheet 2 of 2.)
8. (23018) 33486—Double 16-foot concrete arch culvert at station 27 + 35.
9. (23019) 33487—4-foot by 4-foot R. C. box culvert at station 126 + 72.
10. (23020) 33488—7-foot by 5-foot R. C. box culvert at station 144 + 40.
11. (23021) 33489—Single 16-foot concrete arch culvert at station 163 + 55.
12. (23022) 33490—End walls for pipe culverts.
13. (23023) 179-D-53—Concrete culvert pipe.
14. (23024) 4-E-106—Profile—Lincoln Highway relocation around Echo Reservoir.
15. (23025) D-256—Lincoln overhead, station 77 + 04.7. (Sheet 1 of 4.)
16. (23026) D-256—Ditto. (Sheet 2 of 4.)
17. (23027) D-256—Ditto. (Sheet 3 of 4.)
18. (23028) D-256—Ditto. (Sheet 4 of 4.)
19. (23029) 179-D-84—Standard 12-foot by 4-foot concrete box culvert at station 182 + 15.
20. (23030) 179-D-56—Standard 6-foot by 3-foot concrete box culvert at station 21 + 90.
26. (23036) 179-D-60—Topography and log of test holes.
27. (23037) 179-D-61—General plan and sections.
29. (23039) 179-D-63—Spillway—Counterforted wall—Toe and face slab.
30. (23040) 179-D-64—Spillway—Counterforted wall—Heel slab.
31. (23041) 179-D-65—Spillway—Counterforted wall—Counterforts.
32. (23042) 179-D-66—Spillway—Gate structure and left upstream wall.
33. (23043) 179-D-67—Spillway—Gate structure details.
34. (23044) 179-D-68—Spillway—18-foot by 17-foot counterbalanced radial gate.
35. (23045) 179-D-69—Spillway—Motor-operated radial gate hoist.
36. (23046) 179-D-70—Outlet works—Spillway and outlet basin.
37. (23047) 179-D-71—Outlet works—Trash-rack structure.
38. (23048) 179-D-72—Outlet works—Emergency gate structure.
39. (23049) 179-D-73—Outlet works—5-foot by 6-foot high-pressure emergency gate.
40. (23050) 179-D-74—Outlet works—5-foot by 6-foot emergency gate control piping.
41. (23051) 179-D-75—Outlet works—60-inch balanced needle-valve assembly.
42. (23052) 179-D-76—Outlet works—Needle-valve house—Piping.
43. (23053) 179-D-77—Outlet works—Gantry-crane assembly.
44. (23054) 179-D-78—Outlet works—Remote control house.
45. (23055) 179-D-79—Outlet works—Needle-valve house.
46. (23056) 179-D-80—Outlet works—72-inch outlet pipes.
47. (23057) 179-D-81—Remote-control house roof truss.
48. (23058) 179-D-82—General wiring diagram.

Some of these drawings apply particularly either to the construction of the relocated railroad, the relocated highway, or the dam, others to two of these main features, and still others to all three features. Drawings which apply wholly or in part to a main feature are again listed by number only under the "Detail Specifications" covering the respective feature. The contractor will not be held responsible for the correctness or sufficiency of designs, but shall keep a careful check upon dimensions and details as the work progresses and any errors or discrepancies discovered shall be promptly reported to the contracting officer. The contractor will be furnished such additional copies of the drawings and specifications as may be required for carrying out the work. Prints of the original drawings from which the attached reductions were made will be furnished to the contractor for construction purposes upon request.

16. Commencement, prosecution and completion of work.—The contractor shall begin the work of building camp and transporting equipment to the site of the work within thirty (30) calendar days after date of receipt of notice to proceed, and shall complete all of the work under Schedule 1 within four hundred and thirty (430) calendar days, and all of the work under Schedule 2 within eight hundred and seventy (870) calendar days from that date. As shown on the general map and other drawings the present location of the railroad and highway will preclude considerable construction work on the dam until the work under Schedule 1 is completed, and the relocated railroad and highway made ready for traffic. In case the work under the two schedules is awarded to different contractors, the contractor for Schedule 2 shall so prosecute the work as to interfere with the satisfactory prosecution of the work under Schedule 1 as little as practicable, it being understood upon acceptance of award of contract for Schedule 2, that the contractor shall fit his construction program to the prior construction requirements of Schedule 1. This noninterference requirement, however, shall not relieve the contractor for Schedule 2 from proceeding with construction on items of the work which will not interfere with or be depend­ent upon the completion of the work under Schedule 1. The contractor or contractors for both schedules shall at all times during the continuance of the contract or contracts prosecute the work with such forces and equipment as in the judgment of the contracting officer are sufficient to complete it within the specified time.

17. Liquidated damages.—The damages that may result from any delay in completion of the work by the time agreed upon will be difficult, if not impossible, of ascertainment. If the work is not completed on or before the dates fixed for its completion by the terms of the contract, or by the dates arrived at by any extensions of time that may be allowed under the terms of the contract, the contractor shall pay to the Government as fixed, agreed, and liquidated damages the sum of two hundred dollars ($200) per day for each of the schedules for each calendar day's delay until the work is satisfactorily completed or until such time as the Government may reasonably procure the completion of the work by another contractor or complete the work itself. Whatever sums may be due as liquidated damages for delay may be deducted from payments due to the contractor or may be collected from the contractor's surety or sureties. The provision for liquidated damages shall not prevent the Government from terminating the right of the contractor to proceed in case of default, as provided in article 9 of the contract.

18. Engineer.—Wherever on the drawings, or elsewhere in these specifications, the word "engineer" is used, it shall be interpreted to mean the contracting officer.
DETAIL SPECIFICATIONS, PART 1

For the construction of the relocated Park City and Grass Creek branches of the Union Pacific Railroad system in the location herein described, including side tracks and other tracks in connection therewith

SPECIAL CONDITIONS

19. The requirement.—It is required that the grading for the roadbed and structures necessary for the relocated Park City and Grass Creek branches of the Union Pacific Railroad system be constructed and erected in accordance with these specifications and drawings, as called for in the accompanying schedule.

20. Description.—A portion of the present Park City and Grass Creek branches of the Union Pacific Railroad system will be submerged by the construction of the Echo Reservoir for the storage of irrigation water. The relocated branches will be constructed on higher ground around the reservoir and along the northerly side thereof. The earthwork will consist of the usual cut and fill type of grading, common in railroad construction and the structures will be, in general, of concrete. The relocated railroad will pass the Echo Dam adjacent to its right abutment. The relocated Lincoln Highway will also be constructed around the reservoir and, in general, parallel and adjacent to the relocated railroad as shown on the drawings. The specifications applying particularly to the construction of the relocated highway are given under part 2 hereof. The specifications applying particularly to the construction of the relocated railroad are given under part 1 hereof. The specifications for structural excavation given in paragraphs 211 to 216 inclusive shall apply for all earthwork required in the construction of the structures for both the relocated highway and the relocated railway. The laying of ties and rails and the placing of ballast for the relocated railroad are not included in this contract.

21. Drawings.—The drawings, nos. 1 to 13 inclusive, which are listed with their titles in paragraph 15 apply wholly or in part to the construction of the relocated railroad.

22. Materials furnished by the Government.—All cement, metal parts required to be permanently installed in structures, reinforcing steel, concrete pipe, corrugated metal pipe, handrail pipe, structural steel, anchor bolts, paint, timber, and other materials shown on the drawings, except as otherwise provided, going into the finished structures will be furnished to the contractor by the Government. All fine and coarse aggregates and water for concrete, and for earthwork puddling when required, and tie wire for reinforcing steel shall be furnished by the contractor. The materials furnished by the Government will be delivered to the contractor f. o. b. cars at the railway destination or the unloading point on the railway most convenient to the work, except as otherwise provided for precast concrete pipe. The contractor shall haul all materials from the point of delivery to the work. The contractor shall provide suitable warehouses, or other protection satisfactory to the contracting officer, for all such material or machinery, and will be charged for all material or machinery lost or damaged after delivery. Except as otherwise provided for cement, materials furnished by the Government may be delivered to the contractor at any time after the date specified for the commencement of work that the interests of the Government may render desirable and the contractor shall not be entitled to any increased compensation due to the order or time of delivery of any of such material. All material delivered to the contractor shall be subject to inspection and inventory by the contracting officer at any time and the amount of any damage occurring to such material after delivery to the contractor or the cost to the Government of any such material not promptly accounted for by the contractor upon demand and to the satisfaction of the contracting officer will be charged to the contractor and deducted from any payments due to the contractor. The Government reserves the right to require the contractor to provide ample and suitable warehouses satisfactory to the contracting officer on the work and to properly store therein any material delivered by the Government and not yet used in the work whenever in the opinion of the contracting officer such warehouses are necessary for the proper care of Government materials. Should the contractor fail to provide any such suitable warehouse and to store the material therein as specified promptly upon the order of the contracting officer the Government will provide the warehouse and place the material to be protected therein and the entire cost thereof will be charged to the contractor. The contractor will not be relieved of any responsibility for the care and value of the material by any action of the Government as provided in this paragraph. All unused material, except empty cement sacks, shall be returned to the Government at the Echo Dam site, and the contractor will be charged for any material ton
used and not returned the same amounts that the material cost the Government at the point of delivery to the contractor. When material is furnished on cars, the contractor shall be responsible for the prompt unloading of such material and will be liable for any demurrage charges which may be incurred by failure to unload the material promptly. The cost of unloading, hauling, except as otherwise provided for precast concrete pipe storing, and caring for all materials furnished by the Government shall be included in the unit prices bid for the work in which the materials are used.

CONSTRUCTION

23. Construction program.—The construction program shall at all times be subject to the approval of the contracting officer. The capacity of the construction plant and the sequence and method of operations shall be such as to insure the completion of the work within the time specified.

FORMATION OF ROADBED

24. Alignment.—The center of the roadbed shall strictly conform to the center stakes set for it by the contracting officer.

25. Subgrade.—The grade line on the profile denotes subgrade and this term indicates the tops of embankments or the bottoms of excavations ready to receive the ballast.

26. Formation of roadway.—The roadway shall be formed to the section, slopes, and dimensions shown upon the standard drawings or as may be directed from time to time by the contracting officer.

27. Width of roadway.—When finished and properly settled, the roadway shall conform with the finishing stakes and shall be of the following dimensions at subgrade, for single track, viz: Feet

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<thead>
<tr>
<th>Description</th>
<th>Width</th>
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<tbody>
<tr>
<td>Embankment</td>
<td>17</td>
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<tr>
<td>Earth excavation:</td>
<td></td>
</tr>
<tr>
<td>Width of cutting at base</td>
<td>22</td>
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<tr>
<td>Width of roadbed</td>
<td>16</td>
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<tr>
<td>Rock excavation:</td>
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<td>Width of cutting at base</td>
<td>22</td>
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<td>Width of roadbed</td>
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For each additional track an additional width as designated by the contracting officer shall be made. Where cuts are liable to fill with snow, or on high embankments, these widths may be changed at the discretion of the contracting officer.

28. Slopes.—The slopes of all earth embankments shall be 1 1/2 to 1. Earth excavation shall be 1 1/2 to 1 and well finished to uniform slopes. Solid rock excavation shall be well finished to uniform slopes. Rock embankments shall be well finished to uniform slopes.

29. Clearings.—No allowance will be made to the contractor for clearing of any kind as the cost of such work will be included in the prices paid for excavation. In general, no clearing will be necessary but in a few places it will be necessary to remove small trees and brush from ground to be occupied by the embankment and in such cases all such trees and brush must be cleared away close to the surface of the ground and burned by the contractor at his expense and as the contracting officer may direct.

GRADING

30. Extent.—“Grading” will include all excavations required for the formation of roadbed, embankments, sidings, station grounds, cutting of channels, ditches and drains about or contiguous to the road; all borrow pits, changing of streams, roads or highways, and all other excavations in any way connected with, required for, or incident to, the performance of the work covered by Schedule 1 of the contract to which this specification is attached.

31. Classification.—Excavations will be classified under the following heads, viz, “Solid Rock” and “Earth or Common.”

“Solid Rock” will include all rock found in ledges or masses of more than 1 cubic yard, which, in the judgment of the contracting officer, may be best removed by blasting.

“Earth or Common” excavation will include all other excavation not classified as “Solid Rock” and will include all bowlders and detached masses of rock measuring less than 1 cubic yard; also all slate, shale, soft sandstone and soapstone that can be quarried or moved without blasting, plowed with a good 6-horse or 6-mule team and No. 1 breaking plow or removed by steam shovel without blasting, hardpan, gravel and bowlder deposits and beds.
32. Slopes to be made true.—All excavations shall be taken out to the plane of the true measured prisms, and no projections will be allowed beyond the true plane of the slope toward the center line. In rock excavations the bottom must in all cases be taken out to six (6) inches below subgrade, and filled in again to subgrade with material for roadbed, and side ditches formed at the foot of the slope. Yardage will be allowed for filling roadbed through rock excavation at earth borrow price only under item 3 of Schedule 1, except as otherwise authorized specifically by the contracting officer.

33. All excavated material placed in embankments.—Unless otherwise directed by the contracting officer, no material shall be wasted and all material of cuts will be hauled out and placed in embankments.

34. Right to reduce excavations.—The contracting officer shall have the right to reduce excavations to such widths as he may choose, payment being made only for the number of yards actually moved by the contractor.

35. Large blasts.—The size and positions of large blasts may be determined by the contracting officer.

36. Rock excavation to be deposited as directed.—When directed by the contracting officer, the contractor will deposit at convenient places designated, any rock or stone from excavations, otherwise all such materials will be placed in embankments.

37. Side drains.—Side drains shall be left neat and clear of obstructions. The material taken from side drains will be disposed of as directed by the contracting officer.

38. Surface ditches.—Surface ditches, to prevent surface drainage from running over or against slopes, shall be made wherever directed by the contracting officer and paid for same as excavation.

39. Material from creek beds, etc., to be placed in embankments.—Materials excavated from creek beds or ditches or for changing water courses, or highways, shall be placed in embankments unless otherwise ordered by the contracting officer.

40. Embankments to be made of suitable materials.—Embankments shall be made of suitable materials to be judged of by the contracting officer, and in accordance with his instructions either by dumping from grade or in layers of such thickness as he may direct.

41. Best material to be used.—Where there is a choice of material, the best shall be used on top of embankments for at least one (1) foot in depth.

42. Berms.—Along side embankments, berms shall be left six (6) feet wide on each side, outside slope stakes, except where necessary to protect slopes from possible wash or secur or where otherwise ordered by the contracting officer, the width shall be increased without extra compensation.

43. Embankments built without borrow pits along side.—Embankments built without borrow pits alongside shall, unless otherwise ordered, have a ditch cut without extra charge, with the berms as indicated above and such ditches must be included in the estimate. The Government will furnish at its own cost and expense all land required for borrow pits.

44. All excavated materials to be used in embankments.—Materials excavated from prism of road, ditches, channels, borrow pits, etc., shall be used in the formation of the embankments, unless otherwise directed by the contracting officer.

45. Protection of bridge openings and slopes.—At bridge openings, around the ends of culverts, and other places where wash is likely to occur, sod and earth must be carefully packed to prevent earth from being carried away. Bridge openings and slopes liable to wash must be protected with riprap or brush, when the latter is available. In all cases, the type of protection must be as designated and approved by the contracting officer. No additional compensation will be allowed for any of the protection as described in this paragraph, except for riprap as provided in paragraph 60. No large stones will be allowed within a depth of 2 feet below the grade of the embankment.

46. Plowing of slopes.—Where embankments are formed on steep slopes, steps shall be cut or plowed in the slopes at the contractor’s entire expense as the contracting officer may direct, to avoid slipping of the new embankment and the ground thoroughly roughed up even to the extent of shooting channels in the rock slopes.

47. Shrinkage.—In all cases allowance for skrinkage will be added to the height or width of the embankment, as directed by the contracting officer, without extra charge therefor.

48. Forming embankments against masonry.—In forming embankments over or against masonry or other structures, materials shall be scraped or wheeled to the structure, where water shall be added if necessary, as determined by the contracting officer, after which the materials shall be carefully tamped and rammed and such other precautions shall be taken as may be directed by the contracting officer. The cost of supplying water shall be included in the unit prices per cubic yard bid for excavation.

49. Borrow pits.—Borrow pits shall be confined to such limits as the contracting officer may direct.

50. Borrow pits made neat and to drain.—Where borrow pits are made, they shall be left in as neat shape as practicable, and, unless otherwise ordered, connection shall be made from pit to pit with waterways to provide ample drainage and leave no stagnant pools.
51. Borrow pits not to be made lower than bridge openings.—When it can be avoided the bottom of borrow pits near bridge or culvert openings, shall not be excavated below the surface over which the water runs to pass through such bridge or culvert.

52. Borrow pits on low side of railway.—No material shall be borrowed from between the lines of railway and an adjacent stream, where the natural surface is below high-water mark, and where above high-water mark no borrow pit shall be excavated to a depth below high-water mark, without the permission of the contracting officer.

53. Slopes of borrow pits.—The contracting officer may require borrow pits to be taken from one side of the roadbed only, and in all cases the slopes of borrow pits on the sides toward the embankments shall not be less than that of embankments unless the berm is more than eight (8) feet, in which case they may be proportionately steeper.

54. Disposition of waste.—In general, where wasting is ordered, the material shall, if possible, be deposited below subgrade and under no circumstances shall the waste bank have its nearest edge within twenty-five (25) feet of the slope stakes of the cutting. The disposition of waste and the formation of waste banks shall be in accordance with the direction of the contracting officer.

55. Finish roadbed.—In finishing tops of banks and bottoms of cuts, care shall be taken that the surface be left neat and true and that no wagon or cart tracks or other depressions are left which might lead water in the direction of the road.

56. Grading to be paid for in excavation.—All grading will be estimated and paid for by the cubic yard at the prices specified for the respective materials. Measurement shall be made in excavations only, except where it may be impracticable to measure borrowed material. In such cases the cross-section notes of embankment prisms will be used, making a just and reasonable allowance for change in bulk, so that the quantities shall equal the excavation quantities as nearly as possible. Measured quantities shall be considered correct, as determined by the contracting officer. Wherever it becomes necessary as directed by the contracting officer, to excavate borrow pits for the building of embankments, the material excavated will be classified as “common” or “rock,” and the provisions of paragraph 31 shall apply to this classification. Payment for borrow will be made at the unit prices per cubic yard in the contract, and will include the excavation; all haul except overhaul, and the placing of the material in the embankment or elsewhere as shown in these specifications, on the drawings, or as directed by the contracting officer.

57. Method of handling excavated material.—The contract prices per cubic yard will include the excavation of the material by any method whatsoever, the loading, hauling material for any distance not exceeding four hundred (400) feet, and depositing same in the manner prescribed in these specifications and in places designated by the contracting officer. The price will also include the benching or plowing of slopes as well as all other expenses incident to the work of grading.

58. Overhaul.—For material hauled beyond four hundred (400) feet extreme haul an additional price per cubic yard for each one hundred (100) feet additional will be paid. In computing overhaul the distance between centers of gravity of the mass in excavation and the mass in embankment or waste bank will be considered. The extreme limits of overhaul will be fixed by the contracting officer and shall not be limited by any bridge or opening across or around which a reasonable load can be hauled. The embankment will be paid for in this way regardless of the fact that the contractor may prefer to waste and borrow within the limits of this extreme haul. Where embankments or waste banks are made from rock excavation, the amount of overhaul will be determined by the volume measured in excavation, and no extra allowance will be made for swell of the excavated material. No overhaul will be allowed on borrowed material, except as directed by the contracting officer. Materials removed from excavations for the roadbed prism will be hauled to the embankment and overhaul will be allowed up to the point where the cost of such overhaul will not exceed the unit price of borrow, and material removed from excavations in excess of this must be wasted, whenever practicable, “Below Grade.” No overhaul or classification will be allowed for moving any material taken from excavations in excess of the amount required to form the roadbed prism.

59. Classification of material in borrow pits.—There shall be no classification or allowance made for loose or solid rock in borrow pits, unless necessary to borrow rock as directed by the contracting officer in writing, it being the intent and meaning of part 1 of these specifications that all borrowed material shall be classified and paid for as common earth excavation.

60. Riprap.—Riprap will be of rough, heavy, durable stone, handlaid to such lines as may be directed by the contracting officer. In placing riprap to protect embankments the footing of the riprap must be placed in a trench of such depth and width as may seem proper to the contracting officer to meet the conditions. Such excavations will be paid for per cubic yard as a part of the grading. All riprap will be paid for on the basis of actual measurement in place in the finished structure, and as directed by the contracting officer.
GENERAL PROVISIONS

61. Contractor to care for roads, fences, crops, etc.—Commodious passing places for public and private roads shall be made and kept in good condition by the contractor and good and sufficient fences shall be provided for keeping up enclosures and the preservation of crops. The contractor will be held responsible for trespass or damage to adjacent properties or the public occasioned by any acts or omissions on the part of himself or his subcontractors or employees, and any damage so caused may be paid by the Government and deducted from any moneys due or to become due to the contractor.

62. Contractor to preserve stakes.—Contractor must carefully preserve stakes and bench marks, and in cases of neglect he will be charged with the expenses of restoring them.

63. Contractor to take risk from floods, etc.—Contractor shall take all risk from floods and casualties of every kind, or of possible loss of material in building embankments in water or in streams, and shall make no claim for loss or damage or detention thereby. Whenever any embankment or portion thereof is destroyed before final acceptance, it shall be replaced by the contractor at his own expense.

64. Damage by blasting.—All damage occasioned by blasting of rocks in the progress of the work, or injury done by the contractor or those in his employ, to the crops, fences, buildings, or any property of the Government, or of adjoining land owners or occupants, shall be paid by the contractor or may be paid by the Government and charged to the contractor.

65. Intoxicating liquor.—Contractor shall not, by himself nor by his agents, give or sell any ardent spirits to his workmen, or any person at or near the line of the railway, nor allow any to be brought to the work by the laborers or any other person.

66. Contractor to personally determine character of work.—Contractor must inform himself of the nature of the soil and character of the work before making his contracts, and no information derived from profiles, maps, plans and specifications, or from the contracting officer or his assistants, will relieve the contractor from risks or responsibilities, or from fulfilling the terms of the contract, and no plea that any work or material has been approved or accepted shall bind the Government to pay for any work which is not in accordance with these specifications.

67. Application of force.—The contracting officer shall have power to direct application of force to any portion of the work, which in his judgment requires it, and to order the increase or diminution of forces at any point he may direct.

68. Line divided into sections.—The line will be divided into sections averaging about 1 mile in length, so arranged as to accommodate as near as practicable, the economical distribution of material or excavations or required in embankments. This will not prevent the removal of material required for the roadbed or structures from one section to another whenever the contracting officer may require.

69. Blasting near main tracks.—No heavy blasting will be allowed close to the main tracks. The contractor must take special precautions against discharging a blast during the passage of trains. Whenever the work is liable to affect the safety of trains, the method of doing such work must first be submitted to the contracting officer for his approval, and without his approval no work shall be commenced or prosecuted.

70. Moving railroad company's tracks.—Under no circumstances shall the contractor move or in any way interfere with the Union Pacific Railroad Co.'s tracks. Whenever, during the progress of the work it becomes necessary that the main line or side tracks be moved or that material be excavated or placed beneath existing tracks, this work shall be performed by the Union Pacific Railroad Co., the contractor to provide material alongside the track for raising same and to remove all material excavated by the Union Pacific Railroad Co. from beneath the tracks. Each party to furnish all labor and material necessary to keep the other party at work.

71. Handling material across tracks.—Material will not be handled across present tracks if possible to avoid it, but whenever it is necessary for material of any description to be transported across the existing track or tracks, the location and method of construction must be approved by the contracting officer and the contractor shall furnish at his own cost the lumber and spikes for said crossing and the labor of placing the same. Particular care must be taken to keep flange ways of crossing clear for passage of trains.

72. Precautions for safety of tracks.—Whenever the work as authorized affects the safety of the tracks, the Union Pacific Railroad Co. will take such precautions as it may deem advisable to insure safety of such tracks, and the cost of so doing shall be charged to the contractor and deducted from his estimates; Provided, that where, in the opinion of the contracting officer, the need for such precautions is beyond the control of the contractor the cost of providing them will be borne by the Government.

73. Watchmen or flagmen.—Watchmen or flagmen both day and night will be put on by the Union Pacific Railroad Co. at all places the proper railroad officials consider necessary for the safety of the Union Pacific Railroad Co.'s trains and track. The expense for such watchmen will be borne by the contractor. It is distinctly understood, however, that the providing of watchmen shall not relieve the contractor from his liability and payment for damages caused by his operations.
74. Moving telegraph lines.—Wherever it is necessary, in the opinion of the contracting officer, to move the telegraph line to enable the contractor to proceed with his work, the Union Pacific Railroad Co. will have the poles and wire moved, at the expense of the Government.

75. Passing tracks and side tracks.—The unit prices to be paid for the work will also apply to any grading required in connection with the construction of passing tracks, side tracks, business track or other tracks desired by the railroad company at any point within the limits of the work.

76. Repair and maintenance of fences.—Any injury done by the contractor or those in his employ to crops, fences, buildings, or any property of adjacent land owners, or tenants, or to fences or property of the railroad company, may be paid for by the railroad company and charged to the contractor and deducted from his estimates. In case it becomes necessary for the contractor to remove any portion of the right-of-way fence or any portion of the fences of adjacent property owners or tenants, all the work of removing such fences and of repairing and replacing same shall be done by and at the expense of the contractor.

77. Haul across streams or creeks.—Unless otherwise ordered by the contracting officer, haul of material from cuts will not stop at crossings or creeks and streams. If the contracting officer deems it proper, he may require a bridge or roadway made for difficult crossings at the expense of the contractor.

78. Plowing slopes.—Whenever the existing embankments of four (4) feet in height or over are raised or widened, the slope of the existing embankment shall be deeply plowed in order to bind the new material thoroughly to it.

79. Embankment materials.—Where embankments extend below the maximum water surface in the reservoir, the embankment shall be constructed of rock to the maximum water surface level in the reservoir (El. 5560) with rock carried on the water side or sides of the embankment four (4) feet or more above the maximum water surface in the reservoir.

SPECIFICATIONS FOR CULVERT PIPE

80. General.—All pipe shall be laid to the true line and grade as established by the contracting officer, and shall be laid in excavation to the depth of at least one-third of the diameter of the pipe. During construction, the contractor shall so arrange his work as not to obstruct the flow of water in irrigation ditches.

81. Back filling.—The back filling shall be thoroughly tamped in place around and on top of the pipe and the price paid for placing culvert pipe shall include the cost of excavation, caulking, back filling and tamping, as directed by the contracting officer.

82. Reinforced concrete pipe.—All reinforced concrete pipe not subject to submergence by water impounded in Echo Reservoir and under fills of not less than 3 feet or more than 18 feet shall be as shown for railroad culverts—type 1 on drawing No. 179-D–53. All reinforced concrete pipe subject to partial or entire submergence by waters impounded in Echo Reservoir or under fills of more than 18 feet and less than 30 feet shall be as shown for railroad culverts—type 2 on drawing No. 179–D–53. All such concrete pipe will be furnished by the Government and delivered to the contractor under the provisions of paragraph 22, either f. o. b. cars at the railway destination or the unloading point on the railway most convenient to the work or at a manufacturing plant in the vicinity of the work: Provided, That in the event the contractor is required to haul the pipe from a point at a distance in excess of 1 mile from the nearest point on the relocated railway line covered by the contract, such excess haul will be paid for as extra work. The contractor will be held responsible for the breakage of all pipe after delivery to him and will be required to replace or repair all broken pipe as directed by the contracting officer. The unit prices bid in the schedule for hauling and placing precast concrete pipe shall include the cost of all labor and equipment required in unloading, hauling except as otherwise provided, handling, placing, painting, caulking, excavation and back filling, and tamping, as directed by the contracting officer. The joints shall be fully and neatly filled with cement and sand mortar in proportions determined by the contracting officer and wiped on the inside, all in a workmanlike manner and to the satisfaction of the contracting officer. Measurement for payment will be made of the pipe in place, no allowance being made for the lap at joints. No additional compensation will be allowed the contractor for excavation necessary for pipe culvert headwalls, or for back filling the same.
SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE

GENERAL

83. Materials and methods.—The contractor shall furnish all labor, materials (except cement and reinforcing steel), tools and equipment necessary to entirely complete the work. All materials entering into the work and all methods used by the contractor shall be subject to the approval of the contracting officer and no part of the work will be considered as finally accepted until all of the work is completed.

84. Cleaning.—At the completion of the work all concrete shall be cleaned and left in a manner satisfactory to the contracting officer.

85. Measurement.—All concrete will be paid for on a unit price basis and shall be for the actual measured yardage and shall include the entire value of the sheeting, bracing, and forms used in connection with the work.

MATERIALS

86. Cement.—Cement for the concrete will be furnished to the contractor by the Government, as provided in paragraph 22. Cement will be tested at the mills and shall conform to the United States Government Master Specification No. 1a for Portland Cement, as published in Circular No. 33 of the Bureau of Standards. The contractor shall give the contracting officer not less than 30 days' notice in writing of cement requirements. The requirements shall be stated, as far as practicable, in quantities not less than car lots. It shall be stored in a weather-tight structure with the floor raised not less than one (1) foot from the ground and in such a manner as to permit easy access for proper inspection and identification of each shipment. Cement that has hardened or partially set shall not be used.

87. Empty cement sacks.—Cement in sacks must be handled in such a manner as to avoid damage to the sacks and the latter when empty must be piled in flat bundles and tied, 50 sacks in each bundle, and then stored in a dry place. The contractor shall return to the railway station all empty sacks cleaned of cement in a manner satisfactory to the contracting officer and securely bound in bundles in such manner as the contracting officer may direct. For all sacks not returned in serviceable condition the contractor will be charged the same amount that the sacks cost the Government.

FINE AGGREGATE

88. General requirements.—Fine aggregate shall consist of sand or other approved inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, durable, uncoated grains and free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances.

89. Grading.—Fine aggregate shall range in size from fine to coarse within the limits indicated in Table 1.

<table>
<thead>
<tr>
<th>TABLE 1.—Grading of fine aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>When dry</td>
</tr>
<tr>
<td>Passing through No. 4 sieve</td>
</tr>
<tr>
<td>Passing through No. 50 sieve</td>
</tr>
<tr>
<td>Passing through No. 100 sieve</td>
</tr>
<tr>
<td>Weight removed by decantation</td>
</tr>
</tbody>
</table>

90. Sieve analysis.—The sieves and method of making sieve analysis shall conform to the Standard Method of Test for Sieve Analysis of Aggregates for Concrete (Serial Designation, C-41-24) of the American Society for Testing Materials.

91. Decantation test.—The decantation test shall be made in accordance with the Tentative Method of Decantation Test for Sand and Other Fine Aggregates (Serial, Designation, D 136-22 T) of the American Society for Testing Materials.

(24)
92. **Mortar strength test.**—Fine aggregate shall be of such quality that mortar briquettes, cylinders, or prisms, consisting of 1 part by weight of Portland cement and 3 parts by weight of fine aggregate, will show a tensile or compressive strength at ages of 7 to 28 days not less than that of 1 to 3 standard Ottawa sand mortar of the same plasticity made with the same cement. Concrete tests shall be made in accordance with the Tentative Methods of Making Compression Tests of Concrete (Serial Designation, C 39–21T) of the American Society for Testing Materials.

93. **Organic impurities in sand.**—Sand, when tested in accordance with the Standard Method of Test for Organic Impurities in Sand for Concrete (Serial Designation, C 40–22) of the American Society for Testing Materials, shall show a color not darker than the standard color unless it complies with paragraph 92 hereof.

94. **Permissible variations.**—Fine aggregate which does not conform to the above requirements for grading, mortar strength, or color, may be used only when approved by the contracting officer and then in such proportions as he may require.

### COARSE AGGREGATE

95. **General requirements.**—Coarse aggregate shall consist of crushed stone, gravel, or other approved inert materials with similar characteristics, or combinations thereof, having clean, hard, strong, durable, uncoated particles free from injurious amounts of soft, friable, thin, elongated, or laminated pieces, alkali, organic, or other deleterious matter.

96. **Grading.**—Coarse aggregate shall range in size from fine to coarse within the limits given in Table 2.

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>Passing Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-inch sieve maximum size for plain concrete</td>
<td>Not less than 100.</td>
</tr>
<tr>
<td>1¼-inch sieve maximum size for reinforced concrete in wall 12 inches thick or over</td>
<td>Not less than 100.</td>
</tr>
<tr>
<td>1-inch sieve maximum size for plain concrete in walls or slabs under 12 inches</td>
<td>Not less than 100.</td>
</tr>
<tr>
<td>No. 4 sieve</td>
<td>Not more than 10.</td>
</tr>
<tr>
<td>No. 8 sieve</td>
<td>Not more than 5.</td>
</tr>
</tbody>
</table>

97. **Sieve sizes.**—The test for size and grading of aggregate shall be made in accordance with the Standard Method of Test for Sieve Analysis of Aggregates for Concrete (Serial Designation, C 41–24) of the American Society for Testing Materials.

98. **Permissible variations.**—Coarse aggregate which does not conform to the above requirements may be used only when approved by the contracting officer, and then in such proportions as he may require.

### STORAGE

99. **Storage of aggregate.**—Aggregate shall be so stored as to avoid the inclusion of foreign materials. Frozen aggregate or aggregate containing lumps of frozen material shall be thawed before using.

100. **Water.**—The water used for this work shall be subject to the approval of the contracting officer, and shall be clear and free from loam, clay, oil, acid, alkali, sewage, and any organic matter or any other impurities, and shall be neither brackish nor salty. The contractor shall arrange for his own water supply and shall pay for same.

### METAL REINFORCEMENT

101. **Reinforcing steel.**—Reinforcing steel, consisting of steel bars of the sizes and spacing specified, shall be placed in the concrete where shown on the drawings or as directed by the contracting officer. The reinforcing steel will be furnished by the Government as provided in paragraph 22 and shall be in accordance with Standard Specifications for Billet Steel Reinforcement Bars (Serial Designation, A 15–14) of the American Society for Testing Materials. The exact position, shape, and size of reinforcement bars are not shown in all cases on the drawings accompanying these specifications. The contractor will be furnished supplemental detail drawings and lists which will give the necessary information for cutting, bending, and placing all reinforcement. The reinforcement bars shall be so secured in position that they will not be displaced during the placing of the concrete. Special care shall be used to prevent any disturbance of the steel in concrete that has already been placed. The contractor will be charged for any reinforcing steel furnished and not used or returned the same as the cost of the steel to the Government at the point of delivery to the contractor. Payment for placing reinforcing steel will be at the unit price bid therefor in the schedule, which shall include the cost of unloading,
hauling, storing, cutting where required, bending, placing, wiring, furnishing tie wire, and maintaining in position all reinforcing steel as shown on the drawings or as directed by the contracting officer.

102. Storage of bars.—Proper racks shall be provided by the contractor for the storage of reinforcing bars from the time they are delivered until they are used, and these racks shall prevent the stored bars from coming in contact with the ground.

103. Wire.—Wire for concrete reinforcement, except tie wire, will be furnished by the Government and shall conform to the requirements of the Tentative Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement (Serial Designation, A 82-21T) of the American Society for Testing Materials.

PROPORTIONING OF CONCRETE

104. Proportioning.—The intent and purpose of these specifications is to secure accurate and uniform quantities of cement, stone, and sand and water for every batch of concrete. The water and all aggregates shall be measured by the use of approved measuring devices. No other means of measurement will be permitted. The unit of measure shall be the cubic foot ninety-four (94) pounds; one sack of cement or one-fourth (1/4) barrel of cement shall be assumed as 1 cubic foot. The amount of fine aggregate per batch shall be based on volume measurement when the fine aggregate is completely inundated, i.e., saturated with water. The water used in each batch of concrete shall be that necessary to saturate completely the fine aggregate plus or minus such predetermined accurately measured quantity as may be necessary to produce concrete of a consistency as required by the contracting officer. Correction of the water measure must be made in accordance with the varying moisture content, which naturally occurs in the fine aggregate. When necessary, the coarse aggregate must be suitably moistened to prevent a variable quantity of water being introduced into the concrete. A variation of more than 2 per cent from the exact measurement of the above-mentioned materials will not be tolerated. The exact proportions of the concrete ingredients will depend upon the size and character of the fine and coarse aggregate, but it is the intention to use throughout a mixture which will average as per Table 3.

Table 3.—Proportions for concrete

<table>
<thead>
<tr>
<th>Part of structure</th>
<th>Proportions by volume, dry material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cement</td>
</tr>
<tr>
<td>Footings</td>
<td>1</td>
</tr>
<tr>
<td>Plain concrete in abutments, piers, etc.</td>
<td>1</td>
</tr>
<tr>
<td>Beams, girders, slabs</td>
<td>1</td>
</tr>
<tr>
<td>Columns</td>
<td>1</td>
</tr>
</tbody>
</table>

Variations in the grading of the aggregates, on which the proportions were based, may be made upon the approval of the contracting officer and in such proportions as he may direct, but no claim shall be made for extra compensation therefor. The contracting officer shall have the right to make any changes in proportions or materials that may be necessary or desirable. In general the quantity of water used shall be the minimum necessary to produce concrete of a workability specified in Table 4.

Table 4.—Workability of concrete

<table>
<thead>
<tr>
<th>Type of concrete</th>
<th>Maximum slump</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mass concrete</td>
<td>Inches</td>
</tr>
<tr>
<td>2. Reinforced concrete:</td>
<td></td>
</tr>
<tr>
<td>(a) Thin vertical sections and columns</td>
<td>6</td>
</tr>
<tr>
<td>(b) Heavy sections</td>
<td>3</td>
</tr>
<tr>
<td>(c) Thin confined horizontal sections</td>
<td>8</td>
</tr>
<tr>
<td>3. Roads and pavements:</td>
<td></td>
</tr>
<tr>
<td>(a) Hand finished</td>
<td>3</td>
</tr>
<tr>
<td>(b) Machine finished</td>
<td>1</td>
</tr>
<tr>
<td>4. Mortar for floor finish</td>
<td>2</td>
</tr>
</tbody>
</table>
The inundation method of proportioning will not be required in the construction of concrete end walls for pipe culverts or similar isolated concrete work as determined by the contracting officer.

105. Consistency.—The quantity of water used shall be the minimum necessary to produce concrete of a workability required by the contracting officer. The consistency of the concrete shall be measured by the slump test as described in the Tentative Method of Test for Consistency of Portland Cement, Concrete for Pavements, or for Pavement Base (Serial Designation, D 138–22T) of the American Society for Testing Materials. The slump for the different types of concrete shall not be greater than that indicated in Table 4, unless authorized by the contracting officer.

MIXING OF CONCRETE

106. Machine mixing.—The mixing of concrete, unless otherwise authorized by the contracting officer shall be done in a batch mixer of approved type which will insure a uniform distribution of the materials throughout the mass so that the mixture is uniform in color and homogeneous. The mixer shall be equipped with suitable charging hopper, water storage, and a water-measuring device controlled from a case which can be kept locked and so constructed that the water can be discharged only while the mixer is being charged. It shall also be equipped with an attachment for automatically locking the discharge lever until the batch has been mixed the required time after all materials are in the mixer. The entire contents of the drum shall be discharged before recharging. The mixer shall be cleaned at frequent intervals while in use. The volume of the mixed material per batch shall not exceed the manufacturer’s rated capacity of the mixer.

107. Time of Mixing.—The mixing of each batch shall continue not less than one minute after all the materials are in the mixer, during which the mixer shall rotate at a peripheral speed of about 200 feet per minute.

108. Hand mixing.—When it is permitted to mix by hand, the mixing shall be done on a water-tight platform of sufficient size to accommodate men and materials for the progressive and rapid mixing of at least 2 batches of concrete at the same time. The batches shall not exceed one-half (1⁄2) cubic yard each. The material shall be mixed dry until the mixture is of a uniform color, the required amount of water added, and the mixing continued until the batch is of a uniform consistency and character throughout. Hand mixing will not be permitted for reinforced concrete or for concrete deposited under water.

109. Retempering.—The retempering of concrete or mortar which has partially hardened, that is remixing with or without additional cement, aggregate, or water, will not be permitted.

110. Premixed aggregate.—Will not be permitted.

FORMS FOR CONCRETE

111. General.—Forms shall conform to the shape, lines, and dimensions of the concrete as called for on the plans. Lumber used in forms for exposed surfaces shall be dressed on one side and both edges to a uniform thickness and width, and shall be free from loose knots or other defects. Joints in forms shall be horizontal or vertical. For unexposed surfaces and rough work, undressed lumber may be used. Lumber once used in forms shall have nails withdrawn, and surfaces to be in contact with concrete thoroughly cleaned, before being used again.

112. Earth forms.—Foundation concrete may be placed without forms if, in the opinion of the contracting officer, the sides of the excavation are sufficiently firm so that the concrete may be thoroughly rammed without the adjacent earth yielding, otherwise the concrete must be placed in substantial forms.

113. Anchors, bolts, etc.—The contractor shall build into forms all bolts, ties, wood-nailing blocks, gratings, etc., as indicated on the drawings or called for in the specifications and same shall be attached in such a manner as to prevent their displacement when concrete is placed. He shall also provide all holes and chases for pipes passing through concrete work and make same water-tight after pipes are in place.

114. Design.—Forms shall be substantial and sufficiently tight to prevent leakage of mortar; they shall be properly braced or tied together so as to maintain position and shape. If adequate foundation for shores can not be secured, trussed supports shall be provided.

115. Workmanship.—Bolts and rods shall preferably be used for internal ties; they shall be so arranged that when the forms are removed no metal shall be within 1 inch of any surface. Wire ties will be permitted only on light and unimportant work, and they shall not be used through surfaces where discoloration would be objectionable. Shores supporting successive stories shall be placed directly over those below, or so designed that the load will be transmitted directly to them. Forms shall be set to line and grade and so constructed and fastened as to produce true lines. Special care shall be used to prevent bulging.

116. Moldings.—Unless otherwise specified, suitable moldings or bevels shall be placed in the angles of forms to round or bevel the edges of the concrete.

117. Oiling.—The inside of forms shall generally be coated with nonstaining mineral oil or other approved material or thoroughly wetted (except in freezing weather). Where oil is used, it shall be applied before the reinforcement is placed.

59148—27—3
118. Inspection.—Temporary openings shall be provided at the base of column and wall forms, and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.

119. Nose angles for piers.—The contractor shall build into forms nose angles for piers with anchor bolts as called for on the drawings and same shall be attached in such a manner as to prevent displacement when concrete is placed. Price paid for cubic yard of concrete will include cost of furnishing and installing nose angles and anchor bolts.

120. Removal.—Forms shall not be disturbed until the concrete has adequately hardened. Shoring shall not be removed until the member has acquired sufficient strength to safely support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to support both the member and construction loads in such a manner as will protect the member from damage by the loads; this shoring shall not be removed until the member has acquired sufficient strength to safely support its weight and the load upon it, and then only at the contractor's risk.

DEPOSITING CONCRETE IN AIR

121. General.—Before beginning a run of concrete, hardened concrete and foreign materials shall be removed from the inner surfaces of the mixing and conveying equipment.

122. Approval.—Before depositing any concrete all debris shall be removed from the space to be occupied by the concrete. All steel reinforcing shall be secured in its proper location. All forms shall be thoroughly wetted except in freezing weather unless they have been previously oiled, and all form work and steel reinforcing shall be inspected and approved by the contracting officer.

123. Handling.—Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It shall be so deposited as to maintain, until the completion of the unit, a plastic surface approximately horizontal. Forms for walls or other thin sections of considerable height, shall be provided with openings, or other devices, that will permit the concrete to be placed in a manner that will avoid accumulations of hardened concrete on the forms or metal reinforcement. Under no circumstances shall concrete that has partially hardened be deposited in the work.

124. Chuting.—When concrete is conveyed by chuting, the plant shall be of such size and design as to insure a practically continuous flow in the chute. The angles of the chute with the horizontal shall be such as to allow the concrete to flow without separation of the ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. When the operation is intermittent, the spout shall discharge into a hopper. The chute shall be thoroughly flushed with water before and after each run; the water used for this purpose shall be discharged outside the forms.

125. Compacting.—During and after depositing, the concrete shall be compacted by means of a shovel or other suitable tool moved up and down continuously in the concrete until it has all settled into place and water has flushed to the surface. The concrete shall be thoroughly worked around all reinforcing material so as to completely surround and embed the same. Temporary planking shall be placed at ends of partial layers so that concrete shall not run out to thin edges.

126. Removal of water.—Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the contracting officer. Any flow of water into the excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. Water vent pipes and drains shall be filled by grouting or otherwise, after the concrete has thoroughly hardened.

127. Protection.—Exposed surfaces of concrete shall be protected from premature drying for a period of at least 7 days after being deposited and for longer periods when directed by the contracting officer or when specified on the drawings or in the specifications.

128. Temperature of concrete.—Concrete when deposited shall have a temperature of not less than 40°F, nor more than 120°F. In freezing weather suitable means shall be provided for maintaining the concrete at a temperature of at least 50°F for not less than 72 hours after placing, or until the concrete has thoroughly hardened. The methods of heating the materials and protecting the concrete shall be approved by the contracting officer. Salt, chemicals, or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing, unless approved by the contracting officer.

129. Depositing continuously.—Concrete shall be deposited continuously and as rapidly as practicable until the unit of operation, approved by the contracting officer, is completed. Construction joints at points not provided for in the plans shall be made in accordance with the provisions in paragraphs 144 to 149, inclusive.

130. Bonding.—Before depositing new concrete on or against concrete which has set, the forms shall be retightened, the surface of the set concrete shall be roughened as required by the contracting officer, thoroughly
cleaned of foreign matter and laitance, and saturated with water. The new concrete placed in contact with hardened or partially hardened concrete, shall contain an excess of mortar to insure bond. To insure this excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces of the hardened concrete, including vertical and inclined surfaces, shall first be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

**DEPOSITING CONCRETE UNDER WATER**

131. General.—The methods, equipment, and materials to be used shall be submitted to and approved by the contracting officer before the work is started. Concrete shall be deposited by a method that will prevent the washing of the cement from the mixture, minimize the formation of laitance, and avoid flow of water until the concrete has fully hardened. Concrete shall be placed so as to minimize segregation of materials. Concrete shall not be placed in water having a temperature below 35° F.

132. Proportions.—Concrete to be deposited under water shall contain 1/4 barrels (7 bags) or more of Portland cement per cubic yard of concrete in place.

133. Cofferdams.—Cofferdams shall be sufficiently tight to prevent flow of water through the space in which the concrete is to be deposited. Pumping will not be permitted while concrete is being deposited, nor until it has fully hardened.

134. Depositing continuously.—Concrete shall be deposited continuously, keeping the top surface as nearly level as possible, until it is brought above the water or to the required height. The work shall be carried on with sufficient rapidity to prevent the formation of layers.

135. Method.—The following method shall be used for depositing concrete under water:

   (a) **Tremie.**—The tremie shall be water-tight and sufficiently large to permit a free flow of concrete. It shall be kept filled at all times during depositing. The concrete shall be discharged and spread by raising the tremie in such a manner as to maintain as nearly as practicable a uniform flow and avoid dropping the concrete through water. If the charge is lost during depositing the tremie shall be withdrawn and refilled.

   (b) **Drop-bottom bucket.**—The bucket shall be of a type that can not be dumped until it rests on the surface upon which the concrete is to be deposited. The bottom doors when tripped shall open freely downward and outward. The top of the bucket shall be open. The bucket shall be completely filled, and slowly lowered to avoid backwash. When discharged, the bucket shall be withdrawn slowly until well above the concrete.

136. Laitance.—Great care should be exercised to disturb the concrete as little as possible when it is being deposited in order to avoid the formation of laitance. On completing a section of concrete the laitance shall be entirely removed before work is resumed.

**METAL REINFORCEMENT**

137. Cleaning.—Metal reinforcement, before being positioned, shall be thoroughly cleaned of mill and rust scale and of coatings that will destroy or reduce the bond. Reinforcement appreciably reduced in section shall be rejected. Where there is delay in depositing concrete, reinforcement shall be reinspected and, when necessary, cleaned.

138. Bending.—Reinforcement shall be carefully formed to the dimensions indicated on the plans. Cold bends shall be made around a pin having a diameter of four or more times the least dimension of the reinforcement bars for steel of structural grade and eight or more times that for steel of intermediate or hard grade.

139. Straightening.—Metal reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans shall not be used unless otherwise directed by the contracting officer. Heating of reinforcement will be permitted only when the entire operation is approved by the contracting officer.

140. Placing.—Metal reinforcement shall be accurately positioned, and secured against displacement by using annealed iron wire of not less than No. 18 gauge or suitable clips at intersections and shall be supported by concrete or metal chairs or spacers, or metal hangers. The minimum clear distance between parallel bars shall be one and one-half times the diameter of round bars or one and one-half times the diagonal of square bars; but in no case shall the spacing between bars be less than 1 inch, nor less than one and one-fourth times the maximum size of the coarse aggregate. Bars parallel to the face of any member shall be embedded a clear distance of not less than one diameter from the face.

141. Splicing.—In slabs, beams and girders, splices of reinforcement shall not be made at points of maximum stress without the approval of the contracting officer. Splices, where permitted, shall provide sufficient lap to transfer the stress between bars by bond shear. In such splices the bars shall be placed at the minimum distance specified in paragraph 140; adjacent bars shall not be spliced at the same point. Splices in columns, piers, and struts shall provide sufficient lap to transfer the stress by bond.
142. **Offsets in column reinforcement.**—Where changes in the cross section of a compression member occur, the longitudinal reinforcement bars shall be sloped for the full length of the member or offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion from the axis of the member shall not be more than 1 in 6.

143. **Future bonding.**—Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion.

### JOINTS IN CONCRETE

144. **General.**—Joints not indicated on the plans shall be so designed and located as to least impair the strength and appearance of the structure. To prevent laitance in horizontal joints, excess water shall be removed from the surface forming the joint after depositing the concrete. Surfaces of contact shall be cleaned and wetted before depositing is resumed, and any laitance shall be removed. Where additional resistance to horizontal shear is required, stones shall be partially embedded in such a manner as to key with the adjoining concrete; or mortices or keys shall be formed in the concrete.

145. **Joints in columns.**—Joints in columns shall be made at the underside of the floor. Haunches and column capitals shall be considered as part of and to act continuous with the floor. At least 2 hours must elapse after depositing concrete in the columns or walls before depositing the beams, girders or slabs.

146. **Joints in floors.**—Construction joints in floors shall be located near the middle of spans of slabs, beams or girders, unless a beam intersects a girder at this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. Adequate provision shall be made for shear by use of inclined reinforcement.

147. **Expansion joints.**—Reinforcement shall not extend across an expansion joint; the break between the two sections shall be complete. Exposed edges of expansion joints in walls or abutments shall be rounded. Exposed expansion joints between two distinct concrete members shall be filled with an elastic joint filler of approved quality.

148. **Sliding joints.**—The seat of sliding joints shall be finished to a smooth plane surface and allowed to harden. Two thicknesses of building paper shall be placed on the seat before depositing superimposed concrete.

149. **Water-tight construction joints.**—Horizontal joints shall be constructed by forming a continuous keyway in the lower portion of concrete before the concrete has hardened. Before placing the superimposed concrete the joint shall be thoroughly cleaned of laitance or other foreign material, saturated with water and coated with neat cement grout. The superimposed concrete shall be placed in such a manner as will insure an excess of mortar over the entire surface of the joint. Vertical joints shall be made by sheet lead or other metal stop, approved by the contracting officer, not less than 6 inches wide and extending the full length of the joints and embedded equally in the two deposits of concrete. Seepage water shall be collected and drained from the forms where required. Vent pipes shall be closed after the concrete has thoroughly hardened.

### WATERPROOFING

150. **General.**—Concrete required to be water-tight shall be made with strict adherence to all provisions in these specifications regarding the choice of materials, proportions, consistency, mixing, placing, protecting, and workmanship.

151. **Integral compounds.**—Integral compounds shall not be used for waterproofing unless specifically authorized by the contracting officer.

152. **Water-tight joints.**—Type of waterproofing to be subject to the approval of the contracting officer.

### CONCRETE IN ALKALI SOILS OR WATERS

153. **Proportions.**—Concrete in alkali waters or below ground line of alkali soils shall contain a minimum of $1\frac{1}{4}$ barrels (7 bags) of Portland cement per cubic yard in place.

154. **Consistency.**—The consistency of concrete in alkali soils or waters shall be such as to meet the requirements of paragraph 105.

155. **Placing.**—Concrete shall be placed in such a manner as to minimize the number of horizontal or work planes.

### SURFACE FINISH

156. **General.**—The requirements in these specifications applying to forms and to mixing, conveying, depositing, and finishing concrete shall be followed unless modified by the plans. The whole of a showing face between prescribed construction joints shall be cast in one continuous operation. Construction joints, when not shown on the plans, shall be made as directed by the contracting officer and shall be true to line with sharp unbroken edges. The same brand of cement, and the same kind and size of aggregate, shall be used throughout.
the whole of any showing face. For showing faces the forms shall be smooth and water-tight. If wood is used the boards shall be planed, grooved, and tongued, evenly matched, and tightly placed. They shall be so constructed as to be removable in sections by unscrewing or otherwise loosening them without hammering or prying against the face. Any offsets in the forms that may occur shall be smoothly dressed and any openings pointed flush with stiff clay or plaster of Paris in order to prevent leakage or the formation of fins. Concrete that is to have a showing face, whether any particular finish is called for or not, shall be mixed, placed and worked as may be necessary to secure at the face a uniform distribution of the aggregates, freedom from void spaces and uniform texture. If the finish is required to be one that will expose the coarse aggregate, by either scrubbing, tooling, sand-blasting, or acid treatment, then after the full surface of mortar has been worked against the form, the spading tool shall be inserted in the concrete and the coarse aggregate be pressed against the form in order to secure uniform distribution at the face and a uniform texture after the aggregate is exposed. Face forms shall be removed as soon as practicable in order to facilitate effective repair of void spaces or broken corners, before the surface has dried. Care shall be taken to avoid roughening or injuring corners, and to keep edges sharp. As soon as the face forms are removed any fins or other projection shall be carefully removed and offsets leveled, and any voids or damaged places shall immediately be saturated with water and filled with a mixture of the same composition as that used in the surface by means of a wooden spatula or float. A steel trowel shall not be used to finish the surface. The face shall be finished free from streaks, discolorations or other imperfections. Plastering will not be permitted. Where a surface of mortar is to be the basis of the finish the coarse aggregate shall be worked back from the form with a suitable tool, so as to bring a full surface of mortar against the form, care being taken to prevent the formation of voids and air pockets. Whenever forms are removed from showing faces before the concrete has been hard and dry, the surface of the concrete shall be immediately wetted and kept wet for at least 3 days.

157. Top surfaces not subject to wear.—Top surfaces not subject to wear shall be smoothed with a wood float and kept wet for at least 7 days. Care shall be taken to avoid an excess of water in the concrete, and to drain or otherwise promptly remove any water that comes to the surface. Dry cement or a dry mixture of cement and sand shall not be sprinkled directly on the surface.
For the construction of the relocated Lincoln Highway in the location described herein

SPECIAL CONDITIONS

158. The requirement.—It is required that the grading for the roadbed and structures necessary for the relocated Lincoln Highway around Echo Reservoir be constructed and erected in accordance with these specifications and drawings, as called for in the accompanying schedule.

159. Description.—A portion of the present Lincoln Highway will be submerged by the construction of the Echo Reservoir for the storage of irrigation water. The relocated highway will be constructed on higher ground around the reservoir and along the northerly side thereof. The earthwork will consist of the usual cut and fill type of grading common in highway construction and the structures will be in general of concrete. The relocated highway will pass the Echo Dam adjacent to its right abutment. The relocated Park City and Grass Creek branches of the Union Pacific Railroad system will also be constructed around the reservoir and in general parallel and adjacent to the relocated Lincoln Highway as shown on the drawings. The specifications applying particularly to the construction of the relocated railroad are given under part 1 hereof. The provisions of paragraphs 22 and 23 of part 1 apply in the same manner to the construction of the relocated highway as to the relocated railroad. The preparation and construction of the wearing surface for the relocated highway is not included in this contract.

160. Drawings.—The drawings, Nos. 1 to 7, inclusive, 10, 11, 13 to 22, inclusive, and 27, which are listed with their titles in paragraph 15, apply wholly or in part to the construction of the relocated highway.

161. Interpretation of approximate estimate of quantities.—The bidder's attention is called to the fact that the estimate of quantities of work to be done and material to be furnished under these specifications for the relocated highway, as shown in the schedule, is approximate and is given only as a basis of calculation upon which the award of the contract is to be made. The Government does not assume any responsibility that the quantities shall obtain strictly in the construction of the roadway, nor shall the contractor plead misunderstanding of or deception because of such estimate of quantities or of the character, location, or other conditions pertaining thereto. The Government reserves the right to increase or diminish any or all of the quantities of work or to omit any of them as may be deemed necessary.

162. Familiarity with proposed work.—The bidder should examine carefully the invitation for bids, form of bid, instructions to bidders, form of contract, the drawings and specifications for the work, and the site of the work contemplated. It will be assumed that he has judged for and satisfied himself as to the conditions to be encountered as to the character, quality, and quantities of work to be performed and materials to be furnished and as to the requirements of these specifications and contract.

163. Scope of work.—The contractor shall do all clearing and grubbing, make all excavation and embankments, do all shaping and surfacing, construct all drainage structures, bridges and other appertaining structures, as indicated in the schedule and on the plans, remove all obstructions from within the lines of the highway, and shall do such additional, extra, and incidental work as may be considered necessary to complete the roadway to the finished lines, grades, and cross sections in a substantial and acceptable manner as required by these specifications. He shall furnish, unless otherwise provided in the special provisions of the proposal and in the contract, all implements, machinery, equipment, tools, material, and labor necessary to the prosecution of the work. In short, the contractor shall construct the roadway in strict accordance with the plans, specifications, and contract, and when completed shall leave it in a neat and finished condition.

164. Permits and licenses.—The contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of work.

165. Plans, etc., to be followed.—The approved plans, profiles, and cross sections on file in the office of the contracting officer will show the location, details, and dimensions of the work contemplated, which shall be performed in strict accordance therewith and in accordance with the specifications. Any deviation from the plans, specifications, etc., as may be required by the exigencies of construction, in all cases, will be determined by the contracting officer and authorized in writing.

166. Interpretation of plans, etc.—On all plans, drawings, etc., the figured dimensions shall govern in the case of discrepancy between the scales and figures. The contractor shall take no advantage of any error or
omission in the plans or of any discrepancy between the plans and specifications, and the contracting officer shall make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the specifications and of the plans as construed by him, and his decision shall be final.

167. Payments in case of alteration of plans or of character of work.—The Government reserves the right, with the approval of the State Road Commission of Utah, to make such alterations in the plans or in the character of the work as may be considered necessary or desirable from time to time to complete fully and perfectly the construction of the roadway; provided, that such alterations do not change materially the original plans and specifications, and such alterations shall not be considered as a waiver of any condition of the contract or to invalidate any of the provisions thereof. Should such alteration in the plans result in an increase or decrease of the quantity of work to be performed, the contractor shall accept payment in full at the contract unit prices for the actual quantities of work done; or should such alterations in the character of the work be productive of increased cost or result in decreased cost to the contractor, a fair and equitable adjustment therefor will be made in accordance with article 3 of the contract.

168. Additional work.—The contractor shall perform such work, in additional quantities other than those designated in the approximate estimate, as may be deemed necessary to complete fully the roadway as planned and contemplated and shall receive for such additional work, payment in full, at the prices shown in the contract and in the same manner as if such work had been included in the original estimate of quantities.

169. Unauthorized work.—Work done without lines and grades being given, work done beyond the lines and grades shown on the plans or as given, except as herein provided, or any extra work done without written authority, will be considered as unauthorized and at the expense of the contractor and will not be measured or paid for by the Government. Work so done may be ordered removed and replaced at the contractor's expense.

170. Prosecution of work.—The place where the work is to be started either will be stated in the “Notice to proceed” or will be designated on the ground. The work shall be prosecuted from as many different points, in such part or parts and at such times as may be directed, and shall be conducted in such manner and with sufficient materials, equipment, and labor as is considered necessary to insure its completion within the time specified. Should the prosecution of the work for any reason be discontinued by the contractor with the consent of the contracting officer, he shall notify the contracting officer at least twenty-four (24) hours before again resuming operations.

171. Character of workmen and equipment.—The contractor shall employ such superintendents, foremen, and workmen as are careful and competent, and the contracting officer may demand the dismissal of any person or persons employed by the contractor in, about, or upon the work who shall misconduct himself or be incompetent or negligent in the due and proper performance of his or their duties or any of them, or neglects or refuses to comply with the directions given, and such person or persons shall not be employed again thereon without the written consent of the contracting officer. Should the contractor continue to employ or again employ such person or persons, the Government may withhold all estimates which are or may become due, or the contracting officer may suspend the work, until such orders are complied with. The contractor shall furnish such equipment as is considered necessary for the prosecution of the work in an acceptable manner and at a satisfactory rate of progress. Equipment used on any portion of the work shall be such that no injury to the roadway, adjacent property or other highways will result from its use.

172. Laws to be observed.—(a) The contractor at all times shall observe and comply with all Federal and State laws and local by-laws, ordinances, and regulations in any manner affecting the conduct of the work, and all such orders or decrees as exist at present and those which may be enacted later, of bodies or tribunals having any jurisdiction or authority over the work, and shall indemnify and save harmless the Government and all of its officers, agents, and servants against any claim or liability arising from or based on the violation of any such law, by-law, ordinance, regulation, order or decree, whether by himself or his employees.

(b) On Federal-aid projects the attention of the bidder is invited to the fact that pursuant to the provisions of that certain act of Congress approved July 11, 1916 (39 Stat. 355), entitled “An act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes,” the United States Government through the Department of Agriculture is to pay a portion of the cost of this improvement. The above act of Congress provides that the construction work and labor in each State shall be done in accordance with its laws and under the direct supervision of the State Road Commission subject to the inspection and approval of the Secretary of the United States Department of Agriculture and in accordance with the rules and regulations made pursuant thereto. The construction work, therefore, will be subject to such inspection by the Secretary of Agriculture or his agents as may be necessary to meet the above requirements, but such inspection will in no way interfere with the rights of either party hereunder.
(c) Workmen’s compensation.—The contractor shall accept, in so far as the work covered by this contract is concerned, the provisions of the workmen’s compensation act of July 1, 1917, and any supplements or amendments thereto which may hereafter be passed, and shall insure his liability thereunder.

(d) Employment of soldiers, sailors, and marines.—In the employment of labor, in the performance of this contract, when relating to a Federal-aid project or section thereof, preference shall be given, other conditions being equal, to honorably discharged soldiers, sailors, and marines, but no other preference or discrimination among citizens of the United States shall be made. (Sec. 6 of the act of Congress, approved Feb. 28, 1919, entitled “An act making appropriations for the service of the Post Office Department for the fiscal year ending June 30, 1920, and for other purposes,” public No. 299, 65th Cong.)

173. Sanitary provisions.—The contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Utah State Department of Health or of other bodies or tribunals having jurisdiction thereof. He shall commit no public nuisance.

174. Public convenience and safety detours.—The contractor at all times shall conduct the work in such a manner as to insure the least obstruction to traffic practicable. The convenience of the general public and of the residents along and adjacent to the highway shall be provided for so as to cause as little obstruction to the traveling public as is considered necessary. The contractor shall provide and maintain in a safe condition temporary approaches to and crossings of intersecting highways.

175. Barricades, danger, warning, and detour signs.—The contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient red lights, danger signals, and signs, provide a sufficient number of watchmen, and take all necessary precautions for the protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning signs. The contractor shall provide and maintain standard warning and detour signs at all closures, intersections, and along the detour routes, directing the traffic around the closed portions of the highway, so that the temporary detour route or routes shall be indicated clearly throughout its or their entire length. All barricades and obstruction shall be illuminated at night and all lights shall be kept burning from sunset until sunrise.

176. Use of explosives.—When the use of explosives is necessary for the prosecution of the work, the contractor shall use the utmost care, so as not to endanger life or property, and whenever directed by the contracting officer the number and size of the charges shall be reduced. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly, “DANGEROUS—EXPLOSIVES,” and shall be in care of competent watchmen at all times.

177. Preservation and restoration of property, trees, monuments, etc.—The contractor shall not enter upon private property for any purpose without obtaining permission, and he shall be responsible for the preservation of all public and private property, trees, monuments, etc., along and adjacent to the roadway and shall use every precaution necessary to prevent damages or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits, and other underground structures, and shall protect carefully from disturbance or damage all land monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and shall not remove them until directed. The contractor shall not willfully nor maliciously injure or destroy trees or shrubs and he shall not remove or cut them without proper authority. He shall be responsible for all damages or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing said work satisfactorily, or due to his nonexecution of said work, or at any time due to defective work or materials, and said responsibility shall not be released until the roadway shall have been completed and accepted. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof on the part of the contractor, he shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring, as may be directed by the contracting officer, or he shall make good such damage or injury in an acceptable manner. In case of the failure on the part of the contractor to restore such property, or make good such damage or injury, the contracting officer may, upon forty-eight (48) hours’ notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary and the cost thereof will be deducted from any moneys due or which may become due the contractor under this contract.

178. Responsibility for damage claims, etc.—The contractor shall indemnify and save harmless the Government and all of its officers, agents, and employees from all suits, actions, or claims of any character, name, and description brought for, or on account of any injuries or damages received or sustained by any person, persons, or property by or from the said contractor or in consequence of any neglect in safeguarding the work or through the use of unacceptable materials in constructing the roadway or by or on account of any act or omission, neglect, or misconduct of the said contractor, on or account of any claims or amounts recovered for any infring-
ment of patent, trade-mark, or copyright, or from any claims or amounts arising or recovered under the work-
men's compensation law, or any other by-law, law, ordinance, order, or decree, and so much of the money due
the said contractor under and by virtue of his contract as shall be considered necessary by the contracting
officer may be retained for the use of the Government, or in case no money is due his surety shall be held until
such suit, action or actions, claim or claims, for injuries or damages, as aforesaid, shall have been settled and
suitable evidence to that effect furnished to the Government.

179. Contractor's responsibility for work.—Until acceptance of the roadway by the contracting officer it
shall be under the charge and care of the contractor, and he shall take every necessary precaution against injury
or damage to the roadway or to any part thereof by the action of the elements or from any other cause whatsoever,
whether arising from the execution or from the nonexecution of the work. The contractor shall rebuild,
repair, restore, and make good at his own expense, all injuries or damages to any portion of the roadway
occasioned by any of the above causes before its completion and acceptance.

180. Opening of section of highway to traffic.—Whenever, in the opinion of the contracting officer, any
roadway, or portion thereof, is in acceptable condition for travel, it shall be opened to traffic, as may be directed;
but such opening shall not be held to be in any way an acceptance of the roadway, or any part of it, or as a
waiver of any of the provisions of these specifications and contract. Necessary repairs or renewals made on
any section of the roadway, due to its being opened to travel under instruction from the contracting officer,
to defective materials or work, or to natural causes other than ordinary wear and tear, pending completion
and acceptance of the roadway, shall be performed at the expense of the contractor.

181. Quality of materials and source of supply.—(a) Furnished by contractor.—All materials used in
the work shall meet the requirements of their respective specifications, and no material shall be used until it has
been approved by the contracting officer. All tests of materials shall be made by the contracting officer in
accordance with the official approved methods as described or designated at the laboratory or such other places
as is designated. When tests are made at other places than the laboratory, the contractor shall furnish every
facility for the verification of all scales, measures, etc. The contractor shall submit samples of material as
directed for examination and test. If, after trial, it is found that partially developed quarries, ledges, banks,
etc., which have been approved upon samples or otherwise, do not furnish a uniform product, or if, for any
reason, the product from any source at any time before or during the prosecution of the work proves unaccept­
able, the contractor shall furnish approved material from other sources.

(b) Furnished by the Government.—Where material is furnished by the Government its selection is conclusive
of its acceptability for the purpose designated and the contractor may so continue to use it until otherwise
directed. Local materials, as quarries, banks, ledges, etc., will be understood as being furnished in place and
the contractor will provide and maintain roads thereto at his own expense. Materials furnished by the Gov­
ernment which are not of local occurrence will be understood as being f. o. b. the railroad station nearest or
most convenient to point of use. The contractor or his duly authorized agent will be promptly advised of
the shipment of materials intended for use in the roadway and will be held responsible for any demurrage
charges resulting from his delay in unloading cars. The Government will not be responsible for damages which the
contractor may sustain through failure of the railroad company to furnish cars or for delays of materials in
transit.

182. Cement furnished.—When so indicated in the specifications, cement (not the sacks) will be furnished
the contractor f. o. b. nearest railroad siding at point of use by the Government for the work in hand without
charge under the following conditions:

(a) It is expressly understood by the contractor that no responsibility is assumed by the Government for
the delivery of the cement at the time desired and that no extra compensation will be allowed the contractor
for delays.

(b) The contractor shall assume responsibility for all demurrage charges, and he shall be prepared to
unload and properly protect all cement from weather, dampness, or other destructive agencies. If any cement
is damaged or lost subsequent to the breaking of the car-door seal by the contractor, he shall be charged with
the value of such cement, including freight charges, and it is hereby agreed that all such amounts are to be with­
held from any sums that may be due the contractor under the terms of his contract.

(c) At the time the seal is broken on the freight-car door the contractor shall become responsible for all cloth
cement sacks in the car and shall be charged therefor by the Government the same price that the Government is
obliged to pay for such sacks. These charges shall be withheld from the sum eventually due the contractor.
The provisions of paragraph 87 shall also apply for empty cement sacks.

183. Storage of materials.—Materials shall be stored so as to insure the preservation of their quality and
fitness for the work. When considered necessary by the contracting officer they shall be placed on wooden
platforms, or other hard clean surface, and not on the ground, and shall be placed under cover when directed.
Stored materials shall be located so as to facilitate prompt inspection. Lawns, grass plots, or other private
property shall not be used for storage purposes without written permission of the owner or lessee.
184. Use of materials found on the highway.—The contractor, with the approval of the contracting officer, may use in the construction of the roadway any stone, gravel or sand found in the “Excavation,” and will be paid for the removal of such material at the contract unit price for “Excavation,” but he shall replace, with other suitable material, all of that portion of the material so removed and used, as was contemplated for use in the embankments or otherwise. If it has been contemplated that any or all of the material so excavated and used was to have been wasted, then the contractor will not be required to replace it. The contractor shall not excavate or remove any material from within the highway location which is not within the excavation as indicated by the slope and grade lines, without being authorized in writing.

185. Line, grade and measurement stakes.—The contracting officer will furnish and set survey stakes at a convenient distance from the center line of the contemplated roadway and will furnish the contractor with a grade sheet, showing the horizontal and vertical measurements from said stakes to the center of the roadway as planned. The contractor shall furnish, free of charge, all additional stakes, all templates and other materials necessary for marking and maintaining points and lines given, and shall furnish the contracting officer such assistance as he may require in giving points and lines necessary to the prosecution of the work. The contractor shall be held responsible for the preservation of all stakes and marks and if, in the opinion of the contracting officer, the survey stakes or marks have been carelessly or wilfully destroyed or disturbed by the contractor, the cost to the Government of replacing them shall be charged against him and shall be deducted from the payment for the work. Finished surfaces, in all cases, shall conform with the lines and grades given and as shown on the approved plans.

186. Authority and duties of inspectors.—Inspectors, employed by the Government, shall be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation or manufacture of the materials to be used. An inspector shall be stationed on the roadway to report to the contracting officer as to the progress of the work and the manner in which it is being performed; also to report whenever it appears that the materials furnished and work performed by the contractor fail to fulfill the requirements of the specifications and contract, and call to the attention of the contractor any such failure or other infringement; such inspection, however, shall not relieve the contractor from any obligation to perform all of the work strictly in accordance with requirements of the specifications. In case of any dispute arising between the contractor and the inspector as to materials furnished or the manner of performing the work the inspector shall have the authority to reject materials or suspend the work until the question at issue can be referred to and decided by the contracting officer. The inspector shall perform such other duties as are assigned to him. He shall not be authorized to revoke, alter, enlarge, relax, or release any requirements of these specifications, nor to approve or accept any portion of work, nor to issue instructions contrary to the plans and specifications. The inspector shall in no case act as foreman or perform other duties for the contractor nor interfere with the management of the work by the latter. Any advice which the inspector may give the contractor shall in no wise be construed as binding the contracting officer nor the Government in any way, nor releasing the contractor from the fulfillment of the terms of the contract.

187. Contracting officer to be referee.—To prevent misunderstanding and litigation, the contracting officer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the manner of performance and rate of progress of said work, and shall decide all questions which may arise as to the interpretation of any or all plans relating to the work and the specifications and all questions as to the acceptable fulfillment of the contract on the part of the contractor; and the contracting officer shall determine the amount and quantity of the several kinds of work performed and materials furnished which are to be paid for under the contract, and such decision and estimate shall be final and conclusive, and such estimate, in case any question shall arise, shall be a condition precedent to the right of the contractor to receive any money due under the contract. Any doubt as to the meaning or any obscurity as to the wording of these specifications and contract will be explained by, and all directions and explanations requisite or necessary to complete, explain, or make definite any of the provisions of the specifications or contract and to give them due effect will be given by the contracting officer.

188. Inspection of materials and work.—The contractor shall furnish the contracting officer with every reasonable facility for ascertaining whether or not the work as performed is in accordance with the requirements and intent of the specifications and contract. If the contracting officer requests it, the contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the contractor shall restore said portions of the work to the standard required by the specifications. Should the work as exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed, shall be paid for as “extra work,” but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed shall be at the contractor’s expense. Any work done or materials used with-
out suitable supervision or inspection by a representative of the Government may be ordered removed and replaced at the contractor’s expense.

189. Defective materials and work.—All materials not conforming to the requirements of the specifications shall be considered as defective, and all such materials, whether in place or not, shall be removed immediately from the highway unless otherwise permitted. No material which has been rejected, the defects of which have been corrected or removed, shall be used until approval has been given. All work which has been rejected or condemned shall be remedied or if necessary removed and replaced in an acceptable manner by the contractor at his own expense.

190. Final cleaning up of highway.—Upon completion of the work and before acceptance and final payments shall be made the contractor shall clean and remove from the highway, footways, lawns, and adjacent property, all surplus and discarded materials, rubbish, and temporary structures, restore in an acceptable manner all property, both public and private, which has been damaged during the prosecution of the work, and shall leave the highway in a neat and presentable condition throughout the entire length of the roadway under contract.

191. Temporary suspension of work.—The contracting officer shall have the authority to suspend the work wholly or in part, for such period or periods as he may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for the suitable prosecution of the work, or for such time as is necessarily due to the failure on the part of the contractor to carry out orders given or perform any or all provisions of the contract. If it should become necessary to stop work for an indefinite period, the contractor shall store all materials in such manner that they will not obstruct or impede the traveling public unnecessarily nor become damaged in any way, and he shall take every precaution to prevent damage or deterioration of the work performed, provide suitable drainage of the roadway by opening ditches, shoulder drains, etc., and erect temporary structures where necessary. The contractor shall not suspend the work without authority.
CONSTRUCTION DETAILS

EXCAVATION AND EMBANKMENT

192. Description.—Excavation and embankments shall consist of grading the roadway in conformity with the plans, true to the lines and grades given. This grading shall include all clearing and grubbing, removing structures, obstructions, etc., as indicated or directed, excavating, forming embankments, shaping and sloping, compacting, and other work that may be necessary in bringing the roadway and its appurtenances to the required grade, alignment, and cross section; also the grading of all intersecting roadways, driveways, and approaches, and excavating foundations for structures. This work shall be done in accordance with these specifications.

193. Classification. — Roadway excavation shall be classified under two heads, as follows: Solid-rock excavation and Common excavation.

Solid rock excavation shall include all hard rock found in ledges or masses which can not be removed without blasting, and also all detached rock and bowlders measuring not less than 1 cubic yard each. Common excavation shall include all earth, loose stones, bowlders, and other materials of every nature as found which is not included in the foregoing definition. The frozen condition of any materials taken from excavation shall constitute no claim for higher classification or for extra work on the part of the contractor.

194. Clearing and grubbing.—The ground shall be cleared of all dead trees, stumps, brush, weeds, roots, and other objectionable material within the limits of the highway, and all trees shall be removed from within the limits of the roadway and from slopes as directed, before the grading is started. Timber of any value, which it may be necessary to cut, shall be piled neatly on the abutting property unless otherwise directed. All branches of trees extending within the roadway limits shall be trimmed as directed, and branches which hang within twelve (12) feet of the roadway surface in all cases shall be removed, all of which shall be done carefully. All trees, stumps, etc., removed in the excavation shall be cut off, excavated, and removed to the depth of not less than nine (9) inches below the subgrade surface. Where an embankment is to be made not more than two and one-half (2 1/2) feet in depth, said trees, stumps, roots, etc., shall be cut off flush with the existing ground surface. Where embankments exceeding two and one-half (2 1/2) feet are to be made, said trees, stumps, roots, etc., shall be cut off to within six (6) inches of the ground surface. The contractor shall burn or otherwise dispose of all such trees, stumps, brush, weeds, roots, etc., and all sod taken from the excavation, in a satisfactory manner and shall remove all rubbish and refuse to such point or points beyond the limits of the roadway as may be directed. All excavation made below the subgrade surface by the removal of trees, stumps, etc., shall be filled with suitable material, which shall be compacted thoroughly so as to make the surface of these points conform to the surrounding subgrade. All slopes to cuts, embankments, ditches, and waterways, and all culverts, whether old or new, shall be cleaned and cleared of obstructions in a satisfactory manner and shall be left in a neat and trimmed condition.

195. Removal of structures, obstructions, etc.—All fences, buildings, and structures of any character not necessary to the construction of the roadway, or other encumbrances upon or within the limits of the roadway shall be removed carefully by the contractor and the materials so removed shall be piled on the abutting property, neatly and in an acceptable manner, or otherwise disposed of as required. No additional payment will be made to the contractor for the work described in this paragraph, but the cost thereof will be included in the unit prices per cubic yard bid for excavation and borrow.

196. Roadway excavation.—Roadway excavation shall include the removal and satisfactory disposal of all materials taken from within the limits of the roadway, necessary for the construction and preparation of the roadbed, embankment, subgrade slopes, side ditches, channel changes, surface ditches, intersections, approaches, private entrances, etc., as indicated and directed. All suitable materials removed from the excavation shall be used as far as practicable in the formation of the embankment, subgrade, shoulders, etc., and at such other places as directed. Unless otherwise directed by the contracting officer, all ledge rock encountered between gutters shall be excavated to a depth of six (6) inches below the surface of the roadway shown on the plans, and no material that would be classified as rock or stones which could not be passed through a 3-inch ring shall be left within six (6) inches of the finished earth surface. All breakages and slides shall be removed by the contractor and disposed of as directed. Ditches and waterways shall be excavated to the depth and width shown on the plans, or as may be indicated and directed by the contracting officer. No excavated mate-
197. Embankments.—Embankments shall be formed of suitable material placed as directed by the contracting officer for the full width of the cross section. Stumps, trees, rubbish, sod or any other unsuitable materials or substances shall not be placed in the embankment. When embankments are to be made on a hillside, the slope of the original ground on which the embankment is to be placed shall be ploughed deeply or cut into steps before the filling is commenced. Embankments shall be carried to such heights above grade and to such increased width as may be necessary to allow for shrinkage and compression, and they must be maintained by the contractor to their proper height, dimensions, and slope until the work is finally accepted. Material containing sand in such proportion as to prevent it, when dry, from compacting readily, shall not be used except on written approval. The contractor shall be responsible for the stability of all constructed embankments and shall replace any portions which, in the opinion of the contracting officer, have become displaced due to careless or negligent work on the part of the contractor, or to damage resulting from natural causes, such as storms, cloudbursts, etc., and not attributed to the unavoidable movement of the natural ground upon which the embankment is to be made.

198. Highway at right abutment of dam.—The construction of the highway in its final location adjacent to the right abutment of the dam can not be completed until the completion of this part of the dam. It will, therefore, be necessary and required that the contractor for the work under schedule 1 construct a detour, in addition to a portion of the permanent highway embankment in its final location. The construction of the detour and highway, or portion thereof, shall be as specified in paragraph 307, part 3 of these specifications, which shall apply also to the concrete cut-off wall to be constructed under the highway. The portion of the highway and the detour to be constructed under schedule 1 are shown on the highway drawings, but may be modified at any time as determined by the contracting officer. Payment for the portion of the highway adjacent to the right abutment of the dam constructed under schedule 1 will be made at the unit prices bid in schedule 1.

199. Borrow.—When the amount of the embankment exceeds the amount of the excavation within the limits of the roadway, sufficient suitable material shall be obtained by the contractor from borrow pits located beyond the limits of the roadway. This material shall be known as “borrow” and shall be of a satisfactory quality for the purpose for which it is required. Borrow shall include the excavation of the additional material necessary to complete the embankments, subgrade, shoulders, etc. Where the borrow pits are made along the embankment a berm of not less than four (4) feet in width shall be left between the toe of the slope of the embankment and the edge of the borrow pit. All borrow pits will be located by the contracting officer, and shall be excavated only to such a depth as will admit of their drainage through ditches constructed to the nearest natural outlet. Borrow pits will be furnished by the Government.

200. Disposal of surplus excavation material.—All excavated material not required in the embankment shall be used for widening the shoulders and other purposes if directed, or this material and all material not permitted in the embankment, shoulders, etc., shall be removed from within the limits of the roadway and deposited in waste banks at such point or points as directed by the contracting officer, or if no such point or points are designated the contractor shall find suitable dumping places for all such surplus material at his own expense and no over haul will be allowed for its disposal. No wasted material may be placed within the highway limits at an elevation higher than the grade of the road, nor shall any material be wasted in dedicated streets or in front of barn buildings except as specifically directed by the contracting officer. Both borrow pits and waste banks shall be left in such neat and presentable condition as would harmonize with the adjoining country.

201. Subgrade.—The bottom of the excavation and the top of the fill when completed shall be known as the subgrade and shall be true to the lines, grades, and cross section given. After all drains have been laid and the subgrade has been shaped correctly it shall be brought to a firm, unyielding surface by rolling the entire area with an approved three (3) wheel power roller weighing not less than ten (10) tons. All soft and yielding material and other portions of the subgrade which will not compact readily when rolled shall be removed as directed, and all loose rock or bowlders and all ledge rock encountered found in the earth excavation shall be removed or excavated to a depth of not less than six (6) inches below the surface of the subgrade. All holes or depressions made by the removal of material, as described above shall be filled with suitable material, and the whole surface compacted uniformly. In excavation, the ground shall not be plowed or disturbed below the surface of the subgrade except as specified herein. The requirements of this paragraph will be strictly enforced.

202. Protection of subgrade.—All ditches and drains shall be completed to drain the highway effectively before the placing of any construction material shall be permitted. In handling materials, tools, equipment, etc., the contractor shall protect the subgrade from damage by laying planks thereon when directed and shall take such other precautions as may be deemed necessary. In no case shall vehicles be allowed to travel in a
single track and form ruts. If ruts of two (2) inches or more in depth are formed, all construction materials shall be removed and the subgrade reshaped and rolled. At all times the subgrade shall be kept in such condition that it will drain readily and correctly. No foundation nor surfacing material shall be deposited on the subgrade until it has been checked and approved.

203. Shoulders.—Shoulders shall be constructed as part of the excavation and embankment unless otherwise specified, and shall include rolling to the required cross section shown on the plans or as directed by the contracting officer with a three (3) wheel power roller, weighing not less than ten (10) tons or a traction engine, field engine horse roller provided that the type used be weighted from five (5) to fifteen (15) tons as directed by the contracting officer. Material which contains weeds, sod, or other unsuitable substances or materials, which will not compact readily when rolled, shall not be used in constructing the shoulders.

204. Superelevation and widening.—The top of the finished subgrade of the roadway, from the curve or sideline to the center line shall be as shown on the typical cross sections of the plans, except at intersecting highways or wherever, to insure correct drainage, or for other reasons changes may be directed. On curves or at other places where deemed necessary the contractor will be required to build the roadway to a superelevated grade and, where deemed necessary by the contracting officer, to an extra width.

205. Method determining grading quantities—

Excavation.—Common and rock excavation will be measured in original position by the method of average end areas as shown by the lines and grades given.

Borrow.—Borrow will be measured in its original position by the cross-section method to ascertain the amount of material removed, except where it may be impracticable to do so. In such cases the cross-section notes of embankment prisms will be used, making a just and reasonable allowance for change in bulk, so that the quantities shall equal the excavation quantities as nearly as possible. Clearing, grubbing, and removing of other obstructions will not be measured but will be included in payment in the price bid for borrow. The contractor shall notify the contracting officer sufficiently in advance of the opening of any borrow pit, so that cross sections may be taken. Any material removed or excavated from borrow pits before such measurements have been taken shall not be paid for.

General.—The removal of timber of metal fences, buildings, and other obstructions will not be measured but will be included in the prices bid for excavation. The estimate of grading quantities shown on the plans is an approximation of the work to be done and, where necessary, final cross sections of the completed roadway will be taken to measure alteration in quantities due to line or grade changes, variation in classification of excavated materials, changes in drainage structures, and breakage or slides not attributable to carelessness on the part of the contractor, and which have been removed.

206. Free haul.—No payment will be made for hauling material when the length of haul does not exceed the limit of free haul, which shall be four hundred (400) feet (unless otherwise specified). Two points 400 feet apart shall be determined, one on each side of the neutral grade point, and so located that the included quantities of embankment and excavation shall be balanced.

207. Overhaul.—The distance between the center of gravity of the remaining mass of excavation and center of gravity of the resulting embankment, less 400 feet as above determined, shall be the length of the overhaul. All material shall be measured in excavation in computing overhaul.

208. Overhaul from borrow pits.—The length of overhaul on borrow material shall be determined as per paragraph 207. The quantity of borrow for computing overhaul shall be determined as per paragraph 205.

209. Basis of payment.—Payments for the foregoing work will be made as follows:

(a) Excavation.—All "roadway excavation," including excavation of all intersecting roadways, driveways, approaches, channel changes, and side ditches appertaining to the construction of the roadway, and all "excavation for structures," except where specifically stated otherwise, will be paid for at the contract unit price per cubic yard for excavation which price will include all clearing and grubbing, the removal, unless otherwise stated, of all structures and obstructions and all excavation within the limits of the highway, formation of the embankments, disposal of surplus materials, preparation of subgrade and shoulders and the furnishing of all equipment, tools, labor, and work incidental thereto. No additional compensation will be allowed for plowing or stepping hillside to receive embankments, or for scarifying below subgrade to form a horizontal surface of uniform density to serve as a foundation for a hard-surfaced road.

Overhaul and waste.—Nothing in these specifications or on plans is to be interpreted as preventing the contracting officer from requiring that excess excavation in reasonable quantities at any point be hauled to replace proposed borrow at another point without additional payment to the contractor except for overhaul.

(b) Borrow.—All borrow excavation taken from sources other than those within the limits of the work contracted for will be paid for at the contract unit prices per cubic yard of "borrow," measured as described in paragraph 205, which prices will include excavating, hauling (except overhaul), and placing the material and all equipment, tools, and labor incidental thereto. Wherever as shown on the drawings, or as provided in para-
graph 307 of these specifications, or as determined by the contracting officer, it is required to construct the highway embankment by spreading and rolling the material in eight (8) inch layers, payment for such construction will be made at the unit price per cubic yard bid for, "Borrow, common, spread and rolled in 8-inch layers."
The provisions of paragraph 303 shall govern the construction of this type of highway embankment.

(c) Overhaul.—When the length of the haul is 2,000 feet or less payments will be made at the contract unit price for overhaul measured in units of one (1) cubic yard hauled one hundred (100) feet and designated as one (1) station cubic yard. The length of haul will not exceed 2,000 feet.

210. Resetting miscellaneous public service and other structures.—Any structure or substructure damaged by the contractor during the prosecution of the work shall be replaced by him. All materials and debris falling into the interior of any structure shall be removed. Any structure displaced by the contractor after it has been reset by the owners or lessee shall be again reset by the contractor without compensation. Railway tracks shall be brought to the established line or grade by their owners or lessee. All structures and tracks shall be checked by the contracting officer before any materials or embankment are placed around or against them.

STRUCTURAL EXCAVATION

211. Description.—Excavation for structures shall consist of clearing the site for the proposed work, excavating materials of every nature for the foundation pits, backfilling the excavated areas, and disposing of surplus material, and shall include all pumping, bailing, draining, sheeting, bracing, etc., necessary for the proper execution of the work.

212. Clearing.—All trees and bushes on the site of the proposed work shall be grubbed out to a depth of six (6) inches below the surface. Any existing structure or bridge, including its foundations, shall be removed, unless otherwise specifically noted and all material in the structure or substructure not used for building a temporary crossing, or reserved as hereinafter provided, shall become the property of the contractor and be disposed of by him. The removal of any structure or any material in the substructure will be considered as excavation. Other structures and obstructions shall be removed as specifically provided or as the contracting officer directs.

213. Excavating.—The foundation pits shall be excavated according to the outlines of the footings as shown on the plans and shall be of sufficient size to permit the placing of the full widths and lengths of the footings shown with full horizontal beds. Rounded or undercut corners and edges of footings will not be permitted. In no case will any allowance be made for excavation outside of vertical planes 1 foot beyond near lines of footings. The excavations shall be carried to the elevations established by the contracting officer. The elevations shown on the plans are approximate only, and are for use in figuring quantities which are the basis for comparison of bids. The contractor shall notify the contracting officer a sufficient time in advance of the beginning of excavating for structures so that cross-sectional elevations and measurements may be taken from the existing ground. Any material removed or excavated before such measurements have been taken will not be paid for. Where rock bottom is secured the excavation shall be done in such a manner as to allow the solid rock to be exposed and prepared in horizontal beds for receiving the masonry. All loose and disintegrated rock and thin strata shall be removed. Where foundation piles are used the excavation of each pit shall be completed before the piles are driven. After driving is completed all loose and displaced material shall be removed, leaving a smooth solid bed to receive the masonry. For underwater work a suitable cofferdam shall be provided. The inside dimensions shall be sufficiently large to provide easy access to all parts of the foundation forms; and the cofferdam shall be constructed in such a manner that, so far as the cofferdam is concerned, the excavation may be unwatered. Unless otherwise ordered, all cofferdams, sheeting, and bracing shall be removed after serving their purpose.

214. Back filling.—After the masonry is in place the excavated area shall be back filled to an elevation slightly higher than the original surface to allow for settlement unless the contracting officer establishes a lower elevation. The filling shall consist of acceptable material free from wood or other organic matter, and shall be placed in horizontal layers not over 9 inches thick and be thoroughly compacted by flushing with water or ramming. Sloping sides of excavations adjacent to abutments or retaining walls shall be carried up by "stepping." Filling shall not be placed against green concrete and wedge-shaped sections of loose earth shall not be permitted to rest against walls or abutments. All drainage openings in the masonry shall be covered with at least 1 foot of large broken stone or clean coarse gravel while the filling is being placed.

215. Disposal of surplus.—All excavated material not used for back filling shall be disposed of as directed by the contracting officer. When suitable, this material will in general be placed on the approach fills, but material that is unsuitable or not required for this purpose shall be disposed of in such manner as not to impair the appearance or utility of either the roadway or waterway. In no case shall it be placed in the bed of the stream. The space under the structure and all adjacent area affected by the contractor's operations shall be cleaned up and left in such shape that drift will not collect or scour be induced.
216. Basis of payment.—Excavation for structures will be paid for at the contract unit price per cubic yard for structural excavation, which price will include all grubbing and clearing, backfilling; the disposal of all surplus structural excavation, in the construction of embankments and shoulders or wasted as the contracting officer may direct. No additional compensation will be allowed for cofferdams, bracing, shoring, pumping, or for other labor or material necessary on account of water.

GENERAL REQUIREMENTS FOR CONCRETE FOR STRUCTURES AND METHODS OF CONSTRUCTION

217. Description.—Concrete for structures shall be composed of Portland cement, water, fine and coarse aggregate, and reinforcing steel where indicated on the plans, as specified under “Reinforcement.” The proportions of fine and coarse aggregate specified may be varied slightly by the contracting officer in order to make concrete of maximum density, but the proportion of cement to total aggregate, each measured separately, shall not be changed. The concrete shall be deposited in such places and of the form and dimensions shown on the plans or as directed by the contracting officer. The concrete cut-off wall to be constructed under the highway adjacent to the upstream portion of the right abutment of the dam shall be constructed under the provisions of part 3 of these specifications, but payment will be made therefor at the unit price bid in Schedule 1.

218. Classes.—In general only three classes of concrete will be used. Special instructions requiring other classes of concrete, or requiring modifications in the materials used, will be provided by means of notes on the plans or special clauses in the specifications, or both, or by direction of the contracting officer.

(a) Class A concrete.—Class A concrete shall be composed of one (1) part Portland cement, two (2) parts fine aggregate, and four (4) parts coarse aggregate.

(b) Class B concrete.—Class B concrete shall be composed of one (1) part Portland cement, two and one-half (2½) parts fine aggregate, and five (5) parts coarse aggregate.

(c) Class C concrete.—Class C concrete shall be composed of one (1) part Portland cement, three (3) parts fine aggregate, and six (6) parts coarse aggregate.

Uses.—The class of concrete required for each part of the structure will generally be noted on the plans, and when not so indicated the following requirements shall govern:

(a) Class A concrete shall be used for superstructures, reinforced concrete, arch rings and concrete deposited in water.

(b) Class B concrete shall be used for all unreinforced concrete except footings.

(c) Class C concrete shall be used for unreinforced footings, except when deposited in water, or where otherwise indicated on the plans.

219. Portland cement.—The cement used for this work shall conform to the requirements of the United States Government Master Specification No. 1a (Bureau of Standards Circular No. 33) and will be furnished by the Government under the provisions of paragraph 22.

220. Water.—All water used in concrete shall be subject to the approval of the contracting officer and shall be reasonably clear, free from oil, acid, alkali, or vegetable substance, and neither brackish nor salty.

FINE AGGREGATE FOR CONCRETE (SAND)

221. Description.—The fine aggregate for concrete shall consist of sand conforming to the following requirements:

(a) Sand.—Sand shall consist of clean, hard, durable and uncoated grains, and shall be free from lumps, soft or flaky particles, salt, alkali, organic matter, loam or other deleterious substance.

(b) Grading.—Sand shall be well graded from coarse to fine and when tested by means of laboratory screens, and sieves shall meet the following requirements:

<table>
<thead>
<tr>
<th>Material</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passing a 1/4-inch sieve</td>
<td>100</td>
</tr>
<tr>
<td>Total passing a 20-mesh “standard” sieve</td>
<td>30 to 80</td>
</tr>
<tr>
<td>Total passing a 50-mesh “standard” sieve</td>
<td>Not more than 20</td>
</tr>
<tr>
<td>Passing a 100-mesh “standard” sieve</td>
<td>70</td>
</tr>
<tr>
<td>Weight removed by elutriation test</td>
<td>Not more than 3</td>
</tr>
</tbody>
</table>

(c) Strength.—Mortar composed of one (1) part, by weight, of Portland cement and three (3) parts, by weight, of sand, mixed and tested in accordance with methods described in United States Bureau of Standards Circular No. 33, shall have a tensile strength at the age of seven (7) and twenty-eight (28) days of not less than one hundred (100) per cent of that developed by mortar of the same proportions and consistency, made of the same cement and “standard” Ottawa sand.
222. Tests.—Preliminary acceptance samples shall be subjected to both seven (7) and twenty-eight (28) day tests and acceptance based thereon. During the progress of the work material will be accepted subject to seven (7) days tests.

223. Coarse aggregate for concrete.—The coarse aggregate for concrete shall consist of crushed stone or gravel free from soft, thin, elongated or laminated pieces, disintegrated stone, salt, alkali, vegetable or other deleterious matter.

(a) Crushed stone.—Crushed stone shall be obtained from clean, tough, durable rock having a French coefficient of wear of not less than eight (8).

(b) Gravel.—Gravel shall consist of clean, hard, durable and uncoated pebbles of high resistance to abrasion.

224. Sizes.—The aggregate shall be graded uniformly from the maximum size to pieces one-quarter (\(\frac{1}{4}\)) inch in diameter. The maximum size will generally be given on the plans, but if not given the following shall govern:

For class A concrete the aggregate shall all pass a screen having circular openings one and one-half (1\(\frac{1}{2}\)) inches in diameter, and for class B and class C concrete the aggregate shall all pass a screen having circular openings two and one-half (2\(\frac{1}{2}\)) inches in diameter.

For walls and slabs less than six (6) inches thick the maximum size screen openings shall be not more than one (1) inch in diameter.

225. Grading.—Coarse aggregates shall be well graded from the largest to the smallest pieces, and when tested by means of laboratory screens shall meet the following requirements:

<table>
<thead>
<tr>
<th>Percentages of coarse aggregate passing the various laboratory screens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum size of aggregate</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2(\frac{1}{2})</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1(\frac{1}{4})</td>
</tr>
<tr>
<td>1(\frac{3}{4})</td>
</tr>
<tr>
<td>(\frac{3}{4})</td>
</tr>
</tbody>
</table>

226. Samples and tests.—On large or important structures samples of concrete materials or of the concrete may be required for testing. If required, samples of concrete materials for testing purposes shall be supplied to the contracting officer free of charge. Material shall be delivered far enough in advance of using to allow the contracting officer to select sample and to forward them to the laboratory for testing. The laboratory will usually need at least 10 days for 7-day tests and 31 days for 28-day tests.

227. Strength.—Cylinders of concrete from these samples shall develop compressive strengths as follows:

<table>
<thead>
<tr>
<th>Crushing strength in pounds per square inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix</td>
</tr>
<tr>
<td>Strength per square inch:</td>
</tr>
<tr>
<td>Age, 7 days</td>
</tr>
<tr>
<td>Age, 28 days</td>
</tr>
</tbody>
</table>

If the specimens fail to fulfill the requirements for 7-day tests, but do fulfill the requirements for 28-day tests, the concrete may be accepted.

228. False work.—False work shall be built on good, firm foundation and shall be of sufficient strength to carry the loads without appreciable deformation. It shall be constructed with \(\frac{1}{2}\) inch camber for each foot of span, and, if necessary, wedges shall be kept driven as the weight of concrete is added so that the bottom of the slab will not drop below the lines shown on the plans. If appreciable settlement occurs in the false work,
the contracting officer shall stop the work and require a thorough remodeling to insure a first-class product. For continuous girders, arches having a span of over 50 feet, and large structures, and for trussed centers or other special means of support, detail drawings of the false work shall be submitted for approval.

229. Forms.—Forms shall be so designed and constructed that they may be removed without injuring the concrete. The material to be used in the forms for exposed surfaces shall be sized and dressed lumber, or metal in which all bolts and rivet heads are countersunk, so that in either case a plain smooth surface of the desired contour is obtained. Undressed lumber may be used for backing or other unexposed surfaces. The forms shall be built true to line and braced in a substantial and unyielding manner. They shall be mortar tight and if necessary to close cracks due to shrinkage, shall be thoroughly soaked with water. Forms for reentrant angles shall be chamfered and for corners shall be filleted. Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected and before any concrete shall be placed. The interior surfaces of the forms shall be adequately oiled, greased, or soaped to insure the nonadhesion of mortar. Form lumber which is to be used the second time shall be free from bulge or warp and shall be thoroughly cleaned. The form shall be inspected immediately preceding the placing of concrete, and bulging or warping shall be remedied and all dirt, sawdust, shavings or other débris within the forms shall be removed.

230. Measuring.—All materials shall be accurately measured by volume. The cement shall be measured as packed by the manufacturer, a sack containing not less than 94 pounds being considered one (1) cubic foot. Fine and coarse aggregate shall be measured loose. The contractor shall furnish and use an approved water measuring and discharging device, also boxes or pans of such dimensions as will give, when filled and struck, the exact volume of aggregate required for the class of concrete specified.

231. Consistency.—Sufficient water shall be used in mixing plain concrete to produce a mixture which will flatten and quake when deposited in place, but not enough to cause it to flow, and, in mixing concrete in which reinforcement is to be embedded, to produce a mixture which will flow sluggishly when worked and which at the same time can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In no case shall the quantity of water used be sufficient to cause the collection of a surplus in the forms.

232. Mixing conditions.—The concrete shall be mixed in the quantities required for immediate use and any which has developed initial set, or which does not reach the forms within thirty (30) minutes after the water has been added, shall not be used. Concrete when deposited shall have a temperature of not less than 40° F. nor more than 120° F. In freezing weather suitable means shall be provided for maintaining the concrete at a temperature of at least 50° F. for not less than 72 hours after placing, or until the concrete has thoroughly hardened. The methods of heating the materials and protecting the concrete shall be approved by the contracting officer. Salt, chemicals, or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing unless approved by the contracting officer.

233. Mixing.—Unless hand mixing is specifically permitted by the contracting officer, the mixing shall be done in a batch mixer of approved type which will insure the uniform distribution of the materials throughout the mass so that the mixture is uniform in color and smooth in appearance. The mixing shall continue for a minimum time of one and one-half (1½) minutes after all the ingredients are assembled in the drum, during which time the drum shall revolve at the speed for which it was designed, but shall make not less than 14 nor more than 20 revolutions per minute. The mixer shall be equipped with an attachment for automatically locking the discharging device so as to prevent the emptying of the mixer until all the materials have been mixed together for the minimum time required. The entire contents of the drum shall be discharged before any materials are placed therein for the succeeding batch.

234. Hand mixing.—When hand mixing is permitted it shall be done on a water-tight platform. The fine aggregate and cement shall first be mixed until a uniform color is attained and then spread over the mixing board in a thin layer. The coarse aggregate, which shall have been previously drenched, shall then be spread over the fine aggregate and cement in a uniform layer and the whole mass turned as the water is added. After the water has been added the mass shall be turned at least four (4) times, and more, if necessary, to make the mixture uniform in color and smooth in appearance. Hand-mixed batches shall not exceed one-half (½) cubic yard in volume.

235. Placing.—Concrete shall be placed in the forms immediately after mixing. It shall be so deposited that the aggregates are not separated. Dropping the concrete any considerable distance, depositing large quantities at any point and running or working it along the forms, or any other practice tending to cause segregation of the ingredients will not be allowed. The concrete shall be compacted by continuous tamping, spading, or slicing. Care shall be taken to fill every part of the forms, to work the coarser aggregate back from the face, and to force the concrete under and around the reinforcement without displacing it. Mass concrete shall be deposited in continuous horizontal layers and, whenever practicable, concrete in structures shall be deposited continuously for each monolithic section of the work.
Depositing in water.—Concrete shall be deposited in water only with the permission of the contracting officer and under his supervision. When depositing in water is allowed the concrete shall be carefully placed in the space in which it is to remain, in a compact mass by means of a tremie, bottom dump bucket, or other approved method that does not permit the concrete to fall through the water without adequate protection. The concrete shall not be disturbed after being deposited. No concrete shall be placed in running water, and forms which are not reasonably water-tight shall not be used for holding concrete deposited under water.

236. Freezing weather.—Concrete shall not be placed when freezing temperature prevails or threatens, except upon written permission from the contracting officer, which will not be granted until satisfactory provision has been made for protecting the work. Concrete placed under these conditions shall be thoroughly protected until set, and will not be accepted until after thirty (30) consecutive days, during which the temperature does not fall below 40°F.

237. Construction joints.—Wherever the work of placing concrete is delayed until the concrete shall have taken its initial set, the point of stopping shall be deemed a construction joint. So far as possible the location of construction joints shall be planned in advance and the placing of concrete carried continuously from joint to joint. These joints shall be perpendicular to the principal lines of stress, and in general located at points of minimum shear. Where dowels, reinforcing bars, or other adequate ties are not shown on the plans or required by the contracting officer, keys shall be made by embedding in the soft concrete, water-soaked beveled timbers of a size shown on the details, or as directed by the contracting officer. These shall be removed when the concrete has set. In resuming work the surface of the concrete previously placed shall be thoroughly cleaned be removing mortar until the coarse aggregate is exposed. The surface then shall be thoroughly washed with clean water and painted with neat cement mortar, after which the concreting may proceed. No concrete work shall be stopped or temporarily discontinued within 18 inches of the top of any finished surface unless such work is finished with a coping having a thickness less than 18 inches, in which case the joints shall be made at the under line of the coping.

238. Curing concrete.—Careful attention shall be given by the contractor to the proper curing of the concrete. Handrails, floors, and troweled surfaces shall be protected from the sun, and in drying weather the whole structure shall be kept wet for a period of one (1) week, or longer as shown on the drawings or as directed by the contracting officer. Concrete floor slabs may be covered with damp sand as soon as the concrete has taken hard set, and then shall be kept wet for one (1) week or longer as directed by the contracting officer. Other precautions to insure thorough curing of the concrete shall be taken by the contractor as directed by the contracting officer.

239. Removal of forms.—In order to make possible the obtaining of a satisfactory surface finish, forms or ornamental work, railings, parapets, and vertical surfaces that do not carry loads and which will be exposed in the finished work, shall be removed in not less than twelve (12) nor more than forty-eight (48) hours, depending upon weather conditions. Forms under slabs, beams, girders, and arches shall remain in place at least twenty-one (21) days in warm weather, and in cold weather at the discretion of the contracting officer. Forms shall always be removed from columns before removing shoring from beneath beams and girders, in order to determine the conditions of column concrete. No forms whatever shall be removed at any time without the consent of the contracting officer. Such consent shall not relieve the contractor of responsibility for the safety of the work. As soon as the forms are removed all rough places, holes, and porous spots shall be filled, and all bolts, wires, or other appliances used to hold the forms, and which pass through the concrete, shall be cut off or set back one-half ($\frac{1}{2}$) inch below the surface and the ends covered with cement mortar of the same mix as used in the body of the work.

240. Finishing concrete.—All concrete surfaces shall be reasonably true and even, free from stone pockets, excessive depressions or projections beyond the surface. The concrete bridge seats and tops of walls and curbs shall be brought flush with the finished top surface and generally struck off with a straightedge and floated. Unless otherwise specified, the forms of all ornamental work, railings, parapets, and all exposed vertical surfaces shall be removed as soon as safety of the work will permit (usually in not less than 12 nor more than 48 hours) and any small cavities filled with mortar of the same mix as used in the concrete. The surface finish of all exposed concrete shall be "spaded," "rubbred," or "tooled," as indicated on the plans, but when not so specifically indicated the contractor shall make a spade finish on unexposed surfaces and rubbed finish on all exposed surfaces. The spade finish shall be obtained by forcing a flat blade spade vertically down between the concrete and the form and then by pulling the top of the spade away from the form so that the mortar will, in all cases be on the finished surface. Rubbed finish shall be made by rubbing the surface, previously spaded, with a soft brick or block of wood while the concrete is still green or by rubbing with a block of carborundum after the concrete is set. Care should be taken to use plenty of water, either by dipping brick or block in water, or by throwing water on the concrete with a brush or broom. Tooled finish shall be made on the surface previously spaded, by cutting into the body of the concrete with a pointed tool or brush hammer as indicated.
241. Expansion joints.—Expansion and contraction of concrete structures shall be provided for as shown on the plans. For walls and long abutments, expansion joints shall be located at intervals not exceeding forty (40) feet for plain walls, nor eighty (80) feet for reinforced walls. To be considered reinforced, the longitudinal steel shall be at least equal to one-half (½) of one (1) per cent of the cross-sectional area of the wall. In parapets, railings, and other light work superimposed on heavy work, the expansion joints shall be placed at intervals not exceeding twenty (20) feet.

242. Basis of payment.—All concrete shall be classified as, and measured in accordance with, the dimensions shown on the plans unless changes are ordered by the contracting officer during construction. Payment will be made at the contract unit prices per cubic yard, for the several classes of concrete, complete in place, which price will include all materials (except those which will be furnished by the Government, as provided in paragraph 22) forms, false work, labor, including the construction of drainage and weep holes and placing of all pipes, conduits, anchors, bolts, grillage and expansion joints, tools, machinery, and work incidental thereto except that handling of reinforcement will be paid for as a separate item. No allowance will be made for cofferdams, pumping, braiding, etc., or for any material, labor, or work made necessary on account of water.

REINFORCEMENT FOR CONCRETE STRUCTURES

243. Description.—Concrete reinforcement shall consist of plain, round, or square bars, and shall have a net sectional area equivalent to the section of a plain bar of the size indicated on the drawing.

244. Material.—Unless otherwise specified or determined by the contracting officer reinforcing steel shall meet the requirements of the Standard Specifications for Billet Steel Concrete Reinforcement Bars of the American Society for Testing Materials (serial designation, A-15-14). Where purchased from warehouse in small lots reinforcement may, at the discretion of the contracting officer, be accepted subject to the bending test only.

245. Placing reinforcement.—All reinforcement, when placed, shall be free from mill scale, loose or thick rust, dirt, paint, oil, or grease and shall present a clean surface. When bending is required it shall be accurately done. All reinforcement shall be placed in the exact position shown on the plans or as directed by the contracting officer and shall be so securely held in position, by wiring to and blocking from the forms and wiring together at intersections, that it will not be displaced during the depositing and compacting of the concrete. Placing and fastening of reinforcement in each section of work shall be approved by the contracting officer before any concrete is deposited in the section.

246. Splicing bars.—Whenever it is necessary to splice reinforcement at points other than those shown on the plans, drawings showing the locations of the splices shall be submitted and approved. Splices shall be avoided at points of maximum stress; they shall, where possible, be staggered; and shall be designed to develop the strength of the bar. Where spliced by lapping, the bars shall be securely wired together and the lap shall be long enough to develop the strength of the bar without exceeding a bond stress of 80 pounds per square inch for plain bars or 100 pounds per square inch for bars having a mechanical bond.

247. Basis of payment.—Placing of reinforcement will be paid for at the contract price per pound bid therefor, which price shall include placing the material, and all tools, labor, equipment, and all work incidental thereto. No allowance will be made for clips, wire, or other material used for fastening reinforcement in place. Reinforcement bars will be furnished by the Government.

PIPE CULVERTS

248. Description.—These culverts shall consist of sections of corrugated metal, or reinforced concrete, of the kind and diameter shown on the plans, laid on a firm bed true to line and grade in accordance with these specifications. Both inlet and outlet ends of pipe culverts unless otherwise specified shall be protected by masonry or concrete headwalls constructed in accordance with the designs shown on the plans and in accordance with the specifications.

249. Corrugated metal pipe.—This pipe will be furnished by the Government as provided in paragraph 22. Culvert pipe shall be properly fabricated from the corrugated galvanized sheets of iron or steel and each culvert shall be made of the same kind and quality of metal throughout. The sheets of metal before galvanizing shall be smooth and free from blisters, seams, and pits. All joints shall be even and close, and the jointed pipe shall be straight, circular in sections, true, and rigid. In the longitudinal joints rivets shall be driven in the valley of each corrugation, and in the transverse joints rivets shall be uniformly spaced not more than six (6) inches apart. The rivets shall be driven in such a manner as to draw the sheets tightly together and to fill the rivet holes completely. The rivets shall be at least one (1) inch from the edge of the sheets. All rivets shall be of the same quality of metal as the sheets in which they are used. They shall be thoroughly galvanized and shall be not less than five-sixteenths (5/16) inch in diameter, and shall have neat, workmanlike, semispherical or flat heads. The heads shall have a diameter of not less than one and five-
tenths (1.5) times the diameter of the rivet, plus one-eighth (1/8) of an inch and all flat heads shall have a thickness of not less than six tenths (0.6) of the diameter of the rivet. All pipe shall be furnished in the lengths ordered, except that pipe for culverts twenty-six (26) feet or more in length may be furnished in sections not less than twelve (12) feet in length, provided necessary field connections are furnished free of any charge. The connections shall consist of bands not less than seven and one-half (7 1/2) inches in width, made from the same material as the pipe, and so fabricated that a secure and firm connection of the sections of the pipe may be readily made in the field. The diameter of the metal pipe shall be understood to mean the clear diameter. Galvanizing: The galvanizing shall consist of not less than two (2) ounces of prime spelter per square foot of double exposed surface. It shall be applied in such a manner that the spelter will not peel off during fabrication or in transporting and laying the pipe and any uncoated spots due to poor workmanship, rough handling, or any other reason, shall be sufficient cause for rejecting the pipe. The amount of spelter per square foot will be determined by the lead acetate method upon a sample taken from the culvert. Corrugations: The corrugation shall be not less than two and one-half (2 1/2) inches and not more than three (3) inches from crest to crest and shall have a depth of not less than one-half (1/2) and not more than five-eighths (5/8) inch. Gauges of metal: Corrugated metal culverts shall be made of sheets of the following thickness, United States Standard Gauge Measures:

Pipe from 12 to 20 inches shall be not less than 16 gauge.
Pipe from 24 to 42 inches shall be not less than 14 gauge.
Pipe from 48 to 60 inches shall be not less than 12 gauge.

The corrugated metal pipe shall conform to the following base metal requirements:

Class A—Iron. — The total amount of carbon, phosphorus, sulphur, manganese, and silicon shall not exceed 0.16 of 1 per cent. The sulphur content shall not exceed 0.04 of 1 per cent. The presence of copper is optional.
Class B—Iron. — The total amount of carbon, phosphorus, sulphur, manganese, and silicon shall not exceed 0.25 of 1 per cent. The sulphur content shall not exceed 0.04 of 1 per cent. The presence of copper is optional.
Class C—Steel. — The total amount of carbon, phosphorus, sulphur, manganese, and silicon shall not exceed 0.07 of 1 per cent. The metal shall contain not more than 0.06 of 1 per cent of sulphur nor more than 0.04 of 1 per cent of phosphorus, and must contain at least 0.20 of 1 per cent of copper.

When required by the contracting officer, the contractor or manufacturer shall furnish a certified correct copy of the analysis of the base metal used in the manufacture of the steel. A check analysis may be made from the finished material by the contracting officer.

The arrangement of the above classes does not in any way indicate a preference for any particular grade of base metal; all are considered competitive.

250. Reinforced concrete pipe.—Reinforced concrete culvert pipe shall be of the tongue and groove type as shown on the drawings. Each section of pipe shall be straight and of true circular form. It shall have an uniform thickness throughout and shall be free from porous and seamy spots and spalled edges and any imperfection that may impair its strength. Pipes having defective spots patched or plastered over will not be accepted.
Pipe shall be not less than three (3) feet in length and not more than eight (8) feet in length.
(a) Design.—The dimensions of the different parts of the pipe and weight of steel reinforcement shall not be less than shown for highway culverts type 3 on drawing No. 179–D–53.
(b) Materials.—Materials used shall meet the requirements described herein for class A concrete. Coarse aggregate shall be of such a size that it will pass a revolving screen having three-fourths (3/4) inch circular openings, and be retained on a screen having one-fourth (1/4) inch circular openings. The mixture shall be composed of 1 part by volume of cement and 4 parts fine and coarse aggregate combined in such proportions as to produce a concrete of maximum density. The reinforcement shall consist of woven wire mesh, expanded metal, rods, hoops, spiral or other forms adopted by the manufacturer and approved by the contracting officer, and shall extend into the bell of the pipe.
(c) Strength.—When tested by the 3-point method of applying load in the crushing test as described in U. S. D. A. Bulletin 1216, pipe must show no crack under a load of 1,000 D where D is the inside diameter of the barrel in feet, and shall develop an ultimate strength of 1,500 D.
(d) Absorption.—When tested according to Bulletin 1216, shall not exceed 8 per cent by weight.

251. Forming bed for pipe.—When the pipe is to be laid below the ground line a trench shall be excavated to the required depth, and the bottom of the trench shall be shaped to conform to the bottom of the pipe and shall afford a uniformly firm bed throughout the entire length, and recesses shall be excavated to receive the hubs. Where rock is encountered the trench shall be excavated four (4) inches below the bottom of the pipe and this excess depth shall be refilled with suitable material, which shall be tamped thoroughly. Any soft or yielding material shall be removed and replaced with other suitable material, which shall be tamped thoroughly in place. Where the pipe is not laid in a trench, a uniformly firm bed shall be made as herein specified, for the bottom of the trench.
252. Laying pipe.—The pipe shall be laid carefully, groove ends upgrade, tongue ends fully entered into the adjacent hubs, and true to lines and grades given. All reinforced concrete pipe shall be laid with cemented joints. Before succeeding sections of pipe are laid the lower portion of the groove of the preceding pipe shall be cleaned and plastered on the inside with cement mortar of sufficient thickness to bring the inner surfaces of the abutting pipes flush and even. After the pipe is laid the remainder of the joint shall be filled with similar material, and sufficient additional material shall be used to form a bead around the joint. The inside of the joint shall be wiped and finished smooth. After initial set the cement on the outside shall be protected from the air and sun with an earth covering. When corrugated metal pipe sections are joined on the work the ends shall be butted together and the sections jointed with a band, made of the same material as the pipe, of sufficient width to lap at least one (1) full corrugation on either side of the joint, which band shall be bolted firmly in place. The rivets shall be of the same material as that used in the manufacture of the pipe and shall be painted with red lead or other approved material. Any pipe which is not in true alignment or which shows any settlement after laying shall be taken up and relaid without extra compensation.

253. Refilling around pipe.—The filling around the pipe shall be made in layers with approved material free from rock and each layer shall be tamped thoroughly around and over the pipe.

254. Basis of payment.—The hauling and placing of pipe culverts will be paid for at the contract unit price per linear foot indicated in the contract for "Corrugated Metal Pipe" or "Reinforced Concrete Pipe," as the case may be, complete in place. Measurement for payment will be made of the pipe in place, no allowance being made for the lap at joints. The price will include all materials (except pipe, cement, and reinforcement) equipment, tools, labor and work incidental thereto, including excavation, together with all refilling and disposal of surplus material. No additional compensation will be allowed for excavation necessary for pipe culvert head walls or for back filling the same. Concrete pipe will be furnished by the Government as provided in paragraph 22, either f. o. b. cars at the railroad destination or the unloading point on the railroad most convenient to the work or at a manufacturing plant in the vicinity of the work: Provided, That in the event the contractor is required to haul the pipe from a point at a distance in excess of 1 mile from the nearest point on the relocated highway covered by the contract, such excess haul will be paid for as extra work. The contractor will be held responsible for the breakage of all pipe after delivery to him and will be required to replace or repair all broken pipe as directed by the contracting officer.

WOOD GUARDRAIL.

255. Description.—Railing shall consist of wood railings supported by wooden posts erected where indicated or directed by the contracting officer in accordance with these specifications.

256. Wooden posts.—The wooden posts shall be of well-seasoned, straight, sound Douglas fir, or other approved wood, free from loose or unsound knots or other defects and shall be surfaced on all sides, and shall be 8 inches wide by 8 inches thick.

(a) Treatment of posts.—Lower portion of all posts shall be coated with creosote oil before being set. The creosote shall be applied by means of a brush, in a full free coating, covering the bottom end and extending up the sides for a distance of three (3) feet eight (8) inches. The posts shall not be treated until thoroughly dry.

257. Wooden rail.—The wooden rail shall be made of well-seasoned, straight, sound Douglas fir or other approved wood, free from loose or unsound knots or other defects and shall be surfaced on all sides. The rail shall be eight (8) inches wide by three (3) inches thick, and shall be in lengths of ten (10) feet on tangents and eight (8) feet on curves.

258. Construction methods.—The guardrail or fencing shall be constructed in accordance with the standard plan. The posts shall be set plumb in straight lines, spaced ten (10) feet apart on centers on tangent, and eight (8) feet apart on centers on curves, three (3) feet in the ground and two (2) feet above the ground and to lines and grades given. The side rail shall be fastened securely to each post, as shown on the plan. All joints of the fence shall be painted before being fastened together, and after erecting the entire fence shall be painted with two coats of first quality white lead paint approved by the contracting officer, which shall be brushed in thoroughly.

259. Basis of payment.—This work will be paid for at the contract unit price per linear foot for constructing and painting wood guard railing, complete in place, which price will include all equipment, tools, labor, and work incidental thereto, also all excavation, painting, refilling, tamping, and disposal of surplus material. All lumber, paint, creosote, and boat spikes will be furnished by the Government.
STANDARD HIGHWAY FENCE

260. Description.—Standard highway fence shall consist of woven-wire fabric and wood railings suitably supported by wooden posts.

261. Wooden posts.—Wooden posts shall be of well seasoned, straight, sound, Douglas fir or other approved wood, free from loose or unsound knots or other defects, and shall be 8 inches wide by 8 inches thick by 8 feet long. The lower portion of all posts shall be coated with creosote oil before being set. The creosote shall be applied by means of a brush in a full free coating, covering the bottom end and extending up the sides for a distance of three (3) feet eight (8) inches. The posts shall not be treated until thoroughly dry.

262. Wooden rails.—Wooden rails shall be made of well seasoned, straight, sound Douglas fir or other approved wood, free from loose or unsound knots or other defects, and shall be surfaced on all sides. The rails shall be eight (8) inches wide by three (3) inches thick and shall be in lengths of sixteen (16) feet. There shall be 3 wooden rails spaced as shown on the drawing.

263. Woven-wire fabric.—Woven-wire fabric shall consist of a standard 32-inch galvanized hog-wire fence with the top and bottom wires to be of minimum diameter No. 10 gauge and the intermediate wires and stays a minimum diameter of No. 12½ gauge. The stays shall have a maximum spacing of 12 inches. The maximum distance between the bottom bars shall be 3 inches for a minimum of 8 bars. Woven-wire fabric shall be shipped in 330-foot rolls, tightly rolled and firmly tied.

264. White paint.—Paint.—The material for painting the posts after erection shall be composed of from sixty-five (65) to seventy (70) per cent, by weight, of pigment in paste form and from thirty-five (35) to thirty (30) per cent of vehicle, or sixty (60) to sixty-five (65) per cent, by weight, of dry pigment.

Pigment.—The pigment shall be composed of not less than sixty-five (65) per cent of pure white carbonate of lead and not less than twenty (20) per cent of pure white zine oxide, all finely ground. Not more than fifteen (15) per cent of inert shall be permitted.

Vehicle.—The vehicle shall be composed of not less than ninety (90) per cent of pure raw linseed oil and sufficient first quality japan or other approved drier to cause the applied paint to dry in approximately three (3) days, but in no case shall the drier exceed ten (10) per cent.

265. Staples.—One-inch galvanized staples shall be used.

266. Erection.—Standard highway fence shall be erected in accordance with drawing No. J-342. The posts shall be set plumb in straight lines, spaced eight (8) feet apart to lines and grades given. The woven wire shall be secured to the posts on the side of post facing road with 5 galvanized staples in each post, 1 staple on top of fabric and 1 at bottom and 3 evenly spaced between top and bottom staples. The bottom edge of the woven-wire fabric shall be flush with the ground line.

267. Basis of payment.—Payment will be made at the contract price per linear foot for constructing and painting standard highway fence complete in place, which price shall include all labor, materials not specified as furnished, tools and equipment incidental thereto; also all excavation, refilling and disposal of surplus material. Woven wire, paint, creosote, posts, wooden rails, bolts, and staples will be furnished by the Government.

EXPANSION UNITS

268. Description, etc.—These shall be of the standard type, the plates to be of cast steel, and of the sizes and dimensions shown on drawing No. D-256. The bearing surfaces are to be planed in direction of expansion. All finished surfaces are to be coated with a mixture of white lead and tallow before leaving the foundry. Materials shall be cast steel which shall meet the Standard Specifications for Steel Castings (Serial No. A-27-21) of the American Society for Testing Materials, or any subsequent additions or amendments thereto. Immediately before placing in the structure all machined surfaces shall be thoroughly cleaned, and all surfaces not machined shall receive one coat of red lead paint, followed, when dry, by one coat of black rust-resistant paint.

269. Basis of payment.—Plates, rollers, bolts, nuts, and paint for the expansion units will be furnished by the Government. All other materials, including elasteite and tar felt, tools, equipment, and labor shall be furnished by the contractor, the cost of which shall be included in the lump-sum bid price per unit, which is for installing the unit complete in place according to the drawings and these specifications.

PIPE RAILING WITH CONCRETE POSTS

270. Description.—Pipe railing with concrete posts for bridges, wing walls, retaining wall, etc., shall consist of the materials herein designated, erected above the top of the curb for the protection of traffic.

271. Materials.—(a) Concrete posts shall consist of class A concrete as specified under "General Requirements for Concrete for Structures and Methods of Construction," except that the coarse aggregate shall all
pass a revolving screen having circular openings 3/4 inch in diameter. (b) Pipe railings shall consist of standard black or galvanized iron or steel pipe of the size designated.

272. Construction methods.—Concrete posts shall be cast in place, and the reinforcement shall be carried into the curb to provide sufficient anchorage. The placing, curing, and finishing of concrete shall conform to the specifications hereinbefore given under "General Requirements for Concrete for Structures and Methods of Construction." The ends of pipe railing shall be separated by at least one (1) inch and shall be wrapped with two (2) layers of roofing felt to provide for all necessary expansion. After erection, the pipe railing shall be painted with two (2) coats of approved paint.

273. Basis of payment.—The above work shall be included in and paid for at the contract unit price per linear foot for "pipe railing" complete in place, which price per linear foot shall include all labor, materials not specified as furnished, tools, and equipment incidental thereto. Pipe and paint will be furnished by the Government. Reinforced concrete posts shall be paid for at bid price per cubic yard under item 16 of Schedule 1.
DETAIL SPECIFICATIONS, PART 3

For the construction of Echo Dam, spillway, and appurtenant works

SPECIAL CONDITIONS

274. The requirement.—It is required that the Echo Dam, spillway, and appurtenant works be constructed and completed in accordance with these specifications and drawings as called for in the accompanying schedule.

275. Description.—The Echo Dam will be constructed across the Weber River near the town of Echo, Utah. It will store water for the Salt Lake Basin irrigation project. The main body of the dam will consist of an embankment of clay, sand, and gravel, sprinkled and rolled. The upstream face will be covered with conglomerate riprap, and the downstream face will be covered with gravel and cobbles. The dam will have a length of about 1,800 feet and its crest will be about 125 feet in elevation above the present stream bed. A concrete lined tunnel will be constructed in the conglomerate rock of the left abutment through which the river will be diverted during the construction of the embankment and in which the outlet works will be installed. The outlet works will consist of the trash-rack structure at the upstream end of the tunnel, hydraulically operated slide gates placed about midway between the ends of the tunnel, twin steel pressure pipes from the slide gates to the tunnel outlet and 2 balanced needle valves at the outlet end of the tunnel. The spillway will be an open concrete lined channel adjacent to the dam in the left abutment controlled by 4 radial gates and discharging into an excavated channel to the river. The Lincoln Highway and the Park City branch of the Union Pacific Railway now pass across the dam site and through the reservoir site. These will be moved to new locations in general parallel to each other and above the reservoir past the right abutment of the dam and along the northerly side of the reservoir. The construction of the relocated railway and highway grading and structures is included in Schedule 1 and the detail specifications covering this work are given under parts 1 and 2 of these specifications.

276. Drawings.—The drawings, Nos. 1, 2, 6, 14, and 25 to 48, inclusive, which are listed with their titles in paragraph 15, apply wholly or in part to the construction of the dam. Drawings Nos. 25 to 48, inclusive, show the approximate dimensions, shape, and general arrangement of all features of the dam, spillway, and outlet works. Additional drawings showing the details of the work and the exact location of reinforcing steel, structural steel, and other metal work will be furnished to the contractor as required.

277. Materials furnished by the Government.—All cement, powdered admixtures if used, reinforcing steel (but not including tie wire), structural steel, the gantry crane for the needle-valve house, gates, valves, machinery, pipe, metal work (but not including anchors for concrete forms), lumber (but not including lumber for concrete forms, shoring or tunnel or shaft timbering), nails larger than 20d in size, roofing tile, windows, doors, wire mesh, expansion-joint materials, light posts, electric wire, conduits, apparatus and fixtures, tar paper for cradle seats of outlet pipes, and paint required in the finished structures included in this contract will be furnished to the contractor by the Government. These materials will be delivered to the contractor f. o. b. cars at the railway station or the unloading point most convenient to the work. The contractor shall haul all materials from the point of delivery to the work. The contractor shall provide suitable warehouses or other protection satisfactory to the contracting officer for storing materials and will be charged for any material lost or damaged after delivery to him. Except as otherwise provided for cement, materials furnished by the Government may be delivered to the contractor at any time after the date specified for the commencement of work that the interests of the Government may render desirable, and the contractor shall not be entitled to any increased compensation due to the order or time of delivery of any such material. All material delivered to the contractor shall be subject to inspection and inventory by the contracting officer at any time and the amount of any damage occurring to such material after delivery to the contractor or the cost to the Government of any such material not promptly accounted for by the contractor upon demand and to the satisfaction of the contracting officer will be charged to the contractor and deducted from any payments due to the contractor. The Government reserves the right to require the contractor to provide ample and suitable warehouses, satisfactory to the contracting officer, on the work and to properly store therein any material and machinery delivered by the Government and not yet used in the work whenever, in the opinion of the contracting officer, such warehouses are necessary for the proper care of Government materials. Should the contractor fail to provide any such suitable warehouse and to store the material therein as specified promptly upon the order of the contracting officer the Government will provide the warehouse and place the material to be protected therein and the entire cost thereof will be...
charged to the contractor. The contractor will not be relieved of any responsibility for the care and value of the material by any action of the Government as provided in this paragraph. The contractor shall return to the Government all unused material and will be charged for any material not used and not returned the same amounts that the material cost the Government at the point of delivery to the contractor. When material is furnished to the contractor on cars the contractor shall be responsible for the prompt unloading of such material and will be liable for any demurrage charges which may be incurred by failure to unload the material promptly. The cost of unloading, hauling, storing, and caring for materials furnished by the Government shall be included in the unit prices bid for the work in which the materials are to be used.

278. Sand and gravel pits and quarries. — All clay, sand, gravel, cobbles, and quarried rock required in the construction of the embankment and the appurtenant works shall be taken from required excavations or shall be secured and furnished by the contractor from pits or quarries approved by the contracting officer. Pits and quarries may be located at points approved by the contracting officer, on the property of the Government or on withdrawn public lands in the vicinity of the work, or they may be located upon private lands at the option of the contractor. The contractor shall carefully clear the sites of all pits and quarries of trees, roots, brush, sod, loam, and other objectionable matter and shall develop and maintain the pits and quarries in a condition suitable for the excavation of the required materials. The contractor will not be required to make any payment to the Government for the privilege of taking materials from pits and quarries located on the property of the Government or on withdrawn public lands. Any royalties or other payments required to be made for materials taken from pits or quarries located elsewhere than on the property of the Government or on withdrawn public land, shall be made by the contractor. Pits and quarries shall be so located and operated as not to mar the usefulness or appearance of any parts of the work or of any other property of the Government, and surfaces shall be left in a reasonably smooth and even condition. The contracting officer's approval of the location of pits and quarries shall not be construed as the approval of all the materials coming from them. Material excavated from pits or quarries for embankment construction or backfill will be measured and paid for as described in paragraph 290. The stripping of pits and quarries required for such material will be paid for as material wasted as provided in paragraph 290 (c). All the cost of other material taken from pits or quarries, such as concrete aggregates, will be included in the prices bid for the work in which the material is used.

279. Right to change location and plans. — When additional information regarding foundation conditions becomes available as a result of the excavation work or of further test drilling, it may be found desirable to change the location, alignment, dimensions, or design of the dam, spillway, or appurtenant works, to take advantage of natural conditions. The Government reserves the right to make such reasonable changes as may be considered necessary or desirable, and the contractor shall be entitled to no extra compensation because of such changes, except that any increase in the amount of excavation, concrete, or other work required, will be paid for at the unit prices bid in the schedule. The contractor's plant shall be laid out to accommodate any reasonable change in the location or design of the dam or spillway or any part thereof without additional cost to the Government.

280. Foundation test-drilling records. — The drawings included with these specifications show the available record of the foundation test pits and test drilling that has been done at the dam site. The Government does not guarantee any interpretation of these records. The contractor must assume all responsibility for deductions and conclusions as to the nature of the rock or other materials to be excavated and the difficulties of making and maintaining the required excavations and of final preparation of the foundation for the dam, cut-off trenches and other structures.

281. Timber for use of contractor. — Any available timber required by the contractor for construction purposes or for fuel may be cut from the area to be flooded by the reservoir. The areas from which such timber may be cut shall be subject to the approval of the contracting officer and all brush, logs, branches, or tree trimmings cut by the contractor and not used shall be burned or disposed of by the contractor to the satisfaction of the contracting officer. No timber shall be cut on the property of the Government or on withdrawn public lands outside of the area to be flooded by the reservoir without specific authority of the contracting officer.

282. Camp site. — The contractor will be permitted to use for construction camp purposes any land in the vicinity of the work but outside of the area to be flooded by the reservoir that is the property of the Government: Provided, That such use shall not interfere with any part of the work or of work of other contractors in the vicinity. If private land is used by the contractor for camp purposes, the contractor shall make the necessary arrangements with the owner and pay all rentals or other costs connected therewith. The location, construction, maintenance, operation and removal of the contractor's camp shall be subject to the approval of the contracting officer.

283. Availability of electric energy. — An electric power transmission line of the Utah Power & Light Co. crosses the proposed dam site. This company has expressed its willingness to furnish electrical energy for construction purposes at the dam site, but the charge to be made for this energy is not known. If this energy is
used, the contractor will have to make all necessary arrangements with the power company for it. Changes in
the existing power-transmission line, rendered necessary by the construction of the dam and related works or by
the necessary operations of the contractor in approved borrow pits, will be cared for by the Government.

CONSTRUCTION

284. Construction program.—The construction program shall at all times be subject to the approval of the
contracting officer. The capacity of the construction plant, sequence of operations, and method of operation
shall be such as to insure the completion of the work within the time of completion specified. The relocated
railroad and highway must be completed ready for traffic before the present locations are abandoned. It will
be necessary for the tunnel to be completed and made ready for the diversion of the river before cofferdams for
the main dam can be safely constructed. The spillway structures may be constructed at any time. However,
suitable material is not excavated for the construction of cofferdams for the river before the dam can be safely
constructed. The spillway structures may be constructed at any time. However, the suitable material from
the excavation of these structures will be required for the dam and this material shall, in so far as practicable, be
moved directly from its position in the cut to its final position in the dam.

285. Diversion and care of river and unwatering of foundations.—The contractor shall construct and
maintain all necessary cofferdams, flumes, or other protective works, shall furnish all material required, and
shall install, maintain, and operate all necessary pumping and other equipment for unwatering the site of the
work, and for maintaining the foundation, cut-off trenches, and tunnel free from water during the time required
for constructing the lower part of the structure. The contractor shall be responsible for and shall repair at the
contractor's expense any damage to the dam, tunnel, or other parts of the works caused by floods or failure of
any part of the protective works. After having served their purpose, the cofferdams shall be removed or leveled
to give a slightly appearance, so as to not interfere in any way with the operation or usefulness of the reservoir
and in a manner satisfactory to the contracting officer. The contractor shall not interfere with the natural or
required flow of water for irrigation or power purposes past the dam without the approval of the contracting
officer, and he shall make proper provision for the passage of water during the time when gates, valves, and
pipes are being installed in the tunnel. The cost of all work described in this paragraph shall be included in the
lump-sum price bid in the schedule for diversion and care of river during construction and unwatering foundations.

286. Clearing and grubbing dam site.—Such portions of the dam site as are designated by the contracting
officer shall be cleared of all trees, stumps, roots, and brush. The clearing shall be done in a thorough manner,
and the trees, stumps, brush, or other combustible material shall be burned or otherwise disposed of in a manner
satisfactory to the contracting officer. The entire area covered by the embankment will not require clearing
and grubbing, as described in this paragraph, and such light growth of brush or scattered trees as are required
to be removed over the area not to be cleared and grubbed will be removed as a part of the work of "stripping
for embankment." Clearing and grubbing as described in this paragraph will be paid for at the unit price per
acre bid in the schedule, which price shall include the cost of all work required in removing and disposing of the
materials.

287. Stripping for embankment.—The entire base under the embankment shall be cleared of all rubbish,
brush, and such scattered trees, stumps, and roots as have not been removed in clearing and grubbing, also all
other perishable or objectionable material. These materials shall be burned or otherwise disposed of as directed
by the contracting officer. This area shall then be stripped or excavated to sufficient depth to remove all material
not suitable for use in the embankment. This material shall be wasted or otherwise disposed of as directed by
the contracting officer. Payment for stripping shall be made at the unit price per cubic yard bid therefor in
the schedule. The unit price bid shall include the cost of all work described in this paragraph. The volume of
stripping shall be measured in excavation to the neat lines as prescribed by the contracting officer.

288. Plowing dam foundation.—After stripping, the entire foundation of the dam shall be scored with a
plow making open furrows not less than 5 inches deep at intervals of not more than 3 feet. The entire cost of
this work will be paid for at the lump-sum price bid therefor in the schedule.

EARTHWORK

289. Classification of excavation.—Except as otherwise provided, materials moved in excavation will be
classified for payment as follows:

Solid rock.—Solid rock shall include all ledge rock in place that can not be loosened except by wedging,
barring, or blasting, and all detached masses of solid rock more than 10 cubic feet in volume.

Earth and gravel.—All materials required to be excavated except solid rock shall be classified as earth and
gravel.

No additional allowance above the prices bid for the above classes of material will be made on account of
any of the material being wet or frozen. It is desired that the contractor be present or represented during the
measurement of material excavated. On written request of the contractor, made within 10 days after the receipt
of any monthly estimate, a statement of the quantities and classifications between successive stations included
in said estimate will be furnished by the Government within 10 days after the receipt of such request. This statement will be considered as satisfactory to the contractor unless specific written objections thereto with reasons therefor are filed with the contracting officer within 10 days after receipt by the contractor of said statement. Failure to file such written objections with reasons therefor within said 10 days shall be considered a waiver of all claims based on alleged erroneous estimates of quantities or incorrect classifications of materials for the work covered by such statement.

290. Measurement of and payment for excavation and embankment.—All excavation for the dam or structures shall be measured to the neat lines shown on the drawings, described in the specifications, or established by the contracting officer. Measurement and payment for the various items of excavation, classified in accordance with paragraph 289, will be made as follows:

(a) All material excavated from the tunnel and shaft, stripping for the base of the dam, stope excavation, and excavation from trenches with vertical sides for the upstream cut-off and all solid rock excavation for any part of the dam or related works or from approved borrow pits will be measured for payment in excavation and paid for at the corresponding unit prices bid in the schedule.

(b) All earth and gravel, not included in the above, excavated for any part of the dam or related works or from approved borrow pits and used in the construction of the dam will be measured for payment in place in the dam after being compacted, if required, and payment therefor will be made at the unit prices bid in the schedule for the portion of the dam in which it is deposited, which prices shall include all the cost of excavating the material and placing it in the dam as specified.

(c) Earth and gravel excavated for any part of the dam or related works or for the stripping of pits and quarries, and wasted by direction of the contracting officer, except that specified under (a), will be measured for payment in the waste bank, and payment therefor will be made at the unit price bid in the schedule for "Embarkment, clay, sand, and gravel portion," less $0.10 per cubic yard to adjust for the difference in cost of wasting the material and of placing it in the embankment as specified.

No payment will be made for the rehandling of any excavated material unless such rehandling is ordered in writing by the contracting officer. When so ordered, the rehandling shall be done by the contractor and payment therefor will be as extra work under the provisions of article 5 of the contract and paragraph 10 of these specifications. All material excavated will be measured for payment either in excavation or embankment as outlined in this paragraph, but in no case will the handling of any material be paid for as excavation and again as embankment.

EXCAVATION

291. Excavation of trench for drain tile at downstream toe of dam.—A small trench shall be excavated at the downstream toe of the dam as shown on the drawings or as directed by the contracting officer. All excavated material from this trench, which is suitable, in the opinion of the contracting officer, shall be placed in the main embankment. Other excavated material not suitable for use in the embankment shall be wasted in a manner approved by the contracting officer. The excavation required by this paragraph will be measured and paid for as outlined in paragraph 290.

292. Tunnel and shaft excavation.—A tunnel for the diversion and care of the river during construction and to contain the outlet control works for the delivery of irrigation water shall be excavated in the left abutment, as shown on the drawings or directed by the contracting officer. A vertical shaft leading from the emergency gate chamber to the remote control house shall also be excavated, as shown. The tunnel and shaft shall in all cases be excavated in such a manner and to such dimensions as will give suitable room for any necessary timbering, lining, ventilating, pumping, and drainage. The contractor shall use every reasonable precaution to avoid excavating beyond the outside lines of permanent timbering and beyond the outside neat concrete lines where no permanent timbering is required. All drilling and blasting shall be carefully and skillfully done so as not to shatter the material outside of the neat lines. Any blasting that would injure the work will not be permitted, and any damage done to the work by blasting shall be repaired by the contractor at his expense and in a manner satisfactory to the contracting officer. No projecting rock or permanent timbering shall encroach closer than 8 inches to the face of the finished surface of the concrete lining. Payment for tunnel, emergency gate structure, and shaft excavation will be made at the unit price per cubic yard bid in the schedule. Measurement will be made to the dimensions as excavated, with the following limitations:

(a) Where permanent timbering is not required, payment will be limited to a section the area of which does not exceed the area of a section 12 inches outside of the net inside section of the lined tunnel or shaft.

(b) Where permanent timbering is required, payment will be limited to the smallest average section which will permit the setting of timbers in such a position that they will have the minimum required covering of concrete: Provided, That this section shall not exceed the area of a section 21 inches outside of the net inside section of the lined tunnel or shaft. All suitable material, as determined by the contracting officer, excavated
from the tunnel and shaft shall be placed in the dam in positions approved by the contracting officer or as shown on the drawings. Other material shall be wasted in locations approved by the contracting officer.

293. Timbering tunnel and shaft.—Suitable timbering and lagging shall be used wherever necessary to support the tunnel roof and sides and the vertical sides of the shaft. Where side supports are not required for the tunnel, the roof may be supported by timber arches, benched into the side walls. Timber left in place shall be framed in such a manner as not to weaken the concrete lining. Designs for all timbering shall be subject to the approval of the contracting officer; Provided, That nothing herein contained shall prevent the contractor from placing such additional temporary and permanent timbering as he may deem necessary, nor shall such approval be construed to relieve the contractor from sole and full responsibility for the safety of the tunnel and for damage to persons or property. Lumber for timbering shall be furnished by the contractor and shall be cut and framed by him at his expense. All of the cost of timbering shall be included in the price bid in the schedule for tunnel excavation.

294. Excavation for upstream cut-off.—It is contemplated that under the spillway structure and under a portion of the left abutment of the dam and possibly under a portion of the right abutment, the excavation for the upstream cut-off will be by tunneling or stoping. Shafts, at locations approved by the contracting officer, may be excavated along the line of the cut-off stope to facilitate the removal of the material excavated. The excavation and refilling of these shafts shall be at the contractor's expense, and all operations thereon shall be subject to the approval of the contracting officer. The stopes shall be of sufficient height to extend into the underlying bedrock and the overlying impervious stratum the minimum distance shown on the drawings or determined by the contracting officer; Provided, That the contractor will not be required to excavate to a height of less than 5 feet. All loose and disturbed material shall be completely removed from the cut-off stope. Timbering may be required in the stope excavation, and if used its design shall be subject to the approval of the contracting officer. All such timbering shall be completely removed before concrete is placed in the stope. All of the cost of any timbering used in the stope shall be paid by the contractor and the contractor will be held responsible for its sufficiency and for the safety of life and property dependent thereon. The amount of stoping required will be determined by the contracting officer as the work progresses so as to produce the desired results in the manner most economical to the Government. The stoping may be divided into two or more reaches separated by excavations in open cut, open trench, or otherwise, and the contractor shall not be entitled to any increase in the unit prices to be paid for stoped excavation due to such modifications. It is contemplated that under a portion of the left abutment of the dam where the thickness of the overlying impervious layer of clay, sand, and gravel is not excessive, as determined by the contracting officer, the excavation for the cut-off will be made partly in open cut with side slopes and depth as shown on the drawings or as established by the contracting officer, and partly with an open trench having vertical sides walls extending to solid rock. The widths of this trench and the depth that it shall extend into the bedrock shall be as shown on the drawings or as directed by the contracting officer; Provided, That in no case shall the trench through earth and gravel be less than 2½ feet in width. All loose material shall be removed from the bottom of the trench before concrete is placed therein. Timbering may be required in the excavation of open trench with vertical sides, and if used its design shall be subject to the approval of the contracting officer. All such timbering shall be completely removed from the portion of the trench to be filled with concrete immediately after the placing of the concrete and while it is still in the semifluid state prior to initial set. It shall also be removed from the remainder of the trench in a manner satisfactory to the contracting officer. The cost of any timbering used in the trench shall be paid for by the contractor and the contractor will be held responsible for its sufficiency and for the safety of life and property dependent thereon. Overbreakage or cavities excavated beyond the prescribed lines in stoped excavation or in the portion of open trench to be filled with concrete will not be paid for, and these shall be refilled with concrete in the same manner as specified for the prescribed excavation at the expense of the contractor except that cement contained in such concrete will be furnished by the Government. Under a portion or all of the right abutment and the central portion of the dam and wherever the underlying layer or stratum of gravel is relatively thick it is contemplated that the excavation for the cut-off will be done in open cut. The contemplated cross-sectional dimensions of this open cut are shown on the drawings, but these will be subject to change or reestablishment by the contracting officer as the work progresses. The open cut may be excavated by drag line or other satisfactory means and shall conform as closely as practicable, as determined by the contracting officer, to the specified lines. Accurate trimming of the slopes will not be required. The bottom of the open cut shall follow the surface of the underlying impervious bedrock and a trench of the dimensions shown on the drawings or designated by the contracting officer shall be excavated into this rock to receive the base of the concrete cut-off wall shown on the drawings. In the event it is found by the contracting officer impracticable or uneconomical or otherwise undesirable to excavate for any portion of the cut-off in the manner specified, and it is found desirable to do the required excavation therefor in some other manner, the excavation for such portion of the cut-off shall be done as directed by the contracting officer and equitable
adjustment for payment will be made under the provisions of article 3 of the contract. The contractor will not be entitled to any increase in the unit prices to be paid for the excavation due to changes in quantities as a result thereof. All suitable material, as determined by the contracting officer, required to be excavated under the provisions of this paragraph and not used for backfilling the trenches shall be placed in the dam in the locations directed by the contracting officer and in accordance with the specifications thereof. All other material shall be wasted in locations approved by the contracting officer. Payment for the excavation described in this paragraph will be made at the unit prices bid in the schedule, which shall include its excavation and its final disposition as specified.

295. Excavation for spillway, trash rack, valve house, tunnel approach, and outlet channel.—The excavation for the spillway, trash-rack structure, valve-house structure, tunnel approach, and outlet channel shall be carefully done to the lines and grades shown on the drawings or established by the contracting officer. The required minimum thicknesses of lining and other concrete and structural parts shall be provided for at all points, and the average specified thicknesses shall be exceeded as little as practicable. Proper provision shall be made in the excavation for tile and pipe drains. The use of explosives in such manner as to cause heavy overbreakage or damage to the rock left in place will not be permitted. All material excavated for these structures and channels which, in the opinion of the contracting officer, is suitable shall be placed in the dam or other embankments required in positions approved by the contracting officer. Suitable rock and gravel shall be placed in the rock-fill portion at the downstream toe of the dam; in the gravel and cobble downstream face of the dam, in the riprap on the upstream face of the dam, or elsewhere as directed by the contracting officer. Suitable clay, sand, and gravel shall be placed in the clay, sand, and gravel portion of the dam, or selected materials relatively free from gravel and sand, may be used for clay puddle in the upstream cut-off trench, or elsewhere as directed by the contracting officer. Exca vat ed material which, in the opinion of the contracting officer, is not suitable for use in the dam or other embankments shall be wasted or otherwise disposed of in a manner and in locations approved by the contracting officer. All excavation required by this paragraph will be measured and paid for as outlined in paragraph 290.

296. Limits of excavation.—All excavation for the dam and related works shall be made to the lines and grades described in these specifications, shown on the drawings, or established by the contracting officer. Where not otherwise provided earth and gravel shall be excavated on the steepest practicable slopes as established by the contracting officer. The toe of these slopes shall be 3 feet from the top of the cutting in solid rock. If no solid-rock excavation is required, the toe of slopes shall be 3 feet from the neat lines of the structure. Solid rock shall be excavated as close as practicable to the neat lines of the structure unless otherwise directed by the contracting officer. The prices bid for excavation shall include the cost of all labor and material, hauling, pumping, bailing, draining, and all work necessary to maintain the excavation in good order during construction.

297. Preparation of rock foundation.—Care must be taken not to shatter or disturb the rock foundations unnecessarily. All loose fragments, spalls, dirt, and gravel must be removed from rock surfaces which are to be covered with concrete. After cleaning and before concrete is placed, all water shall be removed from depressions so that the surface can be thoroughly inspected and proper bond may be made with the foundation rock. Payment for all work described above in this paragraph shall be included in the prices bid for excavation. Any flowing springs encountered that are not, in the opinion of the contracting officer, suitably cared for by the construction provided for in the drawings and specifications shall be closed by pressure grouting, removed by drainage, or otherwise cared for as directed by the contracting officer. If, in the opinion of the contracting officer, proper payment for such work is not provided for in the schedule, payment will be made therefor as extra work under the provisions of article 5 of the contract and paragraph 10 of these specifications.

298. Storage and care of explosives.—Caps, detonators, and fuses shall in no case be stored or kept in the same place in which dynamite or other explosives are stored. The location and design of powder magazines, methods of transporting explosives, and in general all precautions taken to prevent accidents must be satisfactory to the contracting officer, but the contractor shall be liable for all damages to persons or property caused by blasts or explosives.

299. Lines and grades.—The contractor shall provide such drill holes, forms, spikes, nails, troughs for plumb-bob lines, light, etc., and such assistance as may be required by the contracting officer in giving lines and grades, and the contracting officer's marks shall be carefully preserved. Work in the shaft, adits, cut-off stope, tunnel, and open-cut excavations or elsewhere shall be suspended for such reasonable time as the contracting officer may require to transfer lines and to mark points for line and grade. No allowance will be made to the contractor for loss of time on account of such suspension.

300. Lighting and ventilating tunnel.—The contractor shall properly light and ventilate the tunnel, cut-off stopes, and shafts during construction.
EMBANKMENT

301. Embankment construction—General.—The main dam and other embankments shall be constructed to the lines and grades shown on the drawings or established by the contracting officer. Embankments shall be built to the heights designated by the contracting officer to allow for settlement. No brush, roots, sod, or other perishable or unsuitable material, as determined by the contracting officer, shall be placed in embankments. No material shall be placed in embankments when either the material or the embankment on which it would be placed is frozen. The contractor shall care for and maintain all embankments in a manner satisfactory to the contracting officer until the completion and final acceptance of the work under the contract. Any approved embankment material lost before the completion of the contract, by floods, by river action, by weathering, by any operation of the contractor, or by any other causes that, in the opinion of the contracting officer, is avoidable or under the control of the contractor, shall be replaced by the contractor in a manner satisfactory to the contracting officer without cost to the Government. Each portion of the embankment shall be constructed in accordance with the specifications therefor, and the cost of all work required by this paragraph shall be included in the unit prices bid therefor in the schedule.

302. Embankment—Conglomerate fill at downstream toe.—The downstream conglomerate fill portion of the main dam shall be constructed to the lines and grades shown on the drawings or established by the contracting officer. It is contemplated that this portion of the dam will be built in advance of the remainder and will serve as the downstream cofferdam for the remainder of the embankment construction. Material for this portion of the dam will consist of excavated conglomerate from the outlet tunnel, tunnel approach, shaft, spillway, and outlet channel excavation, or from the solid rock portions of the upstream cut-off trench. Material shall be placed in approximately horizontal layers 12 inches thick, sprinkled as required for satisfactory compacting, and rolled as specified in paragraph 308. All rock large enough to interfere with the rolling shall be placed on the downstream slope as the work progresses, but the completed downstream face of the dam shall be left neatly trimmed to the lines and grades established as specified, in a workmanlike manner and satisfactory to the contracting officer. A gap with side slopes not steeper than 2 to 1 may be left in this embankment for the passage of the river until the river is diverted through the tunnel. After the river has been diverted through the tunnel the gap shall next be filled to the level of conglomerate fill already placed; thereafter this embankment shall be carried up in as nearly horizontal layers from end to end as practicable. All material taken from the excavation required for other portions of the work and placed in this portion of the embankment will be paid for as excavation at the unit prices bid therefor in the schedule, which shall include the entire cost of excavating and placing the material in the completed embankment. If the required excavations do not furnish sufficient suitable material for this portion of the embankment the balance required shall be obtained from borrow pits approved by the contracting officer. The material taken from borrow pits will be paid for at the unit price bid therefor in the schedule, which price shall include the entire cost of excavating and placing the material in the completed embankment. The estimated amount of borrowed material for this purpose, given in the schedule, is only for use in comparing bids. It may be that no borrowed material will be required, or the amount required may be much greater than that given. The contractor will not be entitled to any increase in the unit price for this material on account of such variation. If the required excavations yield more material of this class than is required for this portion of the dam or for other rock portions of the dam as shown on the drawings or established by the contracting officer, the dimensions of the conglomerate fill may, in the discretion of the contracting officer, be changed as the work progresses to utilize the excess material to the best advantage and the contractor will be entitled to no increase in unit prices due to such changes. If provision is not made to use such excess material it shall be wasted at locations to be approved by the contracting officer.

303. Embankment—Clay, sand, and gravel portion.—The main body of the embankment and the material used in filling the open cut portion of the upstream cut-off excavation shall consist of the natural mixture of clay, sand, and gravel available from the excavations required for other portions of the work and from adjacent borrow pits, the suitability of both the excavations and the borrow pits to be approved by the contracting officer. No separation, sorting, blending, or segregation of the material will be required. The mixture of clay, sand, and gravel shall be placed to the lines and grades shown on the drawings or established by the contracting officer in horizontal layers not more than 8 inches in thickness after rolling: Provided, That until the river is diverted through the tunnel, this material may be placed in layers, the inclination of which is not steeper than 5 per cent and parallel to the axis of the dam. All this material shall be uniformly moistened by sprinkling on the embankment or wetting in the borrow pits. The full thickness of each 8-inch layer shall be moistened to such degree that, in the opinion of the contracting officer, such moistening will secure the maximum compactness of embankment after rolling as specified in paragraph 308. The entire cost of all excavating, loading, hauling, spreading, sprinkling, rolling, harrowing, or other operations required in placing this material in the finished embankment shall be included in the price bid in the schedule.
304. Embankment—Gravel and cobbles on downstream face.—The layer or blanket of gravel and cobbles on the downstream face of the embankment shall be constructed to the lines and grades shown on the drawings or established by the contracting officer. The material for this purpose shall be obtained from the excavations required for the work or from borrow pits approved by the contracting officer. It shall consist of freely draining and durable gravel, cobbles, and rock fragments as it occurs in the natural deposits or excavations from which it is taken. The material shall be placed in horizontal layers 8 inches in thickness, sprinkled as required for satisfactory compacting and rolled as specified in paragraph 308. Any cobbles or rock fragments large enough to interfere with the rolling shall be placed on the downstream slope as the work progresses, but the completed downstream face of the dam shall be left neatly trimmed to the lines and grades established as specified in a workmanlike manner and satisfactory to the contracting officer.

305. Embankment—Conglomerate riprap on upstream face.—A layer of conglomerate riprap shall be placed on the upstream face of the dam to the lines and grades shown on the drawings or established by the contracting officer. This riprap shall consist of fragments of the most durable conglomerate rock excavated for the required work, as determined by the contracting officer, or shall be obtained from borrow pit quarries approved by the contracting officer. It shall consist of quarry run of clean, sound, durable conglomerate rock free from objectionable quantities of loose dirt, sand, gravel, and small rock fragments, and the average volume of the pieces shall be not less than 1 cubic foot. No compacting or hand placing of this riprap will be required other than that necessary to secure a uniform layer of the required thickness having a reasonably smooth surface satisfactory to the contracting officer and true to the established lines and grades.

306. Embankment—Sluiced clay blanket.—The floor of the reservoir in the valley bottom immediately upstream from the dam shall be covered by a blanket of clayey material deposited by sluicing methods to the lines and grades shown on the drawings or established by the contracting officer. It is contemplated that the material for this purpose will be taken from the surface of the hillside adjacent to the valley at this point, but may be obtained elsewhere with the approval of the contracting officer. No segregation or compacting of the material in place will be required. The sluiced clay blanket will be measured for payment in place and the unit price bid therefor in the schedule shall include the entire cost to the Government of the material in the blanket. The right is reserved to eliminate the construction of this blanket from the contract if, in the opinion of the contracting officer, the general stability and condition of the foundation of the dam as disclosed by the excavation for the upstream cut-off or otherwise renders this action permissible. The contractor will not be entitled to any increased compensation for any other part of the work due to the elimination of this item.

307. Embankment—Highway at right abutment of dam.—The grade of the relocated railway adjacent to the right abutment of the dam is about 20 feet in elevation below the top of the dam and reaches an elevation equal to the water surface in the reservoir about 500 feet upstream from the north end of the dam at which point the railway grade is in thorough cut. Between these points the adjacent highway embankment must serve as the end of the dam and be so constructed as to prevent leakage from the reservoir into the railway grading. The construction required is shown on the drawings and it shall be built to the lines and grades shown thereon or as established by the contracting officer. The concrete cut-off wall connecting with the underlying conglomerate bedrock as provided under the upstream portion of the main dam shall be continued to intersect with the center line of the relocated highway to about station 30+00 thereof. The concrete cut-off wall under the relocated highway embankment shall be built in open cut to the dimensions shown on the drawings or as prescribed by the contracting officer and in the same manner as specified for the reinforced concrete cut-off in open cut of the main dam. The filling of the open cut for the concrete cut-off and the impervious core extending above it to the top of the highway embankment as shown on the drawings shall be constructed of clay or earth fill placed in horizontal layers not more than 8 inches thick and sprinkled and rolled in the same manner as that specified in paragraph 308, for the main body of the dam or, at the contractor's option, it shall consist of the same kind of material deposited in water and compacted by puddling. The contractor will be permitted to use material taken from required excavation if suitable, otherwise the material shall be procured from borrow pits approved by the contracting officer. The material used shall be largely of clay or earth with the least practicable amount of sand and gravel, and shall be such as can be readily compacted into a relatively impervious mass. This central core of impervious material shall be built to the dimensions, lines, and grades shown on the drawings or established by the contracting officer. The remainder of the highway embankment upstream from the dam and to about highway station 31+00 shall be constructed of conglomerate rock fill to the lines and grades shown on the drawings or established by the contracting officer. The material used for this purpose shall be quarried rock obtained from required excavation or from borrow pits approved by the contracting officer. It is contemplated that most of this material will come from excavations required for the railroad and highway grading and all excavated under schedule 1. Such of this material as is used for the portions of this embankment that must be placed under schedule 2, as specified below, shall be placed in waste banks under schedule 1 located as directed by the contracting officer not more than 500 feet from the embankment to be built under schedule 2.
This material will later be rehandled under schedule 2 and placed in the highway embankment, after the adjacent dam is constructed. If additional material is needed, it shall be obtained from required excavations or from borrow pits as directed by the contracting officer. The larger rock used in this embankment shall be placed in the face nearest the reservoir as shown on the drawings and no extra compensation will be allowed the contractor for the work required in segregating these larger rock. For the portion of the highway embankment lying downstream from the downstream face of the dam and to be constructed under schedule 2 the material shall consist of material excavated in the construction of the railroad and highway grading and wasted under schedule 1 or at the contractor's option, of earth and gravel obtained from borrow pits approved by the contracting officer. The requirements for compacting all material except the rolled earth or puddled core, that is placed in the highway embankment shall be the same as specified for the normal highway embankments. In order to build the northerly end of the main dam where it merges with the relocated highway embankment, in accordance with these specifications, it will be necessary to omit a portion of the highway embankment from schedule 1 and to provide a temporary detour for highway traffic while the main dam is being constructed. The completion of the gap thus left in the highway embankment shall be done under schedule 2. The portion of this highway embankment and the detour for highway traffic to be constructed under schedule 1 are shown on the highway drawings.

308. Rolling embankments.—Where required by these specifications and where directed by the contracting officer embankments shall be compacted by rolling. The roller used for this purpose shall weigh not less than 2,000 pounds per linear foot of tread. The entire surface of each layer of embankment rolled shall have the roller pass over it at least three times. If, in the opinion of the contracting officer, the rolled surface of any layer of material is too smooth to bond properly with the succeeding layer it shall be roughened or loosened by harrowing or otherwise to the satisfaction of the contracting officer before the succeeding layer is placed therein. The entire cost of all work described in this paragraph shall be included in the unit prices bid in the schedule for the material in the embankments for which compacting by rolling is required.

309. Back fill around spillway and outlet structures.—The contractor shall place and thoroughly compact all back fill around the buttressed and counterforted retaining walls of the spillway and outlet structures or elsewhere as directed by the contracting officer. The compacting obtained shall be satisfactory to the contracting officer and shall be equivalent to that obtained in the clay, sand, and gravel portion of the embankment. The material used for this purpose, the amount thereof, and the manner of depositing the same shall be satisfactory to the contracting officer. Material used for back fill will be measured in place, to the lines of the back fill as established by the contracting officer, and payment therefor will be made at the unit price for cubic yard bid in the schedule, which price shall include the cost of all work connected therewith, including the excavation of the necessary material.

310. Cut-off—Sprinkled and rolled clay, sand, and gravel.—Where an open cut with sloping sides is excavated to bedrock through the overlying materials, the back filling of the cut shall be of the same material, and shall be deposited in the same manner as outlined in paragraph 303, "Embankment — clay, sand, and gravel portion." The material shall be deposited carefully about the concrete wall and shall be carried up evenly on either side to prevent overturning or breaking of the bond between the concrete and the bedrock, at the base. Payment will be made at the unit price bid in the schedule for "Embankment, clay, sand, and gravel portion."

311. Cut-off—Clay-puddled back fill.—The part of the trench with vertical side walls, above the plain concrete wall, shall be completely filled with clay-puddled back fill. The clay used for this purpose shall be subject to the approval of the contracting officer. The contractor will be permitted to use material taken from the required excavation if suitable material can be obtained from this source, otherwise the material shall be procured from borrow pits approved by the contracting officer. The clay to be used shall contain the least practicable amount of sand and gravel and shall be such as can be readily compacted into a relatively impervious mass. It shall be thoroughly tamped and puddled and the amount of water to be used in puddling shall be subject to the approval of the contracting officer. Measurement will be made in place in the trench, to the neat lines of the excavation as shown on the drawings or as established by the contracting officer. Payment will be made at the unit price bid therefor in the schedule which price shall include the cost of all labor and equipment required in procuring, placing, and puddling the material.

CONCRETE

312. Composition.—Concrete shall be composed of cement, sand, and broken rock or clean gravel, well mixed and brought to a proper consistency by the addition of water. The contractor may be required to add hydrated lime or other powdered admixtures as provided in paragraph 316. The exact proportions in which these materials are to be used for different parts of the work will be determined by the contracting officer after analyses and tests have been made of samples of the accepted aggregates furnished by the contractor. In
general, the proportions shall be determined by the contracting officer to produce concrete of maximum practical economy to the Government and having an ultimate compressive strength at the age of 28 days varying from not less than 1,500 pounds per square inch for the work where strength is of least importance, to not less than 2,500 pounds per square inch for the work where strength is of most importance. The mixes will be based upon securing concrete having suitable workability, the maximum density, and the required strengths, without the use of an excessive amount of cement, and using, in so far as practicable, the entire yield of suitable material from the natural deposits from which the concrete aggregates are obtained. If, in the opinion of the contracting officer, it is impracticable to utilize the entire pit run yield of suitable material in the concrete, the contractor will not be entitled to extra compensation due to the necessity of wasting any excess material. The contractor shall provide such means and equipment as are required to determine and control the relative amounts of the various materials, including water, entering the concrete, and these shall be subject to the approval and under the control of the contracting officer. The amount of water added shall be changed as required to adjust for the varying moisture content, which naturally occurs in the sand; Provided, That the inundation method of controlling the water content will not be required. When necessary, broken rock or gravel must be suitably moistened to prevent a variable quantity of water being introduced into the concrete. Tests and analyses of the aggregate and the resulting concrete will be made by the Government at frequent intervals and the mixes used shall be changed whenever necessary, in the opinion of the contracting officer, to secure the required economy, workability, density, or strength, and the contractor shall be entitled to no extra compensation because of such changes. The contractor will be permitted, when approved by the contracting officer to use proportions producing concrete of equal quality but with less economy than the proportions determined by the contracting officer: Provided, That any increase of cost as a result thereof shall be borne by the contractor. Only sufficient water shall be used to secure concrete of suitable workability, as determined by the contracting officer and such as will flow or permit of working properly into place with thorough spading or working. In general, a wetter consistency than that corresponding to a slump of 4 inches, when tested in accordance with the “Tentative Specifications for Workability of Concrete for Concrete Pavements” of the American Society for Testing Materials, will not be permitted for the main portions of the concrete structures. A greater slump than 4 inches but not exceeding a maximum of 6 inches will be permitted where specifically authorized by the contracting officer for concrete in positions difficult to place, such as tunnel lining and stopped cut-offs and in thin reinforced walls or slabs, such as in the parapet walls and gatehouse.

313. Cement.—Cement for concrete will be furnished to the contractor by the Government, as provided in paragraph 277. Cement will be tested at the mills and will conform to the U. S. Government Master Specification No. 1a for Portland Cement, as published in Circular No. 33 of the Bureau of Standards. The contractor shall give the contracting officer not less than 30 days’ notice in writing of cement requirements. The requirements shall be stated as far as practicable in quantities not less than single car lots. The contractor shall return to the railway station at Echo, Utah, all empty sacks cleaned of cement and securely bound in bundles in a manner satisfactory to the contracting officer. For all sacks not returned in serviceable condition the contractor will be charged the same amount that the sacks cost the Government.

314. Sand.—Sand for concrete may be obtained from natural deposits or may be made by crushing suitable rock. The sand particles shall be hard, dense, durable, uncoated, nonorganic rock fragments that will pass a 1/4-inch square or a 1/6-inch round opening. It must be free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. The sand as it is used in the concrete must be so graded that concrete of the required workability, density, and strength can be made without the use of an excess of water or cement. The sand shall have fineness modulus of not less than 2.75 nor more than 3.25, unless approval is given by the contracting officer to use sand not meeting this requirement. The fineness modulus will be determined by dividing by 100, the sum of the percentages retained on Tyler standard sieves, numbers 4, 8, 14, 28, 48, and 100. The suitability of the sand will be determined by the contracting officer with the aid of tests made in accordance with the standard practice of the United States Bureau of Standards. The sand shall be washed unless specific written authority is given by the contracting officer to use unwashed sand. The sand shall be such that tests of briquettes made in proportion of three parts sand to one part cement shall develop a tensile strength not less than the strength developed by such tests with standard Ottawa sand. Any crushing, rolling, blending, screening, washing, or other operation on the sand required to meet these specifications shall be done by the contractor and the cost thereof shall be included in the unit prices bid in the schedule for the concrete in which the sand is used. Acceptable sand can be obtained from deposits in the vicinity of the work.

315. Broken rock or gravel.—The broken rock or gravel for concrete must be hard, dense, durable, uncoated rock fragments free from injurious amounts of soft, friable, thin, elongated or laminated pieces, alkali, organic, or other deleterious matter. It shall be so graded that concrete of the required workability, density, and strength, can be made without the use of an excess of sand, water, or cement. The suitability of the broken
rock or gravel will be determined by the contracting officer with the aid of tests made in accordance with the standard practices of the United States Bureau of Standards. Any crushing, blending, screening, washing, or other operation on the broken rock or gravel required to meet these specifications shall be done by the contractor and the cost thereof shall be included in the unit prices bid in the schedule for the concrete in which the broken rock or gravel is used. The broken rock or gravel shall be washed unless specific authority is given by the contracting officer to use unwashed broken rock or gravel. The broken rock or gravel shall all pass through a screen having 3-inch round openings and shall be retained on a screen having ¾-inch square or ⅛-inch round openings. It shall also be separated into intermediate sizes by screens having round openings of ¾-inch and 1¾-inch diameters. Screens of other shaped openings may be used: Provided, That equivalent results, as determined by the contracting officer, are obtained. The relative amounts of each size of broken rock or gravel to be used in each mix of concrete and in all parts of the work will be determined by the contracting officer and will be based on securing concrete having the required workability, density, strength, and economy, without the use of an excess of sand, water, or cement, and using in so far as practicable, the entire yield of suitable material from the natural deposits from which the broken rock or gravel is obtained. The contracting officer will determine the maximum size of broken rock or gravel to be used in each part of the work. For very thin or heavily reinforced parts, the maximum size will be that determined by the screen having ¾-inch round openings; for the main portions of the work the maximum size will be that determined by the screen having 1¾-inch round openings; and for the more massive portions the maximum size will be that determined by the screen having 3-inch round openings.

316. Use of hydrated lime or other powdered admixtures.—It may be required that hydrated lime, diatomaceous earth, or other powdered admixtures be used in the concrete to secure increased uniformity, workability, or density. The material to be used and the amount thereof shall be as directed by the contracting officer. Hydrated lime, if used, shall not be in excess of 6 per cent by weight of the amount of the cement, and diatomaceous earth, if used, shall not be in excess of 3 per cent by weight of the amount of the cement. Other admixtures, if used, shall be in like moderate proportions. Not more than one admixture shall be used at one time. Powdered admixtures will be furnished by the Government, as provided in paragraph 277, and the cost of hauling, storing, handling, and all other costs incidental to the use of such admixtures in the concrete shall be included in the prices bid in the price of concrete in which the admixture is used.

317. Water.—The water used in concrete must be reasonably clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities.

318. Samples of concrete aggregates.—The sources from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when the materials are required for use in the dam or other structures. Suitable samples of the aggregates are to be used in the concrete shall be furnished to the contracting officer if required and shall be delivered to the railway station at Echo, by the contractor, at least 60 days in advance of the time when the pouring of concrete is to begin. These samples shall be sufficient in quantity to permit making such test specimens as may be required for determining the suitability of the materials and the proportions in which they shall be mixed. The contractor shall furnish samples as required and shall give the contracting officer at all times during the continuation of the contract any necessary assistance in securing and handling the samples, and the cost thereof shall be included in the prices bid in the schedule for concrete.

319. Mixing.—The cement, sand, broken rock or gravel, and powdered admixture, if required, shall be so mixed and the quantities of water added shall be such as to produce a homogeneous mass of proper uniform consistency. Dirt and other undesirable substances shall be carefully excluded. Machine mixing by a batch mixer will be required for all concrete. In general, only sufficient water shall be used in mixing to give a workable mix. The mixing of each batch shall continue not less than 200 minutes after all of the materials, including water, are in the mixer, during which time the mixer shall rotate at a peripheral speed of about 200 feet per minute. Overloading of mixers will not be permitted.

320. Placing.—Concrete shall be placed in the work before the cement takes its initial set. The contractor will be charged for the cement contained in any concrete that is wasted at its actual cost to the Government. No concrete shall be placed in water except under the direct instructions and supervision of the contracting officer. All foundation surfaces upon or against which concrete is to be placed must be made free from mud and débris. When the placing of concrete is to be interrupted long enough for the concrete to take its final set the working face shall be given a shape by the use of forms or other means that will secure a proper union with subsequent work. All concrete surfaces on or against which concrete is to be placed shall be roughened and all laitance shall be removed by thorough scrubbing, brushing, and chipping before placing concrete or mortar upon or against them. Only methods of transportation or placing which will deliver concrete of the proper consistency into the forms will be permitted. All concrete shall be placed in horizontal layers and thoroughly worked and tamped with suitable tools until all voids in the mass are worked out and until it completely
fills the forms, closes snugly against all surfaces, and is in perfect and complete contact with all steel used for reinforcement. Lifts in placing concrete shall be arranged to avoid feather edges. Where smooth surfaces are required and for all surfaces which will be permanently exposed to the back fill, the weather, or water, the adjacent concrete shall be worked, tamped, and stirred so that the coarser material is forced back and a mortar layer is brought next to the forms. No concrete shall be placed except in the presence of a duly authorized Government inspector.

321. Temperature of concrete.—Concrete, when deposited, shall have a temperature of not less than 40° F., nor more than 120° F. In freezing weather suitable means shall be provided for maintaining the concrete at a temperature of at least 50° F. for not less than 72 hours after placing, or until the concrete has thoroughly hardened. The methods used for heating the materials and protecting the concrete shall be subject to the approval of the contracting officer.

322. Finishing.—The surface of concrete placed against forms must be smooth, free from projections, and thoroughly filled with mortar. Immediately upon the removal of forms, all voids shall be neatly filled with cement mortar of the same consistency as the mortar in the concrete, provided that where, in the opinion of the contracting officer, the voids are such as to render the concrete defective and unsuitable for its intended use, such concrete shall be removed and replaced with acceptable concrete by and at the expense of the contractor. Where required by the contracting officer all exposed surfaces shall immediately after the removal of the forms be worked and required and painted with neat cement grout so as to produce a uniform surface, free from objectionable form marks and other defects and otherwise satisfactory to the contracting officer. Exposed surfaces of concrete not placed against forms, such as horizontal or sloping surfaces, shall be brought to a uniform surface and worked with suitable tools to a smooth mortar finish. Where smooth mortar or steel troweled finish of concrete surfaces is required this shall be secured without the use of a separate coat of mortar unless the separate coat is specifically called for on the drawings, in these specifications or ordered by the contracting officer. If it is necessary to add mortar to the surface of the concrete in order to secure the finish specified, it shall be added as soon as the concrete can be screed off and while the concrete is still plastic after which the mortar shall be worked into the concrete by the use of suitable tools until the specified surface is secured. All sharp angles shall be rounded or beveled by the use of molding or suitable finishing tools except where otherwise directed by the contracting officer. The cost of all work described in this paragraph shall be included in the prices bid in the schedule for concrete.

323. Forms.—Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. Forms shall be of sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure and ramming without appreciable deflection from the prescribed lines. The surfaces of all forms in contact with the concrete must be rigid, tight, and smooth. Lagging used in wood forms must be surfaced and bevel edged or matched. Metal forms must be free from bumps, wrinkles, or other imperfections. Suitable devices shall be used to hold adjacent ends and edges of panels or other forms tight together and in accurate alignment. All forms to be repeatedly used shall be oiled before each pouring of concrete with suitable nonstaining oil satisfactory to the contracting officer. Metal rods or other similar devices to hold the forms will be allowed in the structures; Provided, that proper means are used to remove a portion of each rod nearest the surface of the concrete. All holes left after removal of the rods shall be filled immediately and completely with cement mortar, and the surface left in a smooth and workmanlike condition. If wire ties are used, they shall be cut off close to the concrete after the forms are removed. Wooden forms to be used once, where not oiled, shall be wetted thoroughly just before placing concrete so as to prevent injurious drying of the surface of the concrete by absorption. Where forms are placed in successive units for continuous surfaces, care shall be exercised to fit the forms tightly over the completed surface to prevent leakage of mortar from the concrete. Forms shall be left in place until their removal is authorized by the contracting officer, and shall thereafter be removed by the contractor with care to avoid injury to the concrete. The contractor shall furnish all material, labor, and equipment for the forms and their handling, and all the cost thereof shall be included in the prices bid in the schedule for the concrete on which the forms are used.

324. Protection of concrete.—The contractor shall protect all concrete from injury until final acceptance by the Government. Exposed surfaces of concrete, including the surfaces of construction and contraction joints, shall be kept thoroughly moistened, except in freezing weather, for at least 2 weeks after the concrete is placed. Concrete placed or cured in freezing weather shall be protected from freezing.

325. Damaged or defective concrete.—Any concrete damaged by freezing or found defective from other cause at any time before the completion and acceptance of the work shall be removed and replaced with acceptable concrete at the contractor's expense as directed by the contracting officer. The contractor will be charged for the cement used in such concrete the same amount that the cement cost the Government at the point of delivery to the contractor.
326. Reinforcing steel.—Reinforcing steel, consisting of steel bars of the sizes and spacing specified, shall be placed in the concrete where shown on the drawings or as directed by the contracting officer. The reinforcing steel will be furnished by the Government as provided in paragraph 277. The exact position, shape, and size of reinforcement bars are not shown in all cases on the drawings accompanying these specifications. The contractor will be furnished supplemental detailed drawings and lists which will give the necessary information for cutting, bending, and placing all reinforcement. The reinforcement bars shall be so secured in position that they will not be displaced during the placing of the concrete. Special care shall be used to prevent any disturbance of the steel in concrete that has already been placed. The contractor will be charged for any reinforcing steel furnished and not used or returned the same amount as the cost of the steel to the Government at the point of delivery to the contractor. Payment for placing reinforcing steel will be at the unit price bid therefor in the schedule, which shall include the cost of unloading, hauling, storing, cutting, bending, placing, furnishing tie wires, wiring, and maintaining in position all reinforcing steel as shown on the drawings or as directed by the contracting officer.

327. Measurement of concrete.—Measurement of concrete for payment will be made to the neat lines of the structure as required by the specifications and drawings or as established by the contracting officer. The measurement will include only the actual net volume of concrete within the required neat lines of the structures, and the volume of all cavities, depressions, openings, embedded pipes, woodwork, and metal work, except reinforcing steel and anchors, will be deducted.

328. Payment for concrete.—Payment for concrete in the various parts of the work will be made at the prices bid for the respective items of the schedule. The unit prices bid shall include the entire cost of all labor and materials, except cement and powdered admixtures, which will be furnished by the Government as provided for in paragraph 277. The placing of reinforcing steel will be paid for separately at the unit price bid in the schedule.

329. Division of concrete for payment.—Concrete will be separated for payment into the items named in the schedule. The division between the various items shall be determined by the contracting officer. Any small amount of concrete required to be placed which does not come within any of the items named in the schedule shall be placed in that item to which it most nearly conforms, as determined by the contracting officer; or, if it differs materially from all the items named, its construction will be ordered in writing by the contracting officer and payment will be made therefor as extra work under the provisions of article 5 of the contract and paragraph 10 of these specifications.

330. Concrete—Spillway structure.—The spillway structure from station 0—87.0 to station 1+14.55 shall be constructed to the grades and dimensions shown on the drawings or designated by the contracting officer. The piers and the part of the structure in which the radial gates and operating mechanisms are to be installed shall be constructed with particular accuracy to insure that the gates can be operated throughout the full range of movement without binding or permitting excessive leakage due to irregularities in the concrete construction. The steel wall plates and the radial gate-plu bearings shall be carefully set. Anchor bolts and dowels shall be accurately set at the time concrete is being placed. The practice of drilling and grouting anchor bolts and dowels after the concrete has set will not be permitted. The pipe railing may be placed in the curb on the downstream side of the operating platform when concrete is poured, or holes as shown on the drawings may be left in the concrete and the railing posts grouted in place with cement grout at some later time. Drilling of these holes in the concrete will not be permitted. It is contemplated that the excavation for this portion of the spillway structure will be entirely in the clay, sand, and gravel formation. Weep holes shall be placed through the cut-off under the seat of the radial gates. The pipe required for construction of these weep holes will be furnished by the Government. Below this cut-off wall a complete drainage system consisting of a gravel base and sewer-pipe drains shall be constructed. Care shall be taken in placing the concrete floor to so prepare the gravel base and to use concrete of such consistency as will insure that an excessive amount of the mortar is not leached out of the concrete and that concrete is not permitted to enter the pipe drains. Contraction joints as shown on the drawings shall be provided in the floor slab, side walls, and counterforts. These shall be formed as shown and the surface on the side of the joint first completed shall be painted with one coat of water-gas tar before concrete in the other part of the joint is placed. The ends of reinforcing steel passing through the joint in the floor slab shall be painted to prevent bonding with the concrete. The floor slab upstream from counterfort number 7 and downstream from counterfort number 12 shall be placed independently of the toe slab or side walls, no reinforcing steel passing through the construction joint; this construction joint, however, should not be painted. The floor slab between counterforts numbers 7 and 12 shall be made monolithic with the toe slab of the counterforted walls. The drainage system, galvanized-steel feed pipe, wall plates, anchor bolts, pin bearings and other parts to be furnished by the Government and requiring installation before the placing or during the placing of concrete shall be carefully placed in their proper locations. Payment for such installations will be made at the unit prices bid in the schedule covering these installations. Payment for concrete
and the placing of reinforcing steel will be made at the unit prices bid in the schedule. Payment for the concrete of the radial gate counterweights will be made at the same unit price as for the concrete of the structure.

331. Concrete—Spillway and tunnel outlet channels.—The spillway channel from station 1 +14.55 to its lower end and the tunnel outlet channel from station 9 +73.67 to its lower end shall be constructed to the dimensions, alignment, and grades shown on the drawings or established by the contracting officer. Where the excavation is in rock, the side slopes and walls shall be securely anchored to the bedrock as indicated, with bars grouted into the rock with cement grout. Where the section in rock is excavated to greater dimensions than specified, the cavities shall be carefully and solidly back filled with hand-placed rock in a manner satisfactory to the contracting officer. The cost of securing and placing such back fill shall be borne by the contractor. Construction of the concrete in the channel shall be from the bottom towards the top as indicated, and construction joints shall be spaced and constructed as shown on the drawing or as directed by the contracting officer. The cost of making contraction joints shall be included in the unit prices bid for concrete. Side slopes shall be formed and the floor shall be given a steel troweled finish. Measurement of concrete placed where the excavation is in earth or gravel will be made on the basis of the net thickness shown. Measurement in rock sections will be on the basis of the average thickness of concrete specified. Payment for concrete and the placing of reinforcing steel and anchor rods will be made at the unit prices bid in the schedule.

332. Concrete—Tunnel and shaft lining.—The outlet tunnel from stations 0 +90.25 to 5 +68.11 and from stations 6 +09.36 to 9 +28 and the spiral stairway shaft between elevations 5487 and 5570.3 shall be lined throughout with concrete of the thickness shown on the drawings. Where permanent timbering is used it shall be set back a sufficient distance from the face of the lining to provide for a minimum covering of concrete over the timbers of not less than 8 inches. Payment for placing concrete in the outlet tunnel and shaft lining will be made at the unit prices bid in the schedule. Measurement for payment for the concrete in the shaft lining below the natural ground surface will be on the basis of a 12-inch thickness of lining. Above the line of the natural ground surface, measurement shall be to the dimensions as shown on the drawings or established by the contracting officer. Where permanent timbering is not required, payment for the concrete in the tunnel lining will be limited to a 12-inch average thickness. Where permanent timbering is used measurement for payment will be made to the actual outside lines of the excavation; provided, that the average thickness on which payment is based shall not exceed 21 inches. The volume of timbering left in place in the tunnel, and included within the measured volume of concrete, will be deducted from the volume of the concrete. The volume of the timber left embedded in the concrete shall be kept as small as practicable, and wherever practicable, lagging used in timbering of the tunnel or shaft shall be removed before or while the concrete is being placed before the concrete takes its initial set. No timber shall be left in the tunnel lining upstream from the emergency gate structure. If the tunnel or shaft is excavated to greater dimensions than specified, the excess space shall be solidly filled with concrete by the contractor and at his expense, except that cement for this purpose will be furnished by the Government. If necessary, in order to fill the space at the roof of the excavation, the contractor shall place this concrete under pressure. Care shall be taken in placing concrete not to displace the tile or other parts of the drainage system about the structure or to permit concrete to enter the drains. The U-bolt hangers in the roof of the chamber and the rungs for the ladders shall be placed in the forms and securely held in position while concrete is being poured. Care shall be taken in removing the forms about the rungs or the hangers not to displace them or to destroy their bond with the concrete. Drilling holes for and placing the rungs after the concrete is placed will not be permitted. The cost of placing rungs and hangers shall be included in the unit price bid for concrete. The emergency gates, conduit linings, conduit lining transitions, by-pass inlets, air inlets, drainpipes, the seepage drainage system and any other parts that require installation before concrete is placed or during the placing of concrete, shall be carefully placed in their proper locations. Payment for such installations will be made at the unit prices bid in the schedule, covering the various items. If required by the contracting officer, concrete of a richer mixture than used for the remainder of the structure shall be placed about the gate, conduit lining, conduit lining transitions, or elsewhere, as directed by the contracting officer. Payment for concrete and the placing of reinforcing steel will be made at the unit prices bid in the schedule.

333. Concrete—Emergency gate structure.—The emergency gate structure below elevation 5487.0 and between stations 5 +68.11 and 6 +09.36 shall be accurately constructed to the lines, grades, and dimensions shown on the drawings or prescribed by the contracting officer. It is contemplated that the excavation for this structure will be almost entirely in rock and that the concrete can be placed directly against the excavated walls. Any overbreakage in excavation shall be completely filled with concrete, and if the material is excavated to greater dimensions than specified, the extra space shall be solidly filled with concrete by the contractor and at his expense, except that cement for this purpose will be furnished by the Government. If necessary, in order to fill the space at the roof of the excavation, the contractor shall place this concrete under pressure. Care shall be taken in placing concrete not to displace the tile or other parts of the drainage system about the structure or to permit concrete to enter the drains. The U-bolt hangers in the roof of the chamber and the rungs for the ladders shall be placed in the forms and securely held in position while concrete is being poured. Care shall be taken in removing the forms about the rungs or the hangers not to displace them or to destroy their bond with the concrete. Drilling holes for and placing the rungs after the concrete is placed will not be permitted. The cost of placing rungs and hangers shall be included in the unit price bid for concrete. The emergency gates, conduit linings, conduit lining transitions, by-pass inlets, air inlets, drainpipes, the seepage drainage system and any other parts that require installation before concrete is placed or during the placing of concrete, shall be carefully placed in their proper locations. Payment for such installations will be made at the unit prices bid in the schedule, covering the various items. If required by the contracting officer, concrete of a richer mixture than used for the remainder of the structure shall be placed about the gate, conduit lining, conduit lining transitions, or elsewhere, as directed by the contracting officer. Payment for concrete and the placing of reinforcing steel will be made at the unit prices bid in the schedule.

334. Concrete—Trash-rack structure.—The trash-rack structure at the entrance to the outlet tunnel, including the transition section to station 0 +90.25, shall be accurately constructed to the lines, grade, and dimensions
shown on the drawings or prescribed by the contracting officer. The structural channels and the castings to be embedded in the concrete shall be accurately placed at the locations shown, so as to accommodate the trash rack. Weep holes shall be placed in the floor of the trash rack at the locations shown. The material used in forming the holes will be furnished by the Government. Payment for embedding the metal work of the trash rack in the concrete will be made at the unit price bid in the schedule for installing and painting metal work in trash-rack structure. Payment for concrete will be at the unit price bid in the schedule.

335. Concrete—Needle-valve structure.—The needle-valve structure below elevation 5458.67 and between tunnel outlet stations 9 + 28 and 9 + 73.67 shall be accurately constructed to the lines, grades, and dimensions shown on the drawings or prescribed by the contracting officer. The vertical side wall adjacent to the spillway channel shall be securely anchored to the bedrock as shown on the drawings or as directed by the contracting officer. A portion of the wall for supporting the needle valves, as shown on the drawings, shall be formed out when this structure is being built and poured about the valves at a later time when the valves are installed. The concrete used in grouting in the valves will be paid for at the same unit price as for the remainder of the concrete in the structure. The steel outlet pipes, sewer pipe drain, metal pipe and fittings for the operation of the valves, structural steel, anchor bolts and any other parts that require installation during the pouring of concrete shall be carefully placed in their proper locations. Payment for such installations will be made at the unit prices bid in the schedule. Payment for concrete and the placing of reinforcing steel will be made at the unit prices bid in the schedule.

336. Concrete—Parapet.—A reinforced concrete parapet wall shall be built along the top of the embankment at the location shown on the drawings or established by the contracting officer. Contraction joints shall not be placed in the parapet except at its junction with the spillway and remote control-house structures. The foundation for the footing of the wall shall be carefully prepared and the wall constructed accurately to line and grade. Conduits of the sizes shown on the drawings or designated by the contracting officer shall be placed in the upper part of the wall. Anchor bolts for holding the lamp-posts in position shall be accurately set at the time concrete is being poured. Placing of the conglomerate riprap and the embankment material above the footing of the wall shall be carefully done so as not to displace the wall. Payment for placing concrete in the parapet wall will be made at the unit price bid in the schedule. Payment for placing conduits will be made at the unit price per linear foot bid in the schedule. Anchor bolts will be placed as a part of the cost of installing lamp-posts and payment for the placing of reinforcing steel will be made at the unit price bid in the schedule.

337. Concrete—Cradles for 72-inch steel outlet pipes.—Concrete cradles for supporting the steel outlet pipes shall be constructed in the tunnel connecting the emergency gate chamber and the needle valve house. The dimensions and spacing of the cradles shall be as shown on the drawings or as directed by the contracting officer. The cradles shall not be constructed at the time the tunnel lining is being placed as the tunnel will be required for a diversion channel during the construction of the embankment and an unobstructed channel is required. The cradles may be constructed by pouring the concrete about the pipe after it has been completely fabricated and brought to alignment and grade and has been filled with water, or they may be constructed in advance of the time when the pipe is fabricated, in which case a space of 2 inches adjacent to the pipe shall be left to be grouted in after the pipe is fabricated and filled with water. Three thicknesses of tar paper shall be placed between the pipe and the concrete cradle, the entire surface of contact to be covered by the tar paper. Tar paper for this purpose will be furnished by the Government as provided in paragraph 277. Payment for constructing the cradles will be made at the unit price per cubic yard bid in the schedule.

338. Placing anchor bolts in concrete.—Anchor bolts shall be placed in the concrete structures where shown on the drawings or where directed by the contracting officer. Care shall be taken in placing all anchor bolts to insure that the proper length of bolt is left projecting beyond the face of the concrete and that the bolts are in their proper location in the structure and in their proper relation with each other. In case extreme accuracy is required, as in the setting of gates and operating machinery, the anchor bolts shall be placed with properly constructed templates. In general, all anchor bolts shall be placed at the time concrete is poured; however, in some instances it will be permissible, if approved by the contracting officer, to provide suitable recesses in the concrete for the placing of the anchor bolts at some later time. The practice of omitting anchor bolts at the time concrete is poured and later drilling holes in which they will be grouted, is objectionable, and will not be permitted, except in cases where the bolts are to be anchored in massive concrete sections, and then only with the approval of the contracting officer. Anchor bolts to be placed in recesses left in the concrete shall be carefully anchored with cement grout. The hole shall be completely filled with the grout and the anchor bolt forced into the grout. Payment for the placing of anchor bolts in concrete will be included in the prices bid for the concrete in which the bolts are placed or for the machinery anchored by the bolts.

339. Anchoring concrete walls and slabs to rock.—The concrete side slopes of the spillway channel and other concrete walls or slabs, shall be anchored to the bedrock as shown on the drawings or as directed by the contracting officer. The anchors for this purpose shall consist of metal rods or bars grouted into holes drilled
into the rock. The holes for this purpose shall be drilled to the required depth and shall be of such size as to permit of grouting the bars firmly into position. The holes shall be filled with cement grout or mortar of a mix and consistency specified by the contracting officer, and the rods or bars forced into place before the grout or mortar sets. The rods or bars and cement for the anchors will be furnished to the contractor as provided in paragraph 277. Measurement for payment for placing anchors will be made on the basis of the net depth of holes drilled, as required by the contracting officer, and no allowance will be made for the portion of the anchor rod projecting from the drilled hole. Payment will be made at the unit price bid in the schedule for drilling holes for anchor rods and grouting rods in place.

340. Rubble concrete paving downstream from spillway and outlet basin.—It is contemplated that the greater portion of the excavation for the channel immediately below the concrete lined portion of the spillway and outlet structures will be in bedrock. However, it is probable that the slope on the river side and possibly a portion of the base, for some distance below the end of the spillway and outlet basin will be excavated in material that under large discharges would be easily eroded. Where such material is encountered, it shall be removed to the depth below the required channel section, designated by the contracting officer and replaced by rubble concrete paving. The rock used for this purpose shall be the hardest and most durable available rock taken from other required excavation or from borrow. The paving shall consist of rock of the largest size that it is practicable to use, limited by the depth below channel grade to which the loose material has been removed; provided, that the contractor will not be required to handle individual rock exceeding 1 cubic yard in volume. Voids between the rock shall be filled with concrete in a manner satisfactory to the contracting officer, but the contractor will not be required to float or bed each rock in concrete. The surface of the paving shall be brought approximately to the lines and grades shown on the drawings or established by the contracting officers; provided, that a comparatively irregular or uneven surface will be permitted. Payment for rubble concrete paving will be made at the unit price per cubic yard bid in the schedule which price shall include the cost of sand and gravel and of all labor required in placing the paving, but it shall not include the costs of excavating the rock which will be paid for at the unit price bid in the schedule for the excavation of same. Cement will be furnished by the Government under the provisions of paragraph 277.

341. Construction of the remote control house.—The remote control house above the spiral stairway shaft at the crest of the embankment shall be accurately constructed to the lines and dimensions shown on the drawings or prescribed by the contracting officer. The part of the spiral stairway shaft extending up into the house is not to be considered as a part of this structure. All materials required for the construction of the completed house, excepting sand and broken rock or gravel for concrete, will be furnished by the Government, as provided in paragraph 277. The contractor shall haul all of the materials to the site of the house and construct and complete the house as shown on the drawings or as prescribed by the contracting officer. Payment for the construction of the house will be made at the lump sum price bid in the schedule, which price shall be the entire cost to the Government of constructing the completed house, except that payment for the installation of electrical conduit, wiring, and fittings, the motor and oil tank, and the placing of reinforcing steel will not be included in the lump-sum price bid for the construction of the house but will be made at the prices bid for these items in the schedule. The work included is as follows:

(a) Concrete foundation, walls, and floor.—Concrete shall be of the composition shown on the drawings or specified by the contracting officer. The embankment under the foundation walls shall be thoroughly compacted to the satisfaction of the contracting officer. These walls shall then be constructed to the base of the floor, after which time the embankment may be carried up around the walls and the space within the walls shall be thoroughly puddled with selected material. Care shall be taken in placing the embankment about the foundation and in puddling the material within the walls to keep the pressure against opposite sides of the walls as nearly balanced as practicable. After the puddled back fill has been prepared for a foundation to the floor, the floor and concrete walls may then be placed. Dowels for anchorage of the motor and oil pump and tank bases shall be placed in the concrete floor, and the concrete for these bases shall be poured at the time this equipment is placed. The placing of the dowels, the pouring of the concrete bases, and the puddling of the back fill shall be done as a part of the work of constructing the house.

(b) Structural-steel roof trusses.—Structural-steel roof trusses and hip rafters, separately fabricated, will be furnished to the contractor. The rafters shall be field riveted to the trusses and the whole shall be placed and painted by the contractor in accordance with the drawings and in a manner satisfactory to the contracting officer.

(c) Metal doors and windows.—The metal doors and the metal sash windows, together with casings, anchors, clips, hardware, glass, putty, and all other parts, will be furnished to the contractor. The contractor shall install, glaze, and paint the doors and windows in a workmanlike manner satisfactory to the contracting officer.

(d) Roof system.—Lumber, tile, roofing felt and all other materials required for the construction of the roof system will be furnished to the contractor. The contractor shall place and attach all these materials in
a workmanlike manner, satisfactory to the contracting officer. The contractor shall be responsible for all roofing materials furnished and shall use care in handling the roofing tile to avoid breakage, and will be charged for all tile broken in excess of 2 per cent of the number of each kind of tile furnished, in the event that such tiles are broken to an extent that, in the opinion of the contracting officer, they are unfit for use.

(e) Electrical apparatus and control equipment.—The installation of electrical apparatus and control equipment will be paid for separately and will not be considered as a part of the work of constructing the control house.

(f) Painting.—All exposed metal and timber surfaces shall be painted. Paragraph 370 of these specifications in regard to painting will apply to painting to be done in the remote control house.

342. Construction of the needle-valve house.—The needle-valve house above elevation 5,458.67 shall be constructed on top of the needle-valve structure. The house shall be accurately constructed to the dimensions shown on the drawings. At the time the needle-valve structure is being constructed, these dowels will bond the concrete of the side walls to the concrete of the needle-valve structure. Construction may be continuous from the needle-valve structure to the house above or, if the contractor prefers, he may construct the house after the needle valves are installed, or at such later time as he may desire before the required date of completion specified in the contract as determined by the contracting officer. All materials required for the construction of the completed house, excepting sand and broken rock or gravel, will be furnished by the Government as provided in paragraph 277. The contractor shall haul all of the materials to the site of the house and construct and complete the house as shown on the drawings or as prescribed by the contracting officer. Payment for the construction of the house will be made at the lump-sum price bid in the schedule, which price shall be the entire cost to the Government of constructing the completed house, except that payment for the installation of electrical conduits, wiring, and fittings, railings, motor, oil pump, oil tank, and other operating equipment, also the placing of reinforcing steel will not be included in the lump-sum price bid for the construction of the house but will be made separately at the prices covering these items in the schedule. The work included is as follows:

(a) Concrete walls.—The general paragraphs Nos. 312 to 326, inclusive, of these specifications pertaining to concrete will be applicable to the concrete of the walls. The pouring of the concrete bases for the motor, oil pump, and oil tank shall be included as a part of the work of constructing the house.

(b) The provisions of paragraph 341, in regard to the structural-steel roof trusses, metal doors and windows, roof system, electrical apparatus and control system, and painting will also apply to the construction of the needle-valve house.

(c) Locker.—The locker shown on the drawings shall also be constructed and painted as a part of the house, and the cost of this work will be included in the lump-sum price bid.

CONSTRUCTION OF UPSTREAM CUT-OFF

343. Cut-off—General description.—An impervious cut-off shall be constructed under the upstream portion of the embankment. The pervious underlying stratum of sand and gravel shall be excavated along the line of the cut-off and this material replaced with impervious material that shall be bonded into the bedrock at the bottom and into the sprinkled and rolled clay, sand, and gravel portion of the embankment above. The cut-off as a whole will be of several different types of construction. The general location, design, or type of construction is shown on the drawings, but the exact location where the various types will be used, as well as the exact details of these types, will be subject to change by the contracting officer to suit the foundation conditions, at any time during the progress of the work. The type of cut-off to be used at different locations will depend largely on the relative thicknesses of the two strata of material above the bedrock. Where the stratum of pervious sand and gravel is thick it is contemplated that an open cut with sloping sides will be excavated through all of the overlying strata to the bedrock. A reinforced concrete wall of the dimensions shown on the drawings or designated by the contracting officer will be constructed in the middle of this open cut, the base being founded in a trench in the bedrock. The open cut will then be filled with sprinkled and rolled clay, sand, and gravel as used for the main body of the embankment. At other locations, where the pervious stratum of sand and gravel is thin and the overlying stratum of impervious clay, sand, and gravel is relatively thick, it is contemplated that tunneling or stoping will be resorted to and the tunnel thus excavated will be filled with concrete. Where the overlying impervious material is of less thickness and such that other methods of excavation would be more economical, an open cut with sloping sides will be excavated to a depth to be determined by the contracting officer, and an open trench with vertical sides excavated from the base of this open cut through the earth and gravel material and into the bedrock. A concrete wall will be constructed in the bottom of this trench and the remainder of the trench with vertical sides will be filled with puddled clay. If other
types of construction are found necessary or desirable as the work progresses, the work required for such construction will be ordered in writing by the contracting officer, and payment will be made therefor as extra work under the provisions of article 5 of the contract and paragraph 10 of these specifications.

344. Cut-off—Reinforced concrete in open cut.—The contractor shall construct a reinforced concrete wall in the base of the open cut excavation. This wall shall be founded in a trench to be excavated into the bedrock. The dimensions of the wall shall be as shown on the drawings or as directed by the contracting officer. Measurement for payment will be made to the neat lines specified, and payment will be made at the unit price bid therefor in the schedule.

345. Cut-off—Plain concrete in open trench.—A plain concrete wall shall be constructed in the bottom part of the trench to be excavated with vertical sides. The wall shall be founded in a trench to be excavated into the bedrock and its top shall be carried at least 5 feet above the top of the pervious formation. Forms will not be required in case the sides of the trench are firm enough to permit of the concrete being placed directly against them. Care shall be taken to prevent earth or other substances from falling into the concrete during placing, and if the nature of the soil excavated is such as to require it, the earth walls of the trench shall be properly timbered or otherwise supported to prevent their caving in during excavation or the placing of concrete. All such timbering shall be completely removed at the time concrete is placed. Earth or other substances falling into freshly placed concrete shall be removed to the satisfaction of the contracting officer. Cavities excavated outside of the neat lines of the sections as shown on the drawings or as designated by the contracting officer shall be filled with concrete by the contractor and at his expense, except that cement for this purpose will be furnished by the Government. Measurement for payment will be made to the neat lines specified, and payment will be made at the unit price bid therefor in the schedule which price shall include the cost of materials for forming, should forming be required.

346. Cut-off—Plain concrete in stopped excavation.—The part of the cut-off to be excavated by stoping or tunneling shall be backfilled with plain concrete of the composition and consistency designated by the contracting officer. The bottom of the concrete shall be founded in a trench excavated into the bedrock. The top of the concrete shall extend into the impervious stratum above the pervious sand and gravel stratum a minimum of 5 feet. The method of depositing the concrete shall be satisfactory to the contracting officer and such as will insure that the tunnel is completely filled with concrete. The concrete may be deposited through shafts extending from the tunnel to the ground surface, but if such shafts are excavated the cost of such excavation shall be borne by the contractor and the contractor shall also back fill them at his own expense in a manner satisfactory to the contracting officer. Care shall be taken to prevent loose earth from falling into the concrete during placing. Cavities excavated outside of the neat lines of the sections as shown on the drawings or as designated by the contracting officer shall be filled with concrete by the contractor and at his expense, except that cement for this purpose will be furnished by the Government. Measurement for payment will be made to the neat lines of the excavation as shown on the drawings or as directed by the contracting officer, and payment will be made at the unit price bid therefor in the schedule.

DRAINAGE

347. Drainage—General.—The Government will furnish under the provisions of paragraph 277 all drain tile, sewer pipe, timber for V-drains, and black metal pipe, required for the drainage system. Timber for the V-drains will be furnished in stock lengths and the contractor shall cut and assemble it as required. Black metal pipe will be furnished in stock lengths with a sufficient supply of couplings. The contractor shall cut, thread, and assemble the pipe. The contractor shall haul and place all of this material as shown on the drawings or as directed by the contracting officer. The contractor shall also furnish and haul all gravel required about drain st and for the gravel base under the spillway structure, also all nails, tar paper, burlap, oakum, or other materials required for the installation of the drains. The contractor will be responsible for all breakage of tile or sewer pipe after delivery to him.

348. Drains at downstream toe of embankment.—The contractor shall lay 8-inch and 12-inch drain tile in the small trench to be excavated into the impervious clay, sand and gravel soil at the downstream toe of the embankment. An even bed shall be prepared and the drain tile shall be carefully laid to the lines and grades shown on the drawings or established by the contracting officer. The drain tile shall be laid with open joints in a thoroughly workmanlike manner and as directed by the contracting officer. The drains will be located at the base of the gravel and cobble blanket on the downstream face of the dam, and the trench about the drain tile shall be carefully back filled with gravel, care being taken not to displace the tile during the placing of the back fill. Measurement for payment for laying drain tile will be made from end to end of the pipe as laid in the trench. Payment for laying such tile will be made at the unit prices bid in the schedule, which prices shall include the cost of all labor required in unloading, hauling, storing, handling, preparing the bed, laying
the tile, and placing such amount of gravel back fill as is necessary to hold the tile in position while the remainder of the trench is being filled with the gravel and cobbles.

349. Drains under floor of spillway.—A complete drainage system shall be installed under the floor of the spillway gate structure and channel, as shown on the drawings or as directed by the contracting officer. Sewer pipe of 6-inch diameter shall be used for this drainage system, and the pipe shall be carefully laid to the lines and grades shown on the drawings or established by the contracting officer. Under the gate structure and under the part of the spillway channel having an earth foundation, the pipe will be laid in the gravel base, a small trench only being required to provide a proper bed for the pipe and to permit of the pipe being embedded in gravel to the required depth below the concrete floor. Under the part of the spillway channel having a rock foundation, a trench shall be excavated into the rock at the location and of the dimensions shown on the drawings or as directed by the contracting officer, and the pipe shall be carefully bedded and laid in this trench and the trench completely back filled with clean open gravel or broken rock. All of the pipe shall be laid in a thoroughly workmanlike manner, with partially open joints, care being taken in placing the gravel back fill not to disturb the pipe that has been laid. Single sections of pipe shall also be placed in the cut-off walls of the gate structure where shown on the drawings or as directed by the contracting officer, to permit of free access to the outlet drains, of such water as may accumulate in the gravel base. Measurement for payment for laying or placing sewer pipe, as provided in this paragraph, will be made from end to end of the pipe as laid in the trench, no allowance being made for the lap at joints. The nominal length will be taken as the length of single pipe sections placed in cut-off walls. Payment for laying the sewer pipe will be made at the unit price per linear foot bid in the schedule for laying 6-inch sewer pipe under floor of spillway structure. This unit price shall include the cost of all labor and equipment required in unloading, hauling, storing, handling, bedding, and laying the sewer pipe and completely filling the trench, in rock sections, with gravel back fill and placing such amount of gravel back fill as is necessary to hold the pipe in position while the gravel base is being placed, under the portion of the concrete floor resting on earth foundation.

350. Placing gravel under spillway channel and gate structure.—A part of the drainage system for the spillway structure will consist of the gravel base to be placed downstream from the radial gates, and under the portion of the structure to be placed on an earth foundation. The gravel base shall consist of screened gravel carefully placed and compacted as shown on the drawings or as directed by the contracting officer. The material used for this purpose shall be subject to the approval of the contracting officer and shall be obtained from the required excavations or from borrow pits approved by the contracting officer. Measurement of the quantity of gravel in the gravel base will be made in place. Payment will be made at the unit price bid therefor in the schedule.

351. Drain under outlet structure.—An 18-inch sewer pipe drain shall be placed under the outlet structure as shown on the drawings or as directed by the contracting officer. A trench as shown on the drawings shall be excavated into the rock foundation under the structure. The inlet end of the pipe shall be laid with closed joints and shall be completely encased in concrete; the remainder of the pipe shall be laid with partially open joints and shall be completely surrounded with a well graded screened gravel, compacted so as to completely fill the trench. Tar paper shall be placed over the trench to prevent the concrete of the floor from entering the gravel or the joints of the pipe. The tar paper for this purpose shall be furnished by the contractor. Measurement for payment for laying or placing sewer pipe, as provided in this paragraph, will be made from end to end of the pipe in place, no allowance being made for the lap at joints. Payment for laying the pipe will be made at the unit price bid in the schedule for laying 18-inch sewer pipe under outlet structure, the unit price to include all labor and equipment required in unloading, hauling, storing, handling, laying and back filling the trench with gravel. The cost of furnishing tar paper and the gravel for the back fill shall be included in the unit price bid.

352. Drainage system about emergency gate structure.—A complete drainage system shall be installed about the emergency gate structure to prevent the entrance of seepage water as may develop. The complete system will consist of 6-inch wooden V-drains, 4-inch tile drains and 6-inch black metal pipe drains. All drains will communicate with each other and shall be installed as shown on the drawings or as directed by the contracting officer. The wooden V-drains will be used to collect the water from the upper, outside surface of the structure and to lead it to the 4-inch tile drains placed in a horizontal position at about the elevation of the top of the tunnels. The V-drains will consist of two 1-inch by 6-inch boards nailed together so as to produce a 90° angle trough. These troughs shall be so placed and secured against the rock walls of the excavation as to provide V-shaped drainage passages, after concrete has been placed, along the line of contact of the concrete and rock. Extreme care shall be taken in placing the drainage troughs to secure a mortar-tight contact between the troughs and the rock walls. Tar paper, burlap, oakum or other materials may be required for this purpose. All such materials shall be furnished by the contractor. The manner of placing, securing and calking wooden V-drains shall be satisfactory to the contracting officer. The 4-inch tile drains shall be placed in screened gravel pockets or trenches. The gravel shall be well compacted and the tile carefully laid with open joints in a workmanlike manner.
manner such as will insure that the finer portions of the gravel back fill can not be leached out and the alignment of the drains be disturbed during their operation. The 6-inch black pipe drains shall be placed in a vertical position as shown on the drawings or as directed by the contracting officer, and will be used to convey the water from the upper part of the drainage system to the tile drains at the base of the structure. Measurement for payment for placing all drains of this system will be made from end to end of the drains in place. Payment will be made at the unit prices bid in the schedule, which prices shall include the cost of all equipment and labor required in unloading, hauling, storing, handling, and placing the drains. For the 6-inch black pipe the unit price shall include the cost of cutting and assembling the pipe. For the wooden V-drains it shall include the cost of assembling and capping the drains and of furnishing all tar paper, burlap, oakum and nails as required. For the tile drains it shall include the cost of furnishing and placing the gravel back fill about the tile.

GROUTING

353. Requirement for grouting.—As the work progresses it may be found desirable to grout under pressure the rock surrounding the tunnel, under the spillway, or elsewhere on any part of the work. The amount of grouting to be done is unknown and may vary from nothing to several times the amount called for in the schedule. The quantities of work relating thereto in the schedule are only for the purpose of comparing bids, and the contractor shall not be entitled to any extra compensation on account of variations in these quantities. All grouting required will be ordered by the contracting officer.

354. Drilling grout holes.—Holes for grouting shall be drilled into the rock as directed by the contracting officer. Grout holes shall not be less than 1 inch in diameter at the bottom. It may be found necessary, after all the holes in a given region have been drilled and grouted, to drill additional holes. All such holes shall be drilled by the contractor at the unit price bid in the schedule, with no extra allowance for the moving of equipment or other expense incidental to returning to an area previously grouted or moving into a new area. The right is reserved to change the depth, spacing, or location of the holes as the work progresses, and the contractor shall not be entitled to extra compensation because of such changes: Provided, that the contractor will not be required to drill any hole to a depth greater than 30 feet at the price bid in the schedule. If any hole is required to be drilled to a depth greater than 30 feet, payment will be made therefor as extra work under the provisions of article 5 of the contract and paragraph 10 of these specifications. All drilled holes shall be carefully plugged at the top in a temporary manner to prevent accidental obstruction. Payment will be made only for the length of holes actually drilled, exclusive of any pipe or formed hole in the concrete through which the drilling may be done, at the unit price bid therefor in the schedule, which price shall include the cost of all labor, materials, plant, and operation required for drilling holes and maintaining them free from obstruction until grouted.

355. Setting pipe for grout holes and grout connections.—Metal pipe for grout holes or grout connections shall be placed in the concrete wherever required, as directed by the contracting officer. Pipes for grouting shall also be set over springs or crevices in the rock or wherever directed by the contracting officer. As the work progresses, additional grouting may be required, in which case holes will be drilled through the concrete and into the surrounding or underlying rock, if required, and pipes for grout connections set as directed by the contracting officer. The size of these pipes for each hole will be determined by the contracting officer to meet the requirements of the drilling and grouting equipment used. Pipe for the purpose will be furnished by the Government under the provisions of paragraph 277. The pipe will be furnished in stock lengths, and it shall be cut, threaded, fabricated as required, and grouted or anchored in place by the contractor. Payment for all work described in this paragraph will be made at the unit price per pipe bid in the schedule, and no variation will be made on account of the varying size or length of pipe required.

356. Method of grouting.—Each drilled grout hole and grout connection shall have forced into it under a pressure of 100 pounds per square inch, unless a lower pressure is specified by the contracting officer, a grout composed of cement and water, or, where specifically ordered by the contracting officer, of cement, sand, and water, in the proportions to be determined by the contracting officer. Sand for pressure grouting shall be clean and of such fineness that 100 per cent will pass a screen with 64 openings per square inch and 50 per cent will pass a screen with 1,600 openings per square inch. The apparatus for mixing and placing grout shall be of a type approved by the contracting officer and capable of effectively mixing and stirring the grout and forcing it into the holes at any desired pressure up to 100 pounds per square inch. If, during the grouting of any hole, grout be found to flow from adjacent grout connections in sufficient quantity to seriously interfere with the grouting operation or to cause appreciable loss of grout such connections may be temporarily capped. Where such capping is not essential unggrouted holes shall be left open to facilitate the escape of air and water as the grout is forced in. Cement for grouting will be furnished by the Government. Grouting will be paid for at the unit price bid therefor in the schedule. This unit price shall include the cost of all labor and material, except cement, and all plant and every operation incidental to the grouting. Suitable stop valves shall be provided in the grout
line between the machine and the grout connection for use in maintaining the pressure as required until the grout has set. The placing of the pipe connections will be paid for separately at the unit price bid therefor in the schedule as provided in paragraph 355. The unit of measure for payment for pressure grouting will be 1 cubic foot, which will be considered as the amount of grout made from one sack of cement. Payment will be made for each cubic foot of grout or fractional part thereof actually forced into the holes. No payment will be made for grout lost due to improper anchorage of grout pipes, or for grout rejected by the contracting officer on account of improper mixing, and the contractor will be charged for any cement used in such wasted or rejected grout the same amount that it costs the Government.

**MISCELLANEOUS CONSTRUCTION**

357. Timber walk along 72-inch outlet pipe.—The contractor will be required to haul and place all timber required for the walk between the two 72-inch outlet pipes and the timber stairway leading up into the emergency-gate chamber. Timber for the purpose will be furnished to the contractor by the Government as provided in paragraph 277, and shall be hauled and placed as shown on the drawings or as directed by the contracting officer. The timber as delivered will be of standard stock sizes and lengths, and the contractor shall cut it to the dimensions required. Care shall be taken by the contractor to cut the timber furnished to the best advantage and with the least practicable amount of waste. Measurement for payment for erecting the timber will be made on the basis of commercial cross-sectional dimensions and the net lengths of pieces required. The unit price bid in the schedule shall include the cost of all work required by this paragraph, including the cost of placing all nails, bolts, or other fastenings necessary to hold the timbers in place. Nails and spikes larger than 20d in size, and all bolts or other fastenings necessary to hold the timbers in place will be furnished by the Government. Nails of 20d size or smaller shall be furnished by the contractor.

358. Wood guardrail and standard highway fence.—Guard railing or fencing shall be built along the portion of the relocated Lincoln Highway to be constructed as a part of the work required in connection with the construction of the embankment for Echo Dam. All of this work is covered by schedule 2. These railings or fences shall be built at the locations shown on the drawings or where directed by the contracting officer, and shall conform in all respects to the provisions of paragraphs 255 to 267 of part 2 of these specifications. All lumber, paint, creosote, wire mesh, staples, boat spikes, and any other materials required will be furnished to the contractor as provided in paragraph 277. Payment will be made at the unit prices bid therefor in schedule 2.

**STRUCTURAL STEEL, METAL WORK, AND PAINTING**

359. Installing metal work—General.—The radial gates, emergency gates, needle valves, and their operating mechanisms, steel outlet pipes, trash-rack metal, roof trusses, metal stairways, handrails, structural steel, checkered plates, crane, and other metal work required as parts of the completed structures will be furnished to the contractor by the Government as provided in paragraph 277. The contractor shall attach to or build into the dam or related works all such metal work, in a workmanlike manner, as shown on the drawings or as directed by the contracting officer. A part of the metal work as furnished will have been given one or more shop coats of paint. This paint coating shall be protected as much as is practicable during the handling of the metal work and after installation all unfinished surfaces not embedded in concrete shall be painted as provided in paragraph 370. Except as otherwise provided in these specifications payment for installing and painting all metal work will be made to the contractor at the unit prices bid in the schedule, which prices shall include the cost of unloading, hauling, storing, handling, assembling, erecting, adjusting, installing, and painting the materials, machinery, and equipment furnished, and maintaining in position or operating condition until final acceptance by the Government. The cost incidental to hauling, installing, and painting piping not directly connected with operating or control mechanisms, and of handholes and frames, back-pressure turnout gate, and other items of metal work not specifically mentioned or provided for, shall be paid for at the unit prices bid in the schedule for installing or placing the gates or valves and their operating mechanisms, or other metal work covered in the schedule, to which such miscellaneous items of metal work are most nearly appurtenant, as determined by the contracting officer. The cost of placing the metal work of the remote control and needle-valve houses will be covered by the lump-sum bids made in the schedule for the construction of these houses. The cost of placing structural steel, gates, valves, and miscellaneous metal work shall include the cost of making minor changes and the correction of such minor errors in the various parts as may be expected to occur, as determined by the contracting officer, in the ordinary commercial grade of shop work in fabrication and manufacture of such materials.

360. Installing high-pressure emergency gates.—The emergency gates, gate hangers, conduit linings, by-pass piping, pressure pumps, oil tanks, control piping, and all other parts required for the installation and operation of the gates, also the metal doors between the emergency-gate structure and the outlet tunnel, will
be furnished complete for installation. The gates and pressure pump shall be assembled and placed by the contractor in accordance with the drawings or as directed by the contracting officer. All necessary precautions shall be taken to prevent displacement of or damage to metal parts. Rich concrete or mortar shall be thoroughly spaded around the gate bodies, conduit linings, and by-pass piping as directed by the contracting officer to secure proper adhesion and prevent leakage. After the gates and control apparatus have been placed each gate shall be tested by being raised and lowered several times throughout its full stroke. Any adjustments in setting or installation required to secure satisfactory operation, as determined by the contracting officer, of the gates and control apparatus shall be made by the contractor at his own expense; provided, that if any part of the mechanism is found to be defective due to no fault of the contractor, as determined by the contracting officer, the contracting officer may order the contractor to correct such defects, and payment will be made therefor as extra work under article 5 of the contract and paragraph 10 of these specifications.

361. Installing high-pressure control piping and oil tanks for emergency gates.—All extra-heavy pipe, fittings, and valves, and oil-storage tanks for installation in the lower outlet tunnel and in the remote control house, for controlling the operation of the emergency gates will be furnished complete for installation. The pipe will be extra-strong galvanized, furnished in random lengths, with an assortment of nipples. Fittings will be extra-heavy galvanized malleable. The pipe shall be cut to the required lengths and threaded, and the control pipe system shall be installed as shown on the drawings or as directed by the contracting officer. The control pipe system will operate under a pressure of 1,000 pounds per square inch, and special care shall be taken to assure that all threads are full cut; and where necessary, threads on pipe and fittings shall be recut or retapped to insure a proper fit. A mixture of litharge and glycercine to be furnished by the contractor shall be used in all threaded joints. Care shall be taken in cutting and fitting to have pipe runs parallel and to have the control-valve installation in the valve house and emergency-gate structure neat in appearance, and securely fastened in place.

362. Installing 72-inch outlet pipes.—The 72-inch plate steel outlet pipe will be furnished shop fabricated in sections from 18 to 20 feet in length, with flanges and manhole and drain saddle connections in place, and all holes for field riveting punched, reamed, and countersunk. The circumferential joints to be riveted in the field will be single-riveted outside butt-strap joints, with rivets countersunk on the inside. Rivets will be cone or button head, shall be driven hot from the inside, and shall completely fill the holes. Any projection at the rim of the rivet on the inside shall be chipped or ground flush with the plate. All loose, burned, or otherwise defective rivets shall be cut out or removed by drilling, if necessary, and replaced. Drift pins may be used to bring together the several parts, but drifting with such force as to disturb the metal will not be allowed. All butt straps shall be carefully calked on the outside with a round-nose tool. The contractor shall properly support the pipe in a manner approved by the contracting officer until the permanent concrete piers are completed. All the cost of these temporary supports shall be borne by the contractor and they shall be removed by him. Three thicknesses of tar paper furnished by the Government for this purpose as provided in paragraph 277 shall be placed between the concrete piers and the pipe. After the pipes have been placed, connected to gates and valves, and expansion joints packed, all open spaces between the plates at the joints shall be caulked with lead wool. After the pipes have been painted and the paint has dried, each pipe shall be tested by and at the expense of the contractor by being filled with water and subjected to a hydraulic test pressure of 100 pounds per square inch. All leaks shall be stopped by caulkings or other means satisfactory to the contracting officer and any exposed metal re-covered with paint. The contractor will be responsible for all damage done during testing.

363. Installing radial gates.—The radial gates and their hoisting mechanism shall be assembled, installed, and painted, and the hoisting mechanisms, including motor controls, limit switches, and automatic float controls, shall be adjusted for proper operation by the contractor as shown on the drawings or as directed by the contracting officer. Field riveting of the radial gates will be required as shown on the drawings. After the gates have been installed each gate shall be tested for satisfactory operation by being raised and lowered several times through the full arc of travel. Any change in the setting or installation of the gates or hoisting mechanism necessary to secure satisfactory operation shall be made by the contractor at his own expense; provided that if any part of the mechanism is found to be defective, due to no fault of the contractor, as determined by the contracting officer, the contracting officer may order the contractor to correct such defects, and payment therefor will be made as extra work under article 5 of the contract and paragraph 10 of these specifications. Payment for making and placing the concrete counterweights for the radial gates will be made at the unit price bid in the schedule for concrete in the spillway structure.

364. Installing balanced needle valves.—The balanced needle valves and control mechanisms furnished shall be assembled and placed by the contractor as shown on the drawings or as directed by the contracting officer. All necessary precautions shall be taken to prevent displacement of or damage to metal parts. Rich concrete or mortar shall be poured around the valve bodies, in the supporting wall, as shown on the drawings and in a manner satisfactory to the contracting officer. White lead shall be used on the finished faces of the
large valve castings. The control mechanisms shall be carefully installed so that all parts move freely within each other, and any adjustments required to secure satisfactory operation shall be made by the contractor at his own expense; provided, that if any part of the mechanism is found to be defective due to no fault of the contractor, as determined by the contracting officer, the contracting officer may order the contractor to correct such defects, and payment therefor will be made as extra work under the provisions of article 5 of the contract and paragraph 10 of these specifications.

365. Installing metal stairs and floor system in the needle-valve structure.—The structural beams and channels for the metal floor system of the needle-valve structure will be cut to dimensions with holes for field fabrication accurately drilled or punched and with all necessary clip angles, plates, and anchor bars required for erection in the field. The beams and channels shall be securely anchored to the concrete structure and the checkered floor plates shall be placed in their proper positions as shown on the drawings or directed by the contracting officer. The metal stairs leading from the outlet tunnel to the needle-valve house will also be furnished completely fabricated. The stairs shall be placed and secured in position as a part of the work included in this paragraph. All work shall be done in a workmanlike manner and to the satisfaction of the contracting officer.

366. Installing gantry crane and rail.—The gantry crane will be of structural steel, shop fabricated in three assembled sections, as shown on the drawing. The contractor shall rivet these sections together, adjust the chain-operating mechanism, install the rail, and connect the chain hoist (not shown on the drawing) at the unit price bid therefor in the schedule.

367. Installing metal work in trash-rack structure.—The castings, structural channels, and trash-rack bars furnished will be of the exact dimensions required for the structure. The castings and structural channels shall be accurately anchored to the concrete structure with anchor bolts or bars provided for this purpose. The trash-rack bars will require only setting into position in the rack. Dipping of trash-rack bars will be permitted in lieu of the brush painting called for.

368. Installing spiral stairs.—The metal treads, landings, pipe axis, and other accessories required for the complete installation of the spiral stairs, will be furnished complete, ready for installation. The contractor shall assemble, erect, and paint this material as shown on the drawings or as directed by the contracting officer.

369. Installing pipe handrailing.—Pipe for the handrailing of the spiral stairway and of the spillway operating platform and for any other location where pipe handrailing may be required, will be furnished to the contractor properly fabricated and complete for installation. The pipe as furnished will be cut to length, threaded, bent to shape, and complete with fittings, bolts, rivets, and any other accessories necessary for installation. The railings shall be carefully assembled and placed as shown on the drawings or as directed by the contracting officer. Railings to be set in concrete shall either be completely assembled and placed when concrete is poured or recesses shall be left in the concrete to receive the railing posts and the railings completely assembled and grouted in position with cement grout at some later time.

370. Painting.—All exposed, unfinished metal surfaces shall be painted by the contractor. Where such parts have been painted before delivery to the contractor, care shall be taken in unloading, handling, hauling, and erecting such parts to preserve the shop paint in the best practicable condition. After erection the contractor shall thoroughly clean all painted surfaces and repair all damaged places in the original paint film as directed by the contracting officer. After these repaired areas have thoroughly set one or more field coats of paint shall be applied to the exposed surfaces, as herein provided. The cast-iron linings for outlets, the leaves, frames, and other submerged parts of the hydraulically operated sluice gates, the inside and outside surfaces of the steel outlet pipes, all parts of the spillway radial gates, and guides and surfaces of the metal work in the trash racks not embedded in the concrete, shall be given one coat of water-gas tar followed by two coats of coal-gas tar applied hot. Finished surfaces and surfaces of metal work in contact with concrete shall not be painted except as directed by the contracting officer. Other exposed metal work, except pipes in handrails, shall be given one or more coats of oil paint of a color to be specified by the contracting officer. Pipe handrails shall be given a priming coat of red lead in oil and two additional coats of oil paint of a color to be specified by the contracting officer. All painting shall be done in a skilful and workmanlike manner satisfactory to the contracting officer and all coats of paint shall be permitted to properly dry before succeeding coats are applied. All tar and other paint materials will be furnished to the contractor by the Government, as provided in paragraph 277. The cost of unloading, hauling, storing, handling, and applying the paint, and the cost of all work, operations, and equipment required for painting shall be included in the prices bid in the schedule for erecting and painting the various items of metal work, except that the roof trusses and other metal parts to be installed in the needle valve and remote control houses shall be installed and painted by the contractor, at no additional expense to the Government above the lump sum prices bid in the schedule for the construction of these houses.
371. Weights of metal parts.—The weights of metal and other parts, the handling and placing of which under the schedule is to be paid for on the basis of weight, will be determined by the contracting officer. The weights of these items given in the schedules are advance estimates for the purpose of comparing bids only, and the actual weights may vary widely therefrom. The Government will not provide scales for actually weighing all this material and the contracting officer will determine the weight of each part or item involved in the most practicable manner and will use for that purpose, where possible, weights obtained from such sources as railroad shipping weights, manufacturers weights, catalog weights and estimated weights, subject to the provisions of article 15 of the contract, in case of dispute. Net weights only will be paid for and the weight of all tare, packing, blocking, etc., will be deducted.

ELECTRICAL INSTALLATIONS

372. Installing electrical equipment—General.—Electrical conduits, conduit boxes, distribution cabinets, lamp-posts, ball globes, lamp globes, fittings, anchor bolts, conductors, wire, insulating tape and compounds, solder and flux, and any other materials required for the electrical installations will be furnished by the Government as provided in paragraph 277. The contractor shall install all electrical equipment in a workmanlike manner, as shown on the drawings or as directed by the contracting officer. Payment for installing electrical equipment will be made to the contractor at the prices bid in the schedule, which prices shall include the cost of unloading, hauling, storing, handling, installing, testing, and maintaining in position or operating condition, until final acceptance by the Government. The cost of installing motors, limit switches, and such other pieces of equipment that are a definite part of the control mechanisms of gates and valves, shall be included in the unit prices bid in the schedule for the installation of such gates and valves.

373. Installing electrical conduits and equipment.—The contractor shall install all electrical conduits, conduit boxes and fittings, and all distribution cabinets in their correct positions. Conduits or fittings about which concrete is to be placed shall be securely held in position during the pouring of concrete. Conduit installations shall be made in accordance with the “Current National Electrical Code Rules.”

374. Installing electrical conductors, fittings, and apparatus.—The electrical installations required will be approximately as shown on the wiring diagram. The work to be done under the provisions of this paragraph and at the lump-sum price bid in the schedule, shall include the pulling of all wires into the conduits and the mounting and connecting of all electrical fittings and apparatus, complete, ready for operation. The contractor shall test all installations to establish satisfactory operation. The contractor shall provide all necessary tools or equipment for performing the work. The main transformer station indicated on the wiring diagram will not be constructed under these specifications.

375. Installing lamp-posts.—The contractor shall install metal lamp-posts on the parapet wall and on the railing of the spillway operating platform, at the locations shown on the drawings or designated by the contracting officer. The posts shall be securely anchored to the concrete walls by bolts set in the concrete. The installation shall be complete, ready for operation, with all fittings and globes in place. After installation the light circuits shall be tested for satisfactory operation. The cost of painting the lamp-posts as provided in paragraph 370 shall be included as a part of the cost of installations.
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SALT LAKE BASIN PROJECT-UTAH
ECHO RESERVOIR
GENERAL MAP

CENTER LINE LOCATION
OF PARK CITY BRANCH
UNION PACIFIC

CENTER LINE LOCATION
OF LINCOLN HIGHWAY

ECHO

RANGE 5 EAST
RANGE 4 EAST

Scale of Feet

DRAWING NO. 1

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SALT LAKE BASIN PROJECT-UTAH
ECHO RESERVOIR
GENERAL MAP

DRAWN: 
RECORDED:

CHECKED:
APPROVED:

DEER, COLO., DEC. 20, 1924

179-9-58
No. 1

Highway

Embankment + Excavation

No. 2

Railroad

Embankment + Excavation

No. 3

Excavation

Highway

No. 4

Railroad

Embankment + Excavation

Note: Wares Railroad and Highway center lines are more than 30 feet apart, use sections Nos. 1 and 2.

3/4:1 slope in rock cut only.

1/10:1 slope in earth cuts and in fills except in reservoir cut of highway fills above Dam.

(see page 271 to 277, where slope is 2:1)

NOTE: Typical Sections = Railroad Relocation sections 56+ to 61+ and Highway Relocation section 28+ to 30+ indicate sections as finally completed. During construction a detour for the Relocated Highway between highway center lines 22+ and 30+ will be built around the right embankment of the Echo Dam. The quantities for the construction of the detour are included in the schedule for the completion of the Relocated highway. The quantities for the construction of the Echo Dam, the width of roadway, and the embankment quantities included in the schedule for Dam.
Variable depending on nature of foundation material, frost and flood water conditions.

Slope pipe not less than 1" in 8'.

All concrete to be 1:2:4 mix. All exposed masonry corners to be chamfered with 1/8" triangular strips.

Where Corrugated Galvanized Iron or Galv. Iron is approved for use in Culverts, details of End Walls for same are to be similar to details shown on this Drawing.
FOR RAILROAD CULVERTS
For culverts under railroad embankments and
under highway embankments that are contiguos
with adjacent railroad embankments.

FOR HIGHWAY CULVERTS
For culverts under highway embankments
where separated from railroad embankments.

LONGITUDINAL SECTION
HALF SECTION-HALF END VIEW

RAILROAD CULVERTS - TYPE I
DETAILS OF PIPE NOT SUBJECT TO SUBMERGENCE AND UNDER
FILLS OF NOT LESS THAN 3 FEET OR MORE THAN 18 FEET.

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Details based on Drwg. No. 33578 furnished by the Union Pacific Railroad Co.

RAILROAD CULVERTS - TYPE II
DETAILS OF PIPE SUBJECT TO PARTIAL OR ENTIRE SUBMERGENCE OR
UNDER FILLS OF MORE THAN 18 FEET AND LESS THAN 30 FEET.

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Details based on Drwg. No. 33578 furnished by the Union Pacific Railroad Co.

HIGHWAY CULVERTS - TYPE III
DETAILS OF PIPE

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Details taken from Drawing No. 0-203 furnished by State Highway Commission of Utah.

NOTE:
PIPE TO BE SIMILAR TO MASSEY ROUND TONGUE AND GROOVE PIPE OR EQUAL. THIS PIPE SHALL BE
USED IN ALL LOCATIONS WHERE PIPE IS EITHER PARTIALLY OR ENTIRELY BELOW HIGH WATER
LINE IN RESERVOIR; OR WHERE DISTANCE FROM BASE OF RAIL TO TOP OF PIPE IS MORE THAN 3 FEET.
IF THIS PIPE SHALL NOT BE USED IN LOCATIONS WHERE DISTANCE FROM BASE OF RAIL TO TOP OF PIPE
EXCEEDS 30 FEET.

ECHO RESERVOIR
PRECAST CONCRETE CULVERT PIPE
RAILROAD AND HIGHWAY RELOCATION

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SALT LAKE BASIN PROJECT-UTAH

PRECAST CONCRETE CULVERT PIPE
RAILROAD AND HIGHWAY RELOCATION

DRAWN: L.T.E. RECOMMENDED: H.C. Holder
CHECKED: W.H. N. APPROVED: W.H. N.

23023 DENVER, COLO., AUG. 14, 1926 179-D-53
NOTES
All concrete to be class A, 1:2:4 mix. All exposed edges to be chamfered 1/2. All reinforcing steel to be deformed square bars of Structural grade not to exceed 40'-0" in length. Overlay 40 diameters of splices. All reinforcement to be secured positively against displacement by wire intersections with #16 wire. All reinforcement to be spaced 12"c.c. except as otherwise specified. All reinforcing bars not detailed in bending diagrams to be straight bars.
Keep concrete moist 21 days after initial set.
Design identical with that shown by Line 10, Org. No. 167 of Utah State Road Commission.

ESTIMATED QUANTITIES
Concrete 234 Cu. Yds.
Reinf. Steel 4716 Lbs.

| Bars | A-1 | A-1 | B-1 | B-1 | B-1 | B-1 | C-1 | C-1 | C-1 | C-1 | C-1 | C-1 | C-1 | C-1 | C-1 | D-2 | D-2 | D-2 | D-2 | D-2 | D-2 | D-2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size | N°   | Lg  | Size |
| 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  | 134  | 10  | 1"  |

- 8' 0" on Curves
- 10' 0" on tangents

Paint white (2 coats) above creosote line. Chamfer 3/4".
UTAH STATE ROAD COMMISSION

STANDARD HIGHWAY FENCE

H.S. KERR, Chief Engineer
Salt Lake City, Utah

DESIGN OF U.P.R.R. Co., Denver, 1937
SCALE 1/8 INCH = 1 FT.

ISSUED Jan. 11, 1937

DRAWN BY

TRACED BY

CHECKED BY

APPROVED

23032

DRAWING NO. J-342
### QUANTITIES AND DIMENSIONS

<table>
<thead>
<tr>
<th>Gauge of Pipe</th>
<th>Opening Dimensions</th>
<th>QUANTITIES IN ONE END WALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D AREA SQ FT</td>
<td>H G L M F</td>
</tr>
<tr>
<td>12</td>
<td>.45 12.6 5'-0&quot; 6'-4&quot; 2'-6&quot; 4'-0&quot; 2'-0&quot;</td>
<td>29.1 346 637 2 1/2</td>
</tr>
<tr>
<td>14</td>
<td>.4 36.3 4'-6&quot; 5'-10&quot; 2'-3&quot; 3'-6&quot; 2'-0&quot;</td>
<td>32.6 246 472 1 7/8</td>
</tr>
<tr>
<td>16</td>
<td>.3 18.1 2'-6&quot; 3'-10&quot; 1'-2&quot; 1'-7&quot; 1'-3&quot;</td>
<td>17.4 180 362 1 1/2</td>
</tr>
<tr>
<td>20</td>
<td>.24 24.3 3'-0&quot; 4'-4&quot; 1'-5&quot; 2'-1&quot; 1'-4&quot;</td>
<td>13.1 144 275 1</td>
</tr>
<tr>
<td>24</td>
<td>.16 18.1 3'-0&quot; 4'-4&quot; 1'-5&quot; 2'-1&quot; 1'-4&quot;</td>
<td>9.7 107.7 20.0 3/4</td>
</tr>
</tbody>
</table>

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**FOR 15° PIPE USE 18° QUANTITIES**

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**NOTE**

- For corrugated pipe, \( E \) = outside Diameter of pipe
- For Concrete Pipe, \( E = 2D \) + twice the thickness of pipe and dimension \( G \) should be increased accordingly.

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**UTAH STATE ROAD COMMISSION**

**SINGLE PIPE CULVERT HEADWALLS**

**WITH 45° WINGS**

**H.S. KERR**

Chief Engineer Salt Lake City, Ut.

**DRAWN BY:** G.A. U. SCALE: Typical

**CHECKED BY:** J.R. ISSUED JUNE 23, 1941

**EXAMINED BY:** T.T. APPROVED M. HICKMAN

**DRAWING NO. 23**

**DRAWING NO. 23033**

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**NOTE**

- Chamfer all exposed edges 3/4" Provide good foundation under pipe. Use concrete where natural conditions are bad. Protect bed and slopes with rip-rap or paving, laying the paving in concrete mortar or grout.
SUPER-ELEVATION

All curves over 3 degrees shall be super-elevated—Transition to be 100' commencing 50' on either side of P.C. or P.T. of curve. The surface of the roadway to be a plane surface across entire section, including shoulders. 6% grade to be held, inner and outer edge to be lowered and raised respectively as shown, except in flat country when bad drainage conditions might develop, the inner edge to be held, and outer edge raised a distance equal to H.

WIDENING

8° Curves or sharper shall be widened if indicated on plans or directed by Engineer. Transition to be 100' commencing 50' on each side of P.C. or P.T. of curve. Curve to be widened on inside a distance equal to A according to schedule below.

<table>
<thead>
<tr>
<th>Degree</th>
<th>Distance to Widen</th>
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</thead>
<tbody>
<tr>
<td>8°</td>
<td>A = 2'</td>
</tr>
<tr>
<td>15°</td>
<td>A = 3'</td>
</tr>
<tr>
<td>21°</td>
<td>A = 4'</td>
</tr>
</tbody>
</table>

H = 005' x W.D.
D = Degree of curve
W = Width of roadway

All curves sharper than 15° to be super-elevated—same as for 15°
Specifications No. 463

Hydrographs representing discharge at Devils Slide (site within Lost Creek) and discharge of Lost Creek indicate 3% of the discharges indicated to Weber River.

Total Runoff 1905
86,800 A.F.

Total Runoff 1906
98,000 A.F.

Total Runoff 1907
102,000 A.F.

Total Runoff 1908
90,000 A.F.

Total Runoff 1909
107,000 A.F.

Total Runoff 1910
107,000 A.F.

Total Runoff 1911
83,000 A.F.

Total Runoff 1912
70,400 A.F.

Total Runoff 1913
70,000 A.F.

Total Runoff 1914
86,000 A.F.

Total Runoff 1915
80,000 A.F.

Total Runoff 1916
87,000 A.F.

Total Runoff 1917
94,100 A.F.

Total Runoff 1918
75,400 A.F.

Total Runoff 1919
80,000 A.F.

Total Runoff 1920
75,800 A.F.

Total Runoff 1921
80,000 A.F.

Total Runoff 1922
87,000 A.F.

Total Runoff 1923
85,000 A.F.

Total Runoff 1924
83,000 A.F.

Total Runoff 1925
75,000 A.F.

Total Runoff 1926
75,000 A.F.

Total Runoff 1927
75,000 A.F.

Total Runoff 1928
80,000 A.F.

Total Runoff 1929
80,000 A.F.

Total Runoff 1930
80,000 A.F.

Total Runoff 1931
80,000 A.F.

Total Runoff 1932
80,000 A.F.

Total Runoff 1933
80,000 A.F.

Total Runoff 1934
80,000 A.F.

Total Runoff 1935
80,000 A.F.

Total Runoff 1936
80,000 A.F.

Total Runoff 1937
80,000 A.F.

Total Runoff 1938
80,000 A.F.

Total Runoff 1939
80,000 A.F.

Total Runoff 1940
80,000 A.F.

Total Runoff 1941
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Total Runoff 1942
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Total Runoff 2018
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Total Runoff 2019
80,000 A.F.

Total Runoff 2020
80,000 A.F.

Total Runoff 2021
80,000 A.F.

Total Runoff 2022
80,000 A.F.

Total Runoff 2023
80,000 A.F.

Total Runoff 2024
80,000 A.F.

Total Runoff 2025
80,000 A.F.
Note that there is no change in size of Long Bar between Counterforts #1 and #2.

The size and spacing of Negative Steel is the same as the Positive except at the Counterforts where size of Bar changes. At these Points use the Larger Bar.

Bars at Top of Slab at same Elevation as Fourway Channel

Laps in Positive Steel to be squared off at Joint Line. Laps in Negative Steel to be made 1/4 in. at Joint Lines.

All Positive Steel of Counterforts to be Min. 3/4 in. 4-Bar Steel. Min. 55,500 psi

All Negative Steel to be 3/8 in. 4-Bar Steel. Min. 40,000 psi

4-Bar Steel, Min. 40,000 psi

Positive Steel

Step Plank Groove

Negative Steel

Monarch Steel

Reinforcement

Horizontal Stirrups

Vertical Stirrups

48-1/2 in.

8-9 in.

12-1/4 in.

3-3/4 in.

3-5/8 in.

3-1/2 in.

3-1/4 in.

3-1/2 in.

3-1/4 in.

3-1/2 in.
NOTES:

Reinforcing Steel in Heel Slab only shown on this Drawing.

Size and Spacing given for Longitudinal Bars refer to Positive Steel. The Size and Spacing of the Negative Steel is the same as the Positive except at the Counterforts where the Size of Steel changes. All these changes are shown on the Drawing.

1.  Notes shown are only intended to indicate where bars end. Where hooks are required they are specified in the Bending Diagrams.

2.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.

3.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.

4.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.

5.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.

6.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.

7.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.

8.  Bars extend from Toe Thru from Toe and extend into slab same as shown. Bars extend into slab.
WIRING DIAGRAM

NOTE: All Electric Control Equipment except Limit Switch furnished by U.S. MOTOR General Electric Co.

3 Phase, 60 Cycles, 600 R.P.M. Squirrel Cage, Induction Type, Totally Enclosed.
Minimum Starting Torque-53 Lbs. @ 1 Ft. R. Minimum Full Load Torque-35 Lbs. @ 1 Ft. R.
15 Minute rated 50°C rise. See Specifications for Voltage.

OUTLINE OF LIMIT SWITCH ON NEAR SIDE.

ELEVATION

NOTES
Cast "U.S.R." in sharp face Gothic Letters 1" high on each Side of Base. Anchor Bolts furnished by U.S.
Fill Gear Case with Heavy Oil (600 W or similar) to Top Oil Cock. Roller Bearings-Cup No. 78,551- Cone.
No.78,250 - Timken Co. (or equal)
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SALT LAKE BASIN PROJECT-UTAH
WEBER RIVER DIVISION
ECHO DAM-OUTLET WORKS
5 x 6 HIGH PRESSURE EMERGENCY GATE

SPECIFICATIONS NO. 463
DRAWING NO. 39

Height of Gate = 4' 2-1/2"
Transition 5'-6" to 6" Diameter
SPECIFICATIONS NO. 463

PLAN

SECTION CC

C.I. Lamp Posts @ 75'rs

Outlet Tunnel

Note:

- All reinforcing of 1/2" Bars unless otherwise noted.

PARAPET DETAILS

Concrete or Asphaltic Filler with Caper Bars

ELEVATION

SECTION A-A

SIDE WALLS 900' TRUSS SEATS

CORNICE DETAILS

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SALT LAKE BASIN PROJECT - UTAH
WEBER RIVER DIVISION
ECHO DAM-OUTLET WORKS
REMOTE CONTROL HOUSE

END ELEVATION

SECTION B-B

FRONT ELEVATION

Scale of Feet
**Erection Diagram**

- Hip Rafter: 4 required
- Hip Purlin Clip: 12 required
- To be Shop Riveted to Hip Rafters

**Main Truss**

- 2 required
- All Rivets 3/8" holes 1/8" (except 3/8"
- Plate unless otherwise marked. Anchor Bolts furnished by U.S. Paint one shop coat of red lead.

**Notes:**

- See Detail of Hip Connection

**Detail Hip Connection**

- Hip Rafters
- Purlin Clips
- Plate and Sheathing
- Anchor Bolts
- Paint one shop coat of red lead.